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Feedback of Coastal Upwelling on the Near-Surface Wind Speed at the Baltic Sea

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Due to its narrow and elongated basin, coastal upwelling plays an important role in the Baltic Sea. During the thermally stratified period from spring to autumn, a seasonal thermocline separates warm water at the surface from colder water below. A sufficiently strong upwelling event can cause the thermocline to reach the surface leading to a drop of the sea surface temperatures (SSTs). The different SSTs directly affect the turbulent heat fluxes between the ocean and the atmosphere and thus the near-surface air temperature. As consequence, the stability of the atmospheric boundary layer is increased which reduces the vertical momentum transport from the free atmosphere toward the surface. This can cause considerably lower near-surface wind speeds.

In this study, we use a coupled regional climate model, consisting of the atmospheric model REMO and the Baltic Sea Ice Ocean model BSIOM, to investigate the described mechanism at the Baltic Sea. We analyze a twenty-year long simulation from 1989 to 2008 with the ERA-Interim reanalysis as lateral boundary forcing. In total, 47 upwelling events with an average duration of about 8 days are detected at a specific site at the eastern coast of the Baltic Proper using an automatic algorithm. The mean effect and the mean temporal evolution of all detected upwelling events is investigated. To separate the coupling effects from large-scale influences, the results are compared to an uncoupled atmosphere-only simulation using the SSTs from ERA-Interim. On average, the SST drops by about 3°C leading to a considerable reduction of the 10m wind speed of about 0.6 m/s.