18 years of SAR ocean imaging with focus on the greater Agulhas Current regime

by

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18 years of global, repetitive and homogeneous SAR ocean imaging has enabled us to establish long time series and discriminate observations of spatial heterogeneous time-varying phenomena related to near surface wind, waves, current features, oil spill and sea ice field. Whereas access to ERS SAR data was off-line and could take several weeks the Envisat ASAR data are now available for analyses within 20-30 minutes after acquisitions. This facilitates near real time use and hence validation of model predictions as well as assimilation.

The SAR imaging of the moving ocean is very complex and demands advanced processing routines combined with careful analyses to transform radar backscatter signals into reliable geophysical values. Thanks to the continuity of C-band SAR missions allowing the establishment of long records of images the quantitative retrievals have improved significantly. Valuable insight and knowledge have also been gathered from understanding the differences expressed from one image to the next.

At the launch of ERS-1 in 1991 the SAR ocean sensing predominantly aimed at detecting waves and discriminating sea ice and water. Today, 18 years later, science and application have moved the SAR imaging capabilities to unexpected new levels. This is demonstrated in this presentation, notably with respect to: extreme hurricane wind detection; ocean swell tracking; oil spill monitoring; surface current feature detection; and sea ice deformation monitoring. The recent demonstration that the satellite SAR can act as a spaceborne speed-gun for surface velocity measurements will also be highlighted with examples from the Agulhas Current.

However, deficiencies exist regarding our ability to provide consistent and reliable quantitative interpretation of SAR ocean images. A fundamental limitation in this aspect is the lack of physical-based retrieval models that instead forces us to use empirical-based retrieval algorithms. Hitherto, for instance, the quantitative relationship between radar backscatter, surface roughness and consistent retrieval of near surface wind, waves and surface current are unresolved. In turn, the complete ”retrieval code” regarding SAR ocean imaging remains unbroken. Continuity of C-band SAR missions, as ensured with Sentinel-1, is therefore highly needed to ensure advances in quantitative understanding of ocean imaging.