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Evaluation of boundary layer parametrizations in convective boundary layers

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In this paper the results of local and nonlocal schemes for vertical vertical turbulent transport in the atmospheric boundary layer are compared with observations and LES results, in three different cases. The different parametrization schemes are evaluated against 3D case studies of clear and cumulus boundary layers. The local diffusion scheme uses an eddy diffusivity determined by the TKE equation and a mixing length proposed by Bougeault et Lacarrère; for cumulus convection the Bechtold scheme is used. The first nonlocal scheme determines an eddy diffusivity profile based on a diagnosed boundary layer height and a turbulent velocity scale, incorporating nonlocal (vertical) transport effects for heat and moisture. The second nonlocal scheme corresponds to the recently proposed Eddy-Diffusivity Mass-Flux parametrization. This turbulence/convection scheme combines the usual eddy-diffusivity closure and the mass-flux concept. Due to its integrated nature, the parametrization avoids the need to switch between the two schemes in the case of cloudy convective boundary layer. At the same time, it allows for the benefits of the mass-flux approach to the representation of dry convection and, in cloudy conditions, guarantees consistency in the fluxes between the sub-cloud and cloud layers. The clear convective studies considered are the Nieuwstadt case and the CICLUS field experiment (Climate Impact of Changes in Land USe), performed in Southern Portugal. For the cumulus convection regime the ARM case and BOMEX were chosen.