Geophysical Research Abstracts
Vol. 12, EGU2010-7269, 2010
EGU General Assembly 2010

Influence of turbulent parameterization on high resolution numerical modeling of observed tropical convection during NASA TC4 field campaign

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The extraordinary enhancement of computational power makes it now feasible to model deep moist convective processes at very-fine-mesh. However an increasing number of studies exhibit a strong dependence and sensitivity of the meteorological predictions on numerical and physical details when the adopted horizontal resolution is in the range between 100 m and 1000 m. In this range of scales the distinction between mesoscale modeling and LES (Large Eddy Simulation) is not absolute and a twofold approach is possible to simulate turbulent processes. On one side, one can "downscale" the sub-grid scale turbulence parameterization used in mesoscale models; on the other one can "upscale" the LES closure. Neither of them are designed to operate in this range; Lilly (1967) named it "terra incognita".

In this work, deep moist convective processes, observed during the NASA TC4 (Tropical Composition, Cloud and Climate Coupling) field campaign in July 2007, were modeled by means of high resolution numerical simulations with the Weather Research Forecasting (WRF) model. Different turbulent closures were used and their impact on the spatial-temporal structure of predicted convective fields will be discussed through direct comparison with the corresponding observations of TC4 aircraft, which provided profiles and structure measurements of the tropical upper troposphere and lower stratosphere. Particular attention was paid to the comparison of observed and simulated Airborne Dual-Frequency Precipitation Radar APR-2 to evaluate performance of WRF model in the "terra incognita" for this deep moist convective case study.