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Entity-based verification in the intercomparison of three NWP models during a heavy snowfall event

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The Finnish Meteorological Institute has adopted the entity-based CRA (Contiguous Rain Area) methodology for pre-operational use in the verification of precipitation. The idea of the CRA method is to estimate the displacement (or error) between forecasted and observed precipitation fields by producing an estimate of the total error (like the MSE) which is further decomposed into contributions defined as the displacement (location), volume (amplitude) and pattern error. The software also produces a comprehensive set of classical verification measures like frequency bias, probability of detection, false alarm ratio, equitable threat score etc.

A heavy snowfall event was experienced in early November 2006 causing immediate disruption, traffic jams and accidents along the main highway between the two major cities, c. 150 kilometers apart, in south-southwestern Finland. The quality of three operational NWP models or model versions is studied: the deterministic ECMWF with its 25 km resolution, and the two versions of HIRLAM, the reference version RCR and the finer-scale MBE, with resolutions of 22 km and 9 km, respectively. Further, the required precipitation analysis, which is taken as the "truth" in verification, is defined on the one hand based on radar-observed precipitation and on the other hand based on rain gauge data. Notoriously, neither of these can be considered very reliable in analyzing the water content of snowfall. Nevertheless, six sets of comparative verification statistics result. The considerable differences in the results, depending on which of the precipitation analyses is being used as "truth", indicates the large underlying uncertainty in our understanding of the observed state of the atmosphere. Furthermore, the classical verification measures score best for ECMWF and worst for the finest-resolution MBE, which could easily be interpreted as the archetypal double-penalty issue. One must notice, though, that in an idealistic case, with the forecast and

observed entities having a perfect match, also the classical verification scores would yield perfect scores regardless of scale issues. Based on “eyeball” verification, the MBE precipitation field is clearly lagging behind of what was observed during this event. A very detailed analysis and consideration of the inherent uncertainty in verification is required to interpret the potential advantages and shortcomings of the models being verified.