Geophysical Research Abstracts
Vol. 13, EGU2011-3587, 2011
EGU General Assembly 2011

On the reliability of spatially disaggregated global ensemble rainfall forecasts

Étienne Gaborit (1), François Anctil (1), Geneviève Pelletier (1), and Vincent Fortin (2)

(1) Civil Engineering Department, Laval University, Québec, Canada (etienne.gaborit.1@ulaval.ca), (2) Numerical Weather Prediction Research, Environment Canada, Dorval, Canada

Ensemble rainfall forecasts are of potentially high interest for decision making, as they provide an explicit and dynamic assessment of the uncertainty in the forecast. However, global ensemble rainfall forecasts are generally available at lower resolutions than deterministic forecasts because their production is highly time-consuming. For example, in Canada, the operational 15-day ensemble prediction system (EPS) has a resolution of 0.9 degree, which corresponds to a pixel size of approximately 7 000 km2 at mid-latitudes, whereas the 10-day operational deterministic forecasting system has a resolution of 0.45 by 0.3 degree, which corresponds to a pixel size of approximately 1 000 km^2 at mid-latitudes.

The lower resolution of the operational EPS currently limits its use for hydrological forecasting, given the small size of some watersheds for which hydrological forecasts are required (sometimes as small as 10 km^2). Indeed, even for rainfall events which are properly resolved by a low-resolution EPS such that the average precipitation for a grid box is relatively accurate, there is a lack of spatial variability in the rainfall field within that grid box, since rainfall observations will actually exhibit local areas experiencing no rainfall and others with amounts much higher than the average value forecasted for the entire area by the EPS.

The aim of this work is to bridge the gap between ensemble rainfall forecasts' original scale and small watersheds, by increasing the variance of rainfall forecasts. There are at least three options for downscaling low-resolution ensemble forecasts: statistical downscaling, dynamical downscaling, and stochastic downscaling.

Different disaggregation approaches based on a method proposed by Périca and Foufoula-Georgiou (1996), that consists in a recursive stochastic disaggregation method based on scaling relationships (and belongs to stochastic downscaling), have therefore been implemented to spatially disaggregate each member of Environment Canada's global ensemble rainfall forecasts issued at a 100 by 70-km resolution. Each time the method is applied, the resolution increases by a factor of 2, increasing the local rainfall variance while preserving the mean. Resolutions down to 6 by 4-km were thus explored.

For comparison purposes, simpler methods have also been implemented such as bi-linear interpolation, which disaggregates global forecasts without increasing their variance.

An evaluation of the disaggregation methods is performed for 9 consecutive days in the summer of 2009, during which strong rain events have occurred in Quebec City, Canada. Two ensemble forecasts are available each day, with a 3-hour time step. Performance is evaluated using a maximum forecast horizon of 72 hours, and various scores and diagrams, which compare the forecasts to the observations from the Quebec City relatively dense rain gauge network. Disaggregated ensemble products are also studied from a deterministic view point (taking the mean of the ensembles) for comparison with operational Environment Canada deterministic products.

The most important conclusions of this work are that: (a) the overall quality of the forecasts is preserved during the disaggregation procedure (for example from a 100-km to a 6-km resolution), (b) the probabilistic approach (using ensemble products) leads to better results than their deterministic (averaged) counterparts, and (c) the disaggregated products using variance-enhancing methods are of similar quality than products obtained using bi-linear interpolation. However, variance and dispersion of the different members are, of course, much improved for the variance-enhanced products, compared to bi-linear interpolation, which is a decisive advantage.

Therefore, there seems to be an interest in implementing variance-enhancing methods to disaggregate global ensemble rainfall forecasts. Research is still under way in order to improve the reliability of the 6-km ensembles and to assess the impact of the disaggregation procedure on hydrological forecasts.

Reference: Perica, S., and Foufoula-Georgiou, E. 1996. Model for multiscale disaggregation of spatial rainfall based on coupling meteorological and scaling descriptions. Journal Of Geophysical Research, 101(D21): 26347-26361.