GFZ Helmholtz Centre POTSDAM

Natural Hazards and Risks in a Changing World

Inside the Global Dynamic Exposure model: bringing together aggregated models and crowd-sourced building-level data

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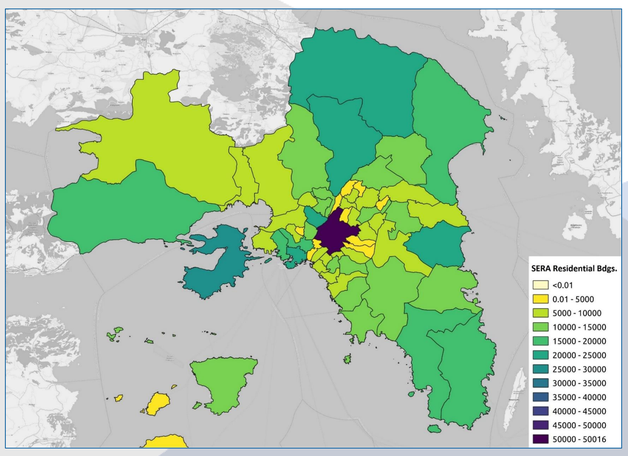
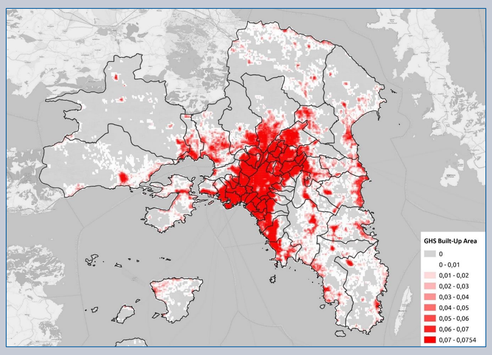
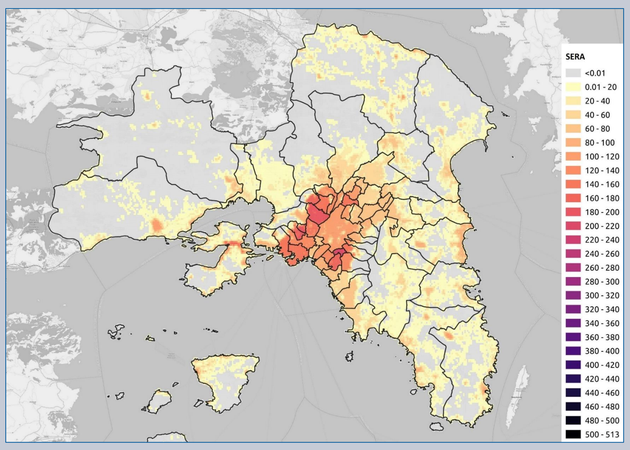


Aggregated Model in Admin. Units
Number of residential buildings in Attica, Greece, as per the exposure model of the European Seismic Risk Model (ESRM20; Crowley et al. 2020).



Built-Up Area per Tile
as per the Global Human Settlement Layer (GHSL; Florczyk et al. 2019).



Aggregated Model Distributed onto Tiles
Number of residential buildings per tile as per the ESRM20 exposure model distributed in proportion to the GHSL built-up areas.

Abstract

We are currently developing a **Global Dynamic Exposure (GDE)** model that continuously retrieves data about individual buildings that are voluntarily mapped by contributors to the OpenStreetMap (OSM) initiative. This is combined with transparent engineering judgement and openly available building exposure models that are defined in terms of administrative units to produce a high-resolution building exposure model to be used for risk assessment. The development of the GDE model comprises components of various kinds, whose details are presented in a series of posters in this conference. Here we focus on our strategy for combining the valuable information contained in aggregated exposure models defined by administrative units with building data that is continuously added to OSM and can thus reflect changes to the building stock in a rapid fashion. This poster describes the full procedure in detail and illustrates it by focusing on the test case of the city of Athens, Greece.

Distribution of Aggregated Exposure Models onto Tiles

Aggregated exposure models defined by administrative unit are distributed onto high-resolution tiles (approximately 100 m wide at the Equator) in proportion to the built-up area (BA) allocated to that tile with respect to the total built-up area of the administrative unit, estimated via remote sensing techniques (e.g. GHS layer). The number of buildings (N_B) in cell *i* in admin. unit *j* is:

$$N_{Bij} = N_{Bj} \frac{BA_{ij}}{\sum_k BA_{kj}}$$

Merging of Aggregated Models and OBM

The merging process takes into account the completeness of each tile in OSM, that is, it considers whether all existing buildings are mapped in OSM or not, which is defined by means of the GDE completeness module.

If the tile is complete, the total number of buildings is retrieved directly from OBM. If the tile is incomplete, the total number of buildings is calculated as

$$N_{B\,TOT} = \mathrm{MAX}\left[N_{B\,aggregated}, N_{B\,OBM}\right]$$

and a number of buildings expected to be in the tile according to the aggregated model but not yet mapped in OBM, i.e. the number of *left-over* buildings, which is calculated as

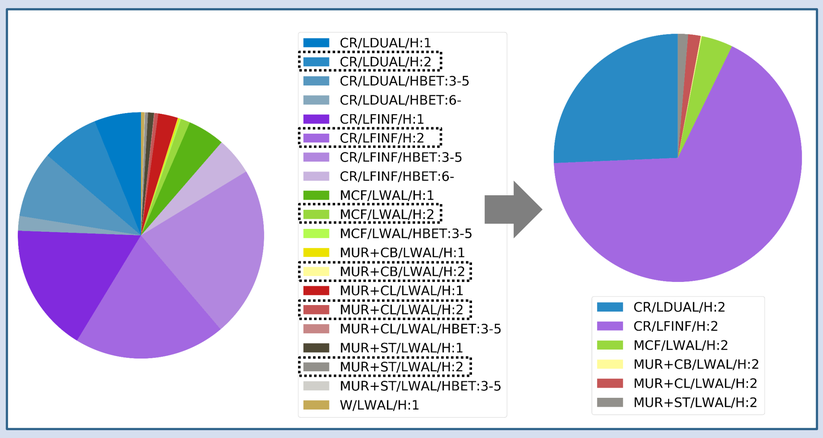
$$N_{B\,left-over} = N_{B\,TOT} - N_{B\,OBM}$$

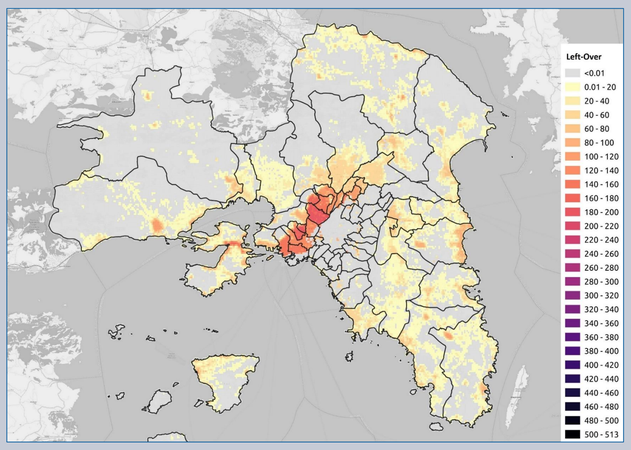
and is represented as a lump sum at the centre of the tile. The number of *left-over* buildings is zero when the number of OBM buildings is larger than that of buildings from the distributed aggregated model.

Operations are carried out at the level of tiles-administrative units intersections.

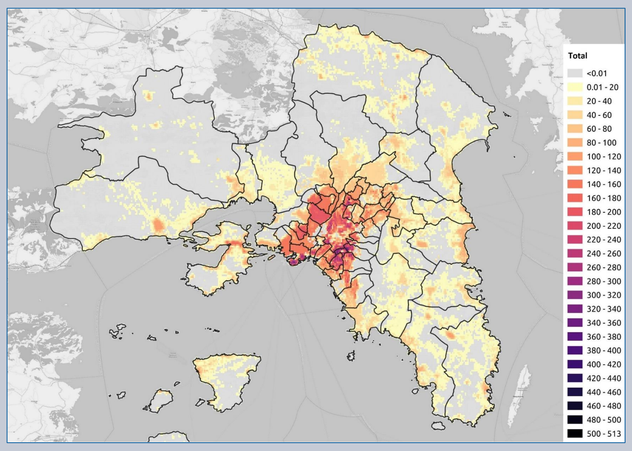
Building Classes of OBM Buildings

Individual OBM buildings get assigned the distribution of possible building classes defined in the aggregated exposure model associated with the administrative unit in which they are located. The proportions in which these classes are present in the aggregated model becomes a probability when assigned to a particular building. If additional attributes from the building are known from OSM, the range of possible building classes is narrowed down accordingly. In this example it is assumed that the OBM building has 2 storeys:

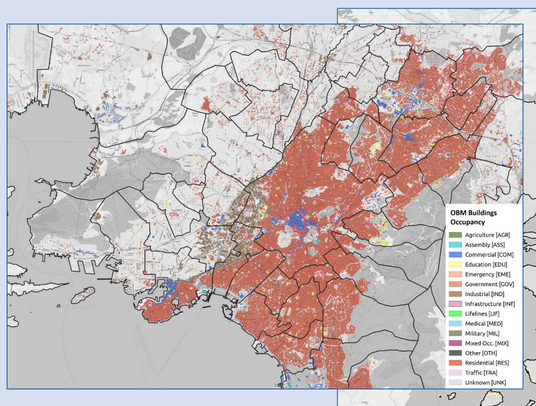




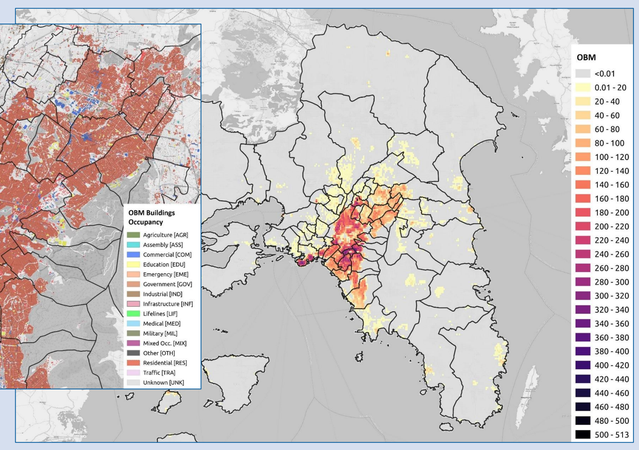
Left-Over Buildings in Tiles



Total Buildings in Tiles



OBM Individual Buildings



OBM Buildings in Tiles

References

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Florczyk A.J., Corbane C. et al. (2019). **GHSL Data Package 2019**, EUR 29788 EN, Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-76-13186-1, doi:10.2760/290498, JRC 117104.

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