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Moisture transports and rain cell statistics in organised convection and their potential role in super Clausius-Clapeyron scaling

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In observations of (sub)hourly precipitation, it is often found that the extremes display a dependency on (dew point) temperature exceeding the Clausius-Clapeyron (CC) relation. Such super CC behaviour is commonly explained by dynamical feedback mechanisms in convective clouds whereby enhanced latent heating (and cooling due to evaporation) could produce more vigorous, or more organised updraft motions. Haerter and Schlemmer proposed that enhanced cold pool dynamics with warming could be crucial with stronger cold pools in warmer conditions leading to larger areas where convection inhibition can be broken, and larger areas of moisture convergence. Here, we study these feedback mechanisms in a set of Large-Eddy Simulations forced by typical mid-latitude large-scale atmospheric conditions. Different weather/climate conditions are emulated by imposing perturbations in temperature and humidity. We start by analysing vertical uniform warming profiles (motivated by present climate day-to-day variability but not the most realistic in a climate change setting) which maximises the potential for dynamical feedbacks. In this set of LES simulation warmer conditions have shown to lead to larger, more organised cloud systems. Here, we specifically analyse the vertical moisture transport in these cloud systems as well as in the sub-cloud layer at the cold pool fronts as a function of cell size. The ultimate goal is to relate this back to the rain statistics in order to understand the conditions that lead to super CC scaling.

Authors: LENDERINK, Geert (KNMI); LOCHBIHLER, Kai; SIEBESMA, Pier (Delft University of Technology)

Presenter: LENDERINK, Geert (KNMI)

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