EGU23-13618, updated on 20 Jul 2023
https://doi.org/10.5194/egusphere-egu23-13618
EGU General Assembly 2023

Radar altimetry for the detection of ship traffic: an improved byproduct of satellite radar altimetry

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The detection of vessels is considered an attractive byproduct of satellite radar altimetry, because it may complement the conventional tracking systems with the possibility to build long-term global statistics of ship traffic based on relatively small and manageable datasets of freely available data. Satellite radar altimetry was initially conceived and applied to the observation of ocean topography, being later extended to the coastal zone and to the observation of inland water.

The potentiality of SAR altimetry for the detection of ships has already been demonstrated with Cryosat2, and today Sentinel-3 is the first operational mission offering global SAR coverage with a constellation of two satellites.

Thanks to the enhanced azimuth (along-track) resolution available in the synthetic aperture radar (SAR) mode, the radar altimeter on board the Sentinel-3 satellite could be beneficial to other applications than ocean topography. In particular, this work studies the performance of algorithms for the automatic detection of ship targets from SAR mode data. In addition, the pre-processing of altimeter data by reliable detection algorithms, filtering out signal outliers from the sea surface response, largely contributes to enhance geophysical products that are typical in ocean topography studies (*e.g.* mean sea level). Thus, altimeter data of today could be regarded as an additional non-cooperative source for vessel traffic monitoring or to map global traffic patterns over long periods of time.

This work proposes a processing chain based on mathematical morphology filtering and robust statistics to estimate the structured background and detect target signatures from radargrams. The detection stage is followed by an additional binary morphological filtering phase that is useful to estimate target characteristics, such as the height. The study shows that robust statistics outperform non-robust ones, in terms of target signal to background ratio and of rejection of false alarms. The study finally provides a first attempt to validate the analysis comparing detected target contacts with automatic identification system (AIS) data.