ESA-MOST Dragon Cooperation
2022 DRAGON 5 MID-TERM RESULTS SYMPOSIUM
17–21 October 2022 | Online Event

# Optimization Of Waveform Retracking Algorithm For Sentinel-3 SAR Altimeter In Coastal Altimetry


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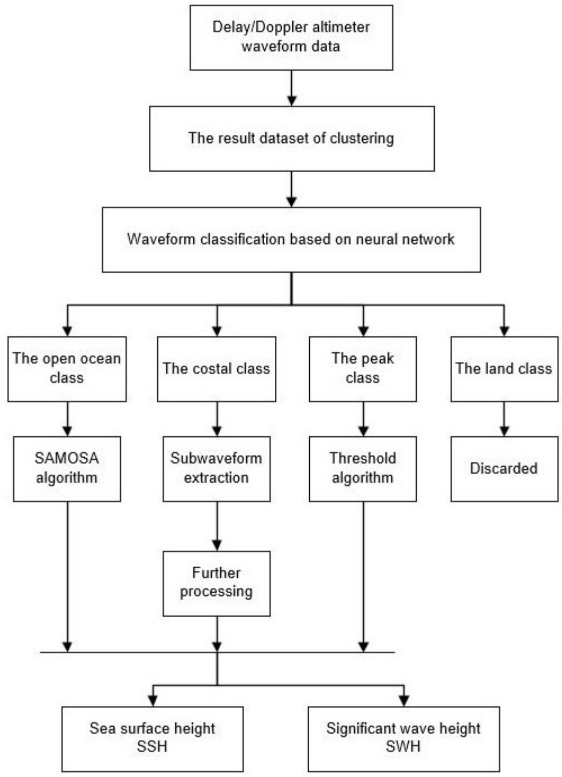
## ABSTRACT


Satellite altimetry has been developed for several decades and obtained abundant information on Marine environment change. At present, the SAR (Delay-Doppler) altimeter has become one of the main loads of satellite altimeters, such as the Sentinel-3 series and Cryosat-2 satellites. The measurement accuracy of SAR altimeter in the open sea is relatively high. However, due to the influence of land, island, and other factors, there are still some problems in the nearshore area, which limits the application of satellite altimeters in this area. Based on the waveform theory of SAR altimeter and the systematic analysis of different types of waveform retracking algorithms, this paper proposes a waveform retracking data processing strategy based on neural network waveform classification and discusses the waveform retracking algorithms suitable for different sea surface types. Based on the Sentinel-3 altimetry data, the accuracy of the algorithm and the change of altimetry sea level is analyzed by using the sea surface height data of the tide station and buoy.


## INTRODUCTION

SAR altimeters offer a large improvement in spatial resolution along the track compared to conventional altimeters, but are still affected by complex topography and sea conditions in the nearshore region. In this paper, the waveform dataset of the altimeter in the nearshore was built by cluster analysis and then trained by neural networks to construct different waveform classifications. Different waveform retracking methods are used for processing, in particular subwaveform retracking for nearshore waveforms, to resolve the noise at the leading and trailing edges, which is validated against tide gauge station data.




## METHODS

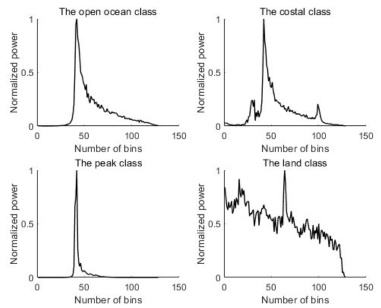
**Cluster Analysis**

- The waveform data from the SAR altimeter near shore (‘dist’<20km) was selected to form the initial dataset
- Normalize the waveforms and calculate the distance similarity between individual waveforms

$$d(\bar{P},\bar{P}') = \min_{-n0\leqslant n\leqslant n0}\left\{\frac{1}{N-2|n|}\sqrt{\sum_{i=1+|n|}^{N-|n|}\left(\bar{P}_{i+n}-\bar{P}'_{i-n}\right)^2}\right\}$$

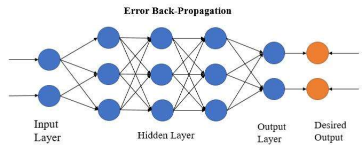
- Clustering using hierarchical clustering to group the waveform data into 15 classes

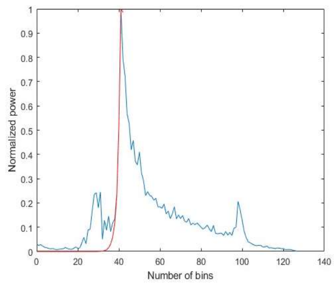
- The above classification needs to be followed by a secondary classification, which can be broadly divided into four classes




**Neural Networks for Classification**

- Extraction of different feature parameters of the dataset waveform as input to the neural network
- Training and validation using Back Propagation neural network
- Evaluation of the performance metrics of neural network classifiers




**Coastal Retracking Strategy**

- Subwaveform extraction
- Detection of abnormal peaks in the subwaveform for smoothing
- Detection of noisy areas and removal of corresponding noise
- Subwaveform retracking using SAMOSA model

**Comparative validation**

- Validation against multiple tide gauge observations published by UHSLC
- Validation against NDBC buoys data

## CONCLUSION

- Classification of a large amount of waveform data using cluster analysis
- Constructed an altimeter waveform nearshore classification network using neural network classification
- Automatic waveform classification using the constructed network and using different strategies for different waveforms
- A subwaveform retracking algorithm was used to remove anomalous peaks from nearshore waveforms
- Comparing with the tide gauge data, the strategy proposed in this paper gives better data

## REFERENCES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