Deriving minimal sea surface temperature monitoring networks from remote sensing data using coherency analysis

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Sea surface temperature (SST) is recognised as an essential climate variable by the Global Climate Observing System programme. Therefore, SST is extensively measured at the global level using both monitoring networks (buoys) and satellites. The buoy systems measure SST at a few thousand spatial locations scattered over the ocean surface. The remote sensing data, on the other hand, are available at a daily or weekly level and with high spatial resolution (e.g. 9 km grid cell). Remote sensing data sets are thus very large, with several million time series.

In order to understand how different areas of the ocean surface behave with respect to SST, it is useful to synthesize the information contained in the data sets mentioned above. To do this, a recently introduced clustering algorithm is adopted, which is based on state-space modelling and which enables clustering of millions of time series with respect to their temporal coherence.

When the clustering algorithm is applied to global SST time series and the clusters mapped in space, we observe that the ocean surface divides into a relatively small number of clusters, with time series in each cluster sharing the same temporal pattern.

In this work, SST clustering for the North Atlantic basin and time period 2003-2009 is provided. The clustering result is used to define a minimal network for point monitoring, in terms of number of buoys and their spatial locations. The minimal network derived following this approach consists of 24 nodes, each located within a cluster. Spatial representativeness of data collected using such network has been validated using SST remote sensing data from 2010 to 2012, computing root mean squared prediction errors over space. This shows that maintaining an SST network at those spatial locations would allow the SST pattern to be described.

Keywords: climate; essential climate variables; clustering; remote sensing.