DEVELOPMENT OF A EUROPEAN BUILDING INVENTORY DATABASE

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This presentation covers work package 7 of the NERA project, which has the objective to develop a database that describes the number and area of different European building typologies (e.g. unreinforced masonry bearing wall, non-ductile reinforced concrete moment resisting frame etc.) within each cell of a grid, with a resolution of at least 30 arc seconds (which is approximately 1km square at the equator) for use in the seismic risk assessment of European buildings (Crowley et al., 2012). The database structure of the Global Exposure Database, an initiative of the Global Earthquake Model (GEM), is being used to store the European building data. Building inventory data is available at different levels of resolution and characterisation across Europe and thus one of the aims of the database is to produce both homogeneous levels of building exposure data as well as provide a place where detailed, high resolution data can be stored. For this reason, the Global Exposure Database has been designed with a number of different levels, which are split between three different databases (as illustrated in the figure below):
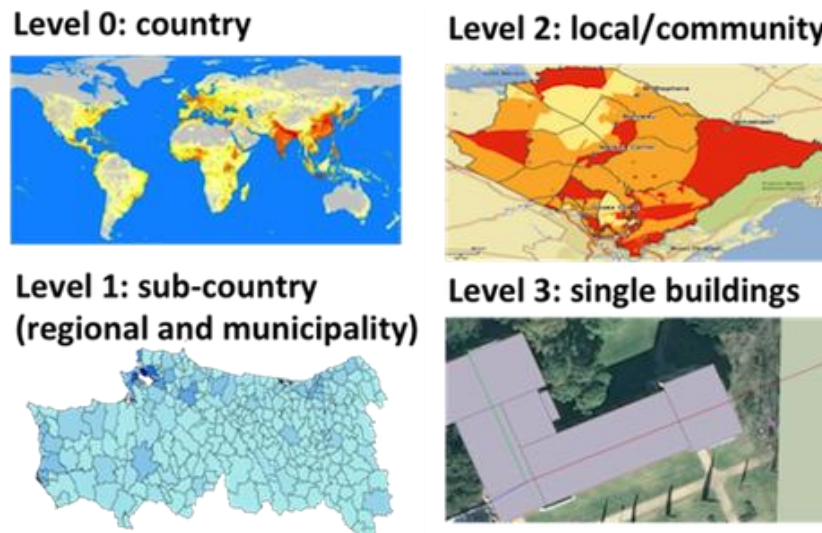

Figure 1. Levels (0, 1, 2 and 3) of the exposure database

The first version of the European Building Inventory Database will make use of the population dataset of the Global Exposure Database, which is based on the Global Rural-Urban Mapping Project, Version 1 (GRUMPv1) which consists of estimates of human population for the year 2000 by 30 arc-second (1km) grid cells. A proportional allocation gridding algorithm, utilizing more than 1,000,000 national

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and sub-national geographic units, is used to assign population values (counts, in persons) to grid cells. The possibility to use European population datasets (such as Gallego (2010), which is available at a resolution of 100m, see Fig 2.) will be explored towards the end of the project, and recommendations for the future will be made. This dataset is an important part of the database, as it is used as a proxy for building distribution and density. A number of algorithms have been developed and implemented in the database to transform population density into building counts.
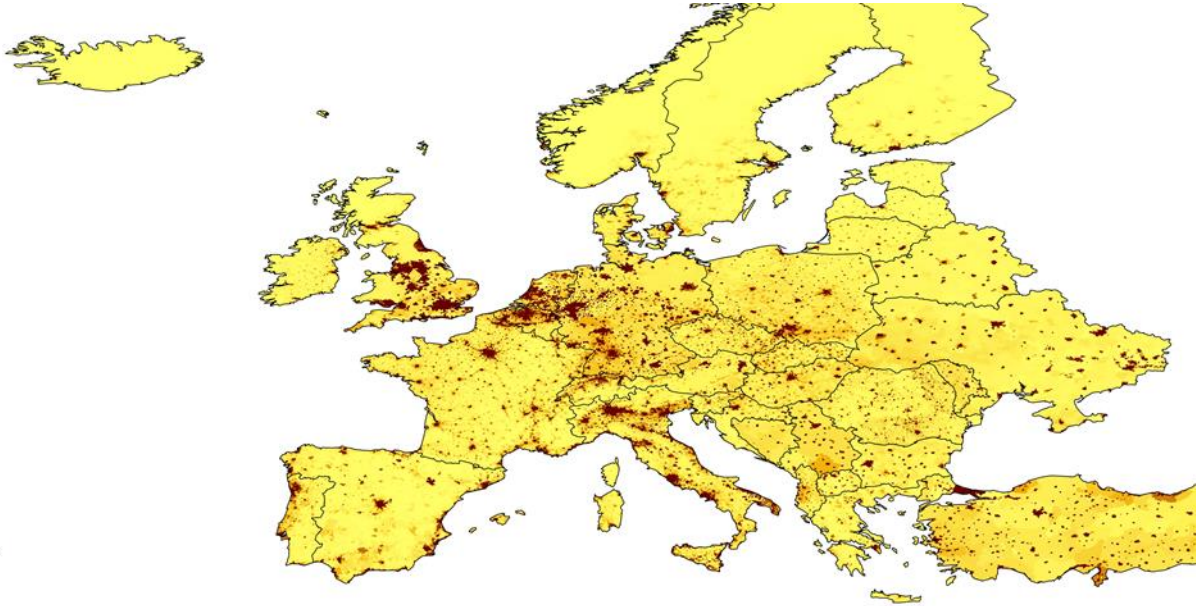

Fig. 2. Population distribution in Europe (Gallego, 2010)

In May 2011, 'Key Players' in European building inventory data collection were identified and a workshop on this topic was held in Pavia, Italy with these experts in order to understand the existing state-of-the-knowledge of buildings in Europe. Following this workshop, and thanks to the input of the participants, an extensive study of the sources of building data in Europe was carried out.

For every European country (45 in total), the national statistical services have been investigated for any available dataset including building/dwelling censuses, surveys, yearbooks or construction reports, as well as other sources such as building inventory initiatives (e.g. WHE-PAGER), European projects related to energy and environmental assessment of buildings (e.g. TABULA, IMPRO Project), European and international databases (Eurostat, UNECE), detailed local building surveys and post-earthquake reports performed by several experts.

Based on the above activities, we currently have the following data:
- Dwelling/building data for 45 European countries to allow a 30-arc second grid of building count and area to be estimated. An example of the types of data being collected is shown in the table below:

Table 1. Extract of the statistics on dwellings and buildings collected for each European country

	Number of Buildings	Number of Dwellings	Average number of dwellings per building	Average number of people per building	Average number of people per dwelling
Albania	598267	1012400	1.69	4.68	3.92
Andorra	3641				2.44
Austria	1764455	3757409	2.13	4.47	2.04
Belarus	1630267	3893638	2.39	5.77	2.41
Belgium	3681826	5179638	1.41	2.48	2.11
Bosnia and Herzegovina		1055000			3.27
Bulgaria	2060745	3887076	1.88	3.54	1.88
Croatia		2257515			1.90
Cyprus		431059	2.03		1.94
Czech Republic	2115886	4756672	2.25	4.77	2.17

- Level 0 (i.e. national) building/dwelling fractions for 45 European countries (building upon work from the PAGER project, JRC IMPRO-Building Project, census data and expert opinion through questionnaires), to allow the above grid to be disaggregated between different building typologies (described with GEM Building Taxonomy v2.0):

Table 2. Extract of the data showing the distribution of building typologies in a number of countries in Europe

Building Fractions (based on IMPRO Project)	AT	BE	CY	CZ	DE	DK	EE	ES	FI	FR
DX/CR/LFINF/DY/CR/LFINF///RES////EWMA//FC/							0.57		0.45	
DX/CR/LFINF/DY/CR/LFINF/HBET:4,10//RES////EWMA//FC/	0.23	0.31	0.02	0.25	0.28	0.28		0.38		0.21
DX/CR/LWAL/DY/CR/LWAL/HBET:4,10//RES////EWC//FC/	0.02	0.00	0.00	0.32	0.08	0.04	0.03	0.03	0.03	0.01
DX/M99+CB99/LWAL/DY/M99+CB99/LWAL/HBET:1,2//RES////EWMA//FC/	0.00	0.03		0.03	0.03	0.02				
DX/M99+CB99/LWAL/DY/M99+CB99/LWAL/HBET:1,2//RES////EWMA//FM/							0.16		0.26	
DX/M99+CB99/LWAL/DY/M99+CB99/LWAL/HBET:1,4//RES////EWMA//FC/			0.00				0.02	0.00	0.02	0.00
DX/M99+CL99/LWAL/DY/M99+CL99/LWAL/HBET:1,3//RES////EWMA//FM/	0.04	0.00	0.00	0.06	0.00	0.00		0.00		0.23
DX/M99+CL99/LWAL/DY/M99+CL99/LWAL/HBET:1,3//RES////EWMA//FW/			0.11					0.07		0.24

- Level 1 (i.e. sub-national) building/dwelling fractions for 18 European countries (e.g. Albania, Belarus, Bulgaria, Cyprus, Greece, Italy, Portugal, Slovenia, Turkey) using census data and other sources to define building typologies.

In April 2012, a Building Inventory Validation meeting was held in Pavia, Italy to discuss various methods to test the European building database with test-bed data from a number of areas. A number of tests have been developed which will be used to test the final level 0 and 1 European building database at the end of the project (Spence et al., 2012).

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