NOWCASTING FOR THE LONDON OLYMPICS

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Abstract

Weather forecasting support for the London Olympic Games will be provided through enhanced web delivery of automated products coupled with dedicated expert input to risk management by meteorological advisors. In addition to existing operational NWP and post-processing capabilities, the Met Office is trialling a convective-scale ensemble for the UK and an hourly NWP nowcast cycle incorporating assimilation of Doppler radar information using 4D-Var.

1. INTRODUCTION

Requirements for weather forecasts in support of the London Olympics can be divided into two categories. On the one hand there is a vast requirement for general information to enable visitors to plan their time, whether attending Games events or enjoying the rest of their time in the UK. On the other hand, there are very specific requirements for forecasts and warnings of high impact weather, which extend well beyond the normal requirement for severe weather warnings, both because of the huge numbers of people at the Games venues, and also because of the specific requirements of Games events.

Met Office support for the Games will be underpinned by a definitive set of forecast outputs (termed “best data”) from our seamless prediction system based on global and regional configurations of the Unified Model. At nowcasting time ranges, we use the 1.5km grid UK forecast model, updated with the latest observations using extrapolation nowcasting and calibrated against recent observations using univariate site-specific Kalman Filters.

The Met Office web site has recently been upgraded to provide enhanced access to generic forecasts, based on the automated “best data” at 5000 locations within the UK. The site provides 3-hourly forecasts out to 5 days ahead, including probabilistic information on precipitation and max/min temperature.

For critical Games-specific applications, the “best data” forecasts will be interpreted in a collaborative decision making context by expert forecasters working with other professionals.

Civil protection agencies will be supported through the normal UK National Severe Weather Warning Service working with the collocated Hazard Centre and the Flood Forecasting Centre, representing the combined forecasting expertise of the Met Office, Environment Agency, Centre for Ecology and Hydrology, British Geological Survey, Health Protection Agency and many others.

In providing expert advice, these experts will have access to several new capabilities that are being trialled for future operational implementation. These include a 2.2km grid short range UK ensemble, a 1.5km hourly update cycle for the southern part of the UK, a 12km grid air quality model, a 300m grid atmospheric model for Weymouth Bay and a 250m grid wave model for Weymouth Bay. In addition, experimental impacts models will be available to provide spatially distributed risk estimates in the event of a severe wind storm or exceptional rain leading to landslides.

In the remainder of this presentation we focus on the development and application of the 2.2km ensemble and the 1.5km hourly update cycle.

2. CONVECTIVE-SCALE ENSEMBLE

The migration from convection parametrizing to convection permitting resolution for UK short range forecasts has led to a dramatic improvement in forecast capability. While much of the benefit was achieved with a 4km grid for some variables, the subsequent move to 1.5km has resulted in forecast precipitation fields that are surprisingly realistic – so much so that it is difficult to distinguish the appearance of a forecast from a radar actual (Lean et al, 2008). Case studies of severe convective rainfall events have demonstrated that the uncertainty in these forecasts can be very great on some occasions and quite small on others, and that the level of uncertainty can depend in quite subtle ways on the accuracy of details of the upper air circulation. As a result it has been recognised that deterministic forecasts of weather associated with convective precipitation are unlikely to be reliable, even at rather short lead times. In attempting to quantify the uncertainty associated with these forecasts, we have followed the experience of case studies which have shown that the greatest influence on accuracy of convective detail comes from the large-scale forcing dynamics. Experience with the Met Office's MOGREPS-R regional ensemble, currently running with an 18km gridlength over the North Atlantic and Europe, shows that low-resolution initial condition perturbations downscaled from the driving global ensemble, which are entirely consistent with the corresponding lateral boundary conditions, can perform better than higher-resolution regional perturbations. With the much smaller domain of the UK ensemble, we have therefore opted to evaluate performance initially using only downscaled initial and boundary perturbations. , allowing the convective-scale uncertainty to evolve as a result of differences in low-resolution forcing. This greatly reduces the risk of spurious convective-scale instabilities spawned from inconsistencies between high and low-resolution ensemble perturbations around the model domain boundaries. In order to optimise the ensemble size within computer-power constraints, we have rescheduled all of our short-range ensembles to a 6-hourly cycle of 12 members per cycle, with ensemble post-processing utilising the most recent two cycles so as to achieve an effective ensemble size of 24. For convective precipitation, this is still far too few members to achieve a smooth probability distribution, so work is underway to add a local adjustment to represent minor positional uncertainty based on neighbourhood processing. For the duration of the Games, a variety of derived probabilistic outputs will be displayed on the Met Office web site to enable the widest possible engagement of the scientific community in the evaluation exercise.

3. 1.5KM HOURLY UPDATE CYCLE

The success of operational convective-scale NWP to date has been largely in dynamical downscaling of accurate global or regional model forecasts using high resolution topographic forcing. This is particularly true in the UK, where the progression of mid-latitude weather systems and the proximity of the coastline mean that there is little memory of one day's convection to the next. However, for prediction of severe weather impacts, it is in the first 6 hours of lead time that the greatest benefits will be realised if high levels of precision and accuracy can be achieved, and in that period convective-scale forecasting is truly an initial value problem. The last decade has seen tremendous advances in data assimilation capability, particularly in global modelling, where hybrids of 4D-Var and the EnKF, are establishing themselves as the state-of-the-art. However, the theoretical foundations of both approaches depend on assumptions about linearity and Gaussianity that are not exhibited by convective-scale predictions. It is therefore currently unclear what methodology will enable precise and accurate nowcasts to be generated. The Met Office currently employs a 3D-Var scheme in its operational convective-scale data assimilation, but has also set up a

Nowcasting Demonstration Project (NDP) to develop a first attempt at a quasi-operational capability for the southern part of the UK using 4D-Var data assimilation enhanced to incorporate Doppler winds (and in due course reflectivity) from the UK radar network, in addition to enhanced time resolution of *in situ* observations. To enable comparison with conventional extrapolation nowcasting outputs, an hourly cycle is used.

REFERENCES

Lean, H., Clark, P., Dixon, M., Roberts, N., Fitch, A., Forbes, R. & Halliwell, C., 2008, Characteristics of high-resolution versions of the Met Office Unified Model for forecasting convection over the United Kingdom. Mon Wea. Rev., 136, pp3408-3424