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Forecasting the weather
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Offshore convective initiation by interacting land breezes

K. Wapler (1) and T. Lane (2)

(1) Deutscher Wetterdienst, Germany (kathrin.wapler@dwd.de), (2) School of Earth Sciences, The University of Melbourne, Australia

The sea- and land-breeze system, i.e. onshore winds during the day and offshore winds during the night, is a wind pattern that is observed along coastal regions globally. In addition to having important influences on coastal temperatures and wind patterns, land and sea breezes affect pollution dispersal and play a key role in the initiation of precipitating convection over both land and ocean.

Nighttime and early morning precipitation is regularly observed over the oceans. However there is still much to learn about the frequency and intensity of individual events. In the Maritime Continent the mean precipitation distributions from long-term observations show a maximum offshore during early morning, however the mechanisms and evolution of individual events is not entirely clear.

A case of offshore convective initiation by interacting land breezes near Darwin, Australia is investigated using cloud-permitting model simulations, radar-derived precipitation observations, thermodynamic profiles from radiosonde soundings and surface measurements. These analyses elucidate the convergence of two land breezes in the Van Diemen Gulf, one originating from the Tiwi Islands and the other from mainland Australia; the convergence is sufficient to initiate a line of convection that forms parallel to the mainland coast in the early morning. While differing in small-scale features, the modeled system shows reasonably good agreement with the observed precipitation accumulations.
Intuitively, it might be expected that model simulations should readily reproduce convective initiation by simple topographically-forced flows, like land breezes, provided the topography is sufficiently well resolved. However, by using simulations with different initialization times and by examining a second case, it is shown that the representation of the land-breeze system and subsequent convective initiation is very sensitive to the upstream wind and thermodynamic conditions, making correct simulation of these processes challenging.

While this study only examines a few cases of convective initiation by land breezes in the Van Diemen Gulf, these cases expose some of the important sensitivities and challenges that conspire against their correct model representation.
As demonstrated, land breezes may play a significant role in the initiation and organization of convection and do make an important contribution to the diurnal cycle of precipitation in low convective inhibition coastal environments like the maritime continent. Thus, it is important that land breezes are realistically represented in models, even though they are usually weaker and less frequently associated with convective initiation than their daytime counterpart