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Work title: **Earth observation-based disaggregation of exposure data for earthquake loss modeling**

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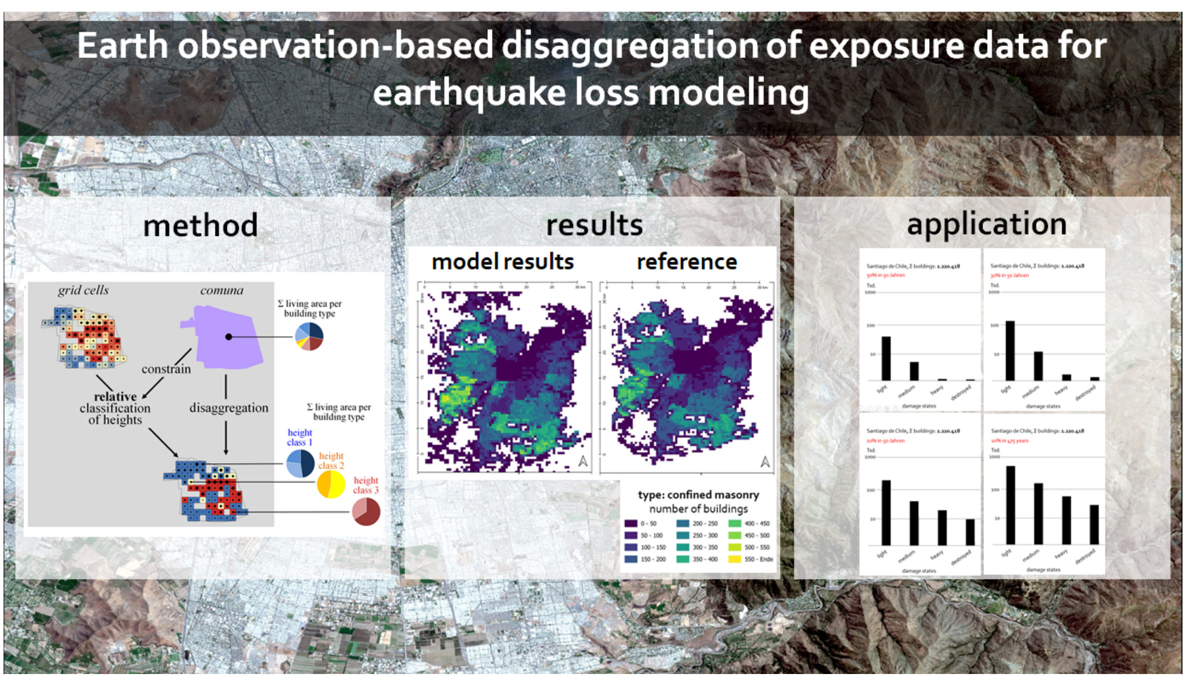
Project Image:

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# Earth observation-based disaggregation of exposure data for earthquake loss modelling

Short project summary (max 250 characters):

We use **TanDEM-X** and **Sentinel-2 observations** to **disaggregate earthquake risk-related exposure** data. We use the refined exposure data and **model earthquake loss**. Results for the city of Santiago de Chile show that **earthquake risk has been underestimated** before due to aggregated exposure data.

Keywords:
TanDEM-X, Sentinel-2, Urban Morphology, Natural Hazard Exposure, Earthquake Loss Estimation

## 1. Introduction:

Exposure is an essential component of risk models and describes elements that are endangered by a hazard and susceptible to damage. The affiliated vulnerability characterizes the likelihood to experience damage regarding a certain level of hazard intensity [1]. Frequently, the compilation of exposure information is the costliest component (in terms of time and labor) of risk assessment procedures [2]. Existing models often describe exposure in an aggregated manner, e.g., by relying on statistical/census data for given administrative entities. Nowadays, earth observation techniques allow the collection of spatially continuous information for large geographic areas while enabling a high geometric and temporal resolution.

## 2. Methods:

We exploit measurements from the earth observation missions TanDEM-X and Sentinel-2, which collect data on a global scale, to characterize the built environment in terms of constituting morphologic properties, namely built-up density and height [3]. To derive *built-up density* and *height* we follow an automated workflow. First, “built-up” and “non-built-up” areas are distinguished by deploying the so-called Global Urban Footprint layer [4]. This information is deployed within a tailored filtering procedure for the TDM digital surface model data [5] to extract elevation information for built-up areas [6]. Subsequently, the intra-urban land cover is mapped under consideration of multispectral Sentinel-2 imagery. Thereby, intra-urban vegetation is pruned and the residual areas, i.e., elevated built-up areas, serve as basis to compute *built-up densities* and *heights*.

Subsequently, we use this information to constrain existing exposure data in a spatial disaggregation approach. Thereby, we develop both absolute and relative disaggregation techniques to spatially disaggregate and eventually constrain existing exposure data from administrative entities based on the derived morphologic properties of the built environment. Finally, we align vulnerability information, i.e., fragility functions, to the exposure data and establish scenario-based seismic loss estimations.

## 3. Results:

Results are presented for the city of Santiago de Chile, Chile, which is prone to natural hazards such as earthquakes. We present earthquake loss estimations and corresponding sensitivity regarding the resolution properties of the exposure data used in the model. Results show how loss estimations vary substantially and that aggregated exposure information underestimates losses in our scenarios.

## 4. Conclusions:

This study underlines the benefits of deploying modern earth observation technologies, that deliver data on a global scale, for refined exposure mapping and related earthquake loss estimation.

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