SEMINAIRE CNRM / GAME

N°2012_28

mardi 30 octobre 2012 à 11h

EVALUATION OF THE MESOSCALE MODEL WRF FOR GABLS3 : IMPACT OF BOUNDARY LAYER SCHEMES, SPIN-UP AND BOUNDARY CONDITIONS

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Résumé :

This study evaluates the performance of the WRF mesoscale model, specifically, the Planetary Boundary-Layer (PBL) parametrizations against Cabauw tower observations, as an extension of the GABLS3 (GEWEX Atmospheric Boundary-Layer Study) one-dimensional model inter-comparison. The WRF version 3.4.1 contains 12 different PBL parametrizations (amongst others YSU, MYJ, Bougeault and Lacarrere), although most of them have not been systematically evaluated. The GABLS3 case offers a clear opportunity to perform such a test, focusing on mesoscale weather maps, time series of near surface weather variables, vertical structure and their inertial oscillations at night. Considering the mesoscale weather maps we find substantial difference between PBL schemes. Generally, non-local schemes tend to produce higher temperature and stronger winds than local ones. Also WRF slightly underestimates the 2m temperature during daytime and substantially underestimates at night in contrast to previous studies. The usual deficiency of mixing in non-local schemes in latest model version is improved compared to observations. Generally, we find substantially different model skill for the Stable Boundary Layer, for different closure schemes. The discrepancy between non-local and local, 1st and higher order PBL parametrization model skill, seems to be still vigorous subject of discussion. We find significant difference in model performance for a range of 12, 18 and 24 hours spin-up times. Longer spin-up time decreases the wind speed bias in models although it increases the negative bias for the temperature. The importance of ECMWF input files vertical resolution on model performance has been confirmed. The difference in the model results between runs with 61 levels input files and 91 levels has been noted, additionally its influence appear more significant for non-local PBL parametrizations. Concerning vertical profiles, the non-local PBL schemes underestimate the PBL depth at night and the Low Level Jet (LLJ) altitude, but overestimates LLJ speed which contradicts to some previous studies. The local, TKE based PBL schemes seems to estimate the LLJ altitude and strength more accurately. The simulation with Bougeault and Lacarrere PBL parametrization showed the greatest bias in the lower part of the atmosphere (below 400m). All model runs shows similar structure for potential temperature with the consistent cold bias at higher part of the PBL compared to observations.

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