Addressing the cause of large-scale circulation errors in the Met Office global model

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Mean high pressure bias over polar oceans



#### GA6 AMIP DJF mean PMSL bias vs ERA-I (hPa)



Seasonal forecast:

Bias in the frequency of DJF anticyclones [GLOSEA GA6 - ERA-Interim] Winter: Threshold 1028.0





## Set Office Perturbed physics ensemble

Dominant parameter for PMSL variance across ensemble

# Fraction of variance explained by nsigma







#### David Sexton, QUMP team

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0.55 0.60 0.65 0.70 0.75 0.80 0.85 0.90 0.95 1.00

## Set Office Impact of reduced nsigma on AMIP

GA6 bias

#### Test bias



#### Reducing drag can eliminate the excess transport of mass to the pole.

## Set Office Impact of reduced nsigma on AMIP Test minus GA6

#### ...and improves tropical precipitation.





 $^{-2}$ 

-0.5

Test bias

0

0.5

10



## Set Office Impact of reduced nsigma on NWP



Change in Z500 RMSE



...but degrades short-range predictability indicating that the climatological response is probably right for the wrong reason.



**Martin Best** 



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#### c/o Irina Sandu (ECMWF)

## Forcing the IFS with MetUM SSO

Impact on NH PMSL (hPa) IFS-UMsso minus IFS

Using UM subgrid fields in IFS recreates the polar high pressure bias. Implies the subgrid orography fields are part of the issue.



## Met Office AMIP DJF PMSL bias – Regional contribution (determined from nudging expts)

N96 AMIP Control

N96 AMIP Control Error

Tropics (10N-10S) Error







**Rockies Error** 

**Greenland Error** 

Tibet Error







Sean Milton, Jose Rodriguez

# Met Office Impact of new OGWD ancillaries GA6 bias Impact of new ancillaries





### Set Office Current performance of full package

#### **NWP verification**



#### Change in mean PMSL bias



16

10

4

0

-4

-10

-16

hPa

## Summary

- Exploiting the seamless nature of the UM to undertake diagnostic analysis across timescales has proved beneficial.
- Analysis of the climate perturbed physics ensemble enabled the general area of investigation to be identified quickly.
- Comparisons with another model which displayed opposing characteristics was useful for this problem.
- Developing a solution is rarely straightforward and often involves dealing with a number of compensating errors.
- Impact on performance is normally detrimental until a package of changes can be developed which addresses these compensating errors (takes time!).