EMS Annual Meeting Abstracts
Vol. 8, EMS2011-201-1, 2011
11th EMS / 10th ECAM

Forecasting the weather
- ensemble techniques
in probabilistic weather prediction

Clustering Numerical Weather Forecasts to Compute Prediction Intervals

A. Zarnani (1) and P. Musilek (2)

(1) Department of Electrical and Computer Engineering, University of Alberta, Edmonton, Canada (azarnani@ualberta.ca),
(2) Department of Electrical and Computer Engineering, University of Alberta, Edmonton, Canada (musilek@ece.ualberta.ca)

Numerical Weather Prediction (NWP) systems are state-of-the-art models of atmosphere that provide forecasts of the future weather. Such forecast can be used by many applications. The outputs of NWP models are point, deterministic predictions, arranged on a three-dimensional grid. Each point prediction provides a single expected value for an attribute of interest, e.g. temperature. However, many applications would benefit from forecasts augmented by the information about their uncertainty. A common way of describing uncertainty is the use of prediction intervals, e.g. minima, maxima, and confidence level percentages. They can be obtained using ensemble forecasts. However, ensembles can be very costly and thus not feasible for some applications using short-term probabilistic forecasts. In this paper, we apply automatic clustering of NWP model outputs to efficiently find conditional prediction intervals. The described approach relies on model's performance history as a valuable source of information for uncertainty analysis. The error statistics of the discovered clusters are used to infer the prediction intervals based on weather situations. To examine suitability of different clustering algorithms, the following methods were applied to find temperature prediction intervals from point forecasts: k-means, clara and hierarchical clustering. This leads to predictions with different amounts of uncertainty, depending on the forecast context. To further improve the probabilistic forecast skill, we apply several derived features and use Principal Component Analysis for feature reduction. All presented methods and the effect of their main parameters are empirically evaluated using a set of experiments. To establish a sound way of evaluating the quality of prediction intervals, we developed a family of quality measures and ranking methods, and examined their adequacy. The experimental results show that a common skill score fails to incorporate some critical quality aspects of prediction interval forecasts. They also suggest that prediction intervals obtained by incorporating the clustering-based uncertainty analysis into the point forecasts provide forecasts with higher skill and resolution. This can improve the quality of results in many applications that require efficient probabilistic forecasts.