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Integrating hydrodynamic models and COSMO-SkyMed derived products for flood damage assessment

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Floods are the most frequent weather disasters in the world and probably the most costly in terms of social and economic losses. They may have a strong impact on infrastructures and health because the range of possible damages includes casualties, loss of housing and destruction of crops.
Presently, the most common approach for remotely sensing floods is the use of synthetic aperture radar (SAR) images. Key features of SAR data for inundation mapping are the synoptic view, the capability to operate even in cloudy conditions and during both day and night time and the sensitivity of the microwave radiation to water. The launch of a new generation of instruments, such as TerraSAR-X and COSMO-SkyMed (CSK) allows producing near real time flood maps having a spatial resolution in the order of 1-5 m. Moreover, the present (CSK) and upcoming (Sentinel-1) constellations permit the acquisition of radar data characterized by a short revisit time (in the order of some hours for CSK), so that the production of frequent inundation maps can be envisaged. Nonetheless, gaps might be present in the SAR-derived flood maps because of the limited area imaged by SAR; moreover, the detection of floodwater may be complicated by the presence of very dense vegetation or urban settlements. Hence the need to complement SAR-derived flood maps with the outputs of physical models.
Physical models allow delivering to end users very useful information for a complete flood damage assessment, such as data on water depths and flow directions, which cannot be directly derived from satellite remote sensing images. In addition, the flood extent predictions of hydraulic models can be compared to SAR-derived inundation maps to calibrate the models, or to fill the aforementioned gaps that can be present in the SAR-derived maps. Finally, physical models enable the construction of risk scenarios useful for emergency managers to take their decisions and for programming additional SAR acquisitions in order to observe the temporal evolution of the event (e.g. the water receding).
In this paper, the first outcomes of a study aiming at combining COSMO-SkyMed derived flood maps with hydrodynamic models are presented. The study is carried out within the framework of the EO-based CHange detection for Operational Flood Management (ECHO-FM) project, funded by the Italian Space Agency (ASI) as part of the research activities agreed in the cooperation between ASI and the Japan Aerospace Exploration Agency (JAXA). The flood that hit the region of Shkodër, in Albania, on January 2010, is considered as test case. The work focuses on the utility of a dense temporal series of SAR data, such as that available through CSK for this case study, used in combination with a hydrodynamic model to monitor over a long time (in the order of 3 weeks) the natural drainage of the Shkodër floodplain. It is shown that by matching the outputs of the model to SAR observations, the hydrodynamic inconsistencies in CSK estimates can be corrected.