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On the uncertainty of verification measures by reference data

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The influence of reference data on NWP-model verification results is evaluated in the framework of a multi-level verification experiment. A set of six limited area NWP-models is evaluated by three model-independent analysis methods, based on the operational GTS network and the JDC (Joint D-PHASE COPS) data set. Verification is performed on four regular grids with horizontal resolutions ranging from 4-32km. In doing so traditional verification measures are combined with scale separation techniques using a 2-dimensional wavelet-transform. Verification uncertainties are estimated by four different applications: A poor man's ensemble derived from the sample of analysis variations, a re-sampling approach, and two different ensemble analysis tools based on random perturbations. The outcomes provide new insights in the interaction of grid resolution, observation density and spatial scale dependence of verification measures.

Variability of verification outcomes increases with larger grid point distance and lower observation density. In order to reduce uncertainty it is therefore advisable to apply gridded reference data on a high-resolution grid based on a preferably high-density observation network. A dense observation network lowers the importance of the interpolation methodology as it enables a simple interpolation technique to provide results equivalent to any advanced analysis tool. The results indicate a clear preference of gridded reference data to pure observations. This is not only a matter of the station number which is considerably lower than the number of grid points in most analysis fields, but also a matter of the spatial representativity of observations. The verification experiments revealed that the question of scale dependence is also of importance for traditional, overall verification scores. If applied on field representations of individual spatial scales verification results for coarse scales show larger deviations or lower correspondence between forecast and analysis because of large amplitudes in the field. However, if verification is performed on ranges of scales, where only fine scale information is removed from the original fields, the scores show better results if compared to results of un-manipulated fields.