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New techniques to retrieve sea surface slopes' PDF from GNSS reflected signals

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The Global Navigation Satellite Systems (GNSS) represent a rich source of signals of opportunity. The L-band signals emitted by the current Global Positioning System (GPS) and the Russian GLONASS densely cover the Globe, rebounding on the sea surface. The coverage will be even better when the European GALILEO will be deployed. A special dedicated receiver flying over the ocean and collecting the reflected signals acts as a multi-static scattering radar, picking the reflections from several (up to 13) GNSS satellite transmitters simultaneously, at different bi-static geometries (azimuth and incidence angle). This concept is also called PAssive Reflectometry and Interferometry System (PARIS). A straightforward application is to provide L-band sea surface roughness to complement radiometric measurements at L-band for ocean salinity retrievals (SMOS-like missions). The actual geophysical content of the GNSS reflected signals is under study: the electromagnetic wavelength is around 20 cm, larger than the wind-scatterometers, therefore the scatterometric response can be also sensitive to other sea and sea-air parameters, widening the final range of user applications.
In order to help understanding the geophysical content of the GNSS-reflections,we have developed a technique to extract the sea surface slopes' Probability Density Function (PDF). Unlike the former PARIS scatterometric techniques, in which the slopes' PDF is modelled as a (bi-)normal distribution to solve for its sigma(s), our new technique retrieves the PDF with no need of constraining its shape to any model. Instead, a discrete range of the slopes is defined, and the PDF of each one is treated as unknown. Consequently, the technique can sense any deviation from Gaussian behavior, skewness and asymmetries. The talk will present the technique itself, its validation, and the analysis of real data obtained with our own developed receiver, GOLD-RTR, during several air-borne campaigns.