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Unveiling Convective Momentum Transport at different scales during EUREC4A

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The transport of horizontal momentum takes place at various spatial and temporal scales: from small-scale turbulence to cloud- and meso-scale circulations. This study focuses on the role of convective momentum transport (CMT) in the momentum budget in trade-wind cloud regimes with different patterns of cloud organization. Observations of the momentum budget during EUREC4A suggest that in early February, deeper convection and larger cloud structures are associated with a different profile of eddy momentum flux divergence than days with shallower cumulus humilis. Using large eddy simulation hindcasts and a mesoscale weather model, we study the profiles of eddy momentum flux associated with turbulence, convection and mesoscale flows in different cloud scenes during EUREC4A. Are turbulent, convective or mesoscale circulations responsible for a deceleration or acceleration of the mean flow? Are along-wind or cross-wind circulations more pronounced? Do the models show evidence of countergradient flux production in the cloud layer?

We select a ten-day period for which the Dutch Atmospheric Large-Eddy Simulation (DALES) model is run on a 150 km x 150 km domain with a resolution of 100 m. Its boundaries are forced hourly with dynamical tendencies from the mesoscale weather model (HARMONIE), which is initialized every 24 hours from ERA5. HARMONIE is also run in a climatological mode on a 3200 km x 2000 km domain with 2.5 km resolution, in runs with shallow convective momentum transport on and off.

In this presentation, we first evaluate the models' ability to reproduce the mean and evolution of the wind profiles and the momentum fluxes during the ten days, as well as the cloud organization. Second, we present and discuss the eddy momentum flux divergence that is carried by flows on different scales and evaluate its role in the momentum budget. Third, we discuss the relationship between shallow convective momentum transport and cloud organization.