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Keeping track of spatial scales in verification of forecasts from NWP models

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Atmospheric phenomena are characterized by the presence of features on many different scales, which are typically driven by different physical processes. For instance, a typical weather map shows large scale precipitation areas driven by large scale vertical motion, along with smaller scale convective activity all embedded in a single system. Verification methods which simply compare the observations to model forecasts are limited in the sense that one cannot diagnose the model performance for different spatial structures or processes which operate on different scales. If one were able to partition forecasts and observations according to scale, one could produce more diagnostic versions of familiar scores which are partitioned according to scale. Furthermore, one could determine the smallest scales for which a model shows positive skill.

In Canada we have been experimenting with wavelet methods for verification of statistical lightning forecasts based on the output of our operational model. Using wavelet analysis, we were able to partition the Brier Skill score according to scale, and found that the forecasts had skill for scales larger than about 500 km.

For the lightning project, we were fortunate to have observations and forecasts which contained information on the same set of scales, which permitted us to focus on the diagnosis of accuracy of the model forecasts of features on different scales. The typical forecast verification problem involves the matching of model variables represented on regularly spaced grids with irregularly spaced point observations. The point observations generally contain information on all spatial scales, yet the smaller spatial scales are seriously undersampled by networks of point observations, and the spatial scales which can be resolved by such a network varies according to the density of the network. The model forecasts contain information on only those spatial scales which can be resolved by the model grid. We are also working on methods for taking account of spatial variations in scale representativeness of observation networks. This work will extend the scale-partitioning methodology to include the more general situation where forecasts and observations do not represent the same set of scales.

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The presentation will focus on the lightning verification project and the results obtained, and will include a brief discussion of other scale partitioning work in progress.