

ECMWF products and performance

David Richardson,

Thanks to:

Met Division colleagues

Outline

- **Forecast system and recent operational changes**
- **Performance**
 - **Jumpiness (inconsistency); 00 v 12 forecast**
- **Product development**
- **Web developments**

The operational forecast system

- **High resolution deterministic forecast:** twice per day
25 km 91-level, to 10 days ahead
- **Ensemble forecast (EPS):** twice daily
51 members, 50/80 km 62-level, to 15 days ahead
- **Ocean waves:** twice daily
Global: 10 days ahead at 40 km
European Waters: 5 days ahead at 10 km
Ensemble: 15 days ahead at 100 km
- **Monthly forecast:** once a week (coupled to ocean model)
51-members, 50/80 km 62 levels, to one month ahead
- **Seasonal forecast:** once a month (coupled to ocean model)
41 members, 125 km 62 levels, to seven months ahead
- **Boundary Conditions:** short cut-off analyses based on 6-hourly
4D-Var initiating a forecast to 3 days, four times per day

Recent operational changes

- **6 November 2007 (cycle 32r3)**
 - Physics changes (more active model); reduced EPS perturbations
- **7 December 2007 (BC suite)**
 - Dissemination steps extended to 90 hours (from 78) for those participating Member States who wish to manage their own backup procedures
- **29 January 2008**
 - Revised production schedule - products available 10 to 25 minutes earlier, depending on the product type
- **11 March 2008**
 - Implementation of VarEPS-Monthly system
- **3 June 2008 (cycle 33r1)**
 - Improved moist physics in assimilation, physics changes, revision of wave model, new wave parameters, extended and higher resolution European wave model

Time series Acc=0.6 Europe ECMWF FORECAST VERIFICATION 12UTC

500hPa GEOPOTENTIAL

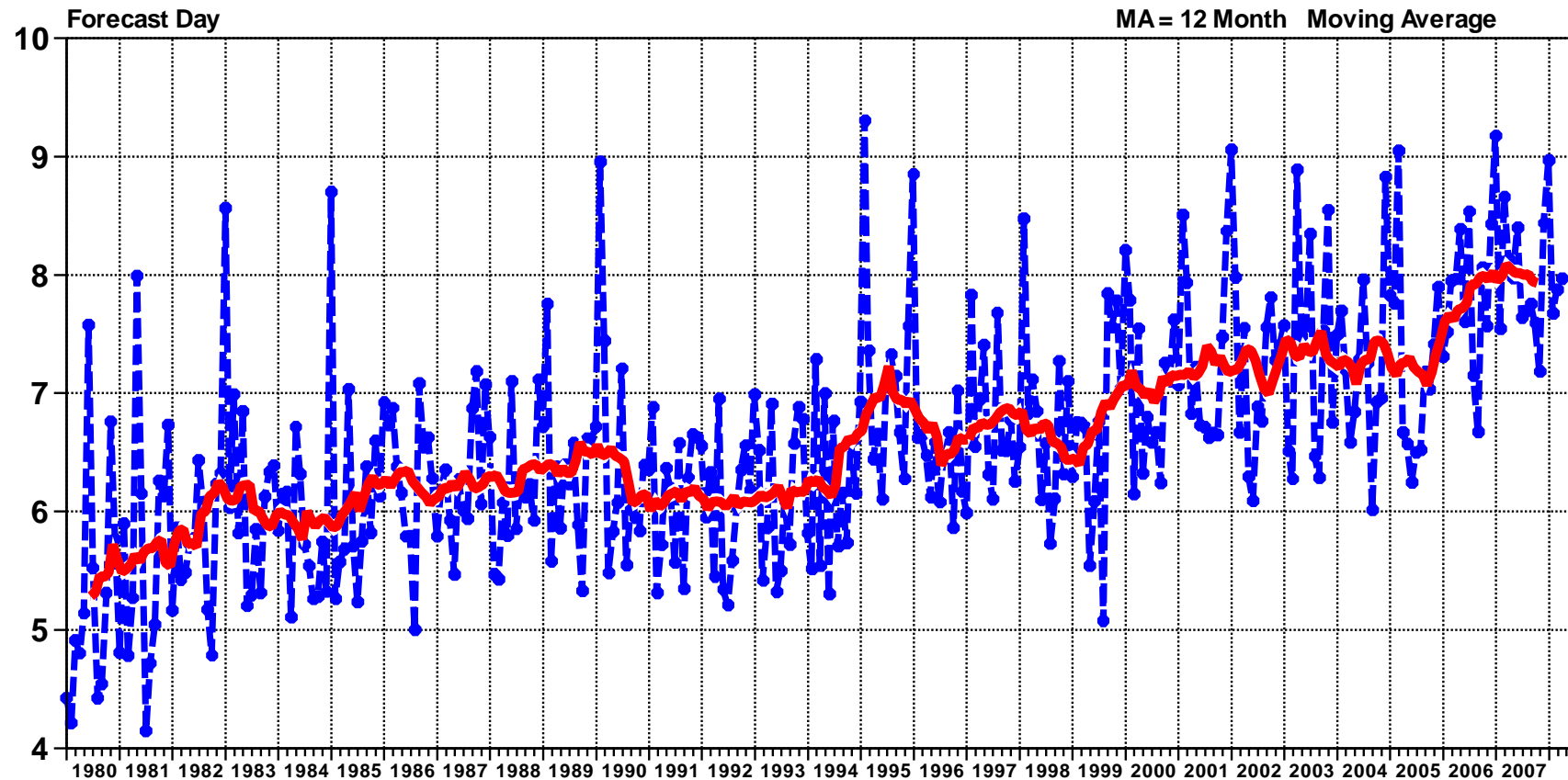
ANOMALY CORRELATION

FORECAST

EUROPE LAT 35.000 TO 75.000 LON -12.500 TO 42.500

—●— SCORE REACHES 60.00

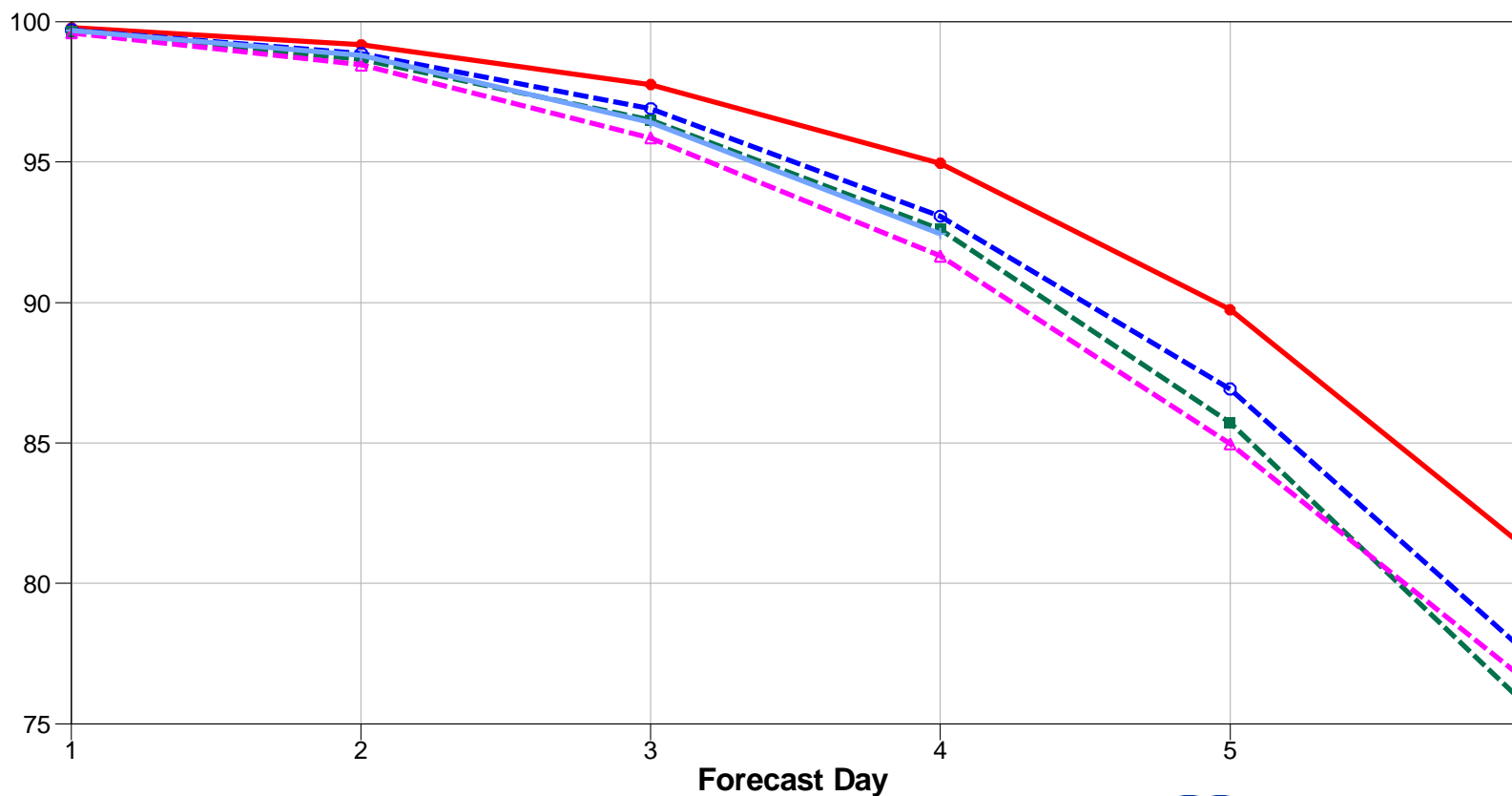
— SCORE REACHES 60.00 MA



Comparison with other centres

Mean curves
500hPa Geopotential
Anomaly correlation forecast
Europe Lat 35.0 to 75.0 Lon -12.5 to 42.5
Date: 20080301 00UTC to 20080531 00UTC
Mean calculation method: standard

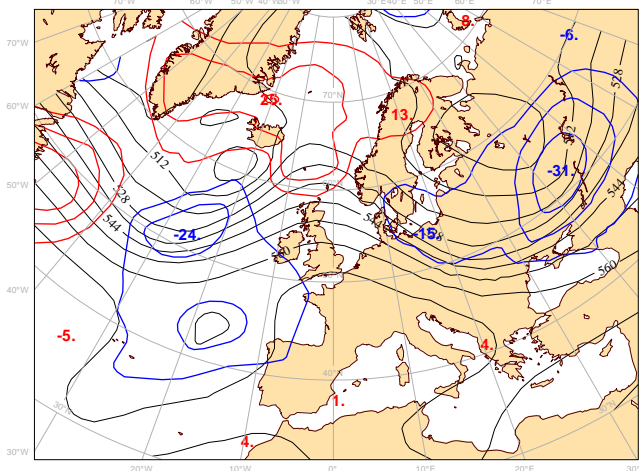
ecmwf
met office
ncep
msc
meteo france



Jumpiness in forecasts

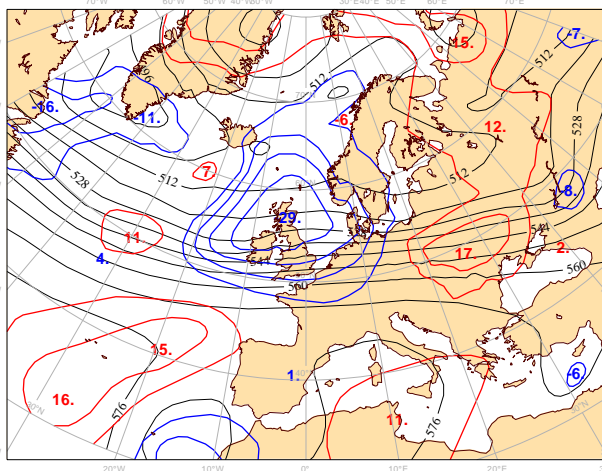
180 hours

Saturday 16 February 2008 00UTC ECMWF Forecast +180 VT: Saturday 23 February 2008 12UTC 500hPa **Geopotential
Saturday 16 February 2008 00UTC ECMWF Forecast +180 VT: Saturday 23 February 2008 12UTC 500hPa Geopotential



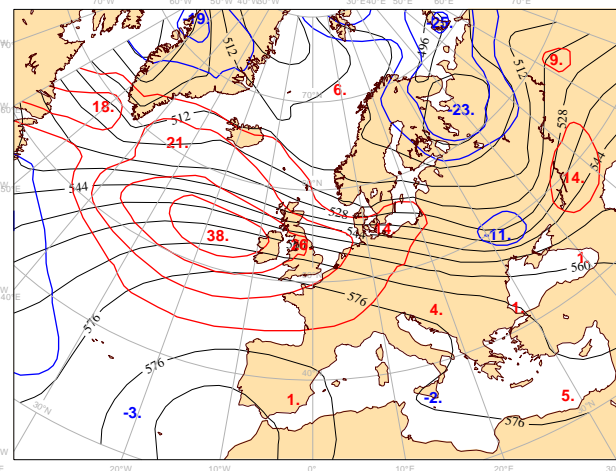
168 hours

Saturday 16 February 2008 12UTC ECMWF Forecast +168 VT: Saturday 23 February 2008 12UTC 500hPa **Geopotential
Saturday 16 February 2008 12UTC ECMWF Forecast +168 VT: Saturday 23 February 2008 12UTC 500hPa Geopotential

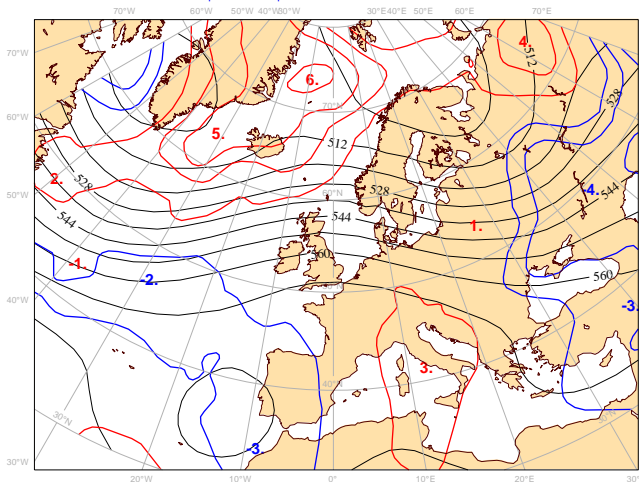


156 hours

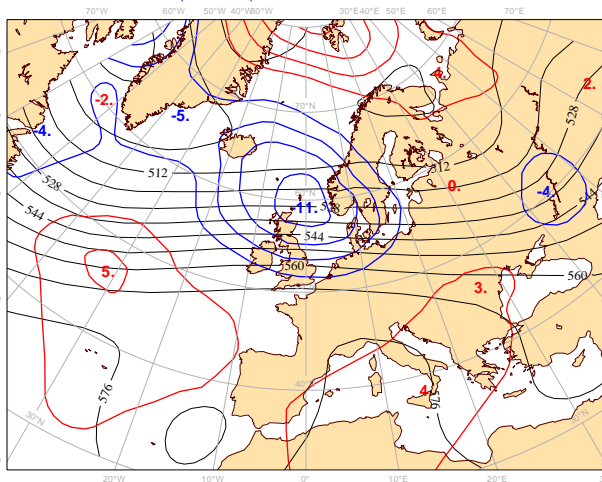
Sunday 17 February 2008 00UTC ECMWF Forecast +156 VT: Saturday 23 February 2008 12UTC 500hPa **Geopotential
Sunday 17 February 2008 00UTC ECMWF Forecast +156 VT: Saturday 23 February 2008 12UTC 500hPa Geopotential



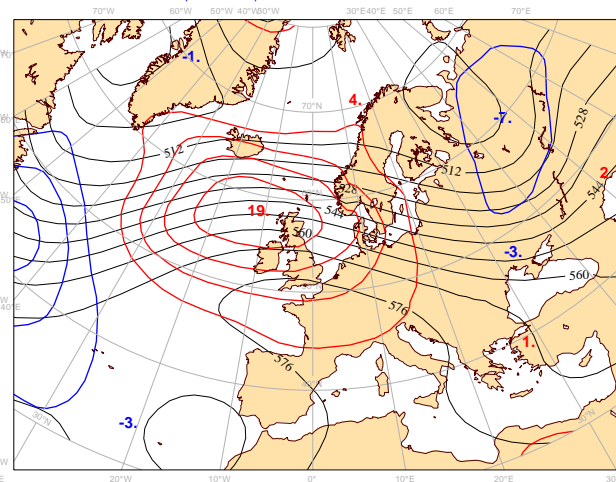
Saturday 16 February 2008 00UTC ECMWF EPS Perturbed Forecast +180 VT: Saturday 23 February 2008 12UTC
500hPa **Geopotential/ Geopotential - Ensemble member number 1 of 51



Saturday 16 February 2008 12UTC ECMWF EPS Perturbed Forecast +168 VT: Saturday 23 February 2008 12UTC
500hPa **Geopotential/ Geopotential - Ensemble member number 1 of 51



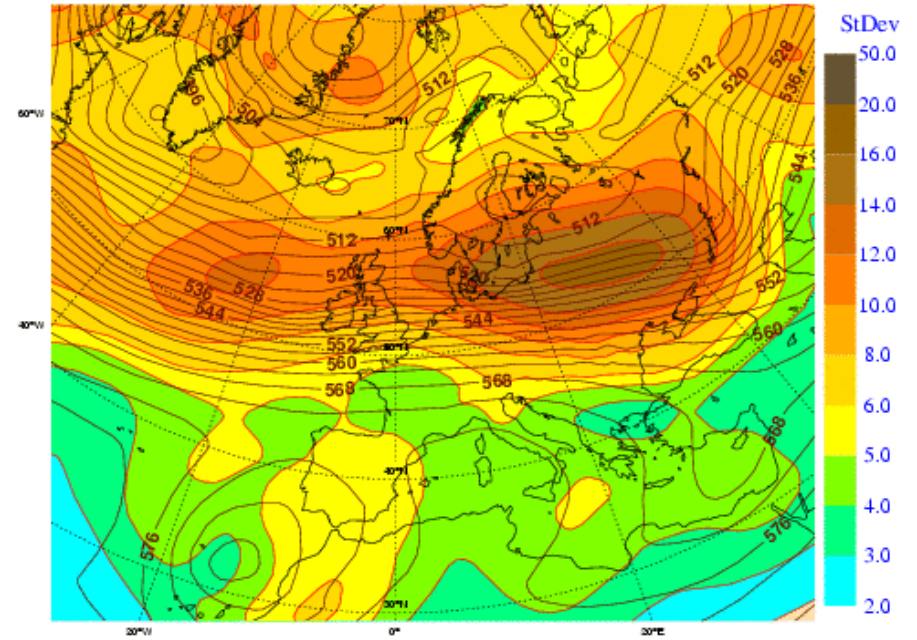
Sunday 17 February 2008 00UTC ECMWF EPS Perturbed Forecast +156 VT: Saturday 23 February 2008 12UTC
500hPa **Geopotential/ Geopotential - Ensemble member number 1 of 51



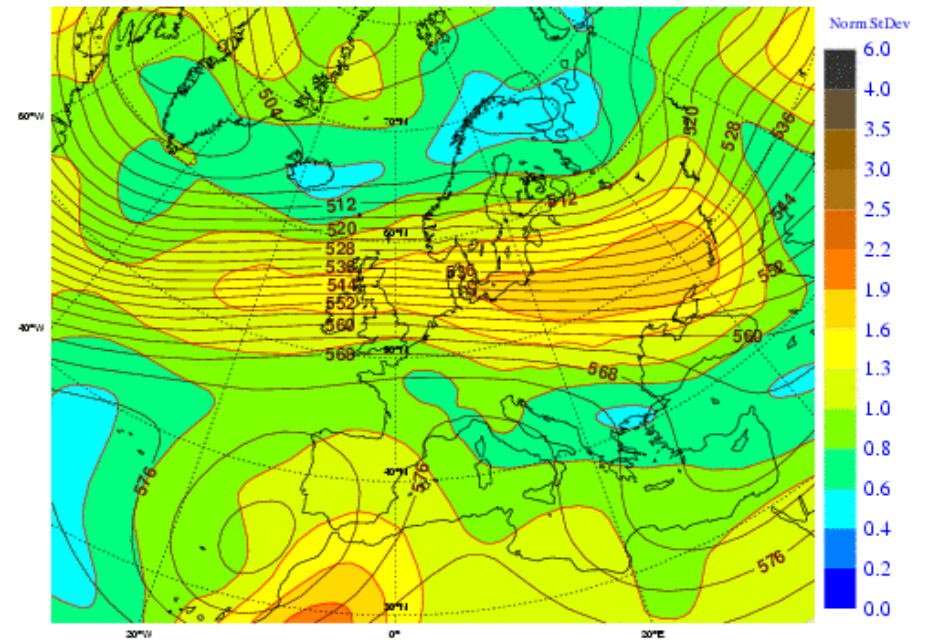
Jumpiness in forecasts

➤ Ensemble mean and spread

Saturday 16 February 2008 12UTC ECMWF Forecast 1+168 VT: Saturday 23 February 2008 12UTC
500hPa Geopotential Deterministic Forecast and Standard Deviation (shaded)

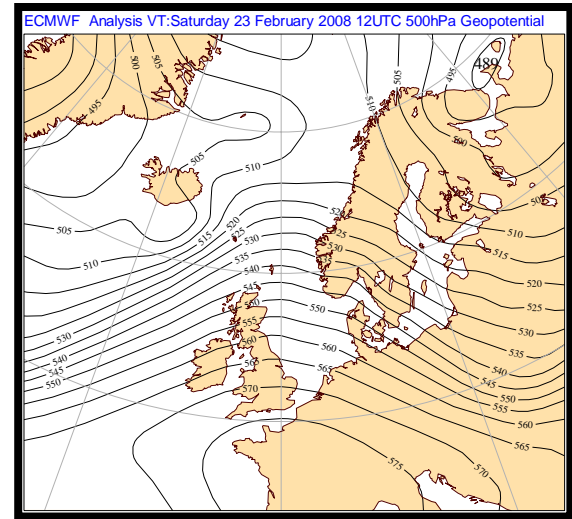


Saturday 16 February 2008 12UTC ECMWF Forecast 1+168 VT: Saturday 23 February 2008 12UTC
500hPa Geopotential Ensemble Mean and Normalised Standard Deviation (shaded)



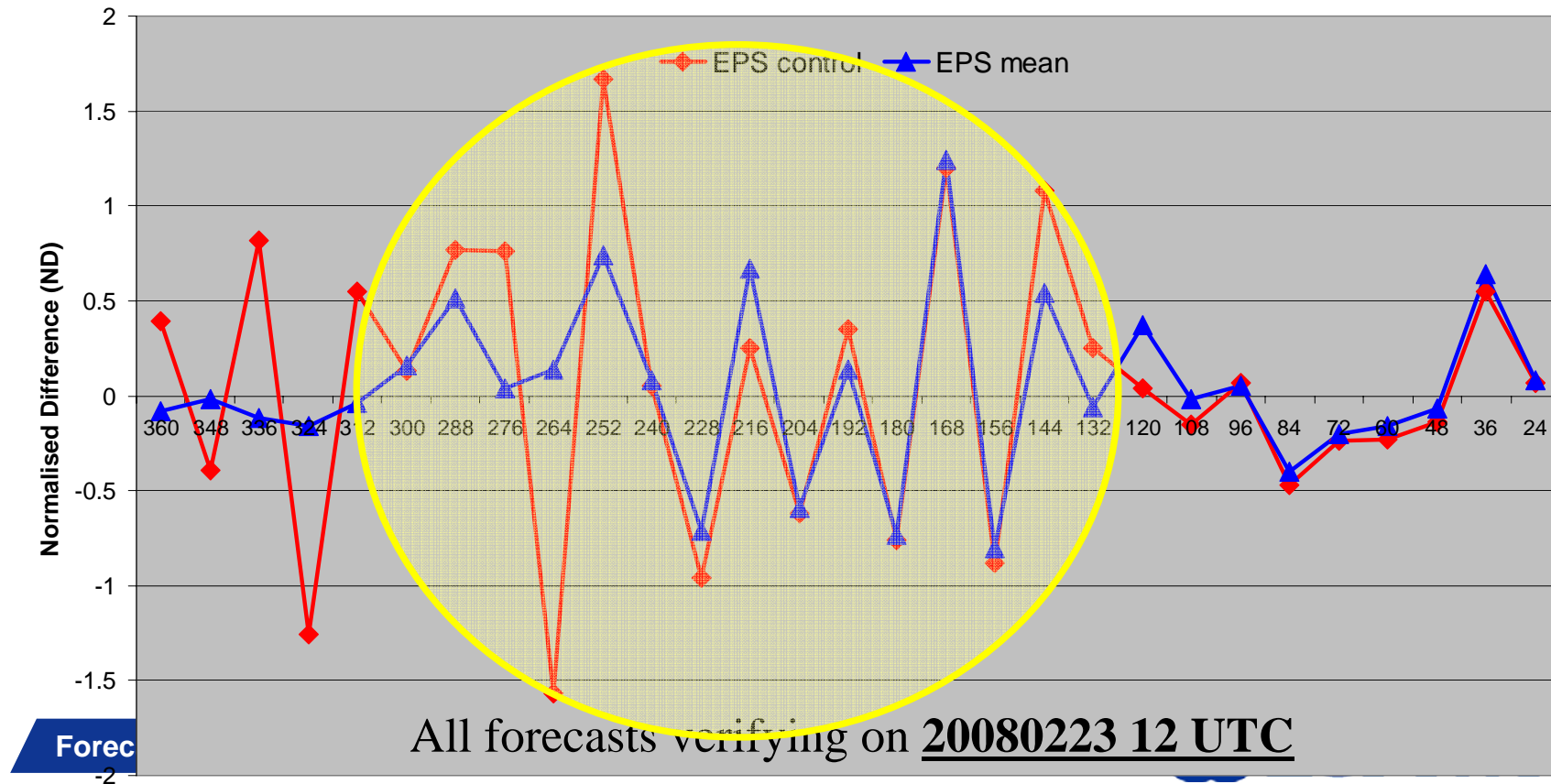
CASE STUDY

Situation of a temporary ridge with awkwardly jumpy behaviour in the EPS & the T799



12 hourly evolution of the EPS mean & Control forecast differences normalised by the RMSE

Fields are averaged over: [50N, 20W, 65N, 20E]

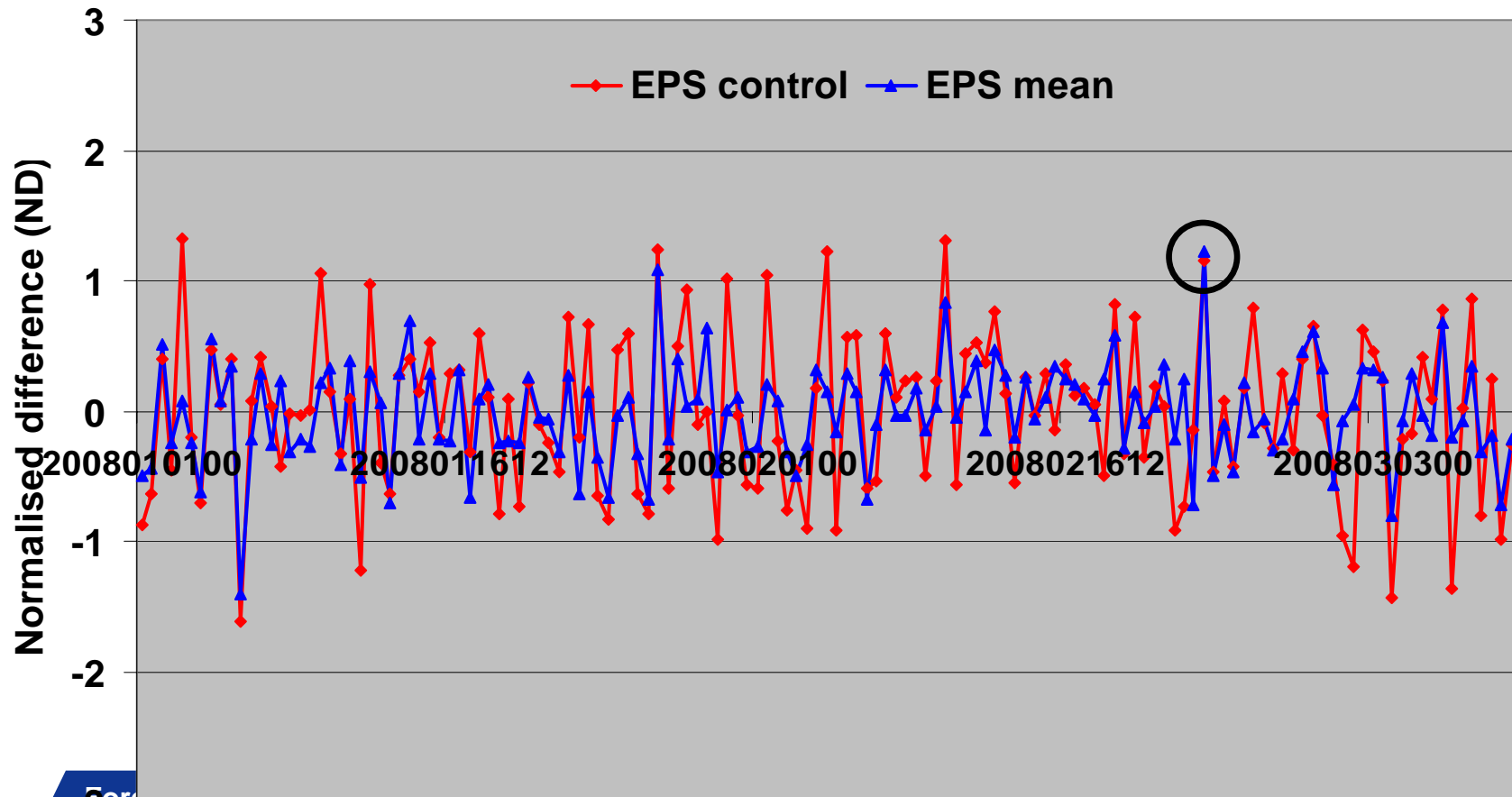


ND-EM and ND-CON time series & statistics

T+156 - T+168

area: [50N, 20W, 65N, 20E]
 Period for statistics: 2006121500 – 2008032000
 Period for plotting: 20080101 – 20080310

STATISTICS	EPS Control	EPS mean
MAND	0.44	0.25
POGEM	0.28	
CORR	0.59	



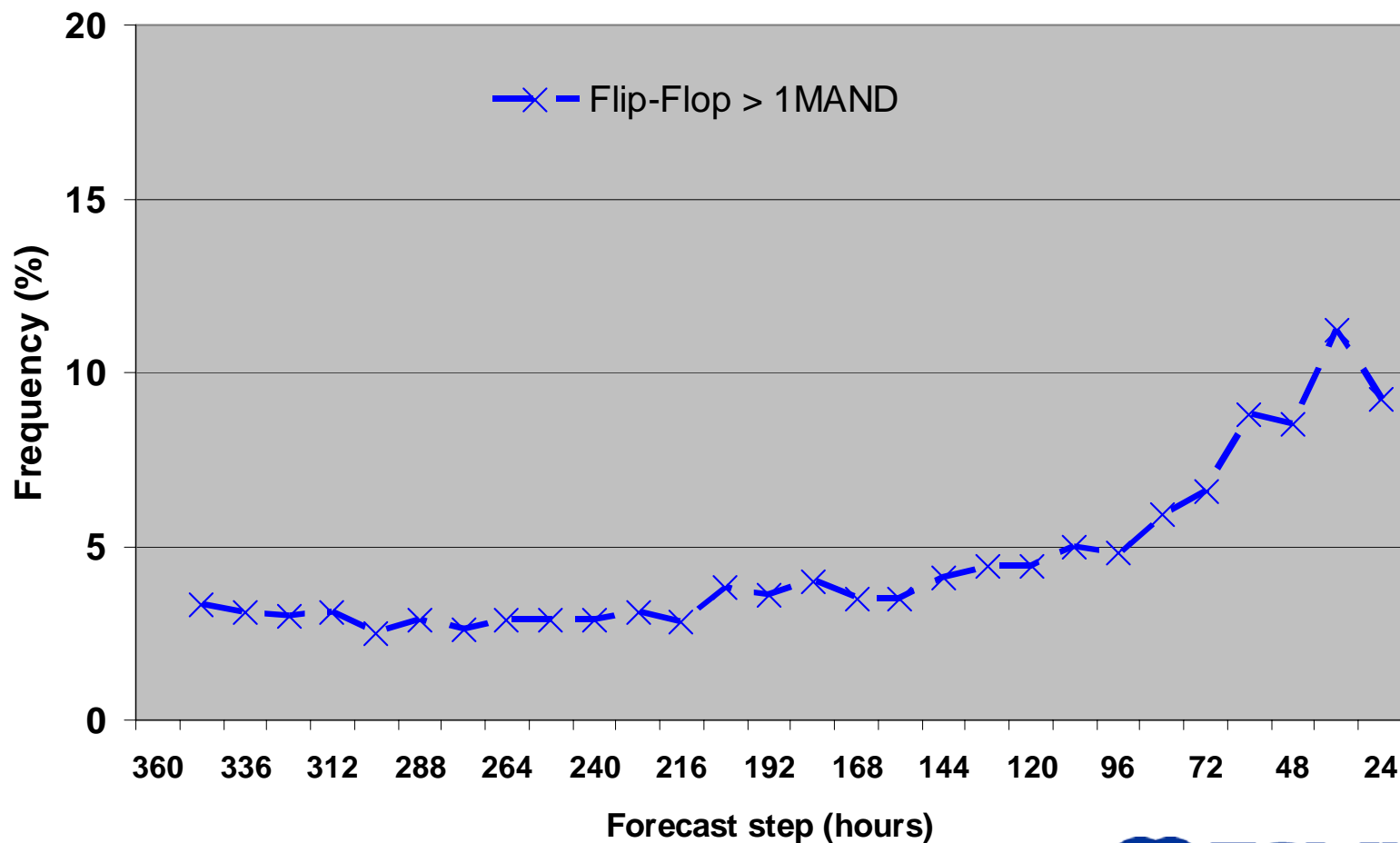
How often do the EPS mean and the Control jump together

area: NWEU - [50N, 20W, 65N, 20E]

Period for statistics: 2006121500 – 2008032000 (VarEPS)

MAND = Average normalised diff. over the whole period

MAND is different for the EPS mean and the Control at each forecast step

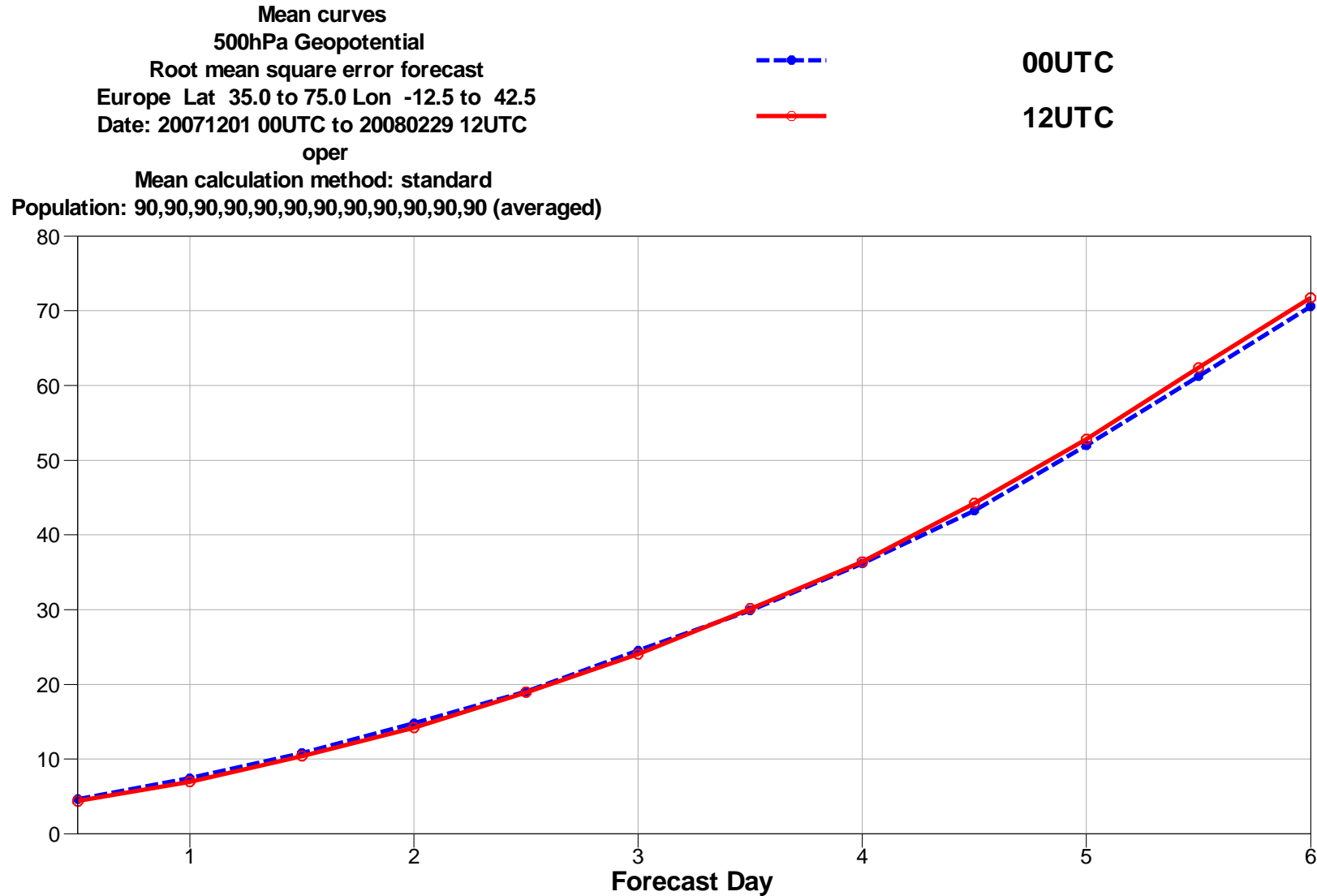


Preliminary conclusions - jumpiness

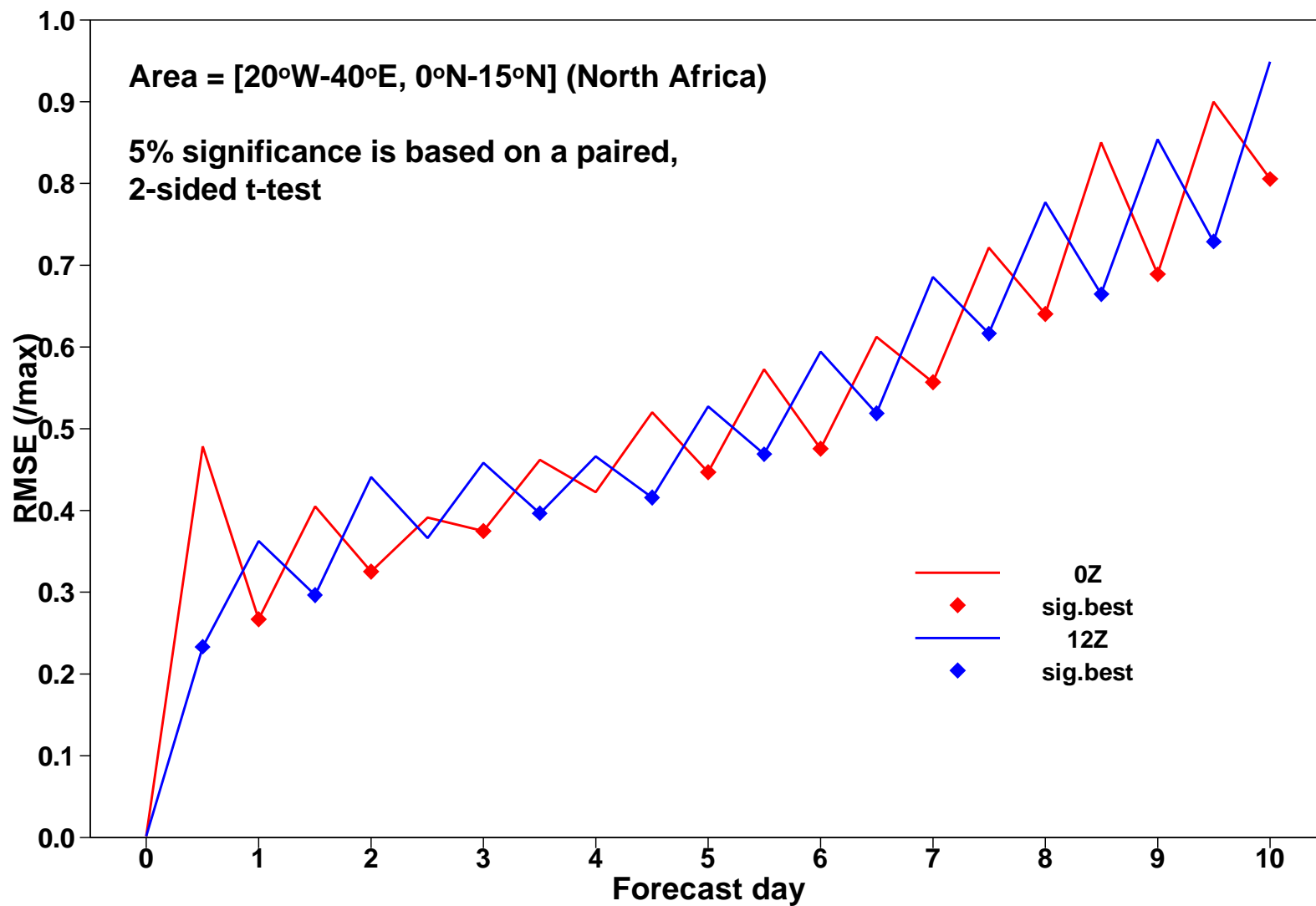
Ervin Zsoter, Roberto Buizza

- **The EPS mean shows much smoother behaviour as the forecast range increases by damping the control's erratic behaviour**
- **'flip-flops' in both control and EPS mean are uncommon**
- **There is little sensitivity of a result to the variable and to the area and also to the period (season/year)**
- **Work is in progress**

Differences between forecasts started at 00 and 12 UTC?

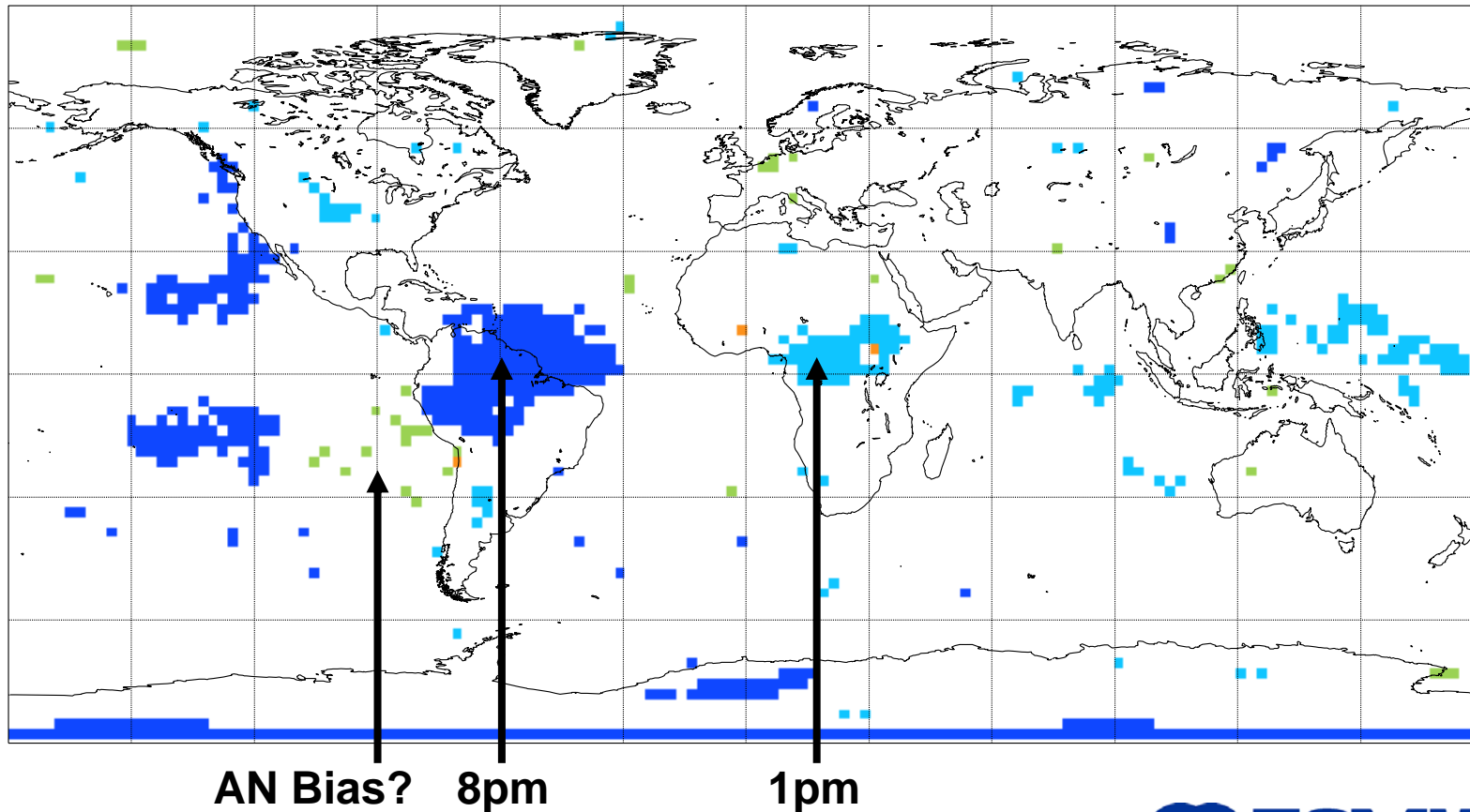


MAM 2007 Z500 RMSE 0Z vs 12Z



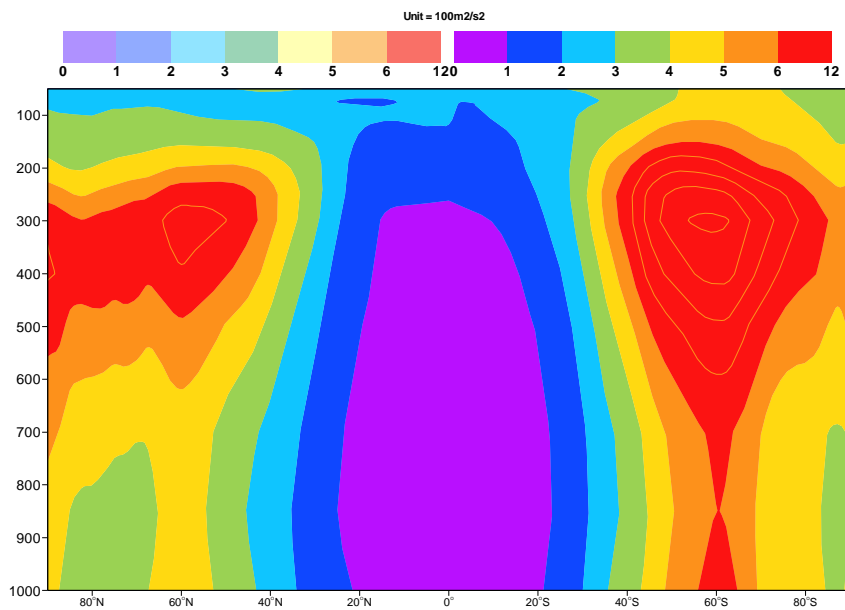
Significant Dominant Error Category

None >40% of days	FC		AN			
	0	12	Bias 0&12	0	Random 12	0&12

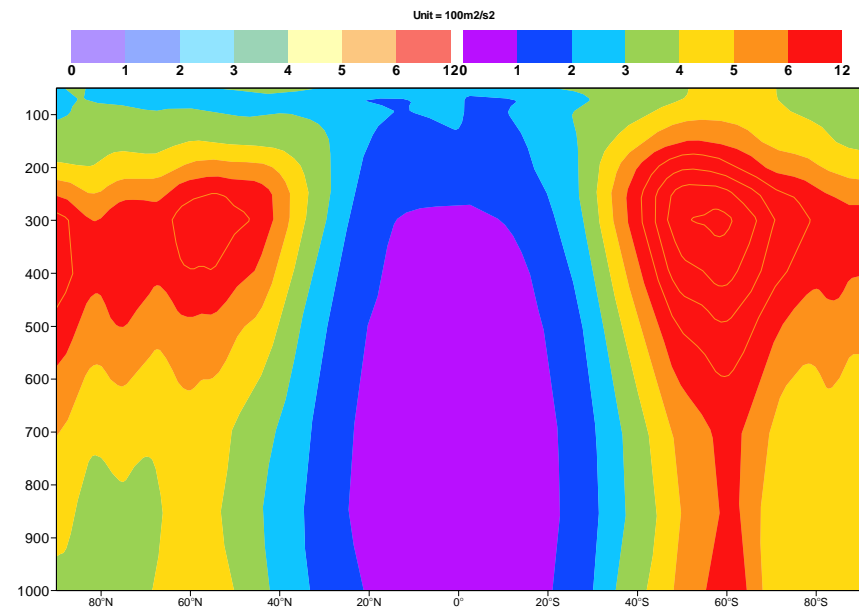


Zonal mean error 0 v 12 UTC

Forecast Error 0UTC D+5: RMS Z, 2008 MAM, Expver=oper 1, Analysis=oper 1. Deep colours = 5% significance



Forecast Error 12UTC D+5: RMS Z, 2008 MAM, Expver=oper 1, Analysis=oper 1. Deep colours = 5% significance



Conclusions 00 v 12

Mark Rodwell

- **No significant difference on average between forecast errors from 00 and 12 UTC over N hemisphere or Europe**
- **Problems over Africa with forecasts verifying at 12Z (mid-day local time)**
 - **Possible problem with timing of convection?**
- **Elsewhere, biases in the analysis can also be the dominant error category, though not with strong statistical significance**

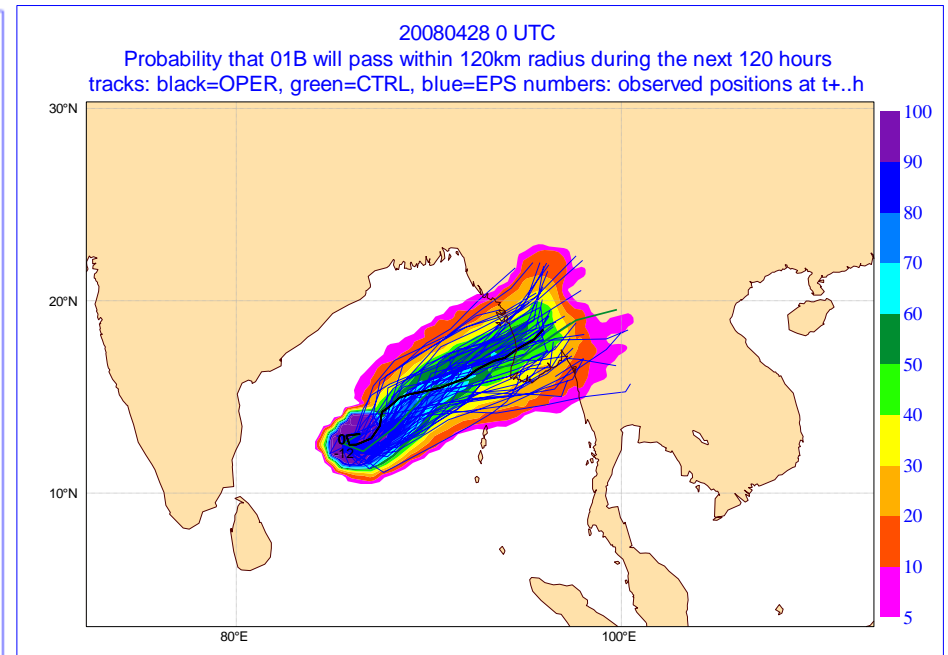
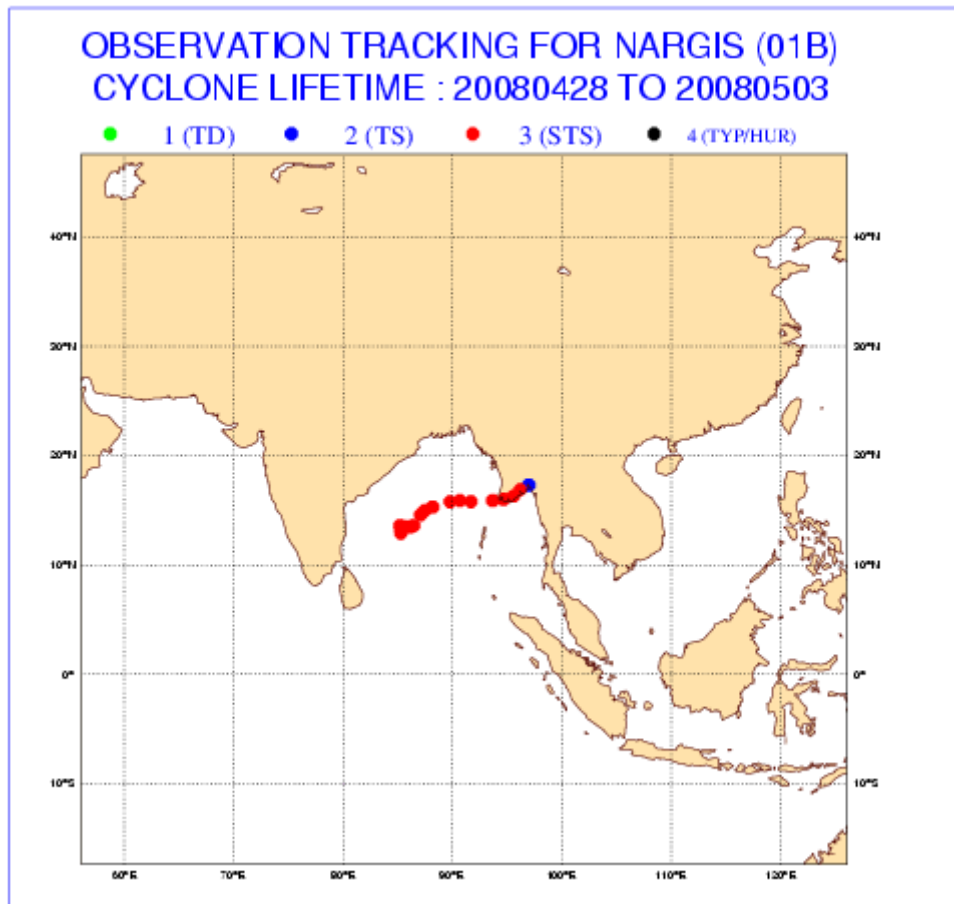
Product Development - implemented

- **All products available 10-25 minutes earlier**
- **Additional pressure levels for deterministic model**
- **Etadot fields available (vertical velocity in model coordinates)**
- **New wave products (maximum wave height)**
- **Ensemble mean and spread added to web**
- **EPSgrams: new parameters (wind direction, waves), revised precipitation scale**

Product Development – in progress

- **Tracking of tropical cyclones developing during forecast**
- **Review of clustering**
- **Percentiles (EPS and model climate)**
- **Clickable EFI map (show EPS and climate distribution at point)**
- **Climate information on EPSgrams, EFI maps**
- **Possible extension of EFI (parameters, steps)**
- **Extra-tropical cyclone products**
- **Collaboration with Meteoalarm on heat wave indices**

Typhoon Nargis – May 2008



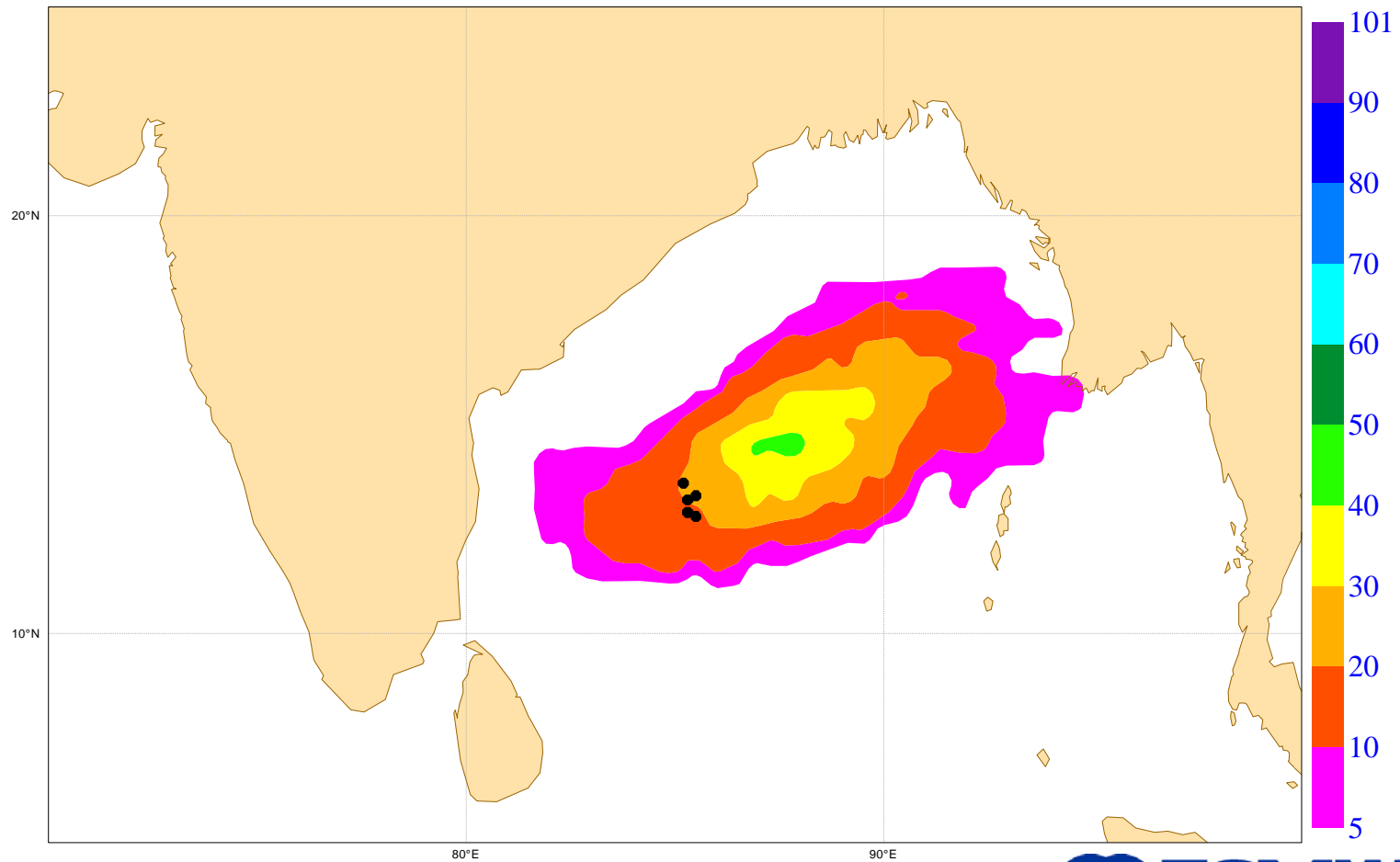
ECMWF strike probability forecast for
Nargis from 00 UTC 28 April

Genesis of typhoon Nargis

20080423 0 UTC

Probability that NARGIS will pass within 120km radius during the next 120 to 144 hours

VT: 20080428 - 20080429

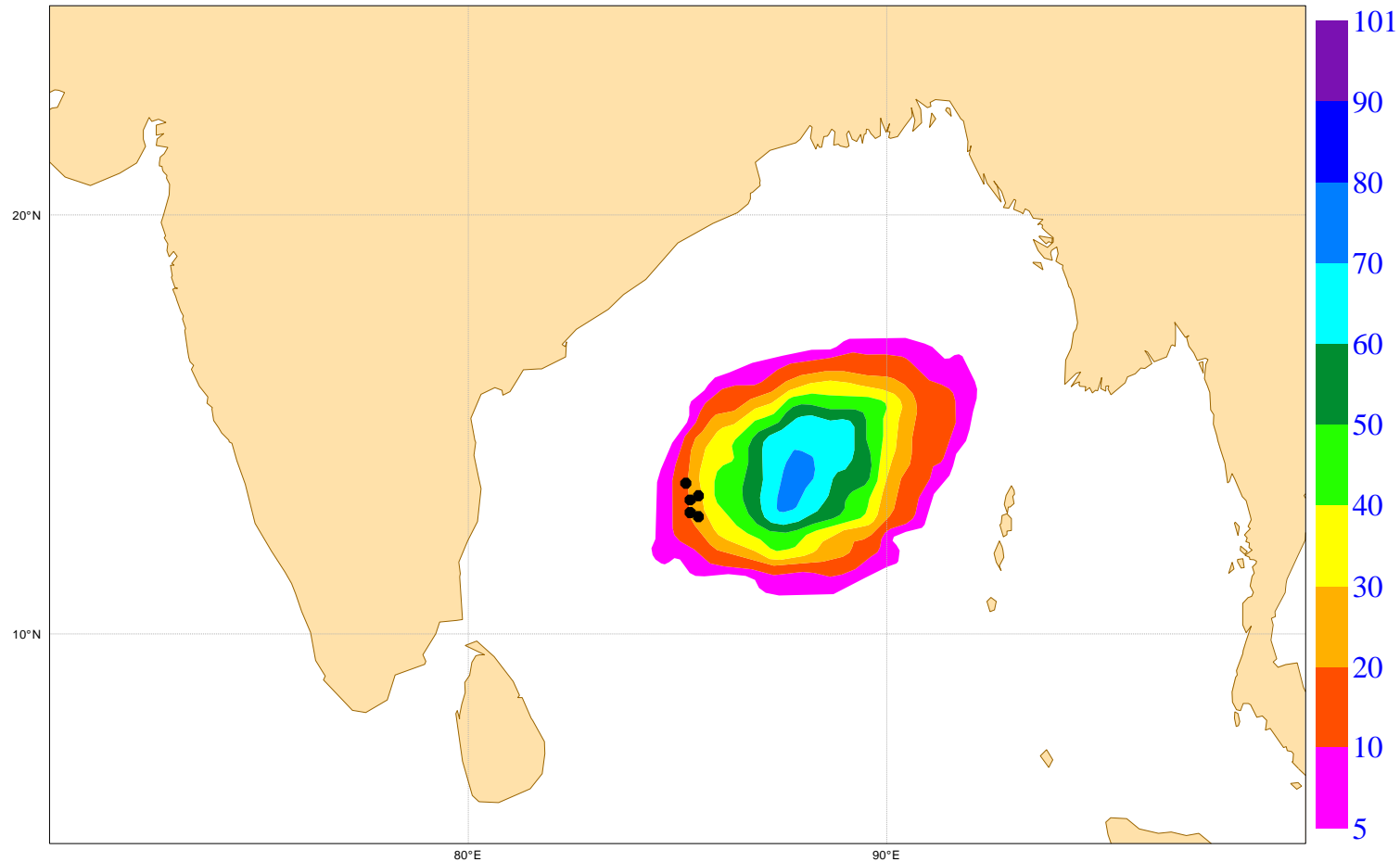


Genesis of typhoon Nargis

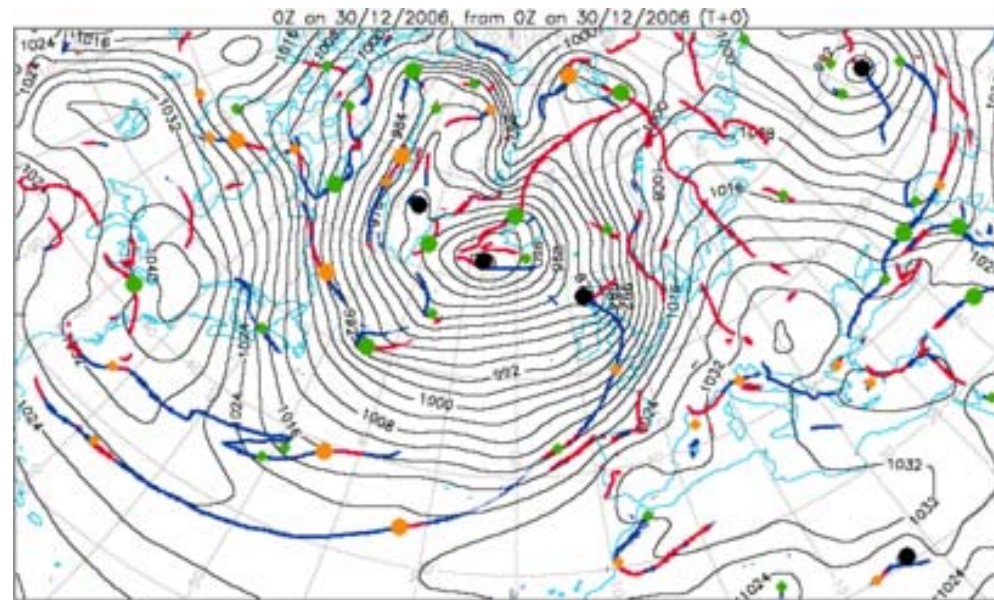
20080426 0 UTC

Probability that NARGIS will pass within 120km radius during the next 48 to 72 hours

VT: 20080428 - 20080429



Extra-tropical cyclones and objective fronts

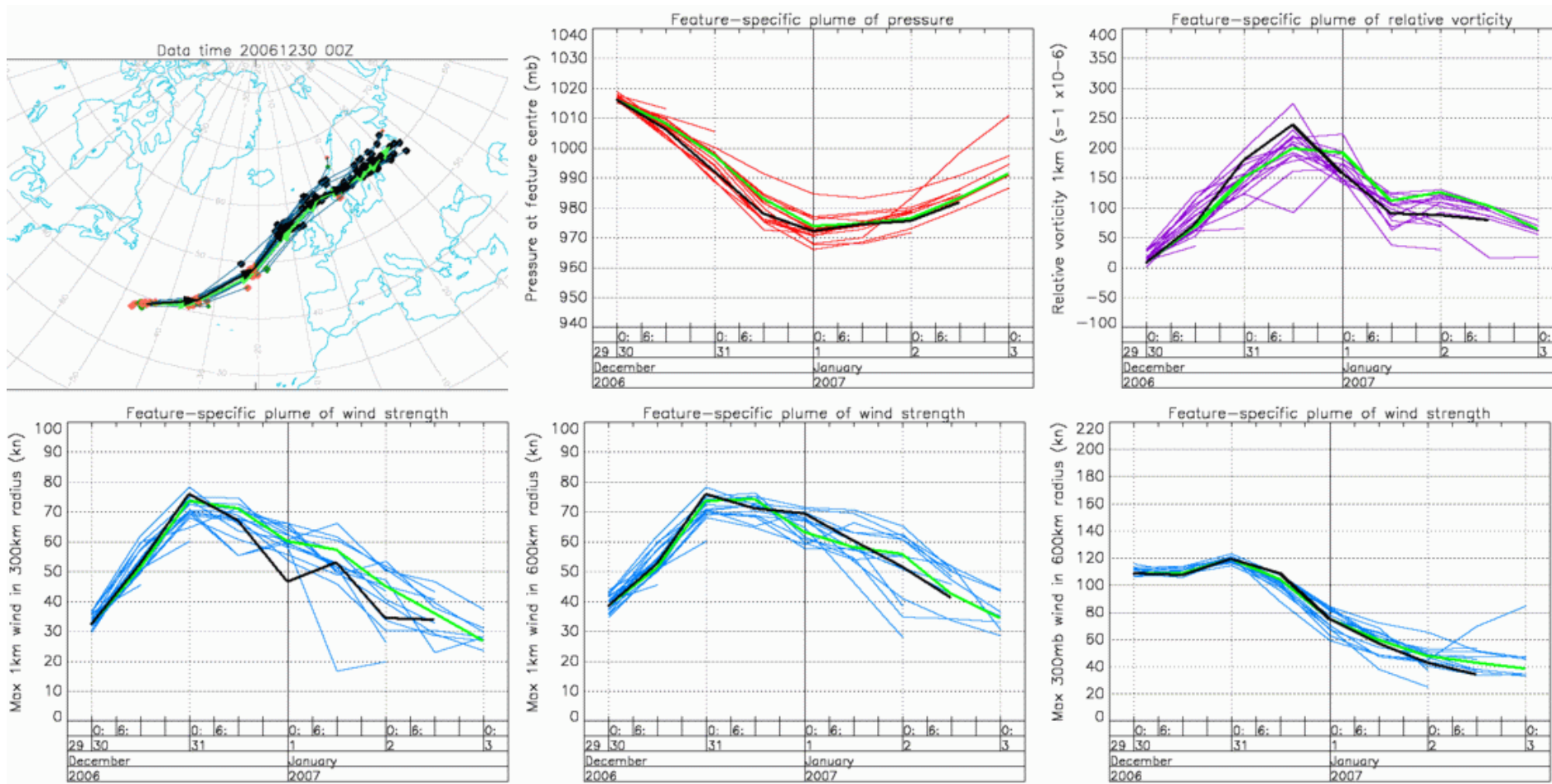


Tim Hewson and Helen Watkins (Met Office)

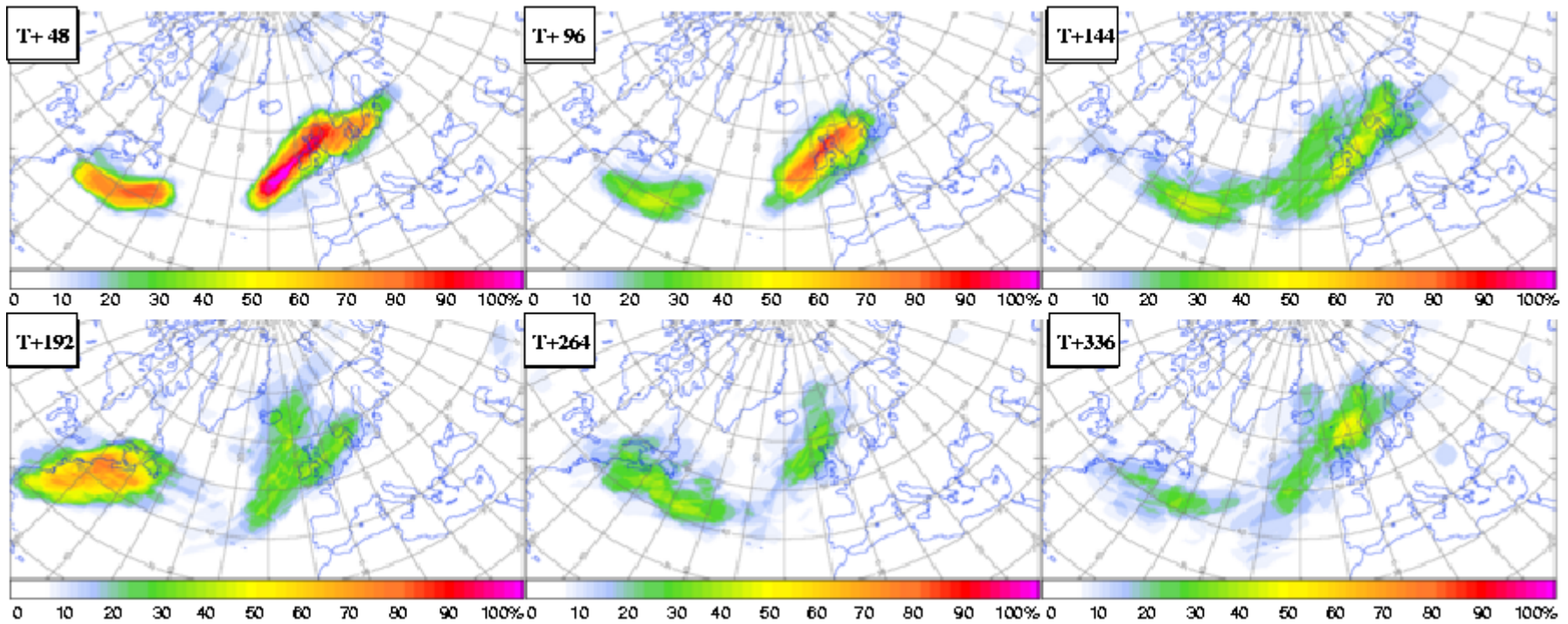
Hewson, T.D. 'Diminutive Frontal Waves - a link between Fronts and Cyclones'. Recently accepted for publication in J. Atmos. Sci.

Hewson, T.D. and Titley, H.A. 'Objective Identification and Typing of Cyclonic Features from Initiation through to Decay'. about to be submitted to Meteorol. Appl.

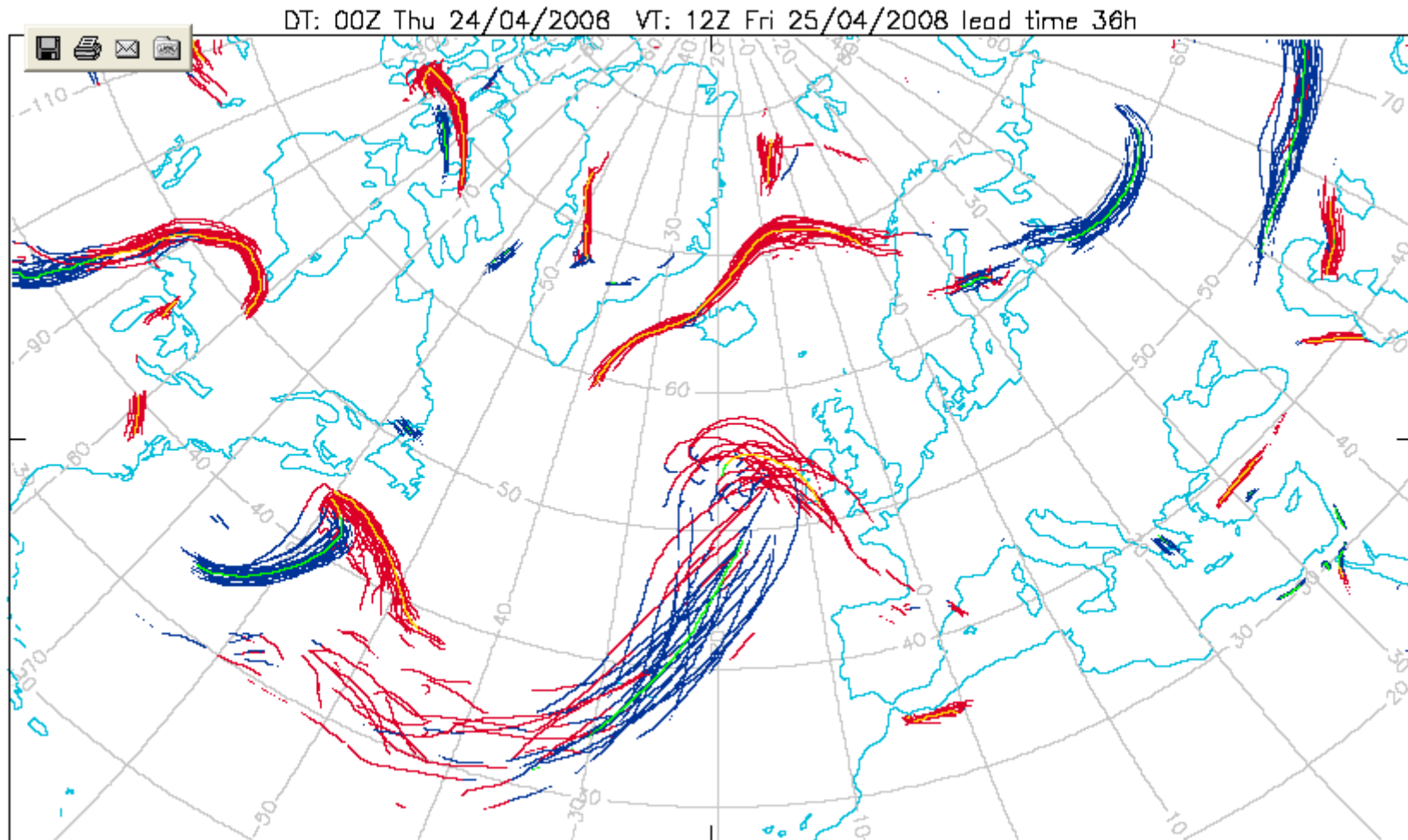
Extra-tropical cyclone tracking



Strike probability



Objective fronts



Web product development

- **Users increasingly rely on ECMWF website for routine forecast information**
- **At present web does not have same operational status as dissemination**
- **Project to improve service for products delivered via the web**
 - **Re-design the architecture (HW, SW) to match the quality of service provided by the operational dissemination**
 - **Produce plots on-demand**
 - **Major effort involving Met Division and Computer Division**
- **User requirements?**

2007 user comments and requests (1)

- **Expressed interest in earlier delivery of day 1-10 products (~30 minutes)**
- **Monthly forecast run on Sunday preferred by some users (Thursday run still also required by other users)**
- **Requests for new products**
 - **Confirmed requirement for current ECMWF product developments**
 - **additional requests for**
 - **More pressure level data**
 - **Interest in improved sunshine duration, precipitation duration/onset (subject to future research)**
 - **Wave EPSgrams and EFI; visualisation of altimeter data with wave analysis fields**
 - **Daily precipitation frequency for seasonal forecast**
 - **Development of extra-tropical cyclone track products**

2007 user comments and requests (2)

- **Strong interest in re-forecasts for both medium-range and monthly use (will be available in unified VarEPS/monthly)**
 - **Request to run ahead of real time (as planned)**
 - **Interest in 51-member hindcast set for performance assessment for medium-range and monthly forecasts**
- **Interest in zoomable maps: display more details (higher resolution) for smaller regions**
- **Interest in development of more sophisticated routines (available to users) for interpolation in both space and time, for use in product generation**

PREVIEW data targeting system (DTS)

- **Interactive web-based system to provide data targeting information and request additional observations to improve short-range (1-3 days) forecasts of potentially high-impact or high uncertainty weather events in Europe**
- **DTS has been developed by ECMWF in partnership with UK Met Office**
- **Funded by EU and EUCOS as part of Eurorisk PREVIEW**

DTS development

- **Prototype trial from September-October 2007**
 - System performed very well
 - Some useful suggestions and improvements
- **Pre-operational trial began in February 2008 (restricted users)**
- **Full access to all interested users began in March 2008**
- **Trial will continue to end December 2008**
- **During trial additional observations can be requested from radiosondes, European ASAP (ship-launched radiosondes), European AMDAR (commercial aircraft)**
- **More information on website:**
http://www.ecmwf.int/research/EU_projects/PREVIEW/DTS/index.html

PREVIEW DTS Statistics

4th February to 22nd April 2008 (inclusive)

- Cases suggested by UKMO, Meteo-France, ECMWF and DWD
 - **Total number of cases proposed: 179**
 - **Total number of cases accepted: 156**
 - **Additional 73 cases from the IPY-THORPEX experiment (automatically accepted)**
- SACs are performed for all accepted cases
- Extra observations requested from 70 cases
 - **558 observations requested (including AMDAR)**
 - **463 observations requested (excluding AMDAR)**
 - **375 extra observations deployed (excluding AMDAR)**
- 84% of requested radiosonde launched were made