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## Request to WGOS for implementation of global model upgrade at PS39

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### Summary

Significant improvement in forecast accuracy through increased resolution in deterministic (10km - N1280) and ensemble (20km - N640), and increased ensemble members from 12 to 18.

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Verification	Deterministic NWP index: +1% (surface fields more realistic)
	Ensemble 1.5 day improvement in CRPS scores for surface fields; +1-2% CRPS (12 mem); +3.5% CRPS (18 mem)
Timings/Resource	UM step +10-15mins. Current run-time in the range of 50-55mins. HPC quartet reservations and further UM optimisations removes any need for a shorter data cutoff
Robustness	Options to address UM failures shown in <a href="#">UM#2695</a> Failure rate is now lower than original package trial and OS38 control
Archiving changes	large increase in archive volume (factor of two to three)

OSAG Minutes showing approval of [package trial results](#) presented on 11 April 2017

[Powerpoint presentation](#)

### Changes from PS38

Full details on [Global package trial page](#)

Ticket	Impact of change	Summary
UM: resolution increase to 10km	+1% average over two seasons on NWP Index	Greater accuracy, especially near surface
SA: Minor package (new instruments, improved calibration, bias correction)	+0.25%	
DA: Increased VAR iterations	Neutral	Improved fit to observations, less instances of non-convergence during minimisation
Snow: Proper snow cover initialisation	+0.1%	

### Package trial results

See [wiki](#) for details of trials, link to output and full failure rate analysis

Package	Number of days	Season	Summary	Cumulative Failures	Failure rate (% cycles)
<b>u-ai226 (orig)</b>	<b>70</b>	<b>JFM 2016</b>	<b>+1.00% [Obs] +1.45% [Anl] +1.20% [EC]</b>	<b>38</b>	<b>15%</b>
u-aj741 (fix1)	48	JFM 2016	+0.51% [Obs] +1.50% [Anl]	11	6%
u-ak307 (fix2)	30	JFM 2016	-0.26% [Obs] +0.49% [Anl]	3	4%
u-ak496 (fix3)	35	JFM 2016	+0.20% [Obs] +0.76% [Anl]	4 (12 prevented)	3%
u-aj664 (fix2b)	24	JFM 2016	+1.00% [Obs] +2.16% [Anl]	5	4%
<b>u-ai108 (orig)</b>	<b>70</b>	<b>JAS 2016</b>	<b>+0.55% [Obs] +0.59% [Anl] -1.46% [EC]</b>	<b>27</b>	<b>10%</b>
u-ak915 (fix3)	20	JAS 2016	+0.35% [Obs] +0.27% [Anl]	5 (8 prevented)	6%
u-al184 (fix3b)	18	JAS 2016	+0.49% [Obs] +1.22% [Anl]	1 (4 prevented)	1%

### Links to supporting evidence

- [Deterministic verification of original Winter package trial](#): Very good as outlined above;
- [Deterministic verification of original Summer package trial](#): Good as outlined above;
- [Winter verification of final proposed stability package \(labelled fix2b above\)](#): shows that stability improvements above come with no significant impact on verification;
- [Tropical cyclone verification](#): Reasonable improvements in track forecasts; cyclones now more intense which is an improvement for most but means that more cyclones will over-deepen, especially in sub-tropics;
- FSD initial assessment: [Summary](#) and [supporting figures](#): summary was little difference in general synoptic evolution, but possible improvements in the over-development of weak troughs.
- [Summary of PS39 GM timings](#): main forecasts now consistently running in under 1 hour using a 750 node reservation.

Potential further improvements without any impact on forecast evolution could be delivered in next few weeks.

**RECOMMENDATION**

N1280/N640 GM/EPS to be implemented as per original package trial except using Stability Fix 2 **Double-double sums** with the ensemble *ricrit* change reverted.

**Impact on other models or downstream products (including availability, quality)**

Increased resolution and increased ensemble members should have positive impact on quality of forecasts, but more data to process.

**Archiving changes**

**Important:** All changes to operational archiving must be notified to the **NWP Archive Management Group** as early as possible.

**Results found during PS39**

More detailed progress reports to OSAG are available:

- [Jan OSAG meeting](#)
- [Feb OSAG meeting](#)
- [Mar OSAG meeting](#)
- [Apr OSAG meeting](#)
- [May OSAG meeting](#)
- [Jun OSAG meeting](#)

**Verification**

Main verification bouquet available [here](#).  
 Ensemble CRPS scorecards [Obs](#) and [Own Anl](#)

```

Period: 20170411 to 20170613
v obs : +0.63
v anl  : +0.81

UKindex basket for global sub-domains:
NH      : +0.68%
Tropics : +3.78%
SH      : +0.16%
NAE area : +0.63%
UK stations : +1.09%

Ensemble CRPS scores:
+1.9% [Obs] and +2.9% [Anl] on standard scorecard due in part to increased resolution to 20km,
but more from increased number of 7-day ensemble forecast members from 12 to 18.
    
```

These headline scores are close to those expected from the combined summer/winter package trial results.

**Assimilation**

The PS39 analyses are slightly **cooler** than OS38. This is also evident globally in the mid-upper troposphere **heights**. The impact is evident in slightly poorer verification of geopotential height and temperature forecasts at short lead-times. However, the difference in temperature/heights between OS38 and PS39 has been gradually but steadily **reducing**. We expect this to be related to a long-term VarBC spin-up as nothing else has been found to be different between the package trials (where this difference did not show up) and the PS39 implementation.

There is a slight increase in Observation and Background Penalties in VAR which is expected because of the increase in the UM resolution. The near-surface data assimilation is improved due to more realistic surface features in the 10km model.

**Resilience**

Following UM dynamics solver improvements we expect PS39 to have about the same or fewer failures than OS38. Full details available at [um.x:#2695](#)

**Timeliness**

About 10 minute longer global deterministic UM runtime.

	<b>OS38</b>	<b>PS39</b>
7-day forecast completes at:	03:52/15:52Z +/- 2:30	04:03/16:03Z +/- 2:30

**Archiving changes**

Roughly doubling of archive volumes due to increased model resolution.

<b>Model</b>	<b>OS38</b>	<b>PS39</b>

global rerun	433T b/day	831 Tb/day
ensemble rerun	442 Tb/day	1010 Tb/day

**Attachments** (6)

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