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Impacts of Wind Farms on the Regional Climate on the North Sea

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Offshore wind deployment is foreseen to expand dramatically in the coming years. The strong expansion of offshore wind parks is likely to affect the regional climatology of the coastal areas surrounding the Atlantic, North Sea and Baltic Sea. A wind farm parameterisation based on Blahak et al. 2010 and Fitch et al. 2010 has been implemented in an idealised version of COSMO-CLM, where an Ekman spiral in neutral conditions is simulated, and has been validated against LES data. A mean bias of 8.5% is observed for the wind speed below the rotor top tip. In a second step, the wind farm parameterisation is implemented in a non idealised version of COSMO-CLM over the North Sea at a kilometer scale resolution. The wind farms enhance the turbulent kinetic energy above and within the rotor. This has an impact on the evaporation at the surface, and low level cloud cover. Futhermore, wind farms change the shape of the Ekman spiral. This has consequences on the height of the planetary boundary layer, which may affect power production.