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Possible changes in wind energy potentials over Europe under future climate conditions using an RCM ensemble

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The impact of climate change on wind power generation potential over Europe is investigated considering two ECHAM5/MPI-OM1 driven regional climate models (RCMs: COSMO-CLM and REMO). Grid resolution is 0.44° for REMO and 0.2° lat/lon for COSMO-CLM. Wind energy density is estimated using hourly near-surface wind speed from RCMs. The bias of GCM climate scenarios is assessed by comparing energy densities for recent climate conditions simulated with ECHAM5 (20C, 1961-2000) and with reanalysis data (ERA-40) driven RCM simulations. Results show similar features in both datasets, as seasonal differences and spatial patterns are comparable. However, the magnitude of energy density is typically higher in the ECHAM5/MPI-OM1 driven data for every season. Further, the inter-annual variability is less consistent between the two datasets.
In order to estimate future changes in wind energy density, data for recent (20C) and future climate conditions (SERS B1 and A1B 2061-2100) is compared. Further, changes in the seasonal distribution and the inter-annual variability of energy density are analyzed. Results show significant changes (95% confidence level) of the mean energy density in some areas, particularly over the North, Baltic and Mediterranean Seas. In annual terms, there are only little changes in the mean energy density, but the inter-annual variability increases significantly in particular for Western Europe. In seasonal terms, changes are much more substantial: For northern Europe, a significant increase is projected especially during wintertime over the North and Baltic Seas, whereas the Mediterranean may experience a decrease in energy density in summer and winter. Changes are comparatively smaller in spring and autumn. These changes in wind energy potentials are associated with alterations of the large-scale circulation over the Euro-Atlantic area during the 21st Century.