Sea-States Clustering Using k-means

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Introduction

- The work aims to improve the partitioning of and characterisation of sea-states by using parameters of the wave field, in addition to wind, for (wind-)sea and swell identification.
- The method uses k-means clustering based on hindcast (HC) data, trained using sea and swell dominated locations (Fig. 1).
- The example below shows feasibility testing of a simple combination of parameters - using the **inverse wave age** & **«spread over frequency»**.
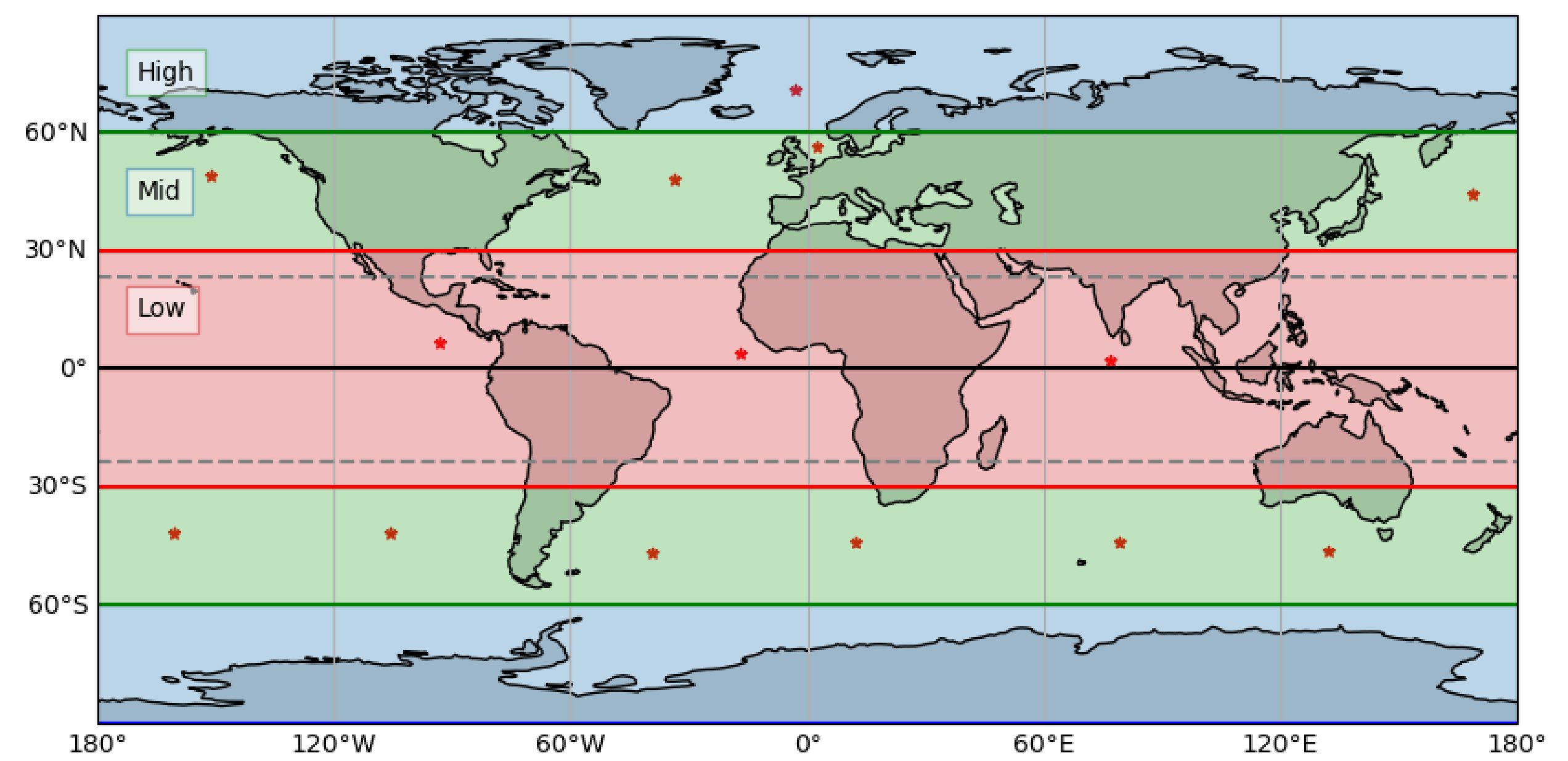

Figure 1: Locations of HC data used for training

Training and Confirming Prediction of Clusters – Sea States

Figures show the k-means training based on the HC data and the scheme's ability to predict wind and swell conditions from an idealised model run ('bathtub' experiment using a regular domain)

- Wave age is allowed to take negative values for better training.

- *Results show that cluster 0 (blue) can be described as (wind-)sea and 1 (green) as swell.*
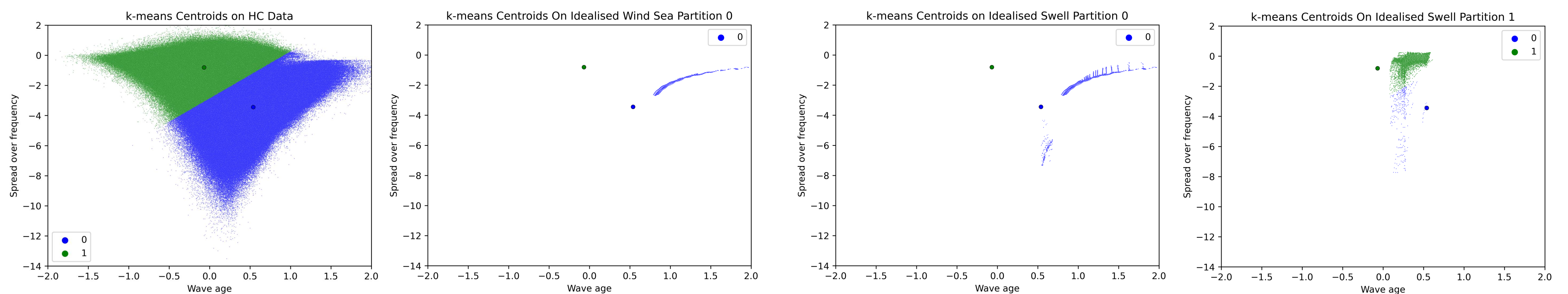
Identification of Sea States on Domain

Based on the above results, wave partitions can then be identified in the bathtub experiment

- Example of sea initialisation of 4m significant wave height and no wind forcing.

- In the first timesteps a sea cluster appears due to the mix of frequencies in early stages of wave dispersion, where forerunners from the left of the domain catch-up to slower waves.

- In later timesteps the scheme identifies swell only as the wave field becomes fully dispersed.
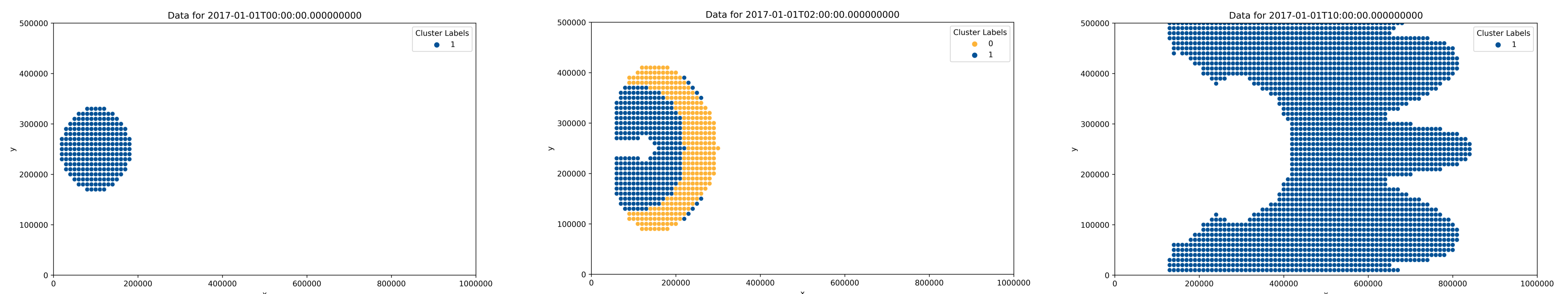
Conclusions

The work suggests that a k-means clustering can be used to successfully identify sea and swell. Next steps will be to test different parameter combinations to find a scheme that is well aligned to conceptual models of (wind-)sea and swell behaviour and test behaviours against current schemes.