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Statistical seasonal forecasts of cyclone numbers in Europe

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In this work we present a statistical method to estimate the future three-month mean cyclone number anomaly in Europe.

Seven parameters from the ERA-20C reanalysis were used: total air column water, snow depth, sea-ice cover, total soil water, near-surface air temperature, sea surface temperature, and the mean sea level pressure. The areal coverage was global and parameters were seasonally averaged for the years 1901–2010. The leading principal components of parameters were then used as predictors.

Cyclone tracking based on finding the local maxima of Laplacian of the mean sea level pressure was used in production of the predictand data. Cross-validated LASSO (least absolute shrinkage and selection operator) regression and random sampling were used to find out the relative importance of the predictors in explaining the cyclone number anomalies in each season separately. Cross-validated linear regression was then used to find the optimal subset of the predictors to be used in the model.

Among the studied predictors, the local persistence of the cyclone number anomaly from the previous season as well as different principal components of global sea surface temperature, mean sea level pressure, soil moisture, and total column water were found to be the most important ones in explaining the future season cyclone numbers in Europe in most of the seasons. Analyses of the cross-validation results from the predictor selection years indicate promising model performance in all seasons except summer. Further tests suggest that the selected predictors might also have predictive power when applied to completely independent set of years.