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Remote Sensing of Rip Currents by Spaceborne High-Resolution Imaging Radar

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Spaceborne synthetic aperture radars (SARs), such as the ones on the satellites ENVISAT, RADARSAT-2, ALOS, COSMO-SkyMed, and TerraSAR-X, can provide images of the earth's surface at spatial resolutions on the order of meters and swath widths of up to 500 km. Being active microwave instruments, SARs are independent of daylight and of cloud coverage. The intensity of backscattered radar signals from water surfaces depends on the small-scale surface roughness. Therefore, SAR images of the ocean can show signatures of surface roughness variations associated with the wind field, surface films, and current gradients that modulate the surface roughness by wave-current interaction. A quantitative interpretation is possible on the basis of theoretical SAR imaging models. In an experimental mode of operation, the German satellite TerraSAR-X even permits direct line-of-sight current measurements by along-track interferometry (ATI).

The University of Miami's Center for Southeastern Tropical Advanced Remote Sensing (CSTARS) has an own receiving station for remote sensing satellites, a large data base of SAR images of the ocean and ancillary data from in-situ measurements and numerical models, and access to state-of-the-art data processing and interpretation techniques. In this presentation we give a brief theoretical overview of the SAR and ATI imaging mechanisms of surface current fields, we show example images of coastal scenarios with rip currents, and we discuss the potential of using spaceborne SARs for dedicated scientific studies on rip current dynamics and for the operational monitoring of spatial and temporal changes of rip current patterns in large coastal regions.