P4.9 IMPLEMENTATION OF A REAL-TIME SHORT RANGE ENSEMBLE FORECASTING SYSTEM AT NCEP: AN UPDATE

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1. INTRODUCTION

Over the past several years ensemble prediction has become a major element in defining the future of numerical weather prediction (NWP) and operational weather forecasting. The principal motivation is to provide a capability to provide quantitative estimates of the intrinsic uncertainties in weather forecasts. It is widely agreed that ensemble based probabilities and/or measures of confidence hold the best potential for enhancing the ability to make user dependent informed decisions. Vision 2005, the National Weather Service Strategic Plan, recognizes this fact by committing the NWS to "provide weather, water, and climate forecasts in probabilistic terms by 2005."

NCEP now runs operationally 23 member ensembles each day with the MRF model for medium-range (3-14 days) predictions. Over the past several years, the NCEP Environmental Modeling Center (EMC) also has been developing a **S**hort-**R**ange (0-3 days) **E**nsemble **F**orecasting (**SREF**) system based on regional models. Following the recommendations from the first SREF workshop (Brooks et al., 1995) a simply constructed SREF system was established at NCEP in 1995 for evaluation by external researchers (Hamill and Colucci, 1997 and 1998; Eckel and Walters, 1998; and Stensrud et al., 1999). This early attempt at SREF was expanded in 1996 with the intent of developing and testing a prototype SREF system which ultimately would be feasible and provide useful information in the context of real-time operations (Tracton and Du, 1998; Du and Tracton, 1999; Hou and Kalnay, 2001). Collectively, these studies provided valuable insights on some of the key scientific and strategic issues in constructing an ensemble system, such as tradeoffs between resolution and ensemble size, the influence of lateral boundary conditions, single versus multi-model ensembles, and methodology for generating perturbations to initial conditions. Moreover, the studies strongly suggested that SREF potentially can provide operationally relevant and useful guidance on the probability distribution of weather elements and events, including quantitative precipitation forecasting (QPF). And now, with the availability of NCEP's enhanced computing resources on the IBM Class VIII, an operational SREF has become feasible.

2. STATUS

Since April 2000, NCEP has been running routinely twice per day an operational prototype SREF system in a time delayed (5-10 hour) mode[2] on the research side of the IBM. This system consists of 10 members composed of five members from both the Eta and Regional Spectral Model (RSM) with 48 km horizontal resolution. It is run to 60 hours over the Eta North American domain. Initial state perturbations are provided by "breeding", as for the NCEP global ensemble system (Toth and Kalnay, 1997), but in the context of the respective regional models. Products, available on the web only, include maps of ensemble mean and spread, "spaghetti" diagrams showing forecast diversity, and probability charts for precipitation, stability indices, etc. Case studies (e.g., the January 2000 east coast snowstorm, Tracton and Du, 2001), preliminary objective diagnostics, and anecdotal evidence unquestionably reinforce the proposition that SREF *could be* very valuable for operational forecasting applications. This is supported unanimously by NCEP service centers (HPC, SPC, AWC, TPC, MPC) .

3. PLANS

To move from the rational speculation expressed above to demonstrable reality, NCEP service centers *require* that SREF be subject to a Real Time Test and Evaluation (RTT&E) before full implementation can be endorsed. That in turn demands that SREF based products be available reliably, timely, and readily accessible for display and/or further processing on NCEP's product display and generation workstations (NAWIPS). To these ends, SREF will be fully implemented internally within NCEP by the end of July, 2001, which means it will be running in the production side of the IBM with NCEP/NCO production standards and support. However, products will not yet be sanctioned nor distributed by the NWS as operational. They will be made available beyond NCEP on the web[2] and in GRIB format from an NCEP server.

The RTT&E SREF system is the same as that described above - 10 members (5 Eta, 5 RSM) with 48 km horizontal resolution and covering the Eta domain

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[2] See: http://lnx48.wwb.noaa.gov/SREF/SREF.html

run twice daily with "regional breeding" for generating initial condition perturbations. To enable product availability about the same time as the operational Eta from 00Z and 12Z, the ensemble runs will start 3 hours earlier (at 21Z and 09Z respectively) and run through 63 hours. Output will be available at 3-hour intervals, rather than the current 6 hours. (Lateral boundary conditions are provided by the respective 9-hour old global ensemble runs.) Prior to the actual RTT&E implementation, this new system will be run in parallel with the current system for EMC to ensure reasonable consistency of forecasts verifying the same time given the three hour difference in initial conditions.

Integral components of the RTT&E include education and training in the concepts and applications of SREF and assessing the performance and value of the SREF system. Education and training can be addressed, for example, by site visits and web based tutorials. The system performance and value will be evaluated objectively (e.g., RMS errors, ranked probability scores, reliability diagrams) and subjectively on the basis of user feedback from NCEP Service Centers and selected ("Beta" site) NWS field offices. Unofficially, input is welcome from all quarters.

Following the initial start of the RTT&E, we will continue to investigate in a parallel mode possible modifications and upgrades of the SREF system and weigh the relative benefits and necessary tradeoffs with regard to, for example, perturbing physics, additional members, higher resolution, inclusion of additional models (RUC), and extension to 87 hours. Also, we will explore adding products in the context of user needs and requirements. Beyond those generated centrally, NCEP Service Centers and other users should have the capability to develop their own specific products from GRIB files of the individual ensemble members.

The target for full NWS sanctioned operational implementation is during the middle of 2002. Toward this end NCEP will work with NWS Headquarters on a NWS wide evaluation, critical issues (e.g., communications, product availability on AWIPS), and on NWS wide education and training..

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