Ensemble forecast products

Supporting users' decision making

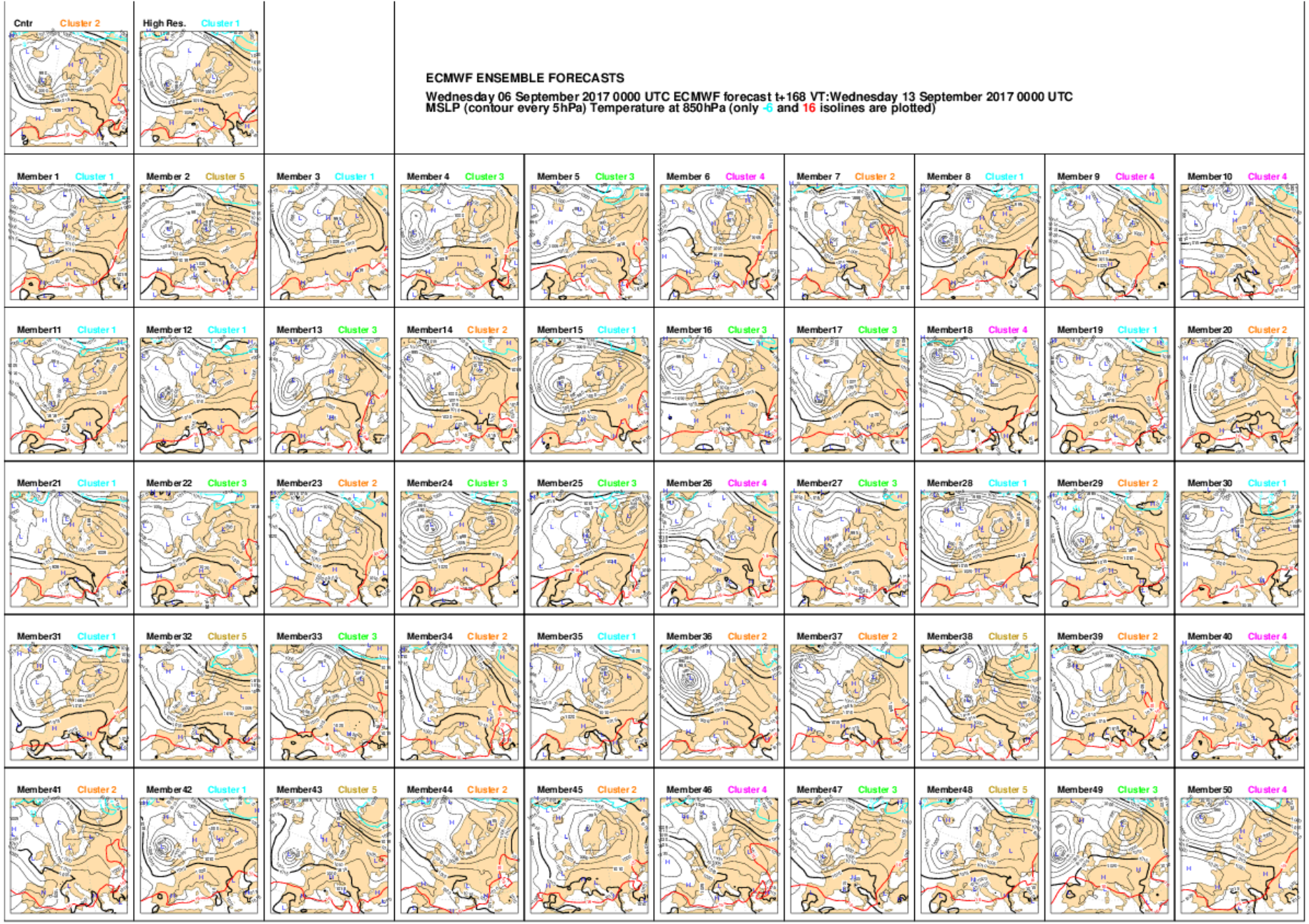
David Richardson

Head of Evaluation, Forecast Department, ECMWF

David.Richardson@ecmwf.int

Thanks to many colleagues (past and present)

ECMWF


Cntr Cluster 2
High Res. Cluster 1
ECMWF ENSEMBLE FORECASTS
Wednesday 06 September 2017 0000 UTC ECMWF forecast t+168 VT:Wednesday 13 September 2017 0000 UTC
MSLP (contour every 5hPa) Temperature at 850hPa (only -6 and 16 isolines are plotted)
Member 1 Cluster 1
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Member25 Cluster 3
Member26 Cluster 4
Member27 Cluster 3
Member28 Cluster 1
Member29 Cluster 2
Member30 Cluster 1
Member31 Cluster 1
Member32 Cluster 5
Member33 Cluster 3
Member34 Cluster 2
Member35 Cluster 1
Member36 Cluster 2
Member37 Cluster 2
Member38 Cluster 5
Member39 Cluster 2
Member40 Cluster 4
Member41 Cluster 2
Member42 Cluster 1
Member43 Cluster 5
Member44 Cluster 2
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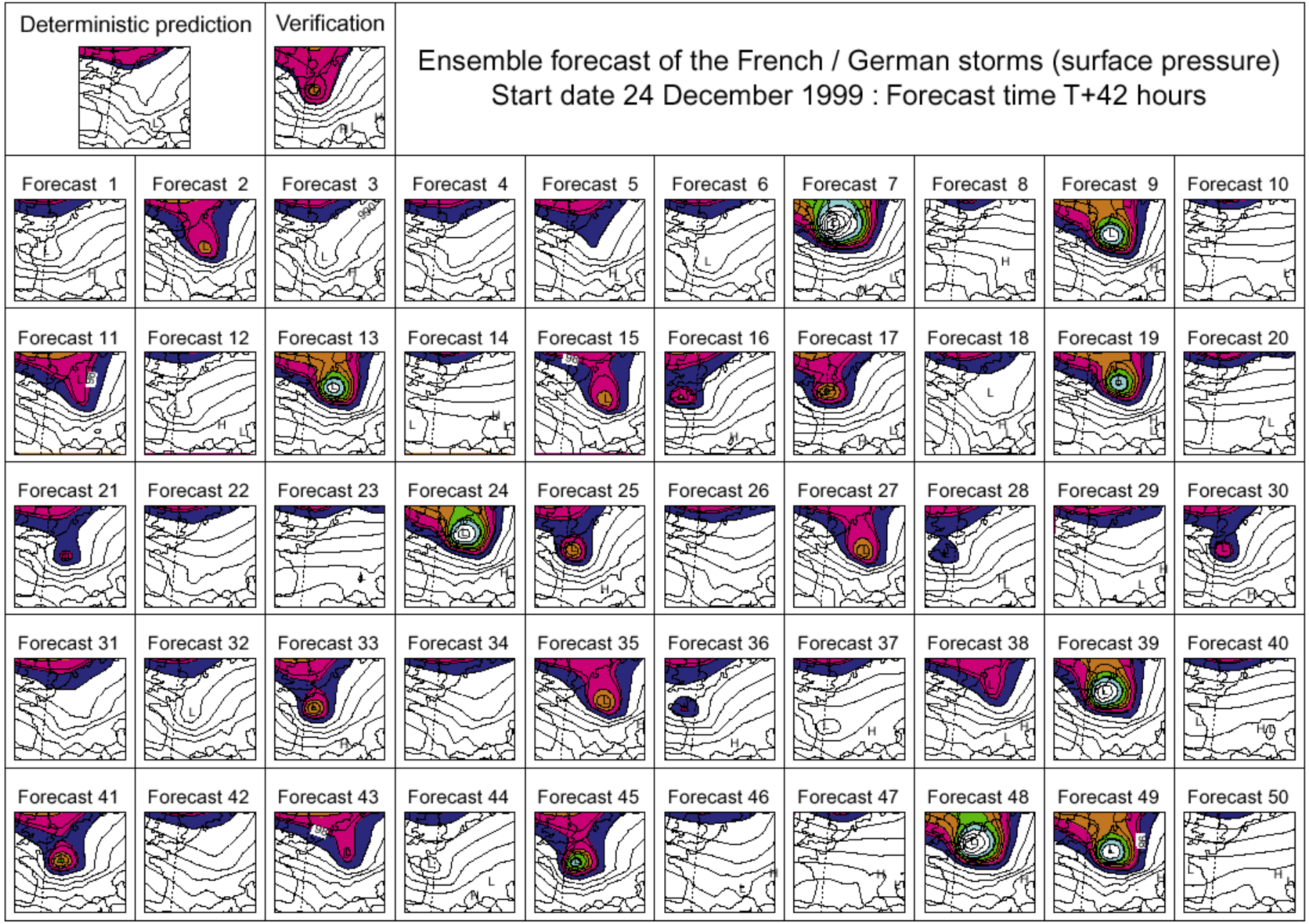
Member46 Cluster 4
Member47 Cluster 3
Member48 Cluster 5
Member49 Cluster 3
Member50 Cluster 4


Deterministic prediction
Verification
Ensemble forecast of the French / German storms (surface pressure)
Start date 24 December 1999 : Forecast time T+42 hours
Forecast 1
Forecast 2
Forecast 3
Forecast 4
Forecast 5
Forecast 6
Forecast 7
Forecast 8
Forecast 9
Forecast 10
Forecast 11
Forecast 12
Forecast 13
Forecast 14
Forecast 15
Forecast 16
Forecast 17
Forecast 18
Forecast 19
Forecast 20
Forecast 21
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Forecast 27
Forecast 28
Forecast 29
Forecast 30
Forecast 31
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Forecast 34
Forecast 35
Forecast 36
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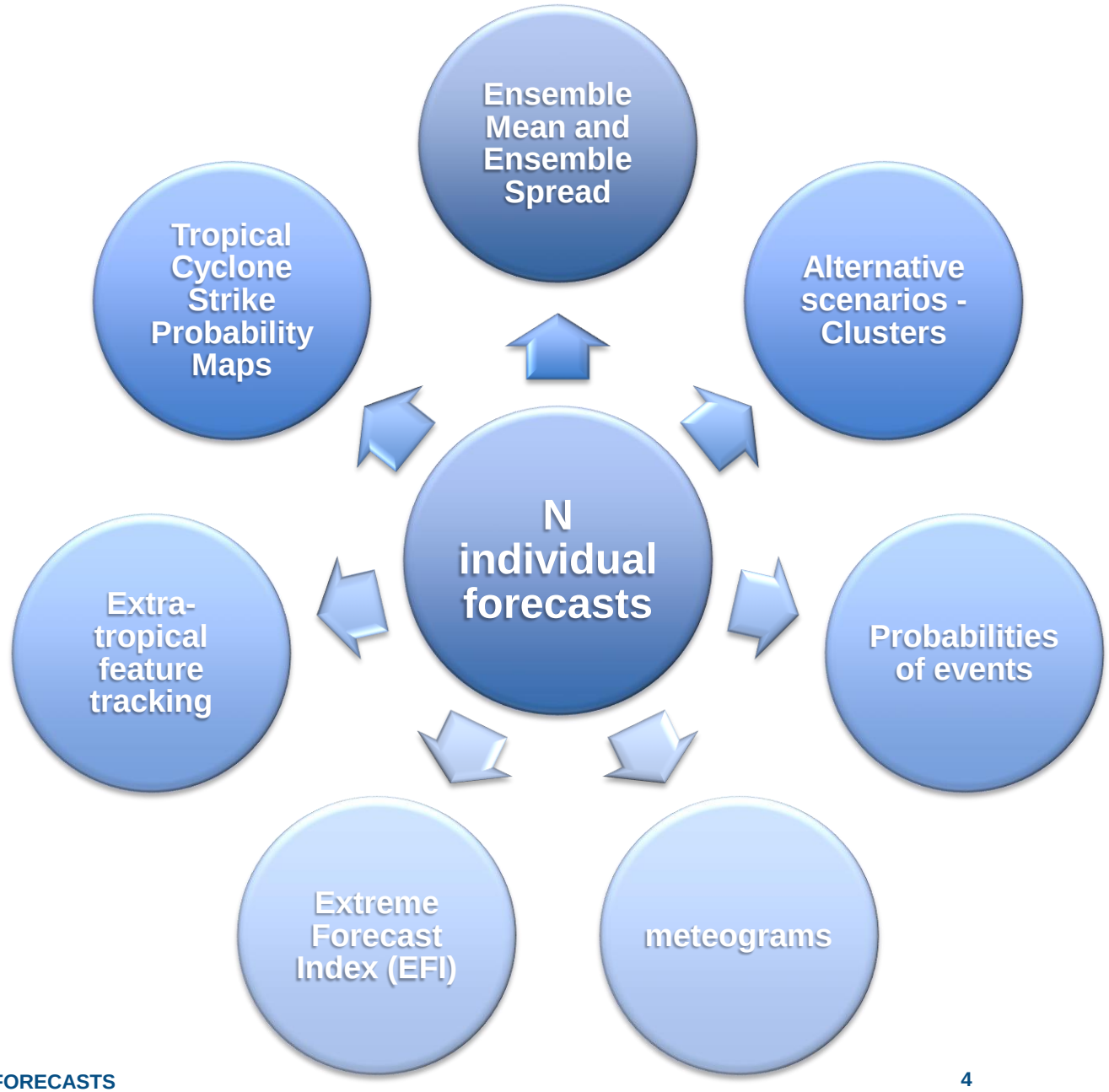
Forecast 39
Forecast 40
Forecast 41
Forecast 42
Forecast 43
Forecast 44
Forecast 45
Forecast 46
Forecast 47
Forecast 48
Forecast 49
Forecast 50

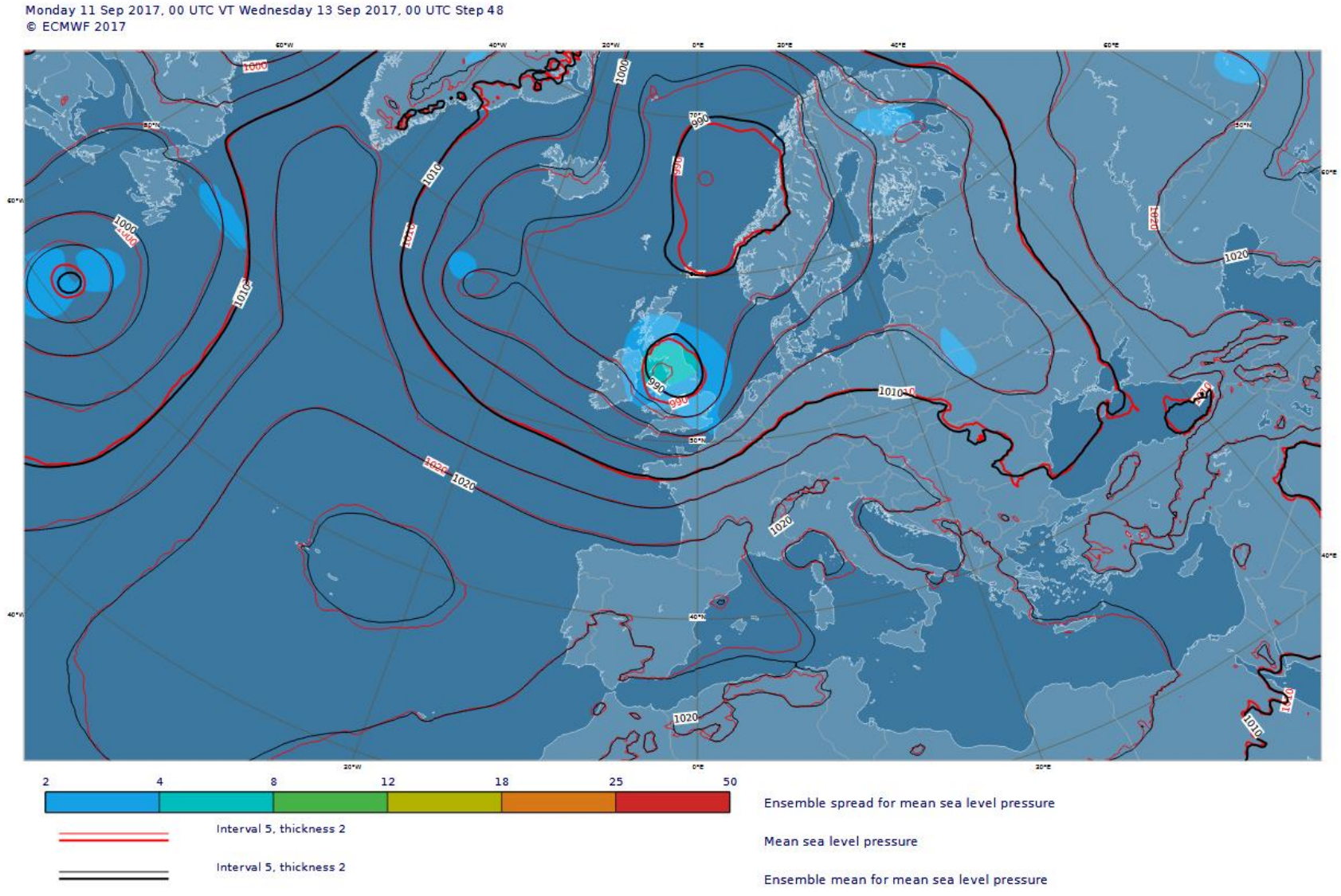
Ensemble forecast products



- To assist operational forecasters
- Users generate their own tailored products for specific applications

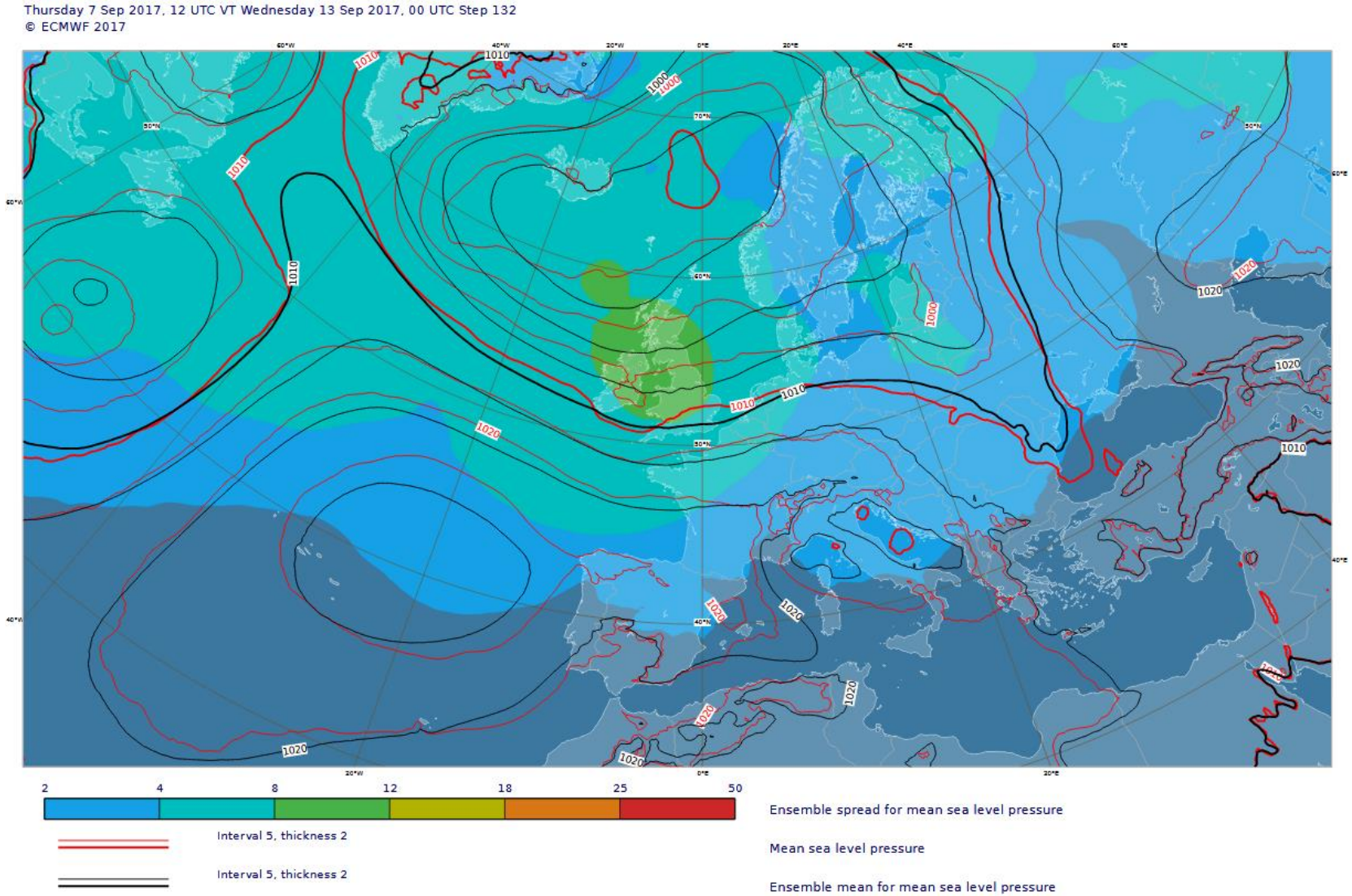
Ensemble mean and spread

Day 2, red = HRES, black=ENS Mean



Ensemble mean and spread

Day 6, red = HRES, black=ENS Mean



Ship routing

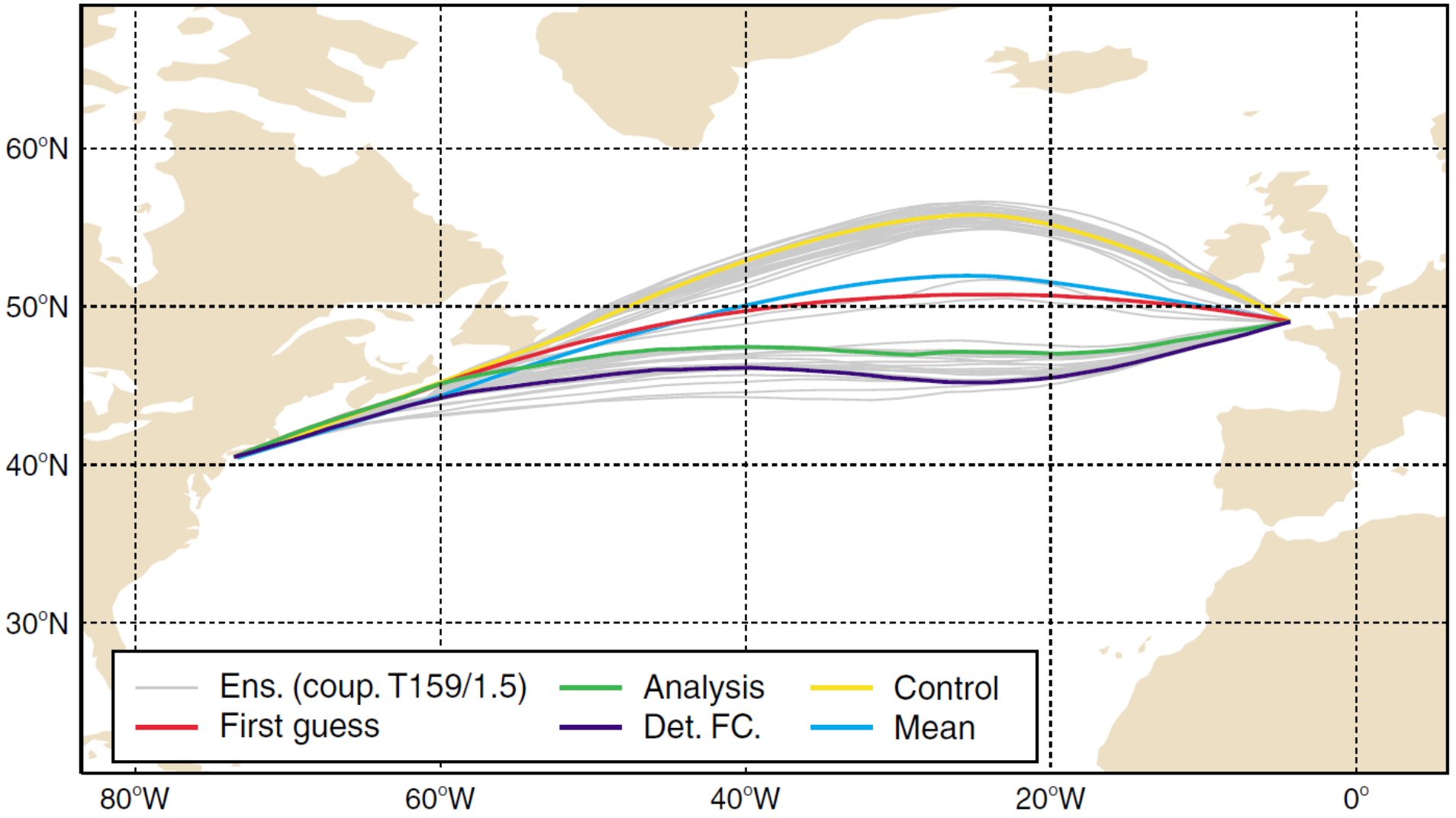
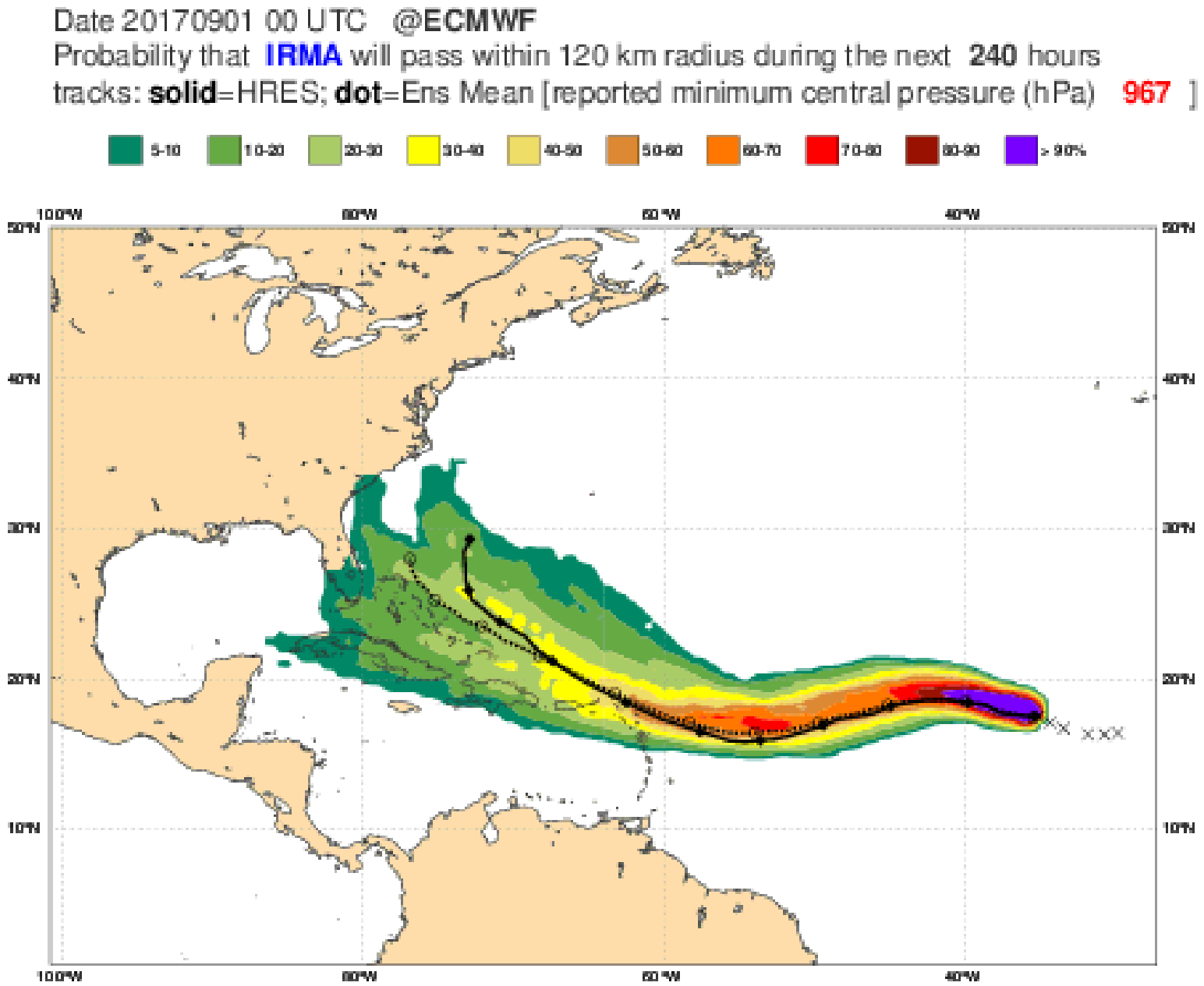


Figure 2: Ship routes for the crossing leaving Brest at 12 UTC 28 February 1999 and arriving in New York at 00 UTC 7 March 1999. Routing either to the north or to the south circumvents a storm centre. The ensemble-mean route method fails to provide an optimum track in these circumstances.

P Janssen,ECMWF Newsletter 85, Autumn 1999


Date 20170901 00 UTC @ECMWF
Probability that IRMA will pass within 120 km radius during the next 240 hours
tracks: solid=HRES; dot=Ens Mean [reported minimum central pressure (hPa) 967]
5-10
10-20
20-30
30-40
40-50
50-60
60-70
70-80
80-90
> 90%
100°W
80°W
60°W
40°W
50°N
40°N
30°N
20°N
10°N

Alternative scenarios - clusters

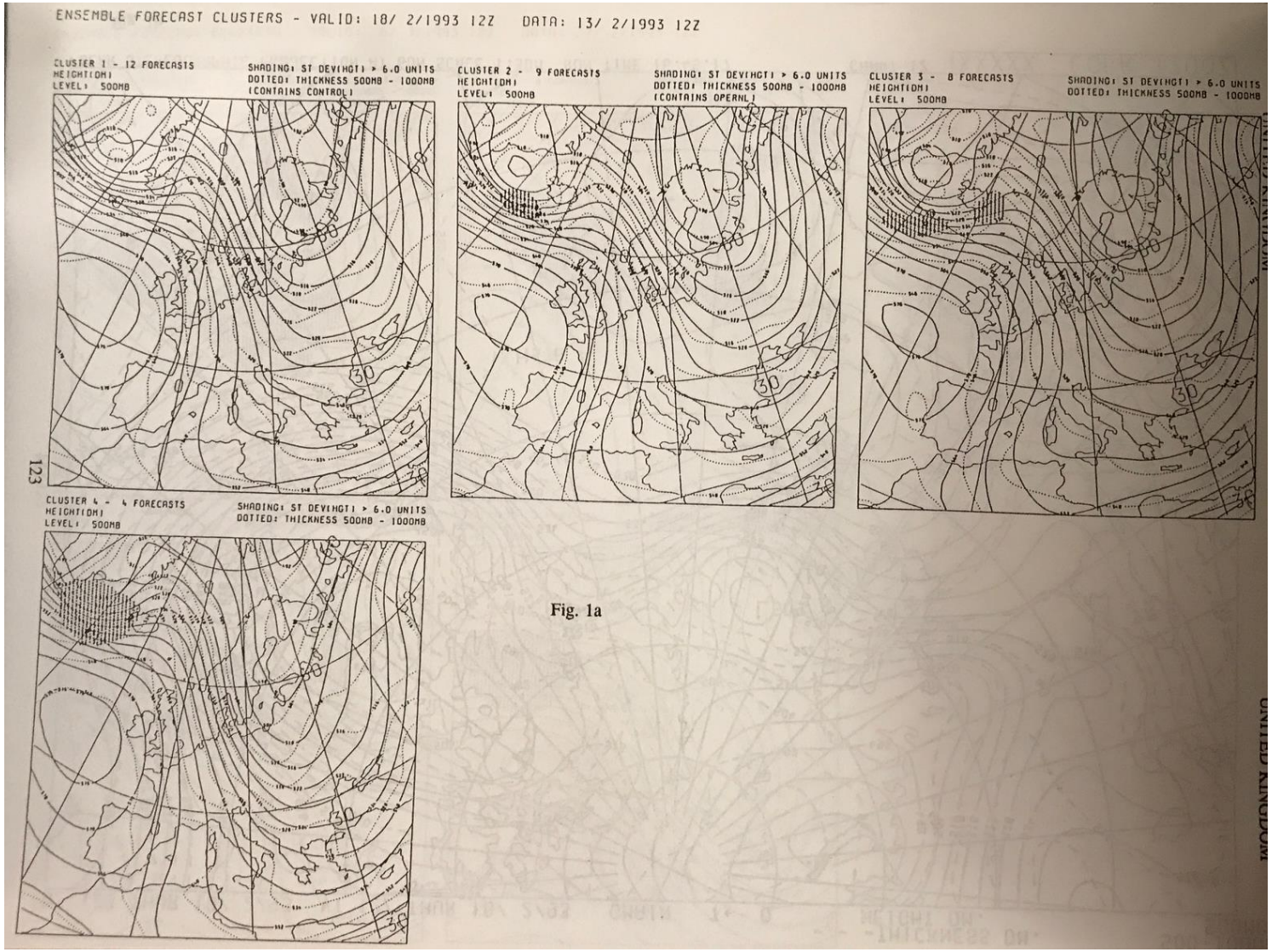
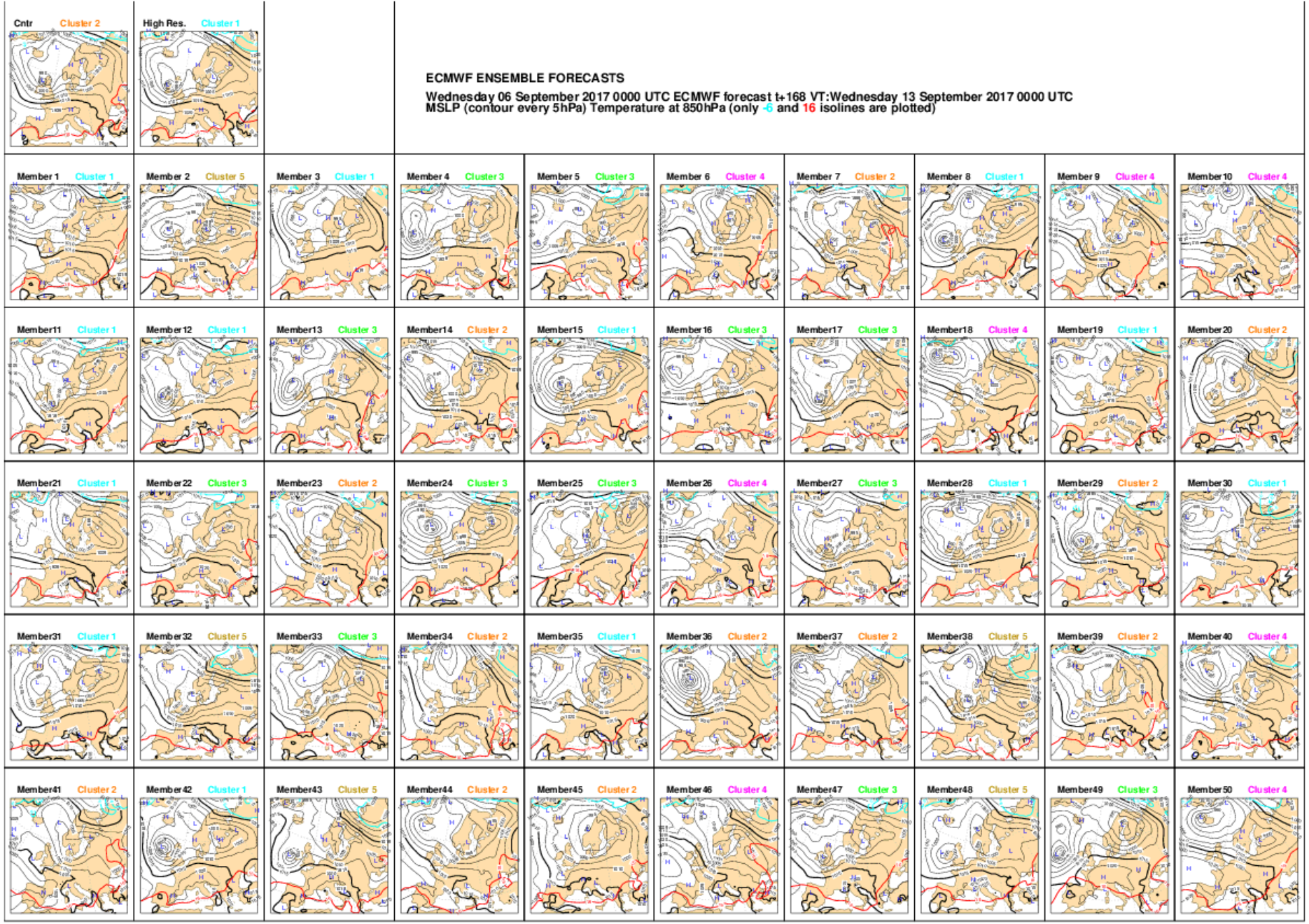


Fig. 1a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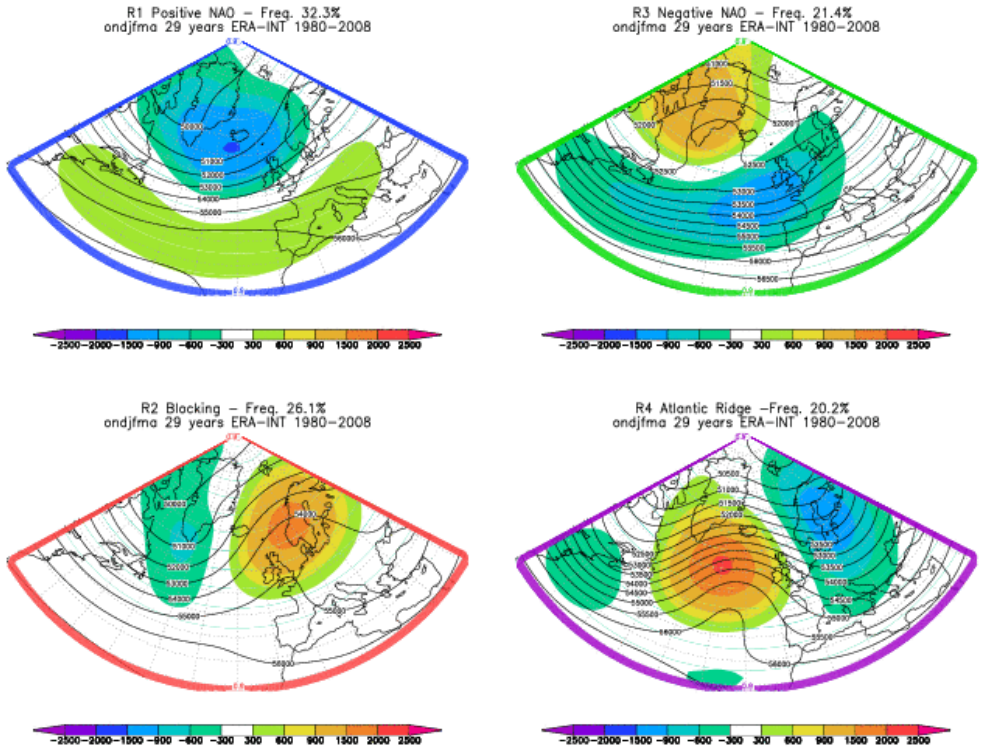
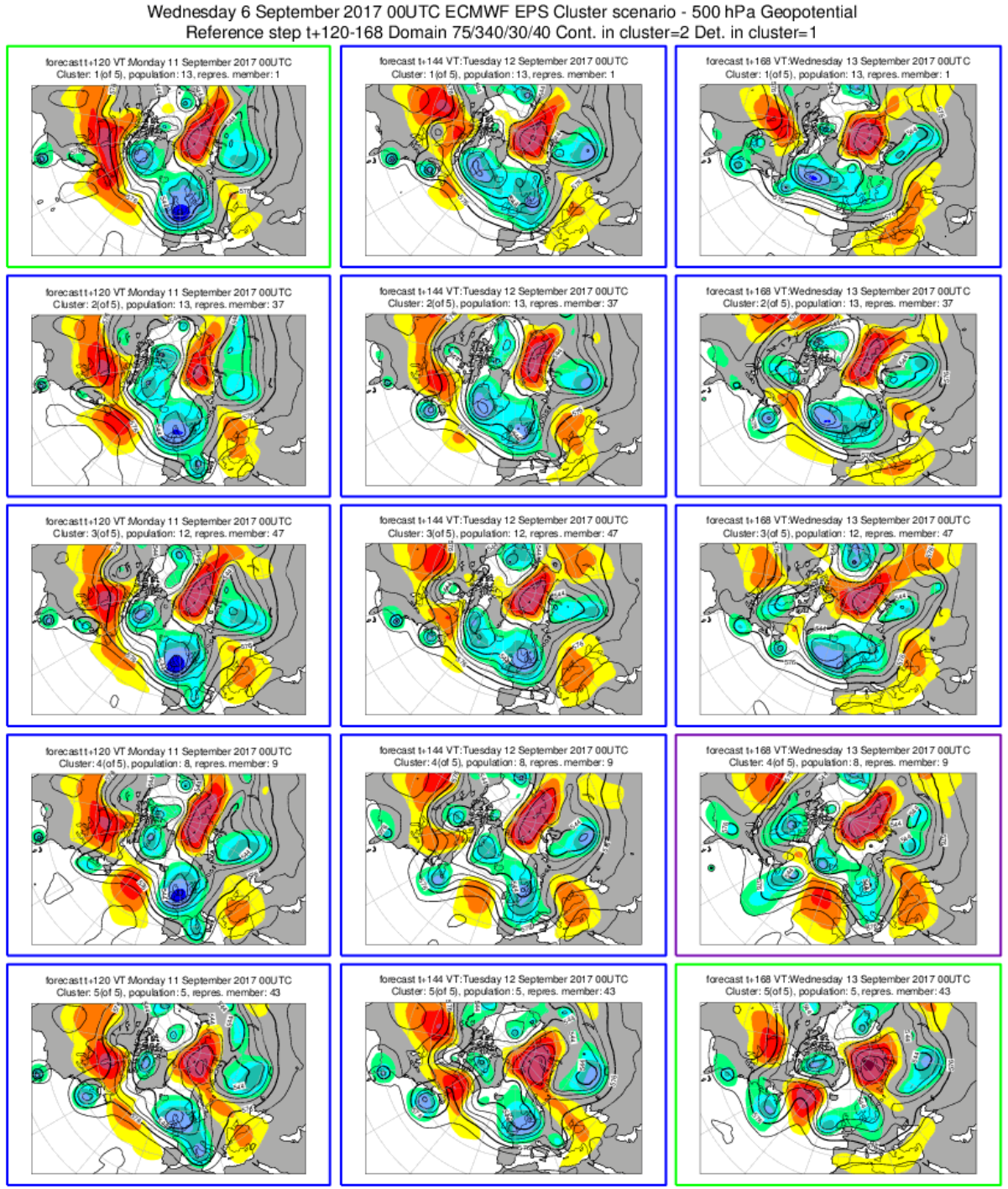
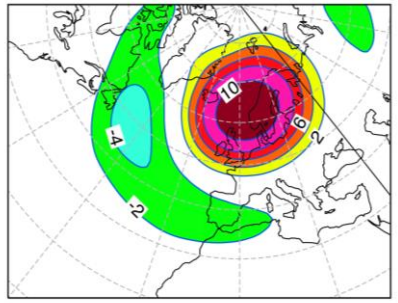
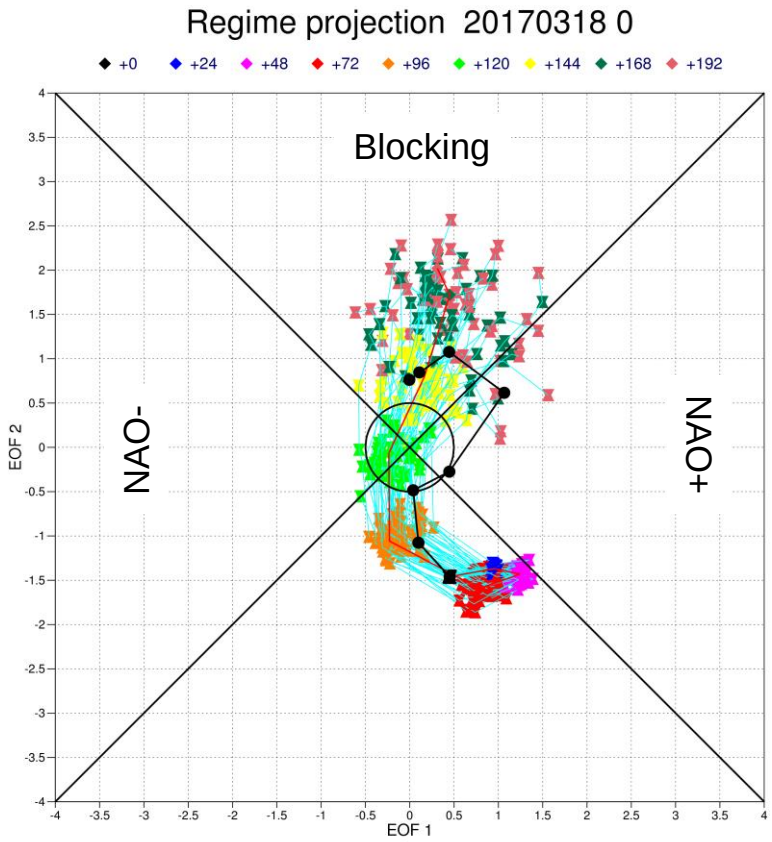
Alternative scenarios - clusters

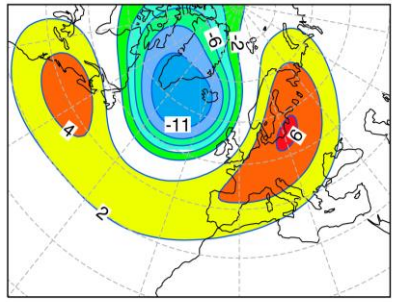


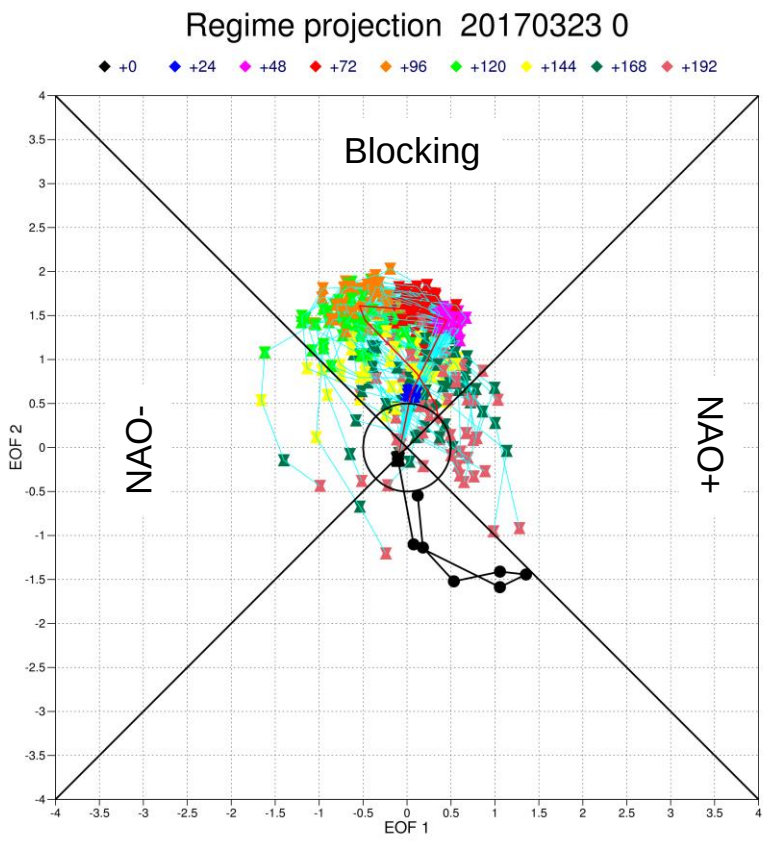


Regime transitions



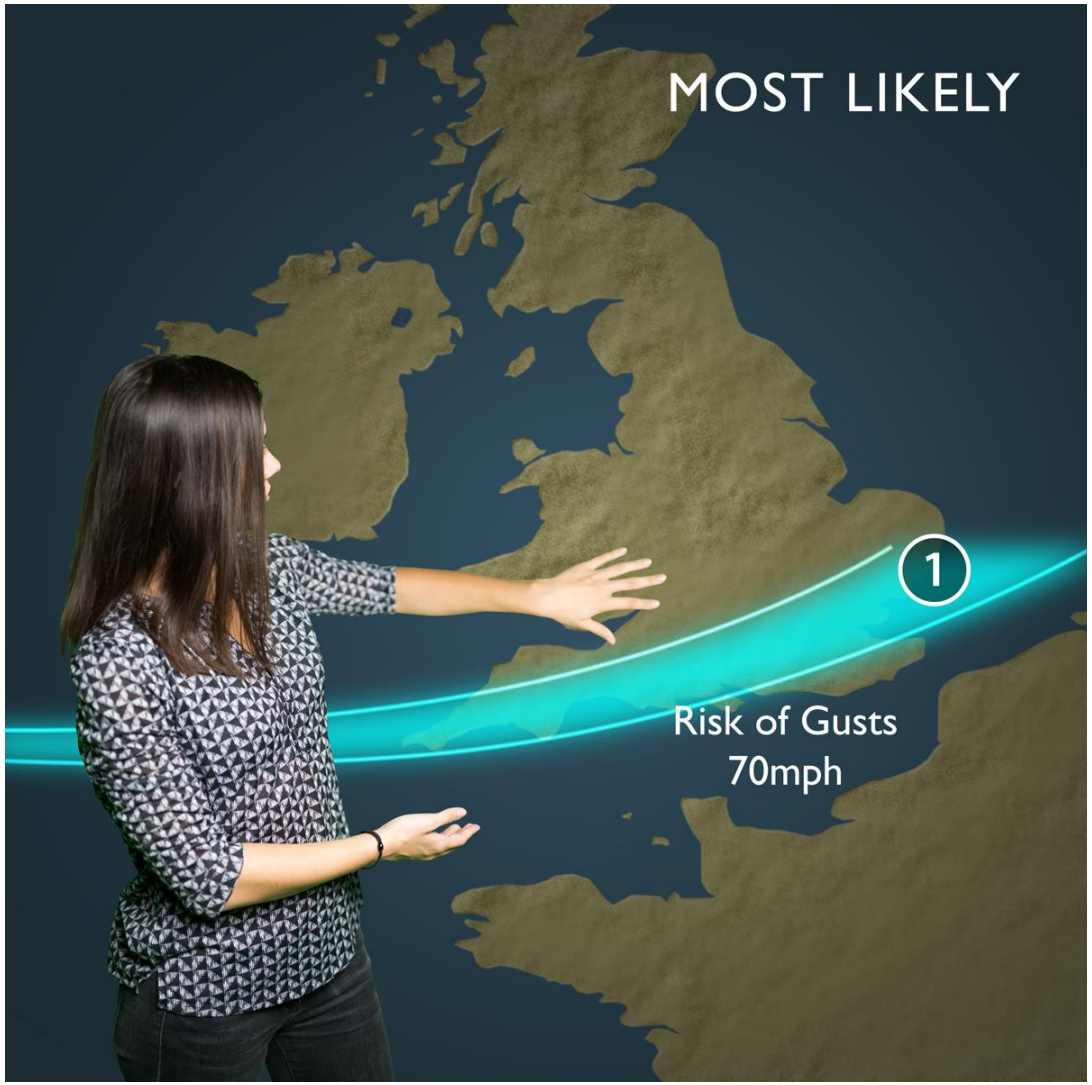


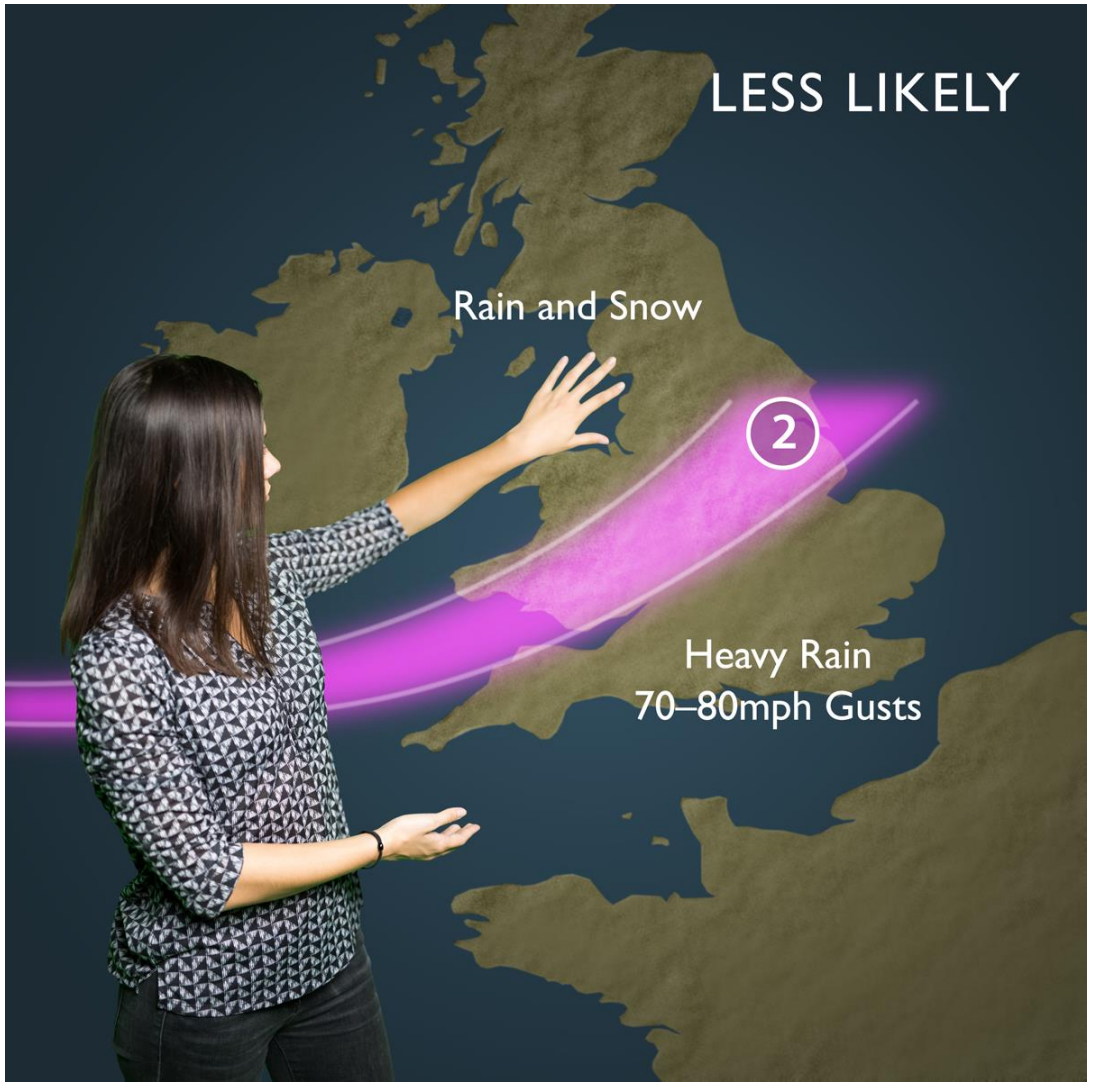




ECMWF

Alternative scenarios

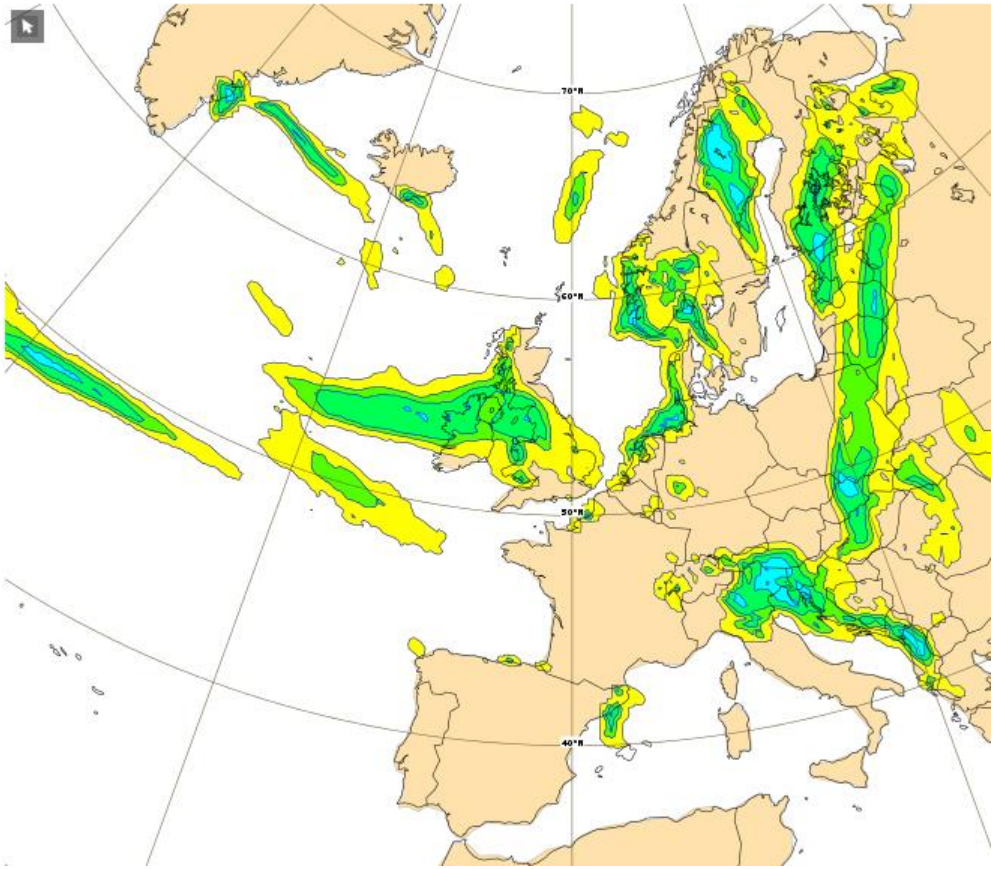


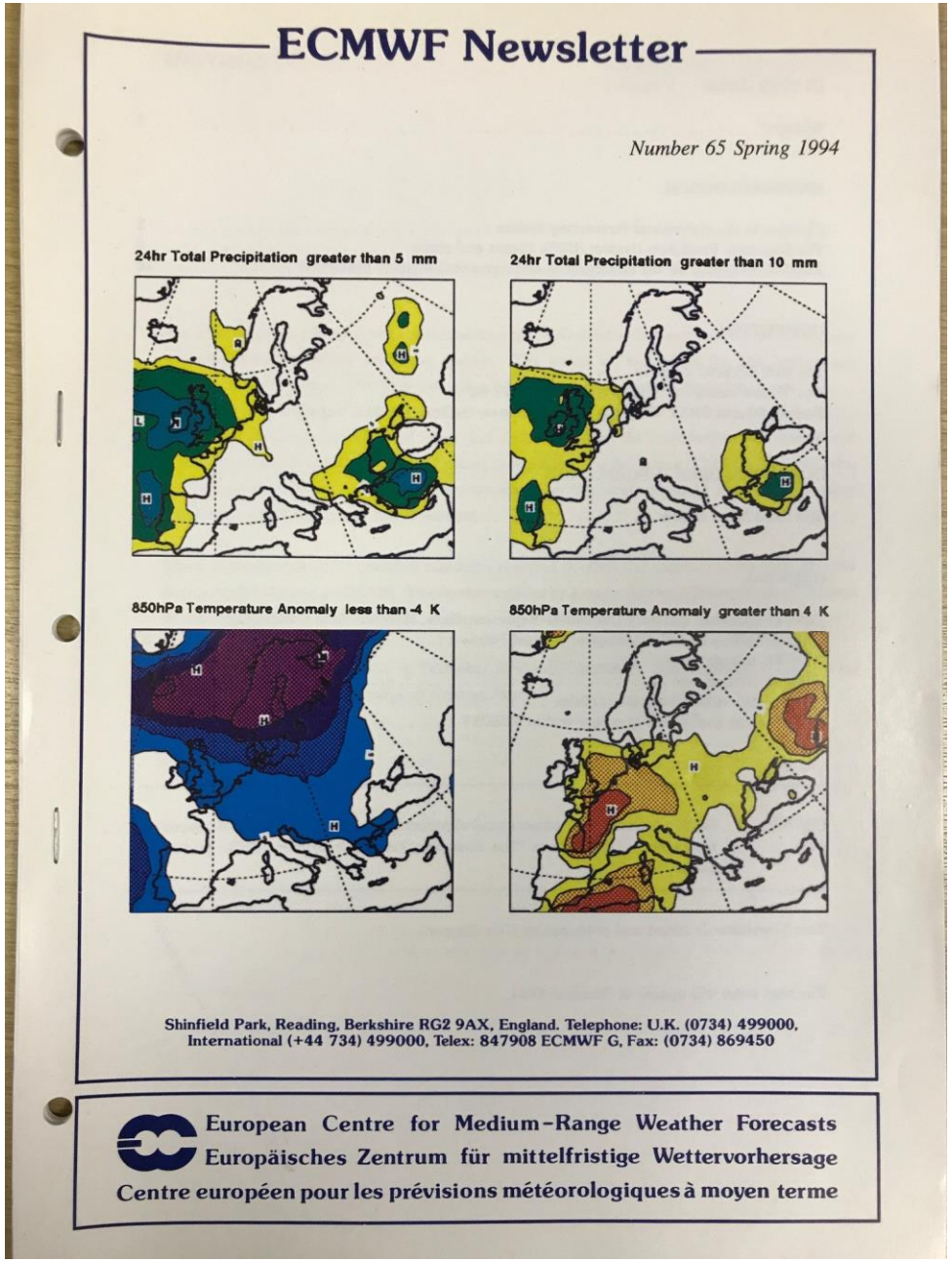


Probabilities

Total precipitation probability >10

Tuesday 12 Sep, 00 UTC T+24 Valid: Wednesday 13 Sep, 00 UTC





ECMWF Newsletter

Number 65 Spring 1994

24hr Total Precipitation greater than 5 mm

24hr Total Precipitation greater than 10 mm

850hPa Temperature Anomaly less than -4 K

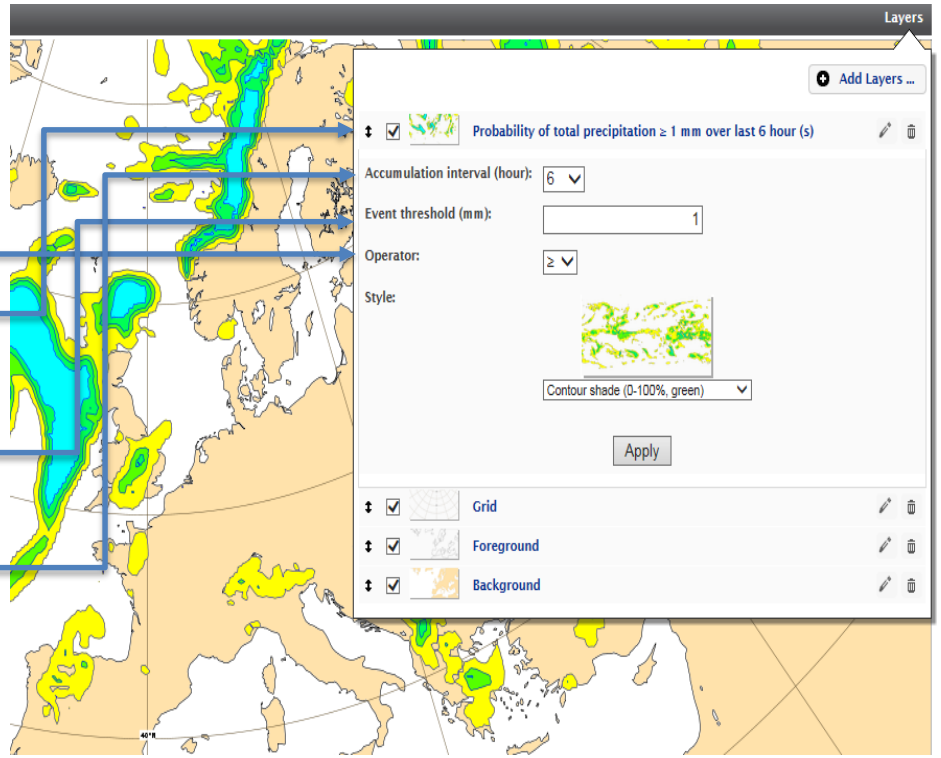
850hPa Temperature Anomaly greater than 4 K

Shinfield Park, Reading, Berkshire RG2 9AX, England. Telephone: U.K. (0734) 499000, International (+44 734) 499000, Telex: 847908 ECMWF G, Fax: (0734) 869450

European Centre for Medium-Range Weather Forecasts
Europäisches Zentrum für mittelfristige Wettervorhersage
Centre européen pour les prévisions météorologiques à moyen terme

Interactive probabilities (and more …) ecCharts

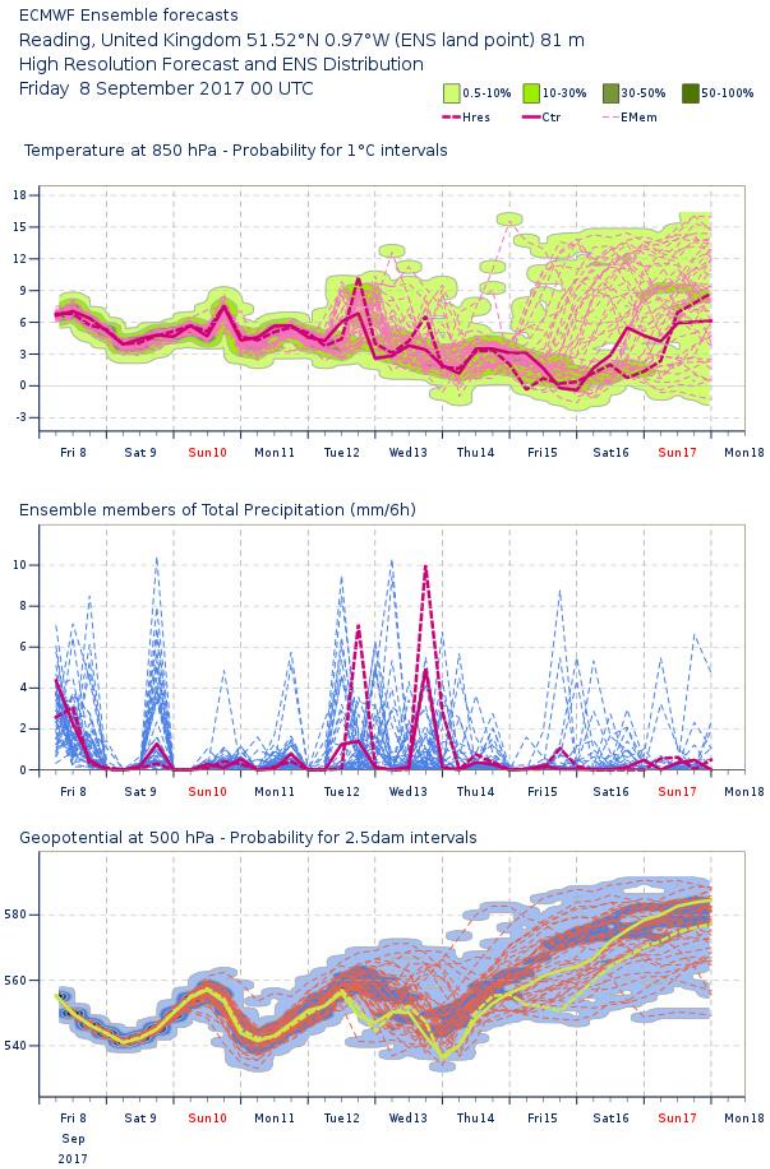
What is the probability of precipitation
>
5 mm/ 6 hr
?
How about over 24 hr ?

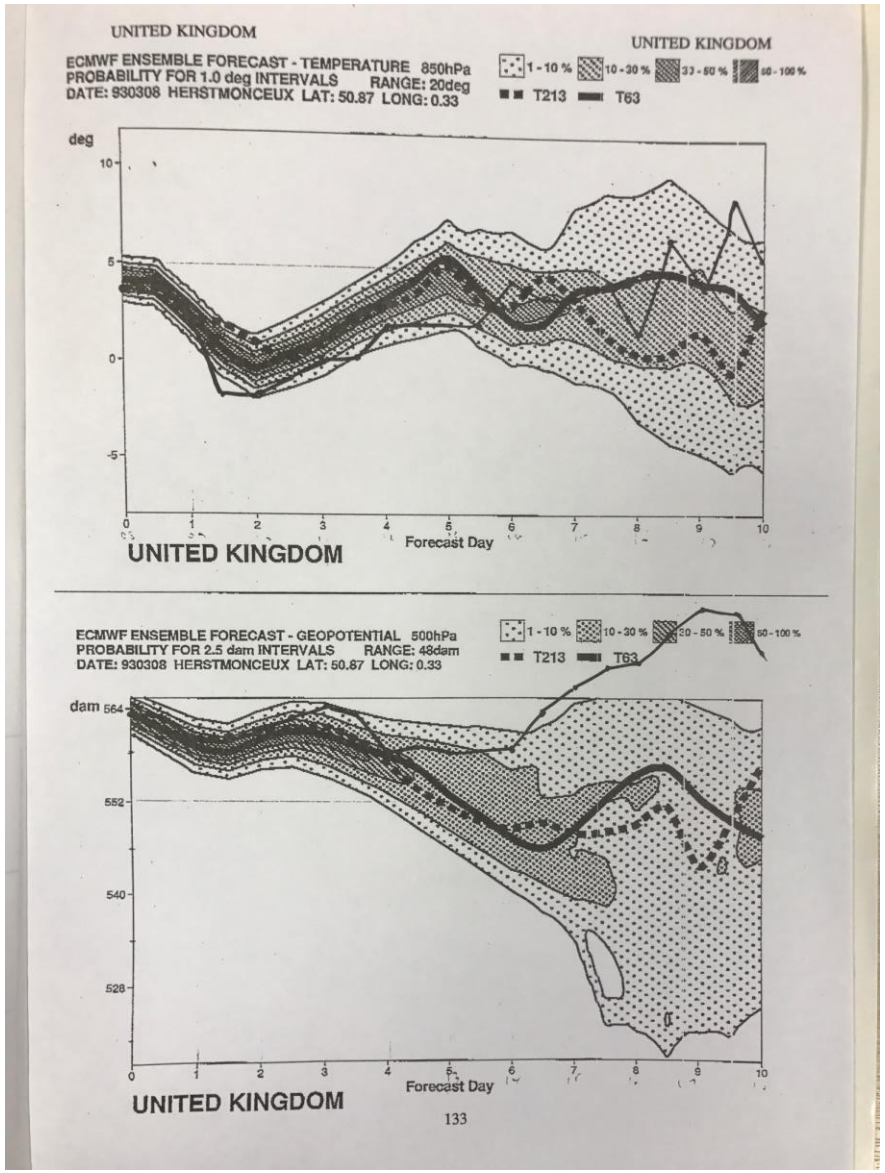


- ENS combined and weighted probabilities
- ENS mean and spread
- EFIs
- SOTs
- Cyclone strike probabilities
- Cyclone tracks
- Model-climate
- Meteograms
- …

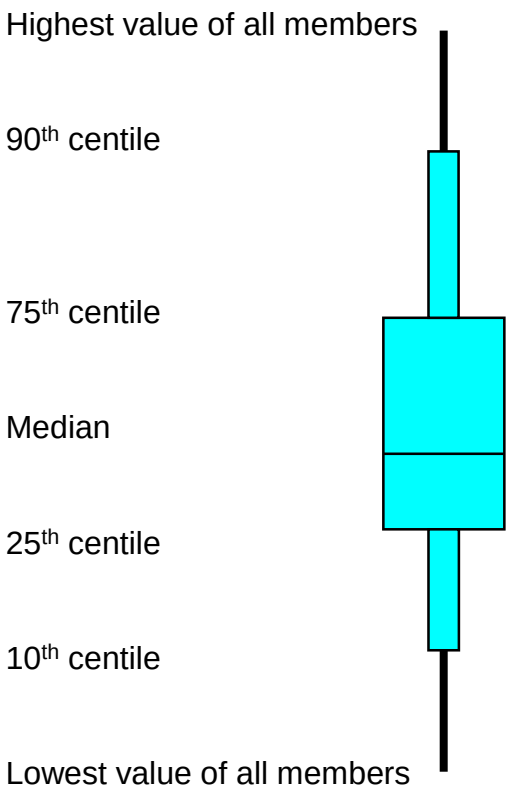
- Similar customisation applies for percentiles and probability of combined events and weighted probabilities …

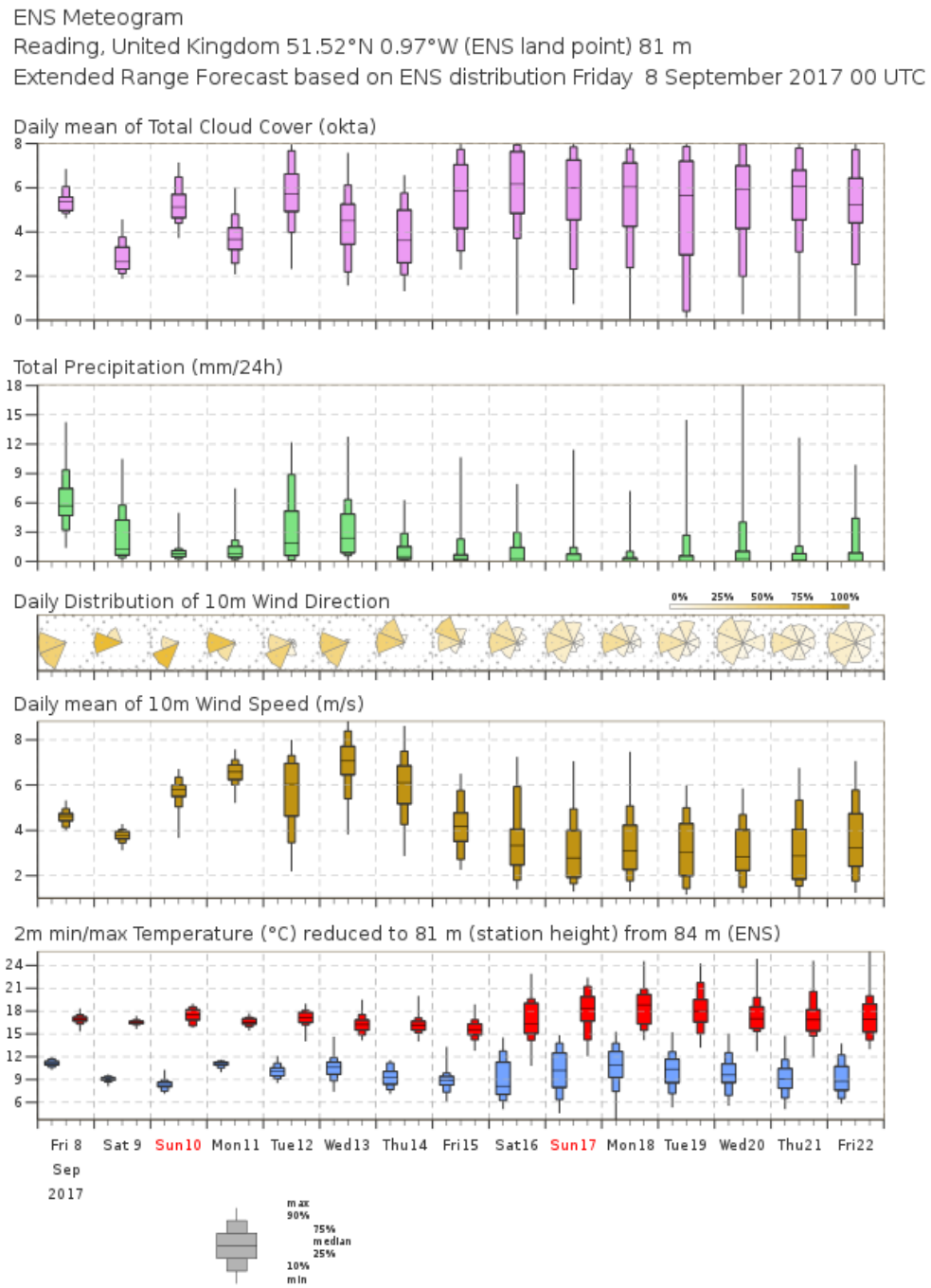
Point forecasts: time-series





Point forecasts: time-series (meteogram)





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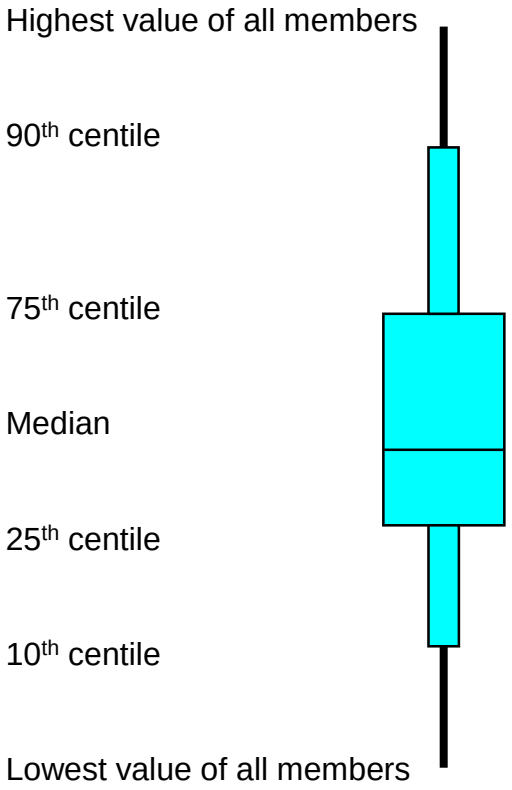
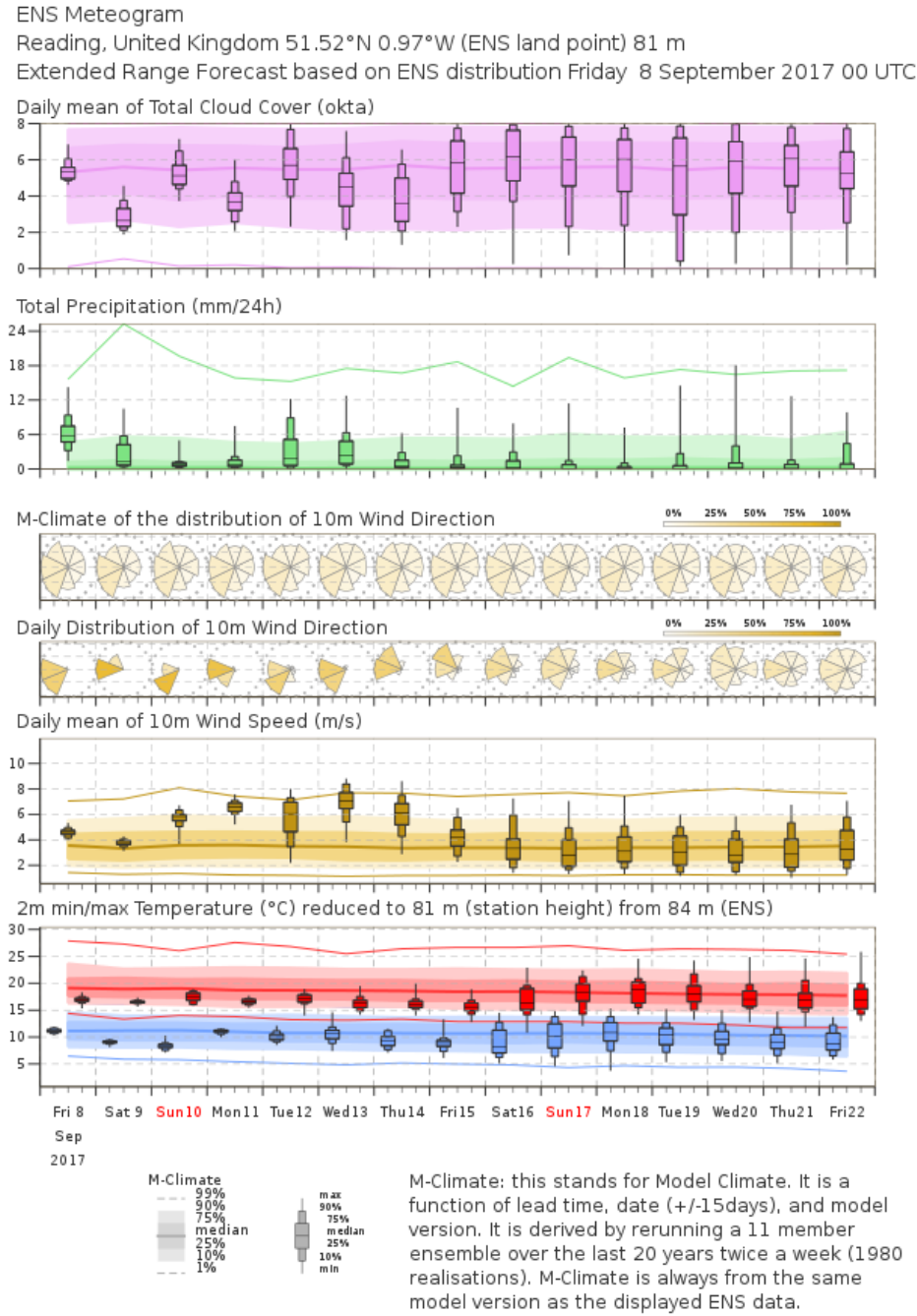
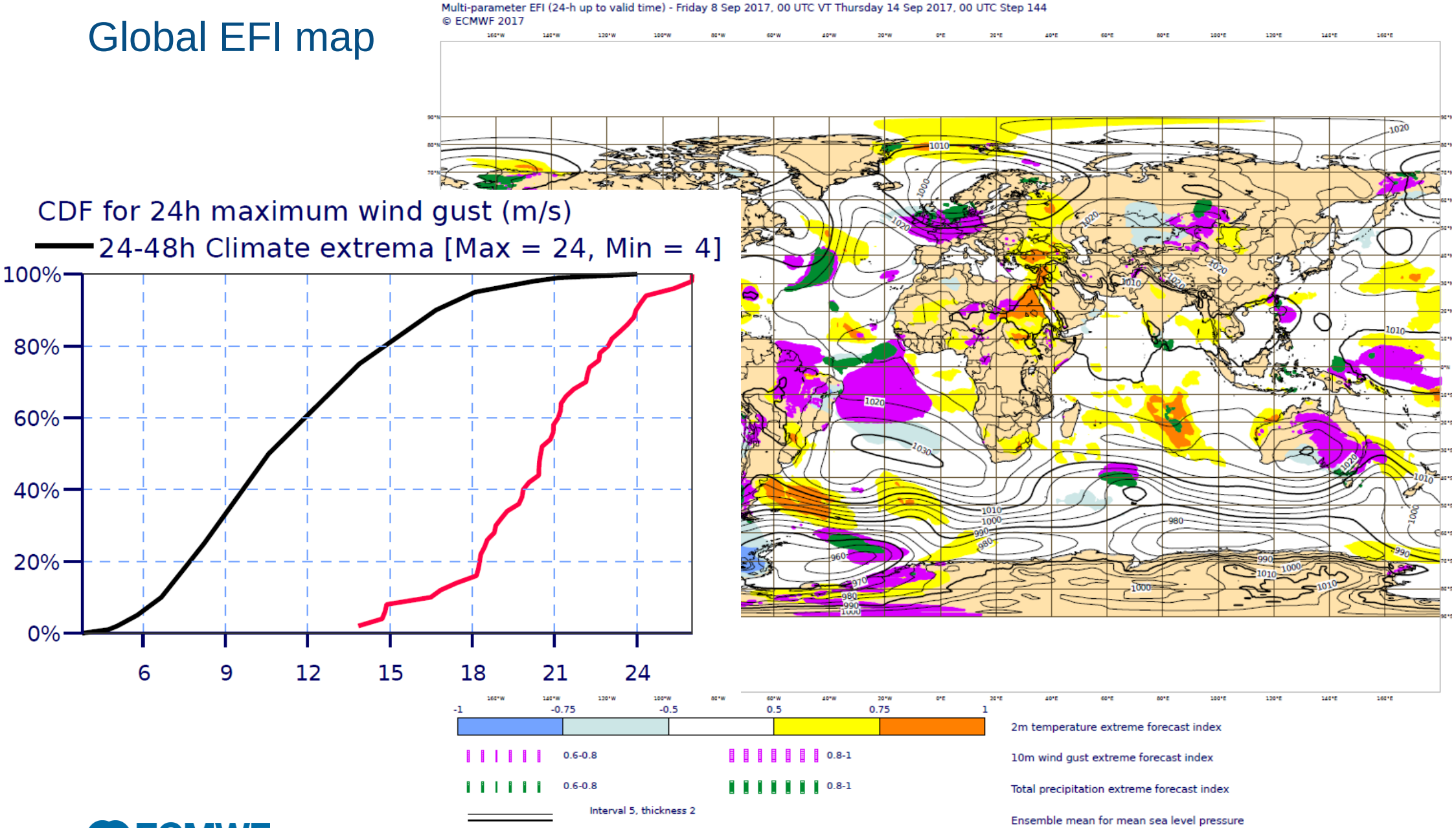


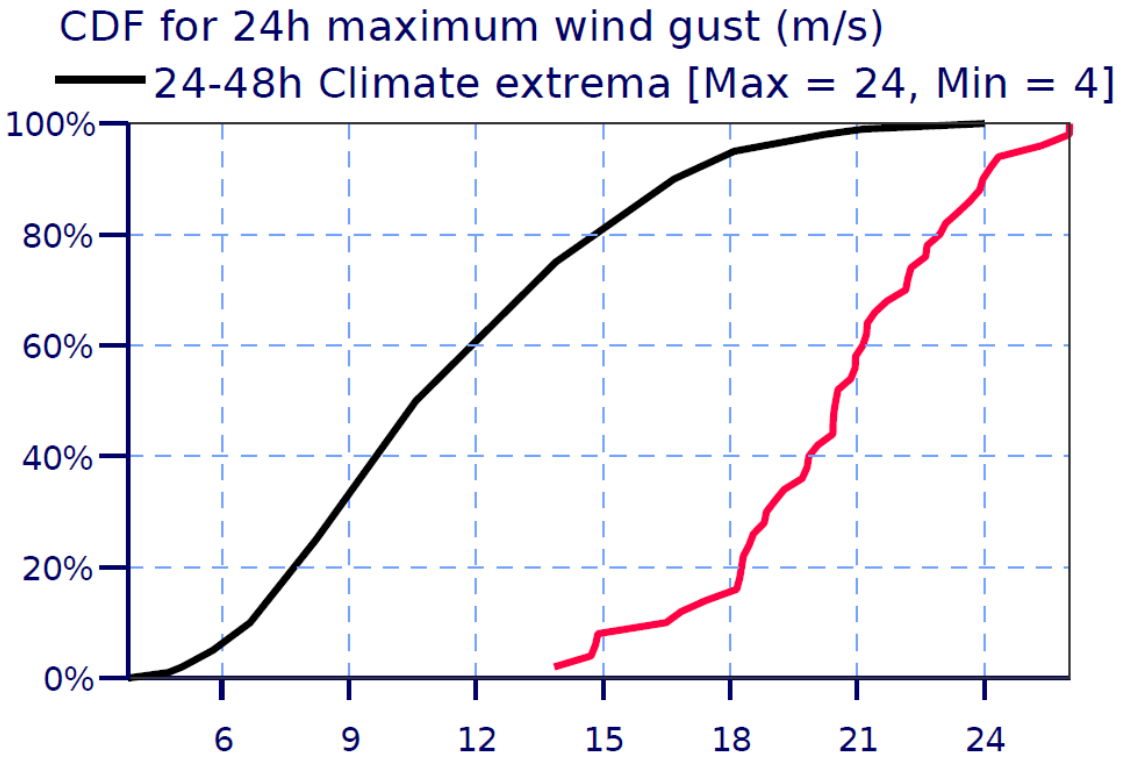


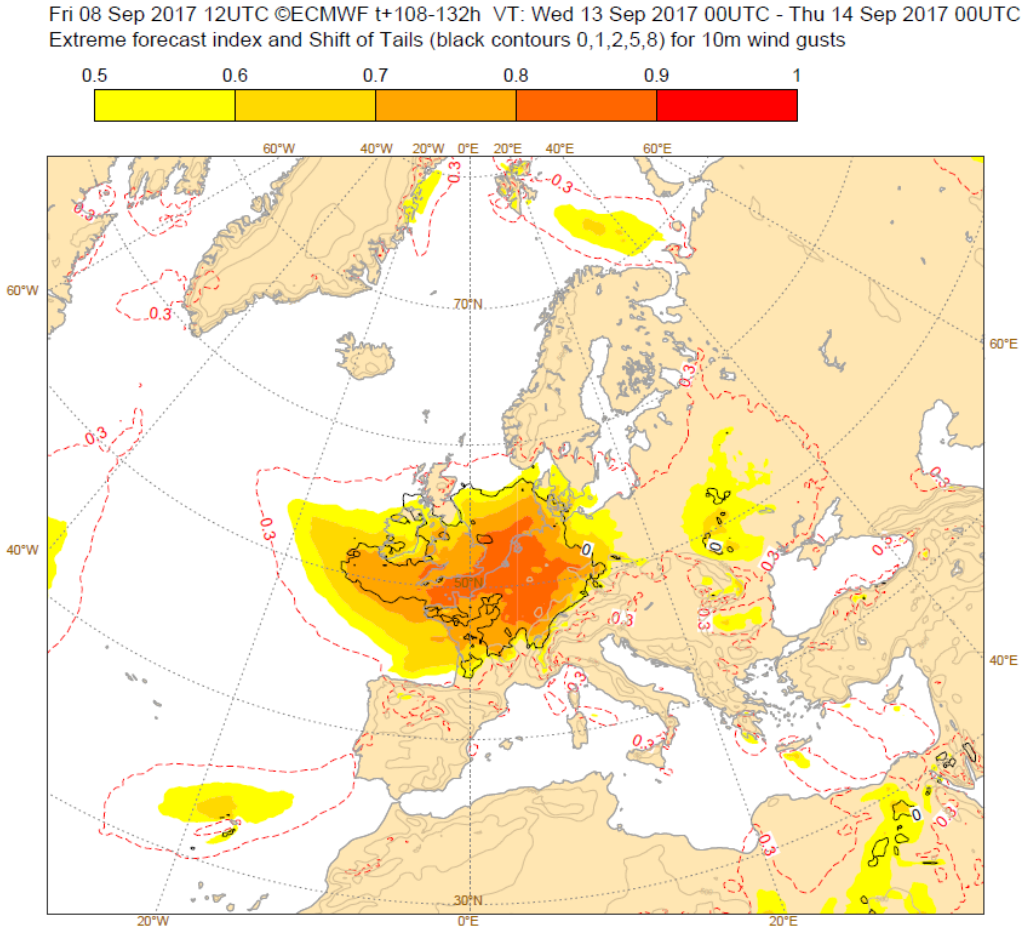
M-Climate: this stands for Model Climate. It is a function of lead time, date (+/-15days), and model version. It is derived by rerunning a 11 member ensemble over the last 20 years twice a week (1980 realisations). M-Climate is always from the same model version as the displayed ENS data.

Global EFI map

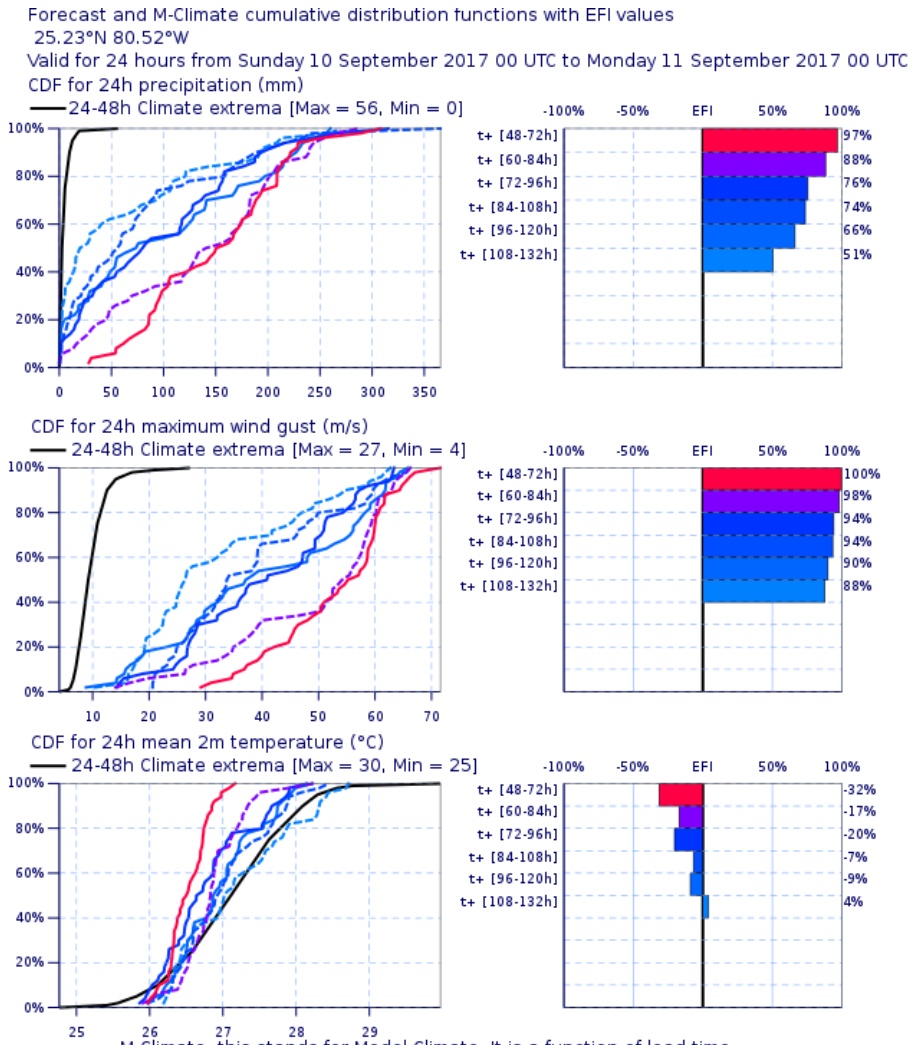


Extreme forecast index (EFI)

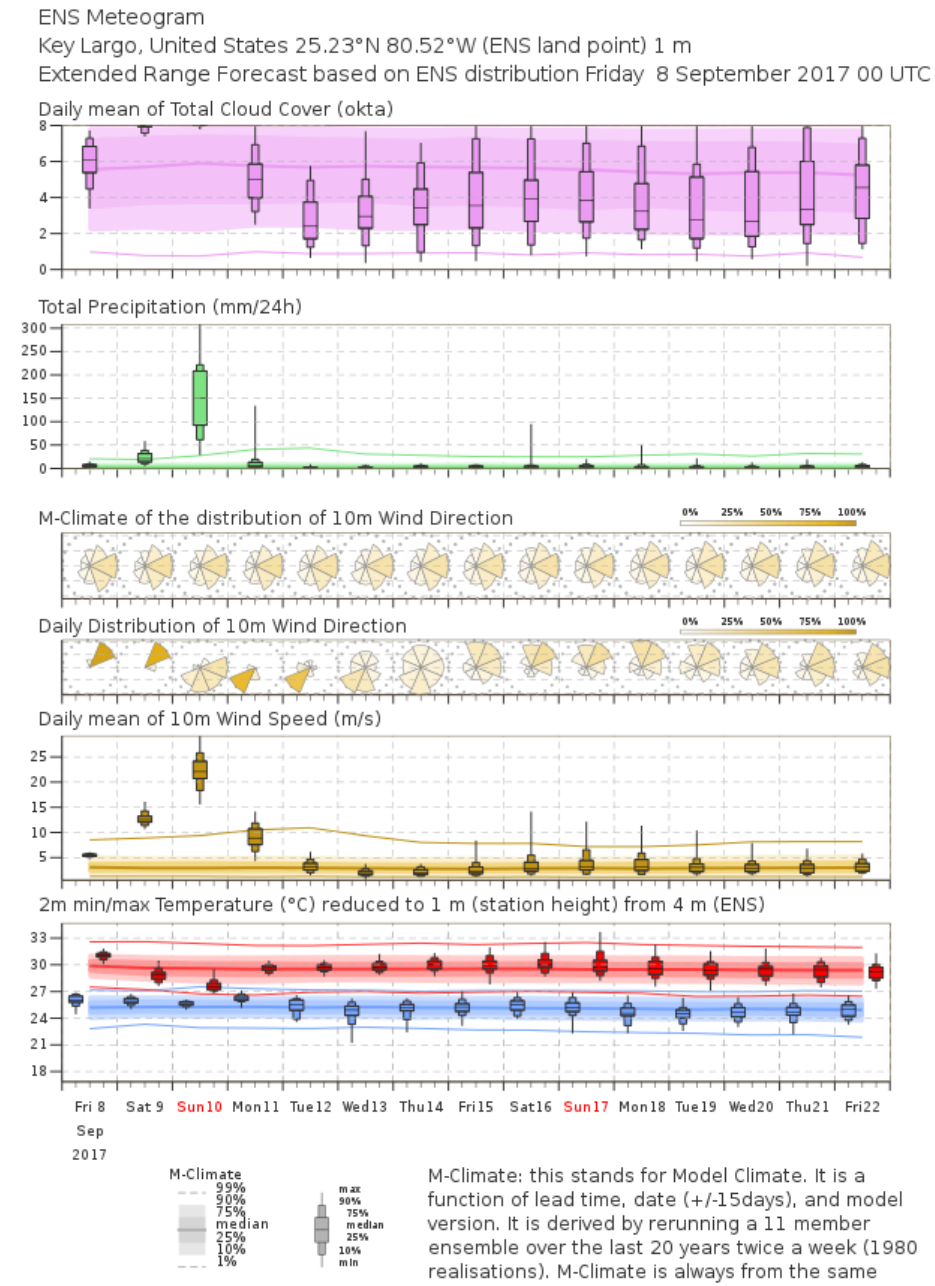




- Measures the distance between the ENS cumulative distribution and the model climate distribution
- Ranges from –1 (all members break climate minimum records) to +1 (all break climate maximum records)
- Indicates places where the ENS distribution is towards the extreme of the climate distribution

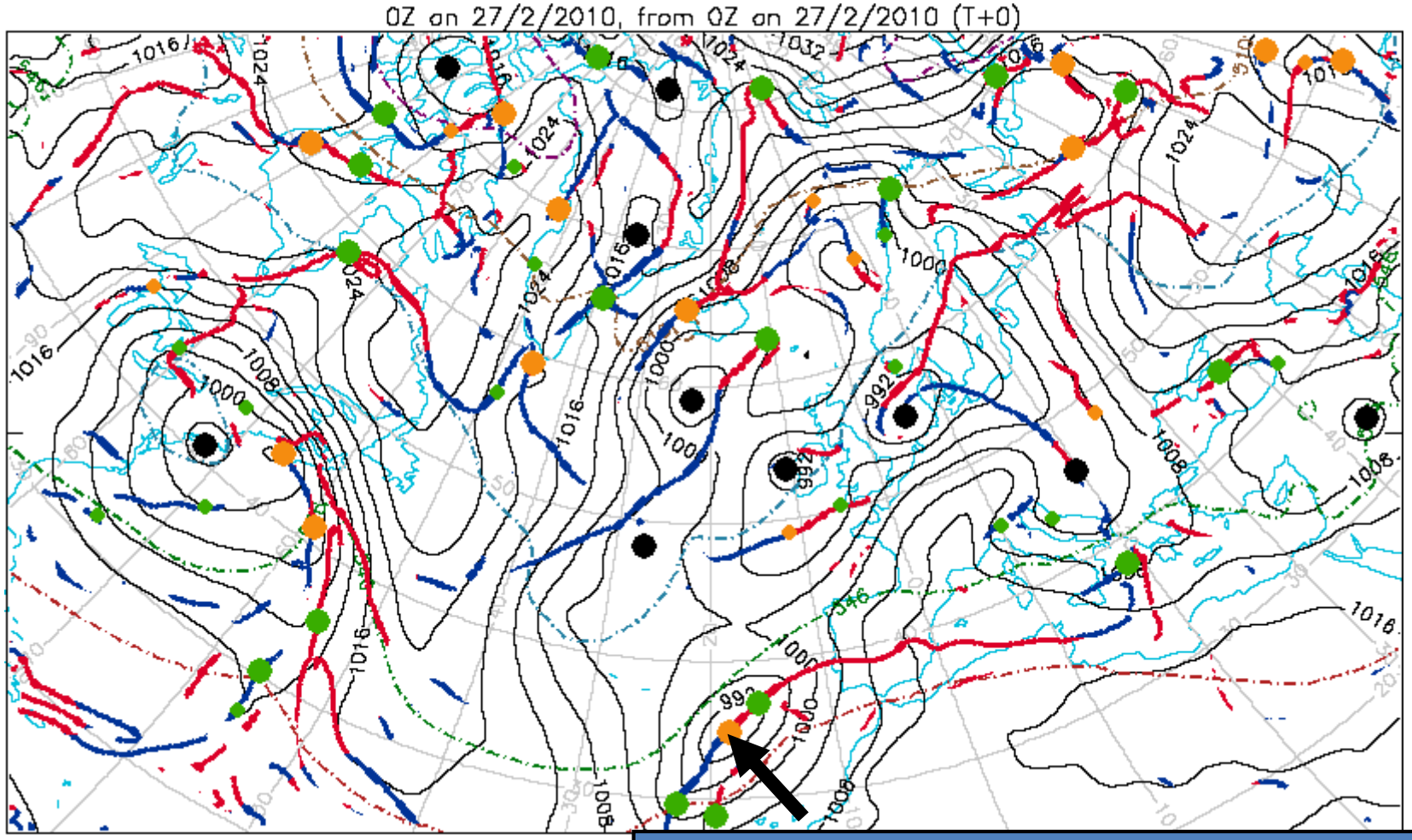


M-Climate: this stands for Model Climate. It is a function of lead time, date (+/-15days), and model version. It is derived by rerunning all member ensemble over the last 20 years twice a week (1980 realisations).
M-Climate is always from the same model version as the displayed ENS data.
On this page only the 24-48 lead M-Climate is displayed.



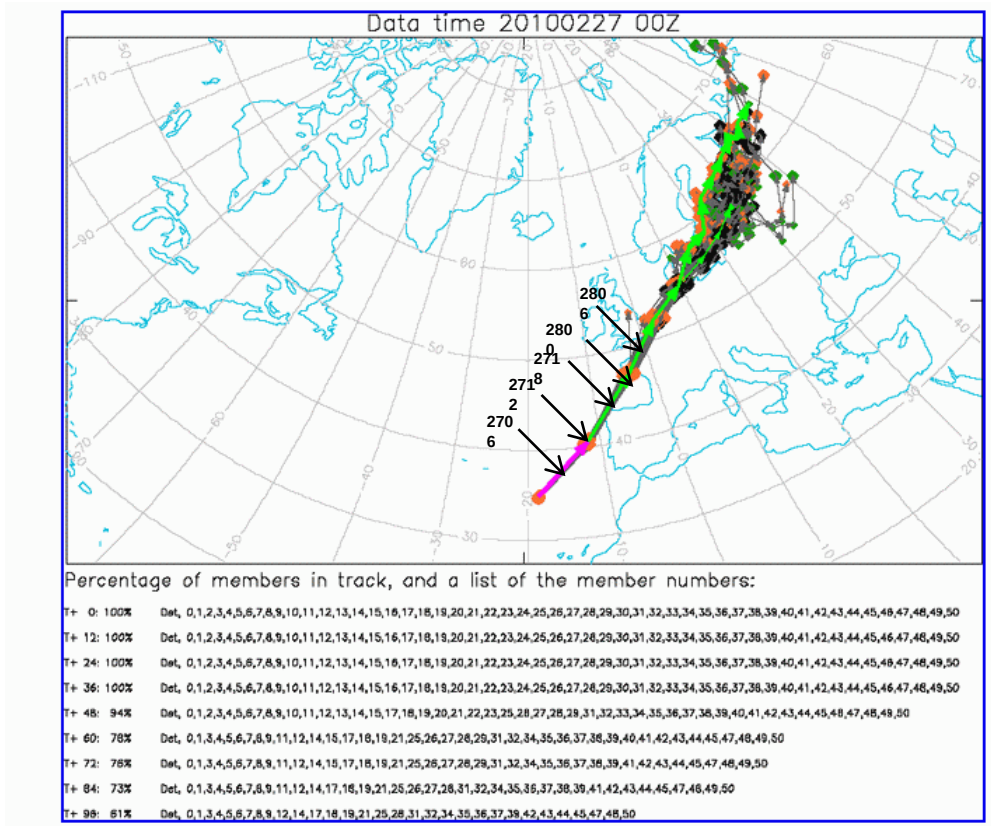
M-Climate: this stands for Model Climate. It is a function of lead time, date (+/-15days), and model version. It is derived by rerunning a 11 member ensemble over the last 20 years twice a week (1980 realisations). M-Climate is always from the same model version as the displayed ENS data.

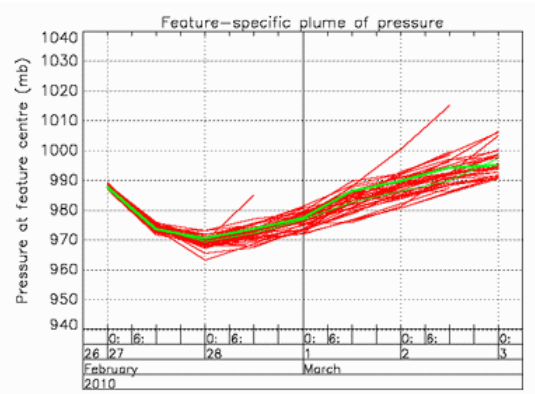
Extra-tropical cyclonic feature tracking

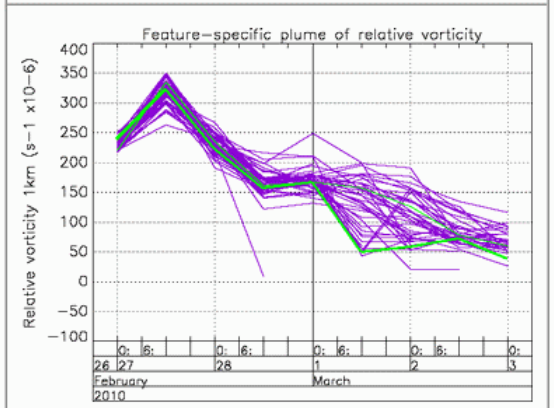


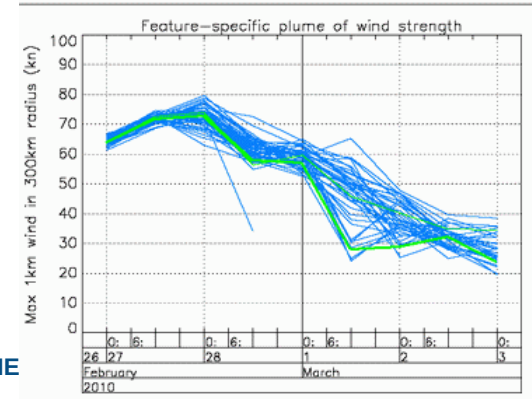
User can click on any spot (= cyclonic feature) to see how that feature evolves in the forecast

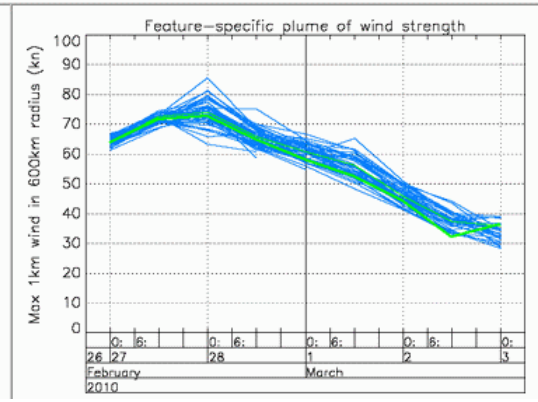
Extra-tropical cyclonic feature tracking

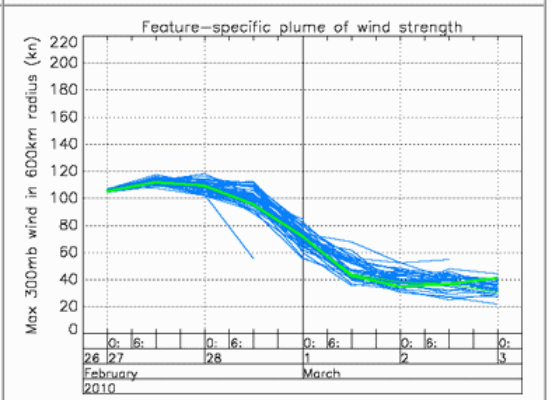




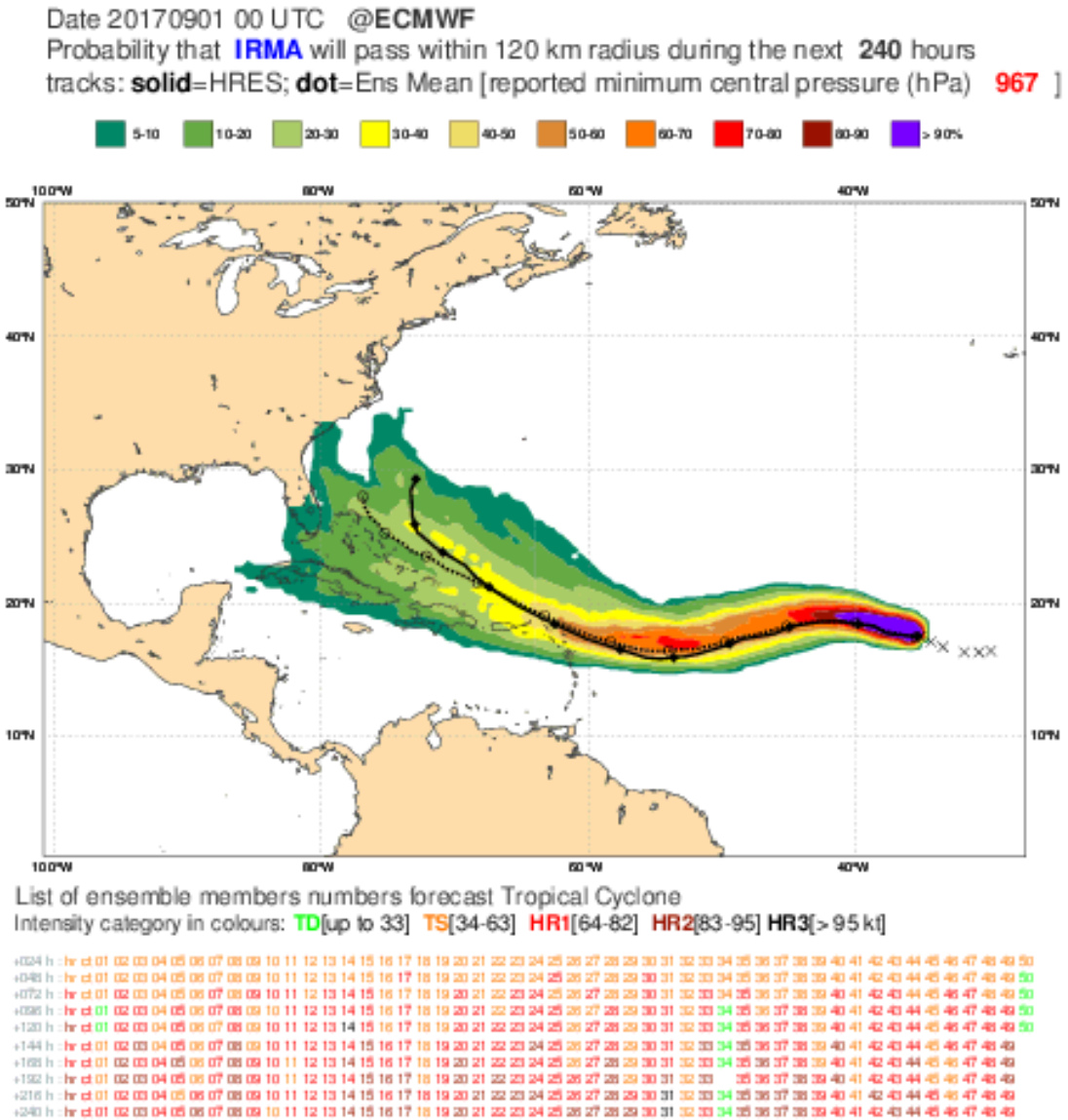


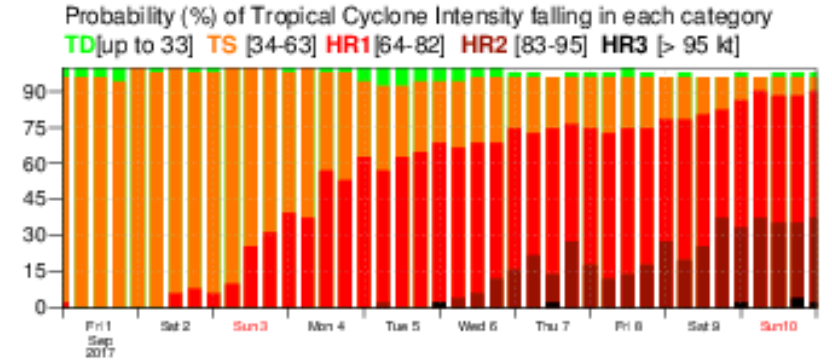


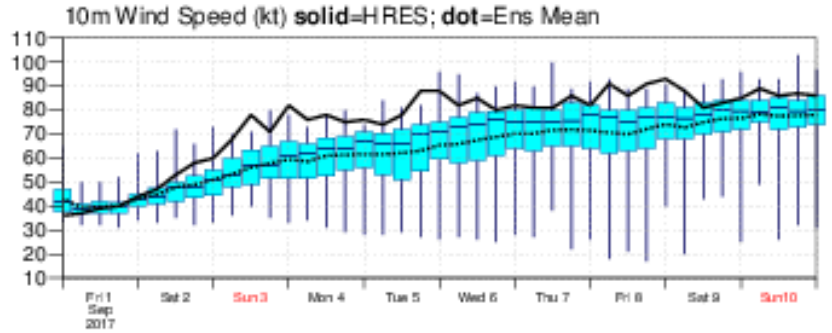


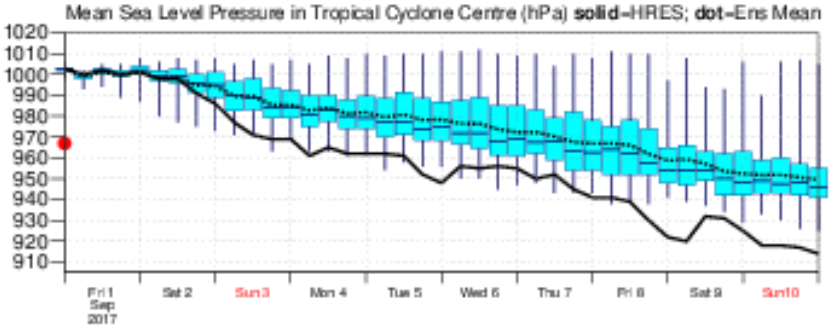


Tropical cyclones



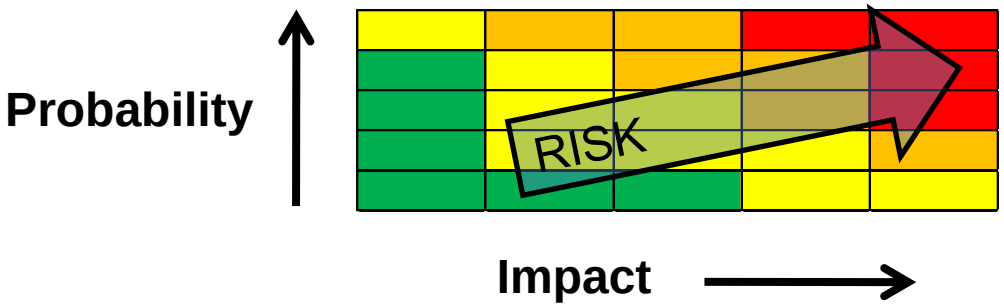


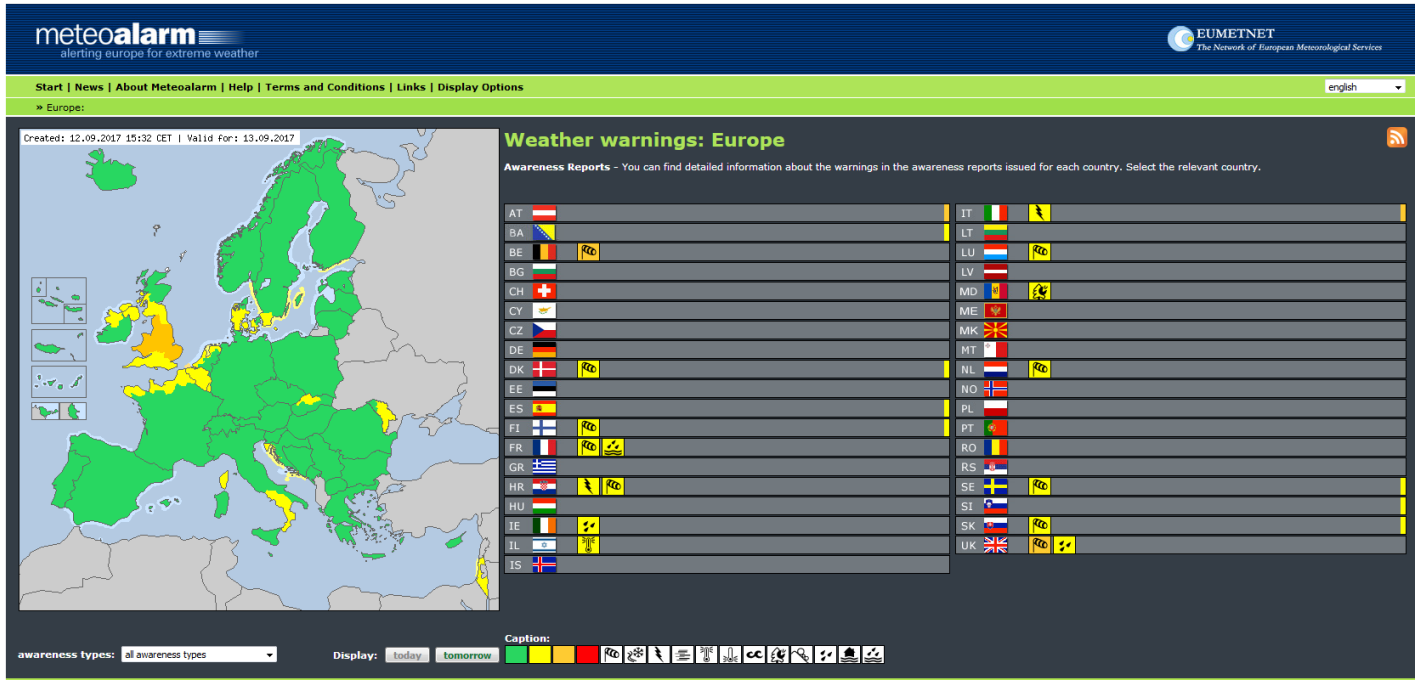




Supporting decision making: societal and economic value of forecasts

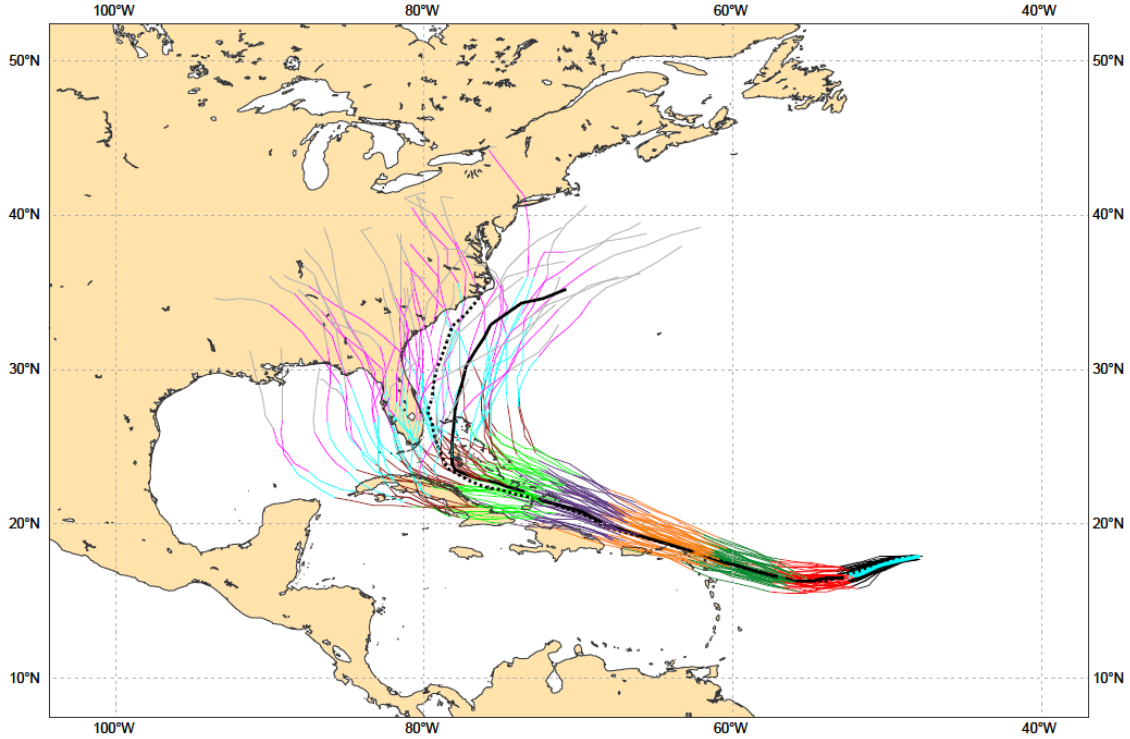
- Forecasts only have value if people use them
  - make a decision or take an action which would not otherwise have been made
- Decisions can be based on deterministic forecasts, but …
- Decisions involve assessment of risk





Decisions, risk and flow-dependent uncertainty

Date 20170903 12 UTC @**ECMWF**
Individual trajectories for **IRMA** during the next **240** hours
tracks: **thick solid**=HRES; **thick dot**=CTRL; **thin solid**=EPS members [coloured]
0-24h **24-48h** **48-72h** **72-96h** **96-120h** **120-144h** **144-168h** **168-192h** **192-216h** 216-240h



Date 20170907 00 UTC @**ECMWF**
Individual trajectories for **JOSE** during the next **240** hours
tracks: **thick solid**=HRES; **thick dot**=CTRL; **thin solid**=EPS members [coloured]
0-24h **24-48h** **48-72h** **72-96h** **96-120h** **120-144h** **144-168h** **168-192h** **192-216h** 216-240h