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ASSESSMENT OF SELF-ORGANISING MAPS FOR THE UNSUPERVISED CLASSIFICATION OF SENTINEL-3 SRAL DATA FOR LEAD DETECTION IN THE ARCTIC OCEAN

Abstract

Measurements of Sea Surface Height in the Arctic Ocean from satellite altimeters are essential for monitoring climate change, enabling the measurement of sea ice thickness. Throughout much of the year the Arctic Ocean is covered in ice floes, so altimetry measurements must be taken from cracks in the ice called leads. As altimeters do not directly detect surface type, returns from ice floes and leads must be discriminated from one another based on the returned waveform's characteristics. Traditionally, discrimination of altimetry returns has been achieved with empirical thresholding methods, although recent research has shown that both supervised and unsupervised machine learning classifiers accomplish this with greater accuracy. There is particular interest in further improvement on the performance of unsupervised machine learning classifiers, as they do not require a labelled dataset for training. Previously, K-Medoids classifiers have demonstrated the highest level of accuracy out of the unsupervised classifiers researched. However, due to the high classification accuracies achieved by supervised Artificial Neural Networks, Self-Organising Maps have been identified as having great potential due to being an unsupervised Artificial Neural Network variant. This paper aims to investigate if an Self-Organising Map classifier can outperform a K-Medoids classifier. To achieve this, a validation dataset of labelled altimetry waveforms was generated from Sentinel-3 SRAL and OLCI data, utilising the satellite's unique instrument configuration that produces overlapping visual and altimeter data. Pixels in cloud-free OLCI images were labelled as an ice floe or a lead based on K-means clustering image segmentation and radiance value thresholding. SRAL altimetry returns were then temporally and spatially aligned with these pixels, allowing for the waveforms to be labelled with the corresponding class. Features that have performed highly in previous studies were then extracted from each waveform; max power, kurtosis, pulse peakiness, trailing-edge width, and stack standard deviation. Sets of labelled feature values were then used to train and test both classifiers. The Self-Organising Map classifier showed improved performance over the K-Medoids classifier, achieving a True Lead Rate 10.5