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Toward near real-time flood loss estimation: model structure and data requirements

Annibale Vecere (1), Mario Martina (1), Ricardo Monteiro (1), and Carmine Galasso (2)

(1) School for Advanced Studies IUSS Pavia, Palazzo del Broletto - Piazza della Vittoria n.15, 27100 Pavia - Italy (annibale.vecere@iusspavia.it), (2) Dept. of Civil Engineering, Environmental and Geomatic Engineering and Institute for Risk and Disaster Reduction, Univ. College London, London WC1E 6BT, U.K

According to the 2016 World Disasters Report by the International Federation of Red Cross, in the last decade, natural hazards have affected more than 1.9Bn people, killed 700k and caused $1.9Tr worth of damage. The increase in the overall cost of natural hazards highlights the importance of financial strategies to enable rapid response and recovery after a disaster strikes. In recent years, innovative financial instruments have been developed to ensure financial resources before the occurrence of an event. Among these, increasing attention is being paid to the use of parametric or 'trigger-based' insurance, especially in countries with low financial capacity. Parametric insurance enables rapid action/payments and is cost effective compared to traditional (indemnity-based) insurance. In the case of parametric insurance, payments are made once a pre-defined environmental threshold, which is highly correlated to loss or damage (e.g. rainfall in a given time period for floods, magnitude for earthquakes, or wind speed for storms) has been reached.

Near Real-Time Loss Estimation Models (NRTLEMs) represent effective tools for developing improved parametric insurance products. These models are capable of rapidly identifying a hazardous event based on the exceedance of specific threshold values for the observed environmental variable (i.e. the trigger) over a predetermined geographic area. Subsequently, a loss index, defined as the ratio of the expected damage over the exposure in the affected area, can be defined by means of ad-hoc damage functions that relate such index to the trigger.

This study presents the preliminary development of such a NRTLEM, specific for floods. Given the importance of the event identification within the proposed methodology, different types of triggers are investigated and compared, with special focus on satellite precipitations estimates. Several features may justify the use of this type of estimates within a flood NRTLEM: worldwide spatial coverage, freely available data on the web, regular measurements characterized by good temporal (up to 30 min) and spatial (up to 8km grid spacing) resolution, provision of near real-time. Data requirements, model structure and its reliability are also discussed. The latter aspect is essential in reducing the so-called basis risk which is typically associated to parametric insurance. Basis risk is commonly defined as the mismatch between the settlement of parametric insurance claims and the actual losses suffered by the insured. From a statistical point of view, it can be related to the sum of missed and false alarms computed by considering both real and simulated events.

An illustrative application of the proposed NRTLEM for flood events in the Philippines, one of the most hazard-prone countries in the world, is finally presented. Several areas of the country are characterized by high wind and heavy rain along the northeast Philippine Sea coast (more than 500 mm/day of precipitation are not uncommon, with registered peaks of 1000 mm/day). For the specific case-study region, a detailed description of the adopted trigger(s) and their structure is presented together with the model calibration and the definition of the optimal trigger threshold (i.e. the one which minimizes basis risk).