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The Potentials Of Gnss-R For Sea Hazard Monitoring

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GNSS-Reflectometry represents a new and innovative approach for ocean remote sensing. This technique exploits signals of opportunity from GNSS constellations (i.e. GPS, Glonass, Galileo etc.), reflected off the surface of the ocean, and uses these reflections to retrieve useful geophysical parameters of the ocean surface. GNSS-R is generating an increasing attention from the Remote Sensing community, especially in recent years, due to its numerous advantages compared to other classical remote sensing techniques. The exploitation of long-term, ubiquitous signals of opportunity freely available, the high space-time sampling capabilities and the ability of its L-band signals to penetrate well through rain all contribute to make this technique very attractive.
An additional and very important strength of GNSS-R is the need for simple, low-cost/low-power GNSS receivers, that could be easily piggybacked on other satellites to form a constellation of receivers. These recognized potentials of GNSS-R have been recently led to the approval of the NASA EV-2 Cyclone Global Navigation Satellite System (CYGNSS), a spaceborne mission focused on tropical cyclone (TC) inner core process studies.
GNSS-R can be used for both scatterometric applications (i.e. wind and wave monitoring) and altimetric applications (i.e. measurements of sea surface height). In particular, its ability to collect multiple GPS reflections anywhere on the globe and at any time (due to the ubiquity of GPS signals) using a large constellation of simple GNSS receivers, makes is very suitable for Real-Time (RT) and Near-Real Time (NRT) applications. These are particularly crucial for monitoring sea hazards related to ship operations and operational oceanography in general. For scatterometric purposes, GNSS-R can potentially detect high wind and waves in RT and NRT, as well as oil spills on the surface of the ocean, through its measurements of the sea surface roughness. In addition to that, GNSS-R could provide densely spaced Sea Surface Height (SSH) measurements, by collecting a number of reflections from different satellites within a field point of view. A number of sea hazards like tsunamis, high tides, storm surges of simply very high solitary waves in the ocean can be easily detected with GNSS-R measurements of SSH. The precision in the SSH measurement that can be achieved with GNSS-R is still considerably lower than that obtained with operational conventional altimetry. For this reason, GNSS-R is currently more suitable to detect large waves, since they generate a large signal in the data that allows for a better detection. The increase in the number of GNSS constellations and signals, and the improvements that the new signals will have (larger bandwidth, longer codes etc.) should ultimately lead to an overcome of the current limitations of GNSS for sea surface altimetry applications.