Watershed method for detection of wave components in 2D wave spectra for SWIM data processing of CFOSAT

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CFOSAT Mission (China France Oceanography Satellile) Overview

Scientific objectives and requirements:
- Global observation of ocean wind and waves with high temporal coverage
- To improve wind and wave forecast and sea-state monitoring
- To improve the knowledge and the modeling of sea-surface processes
- To get a simultaneous wind and wave measures for coupling effects characterization

Secondary objectives (for SWIM):
- Land surface monitoring [soil moisture and soil roughness] and polar ice sheet characteristics

Partitioning spectrum: principle

A method to detect automatically wave components in 2D wave slope spectrum:
- Based on a watershed algorithm improved and adapted to process Level 2 SWIM data
- Get wave parameters: significant wave height, wavelength, direction for each detected partition
- Identify wind sea and swell

KuROS:
- KuROS is an airborne Ku-band Doppler radar to prepare the CFOSAT satellite mission
- Directional sea wave slope spectrum obtained from a 30 s sample of KuROS observations (case of March 6th 2013 12:26:31). The ambiguity in the propagation direction has been removed. Energy density is in colour code.
- Concentric black circles indicate the wavelength. Direction is in the meteor-oceanic convention (North towards top of the figure). Three partitions are identified, sorted by decreasing energy.

Conclusion and limits of watersheding

- Improved watershed method works relatively well on tested cases on real data as well as simulated spectra.
- Limits of the method: problems appear on too noisy spectra, partition boundaries are strict and we can not quantify errors and uncertainty with watersheding.
- Proposed alternative in progress based on a Bayesian approach to fit superposed theoretical spectral forms without resampling spectra and with estimated errors.

Simulated SWIM data

Two examples of 2D slope spectrum obtained from the simulation SWIM data with MFWAM inputs. The data have been processed up to level 2. Contours show detected partitions.

Sentinel 1A data

First data of Sentinel 1A satellite: Directional cross-spectrum in which we detect 3 partitions.