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Catching Cold Pools during FESSTVaL 2020

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Cold pools are formed by evaporatively cooled downdraft air that spread on the surface underneath precipitating clouds and play a key role for the development and maintenance of convection. The passage of a cold pool front a few minutes ahead of the precipitation is generally associated with rapid perturbations of temperature, air pressure and wind speed. Convection-permitting numerical weather prediction (NWP) models and modern Large-Eddy simulations (LES) with grid spacing in the order of 1 km or less can explicitly resolve cold pools. The dynamics of cold pools is arguably one of the most beautiful features of these novel simulations, however, are they realistic? As most operational networks are too coarse to capture the spatial structure of cold pools, we lack observational reference data for the validation of their simulated properties.

The envisioned measurement campaign FESSTVaL (Field Experiment on Submesocale Spatio-Temporal Variability in Lindenberg) aims to test novel measurement strategies with high spatial density for the observation of submesoscale boundary layer structures and phenomena such as cold pools. FESSTVaL is a joint initiative of the partners in the Hans Ertel Centre for Weather Research (HErZ) and will take place at the Meteorological Observatory Lindenberg near Berlin during summer 2020.

We will present plans and preliminary studies for the investigation of cold pools during FESSTVaL. In order to capture the spatial structure of cold pools with sufficient resolution, a dense network of ground-based measurement stations will be deployed within 20 km around the Lindenberg observatory. The network consists of 100 low-cost and power-saving data loggers that autonomously record air pressure and temperature with a temporal resolution of 1 s and are currently developed and tested at the University of Hamburg. A coarser secondary network of approx. 20 WXT weather sensors, a small number of high-precision energy balance stations and a X-band precipitation radar will complete the measurement setup. Analyses of available observational and LES model data consistently show that the mean negative temperature perturbations associated with a cold pool passage lie between 3 and 4 K, while pressure and wind speed anomalies of roughly 1 hPa and 3 m/s can be expected, respectively. Furthermore, the occurrence of cold pools underlies a high inter-annual variability and pronounced annual and diurnal cycles.