A new user-focused Approach for displaying Extended Range forecast maps

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ECMWF

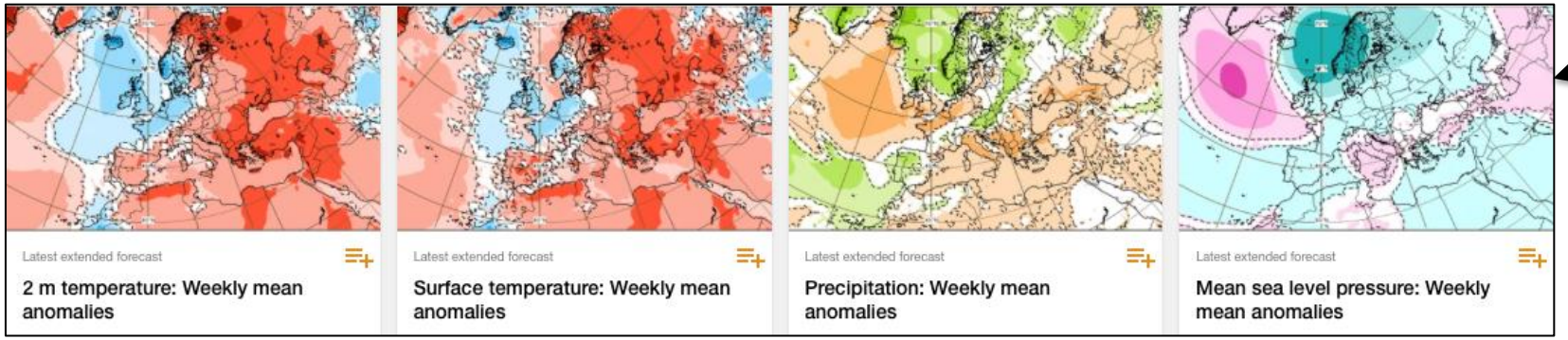
Structure of Talk

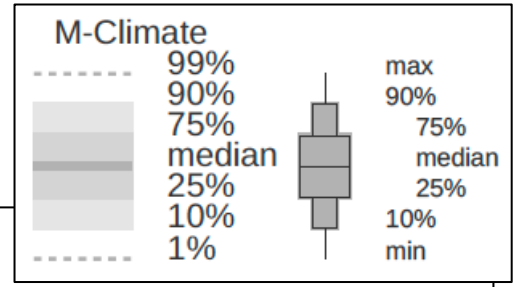
- Motivation and Limitations of current products
- Aim of new products
- Design considerations
- Examples for different variables
- Some technical aspects
- Summary

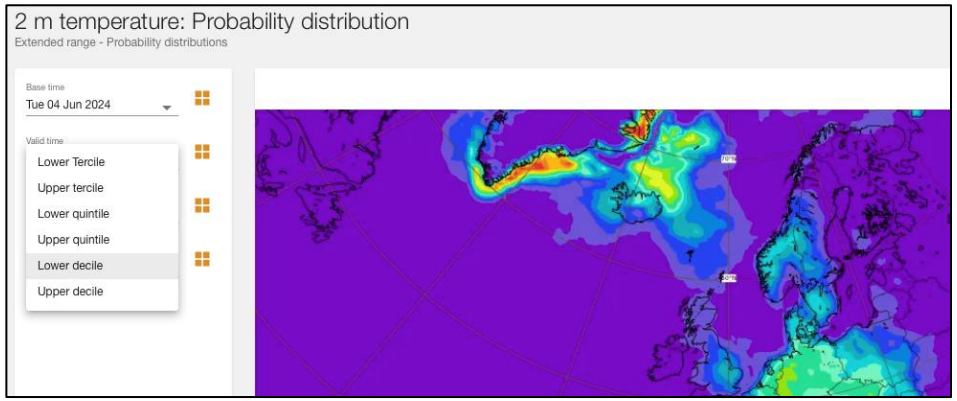
Motivation

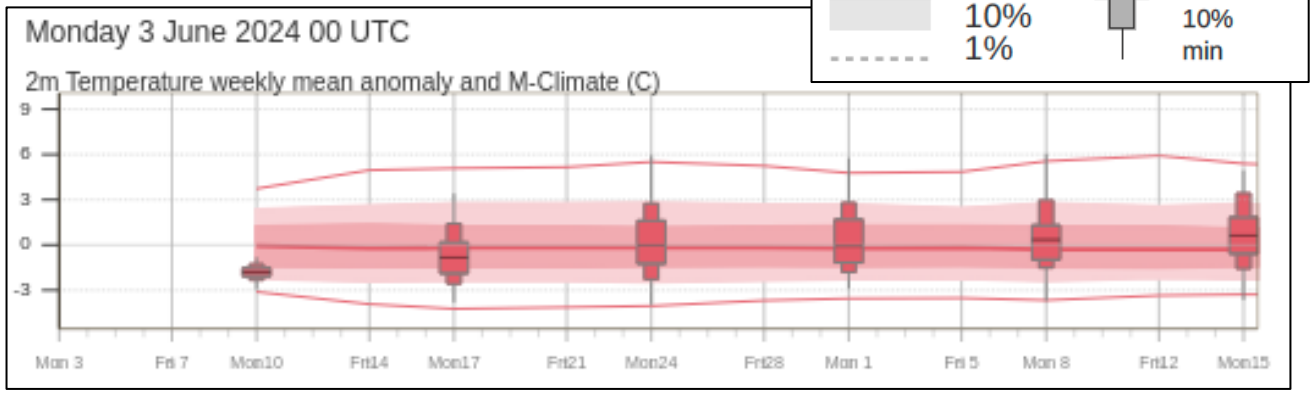
- Currently ECMWF provides a range of Extended Range (XR) forecast products…
  - But do they convey the information that the XR-ENS provides, and that users (*probably*) need ?
  - In a compact and easy-to-understand format ?

Most used products for overall spatial picture?





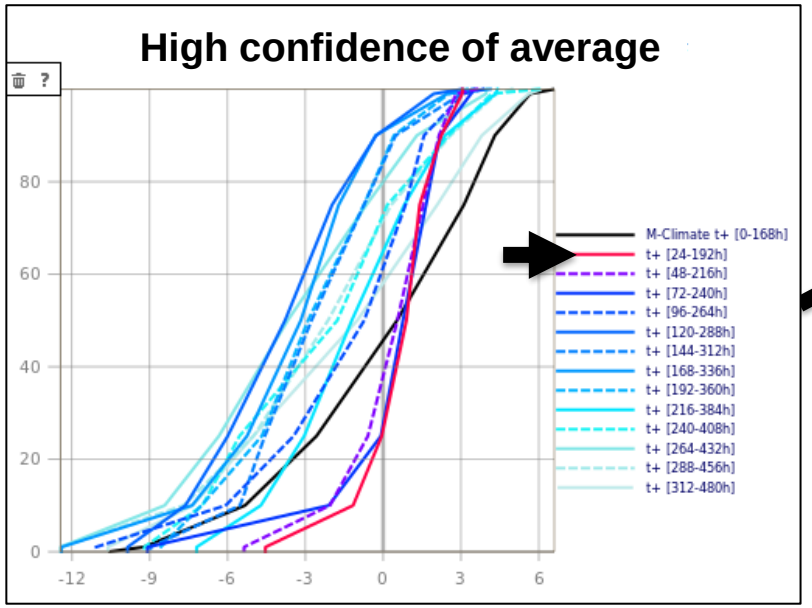


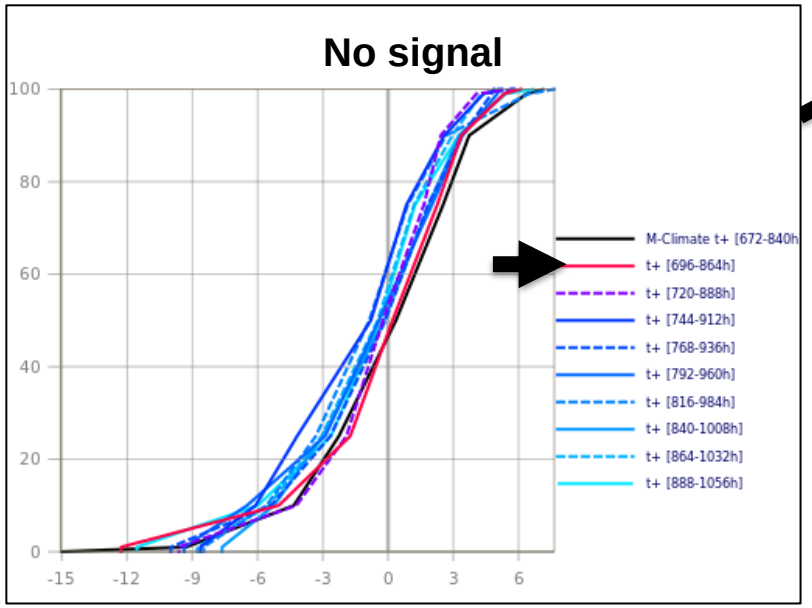


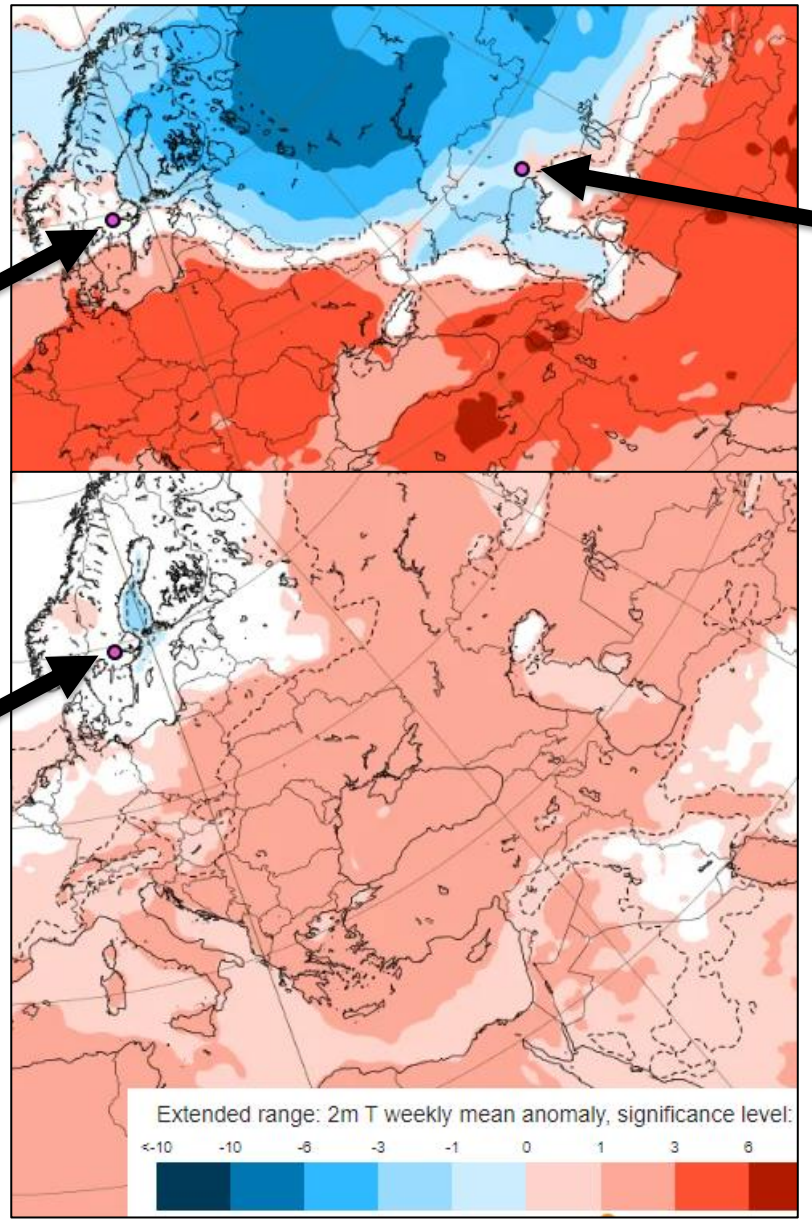
Motivation

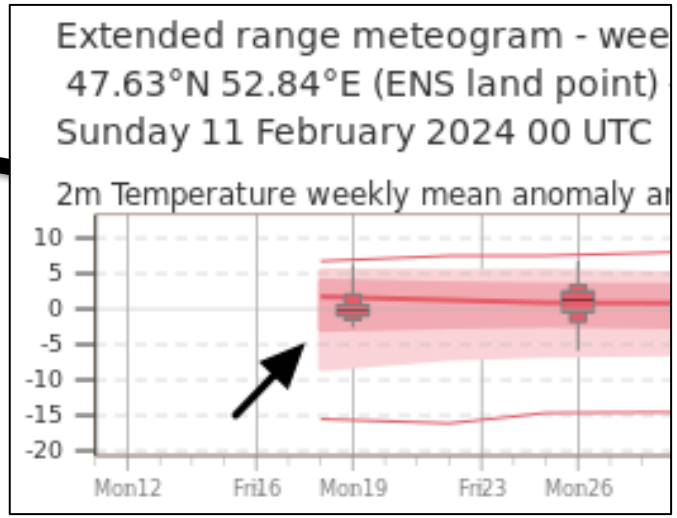
- Map charts have a significance test applied (Wilcoxon-Mann-Whitney), which, in broad terms, relates to the difference in *medians*
  - Yet the chart shows *mean* anomaly. This leads to strange patterns, with scope for misinterpretation

- Example follows…









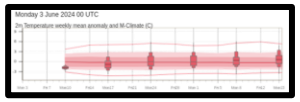
Various product issues

- Why is red and blue shading sometimes but not always adjacent ?
- Caspian point: high confidence of below median, but mean anomaly nil
- What does “white” mean ?

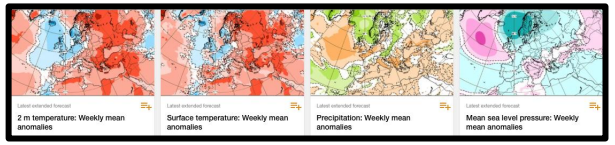
User question on products training course – we did not answer this very well !

Motivation

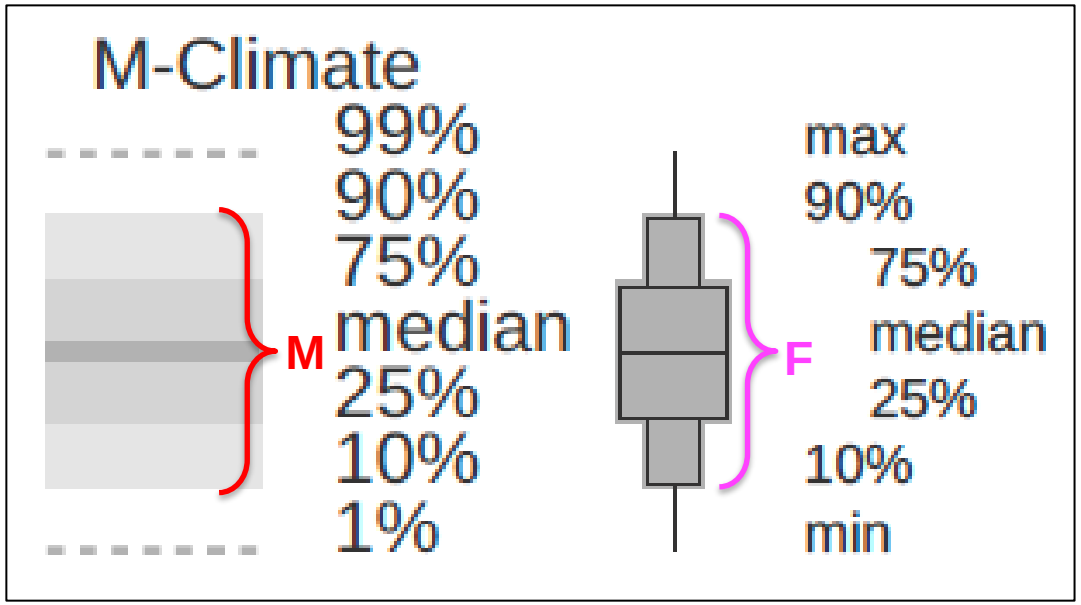
- The Meteogram provides comprehensive information, but only for a point:
  - **Comparing** model climate and forecast distributions, in anomaly space



- Map charts of mean anomaly are widely used, but could they do more ?:
  - Correcting the significance test issue
  - Providing spread information, in relative terms



Alternative Approach



Create a map product that shows:

1. Median values compared, AND
2. A measure of the spread in the forecast distribution relative to the model climate

(1) is straightforward: $F_{median} - C_{median}$

(2) Quantile range ***ratios*** ? from :

- Interquartile range (too limiting)
- Max - min (too noisy)
- Interdecile range : F / M
  - More stable now we have 100 members

Design Considerations

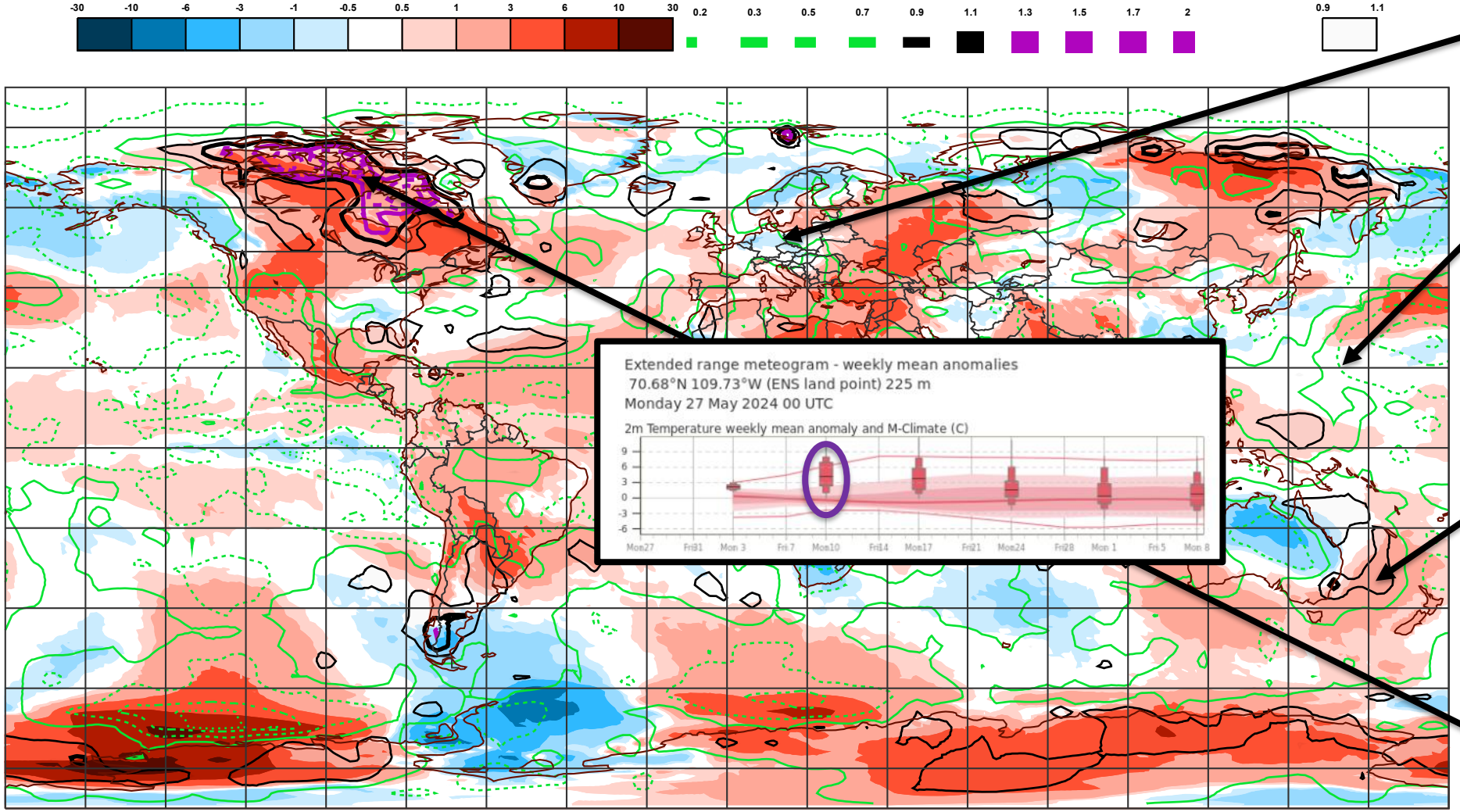
- Want the main feature to be the anomaly
- Good to retain some consistency with pre-existing products (colours for colour fill map, ranges etc.)
- Maybe drop the significance test ?
  - Currently misleading
  - Even if correctly applied, scope for misuse is high (e.g. 90% significance = 90% confidence in forecast!)
  - Retain white for small anomalies – define what small is for each parameter
- Then overlay anomaly colour-fill map with contours showing spread metric (interdecile range ratio = IDRR)
- Need modest highlighting for normal (no signal) IDRR values (~1): heavily transparent grey shading
  - Bounded by black contours
- Need clear but unobtrusive signal of where IDRR < 1: green contours = strong “small spread” signal => go!
- Need eyecatching signal of where IDRR > 1: purple contours = unusually large spread => beware!
- Use different line styles for different IDR values; also thicker for IDRR > 1, thin for IDRR < 1
- IDRR colours carefully selected to work with pre-existing anomaly shades

Lots of experimentation to achieve useable charts !

Example Outputs

- For 2m temperature
- For MSLP
- For 7-day precipitation
  - F/M replaced by F/(M + δ) to avoid division by zero in arid climates

2m temperature week 2



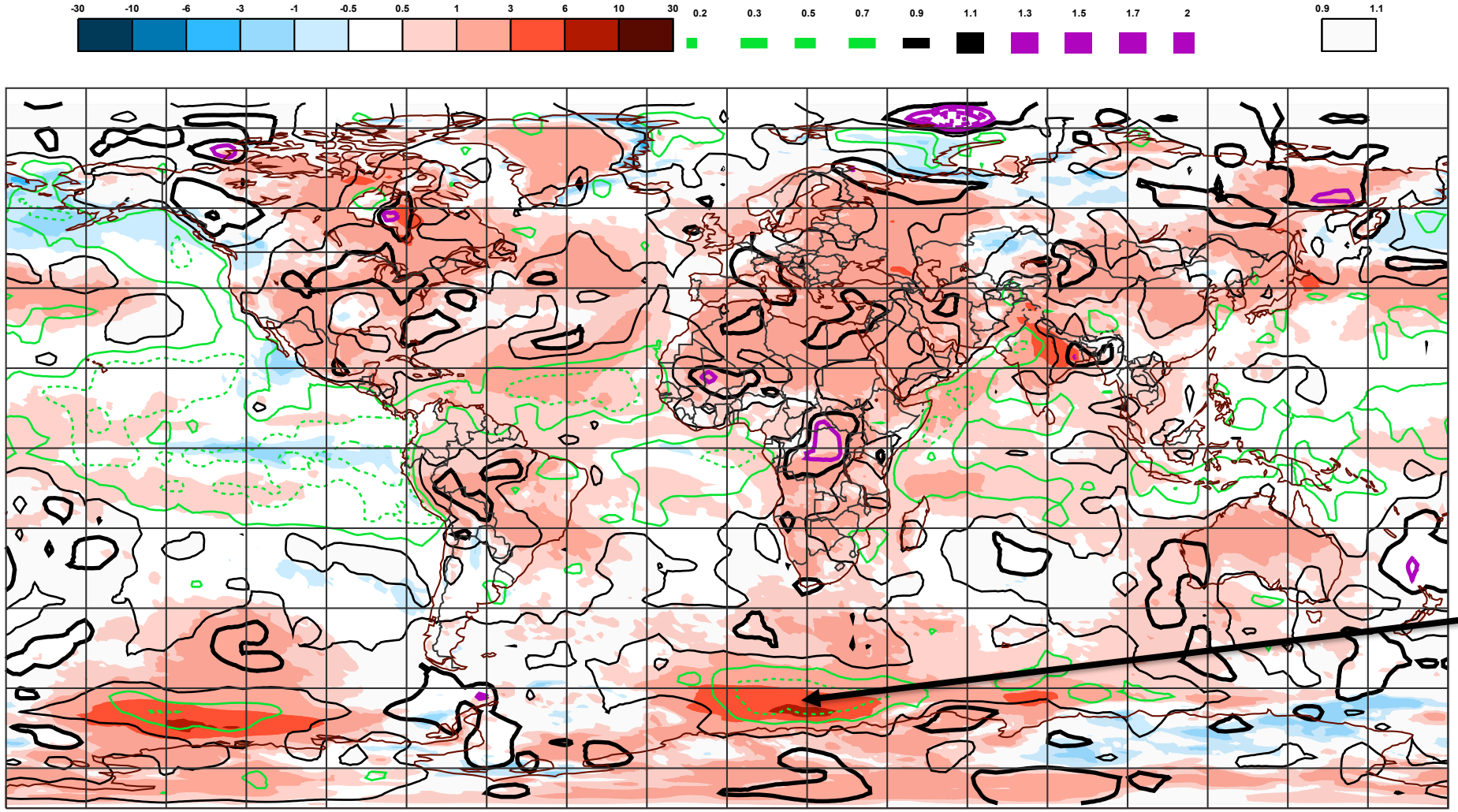
Green contours = relatively small spread - anomaly believable

IDRR = 0.5 & white background = small anomalies likely

Warm signal, but IDRR ~1 (grey shading) so average climatological spread

Very warm signal, but IDRR~1.5 (purple shading) so very uncertain (wrt climatology)

2m temperature week 4

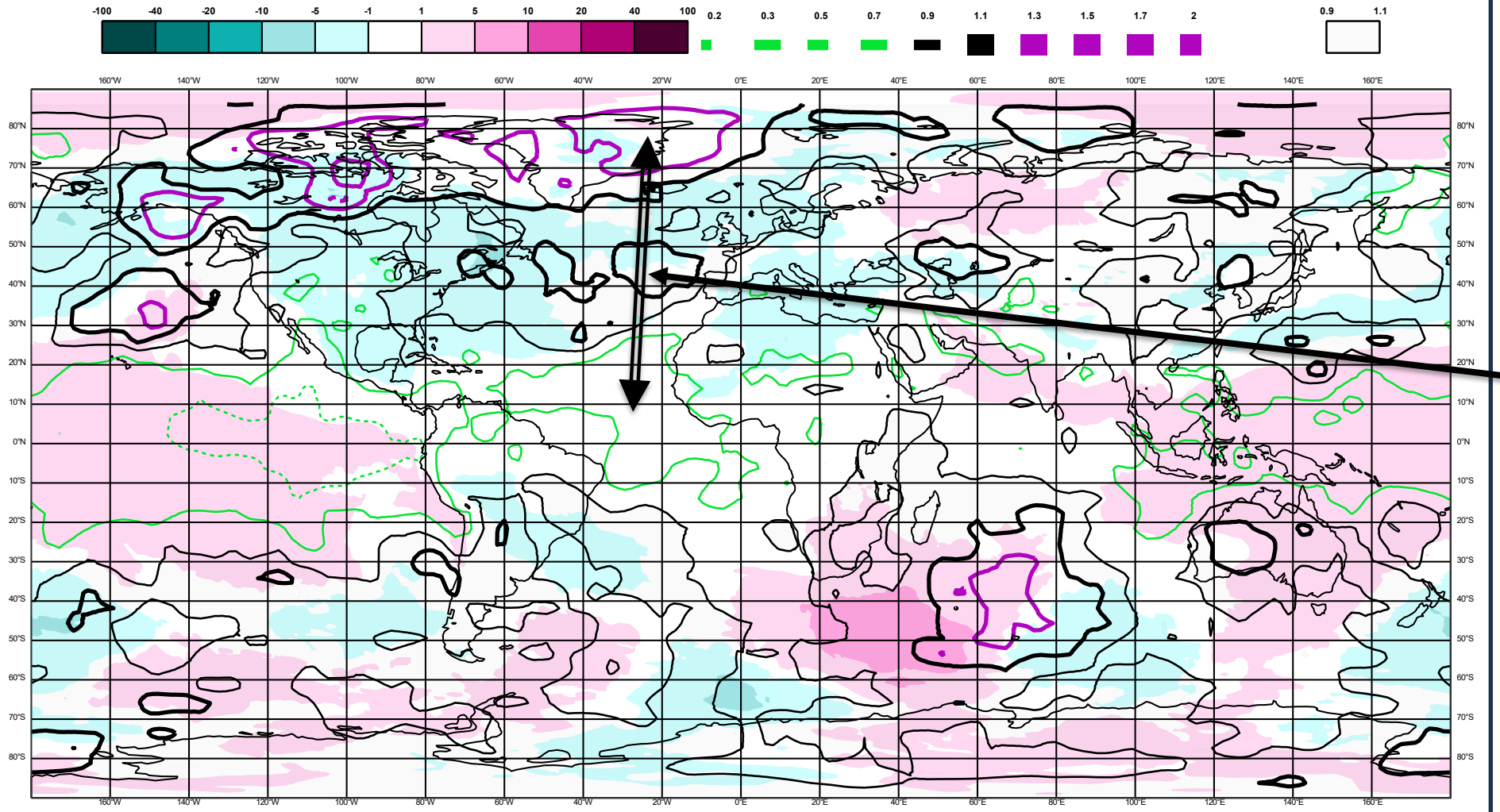


More black contours and more grey shading at longer leads

=> spread is often climatological

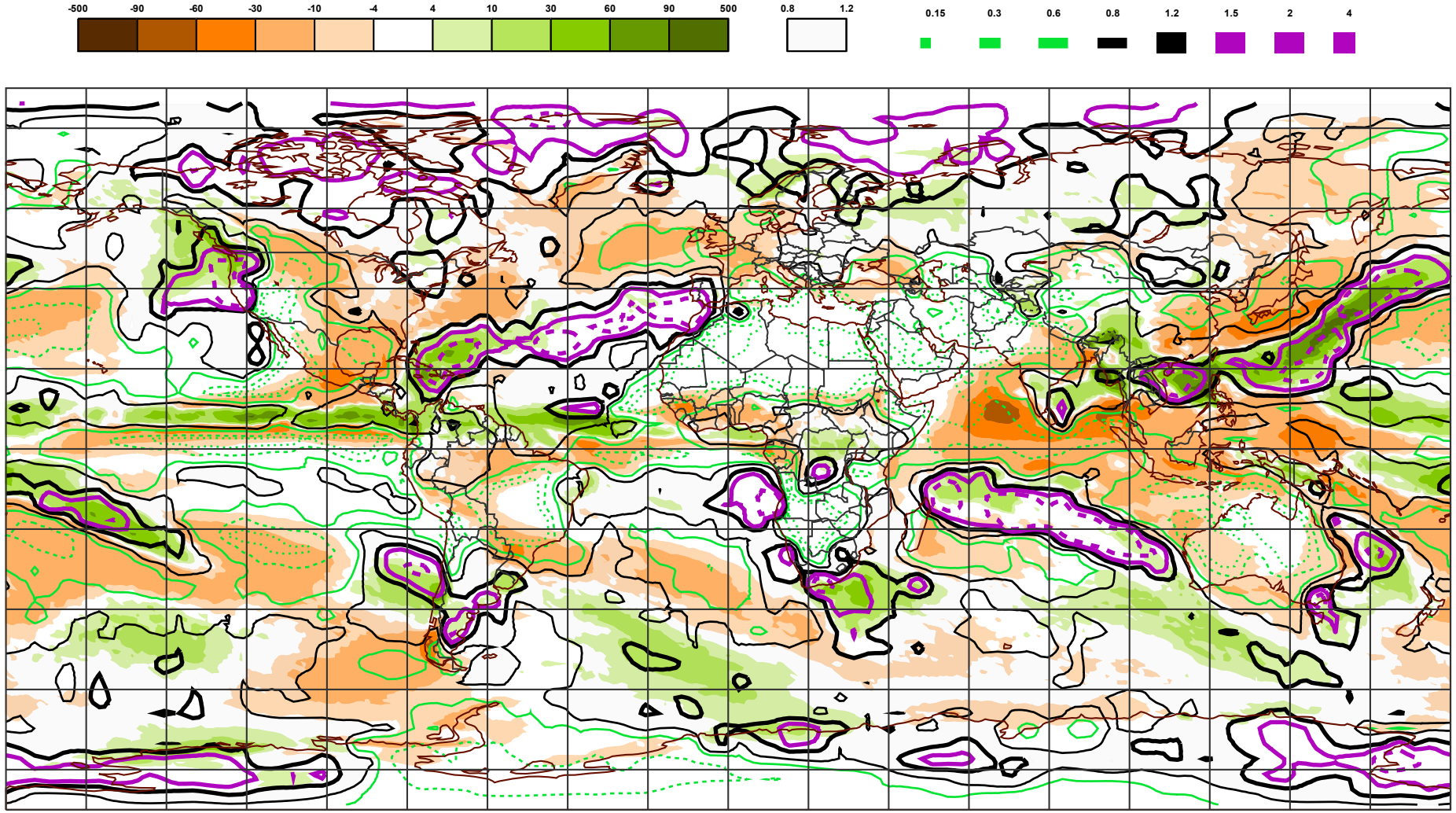
Strong “high confidence” signal for “very warm” retained here for some reason (lack of sea ice?)

MSLP week 3

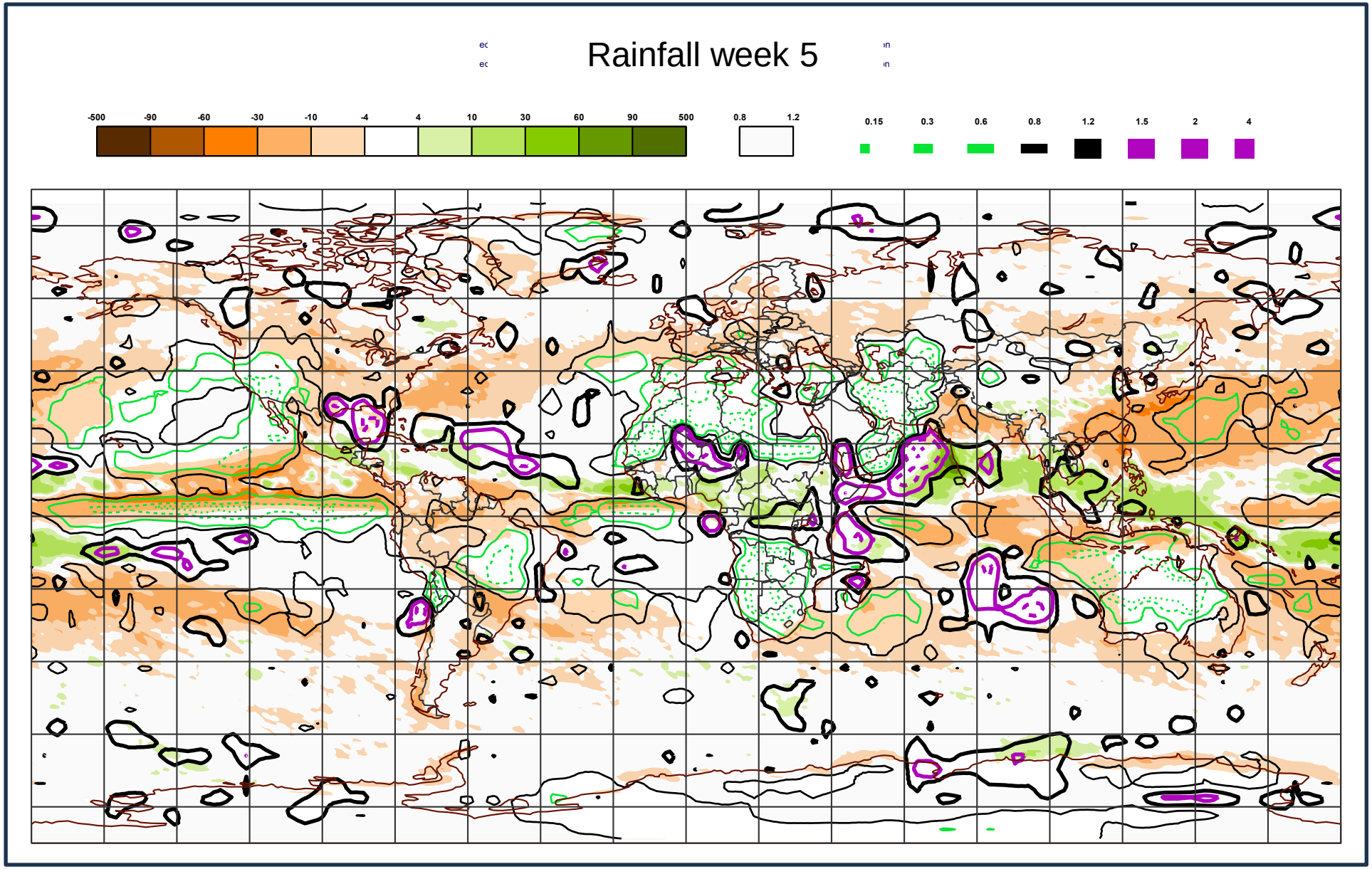


Increasing uncertainty (relative to climatology) going from tropics to extratropics; with slightly lower pressure favoured

Rainfall week 2

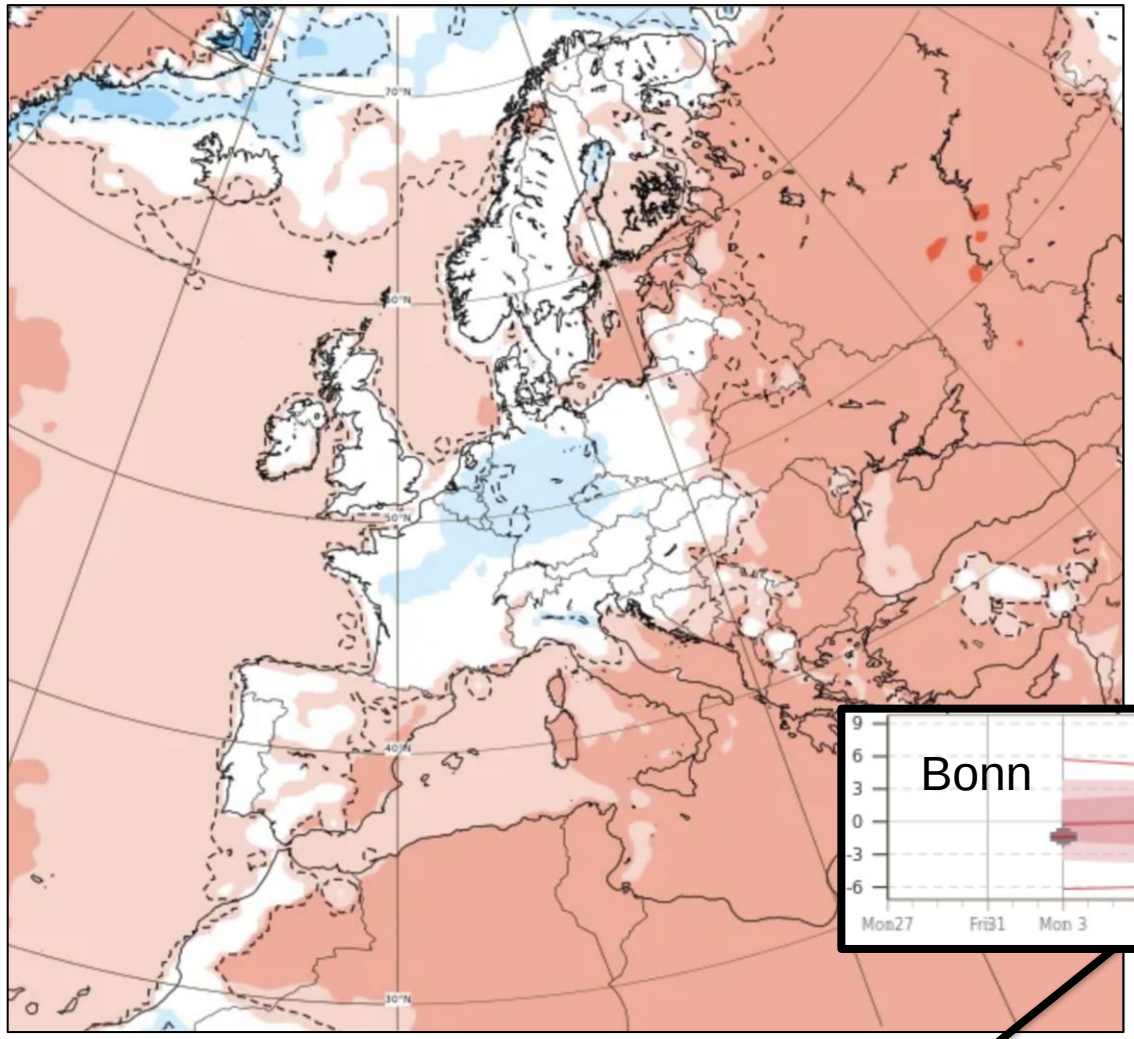


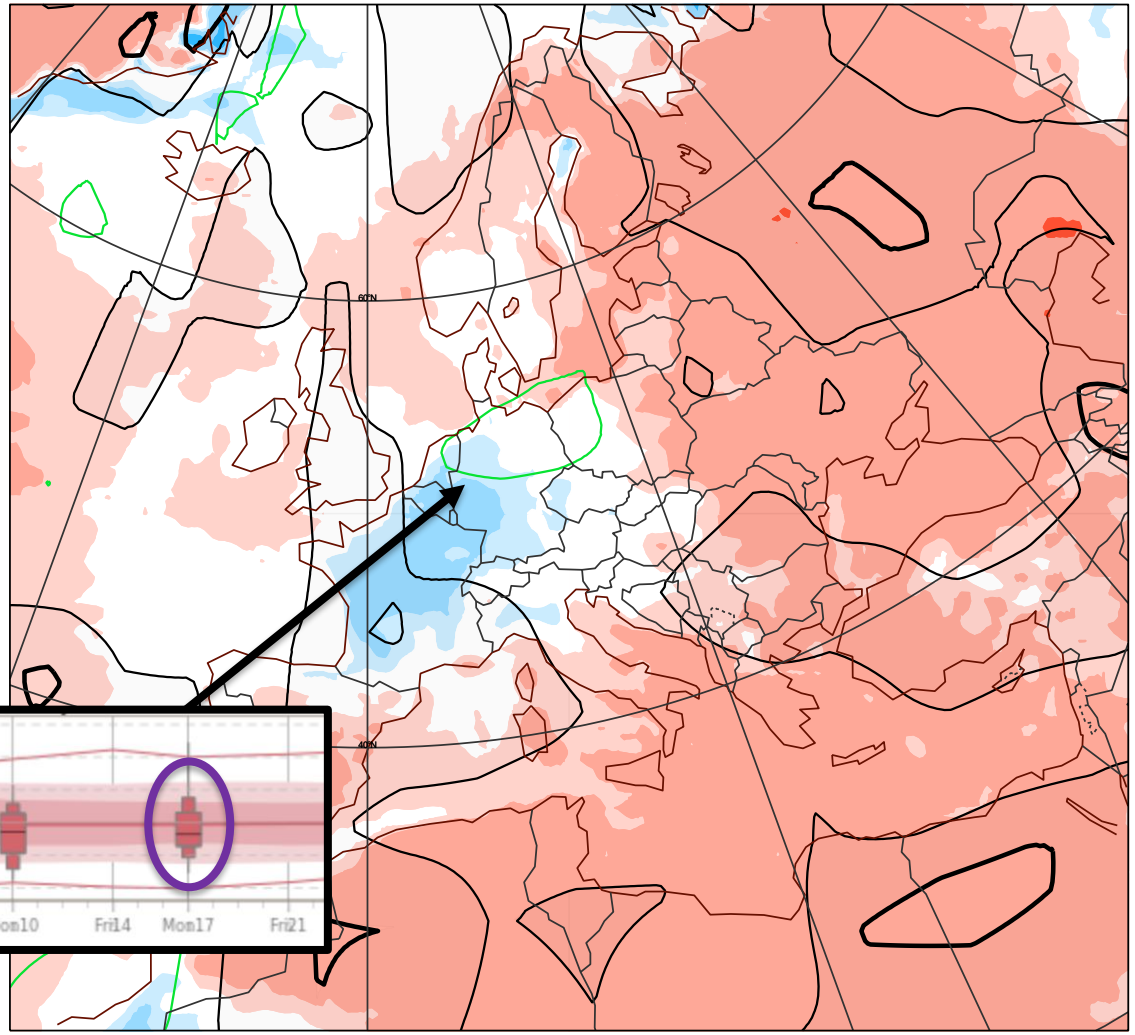
Wetter anomalies tend to be more uncertain, by this metric (by design), but not always.
And vice versa.

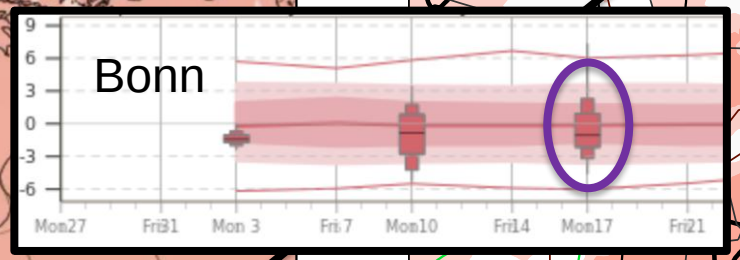


Choice of white range (here -4 to +4mm) has quite a big impact on shading

Two Technical Aspects





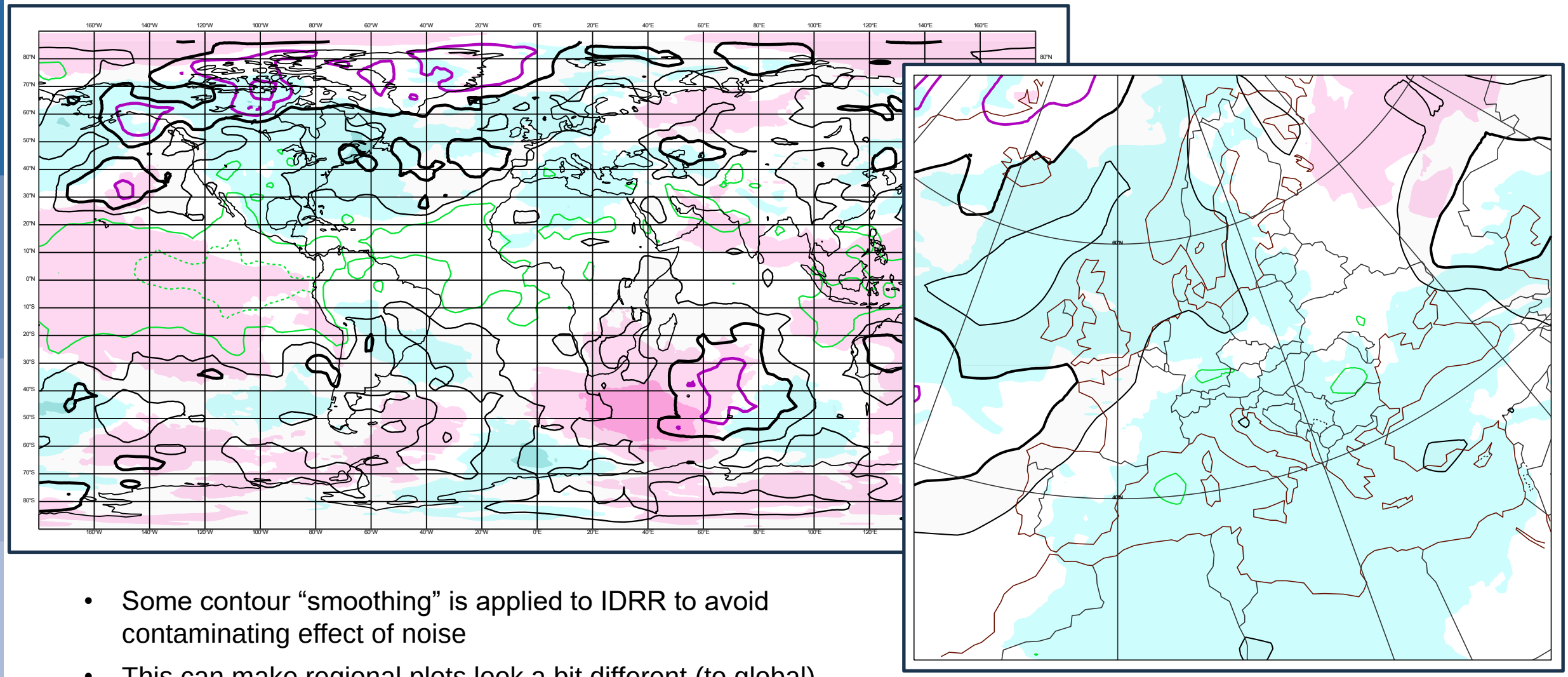


Old style

Proposed style

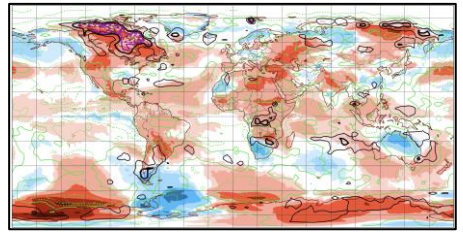
Higher confidence not apparent with old style

- Median here makes France look colder (vs mean to left)
- Could retain use of mean anomaly – a moot point



- Some contour “smoothing” is applied to IDRR to avoid contaminating effect of noise
- This can make regional plots look a bit different (to global)
- This effect is nothing new for ECMWF charts, though the impact here is a bit bigger than normal

Summary



- New product structure proposed for extended range anomaly maps
  - Main aim is to better exploit the XR ensemble information content, for the benefit of users (such as forecasters)
  - Good to dispose of problematic significance tests used on current charts
- Aim would be to include these new charts in OpenCharts, whilst retaining the old style too (for now at least)
  - Then the user can choose !
  - But of course depends also on the views of users
- Further tweaks needed to appearance (notably legends – messy in metview!)
- White zone limits could also be changed
  - Still helpful to retain a white zone though, for near normal
- Can also provide interesting insights into model behaviour (e.g. cryospheric impacts in a changing climate)
- Maybe think also about WMO multi-model S2S web products (SSPMME)…
- **Feedback wanted on all this !**