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High resolution modeling of deep moist convective processes: turbulence, microphysics and grid-spacing are the key ingredients?

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Actual petascale and next-generation exascale modeling platforms are making possible the numerical simulation of severe weather events at unprecedented fine mesh-scale.
This strong progress has the potential for enabling a deeper insight into spatio-temporal properties of deep moist convective processes, but also requires a better understanding of the uncertainties associated with the adoption of the different physical parameterizations, such as turbulence and microphysics closures.
In this paper, deep moist convective processes in idealized and real atmospheric scenarios are studied by means of high resolution numerical simulations.
The focus of the work is to establish if and at which extent the convection-resolving solutions, in the range of grid-spacing between 1 km and 100 m, statistically converge from a turbulence perspective with respect to flow field structure, transport properties and precipitation forecast. Different turbulence closures, microphysics settings and grid-spacings are combined and their joint impact on the spatial-temporal properties of storm processes is assessed and discussed.