MOGREPS-UK 2.2 km ensemble and NWP-based Nowcasting Demonstration Project

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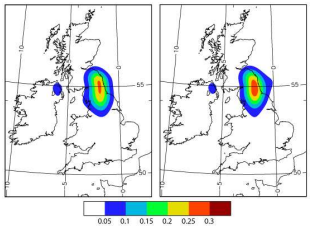
MOGREPS-UK 2.2 km ensemble

The Met Office plans to have a 12-member 2.2 km ensemble from Spring/Summer 2012.
It will run to T+36 and be updated every 6 hours.
Initially this will be a downscaling ensemble (there will be no additional ensemble DA perturbations at the high resolution) and the initial perturbations will come from MOGREPS-EU or MOGREPS-G. To begin with, there will be no physics perturbations / stochastic schemes being used. Research is ongoing and perturbations may be added directly to a deterministic storm-permitting control forecast (UKV 1.5 km model) after 2012.

The boundary information will either come from the MOGREPS-EU 12 km ensemble or from the MOGREPS-G ensemble if it can be run at sufficiently fine resolution.

Up to now we have run several case studies at 1.5 and 2.2 km and found that we can obtain what look like useful probabilities of severe events for sensible meteorological reasons. Of course, we don't have a large enough sample to do proper statistical ensemble verification and that will have to follow the routine system from 2012.

Impact of resolution



2.2km was chosen as the horizontal resolution rather than 1.5km for cost reasons. It was felt that having a greater number of ensemble members was more important than having the extra resolution. However with no experience of running at this resolution, it raises the obvious question of what is the impact of resolution?

Figure 1: Morpeth flood event 5-6 Sept 2008
Probability of exceeding 50mm in 17 hours

In this case, there wasn't much difference between probabilities from a 1.5 km ensemble and 2.2km ensemble (Figure 1). There can be bigger differences in other cases however.

NWP-based Nowcasting Demonstration Project

The Met Office plans to have a km-scale Nowcasting Demonstration System from Summer 2012. This system will use 4D-Var assimilation (hourly cycling) and will include surface field/SST updates. The model will have a horizontal (fixed) resolution of 1.5km and a half resolution VAR grid.

Observations

For the initial quasi-operational demonstration system for the 2012 Olympics it is planned to include Doppler radial winds (hourly or possibly 15 minute, see Figure 6a) and 15 minute wind profiler data. Parallel research projects are looking at the possible future implementation of radar reflectivity, refractivity and ceilometer (cloud base recorder) data.

Data Assimilation

Observation time window of T-30mins to T+30mins (centred on the analysis hour) will be used with a data cut-off 15mins after end of window.
Latent Heat Nudging of 15min precipitation data and MOPS nudging of hourly cloud cover data. The covariance statistics will either be updated UKV ones or new NDP Gen-BE Cov stats.

A 3D-Var system is used for testing new observation types.

Model

Forecast cycles to T+6 or T+12 hours (the latter allows for lagged ensembles of 6 members). Domain as in Figure 6b.
Lateral boundary conditions from the UKV model.

Olympics

The main events are at Olympic Park in London with other events at Eton Dorney (rowing), Weymouth (sailing), Kent (horse riding), Manchester (football) and Glasgow.
There will be some site specific observations including a met buoy in Weymouth and automatic stations that can be used to validate NDP analyses.

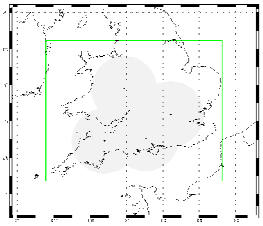
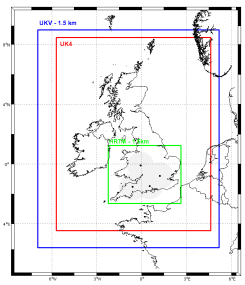
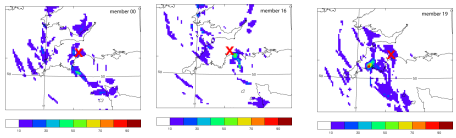


Figure 6. a) NDP domain showing radars producing Doppler radial winds Jan 2011. From left to right – Cobbacombe, Clee Hill, Dean Hill, Chenies.
b) Below: NDP domain (green) nested in UK4 and UKV domains.



Case study: Hailstorm in Ottery St Mary in South West England on 30/10/08. Dramatic thunderstorm with hail leading to very localised flash floods in the Otter Valley.



Highest 6-hour totals 55mm 55mm 96mm

Figure 2. a) top shows 950mb wet-bulb potential temperature from 3 members of MOGREPS-R at 24 km, b) maximum precipitation accumulations from each of the equivalent 1.5km members (computed on 4.5km grid). The 'X' marks the location of the thunderstorm.

The meteorological pattern and fronts is shown by the wet-bulb potential temperature and the spread in the MOGREPS-R ensemble can be seen in three members (Figure 2a). Figure 1b shows the maximum precipitation accumulations from each of the equivalent 1.5 km members. They all give high totals but in different places that relate to the larger-scale pattern.

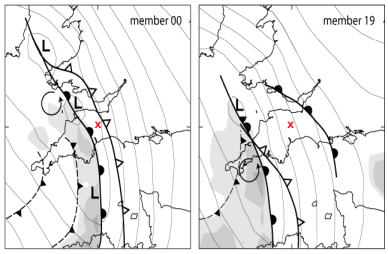


Figure 3. a) As Figure 1 but showing the different synoptic analyses that can be made from two of the members. The area of CAPE is shaded and very much controlled by the positioning and evolution of the fronts.

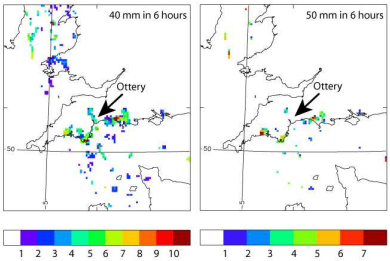


Figure 4. This time showing all the accumulations exceeding critical thresholds for flash flooding from the 24 1.5 km members. The ensemble gave a good indication that those thresholds could be exceeded in the area, but no high totals at the town of Ottery itself.

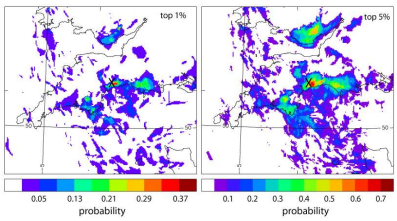


Figure 5. Probability of getting the top 1% or 5% of rainfall amounts (i.e. exceeding the 99th or 95th percentile value of precipitation accumulation) This is calculated from all pixels in the whole UK domain (not just those from the sub area). It shows the area of highest probabilities very close to the town of Ottery. The ensemble gave a very good indication that the highest totals would likely be close to Ottery, but the very highest extreme flood-producing pixels were not in the town itself.

Summary

The Met Office plans to have a 12-member 2.2 km ensemble from Spring/Summer 2012. It will run to T+36 and be updated every 6 hours.
At the same time there are plans to implement a 1.5km Nowcast Demonstration System using NWP with 4D-Var data assimilation and hourly cycling.

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