Coupling Hydrological Overflow Model and EO-data: Benefits on Hazard and Damage Estimation for Floods in France

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Insurers have been increasingly relying on space technologies to estimate flood-related damage more accurately for the last few years. CCR has developed and applied a specific workflow on three major flood events (with losses ranging from 200 million € to 1 billion € for the French insurance market) that occurred in mainland France: Seine and Loire in May-June 2016 (from 900 million € to 1 billion €), Seine and Marne in January-February 2018 (from 180 to 220 million €) and Languedoc in October 2018 (from 250 to 300 million €). Our methodology benefits from a strong validation thanks to thousands of claims collected and geolocalised on each flooded building which is usually a missing but key point. This methodology is based on EO data and remote sensing methods from medium (20 to 30 m) to high (10 m) resolution satellite data collected by Landsat-8, Sentinel-2, and Sentinel-1. The flooded areas inferred from satellite data are combined with CCR’s physical overflow model (1) to improve loss estimation that are shared with insurance companies operating in France and public authorities.

Raw radar images are processed with the ESA SNAP remote sensing software. A radiometric threshold is estimated to distinguish water surfaces from surfaces without water. Moreover, coherence data derived from InSAR processing (2) provide additional data to detect flooded buildings in city centers. For multispectral images, the MNDWI index (3) was selected as it allows to delineate more precisely water surfaces. Finally, a Random Forest classification has proved effective in defining the spatial distribution of the flooded areas on river basins from the learning areas integrated to the algorithm. In the confusion matrix, implemented for validation, the Kappa index (4) reaches 96.2 % with an overall accuracy of 97.7 %.

A large focus is presented on the 2016 Seine and Loire basins flood event. With a loss estimated between 900 million € and 1 billion € and over 10 000 claims, this event allowed us to validate more precisely the remote sensing methodology which we developed. Insurance indicators such as probability of detection, probability of false detection, True Skill Score for both CCR overflow model and remote sensing data model were also calculated to estimate the benefits of this methodology.

(1) Moncoulon, D. and al., 2014. Analysis of the French insurance market exposure to floods: a stochastic model combining river overflow and surface runoff. NHESS
(2) Chini, M. and al., 2019. Sentinel-1 InSar Coherence to Detect Floodwater in Urban Areas: Houston and Hurricane Harvey as a Test Case. Remote Sensing
