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MiKlip-PRODEF: Probabilistic Decadal Forecast for Central and Western Europe

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The demand for skilful climate predictions on time-scales of several years to decades has increased in recent years, in particular for economic, societal and political terms. Within the BMBF MiKlip consortium, a decadal prediction system on the global to local scale is currently being developed. The subproject PRODEF is part of the MiKlip-Module C, which aims at the regionalisation of decadal predictability for Central and Western Europe. In PRODEF, a combined statistical-dynamical downscaling (SDD) and a probabilistic forecast tool are developed and applied to the new Earth system model of the Max-Planck Institute Hamburg (MPI-ESM), which is part of the CMIP5 experiment. Focus is given on the decadal predictability of windstorms, related wind gusts as well as wind energy potentials.
SDD combines the benefits of both high resolution dynamical downscaling and purely statistical downscaling of GCM output. Hence, the SDD approach is used to obtain a very large ensemble of highly resolved decadal forecasts. With respect to the focal points of PRODEF, a clustering of temporal evolving atmospheric fields, a circulation weather type (CWT) analysis, and a storm damage indices analysis is applied to the full ensemble of the decadal hindcast experiments of the MPI-ESM in its lower resolution (MPI-ESM-LR). The ensemble consists of up to ten realisations per yearly initialised decadal hindcast experiments for the period 1960-2010 (altogether 287 realisations). Representatives of CWTs / clusters and single storm episodes are dynamical downscaled with the regional climate model COSMO-CLM with a horizontal resolution of 0.22°. For each model grid point, the distributions of the local climate parameters (e.g. surface wind gusts) are determined for different periods (e.g. each decades) by recombining dynamical downscaled episodes weighted with the respective weather type frequencies.
The applicability of the SDD approach is illustrated with examples of decadal forecasts of the MPI-ESM. We are able to perform a bias correction of the frequencies of large scale weather types and to quantify the uncertainties of decadal predictability on large and local scale arising from different initial conditions. Further, probability density functions of local parameters like e.g. wind gusts for different periods and decades derived from the SDD approach is compared to observations and reanalysis data. Skill scores are used to quantify the decadal predictability for different leading time periods and to analyse whether the SDD approach shows systematic errors for some regions.