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Validating coastal, near and far offshore boundary layer parameterizations with airborne helipod turbulence probe

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The atmospheric boundary layer (ABL) flow is more complex at the land-sea transition zone due to the formation of coherent mesoscale land-sea breeze circulation triggered by abrupt changes in the surface roughness and thermal forcing. Since the structure of the boundary layer flow is closely related to the representation of the surface conditions as determined by e.g. orography, land use, surface roughness etc., we begin with investigating the sensitivity of the boundary layer flow to the surface forcing at the land-sea transition zone including the coastline, the islands, the near (< 10 km) and the far offshore regions at the north-western German coast, the Borkum island and the offshore research platform FINO-1. The turbulent momentum, heat and moisture fluxes derived from in-situ airborne Helipod measurements are compared with results from the Mellor-Yamada-Janic (MYJ), Mellor-Yamada-Nakanishi-Niino (YMNN) and the Quasi Normal Scale Elimination (QSNE) boundary layer parameterization schemes implemented in the WRF (V3.1) mesoscale model.

Since ground stations and measurement towers offer only isolated point measurements, and remote sensing methods rely strongly on assumptions on the turbulent structure of the lower part of the atmospheric boundary layer, the best strategy to obtain precise in-situ data are airborne measurements. Probably the most accurate airborne measurement platform offering highest spatial and temporal resolution of thermodynamic quantities is the helicopter-borne turbulence probe Helipod. The Helipod is attached to a 15 m rope and carried below a helicopter and outside the downwash area of the rotor blades at 40 m/s. At a sampling rate of 500 Hz, measurements of the wind vector, temperature and humidity resolve sub-meter turbulence but also large (e.g. convective) structures. Vertical profiles and horizontal legs can be flown between 1500 m and a few meters above the surface, although the latter is limited by local flight safety rules (settlements, power lines etc.).