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Characterising the nature of ocean-surface heterogeneity extracted from hypertemporal Earth Observation data.

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The ongoing temporal data “explosion” in Earth Observation imagery presents the oceanographic community with opportunities to analyse 30+ year archives of ocean surface measurements. While multiple hyper-temporal analysis tools exist for terrestrial applications, unsupervised data-driven methods are needed to extract and identify spatio-temporal ocean surface patterns. In particular, heterogeneity mapping of the ocean surface is needed to underpin time series analysis of satellite-derived ocean parameters, such as sea surface temperature and chlorophyll. Ultimately, derived products must be of benefit to the oceanographic and marine ecology communities, with clear meaningful guidance on their contents and how to interpret them.

The Ocean-surface Heterogeneity MApping (OHMA) algorithm was developed to extract annual heterogeneity summaries from hyper-temporal datasets of GHRSST multi-sensor SST data. The OHMA algorithm produces a classification ensemble relying on optimised iterations of ISODATA classification. The ensembles highlight spatio-temporally homogeneous and heterogeneous ocean regions. The approach is entirely data-driven to meet current limitations when working with hyper-temporal ocean data, and to overcome challenges of obtaining ocean surface in-situ data which drive more supervised approaches. The OHMA map is validated for 2011 using measures of in-situ spatio-temporal heterogeneity from transect data. This approach can help optimise in-situ sampling efforts, with significant cost savings.

It is critical to provide guidance to oceanographic and ecology users on how to interpret the features an OHMA map presents. Efforts undertaken to clarify interpretation of an OHMA map, through comparing the heterogeneity features highlighted in the OHMA outputs to SST front summaries derived from SST data, clearly demonstrated that heterogeneous regions cannot be explained primarily by the presence and magnitude of SST fronts. The spatio-temporal characteristics of other mesoscale features, such as eddies and surface currents, may also influence the features expressed in an OHMA output which are of interest to end user communities. Measuring the contribution of the various mesoscale features to a region’s heterogeneity, therefore requires a multi-feature (and therefore multi-variable) synergistic approach.

This presentation is part of continued consultation with the oceanography community, aiming to explore and identify the driving mechanisms of unexplained features. Ultimately it intends to guide the selection of suitable satellite-derived data products of different variables for further comparative analysis. The presentation gives an overview of the OHMA algorithm and the validation efforts undertaken, before focusing primarily on the product characterisation efforts which highlight the value of considering multi-variate data. It makes a call for trans-disciplinary discussions, to identify the range of potentially influencing mesoscale features on the hyper-temporal analysis product, ultimately shaping the product guidance provided to end users.

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