Some Meteorological Impacts of Cycle 47r2 (versus 47r1)

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Thanks to Ivan Tsonevsky, Fernando Prates, Richard Forbes, Mark Rodwell
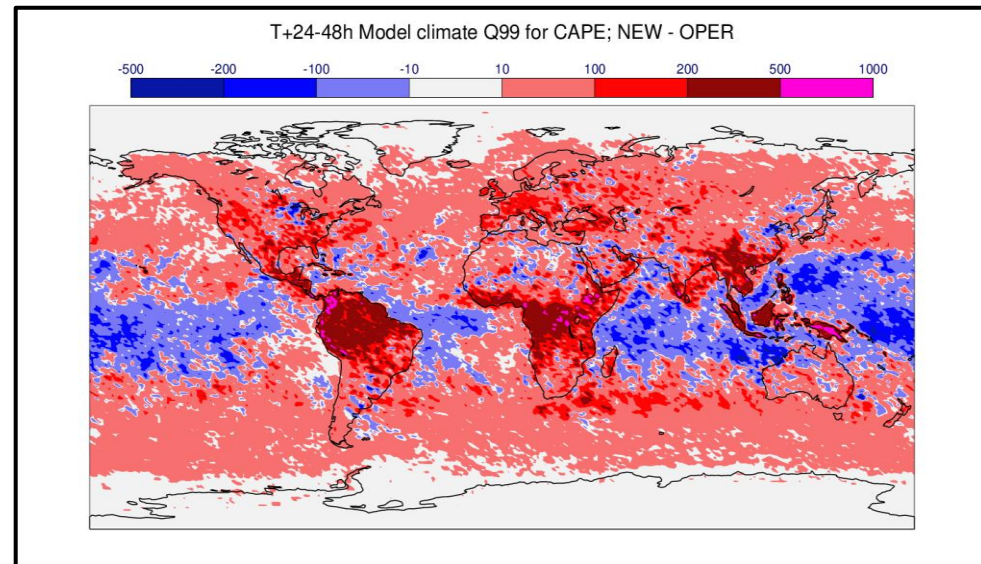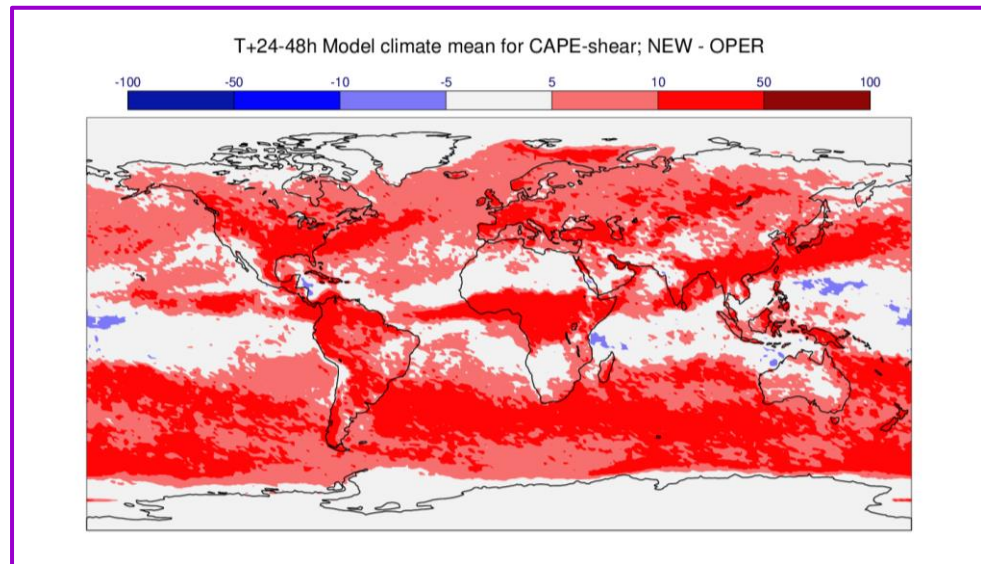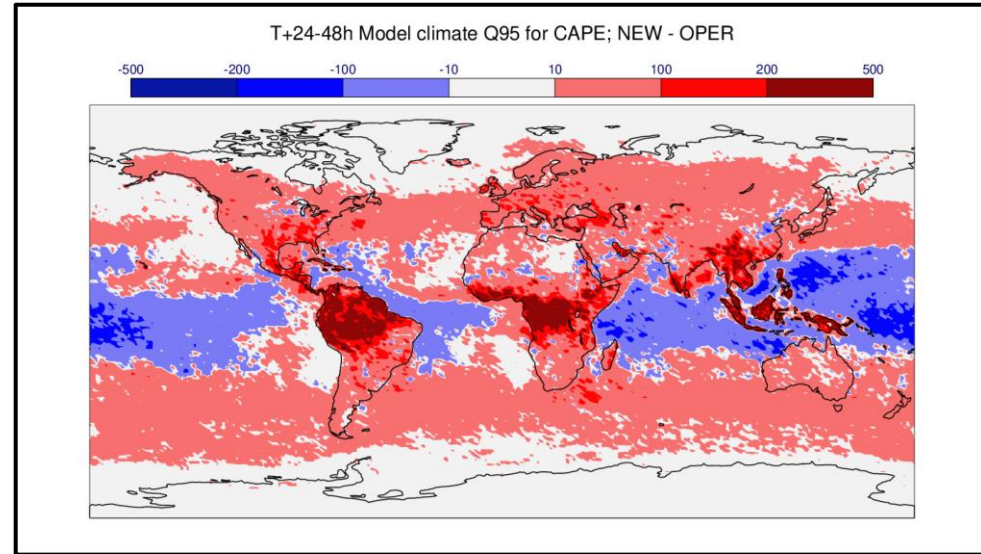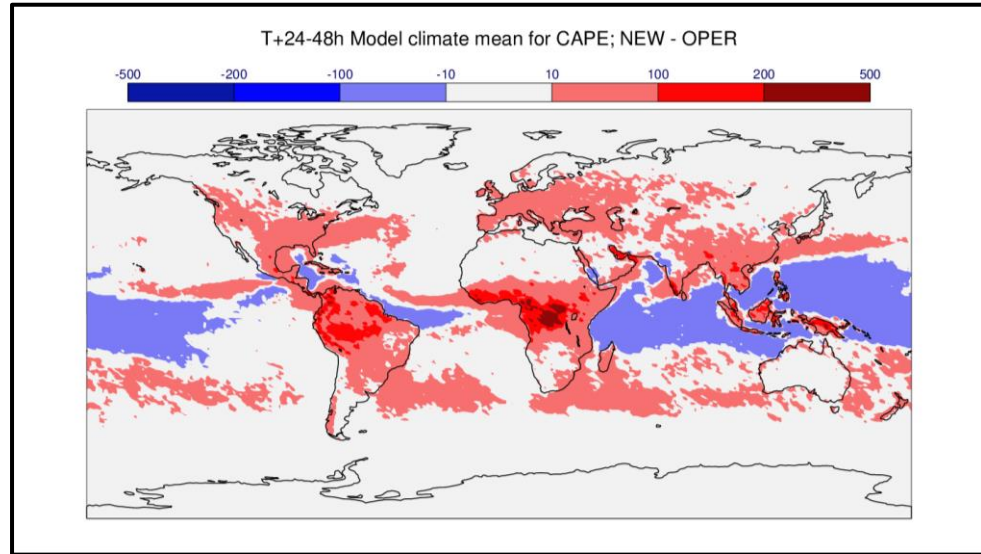
ECMWF

Outline

- Cycle 47r2 was introduced operationally on 11 May 2021

- Note that the only substantive performance-related change was to the Ensemble:

  - 137 levels now, 91 before

- Here we provided an overview of some !meteorological impacts" (i.e. referencing products, weather)

- Follows on from Richard Forbes' talk on Tue morning

- So what weather/product aspects could level number increase have changed, in some systematic way ?

- Quite a lot!

- Recall that the scorecard, comparing with the previous cycle (47r1), was positive…
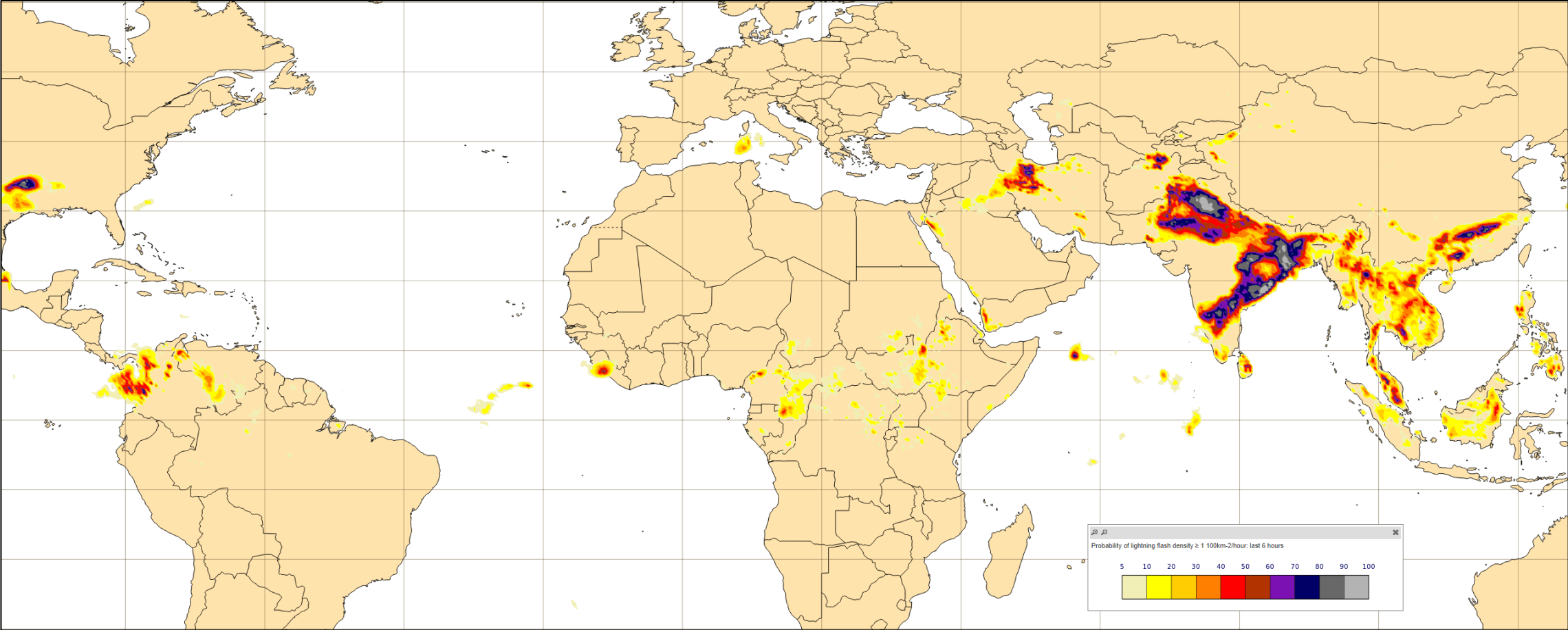
Meteorological Aspects covered here:

- CAPE

- Lightning forecasts

- Precipitation total distributions

- Tropical cyclone frequencies

- Inversions

- Low cloud

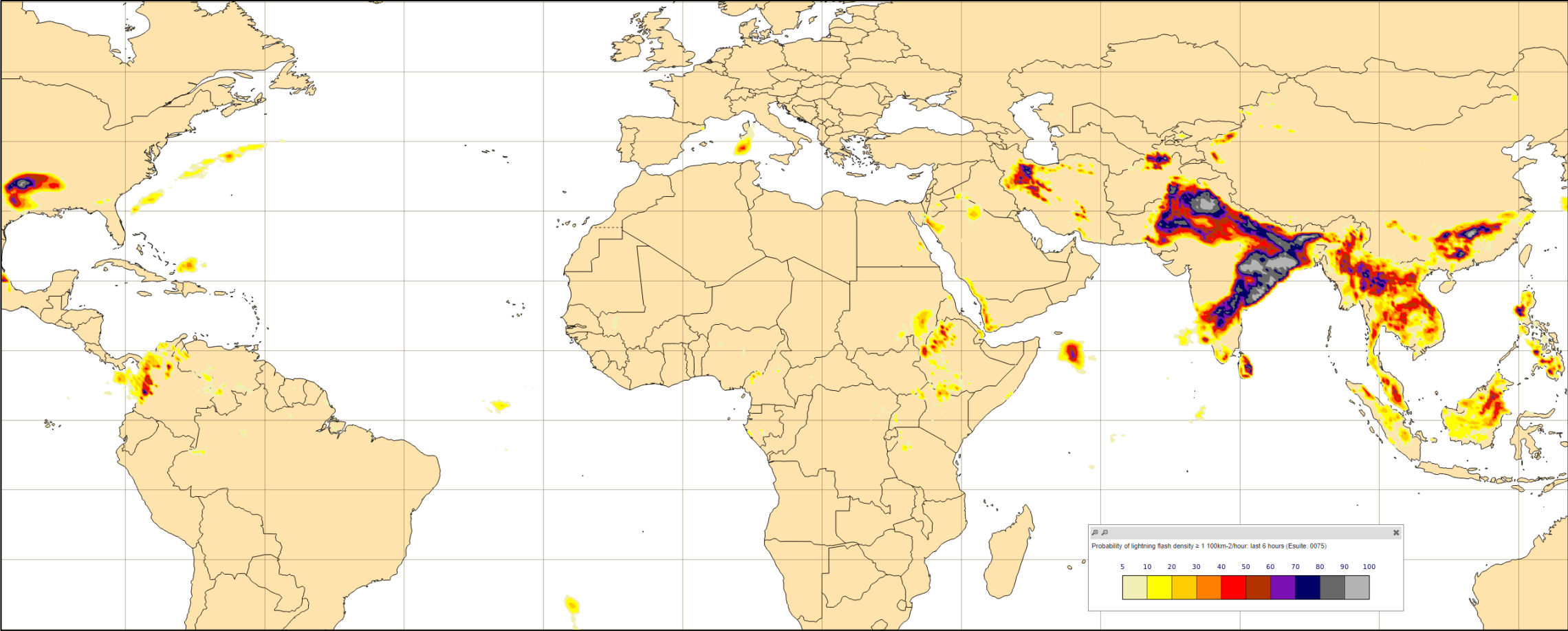(other aspects could well have changed also)

CAPE and CAPE-shear – changes in the Model Climate

T+24-48h Model climate mean for CAPE; NEW - OPER

T+24-48h Model climate Q95 for CAPE; NEW - OPER

T+24-48h Model climate mean for CAPE-shear; NEW - OPER

T+24-48h Model climate Q99 for CAPE; NEW - OPER

Example of ENS Lightning density forecast (6h average of strikes per h per 100km^2) – 47r1

Probability of lightning flash density ≥ 1 100km-2/hour: last 6 hours

| 5 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |

Example of ENS Lightning density forecast (6h average of strikes per h per 100km^2) – 47r2 (same case)

Probability of lightning flash density ≥ 1 100km-2/hour: last 6 hours (Esuite: 0075)

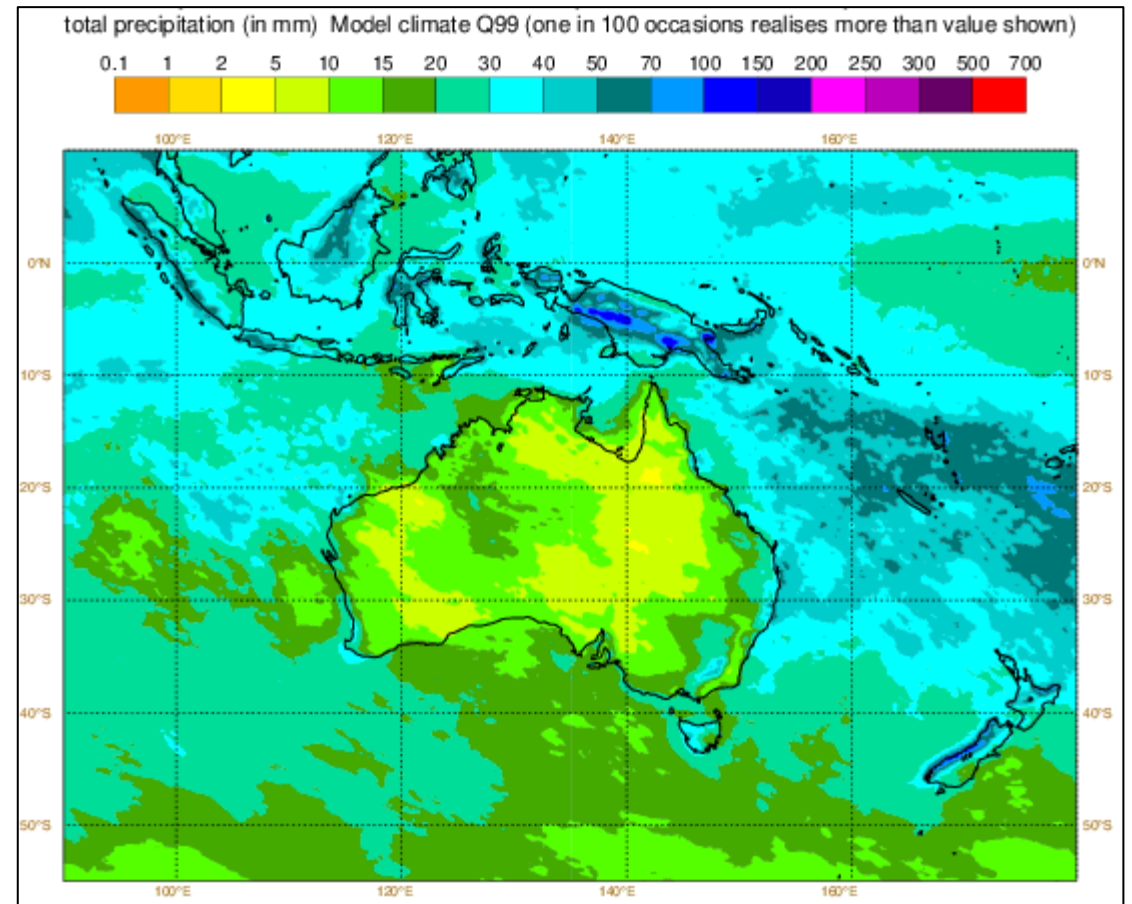| 5 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |

Increases relate to higher CAPE values
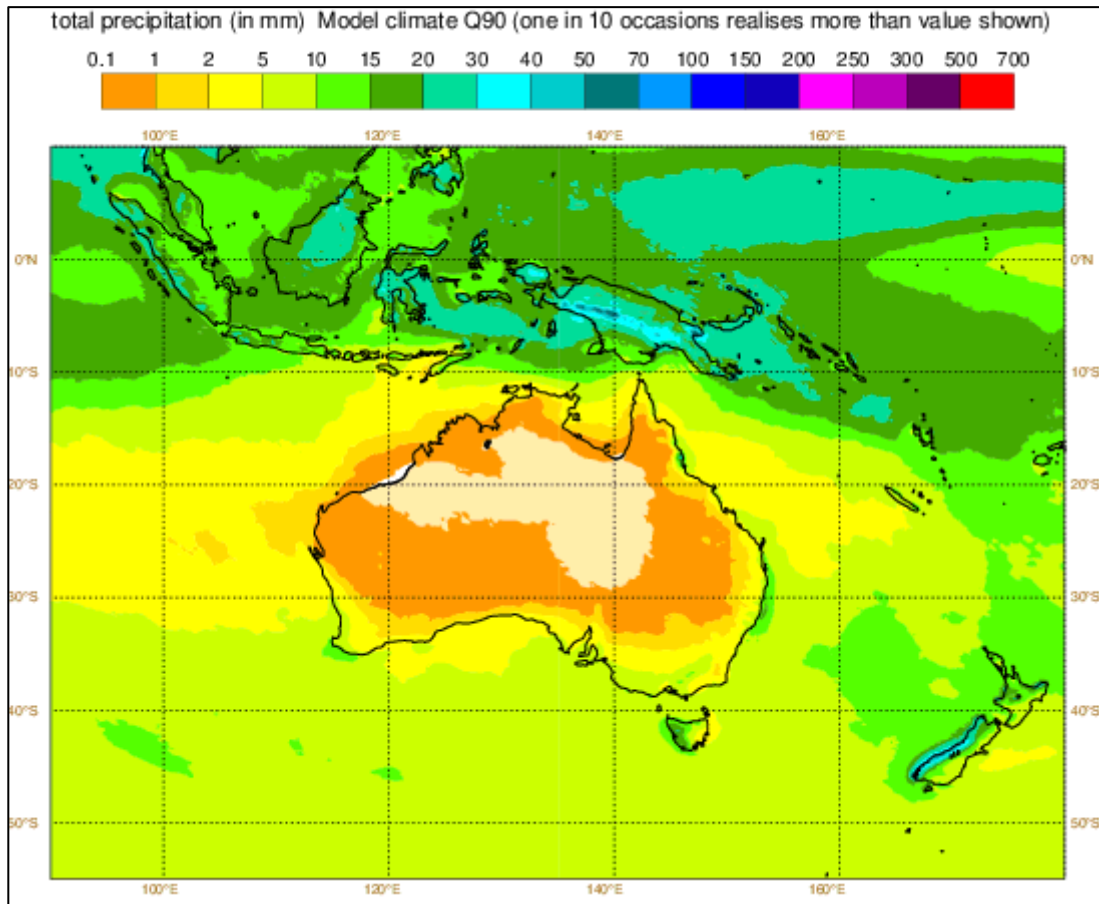
Model Climate for 24h precipitation – 47r1
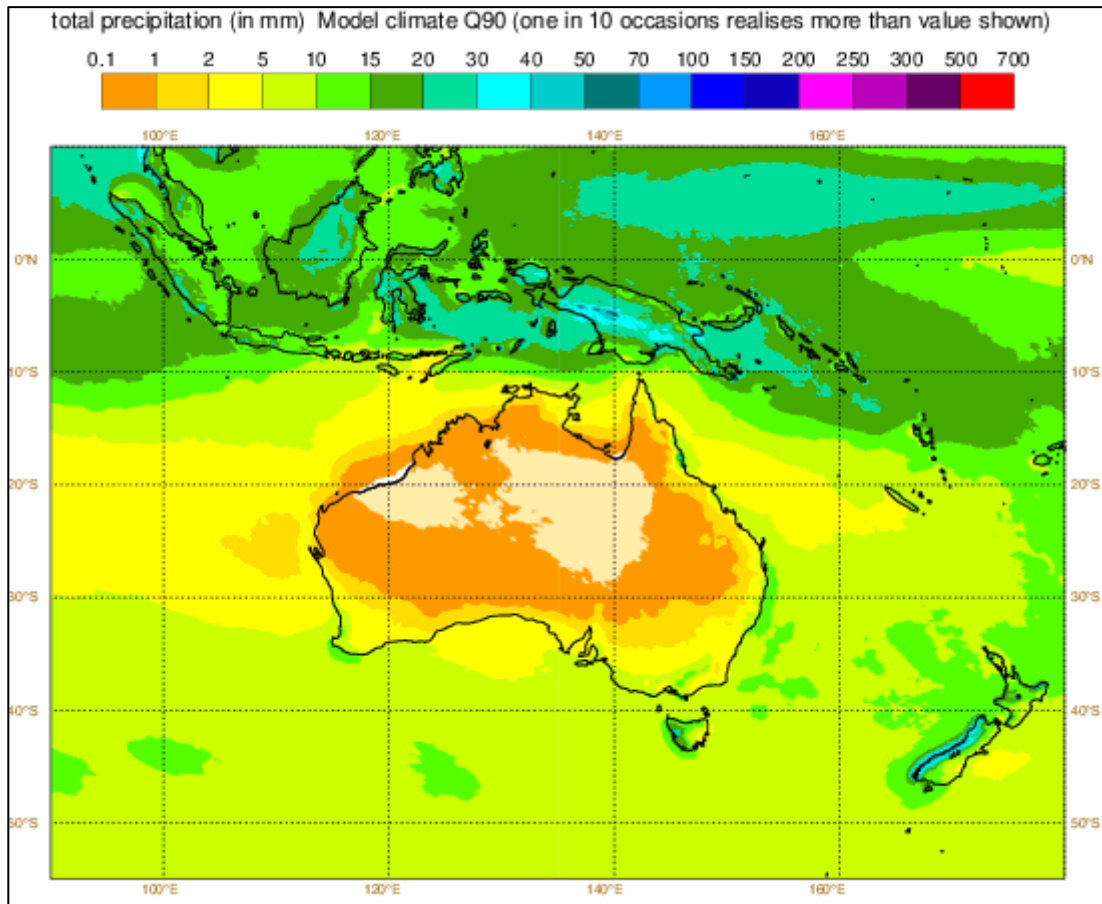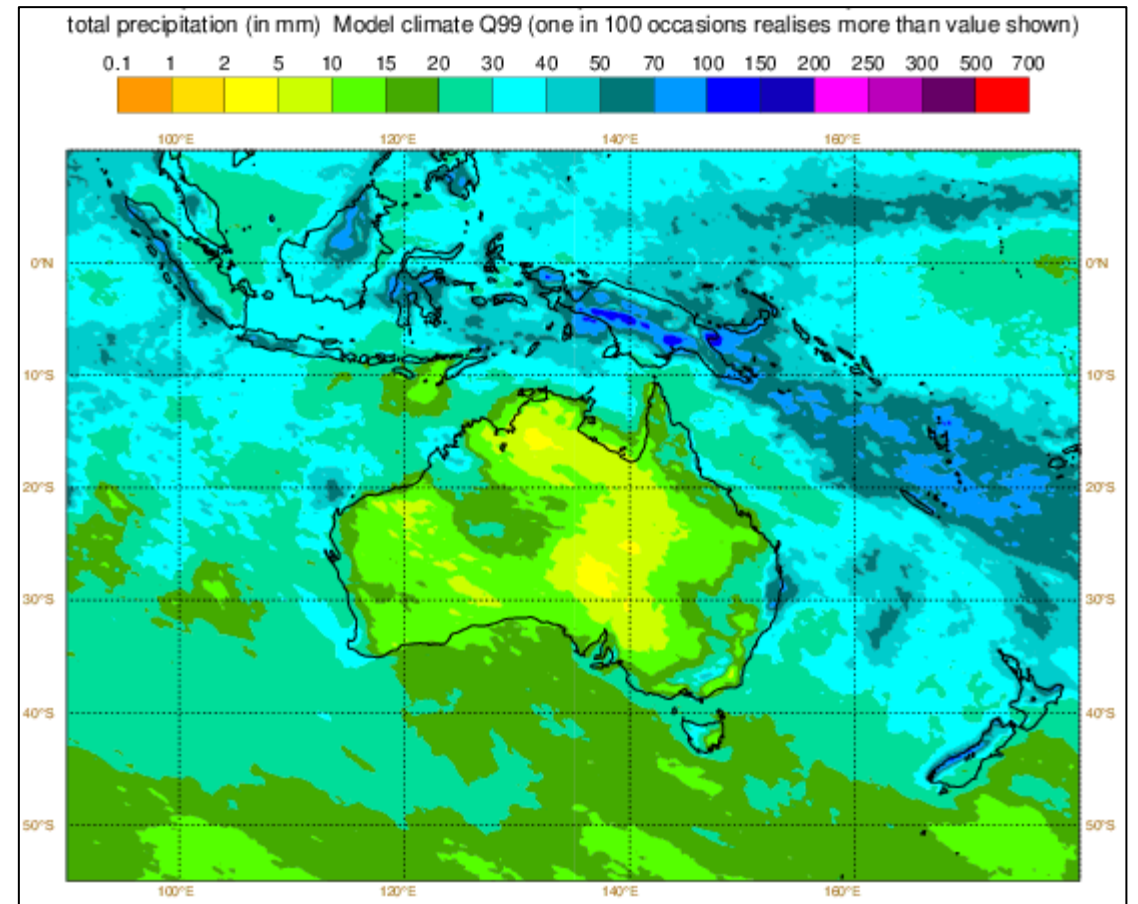

90th percentile 24h precipitation

99th percentile 24h precipitation
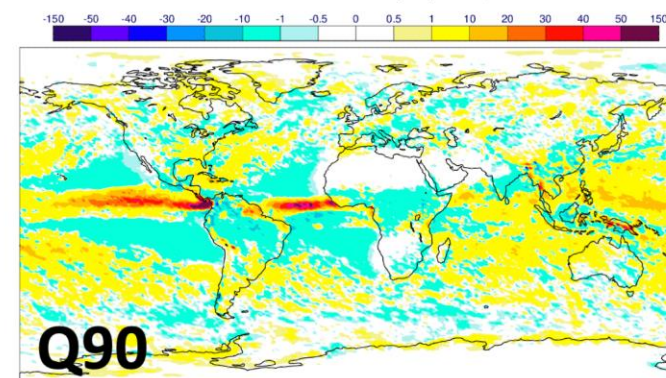
Model Climate for 24h precipitation – 47r2

90th percentile 24h precipitation
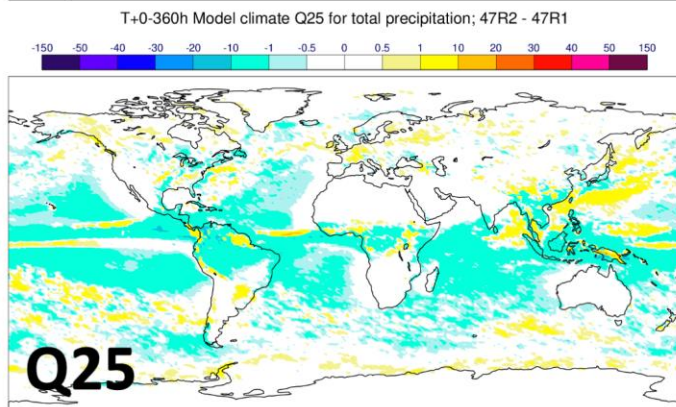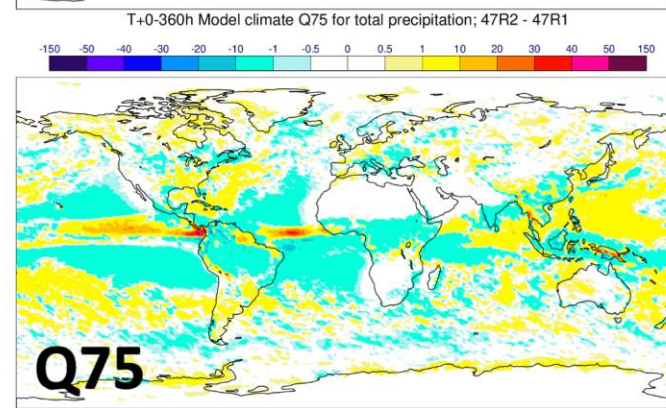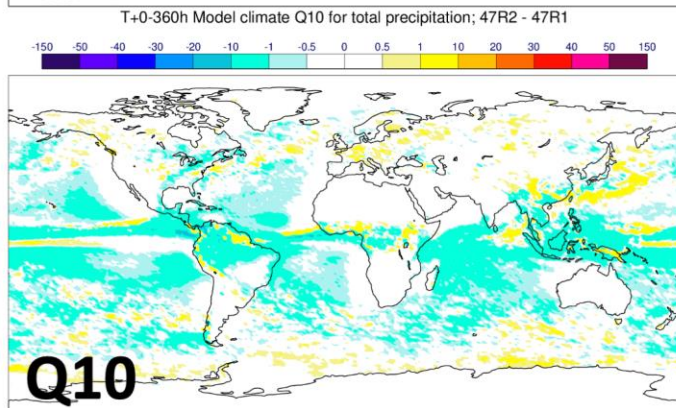
99th percentile 24h precipitation

T+0-360h Model climate Q1 for total precipitation; 47R2 - 47R1

T+0-360h Model climate Q50 for total precipitation; 47R2 - 47R1

T+0-360h Model climate Q10 for total precipitation; 47R2 - 47R1

T+0-360h Model climate Q75 for total precipitation; 47R2 - 47R1

T+0-360h Model climate Q25 for total precipitation; 47R2 - 47R1

T+0-360h Model climate Q99 for total precipitation; 47R2 - 47R1
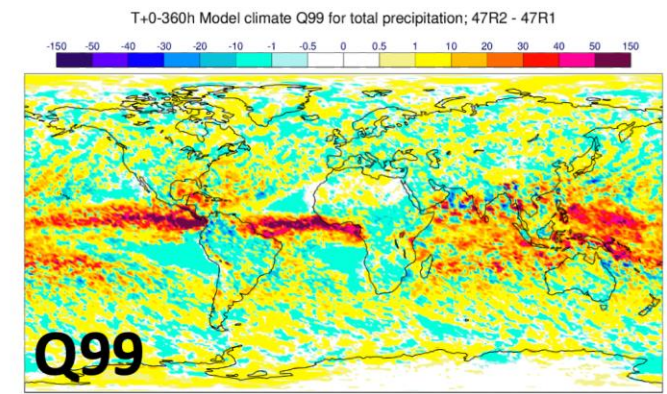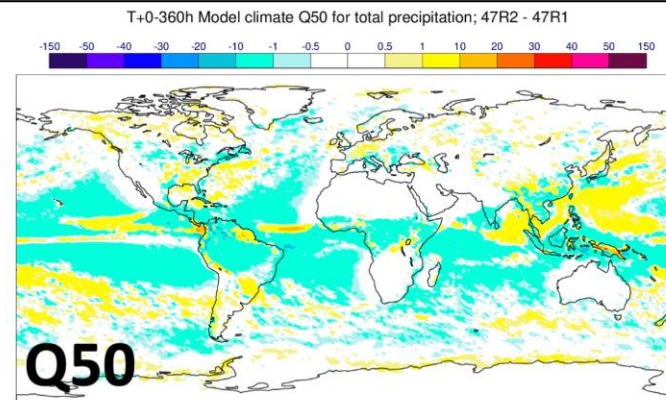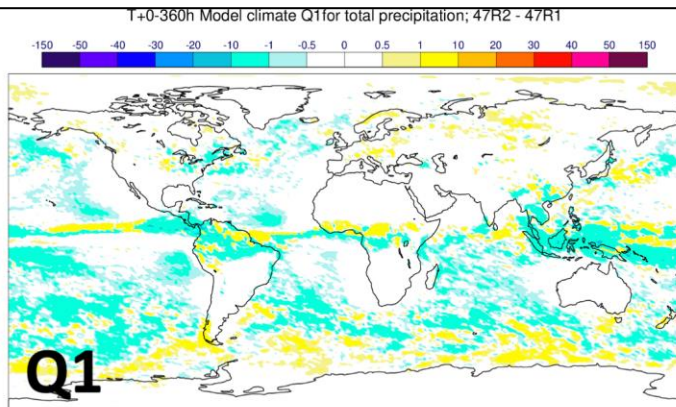
**Model climate 24h
Ppn differences:
47r2 – 47r1**

Different Quantiles

General Comments on ENS precipitation behaviour

- CONTROL forecast shows higher occurrence of extreme precipitation in 47r2 than in 47r1, suggesting **it is therefore sensitive to vertical resolution**

- CONTROL forecast in 47r2 is in closer agreement with HRES, when allowing for different resolutions (as might be expected as they now have the same vertical resolution)

- ENS perturbed forecasts have higher occurrence of extreme precipitation than the unperturbed CONTROL, and both are increased in 47r2
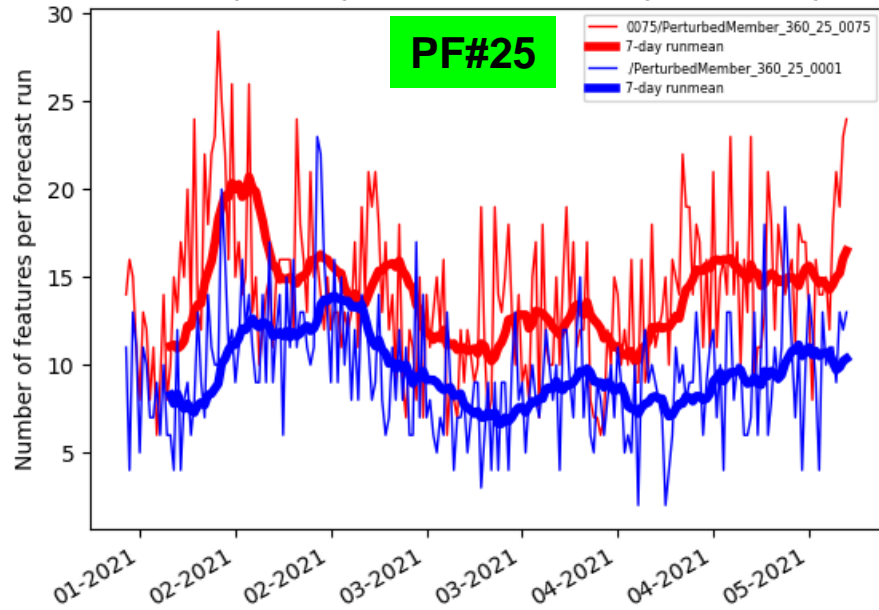
- Biggest differences are in the Tropics

Tropical Cyclone Strike Probs (D5-6) – 47r1 example

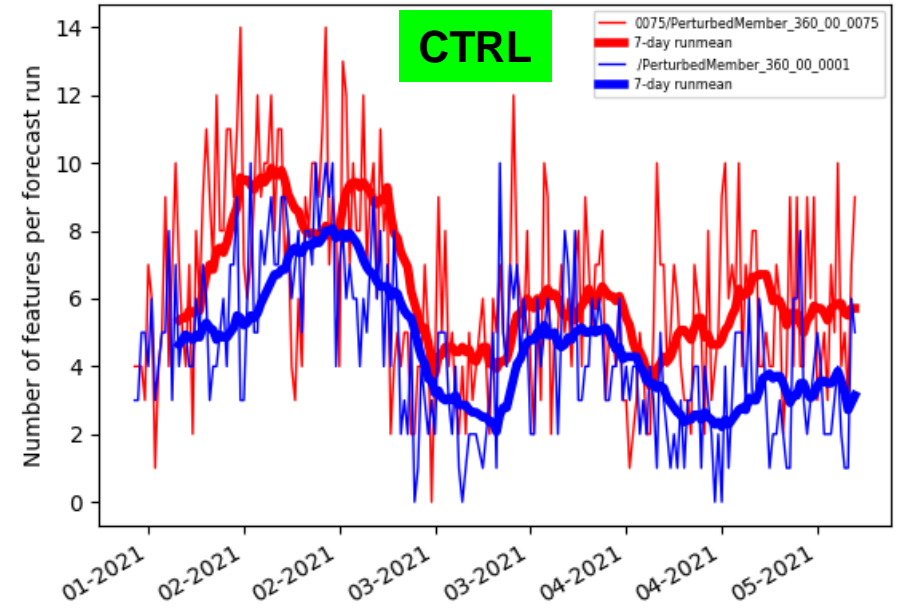ECMWF   EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS
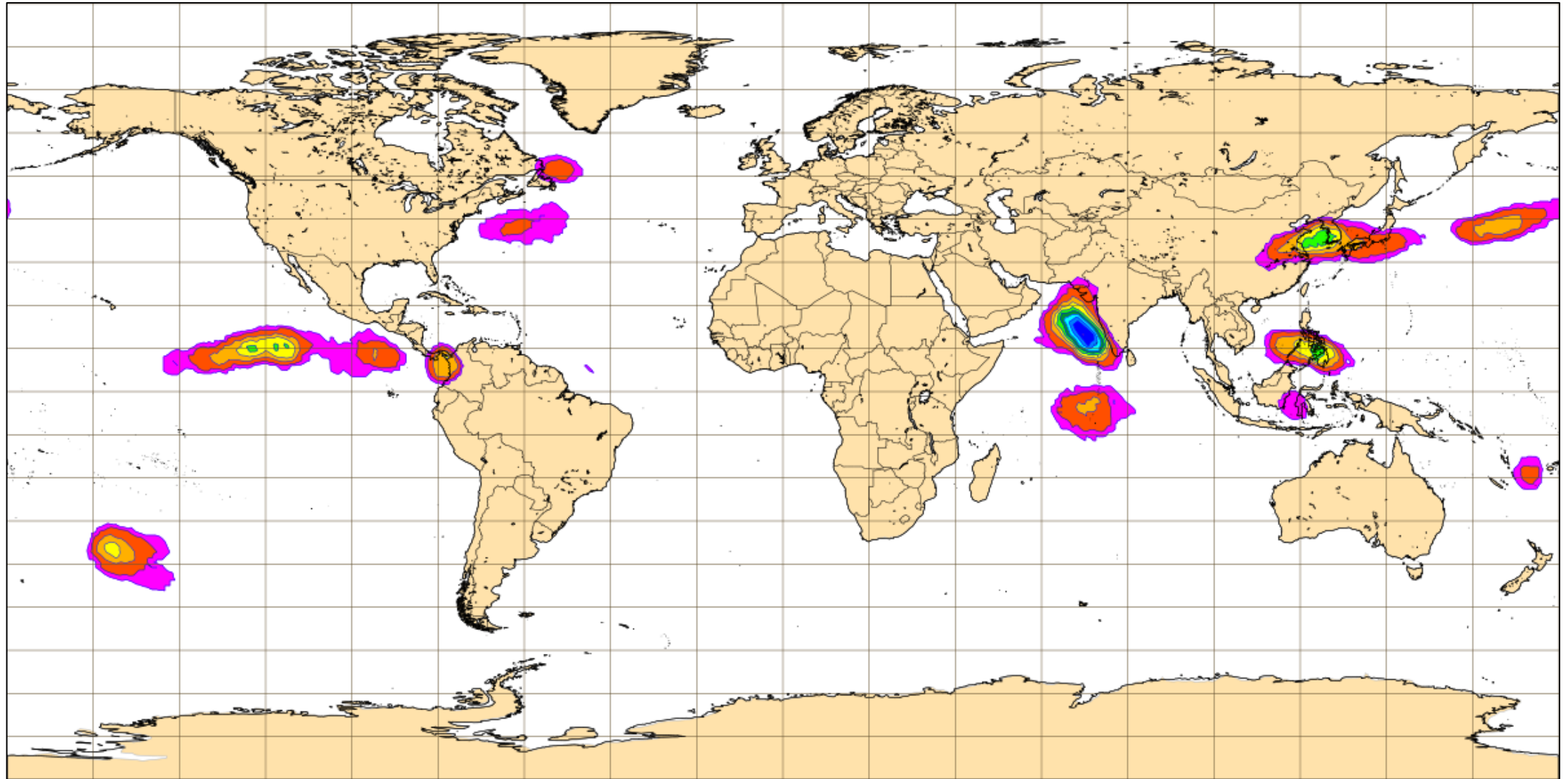
Tropical Cyclone Strike Probs (D5-6) – equivalent 47r2 example
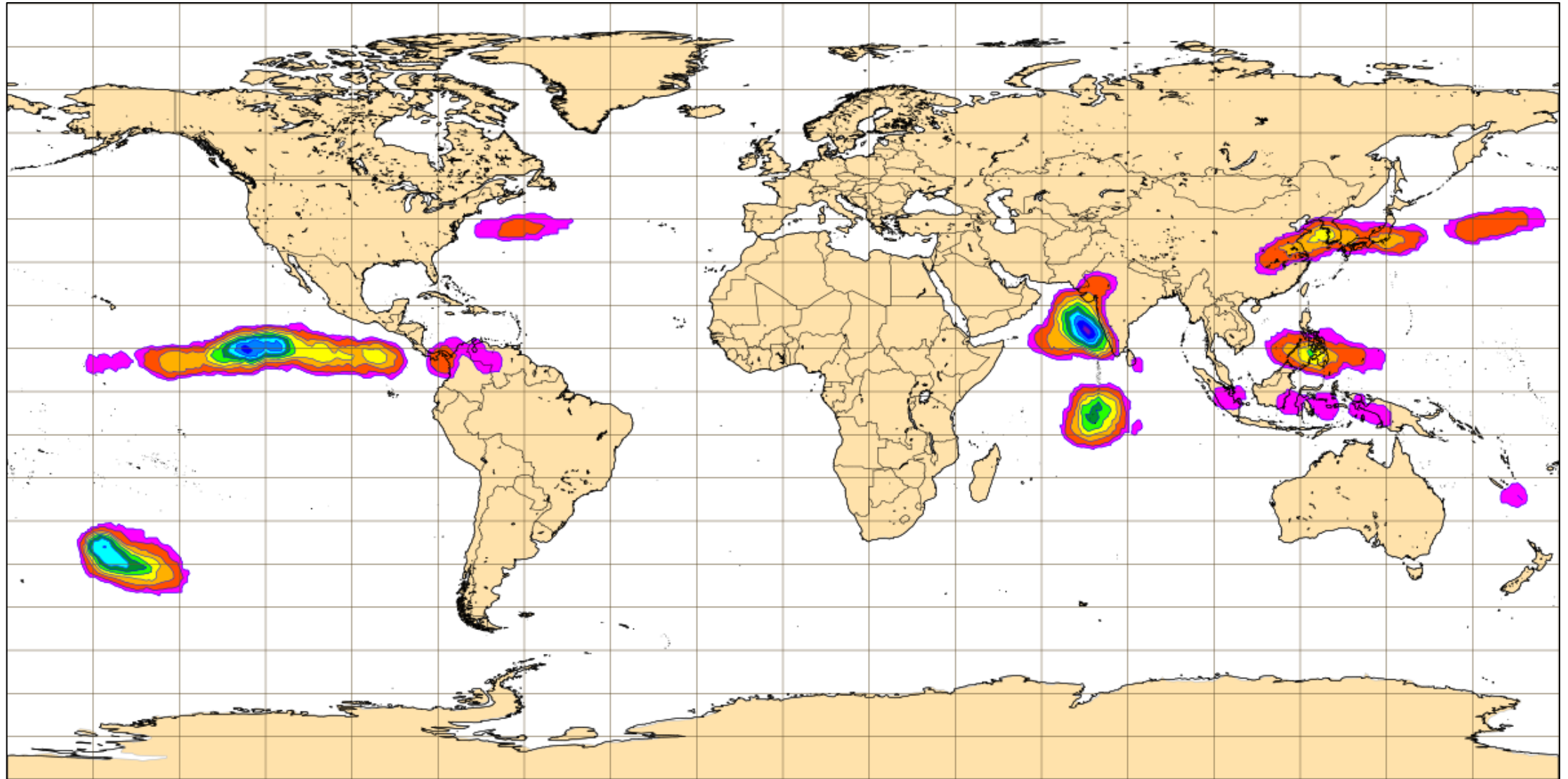
Number of Tropical Depressions in the fcst (up to +360h) per cycle

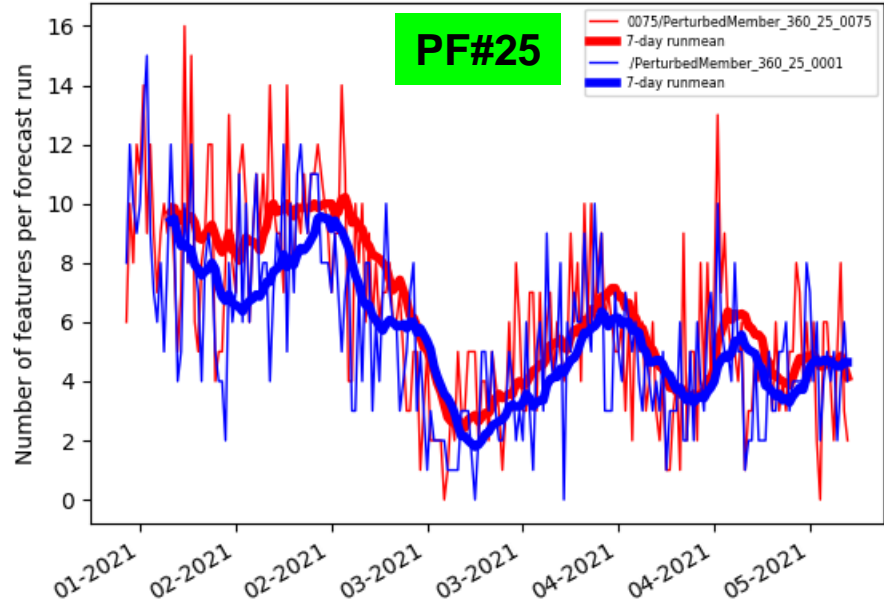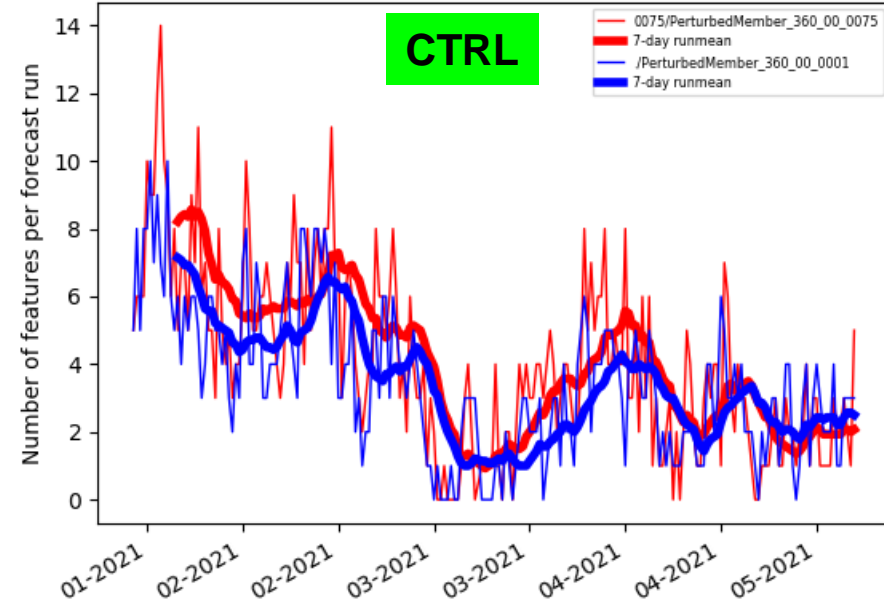Number of Tropical Storms in the fcst (up to +360h) per cycle

PF#25

CTRL

47r1
47r2

Tropical Cyclones

- More Tropical Cyclones "identified" in 47r2

- Main increase in numbers is for the weaker features (tropical depressions)

- TC numbers have increased slightly more for the PERTURBED forecasts than for the CONTROL

- There is high sensitivity to the cut-off thresholds used to define a disturbance as a TC
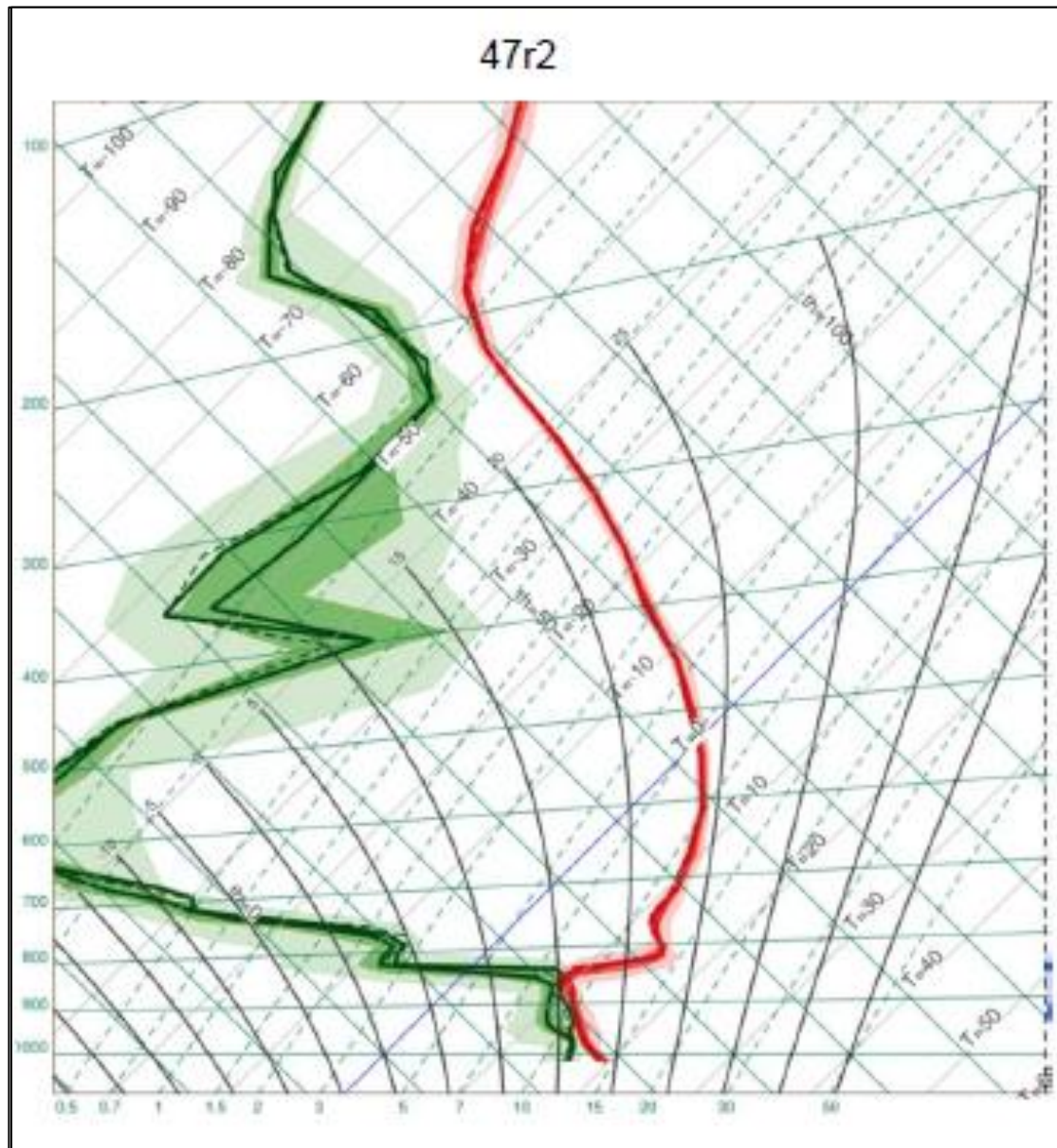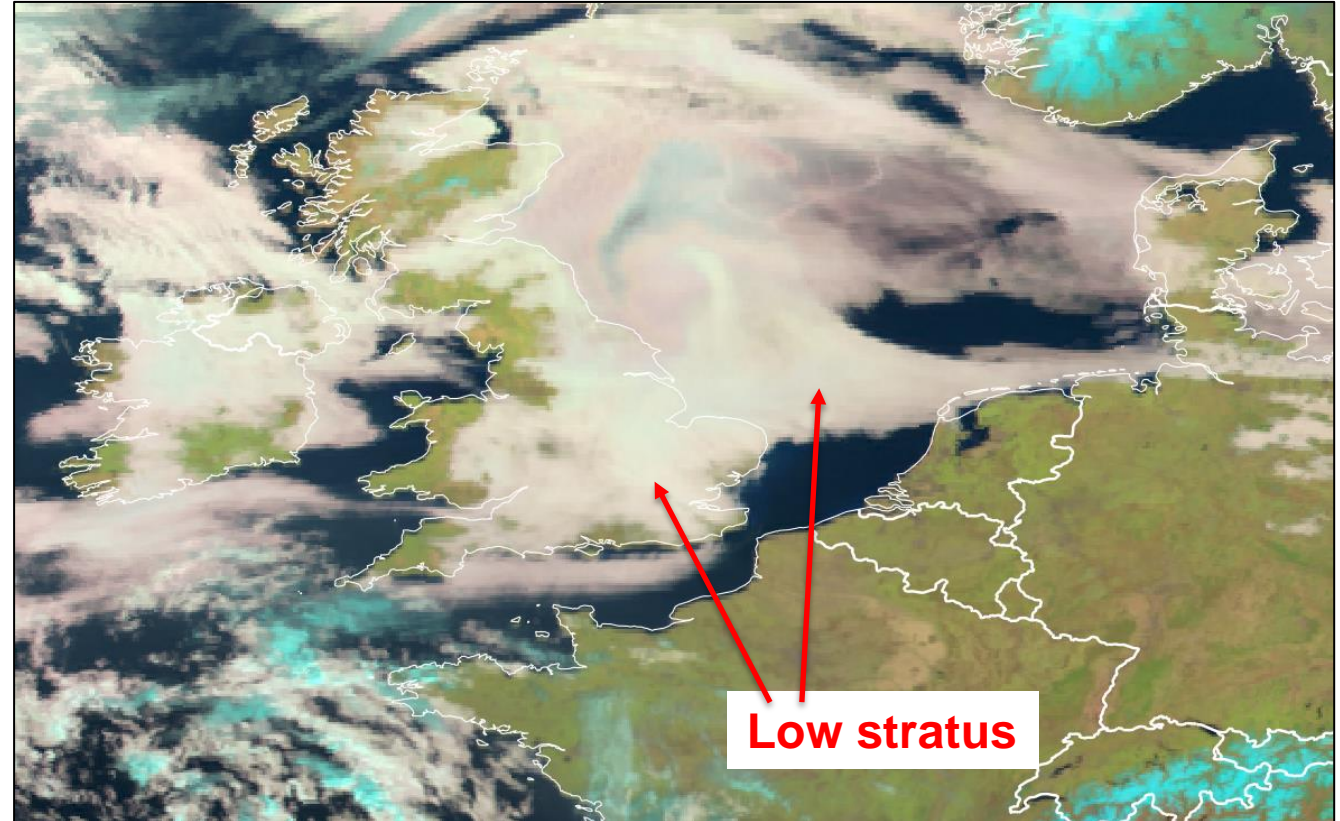
47r2

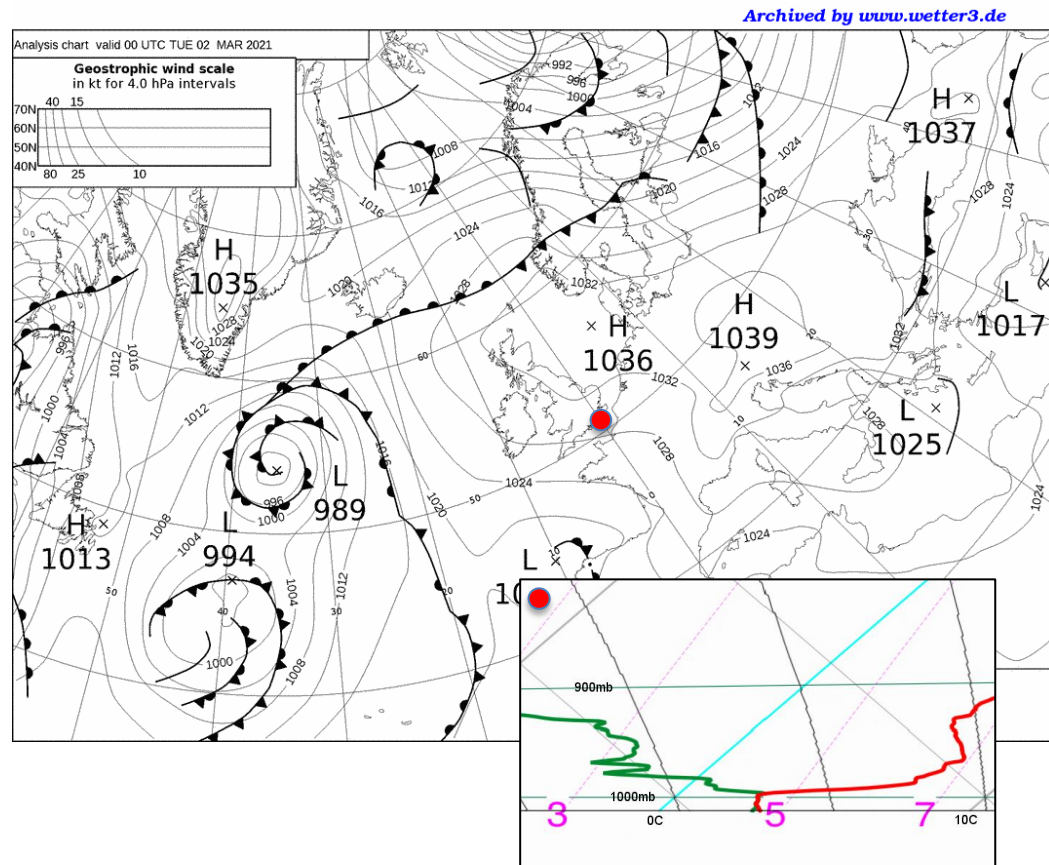Sharper inversions, generally, in new cycle

Site shown is at 20S 90W, 60h lead

Some benefits, notably near inversion level..

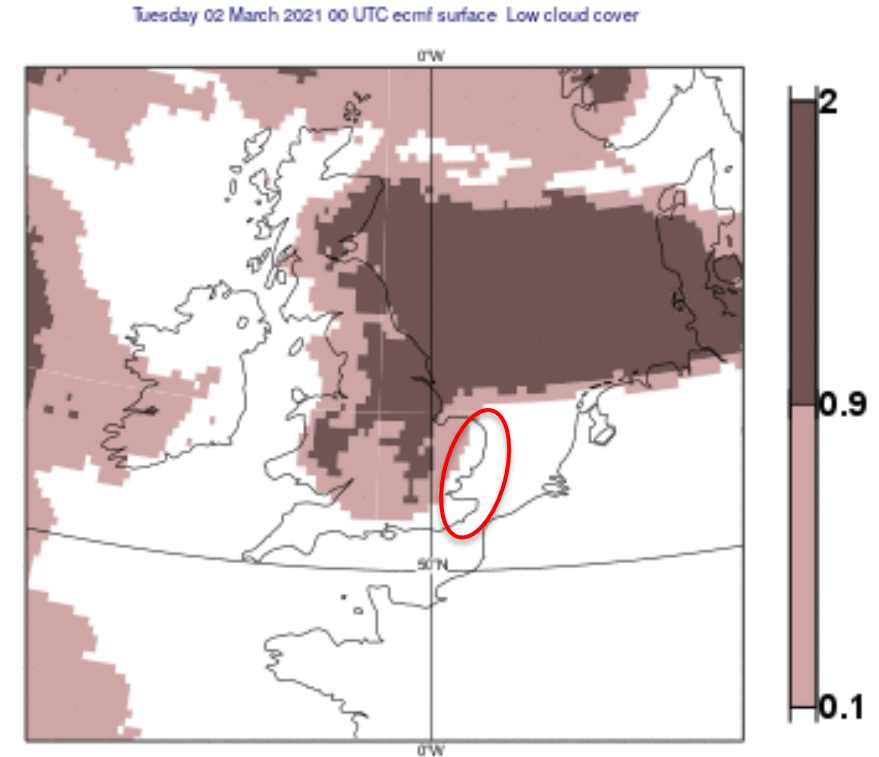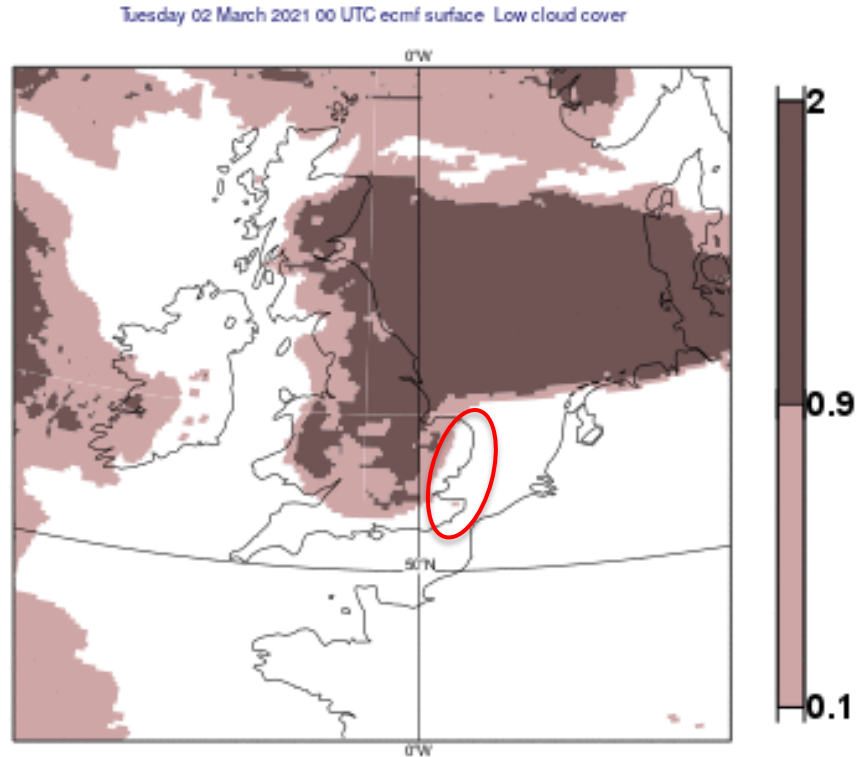- But will problematic low cloud cases be better represented in the new ENS ?

Archived by www.wetter3.de

Analysis chart valid 00 UTC TUE 02 MAR 2021

Geostrophic wind scale
in kt for 4.0 hPa intervals

Low stratus

ECMWF
EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS

137 levels (as in 47r2)   **91** levels (as in 47r1)

Tuesday 02 March 2021 00 UTC ecmf surface Low cloud cover

Tuesday 02 March 2021 00 UTC ecmf surface Low cloud cover

Systematic error in this synoptic set up – insufficient low cloud inside red ellipse (+other areas)

No evidence (from detailed investigation of this case) of any positive benefit of having more levels

Summary

- Purely as a result of an increase in the number of vertical levels in cycle 47r2, certain distributional characteristics of the ENS have changed:

  – More CAPE (over land)

  – More lightning

  – More heavy rainfall

  – More TCs

  – Sharper inversions

- This list is by no means exhaustive

- Sharper inversions are probably better (though problematic low cloud cases may not have improved), but for the other parameters it is not completely clear whether these changes are improvements

- However, the ENS should now be more consistent with HRES

- We don't have complete explanations for all these changes

- Recall also that standard surface weather and upper level skill scores for the ENS are notably better for 47r2 than for 47r1
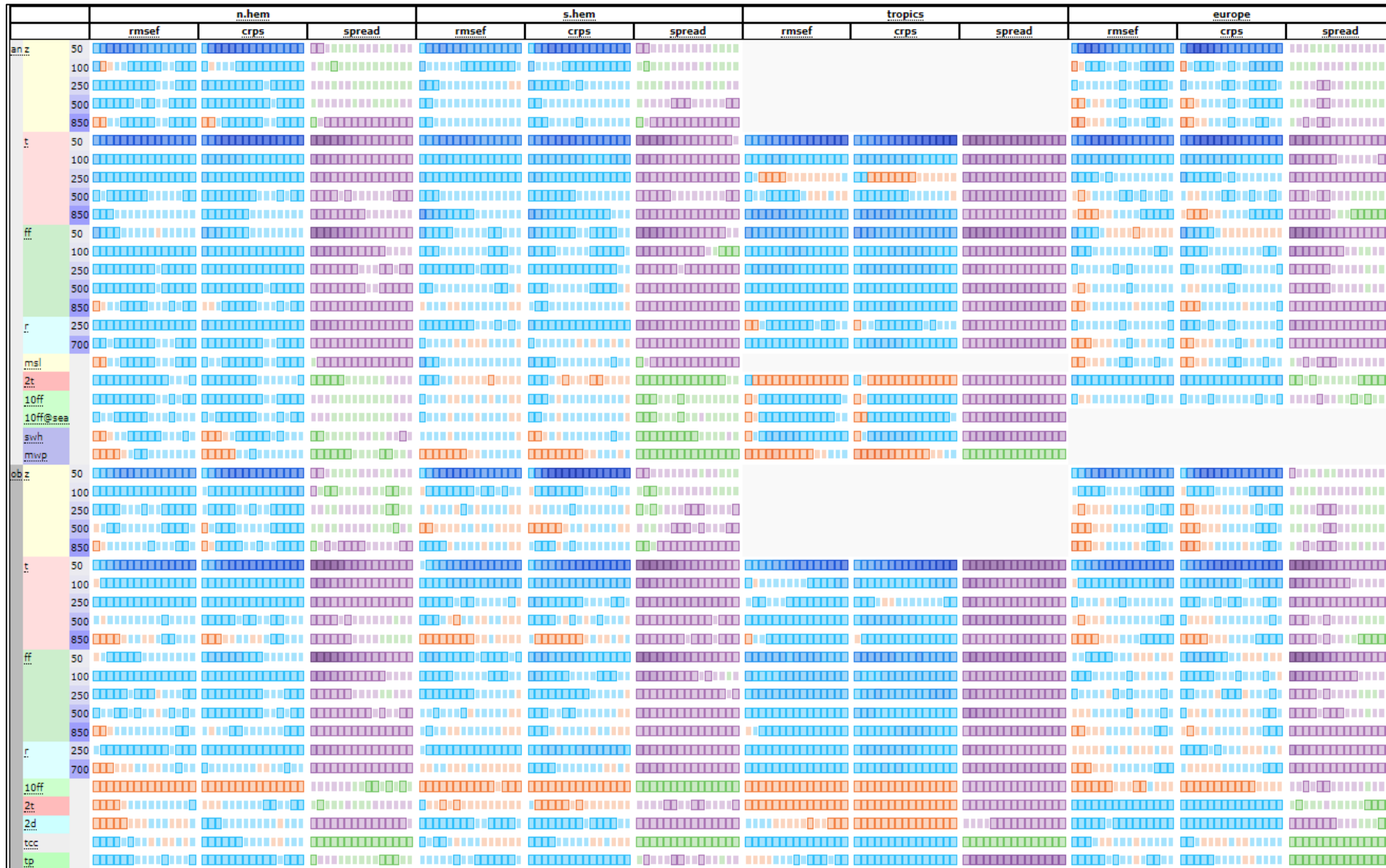
ENS scorecard

47r2 vs 47r1

Blue and Purple
mean 47r2
Is better