OBSERVATIONS OF A COASTAL CURRENT USING ERS-1 SAR

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EXTENDED ABSTRACT

Coastal currents are important dynamical phenomena's in the marine ecosystem. Currents such as the Gulf Stream and the Kurushio are major forces transporting heat from the equatorial regions to the poles regulating the heat budget of the Earth. Regionally, currents also transport pollutants and fish larvae between the different coastal ecosystems. It thus appear important to evaluate the long-term variability of these currents in the context of global change. Unfortunately, coastal currents often exhibit a strong spatial variability making it difficult to monitor their behavior using in-situ measurements. Only remote sensing can provide the large scale vision necessary to observe these variations. Thermal infrared remote sensing has often been the primary tool used to observe currents such as the Gulf Stream. The presence of clouds is the most often encountered problem with the use of such sensors and alternate means of observing these currents would be welcomed. For large-scale currents, radar altimetry is one of the available tools. It is however hardly usable for smaller scale coastal currents of a few kilometers width. Theoretical work showed that current shears should be detected by space borne synthetic aperture radars (SAR). To be detected, such shears should be of the order of 10^{-4} s^{-1}. The Gaspé current located in the St. Lawrence Gulf (Canada) is a coastal current that meets this criteria. The goal of this project was thus to verify the possibility for a space borne instrument to detect the location of coastal currents by comparing active microwave C-band SAR data with concurrent in-situ measurements of current shears.

Two ERS-1 MLD SAR images (September 25 1991 and May 19 1992) were used for the first phase of the project. In-situ measurements consisted of a series of transects perpendicular to the mean current direction made during the two satellite overpass using an acoustic Doppler current profiler (ADCP). Salinity and temperature profiles were also gathered during the transects to determine the density structure of the current.

Image processing first consisted of locating the transects location and extracting sub-images corresponding to these areas. An adaptive Frost filter was then applied on these sub-images to remove speckle while preserving the high frequency features present. Grey level values were then extracted from the images along a line corresponding to the ship track and smoothed using a running mean of size 10.

The analysis of the data from the three transects indicates that the ERS-1 SAR detected the location of the Gaspé current boundary when environmental conditions were favorable (winds between 1 and 5 m s^{-1}) thus opening the possibility of using this tool to monitor coastal currents. It was thus shown that shears of 1 x 10^{-4} s^{-1} were indeed detectable as predicted by theory. The observations in this experiment were however made only with a current flowing roughly in the SAR range direction. Further observations should thus be made with a broader set of currents (including azimuth traveling currents) to further evaluate the capacity of a space borne SAR to detect this type of dynamical features.

OBSERVATIONS D'UN COURANT CÔTIER AU MOYEN DU RADAR À SYNTHÈSE D'OUVERTURE DU ERS-1