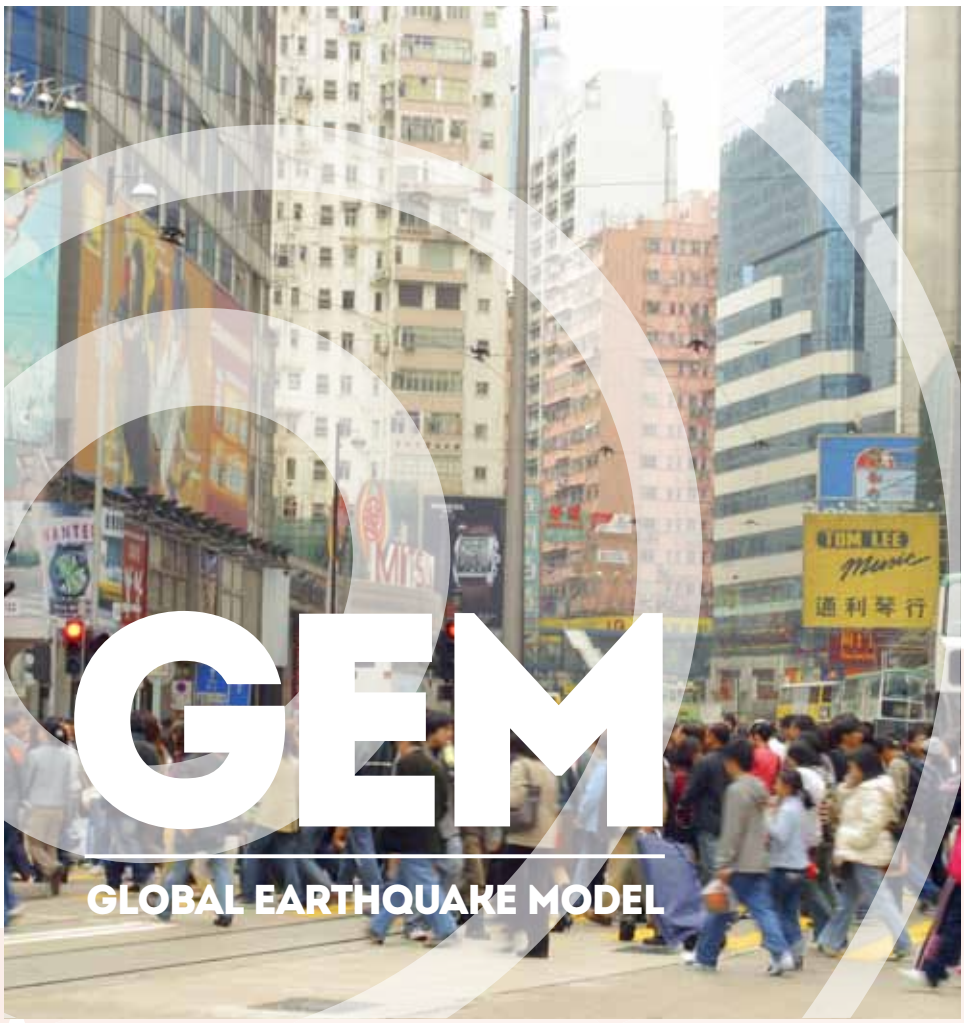
VULNERABILITY AND LOSS MODELLING

Introduction to the GEM Earthquake Consequences Database (GEMECD)

E. So

GEM TECHNICAL REPORT 2014-14 V1.0.0



Introduction to the GEM Earthquake Consequences Database (GEMECD)

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http://www.globalquakemodel.org/

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ABSTRACT

From the inception of the GEM Global Earthquake Consequences Database (GEMECD) the ambition was that the database will serve to inform users on consequences from past events, as a benchmarking tool for analytical loss models and to support the development of tools to create vulnerability data appropriate to specific countries, structures, or building classes. The aim of this report is to summarise the work carried out by 10 international partners to achieve this goal and includes a description of the database in terms of its contents and framework, the development of a set of guidelines for data collection and templates to populate the database and finally some examples of types of information included in GEMECD, notably the updated USGS Shakemaps.

Keywords

Earthquakes; consequences; database; building damage; ShakeMaps

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1 Introduction

GEMECD is a GIS relational database integrated into the Global Earthquake Model (GEM) OpenQuake web portal. For current events, GEMECD will serve as a clearinghouse of information, posted by users based on the standards and protocols set in the GEMECD documentation. In the long term, GEMECD will be a repository of the most relevant and validated data on consequences of the significant events of the last 40 years around the world.

The GEMECD project began in November 2010 and was a three year initiative aimed at creating a global database of standardised information of consequences due to the most significant events in the recent past. The GEMECD repository would be the first of its kind where a full spectrum of earthquake consequences as shown in Figure 1.1 is captured in a single database.

Figure 1.1 Consequences from earthquakes stored in GEMECD

1.1 Partners involved

The international consortium shown in Figure 1.2 was formed to ensure the best available knowledge is employed to fulfil the GEMECD ambition, including partners with expertise in all the important earthquake-prone regions. The existing working relationships and geographical awareness of this international group of partners was crucial in a global initiative such as this. This consortium is in the best position to provide the widest possible geographic coverage, the most valuable and validated data for past events and for laying the foundation for efficiently and thoroughly capturing consequence data from future events. In addition to

those initially identified, the project coordinators also enlisted the help of two external consultants to help complete the work of GNS and SPA at CAR Ltd.

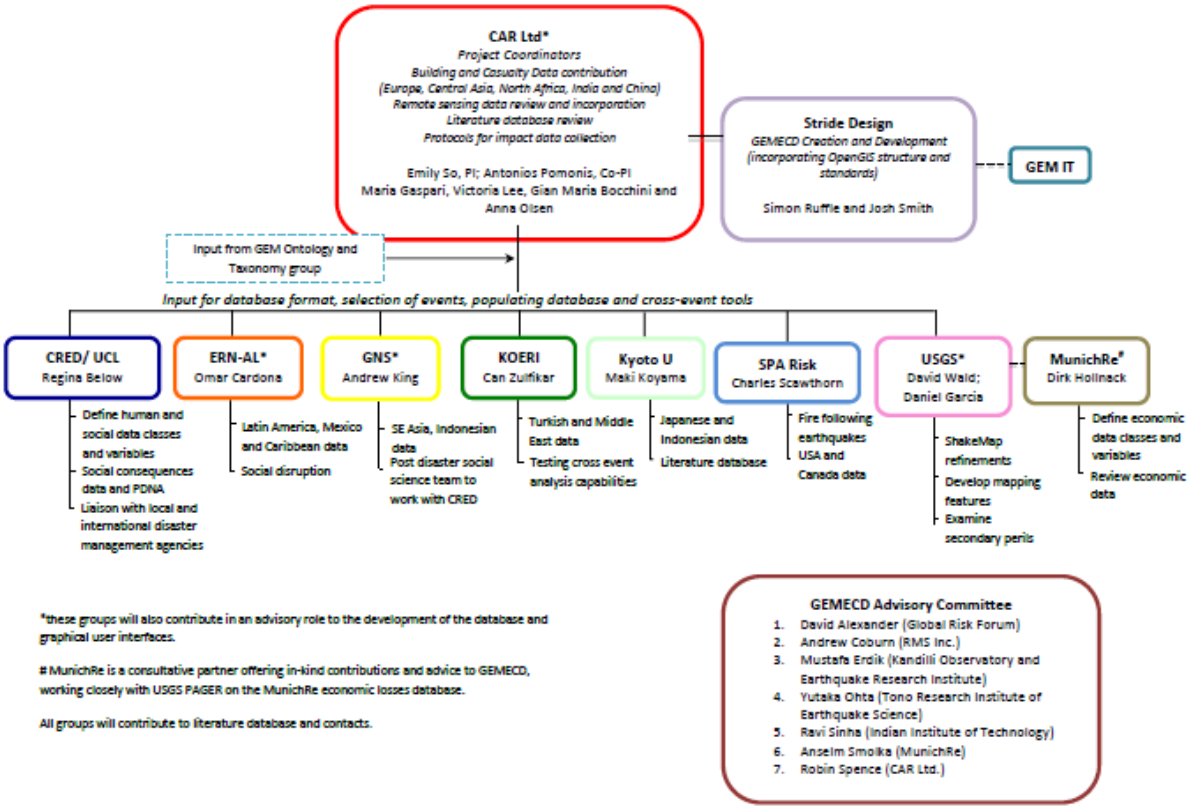


Figure 1.2 The GEMECD consortium and division of responsibilities

1.2 GEMECD statistics

To date (and it is the hope of GEM and all GEMECD partners that the database will continue to grow) the global database housed in the OpenQuake platform (https://platform.openquake.org) consists of 68 global events. The full list and the numbers and types of studies included in each of these events can be found in Appendix A. In summary, the GEMECD statistics are as follows:

Events	68
Studies	228
Building damage	121
Casualty	44
Critical building and Infrastructure	63
Socio-economic	23
Slope failure	4
No. of survey locations	3,760
Survey value records	39,629

Photographs	588
USGS Shake maps	98

In terms of global coverage, this is best illustrated by the pins on the World map in the figure below, taken from the OpenQuake platform, showing the events included in the GEMECD.

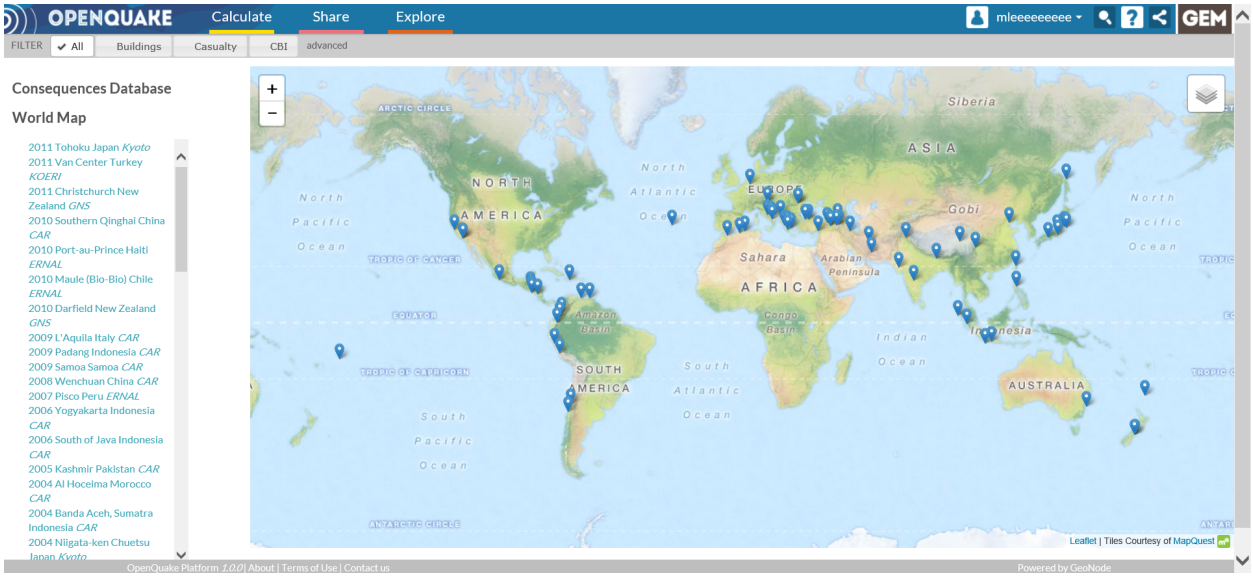


Figure 1.3 A map showing the locations of events included in the GEMECD (as of end of 2014)

In the ensuing chapter, a set of guidelines produced by the consortium on standardisation of inputs for the database will be presented. These guidelines for data collection are a crucial part of the GEMECD project and also other GEM risk projects such as the GEM Building Taxonomy and Inventory Data Capture Tools (IDCT). In addition, this document has been consulted by the European Commission's Joint Research Committee Scientific and Policy report on Recording Disaster Losses: Recommendations for a European Approach (De Groeve et al., 2014). The underlying GEMECD structure will then be explained in Chapter 3, followed by an overview of the tools and templates created for new data uploads into the GEMECD in Chapter 4.

In Chapter 5, some of the innovations and updates brought about by the GEMECD project are highlighted. Most notably, a review of the work in updating the USGS Shakemaps atlas which is the key hazard denominator to all consequences included in GEMECD, and the report by CRED and MunichRe on standardising social economic indicators.

Finally this report will end with some conclusions on the issues and limitations of creating a global consequences database and look to the future of where this public repository can contribute to the field of earthquake engineering and disaster risk reduction.

2 GEMECD Data Collection Guidelines

To ensure a certain degree of uniformity in the data to be included in GEMECD and legacy of the GEMECD project beyond the three year project period, a set of comprehensive guidelines were drafted to give details on the types of data to be collected for the five categories of consequence data. Guidance on assessing data quality, data completeness, data resolution and temporal factors in consequence data (e.g. recovery data) are also discussed in the ensuing sections and examples of how consequence data can be collected and communicated efficiently are provided. The set of guidelines shown were written and approved by all GEMECD partners and adhered to for the population of the consequences database.

2.1 Data Collection

Within the overall GEM development agenda it has been envisaged that the GEMECD project will provide data that are useful for seismic risk modelling purposes and particularly to furnish other GEM Risk projects with the necessary information to carry-out inventory assessments, vulnerability assessments, model calibrations and model validations. Initially GEM's development agenda is to address modelling of risk to standard buildings due to ground shaking, as this interaction of hazard and exposure is the greatest contributor to earthquake risk worldwide. GEMECD will give emphasis to building damage due to ground shaking studies, although the other aspects of earthquake consequences are also covered. As earthquake consequences are varied from region to region the GEMECD project includes the effects of earthquakes to structures other than standard buildings as well as the interaction of all earthquake secondary hazards to exposure.

By inventory classes we mean the following:

- Buildings (including residential, commercial, industrial, agricultural, warehouses, public administration, etc.)
- Non-standard buildings (including schools, hospitals and clinics, historic-monumental buildings of importance, sports arenas, cinemas-theatres, churches, temples, mosques, etc.)
- Industrial installations
- Other structures (water tanks, silos, pylons, etc.)
- Critical facilities (energy production, dams, ports, airports, rigs, etc.)
- Lifelines (water, sewage, canals, electric, gas, telecom)
- Transport infrastructure (roads, railways, bridges, tunnels)
- Underground facilities (metros, mining, etc.)
- Building contents (household, commercial stock, production stock, artefacts, machinery, installations, etc.)

The following sections in this chapter provide information on each of the five categories of consequence data such as types of data to be collected, data quality, data completeness, data resolution, temporal factors in consequence data (e.g. recovery data), and so on. They are in the form of guidelines and examples are

provided of how consequence data can be collected and communicated efficiently. Each category will be dealt with separately.

2.2 The Tier Structure of the GEMECD Interface

The consequence database was envisaged to contain data in four consecutive tiers (Tier 0 to Tier 3). We hereby give some more details for further elucidation. The Tier structure became the basis for the database design described in Chapter 3 and is also explained in Figure 2.1.

2.2.1 Tier 0: Global Map with List of Events

At the top tier (Tier 0), a homepage will show a global map indicating epicentres of all earthquakes for which data are available, and list the earthquakes by countries and dates. The website will use digital maps, which can be viewed at whatever scale is desired, and viewed in standard modes – road map, terrain map, or satellite image. This tier/layer therefore is quite similar to what was in the CEQID database (www.ceqid.org/).

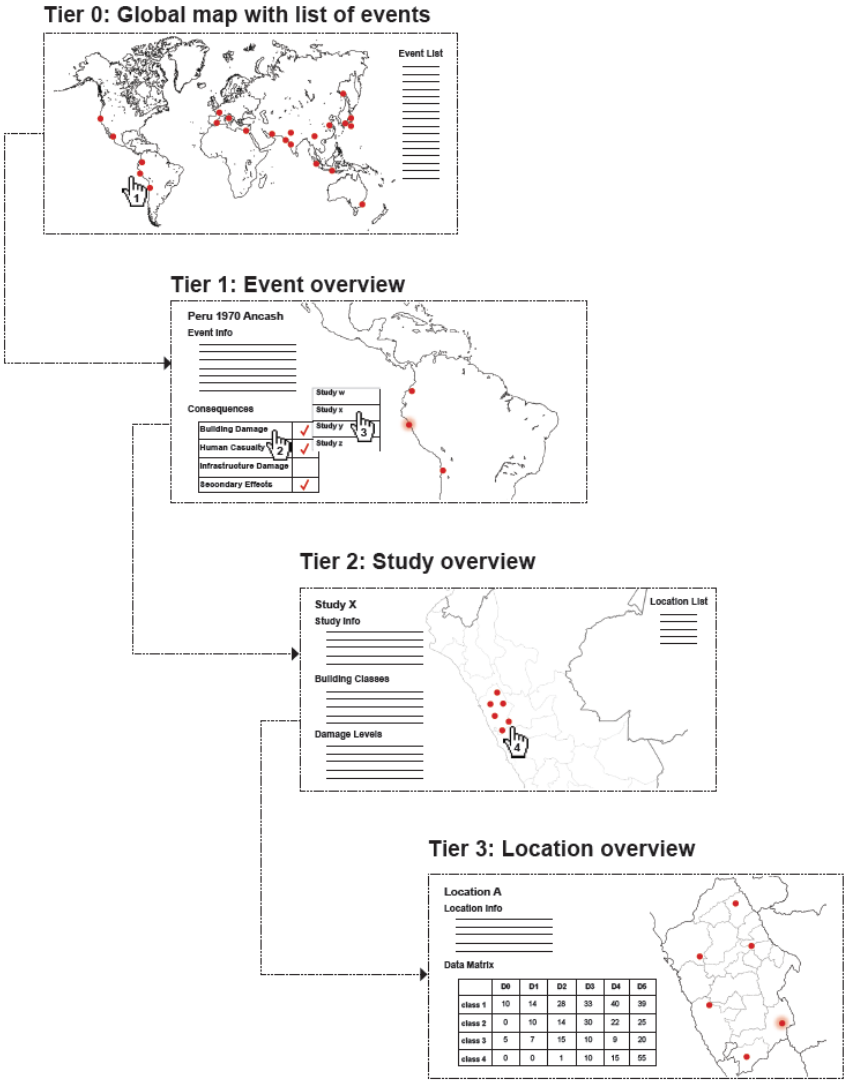


Figure 2.1 Schematic of the GEMECD Tier structure

2.2.2 Tier 1: Event Overview

Upon selecting one of the events in the list or its epicentre on the map, Tier 1 will appear. Here at first we shall include the basic event information contained in the fields shown in Table 2.1. A link will also be provided to the USGS Shake Map Atlas for each event so that more information can be obtained. Note that we propose to add basic information on overall human casualties with the fatalities, missing listed by cause (ground shaking, landslides, tsunami or fire following), homelessness, destroyed buildings and dwelling units (by cause) and contemporaneous estimates of economic loss (in million US$). In order to illustrate this, we have included data on the May 31st, 1970 Peru (Ancash/Chimbote) earthquake in Table 2.1. For events affecting more than one country (e.g. the 2005 Kashmir earthquake etc.), this table will contain the summary of the casualties, damage and losses for all the affected countries.

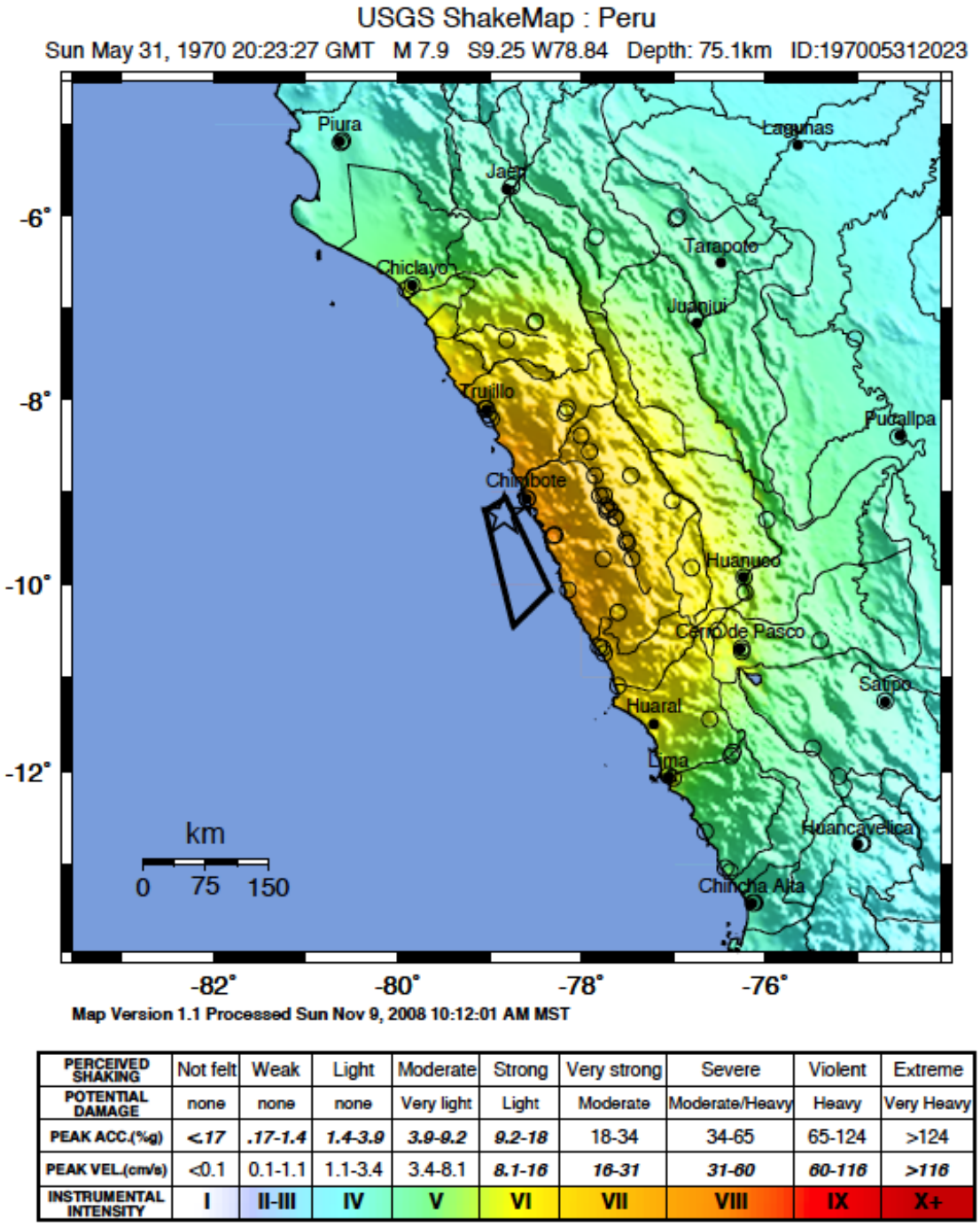
Table 2.1 Table of basic seismological and consequence data for the Ancash earthquake of 1970

Data Fields	Data Format	SOURCE	General Comments
Event ID (date & GMT occur. time)	197005312023	text	text
Event Name	Ancash (Chimbote)	text	text
Date of occurrence (UTC)	31/05/1970	text	text
Date of occurrence (Local)	31/05/1970	text	text
Day of the Week (Local)	Sunday	text	text
Time of occurrence (UTC)	20:23	text	text
Time of occurrence (Local)	15:23	text	text
Magnitude	7.9	text	text
Magnitude type	M_w	text	text
Focal Depth (in km)	75.1	text	text
Epicentral Coordinates (Long)	-9.248	text	text
Epicentral Coordinates (Lat)	-78.842	text	text
Total number of people killed	~32,000	text	text
Total number of people missing	~35,000	text	text
People killed due to ground shaking	~49,000	text	text
People killed due to slope failures	~2,000	text	text
People missing due to slope failures	~16,000	text	text
People killed due to tsunami	0	text	text
People missing due to tsunami	0	text	text
People killed due to fire following	0	text	text
People missing due to fire following	0	text	text
People dying post-disaster but earthquake-related	n/a	text	text
Total number of people injured	~143,500	text	text
People seriously injured and/or hospitalized	n/a	text	text
Total number of buildings collapsed or damaged beyond repair due to ground shaking	n/a	text	text

Data Fields	Data Format	SOURCE	General Comments
Total number of buildings damaged due to ground shaking	n/a	text	text
Total number of dwelling units collapsed or damaged beyond repair due to ground shaking	186,000	text	text
Total number of dwelling units damaged due to ground shaking	n/a	text	text
Total number of buildings in the affected country at the time	n/a	text	text
People Homeless	~ 1,700,000	text	text
Total Estimated Direct Economic Loss (contemporaneous, in million US$)	507 ml US$	text	text
Total Estimated Indirect Economic Loss (contemporaneous, in million US$)	n/a	text	text

For the epicentral coordinates a negative value is used for the western longitudes and southern latitudes. The basic seismological data are already included in USGS' EXPO-CAT (Allen *et al.* 2009b) database, while summary damage information, casualties by cause and homelessness are included in USGS' PAGER-CAT (Allen *et al.* 2009a). Partners are encouraged to check the above databases. Except in cases where it is not available the moment magnitude will be used for all the events in our list as defined by the USGS in the ShakeMap Atlas and the citations/references therein. In this way uniformity and comparativeness is maintained, as the USGS uses the most authoritative moment magnitudes available. However, for the consequence fields in Table 2.1 (casualties, damage, homelessness and loss) if partners find that the information they have is more accurate than what is in the above two databases, they should propose their own figures, with the appropriate references, in the source field.

At Tier 1 the user will be able to select and view the macroseismic intensity ShakeMap of the event and the surface fault rupture (if it occurred) or the fault plane of the event (particularly in the case of large subduction events). Such maps are already available for all the events we have chosen, although improvements to these have been made by the USGS team. Figure 2.2 shows the macroseismic intensity ShakeMap for the illustrated event.



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	*<.17*	*.17-1.4*	*1.4-3.9*	*3.9-9.2*	*9.2-18*	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	*8.1-16*	*16-31*	*31-60*	*60-116*	*>116*
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Figure 2.2 USGS ShakeMap for the May 31, 1970 Peru (Ancash) earthquake

For the events that contain consequence studies due to secondary and induced hazards: landslide outline map, liquefaction outline map, tsunami inundation map (incl. tsunami flow height when possible) and fire affected area maps may in some cases also be shown if partners are able to provide easily importable Shape Files showing the outline of the affected areas (whether for the event as a whole or a particular study area). The main difficulty lies in making the maps compatible to the ShakeMap in terms of projection, scale etc. The USGS agreed to work on providing landslide maps for the 13 chosen events.

For recent events, value added maps derived using remotely sensed data (particularly for tsunami inundation extents and landslide occurrence, but also for ground shaking damage toi buildings, infrastructure) could also be considered. Such maps are made available through websites such as Reliefweb, GDACS and Disaster Charter, as well as other research groups and national laboratories. A link to these maps can be provided in the GEMECD by theme. In terms of the raw satellite/aerial photographs, there have been cases where access to raw data was granted free of charge (e.g. 2010 Haiti earthquake). Links to these datasets may also be provided in GEMECD where appropriate.

It was envisaged for simplicity reasons that events in the secondary hazard consequence studies will address the impacts of a single dominant secondary hazard (e.g. landslides for the 2008 Wenchuan, China earthquake; tsunami inundation for the 2011 Tohoku, Japan earthquake; liquefaction for the 2011 Christchurch and the 2010 Darfield earthquakes in New Zealand; fire following for the 1923 Great Kanto, Japan earthquake etc.).

Whilst in Tier 1, the user will be able to see at this interface whether there are consequences data for this event in each of the five consequence data categories described above (a to e). Upon pointing the browser to any of the five consequence data categories, a new pop-up menu will appear showing the list of studies available in this category (see Figure 2.1). These studies will be clearly named (by type of data and regional name).

There will be links to the literature database for each event and ability to show graphical overviews, e.g. bar charts of damage. These charts can be attached as JPEG images as the web interface will not be generating charts from the data. In addition there will be the ability to assign confidence-reliability levels to the surveys/data (e.g. depending on sample size and format of data etc).

In the event information section of the screen, additional information may also include images of typical construction types, typical damage and population exposure at the time of the event, likely references being, the World Housing Encyclopaedia (WHE), the EXPO-CAT database and other online or partner's own resources. For example, Table 2.2 below shows the estimated population exposed to ground shaking of Modified Mercalli intensity VI and above (at half intensity intervals) for the illustrated 1970 Ancash/Chimbote, Peru earthquake (separately for urban and rural areas).

Photos 1 to 3 show typical damage in the town of Huaraz and a pair of pictures of the town of Yungay destroyed by an avalanche (before and after the avalanche). The objective is to have a photo record for different events and consequences. If there are links to storage sites with photos for particular events in our list, then partners should provide links to the relevant sites. We encourage partners to use their own institution's photos whenever possible, otherwise copyright issues should be checked before uploading images on the platform.

Table 2.2 EXPO-CAT population hindcast by intensity zone for urban and rural areas (MMI≥VI) for the May 31, 1970 Peru (Ancash/Chimbote) earthquake

MM Intensity	Estimated Population	Zone
U060	877,627	Urban
U065	601,223	Urban
U070	92,953	Urban

MM Intensity	Estimated Population	Zone
U075	13,696	Urban
U080	223,398	Urban
U085	0	Urban
U090	0	Urban
U095	0	Urban
U100	0	Urban
R060	428,048	Rural
R065	457,396	Rural
R070	361,988	Rural
R075	84,788	Rural
R080	27,566	Rural
R085	0	Rural
R090	0	Rural
R095	0	Rural
R100	0	Rural

Photo 1 Destruction of adobe houses in Huaraz with 3-storey reinforced masonry building surviving the shaking (Source: NISEE)

Photos 2 & 3 Yungay central square before the avalanche (left); Yungay central square after the avalanche (note the still standing palm trees) (Source: NISEE)

In addition, a general summary of each earthquake can be provided at this tier giving the user an overall idea about the consequences of the event. This will help the users to better understand the various earthquake events that are included in the dataset. For example, for the 2001 Gujarat (Bhuj) earthquake, India, the following description could be included:

"*The M_w 7.6 Gujarat (Bhuj) earthquake occurred in the state of Gujarat, India, at 03:16 UTC (8:16 a.m., local time) on 26 January 2001. The event struck within the Kachchh peninsula near India's western coast and was felt over much of the Indian subcontinent. In addition to strong ground shaking, the earthquake resulted in liquefaction spread over more than 1000 km2. The earthquake exposed the high seismic risk in urban areas in India; dozens of buildings collapsed in Ahmedabad, which was located over 200 km from the epicentre, killing hundreds. Official government data placed the death toll at over 13,000 and the number of injured at 166,000. Government estimates place direct economic losses due to the earthquake at 1.3 billion US dollars, although more recent estimates indicate losses as high as 5 billion US dollars*."

In this general summary the number of buildings (and/or number of dwelling units) destroyed by cause (e.g. ground shaking, landslides, tsunami, liquefaction, fire following) should also be provided when possible.

2.2.3 Tier 2: Study Overview

At Tier 1, upon choosing one particular consequence study in the pop-up menu we enter Tier 2 (Study Overview). This tier is specific to a particular consequence study. For each study, a map will geo-reference all the locations of the individual surveys, date carried-out and data collected within that study. At the Study Information section of the screen we will give details of the study. If the study is about damage to buildings due to ground shaking, there will be a building classes section giving information about the structural types included, their GEM Building Taxonomy code, the number of buildings surveyed, and a link to the glossary of images described by this structural typology, with possibly a bar chart summarising the damage observed. The same could be done for casualty studies (e.g. district, sub-district, town, village or building level casualty data versus the population or building occupancy at the time of occurrence). A link to the literature database will be available directing the user to the documentation and reference material used for the study.

We give emphasis to geo-coding the study locations (usually a town district or neighborhood, or a village) as accurately as possible in order to then link these with the ShakeMap data which will give the user information about the estimated macroseismic intensity, peak ground acceleration (or velocity) and spectral acceleration (for a given period) and the soil category (based on the Vs30 versus slope categorisation).

In addition if good quality maps of the survey areas are available (e.g. isoseismal maps, damage survey maps, tsunami inundation maps, landslide outline maps, burned area maps, liquefaction area maps etc.) these should also be provided. Such maps will be handled as images in much the same way as photos of damage and copyright issues should always checked before uploading images on the platform. The maps related to ground shaking (i.e. isoseismal maps, maps of damage surveys) will be shown in the relevant section of the database (see section 3). The maps related to the secondary, induced hazards will be shown in the relevant section of the database (see section 6).

In recent events with the advent of GIS tools, damage surveys are increasingly becoming available at the individual building level. Such studies of many individual buildings which can be geo-referenced can also be included if permission to use can be obtained from the Institutions that hold the original data. If permission to use is not given, then the data can be given in aggregated form and illustrated by an accompanying map (when this is available).

Whenever possible geographical boundaries will also be provided (e.g. those freely available data from the Global Administrative Areas (GADM database) will be used – www.gadm.org) to facilitate better visualization of the study locations. We have already carried out a feasibility study and found that GADM contains administrative boundaries down to municipality or county level for most of the countries in our events list. For some countries where such data are not available in GADM, (e.g. China, Taiwan, Nepal, Pakistan, Iran, Armenia) we shall request the assistance of our partners.

2.2.4 Tier 3: Location Overview

Selecting a survey location will bring us to the third tier, i.e. the survey data for that site. The presentation of data will be standardised according to pre-determined parameters, harmonised with GEM Risk definitions.

Each study to be shown in Tier 3 will be clearly assigned to its source (e.g. published paper, a report, a survey of proprietary data provided by a partner etc.). Standard bibliographic reference style will be used for crediting the source(s) of any study incorporated in GEMECD.

The next sections give examples of the types of data to be collected for studies in different categories that will be incorporated into Tier 3.

2.3 Consequences of Ground Shaking on Standard Buildings

Building damage due to ground shaking was where the greatest emphasis to detail was given. 63 events appear under the building damage due to ground shaking category, attributed to all the partners (excl. CRED) by their region of responsibility. These events are listed in Table 2.3.

Table 2.3 GEMECD short listed events by partner organisation, for studies on the consequences of ground shaking to standard buildings

Event Name	Affected Country (-ies)	YEAR	MON	DA (UTC)	PARTNER
Friuli	ITALY	1976	5	6	CAR
Tangshan	CHINA	1976	7	27	CAR
Vrancea	ROMANIA & BULGARIA	1977	3	4	CAR
Montenegro	MONTENEGRO	1979	4	15	CAR
Terceira Island (Azores)	PORTUGAL	1980	1	1	CAR
El Asnam	ALGERIA	1980	10	10	CAR
Irpinia	ITALY	1980	11	23	CAR
Gaoual	GUINEA	1983	12	22	CAR
Kalamata	GREECE	1986	9	13	CAR
Udaypur	NEPAL & INDIA	1988	8	20	CAR
Roermond	NETHERLANDS & GERMANY	1992	4	13	CAR
Maharashtra (Latur-Killari)	INDIA	1993	9	29	CAR
Negtegorsk (Sakhalin Island)	RUSSIA	1995	5	27	CAR
Aeghion	GREECE	1995	6	15	CAR
Athens	GREECE	1999	9	7	CAR
Bhuj (Gujarat)	INDIA	2001	1	26	CAR
Boumerdes	ALGERIA	2003	5	21	CAR
Al Hoceima	MOROCCO	2004	2	24	CAR
Kashmir	PAKISTAN & INDIA	2005	10	8	CAR
Wenchuan	CHINA	2008	5	12	CAR
L'Aquila	ITALY	2009	4	6	CAR
Caracas	VENEZUELA	1967	7	30	ERN-AL
Ancash (Chimbote)	PERU	1970	5	31	ERN-AL
Managua	NICARAGUA	1972	12	23	ERN-AL
Popayan	COLOMBIA	1983	3	31	ERN-AL
Valparaiso	CHILE	1985	3	3	ERN-AL
Michoacan	MEXICO	1985	9	19	ERN-AL
San Salvador	EL SALVADOR	1986	10	10	ERN-AL
Cariaco	VENEZUELA	1997	7	9	ERN-AL
Armenia	COLOMBIA	1999	1	25	ERN-AL
San Miguel	EL SALVADOR	2001	1	13	ERN-AL

Event Name	Affected Country (-ies)	YEAR	MON	DA (UTC)	PARTNER
San Salvador	EL SALVADOR	2001	2	13	ERN-AL
Pisco	PERU	2007	8	15	ERN-AL
Port-au-Prince	HAITI	2010	1	12	ERN-AL
Maule (Bio-Bio)	CHILE	2010	2	27	ERN-AL
Edgecumbe	NEW ZEALAND	1987	3	2	GNS
Newcastle	AUSTRALIA	1989	12	27	GNS
Luzon	PHILIPPINES	1990	7	16	GNS
Darfield	NEW ZEALAND	2010	9	3	GNS
Christchurch	NEW ZEALAND	2011	2	21	GNS
Lice	TURKEY	1975	9	6	KOERI
Muradiye (Caldiran)	TURKEY	1976	11	24	KOERI
Tabas	IRAN	1978	9	16	KOERI
Dhamar	YEMEN	1982	12	13	KOERI
Spitak	ARMENIA	1988	12	7	KOERI
Manjil	IRAN	1990	6	20	KOERI
Erzincan	TURKEY	1992	3	13	KOERI
Adana-Ceyhan	TURKEY	1998	6	27	KOERI
Kocaeli	TURKEY	1999	8	17	KOERI
Duzce	TURKEY	1999	11	12	KOERI
Bingol	TURKEY	2003	5	1	KOERI
Bam	IRAN	2003	12	26	KOERI
Kanto	JAPAN	1923	9	1	KYOTO
Miyagi-oki	JAPAN	1978	6	12	KYOTO
Kobe	JAPAN	1995	1	16	KYOTO
Chi-Chi	TAIWAN	1999	9	20	KYOTO
Niigata-Chuetsu	JAPAN	2004	10	23	KYOTO
Yogyakarta	INDONESIA	2006	5	26	KYOTO
Padang	INDONESIA	2009	9	30	KYOTO
Tohoku	JAPAN	2011	3	11	KYOTO
San Fernando	USA	1971	2	9	SPA
Loma Prieta	USA	1989	10	18	SPA
Northridge	USA	1994	1	17	SPA

The general objective is to provide data on building damage by location, in the form of tables of numbers of buildings at different damage grades for different classes of structures, using the GEM Building Taxonomy for what concerns the structural classifications and a standardised damage grade classification whilst ensuring the numbers of undamaged buildings are also recorded. Building by building damage survey data are also acceptable when access to the raw survey data is possible, as long as the individual building locations can be geocoded and the numbers and locations of undamaged buildings are also recorded. Generally preference

should be given to complete damage surveys in a particular location (i.e. covering all the buildings within the chosen damage survey area including the buildings that have not been damaged as well as the buildings that have collapsed and removed from the site).

At Tier 1 (event overview), as specified in Table 2.1, information on damage to standard buildings due to ground shaking will include the following attributes:

- Total number of buildings collapsed or damaged beyond repair due to ground shaking
- Total number of buildings damaged due to ground shaking (excluding the destroyed buildings)
- Total number of dwelling units collapsed or damaged beyond repair due to ground shaking
- Total number of dwelling units damaged due to ground shaking (excluding destroyed dwelling units)
- Total number of buildings in the affected country at the time

In Table 2.4 we provide some typical examples from the GEMECD event list (3 events in Greece). We note that ideally both building and dwelling unit damage statistics should be provided when possible (as in urban areas the majority of the buildings contain many dwelling units), whilst making sure that no double counting occurs and that non-residential buildings are also taken into account. The total number of buildings in the affected country at the time of the earthquake is provided so that the scale of the disaster at country level can be inferred.

Table 2.4 Ground shaking consequence data for standard buildings for three events in Greece

	Kalamata 1986	**Aeghion 1995**	**Athens 1999**
Total number of buildings collapsed or damaged beyond repair due to ground shaking	4,495	1,887	4,900
Total number of buildings damaged due to ground shaking	5,676	5,850	59,700
Total number of dwelling units collapsed or damaged beyond repair due to ground shaking	n/a	n/a	~6,000
Total number of dwelling units damaged due to ground shaking	n/a	n/a	~187,000
Total number of buildings in the country at the time of the earthquake	~3,320,000	~3,770,000	~3,940,000

If for some of the above damage statistics, accurate information is not available, then approximate but reliable figures can be used (denoted by the symbol ~), as it is sometimes common following great earthquakes that the information on the extent and cause of destroyed and damaged buildings and dwelling units are poorly recorded. When data are not available, the "n/a" abbreviation should be used.

For the category of destroyed buildings (and dwelling units), we use data that include buildings that have collapsed totally or partially as well as buildings that have been damaged so seriously that their repair is considered uneconomical and will be demolished and buildings that have been deemed unsafe (e.g. the red-tag category in ATC-20, or damage grades 4 and 5 in the EMS-98 intensity scale, or other such descriptive damage classifications used around the world) and in most cases will be demolished.

For the category of damaged buildings (and dwelling units), we use data that include buildings (and dwelling units) that suffered serious (but repairable damage), moderate and slight damage (e.g. equivalent to the sum of yellow and green-tags in ATC-20, or equivalent to damage grade 1, 2 and 3 in the EMS-98 intensity scale, or other such descriptive damage classifications used around the world).

One appreciates though that this kind of information may not always be available and therefore the above format (Table 2.4) should not be viewed as compulsory. Alternatively the terms “Total number of buildings/dwelling units damaged” and “Total number of buildings/dwelling units destroyed” and “Total number of buildings/dwelling units damaged/destroyed” can also be used.

The availability and quality of existing post-earthquake building damage surveys varies. For old events good quality data may be hard to obtain, while the same remains true for more recent events in parts of the developing world. In GEMECD, we have included significant events since 1970 around the world to ensure global coverage. This means that among the 63 short listed events, there will be earthquakes where it may not be possible to obtain the best quality building damage data. In addition, future significant earthquakes may occur during the development of GEMECD (such as the 2011 Christchurch and 2011 Tohoku earthquakes), therefore should partners feel there are insufficient quality data available for the selected earthquakes, some events may be added or taken off the list.

Preference should be given to damage surveys that contain the entire building stock in a chosen location (e.g. a city block, a town or a village), that have sufficient information about the structural attributes of the buildings such as type of load-bearing structure (including structural details/irregularities that affect vulnerability like the existence of tie-rods or ring-beams in unreinforced masonry buildings or of a soft-storey in the case of reinforced concrete buildings); type of horizontal structure (e.g. flexible or rigid floor system); type of roof; type of wall; number of floors; year or period of construction (related to the earthquake code in practice during the respective period), and any other important structural irregularities (e.g. overhangs, irregular plan, etc.). For recent events the location of the individual buildings in the damage survey should ideally be geocoded (e.g. using GPS location or existing cadastral maps). The occupancy type of the buildings should also be recorded if possible, including buildings of mixed occupancy types.

In the case of earthquakes affecting large cities with a very large number of buildings, a sampling system has often been chosen in order to capture variations in damage severity across the boundaries of an affected city (e.g. Thessaloniki, Greece 1978 or Padang, Indonesia, 2009). In other cases only a part of a city had been surveyed in detail (e.g. Aegion, Greece 1995 or Concepción, Chile, 2010). Examples of the latter two surveys are shown in Figures 2.3 and 2.4, respectively. Such maps are really useful and should accompany the data whenever this is possible. They will be treated as additional images, like photographs, but copyright issues should always be checked in advance.

Figure 2.3 Damage survey for RC buildings in the city centre of Aegion city (Greece) affected by the June 1995 earthquake (Karantoni and Fardis, 2004) recorded on a cadastral map. Buildings in grey are unreinforced masonry and have also been surveyed and an equivalent map is shown in Karantoni and Fardis, 2005.

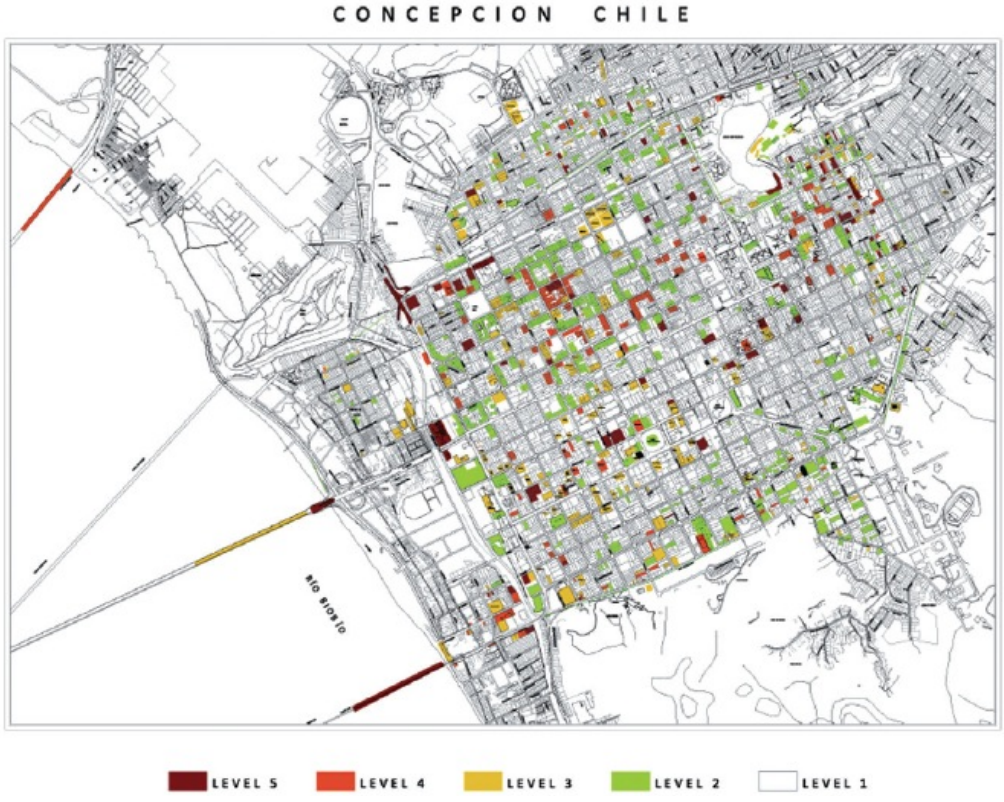
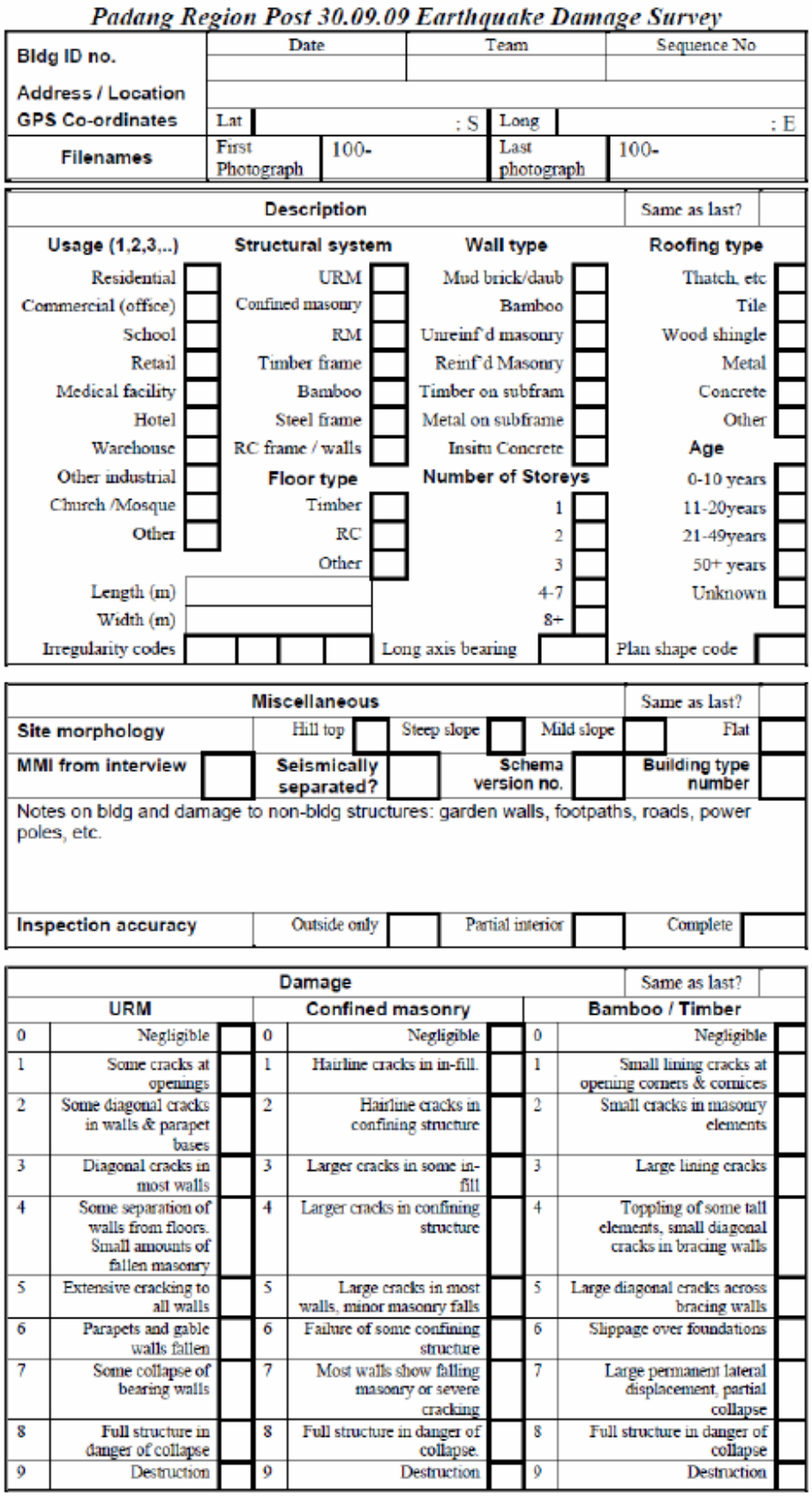


Figure 2.4 Map of distribution of damage to buildings regardless of type of structure, height and age in the city centre of Concepción due to the February 27, 2010 earthquake (Betanzo, 2010)

Such sample or partial damage surveys are also acceptable although the sampling method and sample size must be clearly described in the Study Information section of Tier 2. At any given location (city block(s), town or village), for a sample to be statistically significant at least 20 buildings should be included for each structural type category, but data that have fewer buildings than this minimum can also be included, as various sub-divisions by height, age or structural type may reduce the sample sizes. It is understood that this level of detail may not be available for many of the chosen events.

A recent damage survey in the cities of Padang and Pariaman affected by the September 30, 2009 West Sumatra earthquake was carried-out by a team of Indonesian and international engineers and scientists. The activity was jointly led by the Centre for Disaster Mitigation at the Institut Teknologi Bandung (ITB) and Geoscience Australia (Sengara *et al.,* 2010). We consider the methodology followed by this international damage survey team excellent as the survey forms were well designed to capture important information. Of course there is a direct relationship between the level of detail that can be captured and the extent of a survey in terms of the geographic area and number of buildings. In the case of Sumatra, the damage survey contains 3,896 buildings with each building location recorded by GPS. Padang city was divided into 9 sectors and within each sector representative streets were chosen and every building on those streets was surveyed (damaged or undamaged). Detailed structural typologies were drawn including some unique to the local area. The damage scale used was split into 10 grades (0=undamaged to 10=destruction) and separate definitions were given for unreinforced masonry, confined masonry, bamboo or timber, reinforced concrete frame/walls and steel frame buildings. In addition there was also a geotechnical damage scale addressing liquefaction, foundation movement and lateral spreading of the buildings. For structural irregularities the Structural Engineers Association of California (SEAOC) codes were used. This report can be downloaded from the GEMECD page in NEXUS (http://www.nexus.globalquakemodel.org/gemecd). The survey form used in this study is shown in Figures 2.5 and 2.6 (front and back sheets, respectively).



Padang Region Post 30.09.09 Earthquake Damage Survey

Bldg ID no.	Date	Team	Sequence No
Address / Location			
GPS Co-ordinates	Lat : S	Long : E	
Filenames	First Photograph 100-	Last photograph 100-	

Description — Same as last?

Usage (1,2,3,..)	Structural system	Wall type	Roofing type
Residential	URM	Mud brick/daub	Thatch, etc
Commercial (office)	Confined masonry	Bamboo	Tile
School	RM	Unreinf'd masonry	Wood shingle
Retail	Timber frame	Reinf'd Masonry	Metal
Medical facility	Bamboo	Timber on subfram	Concrete
Hotel	Steel frame	Metal on subframe	Other
Warehouse	RC frame / walls	Insitu Concrete	
Other industrial	**Floor type**	**Number of Storeys**	**Age**
Church /Mosque	Timber	1	0-10 years
Other	RC	2	11-20years
	Other	3	21-49years
		4-7	50+ years
		8+	Unknown

Length (m) | Width (m) | Irregularity codes | Long axis bearing | Plan shape code

Miscellaneous — Same as last?

Site morphology	Hill top	Steep slope	Mild slope	Flat
MMI from interview	Seismically separated?	Schema version no.	Building type number	

Notes on bldg and damage to non-bldg structures: garden walls, footpaths, roads, power poles, etc.

Inspection accuracy	Outside only	Partial interior	Complete

Damage — Same as last?

URM		Confined masonry		Bamboo / Timber	
0	Negligible	0	Negligible	0	Negligible
1	Some cracks at openings	1	Hairline cracks in in-fill.	1	Small lining cracks at opening corners & cornices
2	Some diagonal cracks in walls & parapet bases	2	Hairline cracks in confining structure	2	Small cracks in masonry elements
3	Diagonal cracks in most walls	3	Larger cracks in some in-fill	3	Large lining cracks
4	Some separation of walls from floors. Small amounts of fallen masonry	4	Larger cracks in confining structure	4	Toppling of some tall elements, small diagonal cracks in bracing walls
5	Extensive cracking to all walls	5	Large cracks in most walls, minor masonry falls	5	Large diagonal cracks across bracing walls
6	Parapets and gable walls fallen	6	Failure of some confining structure	6	Slippage over foundations
7	Some collapse of bearing walls	7	Most walls show falling masonry or severe cracking	7	Large permanent lateral displacement, partial collapse
8	Full structure in danger of collapse	8	Full structure in danger of collapse.	8	Full structure in danger of collapse
9	Destruction	9	Destruction	9	Destruction

Figure 2.5 Geoscience Australia, Padang 2009 damage survey form (front sheet)

Damage continued								
RC Frame / Walls			**Steel Frame**			**Geotechnical**		
0	Negligible		0	Negligible		0	Negligible	
1	Hairline cracks at in-fill / column joints		1	Minor plate deformations or brace deformation		A1	Liquefaction settlements <50mm	
2	Hairline cracks in structure & in-fill		2	Minor hairline cracking in welds		A2	Liquefaction settlements 50 - 200mm	
3	Some frame elements yielded. Larger cracks in in-fill.		3	Some permanent joint rotations, few major cracks in welds		A3	Liquefaction settlements >200mm	
4	Larger flexural cracks and spalling. Some crushing of in-fill at corners.		4	Some broken bolts and welds or enlarged holes, some yielded braces		B1	Vertical foundation movement <50mm	
5	Some failures to non-ductile elements. Most in-fill exhibits large cracks, minor falls		5	Most members yielded, anchor bolts stretched		B2	Vertical foundation movement 50 - 100mm	
6	Many failures to non-ductile elements. Some in-fill fallen or bulged		6	Some critical connections and members failed. Partial collapse of portions.		B3	Vertical foundation movement >100mm	
7	Most non-ductile elements failed. Severe deformation. Most in-fill fallen or severely damaged.		7	Most elements exceeded yield capacity. Dangerous lateral displacement. Partial collapse.		C1	Slight horizontal spreading <25mm	
8	Full structure in danger of collapse		8	Full structure in danger of collapse		C2	Moderate horizontal spreading 25 to 100mm	
9	Destruction		9	Destruction		C3	Severe horizontal spreading >100mm	

Population				Same as last?	
No of inhabitants in bldg		**Temporary accommodation**		**Injuries**	
Day	Night	None (homeless)		No of persons injured	
		Friends / family		Severe cuts, minor burns	
Bldg evacuated during Earthquake?		Local community bldg		Severe injuries, breaks, burns requiring hospitalisation or surgery	
Yes	No	Aid agency		Life threatening requiring quick intensive treatment to avoid death	
Bldg evacuated after Earthquake?		Govt temporary accommodation		Deaths	
Yes	No	Unknown			
Did inhabitants have an EQ evacuation plan?		Distance to temp accommodation from home (km)		**% Floor area collapsed (count roof as a floor)**	
Yes	No	NA (non residential building)			
How long before bldg reoccupied?				**Loss of utilities**	
Days				Service / Days / Weeks	
Weeks				Water	
Unable				Power	
				Gas	
				Telecom	

Figure 2.6 Geoscience Australia Padang 2009 damage survey form (back sheet)

In the recent earthquake in Tohoku, Japan (March 11, 2011) where building damage due to ground shaking was not so severe, the Japanese authorities used a new damage recording method for the hundreds of

thousands of affected single-family timber frame dwellings. The surveys assigned damage level to these buildings in terms of the extent of cracks just above the foundation level, in terms of the ratio of displaced roof tiles and in terms of area of dislodged plaster on the buildings' walls.

It is evident that there are different damage surveys for earthquakes around the World, as these evolved with knowledge and organisational abilities and are tailored to the nature of the damage. As reference, a history of the post-earthquake damage surveys evolution in Italy during the period 1976-2002 can be found in Goretti and Di Pasquale (2002). For a review of recent European approaches to post-earthquake damage surveys and scales please consult Anagnostopoulos and Moretti (2008 a, 2008 b).

In GEMECD, before attempting to homogenize such temporally and geographically varied approaches to post-earthquake damage surveys, as much as possible the information in its original form is captured as this is deemed important. The limitations of such data sets are fully recognised but to enable a truly global understanding of available data and its potential it is desirable to include this information. Furthermore, it is envisaged within GEMECD that users can standardise data sets when they use the GEM Building Taxonomy and consistent damage scales/grades. Users for example will be able to filter all survey results for a particular basic attribute (e.g. reinforced concrete buildings) and carry out cross event analyses.

In addition when partners have access to damage survey data in their regions that have been processed and/or homogenised in various ways, they should also provide such data sets to GEMECD.

Various formats of data preparation for input into GEMECD can be used depending on the survey. These can vary from building by building raw damage survey data (when the building locations are geocoded) to aggregated damage statistics tables of the type that appear for many events in the CEQID database (including data by location and data averaged over an estimated/calculated level of shaking intensity).

One of the most common forms of summary damage statistics tables, recording damage to buildings due to ground shaking are those that contain good information on the types of existing structures at the time of the earthquake and include all buildings of any studied structural typology in the survey area (including those that were not damaged). Having in addition a good description of the damage grades used. The basic five structural attributes needed are:

1. lateral load resisting system (e.g. reinforced concrete moment resistant frame with infill masonry; unreinforced stone masonry etc.)
2. the number of storeys (or a floor height grouping e.g. 1-2 storey buildings; 3-4 storey buildings etc.)
3. the type of horizontal load resisting system (e.g. reinforced concrete slab; wooden floors; etc.)
4. the date/period of construction (or a time period grouping related to particular vintage of an earthquake code; e.g. in Greece: pre-1959 for pre-code buildings; 1959-1984 for the first earthquake code; 1984-1994 for the second earthquake code; 1995-2003 for the third earthquake code and so on)
5. existence or not of structural irregularities (e.g. with or without soft-storey for the case of RC frame buildings etc.).

In Table 2.5 a typical template, which uses the EMS-98 intensity scale's six damage grades (from D0 for undamaged buildings to D5 for collapsed buildings) including a random selection of structural types, heights and periods of construction is shown.

Table 2.5 A template showing structural types by period of construction and their corresponding damage levels derived from an engineering damage survey in a particular location

			Damage Level (Grade) – Number of Buildings					
Structural Type	**Period of Construction**	**GEM Taxonomy**	**D0**	**D1**	**D2**	**D3**	**D4**	**D5**
1-3 Floor Reinforced Concrete Frame with Brick Infill Masonry without soft-storey built in the period 1959-1984								
1-3 Floor Reinforced Concrete Frame with Brick Infill Masonry with soft-storey built in the period 1985-1994								
4-7 Floor Reinforced Concrete Frame with Brick Infill Masonry without soft-storey built before 1959								
4-7 Floor Reinforced Concrete Frame with Brick Infill Masonry with soft-storey built in the period 1995-2003								
1-3 Floor Unreinforced Stone Masonry with wooden floors (without ties or ring beams) built in the period 1919-1959								
1-3 Floor Unreinforced Stone Masonry with RC floors (without ties or ring beams) built in the period 1960-1974								
1-3 Floor Unreinforced Stone Masonry with steel floors incl. wall-ties built in the period 1919-1959								

For events where detailed damage survey data will not be available, we propose to classify the damage in two main groups: a) generalised damage to commonly found construction types and b) specific cases of damage when information is available. These are shown in Table 2.6 and 2.7 respectively. The information on the soil type at a location is optional.

As shown in Table 2.6 it is also important to report groups of specific construction types that did not have any damage in the same format to allow vulnerability calibration.

Table 2.6 Generalised damage data form to particular types of construction (to be used for events where detailed damage survey data may not be available)

Location Name	Geo-reference	Soil type in the location	Construction type	Intensity	Average observed damage
a		alluvium	RC frames pre-1980	VIII	10% damaged; 1% collapsed
a		alluvium	URM with wood floors	VIII	25% damaged; 5% collapsed
b		stiff	RC frames pre-1980	VII	5% damaged
b		stiff	URM with wood floors	VII	15% damaged; 2% collapsed
c		hard	RC frames pre-1980	VIII+	20% damaged; 2% collapsed
c		hard	URM with wood floors	VIII+	40% damaged; 7% collapsed
d		alluvium	RC frames pre-1980	IX	40% damaged; 5% collapsed
d		alluvium	URM with wood floors	IX	60% damaged; 10% collapsed

For specific cases of damage to a particular building or facility, information required would be as shown in Table 2.7, including clear damage descriptions and information on the probable cause of the observed damage (irregularity, overload, previous damage or pathologies, etc.). Whenever possible such data should also be accompanied by good quality non-copyrighted photos of corresponding damaged buildings.

Table 2.7 Specific cases of damage to particular types of construction

Building Name (or Address)	**Geo-reference**	**Soil type in the location**	**Construction type**	**GEM Taxonomy**	**Intensity at the site**	**Damage Description**	**Probable Cause of Damage**
1		alluvium	RC frame pre-code		VIII		
2		stiff	RC frame 1995-2003		VII		
3		hard	RC shear wall post-1980		VIII+		
4		alluvium	URM with wood floors		IX		

Furthermore for some events, processed damage data may be published in the literature but access to the raw data may not be possible. In such cases the processed data (e.g. by intensity zone) can also be provided. A typical example of data averaged over an estimated/calculated level of shaking intensity from analysis of damage statistics of the 2008 Wenchuan earthquake in Sichuan province, China is shown in Table 2.8.

Table 2.8 A typical example of data averaged over an estimated/calculated level of shaking intensity from analysis of damage statistics of the 2008 Wenchuan earthquake (Source: Sun and Zhang, 2010)

Table 6 Vulnerability matrix of unfortified masonry buildings

Intensity	Intact	Slight damage	Medium damage	Serious damage	Destroyed
VI	-	0.3333 0.3884	-	0.6667 0.6116	-
VII	0.2868 0.2782	0.3245 0.3518	0.2528 0.2783	0.1170 0.0905	0.0189 0.0013
VIII	0.0952 0.0859	0.2500 0.3720	0.2083 0.1908	0.3452 0.3178	0.1012 0.0336
IX	0.0628 0.0110	0.0711 0.0577	0.1925 0.2305	0.5649 0.6618	0.1088 0.0390
X	0.0980 0.0788	0.1961 0.4049	0.1373 0.1720	0.3137 0.2354	0.2549 0.1089
XI	0.0725 ——	0.1014 0.7230	0.0870 0.2770	0.3188 ——	0.4203 ——

Table 7 Vulnerability matrix of fortified masonry buildings

Intensity	Intact	Slight damage	Medium damage	Serious damage	Destroyed
VI	0.2000 0.1892	-	0.6000 0.6482	0.2000 0.1626	-
VII	0.4347 0.4304	0.3526 0.3252	0.1626 0.2079	0.0456 0.0358	0.0046 0.0007
VIII	0.2213 0.2999	0.2578 0.3196	0.2787 0.2493	0.2282 0.1281	0.0139 0.0030
IX	0.0980 0.1454	0.1625 0.1268	0.2997 0.3866	0.3529 0.3160	0.0868 0.0252
X	0.3218 0.3150	0.2529 0.2336	0.2529 0.3280	0.1379 0.1193	0.0345 0.0042
XI	0.2237 0.0677	0.2237 0.0682	0.0921 0.0402	0.3421 0.8110	0.1184 0.0130

2.4 Human Casualty Statistics

The basic objective is to provide statistical data on human casualties by event, study and location in the form of tables of numbers dead and injured, and total population. In total, casualty studies for 15 events were included in the final GEMECD as shown in Appendix A. These are related to ground shaking effects on buildings (i.e. building collapse due to shaking) and tsunami and landslide human casualty studies have not been included. More than 77% of worldwide human casualties since 1968 are related to building collapse due to ground shaking (Marano *et al.,* 2009), although in some regions the proportion of life losses attributed to slope failures and tsunami are also quite significant (e.g. approx. 30% of fatalities in South America in the last 52 years (1960-2011) were due to landslides and avalanches; aprrox. 20% of fatalities in the 2008 Wenchuan earthquake were due to landslides; 84% of life losses in Indonesia since 1900 is attributed to tsunami; 67% of fatalities in Japan since 1946 were due to tsunami).

At Tier 1 (the event overview) specified in Table 2.1, information on human casualties will include the following attributes:

1. Total number of people killed
2. Total number of people missing
3. People killed due to ground shaking
4. People killed due to slope failures
5. People missing due to slope failures
6. People killed due to tsunami
7. People missing due to tsunami
8. People killed due to fire following
9. People missing due to fire following
10. People dying post-disaster but earthquake-related
11. Total number of people injured
12. People seriously injured and/or hospitalized

In Table 2.9, some typical examples from the GEMECD event list are shown.

Table 2.9 Typical examples of human casualty data to be included in the GEMECD

	Ancash 1970	**Kobe 1995**	**Wenchuan 2008**	**Tohoku 2011**	**Christchurch 2011**
Total number of people killed	~32,000	6,434	69,712	16,019	181
Total number of people missing	~35,000	0	17,921	3,805	0
People killed due to ground shaking	~49,000	4,918	~65,650	~90	177
People killed due to slope failures	~2,000	34	~5,000	14	4
People missing due to slope failures	~16,000	0	~17,000	0	0
People killed due to tsunami	0	0	0	~15,600	0
People missing due to tsunami	0	0	0	3,805	0
People killed due to fire following	0	550	0	~40	0
People missing due to fire following	0	0	0	0	0
People dying post-disaster but earthquake related	n/a	932	n/a	~586	0
Total number of people injured	~143,500	41,521	374,643	6,121	7,666
People seriously injured and/or hospitalized	n/a	2,540	96,449	658	164

For some categories approximate figures are used, as it is quite common following earthquake disasters that the information on the extent and cause of the human casualties is poorly recorded (especially in the case of older events). When data are not available, the "n/a" abbreviation should be used.

At Tier 2, the types and level of resolutions of studies would depend on the earthquake. At the very least, a study of district level casualty information and the contemporaneous population at these geographical units at the time of the earthquake must be included for all the specified events. An example with the attributes for this level of resolution data is shown in Table 2.10 (the 1972 Ghir, Iran earthquake, at present not included in the list of 25 events).

Table 2.10 Attributes associated with human casualty information at village level for Ghir, Iran 1972 (extract from Razani and Lee, 1973)

				Raw Data		
Village	**Location (Lat/Long)**	**No. of Buildings**	**Population**	**Buildings Destroyed**	**Injured**	**Killed**
Ab Bad	28.3669 53.226	14	59	14	0	8
Ab Garm	32.3243 49.0327	48	255	48	5	20
Abu Askar	N/A	12	65	12	4	1
Aliabad	28.3669 53.226	172	852	172	0	9
Azizabad	35.9416 46.6324	32	183	32	10	31
Bagh-Now	N/A	86	467	86	60	75
Barikhun	N/A	32	160	32	7	40
Bayan	34.0977 48.4136	168	941	168	45	300
Bedeh	28.7936 51.7512	44	242	44	15	60
Dasht Shur	N/A	21	144	21	15	23
Deh Beh	28.4512 53.1244	293	1,117	293	10	20
Dotu Leghaz	N/A	14	94	14	3	4
Fakhrabad	32.7798 52.5377	34	203	34	6	13
Fathabad	35.3203 51.518	3	17	3	1	3
Gavaki	N/A	181	872	181	100	400
Ghalatu	29.9865 57.2775	71	362	71	3	29
Ghassemabad	N/A	56	178	56	6	14
Ghir	N/A	809	5,068	809	889	3,399

The number of injured may be further divided into sub classes of injuries and if available, these should be included at this level. The number of buildings destroyed and total number of buildings in the district or village may be directly entered here or taken from building damage surveys.

At Tier 2, it may also be possible to record causes of deaths and injury studies, similar to the one carried out by the Fire and Disaster Management Agency (FDMA) in Japan after the Niigata-ken Chuetsu earthquake of 2004 where at ward level, the number of deaths and their causes were captured in a study.

For some events, it may be possible to inform lethality of collapse of particular building types from information on distribution of building types, number of occupants (either from typical occupancy rates of dwellings or from actual reports) and the total killed in these types of structures. Since most deaths from

ground shaking are assumed to be from collapsed buildings, supported by empirical observations, a fatality rate can be approximated for particular buildings types. A useful parameter, which would inform loss estimation models of mode of collapse, would be the volume loss of these collapsed buildings. For example, Table 2.11 captures this kind of data.

Table 2.11 Attributes associated with human casualties information by structural types for the 1988 Armenia earthquake (for Nalband town, in Noji *et al.,* 1990)

Structure type	Total no. of Buildings	No. of Collapsed Buildings	Occupants	Killed	Fatality Rate (%)	Typical volume loss
Stone Masonry	-	38	415	53	12.8%	10-80%
Precast concrete panel	-	2	40	19	47.5%	
Precast concrete frame	-	8	577	502	87.0%	90%
Total	-	48	1032	574	55.6%	

A higher resolution study would be a survey of particular building types, carried out with a known total number of occupants at the time of the earthquake and numbers of buildings surveyed. From each of these households, the damage level of the dwelling and the number of deaths and level of injuries are also recorded. In order to derive casualty rates for earthquake loss estimation models, the data shown in Table 2.12 are the minimum information needed.

Table 2.12 An example showing human casualties information by structural types and corresponding damage levels after the Pisco earthquake in Peru 2007 (So, 2009)

Building Type			Injury Type						
		Building Damage	No injury	Slightly injured	Moderately injured	Seriously injured	Critically injured	Killed	Total
Brick		moderately damage	0	1	0	0	0	0	1
Total Number of People in Survey	**17**		0.00%	100.00 %	0.00%	0.00%	0.00%	0.00%	
		substantially damaged	0	0	1	0	0	0	1
			0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	
		heavily damaged	0	1	2	7	0	1	11
			0.00%	9.09%	18.18%	63.64%	0.00%	9.09%	
		complete/ collapse	1	0	1	1	0	1	4
			25.00 %	0.00%	25.00%	25.00%	0.00%	25.00 %	
	Total		1	2	4	8	0	2	17
Adobe		substantially damaged	0	0	0	2	1	0	3
Total Number of People in Survey	**87**		0.00%	0.00%	0.00%	66.67%	33.33%	0.00%	
		heavily damaged	13	6	9	11	0	3	42
			30.95	14.29%	21.43%	26.19%	0.00%	7.14%	

Building Type		Injury Type						
	Building Damage	No injury	Slightly injured	Moderately injured	Seriously injured	Critically injured	Killed	Total
		%						
	complete/ collapse	6	10	4	16	2	4	42
		14.29 %	23.81%	9.52%	38.10%	4.76%	9.52%	
Total		19	16	13	29	3	7	87

However, there are some earthquakes where the death tolls are governed by extreme cases of catastrophic collapses. This was the case for the Armenian earthquake in 1988 and also more recently in the Christchurch New Zealand earthquake of February 2011, where the collapse of two mid-rise reinforced concrete buildings accounted for 75% of the total event death toll of 181.

Credit: NZ Herald

Photo 4 Catastrophic collapse of the Pyne Gould Corporation Building in the Central Business District of Christchurch, New Zealand

These case studies although impossible to incorporate in general loss models (the two buildings only accounted for 2% of this building type in the Central Building District) can inform our understanding of the survivability of occupants when such buildings collapse. These studies provide great accounts for future search and rescue efforts. These data also provide low probability and high consequence limits for loss estimation. For some events where data are available, these studies can be recorded as shown in Table 2.13. The parameters M2 and M3 are taken from the notation used for the University of Cambridge model (Coburn et al., 1992) where M2=occupants inside the building at the time of collapse – T0 and M3=number of people trapped due to the collapse of the structure.

Table 2.13 Casualty distribution of occupants in two collapsed RC buildings during the 2011 Christchurch event (Pomonis et al., 2011)

Building Name	M2 (occupants at T0)	M3 (trapped)	M2-M3 (not trapped)	Dead	Rescued	Life Threat/ Seriously Injured	Moderately Injured	Lightly Injured	Not injured	Unknown Injury
PGC	38	37	1	16	22	5	2	5	7	4
CTV	158	137	21	119	39	5	11	1	17	6
SUM	**196**	**174**	**22**	**135**	**61**	**10**	**13**	**6**	**24**	**10**

2.5 Consequences of ground shaking on non-standard buildings, critical facilities, important infrastructure & lifelines

The general objective is to provide observational data on the impact of ground shaking on non-standard building types, critical buildings, infrastructure e.g. roads, railways, bridges, tunnels, dams, underground pipelines, and urban systems, etc., with descriptions, damage photographs (including remotely-sensed images or maps) and locations to enable their display on maps and linkage to levels of ground shaking and to more detailed reports. Another important aspect is to prepare an interface that will enable impact damage due to ground shaking to non-standard buildings, critical facilities, important infrastructure and lifelines in future earthquakes to be captured and uploaded to the database.

In total the final GEMECD contains consequences of ground shaking on non-standard buildings, critical facilities, important infrastructure and lifelines category for 24 events (see Appendix A). It was recognised that for a number of older earthquakes included in the original list of events, there will be ones for which it may be difficult to obtain exact geocoded locations for affected buildings or facilities. Partners were encouraged to modify the list according to their knowledge of geocoded data in their region of responsibility, perhaps focusing on more recent events, whilst at the same time trying to maintain the number of events studied at a level not dissimilar to the 22 events originally envvisaged. In terms of the number of studies per event to be submitted, a minimum of three studies per event is envisaged, but more studies can be submitted if available in reputable post-event reconnaissance reports or published literature in journal or regional, world earthquake engineering conference proceedings or others.

By critical buildings and facilities we would envisage (following HAZUS, FEMA, 1999, Vol 1 Chapter 3) buildings such as emergency response buildings, hospitals, schools, as well as dams and nuclear power facilities; non-standard buildings include stadia, large occupancy halls (such as cinemas, theatres). Critical facilities would include ports, airports, railway or bus stations, dams etc. Infrastructure includes roads, railways, and their bridges and tunnels, water and wastewater pipelines as well as ports, airports. Finally historic buildings include palaces and mansions, churches, mosques, temples, as well as archaeological sites.

At this stage of GEMECD we shall focus on schools, hospitals, bridges (road or rail, including elevated motorways or railways) and historic-monumental buildings (incl. churches, mosques, temples etc.). However if partners have geocoded data about the performance of another non-standard building type or another critical facility (e.g. a dam or a nuclear power plant etc.) or another type of infrastructure or lifeline, they are encouraged to submit these studies.

For each event, a menu at Tier 1 will identify a number of separate studies, each providing data related to one of the following four broad facility **classes.**

- Critical building
- Non-standard building
- Infrastructure
- Historic building

Each of these classes will comprise a number of defined **types** and **subtypes**.

Tier 2 will give details of an individual study and will include a map showing the location of each facility included with markers showing its type. Tier 2 may also include data on particular types of facilities (e.g., schools) collected at the scale of an administrative district. Table 2.14 shows an example from the Athens 1999 earthquake with the number of school buildings by damage grade and municipality.

Table 2.14 Damage to schools in the September 7, 1999 Athens earthquake, by municipality (Vima newspaper, September 16, 1999)

Municipality	Total	Surveyed	Minor Damage	Non-structural damage	Structural damage	Severe structural damage (to be demolished)
Ano Liosia	24	24	12	9	2	1
Aharnes	68	68	44	17	7	0
Nea Philadephia	31	31	10	19	2	0
Kifissia	23	23	18	4	1	0
Ilion	76	76	47	26	3	0
Nea Ionia	55	55	42	11	2	0
Elefsis	27	25	19	5	0	1
Kamateron	22	22	14	6	2	0
Metamorphosis	18	18	12	6	0	0
Petroupolis	37	35	30	5	0	0
Haidari	39	27	21	4	2	0
Aghii Anarghiri	32	30	23	7	0	0
TOTAL	**420**	**404**	**269**	**112**	**21**	**2**

Tier 3 will show a standardised table of the individual facilities with data for each about its type and subtype, its form of construction, location, level of damage and other data. Most of the fields in this table will involve selecting from pull-down menus facilitating entry, and enabling cross-study and cross-event comparisons and analysis to be done by users who wish to download data by certain categories. Locations will be in standard lat/long coordinates. A few fields will be available for text to amplify the data fields. The proposed fields are shown in Table 2.15.

Completing some of the fields will be required for the facility to be included in the table. These include the class, type and sub-type, the form of construction, the location and an assessment of the level of damage in the event.

Table 2.15 The fields available for each facility. Those with * are required fields

*Class	*Menu A*
*Type	*linked Menu B*
*Sub type	*linked Menu C*
Name	*Text*
*Form of const	*linked Menu D*
No of stories	*Menu J*
Date of constr	*linked Menu E*
Applicable Design Code	*Text*
Evidence/knowledge of retrofit	*Yes/No*
Type of retrofit	*Text*
*GEM Taxonomy	*Text (check with Parser)*
*Location (lat/long)	*Decimal, degrees*
Soil conditions	*Menu H*
Shakemap MMI Intensity at location	*Link to Shakemap Shapefile for Lat/Long*
*Overall damage level	*Menu F*
*Overall damage level for pipelines	*Menu K*
*Principal cause of damage	*Menu G*
Detailed damage description	*Text*
Photo reference	*Ref to ECD photoarchive*

Table 2.16 shows the proposed pull-down menu options for class, type and subtype.

Table 2.16 Classes (Menu A), types (Menu B) and sub-types (Menu C)

Menu A	**Menu B**	**Menu C**	**Applicable linked menus**
Class	**Type**	**Sub-type**	**Description**
Critical facilities	Medical care	Small hospital	less than 50 beds
		Medium hospital	between 50 and 150 beds
		Large Hospital	more than 150 beds
		Medical Clinic	Clinics, Labs, Blood banks
	Emergency Response	Fire station	
		Police station	
		Emergency operation centre	
	School	Elementary school	typically age 5 to 11
		Middle school	typically age 12 to 18
		College/University	typically post 18
	Concrete Gravity Dam	Hydropower	
		Flood Control	
		Irrigation	
		Industrial	
	Concrete Arch Dam	Hydropower	
		Flood Control	
		Irrigation	
		Industrial	

Menu A	Menu B	Menu C	Applicable linked menus	
Class	**Type**	**Sub-type**		**Description**
	Earth Fill Dam	Hydropower		
		Flood Control		
		Irrigation		
		Industrial		
	Rock Fill Dam	Hydropower		
		Flood Control		
		Irrigation		
		Industrial		
	Nuclear Power Facility			
	Military installation			
Non-standard building	Stadium			
	Large assembly hall			
	Other			
Infrastructure	Road	Urban road		
		Major road		
		Minor road		
	Highway bridge	Single span	separation by form of construction	
		Multi-span	separation by form of construction	
	Tunnel		bored or cut and cover	
	Railway track			
	Railway bridge		separation by form of construction	
	Railway station		separation by form of construction	
	Railway tunnel		bored or cut and cover	
	Other railway structure		separation by form of construction	
	Bus station or other facility		separation by form of construction	
	Pier or dock			
	Crane or cargo handling equipment			
	Port structure or warehouse		separation by form of construction	
	Ferry terminal		separation by form of construction	
	Airport runway			
	Airport control tower			
	Airport passenger terminal			
	Airport parking structure			
	Airport maintenance facility			
	Airport fuel facility			
	Water pipeline	brittle or ductile		
	Water treatment plant			

Menu A	Menu B	Menu C	Applicable linked menus
Class	**Type**	**Sub-type**	**Description**
	Water pumping plant		
	Water storage tank - on ground		separation by form of construction
	Water storage tank - elevated		separation by form of construction
	Well		
	Waste water Pipeline	brittle or ductile	
	Waste water treatment plant		
	Waste water pumping plant		
	Other Pipeline	brittle or ductile	
	Gas Pipeline	brittle or ductile	
	Gas Power Plant		
	Gas Tank		
	Gas Pressure Regulator		
	Refinery		
	Tank farm		
	Pumping plant		
	Electric Power generation plant		
	Power Transmission Line		
	Electric substation (low voltage)		
	Electric substation (high voltage)		
	Telecommunications Transmission tower		
Historic building	Palace/mansion		separation by form of construction (limited menu)
	Castle		separation by form of construction (limited menu)
	Church		separation by form of construction (limited menu)
	Religious institution		separation by form of construction (limited menu)
	Mosque		separation by form of construction (limited menu)
	Market		separation by form of construction (limited menu)
	Tower/obelisk		separation by form of construction (limited menu)
	Arch or colonnade		separation by form of construction (limited menu)
	Archaeological site		separation by form of construction (limited menu)
	Historic urban centre		separation by form of construction (limited menu)

Tables 2.17 to 2.23 show the proposed pull-down menu options for Form of Construction, Date of Construction, Overall damage level, Subsoil conditions, Principal Cause of Damage. Variants on these lists apply for some types or sub-types. In the case of pipelines (brittle or ductile) for gas, water, wastewater, etc. a different damage scale and damage description applies and is shown in Table 2.16 (Menu K). In this way we capture the two different types of pipeline damage (break or leak) that are respectively associated with ground failure and ground shaking. We also capture the different way in which such damage is being reported (e.g. length of pipeline affected and density of leaks or breaks per running kilometre of pipeline).

Table 2.17 Form of Construction (Menu D)

Adobe or earthen construction
Timber frame
Stone masonry
Brick or block masonry
Reinforced concrete frame
Reinforced concrete shearwall
Steel frame
Other

(with variation for historic structures)

Table 2.18 Date of Construction (Menu E)

Normal	*Historic buildings*
Pre 1900	BC
1900-1939	1 to 1000 AD
1940-1979	1000 -1500 AD
1980-1989	1500 - 1750 AD
1990-1999	1750 - 1900 AD
since 2000	since 1900

Table 2.19 Overall level of damage (Menu F)

Undamaged
Slight damage
Moderate damage
Heavy damage
Very heavy damage/partial collapse
Destruction

Table 2.20 Principal cause of damage (Menu G)

Ground shaking
Landslide/slope failure
Fault rupture
Tsunami
Liquefaction/subsidence
Fire following

Table 2.21 Subsoil conditions (Menu H)

Unknown
Hard rock: Vs>1500m/s (NEHRP Site class A)
Rock: 760<Vs<1500 m/s (NEHRP Site class B)
Dense soil or soft rock: 360<Vs<760 m/s (NEHRP Site class C)
Stiff soil: 180<Vs<360 m/s (NEHRP Site class D)
Soft soil: Vs<180 m/s (NEHRP Site class E)
Very poor soil requiring specific evaluation (NEHRP Site class F)

Table 2.22 Number of stories (Menu J)

Unknown
1
2
3
4 to 7
8 to 11
12 or more

Table 2.23 Pipeline damage (Menu K)

Undamaged
Total length of gas pipelines affected by breaks (km)
Density of gas pipeline break damage (no. of breaks/km)
Total length of water pipelines affected by breaks (km)
Density of water pipeline break damage (no. of breaks/km)
Total length of waste water pipelines affected by breaks (km)
Density of waste water pipeline break damage (no. of breaks/km)
Total length of other pipelines affected by breaks (km)
Density of water pipeline break damage (no. of breaks/km)
Total length of gas pipelines affected by leaks (km)
Density of gas pipeline leak damage (no. of leaks/km)
Total length of water pipelines affected by leaks (km)
Density of water pipeline leak damage (no. of leaks/km)
Total length of waste water pipelines affected by leaks (km)

Density of waste water pipeline leak damage (no. of leaks/km)
Total length of other pipelines affected by leaks (km)
Density of water pipeline leak damage (no. of leaks/km)

Table 2.24 shows the table structure with some examples. The information given here is deliberately summarised both for the purpose of systematic organisation, and also because it will serve as an introduction to the study document from which it is derived, which is likely to give more detail on all these aspects. The table also helps towards fulfilling the second GEMECD objective of creating a structure and a standard interface to assist in planning the capture of information on damage to facilities in future events.

Table 2.24 Proposed table structure for recording consequences of ground shaking on non-standard buildings, critical facilities, important infrastructure and lifelines

Event	Date	Class	Type	Sub type	Name	Form of const	No of stories	Date of constr	Applicable Design Code (or Unknown)	GEM Taxonomy	Location		Soil conditions (if known)	Shakemap MMI Intensity at location	Overall damage level	Principal cause of damage	Detailed damage description	Photo reference
											Lat (deg)	Long (deg)						
		PD Menu A	*linked PD Menu B*	*linked PD Menu C*	*Text*	*linked PD Menu D*	*PD menu J*	*linked PD menu E*	*Text*	*Text (check with Parser)*	*Decimal*	*Decimal*	*PD Menu H*	*Link to Shakemap Shapefile for Lat/Long*	*PD Menu F*	*PD Menu G*	*Text*	*Ref to ECD photoarchive*
Wenchuan	2008	Essential Facility	School	Middle School	Middle School	block masonry	4 to 6	1940-79	Unknown				Unknown		Partial collapse	Ground shaking	ground floor and	Report Fig 4.2
Wenchuan	2008	Highway system	Bridge	Multispan	River Zipingpu	Reinforced concrete	N/A	Unknown	Unknown				Unknown		Partial collapse	Ground shaking	loss of one span	Report Fig 5.2b
L'Aquila	2009	Historical building	Church		S. Maria del Suffragio	Masonry		1713			42.349	13.398			Heavy damage	Ground shaking	dome collapsed	EEFIT Report Fig 8
L'Aquila	2009	Essential facilities	School	Elementary school	Elementary School	Reinforced concrete	3	1940-79			42.352	13.396			Slight damage	Ground shaking	damage to rc infill	Report Fig 47
L'Aquila	2009	Highway system	Bridge	Single span	Fossa minor road bridge	Reinforced concrete		Unknown			42.304	13.503			Collapse	Ground shaking		Report Fig 51
Maule	2010	Historical building	Church		Señora del Rosario,	masonry, with	1	1835			-35.094	-72.018			Heavy damage	Ground shaking	with the cross ties	Report Fig 5.4
Maule	2010	Highway systems	Bridge	Multispan	Bridge, Southbound	Brick/block masonry	N/A	1750-1900			-35.183	-71.39			Destruction	Ground shaking	spans collapsed,	Report Fig 5.19

2.6 Consequences of secondary hazards to all types of inventory classes

The general objective is to provide observational data on slope failures (landslides, mudlflows etc.), liquefaction and other induced effects such as tsunami and fire following, with descriptions, photographs (including remotely-sensed images or maps) and locations to enable their display on maps and linkage to levels of ground shaking and to more detailed reports. Another important aspect is to prepare an interface that will enable impact damage from secondary hazards in future earthquakes to be captured and uploaded to the database.

2.7 Earthquake-Triggered Landslides

There were 24 events short-listed under the consequences of secondary hazards, attributed to all the partners (excluding CRED) by their region of responsibility in the original GEMECD proposal. The USGS Landslides Hazard Group was responsible for gathering information and reporting on the effects of slope failures (13 events) and could be assisted by regional partners if required. The events with significant slope failure effects that were short-listed are shown in Table 2.25.

Table 2.25 GEMECD short-listed events, for studies on the consequences of slope failures

Event Name	*Country (-ies)*	*YEAR*	*MON*	*DA (UTC)*	*PARTNER*
Ancash (Chimbote)	PERU	1970	5	31	USGS / ERN-AL
Guatemala	GUATEMALA	1976	2	4	USGS / CAR
Irpinia	ITALY	1980	11	23	USGS / CAR
Reventador	ECUADOR	1987	3	6	USGS / ERN-AL
Luzon	PHILIPPINES	1990	7	16	USGS / GNS
Northridge	USA	1994	1	17	USGS/ SPA
Chi-Chi	TAIWAN	1999	9	20	USGS / KYOTO
San Miguel	EL SALVADOR	2001	1	13	USGS / ERN-AL
San Salvador	EL SALVADOR	2001	2	13	USGS / ERN-AL
Niigata Chuetsu	JAPAN	2004	10	23	USGS / KYOTO
Kashmir	PAKISTAN & INDIA	2005	10	8	USGS / CAR
Wenchuan	CHINA	2008	5	12	USGS / CAR
Padang	INDONESIA	2009	9	30	USGS / KYOTO

At Tier 1, the basic event information should include the following:

a. Were landslides of significance in this event?

b. An overview map of landslides in this event. An example map of induced landslides that were triggered by the 1976 Guatemala earthquake is shown in Figure 6.1 (Godt et al., 2009).

c. Type of landslides (rock, soil, slide, debris flow).

d. People injured or killed and missing by landslide.

e. Overall impact on buildings and infrastructure.

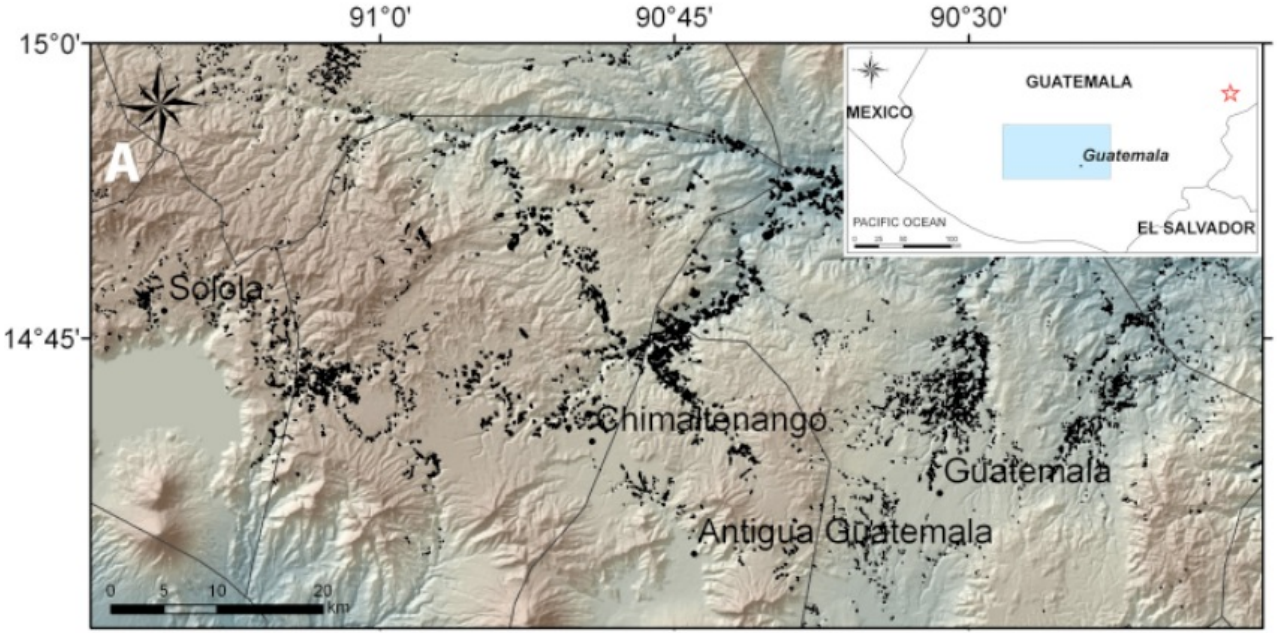


Figure 2.7 Map showing the landslides triggered by the M7.6 Guatemala earthquake

Tier 2 will give details of individual landslide studies and will include a map showing the locations of these study areas. For each study, in addition to the ID, study quality and geographic basis, some basic descriptive parameters are included in Table 2.26. It is not expected that all of these fields will be completed for the listed events.

Table 2.26 List of descriptors of slope failures

Category	GEMECD fields	Description
Where*	Location of landslide	
	Street Address of Landslide	
	City of Landslide	
	County of Landslide	
	State of Landslide	
	Road number	
	Road type	
When*	Date Observed	date
	Time	hour
	Date Occurred	date or unknown
	Time	hour or unknown
	Duration--How long did movement last?	Time in days, minutes, hours or unknown
	Continuity of movement	Once/Sporadic, Continuous, Episodic, Other, or Unknown
	Conditions immediately prior to the landslide	Average weather, Unusually dry weather, Unusually wet weather, Short-lived intense rainfall, Prolonged moderate rainfall, Snowmelt, Intense wave erosion, Intense stream erosion, Earthquake, Construction

Category	GEMECD fields	Description
What	General Setting?	Open slope, Side-slope of steep canyon, Gully or Ravine, Housing development, Mine or quarry, Canal or waterway, Forest, Burned hillside, Coastal or River bluff, Other, Unknown
	Slope Modified?	natural, cut, fill, embankment, graded (cut and fill), unknown
	Material	Bedrock, Coarse (gravel-, cobble- and boulder-sized), Fine (sand, silt, clay), Mixture of coarse and fine, unknown
	Consistency	liquid, solid-wet, solid-dry, rubble, unknown
	Trees	standing upright, fallen, leaning uphill, leaning downhill, leaning all directions, none, unknown
	Scar height on trees	height, m
	Height of mud coating on trees	height, m
	Movement Type	fall, flow, topple, rotational slide, translational slide, spread, avalanche, unknown
How Fast	Speed	Choose from range of speeds by comparison with common things or enter a value
How big	Length or travel distance (top to bottom)	Choose from a range of dimensions based on comparison with common items or enter a dimension
	Width of source area (along contour)	Choose from a range of dimensions based on comparison with common items or enter a dimension
	Width of deposit (along contour)	Choose from a range of dimensions based on comparison with common items or enter a dimension
	Height/Depth source area	Choose from a range of dimensions based on comparison with common items or enter a dimension
	Height/Depth deposit	Choose from a range of dimensions based on comparison with common items or enter a dimension

When reliable secondary hazard consequence data such as damage to buildings or human casualties are available, tables of these consequences should also be collected. Tier 3 will include impact studies for one or more slope failures. The location and size of these failures should be recorded and geocoded on a map. The studies should focus on impact on not only fatalities but also critical infrastructure, pipelines and transportation network and in addition to the attributes listed for describing the landslide shown in Table 2.26, Tier 3 will include menus that can capture the following impact data:

Table 2.27 Transportation damage (Menu A)

Cars and trucks damaged	Number or unknown/not observed
Cars and trucks destroyed	Number or unknown/not observed
Railway cars damaged	Number or unknown/not observed
Railway cars destroyed	Number or unknown/not observed

Table 2.28 Building Damage (Menu B)

Single-family houses damaged	Number or unknown/not observed
Single-family houses destroyed	Number or unknown/not observed
Multi-family homes damaged	Number or unknown/not observed
Multi-family homes destroyed	Number or unknown/not observed
Non-residential buildings damaged	Number or unknown/not observed
Non-residential buildings destroyed	Number or unknown/not observed

Table 2.29 Infrastructure damage (Menu C)

Street/Highway lanes damaged	Number or unknown/not observed
Street/Highway lanes destroyed	Number or unknown/not observed
Railway lines damaged	Number or unknown/not observed
Railway lines destroyed	Number or unknown/not observed
Bridges damaged	Number or unknown/not observed
Bridges destroyed	Number or unknown/not observed

Table 2.30 Critical facilities damage (Menu D)

Pipelines damaged	Number or unknown/not observed
Pipelines destroyed	Number or unknown/not observed
Above-ground utilities damaged (overhead power lines, etc.)	Number or unknown/not observed
Above-ground utilities destroyed (overhead power lines, etc.)	Number or unknown/not observed
Dams damaged	Number or unknown/not observed
Dams destroyed	Number or unknown/not observed

Table 2.31 Land damage (Menu E)

Agricultural Land	acres destroyed or yes/no
Forest, Grassland	acres destroyed or yes/no
Railway lines damaged	polluted, partially blocked, dammed

Table 2.32 Social economic cost (Menu F)

Cost	dollars
Persons Injured	number
Persons Killed	number
Persons missing	number

For example, Table 2.33 shows a list of slope failures, their locations and resulting fatalities caused by the May 12, 2008 Wenchuan earthquake (Yin *et al.,* 2009). Efforts should be made to ensure that the locations of these slope failures are accurately geocoded to enable a link with the ShakeMap of the event in question.

Table 2.33 Example of slope failure consequence data triggered by the May 12, 2008 Wenchuan earthquake

Name of the geohazard	Type of geohazard	Location of the geohazard	Volume ($x10^4 m^3$)	Fatalities
Chengxi landslide	Slide	Wangjiayan, Old area of Beichuan County Town	480	1,600
Yingtaogou landslide	Slide	Chayuanliang-cun Village, Chenjiaba Town, Beichuan County	188	906
Xinbei Middle School landslide	Slide	New area of New County Junior High School, Beichuan County	240	500
Jingjiashan rockfall	Rockfall	Main road of Southern Beichuan County Town	50	60
Hanjiashan landslide group	Slide	Team 1, Dujiaba-cun Village, Guixi Town, Beichuan County	30	50
Chenjiaba landslide	Slide	Chengjiaba Town, Beichuan County	1,200	400
Hongyancun landslide	Slide	Hongyan-cun Village, Chenjiaba Town, Beichuan County	480	141
Taihongcun landslide	Slide	Taihong-cun Village, Chenjiaba Town, Beichuan County (landslide lake)	200	150
Donghekou landslide	Slide	Donghekou-cun Village, Hongguang Town, Qing-chuan County	1000	260
Dayanke rockfall	Rockfall	Jianxin-cun Village, Quhe Town, Qingchuan County	70	41
Zhengjiashan landslide group	Slide	Xinping-cun Village, Nanba Town, Pingwu County	1250	60
Linjiaba landslide	Slide	Linjiaba Dam, Pingwu County	200	60
Maanshi landslide group	Slide	Maanshi-cun Village, Shuiguan Town, Pingwu County	400	34
Guantan landslide	Slide	Guantan-cun Village, Cuishui Town, An County	144	100
Hongcun HPS landslide	Slide	Hongcun HPS, Shitingjiang River, Shifang County		150
Limingcun landslide	Slide	Liming-cun Village, Zipingpu Town, Dujiangyan City (National Road 213)	20	120
Xiaolongtan rockfall	Rockfall	Yinchanggou Resort, Pengzou City	5.4	100
Dalongtan goukou rockfall	Rockfall	Yinchanggou Resort, Pengzou City	10	100
Xiejiadianzi landslide	Slide	Team 7, Jiufeng-cun Village, Pengzou City	400	100
Liangaiping landslide	Slide	Tuanshan-cun Village, Pengzou City	40	30
Total				**4,962**

As shown in Table 2.34, the consortium had hoped to collect and record secondary hazards data for 12 events in GEMECD, however due to various limitations which will be explained in Chapter 6, this was not possible. The data envisaged (and ideal set of information) for GEMECD for each of the other secondary hazards included in GEMECD are discussed in turn in the following sections.

Table 2.34 GEMECD short listed events for studies on the consequences of liquefaction, tsunami and fire following on all types of inventory classes, by type of hazard and partner organisation

Event Name	*Country (-ies)*	*YEAR*	*MON*	*DA (UTC)*	*PARTNER*	*Observational data-info on liquefaction, tsunamis, fire following, fault rupture (N=11)*
Maule (Bio-Bio)	CHILE	2010	2	27	ERN-AL	(Tsunami)
South of Java	INDONESIA	2006	7	17	GNS	South of Java
Samoa	SAMOA & AMER. SAMOA	2009	9	29	GNS	(Tsunami)
Darfield	NEW ZEALAND	2010	9	3	GNS	(Liquefaction)
Christchurch	NEW ZEALAND	2011	2	21	GNS	(Liquefaction)
Kocaeli	TURKEY	1999	8	17	KOERI	(Liquefaction)
Duzce	TURKEY	1999	11	12	KOERI	(Liquefaction)
Kanto	JAPAN	1923	9	1	KYOTO	(Fires)
Kobe	JAPAN	1995	1	17	KYOTO	(Fires)
Sumatra-Andaman Islands	INDONESIA, SRI LANKA ETC.	2004	12	26	CAR	(Tsunami)
Tohoku	JAPAN	2011	3	11	KYOTO	(Tsunami, Fires)
Loma Prieta	USA	1989	10	18	SPA	(Fires)

2.8 Liquefaction and Lateral Spreading

The general objective is to provide observational data on the impact of liquefaction and lateral spreading on buildings, critical facilities, infrastructure with descriptions, damage photographs (including remotely-sensed images or maps) and locations to enable their display on maps and links to more detailed reports. Another important aspect is to prepare an interface that will enable liquefaction damage from future earthquakes to be captured and uploaded to the database.

At Tier 1, the basic event information will be summarised with the basic descriptors as shown in Table 2.35 and an overview map of the extent of liquefaction affected areas. An example map of areas affected by the 2010 Darfield earthquake (New Zealand) is shown in Figure 2.8. For events affecting expansive land areas more than one map may be needed (e.g. for the Darfield 2010 event there are two more maps at 1:100,000 scale for other liquefaction affected areas).

Table 2.35 Tier 1 tsunami event summary table

GEMECD Tier 1 Liquefaction Event Descriptors	*Description*
Date of the event	Year/Month/Day
Moment Magnitude	Mw
Focal Depth of the event	km
Total land area affected by liquefaction (km^2)	km^2
Population living and working in the liquefaction zone	number
Number of buildings affected	number
of which number of buildings that need to be pulled-down	number

Number of roads affected (all types of roads)	number
Financial impact of the liquefaction (direct estimated loss)	million US$

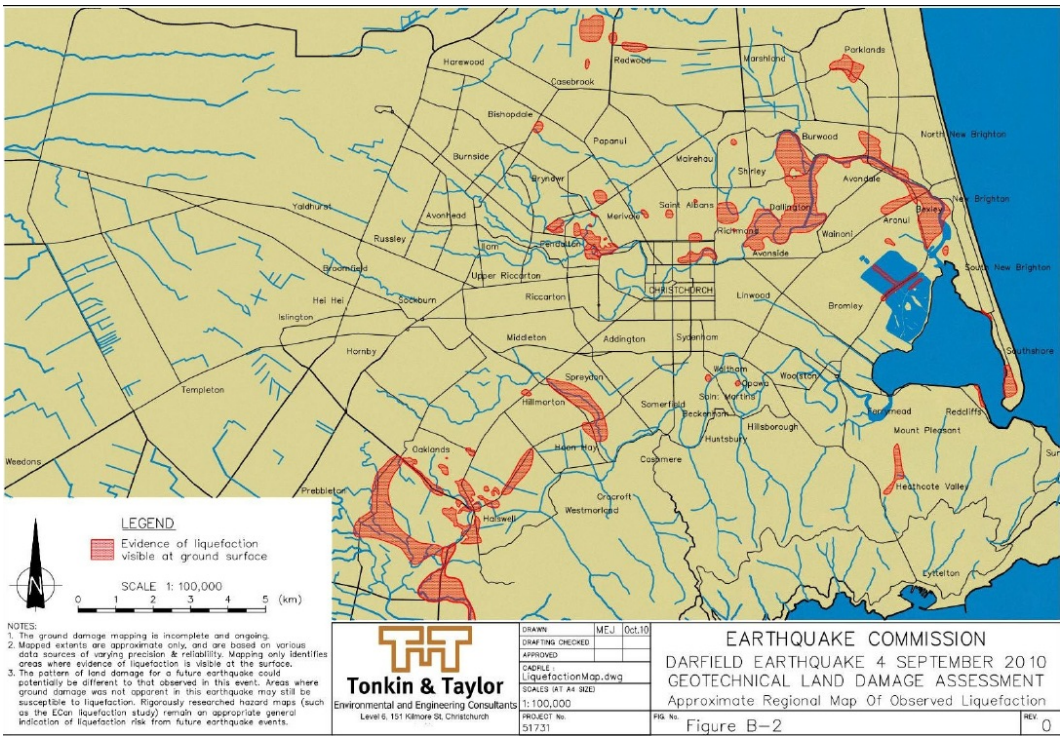


Figure 2.8 Areas affected by liquefaction in the greater Christchurch urban region, during the September 4, 2010 Darfield earthquake (Source: Jacka & Murahidy (2010))

Tier 2 will give details of individual liquefaction and lateral spreading consequence studies at town, neighbourhood or village level. The Tier 2 screen will include a map showing the locations of the study areas, a Location List table and general information on the type of studies included (that will be accessed at the Tier 3 level, by clicking on the individual locations on the Tier 2 map). At Tier 2 for each study location, the study level liquefaction event descriptive parameters required are shown in Table 2.36 (although it is not expected that all of these fields will be completed for each of the listed event-locations, "n/a" can be used whenever the information required in not available). Clicking on the Location List appearing on the Tier 2 screen will direct the user to the Tier 2 descriptors table.

Table 2.36: Tier 2 Basic Liquefaction Parameters for Individual Study Locations

Category	*GEMECD Tier 2 Liquefaction Event Descriptors*	*Field Type*	*Description*
Where	Name of Event	Text	Use commonly accepted name
	Location of the Study	Text	Name of the Location
	Soil type in the affected location	Text	Soft soil: Vs<180 m/s (NEHRP Site class E) or Very poor soil requiring specific evaluation (NEHRP Site class F)
	Occurrence of liquefaction	Text	Yes or No, if Yes give brief description
	Occurrence of lateral spreading	Text	Yes or No, if Yes give brief description

Category	*GEMECD Tier 2 Liquefaction Event Descriptors*	*Field Type*	*Description*
	Occurrence of ground or coastal subsidence	Text	Yes or No, if Yes give brief description
What	Land type	Text	Man-made island, Other artificial fill, Ports, Previously a swampland or wetland, River banks, Lake shores, Coastal Areas (within 500m from coast), Inland areas (>500m from coast)
	Land Use type	Text	Sparse residential - wooden houses, Dense residential - wooden houses, Sparse residential – non-wooden houses, Dense residential –non-wooden houses, Industrial, Port facilities, CBD, Industry of Hazardous Materials, Other, Mixed land use, Unknown
	Existence of previous land improvements	Text	Yes or No, if Yes give brief description
How Serious	Total land area affected by liquefaction and/or lateral spreading	Number	in km^2
	Total land area affected by land and/or coastal subsidence	Number	in km^2

Tier 3 will include impact studies to standard buildings and lifelines for one or more seriously affected locations (already viewed on the Tier 2 map). The required information is summarised in Tables 2.37 through 2.43 below. These tables will be accessed with pull down menus.

Table 2.37 Buildings loosing stability due to significant irregular settlement induced by liquefaction and/or lateral spreading (Menu A)

Single-family wooden buildings to be demolished	Number or unknown/not observed
Single-family non-wooden buildings to be demolished	Number or unknown/not observed
Multi-family wooden buildings to be demolished	Number or unknown/not observed
Multi-family non-wooden to be demolished	Number or unknown/not observed
Public ownership & Commercial buildings to be demolished	Number or unknown/not observed
Industrial buildings to be demolished	Number or unknown/not observed

Table 2.38 Buildings Affected by minor irregular settlement (Menu A)

Single-family wooden buildings with repairable damage	Number or unknown/not observed
Single-family non-wooden buildings with repairable damage	Number or unknown/not observed
Multi-family wooden buildings with repairable damage	Number or unknown/not observed
Multi-family non-wooden buildings with repairable damage	Number or unknown/not observed
Public ownership & Commercial buildings with repairable damage	Number or unknown/not observed
Industrial buildings with repairable damage	Number or unknown/not observed

Table 2.39 Liquefaction damage to the Transportation Infrastructure (Menu B)

Length of Roads affected	Number (in km) or unknown (n/a)
Length of Railway affected	Number (in km) or unknown (n/a)
Bridges directly affected	Number (in km) or unknown (n/a)

Table 2.40 Damage to Lifelines, Utilities (Menu C)

Length of damaged wastewater pipelines	Number (in km) or unknown (n/a)
Length of damaged natural gas network	Number (in km) or unknown (n/a)
Length of the damaged water distribution network	Number (in km) or unknown (n/a)
Length of damaged drainage network	Number (in km) or unknown (n/a)
Length of damaged electricity supply network	Number (in km) or unknown (n/a)

Table 2.41 Critical facilities damage (Menu D)

Industrial facilities affected	Number or unknown/not observed
Schools affected	Number or unknown/not observed
Hospitals, Clinics, Nursing Homes, Health Centres affected	Number or unknown/not observed
Fire and Police Stations affected	Number or unknown/not observed
Other important buildings affected	Number or unknown/not observed
Ports affected	Number or unknown/not observed

Table 2.42 Land damage (Menu E)

Agricultural Land	acres flooded or yes/no
Wetland, Grassland, Parks, Open urban land	acres flooded or yes/no
Industrial Land	acres flooded or yes/no
Commercial Land	acres flooded or yes/no
Residential Land	acres flooded or yes/no

Table 2.43 Costs, Exposed Population and Human Casualties (Menu F)

Cost of the Liquefaction damage to buildings(direct)	dollars
Cost of the Liquefaction damage to the public infrastructure networks (direct)	dollars
Cost for the Land Remediation	dollars
Indirect Costs as a result of the liquefaction, lateral spreading, land/coastal subsidence due to business, utility supply interruptions etc.	dollars
Population living and working inside the liquefaction, lateral spreading, land/coastal subsidence zone	number
Persons Injured in the liquefaction zone	number
Persons Killed in the liquefaction zone	number
Persons missing in the liquefaction zone	number

At Tier 3, a map of the liquefaction footprint will be shown, perhaps overlaid by a surficial geology map. These maps will be imported from relevant studies and can be GIS shape files, simple map images (e.g. JPEG, TIFF, etc.). An example is shown in Figure 2.9.

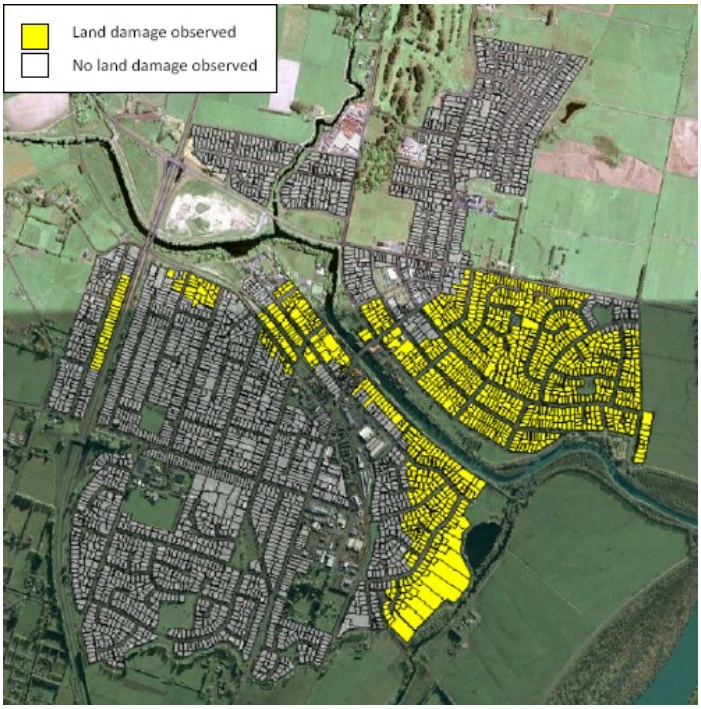


Figure 2.9 Overview map showing extent of observed land damage due to liquefaction in Kaiapoi town, New Zealand due to the September 4, 2010 Darfield earthquake (Source: Tonkin and Taylor (2010))

Photographs from the liquefaction, lateral spreading or land/coastal subsidence affected locations will be stored in Tier 3. These can be photos of individual buildings showing representative damage typologies for wooden, masonry, reinforced concrete frame or shear wall and steel frame structures.

In addition liquefaction, lateral spreading or land/coastal subsidence damage studies to individual non-standard buildings, critical buildings, critical facilities, lifelines, other important infrastructure and historic buildings can be presented in the relevant part of GEMECD.

2.9 Fire Following Earthquakes

At Tier 1, the basic event information for fire following should include the following:

a) An overview map of the extent and/or location of FFEs. An example map of areas devastated by fire triggered by the 1995 Kobe earthquake is shown in Figure 2.10 (University of Texas, 1996).

b) Total number of fire ignitions

c) People injured or killed by fires in this event

d) Overall impact of the fires on buildings and infrastructure

e) Financial impact of the fires

Figure 2.10 Area devastated by fire in the Kobe earthquake of 1995 (Uni of Texas)

Tier 2 will give details of individual FFE studies and will include a map showing the locations of these study areas. For each study, in addition to the ID, study quality and geographic basis, some basic descriptive parameters are shown below though it is not expected that all of these fields will be completed for the listed events:

- number of ignitions (ignition rate),
- number of large fires,
- final burnt area, in single-family dwelling equivalent (SFED)[1],
- wind speed/direction profile by hour/day during the fire,
- square footage of the property,
- property type (residential, commercial, etc.),
- estimation of fire load,
- density of the area that has been burnt (square footage of all buildings minus parks and the whole quantity divided by the whole area).

[1] An average single family equivalent dwelling (SFED) is 140 sq. m.

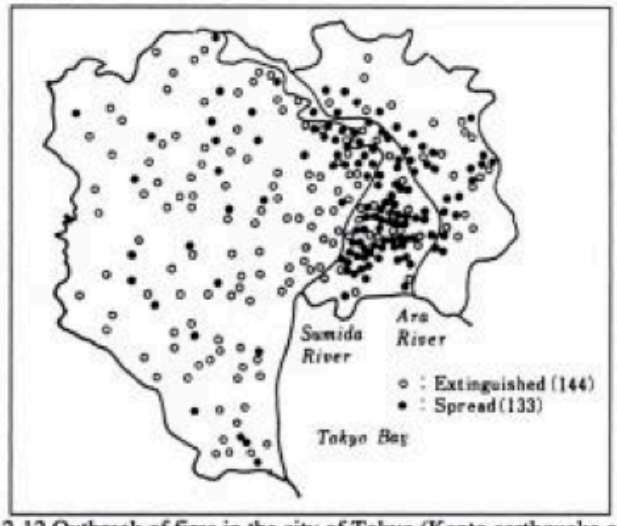


Figure 2-12 Outbreak of fires in the city of Tokyo (Kanto earthquake of 1923)

Figure 2-13 Firespread in Central Tokyo, showing direction and hourly progress of flame front

Figure 2.11 Sketches taken from Scawthorn et al. (2005) showing the locations of outbreaks and spread of fire after the 1923 Kanto earthquake

When reliable fire following earthquake consequence data, such as damage to buildings or human casualties are available then tables of these consequences should also be collected. Tier 3 will include impact studies for one or more large fires. The location and size of these breakouts should be recorded and geocoded on a map. The studies should focus on impact on structures and the exposed population.

Table 2.44 List of descriptors for fire following earthquake

Category	GEMECD fields	Description
Where*	Location of Fire(s)	
	Street Address of Fire(s)	
	City of Fire(s)	
	Prefecture of Fire(s)	
	Land Use type	Sparse residential, Dense residential, Industrial, CBD
When*	Date Started	Date (Day/Month/Year)
	Date Ended	Date (Day/Month/Year)

Category	GEMECD fields	Description
	Local Time Started	Hour, minute
	Duration--How long did it last?	Time in days, minutes, hours or unknown
	Continuity of fire propagation	Did not propagate, Limited spread, Episodic, Extensive spread, Other, or Unknown
	Weather conditions at the start of the Fire(s)	Average for the season, Unseasonably dry, Unusually wet, Short-lived intense rainfall, Prolonged moderate rainfall, Light Breeze, Strong winds, Typhoon, Other, Unknown
	Weather conditions during the Fire(s)	Average for the season, Unseasonably dry, Unusually wet, Short-lived intense rainfall, Prolonged moderate rainfall, Light Breeze, Strong winds, Typhoon, Other, Unknown
What	General Setting (Land Use type)	Sparse residential - wooden houses, Dense residential - wooden houses, Sparse residential – non-wooden houses, Dense residential –non-wooden houses, Industrial, CBD, Mixed land use, Industry of Hazardous Materials, Other, Unknown
	Natural Breaks	Large road, Open ground, Other, Unknown
How Fast	Speed of fire propagation	Choose from range of speeds by comparison with common things or enter a value
How big	Footprint of burnt area	Choose from a range of dimensions based on comparison with common items or enter a dimension
	Width of burnt area (estimated along contour)	Choose from a range of dimensions based on comparison with common items or enter a dimension
	Length of burnt area (estimated along contour)	Choose from a range of dimensions based on comparison with common items or enter a dimension

Table 2.45 Transportation vehicle damage (Menu A)

Cars, buses and trucks burnt (partially & totally)	Number or unknown/not observed
Railway cars burnt (partially & totally)	Number or unknown/not observed

Table 2.46 Buildings Burnt Totally (Menu B)

Single-family wooden buildings totally burnt	Number or unknown/not observed
Single-family non-wooden buildings totally burnt	Number or unknown/not observed
Multi-family wooden buildings totally burnt	Number or unknown/not observed
Multi-family non-wooden buildings totally burnt	Number or unknown/not observed
Public ownership & Commercial buildings totally burnt	Number or unknown/not observed
Industrial buildings totally burnt	Number or unknown/not observed

Table 2.47 Buildings Burnt Partially (Menu B)

Single-family wooden buildings partially burnt	Number or unknown/not observed
Single-family non-wooden buildings partially burnt	Number or unknown/not observed
Multi-family wooden buildings partially burnt	Number or unknown/not observed
Multi-family non-wooden buildings partially burnt	Number or unknown/not observed
Public ownership & Commercial buildings partially burnt	Number or unknown/not observed
Industrial buildings partially burnt	Number or unknown/not observed

Table 2.48 Infrastructure damage (Menu C)

Narrow Streets affected	Number or unknown/not observed
Wide Streets affected	Number or unknown/not observed
Railway lines affected	Number or unknown/not observed
Utilities affected	Number or unknown/not observed
Bridges affected	Number or unknown/not observed

Table 2.49 Critical facilities damage (Menu D)

Pipelines damaged	Number or unknown/not observed
Pipelines destroyed	Number or unknown/not observed
Above-ground utilities damaged (overhead power lines, etc.)	Number or unknown/not observed
Above-ground utilities destroyed (overhead power lines, etc.)	Number or unknown/not observed
Ports/Airports/Stations partially burnt	Number or unknown/not observed
Ports/Airports/Stations totally burnt	Number or unknown/not observed

Table 2.50 Land damage (Menu E)

Agricultural Land	acres burnt or yes/no
Forest, Grassland	acres burnt or yes/no
Industrial Land	acres burnt or yes/no
Commercial Land	acres burnt or yes/no
Residential Land	acres burnt or yes/no

Table 2.51 Cost and Human Casualties (Menu F)

Cost of the Fire(s)	dollars
Persons Injured	number
Persons Killed	number
Persons missing	number

2.10 Tsunami

The general objective is to provide observational data on the impact of tsunami on buildings, critical facilities, infrastructure with descriptions, damage photographs (including remotely-sensed images or maps) and locations to enable their display on maps and linkage to more detailed reports. Another important aspect is

to prepare an interface that will enable tsunami damage in future earthquakes to be captured and uploaded to the database.

At Tier 1, the basic event information will be summarised with the basic descriptors shown in Table 2.1 and an overview map of the extent of tsunami affected areas. An example map of areas affected by the 2004 Sumatra (Indian Ocean) earthquake in Aceh province (Sumatra, Indonesia) is shown in Figure 2.12. For events affecting long stretches of coast or more than one country more than one maps will be needed (e.g. Sri Lanka, Thailand, India, Sumatra maps for the 2004 Indian Ocean tsunami; Iwate prefecture, Miyagi prefecture, Fukushima prefecture maps for the 2011 Tohoku tsunami etc.). At Tier 2, one more event overview table (Table 2.52) will be shown to address the overall consequences of tsunami events in more detail, as these events often occurring far offshore have unique set of consequences unlike the other non-tsunami events.

Table 2.52 Tier 2 tsunami event consequences summary table

GEMECD Tsunami Event Descriptors	Description
Total Length of Coast Affected	km
Total land area flooded by the tsunami (km2)	km^2
Population inside the tsunami inundation zone (or within 1-km from the affected coast)	number
Number of buildings washed away or destroyed by the tsunami	number
Number of buildings flooded but not destroyed	number
Number of bridges destroyed (all types of bridges)	number
Number of ports affected	number
Number of boats destroyed (all types of boats)	number
Number of vehicles destroyed (all types of vehicles)	number
Financial impact of the tsunami (direct estimated loss)	million US$

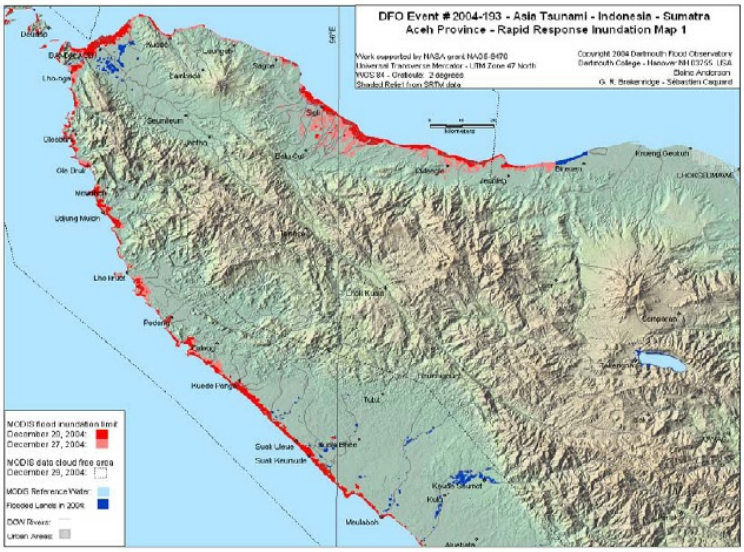


Figure 2.12 Areas affected by tsunami inundation along the western, northern and eastern shores of Aceh province, Sumatra, Indonesia, during the December 26, 2004 tsunami (Source: Dartmouth Flood Observatory, http://www.dartmouth.edu/~floods/2004193.html).

Furthermore, Tier 2 will give details of individual tsunami consequence studies at town, neighbourhood or village level. The Tier 2 screen will also include a map showing the locations of the study areas, a Location List table and general information on the type of studies included (that will be accessed at the Tier 3 level, by clicking on the individual locations in the Tier 2 map). At Tier 2 for each study location, the study-level tsunami descriptive parameters are shown in Table 2.53 (although it is not expected that all of these fields will be completed for each of the listed events-locations, "n/a" can be used whenever the information required in not available). Clicking on the Location List appearing on the Tier 2 screen will direct the user to the Tier 2 descriptors table.

Table 2.53 Tier 2 Basic Tsunami Parameters for Individual Study Locations

Category	GEMECD fields	Field Type	Description
Where	Location of Tsunami	Text	Name of the region
	Location Affected	Text	Name of the Location
	Coastal type	Text	Rias, Wide Bay, Open Ocean
	Near-sea morphology	Text	Mangroves, Sand dunes, Coastal forest, Open land, Built-up land, Mixed, or any combination
	Land Topography	Text	Flat, Gentle slope (<5 degrees), Moderate slope (5-10 degrees), Steep slope (>10 degrees)
When	Local Time Started	Time	Hour/Minute
	Local Time Ended (incl. the drawback phase)	Time	Hour/Minute
	Duration--How long did it last?	Time	Hour/Minutes
	Sea withdrawal prior to tsunami inundation	Text	Yes or No
	Time available for evacuation	Time	Hours/Minutes between earthquake occurrence and tsunami arrival
	Pre-tsunami evacuation warning	Text	Yes or No (if Yes, choose from the following: tsunami sirens, radio-TV broadcast, or both)
	Tide level during the tsunami	Text	High Tide or Medium Tide or Low Tide
What	General Setting (Land Use type)	Text	Sparse residential - wooden houses, Dense residential - wooden houses, Sparse residential – non-wooden houses, Dense residential –non-wooden houses, Industrial, CBD, Mixed land use, Industry of Hazardous Materials, Other, Mixed, Unknown
	Tsunami Protection Systems	Text	Type of protection (coastal sea wall, offshore tsunami breaker, sand dune, natural forest, lagoon, or any combination)
How Fast	Tsunami Velocity	Number (one decimal)	Choose from range of speeds by comparison with common things or enter a value in m/sec
How Serious	Total inundation area	Number	Choose from a range of dimensions based on comparison with common items or enter a dimension (in km2)
	Extent of Tsunami Inundation	Integer	Distance Travelled Inland (in m) or >1km, 500-1000m, 250-500m, 100-250m, <100m
	Tsunami Run-Up Height	Number	Maximum height of water at the inland-most reach of the tsunami relative to the tide level at the time of event (in m, e.g. 8.5 m)
	Tsunami Inundation Height	Number	Height of the tsunami relative to the tide level at the time of event at a chosen location (in m, e.g. 7.8 m)
	Tsunami Flow Depth	Number	Height of the tsunami relative to ground level at a chosen location (in m, e.g. 6.7 m)

Category	GEMECD fields	Field Type	Description
	Fire following tsunami	Text	Yes or No (if Yes, give some general description, e.g. land area affected, or industry affected etc.)

Tier 3 will include impact studies to standard buildings and the exposed population for one or more seriously affected locations (already viewed on the Tier 2 map). The required information is summarized in Tables 2.54 through 2.60 below. These tables will be accessed via pull down menus.

Table 2.54 Buildings Washed-Away, Destroyed (Menu A)

Single-family wooden buildings washed–away, destroyed	Number or unknown/not observed
Single-family non-wooden buildings destroyed	Number or unknown/not observed
Multi-family wooden buildings washed–away, destroyed	Number or unknown/not observed
Multi-family non-wooden buildings destroyed	Number or unknown/not observed
Public ownership & Commercial buildings destroyed	Number or unknown/not observed
Industrial buildings destroyed	Number or unknown/not observed

Table 2.55 Buildings Damaged (Menu A)

Single-family wooden buildings damaged	Number or unknown/not observed
Single-family non-wooden buildings damaged	Number or unknown/not observed
Multi-family wooden buildings damaged	Number or unknown/not observed
Multi-family non-wooden buildings damaged	Number or unknown/not observed
Public ownership & Commercial buildings damaged	Number or unknown/not observed
Industrial buildings damaged	Number or unknown/not observed

Table 2.56 Vehicle & Transportation damage (Menu B)

Cars, buses and trucks destroyed (partially & totally)	Number or unknown/not observed
Length of Railway line over flown	Number or unknown/not observed

Table 2.57Damage to boats, vehicles, railways, roads (Menu C)

Boats Destroyed	Number or unknown/not observed
Vehicles Destroyed	Number or unknown/not observed
Length of Railway lines directly affected	Number (in km) or unknown/not observed
Length of Roads directly affected	Number (in km) or unknown/not observed
Bridges directly affected	Number or unknown/not observed

Table 2.58 Critical facilities damage (Menu D)

Industrial facilities damaged	Number or unknown/not observed
Schools damaged	Number or unknown/not observed
Hospitals, Clinics damaged	Number or unknown/not observed
Fire and Police Stations damaged	Number or unknown/not observed
Other important buildings damaged	Number or unknown/not observed
Airports/Other Stations damaged	Number or unknown/not observed

Table 2.59 Land damage (Menu E)

Agricultural Land	acres flooded or yes/no
Forest, Grassland	acres flooded or yes/no
Industrial Land	acres flooded or yes/no
Commercial Land	acres flooded or yes/no
Residential Land	acres flooded or yes/no

Table 2.60 Cost, Exposed Population and Human Casualties (Menu F)

Cost of the Tsunami Damage (direct)	dollars
Population living and working inside the tsunami inundation zone or within 1-km from the coast	number
Persons Injured	number
Persons Killed	number
Persons missing	number

At Tier 3, the footprint of the tsunami-flooded area will be shown (when possible this map should also include the tsunami inundation height or tsunami flow depth). These maps will be imported from relevant studies and can be either GIS shape files or simple map images (e.g. JPEG, TIFF, etc.) or remote sensing tsunami flood maps. An example is shown in Figure 2.13.

Photographs from the tsunami affected location will also be shown in Tier 3. These can be photos of individual buildings showing representative damage typologies for wooden, masonry, reinforced concrete frame or shear wall, steel frame structures. Bird-eye view photos of the affected locations can also be shown (preferably from good quality aerial photographs).

In addition tsunami damage studies to individual non-standard buildings, critical buildings, critical facilities, lifelines, other important infrastructure and historic buildings can be presented in the relevant part of GEMECD (see section 5 in this report).

Figure 2.13 Tsunami inundation map of Minamisanriku town (Miyagi prefecture, Japan). This map shows the tsunami flood zone during the 1960 Chile and the 2011 Tohoku tsunami (in yellow and blue respectively). The pink flood zone is the tsunami hazard map compiled for the town authorities prior to the 2011 tsunami based on a more moderate tsunamigenic earthquake (Mw<8) occurring offshore Miyagi Prefecture's coast.

2.11 Socio-economic Consequences and Recovery

The general objective is to provide data on social disruption (homelessness, recovery) and economic loss. 18 events were listed under the socio-economic consequences and recovery category in the GEMECD proposal. These events are listed in Table 2.59. The acquisition of socio-economic and recovery data were coordinated by CRED and the GNS social science team, assisting with their experience in post-earthquake reconnaissance.

Table 2.61 GEMECD short listed events, for studies on socio-economic consequences and recovery

Event Name	Country (-ies)	YEAR	MON	DA (UTC)	PARTNER
Vrancea	ROMANIA	1977	3	4	CRED (GNS) / CAR
Michoacan	MEXICO	1985	9	19	CRED (GNS) / ERN-AL
Erzincan	TURKEY	1992	3	13	CRED (GNS) / KOERI
Northridge	USA	1994	1	17	CRED (GNS) / SPA
Kobe	JAPAN	1995	1	16	CRED (GNS) / KYOTO
Kocaeli	TURKEY	1999	8	17	CRED (GNS) / KOERI
Chi-Chi	TAIWAN	1999	9	20	CRED (GNS) / KYOTO
Gujarat (Bhuj)	INDIA	2001	1	26	CRED (GNS) / CAR
Bam	IRAN	2003	12	26	CRED (GNS) / KOERI

Sumatra-Andaman Islands	INDONESIA	2004	12	26	CRED (GNS) / CAR
Kashmir	PAKISTAN	2005	10	8	CRED (GNS) / CAR
Yogyakarta	INDONESIA	2006	5	26	CRED (GNS) / KYOTO
Wenchuan	CHINA	2008	5	12	CRED (GNS) / CAR
Port-au-Prince	HAITI	2010	1	12	CRED (GNS) / ERN-AL
Maule (Bio-Bio)	CHILE	2010	2	27	CRED (GNS) / ERN-AL
Darfield	NEW ZEALAND	2010	9	3	GNS / CRED
Christchurch	NEW ZEALAND	2011	2	21	GNS / CRED
Tohoku	JAPAN	2011	3	11	CRED (GNS) / KYOTO

Following discussions between CRED and CAR a list of the 10 most important and commonly reported socio-economic and recovery indicators was drawn. In addition a list of 15 economic (loss related) indicators was also drawn. Some of the indicators, particularly the ones related to the post-event recovery have more than one field type (e.g. number, percentage and date stamp). A column is provided for the source of the data and a column for additional comments, as some of these data often need further clarification. For events affecting more than one country (i.e. the 2004 Sumatra-Andaman Islands and the 2005 Kashmir earthquake), this table will contain the socio-economic effects for the worst affected countries (i.e. Indonesia and Pakistan, respectively).

2.11.1 Explanatory Note for Earthquake Socio Economic Indicators

This explanatory section is designed to define, clarify key terms, and provide guidance for the compilation and collection of the data for the chosen socio-economic indicators (45) completed for the 18 earthquake events in GEMECD.

The earthquake impact indicators are divided by type into social, social-recovery and economic indicators. Generally indicators are mostly applied to entire affected area where impact has occurred, but in certain situations, the indicator may actually reflect a reduced area (not the entire affected geographical area) due to data availability constraints. Indicator specification, therefore, is based on an optimal situation. Moreover, indicators can be either measured in the affected area or entire affected country. Which of these used for a defined area is governed by the source of information.

Attempting to measure all 45 socio-economic indicators in any given post-disaster context is the desirable objective, but data availability constraints mean this is not always feasible. Another consideration is that quite often multiple sources of data are required to measure all indicators (e.g. Reinsurance Companies such as MünichRe or SwissRe, International organization situation reports such as produced from the United Nations Office for the Coordination of Humanitarian Affairs (OCHA) or the International Federation of Red Cross and Red Crescent Societies (IFRC), Post-Disaster Needs Assessment (PDNA) case-studies, such as the ones conducted by the World Bank (WB). Consequently, this can mean slight variations exist in estimates and totals.

This following describes the structure of how the indicators are recorded:

Type: Earthquake impact indicators are divided into social, social-recovery, and economic indicators

Field type: refers to unit value for which the indicator is measured

e.g number (integer) or percentage

Source: the source of information (e.g. government, NGO), including the title of the document.

e.g. UN Office for the Coordination of Humanitarian Affairs (OCHA) –situation reports -1-11

General comments: If appropriate this is used to give an approximation (e.g. stating whether indicator data is based on affected area or the entire country)

In relation to indicator 13 'number of people losing electricity supply in the immediate aftermath'

e.g. Estimate – 40% of the estimated population of Mexico City metropolitan area (+/- 15,000,000)

Specification: If appropriate this will go into further detail on the meaning of the indicator e.g. in relation to indicator 33 'Total direct economic losses by type of hazard'. A text field providing information on insured losses by type of hazard (ground shaking, liquefaction, or secondary hazard (e.g. mass movement) when it becomes available.

or

e.g. 'In relation to indicator 3, 'Total number of households in the affected country (contemporaneous)'… To be obtained from Census sources or estimated by dividing the contemporaneous population with the reported average household size for that country'

Indicator definitions (45 in total)

1) Number of Dwelling Units destroyed and

2) Number of Dwelling Units damaged (incl. shaking and secondary hazards): Both relate to dwellings, these are defined as buildings which act as place of residence although usually equal, in some situations households can be are differentiated from a dwelling. A building with multiple dwelling units should be considered as multiple households.

3) Total number of households in the affected country (contemporaneous): To be obtained from Census sources or estimated by dividing the contemporaneous population with the reported average household size for that area. Census data will vary based on country of interest.

4) Estimated from EXPO-CAT is total number of households in the affected area (contemporaneous): To be obtained from EXPO-CAT by dividing the urban & rural population inside intensity ≥VI with an average contemporaneous size of household for the affected urban & rural areas. Note: this can be taken for events before 2007, however after 2007 will depend on data availability.

5) Number of buildings destroyed and

6) Number of buildings damaged (incl. shaking and secondary hazards)

A building is differentiated from a dwelling as it represents a building that is not used a place of residence.

7) Educational buildings destroyed & damaged (number),

8) Educational buildings destroyed & damaged (percentage) and

9) Educational buildings destroyed & damaged (loss in contemporaneous $ value): Indicators 7, 8 and 9 relate to Educational buildings destroyed & damaged (given in number and percentage), as well as in economic losses expressed in contemporaneous US$

10) Health facilities destroyed & damaged (number)

11) Health facilities destroyed & damaged (percentage)

12) Health facilities (hospitals and clinics) destroyed & damaged (loss in contemporaneous US$ value). Health facilities refer to buildings (i.e. hospitals, clinics, health centres) used for health purposes. Indicators

10,11 and 12 refer to health facilities in the affected area, both in terms of number (integer) and also expressed as a percentage (1 decimal), and also as contemporaneous US$ value

13) Number of people losing electricity supply in the immediate aftermath,

14) Percentage of people losing electricity supply in the immediate aftermath,

15) Date Stamp for the Number of people losing electricity supply in the immediate aftermath ,

16) Number of people losing electricity supply for a significant duration of time ,

17) Percentage of people losing electricity supply for a significant duration of time and

18) Date Stamp for the Number of people losing electricity supply for a significant duration of time: Indicators 13-18 refer to people losing electricity in the affected area, in the immediate aftermath and for a significant period of time, both in terms of number (integer) and also expressed as a percentage. The date of the report is also given.

19) Number of people losing water supply in the immediate aftermath,

20) Percentage of people losing water supply in the immediate aftermath,

21) Date Stamp for the Number of people losing water supply in the immediate aftermath,

22) Number of people losing water supply for a significant duration of time,

23) Percentage of people losing water supply for a significant duration of time and

24) Date Stamp for the Number of people losing water supply for a significant duration of time: Indicators 19-24 refer to people losing water supply in the affected area, in the immediate aftermath and for a significant period of time, both in terms of number (integer) and also expressed as a percentage. The date of the report is also given.

25) Number of homeless people in the immediate aftermath. There are people in need of immediate assistance with shelter,

26) Date Stamp for the Number of homeless people in the immediate aftermath,

27) Number of homeless people for a significant duration of time and

28) Date Stamp for the Number of homeless people for a significant duration of time: Indicators 25-28 refer to homeless people in the affected area, in the immediate aftermath and for a significant period of time, both in terms of number (integer) and also expressed as a percentage. The date of the report is also given.

29) Number of people losing employment as a direct result of the damage to the production/commercial/service sector units and

30) Date Stamp for the Number of people losing employment as a direct result of the damage to the production/commercial/service sector units: Indicators 29 and 30 refer to people losing employment in the affected area. The date of the report is also given.

31) Total direct economic losses (US$) (contemporaneous): A value of all damages and economic losses directly related to the disaster. Damage (direct impact) refers to the impact on assets, stock, property, valued at agreed replacement (as opposed to reconstruction) unit prices, considering the level of damage, e.g., whether an asset can be rehabilitated or repaired, or has been completely destroyed. Losses (indirect impact) refer to flows that will be affected, such as revenue, public and private expenditure, etc. over the time period until the assets are recovered.

32) Total direct economic losses per sector (US$) (contemporaneous). It may be measured by obtaining data when it becomes available and producing a text field on direct losses per sector. Social sector includes: housing, health and education services and the places of worship. Physical Infrastructure includes transport, communications, energy, water and sanitation, flood control and irrigation works. The Productive sector includes agriculture and livestock, fisheries & industry and trade. Cross-sectoral sector includes governance and administration, bank and finance & environment. It is important to note that all sectors may not be defined or standardised in same manner, thus may change depending on the report.

33) Total direct economic losses by type of hazard (contemporaneous). This will generally involve obtaining data on direct losses by type of hazard (e.g. ground shaking), and secondary hazards such as landslides, liquefaction, tsunami, and fire.

34) Total indirect economic losses (contemporaneous): A value of all damages and economic losses indirectly related to the disaster. Indirect losses are those that follow from the physical damages e.g. government and administration costs, commuter disruptions, loss of local tax revenues, reduced tourism. This indicator may require time for data to emerge and become available.

35) Total indirect economic losses by cause (contemporaneous). The measurement of the indicator will be based on data providing indirect losses by cause (e.g. cost of the damage buildings by type of occupancy, cost of damage to utilities, cost of damage to other infrastructure etc.) when it becomes available.

36) Contemporaneous country Gross Domestic product (GDP). This is defined as the value of all final goods and services produced in a country in one year. The GDP can be measured by adding up all of an economy's incomes- wages, interest, profits, and rents- or expenditures- consumption, investment, government purchases, and net exports (exports minus imports). This will derived from The World Bank . The contemporaneous GDP refers to the pre-event GDP.

37) Total direct economic losses as % of contemporaneous GDP and

38) Total indirect economic losses as % of contemporaneous national GDP:

Calculated from 2011 World Bank contemporaneous GDP, from both direct damages and indirect losses.

39) Present-time country GDP. Present-time refers to GDP after an event has occurred and is usually based on GDP data from 2011.

40) Insurance losses (contemporaneous). Economic damages which are covered by the insurance industry. Based on US$ Value of the year of EQ occurrence,

41) Insurance losses (contemporaneous) by type of hazard and

42) Insurance losses (contemporaneous) by line of business

Indicators 40-42 refers to insurance losses by line of business which is divided into categories such as residential, commercial, industrial, marine, auto, business interruption residential contents, industrial contents, commercial contents. This data may available immediately and may vary slightly depending on the report used.

43) Cost of reconstruction (contemporaneous): These cost (given in US$) are for the replacement of lost assets. Reconstruction costs are different than total damages as they must take into account present construction or purchase costs of goods, as well as the additional cost of prevention and mitigation measures to reduce damage from future disasters.

44) Amount of aid contribution: The total amount (given in US$) of contributions for immediate relief activities given to the country as a response to the disaster (mainly using the Financial Tracking System of OCHA from 1992 onwards)

45) Multiplier to project the contemporaneous losses, costs, aid contributions in 2011. This will incorporate information on insured losses by line of business (e.g. residential, commercial, industrial, marine, business interruption) when it becomes available.

3 Database Structure

The GEM Earthquakes Consequences Database was designed in accordance with the requirements set out in the guidelines for data collection presented in Chapter 2. GEMECD is part of the OpenQuake platform and has been designed to be fully compatible with it, adopting the GEM database design rules and principles. The formal definition of the database schema is given through a set of statements in the Structured Query Language (SQL) and this document should be read in conjunction with those (see Appendix). The SQL is designed for, and has been tested with, PostGIS 1.5. Input to and output from the database is either via an XML-based data input format, or a web interface. Detailed instructions for uploading data through the web interface can be found in the GEMECD Web Interface Guide.

It is important to the GEMECD project that it faithfully records raw data from historic earthquake studies. To this end, it is desirable to store data in a form as close as possible to that recorded by the original survey. In order to maximize compatibility between this historic data and recent studies using more advanced techniques and modern taxonomies, (many used and defined by the GEM project itself,) the database has been designed to allow the definition of mapping functions which will, where feasible, transform this historic data into formats used by other components of the GEM project. This will allow the GEMECD data to be employed for a variety of tasks within the wider GEM model.

The GEMECD database uses a hierarchical structure to store data. At the top of this hierarchy are the earthquake events themselves. These events then have a number of studies associated with them, and each study contains a set of locations and study specific data. In this way, every piece of data in the database can be easily traced back to a unique study and event.

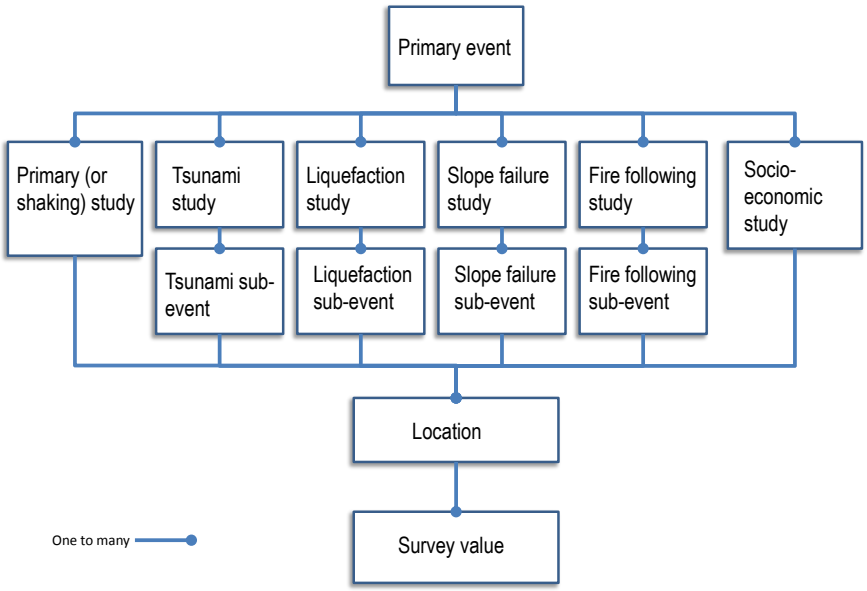


Figure 3.1 Hierarchical Structure of GEMECD

3.1 Events

An event is an individual earthquake, and represents the broadest category in the database. These events will contain seismological data such as date, time and magnitude. They can also contain data which takes an holistic view of an earthquake's effects; for example, the number of human casualties caused by the earthquake, taking all hazards into account.

For a full list of the data fields at event level, see Appendix B.

3.2 Studies

Studies offer a convenient way of packaging data by source. Some of these will be records of historic earthquake consequence studies, while others will represent data gathered by GEMECD partners from previous work. Although each study must be associated with a unique earthquake, the database can contain multiple studies by multiple partners for each event. There are three types of study:

3.2.1 Primary studies

These deal with a range of direct consequences of the earthquake, and may for example contain data concerning human casualty studies and statistics, and the consequences of ground shaking on buildings and infrastructure. In this respect, primary studies are essentially shaking studies. They may have a list of locations associated with them, under which survey data can be stored. (see sections 8 and 9 below).

3.2.2 Secondary studies

Secondary studies are hazard-specific, and can be one of four types:

- Tsunami studies
- Liquefaction studies
- Slope failure studies
- Fire following studies

Unlike primary studies, secondary studies do not have locations directly associated to them, but rather can contain a set of sub events. Sub events describe individual occurrences of secondary hazards relating to the earthquake; for example individual landslides. Specific locations can then be associated with each sub event, allowing the user to record precise survey data relating to the hazard. These sub events are defined to be of the same type as the study – a fire following study will have fire following sub events, etc.

As an example, a secondary study concerning the effect of a tsunami along a stretch of coast may contain a tsunami sub event for the damage to an individual coastal inlet, with specific locations along the inlet (for example individual buildings or villages) associated with the sub event. 7

3.2.3 Socio-economic studies

Socio-economic studies contain a wide range of social and economic effects caused by the parent earthquake. Although it is possible to define a set of locations for these, they are likely to take a wider view of the event and are therefore more likely to contain only overview data (see below).

For a full list of the data fields in the various types of study table, see the Appendix section A.2.

3.3 Overview and Survey Data

The GEMECD database is designed to store two distinct types of data: overview data and survey data.

3.3.1 Overview data

Each event, study and sub event is able to store a set of overview data, designed to provide a descriptive overview of the event. The GEMECD database has been designed to cater for an extremely wide range of overview data, and many partners will find that they will only need to fill in a small subset of the fields provided – it may rarely be possible, and is certainly not necessary, to complete every field on any given page. The form this data takes will depend on the event, study or sub event to which it is attached, but an example is the total number of buildings destroyed in an earthquake, or the duration of a slope failure event.

3.3.2 Survey data

Survey data records the precise data gathered by the field study teams, and must be geospatially referenced. For this reason, it is only possible to attach survey data values to locations. The GEMECD database is designed to allow survey data to be analysed independently of the study to which it belongs, thus enabling extensive cross-event research and analysis. A more detailed look at survey data is given in section 9 below.

3.4 Study Level Metadata

Certain key metadata is attached at the study level, making studies important wrappers around the data in GEMECD. At study level it is possible to attach a damage scale, a casualty scale, a set of inventory classes, and a geographic referencing system or geobase (see 'georeferenced locations' below.) It is also possible to attach map layers, documents and images.

In the majority of cases, if survey data is to be added to a study (as opposed to overview data) then inventory classes plus either (or both) casualty and damage scales will need to be defined. Defining a geobase is optional but will confer certain benefits, as discussed below. Map layers, documents and images do not play a part in the formal GEMECD data structure but can be used for visualisation and illustration.

3.4.1 Damage scales

Damage scales are established, one per study, by defining one or more damage levels. Each damage level should be given the name used by the original survey. The level order field should be provided to put the damage levels into the correct order; for example D0, D1, D2, D3, D4, D5 would be ordered 0,1,2,3,4,5.

3.4.2 Casualty scales and inventory classes

Casualty scales and inventory classes are established in a similar way to damage scales, above. Inventory classes also have the ability to map an individual class from the original survey to a GEM Basic Building Taxonomy definition. This is explained in more detail below.

3.5 Locations

The GEMECD database is fundamentally geospatial and contains a locations table which stores geographic references for each piece of survey data in the database. All survey data is related to a location, which can be a simple point, a defined line or polygon, or a reference to a separate geographic region defined in the geobase. A location can alternatively be related to an intensity zone.

Locations can be parented from any one of the following: Primary studies; socio economic studies, tsunami sub events, liquefaction sub events, slope failure sub events, or fire following sub events. Each location record in the database contains the type and ID of the entity which it is parented from, allowing every location to work out its parent. Locations can also store their soil type.

Location is a highly flexible concept. Locations will often be aggregated, as in GADM administrative areas, but can, for example, be as wide ranging as a city boundary, or as specific as an individual building or piece of infrastructure. For this reason, GEMECD does not have a separate data storage concept for "non-standard buildings, critical facilities, important infrastructure and lifelines"

There are two types of location:

3.5.1 User defined locations

In the case of a user defined location, the position is defined within the location record. This position is stored in the Open Geospatial Consortium [4] (OGC) Well Known Text format (WKT), allowing it to be recorded as, for example, a point, a polyline or a polygon. Any point by point data in a survey should be entered using user-defined locations.

3.5.2 Georeferenced locations

Data for the position of a georeferenced location is obtained from an internal lookup table of predefined positions held in the database. This relies on the survey data containing a 'geocoded' field which can be looked up. Each study containing georeferenced survey data will require a unique geobase, or geographic basis. Any given study can only store geocoded survey data records located with respect to one kind of geographic basis – for example, a study with geobase China GADM Level 3 can only store data geocoded by China GADM Level 3 areas.

The default geobases for the GEMECD database are the GADM administrative areas [6] – these are contained in the database in their entirety. Intensity zones may also be used, though partners will need to contact a database administrator to arrange for these to be uploaded to the database. It is extremely important that the names of any administrative areas entered as survey data for georeferenced locations exactly matches the names of the boundaries held in the database for the particular level and boundary source defined for that study.

Locations are capable of being assigned an optional globally unique identifier (GUID) which follows the format of the Postgres UUID type. This is useful when locations are read from other GEM components.

3.5.3 Boundaries

Occasionally, it will be convenient to store spatial data concerning (for example) the area affected by a sub event without defining a separate location. To this end, there is an optional boundary field associated with each sub event, which can contain a set of user defined co-ordinates in WKT format, or use one of the preloaded GADM areas. Unlike locations, boundaries cannot have survey data associated with them – they purely represent boundary data about a sub event.

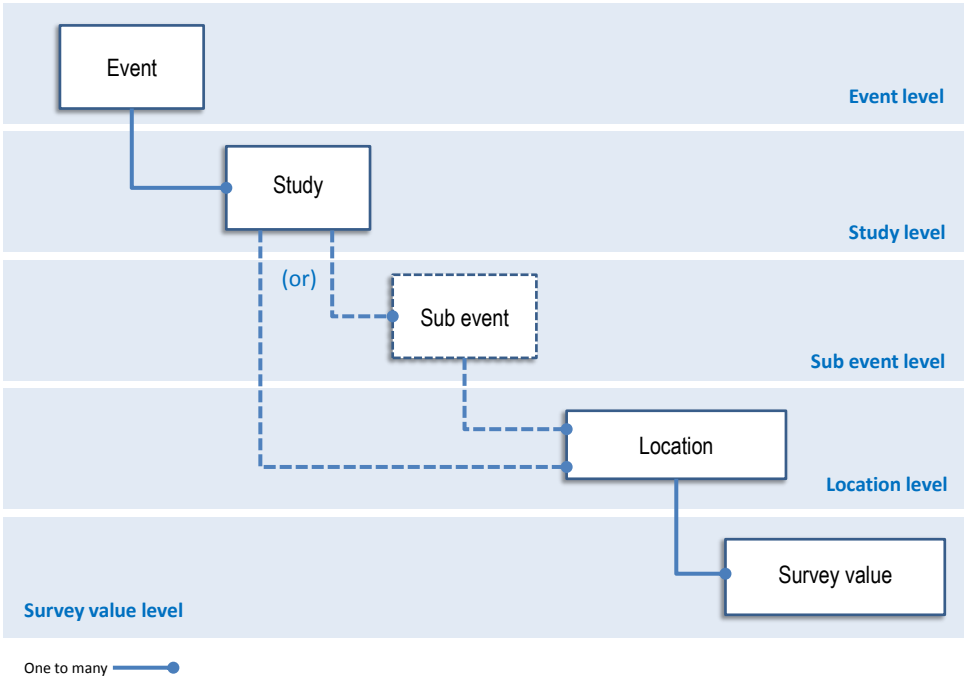


Figure 3.2 Hierarchical data structure

3.6 Survey Data

The historic data that GEMECD will be storing is drawn from a variety of studies, each organised in its own individual way as chosen by the original researchers. Often these studies are not compatible with each other or with modern practice. The challenge for GEMECD is to design a structure for storing this data which is sufficiently flexible to encompass the range of original studies but achieves enough commonality to allow future researchers to conduct cross study analysis using the modern techniques and taxonomies of the wider GEM project.

On the one hand GEMECD must offer a range of flexible data storage options; on the other it must not provide a different option for every different study. There must be as few data storage options as possible – to simplify cross compatibility – whilst not offering so few options that some studies cannot be meaningfully stored.

The proposed approach stores survey data by location, meaning that no survey data can exist unless tied to a location. The use of georeferenced locations, particularly the GADM areas, provides the database with a globally recognised, rigid standard for locating data, while supporting user-defined locations expressed in WKT provides a degree of flexibility - as well as the obvious points and polygons, these locations could define cities, countries or more abstract entities.

All survey data in the entire database is stored in a single table, regardless of its parent study. In this survey value table, each record is parented from a defined location and represents a single number. This method will enable future researchers wishing to extract data from GEMECD to perform cross event analysis by focussing their attention on just one table. The survey data table has been designed to be flexible enough to store a wide variety of data; both aggregated and for individual assets.

A record in the survey value table contains a single value, related to the parent location. It must also contain a definition of the metric, i.e. what is being measured by this number, which must be one of:

- Number of buildings or assets
- Number of people, population or occupants
- Length of an asset affected (m)
- Height of an asset affected (m)
- Area of an asset affected (sq m)
- Volume of an asset affected (cu m)
- Loss cost $
- Damage ratio
- Damage per km
- Percentage buildings or asset
- Percentage of people
- Percentage area

The meaning of the value can be modified or refined by zero or more optional relationships that can be set up for the record. These are:

- Asset class, type, sub-type and construct type
- Inventory class
- Damage level
- Casualty level
- Type of damage (normally inherited from the parent study type, but can be overridden here)

For example, let us take a value of 42, stored in a survey value record. At the simplest level, if that record had parent location “Apice village”, and a metric “number of buildings”, then the meaning of the record in English would be “In Apice village there were 42 buildings”.

If that record contained the additional relationships:

asset class =”residential”; inventory class = “unreinforced masonry”; damage level = “D3”,

then the meaning of the record would be: “In Apice village 42 residential buildings built of unreinforced masonry were damaged at a level D3”

If the metric is now changed to “Number of people, population or occupants” and the relationship

casualty level = “severely injured”,

is added to the record, then the meaning of the record becomes: “In Apice village in residential buildings built of unreinforced masonry damaged at a level D3, 42 people were severely injured”.

For individual assets such as facilities, where the data is not aggregated, the survey records store a value of 1. For example, in the case of a record with value of 1 with parent location “Elefsis school”, metric “number of buildings”, and the relationships:

asset sub-type = “elementary school”; inventory class = “unreinforced masonry”; damage level = “D3”,

the meaning of the record would be “Elefsis school is an elementary school building built of unreinforced masonry which was damaged at a level D3”.

This approach allows aggregation within an individual asset. For example, a record with value of 27 with parent location “Elefsis school”, metric “Number of people, population or occupants” and relationships:

asset sub-type = “elementary school”; inventory class = “unreinforced masonry”; damage level = “D3”, casualty level = “Injured”

means “at Elefis school, an elementary school built of unreinforced masonry damaged to level D3, 27 people were injured”.

This approach can handle averaged linear damage as follows. For example a record with value 7 with parent location “Campania”, metric “damage per km”, relationships:

cause of damage=”leaks”, asset class = “infrastructure”, type=”gas pipeline”, sub-type=”ductile”

means “in Campania region, ductile gas pipelines suffered 7 leaks per km”.

Damage and casualty scales and associated levels, and inventory classes are user-defined and are defined at the level of the study. Asset classes / types / sub-types / construction, causes of damage and soil types are pre-defined. A survey value can optionally be given a title; for example “total population.” This is to help with readability and will not be used by the future cross event query mechanism.

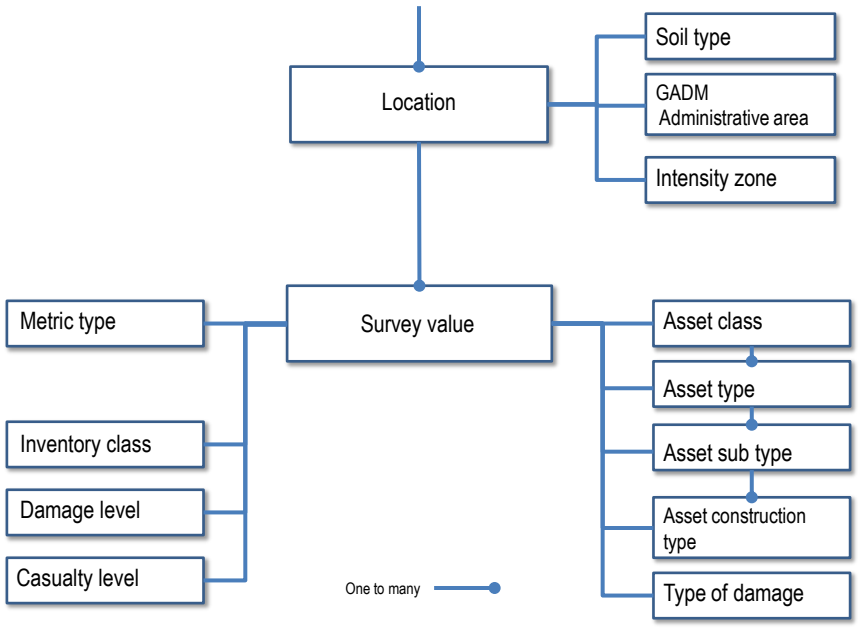


Figure 3.3 Simplified relationships for the Location and Survey value tables – for a detailed entity relationship diagram of this part of the database see appendix E, or an interactive version can be found at http://gemecd.org/gemecd/econd_core_schema.html (HTML5 browsers only)

3.7 GEM Building Taxonomy

Taxonomy definitions in the GEM Building Taxonomy (Brzev et al., 2013) are stored in a relational database using a table structure consisting of an *object table* along with an *attribute type table* and an *attribute value table*. The object table stores individual taxonomy definitions with attribute values stored as short strings. The attribute value table translates from those short strings into human readable descriptions and in

addition lists all the possible values that attributes can take. The attribute type table defines each attribute type and gives it a unique code.

This attribute type and attribute value approach is flexible in that it is possible to add new attribute values and new attribute types to the taxonomy in the future without altering the database schema.

3.7.1 Attribute type table

Table 3.1 lists each of the attribute types in the GEM Building Taxonomy. Each row in this table, apart from height and date values, corresponds to one of the Table/Level components of the taxonomy – this correspondence is shown in the table below. The attribute type code does not occur in the GEM Building Taxonomy document, this has been added for GEMECD.

Table 3.1 Attribute types in the GEM Basic Building Taxonomy

ATTRIBUTE_TYPE_CODE	SHORT_DESCRIPTION	Correspondence to taxonomy
MTYPE	Material Type	Table 1 Level 1
MTECH	Material Technology	Table 1 Level 2
MORT	Masonry Mortar Type	Table 1 Level 3
MREIN	Masonry reinforcement	Table 1 Level 3
SCONN	Steel Connection Type	Table 1 Level 3
LLRS	Lateral Load-Resisting System	Table 2 Level 1
LLRSD	Lateral Load-Resisting System Ductility	Table 2 Level 2
RMAT	Roof material	Table 3 Level 1
RTYPE	Roof type	Table 3 Level 2
FMAT	Floor material	Table 4 Level 1
FTYPE	Floor type	Table 4 Level 2
H	Height status	Table 5 Level 1
H1	HEIGHT1 value (storeys)	
H2	HEIGHT2 value (storeys)	
D	Construction date status	Table 6 Level 1
D1	DATE1 value (year)	
D2	DATE2 value (year)	
STRI	Structural Irregularity	Table 7 Level 1
STRHI	Structural Horizontal Irregularity	Table 7 Level 2
STRVI	Structural Vertical Irregularity	Table 7 Level 2
OCC	Occupancy	Table 8 Level 1
OCCD	Occupancy Detail	Table 8 Level 2

3.7.2 Attribute value table

Table 3.2 lists all the values that attributes can take and associates each value with an attribute type from the table above. The full table can be found at http://gemecd.org/gemecd/DIC_TYPE_VALUE_version2.xlsx, or by following the link from the GEMECD homepage at www.gemecd.org, but a sample of records is shown below. Those shown are the values that are possible for the Material Type (MTECH) attribute type from the table above. The attribute value and description will be familiar from the taxonomy.

The attribute scope column in Table 3.2 is used to store a code that can be used to define possible relationships between attribute values, and can be understood better by inspecting the full table in the appendix. For example, say the value of S (Steel) is chosen as a value for material type. This value has an attribute scope of S. Within the taxonomy table 1 only attribute values WEL, RIV and BOL have an attribute scope of S so only these can be chosen as well.

Table 3.2 Attribute value table

ATTRIBUTE VALUE	ATTRIBUTE_ TYPE_CODE	DESCRIPTION	ATTRIBUTE SCOPE	TRANS LATION	TAKES_ QUALIFIER
MAT99	MTYPE	Unknown material	X		
C99	MTYPE	Concrete, unknown reinforcement	C		
CU	MTYPE	Concrete, unreinforced	C		
CR	MTYPE	Concrete, reinforced	C		
SRC	MTYPE	Concrete, composite with steel section	C		
S	MTYPE	Steel	S		
ME	MTYPE	Metal (except steel)	ME		
M99	MTYPE	Masonry, unknown reinforcement	M		
MUR	MTYPE	Masonry, unreinforced	M		
MCF	MTYPE	Masonry, confined	M		
MR	MTYPE	Masonry, reinforced	M		
E99	MTYPE	Earth, unknown reinforcement	E		
EU	MTYPE	Earth, unreinforced	E		
ER	MTYPE	Earth, reinforced	E		
W	MTYPE	Wood	W		
MATO	MTYPE	Other material	X		

3.7.3 Dictionary table

In GEMECD, each attribute value is stored with its attribute code in a dictionary table where each record is a simple pair describing an attribute and its value. For example, MTYPE MUR means Masonry, unreinforced from the Material Type attribute (table 1 level 1). To define a taxonomy string several of these records will be needed and are related by sharing the same id value.

Table 3.3 Dictionary table used in GEMECD for the building taxonomy

id	The id of the taxonomy definition
attributetypecode	Attribute type code
attributevalue	Attribute value

The following figure shows the relationship of GEMECD's inventory class to the attribute types and their corresponding tables and level in the taxonomy in diagrammatic form. Note that all the attribute values of each of these tables and levels are held together in one table – the Dictionary table. When a group of values for just one attribute type are required (say to populate a dropdown selector) this is achieved in GEMECD by querying out the required values using an SQL query contained in a view.

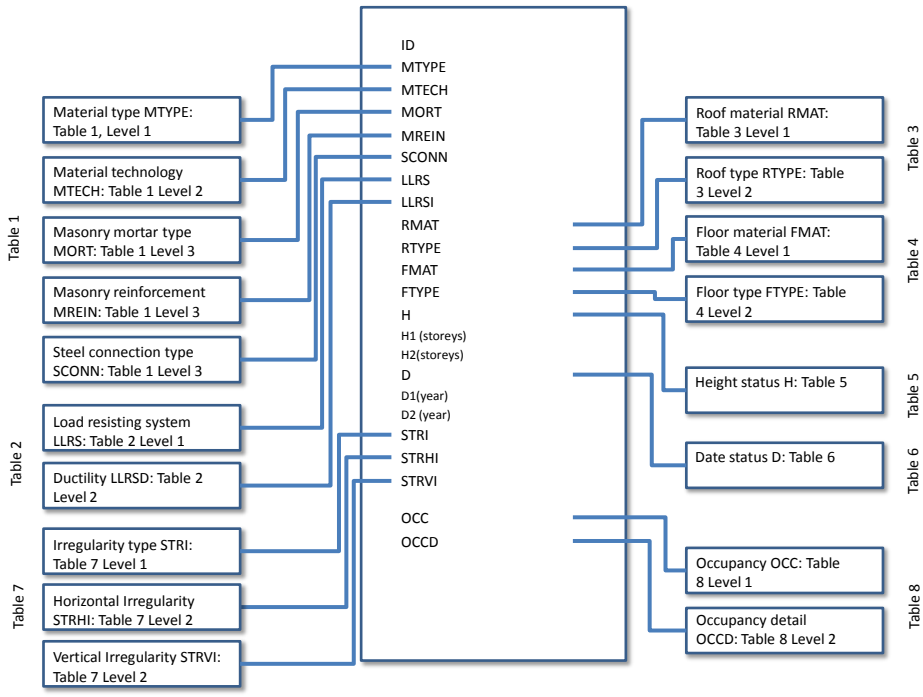
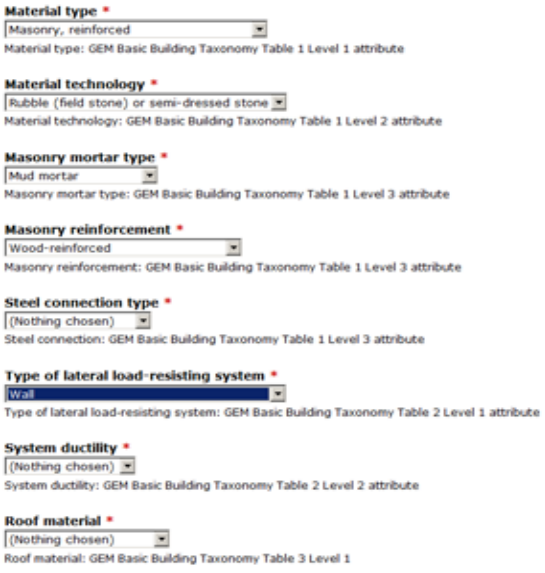


Figure 3.4 Relationship of Inventory Class to GEM Building Taxonomy

Example

This example takes Example 1 Option 2 from the GEM Building Taxonomy - “a reinforced rubble stone masonry building with horizontal timber elements” with mud mortar. The Taxonomy string given in that document is: **MR+RW+STRUB+MOM/LWAL/**

This taxonomy definition has been stored using the model as described above in the GEMECD database using the object table and the screen shot below shows part of the input form in the Simple GEMECD Web Interface and shows dropdown selectors for choosing human readable attribute values for this definition example.



Saving the above in the GEMECD database produces the following output as the Taxonomy string:

MR+RW+STRUB+MOM/LWAL////

This closely matches the string as shown in the *GEM Building Taxonomy* document (Brzev et al., 2013).

3.8 Reliability and Accuracy- Sources, Comments and Status Codes

GEMECD is able to store information about reliability of data. This is recorded at the level of the study and records limitations in terms of the completeness and quality of the data in the study. There is a field for a text description along with the following rating metrics:

The terms "Superior," "Average," and "Marginal" are used as quality ratings for the various ratable categories. Ratings also include the term "None" for cases where no data is available and "Not Applicable" for cases where behavior cannot be explained or rationalized by engineering principles.

3.9 Study Quality Rating Dimensions

(1) Data quality, i.e., quality of the source data, number of data points, coverage over the range of damage states, how well constrained the coordinates of the observations are, number of independent observers, and means of observing engineering demands and performance.

(2) Documentation quality, i.e., how well the author has documented the data, the analysis, and the results.

(3) Locational, i.e the reliability of data concerning geographic locations contained in the study.

3.10 Meta Data: Sources, Comments and Status Codes

Many key data items in the database have source, comment and status codes fields. Source is used to describe the source of the data; comment can be used to write a comment about the data, and the "status code" stores information about the current status of a particular piece of data. For a list of these status codes see Appendix B.

Meta data concerning source, comment and status is related to the field it applies to by appending the suffixes *_s, _c* and *_q* respectively to the field name. For example the field *peopleinjuredduetotsunami* has three related fields for source, comment and status respectively named *peopleinjuredduetotsunami_s, peopleinjuredduetotsunami_c* and *peopleinjuredduetotsunami_q*. This greatly enlarges the size of the GEMECD database, and in an attempt to keep this under control these meta fields are provided according to the following logic:

- All numeric fields at event and study level have _s, _c and _q meta fields.
- Study level has an additional survey_c field. This applies to all the survey data for that study.
  Numeric fields below the level of study in general do not have meta fields, except for the following exceptions:
    - Damage and casualty scales and inventory classes have a _c meta field.
    - Location geometry and survey values have _q meta fields.

3.11 Attaching Map Layers, Images and Documents

GEMECD automatically produces simple maps of events and locations, accessible via a link at the top right of each study page. However, the GEMECD database does not formally capture map layers, images and documents in its data structure. The intention is for this 'unstructured' data to perform an illustrative function only. It is not inherently analyzable by future data analysis tools.

3.11.1 Map layers

Map layers can be attached to studies. Each map layer is a layer from Geoserver running on the gemecd.org server. Thus, to establish a map layer it is first necessary to create a layer in Geoserver.

3.11.2 Images and documents

Images and documents are stored via the Drupal content management system. They can be attached at event, study, sub event and location level.

4 Populating GEMECD

There are two methods of uploading consequences data into the GEMECD: directly with the web interface or uploading batches of data using the specifically designed templates. These are explained in the following chapter.

The graphics used for this part of the report is based on a temporary interface (www.gemecd.org) created for GEMECD partners for uploading data. It is envisaged that the web interface will change and be incorporated into the OpenQuake platform in the near future, but the actual directions for upload should remain the same.

4.1 Direct data entry via the web interface

An XML based file format is provided for bulk data input into GEMECD. Files can be uploaded via the "Click here to upload an XML file" link on the home page of www.gemecd.org.

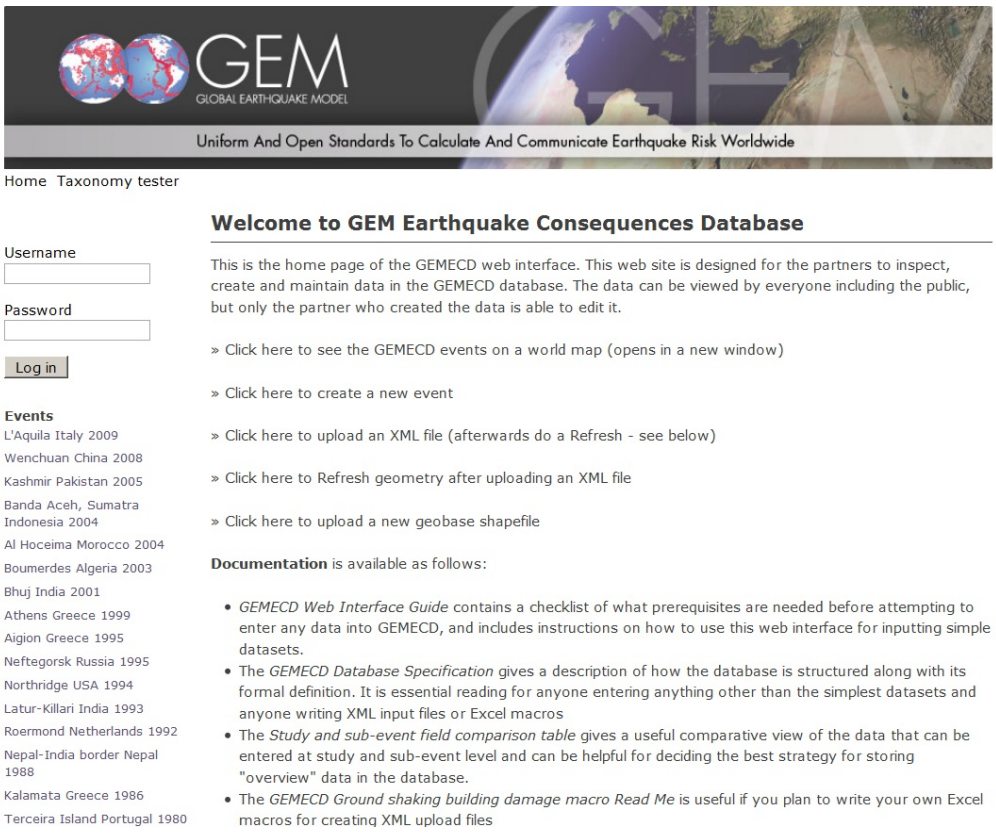


Figure 4.1 The GEMECD Home page (will be superseded by the OpenQuake platform)

The format is XML element based and relies on nesting elements inside each other. These elements contain data to be entered into the database. As an example, the element

```
<country>Greece</country>
```

represents an instruction to enter the data 'Greece' into the 'country' field for some event.

Element names must exactly match the table names and field names of GEMECD, and are all lower case with no spaces. Element contents must follow the same rules as given in the database schema (e.g. attempting to enter a null into a record with a non-null field will lead to the record being rejected). If an attribute present in the database is not present in the XML file a default value will be placed into the corresponding field in the record.

You can also use the XML importer to add damage levels, casualty scales and inventory classes to a study. For example, say a partner wishes to import the historic study by Savvaidis of the Thessaloniki 1978 event. The damage scale used by the study uses “color bands” and the levels are Green, Yellow, Red and Collapsed.

These would be input by the following lines of NRML:

```
<damagelevel>
      <name>Green</name>
      <description>Useable - no serious damage</description>
</damagelevel>
<damagelevel>
      <name>Yellow</name>
      <description>Temporarily unusable - with damage, useable after the repairs</description>
</damagelevel>
<damagelevel>
      <name>Red</name>
      <description>Unusable, dangerous</description>
</damagelevel>
<damagelevel>
      <name>Collapsed</name>
      <description />
</damagelevel>
```

There are two inventory classes in the study, RC and Masonry, which would be input like this:

```
<inventoryclass>
      <name>RC</name>
      <description>Reinforced Concrete</description>
</inventoryclass>
<inventoryclass>
      <name>Masonry</name>
      <description>Masonry</description>
</inventoryclass>
```

The study is of one location which is input like this:

```
<location>
      <name>Greater Thessaloniki</name>
      <location_c>This event only refers to the total number of buildings in the Thessaloniki urban area
      which includes the municipality of Thessaloniki and a number of neighboring-urban
      municipalities, rather than the total effects of the earthquake
      </location_c>
      <location>POINT(23.303 40.76)</location>
 </location>
```

To input a building damage survey record that expresses 4 RC buildings collapsed in Greater Thessaloniki this survey value needs to be nested inside the location, thus:

```
<location>
      <name>Greater Thessaloniki</name>
      <location_c>This event only refers to the total number of buildings in the Thessaloniki urban area
      which includes the municipality of Thessaloniki and a number of neighboring-urban
      municipalities, rather than the total effects of the earthquake
      </location_c>
      <location>POINT(23.303 40.76)</location>
      <surveyvalue>
            <name>Survey Record ID 34845</name>
            <value>4</value>
```

```
            <lookup_inventoryclass>RC</lookup_inventoryclass>
            <lookup_damagelevel>Collapsed</lookup_damagelevel>
            <metriccode>N</metriccode>
        </surveyvalue>

    </location>
```

Objects in the database that require a parent study, such as damage levels, are simply nested within the study, and similarly studies are nested in their parent earthquake. The earthquakes are then nested within an overall <nrml> tag. Information concerning the user uploading the file, such as user name and number, is contained within attributes of this tag, as follows:

```
<nrml userid="ceqid" rowmode="element" schema="econd" version="1.0" uid="16">
```

This is the basic structure of the Thessaloniki XML file:

```
<?xml version="1.0" ?>

<nrml userid="ceqid" rowmode="element" schema="econd" version="1.0" uid="16">
    <event>
        <usgsshakemapid>197820062003</usgsshakemapid>
        <name>Thessaloniki</name>
        <eventdate>Tue, 20 Jun 1978 00:00:00 GMT</eventdate>
        <eventtime />
        <eventtimelocal>Sat, 01 Jan 2000 20:03:00 GMT</eventtimelocal>
        <location>POINT(23.303 40.76)</location>
        <depth>7.4</depth>
        <magnitude>6.5</magnitude>
        <country>Greece</country>
        <region>Thessaloniki</region>
        <location_c />
        <peoplekilledduetoshake>50</peoplekilledduetoshake>
        <study>
            <name>Analysis of the damage from the 1978 earthquake to the buildings of Thessaloniki</name>
            <studydate>Tue, 01 Jan 2008 00:00:00 GMT</studydate>
            <authors>Prof. Savvaidis et al.</authors>
            <damagescalename>MMI</damagescalename>
            <damagescale_c />
            <studynarrative>In the Greater Thessaloniki area to which the Savvaidis data refer, the MMI was assessed as VI-VII, one strong motion record in the city centre recorded: PGA of 0.14g. The PDF (Savvaidis_et_al_on_SEISIMPACT.pdf) in the Downloadable Documents shows in detail the assessed MMIs within the city of Thessaloniki (see map in Figure 5), where it is seen that in the upper part of the city (on the hills) MMI4-5.9 was assessed, while in the city centre (near the coast) MMI6-7 was assessed (Leventakis et al_2008 3GrNCEE_Thessaloniki 1978 isoseismals.pdf) See Downloadable Documents</studynarrative>
            <inventoryclasses_c>It must be pointed out that the RC buildings of Thessaloniki in 1978 were all pre-code and low-code (in roughly 20/80 split, 11/89 in the area surveyed by Penelis in the east of the city, which is newer). It must be pointed out that the RC buildings of Thessaloniki are mostly 4 to 10 storeys (82% of the Penelis sample) and that the % of RC buildings damaged increased with the height (single-storey 5.6% damaged; 7-10 storey 34.8% damaged).</inventoryclasses_c>
            <inventoryclass>
                <name>RC</name>
                <description>Reinforced Concrete</description>
                <inventoryclass_c />
            </inventoryclass>
            <inventoryclass>
                <name>Masonry</name>
                <description>Masonry</description>
                <inventoryclass_c />
            </inventoryclass>
            <damagelevel>
                <name>Green</name>
                <description>Useable - no serious damage</description>
                <mappingid />
            </damagelevel>
            <damagelevel>
```

```
            <name>Yellow</name>
            <description>Temporarily unusable - with damage, useable after the repairs</description>
            <mappingid />
        </damagelevel>
        <damagelevel>
            <name>Red</name>
            <description>Unusable, dangerous</description>
            <mappingid />
        </damagelevel>
        <damagelevel>
            <name>Collapsed</name>
            <description />
            <mappingid />
        </damagelevel>
        <location>
            <name>Greater Thessaloniki</name>
            <location_c>This event only refers to the total number of buildings in the Thessaloniki urban area which includes the municipality of Thessaloniki and a number of neighboring-urban municipalities, rather than the total effects of the earthquake</location_c>
            <location>POINT(23.303 40.76)</location>
            <boundary_c />
            <surveyvalue>
                <name>34842</name>
                <value>17991</value>
                <lookup_inventoryclass>RC</lookup_inventoryclass>
                <lookup_damagelevel>Green</lookup_damagelevel>
                <metriccode>N</metriccode>
            </surveyvalue>
            <surveyvalue>
                <name>34843</name>
                <value>2971</value>
                <lookup_inventoryclass>RC</lookup_inventoryclass>
                <lookup_damagelevel>Yellow</lookup_damagelevel>
                <metriccode>N</metriccode>
            </surveyvalue>
            <surveyvalue>
                <name>34844</name>
                <value>273</value>
                <lookup_inventoryclass>RC</lookup_inventoryclass>
                <lookup_damagelevel>Red</lookup_damagelevel>
                <metriccode>N</metriccode>
            </surveyvalue>
            <surveyvalue>
                <name>34845</name>
                <value>4</value>
                <lookup_inventoryclass>RC</lookup_inventoryclass>
                <lookup_damagelevel>Collapsed</lookup_damagelevel>
                <metriccode>N</metriccode>
            </surveyvalue>
            <surveyvalue>
                <name>34846</name>
                <value>20211</value>
                <lookup_inventoryclass>Masonry</lookup_inventoryclass>
                <lookup_damagelevel>Green</lookup_damagelevel>
                <metriccode>N</metriccode>
            </surveyvalue>
            <surveyvalue>
                <name>34847</name>
                <value>6185</value>
                <lookup_inventoryclass>Masonry</lookup_inventoryclass>
                <lookup_damagelevel>Yellow</lookup_damagelevel>
                <metriccode>N</metriccode>
            </surveyvalue>
            <surveyvalue>
                <name>34848</name>
                <value>1962</value>
                <lookup_inventoryclass>Masonry</lookup_inventoryclass>
                <lookup_damagelevel>Red</lookup_damagelevel>
```

```
                    <metriccode>N</metriccode>
                </surveyvalue>
                <surveyvalue>
                    <name>34849</name>
                    <value>93</value>
                    <lookup_inventoryclass>Masonry</lookup_inventoryclass>
                    <lookup_damagelevel>Collapsed</lookup_damagelevel>
                    <metriccode>N</metriccode>
                </surveyvalue>
            </location>
        </study>
    </event>

</nrml>
```

See the complete Thessaloniki NRML file which can be downloaded from the CEQID website – see below.

Foreign key lookups: e.g. <lookup_damagelevel>**Collapsed**</lookup_damagelevel>

Foreign key lookups provide a method for retrieving the id of a record given the record's name, and the name of the table in the database where this record is stored. The record is contained within the element, and the name of the table is written into the element name, prefixed with 'lookup_'.

For example, the line

<lookup_damagelevel>**Collapsed**</lookup_damagelevel>

in the .xml file will return the id for the record with name 'Collapsed' inside the table 'damagelevel.'

It is only possible to perform foreign key lookups on tables (damage scales, inventory classes etc) which have been defined within an element's parent study. This means that lookup elements such as Damage level, Inventory Class and Casualty Level must be defined inside the study before the data in the XML stream and must have unique names inside the study.

Note, all dates and times must be in RFC422 format. Dates should have a time of 00:00. Times should have a date which will be ignored.

The format described thus far is fine for inserting new data. For altering data, additional behaviour is defined as follows.

XML files must always be complete in the sense there must be an event containing a study and so on even when altering data. You cannot input, say, a set of locations on their own. When the XML importer reads a record in a table it first looks to see if the record already exists – this is done by a strictly exact name match. If the record exists already the importer assumes that the input data is a modification of that record and overwrites all provided fields of the record. Thus importing the same XML file twice will result in the same data in the database (not two copies of the data), with the last updated timestamp of the data being the time of the most recent import.

It is not possible to delete records via the XML import. Note that XML uploads are transactional; if any error occurs the whole upload is rolled back and no changes to the database take place. When you upload to the web interface you will see a log file displayed which will contain any errors that occurred during import.

4.1.1 Step-by-step guide to uploading data

You will need to log in before you can enter or edit data into the database. To log in:

- Go to www.gemecd.org
- Enter your details into the **username** and **password** fields in the top left of the page
- Click the **Log in** button

To log out:

- Click **Log out,** located at the top right of the screen

View mode and Edit mode

View mode and **Edit** mode are two ways of looking at data in the web interface.

In **View** mode, which is the default, you can see data (including data entered by other users) but cannot make any changes to it. You will also be unable to see any fields which have been left empty.

In **Edit** mode, you are able to add and change data, and can see all available fields from the page you are on. You cannot edit data belonging to another user. No changes to data will be made until you click the **Save** button.

To enter View mode:

- Click the **View** button at the top right of the page.

To enter Edit mode:

- Click the **Edit** button, at the top right of the page.
- Clicking the **Save** button at the bottom left will take you back to **View** mode, allowing you to check any data entered.

Editing existing data

To edit or add to any existing data in the database:

- Ensure you are **logged in**
- Navigate sto the page which contains the data you wish to edit. (Note: Fields which do not currently contain any data will not be visible in **View mode**)
- Click **Edit** in the top right hand corner of the page
- Make the necessary changes and additions
- Click **Save** at the bottom of the page

Note: You cannot edit data entered by or owned by a partner with a different username.

Adding a new event

Events represent individual earthquakes, and are the broadest category in the database.

To add a new event:

- Ensure you are **logged in**
- Click **Home** at the top left of the screen.
- From the **Home** page, select **>> Click here to create a new event**, which is a few lines down in the centre.

- Use the fields and dropdown menus to enter any data concerning the event. You do not need to enter data into every field, although the **Event ID** field is mandatory.

- You can also enter optional **overview data** using the coloured menus at the bottom of the page. To do so, click **show** next to any category you have data for, and enter your data into the fields provided. Click **hide** to close these menus again.

- When finished, click the **Save** button at the bottom of the sheet. (You will be able to return to this study and make changes later if necessary.)

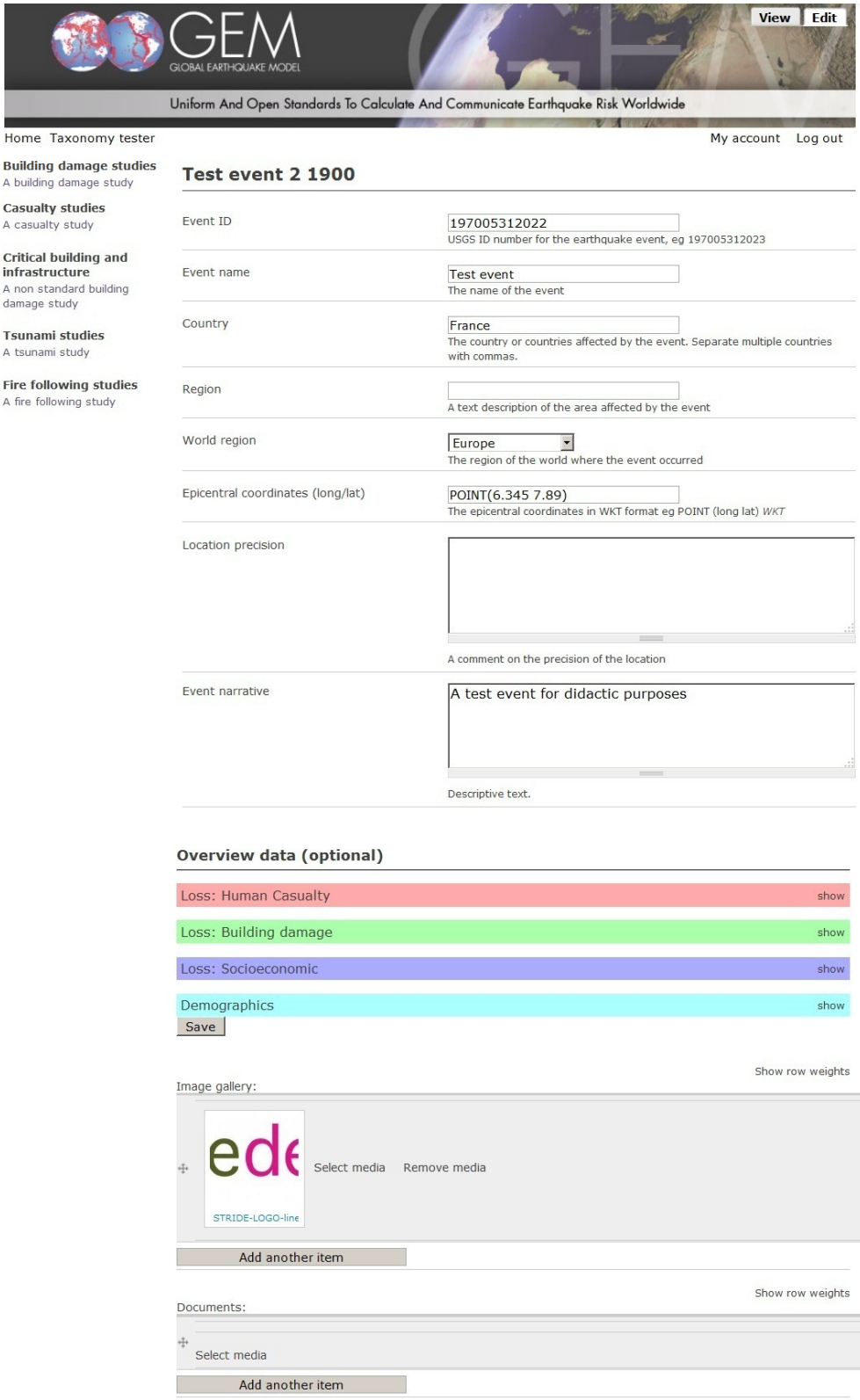


Figure 4.2 An event page in Edit mode

Figure 4.3 The same event page in View mode

Adding a new study

Studies cannot exist in the database without being related to an **event.** Studies nest inside events, and can concern a wide range of data.

To add a new study:

- Ensure you are **logged in**

- From the **Events** menu on the left of the **Home** page, click on the name of the event which this study belongs to. If this name is not present, you will need to **add a new event** *(see above)*

- Click **Add…** at the top right of the page, below 'Log out'

- Choose the type of study you want to add, from the following list:

  - Building, casualty or nonstandard building
  - Tsunami
  - Slope failure
  - Fire following
  - Liquefaction
  - Socio-economic

- Use the fields and dropdown menus to enter any data concerning the study. You do not need to enter data into every field, although if you are entering a Building, casualty or nonstandard building study, you will need to choose a **study type** from the dropdown menu
- The **geobase** field represents the geographic basis for your study. If the geobase you have used in the study is not present, or for more information on this field, see '**Adding a Geobase**' below, or **'Georeferenced locations'** in section 8 of the GEMECD specification.
- You can also enter optional **overview data** using the coloured menus at the bottom of the page. To do so, click **show** next to any category you have data for, and enter your data into the fields provided. Click **hide** to close these menus again.
- When finished, click **Save** at the bottom of the sheet. (You will be able to return to this study and make changes later if necessary.)

To add a new sub-event to a study:

Tsunami, **slope failure, fire following** and **liquefaction** studies can have **sub-events** associated with them. Sub events can be added to studies in much the same way as studies are added to events.

- Ensure you are **logged in**
- From the **Events** menu on the left of the **Home** page, click on the name of the event which the desired study belongs to.
- From the **Event** page, Choose this study from the menu on the left
- Click **Add…** and choose **Add sub event**
- Enter any relevant sub event data. You do not need to complete every field.
- Click **Save**

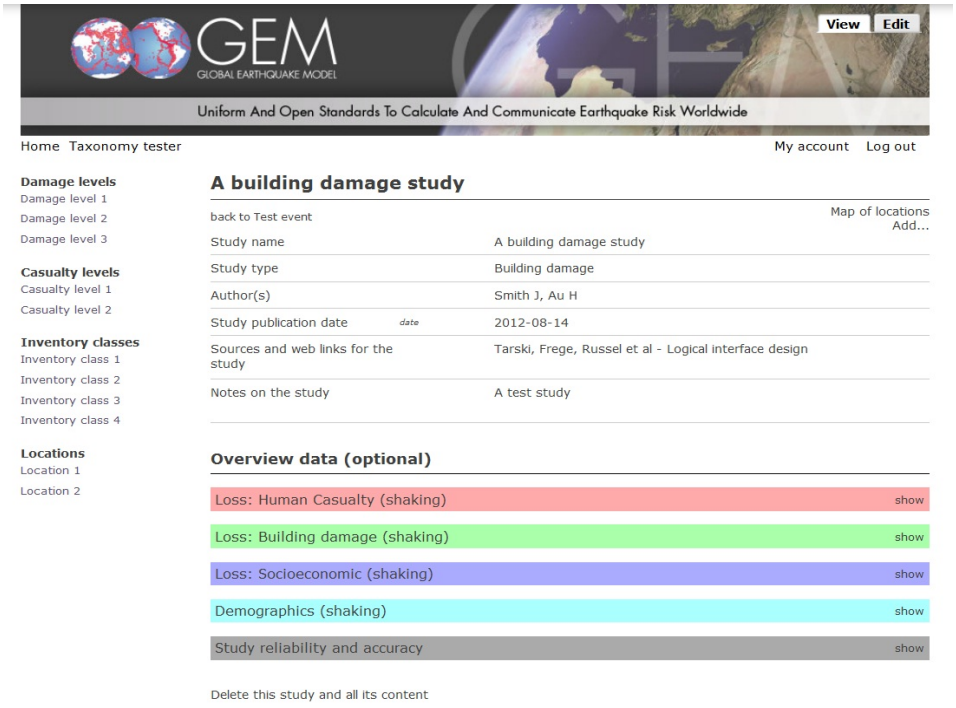


Figure 4.4 A study page in View mode

Attaching documents and images

The GEMECD database has the ability to store images and documents associated with **events**, **studies** and **locations**.

To attach images or documents:

- Ensure you are **logged in**
- Use the menus on the left of the screen to find the desired **event, study** or **location.**
- At the very bottom of the page, click **Select Media** under **Image Gallery** or **Documents.**
- Click **Browse…** and use the window which appears to locate the file you want to upload.
- Select the file and click **Open**
- Click **Submit**
- To add additional images or documents, click **Add Another Item** and repeat the previous four steps.
- Click the **Save** button**,** located above the **Documents:** field.

Adding a new location

Locations represent the locations in a study at which survey data has been collected.

To add a new location to a study:

- Ensure you are **logged in**
- From the **Events** menu on the left of the **Home** page, click on the name of the event which your study belongs to.
- Choose the study from the list on the left of the **Event** page.
- Click **Add…** at the top right of the page.
- Click **Add location**
- Enter the details of the location
- Click **Save**

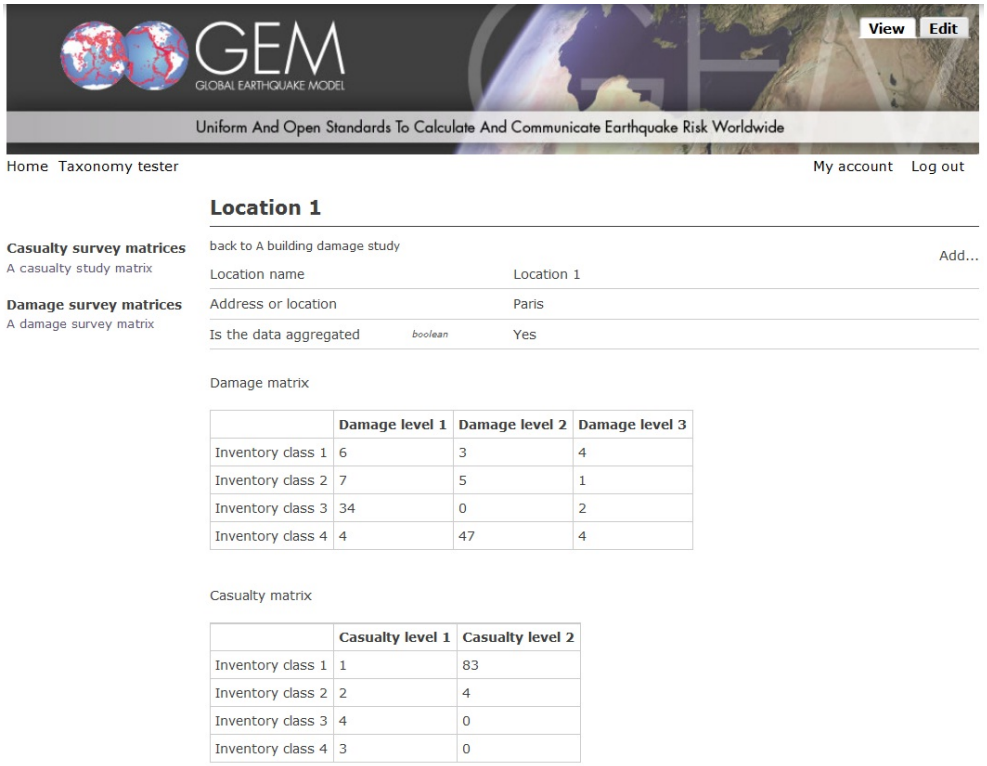


Figure 4.5 A location page in view mode with survey values entered

Adding damage levels, casualty levels and inventory classes

In order to store **survey data,** each study must have a set of levels and classes associated with it. These can be defined by the user.

To add a damage level, a casualty level or an inventory class to a study:

- Ensure you are **logged in**
- Use the menus on the left to navigate to the desired **study.**
- From the **Study page,** click **Add…** at the top right of the page
- Click **'Add damage level'** / '**Add casualty level**' / **'Add inventory class'**
- Enter level / class data.
- In the **level order** field, enter a number for each level, in order of magnitude. For example, the damage level 'D0 – Undamaged' should have a level order of 0, 'D1 – Slight damage' should have an order of 1 etc. The levels will then be displayed in order of these numbers.
- Click **Save**

Entering survey values

Survey values represent the raw numeric data collected in the study concerning levels of damage or casualty after an earthquake. They can only be attached to locations. There are a number of ways to enter survey values into the database once the inventory classes and levels used in that study have been defined (see

above) – you can choose to enter them singly, or upload a matrix of the correct shape from Excel. Bulk uploads can be achieved by uploading an NRML file.

To enter a single survey value

- Ensure you are **logged in**
- Use the menus on the left of the screen to navigate to the **study** which contains the desired **location.**
- Any **inventory classes, damage** and **casualty levels** entered for this study are displayed in a menu on the left. Ensure any levels or classes used in the survey are present. If they are not, you will need to add to or edit them (see above.)
- Select the desired location from the **Locations** menu on the left of the screen
- From the **Location page,** click **Add…** at the top right of the page, below 'Log out'
- Click **Add survey value**
- Enter the numeric survey value into the **Value** field, and fill as many other fields as possible.
- Click **Save**

To enter multiple survey values in matrix form

These instructions will pertain to adding a **damage survey matrix** - the procedure for casualty scales is extremely similar.

- Ensure you are **logged in**
- Use the menus on the left of the screen to navigate to the **study** which contains the desired **location.**
- Any **inventory classes, damage** and **casualty levels** entered for this study are displayed in a menu on the left. Ensure the correct levels for your survey data are present. If they are not, you will need to add to or edit them (see above.)
- From the **study** page, select the **location** to which you want to add survey values from the list on the left.
- Open **Microsoft Excel,** or a similar spreadsheet program.
- In Excel, create a table sized **X** rows by **Y** columns**,** where **X** is the number of inventory classes in the study and **Y** the number of damage levels. (these are listed on the left hand side of the **study** page)
- On the **Location** page, you will a see a **Damage matrix** table, with rows labelled with inventory classes, and columns headed by damage levels. The survey data contained in your Excel file should have the same format as this table – in particular, the classes and levels should be in the same order.
- Fill in the Excel table with any survey values you have for the location.
- From the **location** page, click **Add…** and choose **Add damage survey matrix**
- Fill in as much data concerning the matrix as possible, using the fields and menus provided

- In excel, highlight your **X** by **Y** table and **copy** it (This can be done by pressing **Ctrl+C** on most PCs)
- Back on the web interface, **paste** (Ctrl+V) the Excel table into the large white **Matrix** field
- Click **Save**

Bulk uploading data

While it is possible to upload a large amount of data through the web interface, uploading bulk data by this means may prove time consuming. To handle larger uploads, the GEMECD database supports uploading data in **XML** format. Any XML files used need to be written in **NRML,** a version of XML specifically designed for Natural Risk data – for detailed documentation of this format, see the database specification.

Partners may wish to write their own programs to automate conversion to NRML format. Some Excel macros already exist to accomplish this for various types of data – these are explained the next section 4.2.

To upload an XML file

Once you have a complete XML file in correct NRML format, you can upload this to the database. Note: XML files can contain a range of data – they are not limited to survey values.

- Ensure you are **logged in**
- From the **Home** page, select **» Click here to upload an XML file**
- Click the **Browse…** button next to the **NRML file upload** field
- Locate the .xml file you wish to upload, and click **Open**
- Click **Save**
- Any problems encountered during the upload will be displayed in a green box on the next page, with a full summary of all data uploaded below this. Note: if an error is encountered during the upload, no data will be added or uploaded at all.
- Once the upload is successful, click **Home**
- Click **>>Click here to Refresh geometry after uploading an XML file**
- Click **Refresh**

Deleting data

Building, casualty and nonstandard building studies and individual fields can be easily deleted through the web interface. Deleting socioeconomic and secondary studies (Tsunami, slope failure, liquefaction and fire following) is currently not possible through the web interface. It is also currently not possible to delete events through the web interface, although setting an extremely early date to an event and naming it TO BE DELETED will relegate it to the bottom of the event list on the Home page, where it can be deleted by an administrator.

To delete data contained in an individual field

- Ensure you are **logged in**
- Enter **Edit mode** by clicking **Edit** at the top right of the page

- Delete the contents of that field.
- Click **Save.** Note: this procedure cannot be undone.

To delete a building, casualty or nonstandard building study

- Ensure you are **logged in**
- Use the menus on the left of the screen to navigate to the study to be deleted
- Click **Delete this study and all its content**, at the bottom of the page
- You will be given a list of data to be deleted. Note that deleting a study will delete all damage levels, casualty levels and inventory classes attached to that study. This action cannot be undone.
- Click **Confirm delete**

Adding a new Geobase

It is possible to **georeference** various types of locational data in the study. Georeferenced data is linked to predefined lookup tables, containing boundary data, in the database, allowing for unambiguous locational data to be used across GEMECD. Commonly used boundary files are the **GADM administrative areas,** although it is also possible for partners to create and upload their own **User defined boundary files.**

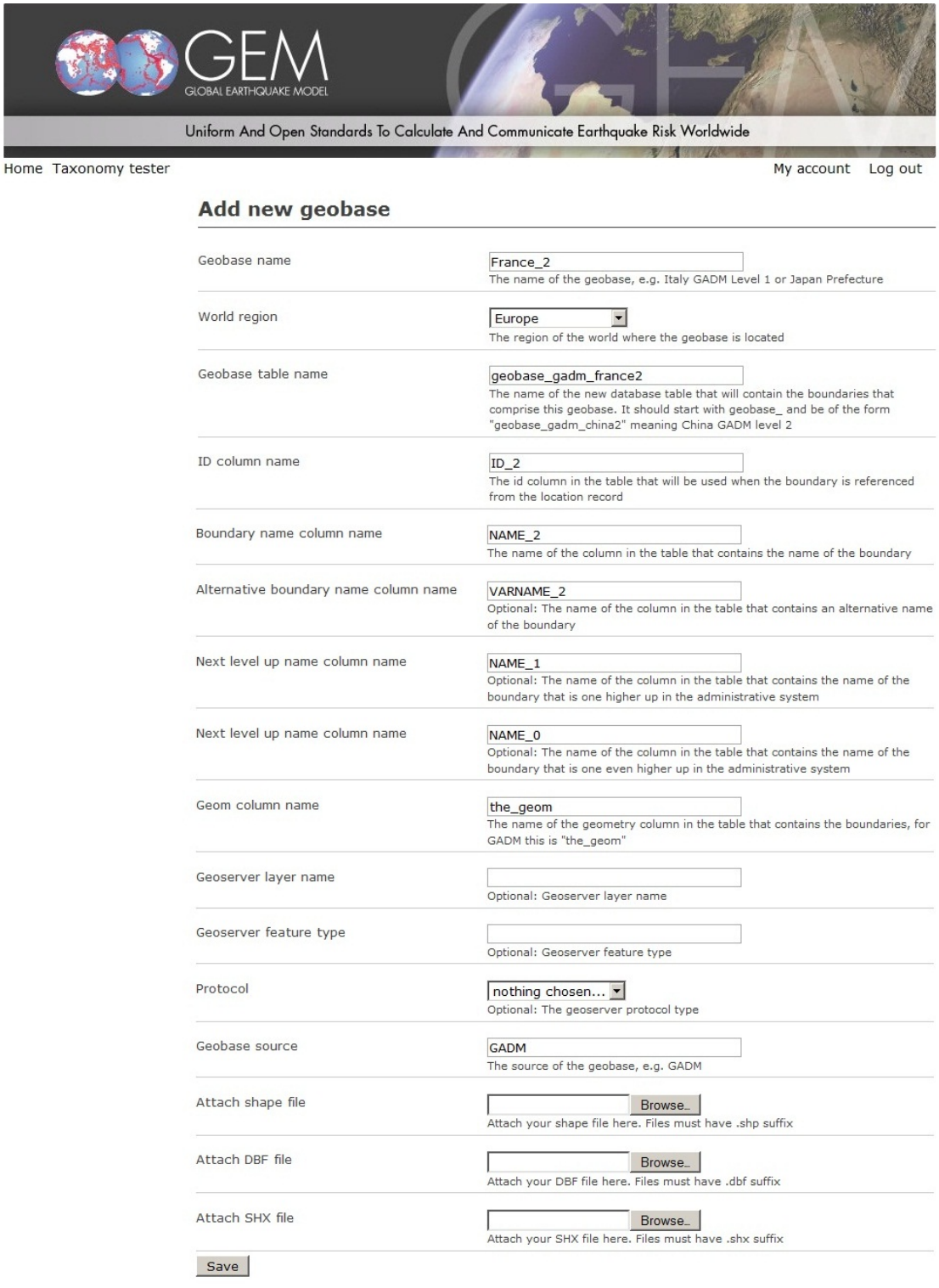


Figure 4.6 Example - Uploading the GADM file for France level 2

To upload a GADM boundary file to the database

- Ensure you are **logged in**

- From the **Home** page, select **» Click here to upload a new geobase shapefile** about half way down the page in the centre.

- Go to http://www.gadm.org/country

- Select a country from the dropdown menu.

- Make sure **Shapefile** is selected in the **'File format'** dropdown menu.

- Click **OK**

- A picture of the file you about to download will appear. Click the blue **download** link immediately underneath this picture.

- The downloaded folder will contain files for multiple administrative levels. These are numbered in order of increasing detail from 0 to 5. If you are unsure about which level to use, opening the file ***countryname***_adm***x***.csv with Excel will display the data for GADM level ***x***.

  Note: ***countryname*** *as used above represents a three letter country code for the data. For instance, the .csv file for France level 2 is called* ***FRA_ADM2.csv***

- In order to upload the geobase file, you will need to enter some data through the web interface. This can be done from the **'Create a new geobase'** page. From this page, complete the following fields:

  Geobase name: In the interests of standardisation, please name your GADM geobase using the convention ***Full name of country _ level*** – for example, a file containing data from France level 2 would be named 'France_2'

  World region: Choose from dropdown.

  Geobase table name: This name should follow the instructions given on the webpage.

  (for example: geobase_gadm_france_2)

  The next five fields should contain the column names for various categories of data contained in the geobase file. The column names for level ***x*** can be found in the spreadsheet ***countryname***_adm***x***.csv, (located in the folder downloaded from the GADM website,) or in the instructions below. To enter data of level ***x***, complete the fields as follows:

  ID column name: ID_***X*** (e.g for France Level 2 – ID_2)

  Boundary name column name: NAME_***X***

  Alternative boundary name column name: VARNAME_***X***

  Next level up name column name (1): NAME_***X-1***. (e.g NAME_1)

  Only fill this in if your data is of level 1 or above***.***

  Next level up name column name (2): NAME_***X-2***. (e.g NAME_0)

  Only fill this in if your data is of level 2 or above***.***

Geom column name: the_geom (this is the same for all GADM geobase files)

Geobase source: GADM

- When these fields have been filled in, click **Browse…** next to **Attach shape file**
- Use the window which appears to find the folder named ***countryname***_adm, downloaded from the GADM site earlier. *(Note: if this folder has the extension '.zip' you may need to extract it before you can open it. The method of extracting files will depend on your computer.)*
- From this folder, select the file named ***countryname***_adm***x***.shp (e.g FRA_adm2.shp) and click **Open**.
- Repeat the last three steps to attach **DBF** and **SHX** files for your GADM level. These are also located in the ***countryname***_adm folder, and are named ***countryname***_adm***x***.dbf and ***countryname***_adm***x***.shx respectively.
- Click **Save.**

To upload a user defined boundary file to the database

- Ensure you are **logged in**
- From the **Home** page, click on **'Create a new Geobase'**, about half way down the page in the centre.
- Fill in the details of your geobase. All fields not marked 'optional' must be filled in for the upload to succeed.
- The **name** of the geobase should be identical to the name of the **shapefile** to be uploaded (without extension – for example, if your shapefile name **is France_intensity_zone_1.shp**, the geobase should be named **France_intensity_zone_1**)
- Use the **Browse…** buttons at the bottom of the page to attach a **shape file,** a **DBF file** and an **SHX file** for your geobase. Each of these must be provided for the upload to succeed.
- Click **Save.**

4.2 Templates for batch upload

In order to help users upload data quickly into GEMECD. A suite of templates were developed with detailed instructions for batch upload using Microsoft Excel Macros. Templates have been designed to upload buidlling damage studies, for casualty studies and for critical buildings and infrastructure. These can be found in the GEMECD portal. The figures below show some examples of these pages.

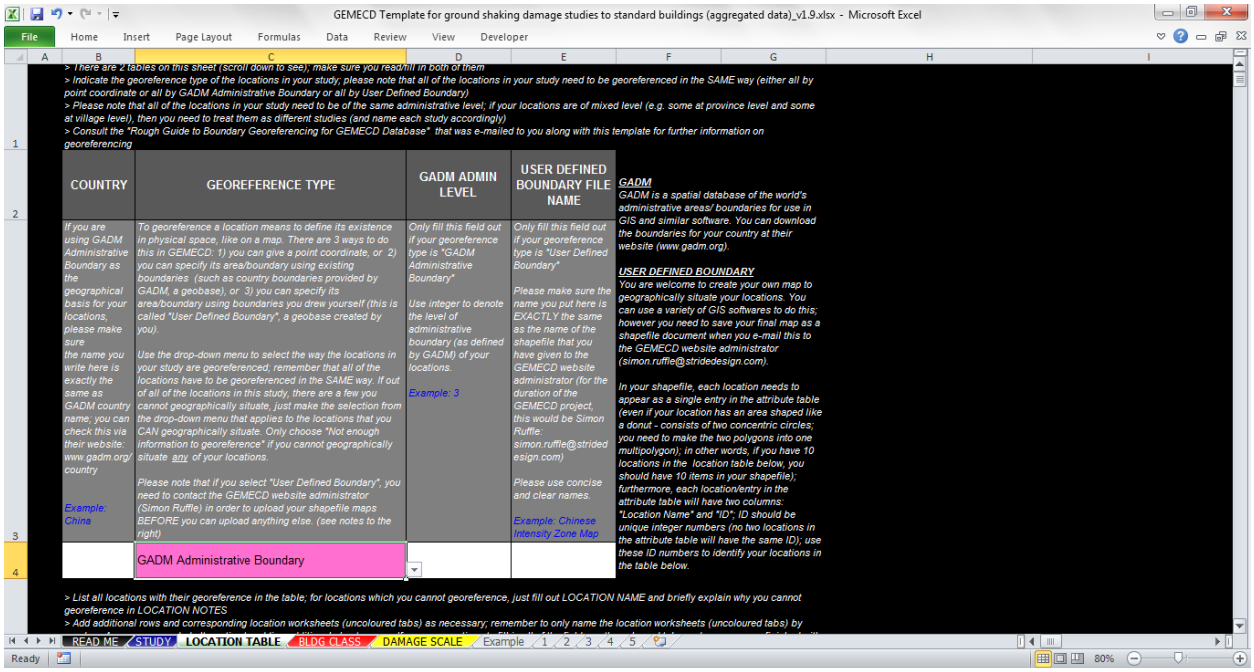


Figure 4.7 Locational data input page of the aggregated building damage study due to ground shaking Excel macro template

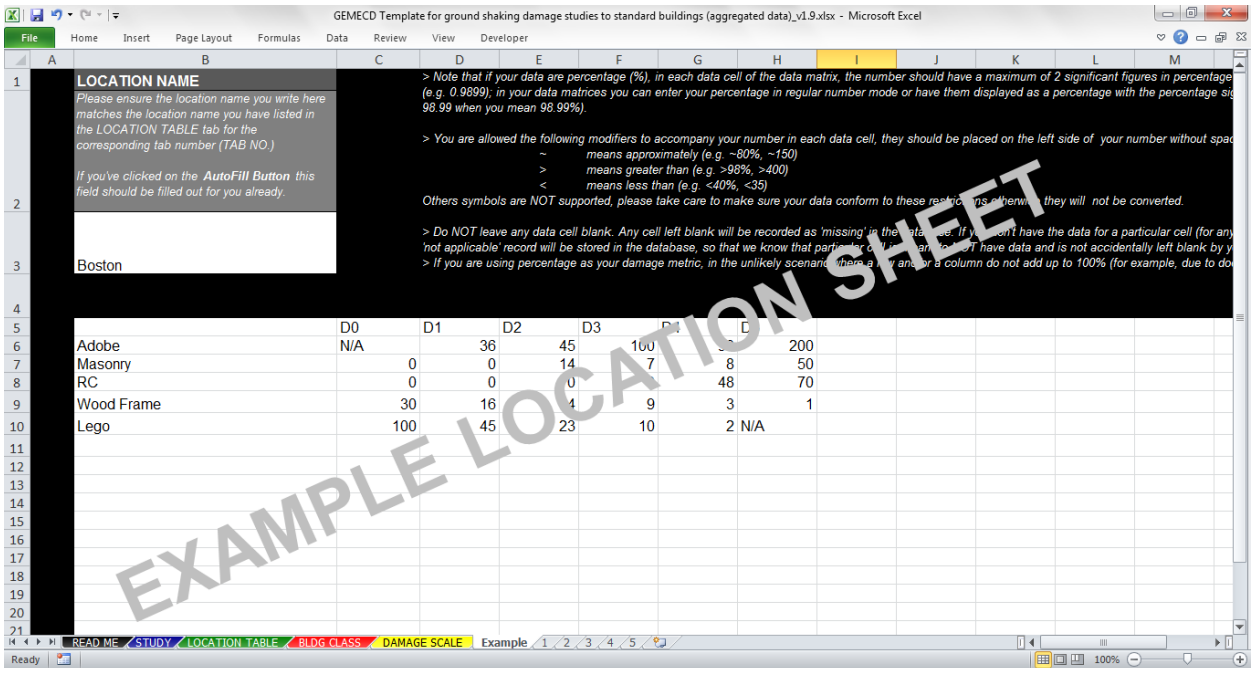


Figure 4.8 Building damage page for a specific location in the study (Excel macro template

5 Important features in GEMECD

The GEMECD project prompted some key pieces of research and updates to existing work which affects the global provision of information and standardisation. Most notably the updates to the USGS ShakeMap Atlas and also the specification of socioeconomic indicators for international standards, like the Integrated Research on Disaster Risk (IRDR)'s IRDR Peril Classification and Hazard Glossary (IRDR, 2014). In this chapter, the improvements made to the ShakeMaps during the GEMECD are described. It is worth noting that the USGS ShakeMaps are the standard hazard component of GEMECD and are used to relate consequences to ground shaking.

5.1 USGS Shakemap Atlas

At the end of the project USGS is providing to GEMECD ShakeMaps and related products for 98 important earthquakes in the period 1970-2011, including two pre-1970 events (1923 Kanto and 1967 Caracas). For each event the set of ShakeMaps has involved:

- comprehensive literature search for fault information;
- local, regional, and global source catalogs examination, aggregation, and disambiguation;
- numerous data requests, formatting and filtering;
- careful selection of the predictive and conversion equations (García *et al*., 2012a);
- detailed quality assessment;
- massive calibration and testing of different seismological parameters and mapping options through the ShakeMap Atlas v2.0 effort (García *et al*., 2012b);
- abundant documentation; and
- use of software that represents the state-of-the-art in ground motion modeling (Worden *et al*., 2010).

As such, the GEMECD database constitutes a gold standard in the elaboration of ShakeMaps for recent historical earthquakes worldwide.

1) *GEMECD Event Selection*. The preliminary GEMECD event list was revised several times during the course of the project due to the lack of consequences data for some events and the occurrence of remarkable earthquakes worthwhile to be included in the final list. In the last year of the project, three more events (1990 Vrancea, 2002 Molise, and 2003 Lefkada Island -Figure 5.1) were added to this list due to their relevance and high data quality for both hazard and losses. The USGS is providing ShakeMaps for all events once considered for GEMECD (98 earthquakes), even if they were finally discarded.

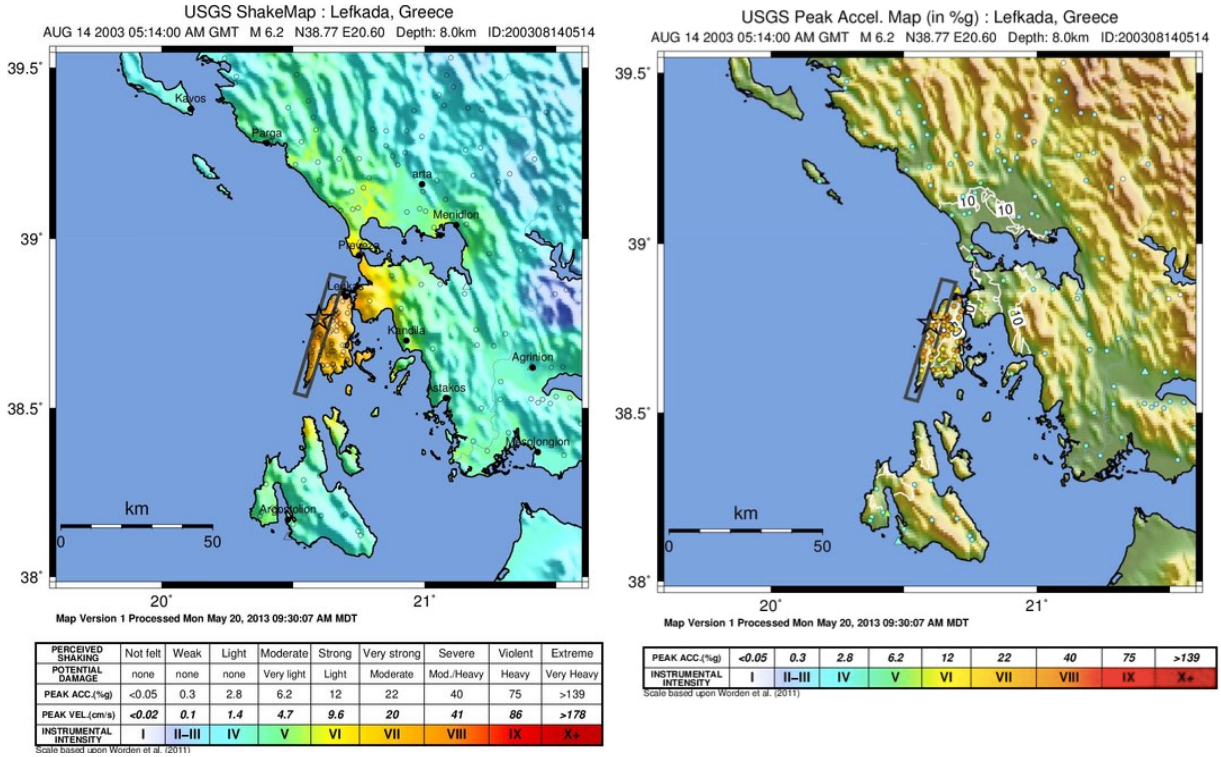


Figure 5.1 Example of completed ShakeMaps for an event with a wealth of source information and ground shaking observations: the 2003 Lefkada Island, Greece, M6.2 earthquake. Maps for MMI (left) and peak ground acceleration (right). Thin black line: surface projection of the FFM. Circles: MMI data; triangles: strong motion stations. Ground motion data are color-coded to MMI via GMICE relations (Worden *et al.*, 2012).

2) Data Assembly. The ShakeMap grid is built combining information on the earthquake source (hypocentral location, magnitude, focal mechanism, and finite fault model -FFM-, if available) and the severity of the ground shaking, given by ground-motion (GM) parameters (peak ground acceleration and velocity, and response spectrum ordinates) and macroseismic intensity observations (MMI) or by GM or MMI prediction equations (GMPEs and IPEs, respectively) wherever there are no data available.

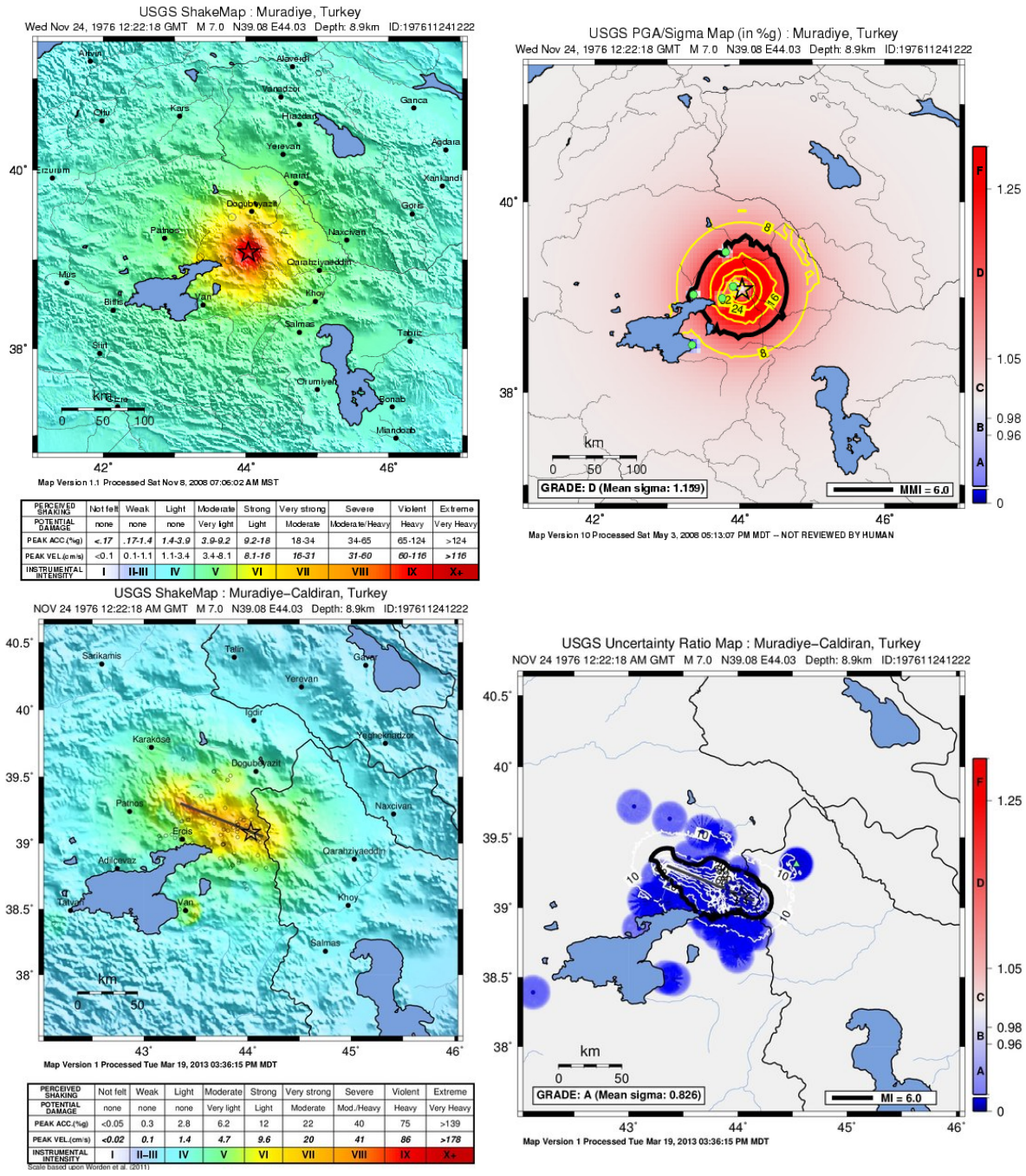
After considerable difficulties a rich set of MMI observations for the Turkish GEMECD events was compiled, reviewed, and shared by KOERI, which resulted in a significant improvement of these ShakeMaps, as shown in Figure 5.2.

The final dataset provided by the USGS comprises a coherent earthquake source database that includes FFMs for 90 of the events and a wealth of GM and MMI data for all but five events (none in the final GEMECD list).

3) ShakeMap Generation. ShakeMaps provide the site hazard basis or "denominator" for GEMECD consequences at their location of occurrence. The product suite for each event includes MMI and GM parameter maps, regression plots, and uncertainty maps -a crucial addendum of the grids.

In order to improve the products in the ShakeMap Atlas v1.0 (Allen *et al.*, 2008) for the GEMECD events the USGS has taken several key steps described in the annual reports of years one and two. After this process we submitted to CAR a calibration subset of about 30 data-rich events that had been subjected to close scrutiny, especially regarding GEMECD needs in terms of mapping resolution and geographical span. Once CAR

approved this calibration subset the USGS generated and provided the rest of events with resolution and mapping characteristics in accordance to those defined for the former subset.



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	*<.17*	*.17-1.4*	*1.4-3.9*	*3.9-9.2*	*9.2-18*	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	*8.1-16*	*16-31*	*31-60*	*60-116*	*>116*
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Mod./Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<0.05	0.3	2.8	6.2	12	22	40	75	>139
PEAK VEL.(cm/s)	*<0.02*	*0.1*	*1.4*	*4.7*	*9.6*	*20*	*41*	*86*	*>178*
INSTRUMENTAL INTENSITY	I	II–III	IV	V	VI	VII	VIII	IX	X+

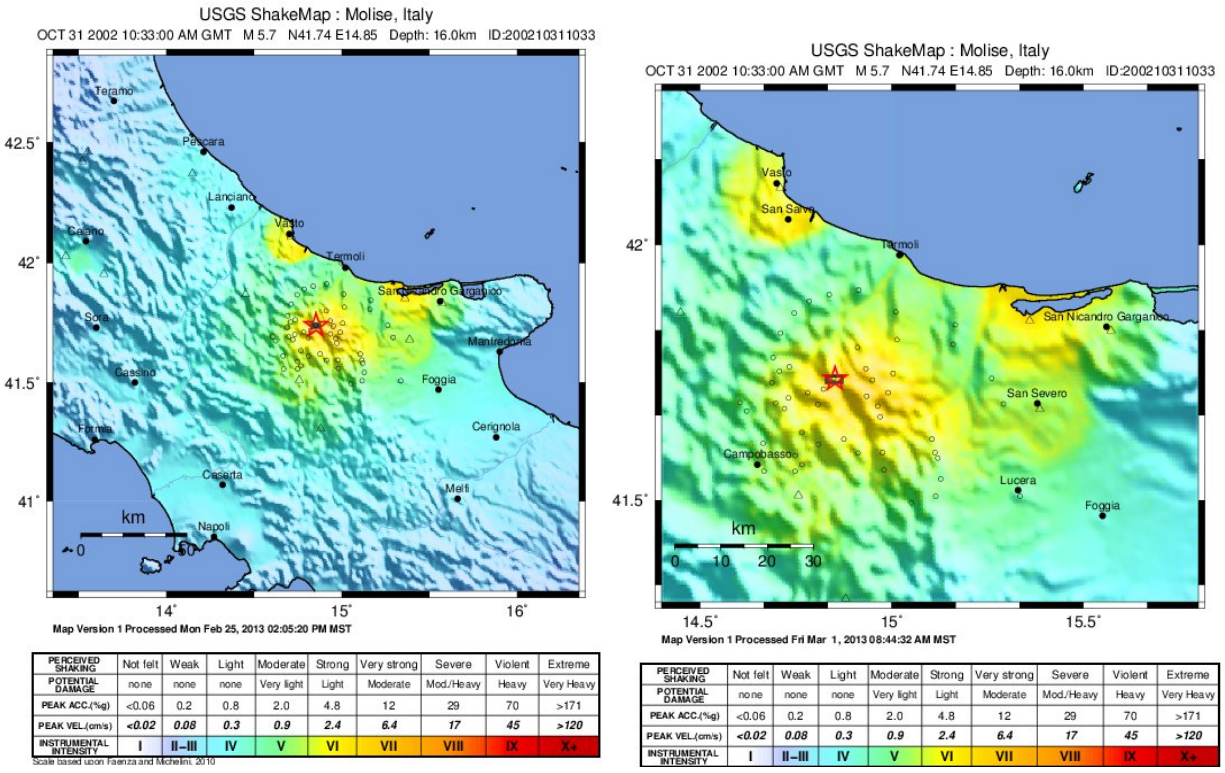
Scale based upon Worden et al. (2011)

Figure 5.2 Example of the improvement in a Turkish GEMECD event (Muradiye 1976, M7.0) after including MMI data compiled by KOERI.

As shown in Figure 5.2 Upper row: MMI (left) and uncertainty (right) maps before the inclusion (ShakeMap Atlas 1.0; Allen et al., 2008); lower row: same for the GEMECD final ShakeMaps. Thin black line: surface projection of the FFM. Circles: MMI data; triangles: strong motion data. Uncertainties are expressed as a multiplicative factor applied to the standard deviation (sigma) of the IPE used in each case. Blue colors indicate points where uncertainty is lower than the IPE sigma, due to the existence of data nearby. Red colors indicate points where uncertainty is higher than the IPE sigma, due to the lack of knowledge on the

finite source geometry and absence of data. Mean uncertainty within the MMI 6 contour (thick black line) is shown at the left bottom corner.

For every earthquake we have provided two versions of each map (a general map and a zoomed one). The larger scale map allows resolving regions of the most severe damage, whereas smaller scale maps provide an overview of the entire shaken area containing all regions that may have suffered any damage at all (Figure 5.3).



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Mod./Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<0.06	0.2	0.8	2.0	4.8	12	29	70	>171
PEAK VEL.(cm/s)	*<0.02*	*0.08*	*0.3*	*0.9*	*2.4*	*6.4*	*17*	*45*	*>120*
INSTRUMENTAL INTENSITY	I	II–III	IV	V	VI	VII	VIII	IX	X+

Scale based upon Faenza and Michelini, 2010

PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Mod./Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<0.06	0.2	0.8	2.0	4.8	12	29	70	>171
PEAK VEL.(cm/s)	*<0.02*	*0.08*	*0.3*	*0.9*	*2.4*	*6.4*	*17*	*45*	*>120*
INSTRUMENTAL INTENSITY	I	II–III	IV	V	VI	VII	VIII	IX	X+

Figure 5.3 Example of the MMI general (left) and zoomed (right) maps for the 2002 Molise, Italy, M5.7 earthquake. Thin black line: surface projection of the FFM. Circles: MMI data; triangles: strong motion stations. Ground motion data are color-coded to MMI via GMICE relations (Faenza and Michelini, 2010).

4) GEMECD Documentation. ShakeMap improvements for each event are documented in the form of spreadsheets containing the references of any source information or MMI/GM data contributor. This information will also be incorporated to the USGS ShakeMap Atlas, which in its upcoming version (2.0) will contain nearly 10,000 damaging and potentially damaging events that occurred between 1973 and 2010, plus a few selected earthquakes before 1973. *The entire Version 2.0 ShakeMap Atlas will likely have other benefits to GEM.*

Among the earthquakes included in the final list (68 events), only three of them lack any kind of data, whether parametric or macroseismic: 1923 Kanto, 1986 San Salvador, and 2010 Qinghai. For Kanto we are aware of detailed macroseismic information, but its conversion into reliable MMI estimations exceeds the scope of this project given the need of considering the characteristics of early 20th century Japanese constructions. For San Salvador there might be macroseismic surveys that we could not find. Finally for Qinghai -as for most Chinese GEMECD earthquakes- the problem is twofold: establishing a reliable conversion between the MMI and the Chinese Earthquake Administration macroseismic intensity scales, and

gaining access to the ground-motion records available in China (the case of 2008 Wenchuan has been a fortunate exception).

Most Indonesian earthquakes also suffer from data scarcity due to the lack of macroseismic surveys and instrumentation in the past, and currently because of restrictions in sharing parametric data. We have found even more severe restrictions for most Indian events; despite the existence of numerous ground motion records for pre-2000 events, all our efforts to obtain them have failed. We hope GEM efforts will overcome these obstacles in the near future.

All these limitations mean that, for these earthquakes, the provided ShakeMaps are mostly based on predictive equations, not in ground-truth data. Furthermore, these equations have been developed for other regions where more data are available, which may result in further inaccuracy when used in low-data regions with poorly known source and attenuation characteristics.

In addition, there is also one large earthquake of the final list that lacks a finite fault model: 1987 Reventador (M 7.1). Given its magnitude and the few available data, the uncertainty on the fault geometry may result in inadequate estimation of the ground shaking in the epicentral area.

6 Limitations of GEMECD and Future Work on Recording Disaster Losses

6.1 Limitations

6.1.1 Availablity of public datasets

For various reasons, the studies at GEMECD are not exhaustive of damage studies available for the events listed. The main reason for these omissions is to do with intellectual property rights. In addition, the consortium also encountered issues with the quality of geospatial information. As an example, for the United States earthquakes in GEMECD, SPA had found aggregated data from the Association of Bay Area Governments (ABAG) by postal (ZIP) code for the Loma Prieta earthquake. The data are of yellow- or red-tagged buildings in certain cities in the San Francisco Bay area; ABAG did not have information on green-tagged buildings. In each ZIP code, counts of tagged buildings were provided separately by each available characteristic, rather than counts of buildings with the same set of characteristics. CAR tried to retrieve the original data set from ABAG but learned that they lost the data in the course of updating computer servers.

For the Northridge earthquake, there were three data sets found. One data set contained information on tagged buildings in the City of Los Angeles. The location of each building as a latitude and longitude coordinate to three decimal places and a ZIP code were provided though the location information was insufficient to aggregate the buildings because: the imprecise coordinates would have misplaced buildings near ZIP code boundaries; there is no standard areal definition of ZIP codes; and many ZIP codes were reported as 0, an invalid value. We sought the original data but learned that we needed permission from the City of Los Angeles Department of Building and Safety.

There was also damage data from the California Governor's Office of Emergency Services. These data came with use restrictions: "it is to be cited as 'Courtesy of the California Governor's Office of Emergency Services'" and "it is provided and is to be used for non-commercial purposes only."

6.1.2 Secondary Hazards

Regarding secondary hazards, despite successfully gathering datasets for some key earthquakes, USGS scientists were frustrated by the significant limitations and challenges in collecting and redistributing secondary-hazard geospatial databases.

First, there are relatively few useful datasets available, either mapped or (better) in digital form. Second, most of these datasets are not *comprehensive,* nor *complete*. We refer to *comprehensive* as mapping all, for example, landslide occurrences over a specified dimension (*e.g.*, 1 m^2) and *complete* as covering the entire domain over which landslides might have occurred for a given earthquake. These terms are essential for accurately modeling landslide occurrence from a statistical standpoint. Often these conditions must be inferred for a given study, since standards for the collection of these data do not exist. In terms of secondary-hazard geospatial databases, GEM may need to acquire data for some key older events in a piecemeal fashion since, in some cases, this requires obtaining permission from the authors in order to allow redistribution. In other cases where mapped point and polygon data can be scanned and digitized redistribution should be allowed simply by reference to the original maps or publications.

Lastly many authors allow the use of digital data, but only upon request to the authors (they do not distribute them). This requires permission for use and redistribution. All USGS studies (mainly by R. Jibson and E. Harp) are publicly available and can be freely redistributed, but few other studies provide secondary hazard data with comparable liberal use permissions.

We expect that the pending Atlas of ShakeMaps for landslide and liquefaction case history events, which will be made available online, will aid in improving the accuracy of loss-modeling systems such as PAGER and GEM, as well as allow for a common framework for other mechanistic and empirical studies. Nowicki *et al*. (2013) and Zhu *et al*. (2013) have documented important examples of strategies for employing ShakeMap layers along with liquefaction and landslide data sets.

6.2 The Future of GEMECD

"Understanding and documenting impacts from natural hazards is the foundation for decision-making and policy-setting in disaster risk reduction." This is a direct quote from the Integrated Research on Disaster Risk (IRDR) project on disaster loss data (DATA). The international community like the European Commission's Joint Research Committee and the IRDR are already consulting and collaborating with the GEMECD consortium to standardise and promote disaster impact record collection.

It is the ambition of the consortium that now housed in the OpenQuake platform, partners and all users of GEM will be able to help maintain the quality and quantity of data on earthquake consequences in the database.

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2. Global Administrative Areas (GADM database)
www.gadm.org

APPENDIX A Events and studies in GEMECD

Year	Events	Country	Responsible Partner	Socioeconomic Tables (CRED)	Aggregated building damage	Casualties	Critical Buildings and Infrastructure	Secondary Hazards
1923	Kanto	Japan	**Kyoto**		**X**			
1967	Caracas	Venezuela	**ERN-AL**		**X**			
1970	Ancash (Chimbote)	Peru	**ERN-AL**		**X**			
1971	San Fernando	USA	**SPA**	**X**	**X**		**X**	
1972	Managua	Nicaragua	**ERN-AL**		**X**			
1975	Diyarbakir-Lice	Turkey	**KOERI**		**X**			
1976	Friuli	Italy	**CAR**		**X**	**X**		
1976	Guatemala	Guatemala	**CAR**		**X**			
1976	Tangshan	China	**CAR**		**X**			
1976	Van-Caldiran	Turkey	**KOERI**		**X**			
1977	Vrancea	Romania	**CAR**	**X**	**X**		**X**	
1978	Miyagi-ken	Japan	**Kyoto**		**X**			
1978	Tabas	Iran	**CAR**			**X**		
1979	Montenegro, Serbia	Montenegro	**CAR**		**X**			
1980	El Asnam	Algeria	**KOERI**		**X**			
1980	Irpinia	Italy	**CAR**		**X**	**X**		
1980	Terceira Island	Portugal	**CAR**		**X**			
1983	Popayan	Colombia	**ERN-AL**		**X**			

Year	Events	Country	Responsible Partner	Socioeconomic Tables (CRED)	Aggregated building damage	Casualties	Critical Buildings and Infrastructure	Secondary Hazards
1985	Michoacan	Mexico	**ERN-AL**	**X**	**X**	**X**	**X**	
1985	Valparaiso	Chile	**ERN-AL**		**X**			
1986	Kalamata	Greece	**CAR**		**X**			
1986	San Salvador	El Salvador	**ERN-AL**		**X**	**X**	**X**	
1987	Edgecumbe	New Zealand	**CAR**		**X**			
1987	Reventador	Ecuador	**ERN-AL**				**X**	**X**
1988	Nepal-India border	Nepal	**CAR**		**X**			
1988	Spitak	Armenia	**KOERI**		**X**	**X**	**X**	
1989	Loma Prieta	USA	**SPA**	**X**	**X**		**X**	**X**
1989	Newcastle	Australia	**CAR**		**X**			
1990	Luzon	Philippines	**CAR**		**X**			**X**
1990	Manjil	Iran	**KOERI**		**X**			
1990	Vrancea area	Romania	**CAR**		**X**			
1992	Erzincan	Turkey	**KOERI**	**X**	**X**	**X**	**X**	
1992	Roermond	Netherlands	**CAR**		**X**			
1993	Latur-Killari	India	**CAR**		**X**	**X**		
1994	Northridge	USA	**SPA**	**X**	**X**			**X**
1995	Aigion	Greece	**CAR**		**X**	**X**		
1995	Kobe	Japan	**Kyoto**	**X**	**X**	**X**	**X**	**X**
1995	Neftegorsk	Russia	**CAR**		**X**			
1997	Cariaco	Venezuela	**ERN-AL**		**X**		**X**	
1998	Adana-Ceyhan	Türkiye	**KOERI**		**X**			
1999	Armenia	Colombia	**ERN-AL**		**X**	**X**	**X**	

Year	Events	Country	Responsible Partner	Socioeconomic Tables (CRED)	Aggregated building damage	Casualties	Critical Buildings and Infrastructure	Secondary Hazards
1999	Athens	Greece	**CAR**		**X**	**X**		
1999	Chi-Chi	Taiwan	**Kyoto**	**X**	**X**	**X**	**X**	
1999	Duzce-Kaynasli	Türkiye	**KOERI**		**X**		**X**	
1999	Kocaeli-Golcuk	Türkiye	**KOERI**	**X**	**X**	**X**	**X**	**X**
2001	Gujarat (Bhuj)	India	**CAR**	**X**	**X**	**X**	**X**	
2001	San Miguel	El Salvador	**ERN-AL**		**X**			
2001	San Salvador	El Salvador	**ERN-AL**		**X**			
2002	Molise	Italy	**CAR**		**X**			
2003	Bam	Iran	**KOERI**	**X**	**X**	**X**	**X**	
2003	Bingol	Turkey	**KOERI**		**X**		**X**	
2003	Boumerdes	Algeria	**CAR**		**X**			
2003	Lefkada Island	Greece	**CAR**		**X**			
2004	Al Hoceima	Morocco						
2004	Banda Aceh, Sumatra	Indonesia	**CAR**	**X**	**X**	**X**		**X**
2004	Niigata-ken Chuetsu	Japan	**Kyoto**		**X**			
2005	Kashmir	Pakistan	**CAR**	**X**	**X**	**X**		
2006	Yogyakarta	Indonesia	**CAR**	**X**	**X**	**X**	**X**	
2006	South of Java	Indonesia	**CAR**			**X**		
2007	Pisco	Peru	**ERN-AL**		**X**	**X**	**X**	
2008	Wenchuan	China	**CAR**	**X**	**X**	**X**	**X**	**X**
2009	L'Aquila	Italy	**CAR**		**X**	**X**	**X**	
2009	Padang	Indonesia	**CAR**		**X**			
2009	Samoa	Samoa	**CAR**					**X**

Year	Events	Country	Responsible Partner	Socioeconomic Tables (CRED)	Aggregated building damage	Casualties	Critical Buildings and Infrastructure	Secondary Hazards
2010	Darfield	New Zealand	**GNS**	**X**	**X**		**X**	
2010	Maule (Bio-Bio)	Chile	**ERN-AL**		**X**	**X**		**X**
2010	Port-au-Prince	Haiti	**ERN-AL**	**X**	**X**		**X**	
2010	Southern Qinghai	China	**CAR**		**X**			
2011	Christchurch	New Zealand	**GNS**	**X**	**X**	**X**	**X**	
2011	Tohoku	Japan	**Kyoto**	**X**	**X**	**X**		**X**
2011	Van Center	Turkey	**KOERI**		**X**			

APPENDIX B Database Schema SQL Definition

GEM's name for this schema is "econd". Entries highlighted in grey are not currently being used.

B.1 Event Level

B.1.1 Event table

```
CREATE TABLE event
(
  id serial NOT NULL, -- Primary Key: Internal database id for the event
  usgsshakemapid character varying(50) NOT NULL DEFAULT 0, -- ID number for the earthquake event, eg 197005312023
  "name" character varying(50) NOT NULL DEFAULT 'untitled'::character varying, -- The name of the event
  country character varying(50), -- The country or countries affected by the event. Separate multiple countries with commas.
  region character varying(50), -- A text description of the area affected by the event
  regioncode character varying(10) NOT NULL DEFAULT '0'::character varying, -- The region of the world where the event occurred
  eventdate timestamp without time zone, -- The date of the event, eg 1970-05-31
  eventtime timestamp without time zone, -- The time of the event in UTC, eg 20:23
  eventdatelocal timestamp without time zone, -- The date of the event in local time, eg 1970-05-31
  eventtimelocal timestamp without time zone, -- The time of the event in local time, eg 15:23
  dayofweeklocal character varying(10), -- The day of the week (local) eg Sunday
  wasaholiday integer NOT NULL DEFAULT 0, -- Was a holiday: 1 for yes 0 for no
  enddate timestamp without time zone, -- The date that the event ended, for events that have a duration over days, eg 1970-05-31
  magnitude double precision, -- Magnitude
  magnitudeunitcode character varying(10) NOT NULL DEFAULT '0'::character varying, -- The units of the magnitude
  depth double precision, -- The focal depth of the event, km
  "location" character varying(50), -- The epicentral coordinates in WKT format eg POINT (long lat)
  eventnarrative text, -- Descriptive text.
  seismologicaldata_s character varying(255), -- The source of the event-level seismological data
  seismologicaldata_c text, -- A comment on the event-level seismological data
  peopleinjured bigint, -- Total people injured in event (all hazards)
  peopleinjured_s character varying(255), -- The source of the data
  peopleinjured_c text, -- A comment on the data
  peopleinjured_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  peoplemissing bigint, -- Total people missing in event (all hazards)
  peoplemissing_s character varying(255), -- The source of the data
  peoplemissing_c text, -- A comment on the data
  peoplemissing_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  peoplekilled bigint, -- Total people killed in event (all hazards)
  peoplekilled_s character varying(255), -- The source of the data
  peoplekilled_c text, -- A comment on the data
  peoplekilled_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  peopledyingpostcatastrophe bigint, -- People dying after time has passed but their deaths related to the original catastrophe (all hazards)
  peopledyingpostcatastrophe_s character varying(255), -- The source of the data
  peopledyingpostcatastrophe_c text, -- A comment on the data
  peopledyingpostcatastrophe_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  numberofbuildingsdestroyed bigint, -- Total number of buildings destroyed, collapsed or damaged beyond repair(all hazards)
  numberofbuildingsdestroyed_s character varying(255), -- The source of the data
  numberofbuildingsdestroyed_c text, -- A comment on the data
  numberofbuildingsdestroyed_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  numberofbuildingsdamaged bigint, -- Total number of buildings damaged (all hazards)
  numberofbuildingsdamaged_s character varying(255), -- The source of the data
  numberofbuildingsdamaged_c text, -- A comment on the data
  numberofbuildingsdamaged_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  numberofdwellingsdestroyed bigint, -- Total number of dwelling units destroyed, collapsed or damaged beyond repair (all hazards)
  numberofdwellingsdestroyed_s character varying(255), -- The source of the data
  numberofdwellingsdestroyed_c text, -- A comment on the data
```

numberofdwellingsdestroyed_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
numberofdwellingsdamaged bigint, -- Total number of dwelling units damaged (all hazards)
numberofdwellingsdamaged_s character varying(255), -- The source of the data
numberofdwellingsdamaged_c text, -- A comment on the data
numberofdwellingsdamaged_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
peoplehomeless bigint, -- Total number of people homeless for a significant duration of time (all hazards)
peoplehomeless_s character varying(255), -- The source of the data
peoplehomeless_c text, -- A comment on the data
peoplehomeless_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
directeconomicloss double precision, -- Total estimated direct economic loss, million US$, contemporaneous. In absolute US$ value of the year of occurrence. Only includes direct effects. (all hazards)
directeconomicloss_s character varying(255), -- The source of the data
directeconomicloss_c text, -- A comment on the data
directeconomicloss_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
indirecteconomicloss double precision, -- Total estimated indirect economic loss, million US$, contemporaneous. In absolute US$ value of the year of occurrence. Only includes indirect effects. (all hazards)
indirecteconomicloss_s character varying(255), -- The source of the data
indirecteconomicloss_c text, -- A comment on the data
indirecteconomicloss_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
numberofhouseholds bigint, -- Total number of households in the affected countries (contemporaneous)
numberofhouseholds_s character varying(255), -- The source of the data
numberofhouseholds_c text, -- A comment on the data
numberofhouseholds_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
totalnumberofbuildings bigint, -- Total number of buildings in the affected countries (contemporaneous)
totalnumberofbuildings_s character varying(255), -- The source of the data
totalnumberofbuildings_c text, -- A comment on the data
totalnumberofbuildings_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
overallimpact text, -- Overall socio economic impact (all hazards)
peopleinjuredduetoshake bigint, -- People injured due to ground shaking
peopleinjuredduetoshake_s character varying(255), -- The source of the data
peopleinjuredduetoshake_c text, -- A comment on the data
peopleinjuredduetoshake_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
peoplemissingduetoshake bigint, -- People missing due to ground shaking
peoplemissingduetoshake_s character varying(255), -- The source of the data
peoplemissingduetoshake_c text, -- A comment on the data
peoplemissingduetoshake_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
peoplekilledduetoshake bigint, -- People killed due to ground shaking
peoplekilledduetoshake_s character varying(255), -- The source of the data
peoplekilledduetoshake_c text, -- A comment on the data
peoplekilledduetoshake_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
peopledyingpostcatastropheshake bigint, -- People dying after time has passed but their deaths related to the original shaking
peopledyingpostcatastropheshake_s character varying(255), -- The source of the data
peopledyingpostcatastropheshake_c text, -- A comment on the data
peopledyingpostcatastropheshake_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
numberofbuildingsdestroyedshake bigint, -- Total number of buildings destroyed, collapsed or damaged beyond repair by shaking
numberofbuildingsdestroyedshake_s character varying(255), -- The source of the data
numberofbuildingsdestroyedshake_c text, -- A comment on the data
numberofbuildingsdestroyedshake_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
numberofbuildingsdamagedshake bigint, -- Total number of buildings damaged by shaking
numberofbuildingsdamagedshake_s character varying(255), -- The source of the data
numberofbuildingsdamagedshake_c text, -- A comment on the data
numberofbuildingsdamagedshake_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
numberofdwellingsdestroyedshake bigint, -- Total number of dwelling units destroyed, collapsed or damaged beyond repair by shaking
numberofdwellingsdestroyedshake_s character varying(255), -- The source of the data
numberofdwellingsdestroyedshake_c text, -- A comment on the data
numberofdwellingsdestroyedshake_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
numberofdwellingsdamagedshake bigint, -- Total number of dwelling units damaged by shaking
numberofdwellingsdamagedshake_s character varying(255), -- The source of the data
numberofdwellingsdamagedshake_c text, -- A comment on the data
numberofdwellingsdamagedshake_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
peoplehomelessshake bigint, -- Total number of people homeless for a significant duration of time (shaking)
peoplehomelessshake_s character varying(255), -- The source of the data
peoplehomelessshake_c text, -- A comment on the data
peoplehomelessshake_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data

directeconomiclossshake bigint, -- Total estimated direct economic loss due to shaking, million US$, contemporaneous. In absolute US$ value of the year of occurrence. Only includes direct effects.
directeconomiclossshake_s character varying(255), -- The source of the data
directeconomiclossshake_c text, -- A comment on the data
directeconomiclossshake_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
indirecteconomiclossshake bigint, -- Total estimated indirect economic loss due to shaking, million US$, contemporaneous. In absolute US$ value of the year of occurrence. Only includes indirect effects.
indirecteconomiclossshake_s character varying(255), -- The source of the data
indirecteconomiclossshake_c text, -- A comment on the data
indirecteconomiclossshake_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
numberofhouseholdsshake bigint, -- Total number of households in the zone affected by shaking (contemporaneous)
numberofhouseholdsshake_s character varying(255), -- The source of the data
numberofhouseholdsshake_c text, -- A comment on the data
numberofhouseholdsshake_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
totalnumberofbuildingsshake bigint, -- Total number of buildings in the zone affected by shaking (contemporaneous)
totalnumberofbuildingsshake_s character varying(255), -- The source of the data
totalnumberofbuildingsshake_c text, -- A comment on the data
totalnumberofbuildingsshake_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
overallimpactshake text, -- Overall socio economic impact of shaking
ownerid integer NOT NULL DEFAULT 1, -- ID of the creator/owner of the event
lastupdatebyid integer NOT NULL DEFAULT 1, -- ID of the last person to update this record
lastupdate timestamp without time zone, -- Last record update date
peopleinjuredduetotsunami bigint, -- People injured due to tsunami
peopleinjuredduetotsunami_s character varying(255), -- The source of the data
peopleinjuredduetotsunami_c text, -- A comment on the data
peopleinjuredduetotsunami_q integer NOT NULL DEFAULT 0, -- The status of the data
peoplemissingduetotsunami bigint, -- People missing due to tsunami
peoplemissingduetotsunami_s character varying(255), -- The source of the data
peoplemissingduetotsunami_c text, -- A comment on the data
peoplekilledduetotsunami bigint, -- People killed due to tsunami
peoplekilledduetotsunami_s character varying(255), -- The source of the data
peoplekilledduetotsunami_c text, -- A comment on the data
peopleinjuredduetoslopefailures bigint, -- People injured due to slope failures
peopleinjuredduetoslopefailures_s character varying(255), -- The source of the data
peopleinjuredduetoslopefailures_c text, -- A comment on the data
peopleinjuredduetoslopefailures_q integer NOT NULL DEFAULT 0, -- The status of the data
peoplemissingduetoslopefailures bigint, -- People missing due to slope failures
peoplemissingduetoslopefailures_s character varying(255), -- The source of the data
peoplemissingduetoslopefailures_c text, -- A comment on the data
peoplekilledduetoslopefailures bigint, -- People killed due to slope failures
peoplekilledduetoslopefailures_s character varying(255), -- The source of the data
peoplekilledduetoslopefailures_c text, -- A comment on the data
peopleinjuredduetofirefollowing bigint, -- People injured due to fire following
peopleinjuredduetofirefollowing_s character varying(255), -- The source of the data
peopleinjuredduetofirefollowing_c text, -- A comment on the data
peopleinjuredduetofirefollowing_q integer NOT NULL DEFAULT 0, -- The status of the data
peoplemissingduetofirefollowing bigint, -- People missing due to fire following
peoplemissingduetofirefollowing_s character varying(255), -- The source of the data
peoplemissingduetofirefollowing_c text, -- A comment on the data
peoplekilledduetofirefollowing bigint, -- People killed due to fire following
peoplekilledduetofirefollowing_s character varying(255), -- The source of the data
peoplekilledduetofirefollowing_c text, -- A comment on the data
the_geom geometry,
location_c text, -- A comment on the precision of the location
population bigint, -- Population in the affected countries (contemporaneous)
population_c text, -- A comment on the data
population_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
contemporaneousdate timestamp without time zone, -- Base date for contemporaneous data, if not date of event, eg 1970-05-31
population_s character varying(255), -- The source of the data
yearint integer, -- Year as a number for sorting purposes
peopleseriouslyinjured bigint, -- Total people seriously injured and/or hospitalised
peopleseriouslyinjured_s character varying(255), -- The source of the data
peopleseriouslyinjured_c text, -- A comment on the data
peopleseriouslyinjured_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
peoplemissingduetotsunami_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data

```
  peoplekilledduetotsunami_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  peoplemissingduetoslopefailures_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  peoplekilledduetoslopefailures_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  peoplemissingduetofirefollowing_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  peoplekilledduetofirefollowing_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  CONSTRAINT event_pkey PRIMARY KEY (id),
  CONSTRAINT enforce_dims_the_geom CHECK (st_ndims(the_geom) = 2),
  CONSTRAINT enforce_geotype_the_geom CHECK (geometrytype(the_geom) = 'POINT'::text OR the_geom IS NULL),
  CONSTRAINT enforce_srid_the_geom CHECK (st_srid(the_geom) = 4326)
)
```

B.2 Study Level

B.2.1 Primary study table

```
CREATE TABLE study
(
  id serial NOT NULL, -- Primary Key: Internal database id
  "name" character varying(255) NOT NULL DEFAULT 'untitled'::character varying, -- The name of the study
  authors character varying(255), -- The authors of the study
  studydate timestamp without time zone, -- Study publication date, eg 1980-05-31
  parentid integer NOT NULL DEFAULT 0, -- The event of which this is a study
  regioncovered character varying(255), -- The country, province or region covered by the study, described in words
  geobaseid integer NOT NULL DEFAULT 0, -- The geographic basis of the study, eg Italy GADM Level 1. Can also be intensity level zones for the event
  studynarrative text, -- Descriptive text describing the study
  peopleinjuredduetoshake bigint, -- People injured due to ground shaking
  peopleinjuredduetoshake_s character varying(255), -- The source of the data
  peopleinjuredduetoshake_c text, -- A comment on the data
  peopleinjuredduetoshake_q integer NOT NULL DEFAULT 0, -- The status of the data
  peoplemissingduetoshake bigint, -- People missing due to ground shaking
  peoplemissingduetoshake_s character varying(255), -- The source of the data
  peoplemissingduetoshake_c text, -- A comment on the data
  peoplemissingduetoshake_q integer NOT NULL DEFAULT 0, -- The status of the data
  peoplekilledduetoshake bigint, -- People killed due to ground shaking
  peoplekilledduetoshake_s character varying(255), -- The source of the data
  peoplekilledduetoshake_c text, -- A comment on the data
  peoplekilledduetoshake_q integer NOT NULL DEFAULT 0, -- The status of the data
  peopledyingpostcatastrophe bigint, -- People dying after time has passed but their deaths related to the original shaking
  peopledyingpostcatastrophe_s character varying(255), -- The source of the data
  peopledyingpostcatastrophe_c text, -- A comment on the data
  peopledyingpostcatastrophe_q integer NOT NULL DEFAULT 0, -- The status of the data
  numberofbuildingsdestroyed bigint, -- Total number of buildings destroyed, collapsed or damaged beyond repair by shaking
  numberofbuildingsdestroyed_s character varying(255), -- The source of the data
  numberofbuildingsdestroyed_c text, -- A comment on the data
  numberofbuildingsdestroyed_q integer NOT NULL DEFAULT 0, -- The status of the data
  numberofbuildingsdamaged bigint, -- Total number of buildings damaged by shaking
  numberofbuildingsdamaged_s character varying(255), -- The source of the data
  numberofbuildingsdamaged_c text, -- A comment on the data
  numberofbuildingsdamaged_q integer NOT NULL DEFAULT 0, -- The status of the data
  numberofdwellingsdestroyed bigint, -- Total number of dwelling units destroyed, collapsed or damaged beyond repair by shaking
  numberofdwellingsdestroyed_s character varying(255), -- The source of the data
  numberofdwellingsdestroyed_c text, -- A comment on the data
  numberofdwellingsdestroyed_q integer NOT NULL DEFAULT 0, -- The status of the data
  numberofdwellingsdamaged bigint, -- Total number of dwelling units damaged by shaking
  numberofdwellingsdamaged_s character varying(255), -- The source of the data
  numberofdwellingsdamaged_c text, -- A comment on the data
  numberofdwellingsdamaged_q integer NOT NULL DEFAULT 0, -- The status of the data
  peoplehomeless bigint, -- Total number of people homeless for a significant duration of time (shaking)
  peoplehomeless_s character varying(255), -- The source of the data
  peoplehomeless_c text, -- A comment on the data
  peoplehomeless_q integer NOT NULL DEFAULT 0, -- The status of the data
  directeconomicloss double precision, -- Total estimated direct economic loss due to shaking, million US$, contemporaneous. In absolute US$ value of the year
of occurrence. Only includes direct effects.
```

```
  directeconomicloss_s character varying(255), -- The source of the data
  directeconomicloss_c text, -- A comment on the data
  directeconomicloss_q integer NOT NULL DEFAULT 0, -- The status of the data
  indirecteconomicloss double precision, -- Total estimated indirect economic loss due to shaking, million US$, contemporaneous. In absolute US$ value of the year of occurrence. Only includes indirect effects.
  indirecteconomicloss_s character varying(255), -- The source of the data
  indirecteconomicloss_c text, -- A comment on the data
  indirecteconomicloss_q integer NOT NULL DEFAULT 0, -- The status of the data
  numberofhouseholds bigint, -- Total number of households in the zone affected by shaking (contemporaneous)
  numberofhouseholds_s character varying(255), -- The source of the data
  numberofhouseholds_c text, -- A comment on the data
  numberofhouseholds_q integer NOT NULL DEFAULT 0, -- The status of the data
  totalnumberofbuildings bigint, -- Total number of buildings in the zone affected by shaking (contemporaneous)
  totalnumberofbuildings_s character varying(255), -- The source of the data
  totalnumberofbuildings_c text, -- A comment on the data
  totalnumberofbuildings_q integer NOT NULL DEFAULT 0, -- The status of the data
  overallimpact text, -- Overall socio economic impact of shaking
  reliabilityoverallcode character varying(10) NOT NULL DEFAULT '0'::character varying, -- Overall reliability of source data
  reliabilitydataqualitycode character varying(10) NOT NULL DEFAULT '0'::character varying, -- Quality of source data
  reliabilitydatarelevancecode character varying(10) NOT NULL DEFAULT '0'::character varying, -- How well the data matches or envelopes the conditions that will be encountered
  reliabilitydocumentationqualitycode character varying(10) NOT NULL DEFAULT '0'::character varying, -- How well the author has documented the data, analysis and results
  reliabilityrationalitycode character varying(10) NOT NULL DEFAULT '0'::character varying, -- How well the the behavior can be explained or rationalized by intuition, calculation or principles of engineering mechanics
  reliabilitylocationalcode character varying(10) NOT NULL DEFAULT '0'::character varying, -- How reliable the geographic locations are
  reliability_c text, -- A comment on the study reliability
  surveydata_s character varying(255), -- The source of the survey data
  surveydata_c text, -- A comment on the survey data
  significantfigures integer, -- The significant figures for the data in the study
  partner character varying(255), -- The names of the GEMECD partner(s) who have developed this study record in the GEMECD database
  ownerid integer NOT NULL DEFAULT 1, -- ID of the creator/owner of the record
  lastupdatebyid integer NOT NULL DEFAULT 1, -- ID of the last person to update this record
  lastupdate timestamp without time zone, -- Last record update date
  inventoryclasses_c text,
  population bigint, -- Population (contemporaneous)
  population_c text, -- A comment on the data
  population_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  contemporaneousdate timestamp without time zone, -- Base date for contemporaneous data, if not date of event, eg 1970-05-31
  population_s character varying(255), -- The source of the data
  damagescalename character varying(255), -- Name of the damage scale, if any
  damagescale_c text, -- Descriptive text describing the damage scale in this study
  damagemappingid integer NOT NULL DEFAULT 0, -- Mapping to unified damage scale
  damagepercentage integer NOT NULL DEFAULT 0, -- If the damage scale values are percentages put 1 in this field
  casualtyscalename character varying(255), -- Name of the casualty scale, if any
  casualtyscale_c text, -- Descriptive text describing the casualty scale in this study
  casualtymappingid integer NOT NULL DEFAULT 0, -- Mapping to unified casualty scale
  casualtypercentage integer NOT NULL DEFAULT 0, -- If the casualty scale values are percentages put 1 in this field
  sources text, -- Sources and web links for the study
  studytypecode character varying(10) DEFAULT 'B'::character varying, -- Type of study
  originallanguage character varying(50), -- The original language of the study
  CONSTRAINT study_pkey PRIMARY KEY (id)
)
```

B.2.2 Tsunami study table

```
CREATE TABLE tsunamistudy
(
  id serial NOT NULL, -- Primary Key: Internal database id
  "name" character varying(255) NOT NULL DEFAULT 'untitled'::character varying, -- The name of the tsunami study
  authors character varying(255), -- The authors of the study
  studydate timestamp without time zone, -- Study publication date, eg 1980-05-31
  parentid integer NOT NULL DEFAULT 0, -- The event of which this is a study
```

regioncovered character varying(255), -- The country, province or region covered by the study, described in words
geobaseid integer NOT NULL DEFAULT 0, -- The geographic basis of the study, eg Italy GADM Level 1. Can also be intensity level zones for the event
studynarrative text, -- Descriptive text describing the study
totalcoastaffected double precision, -- Total length of coast affected, km
totalcoastaffected_s character varying(255), -- The source of the data
totalcoastaffected_c text, -- A comment on the data
totalcoastaffected_q integer NOT NULL DEFAULT 0, -- The status of the data
totallandflooded double precision, -- Total land area flooded by the tsunami, sq km
totallandflooded_s character varying(255), -- The source of the data
totallandflooded_c text, -- A comment on the data
totallandflooded_q integer NOT NULL DEFAULT 0, -- The status of the data
peopleinjuredduetotsunami bigint, -- People injured due to tsunami
peopleinjuredduetotsunami_s character varying(255), -- The source of the data
peopleinjuredduetotsunami_c text, -- A comment on the data
peopleinjuredduetotsunami_q integer NOT NULL DEFAULT 0, -- The status of the data
peoplemissingduetotsunami bigint, -- People missing due to tsunami
peoplemissingduetotsunami_s character varying(255), -- The source of the data
peoplemissingduetotsunami_c text, -- A comment on the data
peoplemissingduetotsunami_q integer NOT NULL DEFAULT 0, -- The status of the data
peoplekilledduetotsunami bigint, -- People killed due to tsunami
peoplekilledduetotsunami_s character varying(255), -- The source of the data
peoplekilledduetotsunami_c text, -- A comment on the data
peoplekilledduetotsunami_q integer NOT NULL DEFAULT 0, -- The status of the data
peopleinsideinundationzone bigint, -- Population inside the tsunami inundation zone (or within 1km from the affected coast)
peopleinsideinundationzone_s character varying(255), -- The source of the data
peopleinsideinundationzone_c text, -- A comment on the data
peopleinsideinundationzone_q integer NOT NULL DEFAULT 0, -- The status of the data
numberbuildingswashedaway bigint, -- Number of buildings washed away or destroyed by the tsunami
numberbuildingswashedaway_s character varying(255), -- The source of the data
numberbuildingswashedaway_c text, -- A comment on the data
numberbuildingswashedaway_q integer NOT NULL DEFAULT 0, -- The status of the data
numberbuildingsflooded bigint, -- Number of buildings flooded but not destroyed
numberbuildingsflooded_s character varying(255), -- The source of the data
numberbuildingsflooded_c text, -- A comment on the data
numberbuildingsflooded_q integer NOT NULL DEFAULT 0, -- The status of the data
numberbridgesdestroyed bigint, -- Number of bridges destroyed (all types of bridges)
numberbridgesdestroyed_s character varying(255), -- The source of the data
numberbridgesdestroyed_c text, -- A comment on the data
numberbridgesdestroyed_q integer NOT NULL DEFAULT 0, -- The status of the data
numberportsaffected bigint, -- Number of ports affected
numberportsaffected_s character varying(255), -- The source of the data
numberportsaffected_c text, -- A comment on the data
numberportsaffected_q integer NOT NULL DEFAULT 0, -- The status of the data
numberboatsdestroyed bigint, -- Number of boats destroyed (all types of boats)
numberboatsdestroyed_s character varying(255), -- The source of the data
numberboatsdestroyed_c text, -- A comment on the data
numberboatsdestroyed_q integer NOT NULL DEFAULT 0, -- The status of the data
numbervehiclesdestroyed bigint, -- Number of vehicles destroyed (all types of vehicles)
numbervehiclesdestroyed_s character varying(255), -- The source of the data
numbervehiclesdestroyed_c text, -- A comment on the data
numbervehiclesdestroyed_q integer NOT NULL DEFAULT 0, -- The status of the data
peopledyingpostcatastrophe bigint, -- People dying after time has passed but their deaths related to the original tsunami
peopledyingpostcatastrophe_s character varying(255), -- The source of the data
peopledyingpostcatastrophe_c text, -- A comment on the data
peopledyingpostcatastrophe_q integer NOT NULL DEFAULT 0, -- The status of the data
numberofbuildingsdestroyed bigint, -- Total number of buildings destroyed, collapsed or damaged beyond repair due to tsunami
numberofbuildingsdestroyed_s character varying(255), -- The source of the data
numberofbuildingsdestroyed_c text, -- A comment on the data
numberofbuildingsdestroyed_q integer NOT NULL DEFAULT 0, -- The status of the data
numberofbuildingsdamaged bigint, -- Total number of buildings damaged due to tsunami
numberofbuildingsdamaged_s character varying(255), -- The source of the data
numberofbuildingsdamaged_c text, -- A comment on the data
numberofbuildingsdamaged_q integer NOT NULL DEFAULT 0, -- The status of the data
numberofdwellingsdestroyed bigint, -- Total number of dwelling units destroyed, collapsed or damaged beyond repair due to tsunami
numberofdwellingsdestroyed_s character varying(255), -- The source of the data

```
  numberofdwellingsdestroyed_c text, -- A comment on the data
  numberofdwellingsdestroyed_q integer NOT NULL DEFAULT 0, -- The status of the data
  numberofdwellingsdamaged bigint, -- Total number of dwelling units damaged due to tsunami
  numberofdwellingsdamaged_s character varying(255), -- The source of the data
  numberofdwellingsdamaged_c text, -- A comment on the data
  numberofdwellingsdamaged_q integer NOT NULL DEFAULT 0, -- The status of the data
  peoplehomeless bigint, -- Total number of people homeless for a significant duration of time due to tsunami
  peoplehomeless_s character varying(255), -- The source of the data
  peoplehomeless_c text, -- A comment on the data
  peoplehomeless_q integer NOT NULL DEFAULT 0, -- The status of the data
  directeconomicloss double precision, -- Total estimated direct economic loss due to tsunami, million US$, contemporaneous. In absolute US$ value of the year of occurrence. Only includes direct effects.
  directeconomicloss_s character varying(255), -- The source of the data
  directeconomicloss_c text, -- A comment on the data
  directeconomicloss_q integer NOT NULL DEFAULT 0, -- The status of the data
  indirecteconomicloss double precision, -- Total estimated indirect economic loss due to tsunami, million US$, contemporaneous. In absolute US$ value of the year of occurrence. Only includes indirect effects.
  indirecteconomicloss_s character varying(255), -- The source of the data
  indirecteconomicloss_c text, -- A comment on the data
  indirecteconomicloss_q integer NOT NULL DEFAULT 0, -- The status of the data
  numberofhouseholds bigint, -- Total number of households in the tsunami affected zone (contemporaneous)
  numberofhouseholds_s character varying(255), -- The source of the data
  numberofhouseholds_c text, -- A comment on the data
  numberofhouseholds_q integer NOT NULL DEFAULT 0, -- The status of the data
  totalnumberofbuildings bigint, -- Total number of buildings in the tsunami affected zone (contemporaneous)
  totalnumberofbuildings_s character varying(255), -- The source of the data
  totalnumberofbuildings_c text, -- A comment on the data
  totalnumberofbuildings_q integer NOT NULL DEFAULT 0, -- The status of the data
  overallimpact text, -- Overall socio economic impact
  reliabilityoverallcode character varying(10) NOT NULL DEFAULT '0'::character varying, -- Overall reliability of source data
  reliabilitydataqualitycode character varying(10) NOT NULL DEFAULT '0'::character varying, -- Quality of source data
  reliabilitydatarelevancecode character varying(10) NOT NULL DEFAULT '0'::character varying, -- How well the data matches or envelopes the conditions that will be encountered
  reliabilitydocumentationqualitycode character varying(10) NOT NULL DEFAULT '0'::character varying, -- How well the author has documented the data, analysis and results
  reliabilityrationalitycode character varying(10) NOT NULL DEFAULT '0'::character varying, -- How well the the behavior can be explained or rationalized by intuition, calculation or principles of engineering mechanics
  reliabilitylocationalcode character varying(10) NOT NULL DEFAULT '0'::character varying, -- How reliable the geographic locations are
  reliability_c text, -- A comment on the study reliability
  surveydata_s character varying(255), -- The source of the survey data
  surveydata_c text, -- A comment on the survey data
  significantfigures integer, -- The significant figures for the data in the study
  partner character varying(255), -- The names of the GEMECD partner(s) who have developed this study record in the GEMECD database
  ownerid integer NOT NULL DEFAULT 1, -- ID of the creator/owner of the record
  lastupdatebyid integer NOT NULL DEFAULT 1, -- ID of the last person to update this record
  lastupdate timestamp without time zone, -- Last record update date
  inventoryclasses_c text, -- Descriptive text describing the inventory classes in this study
  population bigint, -- Population (contemporaneous)
  population_c text, -- A comment on the data
  population_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  contemporaneousdate timestamp without time zone, -- Base date for contemporaneous data, if not date of event, eg 1970-05-31
  population_s character varying(255), -- The source of the data
  damagescalename character varying(255), -- Name of the damage scale, if any
  damagescale_c text, -- Descriptive text describing the damage scale in this study
  damagemappingid integer NOT NULL DEFAULT 0, -- Mapping to unified damage scale
  damagepercentage integer NOT NULL DEFAULT 0, -- If the damage scale values are percentages put 1 in this field
  casualtyscalename character varying(255), -- Name of the casualty scale, if any
  casualtyscale_c text, -- Descriptive text describing the casualty scale in this study
  casualtymappingid integer NOT NULL DEFAULT 0, -- Mapping to unified casualty scale
  casualtypercentage integer NOT NULL DEFAULT 0,
  sources text, -- Sources and web links for the study
  originallanguage character varying(50), -- The original language of the study
  CONSTRAINT tsunamistudy_pkey PRIMARY KEY (id)
)
```

B.2.3 Slope failure study table

```
CREATE TABLE slopefailurestudy
(
  id serial NOT NULL, -- Primary Key: Internal database id
  "name" character varying(255) NOT NULL DEFAULT 'untitled'::character varying, -- The name of the slope failure study
  authors character varying(255), -- The authors of the study
  studydate timestamp without time zone, -- Study publication date, eg 1980-05-31
  parentid integer NOT NULL DEFAULT 0, -- The event of which this is a study
  regioncovered character varying(255), -- The country, province or region covered by the study, described in words
  geobaseid integer NOT NULL DEFAULT 0, -- The geographic basis of the study, eg Italy GADM Level 1. Can also be intensity level zones for the event
  studynarrative text, -- Descriptive text describing the study
  peopleinjuredduetoslopefailures bigint, -- People injured due to slope failures
  peopleinjuredduetoslopefailures_s character varying(255), -- The source of the data
  peopleinjuredduetoslopefailures_c text, -- A comment on the data
  peopleinjuredduetoslopefailures_q integer NOT NULL DEFAULT 0, -- The status of the data
  peoplemissingduetoslopefailures bigint, -- People missing due to slope failures
  peoplemissingduetoslopefailures_s character varying(255), -- The source of the data
  peoplemissingduetoslopefailures_c text, -- A comment on the data
  peoplemissingduetoslopefailures_q integer NOT NULL DEFAULT 0, -- The status of the data
  peoplekilledduetoslopefailures bigint, -- People killed due to slope failures
  peoplekilledduetoslopefailures_s character varying(255), -- The source of the data
  peoplekilledduetoslopefailures_c text, -- A comment on the data
  peoplekilledduetoslopefailures_q integer NOT NULL DEFAULT 0, -- The status of the data
  peopledyingpostcatastrophe bigint, -- People dying after time has passed but their deaths related to the original slope failure
  peopledyingpostcatastrophe_s character varying(255), -- The source of the data
  peopledyingpostcatastrophe_c text, -- A comment on the data
  peopledyingpostcatastrophe_q integer NOT NULL DEFAULT 0, -- The status of the data
  numberofbuildingsdestroyed bigint, -- Total number of buildings destroyed, collapsed or damaged beyond repair due to slope failure
  numberofbuildingsdestroyed_s character varying(255), -- The source of the data
  numberofbuildingsdestroyed_c text, -- A comment on the data
  numberofbuildingsdestroyed_q integer NOT NULL DEFAULT 0, -- The status of the data
  numberofbuildingsdamaged bigint, -- Total number of buildings damaged due to slope failure
  numberofbuildingsdamaged_s character varying(255), -- The source of the data
  numberofbuildingsdamaged_c text, -- A comment on the data
  numberofbuildingsdamaged_q integer NOT NULL DEFAULT 0, -- The status of the data
  numberofdwellingsdestroyed bigint, -- Total number of dwelling units destroyed, collapsed or damaged beyond repair due to slope failure
  numberofdwellingsdestroyed_s character varying(255), -- The source of the data
  numberofdwellingsdestroyed_c text, -- A comment on the data
  numberofdwellingsdestroyed_q integer NOT NULL DEFAULT 0, -- The status of the data
  numberofdwellingsdamaged bigint, -- Total number of dwelling units damaged due to slope failure
  numberofdwellingsdamaged_s character varying(255), -- The source of the data
  numberofdwellingsdamaged_c text, -- A comment on the data
  numberofdwellingsdamaged_q integer NOT NULL DEFAULT 0, -- The status of the data
  peoplehomeless bigint, -- Total number of people homeless for a significant duration of time due to slope failure
  peoplehomeless_s character varying(255), -- The source of the data
  peoplehomeless_c text, -- A comment on the data
  peoplehomeless_q integer NOT NULL DEFAULT 0, -- The status of the data
  directeconomicloss double precision, -- Total estimated direct economic loss due to slope failure, million US$, contemporaneous. In absolute US$ value of the year of occurrence. Only includes direct effects.
  directeconomicloss_s character varying(255), -- The source of the data
  directeconomicloss_c text, -- A comment on the data
  directeconomicloss_q integer NOT NULL DEFAULT 0, -- The status of the data
  indirecteconomicloss double precision, -- Total estimated indirect economic loss due to slope failure, million US$, contemporaneous. In absolute US$ value of the year of occurrence. Only includes indirect effects.
  indirecteconomicloss_s character varying(255), -- The source of the data
  indirecteconomicloss_c text, -- A comment on the data
  indirecteconomicloss_q integer NOT NULL DEFAULT 0, -- The status of the data
  numberofhouseholds bigint, -- Total number of households in the affected slope failure zone (contemporaneous)
  numberofhouseholds_s character varying(255), -- The source of the data
  numberofhouseholds_c text, -- A comment on the data
```

```
  numberofhouseholds_q integer NOT NULL DEFAULT 0, -- The status of the data
  totalnumberofbuildings bigint, -- Total number of buildings in the affected slope failure zone (contemporaneous)
  totalnumberofbuildings_s character varying(255), -- The source of the data
  totalnumberofbuildings_c text, -- A comment on the data
  totalnumberofbuildings_q integer NOT NULL DEFAULT 0, -- The status of the data
  overallimpact text, -- Overall socio economic impact
  reliabilityoverallcode character varying(10) NOT NULL DEFAULT '0'::character varying, -- Overall reliability of source data
  reliabilitydataqualitycode character varying(10) NOT NULL DEFAULT '0'::character varying, -- Quality of source data
  reliabilitydatarelevancecode character varying(10) NOT NULL DEFAULT '0'::character varying, -- How well the data matches or envelopes the conditions that will be encountered
  reliabilitydocumentationqualitycode character varying(10) NOT NULL DEFAULT '0'::character varying, -- How well the author has documented the data, analysis and results
  reliabilityrationalitycode character varying(10) NOT NULL DEFAULT '0'::character varying, -- How well the the behavior can be explained or rationalized by intuition, calculation or principles of engineering mechanics
  reliabilitylocationalcode character varying(10) NOT NULL DEFAULT '0'::character varying, -- How reliable the geographic locations are
  reliability_c text, -- A comment on the study reliability
  surveydata_s character varying(255), -- The source of the survey data
  surveydata_c text, -- A comment on the survey data
  significantfigures integer, -- The significant figures for the data in the study
  partner character varying(255), -- The names of the GEMECD partner(s) who have developed this study record in the GEMECD database
  ownerid integer NOT NULL DEFAULT 1, -- ID of the creator/owner of the record
  lastupdatebyid integer NOT NULL DEFAULT 1, -- ID of the last person to update this record
  lastupdate timestamp without time zone, -- Last record update date
  inventoryclasses_c text, -- Descriptive text describing the inventory classes in this study
  population bigint, -- Population (contemporaneous)
  population_c text, -- A comment on the data
  population_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  contemporaneousdate timestamp without time zone, -- Base date for contemporaneous data, if not date of event, eg 1970-05-31
  population_s character varying(255), -- The source of the data
  damagescalename character varying(255), -- Name of the damage scale, if any
  damagescale_c text, -- Descriptive text describing the damage scale in this study
  damagemappingid integer NOT NULL DEFAULT 0, -- Mapping to unified damage scale
  damagepercentage integer NOT NULL DEFAULT 0, -- If the damage scale values are percentages put 1 in this field
  casualtyscalename character varying(255), -- Name of the casualty scale, if any
  casualtyscale_c text, -- Descriptive text describing the casualty scale in this study
  casualtymappingid integer NOT NULL DEFAULT 0, -- Mapping to unified casualty scale
  casualtypercentage integer NOT NULL DEFAULT 0, -- If the casualty scale values are percentages put 1 in this field
  sources text, -- Sources and web links for the study
  originallanguage character varying(50), -- The original language of the study
  CONSTRAINT slopefailurestudy_pkey PRIMARY KEY (id)
)
```

B.2.4 Liquefaction study table

```
CREATE TABLE liquefactionstudy
(
  id serial NOT NULL, -- Primary Key: Internal database id
  "name" character varying(255) NOT NULL DEFAULT 'untitled'::character varying, -- The name of the liquefaction study
  authors character varying(255), -- The authors of the study
  studydate timestamp without time zone, -- Study publication date, eg 1980-05-31
  parentid integer NOT NULL DEFAULT 0, -- The event of which this is a study
  regioncovered character varying(255), -- The country, province or region covered by the study, described in words
  geobaseid integer NOT NULL DEFAULT 0, -- The geographic basis of the study, eg Italy GADM Level 1. Can also be intensity level zones for the event
  studynarrative text, -- Descriptive text describing the study
  totallandareaaffected double precision, -- Total land area affected by liquefaction, sq km
  totallandareaaffected_s character varying(255), -- The source of the data
  totallandareaaffected_c text, -- A comment on the data
  totallandareaaffected_q integer NOT NULL DEFAULT 0, -- The status of the data
  peopleinjuredduetoliquefaction bigint, -- People injured due to liquefaction
  peopleinjuredduetoliquefaction_s character varying(255), -- The source of the data
  peopleinjuredduetoliquefaction_c text, -- A comment on the data
  peopleinjuredduetoliquefaction_q integer NOT NULL DEFAULT 0, -- The status of the data
```

peoplemissingduetoliquefaction bigint, -- People missing due to liquefaction
peoplemissingduetoliquefaction_s character varying(255), -- The source of the data
peoplemissingduetoliquefaction_c text, -- A comment on the data
peoplemissingduetoliquefaction_q integer NOT NULL DEFAULT 0, -- The status of the data
peoplekilledduetoliquefaction bigint, -- People killed due to liquefaction
peoplekilledduetoliquefaction_s character varying(255), -- The source of the data
peoplekilledduetoliquefaction_c text, -- A comment on the data
peoplekilledduetoliquefaction_q integer NOT NULL DEFAULT 0, -- The status of the data
peopleinsideliquefactionzone bigint, -- Population inside the liquefaction zone
peopleinsideliquefactionzone_s character varying(255), -- The source of the data
peopleinsideliquefactionzone_c text, -- A comment on the data
peopleinsideliquefactionzone_q integer NOT NULL DEFAULT 0, -- The status of the data
numberbuildingsaffected bigint, -- Number of buildings saffected
numberbuildingssaffected_s character varying(255), -- The source of the data
numberbuildingssaffected_c text, -- A comment on the data
numberbuildingssaffected_q integer NOT NULL DEFAULT 0, -- The status of the data
numberbuildingspulleddown bigint, -- Number of buildings pulled down
numberbuildingspulleddown_s character varying(255), -- The source of the data
numberbuildingspulleddown_c text, -- A comment on the data
numberbuildingspulleddown_q integer NOT NULL DEFAULT 0, -- The status of the data
numberroadsaffected bigint, -- Number of roads affected
numberroadsaffected_s character varying(255), -- The source of the data
numberroadsaffected_c text, -- A comment on the data
numberroadsaffected_q integer NOT NULL DEFAULT 0, -- The status of the data
peopledyingpostcatastrophe bigint, -- People dying after time has passed but their deaths related to the original liquefaction event
peopledyingpostcatastrophe_s character varying(255), -- The source of the data
peopledyingpostcatastrophe_c text, -- A comment on the data
peopledyingpostcatastrophe_q integer NOT NULL DEFAULT 0, -- The status of the data
numberofbuildingsdestroyed bigint, -- Total number of buildings destroyed, collapsed or damaged beyond repair due to liquefaction
numberofbuildingsdestroyed_s character varying(255), -- The source of the data
numberofbuildingsdestroyed_c text, -- A comment on the data
numberofbuildingsdestroyed_q integer NOT NULL DEFAULT 0, -- The status of the data
numberofbuildingsdamaged bigint, -- Total number of buildings damaged due to liquefaction
numberofbuildingsdamaged_s character varying(255), -- The source of the data
numberofbuildingsdamaged_c text, -- A comment on the data
numberofbuildingsdamaged_q integer NOT NULL DEFAULT 0, -- The status of the data
numberofdwellingsdestroyed bigint, -- Total number of dwelling units destroyed, collapsed or damaged beyond repair due to liquefaction
numberofdwellingsdestroyed_s character varying(255), -- The source of the data
numberofdwellingsdestroyed_c text, -- A comment on the data
numberofdwellingsdestroyed_q integer NOT NULL DEFAULT 0, -- The status of the data
numberofdwellingsdamaged bigint, -- Total number of dwelling units damaged due to liquefaction
numberofdwellingsdamaged_s character varying(255), -- The source of the data
numberofdwellingsdamaged_c text, -- A comment on the data
numberofdwellingsdamaged_q integer NOT NULL DEFAULT 0, -- The status of the data
peoplehomeless bigint, -- Total number of people homeless for a significant duration of time due to liquefaction
peoplehomeless_s character varying(255), -- The source of the data
peoplehomeless_c text, -- A comment on the data
peoplehomeless_q integer NOT NULL DEFAULT 0, -- The status of the data
directeconomicloss double precision, -- Total estimated direct economic loss due to liquefaction, million US$, contemporaneous. In absolute US$ value of the year of occurrence. Only includes direct effects.
directeconomicloss_s character varying(255), -- The source of the data
directeconomicloss_c text, -- A comment on the data
directeconomicloss_q integer NOT NULL DEFAULT 0, -- The status of the data
indirecteconomicloss double precision, -- Total estimated indirect economic loss due to liquefaction, million US$, contemporaneous. In absolute US$ value of the year of occurrence. Only includes indirect effects.
indirecteconomicloss_s character varying(255), -- The source of the data
indirecteconomicloss_c text, -- A comment on the data
indirecteconomicloss_q integer NOT NULL DEFAULT 0, -- The status of the data
numberofhouseholds bigint, -- Total number of households in the zone affected by liquefaction (contemporaneous)
numberofhouseholds_s character varying(255), -- The source of the data
numberofhouseholds_c text, -- A comment on the data
numberofhouseholds_q integer NOT NULL DEFAULT 0, -- The status of the data
totalnumberofbuildings bigint, -- Total number of buildings in the zone affected by liquefaction (contemporaneous)
totalnumberofbuildings_s character varying(255), -- The source of the data
totalnumberofbuildings_c text, -- A comment on the data

```
  totalnumberofbuildings_q integer NOT NULL DEFAULT 0, -- The status of the data
  overallimpact text, -- Overall socio economic impact
  reliabilityoverallcode character varying(10) NOT NULL DEFAULT '0'::character varying, -- Overall reliability of source data
  reliabilitydataqualitycode character varying(10) NOT NULL DEFAULT '0'::character varying, -- Quality of source data
  reliabilitydatarelevancecode character varying(10) NOT NULL DEFAULT '0'::character varying, -- How well the data matches or envelopes the conditions that will be encountered
  reliabilitydocumentationqualitycode character varying(10) NOT NULL DEFAULT '0'::character varying, -- How well the author has documented the data, analysis and results
  reliabilityrationalitycode character varying(10) NOT NULL DEFAULT '0'::character varying, -- How well the the behavior can be explained or rationalized by intuition, calculation or principles of engineering mechanics
  reliabilitylocationalcode character varying(10) NOT NULL DEFAULT '0'::character varying, -- How reliable the geographic locations are
  reliability_c text, -- A comment on the study reliability
  surveydata_s character varying(255), -- The source of the survey data
  surveydata_c text, -- A comment on the survey data
  significantfigures integer, -- The significant figures for the data in the study
  partner character varying(255), -- The names of the GEMECD partner(s) who have developed this study record in the GEMECD database
  ownerid integer NOT NULL DEFAULT 1, -- ID of the creator/owner of the record
  lastupdatebyid integer NOT NULL DEFAULT 1, -- ID of the last person to update this record
  lastupdate timestamp without time zone, -- Last record update date
  inventoryclasses_c text, -- Descriptive text describing the inventory classes in this study
  population bigint, -- Population (contemporaneous)
  population_c text, -- A comment on the data
  population_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  contemporaneousdate timestamp without time zone, -- Base date for contemporaneous data, if not date of event, eg 1970-05-31
  population_s character varying(255), -- The source of the data
  damagescalename character varying(255), -- Name of the damage scale, if any
  damagescale_c text, -- Descriptive text describing the damage scale in this study
  damagemappingid integer NOT NULL DEFAULT 0, -- Mapping to unified damage scale
  damagepercentage integer NOT NULL DEFAULT 0, -- If the damage scale values are percentages put 1 in this field
  casualtyscalename character varying(255), -- Name of the casualty scale, if any
  casualtyscale_c text, -- Descriptive text describing the casualty scale in this study
  casualtymappingid integer NOT NULL DEFAULT 0, -- Mapping to unified casualty scale
  casualtypercentage integer NOT NULL DEFAULT 0, -- If the casualty scale values are percentages put 1 in this field
  sources text, -- Sources and web links for the study
  originallanguage character varying(50), -- The original language of the study
  CONSTRAINT liquefactionstudy_pkey PRIMARY KEY (id)
)
```

B.2.5 Fire following study table

```
CREATE TABLE firefollowingstudy
(
  id serial NOT NULL, -- Primary Key: Internal database id
  "name" character varying(255) NOT NULL DEFAULT 'untitled'::character varying, -- The name of the fire following study
  authors character varying(255), -- The authors of the study
  studydate timestamp without time zone, -- Study publication date, eg 1980-05-31
  parentid integer NOT NULL DEFAULT 0, -- The event of which this is a study
  regioncovered character varying(255), -- The country, province or region covered by the study, described in words
  geobaseid integer NOT NULL DEFAULT 0, -- The geographic basis of the study, eg Italy GADM Level 1. Can also be intensity level zones for the event
  studynarrative text, -- Descriptive text describing the study
  peopleinjuredduetofirefollowing bigint, -- People injured due to fire following
  peopleinjuredduetofirefollowing_s character varying(255), -- The source of the data
  peopleinjuredduetofirefollowing_c text, -- A comment on the data
  peopleinjuredduetofirefollowing_q integer NOT NULL DEFAULT 0, -- The status of the data
  peoplemissingduetofirefollowing bigint, -- People missing due to fire following
  peoplemissingduetofirefollowing_s character varying(255), -- The source of the data
  peoplemissingduetofirefollowing_c text, -- A comment on the data
  peoplemissingduetofirefollowing_q integer NOT NULL DEFAULT 0, -- The status of the data
  peoplekilledduetofirefollowing bigint, -- People killed due to fire following
  peoplekilledduetofirefollowing_s character varying(255), -- The source of the data
  peoplekilledduetofirefollowing_c text, -- A comment on the data
  peoplekilledduetofirefollowing_q integer NOT NULL DEFAULT 0, -- The status of the data
  totalnumberofignitions bigint, -- Total number of ignitions
```

totalnumberofignitions_s character varying(255), -- The source of the data
totalnumberofignitions_c text, -- A comment on the data
totalnumberofignitions_q integer NOT NULL DEFAULT 0, -- The status of the data
numberoflargefires bigint, -- Number of large fires
numberoflargefires_s character varying(255), -- The source of the data
numberoflargefires_c text, -- A comment on the data
numberoflargefires_q integer NOT NULL DEFAULT 0, -- The status of the data
finalburntarea double precision, -- Final burnt area: SFED (single family equivalent dwelling)
finalburntarea_s character varying(255), -- The source of the data
finalburntarea_c text, -- A comment on the data
finalburntarea_q integer NOT NULL DEFAULT 0, -- The status of the data
peopledyingpostcatastrophe bigint, -- People dying after time has passed but their deaths related to the original fire following event
peopledyingpostcatastrophe_s character varying(255), -- The source of the data
peopledyingpostcatastrophe_c text, -- A comment on the data
peopledyingpostcatastrophe_q integer NOT NULL DEFAULT 0, -- The status of the data
numberofbuildingsdestroyed bigint, -- Total number of buildings destroyed, collapsed or damaged beyond repair due to fire following
numberofbuildingsdestroyed_s character varying(255), -- The source of the data
numberofbuildingsdestroyed_c text, -- A comment on the data
numberofbuildingsdestroyed_q integer NOT NULL DEFAULT 0, -- The status of the data
numberofbuildingsdamaged bigint, -- Total number of buildings damaged due to fire following
numberofbuildingsdamaged_s character varying(255), -- The source of the data
numberofbuildingsdamaged_c text, -- A comment on the data
numberofbuildingsdamaged_q integer NOT NULL DEFAULT 0, -- The status of the data
numberofdwellingsdestroyed bigint, -- Total number of dwelling units destroyed, collapsed or damaged beyond repair due to fire following
numberofdwellingsdestroyed_s character varying(255), -- The source of the data
numberofdwellingsdestroyed_c text, -- A comment on the data
numberofdwellingsdestroyed_q integer NOT NULL DEFAULT 0, -- The status of the data
numberofdwellingsdamaged bigint, -- Total number of dwelling units damaged due to fire following
numberofdwellingsdamaged_s character varying(255), -- The source of the data
numberofdwellingsdamaged_c text, -- A comment on the data
numberofdwellingsdamaged_q integer NOT NULL DEFAULT 0, -- The status of the data
peoplehomeless bigint, -- Total number of people homeless for a significant duration of time due to fire following
peoplehomeless_s character varying(255), -- The source of the data
peoplehomeless_c text, -- A comment on the data
peoplehomeless_q integer NOT NULL DEFAULT 0, -- The status of the data
directeconomicloss double precision, -- Total estimated direct economic loss due to fire following, million US$, contemporaneous. In absolute US$ value of the year of occurrence. Only includes direct effects.
directeconomicloss_s character varying(255), -- The source of the data
directeconomicloss_c text, -- A comment on the data
directeconomicloss_q integer NOT NULL DEFAULT 0, -- The status of the data
indirecteconomicloss double precision, -- Total estimated indirect economic loss due to fire following, million US$, contemporaneous. In absolute US$ value of the year of occurrence. Only includes indirect effects.
indirecteconomicloss_s character varying(255), -- The source of the data
indirecteconomicloss_c text, -- A comment on the data
indirecteconomicloss_q integer NOT NULL DEFAULT 0, -- The status of the data
numberofhouseholds bigint, -- Total number of households in the zone affected by fire following (contemporaneous)
numberofhouseholds_s character varying(255), -- The source of the data
numberofhouseholds_c text, -- A comment on the data
numberofhouseholds_q integer NOT NULL DEFAULT 0, -- The status of the data
totalnumberofbuildings bigint, -- Total number of buildings in the zone affected by fire following (contemporaneous)
totalnumberofbuildings_s character varying(255), -- The source of the data
totalnumberofbuildings_c text, -- A comment on the data
totalnumberofbuildings_q integer NOT NULL DEFAULT 0, -- The status of the data
overallimpact text, -- Overall socio economic impact
reliabilityoverallcode character varying(10) NOT NULL DEFAULT '0'::character varying, -- Overall reliability of source data
reliabilitydataqualitycode character varying(10) NOT NULL DEFAULT '0'::character varying, -- Quality of source data
reliabilitydatarelevancecode character varying(10) NOT NULL DEFAULT '0'::character varying, -- How well the data matches or envelopes the conditions that will be encountered
reliabilitydocumentationqualitycode character varying(10) NOT NULL DEFAULT '0'::character varying, -- How well the author has documented the data, analysis and results
reliabilityrationalitycode character varying(10) NOT NULL DEFAULT '0'::character varying, -- How well the the behavior can be explained or rationalized by intuition, calculation or principles of engineering mechanics
reliabilitylocationalcode character varying(10) NOT NULL DEFAULT '0'::character varying, -- How reliable the geographic locations are
reliability_c text, -- A comment on the study reliability
surveydata_s character varying(255), -- The source of the survey data

```
 surveydata_c text, -- A comment on the survey data
 significantfigures integer, -- The significant figures for the data in the study
 partner character varying(255), -- The names of the GEMECD partner(s) who have developed this study record in the GEMECD database
 ownerid integer NOT NULL DEFAULT 1, -- ID of the creator/owner of the record
 lastupdatebyid integer NOT NULL DEFAULT 1, -- ID of the last person to update this record
 lastupdate timestamp without time zone, -- Last record update date
 inventoryclasses_c text, -- Descriptive text describing the inventory classes in this study
 population bigint, -- Population (contemporaneous)
 population_c text, -- A comment on the data
 population_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
 contemporaneousdate timestamp without time zone, -- Base date for contemporaneous data, if not date of event, eg 1970-05-31
 population_s character varying(255), -- The source of the data
 damagescalename character varying(255), -- Name of the damage scale, if any
 damagescale_c text, -- Descriptive text describing the damage scale in this study
 damagemappingid integer NOT NULL DEFAULT 0, -- Mapping to unified damage scale
 damagepercentage integer NOT NULL DEFAULT 0, -- If the damage scale values are percentages put 1 in this field
 casualtyscalename character varying(255), -- Name of the casualty scale, if any
 casualtyscale_c text, -- Descriptive text describing the casualty scale in this study
 casualtymappingid integer NOT NULL DEFAULT 0, -- Mapping to unified casualty scale
 casualtypercentage integer NOT NULL DEFAULT 0, -- If the casualty scale values are percentages put 1 in this field
 sources text, -- Sources and web links for the study
 originallanguage character varying(50), -- The original language of the study
 CONSTRAINT firefollowingstudy_pkey PRIMARY KEY (id)
)
```

B.2.6 Socio economic study table

```
CREATE TABLE socioeconomicstudy
(
 id serial NOT NULL, -- Primary Key: Internal database id
 "name" character varying(255) NOT NULL DEFAULT 'untitled'::character varying, -- The name of the socio-economic study
 authors character varying(255), -- The authors of the study
 studydate timestamp without time zone, -- Study publication date, eg 1980-05-31
 parentid integer NOT NULL DEFAULT 0, -- The event of which this is a study
 regioncovered character varying(255), -- The country, province or region covered by the study, described in words
 geobaseid integer NOT NULL DEFAULT 0, -- The geographic basis of the study, eg Italy GADM Level 1. Can also be intensity level zones for the event
 studynarrative text, -- Overview descriptive text describing the study
 numberofdwellingunitsdestroyed double precision, -- Number of dwelling units destroyed (incl. shaking and secondary hazards)
 numberofdwellingunitsdestroyed_s character varying(255), -- The source of the data
 numberofdwellingunitsdestroyed_c text, -- A comment on the data
 numberofdwellingunitsdestroyed_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
 numberofdwellingunitsdamaged double precision, -- Number of dwelling units damaged (incl. shaking and secondary hazards)
 numberofdwellingunitsdamaged_s character varying(255), -- The source of the data
 numberofdwellingunitsdamaged_c text, -- A comment on the data
 numberofdwellingunitsdamaged_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
 totalnumberofhouseholdscountry double precision, -- Total number of households in the affected country (contemporaneous)
 totalnumberofhouseholdscountry_s character varying(255), -- The source of the data
 totalnumberofhouseholdscountry_c text, -- A comment on the data
 totalnumberofhouseholdscountry_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
 totalnumberofhouseholdsarea double precision, -- Estimated from EXPO-CAT total number of households in the affected area (contemporaneous)
 totalnumberofhouseholdsarea_s character varying(255), -- The source of the data
 totalnumberofhouseholdsarea_c text, -- A comment on the data
 totalnumberofhouseholdsarea_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
 numberofbuildingsdestroyed double precision, -- Number of buildings destroyed (incl. shaking and secondary hazards)
 numberofbuildingsdestroyed_s character varying(255), -- The source of the data
 numberofbuildingsdestroyed_c text, -- A comment on the data
 numberofbuildingsdestroyed_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
 numberofbuildingsdamaged double precision, -- Number of buildings damaged (incl. shaking and secondary hazards)
 numberofbuildingsdamaged_s character varying(255), -- The source of the data
 numberofbuildingsdamaged_c text, -- A comment on the data
 numberofbuildingsdamaged_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
 numberofeducationalbuildingsdestroyedordamaged double precision, -- Educational buildings destroyed or damaged
 numberofeducationalbuildingsdestroyedordamaged_s character varying(255), -- The source of the data
 numberofeducationalbuildingsdestroyedordamaged_c text, -- A comment on the data
```

numberofeducationalbuildingsdestroyedordamaged_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
percentageofeducationalbuildingsdestroyedordamaged double precision, -- Educational buildings destroyed or damaged
percentageofeducationalbuildingsdestroyedordamaged_s character varying(255), -- The source of the data
percentageofeducationalbuildingsdestroyedordamaged_c text, -- A comment on the data
percentageofeducationalbuildingsdestroyedordamaged_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
costofeducationalbuildingsdestroyedordamaged double precision, -- Educational buildings destroyed or damaged (contemporaneous)
costofeducationalbuildingsdestroyedordamaged_s character varying(255), -- The source of the data
costofeducationalbuildingsdestroyedordamaged_c text, -- A comment on the data
costofeducationalbuildingsdestroyedordamaged_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
numberofhealthfacilitiesdestroyedordamaged double precision, -- Health facilities (hospitals and clinics) destroyed or damaged
numberofhealthfacilitiesdestroyedordamaged_s character varying(255), -- The source of the data
numberofhealthfacilitiesdestroyedordamaged_c text, -- A comment on the data
numberofhealthfacilitiesdestroyedordamaged_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
percentageofhealthfacilitiesdestroyedordamaged double precision, -- Health facilities (hospitals and clinics) destroyed or damaged
percentageofhealthfacilitiesdestroyedordamaged_s character varying(255), -- The source of the data
percentageofhealthfacilitiesdestroyedordamaged_c text, -- A comment on the data
percentageofhealthfacilitiesdestroyedordamaged_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
costofhealthfacilitiesdestroyedordamaged double precision, -- Health facilities (hospitals and clinics) destroyed or damaged (contemporaneous)
costofhealthfacilitiesdestroyedordamaged_s character varying(255), -- The source of the data
costofhealthfacilitiesdestroyedordamaged_c text, -- A comment on the data
costofhealthfacilitiesdestroyedordamaged_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
numberofpeopletempwithoutelectricity double precision, -- Number of people losing electricity supply in the immediate aftermath
numberofpeopletempwithoutelectricity_s character varying(255), -- The source of the data
numberofpeopletempwithoutelectricity_c text, -- A comment on the data
numberofpeopletempwithoutelectricity_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
percentageofpeopletempwithoutelectricity double precision, -- Percentage of people losing electricity supply in the immediate aftermath
percentageofpeopletempwithoutelectricity_s character varying(255), -- The source of the data
percentageofpeopletempwithoutelectricity_c text, -- A comment on the data
percentageofpeopletempwithoutelectricity_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
datestampfornumberofpeopletempwithoutelectricity timestamp without time zone, -- Date stamp for the number of people losing electricity supply in the immediate aftermath - eg 1980-05-31
datestampfornumberofpeopletempwithoutelectricity_s character varying(255), -- The source of the data
datestampfornumberofpeopletempwithoutelectricity_c text, -- A comment on the data
datestampfornumberofpeopletempwithoutelectricity_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
numberofpeoplesigwithoutelectricity double precision, -- Number of people losing electricity supply for a significant duration of time
numberofpeoplesigwithoutelectricity_s character varying(255), -- The source of the data
numberofpeoplesigwithoutelectricity_c text, -- A comment on the data
numberofpeoplesigwithoutelectricity_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
percentageofpeoplesigwithoutelectricity double precision, -- Percentage of people losing electricity supply for a significant duration of time
percentageofpeoplesigwithoutelectricity_s character varying(255), -- The source of the data
percentageofpeoplesigwithoutelectricity_c text, -- A comment on the data
percentageofpeoplesigwithoutelectricity_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
datestampfornumberofpeoplesigwithoutelectricity timestamp without time zone, -- Date Stamp for the number of people losing electricity supply for a significant duration of time - eg 1980-05-31
datestampfornumberofpeoplesigwithoutelectricity_s character varying(255), -- The source of the data
datestampfornumberofpeoplesigwithoutelectricity_c text, -- A comment on the data
datestampfornumberofpeoplesigwithoutelectricity_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
numberofpeopletempwithoutwater double precision, -- Number of people losing water supply in the immediate aftermath
numberofpeopletempwithoutwater_s character varying(255), -- The source of the data
numberofpeopletempwithoutwater_c text, -- A comment on the data
numberofpeopletempwithoutwater_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
percentageofpeopletempwithoutwater double precision, -- Percentage of people losing water supply in the immediate aftermath
percentageofpeopletempwithoutwater_s character varying(255), -- The source of the data
percentageofpeopletempwithoutwater_c text, -- A comment on the data
percentageofpeopletempwithoutwater_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
datestampfornumberofpeopletempwithoutwater timestamp without time zone, -- Date stamp for the number of people losing water supply in the immediate aftermath - eg 1980-05-31
datestampfornumberofpeopletempwithoutwater_s character varying(255), -- The source of the data
datestampfornumberofpeopletempwithoutwater_c text, -- A comment on the data
datestampfornumberofpeopletempwithoutwater_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
numberofpeoplesigwithoutwater double precision, -- Number of people losing water supply for a significant duration of time
numberofpeoplesigwithoutwater_s character varying(255), -- The source of the data
numberofpeoplesigwithoutwater_c text, -- A comment on the data
numberofpeoplesigwithoutwater_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
percentageofpeoplesigwithoutwater double precision, -- Percentage of people losing water supply for a significant duration of time

percentageofpeoplesigwithoutwater_s character varying(255), -- The source of the data
percentageofpeoplesigwithoutwater_c text, -- A comment on the data
percentageofpeoplesigwithoutwater_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
datestampfornumberofpeoplesigwithoutwater timestamp without time zone, -- Date stamp for the number of people losing water supply for a significant duration of time
datestampfornumberofpeoplesigwithoutwater_s character varying(255), -- The source of the data
datestampfornumberofpeoplesigwithoutwater_c text, -- A comment on the data
datestampfornumberofpeoplesigwithoutwater_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
numberoftemphomeless double precision, -- Number of people homeless in the immediate aftermath
numberoftemphomeless_s character varying(255), -- The source of the data
numberoftemphomeless_c text, -- A comment on the data
numberoftemphomeless_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
datestampfornumberoftemphomeless timestamp without time zone, -- Date Stamp for the number of people homeless in the immediate aftermath
datestampfornumberoftemphomeless_s character varying(255), -- The source of the data
datestampfornumberoftemphomeless_c text, -- A comment on the data
datestampfornumberoftemphomeless_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
numberofsighomeless double precision, -- Number of people homeless for a significant duration of time
numberofsighomeless_s character varying(255), -- The source of the data
numberofsighomeless_c text, -- A comment on the data
numberofsighomeless_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
datestampfornumberofsighomeless timestamp without time zone, -- Date Stamp for the number of people homeless for a significant duration of time
datestampfornumberofsighomeless_s character varying(255), -- The source of the data
datestampfornumberofsighomeless_c text, -- A comment on the data
datestampfornumberofsighomeless_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
numberunemployed double precision, -- Number of people losing employment as a direct result of the damage to the production / commercial / service sector units
numberunemployed_s character varying(255), -- The source of the data
numberunemployed_c text, -- A comment on the data
numberunemployed_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
datestampfornumberunemployed timestamp without time zone, -- Date Stamp for the number of people losing employment as a direct result of the damage to the production / commercial / service sector units
datestampfornumberunemployed_s character varying(255), -- The source of the data
datestampfornumberunemployed_c text, -- A comment on the data
datestampfornumberunemployed_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
totaldirecteconomicloss double precision, -- Total direct economic losses (contemporaneous)
totaldirecteconomicloss_s character varying(255), -- The source of the data
totaldirecteconomicloss_c text, -- A comment on the data
totaldirecteconomicloss_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
totaldirecteconomiclosspersector text, -- Total direct economic losses per sector (contemporaneous)
totaldirecteconomiclosspersector_s character varying(255), -- The source of the data
totaldirecteconomiclosspersector_c text, -- A comment on the data
totaldirecteconomiclosspersector_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
totaldirecteconomiclossbyhazard text, -- Total direct economic losses by type of hazard (contemporaneous)
totaldirecteconomiclossbyhazard_s character varying(255), -- The source of the data
totaldirecteconomiclossbyhazard_c text, -- A comment on the data
totaldirecteconomiclossbyhazard_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
totalindirecteconomicloss double precision, -- Total indirect economic losses (contemporaneous)
totalindirecteconomicloss_s character varying(255), -- The source of the data
totalindirecteconomicloss_c text, -- A comment on the data
totalindirecteconomicloss_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
totalindirecteconomiclossbycause text, -- Total indirect economic losses by cause (in contemporaneous US$)
totalindirecteconomiclossbycause_s character varying(255), -- The source of the data
totalindirecteconomiclossbycause_c text, -- A comment on the data
totalindirecteconomiclossbycause_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
countrygdp double precision, -- Contemporaneous country GDP (US$)
countrygdp_s character varying(255), -- The source of the data
countrygdp_c text, -- A comment on the data
countrygdp_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
totaldirecteconomiclossaspercentofgdp double precision, -- Total direct economic losses as % of contemporaneous GDP
totaldirecteconomiclossaspercentofgdp_s character varying(255), -- The source of the data
totaldirecteconomiclossaspercentofgdp_c text, -- A comment on the data
totaldirecteconomiclossaspercentofgdp_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
totalindirecteconomiclossaspercentofgdp double precision, -- Total indirect economic losses as % of contemporaneous GDP
totalindirecteconomiclossaspercentofgdp_s character varying(255), -- The source of the data
totalindirecteconomiclossaspercentofgdp_c text, -- A comment on the data

```
  totalindirecteconomiclossaspercentofgdp_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  presentcountrygdp double precision, -- Present-time country GDP
  presentcountrygdp_s character varying(255), -- The source of the data
  presentcountrygdp_c text, -- A comment on the data
  presentcountrygdp_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  insurancelosses double precision, -- Insurance losses (contemporaneous)
  insurancelosses_s character varying(255), -- The source of the data
  insurancelosses_c text, -- A comment on the data
  insurancelosses_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  insurancelossesbyhazard text, -- Insurance losses (contemporaneous) by type of hazard
  insurancelossesbyhazard_s character varying(255), -- The source of the data
  insurancelossesbyhazard_c text, -- A comment on the data
  insurancelossesbyhazard_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  insurancelossesbybusiness text, -- Insurance losses (contemporaneous) by line of business
  insurancelossesbybusiness_s character varying(255), -- The source of the data
  insurancelossesbybusiness_c text, -- A comment on the data
  insurancelossesbybusiness_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  reconstructioncost double precision, -- Cost of reconstruction (contemporaneous)
  reconstructioncost_s character varying(255), -- The source of the data
  reconstructioncost_c text, -- A comment on the data
  reconstructioncost_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  aidcontribution double precision, -- Amount of aid contribution
  aidcontribution_s character varying(255), -- The source of the data
  aidcontribution_c text, -- A comment on the data
  aidcontribution_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  multiplier double precision, -- Multiplier to project the contemporaneous losses, costs, aid contributions
  multiplier_s character varying(255), -- The source of the data
  multiplier_c text, -- A comment on the data
  multiplier_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  reliabilityoverallid integer NOT NULL DEFAULT 0, -- Overall reliability of source data
  reliabilitydataqualityid integer NOT NULL DEFAULT 0, -- Quality of source data
  reliabilitydatarelevanceid integer NOT NULL DEFAULT 0, -- How well the data matches or envelopes the conditions that will be encountered
  reliabilitydocumentationqualityid integer NOT NULL DEFAULT 0, -- How well the author has documented the data, analysis and results
  reliabilityrationalityid integer NOT NULL DEFAULT 0, -- How well the the behavior can be explained or rationalized by intuition, calculation or principles of
engineering mechanics
  reliabilitylocationalid integer NOT NULL DEFAULT 0, -- How reliable the geographic locations are
  reliability_c text, -- A comment on the study reliability
  surveydata_s character varying(255), -- The source of the survey data
  surveydata_c text, -- A comment on the survey data
  significantfigures integer, -- The significant figures for the data in the study
  "location" character varying(255), -- The bounding area for the study defined by a shapefile
  partner character varying(255), -- The names of the GEMECD partner(s) who have developed this study record in the GEMECD database
  ownerid integer NOT NULL DEFAULT 1, -- ID of the creator/owner of the record
  lastupdatebyid integer NOT NULL DEFAULT 1, -- ID of the last person to update this record
  lastupdate timestamp without time zone, -- Last record update date
  originallanguage character varying(50), -- The original language of the study
  CONSTRAINT socioeconomicstudy_pkey PRIMARY KEY (id)
)
```

B.2.7 Study map layer table – links the Geoserver map layers that can be drawn when a study is mapped

```
CREATE TABLE maplayer
(
  id serial NOT NULL, -- Primary Key: Internal database id
  "name" character varying(255) NOT NULL DEFAULT 'Layer name'::character varying, -- Map layer name
  parentid integer NOT NULL DEFAULT 0, -- The entity which owns this map layer. Set on creation, this must not be changed.
  parenttype character varying(25), -- The entity which owns this map layer. Set on creation, this must not be changed.
  description character varying(255), -- Optional description of the map layer
  geoserverlayername character varying(255), -- Geoserver layer name - the name by which Geoserver stores the layer
  geoserverfeaturetype character varying(255), -- Geoserver feature type
  geoservergeometryname character varying(255), -- Geoserver geometry name
  protocoltypeid integer NOT NULL DEFAULT 1, -- The geoserver protocol type
  layerorder integer NOT NULL DEFAULT 0, -- Used to put the layers in the desired order
  ownerid integer NOT NULL DEFAULT 1, -- ID of the creator/owner of the record
```

```
  lastupdatebyid integer NOT NULL DEFAULT 1, -- ID of the last person to update this record
  lastupdate timestamp without time zone, -- Last record update date
  CONSTRAINT maplayer_pkey PRIMARY KEY (id)
)
```

B.3 Sub-event Level

B.3.1 Tsunami sub event table

```
CREATE TABLE tsunamisubevent
(
  id serial NOT NULL, -- Primary Key: Internal database id
  "name" character varying(255) NOT NULL DEFAULT 'untitled'::character varying, -- The name of the tsunami
  parentid integer NOT NULL DEFAULT 0, -- The tsunami study of which this is a subevent
  "location" character varying(255) DEFAULT ''::character varying, -- Name of the region
  locationaffected character varying(255) DEFAULT ''::character varying, -- Name of the location
  coastaltype character varying(255) DEFAULT ''::character varying, -- Coastal type: Rias, Wide bay, open ocean
  nearseamorphology character varying(255) DEFAULT ''::character varying, -- Near sea morphology: Mangroves, Sand dunes, Coastal forest, Open land, Builtup land, Mixed, or any combination
  landtopography character varying(255) DEFAULT ''::character varying, -- Land topography: Flat, Gentle slope (<5 degrees), Moderate slope (5-10 degrees), Steep slope (>10 degrees)
  localtimestarted timestamp without time zone, -- The local time the tsunami started, eg 15:23
  localtimeended timestamp without time zone, -- The local time the tsunami ended including drawback phase, eg 15:23
  duration timestamp without time zone, -- Duration: how long did it last, eg 03:30
  seawithdrawal character varying(255) DEFAULT ''::character varying, -- Sea withdrawal prior to tsunami inundation - yes or no
  timeavailableforevacuation timestamp without time zone, -- Time available for evacuation: Hours/Minutes between earthquake occurrence and tsunami arrival, eg 01:30
  pretsunamievacuationwarning character varying(255) DEFAULT ''::character varying, -- Pre tsunami evacuation warning: Yes or No (if Yes, choose from the following: tsunami sirens, radio-TV broadcast, or both)
  tidelevel character varying(255) DEFAULT ''::character varying, -- Tide level during the tsunami: High Tide or Medium Tide or Low Tide
  generalsetting character varying(255) DEFAULT ''::character varying, -- General setting (Land use type): Sparse residential - wooden houses, Dense residential - wooden houses...
  protectionsystems character varying(255) DEFAULT ''::character varying, -- Tsunami protection systems: Type of protection (coastal sea wall, offshore tsunami breaker, sand dune, natural forest, lagoon, or any combination)
  velocity double precision, -- Tsunami velocity, metres per second
  totalinundationarea double precision, -- Total inundation area, square kilometres
  extentofinundation bigint, -- Extent of tsunami inundation: distance travelled inland, metres
  runupheight double precision, -- Tsunami run up height: Maximum height of water at the inland-most reach of the tsunami relative to the tide level at the time of event, metres
  inundationheight double precision, -- Tsunami inundation height: Height of the tsunami relative to the tide level at the time of event at a chosen location, metres
  flowdepth double precision, -- Tsunami flow depth: Height of the tsunami relative to ground level at a chosen location, metres
  firefollowing character varying(255) DEFAULT ''::character varying, -- Fire following tsunami: Yes or No (if Yes, give some general description, e.g. land area affected, or industry affected etc.)
  boundaryid integer NOT NULL DEFAULT 0, -- Optional. The bounding area of the tsunami inundation zone. This is a boundary within the geobase. Note alternatively maps can be added as map layers.
  subeventnarrative text, -- Descriptive text describing the tsunami sub event
  totalcoastaffected double precision, -- Total length of coast affected, km
  totalcoastaffected_s character varying(255), -- The source of the data
  totalcoastaffected_c text, -- A comment on the data
  totalcoastaffected_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  totallandflooded double precision, -- Total land area flooded by the tsunami, sq km
  totallandflooded_s character varying(255), -- The source of the data
  totallandflooded_c text, -- A comment on the data
  totallandflooded_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  peopleinjuredduetotsunami bigint, -- People injured due to tsunami
  peopleinjuredduetotsunami_s character varying(255), -- The source of the data
  peopleinjuredduetotsunami_c text, -- A comment on the data
  peopleinjuredduetotsunami_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  peoplemissingduetotsunami bigint, -- People missing due to tsunami
  peoplemissingduetotsunami_s character varying(255), -- The source of the data
  peoplemissingduetotsunami_c text, -- A comment on the data
  peoplemissingduetotsunami_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  peoplekilledduetotsunami bigint, -- People killed due to tsunami
```

peoplekilledduetotsunami_s character varying(255), -- The source of the data
peoplekilledduetotsunami_c text, -- A comment on the data
peoplekilledduetotsunami_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
peopleinsideinundationzone bigint, -- Population inside the tsunami inundation zone (or within 1km from the affected coast)
peopleinsideinundationzone_s character varying(255), -- The source of the data
peopleinsideinundationzone_c text, -- A comment on the data
peopleinsideinundationzone_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
numberbuildingswashedaway bigint, -- Number of buildings washed away or destroyed by the tsunami
numberbuildingswashedaway_s character varying(255), -- The source of the data
numberbuildingswashedaway_c text, -- A comment on the data
numberbuildingswashedaway_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
numberbuildingsflooded bigint, -- Number of buildings flooded but not destroyed
numberbuildingsflooded_s character varying(255), -- The source of the data
numberbuildingsflooded_c text, -- A comment on the data
numberbuildingsflooded_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
numberbridgesdestroyed bigint, -- Number of bridges destroyed (all types of bridges)
numberbridgesdestroyed_s character varying(255), -- The source of the data
numberbridgesdestroyed_c text, -- A comment on the data
numberbridgesdestroyed_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
numberportsaffected bigint, -- Number of ports affected
numberportsaffected_s character varying(255), -- The source of the data
numberportsaffected_c text, -- A comment on the data
numberportsaffected_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
numberboatsdestroyed bigint, -- Number of boats destroyed (all types of boats)
numberboatsdestroyed_s character varying(255), -- The source of the data
numberboatsdestroyed_c text, -- A comment on the data
numberboatsdestroyed_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
numbervehiclesdestroyed bigint, -- Number of vehicles destroyed (all types of vehicles)
numbervehiclesdestroyed_s character varying(255), -- The source of the data
numbervehiclesdestroyed_c text, -- A comment on the data
numbervehiclesdestroyed_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
peopledyingpostcatastrophe bigint, -- People dying after time has passed but their deaths related to the original tsunami
peopledyingpostcatastrophe_s character varying(255), -- The source of the data
peopledyingpostcatastrophe_c text, -- A comment on the data
peopledyingpostcatastrophe_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
numberofbuildingsdestroyed bigint, -- Total number of buildings destroyed, collapsed or damaged beyond repair due to tsunami
numberofbuildingsdestroyed_s character varying(255), -- The source of the data
numberofbuildingsdestroyed_c text, -- A comment on the data
numberofbuildingsdestroyed_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
numberofbuildingsdamaged bigint, -- Total number of buildings damaged due to tsunami
numberofbuildingsdamaged_s character varying(255), -- The source of the data
numberofbuildingsdamaged_c text, -- A comment on the data
numberofbuildingsdamaged_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
numberofdwellingsdestroyed bigint, -- Total number of dwelling units destroyed, collapsed or damaged beyond repair due to tsunami
numberofdwellingsdestroyed_s character varying(255), -- The source of the data
numberofdwellingsdestroyed_c text, -- A comment on the data
numberofdwellingsdestroyed_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
numberofdwellingsdamaged bigint, -- Total number of dwelling units damaged due to tsunami
numberofdwellingsdamaged_s character varying(255), -- The source of the data
numberofdwellingsdamaged_c text, -- A comment on the data
numberofdwellingsdamaged_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
peoplehomeless bigint, -- Total number of people homeless for a significant duration of time due to tsunami
peoplehomeless_s character varying(255), -- The source of the data
peoplehomeless_c text, -- A comment on the data
peoplehomeless_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
directeconomicloss double precision, -- Total estimated direct economic loss due to tsunami, million US$, contemporaneous. In absolute US$ value of the year of occurrence. Only includes direct effects.
directeconomicloss_s character varying(255), -- The source of the data
directeconomicloss_c text, -- A comment on the data
directeconomicloss_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
indirecteconomicloss double precision, -- Total estimated indirect economic loss due to tsunami, million US$, contemporaneous. In absolute US$ value of the year of occurrence. Only includes indirect effects.
indirecteconomicloss_s character varying(255), -- The source of the data
indirecteconomicloss_c text, -- A comment on the data
indirecteconomicloss_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data

```
  numberofhouseholds bigint, -- Total number of households in the tsunami affected zone (contemporaneous)
  numberofhouseholds_s character varying(255), -- The source of the data
  numberofhouseholds_c text, -- A comment on the data
  numberofhouseholds_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  totalnumberofbuildings bigint, -- Total number of buildings in the tsunami affected zone (contemporaneous)
  totalnumberofbuildings_s character varying(255), -- The source of the data
  totalnumberofbuildings_c text, -- A comment on the data
  totalnumberofbuildings_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  overallimpact text, -- Overall socio economic impact
  ownerid integer NOT NULL DEFAULT 1, -- ID of the creator/owner of the record
  lastupdatebyid integer NOT NULL DEFAULT 1, -- ID of the last person to update this record
  lastupdate timestamp without time zone, -- Last record update date
  boundaryaffected character varying(255), -- Optional - an alternative to a boundary within the geobase. The bounding area in WKT format eg POINT (long lat).
  parenttype character varying(25), -- The type of study which owns this subevent. Set on creation, this must not be changed.
  boundary_c text, -- A comment on the precision of the boundary
  population_c text, -- A comment on the data
  population_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  contemporaneousdate timestamp without time zone, -- Base date for contemporaneous data, if not date of event, eg 1970-05-31
  population bigint, -- Population (contemporaneous)
  population_s character varying(255), -- The source of the data
  CONSTRAINT tsunamisubevent_pkey PRIMARY KEY (id)
)
```

B.3.2 Slope failure sub event table

```
CREATE TABLE slopefailuresubevent
(
  id serial NOT NULL, -- Primary Key: Internal database id
  "name" character varying(255) NOT NULL DEFAULT 'untitled'::character varying, -- The name of the slope failure
  parentid integer NOT NULL DEFAULT 0, -- The slope failure study of which this is a subevent
  typeofslopefailure character varying(50) DEFAULT ''::character varying, -- Type of slope failure: rock, soil, slide, debris flow
  "location" character varying(255) DEFAULT ''::character varying, -- Location of slope failure
  address character varying(255) DEFAULT ''::character varying, -- Street address of slope failure
  city character varying(255) DEFAULT ''::character varying, -- City of slope failure
  county character varying(255) DEFAULT ''::character varying, -- County of slope failure
  state character varying(255) DEFAULT ''::character varying, -- State of slope failure
  roadnumber character varying(255) DEFAULT ''::character varying, -- Road number
  roadname character varying(255) DEFAULT ''::character varying, -- Road name
  dateobserved timestamp without time zone, -- The date of observation in local time, eg 1970-05-31
  timeobserved timestamp without time zone, -- The time of observation in local time, eg 14:30
  dateoccurred timestamp without time zone, -- The date of occurrance in local time, eg 1970-05-31
  timeoccurred timestamp without time zone, -- The time of occurrance in local time, eg 14:30
  duration timestamp without time zone, -- Duration: how long did it last, eg 03:30
  continuityofmovement character varying(255) DEFAULT ''::character varying, -- Continuity of movement: Once/Sporadic, Continuous, Episodic, Other, or Unknown
  conditionsimmediatelyprior character varying(255) DEFAULT ''::character varying, -- Conditions immediately prior to the slope failure: Average weather, Unusually dry weather, Unusually wet weather...
  generalsetting character varying(255) DEFAULT ''::character varying, -- General setting (Land use type): Sparse residential - wooden houses, Dense residential - wooden houses...
  slopemodification character varying(255) DEFAULT ''::character varying, -- Slope modification: natural, cut, fill, embankment, graded (cut and fill), unknown
  material character varying(255) DEFAULT ''::character varying, -- Material: Bedrock, Coarse (gravel-, cobble- and boulder-sized), Fine (sand, silt, clay), Mixture of coarse and fine, unknown
  consistency character varying(255) DEFAULT ''::character varying, -- Consistency: liquid, solid-wet, solid-dry, rubble, unknown
  trees character varying(255) DEFAULT ''::character varying, -- Trees: standing upright, fallen, leaning uphill, leaning downhill, leaning all directions, none, unknown
  treescarheight double precision, -- Scar height on trees, metres
  treemudheight double precision, -- Mud coating height on trees, metres
  movementtype character varying(255) DEFAULT ''::character varying, -- Movement type: fall, flow, topple, rotational slide, translational slide, spread, avalanche, unknown
  speed double precision, -- Speed, metres per second
  length double precision, -- Length or travel distance (top to bottom), metres
  width double precision, -- Width of source area (along contour), metres
  widthofdeposit double precision, -- Width of deposit (along contour), metres
  depth double precision, -- Depth of source area, metres
```

depthofdeposit double precision, -- Depth of deposit, metres
volume double precision, -- Volume, cubic metres
boundaryid integer NOT NULL DEFAULT 0, -- Optional. The bounding area of the slope failure. This is a boundary within the geobase. Note alternatively maps can be added as map layers.
subeventnarrative text, -- Descriptive text describing the slope failure
peopleinjuredduetoslopefailures bigint, -- People injured due to slope failures
peopleinjuredduetoslopefailures_s character varying(255), -- The source of the data
peopleinjuredduetoslopefailures_c text, -- A comment on the data
peopleinjuredduetoslopefailures_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
peoplemissingduetoslopefailures bigint, -- People missing due to slope failures
peoplemissingduetoslopefailures_s character varying(255), -- The source of the data
peoplemissingduetoslopefailures_c text, -- A comment on the data
peoplemissingduetoslopefailures_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
peoplekilledduetoslopefailures bigint, -- People killed due to slope failures
peoplekilledduetoslopefailures_s character varying(255), -- The source of the data
peoplekilledduetoslopefailures_c text, -- A comment on the data
peoplekilledduetoslopefailures_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
peopledyingpostcatastrophe bigint, -- People dying after time has passed but their deaths related to the original slope failure
peopledyingpostcatastrophe_s character varying(255), -- The source of the data
peopledyingpostcatastrophe_c text, -- A comment on the data
peopledyingpostcatastrophe_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
numberofbuildingsdestroyed bigint, -- Total number of buildings destroyed, collapsed or damaged beyond repair due to slope failure
numberofbuildingsdestroyed_s character varying(255), -- The source of the data
numberofbuildingsdestroyed_c text, -- A comment on the data
numberofbuildingsdestroyed_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
numberofbuildingsdamaged bigint, -- Total number of buildings damaged due to slope failure
numberofbuildingsdamaged_s character varying(255), -- The source of the data
numberofbuildingsdamaged_c text, -- A comment on the data
numberofbuildingsdamaged_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
numberofdwellingsdestroyed bigint, -- Total number of dwelling units destroyed, collapsed or damaged beyond repair due to slope failure
numberofdwellingsdestroyed_s character varying(255), -- The source of the data
numberofdwellingsdestroyed_c text, -- A comment on the data
numberofdwellingsdestroyed_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
numberofdwellingsdamaged bigint, -- Total number of dwelling units damaged due to slope failure
numberofdwellingsdamaged_s character varying(255), -- The source of the data
numberofdwellingsdamaged_c text, -- A comment on the data
numberofdwellingsdamaged_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
peoplehomeless bigint, -- Total number of people homeless for a significant duration of time due to slope failure
peoplehomeless_s character varying(255), -- The source of the data
peoplehomeless_c text, -- A comment on the data
peoplehomeless_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
directeconomicloss double precision, -- Total estimated direct economic loss due to slope failure, million US$, contemporaneous. In absolute US$ value of the year of occurrence. Only includes direct effects.
directeconomicloss_s character varying(255), -- The source of the data
directeconomicloss_c text, -- A comment on the data
directeconomicloss_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
indirecteconomicloss double precision, -- Total estimated indirect economic loss due to slope failure, million US$, contemporaneous. In absolute US$ value of the year of occurrence. Only includes indirect effects.
indirecteconomicloss_s character varying(255), -- The source of the data
indirecteconomicloss_c text, -- A comment on the data
indirecteconomicloss_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
numberofhouseholds bigint, -- Total number of households in the affected slope failure zone (contemporaneous)
numberofhouseholds_s character varying(255), -- The source of the data
numberofhouseholds_c text, -- A comment on the data
numberofhouseholds_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
totalnumberofbuildings bigint, -- Total number of buildings in the affected slope failure zone (contemporaneous)
totalnumberofbuildings_s character varying(255), -- The source of the data
totalnumberofbuildings_c text, -- A comment on the data
totalnumberofbuildings_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
overallimpact text, -- Overall socio economic impact
ownerid integer NOT NULL DEFAULT 1, -- ID of the creator/owner of the record
lastupdatebyid integer NOT NULL DEFAULT 1, -- ID of the last person to update this record
lastupdate timestamp without time zone, -- Last record update date
boundaryaffected character varying(255), -- Optional - an alternative to a boundary within the geobase. The bounding area in WKT format eg POINT (long lat).
parenttype character varying(25), -- The type of study which owns this subevent. Set on creation, this must not be changed.

```
  boundary_c text, -- A comment on the precision of the boundary
  population_c text, -- A comment on the data
  population_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  contemporaneousdate timestamp without time zone, -- Base date for contemporaneous data, if not date of event, eg 1970-05-31
  population bigint, -- Population (contemporaneous)
  population_s character varying(255), -- The source of the data
  CONSTRAINT slopefailuresubevent_pkey PRIMARY KEY (id)
)
```

B.3.3 Liquefaction sub event table

```
CREATE TABLE liquefactionsubevent
(
  id serial NOT NULL, -- Primary Key: Internal database id
  "name" character varying(255) NOT NULL DEFAULT 'untitled'::character varying, -- The name of the liquefaction: Commonly accepted name
  parentid integer NOT NULL DEFAULT 0, -- The liquefaction study of which this is a subevent
  "location" character varying(255) DEFAULT ''::character varying, -- Name of the location
  soiltype character varying(255) DEFAULT ''::character varying, -- Soil type in the affected loation: Soft soil: Vs<180 m/s (NEHRP Site class E) or Very poor soil requiring specific evaluation (NEHRP Site class F)
  occurrenceofliquefaction character varying(255) DEFAULT ''::character varying, -- Occurrence of liquefaction: Yes or No, if Yes give brief description
  occurrenceoflateralspreading character varying(255) DEFAULT ''::character varying, -- Occurrence of lateral spreading: Yes or No, if Yes give brief description
  occurrenceofsubsidence character varying(255) DEFAULT ''::character varying, -- Occurrence of ground or coastal subsidence: Yes or No, if Yes give brief description
  landtype character varying(255) DEFAULT ''::character varying, -- Land type: Man-made island, Other artificial fill, Ports, Previously a swampland or wetland,...
  landusetype character varying(255) DEFAULT ''::character varying, -- Land use type: Sparse residential - wooden houses, Dense residential - wooden houses,,...
  existenceofpreviousimprovements character varying(255) DEFAULT ''::character varying, -- Existence of previous improvements: Yes or No, if Yes give brief description
  totalareaaffectedbyliquefaction double precision, -- Total land area affected by liquefaction and/or lateral spreading, square kilometres
  totalareaaffectedbysubsidence double precision, -- Total land area affected by land and/or coastal subsidence, square kilometres
  boundaryid integer NOT NULL DEFAULT 0, -- Optional. The bounding area of the liquefaction zone. This is a boundary within the geobase. Note alternatively maps can be added as map layers.
  subeventnarrative text, -- Descriptive text describing the liquefaction sub event
  totallandareaaffected double precision, -- Total land area affected by liquefaction, sq km
  totallandareaaffected_s character varying(255), -- The source of the data
  totallandareaaffected_c text, -- A comment on the data
  totallandareaaffected_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  peopleinjuredduetoliquefaction bigint, -- People injured due to liquefaction
  peopleinjuredduetoliquefaction_s character varying(255), -- The source of the data
  peopleinjuredduetoliquefaction_c text, -- A comment on the data
  peopleinjuredduetoliquefaction_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  peoplemissingduetoliquefaction bigint, -- People missing due to liquefaction
  peoplemissingduetoliquefaction_s character varying(255), -- The source of the data
  peoplemissingduetoliquefaction_c text, -- A comment on the data
  peoplemissingduetoliquefaction_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  peoplekilledduetoliquefaction bigint, -- People killed due to liquefaction
  peoplekilledduetoliquefaction_s character varying(255), -- The source of the data
  peoplekilledduetoliquefaction_c text, -- A comment on the data
  peoplekilledduetoliquefaction_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  peopleinsideliquefactionzone bigint, -- Population inside the liquefaction zone
  peopleinsideliquefactionzone_s character varying(255), -- The source of the data
  peopleinsideliquefactionzone_c text, -- A comment on the data
  peopleinsideliquefactionzone_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  numberbuildingsaffected bigint, -- Number of buildings saffected
  numberbuildingssaffected_s character varying(255), -- The source of the data
  numberbuildingssaffected_c text, -- A comment on the data
  numberbuildingssaffected_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  numberbuildingspulleddown bigint, -- Number of buildings pulled down
  numberbuildingspulleddown_s character varying(255), -- The source of the data
  numberbuildingspulleddown_c text, -- A comment on the data
  numberbuildingspulleddown_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  numberroadsaffected bigint, -- Number of roads affected
  numberroadsaffected_s character varying(255), -- The source of the data
  numberroadsaffected_c text, -- A comment on the data
```

```
  numberroadsaffected_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  peopledyingpostcatastrophe bigint, -- People dying after time has passed but their deaths related to the original liquefaction event
  peopledyingpostcatastrophe_s character varying(255), -- The source of the data
  peopledyingpostcatastrophe_c text, -- A comment on the data
  peopledyingpostcatastrophe_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  numberofbuildingsdestroyed bigint, -- Total number of buildings destroyed, collapsed or damaged beyond repair due to liquefaction
  numberofbuildingsdestroyed_s character varying(255), -- The source of the data
  numberofbuildingsdestroyed_c text, -- A comment on the data
  numberofbuildingsdestroyed_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  numberofbuildingsdamaged bigint, -- Total number of buildings damaged due to liquefaction
  numberofbuildingsdamaged_s character varying(255), -- The source of the data
  numberofbuildingsdamaged_c text, -- A comment on the data
  numberofbuildingsdamaged_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  numberofdwellingsdestroyed bigint, -- Total number of dwelling units destroyed, collapsed or damaged beyond repair due to liquefaction
  numberofdwellingsdestroyed_s character varying(255), -- The source of the data
  numberofdwellingsdestroyed_c text, -- A comment on the data
  numberofdwellingsdestroyed_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  numberofdwellingsdamaged bigint, -- Total number of dwelling units damaged due to liquefaction
  numberofdwellingsdamaged_s character varying(255), -- The source of the data
  numberofdwellingsdamaged_c text, -- A comment on the data
  numberofdwellingsdamaged_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  peoplehomeless bigint, -- Total number of people homeless for a significant duration of time due to liquefaction
  peoplehomeless_s character varying(255), -- The source of the data
  peoplehomeless_c text, -- A comment on the data
  peoplehomeless_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  directeconomicloss double precision, -- Total estimated direct economic loss due to liquefaction, million US$, contemporaneous. In absolute US$ value of the
year of occurrence. Only includes direct effects.
  directeconomicloss_s character varying(255), -- The source of the data
  directeconomicloss_c text, -- A comment on the data
  directeconomicloss_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  indirecteconomicloss double precision, -- Total estimated indirect economic loss due to liquefaction, million US$, contemporaneous. In absolute US$ value of
the year of occurrence. Only includes indirect effects.
  indirecteconomicloss_s character varying(255), -- The source of the data
  indirecteconomicloss_c text, -- A comment on the data
  indirecteconomicloss_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  numberofhouseholds bigint, -- Total number of households in the zone affected by liquefaction (contemporaneous)
  numberofhouseholds_s character varying(255), -- The source of the data
  numberofhouseholds_c text, -- A comment on the data
  numberofhouseholds_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  totalnumberofbuildings bigint, -- Total number of buildings in the zone affected by liquefaction (contemporaneous)
  totalnumberofbuildings_s character varying(255), -- The source of the data
  totalnumberofbuildings_c text, -- A comment on the data
  totalnumberofbuildings_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  overallimpact text, -- Overall socio economic impact
  ownerid integer NOT NULL DEFAULT 1, -- ID of the creator/owner of the record
  lastupdatebyid integer NOT NULL DEFAULT 1, -- ID of the last person to update this record
  lastupdate timestamp without time zone, -- Last record update date
  boundaryaffected character varying(255), -- Optional - an alternative to a boundary within the geobase. The bounding area in WKT format eg POINT (long lat).
  parenttype character varying(25), -- The type of study which owns this subevent. Set on creation, this must not be changed.
  boundary_c text, -- A comment on the precision of the boundary
  population_c text, -- A comment on the data
  population_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  contemporaneousdate timestamp without time zone, -- Base date for contemporaneous data, if not date of event, eg 1970-05-31
  population bigint, -- Population (contemporaneous)
  population_s character varying(255), -- The source of the data
  CONSTRAINT liquefactionsubevent_pkey PRIMARY KEY (id)
)
```

B.3.4 Fire following sub event table

```
CREATE TABLE firefollowingsubevent
(
  id serial NOT NULL, -- Primary Key: Internal database id
  "name" character varying(255) NOT NULL DEFAULT 'untitled'::character varying, -- The name of the fire
```

parentid integer NOT NULL DEFAULT 0, -- The fire following study of which this is a subevent
"location" character varying(255) DEFAULT ''::character varying, -- Location of fire
address character varying(255) DEFAULT ''::character varying, -- Street address of fire
city character varying(255) DEFAULT ''::character varying, -- City of fire
prefecture character varying(255) DEFAULT ''::character varying, -- Prefecture of fire
state character varying(255) DEFAULT ''::character varying, -- State of fire
datestarted timestamp without time zone, -- The date of fire start in local time, eg 1970-05-31
timestarted timestamp without time zone, -- The time of start in local time, eg 14:30
dateended timestamp without time zone, -- The date of end in local time, eg 1970-05-31
timeended timestamp without time zone, -- The time of end in local time, eg 14:30
duration timestamp without time zone, -- Duration: how long did it last, eg 03:30
continuityofpropagation character varying(255) DEFAULT ''::character varying, -- Continuity of fire propagation: Did not propagate, Limited spread, Episodic, Extensive spread, Other, or Unknown
conditionsimmediatelyprior character varying(255) DEFAULT ''::character varying, -- Conditions immediately prior to the fire: Average for the season, Unseasonably dry, Unusually wet,...
conditionsduring character varying(255) DEFAULT ''::character varying, -- Conditions during the fire: Average for the season, Unseasonably dry, Unusually wet,...
generalsetting character varying(255) DEFAULT ''::character varying, -- General setting (Land use type): Sparse residential - wooden houses, Dense residential - wooden houses...
naturalbreaks character varying(255) DEFAULT ''::character varying, -- Natural breaks: Large road, Open ground, Other, Unknown
speed double precision, -- Speed of fire propagation, metres per second
area double precision, -- Burnt area footprint, square metres
width double precision, -- Width of burnt area (estimated along contour), metres
length double precision, -- Length of burnt area (estimated along contour), metres
boundaryid integer NOT NULL DEFAULT 0, -- Optional. The bounding area of the fire zone. This is a boundary within the geobase. Note alternatively maps can be added as map layers.
subeventnarrative text, -- Descriptive text describing the fire
peopleinjuredduetofirefollowing bigint, -- People injured due to fire following
peopleinjuredduetofirefollowing_s character varying(255), -- The source of the data
peopleinjuredduetofirefollowing_c text, -- A comment on the data
peopleinjuredduetofirefollowing_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
peoplemissingduetofirefollowing bigint, -- People missing due to fire following
peoplemissingduetofirefollowing_s character varying(255), -- The source of the data
peoplemissingduetofirefollowing_c text, -- A comment on the data
peoplemissingduetofirefollowing_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
peoplekilledduetofirefollowing bigint, -- People killed due to fire following
peoplekilledduetofirefollowing_s character varying(255), -- The source of the data
peoplekilledduetofirefollowing_c text, -- A comment on the data
peoplekilledduetofirefollowing_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
totalnumberofignitions bigint, -- Total number of ignitions
totalnumberofignitions_s character varying(255), -- The source of the data
totalnumberofignitions_c text, -- A comment on the data
totalnumberofignitions_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
numberoflargefires bigint, -- Number of large fires
numberoflargefires_s character varying(255), -- The source of the data
numberoflargefires_c text, -- A comment on the data
numberoflargefires_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
finalburntarea double precision, -- Final burnt area: SFED (single family equivalent dwelling)
finalburntarea_s character varying(255), -- The source of the data
finalburntarea_c text, -- A comment on the data
finalburntarea_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
peopledyingpostcatastrophe bigint, -- People dying after time has passed but their deaths related to the original fire following event
peopledyingpostcatastrophe_s character varying(255), -- The source of the data
peopledyingpostcatastrophe_c text, -- A comment on the data
peopledyingpostcatastrophe_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
numberofbuildingsdestroyed bigint, -- Total number of buildings destroyed, collapsed or damaged beyond repair due to fire following
numberofbuildingsdestroyed_s character varying(255), -- The source of the data
numberofbuildingsdestroyed_c text, -- A comment on the data
numberofbuildingsdestroyed_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
numberofbuildingsdamaged bigint, -- Total number of buildings damaged due to fire following
numberofbuildingsdamaged_s character varying(255), -- The source of the data
numberofbuildingsdamaged_c text, -- A comment on the data
numberofbuildingsdamaged_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
numberofdwellingsdestroyed bigint, -- Total number of dwelling units destroyed, collapsed or damaged beyond repair due to fire following
numberofdwellingsdestroyed_s character varying(255), -- The source of the data

```
  numberofdwellingsdestroyed_c text, -- A comment on the data
  numberofdwellingsdestroyed_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  numberofdwellingsdamaged bigint, -- Total number of dwelling units damaged due to fire following
  numberofdwellingsdamaged_s character varying(255), -- The source of the data
  numberofdwellingsdamaged_c text, -- A comment on the data
  numberofdwellingsdamaged_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  peoplehomeless bigint, -- Total number of people homeless for a significant duration of time due to fire following
  peoplehomeless_s character varying(255), -- The source of the data
  peoplehomeless_c text, -- A comment on the data
  peoplehomeless_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  directeconomicloss double precision, -- Total estimated direct economic loss due to fire following, million US$, contemporaneous. In absolute US$ value of the year of occurrence. Only includes direct effects.
  directeconomicloss_s character varying(255), -- The source of the data
  directeconomicloss_c text, -- A comment on the data
  directeconomicloss_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  indirecteconomicloss double precision, -- Total estimated indirect economic loss due to fire following, million US$, contemporaneous. In absolute US$ value of the year of occurrence. Only includes indirect effects.
  indirecteconomicloss_s character varying(255), -- The source of the data
  indirecteconomicloss_c text, -- A comment on the data
  indirecteconomicloss_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  numberofhouseholds bigint, -- Total number of households in the zone affected by fire following (contemporaneous)
  numberofhouseholds_s character varying(255), -- The source of the data
  numberofhouseholds_c text, -- A comment on the data
  numberofhouseholds_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  totalnumberofbuildings bigint, -- Total number of buildings in the zone affected by fire following (contemporaneous)
  totalnumberofbuildings_s character varying(255), -- The source of the data
  totalnumberofbuildings_c text, -- A comment on the data
  totalnumberofbuildings_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  overallimpact text, -- Overall socio economic impact
  ownerid integer NOT NULL DEFAULT 1, -- ID of the creator/owner of the record
  lastupdatebyid integer NOT NULL DEFAULT 1, -- ID of the last person to update this record
  lastupdate timestamp without time zone, -- Last record update date
  boundaryaffected character varying(255), -- Optional - an alternative to a boundary within the geobase. The bounding area in WKT format eg POINT (long lat).
  parenttype character varying(25), -- The type of study which owns this subevent. Set on creation, this must not be changed.
  boundary_c text, -- A comment on the precision of the boundary
  population_c text, -- A comment on the data
  population_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  contemporaneousdate timestamp without time zone, -- Base date for contemporaneous data, if not date of event, eg 1970-05-31
  population bigint, -- Population (contemporaneous)
  population_s character varying(255), -- The source of the data
  CONSTRAINT firefollowingsubevent_pkey PRIMARY KEY (id)
)
```

B.4 User Defined Study Level Classes

B.4.1 Inventory class table

```
CREATE TABLE inventoryclass
(
  id serial NOT NULL, -- Primary Key: Internal database id
  "name" character varying(50) NOT NULL DEFAULT 'Inventory class name'::character varying, -- Inventory class name from original survey
  parentid integer NOT NULL DEFAULT 0, -- The study which owns this inventory class. Set on creation, this must not be changed.
  parenttype character varying(25), -- The type of study which owns this inventory class. Set on creation, this must not be changed.
  mtype character varying(20) NOT NULL DEFAULT '0'::character varying, -- Material type: GEM Basic Building Taxonomy Table 1 Level 1 attribute
  mtech character varying(20) NOT NULL DEFAULT '0'::character varying, -- Material technology: GEM Basic Building Taxonomy Table 1 Level 2 attribute
  mort character varying(20) NOT NULL DEFAULT '0'::character varying, -- Masonry mortar type: GEM Basic Building Taxonomy Table 1 Level 3 attribute
  mrein character varying(20) NOT NULL DEFAULT '0'::character varying, -- Masonry reinforcement: GEM Basic Building Taxonomy Table 1 Level 3 attribute
  sconn character varying(20) NOT NULL DEFAULT '0'::character varying, -- Steel connection: GEM Basic Building Taxonomy Table 1 Level 3 attribute
  llrs character varying(20) NOT NULL DEFAULT '0'::character varying, -- Type of lateral load-resisting system: GEM Basic Building Taxonomy Table 2 Level 1 attribute
  llrsd character varying(20) NOT NULL DEFAULT '0'::character varying, -- System ductility: GEM Basic Building Taxonomy Table 2 Level 2 attribute
  rmat character varying(20) NOT NULL DEFAULT '0'::character varying, -- Roof material: GEM Basic Building Taxonomy Table 3 Level 1
  rtype character varying(20) NOT NULL DEFAULT '0'::character varying, -- Roof type: GEM Basic Building Taxonomy Table 3 Level 2
```

```
  fmat character varying(20) NOT NULL DEFAULT '0'::character varying, -- Floor material: GEM Basic Building Taxonomy Table 4 Level 1
  ftype character varying(20) NOT NULL DEFAULT '0'::character varying, -- Floor type: GEM Basic Building Taxonomy Table 4 Level 2
  h character varying(20) NOT NULL DEFAULT '0'::character varying, -- Height: GEM Basic Building Taxonomy Table 5
  h1 integer, -- Upper bound of height range (storeys)
  h2 integer, -- Lower bound of height range (storeys)
  d character varying(20) NOT NULL DEFAULT '0'::character varying, -- Date of construction: GEM Basic Building Taxonomy Table 6
  d1 integer, -- Upper bound of date of construction range (year)
  d2 integer, -- Lower bound of date of construction range (year)
  stri character varying(20) NOT NULL DEFAULT '0'::character varying, -- Structural irregularity type: GEM Basic Building Taxonomy Table 7 Level 1
  strhi character varying(20) NOT NULL DEFAULT '0'::character varying, -- Structural horizontal irregularity description: GEM Basic Building Taxonomy Table 7
Level 2:
  strvi character varying(20) NOT NULL DEFAULT '0'::character varying, -- Structural vertical irregularity description: GEM Basic Building Taxonomy Table 7
Level 2:
  occ character varying(20) NOT NULL DEFAULT '0'::character varying, -- Occupancy: GEM Basic Building Taxonomy Table 8 Level 1 attribute
  occd character varying(20) NOT NULL DEFAULT '0'::character varying, -- Occupancy detail: GEM Basic Building Taxonomy Table 8 Level 2 attribute
  designcode character varying(10), -- Applicable design code from original survey
  retrofit character varying(255), -- Type of retrofit from original survey
  description character varying(255), -- Inventory class description from original survey
  inventoryclass_c text, -- A comment on the inventory class
  ownerid integer NOT NULL DEFAULT 1, -- ID of the creator/owner of the record
  lastupdatebyid integer NOT NULL DEFAULT 1, -- ID of the last person to update this record
  lastupdate timestamp without time zone, -- Last record update date
  levelorder integer, -- Use this field when the inventory classes need to be in a particular order, eg when used in a survey matrix
  CONSTRAINT inventoryclass_pkey PRIMARY KEY (id)
  CONSTRAINT fk_inventoryclass FOREIGN KEY (designcode)
     REFERENCES lookupdesigncode (id) MATCH SIMPLE
     ON UPDATE NO ACTION ON DELETE NO ACTION
)
```

For construction related lookup tables see section A.7.

B.4.2 Damage level table

```
CREATE TABLE damagelevel
(
  id serial NOT NULL, -- Primary Key: Internal database id
  "name" character varying(50) NOT NULL DEFAULT 'Damage level name'::character varying, -- Damage level name eg "collapsed", or "D3", or "yellow"
  parentid integer NOT NULL DEFAULT 0, -- The study which owns this damage level - normally no need to change this
  mappingid integer NOT NULL DEFAULT 0, -- Mapping to unified damage level in the parent scales unified scale mapping
  description character varying(255), -- Damage level description
  ownerid integer NOT NULL DEFAULT 1, -- ID of the creator/owner of the record
  lastupdatebyid integer NOT NULL DEFAULT 1, -- ID of the last person to update this record
  lastupdate timestamp without time zone, -- Last record update date
  parenttype character varying(25), -- The type of parent which owns this. Set on creation, this must not be changed.
  levelorder integer, -- Use this field when the scale levels need to be in a particular order, eg when used in a survey matrix
  CONSTRAINT damagelevel_pkey PRIMARY KEY (id),
  CONSTRAINT fk_damagelevel FOREIGN KEY (mappingid)
     REFERENCES unifieddamagelevel (id) MATCH SIMPLE
     ON UPDATE NO ACTION ON DELETE NO ACTION
)
```

B.4.3 Casualty level table

```
CREATE TABLE casualtylevel
(
  id serial NOT NULL, -- Primary Key: Internal database id
  "name" character varying(50) NOT NULL DEFAULT 'casualty level name'::character varying, -- casualty level name
  parentid integer NOT NULL DEFAULT 0, -- The study which owns this casualty level - normally no need to change this
  mappingid integer NOT NULL DEFAULT 0, -- Mapping to unified casualty level in the parent scales unified scale mapping
  description character varying(255), -- casualty level description
  ownerid integer NOT NULL DEFAULT 1, -- ID of the creator/owner of the record
```

```
  lastupdatebyid integer NOT NULL DEFAULT 1, -- ID of the last person to update this record
  lastupdate timestamp without time zone, -- Last record update date
  parenttype character varying(25), -- The type of parent which owns this. Set on creation, this must not be changed.
  levelorder integer, -- Use this field when the scale levels need to be in a particular order, eg when used in a survey matrix
  CONSTRAINT casualtylevel_pkey PRIMARY KEY (id),
  CONSTRAINT fk_casualtylevel FOREIGN KEY (mappingid)
      REFERENCES unifiedcasualtylevel (id) MATCH SIMPLE
      ON UPDATE NO ACTION ON DELETE NO ACTION
)
```

B.5 Location

B.5.1 Location table

```
CREATE TABLE "location"
(
  id serial NOT NULL, -- Primary Key: Internal database id
  "name" character varying(50) NOT NULL DEFAULT 'Location name'::character varying, -- Location name
  parentid integer NOT NULL DEFAULT 0, -- The  primary study or subevent which owns this location. Set on creation, this must not be changed.
  parenttype character varying(25), -- The type of primary study or subevent which owns this location. Set on creation, this must not be changed.
  isaggregated integer NOT NULL DEFAULT 1, -- This field determines if this location is a single asset (value 0) or an aggregation of assets (value 1, default)
  "location" character varying(50), -- Optional. The location in WKT format eg POINT (long lat). Can be null in which case use the boundary or intensity zone
  location_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  boundaryid integer NOT NULL DEFAULT 0, -- Optional. A boundary within the geobase, which is defined in the parent study.
  intensityzonecode character varying(10) NOT NULL DEFAULT '0'::character varying, -- Optional. Only use this if the location is an intensity zone: The intensity
zone on a standard scale.
  soilclasscode character varying(10) NOT NULL DEFAULT '0'::character varying, -- Optional. For future NEHRP Soil Class.
  location_c text, -- An optional comment on the location and loss at the location
  ownerid integer NOT NULL DEFAULT 1, -- ID of the creator/owner of the record
  lastupdatebyid integer NOT NULL DEFAULT 1, -- ID of the last person to update this record
  lastupdate timestamp without time zone, -- Last record update date
  boundary_c text, -- A comment on the precision of the location or boundary
  originalsurveyreference character varying(50), -- Optional original survey reference
  address character varying(255), -- Optional address
  guid uuid, -- Optional globally unique identifier for compatibility with other GEM components
  generalsoilconditions_c text,
  the_geom geometry,
  CONSTRAINT location_pkey PRIMARY KEY (id),
  CONSTRAINT fk_location FOREIGN KEY (intensityzonecode)
      REFERENCES lookupintensityzone (id) MATCH SIMPLE
      ON UPDATE NO ACTION ON DELETE NO ACTION,
  CONSTRAINT fk_location_0 FOREIGN KEY (soilclasscode)
      REFERENCES lookupsoilclass (id) MATCH SIMPLE
      ON UPDATE NO ACTION ON DELETE NO ACTION,
  CONSTRAINT fk_location_1 FOREIGN KEY (isaggregated)
      REFERENCES lookupyesno (id) MATCH SIMPLE
      ON UPDATE NO ACTION ON DELETE NO ACTION,
  CONSTRAINT enforce_dims_the_geom CHECK (st_ndims(the_geom) = 2),
  CONSTRAINT enforce_srid_the_geom CHECK (st_srid(the_geom) = 4326)
)
```

B.5.2 Location detail table

TO BE DEFINED – WILL STORE DETAILED LOCATION INFO FOR BUILDING BY BUILDING SURVEYS

```
CREATE TABLE locationdetail
(
  id serial NOT NULL, -- Primary Key: Internal database id
  parentid integer NOT NULL DEFAULT 0, -- The location which owns this detail record - normally no need to change this
  address character varying(255), -- Address - used for individual building records
  reference character varying(50), -- Reference can used for individual building records, eg survey building number
```

```
  metriccode character varying(10) NOT NULL DEFAULT '0'::character varying, -- The metric of the value - number of buildings/assets, number of people, length m, height m, area sq m, volume cu m, cost $, ratio, damage per km
  damagescaleid integer NOT NULL DEFAULT 0, -- Damage scale
  damagelevelid integer NOT NULL DEFAULT 0, -- Damage level in the chosen damage scale
  casualtyscaleid integer NOT NULL DEFAULT 0, -- casualty scale
  casualtylevelid integer NOT NULL DEFAULT 0, -- casualty level in the chosen casualty scale
  inventoryclassid integer NOT NULL DEFAULT 0, -- Inventory class
  assetclasscode character varying(10) NOT NULL DEFAULT '0'::character varying, -- Asset class
  assettypecode character varying(10) NOT NULL DEFAULT '0'::character varying, -- Asset type
  assetsubtypecode character varying(10) NOT NULL DEFAULT '0'::character varying, -- Asset sub type
  typeofdamagecode character varying(10) NOT NULL DEFAULT '0'::character varying, -- Type of damage
  ownerid integer NOT NULL DEFAULT 1, -- ID of the creator/owner of the record
  lastupdatebyid integer NOT NULL DEFAULT 1, -- ID of the last person to update this record
  lastupdate timestamp without time zone, -- Last record update date
  "name" character varying(64) NOT NULL,
  CONSTRAINT locationdetail_pkey PRIMARY KEY (id)
)
```

B.6 Survey Data

B.6.1 Survey values table

```
CREATE TABLE surveyvalue
(
  id serial NOT NULL, -- Primary Key: Internal database id
  parentid integer NOT NULL DEFAULT 0, -- The location which owns this survey value record - normally no need to change this
  metriccode character varying(5) NOT NULL DEFAULT 'N'::character varying, -- The metric of the value - number of buildings/assets, number of people, length m, height m, area sq m, volume cu m, cost $, ratio, damage per km
  damagelevelid integer NOT NULL DEFAULT 0, -- Damage level in the chosen damage scale
  casualtylevelid integer NOT NULL DEFAULT 0, -- casualty level in the chosen casualty scale
  inventoryclassid integer NOT NULL DEFAULT 0, -- Inventory class
  assetclasscode character varying(10) NOT NULL DEFAULT '0'::character varying, -- Asset class
  assettypecode character varying(10) NOT NULL DEFAULT '0'::character varying, -- Asset type
  assetsubtypecode character varying(10) NOT NULL DEFAULT '0'::character varying, -- Asset sub type
  typeofdamagecode character varying(10) NOT NULL DEFAULT '0'::character varying, -- Type of damage
  "value" double precision, -- The survey value, a single number or percentage
  value_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  ownerid integer NOT NULL DEFAULT 1, -- ID of the creator/owner of the record
  lastupdatebyid integer NOT NULL DEFAULT 1, -- ID of the last person to update this record
  lastupdate timestamp without time zone, -- Last record update date
  "name" character varying(64) NOT NULL DEFAULT 'initialising'::character varying,
  assetconstructioncode character varying(10) NOT NULL DEFAULT '0'::character varying, -- Asset form of construction
  parentdamagesurveymatrixid integer NOT NULL DEFAULT 0, -- If this survey value was created through a survey matrix this records its id
  parentcasualtysurveymatrixid integer NOT NULL DEFAULT 0, -- If this survey value was created through a survey matrix this records its id
  CONSTRAINT surveyvalue_pkey PRIMARY KEY (id),
  CONSTRAINT fk_surveyvalue FOREIGN KEY (inventoryclassid)
      REFERENCES inventoryclass (id) MATCH SIMPLE
      ON UPDATE NO ACTION ON DELETE NO ACTION,
  CONSTRAINT fk_surveyvalue_0 FOREIGN KEY (parentid)
      REFERENCES "location" (id) MATCH SIMPLE
      ON UPDATE NO ACTION ON DELETE NO ACTION,
  CONSTRAINT fk_surveyvalue_1 FOREIGN KEY (metriccode)
      REFERENCES lookupmetric (id) MATCH SIMPLE
      ON UPDATE NO ACTION ON DELETE NO ACTION,
  CONSTRAINT fk_surveyvalue_2 FOREIGN KEY (damagelevelid)
      REFERENCES damagelevel (id) MATCH SIMPLE
      ON UPDATE NO ACTION ON DELETE NO ACTION,
  CONSTRAINT fk_surveyvalue_3 FOREIGN KEY (casualtylevelid)
      REFERENCES casualtylevel (id) MATCH SIMPLE
      ON UPDATE NO ACTION ON DELETE NO ACTION,
  CONSTRAINT fk_surveyvalue_4 FOREIGN KEY (typeofdamagecode)
      REFERENCES lookuptypeofdamage (id) MATCH SIMPLE
```

```
    ON UPDATE NO ACTION ON DELETE NO ACTION,
  CONSTRAINT fk_surveyvalue_5 FOREIGN KEY (assetclasscode)
    REFERENCES lookupassetclass (id) MATCH SIMPLE
    ON UPDATE NO ACTION ON DELETE NO ACTION,
  CONSTRAINT fk_surveyvalue_6 FOREIGN KEY (assettypecode)
    REFERENCES lookupassettype (id) MATCH SIMPLE
    ON UPDATE NO ACTION ON DELETE NO ACTION,
  CONSTRAINT fk_surveyvalue_7 FOREIGN KEY (assetsubtypecode)
    REFERENCES lookupassetsubtype (id) MATCH SIMPLE
    ON UPDATE NO ACTION ON DELETE NO ACTION,
  CONSTRAINT fk_surveyvalue_8 FOREIGN KEY (assetconstructioncode)
    REFERENCES lookupassetconstruction (id) MATCH SIMPLE
    ON UPDATE NO ACTION ON DELETE NO ACTION
)
```

B.6.2 Damage survey matrix table

```
CREATE TABLE damagesurveymatrix
(
  id integer NOT NULL DEFAULT nextval('surveymatrix_id_seq'::regclass), -- Primary Key: Internal database id
  parentid integer NOT NULL DEFAULT 0, -- The location which owns this survey matrix record - normally no need to change this
  metriccode character varying(10) NOT NULL DEFAULT '1'::character varying, -- The metric of the matrix values - number of buildings/assets, number of people, length m, height m, area sq m, volume cu m, cost $, ratio, damage per km
  assetclasscode character varying(10) NOT NULL DEFAULT '0'::character varying, -- Asset class
  assettypecode character varying(10) NOT NULL DEFAULT '0'::character varying, -- Asset type
  assetsubtypecode character varying(10) NOT NULL DEFAULT '0'::character varying, -- Asset sub type
  typeofdamagecode character varying(10) NOT NULL DEFAULT '0'::character varying, -- Type of damage
  matrix text, -- The matrix of survey values
  value_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  ownerid integer NOT NULL DEFAULT 1, -- ID of the creator/owner of the record
  lastupdatebyid integer NOT NULL DEFAULT 1, -- ID of the last person to update this record
  lastupdate timestamp without time zone, -- Last record update date
  "name" character varying(64) NOT NULL DEFAULT 'initialising'::character varying,
  assetconstructioncode character varying(10), -- Asset form of construction
  CONSTRAINT surveymatrix_pkey PRIMARY KEY (id)
)
```

B.6.3 Casualty survey metric table

```
CREATE TABLE casualtysurveymatrix
(
  id serial NOT NULL, -- Primary Key: Internal database id
  parentid integer NOT NULL DEFAULT 0, -- The location which owns this survey matrix record - normally no need to change this
  metriccode character varying(10) NOT NULL DEFAULT '1'::character varying, -- The metric of the matrix values - number of buildings/assets, number of people, length m, height m, area sq m, volume cu m, cost $, ratio, damage per km
  assetclasscode character varying(10) NOT NULL DEFAULT '0'::character varying, -- Asset class
  assettypecode character varying(10) NOT NULL DEFAULT '0'::character varying, -- Asset type
  assetsubtypecode character varying(10) NOT NULL DEFAULT '0'::character varying, -- Asset sub type
  matrix text, -- The matrix of survey values
  value_q character varying(10) NOT NULL DEFAULT '0'::character varying, -- The status of the data
  ownerid integer NOT NULL DEFAULT 1, -- ID of the creator/owner of the record
  lastupdatebyid integer NOT NULL DEFAULT 1, -- ID of the last person to update this record
  lastupdate timestamp without time zone, -- Last record update date
  "name" character varying(64) NOT NULL DEFAULT 'initialising'::character varying,
  assetconstructioncode character varying(10), -- Asset form of construction
  CONSTRAINT casualtysurveymatrix_pkey PRIMARY KEY (id)
)
```

B.6.4 Type of damage lookup table

```
CREATE TABLE lookuptypeofdamage
(
  id character varying(10) NOT NULL, -- Primary Key: lookup code
  "name" character varying(255) DEFAULT ''::character varying, -- The name
  weight integer DEFAULT 0, -- Controls order in which items are displayed in menus
  CONSTRAINT lookuptypeofdamage_pkey PRIMARY KEY (id)
)
```

B.6.5 Asset class lookup table

```
CREATE TABLE lookupassetclass
(
  id character varying(10) NOT NULL, -- Primary Key: lookup code
  "name" character varying(255) DEFAULT ''::character varying, -- The name
  weight integer DEFAULT 0, -- Controls order in which items are displayed in menus
  CONSTRAINT lookupassetclass_pkey PRIMARY KEY (id)
)
```

B.6.6 Asset construction lookup table

```
CREATE TABLE lookupassetconstruction
(
  id character varying(10) NOT NULL, -- Primary Key: lookup code
  "name" character varying(255) DEFAULT ''::character varying, -- The name
  weight integer DEFAULT 0, -- Controls order in which items are displayed in menus
  parentid character varying(10) NOT NULL DEFAULT 0,
  CONSTRAINT lookupassetconstruction_pkey PRIMARY KEY (id),
  CONSTRAINT fk_lookupassetconstruction FOREIGN KEY (parentid)
      REFERENCES lookupassetsubtype (id) MATCH SIMPLE
      ON UPDATE NO ACTION ON DELETE NO ACTION
)
```

B.6.7 Asset type lookup table

```
CREATE TABLE lookupassettype
(
  id character varying(10) NOT NULL, -- Primary Key: lookup code
  "name" character varying(255) DEFAULT ''::character varying, -- The name
  weight integer DEFAULT 0, -- Controls order in which items are displayed in menus
  parentid character varying(10) NOT NULL DEFAULT 0,
  CONSTRAINT lookupassettype_pkey PRIMARY KEY (id),
  CONSTRAINT fk_lookupassettype FOREIGN KEY (parentid)
      REFERENCES lookupassetclass (id) MATCH SIMPLE
      ON UPDATE NO ACTION ON DELETE NO ACTION
)
```

B.6.8 Asset sub type lookup table

```
CREATE TABLE lookupassetsubtype
(
  id character varying(10) NOT NULL, -- Primary Key: lookup code
  "name" character varying(255) DEFAULT ''::character varying, -- The name
  weight integer DEFAULT 0, -- Controls order in which items are displayed in menus
  parentid character varying(10) NOT NULL DEFAULT 0,
  CONSTRAINT lookupassetsubtype_pkey PRIMARY KEY (id),
  CONSTRAINT fk_lookupassetsubtype FOREIGN KEY (parentid)
      REFERENCES lookupassettype (id) MATCH SIMPLE
```

```
    ON UPDATE NO ACTION ON DELETE NO ACTION
)
```

B.7 Inventory Class Dictionary tables

These tables relate to the GEM Basic Taxonomy [7].

B.7.1 Attribute type table

```
CREATE TABLE dic_attribute_type
(
  attribute_type_code character varying(20) NOT NULL DEFAULT '0'::character varying, -- Primary Key: The attribute type code
  short_description character varying(50) NOT NULL DEFAULT 'unknown'::character varying, -- The short description of the attribute type
  description character varying(255), -- The description of the attribute type
  concept_space character varying(20) NOT NULL DEFAULT 'unknown'::character varying, -- The attribute type scope
  weight integer NOT NULL DEFAULT 0, -- Weight for ordering of dropdown menus
  CONSTRAINT dic_attribute_type_pkey PRIMARY KEY (attribute_type_code)
)
```

B.7.2 Dictionary table

```
CREATE TABLE dic_type_value
(
  attribute_value character varying(20) NOT NULL DEFAULT '0'::character varying, -- Primary Key: The attribute value
  attribute_type_code character varying(20) NOT NULL DEFAULT '0'::character varying, -- The attribute type code, which is looked up from a view on the dic_attribute_type table
  description character varying(255) NOT NULL DEFAULT 'unknown'::character varying, -- The description of the attribute
  attribute_scope character varying(10) NOT NULL DEFAULT 'unknown'::character varying, -- The attribute scope
  translation character varying(10), -- The translation
  takes_qualifier character varying(10), -- The takes qualifier value
  weight integer NOT NULL DEFAULT 0, -- Weight for ordering of dropdown menus
  CONSTRAINT dic_type_value_pkey PRIMARY KEY (attribute_value)
)
```

B.8 Unified Scale Tables

```
CREATE TABLE unifieddamagescale
(
  id integer NOT NULL, -- Primary Key: lookup code
  "name" character varying(255) DEFAULT ''::character varying, -- The name
  weight integer DEFAULT 0, -- Controls order in which items are displayed in menus
  CONSTRAINT unifieddamagescale_pkey PRIMARY KEY (id)
)

CREATE TABLE unifieddamagelevel
(
  id integer NOT NULL, -- Primary Key: lookup code
  "name" character varying(255) DEFAULT ''::character varying, -- The name
  weight integer DEFAULT 0, -- Controls order in which items are displayed in menus
  CONSTRAINT unifieddamagelevel_pkey PRIMARY KEY (id)
)

CREATE TABLE unifiedcasualtyscale
(
  id integer NOT NULL, -- Primary Key: lookup code
  "name" character varying(255) DEFAULT ''::character varying, -- The name
  weight integer DEFAULT 0, -- Controls order in which items are displayed in menus
```

```
  CONSTRAINT unifiedcasualtyscale_pkey PRIMARY KEY (id)
)

CREATE TABLE unifiedcasualtylevel
(
  id integer NOT NULL, -- Primary Key: lookup code
  "name" character varying(255) DEFAULT ''::character varying, -- The name
  weight integer DEFAULT 0, -- Controls order in which items are displayed in menus
  CONSTRAINT unifiedcasualtylevel_pkey PRIMARY KEY (id)
)
```

B.9 Miscellaneous Lookup Tables

```
CREATE TABLE lookupdesigncode
(
  id character varying(10) NOT NULL, -- Primary Key: lookup code
  name character varying(255) DEFAULT ''::character varying, -- The name
  weight integer DEFAULT 0, -- Controls order in which items are displayed in menus
  CONSTRAINT lookupdesigncode_pkey PRIMARY KEY (id )
)

CREATE TABLE lookupsoilclass
(
  id character varying(10) NOT NULL, -- Primary Key: lookup code
  name character varying(255) DEFAULT ''::character varying, -- The name
  weight integer DEFAULT 0, -- Controls order in which items are displayed in menus
  CONSTRAINT lookupsoiltype_pkey PRIMARY KEY (id )
)

CREATE TABLE lookupgeoserverprotocol
(
  id character varying(10) NOT NULL, -- Primary Key: lookup code
  "name" character varying(255) DEFAULT ''::character varying, -- The name
  weight integer DEFAULT 0, -- Controls order in which items are displayed in menus
  CONSTRAINT lookupgeoserverprotocol_pkey PRIMARY KEY (id)
)

CREATE TABLE lookupintensityzone
(
  id character varying(10) NOT NULL, -- Primary Key: lookup code
  "name" character varying(255) DEFAULT ''::character varying, -- The name
  weight integer DEFAULT 0, -- Controls order in which items are displayed in menus
  CONSTRAINT lookupintensityzone_pkey PRIMARY KEY (id)
)

CREATE TABLE lookupmagnitudeunit
(
  id character varying(10) NOT NULL, -- Primary Key: lookup code
  "name" character varying(255) DEFAULT ''::character varying, -- The name
  weight integer DEFAULT 0, -- Controls order in which items are displayed in menus
  CONSTRAINT lookupmagnitudeunit_pkey PRIMARY KEY (id)
)

CREATE TABLE lookupmetric
(
  id character varying(10) NOT NULL, -- Primary Key: lookup code
  "name" character varying(255) DEFAULT ''::character varying, -- The name
  weight integer DEFAULT 0, -- Controls order in which items are displayed in menus
  CONSTRAINT lookupmetric_pkey PRIMARY KEY (id)
)

CREATE TABLE lookupqualitymetric
(
```

```
  id character varying(10) NOT NULL, -- Primary Key: lookup code
  "name" character varying(255) DEFAULT ''::character varying, -- The name
  weight integer DEFAULT 0, -- Controls order in which items are displayed in menus
  CONSTRAINT lookupqualitymetric_pkey PRIMARY KEY (id)
)

CREATE TABLE lookupregion
(
  id character varying(10) NOT NULL, -- Primary Key: lookup code
  "name" character varying(255) DEFAULT ''::character varying, -- The name
  weight integer DEFAULT 0, -- Controls order in which items are displayed in menus
  CONSTRAINT lookupregion_pkey PRIMARY KEY (id)
)

CREATE TABLE lookupstatus
(
  id character varying(10) NOT NULL, -- Primary Key: lookup code
  "name" character varying(255) DEFAULT ''::character varying, -- The name
  weight integer DEFAULT 0, -- Controls order in which items are displayed in menus
  CONSTRAINT lookupstatus_pkey PRIMARY KEY (id)
)

CREATE TABLE lookupunit
(
  id character varying(10) NOT NULL, -- Primary Key: lookup code
  "name" character varying(255) DEFAULT ''::character varying, -- The name
  weight integer DEFAULT 0, -- Controls order in which items are displayed in menus
  CONSTRAINT lookupunit_pkey PRIMARY KEY (id)
)
```

B.10 Unstructured Data

B.10.1 Digital assetlink table -- links any database entity to any number of assets stored in the Digital Asset Management System.

```
CREATE TABLE digitalasset
(
  id serial NOT NULL, -- Primary Key: Internal database id
  "name" character varying(255) NOT NULL DEFAULT 'Asset name'::character varying, -- Digital asset name
  parentid integer NOT NULL DEFAULT 0, -- The entity which owns this digital asset.
  parenttype character varying(25), -- The type of entity which owns this digital asset.
  description character varying(255), -- Optional description of the asset
  url character varying(255), -- the URL of the asset
  assettypeid integer NOT NULL DEFAULT 0, -- The mime type of the asset
  ownerid integer NOT NULL DEFAULT 1, -- ID of the creator/owner of the record
  lastupdatebyid integer NOT NULL DEFAULT 1, -- ID of the last person to update this record
  lastupdate timestamp without time zone, -- Last record update date
  CONSTRAINT digitalasset_pkey PRIMARY KEY (id)
)
```

B.11 LOOKUP Table

B.11.1 Asset class

id	name	weight
0	n/a	0
CF	Critical facilities	1

NS	Non-standard building	2
I	Infrastructure	3
HB	Historic building	4

B.11.2 Asset type

id	name	weight	parentid
0	n/a	0	0
MC	Medical care	0	CF
ER	Emergency response	1	CF
S	School	2	CF
DAM	Dam	3	CF
NP	Nuclear power facility	4	CF
M	Military installation	5	CF
STA	Stadium	6	NS
LAS	Large assembly hall	7	NS
R	Road	8	I
HB	Highway bridge	9	I
TUN	Tunnel	10	I
RAILT	Railway track	11	I
RAILB	Railway bridge	12	I
RAILS	Railway station	13	I
RAILTUN	Railway tunnel	14	I
RAILOTH	Railway other structure	15	I
BUS	Bus station or other facility	16	I
PB	Pier or dock	17	I
CRANE	Crane or cargo handling equipment	18	I
PORT	Port structure or warehouse	19	I
FERRY	Ferry terminal	20	I
AIRRUN	Airport runway	21	I
AIRCT	Airport control tower	22	I
AIRPT	Airport passenger terminal	23	I
AIRPARK	Airport parking structure	24	I
AIRMAINT	Airport maintenance facility	25	I
AIRFUEL	Airport fuel facility	26	I
WATERP	Water pipeline	27	I
WATERT	Water treatment plant	28	I
WATERPP	Water pumping plant	29	I
WATERSG	Water storage tank on ground	30	I
WATERSE	Water storage tank elevated	31	I
WELL	Well	32	I
WASTEP	Waste water pipeline	33	I
WASTET	Waste water treatment plant	34	I
WASTEPP	Waste water pumping plant	35	I

PIPE	Pipeline	36	I
REF	Refinery	37	I
TANK	Tank farm	38	I
PUMP	Pumping plant	39	I
ELEC	Electricity power generation plant	40	I
ELECT	Power transmission line	41	I
ELECLV	Electric substation low voltage	42	I
ELECHV	Electric substation high voltage	43	I
TELTOWER	Telecommmunications transmission tower	44	I
PAL	Palace/mansion	45	HB
CAS	Castle	46	HB
CHU	Church	47	HB
RI	Religious institution	48	HB
MOS	Mosque	49	HB
MAR	Market	50	HB
TOWER	Tower/obelisk	51	HB
ARCH	Arch or colonnade	52	HB
AR	Archaeological site	53	HB
CEN	Historic urban centre	54	HB

B.11.3 Asset sub type

id	name	weight	parentid
0	n/a	0	0
UNK	Unknown	0	0
MCS	Small hospital	1	MC
MCM	Medium hospital	2	MC
MCL	Large hospital	3	MC
MCMC	Medical clinic	4	MC
ERFS	Fire station	5	ER
ERPS	Police station	6	ER
EROS	Emergency operations centre	7	ER
SES	Elementary school	8	S
SMS	Middle school	9	S
SCU	College/University	10	S
RU	Urban road	11	R
RMA	Major road	12	R
RMI	Minor road	13	R
HBS	Single span	14	HB
HBM	Multi span	15	HB

B.11.4 Asset construction – Currently unfilled

B.11.5 B.5 Geoserver protocol– Currently unfilled

B.11.6 USGS Intensity zone

id	name	weight
0	n/a	0
I	I	1
II	II	2
III	III	3
IV	IV	4
V	V	5
VI	VI	6
VII	VII	7
VIII	VIII	8
IX	IX	9
X	X	10
XI	XI	11
XII	XII	12
XII+	XII+	13

B.11.7 Magnitude unit

id	name	weight
MD	Duration (Md)	1
ML	Local (ML)	2
MS	Surface wave (Ms)	3
MW	Moment (Mw)	4
ME	Energy (Me)	5
MI	Moment (Mi)	6
MB	Body (Mb)	7
MLG	Surface wave (MLg)	8

B.11.8 Metric

id	name	weight
0	n/a	0
N	Number of buildings or assets	1
P	Number of people	2
L	Length of asset affected (m)	3
H	Height of asset affected (m)	4
A	Area of asset affected (sq m)	5
V	Volume of asset affected (cu m)	6

C	Cost (US$)	7
R	Ratio	8
K	Damage per km	9
PN	Percentage of buildings or assets	10
PP	Percentage of people	11
PA	Percentage area	12

B.11.9 Quality metric

id	name	weight
0	n/a	0
S	Superior	1
A	Average	2
M	Marginal	3
N	None	4

B.11.10 Region

id	name	weight
AF	Africa	1
AS	Asia	2
EU	Europe	3
NA	North America	4
SA	South America	5
OC	Oceania	6

B.11.11 Soil class

id	name	weight
0	N/A	0
A	A (>1500)	1
B	B (760 - 1500)	2
C	C (360 - 760)	3
D	D (180 - 360)	4
E	E (<180)	5

B.11.12 Status

id	name	weight
WAITING	Waiting for input	0
OK	OK	1
APPROX	Approximate	2
GT	Greater than	3
LT	Less than	4

NA	N/A	5
IMPROVE	Needs improvement	6
EQUIV	Equivalent	7
MI	Missing	8
WH	Withheld	9
COMM	See comments	10

B.11.13 Type of damage - Currently unfilled

B.11.14 Unit - Currently unfilled

THE GLOBAL EARTHQUAKE MODEL

The mission of the Global Earthquake Model (GEM) collaborative effort is to increase earthquake resilience worldwide.

To deliver on its mission and increase public understanding and awareness of seismic risk, the GEM Foundation, a non-profit public-private partnership, drives the GEM effort by involving and engaging with a very diverse community to:

- Share data, models, and knowledge through the OpenQuake platform
- Apply GEM tools and software to inform decision-making for risk mitigation and management
- Expand the science and understanding of earthquakes.

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GEM
GLOBAL EARTHQUAKE MODEL
working together to assess risk