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Multidecadal Surface Seasonal Wind Variability Over Northeastern North America Via Statistical Downscaling: Methodological Sensitivity

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Surface wind is a fundamental meteorological variable that has an appreciable effect in the society in many day to day applications, from pollutant dispersion and crop growth to structural vulnerability, and, in recent times, power production. Northeastern North America is a region where the large-scale dynamics foster the transit of cyclones of either tropical or extratropical origin. This, in combination with the topographical effects on the area, contributes to a high wind variability and the occurrence of extreme wind events all year round. This work presents the first attempt to analyse the climatological variability of the observed surface wind (predictand) in relation with the large-scale circulation patterns (predictors) that govern this region. The study is conducted during two extended seasons with differentiated circulation patterns and associated winds: winter (NDJFM) and summer (JJASO).

The current analysis is carried out via a Statistical Downscaling (SD) methodology based on the application of Empirical Orthogonal Functions (EOF) and Canonical Correlation Analysis (CCA). The SD technique is implemented at different large-scale domain sizes and with several EOF/CCA combinations of predictor variables provided by all existing (12) global reanalysis products. The predictand dataset consists of a set of 525 sites distributed over North Eastern North America that span over a period of about 60 years (1953-2010).

An initial parameter configuration of the SD model identifies the main large-scale to local dynamical associations over this area. A systematic sampling of the different model factors allows for a sensitivity assessment of the SD estimations. An evaluation of the SD wind estimates obtained with an adequate choice of parameters is presented in a site-by-site comparison with the wind outputs from the reanalysis products. An intercomparison of the predictive skill of the wind outputs between all reanalyses is also carried out.

Additionally, this SD methodology permits the reconstruction of the regional wind variability back to mid 19th century, far beyond the observational dataset, through various century-long reanalysis and instrumental sea level pressure datasets.