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Convective momentum transport by shallow convection in cold air outbreaks

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A cold air outbreak in the North Atlantic has been the focus of an intercomparison case of global and LES models (CONSTRAIN). The case is characterized by significant wind shear and has been used to study momentum transport by shallow convection and its parametrization in the ECMWF IFS, in a recent study by Schlemmer et al (2017). So far, relatively little is known about how to parameterize convective momentum transport (CMT) by shallow convection, such as the stratocumulus and cumulus clouds typical for cold air outbreaks.
The study by Schlemmer et al has shown that conventional parametrizations of convection (the mass flux approach) perform well for temperature and moisture, but not so well for momentum. A possible explanation is that the cross-cloud pressure gradient is a missing term in the mass flux approach. Yet, whether this approach is well suited for momentum in the first place is to be determined.
In this study we address this problem by systematically analyzing the horizontal and vertical structure of CMT along the stratocumulus-to-cumulus transition of CONSTRAIN. We do this through DALES simulations run at increasing horizontal and vertical resolution on large domains, which support significant organization in the cloud field. By varying the background wind shear, resolution and domain size we study how CMT depends on the wind profile, the character of convection, and the scales of organization. Using the conditionally sampled budget of zonal and meridional wind, we will address the importance of cross-cloud pressure gradients, and evaluate the mass flux approach.
Finally, we will assess the relative influence of momentum flux divergence, and the contribution by CMT, in the momentum budget, and discuss its potential role in determining near-surface winds on the scales of mid-latitude weather systems.