Future wind energy resources in the North Sea as predicted by CMIP6 models

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Net carbon dioxide emissions have to be brought down to zero in the coming decades to hold the rise in global temperature in this century below the 2°C from pre-industrial levels. This target implies a fundamental transformation of the global energy system that will have to rely heavily on renewable energy sources. Among these, the harvesting of electricity from the wind plays an important role. Yet, climate change itself can impact the supply of renewable energy. Therefore, national climate mitigation plans need to make informed decisions regarding any changes to future extractable wind resources to consider the possible risks.

In this work, we explore the changes in wind climatology over the North Sea in the different shared socioeconomic pathways (SSP) emission scenarios as identified by the output of a selection of CMIP6 simulations. Many northern European countries rely on the wind resources of the North Sea for climate mitigation. As a first step, however, we validate various aspects of the wind speed and direction and their variability in the historical CMIP6 simulations as compared to multiple long-term reanalyses. The work also includes calculations of annual energy production for existing and planned wind farms in the North Sea and how these could change in the coming decades.