A Spectral Based Method To Retrieve Extreme Winds From SAR Imagery

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ABSTRACT. *In this work, a spectral based method, the azimuth cut-off (λc) approach is investigated, improved and studied under extreme weather conditions, i.e.; tropical cyclones. In particular, all the λc-dependent parameters are analyzed and set to make the estimates independent from the sensor and rhe scene.*

1. INTRODUCTION

In this study, the azimuth cut-off (λc) method is analyzed under high wind regimes. Firstly, the importance of the pixel spacing, the box size and the image texture in terms of homogeneities are discussed. The objective of the work is to make the λc estimation independent from the scene and the sensor.

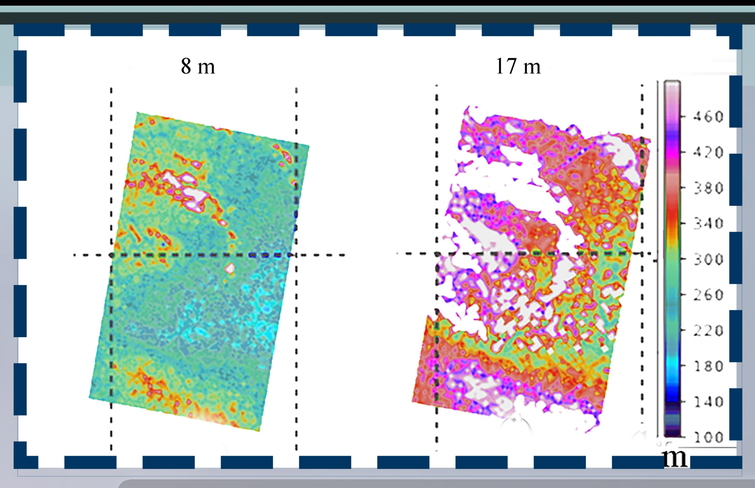
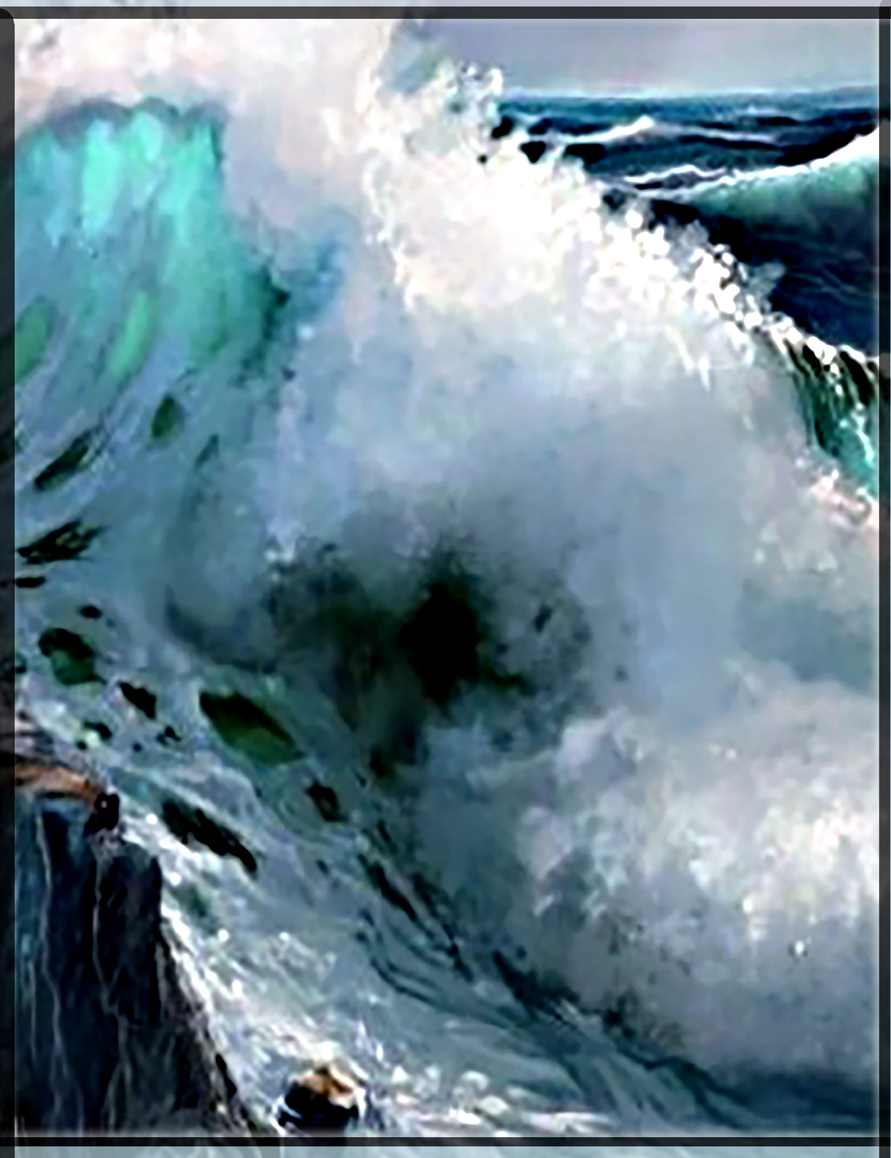


Fig.1 Estimation of λc using the TS-X SAR imagery and considering different pixel spacings (8 m (a), 17 m (b)).

2. METHODS

The SAR image is divided into SAR imagette of 1 km x 1 km;

- The autocorrelation function (ACF) of each imagette is evaluated,
- A 100-110 m median filter window is applied;
- The best Gaussian fit is retrieved;
- The λc value is estimated;



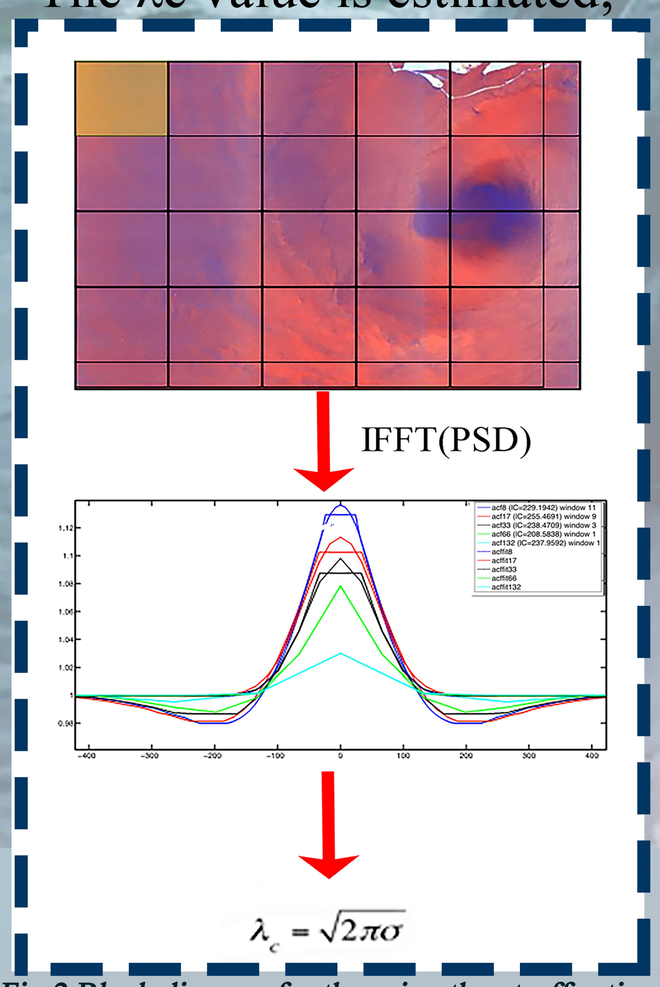


Fig.2 Block diagram for the azimuth cut-off estimation

- A χ^2-based test is used to filter unreliable λc estimates.

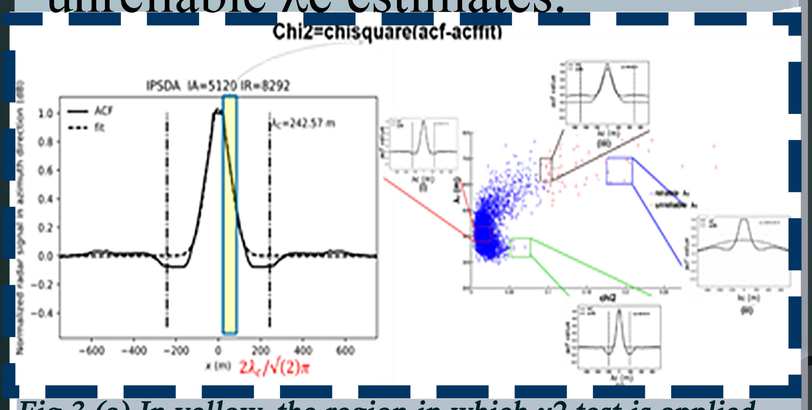


Fig.3 (a) In yellow, the region in which χ2 test is applied. (b) Scatterplot between χ2 values and λc.

3. EXPERIMENTS

$$\lambda_c = a + bU_{10}$$

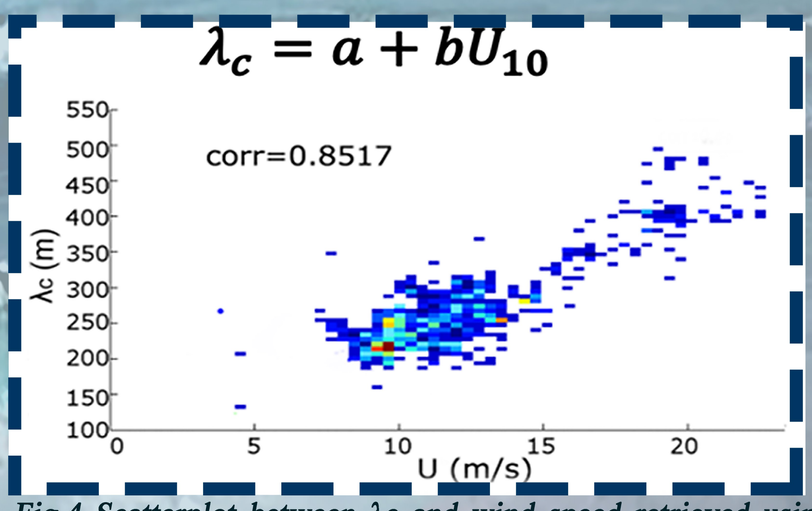
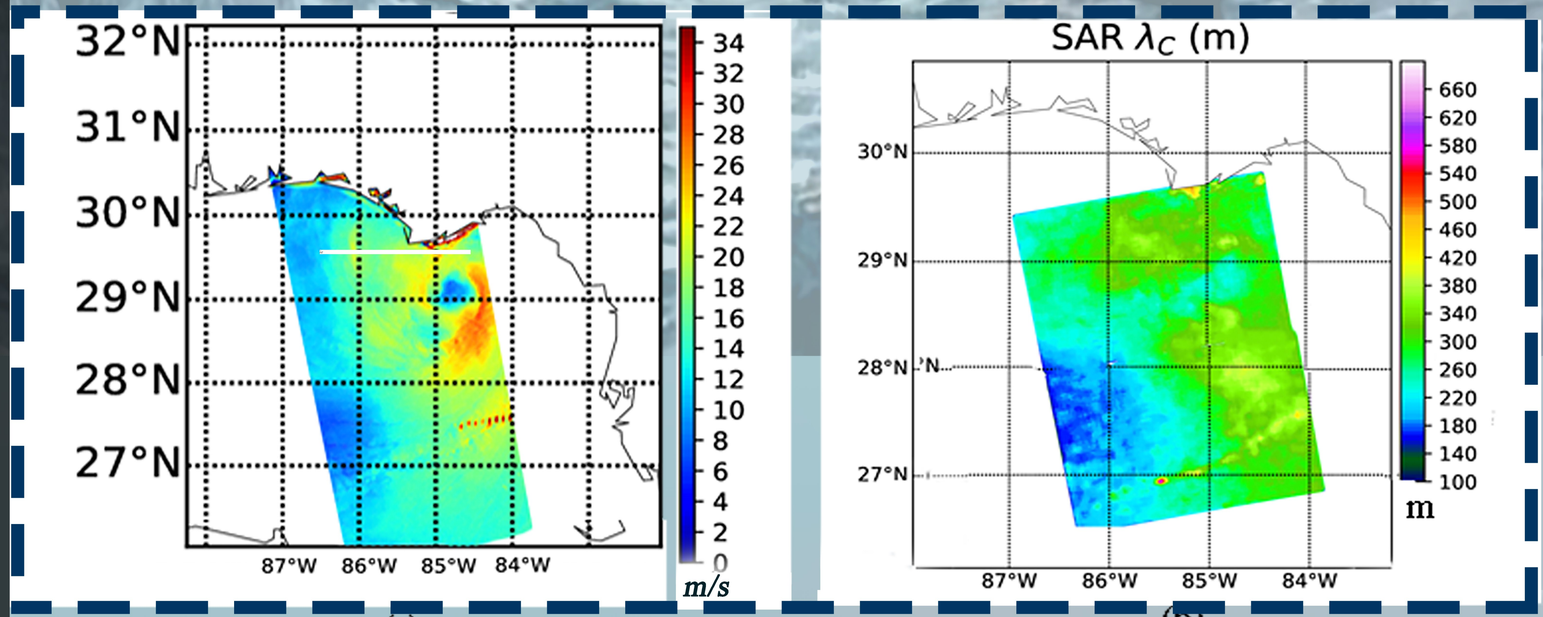


Fig.4 Scatterplot between λc and wind speed retrieved using azimuth cut-off under fully developed sea state conditions.

The test is conducted over 355 Sentinel-1 images in StripMap mode with 10 m pixel spacing. Interpolated ECMWF wind speed output to the SAR acquisition time and location is used to verify the effectiveness of the χ2-based filter.

4. RESULTS



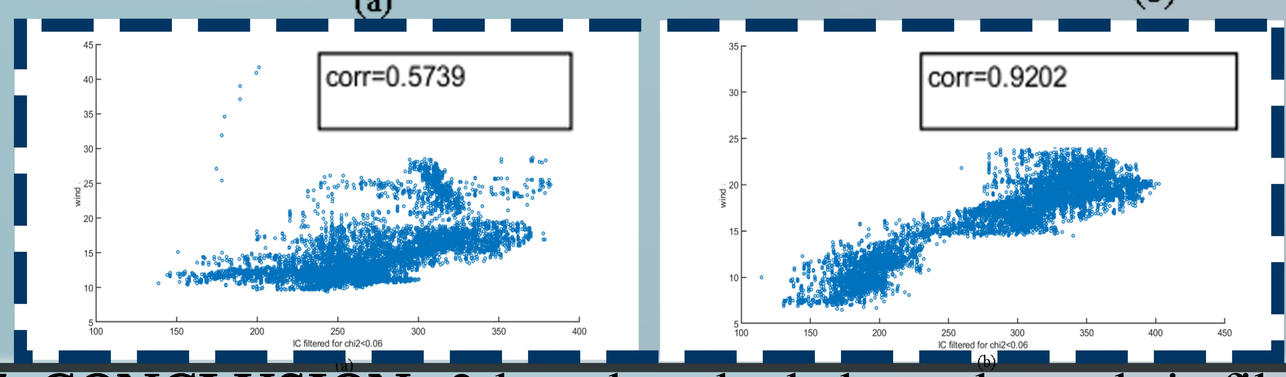


Fig.5 – (a) Wind speed map provided by Ifremer for hurricane Hermine; (b) λc map estimated taking into account the criteria described in this work for hurricane Hermine. Scatterplot between λc values and wind speed for (c) the northern and (d) southern region of the map.

5. CONCLUSION χ2-based method plays a key role in filtering out unreliable λc estimations. The novel approach seems to work well in extreme cases.