Spatial forecast verification with wavelets

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The quality of precipitation forecasts is difficult to evaluate because images with discrete features surrounded by empty space cannot helpfully be compared pixel by pixel: A slight displacement between observed and predicted field is punished twice, generally leading to better marks for coarser models. To answer the question whether a highly resolved model truly delivers an improved representation of precipitation processes, alternative tools are thus needed. Wavelet transformations can be used to summarize high-dimensional data in a few numbers which characterize the field's texture. A comparison of these transformed fields allows us to judge models based on their ability to predict spatial correlations. The fidelity of the forecast's overall structure is thus investigated separately from potential errors in feature location.

In this talk, we discuss new wavelet based structure-scores for the verification of deterministic as well as ensemble predictions. The properties of these scores are rigorously tested in an idealized setting: A recently developed Gaussian stochastic model for precipitation extremes allows us to generate realistic pairs of artificial observations and forecasts with prespecified spatial correlations. We demonstrate that wavelet spectra are highly sensitive to differences in structural properties and can thus be used to judge the performance of state-of-the-art forecast systems. Our random rain fields prove to be a useful test-bed for any verification tool that aims for an assessment of structure.