Research on Small-Scale Dynamical Processes in Air-Sea Coupling Models

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This study employs the Parallelized Large Eddy Simulation Air-Sea Coupling Model (PALM) to investigate the interactions between the atmosphere and the ocean, focusing on the impact of small-scale dynamical processes on air-sea fluxes. Simulations under different wind speeds (5, 10, 15 ms-1) in the atmospheric boundary layer and oceanic mixed layer reveal a close relationship between air-sea fluxes and wind speed, with increased wind speeds leading to higher net heat and buoyancy fluxes. Small-scale dynamical processes significantly influence near-surface regions, with wind speed being a major factor. The introduction of Langmuir circulation showed enhanced vertical momentum transfer and altered the distribution of small-scale dynamical processes. Additionally, simulating island topography's impact on oceanic velocity fields and upper layer mixing indicated that the interaction between wind fields and Langmuir circulation significantly alters flow structures, especially in the wake of islands. The findings of this study are crucial for a deeper understanding of the role and impact of small-scale dynamical processes in air-sea coupling models, providing new perspectives and data support for improvements in climate models.

Keywords: Air-Sea interaction, small-scale dynamics, large eddy simulation

