Hydrological applications of EOS-04 synthetic aperture radar

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Synthetic aperture radars (SARs) have enabled all-weather sensing of land surfaces, which has significantly benefitted surface hydrology. In this article, we explore various hydrological applications enabled by Indian Space Research Organisation's (ISRO's) recently launched Earth observation satellite-04 (EOS-04) C-band SAR satellite. We present the preliminary results of EOS-04 driven flood inundation mapping, monitoring of water bodies and study of river dynamics. Novel application of EOS-04 SAR data in estimation of sedimentation rate is presented for Jayakwadi reservoir, Maharashtra, India. Additionally, this article explores the integrated use of SAR and altimeter data for estimation of lake and reservoir water level and volume. We have used multi-date observations from EOS-04 SAR and Sentinel-3A/3B altimeters to derive river width and estimate area–water level hypsometric curves for reservoirs. Long-term and near real-time availability of EOS-04 data can provide an indispensable tool for monitoring water bodies and extreme events like floods, at regional scales.

Keywords: Bathymetry, EOS-04, flood, hydrology, synthetic aperture radar, water level.

Introduction

Some major applications of SAR sensors in the field of hydrology include: (i) flood/inundation mapping, (ii) wetland monitoring, (iii) reservoir management and (iv) estimating river geometry. Flooded areas exhibit lower backscatter compared to dry land, and hence provide tonal contrast over regions that are inundated[6–9]. SAR data provides near real-time information about inundation extent, its progression, recession and persistence. This information is crucial for early warning systems and emergency response during extreme events. SAR can track changes in wetland water dynamics, including inundation patterns, storage cycle, wetting, drying, peak water and vegetation cover. It can also be used to monitor changes in water area and estimate sediment accumulation in reservoirs, optimizing water storage and hydropower operations. In Indian context, SAR technology is critical for observing monsoonal water dynamics and monitoring floods due to its ability to provide high-resolution all-weather information in the absence of cloud-free optical data.

Polarization of microwave signals directly affects the accuracy of water classification in SAR images. It has been observed that flooded areas are easier to identify with like-polarized data rather than cross-polarized data[10]. SAR images in HH polarization are preferred due to its high radiometric dynamics, less backscattering nature, and reduced sensitivity to water surface[11]. Similarly, VV polari-