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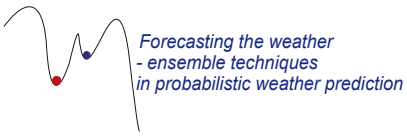

Simulating stable boundary layers on different spatial and temporal scales

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This talk discusses two problematic aspects of stable boundary layer modeling. The first part deals with some current issues related to small-scale non-turbulent motions in stable boundary layers, with solutions for their modeling being out of sight at this point. Specifically, meandering flow strongly influences the turbulence and dispersion of pollutants in weak-wind conditions, but this influence is frequently under-represented in models. Typical time-scales associated with meandering are between the turbulence and the applied averaging time, which is usually 1 h. At the same time, the meandering spatial scales range roughly from tens of meters to several kilometers, and are hence termed submeso motions. Since meandering and its generating mechanisms are not fully understood, we have examined the possibility of reproducing this submeso variability by the atmospheric numerical model WRF-ARW at 1/3 km horizontal grid spacing. A weak-wind night during the CASES99 experiment has been chosen for this purpose.

One of the key result is that WRF-ARW is unable to reproduce the submeso variability with its typical set-up. The underrepresentation in terms of variability is traced to too-strong horizontal diffusion rather than the horizontal resolution. By removing or reducing the horizontal diffusion, the model reproduces the variability at submesoscales that is comparable to the measured variability. In that case, the model also simulates the behaviour of a passive tracer plume in a seemingly realistic way. However, the fully realistic reproduction of individual submeso motions by a model does not seem possible regardless of the horizontal resolution used, since the nature of these motions appears to be stochastic. At this point, the inclusion of this missing variability in models appears realisable only through parametrizations.

The second part of the talk discusses recent experience with open issues in simulating very stable conditions over Europe on climatological time-scales using RegCM4 model, and approaches to alleviate them.