A short-range weather prediction system for South Africa based on a multi-model approach

Stephanie Landman[1,2]*, Francois A Engelbrecht[3,4], Christien J Engelbrecht[5], Liesl L Dyson[2] and Willem A Landman[2,3]

[1]South African Weather Service, Pretoria 0001, South Africa

[2]Department of Geography. Geoinformatics and Meteorology, University of Pretoria 0002, South Africa

[3]CSIR Natural Resources and the Environment: Climate Studies, Modelling and Environmental Health, Pretoria 0001, South Africa

[4]Climatology Research Group, GAES, University of the Witwatersrand, South Africa

[5]Agricultural Research Council – Institute for Soil, Climate and Water, Pretoria 0001, South Africa

Abstract

The accurate prediction of rainfall events, in terms of their timing, location and rainfall depth, is important to a wide range of social and economic applications. At many operational weather prediction centres, as is also the case at the South African Weather Service, forecasters use deterministic model outputs as guidance to produce subjective probabilistic rainfall forecasts. The aim of this research was to determine the skill of a new objective multi-model, multi-institute probabilistic ensemble forecast system for South Africa. Such forecasts are obtained by combining the rainfall forecasts of 2 operational high-resolution regional atmospheric models in South Africa. The first model is the Unified Model (UM), which is operational at the South African Weather Service. The UM contributes 3 ensemble members, each with a different physics scheme, data assimilation techniques and horizontal resolution. The second model is the Conformal-Cubic Atmospheric Model (CCAM) which is operational at the Council for Scientific and Industrial Research, which in turn contributed 2 members to the ensemble system based on different horizontal resolutions. A single-model ensemble forecast, with each of the ensemble members having equal weights, was constructed for the UM and CCAM models, respectively. These UM and CCAM single-model ensemble predictions are then combined into a multi-model ensemble prediction, using simple un-weighted averaging. The probabilistic forecasts produced by the single-model system as well as the multi-model system have been tested against observed rainfall data over 3 austral summer 6-month periods from 2006/07 to 2008/09, using the Brier skill score, relative operating characteristics, and the reliability diagram. The forecast system was found to be more skilful than the persistence forecast. Moreover, the system outscores the forecast skill of the individual models.

Keywords: short-range, ensemble, forecasting, precipitation, multi-model, verification