

PRELIMINARY MODEL FOR WIND ESTIMATION FROM COSMO/SKYMED X BAND SAR DATA

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1. ABSTRACT

Ocean monitoring with Synthetic Aperture Radar represents an active field of research because it can provide data on a space-scale currently not operationally covered by the other classical oceanographic remote sensing instruments such as scatterometers and altimeters. Local monitoring of parameters such as wind, wave and currents are of the utmost interest within several applications, for example in forecasting the fate of oil spills and in marine engineering for coasts protection as well. Several algorithms have been developed in order to extract wind parameters from SAR images. A common approach to measure the wind intensity is based on the relationship between the surface roughness, determined by the wind blowing over the sea surface, and the radar back scattering. In more general terms, as wind speed increases, surface roughness increases too and hence Radar Cross Section (RCS) increases. At a given wind speed and incident angle, the maximum RCS occurs when the wind blows towards the near range direction, a second smaller local maximum is present when wind blows away from the radar, i.e. towards the far range direction. RCS is minimum when wind blows perpendicular to the radar look direction i.e. along the azimuth direction (Ulaby et al 1982). A single RCS value can correspond to different wind speed and direction pairs but when wind direction is given it is possible to estimate the actual wind speed just inverting the following expression (Thompson 2004) :

$$(1) \quad \sigma = aU^\gamma \{1 + b \cos(\varphi - \varphi_w) + c \cos[2(\varphi - \varphi_w)]\}$$

Where U is the wind speed, φ_w the wind direction, φ the radar look direction (fig. 2) and a, b, c, γ are parameters depending of the Radar wavelength, incidence angle and wind speed. They have been estimated for the C band (CMOD4 Stofflen et al.1997, CMOD5 Hershbach 2003) and extensively validated. In this paper we present a preliminary X-model estimated from the X SAR Cosmo/SkyMed data. The data set we have used is constituted of more than 300 images acquired in strip mode and the wind data made available by the QuickScat mission. We have derived 18 parameters for the expression (1) and implemented an inversion schema in order to evaluate the wind on any Cosmo/SkyMed image product. The preliminary validation results are encouraging although our data set can't be considered adequate for any wind speed, direction and incidence angle. For what concern the wind

direction we have used both an external information and the one derived by the image itself applying the method of the gradient. (Kock, 2004, Zecchetto 2008).

2. REFERENCES

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