Characterization of ocean and coastal features using EOS-04 and application in deciphering its spatio-temporal dynamics

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Here we discuss various coastal and ocean science applications of the Earth Observation Satellite-04 (EOS-04) mission by the Indian Space Research Organisation. Automated oil spill detection using EOS-04, Medium Resolution ScanSAR data is carried out that involves segmenting of dark regions and classification of oil spills from look-alikes using a rank based algorithm. Lagrangian forecasting model is then used to predict the oil spill track. Genetic algorithm is employed to convert backscatter from EOS-04 into Significant Wave Height and wave spectra. The wavelength and propagation direction of ocean internal solitary waves are estimated using EOS-04 data. High resolution data in Fine Resolution Stripmap mode is used to estimate coastal bathymetry based on wave shoaling effect. The unique ability of EOS-04, with a range of spatial resolutions and various modes of operation form an essential ocean observation dataset that enables the scientific community to improve the understanding of complex coastal ocean processes.

Keywords: Coastal bathymetry, EOS-04, internal solitary waves, oil spill, Ocean wave spectra.

Introduction

The timely detection of marine oil spills and prompt dissemination of information are crucial for effective response and containment efforts. On the ocean surface, the presence of oil slicks has a dampening effect on short gravity-capillary waves, leading to a reduction in radar backscattering levels. Consequently, the oil spill region appears dark in SAR images[1,2]. However, challenges arise in distinguishing oil spills from other dark regions, such as biogenic slicks, low wind regions and shear zones[3]. The application of SAR images in oil spill detection extends to mitigation activities during accidental seepages[4], aids in identification of tar balls along the coast[5] and proves valuable in identifying probable natural oil seepage regions[6].

Another major application of SAR images in oceanography involves the estimation of significant wave height. The coastal information on significant wave height is limited due to the prevailing inaccuracies of the wave models in the coastal regions and coastal masking of altimeter data. These challenges are overcome by assimilating observations from various sources into the models to enhance their predictive capabilities[7]. By employing a data-adaptive approach that combines genetic algorithms with SAR backscatter coefficients (σ_0), it is possible to establish a relationship between SAR observations and significant wave height[8].

The internal solitary waves (ISW) are non-linear and