Mapping Maximum Flood Extent Using Multi-Temporal Independent Component Analysis and Landsat-8 Along Colorado's Front Range

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Abstract: Satellite remote sensing is a rapid and inexpensive tool for regional-scale mapping and assessment of floods. However, the full extent of such events is rarely captured due to the low probability of a satellite's orbit coinciding with the peak of the flooding. These temporal constraints, along with storm-related cloud cover and misclassification in developed areas, significantly limits the utility of optical sensors for flood mapping. We addressed these challenges with Landsat-8 and a multi-temporal independent component analysis change detection (MICA) to extract peak flood extent of the unprecedented 2013 flooding along Colorado's Front Range. Pre- and post-event images were composited and transformed with an ICA. Inundated areas were extracted using image segmentation and thresholds, and were further refined using cloud and agricultural masks derived from the ICA procedure. Pixel-to-pixel validation of results with World View-2 imagery captured near the peak of the flooding yielded an overall accuracy of 88% and Kappa of 0.75. Qualitative assessment with color aerial orthophotography flown two days after peak flow showed close agreement with visible water and scoured river banks. Moreover, the method was able to adequately avoid confusion across multiple drainages and land covers, and requires no ancillary datasets for rapid and effective implementation.