A NEW MESOSCALE SYSTEM NWP FOR AUSTRALIA

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1. ABSTRACT

The Australian Bureau of Meteorology recently initiated a project to enable the use of radar data within numerical weather prediction (NWP). The aim is to develop an NWP system capable of bridging the gap between purely observation based precipitation nowcasting and existing regional scale NWP systems. The system is being developed as part of the broader modelling effort of the Australian Community Climate and Earth System Simulator (ACCESS). The NWP component of this model is in turn is based on the UK Met Office Unified Modelling and variational assimilation system – specifically the 1.5km UKV system (Dixon et al. 2009).

Extensive trials have been carried out from September 2011 to May 2012, as well as for specific periods over 2010-11. Despite the differences in observation networks and weather conditions between Australian and the UK the system is providing useful guidance – far superior to existing global and regional NWP systems. This presentation will discuss some of the challenges in applying this system to tropical or semi-tropical conditions as well as an overview of the performance of the 1.5km system relative to other systems.

2. INTRODUCTION

Since 2009 the Australian Bureau of Meteorology has used the ACCESS system to provide operational NWP (Puri et al.,2012 and Bureau of Meteorology Operations Bulletin 81). The global and regional NWP systems are local implementations of the Met Office Unified model and 4d variational (VAR) assimilation systems (Rawlins et al. 2007) with modifications to enhance performance over the Australian region and to integrate with the Bureau's data streams. These NWP systems are also capable of being used at much higher resolution than had been previously possible, with a 1.5km grid being feasible operationally. The primary focus of the 1.5km system has been on the east coast of Australia near the major population area, Sydney. This area is also prone to severe storms and heavy rainfall, has significant orographic effects and is well observed relative to the rest of the nation. Testing has also been conducted on other areas closer to the tropics in order to robustly assess the system during periods of strong convection.

Another feature of this system is the ability to be used in a model-on-demand configuration. Such ability is necessary as it is not feasible, nor necessary to run high resolution NWP systems over all of Australia. This system would be used to cover major severe weather or other high profile forecasts in areas not covered by routine high resolution systems which are focussed on the major population centres.

3. ASSIMILATION

The initial system was based on 3dVAR at time T using observations from T-2 to T+1, with the forecast from the previous analysis being used as the background or first guess field. There has also been some testing with hourly assimilation. Satellite sounding data is not used due to the mismatch between grid spacing and satellite footprint – although satellite data exerts a strong influence on the forecasts via the lateral boundary conditions from the regional scale model. The observations are otherwise the same as the global and regional NWP systems, augmented by Doppler radial winds. Furthermore, half hourly rain rates estimated from analyses of radar rain gauge data (Chumchean et al.) are used to nudge the latent heat of the model forecast from T-2 to T+2.

4. RESULTS

The focus of the testing has been on precipitation forecasting, as reliable high resolution rainfall estimates are available for validation. A wide variety of scores have been assessed with the Fractions Skill Score (Roberts and Lean, 2008) being favoured due to the information on useful resolution. Comparisons show that each of high resolution NWP, more frequent updating, the use of latent heat nudging, Doppler radial winds and atmospheric model improvements add significant value to global and regional scale NWP.

There are however caveats, such as the value of the high resolution assimilation against dynamical downscaling from coarser resolutions generally only seems to last for 6-12 hours. It should be noted however that the impact in rapidly intensifying systems is harder to quantify due to the limited number of cases available.

The frequency distribution of rainfall also remains a problem – with too little light rain and too much heavy rain. Investigations into refinements to the modelling of cloud and precipitation processes are continuing.

Despite these limitations, the high resolution system is considered to provide valuable short-range forecast guidance beyond standard NWP systems. Consideration is now being given to a more precise description of how this information can be used in operational forecasting. This will also be outlined during the presentation.

5. REFERENCES

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