



MOGREPS short-range ensemble forecasting
and
the PREVIEW Windstorms Project

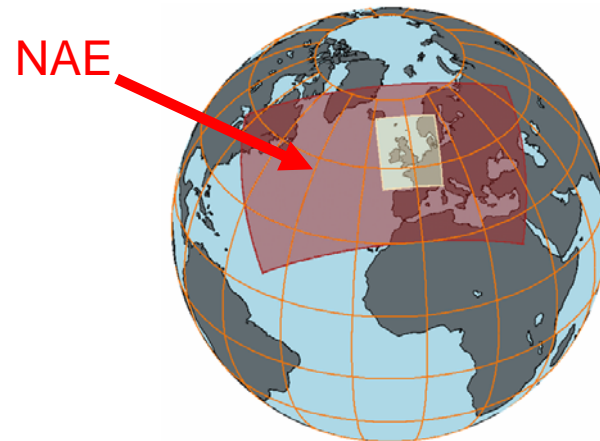
Ken Mylne

Thanks to all those who have contributed to both projects.

- **MOGREPS**
 - System outline
 - Product examples
 - Verification

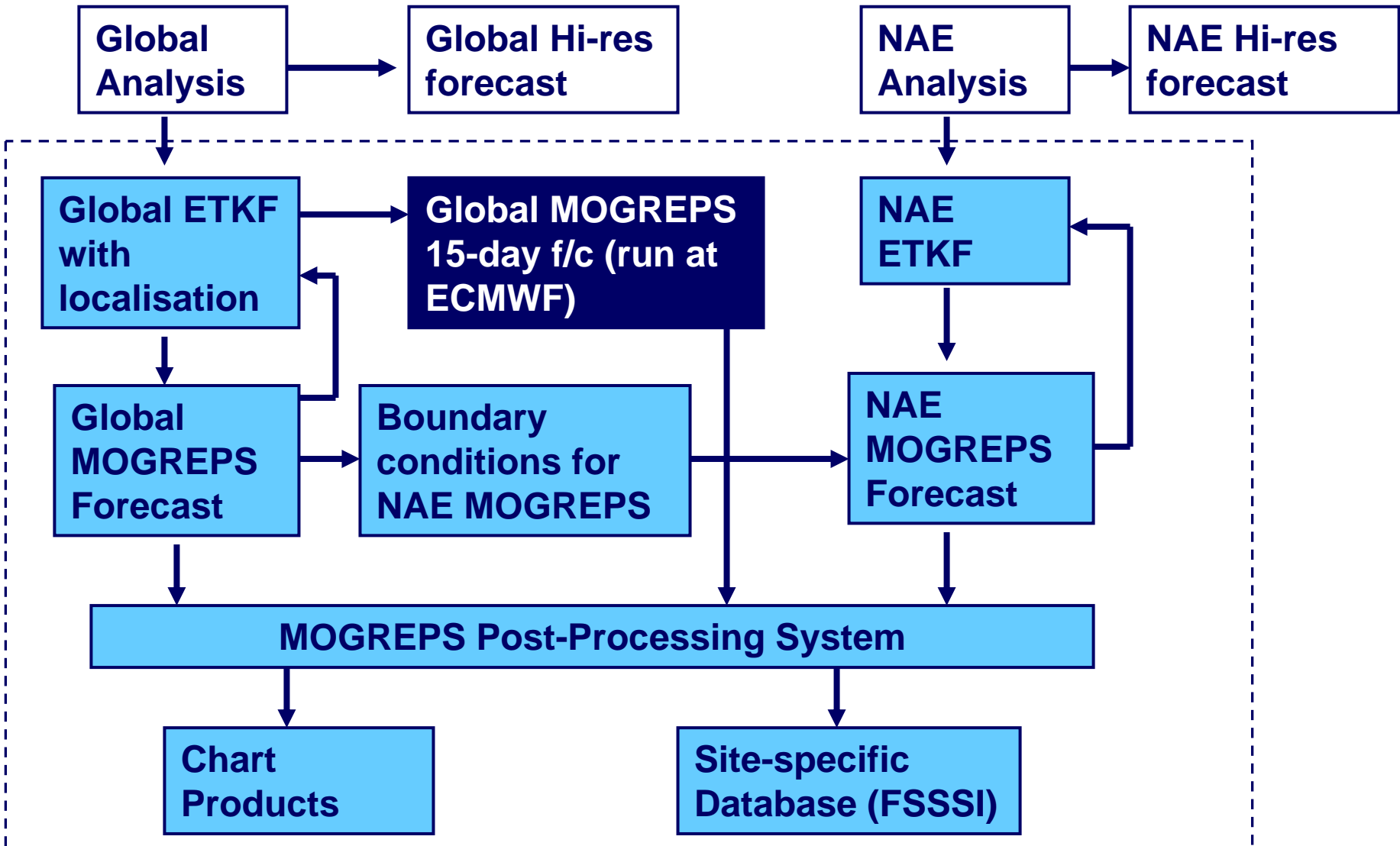
- **PREVIEW Windstorms**
 - The same!

- 24-member ensemble designed for short-range forecasting
 - Regional ensemble over N. Atlantic and Europe (NAE) (24km resolution, 38 levels) to T+54
 - Global ensemble (~90km resolution, 38 levels) to T+72
 - Also runs to 15 days at ECMWF for THORPEX
 - ETKF for initial condition perts
 - Stochastic physics
 - Global run at 0Z and 12Z. Regional run at 6Z & 18Z

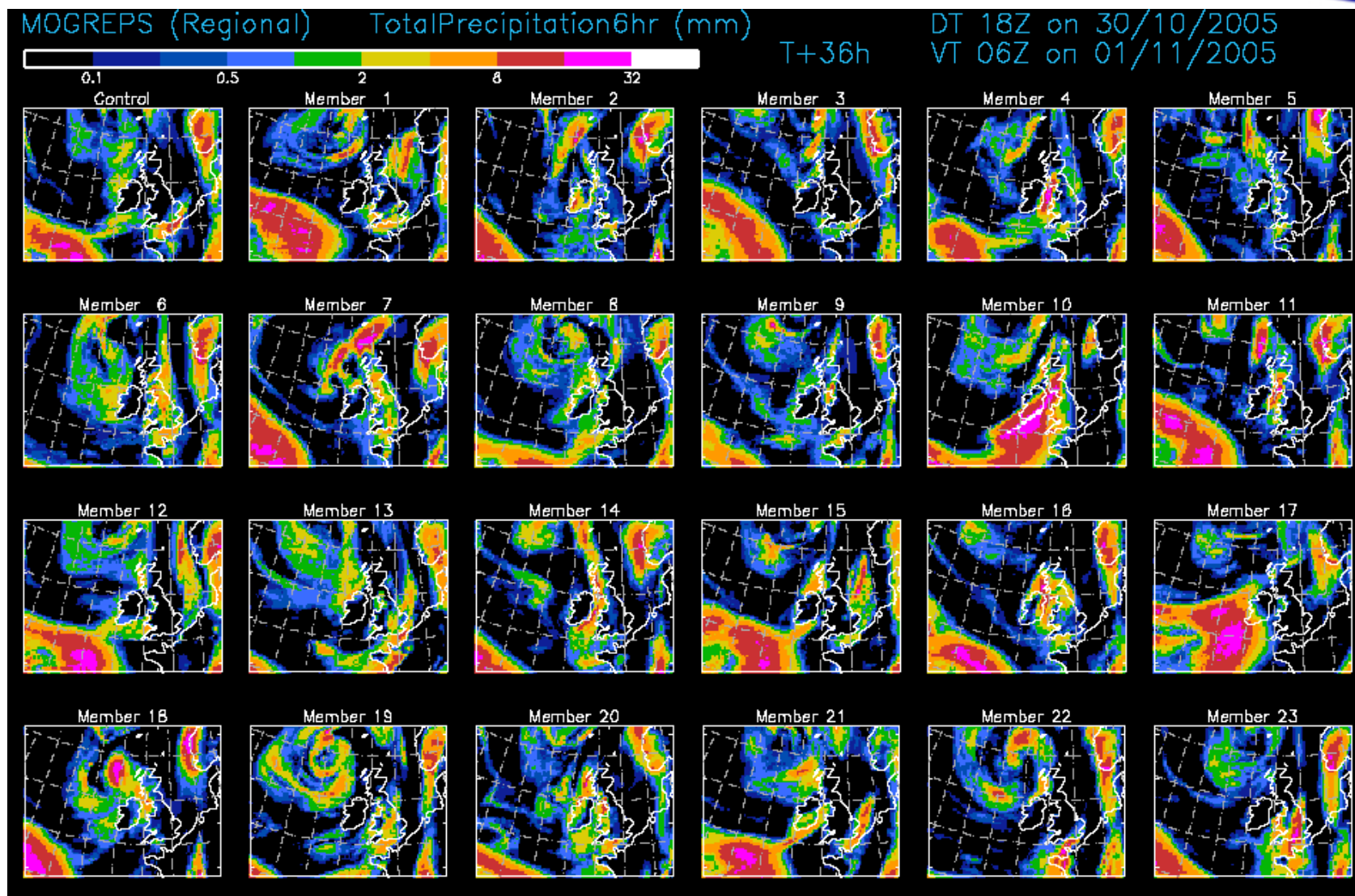


MOGREPS has successfully completed a 1-year Operational Trial. Planned to become operational by March 2008.

MOGREPS System diagram

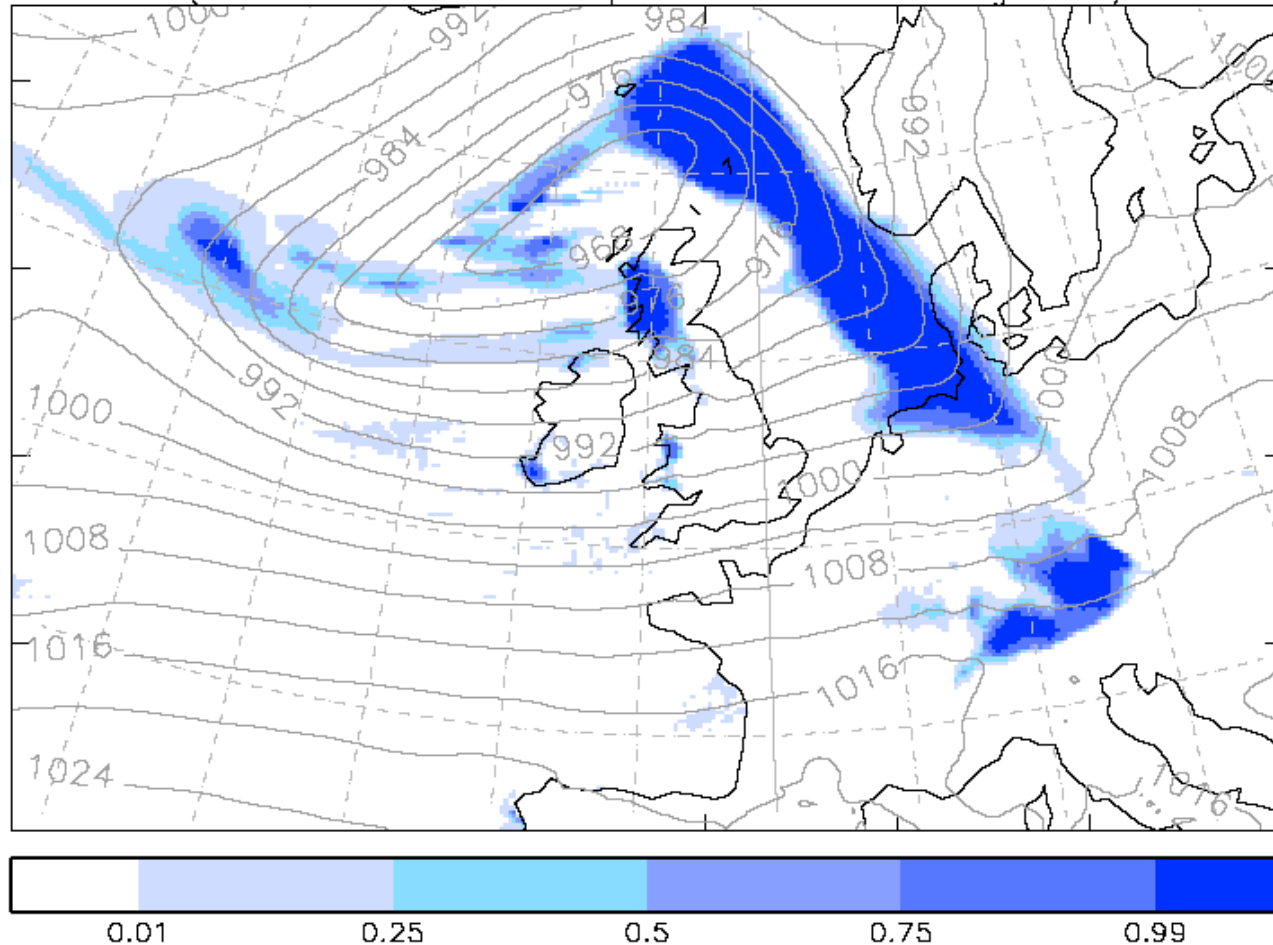


Example MOGREPS 33h Rainfall forecast



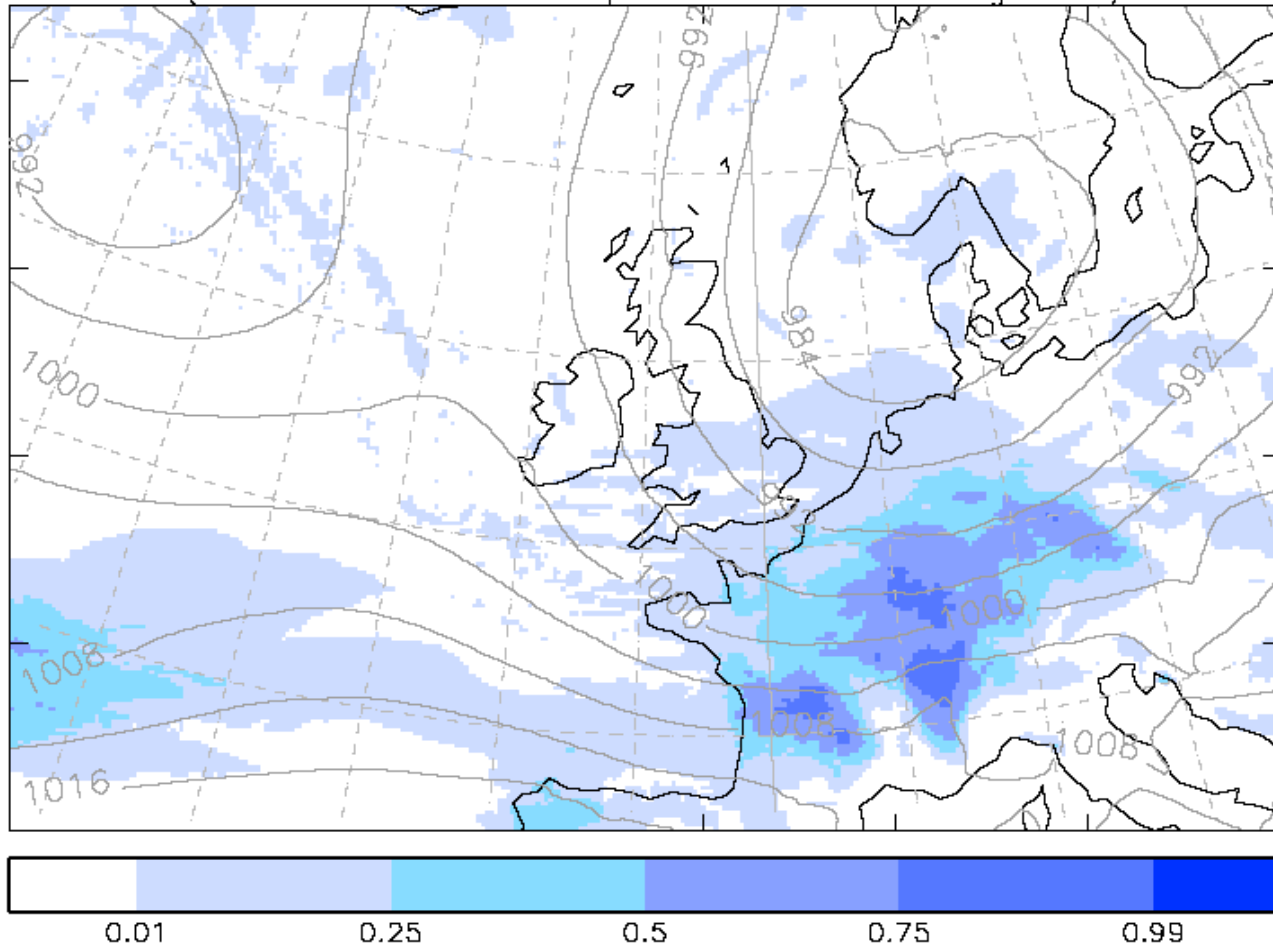
Products – Probability charts

MOGREPS (Regional) Probability map for 6HourPrecip > 5.0mm
DT 18Z on 27/02/2007 VT 00Z on 28/02/2007 lead time 06h
(Ensemble Mean PMSL plotted as faint background)



Products – Probability charts

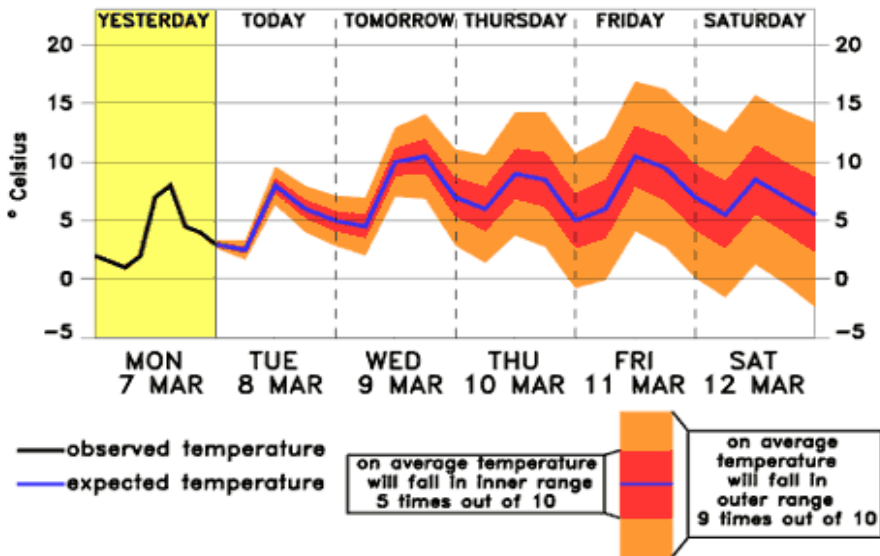
MOGREPS (Regional) Probability map for 6HourPrecip > 5.0mm
DT 18Z on 27/02/2007 VT 00Z on 02/03/2007 lead time 54h
(Ensemble Mean PMSL plotted as faint background)



MOGREPS Site-specific forecasts



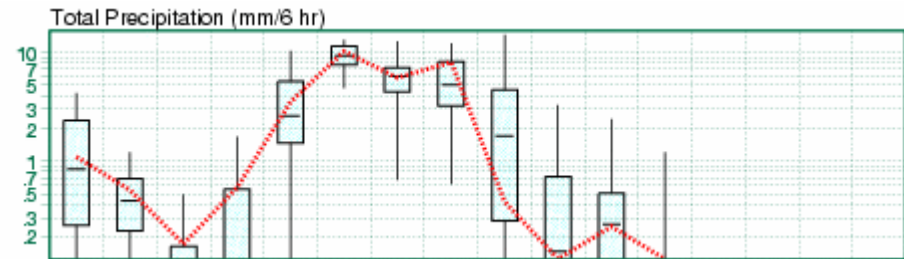
- Fan chart – can mix MOGREPS and ECMWF data



- Kalman filter MOS is being implemented for MOGREPS forecasts

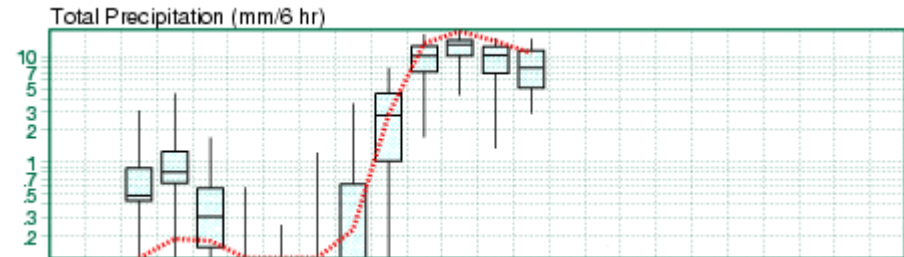
MOGREPS Global EPS Meteogram

EXETER HQ SITE (99085) 50.7° N 3.5° W
RAW - EPS Forecasts : 20 May 2006 00 UTC



MOGREPS European EPS Meteogram

EXETER HQ SITE (99085) 50.7° N 3.5° W
RAW - EPS Forecasts : 20 May 2006 6 UTC



Hurricane Katrina

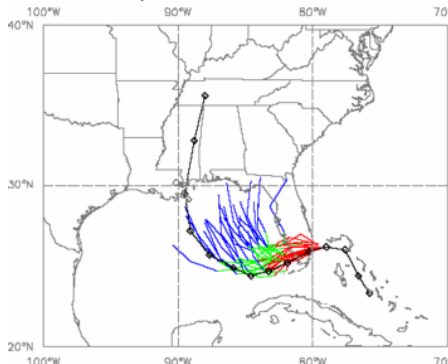


Tropical cyclone products from the experimental MOGREPS 15-day ensemble



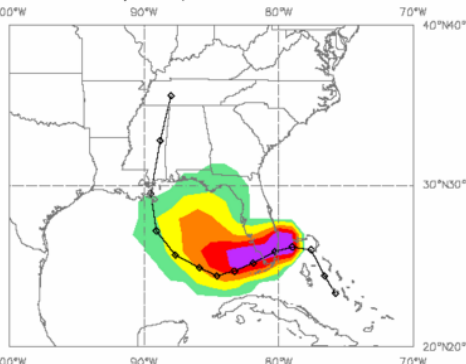
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KATRINA : DT 00Z 26/08/2005
a) Ensemble forecast tracks



— T0-24 — T72-96 — T144-168 — T216-240
— T24-48 — T96-120 — T168-192 — T240-264
— T48-72 — T120-144 — T192-216 — T264-288

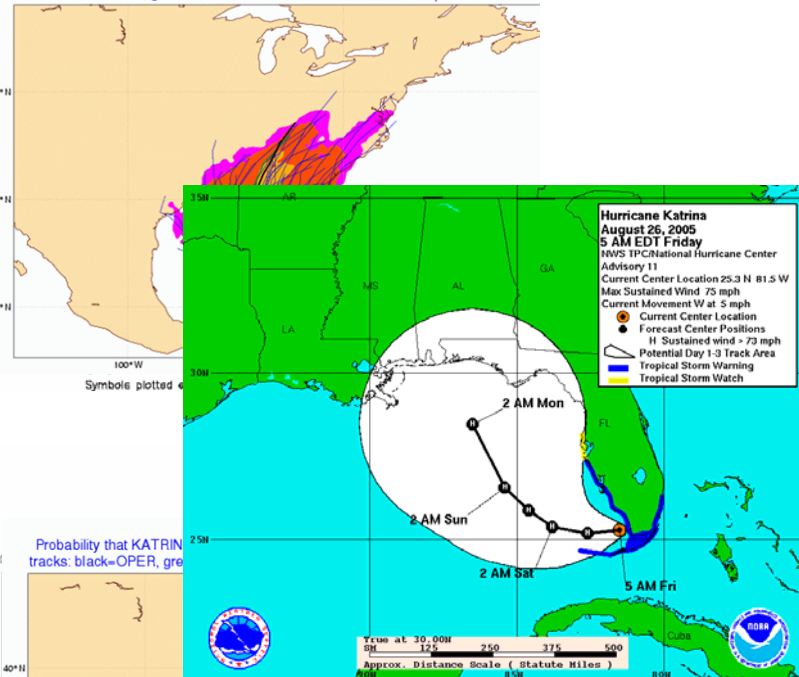
KATRINA : DT 00Z on 26/08/2005
b) Strike probabilities



Probability will pass within 75 miles in next 12 days

■ 5-19% ■ 20-39% ■ 40-59% ■ 60-79% ■ 80-100%

20050826 0 UTC
Probability that KATRINA will pass within 120km radius during the next 120 hours
tracks: black=OPER, green=CTRL, blue=EPS numbers: observed positions at t+ .h

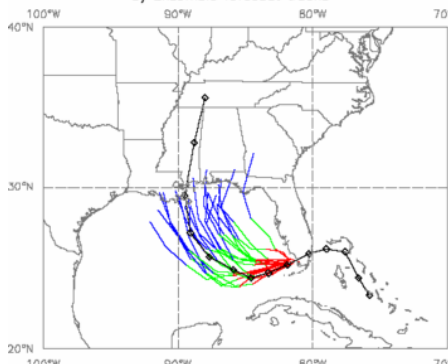


Tropical cyclone products from the experimental MOGREPS 15-day ensemble



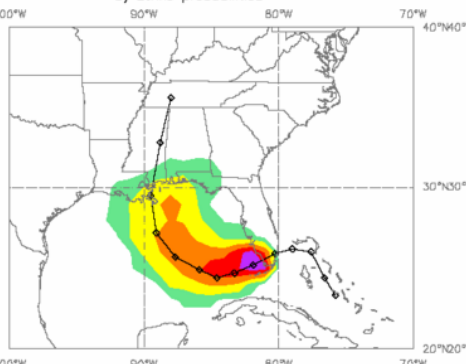
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KATRINA : DT 12Z 26/08/2005
a) Ensemble forecast tracks



— T0-24 — T72-96 — T144-168 — T216-240
— T24-48 — T96-120 — T168-192 — T240-264
— T48-72 — T120-144 — T192-216 — T264-288

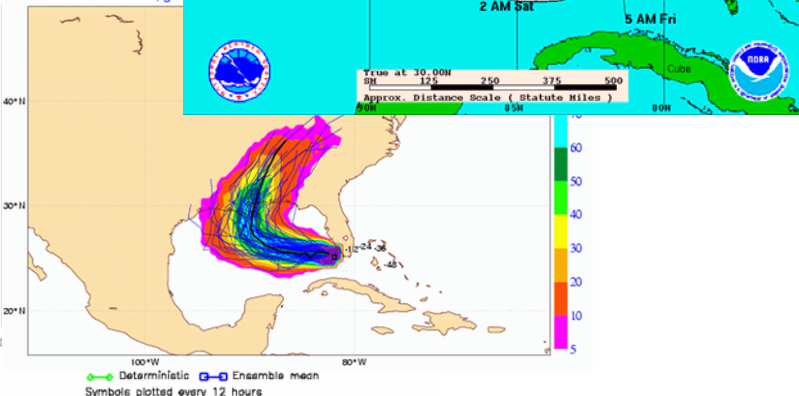
KATRINA : DT 12Z on 26/08/2005
b) Strike probabilities



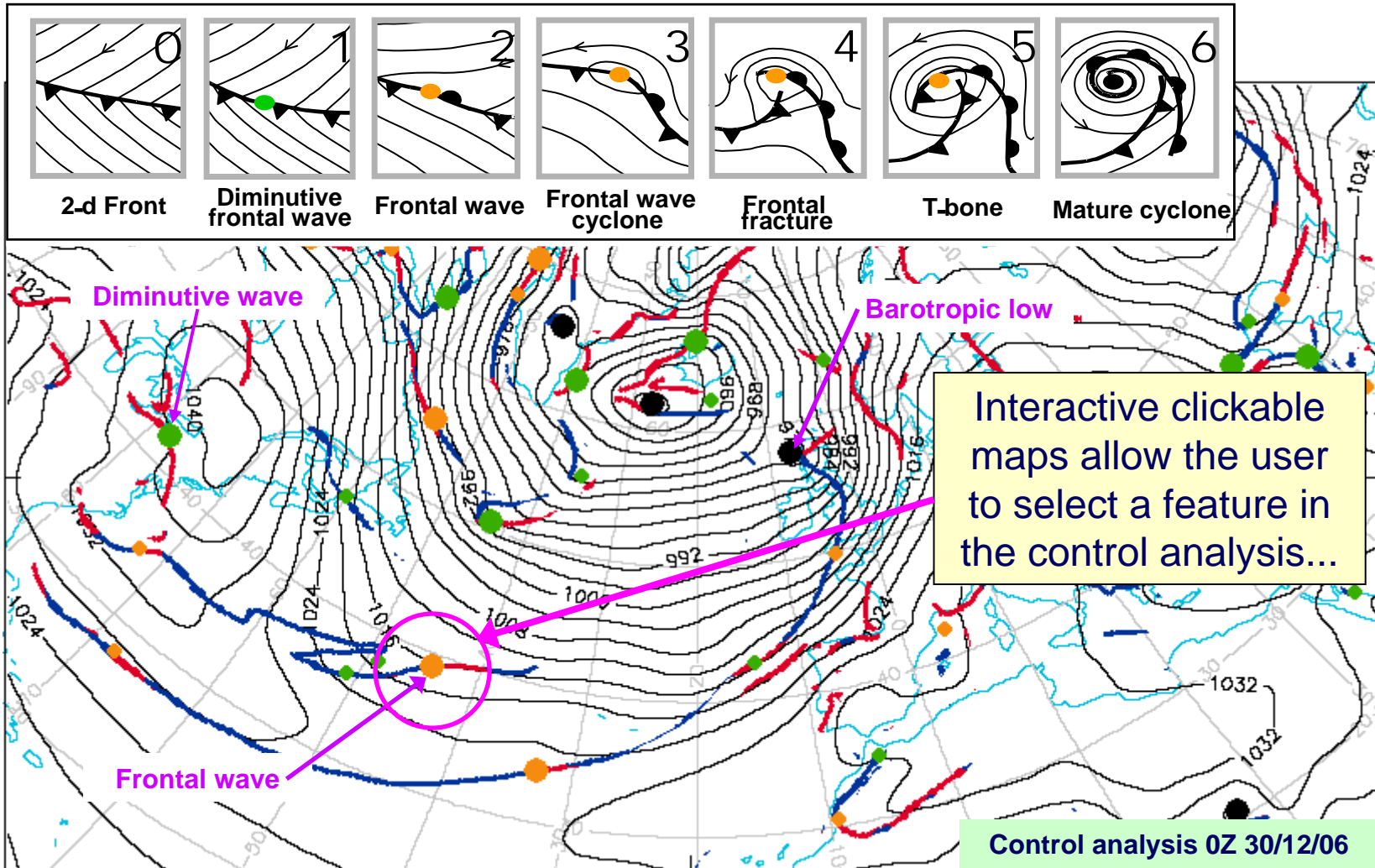
Probability will pass within 75 miles in next 12 days

■ 5-19% ■ 20-39% ■ 40-59% ■ 60-79% ■ 80-100%

Probability that KATRINA will pass within 120km radius during the next 120 hours
tracks: black=OPER, green=CTRL, blue=EPS numbers: observed positions at t+ .h



Cyclone database & New Year's Eve storm

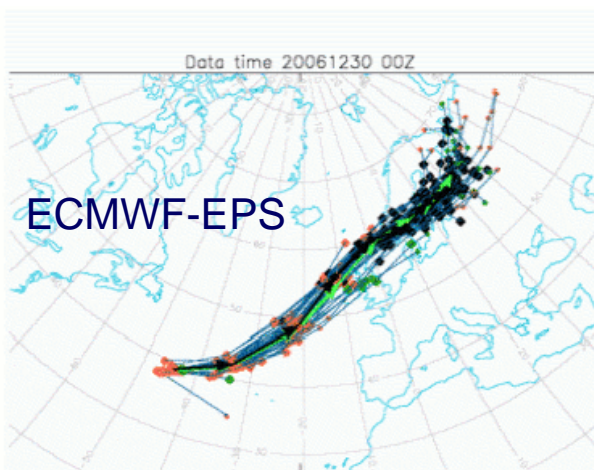
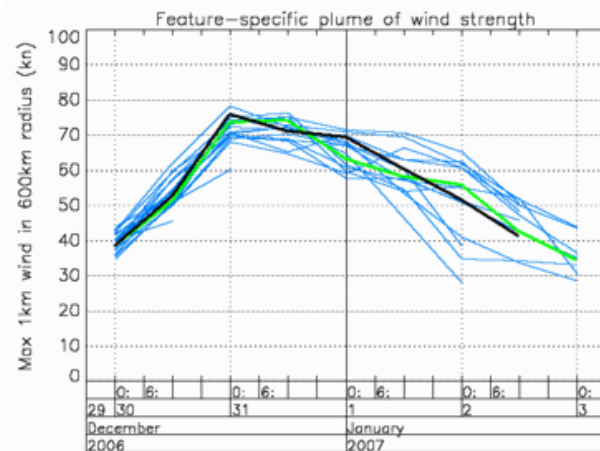
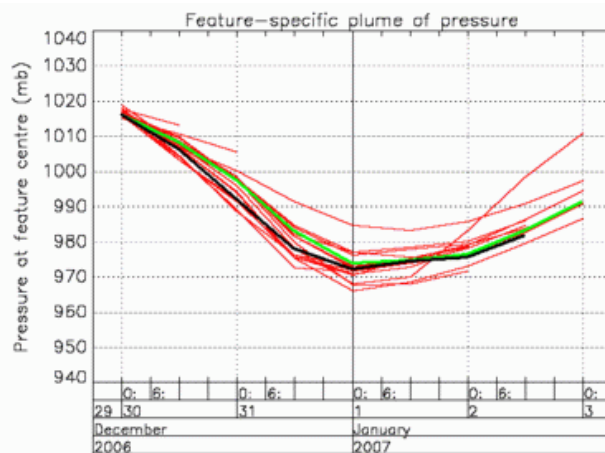
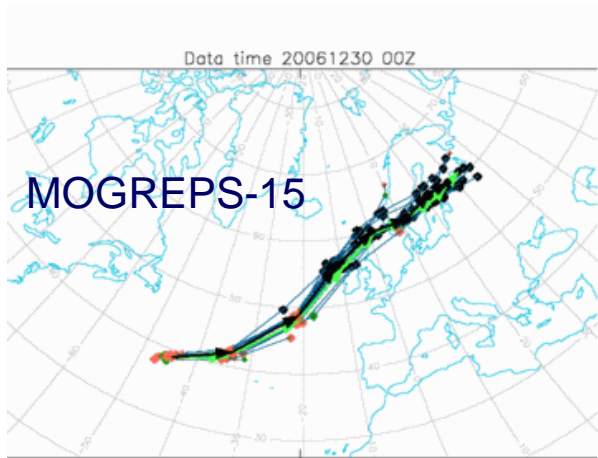


- Tracking scheme uses a combination of forward and backward tracking. It uses extrapolation and 500hPa steering wind to estimate positions, and matches features based on separation distance, type and thickness

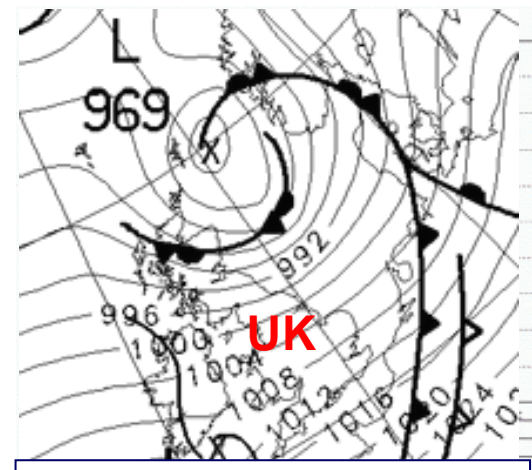
Cyclone database: 31/12/2006 example



- Clicking on a feature brings up feature-specific tracks from each ensemble member and matching plumes of intensity measures to identify the potential for high-impact weather



This storm tracked across Scotland, with gusts up to 100mph, leading to the high-profile cancellation of New Year's Eve celebrations and loss of power to 1000s of homes

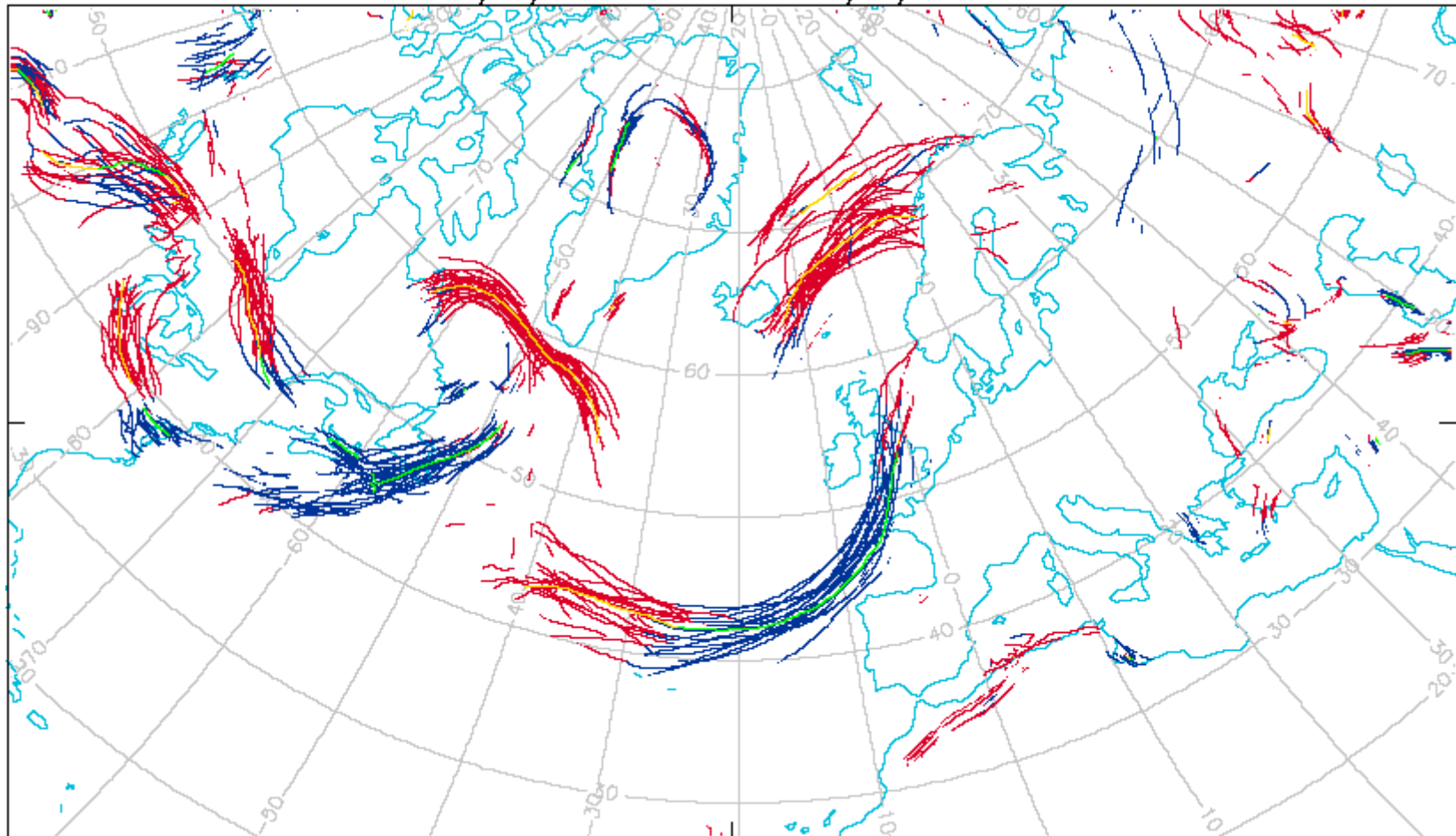


Analysis 00Z 01/01/2007

Cyclone database: Spaghetti plot of objective fronts

- The cyclone database objectively identifies fronts and cyclonic features in the extra-tropics

DT: 00Z Fri 21/09/2007 VT: 00Z Mon 24/09/2007 lead time 72h

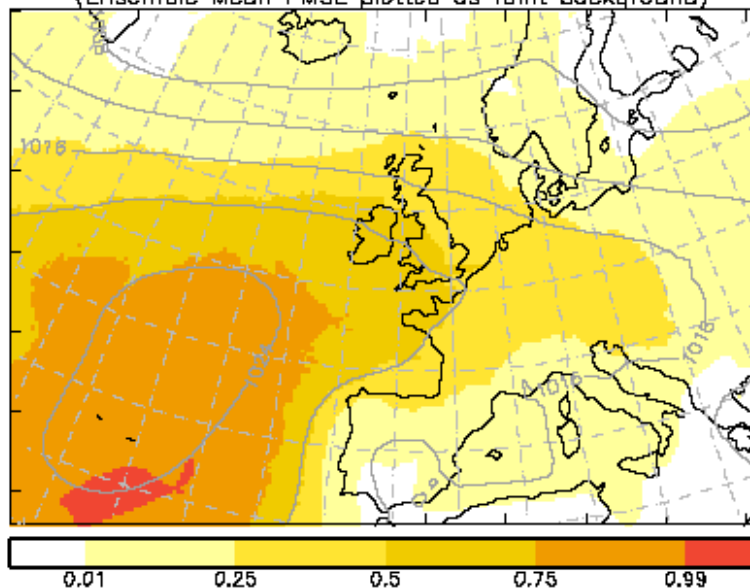
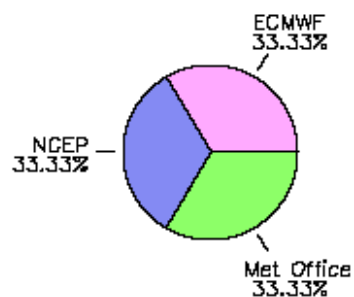


THORPEX Multimodel products: Probability plot



THORPEX Multimodel Probability map for PMSL > 1020hPa
DT: 00Z Thu 23/08/2007 VT: 12Z Fri 31/08/2007 lead time 204h
(Ensemble Mean PMSL plotted as faint background)

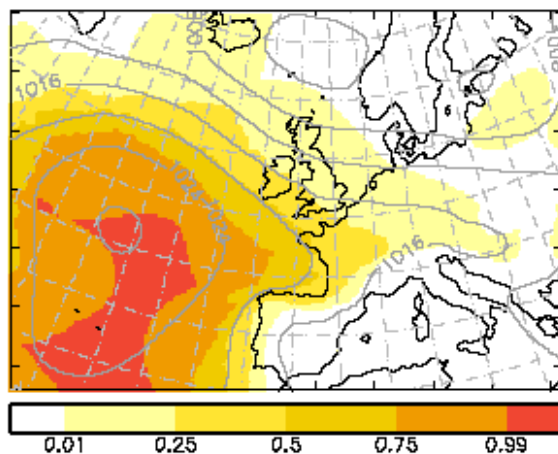
Model weights in the multimodel
(averaged over plot area)



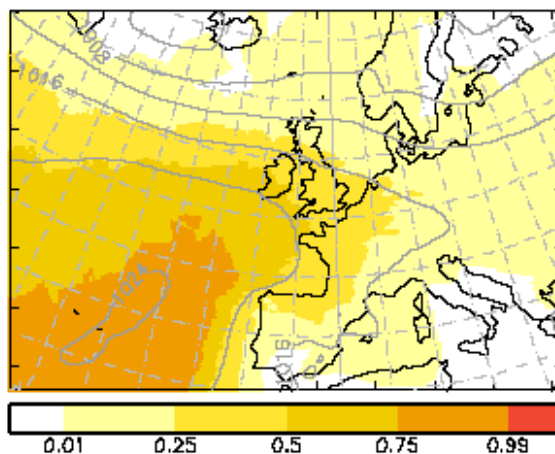
T+204

PMSL > 1020 hPa

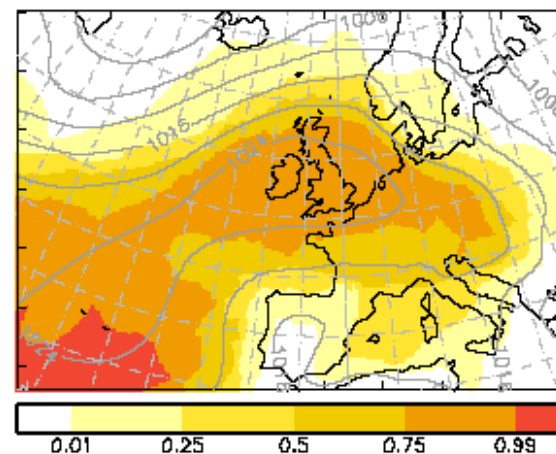
Met Office Ensemble (bias corrected)



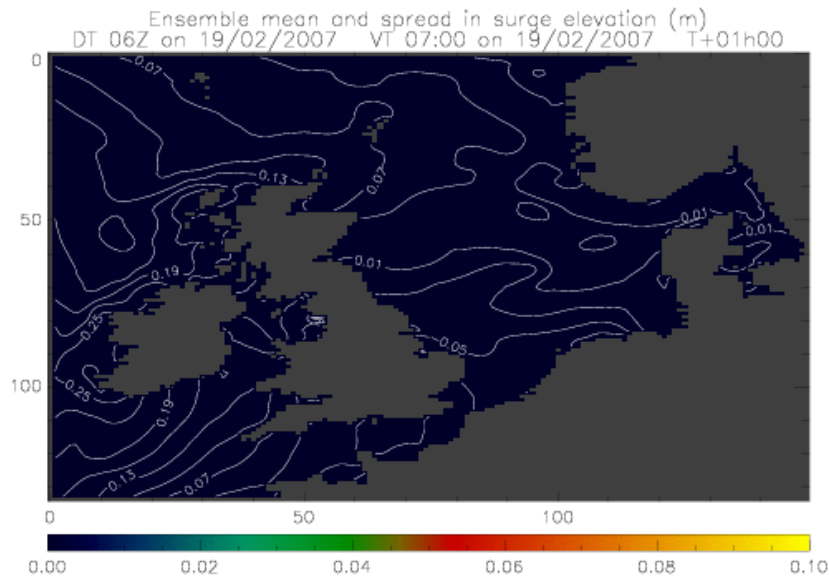
ECWFW Ensemble (bias corrected)



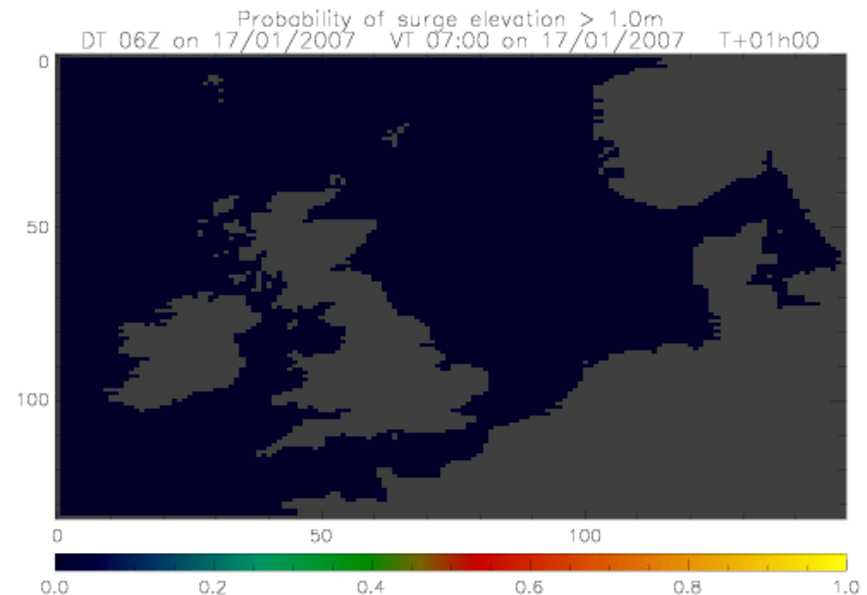
NCEP Ensemble (bias corrected)



- Surge elevation
Mean and spread



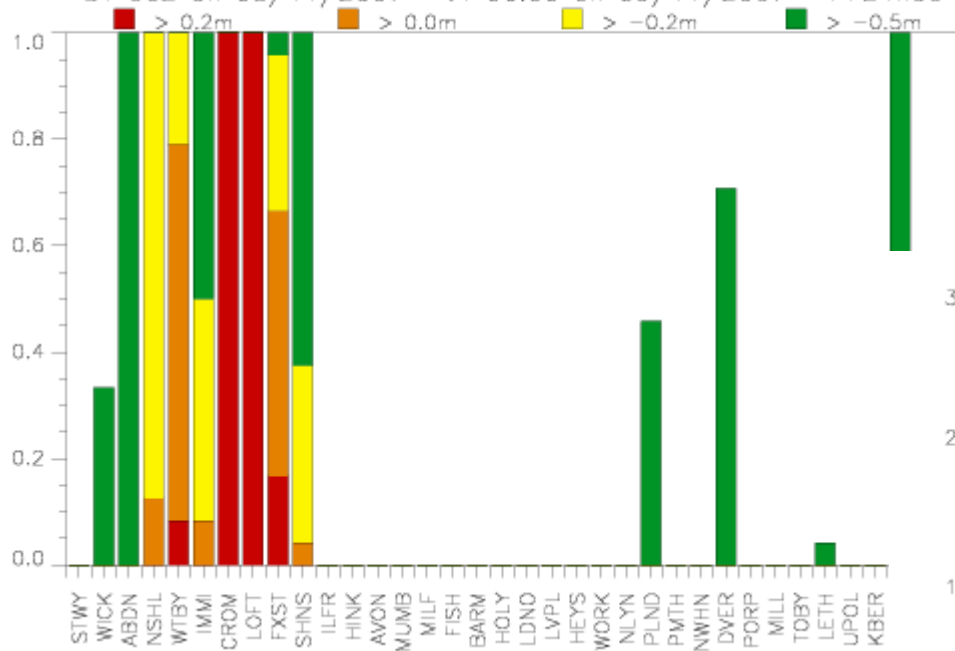
- Probability of
Surge elevation > 1.0m



9th Nov 2007 – Biggest North Sea surge since 1953



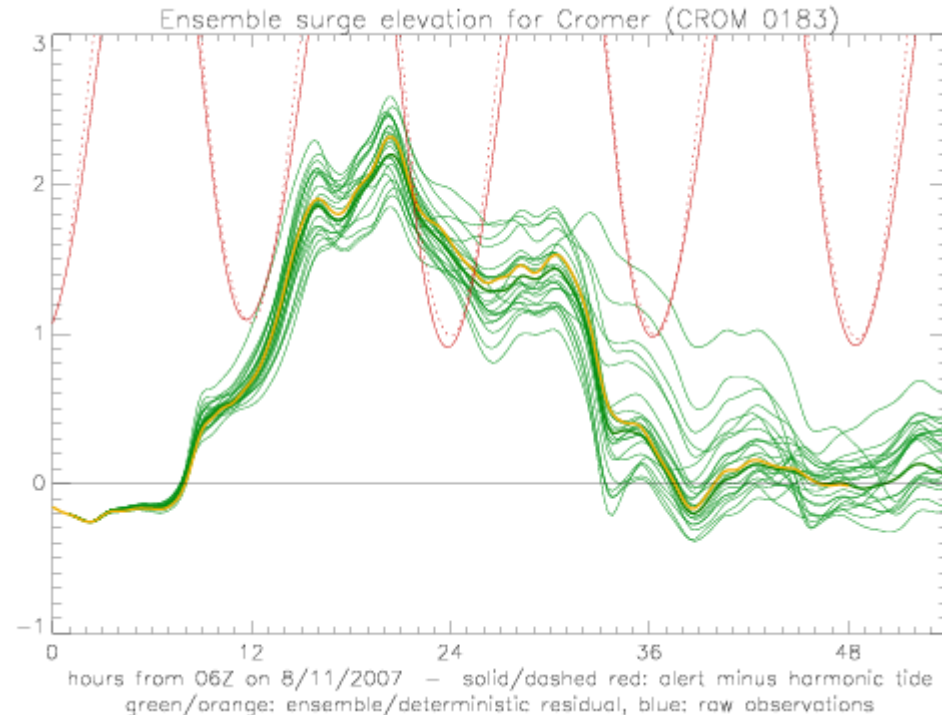
Probability of total water minus alert exceeding threshold in 12h period
 DT 06Z on 08/11/2007 VT 06:00 on 09/11/2007 T+24h00



12h ending
0600 (T+24)

Probability of water level
exceeding danger level

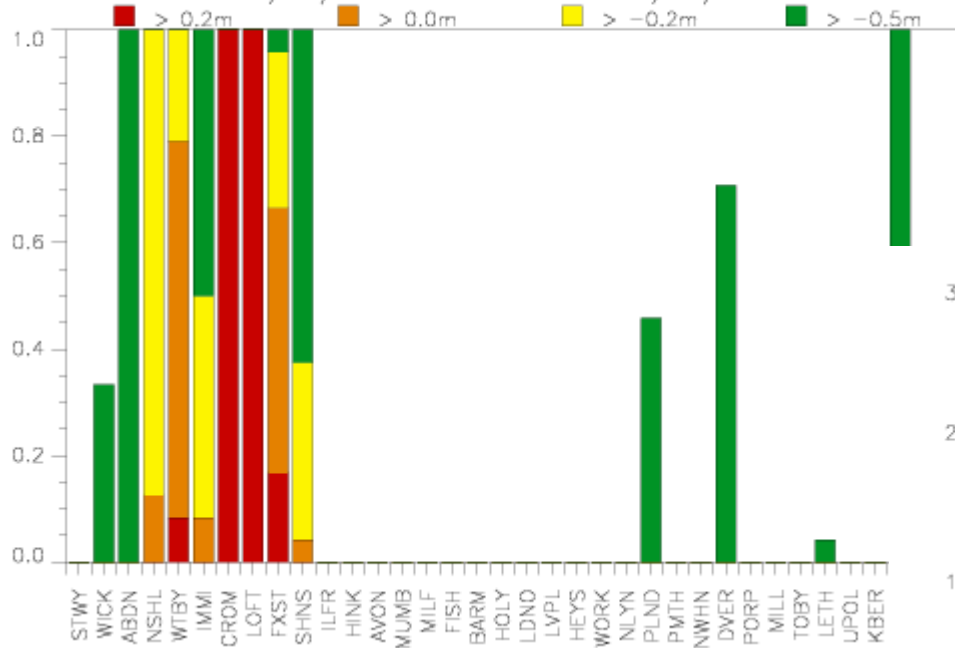
Cromer (Norfolk)



9th Nov 2007 – Biggest North Sea surge since 1953



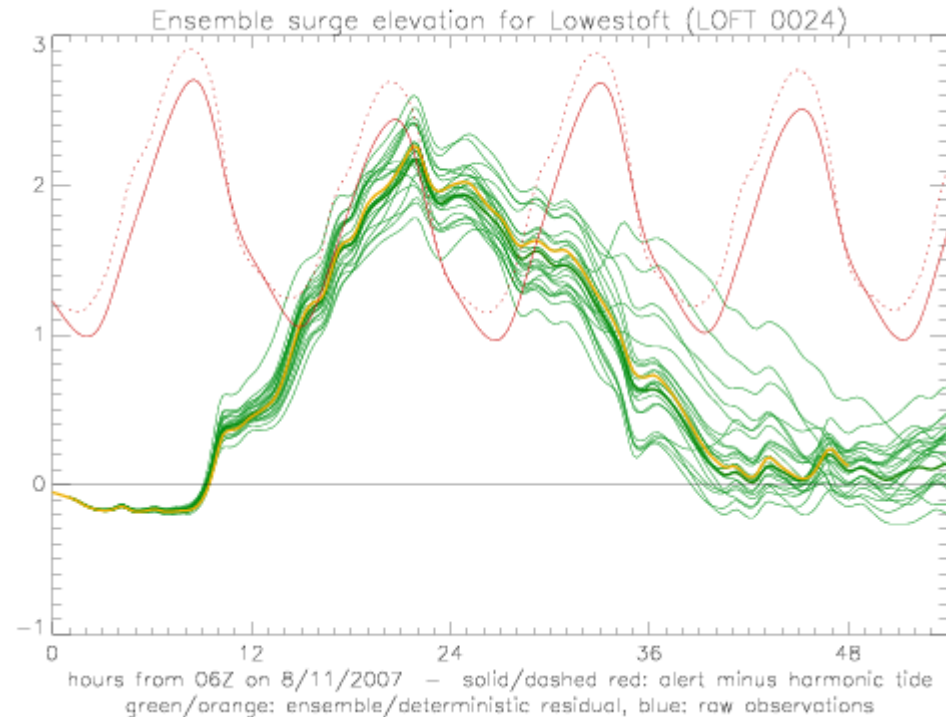
Probability of total water minus alert exceeding threshold in 12h period
 DT 06Z on 08/11/2007 VT 06:00 on 09/11/2007 T+24h00



12h ending
0600 (T+24)

Probability of water level
exceeding danger level

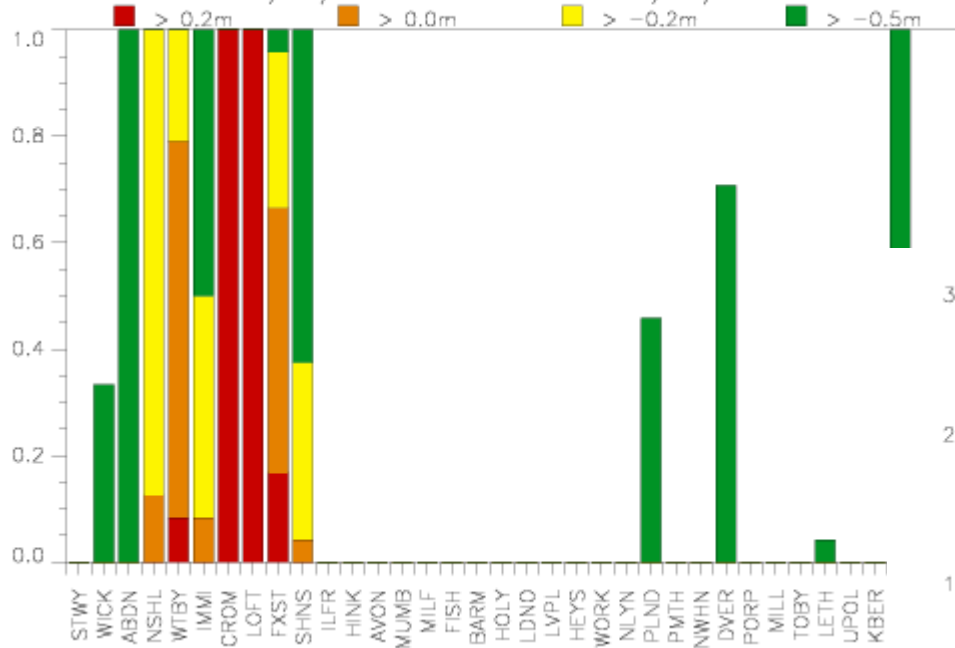
Lowestoft



9th Nov 2007 – Biggest North Sea surge since 1953



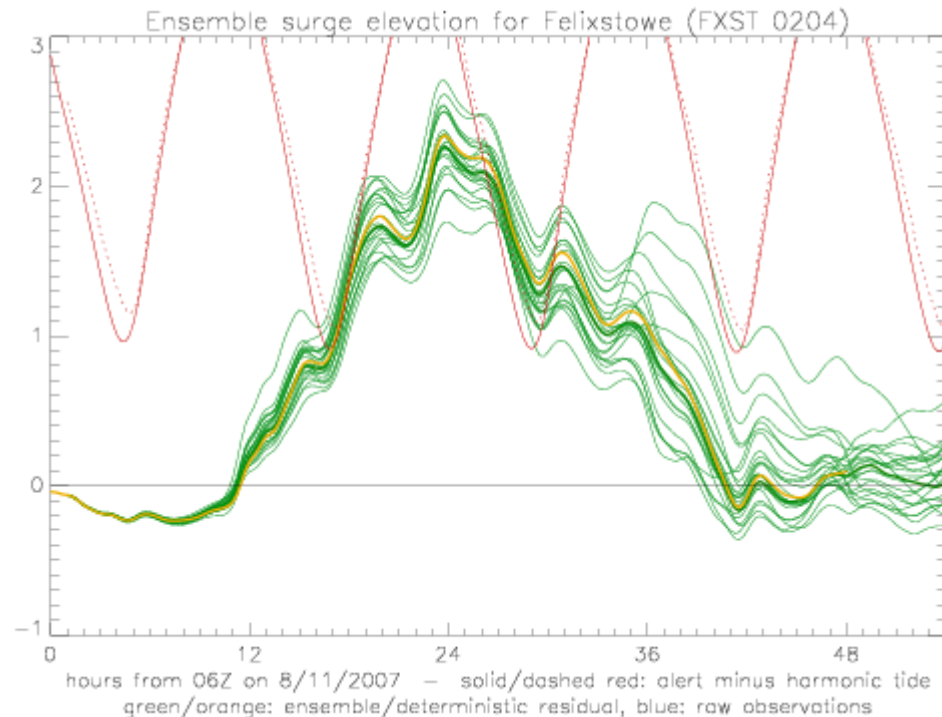
Probability of total water minus alert exceeding threshold in 12h period
 DT 06Z on 08/11/2007 VT 06:00 on 09/11/2007 T+24h00



↑
 12h ending
 0600 (T+24)

Probability of water level
 exceeding danger level

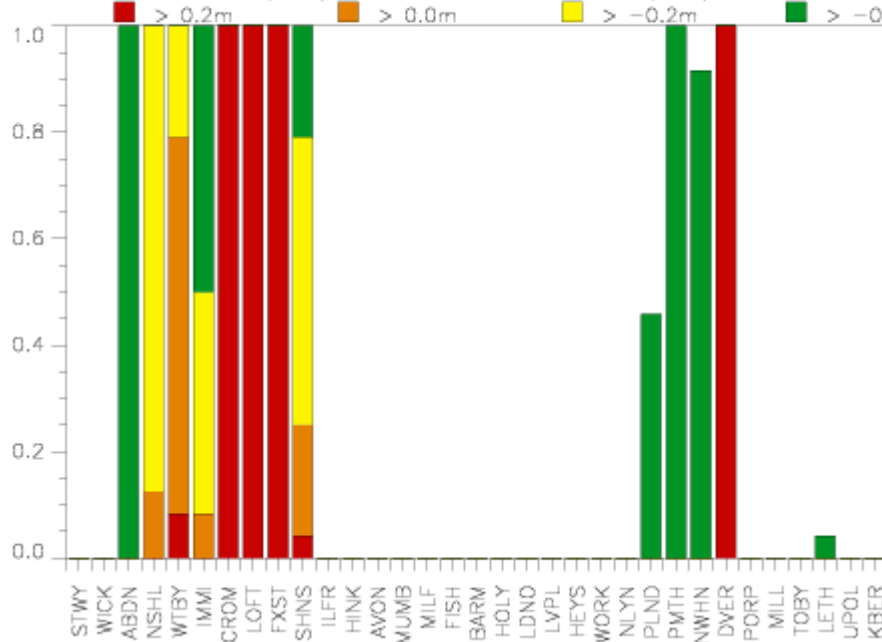
Felixstowe



9th Nov 2007 – Biggest North Sea surge since 1953



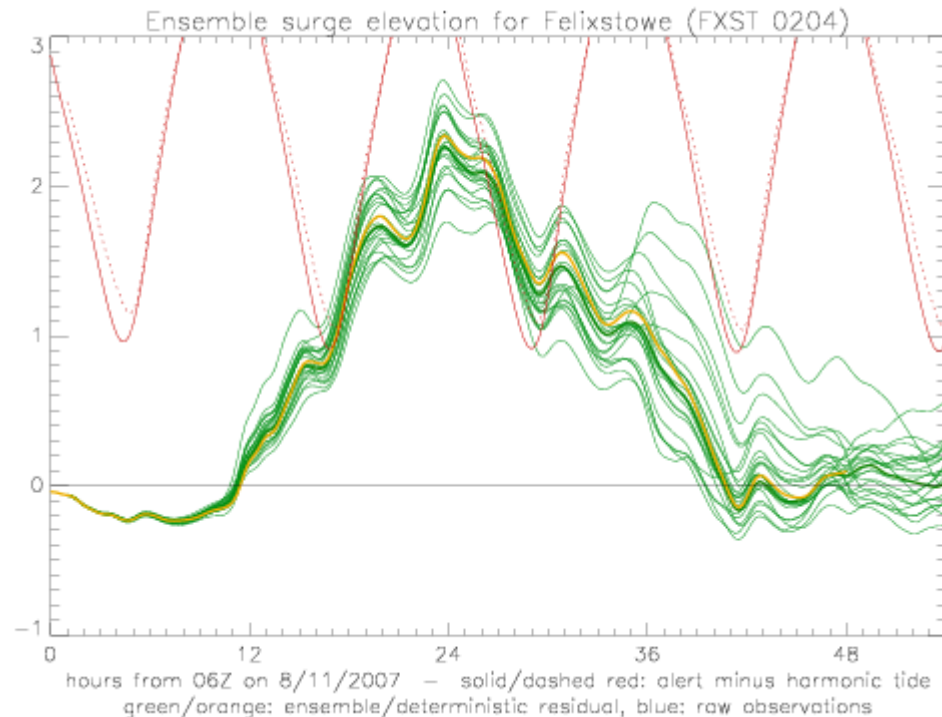
Probability of total water minus alert exceeding threshold in 12h period
 DT 06Z on 08/11/2007 VT 12:00 on 09/11/2007 T+30h00



↑
 12h ending
 1200 (T+30)

Probability of water level
 exceeding danger level

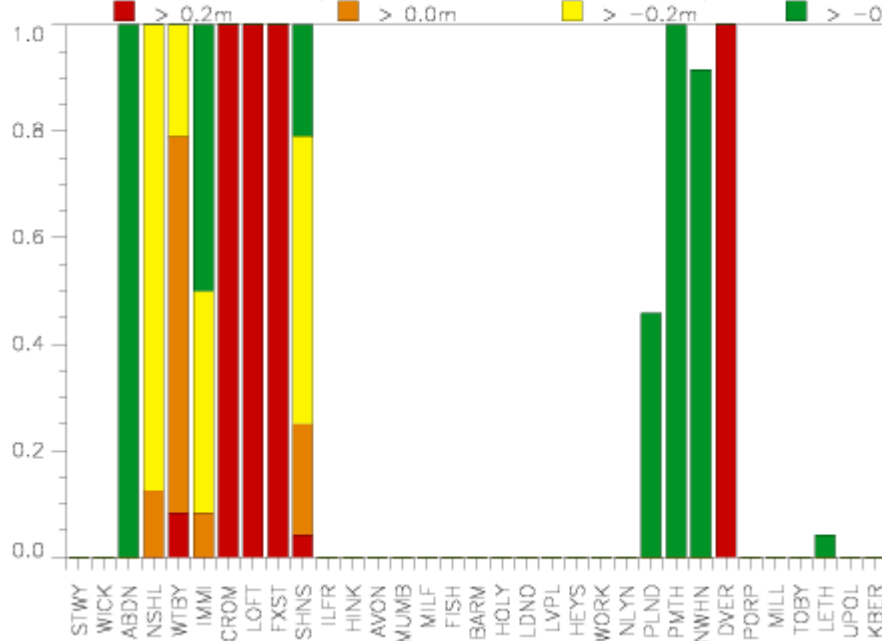
Felixstowe



9th Nov 2007 – Biggest North Sea surge since 1953



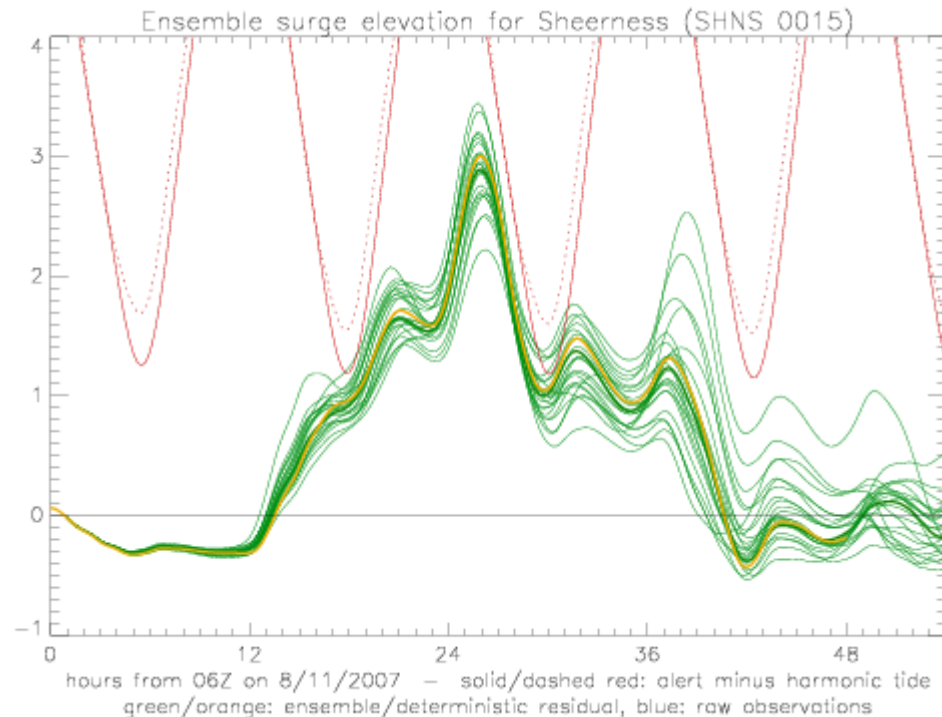
Probability of total water minus alert exceeding threshold in 12h period
 DT 06Z on 08/11/2007 VT 12:00 on 09/11/2007 T+30h00



↑ 12h ending 1200 (T+30)

Probability of water level exceeding danger level

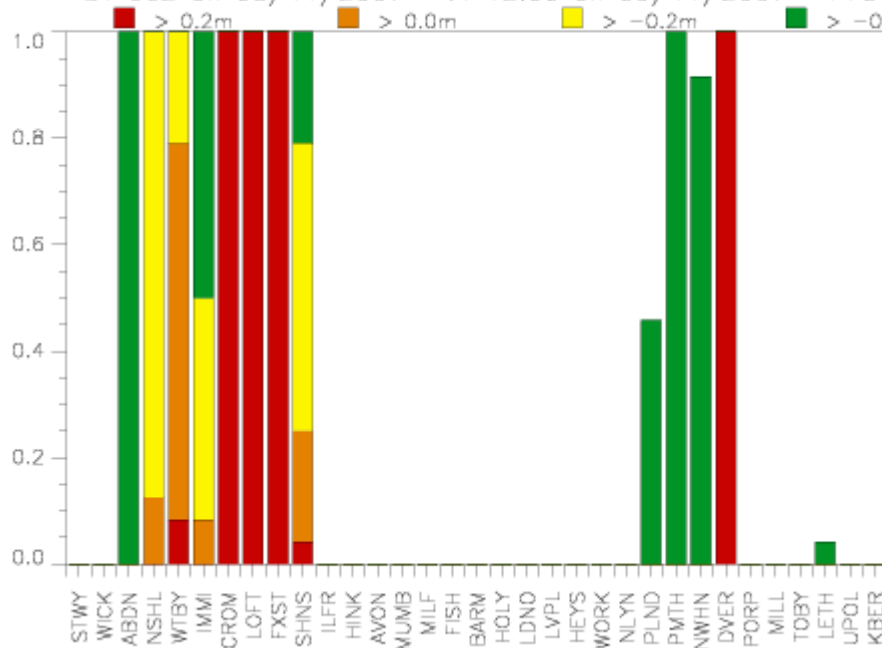
Sheerness (Thames Estuary)



9th Nov 2007 – Biggest North Sea surge since 1953



Probability of total water minus alert exceeding threshold in 12h period
 DT 06Z on 08/11/2007 VT 12:00 on 09/11/2007 T+30h00

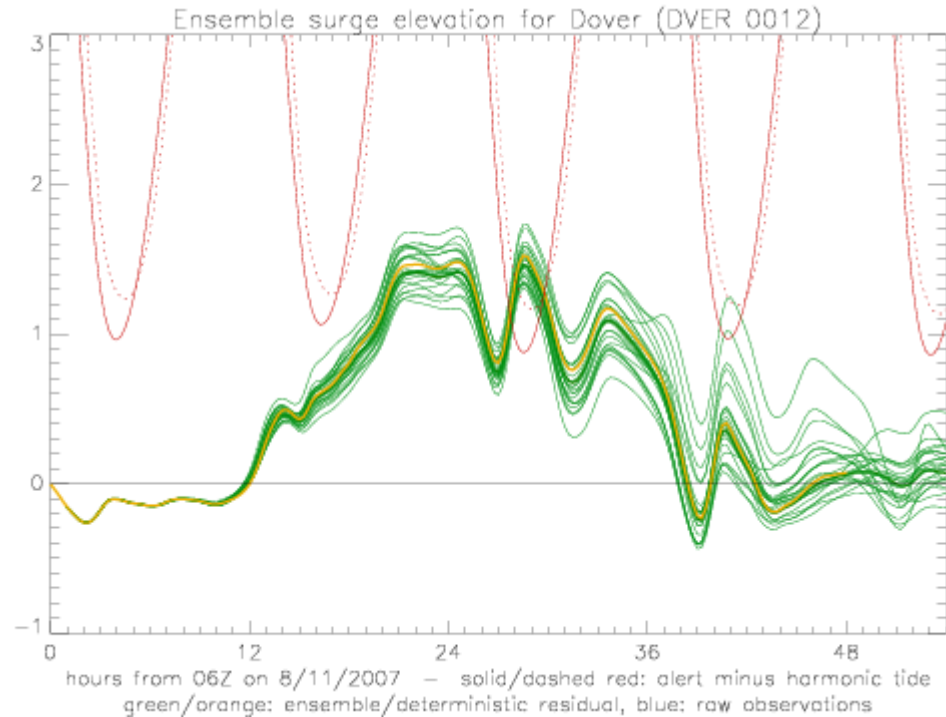


12h ending
1200 (T+30)



Probability of water level
exceeding danger level

Dover

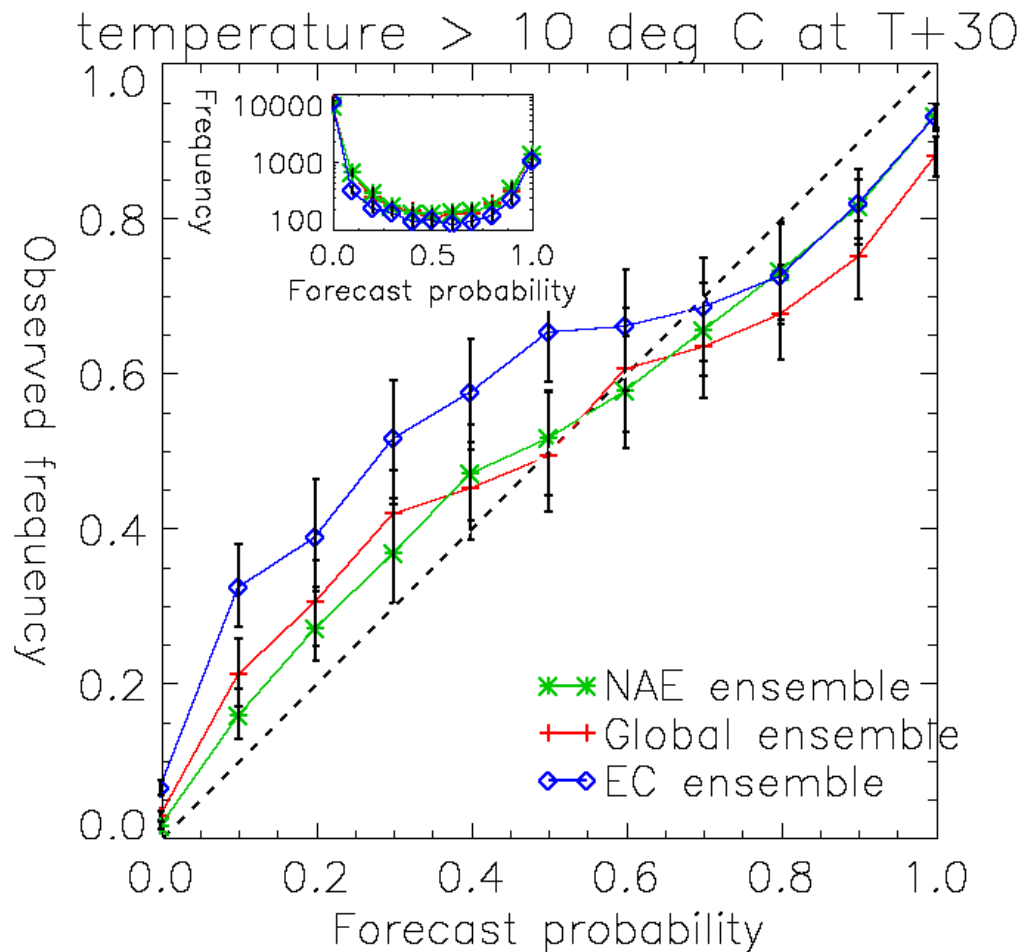


MOGREPS Verification

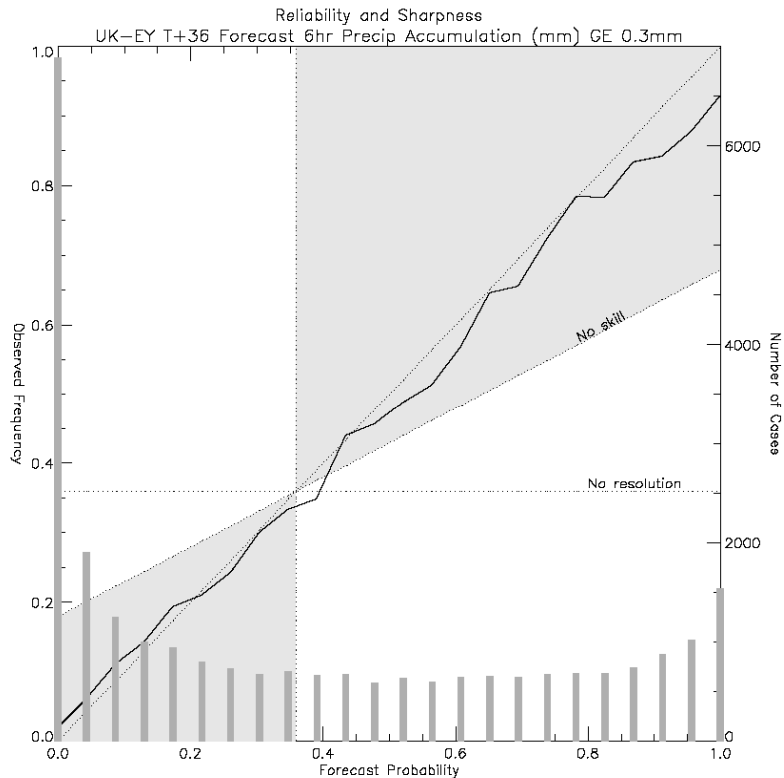
Reliability diagram for surface temperature



- Reliability diagram for Temp > 10C
- 79 sites UK & Europe
- 6 Nov 2006 – 28 Feb 2007



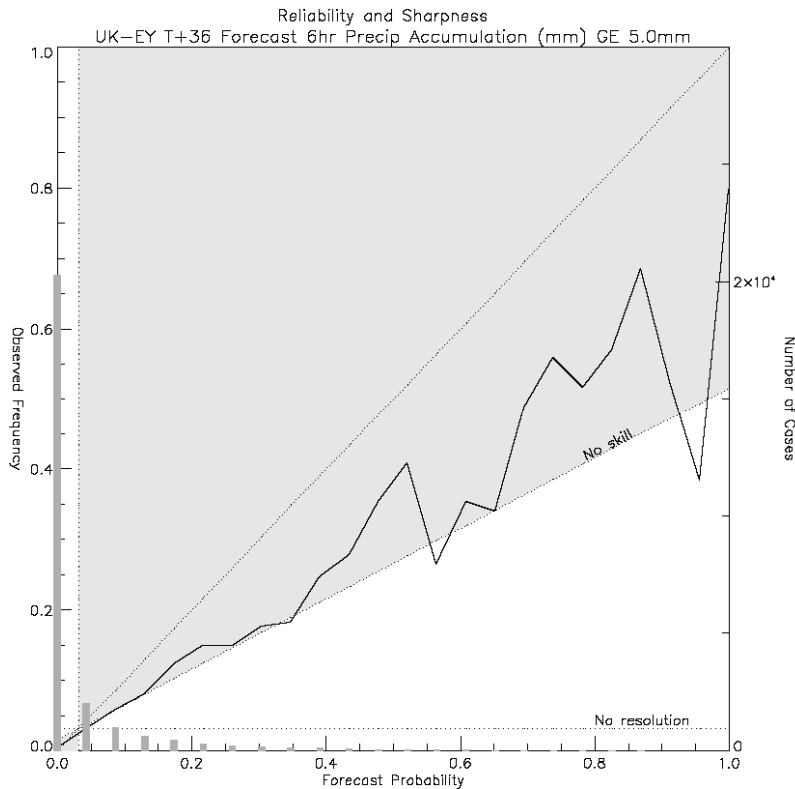
6hr precip > 0.3mm against gridded analysis



Verification against Analysis for Reduced old NAE Model area (up to June 07), 1.0 deg grid - NAE EPS model area (area mean method)

- Reliability and sharpness diagram for T+36 forecast.
- 6h precip > 0.3mm
- Verification against Nimrod Analysis over the UK at 1.0 degree resolution.

6hr precip 5mm against gridded analysis



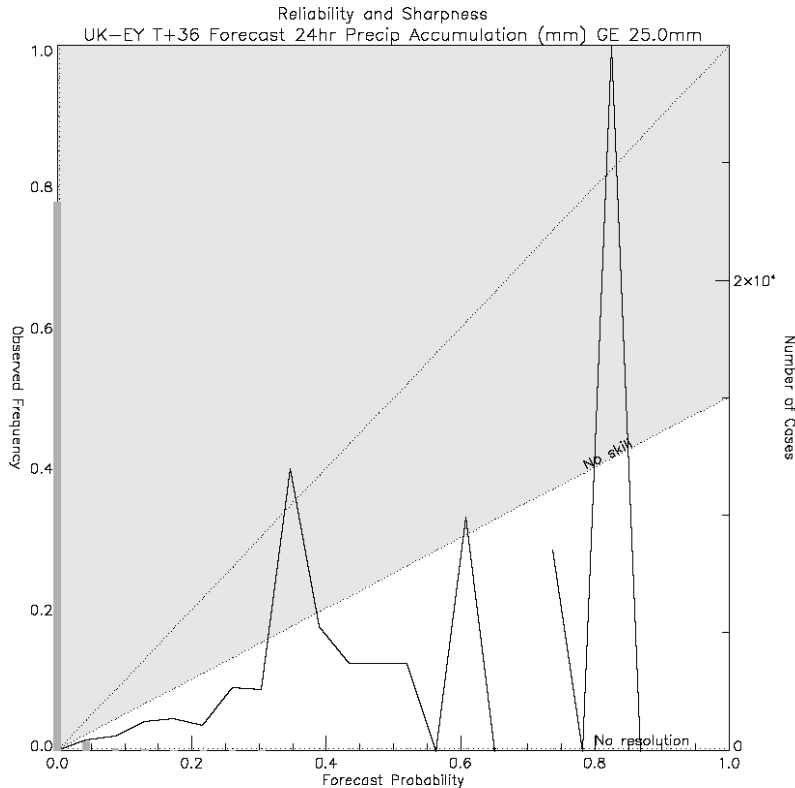
Verification against Analysis for Reduced old NAE Model area (up to June 07), 1.0 deg grid - NAE EPS model area (area mean method)

- Reliability and sharpness diagram for T+36 forecast.

- 6h precip > 5mm

- Verification against Nimrod Analysis over the UK at 1.0 degree resolution.

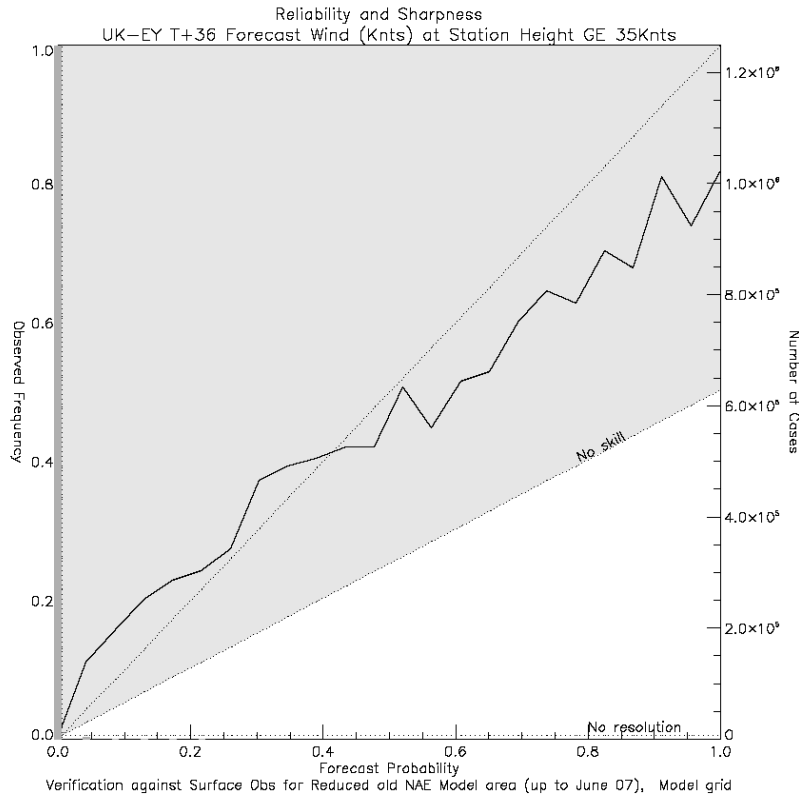
6hr precip 25mm against gridded analysis



Verification against Analysis for Reduced Mesoscale Model area, 1.0 deg grid - NAE EPS model area (area mean method)

- Reliability and sharpness diagram for T+36 forecast.
- 6h precip > 5mm
- Verification against Nimrod Analysis over the UK at 1.0 degree resolution.

Wind speed at least gale force 8



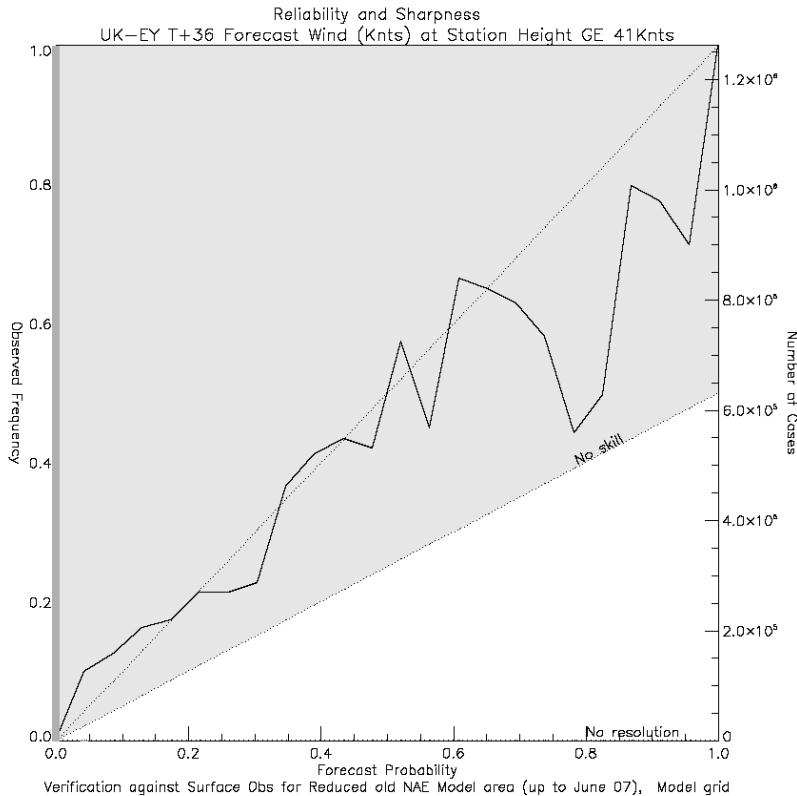
- Reliability and sharpness diagram for T+36 forecast.

- 10m Wind > F8

- Verification against surface obs over UK and Europe.

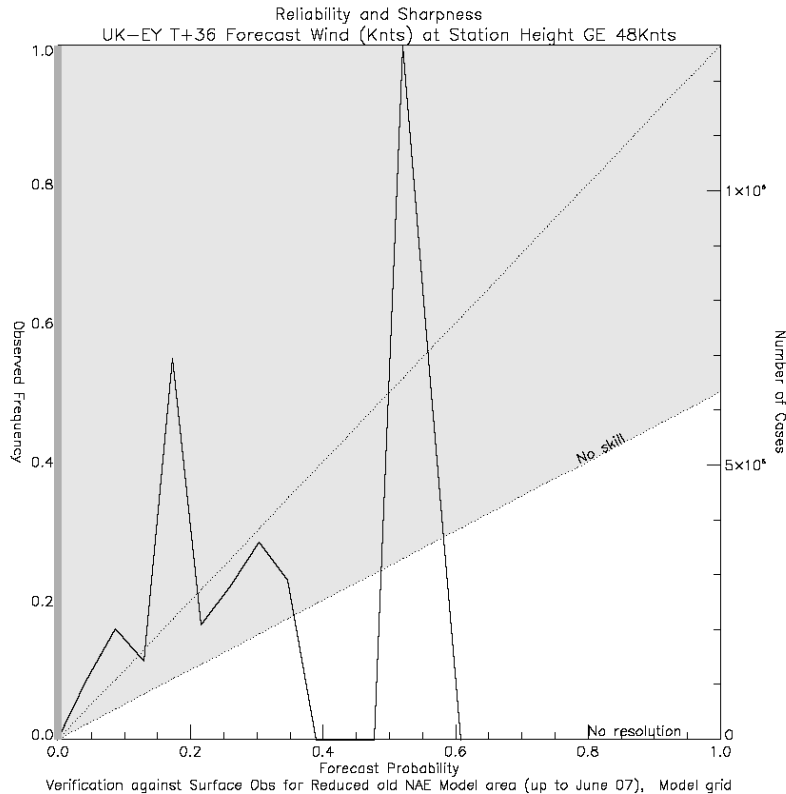
- 1 Jan 06 – 28 Feb 07

Wind speed at least severe gale force 9



- Reliability and sharpness diagram for T+36 forecast.
- 10m Wind > F9
- Verification against surface obs over UK and Europe.
- 1 Jan 06 – 28 Feb 07

Wind speed at least storm force 10



- Reliability and sharpness diagram for T+36 forecast.

- 10m Wind > F10

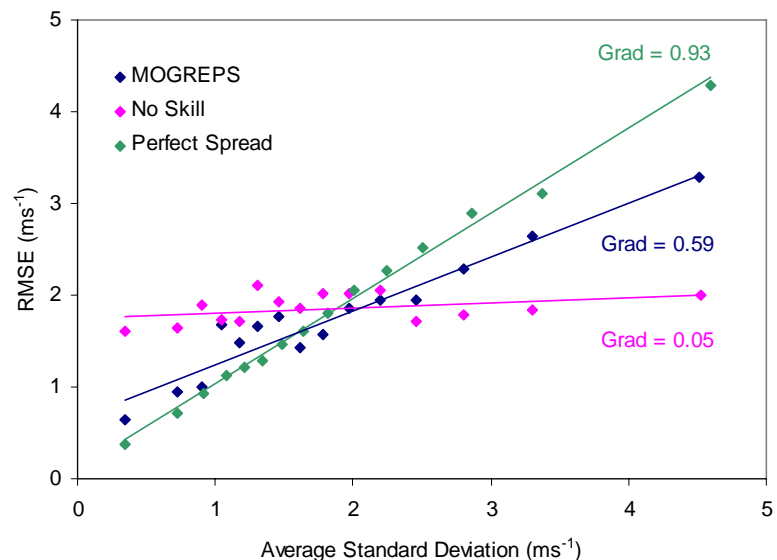
- Verification against surface obs over UK and Europe.

- 1 Jan 06 – 28 Feb 07

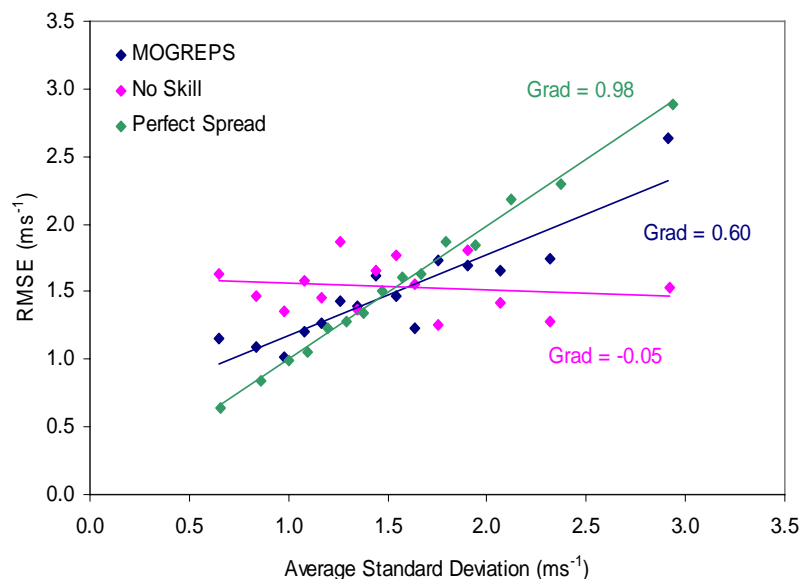
Spread-skill relationship – wind speed

- Spread-skill for wind-speed binned into equal population bins by spread
 - Skill corrected for observation error

- Blue – MOGREPS
- Pink – No Skill
- Green – Perfect



DJF



JJA

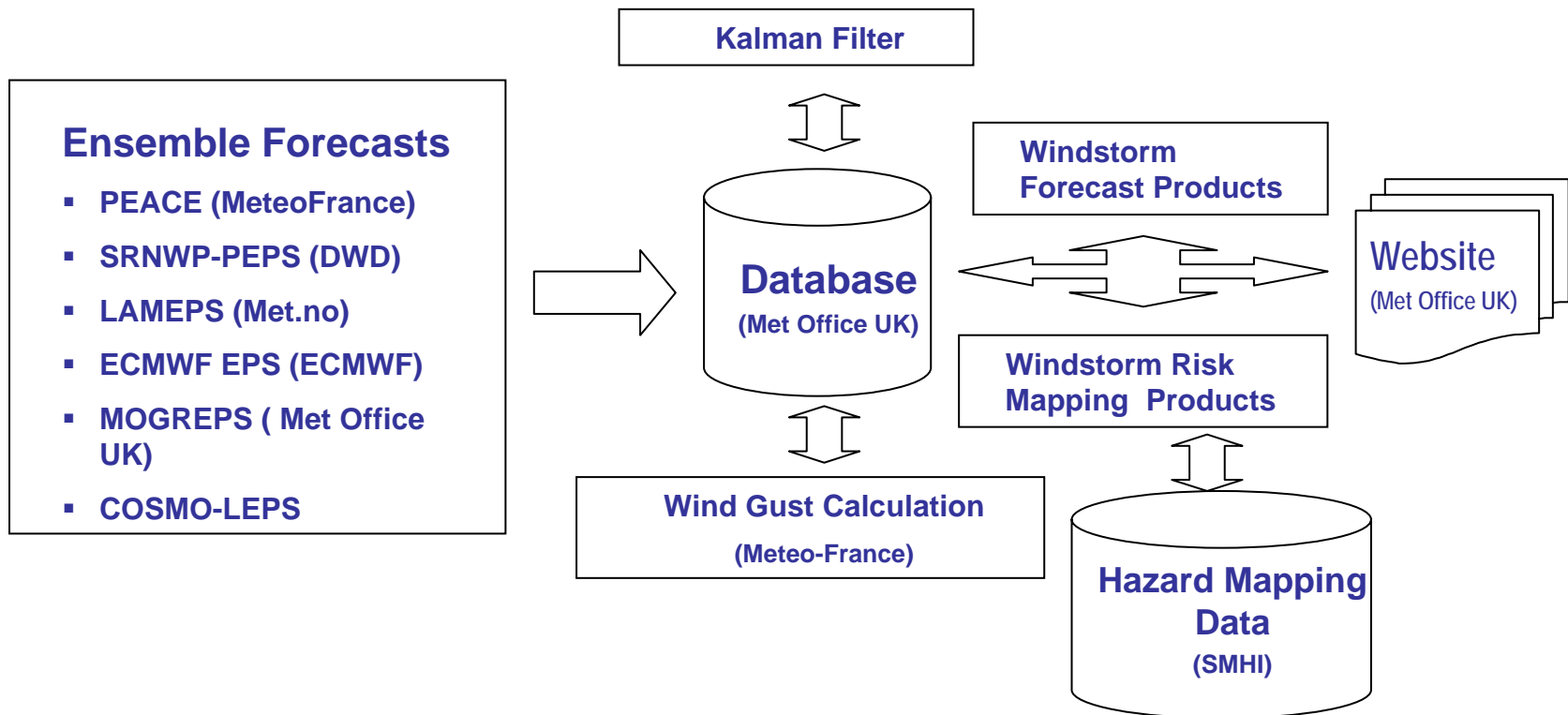


EURORISK PREVIEW Windstorms Overview



- Windstorms cause a large percentage of the weather-related damage each year
- The windstorms service offers a regularly updated forecast of wind strengths and directions and puts it into context of wind storms events of the past 40 years.
- Visual overview of the chance of windstorms at sites across Europe using latest multi-model high resolution ensemble forecasts.
- Historical analysis gives users information on the strength and direction of previous windstorm events at each site.

Overview – the plan





Medium-Range Ensembles used for Days 3-5

- (i) ECMWF EPS
- (ii) COSMO-LEPS

Short-Range Ensembles used for Days 1-2

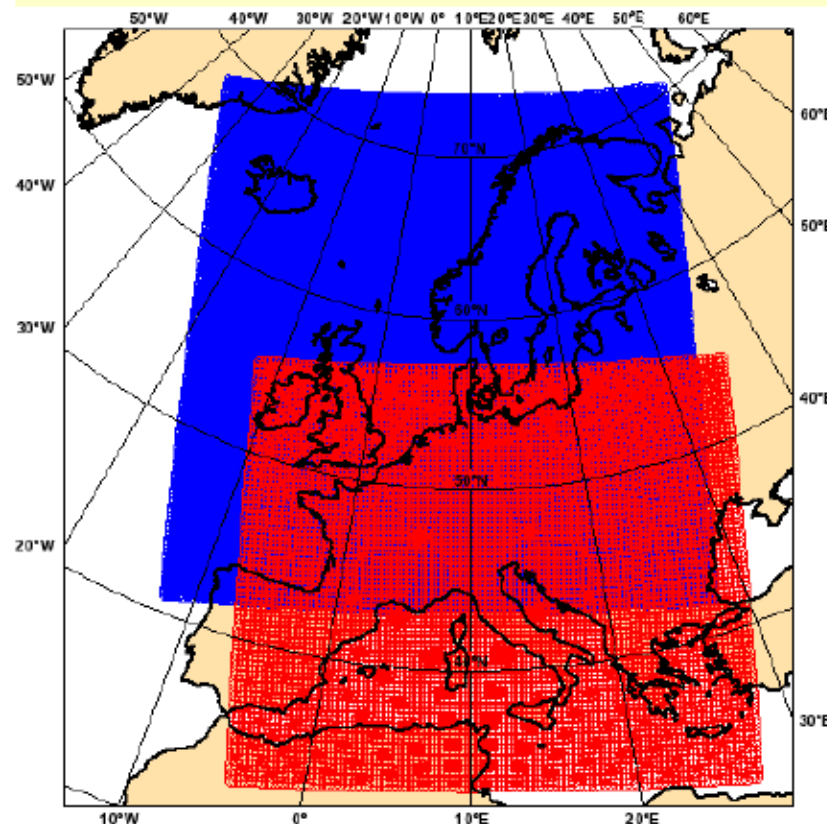
- (i) MOGREPS NAE
- (ii) MOGREPS Global
- (iii) PEACE
- (iv) LAMEPS
- (v) COSMO-LEPS
- (vi) SRNWP-PEPS



Deutscher Wetterdienst



- 1-5 days ahead.
- run at ECMWF by ARPA-SIM
- Two versions of COSMO-LEPS
 - The standard version
 - 16-member ensemble
 - 10km grid spacing over southern part of Europe.
 - A second version is run specifically in support of Windstorms to cover the north-western part of Europe,
 - only 10 members.

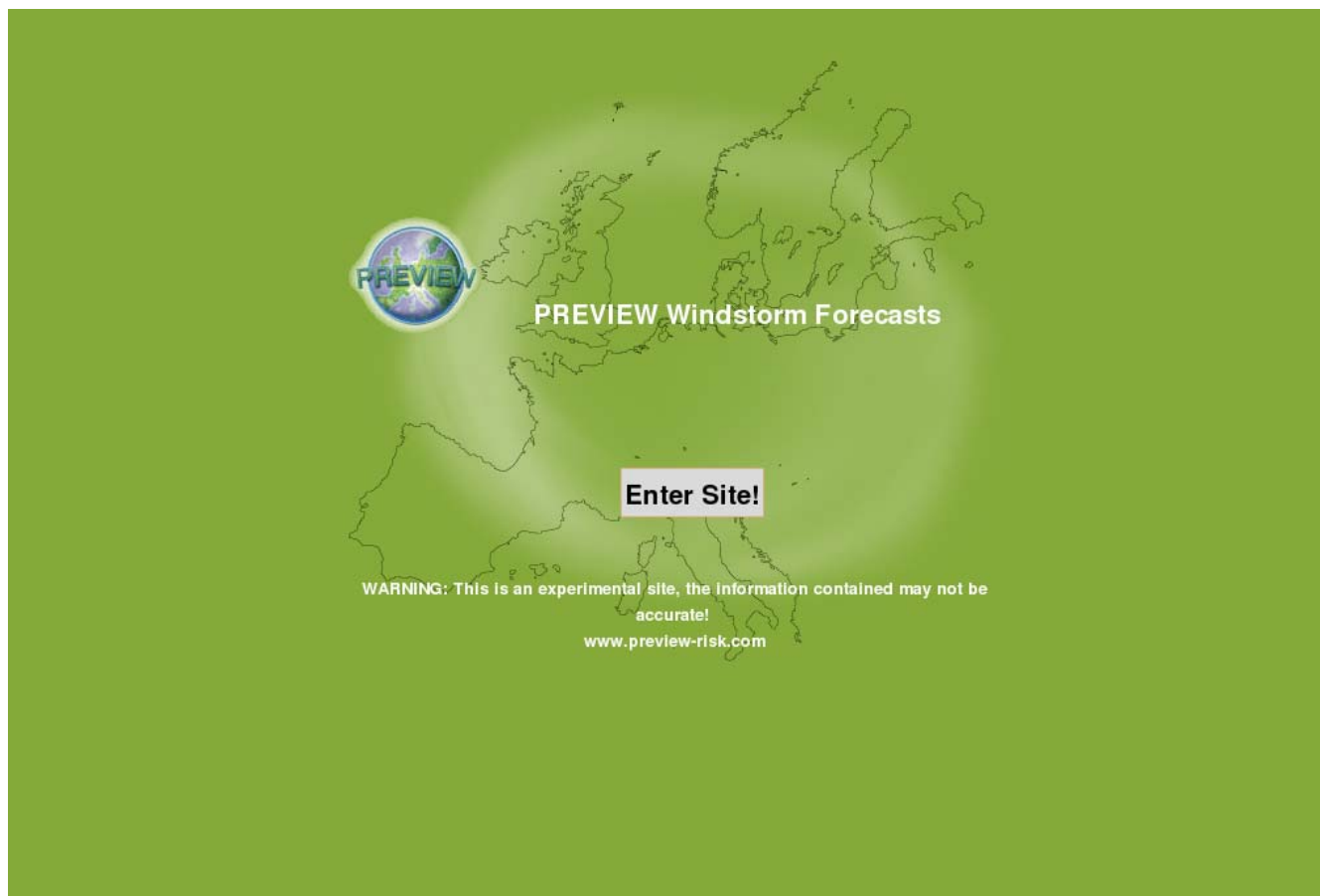




- Windstorms service includes an analysis of historical wind events from ERA-40 done by SMHI
 - Spans 1958-2002 (2006)
 - Statistics and return periods estimated

- Limitations
 - Extreme windspeeds underestimated due to resolution of ERA-40
 - Significant events missed due to 6-hour resolution

<http://www.preview-windstorms.eu/>

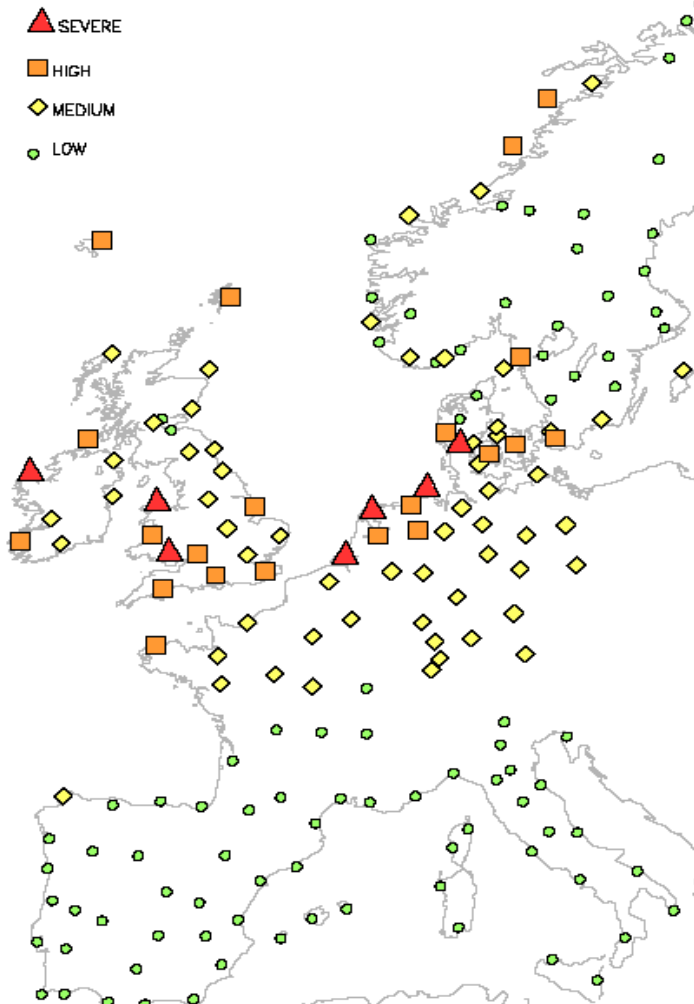


Web site – Traffic lights



VT 0000UTC 17 Jan 2007 – 0000UTC 19 Jan 2007

- SEVERE
- HIGH
- MEDIUM
- LOW



- SEVERE
- HIGH
- MEDIUM
- LOW

WARNING: This is an experimental Windstorm site, the information contained may vary. www.preview-r.com

Forecast | Climate Data | Help | Feedback Form

Europe 1-2(Days) | Europe 3-5(Days) | Europe Latest

Days 1-2

Site : 01205

Site Name : SVINOY FYR
Latitude : 62.33 Longitude : 5.27

Current Windstorm Rating : AMBER

Prob WS> 15.0M/S above 40%
Actual Prob = 18%

Prob WG> 22.5M/S above 40%
Actual Prob = 67%

[Link to definition of Windstorm Ratings for this site](#)

[Link to Climate data for this site](#)

[Combined EPS Forecast \(image\)](#)

[Combined Windroses \(image\)](#)

National Met Service Users only - click here.....

- [MOGREPS Global, Met Office, EPS Forecast \(image\) | Wind Rose \(image\)](#)
- [MOGREPS European, Met Office, EPS Forecast \(image\) | Wind Rose \(image\)](#)
- [PEACE, Meteo-France, EPS Forecast \(image\) | Wind Rose \(image\)](#)
- [SRNWP-PEPS, European multi-model ensemble, EPS Forecast \(image\) | Wind Rose \(image\)](#)
- [LAMEPS, Met.no, EPS Forecast \(image\) | Wind Rose \(image\)](#)
- [COSMO-LEPS, EPS Forecast \(image\) | Wind Rose \(image\)](#)

[Back to previous page..](#)

© 2007, Preview Windstorm

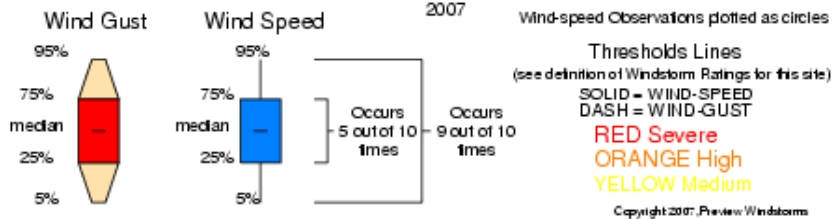
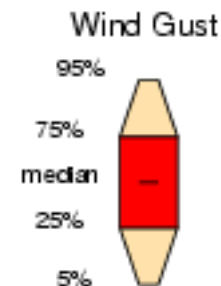
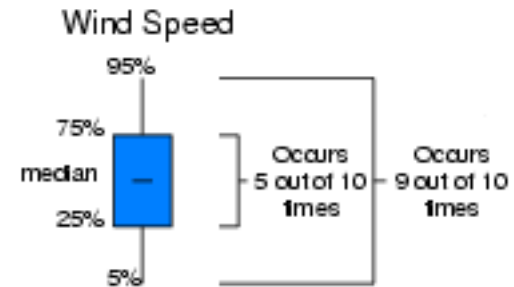
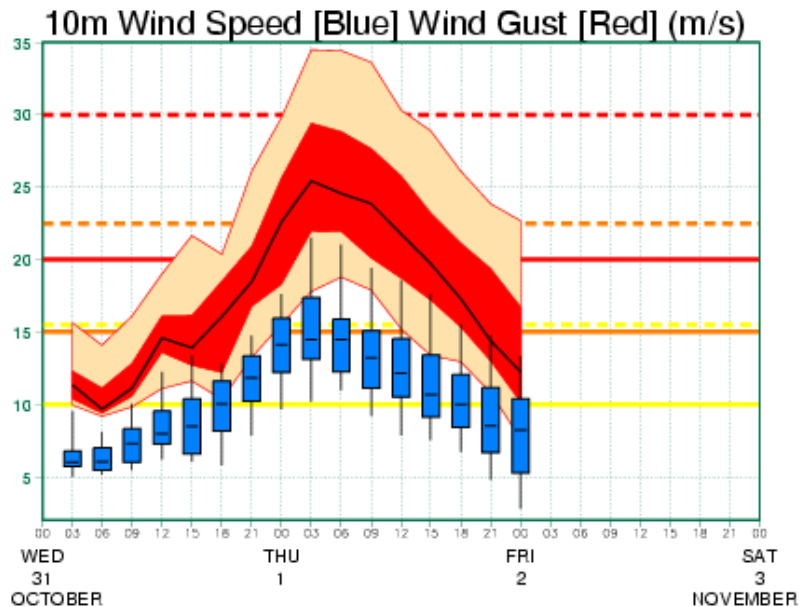
site designed and maintained by the Met Office

Latest update: 0900UTC 17 Jan 2007

Web site - Meteograms



Windstorm combined EPS Meteogram
 ORLAND III (01241) 63.7° N 9.6° E
 Forecasts from 31 October 2007 0 UTC



Copyright 2007, Preview Windstorms

Web site – wind roses



Key for wind direction & speed on windrose:

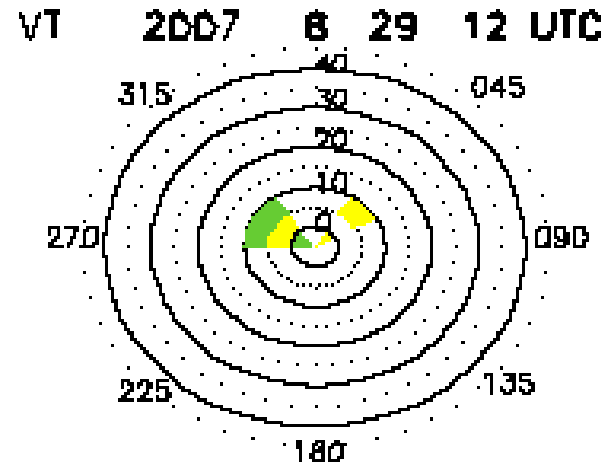
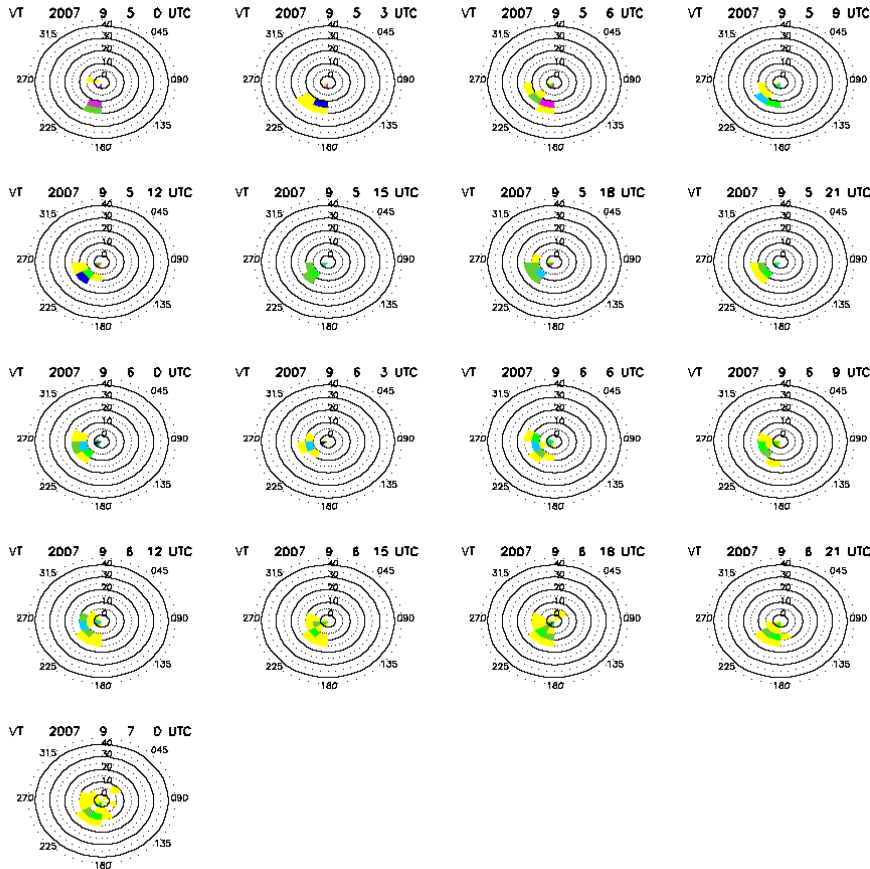
Compass Direction which wind is coming from in 30 degree sectors (000-030, 030-060, ..., 330-360)
innermost circle only for wind direction

outer circles are divided into 5 m/s bands, with wind speed increasing outwards

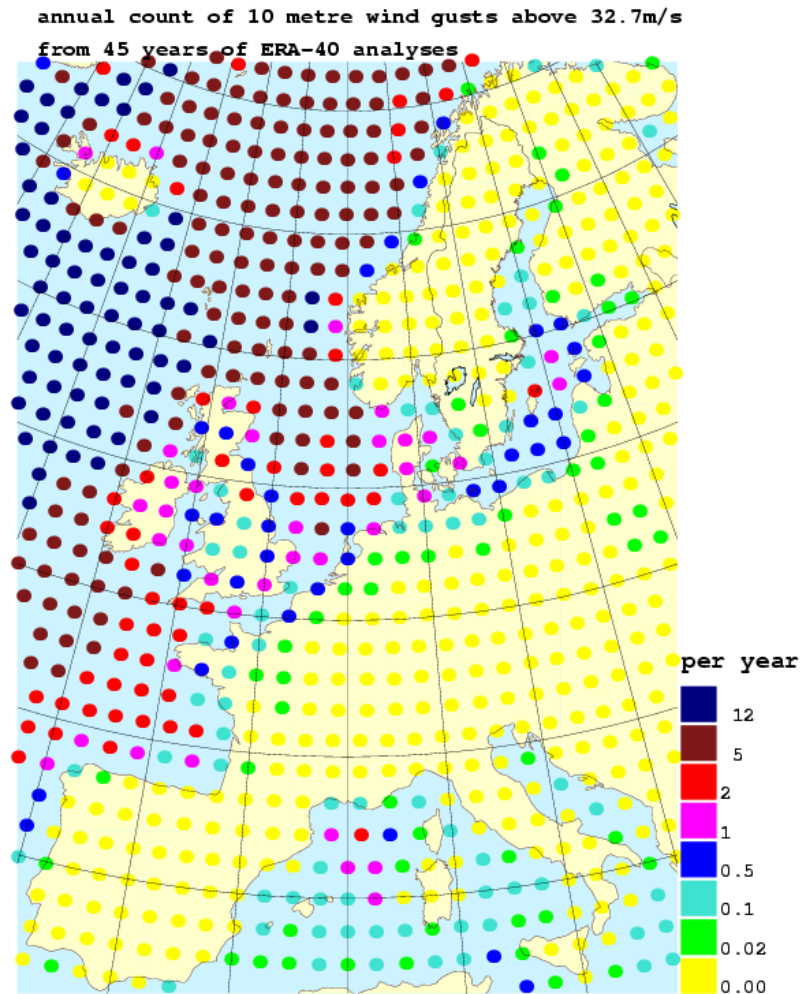
1% to 10% probability =		50% to 60% probability =	
10% to 20% probability =		60% to 70% probability =	
20% to 30% probability =		70% to 80% probability =	
30% to 40% probability =		80% to 90% probability =	
40% to 50% probability =		90% to 100% probability =	

VT=Validity Time

Model type: EURDRISK Model runtime: 2007 9 5 0 UTC Station:SVINDY FYR



Copyright 2007, Preview Windstorms

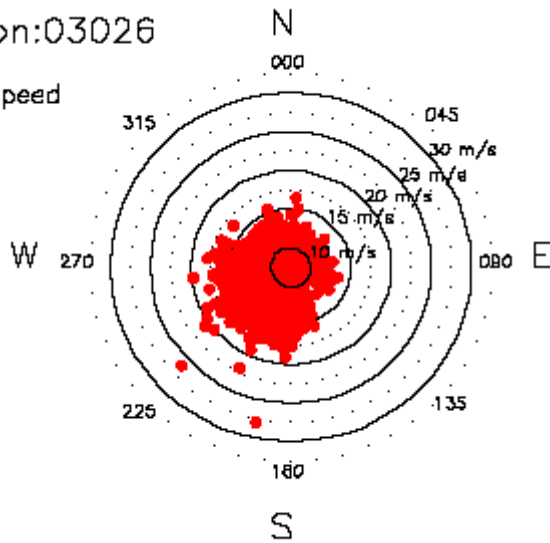


Web site – Climate Wind roses



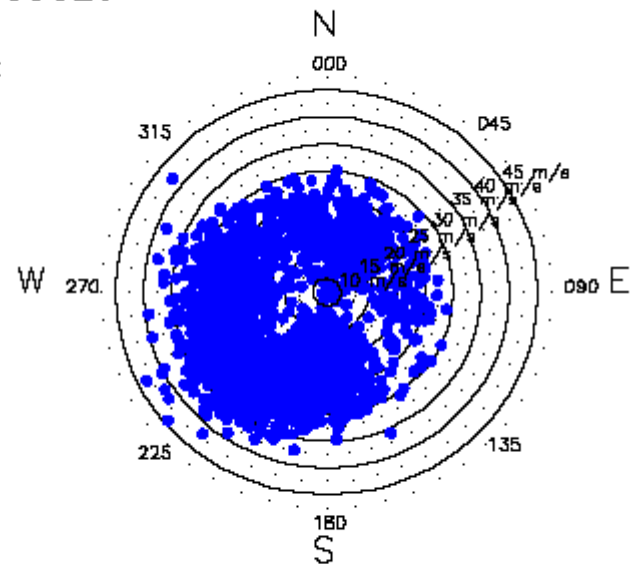
Station:03026

Wind-speed



Station:03026

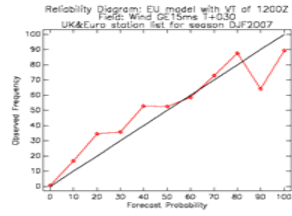
Wind-gust



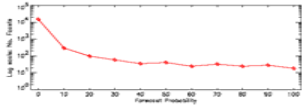
Verification – Reliability Diagrams (DJF 0607)



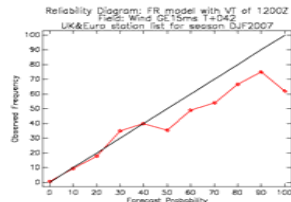
MOGREPS 15m/s



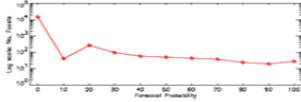
Forecast type: RAW
Reliability Score: 0.000458680



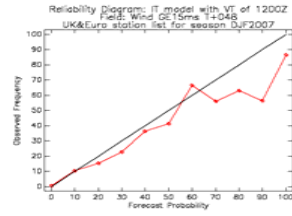
PEACE 15m/s



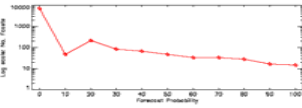
Forecast type: RAW
Reliability Score: 0.000558961



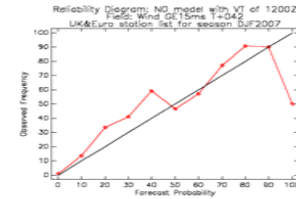
COSMO-LEPS 15m/s



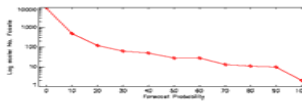
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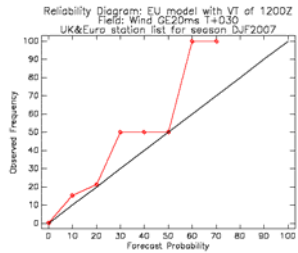
LAMEPS 15m/s



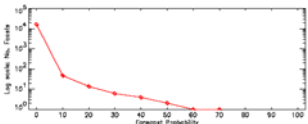
Forecast type: RAW
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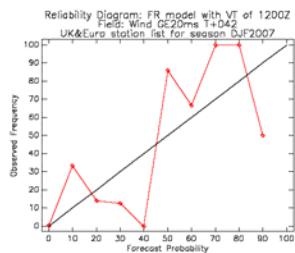
MOGREPS 20m/s



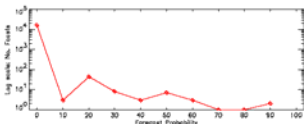
Forecast type: RAW
Reliability Score: 4.51173e-05



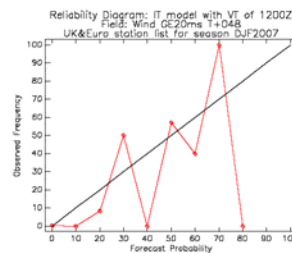
PEACE 20m/s



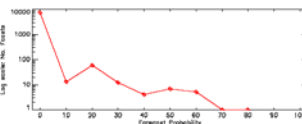
Forecast type: RAW
Reliability Score: 0.000155552



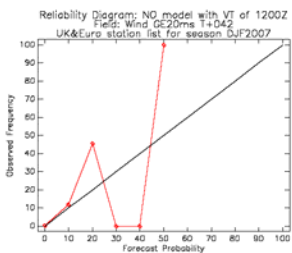
COSMO-LEPS 20m/s



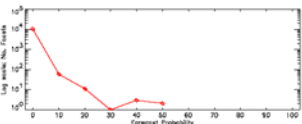
Forecast type: RAW
Reliability Score: 0.000397320



LAMEPS 20m/s



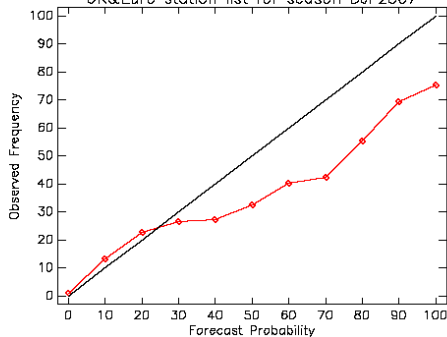
Forecast type: RAW
Reliability Score: 0.000181158



Reliability of Combined Warnings

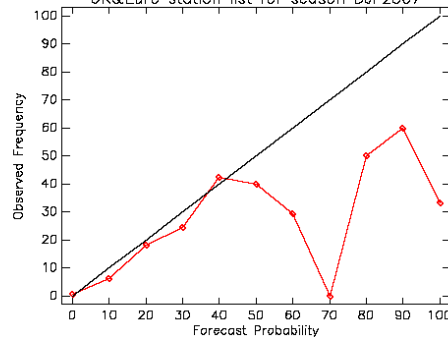


Reliability Diagram: Combined Ensemble for Days1-2
Field: Wind GE15ms
UK&Euro station list for season DJF2007

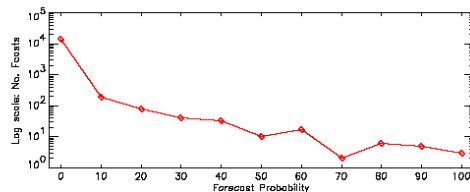
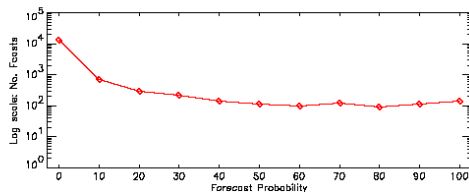


Feast type: RAW
Reliability Score: 0.00276726
15m/s

Reliability Diagram: Combined Ensemble for Days1-2
Field: Wind GE20ms
UK&Euro station list for season DJF2007



Feast type: RAW
Reliability Score: 0.000390943
20m/s

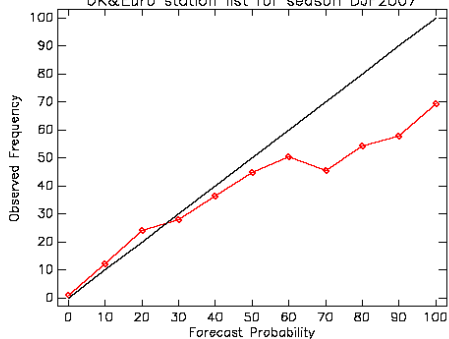


- Reliability for Day 1-2 forecasts
- Some over-forecasting at higher probability thresholds
 - Looks worse than individual ensembles, but this is for 2-day period, not a fixed time
 - 20% at 20m/s threshold used for Red warning is reliable
 - 40% at 15m/s used for Amber is also reasonable

Reliability of Combined Warnings Days 3



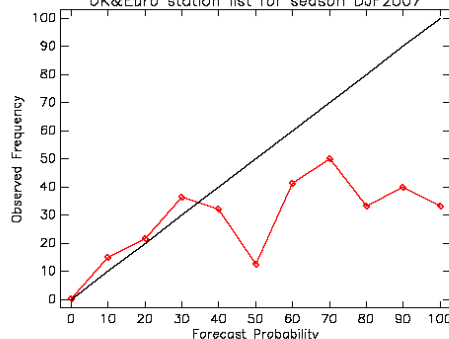
Reliability Diagram: Combined Ensemble for Days3-5
Field: Wind GE15ms
UK&Euro station list for season DJF2007



Forecast type: RAW
Reliability Score: 0.00289547

15m/s

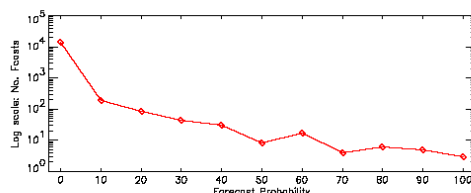
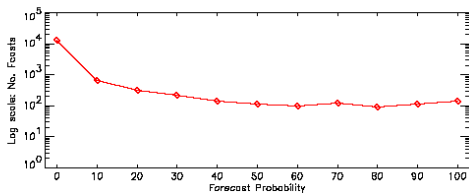
Reliability Diagram: Combined Ensemble for Days3-5
Field: Wind GE20ms
UK&Euro station list for season DJF2007



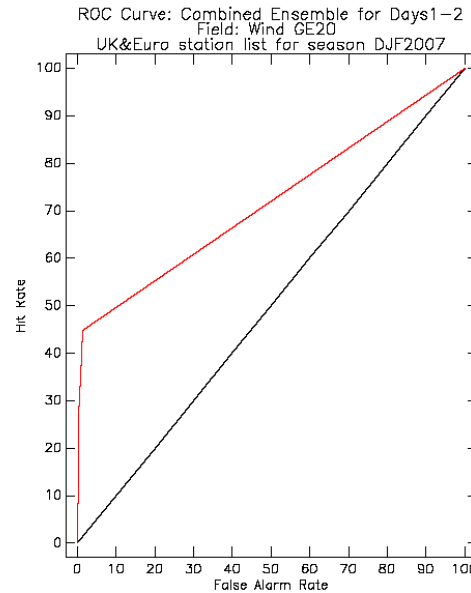
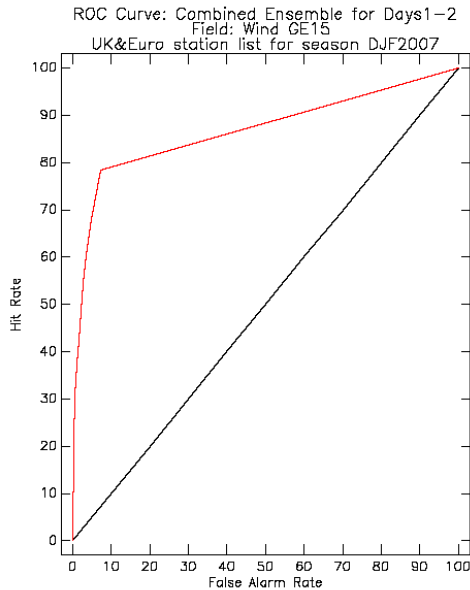
Forecast type: RAW
Reliability Score: 0.000465110

20m/s

- Reliability for Day 3-5 forecasts
- Some over-forecasting at higher probability thresholds
- Similar to day 1-2 forecasts
- 20% at 20m/s threshold used for Red warning is reliable
- 40% at 15m/s used for Amber is also reasonable



ROC for Combined Warnings Days 1-2



- ROC for Day 1-2 forecasts
- Useful resolution in forecasts at both the Amber and Red threshold levels

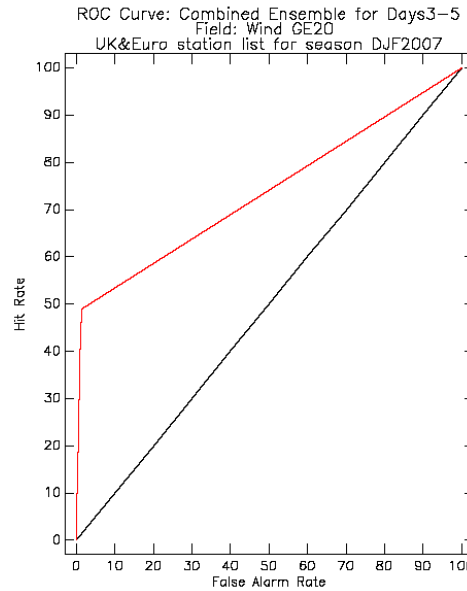
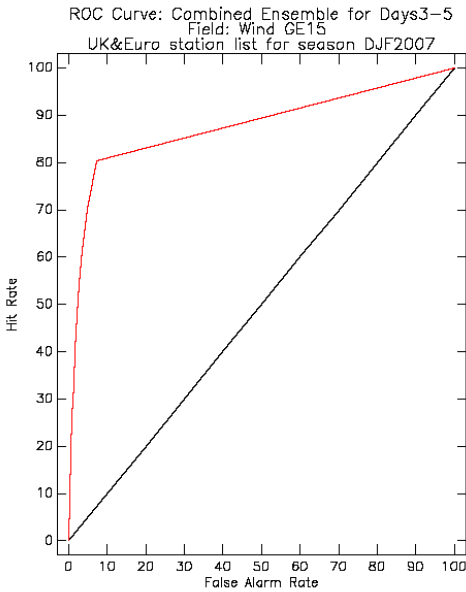
Forecast type Area
RAW 0.868285

15m/s

Forecast type Area
RAW 0.718182

20m/s

ROC for Combined Warnings Days 3-5



- ROC for Day 3-5 forecasts
- Useful resolution in forecasts at both the Amber and Red threshold levels

Cast type Area
RAW 0.876573

15m/s

Cast type Area
RAW 0.738985

20m/s

Questions & Answers

Acknowledgements

MOGREPS

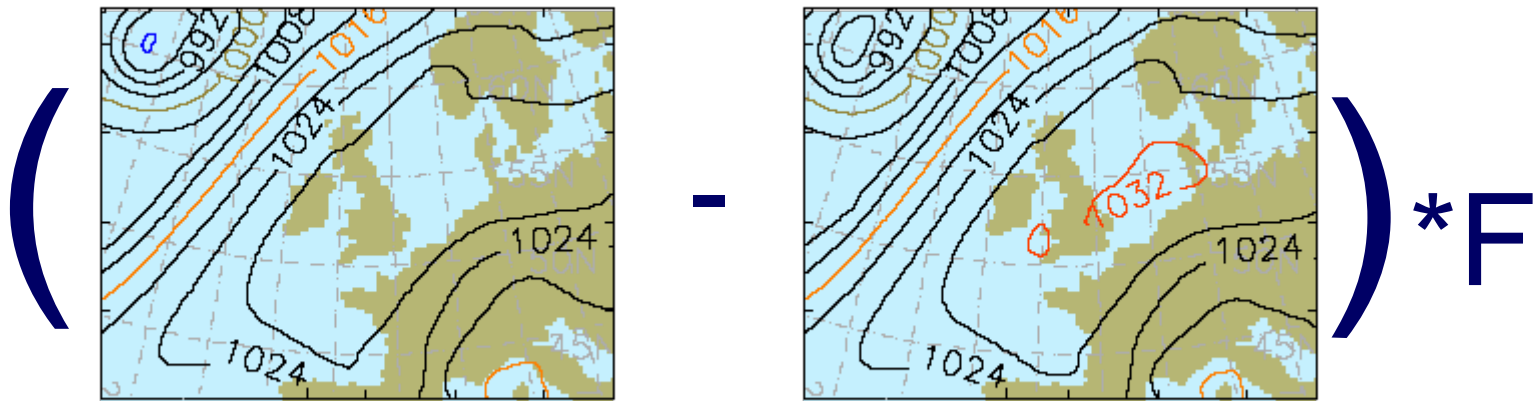
- Neill Bowler
- Caroline Woolcock
- Sarah Beare
- Tim Legg
- Alberto Arribas
- Anette Van Der Wal
- Rob Darvell
- Kelvyn Robertson
- Helen Titley
- Christine Johnson
- Jonathan Flowerdew
- Marie Dando
- David Goddard & Ian Anderson
- and many others!

Windstorms

- Caroline Woolcock
- Per Kallberg
- Pat Mackenzie & Marion Ricketts
- Andrea Montani
- Jean Nicolau
- Marit Jensen
- Michael Denhard
- Rob Darvell
- Graeme Loudon
- Leif Sandahl
- and many others!

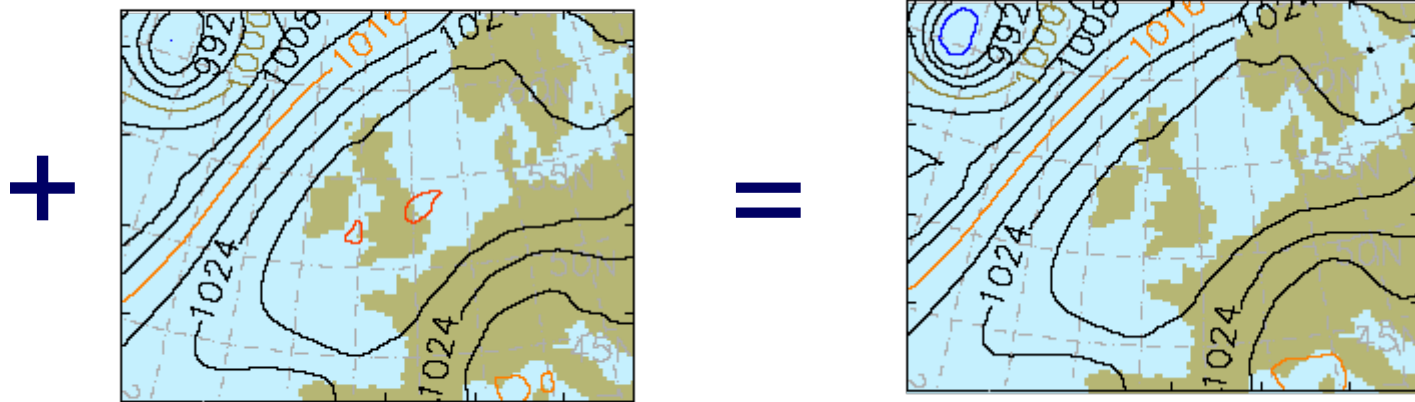
<http://www.preview-windstorms.eu/>
Username/password: Contact
ken.mylne@metoffice.gov.uk

Analysis Perturbations - Error Breeding



T+12 perturbed forecast

T+12 control forecast



Control analysis

Perturbed analysis

Ensemble Transform Kalman Filter (ETKF)

