Estimation of above-ground biomass and delineation of vegetation of tropical forests using EOS-04 data

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The C-band SAR on-board EOS-04 mission provides unique opportunities to characterize forest vegetation through its sensitiveness to vegetation structure and all-weather imaging capability over regions of perpetual cloud cover. The present study has brought out the applications of EOS-04 data for estimation of above-ground biomass (AGB) of tropical deciduous forests and scrublands, mapping of forest cover and delineation of mangroves vegetation. The study suggested that EOS-04 data can be used for mapping AGB of tropical scrublands and low density forests of AGB ≤ 80 t/ha. The overall RMSE for all vegetation with AGB ≤ 80 t/ha was 15.3 t/ha (R^2 – 0.49). It was shown that the integration of EOS-04 and Sentinel-2 data improved AGB estimates across biomass ranges of 0–245 t/ha (RMSE – 21.60 t/ha and 0.81). EOS-04 data was also found to be useful for the delineation of mangroves and forest vegetation using machine-learning algorithms. The study supports operational use of EOS-04 data for estimation of AGB over low biomass tropical forests and scrublands.

Keywords: Above-ground biomass, C-band SAR, forest cover, mangrove vegetation, MRS data, random forest regression, tropical forests.

applications in forestry such as monitoring forest disturbances, delineation of forest and mangroves vegetation and retrieval of forest above-ground biomass (AGB) due to its capability of providing more dynamic range for vegetation growth variables as compared to optical data[1–3]. Combining multi-sensor data, such as optical, radar and LiDAR, enables a comprehensive understanding of the complex interactions between vegetation and the environment[4–6].

The C-band SAR onboard EOS-04 provides valuable data through its systematic coverage over Indian region for vegetation monitoring and has great potential for forest applications. EOS-04 is a follow-on mission to the earlier RISAT-1 mission[7] with similar specifications that was operated during April 2012–September 2016 and contributed to various land, ocean applications[8] and forest characterization[9]. EOS-04 collects medium resolution ScanSAR (MRS) mode data sampled at 18 m pixel spacing in HH and HV polarizations (H-horizontal and V-vertical) through its descending orbits, systematically over the Indian region with a repeat cycle of 17 days. The ascending orbits are reserved for collection of data in various other modes with varying polarizations and resolutions based on user requests. Hence, the MRS mode of EOS-04 provides reliable data for various land applications including vegetation monitoring that relies on temporal data.

Tropical forests contribute to approximately 25% of the