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Spatial verification of high-resolution precipitation forecasts through wavelets

Florian Kapp, Petra Friederichs, and Michael Weniger
Bonn, Meteorological Institute, Germany (s6flkapp@uni-bonn.de)

Spatial verification of high-resolution numerical weather predictions are of key interest. Traditional gridpoint-by-gridpoint comparisons exhibit several problems, including double-penalty and domination of scores by small-scale features. High-resolution models thus require new spatial verification techniques to cope with small-scale features such as convective precipitation patterns. Wavelet transforms provide a framework to analyse spatial data on separate scales and in different directions. Several wavelet based spatial verification techniques have been developed over the past decade, which focus on the assesment of forecast performance on distinct physical scales (e.g. spatial or small-scale precipitation). However, wavelet transforms as advance in scientific fields such as texture analysis, face or fingerprint recognition or feature detection still reveal unused potential in meteorological applications.

Here, we present a technique developed for image texture analysis to evaluate spatial forecasts of precipitation. The forecasts are provided by the the high-resolution COSMO-DE ensemble prediction system of the German meteorological service (Deutscher Wetterdienst). A discrete wavelet transform is used to estimate the forecasts' power-spectra on distinct scales. We thus concentrate on the verification of spatial structures of precipitation instead of a gridpoint-by-gridpoint comparison. A linear discriminant analysis is applied to analyse ensemble member clustering. Image texture analysis shows promising results in discriminating ensemble members by their distinct driving boundary conditions, as well as different forecast dates.