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A weather type method to study surface ocean variables

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The set of methodologies for obtaining wave climate information at high spatial resolution from relatively coarse resolution is known as downscaling. Dynamic downscaling, based on the use of numerical models, is perhaps the most widely used methodology for surface ocean variables. An alternative approach is the statistical downscaling, that can be conducted by means of regression methods or weather pattern-based approaches. The main advantages of the statistical downscaling based on weather patterns are: the low computational requirements; the ease of implementation; the additional climatology information; and local forecast application. Moreover, this technique allows exploring the synoptic atmospheric climatology and their relationship with surface ocean variables.
It is well known nowadays that the seasonal-to-interannual variability of wave climate is linked to the atmosphere circulation patterns. We proposed a statistical approach based on the predictand (eg. local wave characteristics) is associated to a particular synoptic-scale weather type (predictor). The predictor is the n-days-averaged sea level pressure field (SLP) anomalies, which are synthesized using data mining techniques to describe a number of weather types. In particular, we focus in NE Atlantic (NAO region) using as predictor the 3-days-averaged SLP fields calculated by NCEP atmospheric reanalysis (1948-2010). A principal component analysis is applied over SLP fields to reduce the spatial and temporal dimensions. The K-means clustering technique is then applied to the two-dimensional sample of the principal components which explain more than 95% variance of the SLP. The K-means technique divides the data space into a number of clusters, where each of them is characterized by a centroid and formed by the data for which the centroid is the nearest. Finally, we visualize the weather types associated to each centroid in an ordered way similar to self-organizing maps, SOMs.
The probability distributions of several sea state parameters (significant wave height, mean direction, energy flux,..) are the predictand. The method has been validated by using a high-resolution wave reanalysis in the Spanish Coast. This allows understanding how possible changes in the occurrence of the weather types might affect the local ocean variable.