Recent updates to the Random Parameter Scheme for RAL3
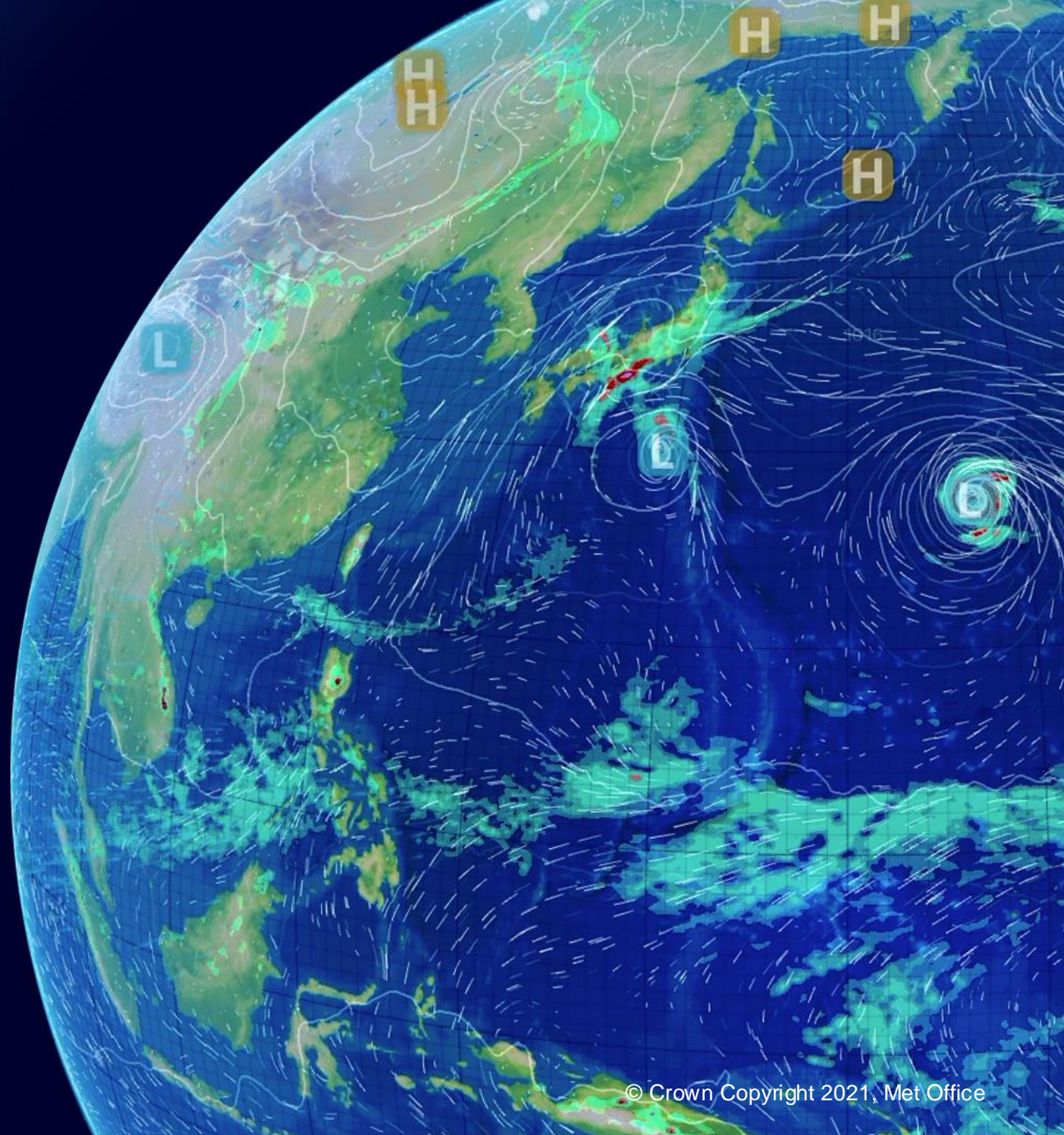
11th September 2024
Near-surface processes
Convective Scale Workshop
Melbourne

Anne McCabe, Adrian Lock, Paul Field, Jonathan Wilkinson

Outline

- Change to ensemble spread with RAL3

- Random Parameter Scheme

- New Parameters for RAL3p2

- Impact on spread-error relationship

- SOFOG case study

Met Office

Changes to ensemble spread in RAL3

- Original MOGREPS-UK RAL3 trials compared with RAL2 showed:
  - *reduction* in spread in 10m wind for both summer and winter
  - *reduction* in spread in 1.5m temperature for the summer period
  - *increase* in spread in 1.5m temperature for the winter period

- Stochastic physics changes in RAL3:
  - No more stochastic BL perturbations to theta and moisture
 - Reduced number of random parameters in the RP scheme
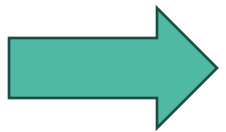
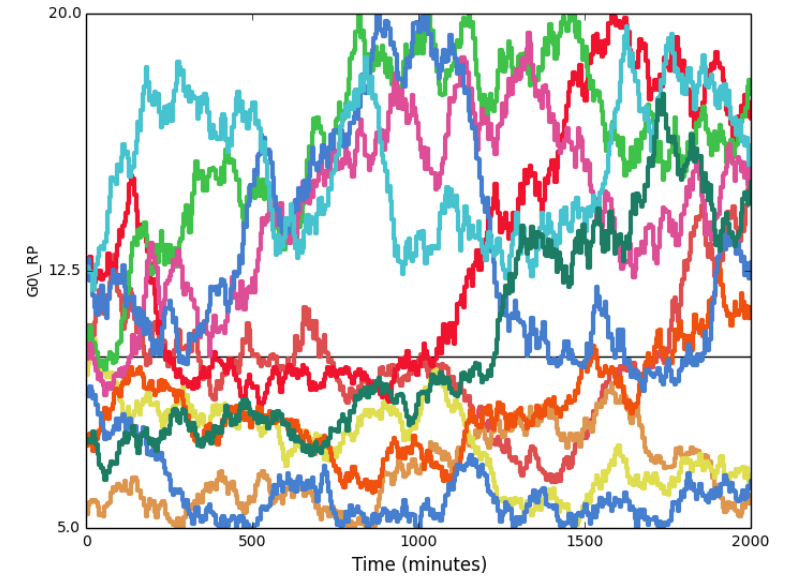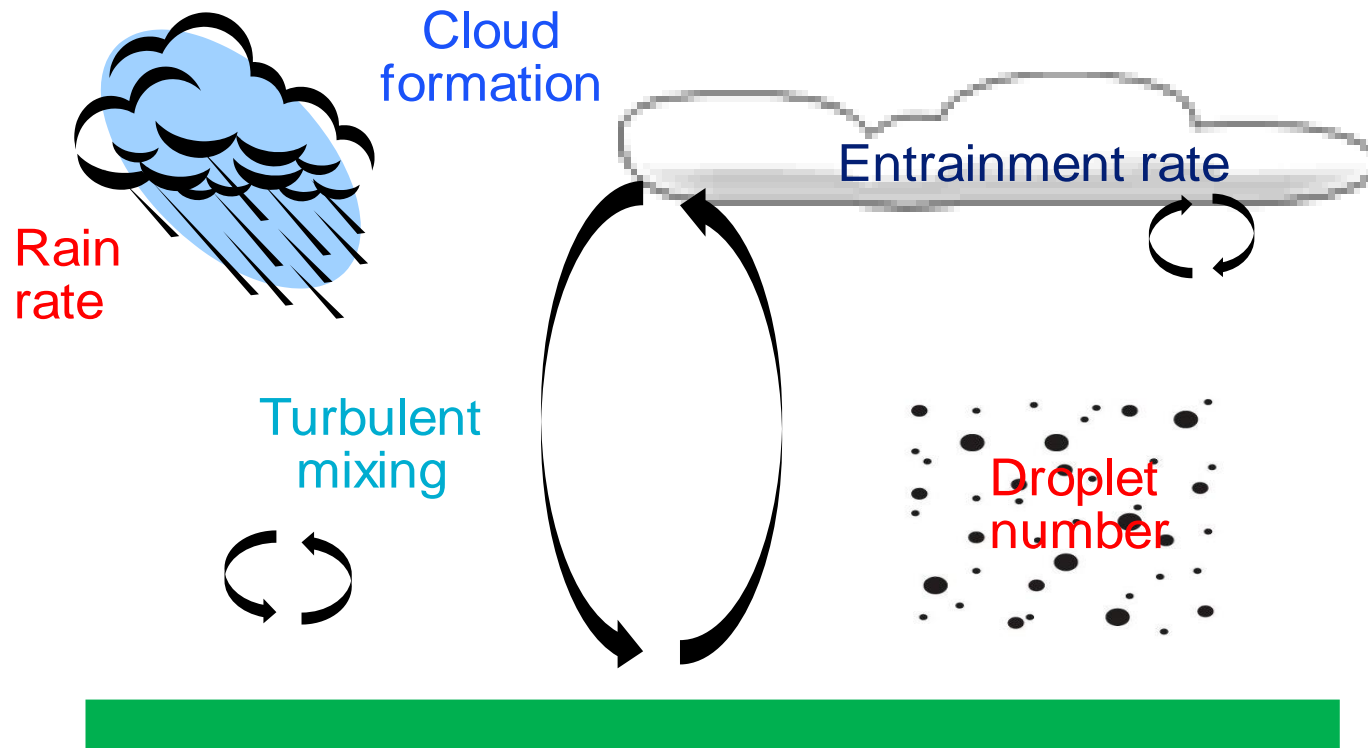➡️ *Re-visit the RP scheme so that it represents uncertainty in new model configuration*
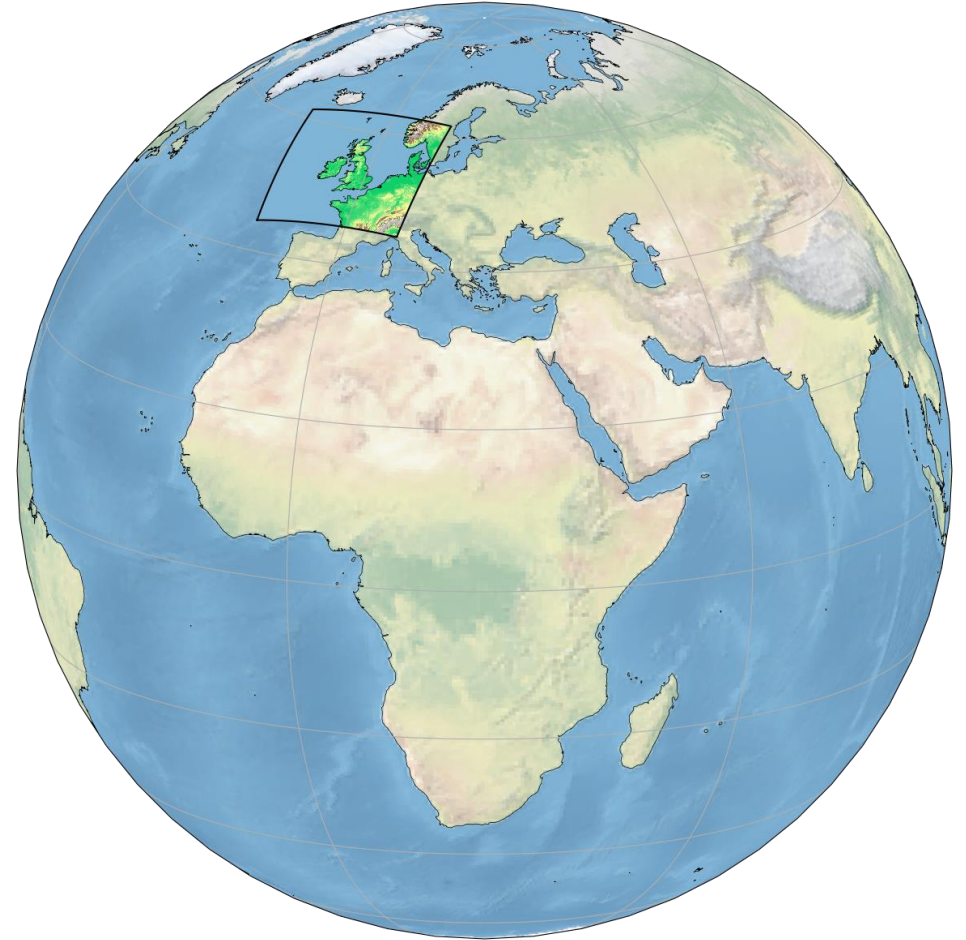
Representing uncertainty in MOGREPS-UK

Three sources of uncertainty: (i) initial conditions, (ii) lateral boundary conditions, (iii) model uncertainty

Random Parameter (RP) scheme

Lateral forcing from MOGREPS-G

UKV analysis + MOGREPS-G perturbations
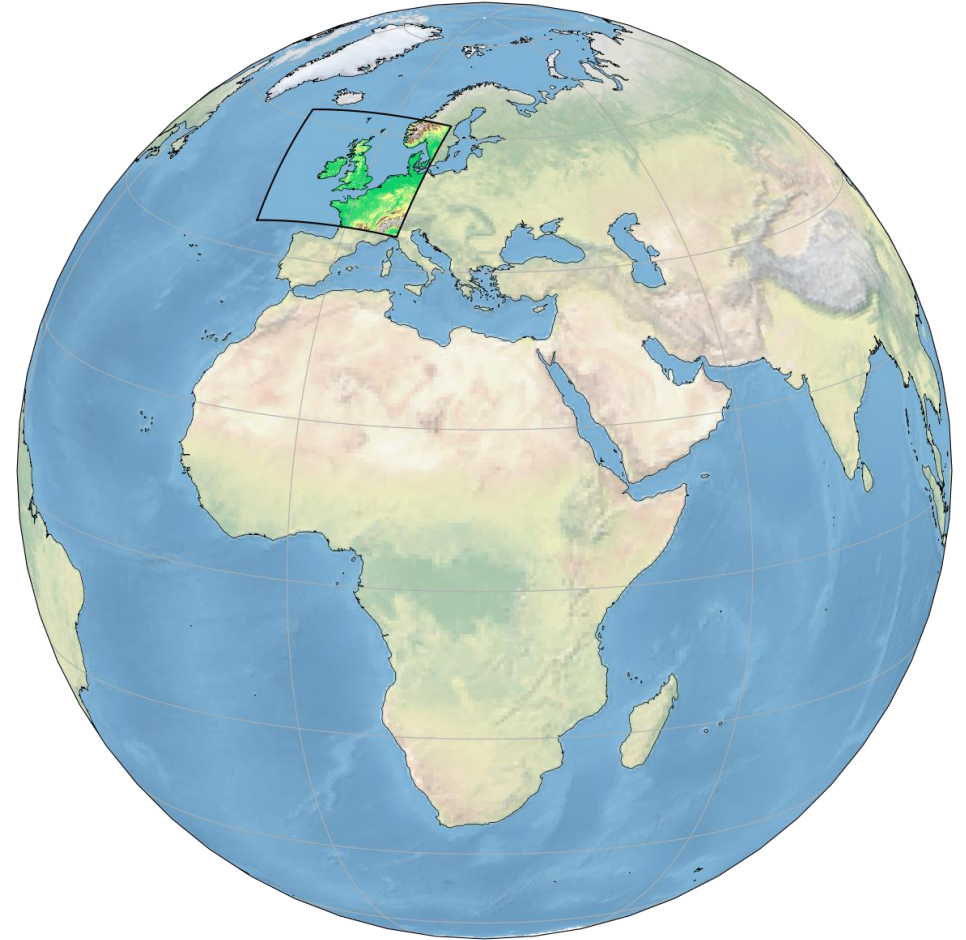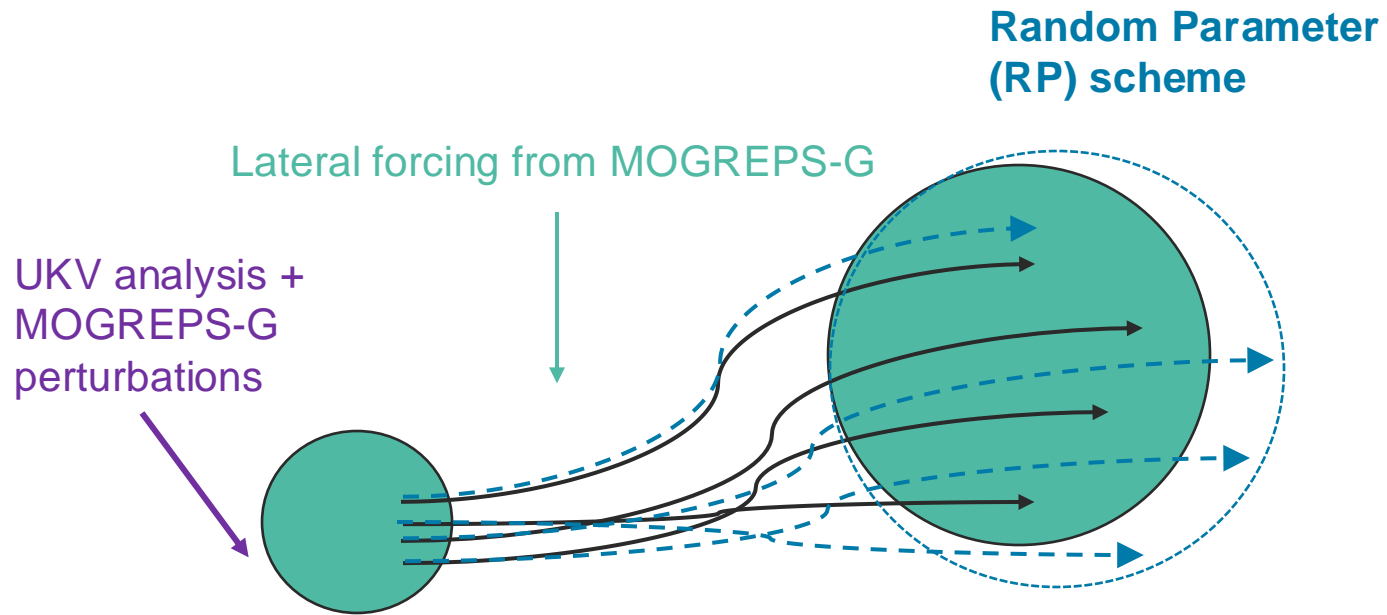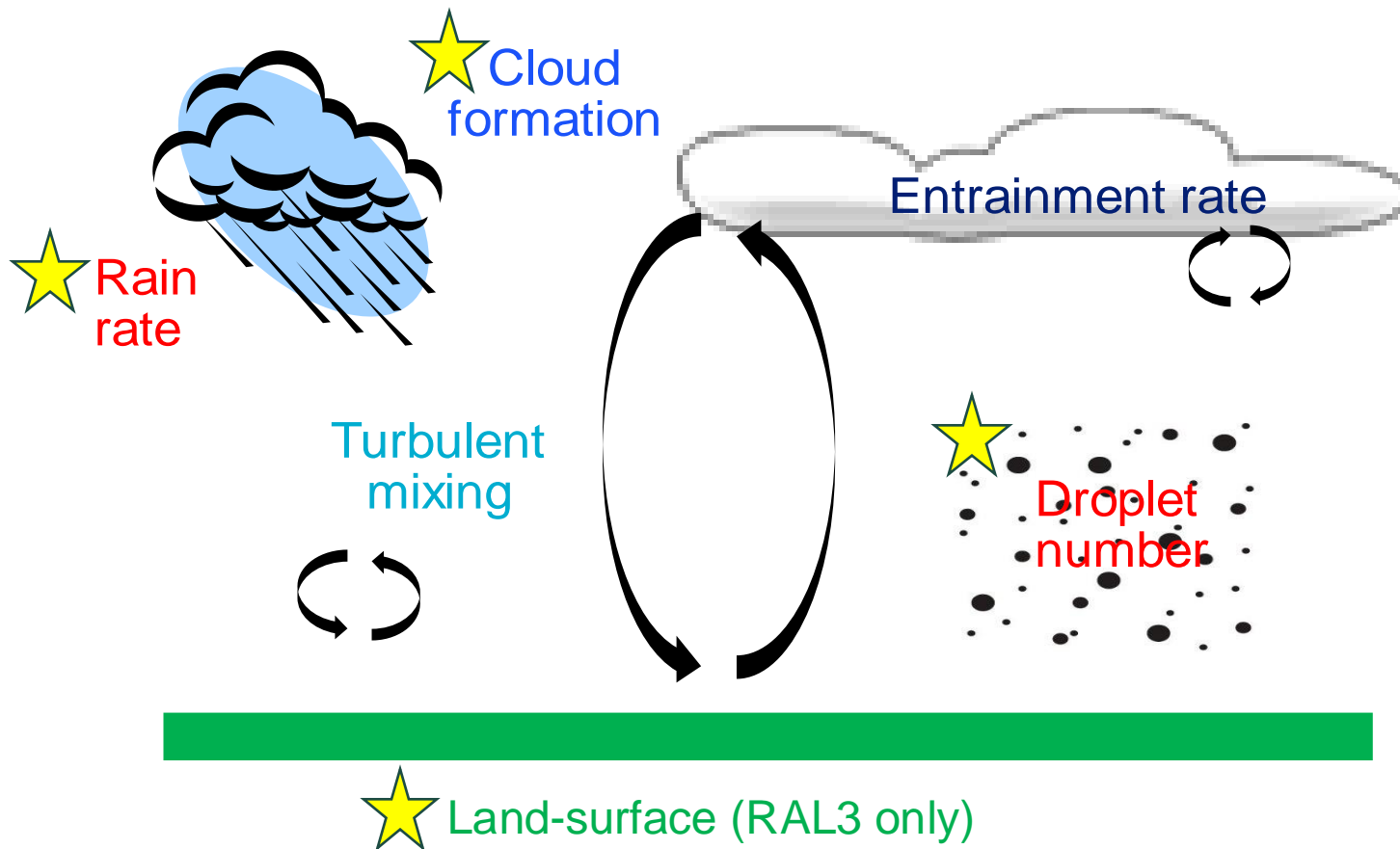
Random Parameter Scheme

Parameters are chosen to represent uncertainty in the parametrization schemes

The parameters are varied throughout the forecast to explore the range of possible values

The parameter value takes a different path in each ensemble member

Updates for RAL3

- Microphysics parameters perturbed in current operational configuration have been removed in RAL3

- Updated RP scheme includes:

  ➢ Additional parameters relevant to the new micro-physics and cloud scheme*

  ➢ Additional parameters in the land-surface scheme

*new microphysics parameters listed in additional slides at the end of this slide deck

New parameters developed with Adrian Lock, Paul Smith, Jonathan Wilkinson and Stu Webster

New parameters for RP scheme: Land-surface and orographic drag

Parameter	Description	Min	Default	Max
z0v	Vegetation tile roughness length for momentum	0.6,0.6,0.01,0.01,0.1	1.1,1.1,0.1,0.1,0.4	1.6,1.6,0.3,0.3 0.7
z0_urban_mult (MORUSES only)	Roughness length for urban canyon and roof tiles	0.5	1.0	1.5
z0hm_pft	Ratio of roughness length for heat Varies with z0v	0.5,0.5,0.001,0.001,0.001	1.00,1.00,0.022,0.022,0.025	1.5,1.5,0.05,0.05,0.05
z0hm_soil	Ratio of roughness length for heat over bare soil	0.01	0.2	0.5
orog_drag_param	Drag coefficient for orographic form drag	0.01	0.15	0.3
lai_mult	Leaf area index multiplier	0.5	1.0	2.0
alnir	Surface albedo on vegetation tiles (4 different parameters)	0.3,0.2,0.3,0.3,0.3	0.341,0.272,0.369,0.368,0.395	0.5,0.45,0.7,0.7,0.7
alpar		0.05,0.04,0.05,0.05,0.05	0.057,0.041,0.071,0.083,0.074	0.15,0.11,0.2,0.2,0.2
omega		0.05,0.05,0.1,0.1,0.1	0.101,0.083,0.132,0.135,0.115	0.2,0.2,0.2,0.2,0.2
omnir		0.7,0.4,0.6,0.6,0.6	0.788,0.545,0.864,0.787,0.785	0.9,0.6,0.9,0.9,0.9

Additional parameter, z0_soil, was found to have minimal impact over the UK so is not included in this set. This parameter may have more impact for other domains, however, such as Australia, so we have plans to add it back to the branch but to switch it off for the UK.

The new RP improve the spread-error ratio for the summer 1.5m temperatures and 10m wind speed
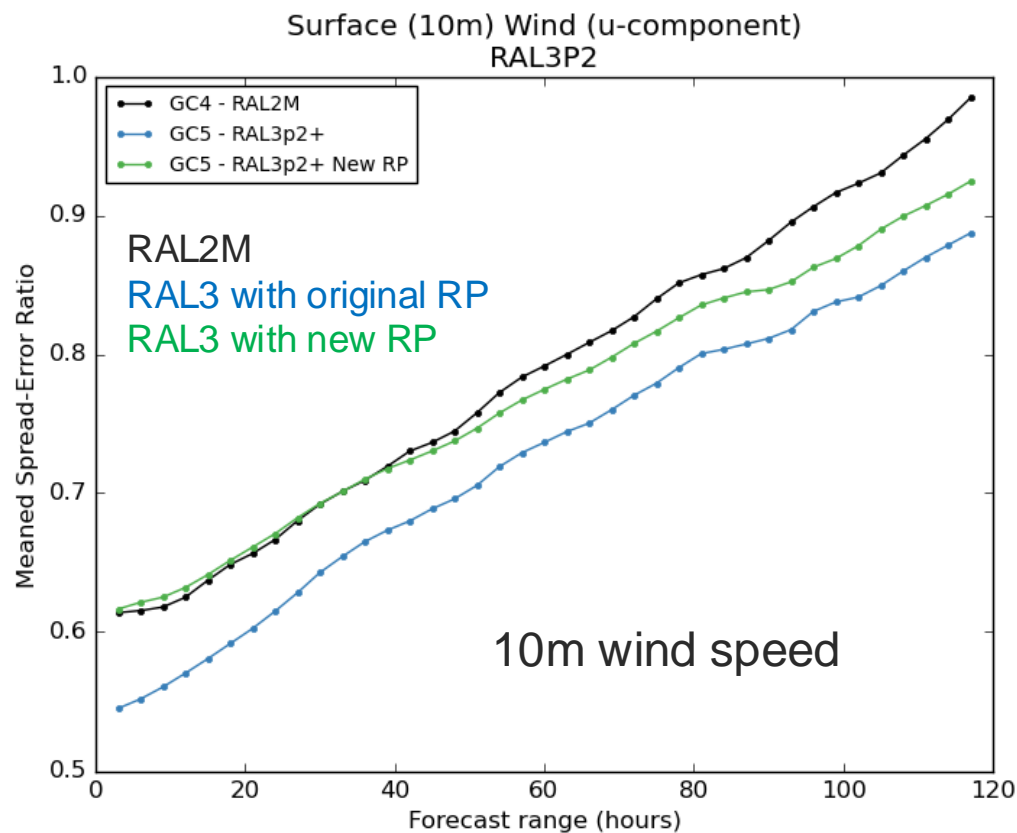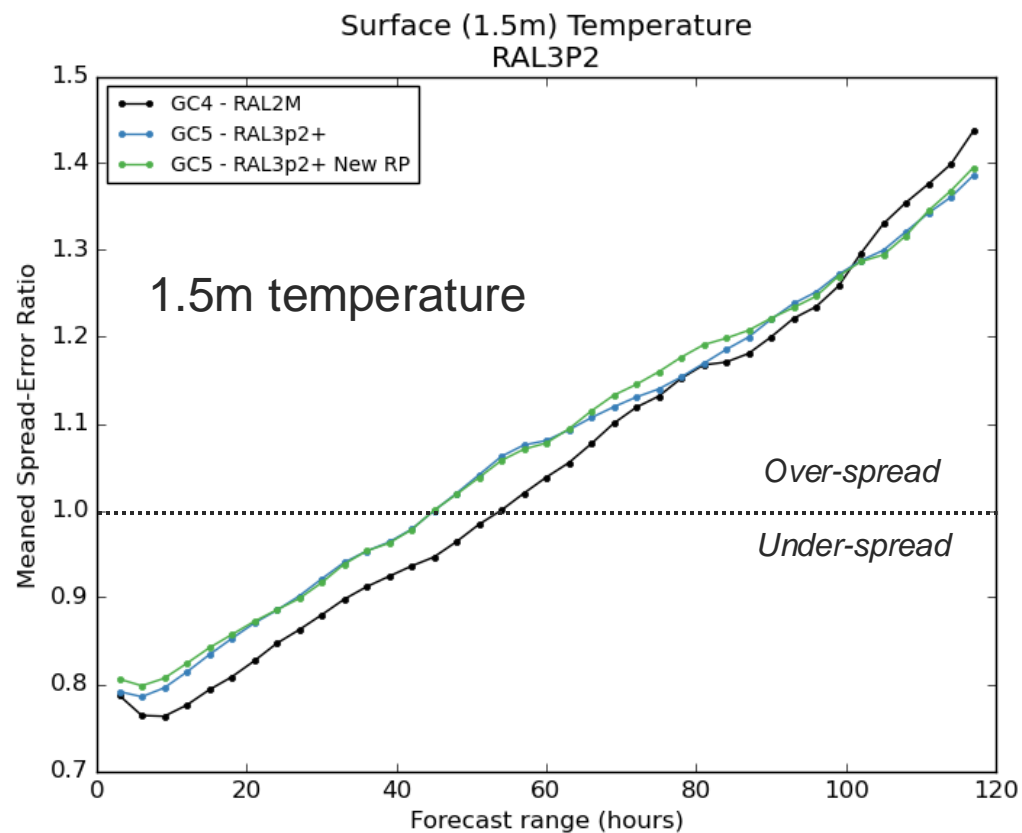

Summer
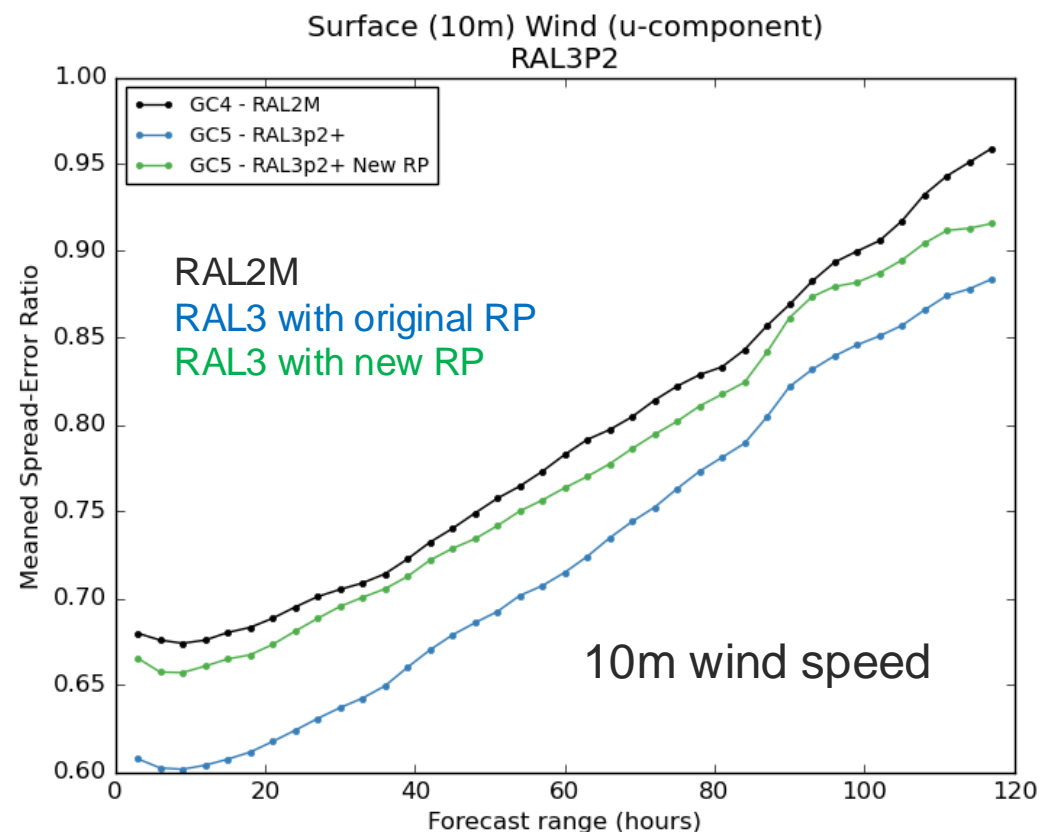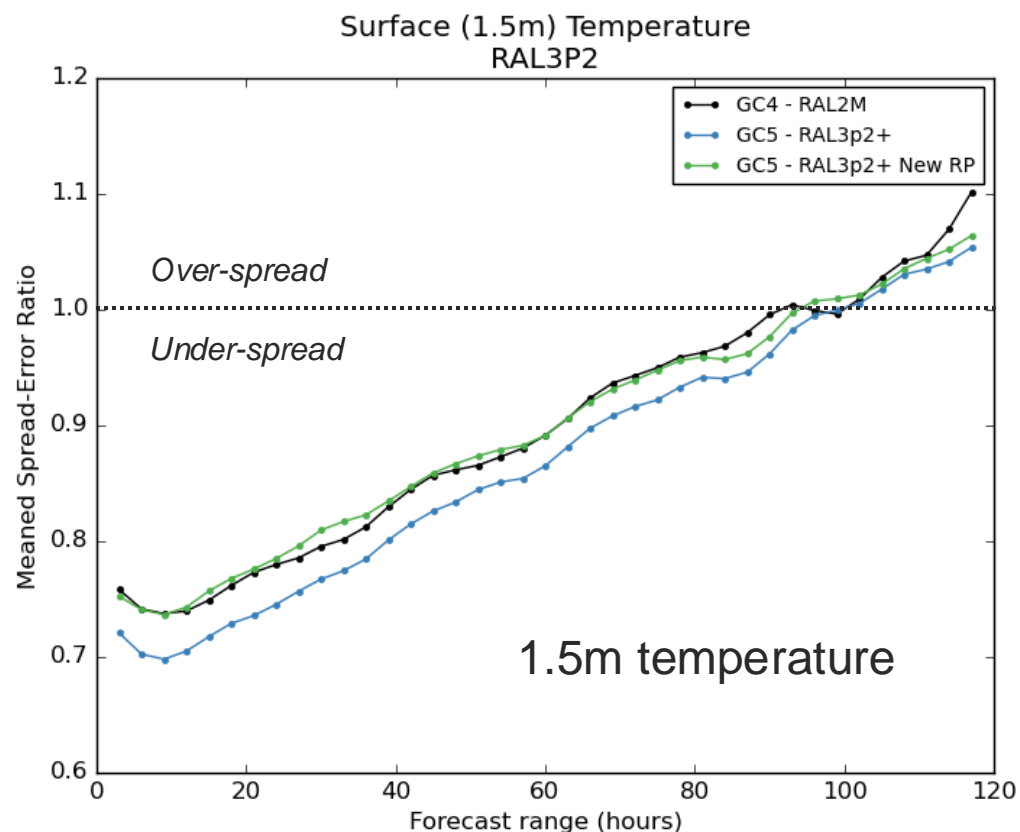
Note that RAL2M is driven by GC4 and RAL3p2 by GC5*

GC5* reduces the spread over the UK

*Improvements have since been made to GC5 to improve the ensemble forecasts over Europe

In an ideal ensemble with no observational error, the spread-error ratio should equal 1
The changes to the ratio are almost entirely down to changes in spread, rather than error

The new RP scheme has only a limited impact on winter screen temperature but a similar improvement to the 10m wind

Winter

Note that RAL2M is driven by GC4 and RAL3p2 by GC5*
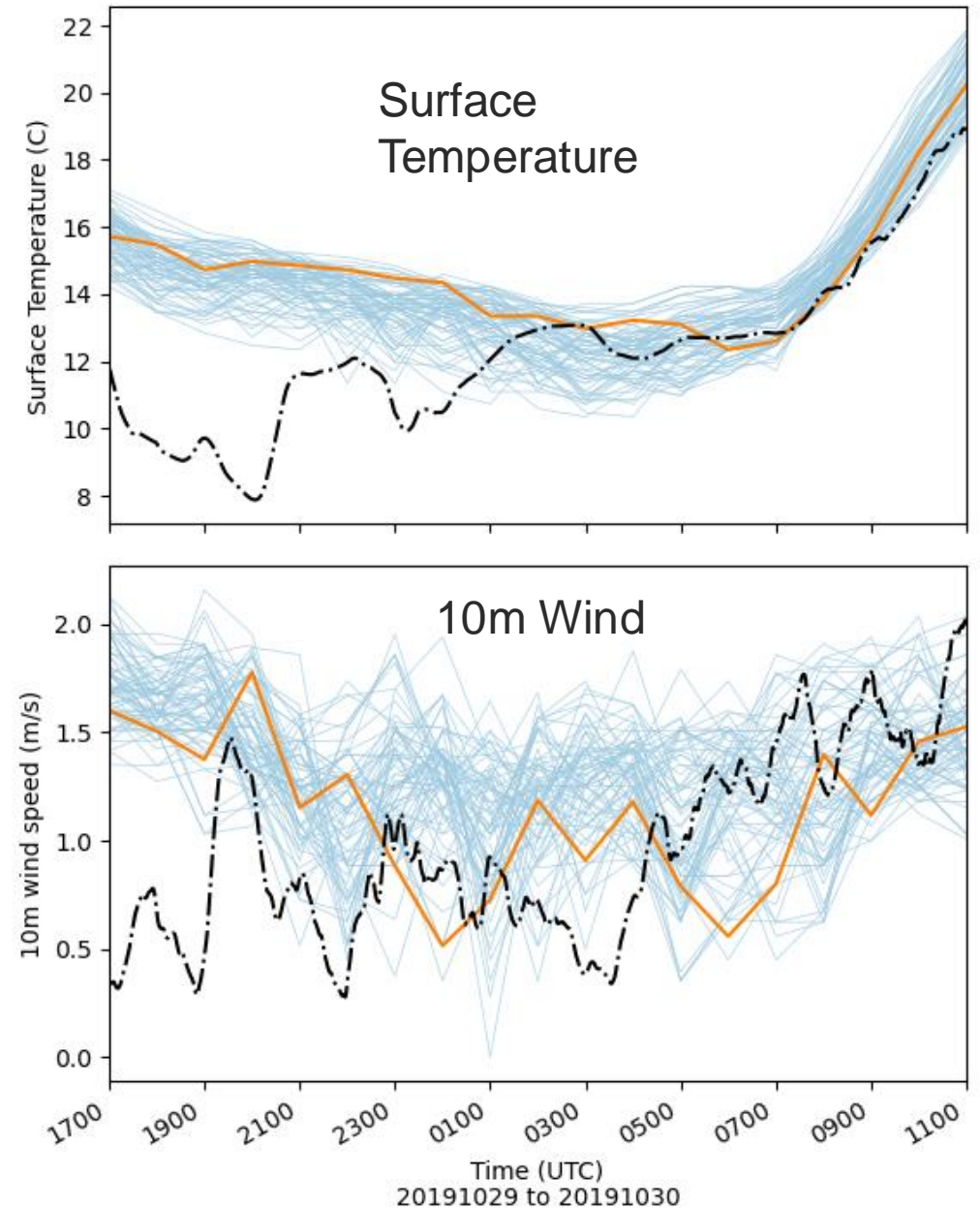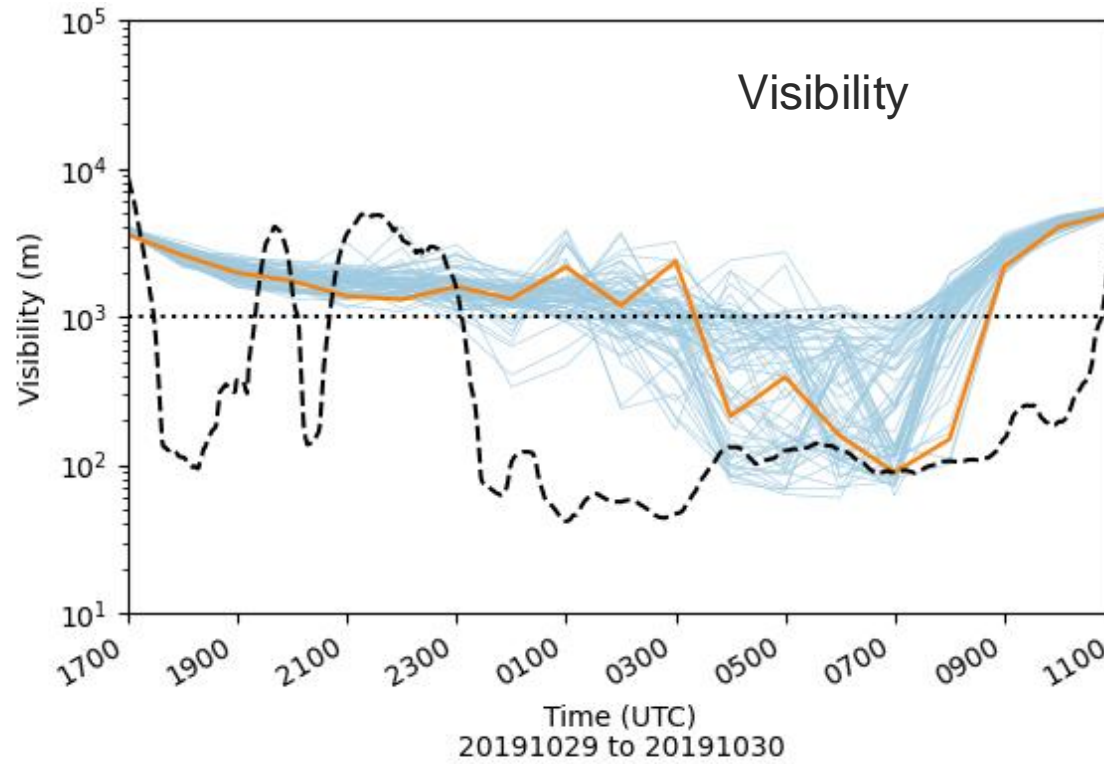
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SOFOG3D Case Study
29th – 30th October 2019
*RAL3.2 with **no RP** scheme*

Time Series at Le Couye (Met Office) site in SOFOG3D observation campaign; each line shows a different ensemble member for the four points surrounding the site; one of the foggier members has been highlighted in orange (not the control member); observations are in black.
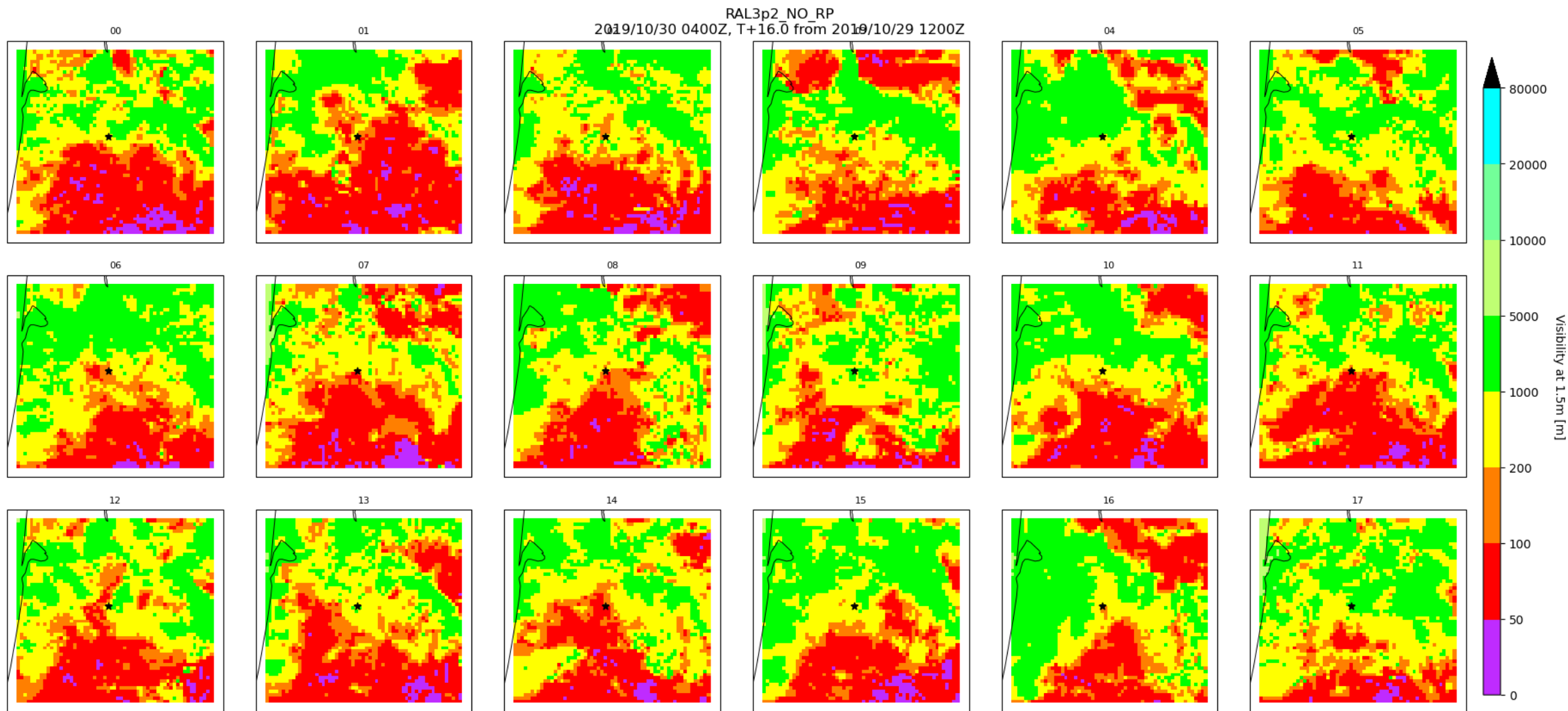
Sensitivity to RP scheme

Met Office
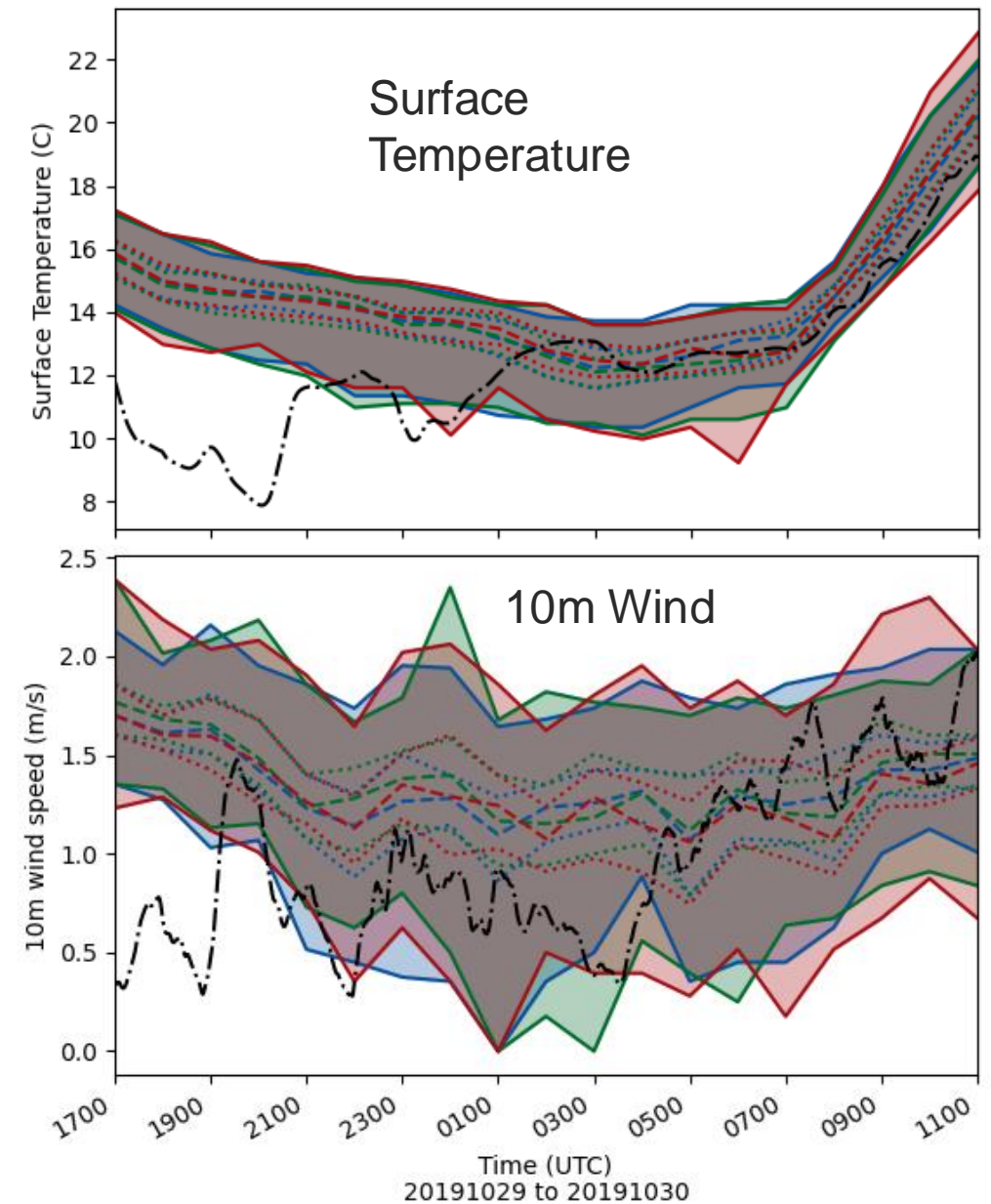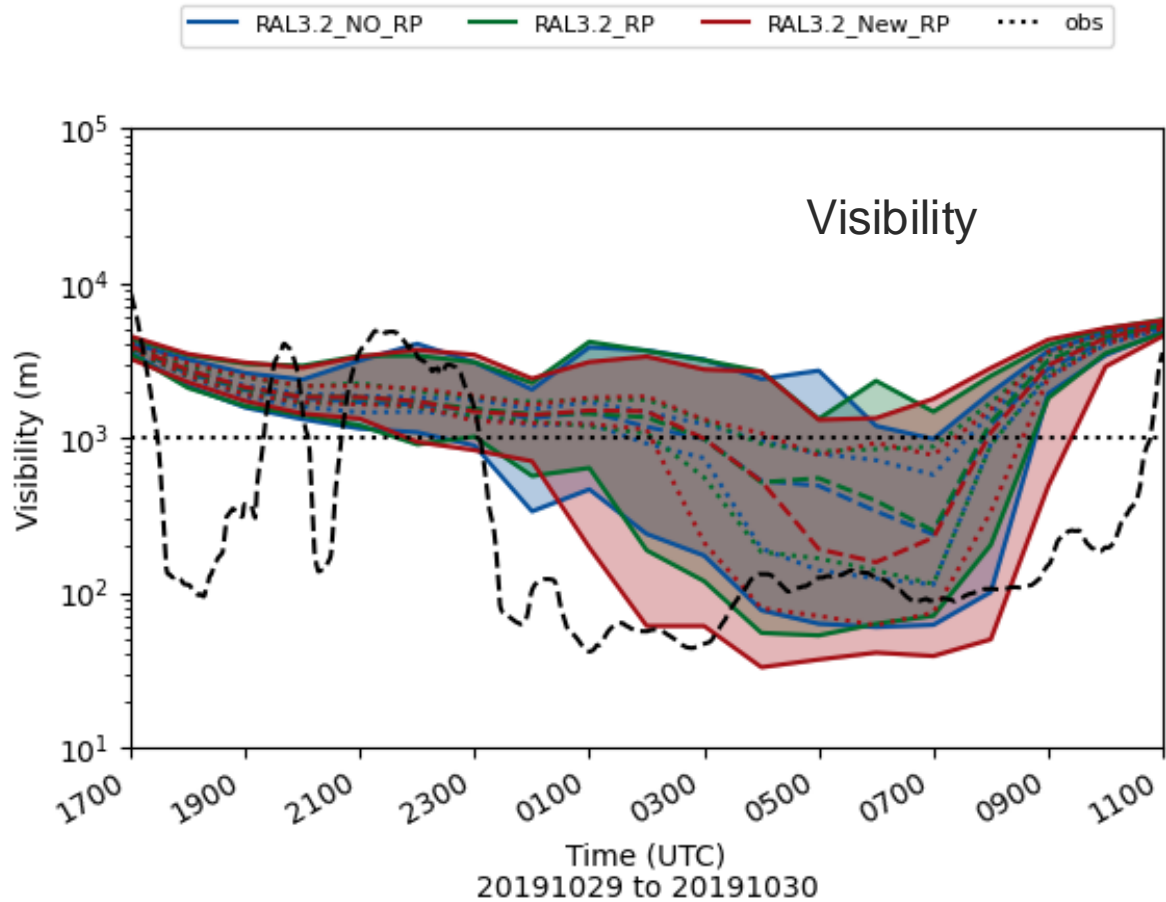
Dashed line shows the median, dotted lines the 25th and 75th percentile, solid lines the max and min of the ensembles

Postage Stamps of visibility in surrounding area show a large area of fog to the south of the site …

NO RP

RAL3p2_NO_RP
2019/10/30 0400Z, T+16.0 from 2019/10/29 1200Z

Visibility at 1.5m [m]

… there are some changes to the extent of the fog with the standard RP scheme …

Std RP

RAL3p2_RP
2019/10/30 0400Z, T+16.0 from 2019/10/29 1200Z
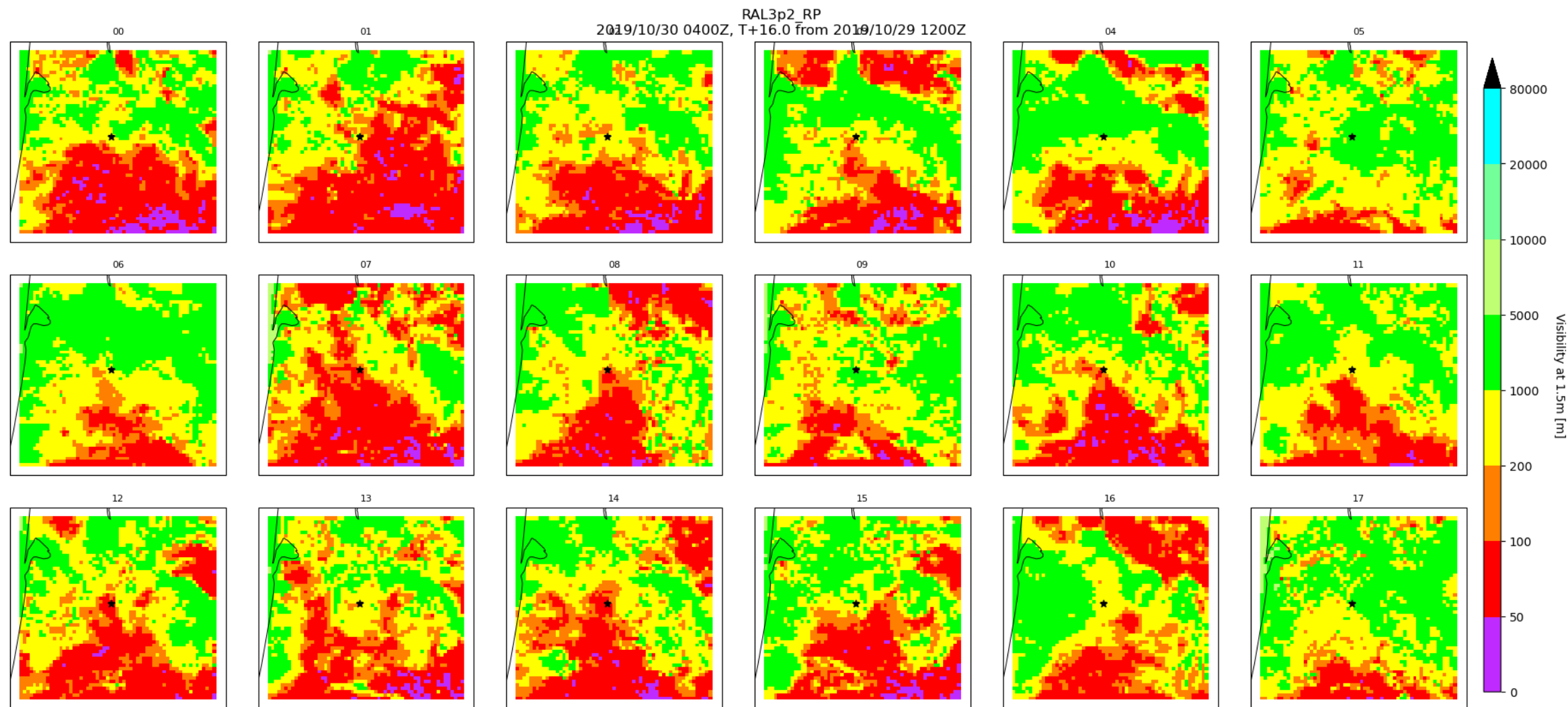
… the new RP scheme has more of an impact and suggests a two-scenario forecast

New RP
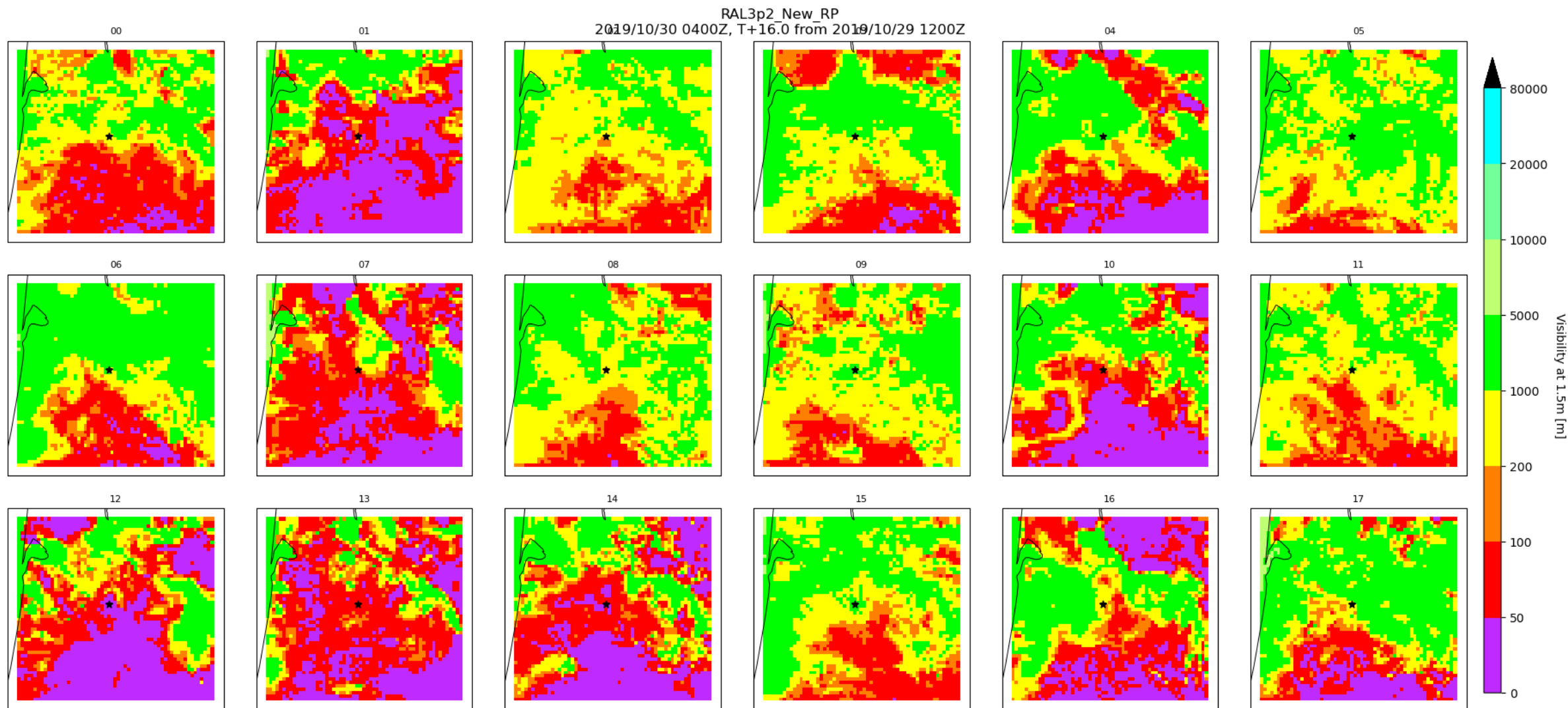
Summary

- New parameters have been added to the RP scheme to work with RAL3 science

- Particular sensitivity was found to parameters in the land-surface

- The new parameters show a large improvement to the spread-error relationship for the 10m wind speed in both summer and winter trial periods

- The new parameters have a positive benefit for the summer 1.5m temperatures, but a neutral impact in the winter

- Case studies suggest that the new parameters have the potential to increase the variability in the fog forecasts

Met Office

Thank you for listening

Met Office

Additional Slides

New parameters for RP scheme: Microphysics

Met Office

- In RAL3, the majority of the microphysics parameters are no longer available

- A new set of parameters has been trialled to represent the uncertainty in CASIM and the bimodal cloud scheme

- These have a similar impact to the microphysics parameters used in RAL2-M – in general a small impact, slightly increasing the spread in surface temperature

Parameter	Min	Default	Max
snow_fspd	7.2	12	16.8
ice_fspd	3600000	6000000	8400000
ndrop_surf	2.0e+06	1.0e+07	10.0e+07
mpof	0.1	0.5	0.6
fxd_cld_num	50.0e+06	150.0e+06	300.0e+06
mp_c_zero	4.0	10.0	10.0