Measurement of ocean waves velocity fields from a single spot-5 dataset using correlation between panchromatic and multispectral bands

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MEASUREMENT OF OCEAN WAVES VELOCITY FIELDS FROM A SINGLE SPOT-5 DATASET USING CORRELATION BETWEEN PANCHROMATIC AND MULTISPECTRAL BANDS.

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1. ABSTRACT

Ocean waves represent an important oceanographic phenomenon for manifold reasons. For instance, they strongly influence the most superficial water layer where the exchanges and heat transfer between the ocean and the atmosphere take place. Moreover, the ocean swell highly affects coastal areas, being one of the principal agents responsible for coastal erosion. Furthermore, their propagation pattern being affected by shallow bathymetry, the understanding of the local ocean waves' velocity field and its temporal variation can provide invaluable information about the ocean floor topography at shallow depth. Therefore, measuring the different parameters that characterize ocean waves' velocity field is of primarily importance. We present a method based on space-borne optical imagery from the SPOT-5 satellite to directly measure the ocean waves' velocity field.

The panchromatic and multispectral scenes acquired by SPOT 5 the same day on the same area are not strictly superimposable due to the different locations of the CCDs in the focal plane of the instrument. Such a difference corresponds to a time shift of about 2s between the two images. Here, we propose a method that exploits this temporal lag between the panchromatic and multispectral scenes to measure the ocean surface velocity field. Differences of ocean surface features' locations in the two scenes are identified and quantified using sub-pixel image correlation techniques (COSI-corr software, [1]). The measured offsets therefore represent the displacements of the corresponding ocean surface features during the 2s time span and can be interpreted as a wave velocity field.

As application test site, we selected an area offshore La Reunion Island. In Figure 1, we compared - upon certain assumptions: in particular the possibility of separating the swell from the wind generated waves by filtering in the Fourier domain - the results against a swell propagation model (SWAN, [2]).

The consistency between the observation and the model confirms that the method is reliable and can be immediately extended to other (in particular, higher resolution sensors able to provide better precision on the results) push-broom sensors.

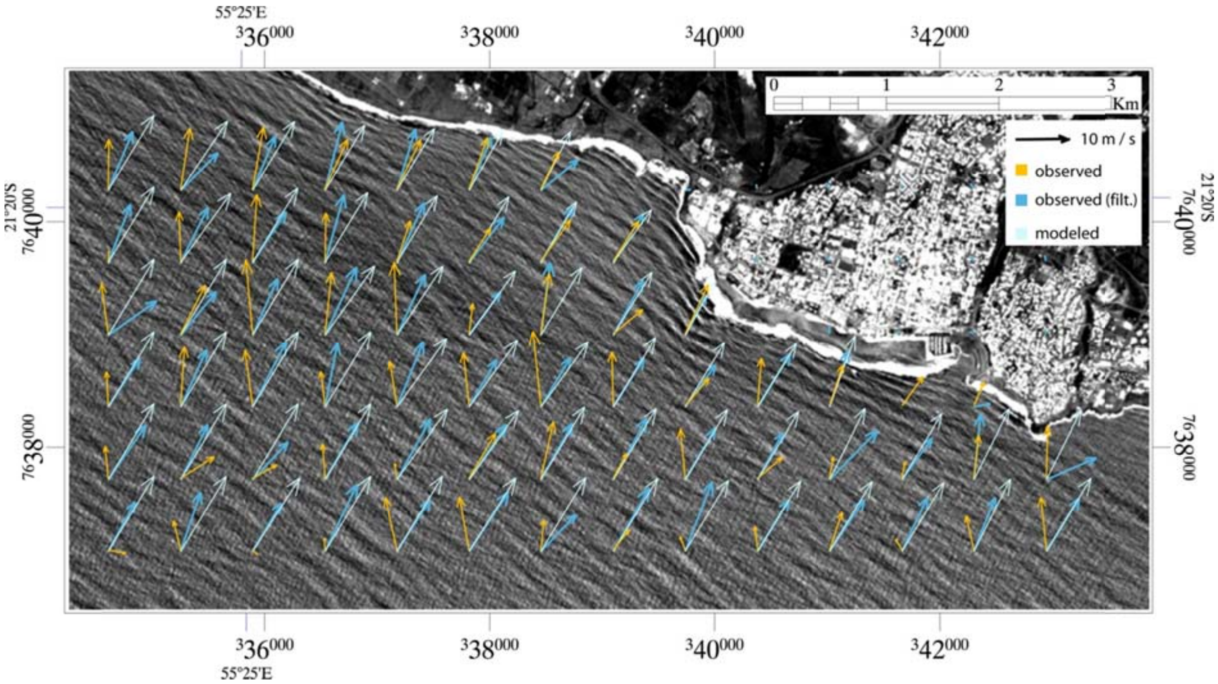

Figure 1: Waves velocity field retrieved from the SPOT-5 dataset (both filtered from the wind generated waves and not filtered) compared to SWAN modeled results. Orange vectors: velocity vectors obtained from COSI-corr analysis on non-filtered SPOT-5 data. They represent the velocity field that result from both the swell and the wind waves motion. Dark blue vectors: velocity vectors obtained from COSI-corr analysis on filtered SPOT-5 data. These vectors reasonably correspond to swell velocity field. Light blue vectors: velocity vectors obtained from SWAN swell analysis.

2. REFERENCES

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3. AKNOWLEDGEMENTS

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