Mapping of Flooded Heritage Structures Using SAR Polarimetry and Google Earth Engine

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The growing flood events and the associated risk in heritage structures are an increasingly crucial issue for India, which possesses heritage richness. However, it is more critical for developing countries where often the case is poorly understudied. Hampi, also referred to as the Group of Monuments, is a UNESCO World Heritage Site located in east-central Karnataka, India. Several monuments at the heritage site of Hampi along the Tungabhadra river are inundated several times within a year. After every flood, the river changes its course, inundating areas that were supposed to be safe from floods. The post-flood silt deposition over structures makes them more vulnerable to erosion and distortion. So, to restore, mapping of flooded structures is crucial. The changes in the cultural landscape should be monitored on a spatial and temporal basis. Rapid and precise extraction of the flooded areas is key to supporting emergency-response planning and providing damage assessment in spatial and temporal measurements to monuments.

The European Space Agency’s (ESA) Copernicus is one of the most ambitious Earth Observation (EO) programs having operational satellite constellations providing continuous, accurate, and easily accessible satellite data for the entire globe. This study demonstrates the use of Google Earth Engine (GEE) and Dual polarized (VV and VH) Sentinel-1 Synthetic Aperture Radar (SAR) data for mapping flooded areas. Change detection and thresholding methodology have been adopted in Google Earth Engine (Python-based) Platform to determine the extent of flooding using multiple Sentinel-1 SAR images captured before and after the floods of August 2019 in Hampi. Thresholding is one of the most commonly adopted SAR imagery methods to discriminate between water and non-water surface. An automatic thresholding approach using the Otsu algorithm is optimal for large thresholding objects from the background, which means that it is strongly dependent on the histogram’s bimodality. SAR Polarimetry backscatter properties being used effectively for stone structure extraction. The Wishart distance classification method has been used in PolsarPro software, which fits for the homogenous area. GEE can be effectively used for planning disaster risk reduction, damage assessment, affected areas, and can be used well along with cultural landscape information.