A SENSITIVITY ANALYSIS OF SENTINEL-1 SAR SPECTRAL SIGNATURES OF LOW-BACKSCATTERING SEA AREAS

Valeria Corcione[1], Ferdinando Nunziata[1], Andrea Buono[1], Marcos Portabella[2]z, Maurizio Migliaccio[1]

1 Università degli Studi di Napoli Parthenope, Dipartimento di Ingegneria, Naples, Italy

2 The institute of Marine Sciences (ICM-CSIC), Spain

Abstract

In this study, the effects of low-backscattering areas of anthropogenic and natural origin on the azimuth autocorrelation function (AACF) are analyzed using VV-polarized SAR measurements. Two objective metrics are introduced to quantify the deviation of the AACF evaluated over low-backscattering areas with reference to slick-free sea surface. Experiments, undertaken on six Sentinel-1 SAR scenes, collected in Interferometric Wide Swath VV+VH imaging mode over large low-backscattering areas of different origin under low-to-moderate wind conditions (speed ≤ 7 m/s), spanning a wide range of incidence angles (from about 30° up to 46°), demonstrated that the AACF evaluated within low-backscattering sea areas remarkably deviates from the slick-free sea surface one and the largest deviation is observed over oil slicks.

Introduction

Sea oil spill monitoring is of extreme importance for researchers, ecologists, local authorities and a wide set of stakeholders, every day, a significant amount of oil is released into the maritime environment representing a serious threat. In this study, a novel spectral method that relies on the azimuth cut-off is applied on single-polarization C-band SAR imagery to perform sea oil spill monitoring.

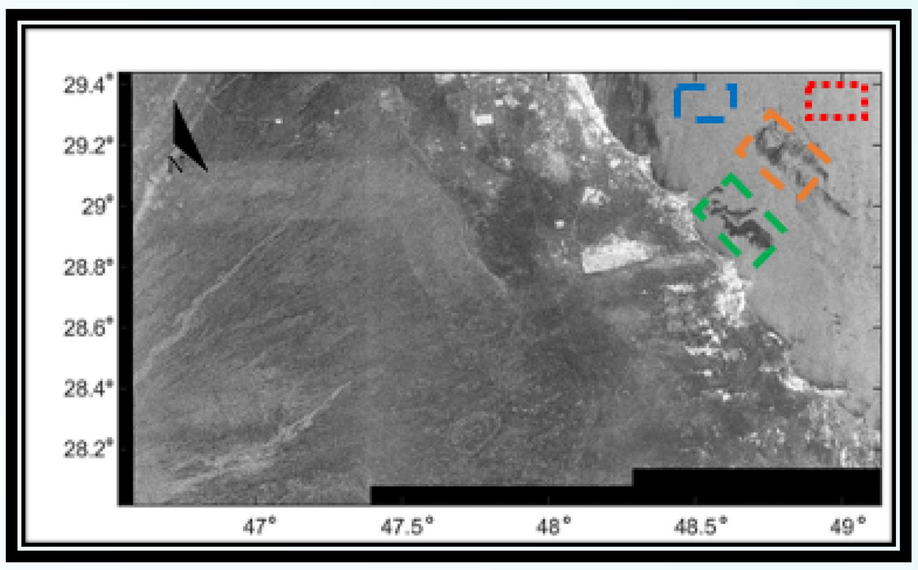

Fig.1 - VV polarized NRCS image related to the Sentinel-1 SAR scene

Methodology

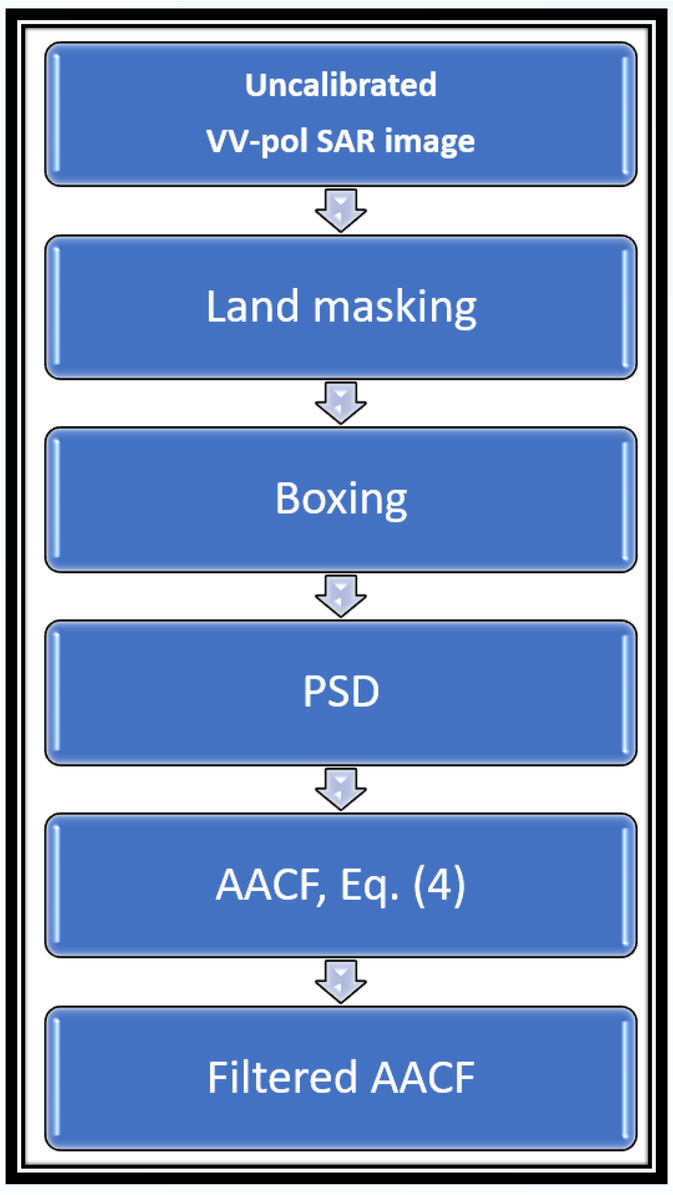

Fig.2 - Flow chart of the proposed methodology

Results

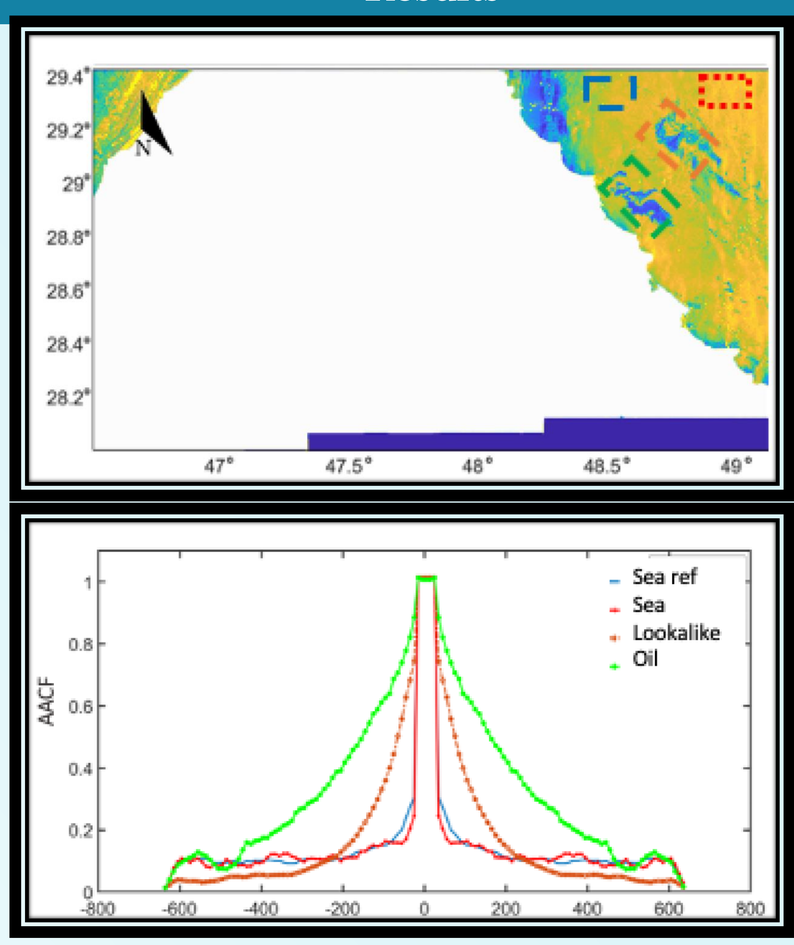

Fig.3- Up: SNR images, in dB scale, evaluated over the SAR dataset shown in Fig. 1

Down: AACFs evaluated over the ROIs highlighted in Fig. 1

Conclusion

Experiments, undertaken on 6 S1 VV-polarized SAR images, collected in IW dual-polarimetric imaging mode, where known oil slicks and low-backscattering sea areas due to natural phenomena are observed under low-to-moderate wind conditions (2 m/s–7 m/s) in a broad range of incidence angles (≈30°–46°), showed that:

- The AACF is sensitive to different low-backscattering areas, with dE and Drel values which are at least twice and 50% larger, respectively, than the intrinsic sea surface variability;
- Among the low-backscattering sea areas, the oil slicks exhibit the largest AACF deviation with respect to the reference slick-free sea surface, with a maximum of dE = 3.31 and Drel = 98.2%;
- The additive noise does not play a key role in broadening the AACF;
- The AACF is practically independent on the incidence angle while the backscattering contrast depends on it.

References

[1] Corcione, V., G. Grieco, M. Portabella, F. Nunziata and M. Migliaccio 2019. “A novel azimuth cutoff implementation to retrieve sea surface wind speed from SAR imagery.” IEEE Transactions on Geoscience and Remote Sensing. 57(6).

[2] Liu, P., C. Zhao, X. Li, M. He and W. Pichel 2010. “ Identification of ocean oil spills in SAR imagery based on fuzzy logic algorithm.” International Journal of Remote Sensing. 31(17): 4819–4833.

[3] Jagdish, M., and S. Jerritta 2018. “K-mean clustering algorithm for oil spill monitoring and detection.” International Journal of Advance Engineering and Research Development. 5(3): 573–577