Cloud Free Flood Mapping: Towards a Radar-Based Approach to Flood Detection for Index Insurance Applications in Northern Bangladesh

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New types of financial instruments, such as index insurance, are being piloted in flood-prone Bangladesh. Current remote-sensing flood index insurance contracts in Bangladesh rely on optical satellite sensors (MODIS) for flood detection. Radar-based satellites can penetrate clouds, offering more consistent mapping during flood events. Here we investigate the feasibility of radar sensors to estimate inundation in Northern Bangladesh by analyzing performance from Sentinel-1 Synthetic Aperture Radar (SAR) (every 6-12 days at 10m resolution since 2014) and SSMI Passive Microwave sensors (twice daily at 3.125 km resolution since 1992). A Synthetic Aperture Radar time series is developed from Sentinel-1 in Google Earth Engine by using a time series approach to identify statistically anomalous drops in backscatter for each pixel. We adapt the DeVries et al. (2020) Sentinel-1 flood detection algorithm to i) estimate inundated area with each satellite overpass, ii) employ post processing to improve accuracy, iii) adjust image baselines to account for local irrigation dynamics in Northern Bangladesh. We use the SSMI time series to estimate flooded area from changes in brightness temperature by implementing the De Groeve and Riva (2009) algorithm. We compare each flooded area time series to river water level data in Northern Bangladesh to assess consistency in the signal and select specific flood events to assess accuracy of flood area predictions. Comparisons to river water level data reveal Sentinel-1 provides a more consistent flood signal than the noisier signal of SSMI. Comparison of radar flood maps to optical data (Sentinel-2) of an April 2017 flood over a 7.4 km^2 region in Sylhet finds higher flooded area accuracy from Sentinel-1 (F1 = 0.92, 74,000 pixels) than from SSMI (F1 = 0.63, <1 pixel). We will further present spatial accuracy metrics of flooded area in 3 additional large floods in Northern Bangladesh (August 2017, July 2019, and July 2020). Preliminary results indicate Sentinel-1 can support an inundation time series suitable for index insurance triggers despite observation frequency limitations, while an SSMI time series could provide valuable long-term risk assessment for insurance purposes. However, more work is needed to improve the accuracy of an SSMI time series for index insurance applications.