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Automatic Flood Monitoring based on SAR Intensity and Interferometric Coherence using Machine Learning

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Synthetic Aperture Radar (SAR) observations are widely used in emergency response for flood mapping and monitoring. Emergency responders frequently request satellite-based crisis information for flood monitoring to target the often-limited resources and to prioritize response actions throughout a disaster situation. Flood mapping algorithms are usually based on automatic thresholding algorithms for the initialization of the classification process in SAR amplitude data. These thresholding processes like Otsu thresholding, histogram leveling etc., are followed by clustering techniques like K-means, ISODATA for segmentation of water and non-water areas. These methods are capable of extracting the flood extent if there is a significant contrast between water and non-water areas in the SAR data. However, the classification result may be related to overestimations if non-water areas have a similar low backscatter as open water surfaces and also, these backscatter values differentiate from VV and VH polarizations. Our method aims at improving existing satellite-based emergency mapping methods by incorporating systematically acquired Sentinel-1A/B SAR data at high spatial (20m) and temporal (3-5 days) resolution. Our method involves a supervised learning method for flood detection by leveraging SAR intensity and interferometric coherence as well as polarimetry information. It uses multi-temporal intensity and coherence conjunctively to extract flood information of varying flooded landscapes. By incorporating multitemporal satellite imagery, our method allows for rapid and accurate post-disaster damage assessment and can be used for better coordination of medium- and long-term financial assistance programs for affected areas. In this paper, we present a strategy using machine learning for semantic segmentation of the flood map, which extracts the spatio-temporal information from the SAR images having both intensity as well coherence bands. The flood maps produced by the fusion of intensity and coherence are validated against state-of-the art methods for producing flood maps.