THE MET OFFICE NWP-BASED NOWCASTING DEMONSTRATION PROJECT FOR THE LONDON OLYMPICS 2012

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ABSTRACT

The Met Office has developed a high resolution (1.5km) NWP system over southern England and Wales for nowcasting (NDP) for the London Olympics 2012 using hour cycling 4D-Var data assimilation. The system produces 6 hour forecasts every hour. This has been running near-real-time since March 2012 on the IBM Power 6 with plans to move it to real-time running on the new IBM Power 7 before the Olympics. The system uses latent heat nudging of radar derived rain rates, direct assimilation in VAR of a 3D cloud cover analysis and high time frequency subhourly radar Doppler winds (6 per hour), wind profiler, GPS and MSG SEVIRI upper tropospheric water vapour channels. Results will be shown comparing the NDP with observations and the current UKPP/STEPS nowcasts and the 6hourly UK NWP forecasts.

1. INTRODUCTION

The Met Office has developed an hourly cycling high resolution (1.5km) NWP system (NDP) covering southern England and Wales, fig.1, for nowcasting. This is based on the Met Office Unified Model, UM, and 4D-variational data assimilation system plus latent nudging.

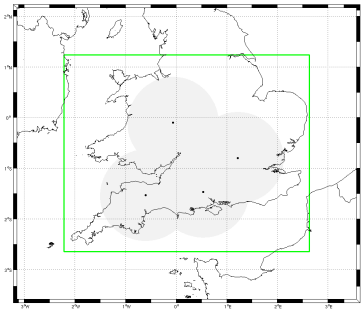

Figure 1 NDP domain showing locations of the initial 4 Doppler radars

The domain includes 8 of the UK network radars of which 4, to become 9 by end of 2012, are providing Doppler radial winds , 4 wind profilers and potentially 61 GPS sites. Boundary condition updates are provided every 30mins from 1.5km resolution 6hourly forecasts from a 3hourly cycling 3-km 3D-VAR for the UK region, UKV model.

The NDP uses a 4D-Var data assimilation system with 1/2 UM resolution (i.e. 3km), hourly assimilation windows with 10 minute LS states, and 100 second timestep. The PF model and its adjoint have dimensions of 180 x 144 x 70. Observations are extracted in the observation time window T-30 mins to T+30 mins. The 1.5km UM (360 x 288 x 70) uses 50 sec time-stepping on 6 nodes in 12 x16 decomposition. 4D-Var increments are added to UM at the initial forecast time T-30 mins (at first UM time step).

2. OBSERVATION USEAGE

One challenge for the system has been the use of subhourly data in near real-time when the Met Office database was set up for hourly observations with 60-90minute latency. Once running in real-time the NDP will start at T+45mins and has to complete within 1 hour. Depending on the amount of rain in the domain, it currently takes about 15-30mins on the IBM Power 6 for observation processing, 4D-Var and forecasts from T-30min to T+7.5hours. The observation provision and database has been modified to enable use of radar rain

rates at T-30, T-15, T+0, T+15, Doppler radial winds at T-30, T-20,T-10 T+0, T+10, T+20mins (within 5min period eg T-10 to T-5mins), wind profiler every 15 mins, Ground GPS every 10 mins , SEVIRI clear radiances every 15 mins . The ground GPS data used to be in hourly batches available at T+90mins, they are now in 15min batches available within 10mins but this has not yet been tested. A 3D cloud cover analysis is available every hour and is assimilated in 4D-VAR via conversion to relative humidity. Surface synoptic reports are used hourly as well as AMDAR reports. Eumetsat Satellite winds (AMVs) are used but they are very coarse horizontally and temporally eg T-30mins only. A new local processing system for AMVs has been developed which should allow high resolution in space and time to be tested.

3. BACKGROUND ERRORS

Background error covariances have been produced from T+6-T+3 NDP lagged forecast differences. The UK models have used background errors with a SOAR function for the horizontal correlations with specified lengths scales of 180km for streamfunction, 130km for velocity potential and unbalanced pressure and 90km for humidity and logm. These long lengthscales had been calculated using the Hollingsworth and Lonnberg method for the original 12km UK model and the covariance model used for the UM variational assimilation system did not allow derivation of lengthscale direct from the forecast differences. Therefore a new system for generating background error statistics has been developed.

Whilst that new system was being developed, in order to investigate horizontal correlation lengthscales derived direct from a population of forecast differences, the NCAR WRF covariance derivation software, Gen-Be was adapted to use NDP forecast differences and to output files that can be used by the Met Office variational assimilation system. Background errors were derived from 75 pairs of NDP T+6/T+3 forecasts produced every 6 hours using Gen-BE to calculate error covariances and SOAR length scales which were calculated as 60 -10km velocity potential and stream function , 30-2km unbalanced pressure and 30-2km for humidity depending on vertical mode.

4. VERIFICATION AND RESULTS

The Met Office verification system is being modified to allow direct verification of the hourly NDP forecasts and comparison with the skill of the current nowcast system STEPS/UKPP and the UKV model forecasts. Output will be displayed internally in a version of the system used for the current nowcasts and also in a system allowing the NDP precipitation forecasts to be displayed alongside the radar, UKPP or UKV forecasts.

This paper will describe the NDP system and show examples of the NDP forecasts and impact of radar radial Doppler winds.

Studies in a 3D-VAR version of the NDP suite showed benefit from the Doppler winds out to about T+5 hours on the fit to Doppler winds and the surface precipitation rate. The surface precipitation rate showed about 1 hours gain in skill to T+5, figure 2. In 4D-Var additional benefit was shown by use of the Doppler radial winds 6 times per hour.

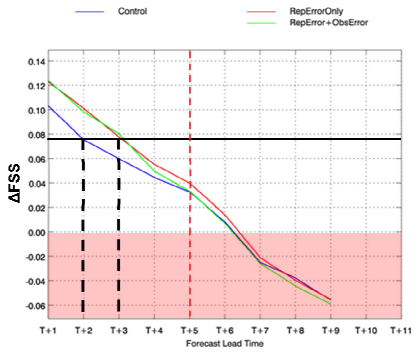

Figure 2. ΔFSS v forecast period for 0.2mm accumulation threshold at a scale of 55km. Positive values of ΔFSS represent skillful forecasts