Geophysical Research Abstracts
Vol. 17, EGU2015-11807-2, 2015
EGU General Assembly 2015

Influence of tides on the sea breeze in the German Bight: How much model complexity is needed?

Jana Fischereit (1), K. Heinke Schlünzen (2), Andrea M. U. Gierisch (3), David Grawe (4), Ronny Petrik (5), Udo Hübner (6), and Jan Backhaus (7)

(1) Meteorological Inst., CEN, Univ. Hamburg, Germany (jana.fischereit@uni-hamburg.de), (2) Meteorological Inst., CEN, Univ. Hamburg, Germany (heinke.schluenzen@uni-hamburg.de), (3) Meteorological Inst., CEN, Univ. Hamburg, Germany (andrea.gierisch@zmaw.de), (4) Meteorological Inst., CEN, Univ. Hamburg, Germany (david.grawe@zmaw.de), (5) Meteorological Inst., CEN, Univ. Hamburg, Germany (ronny.petrik@zmaw.de), (6) Inst. for Oceanography, CEN, Univ. Hamburg, Germany (udo.huebner@zmaw.de), (7) Inst for Oceanography., CEN, Univ. Hamburg, Germany (jan.backhaus@zmaw.de)

The state of the atmosphere near the coast is affected by the interaction of atmosphere and ocean. Thus, in order to predict the state of the atmosphere in coastal areas correctly, different oceanic characteristics and processes need to be considered. The goal of the present study is to identify whether tidal effects are relevant for the prediction of sea breezes at the German North Sea coast. For that an atmosphere model was extended to simulate the ocean in different complexities, leading to a coupled ocean-atmosphere-model. In contrast to many other studies the present study considers a two-way-coupling for momentum. That is, the simulation not only consideres a transfer of momentum from the atmosphere to the ocean but also a transfer from the ocean to the atmosphere. The model system is tested for a sea breeze situation, which is a common phenomenon in the German Bight in May and June. Six different scenarios with a grid size of 1.5 km are calculated: Inundated/dry mudflats for the entire simulation, high/low tide at Heligoland at midday and high/low tide at Heligoland at midday with a two-way-coupling for momentum.

Tides influence sea breezes in two ways. Firstly, they influence the heat budget in coastal areas, as mudflats are inundated and fall dry. The study reveals that the air temperature in 10 m height follows the tidal cycle and thus reflects an inundated scenario during high tide and a dry scenario during low tide, respectively. Because of the alternation of the air temperature above the mudflats, the temperature gradient between land and sea areas is influenced, which modifies the sea breeze development. A time difference of one hour is found for the formation of the sea breeze front and its related cloud formation between those scenarios where low tide and high tide occur at midday respectively. Also the inland penetration of sea breezes is influenced by tides: with incoming tide their fronts are moved further inland.

Secondly, tidal currents influence the wind speed directly. An effect of tidal currents was found in the results of simulations, which include a two-way coupling for momentum. Depending on the direction of the tidal flow with respect to wind direction, the wind speed over the open North Sea is increased (or decreased) by around 0.2 m/s.

Furthermore, an influence of tides on the atmosphere is found not only directly at the coast. Due to nonlinear effects with clouds, tides also influence the state of the atmosphere further inland.

Considering the findings of the study, it is shown how complex a model system for coastal meteorology might need to be.