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## Large-scale compound flood mapping with deep learning and data fusion techniques

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Compound flooding (CF), as a result oceanic, hydrological, meteorological and anthropogenic processes, is an extreme event that threatens life and assets of people living in low-lying areas worldwide. Large-scale CF is often studied with hydrodynamic models that combine either successive or concurrent processes to simulate flood dynamics. In recent years, convolutional neural networks (CNNs) and data fusion (DF) techniques have emerged as feasible and simple alternatives for post-flood mapping when compared to complex modeling. Yet, both techniques have not been explored for large-scale CF mapping. Here, we evaluate the performance of a CNN & DF framework for generating CF maps driven by Hurricane Matthew that hit the southeast Atlantic coast of the U.S. in October, 2016. The framework fuses multispectral imagery (Landsat ARD), dual-polarized synthetic aperture radar data (SAR) and coastal digital elevation maps (DEMs) to generate flood maps of moderate (30 m) spatial resolution. We first train/validate the CNN & DF framework with official land cover maps (C-CAP) as well as flood maps obtained from a calibrated Delft3D-FM model of Savannah River estuary in Georgia, and then evaluate the framework in the southeast Atlantic coast. The highest overall accuracy (97%) and f1-score for permanent/flood water classes (99/100%) are achieved when ARD, SAR and DEM datasets are readily available and adequately fused. Moreover, the resulting CF maps agree well (80%) with hindcast surge and flood guidance maps of the Coastal Emergency Risk Assessment (CERA) web mapper. We also evaluate the framework with different DF alternatives and highlight its usefulness for large-scale compound flood hazard assessments and a thorough calibration of hydrodynamic models. Future work is envisioned toward a comprehensive CNN & DF framework that provides not only accurate large-scale flood extent maps, but also inundation depth based on both deep learning and multi-source data fusion.