Algorithmic tools for mesoscale data assimilation in the limited area model

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Summary

Data assimilation in limited area NWP models shall focus on the mesoscale processes, those that are not treated by the analyses of the driving (global) models. These small scale features are often difficult to observe and/or measure with conventional methods, therefore an alternative strategies for mesoscale data assimilation shall be sought. In presented dissertation some algorithms are proposed, tested and validated for LAM model ALADIN for this purpose. New diagnostic techniques to asses the quality of the analyses and subsequent forecasts are presented as well.

In the pseudoassimilation cycle based on the blending by digital filter the large scale part of spectra of the global model analysis is combined with the short waves coming from the short forecast of the high-resolution limited area model. Scale selection is made using the digital filter. The new blended state provides initial conditions leading to beter forecast of the near-surface parameters in the first hours of integration, compared with dynamical adaptation.

The variational formulation of the analysis requires an a-priori knowledge of the forecast error statistic. An alternative formulation of the NMC method is proposed, that estimates J_b statistics from the pairs of forecasts computed with constant boundary conditions. These lagged J_b statistics exhibit several mesoscale properties compared to previous version of J_b, both in diagnostics, academic experimenst and real 3DVAR simulations.

To built a multiincremental algorithm for a mesoscale assimilation both alternative tools (blending by digital filter and mesoscale J_b statistics) were combined in one assimilation step. Several open methodological problems were studied concerning the coupling, initialisation and organisation of such setup. Positive response of the proposed assimilation system was diagnosed, that was later confirmed by other colleagues in real meteorological simulations.