

Theme: Synthetic Aperture Radar (SAR) wind and wave observations

Wave-age dependence of SAR backscatter

Wind speed and direction have been estimated from spaceborne scatterometry for more than two decades. Scatterometers observe backscatter from three lines-of-sight as a proxy for the directional surface stress, or short-wavelength surface roughness. To link the observed backscatter to wind speed and direction it is inherently assumed that the local wind is responsible for the short-wavelength surface roughness. For low-resolution (~20 km) observations of scatterometers this appears to be a reasonable assumption. However, for high-resolution (~2 km) observations made with SAR the assumption is likely not valid. Long waves, that develop over long distances, are nearly unaffected by short-scale wind variations, but still exchange energy with short waves and can affect the local wind profile. The backscatter in the presence of long waves is therefore expected to differ from the backscatter in the absence of long waves at the same local wind speed.

In this master thesis you will help us to prepare for the bistatic radar mission Harmony, which will fly in a constellation with one of the Sentinel-1 satellites. Harmony provides effectively high-resolution scatterometry data, which requires new adaptive inversion strategies to accurately obtain wind speed and direction at high resolution. The design of these data processing methods requires an comprehensive understanding of the interaction between ocean and atmosphere. You will investigate the effect of the wave-age (the development of a wave system) on the backscatter by comparing the backscatter of Sentinel-1 inside and outside of atolls. Due to a short fetch inside atolls, only short waves can develop. Outside atolls wave systems can develop over long distance with peak wavelengths reaching up to ~100 m. The observed differences inside and outside of the atolls should give us insight in the wave-age dependence of SAR backscatter.



Sentinel-1 SAR backscatter at an atoll (Nissan island).

Source: Ocean Virtual Laboratory.

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