Use of ECMWF products at Météo-France

Mireille Mayoka

Deputy Head of General Forecast Department

Thanks to Bruno Gillet-Chaulet, Nicole Girardot, Fabrice Guillemot, Thierry Dupont …

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31 October - 4 November 2011

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Outline

Use of ECMWF products at Météo-France :

- Severe weather forecast for D+2 and D+3
- Medium and extended range forecast
- Feedback on ecCharts
- Tropical cyclone forecast

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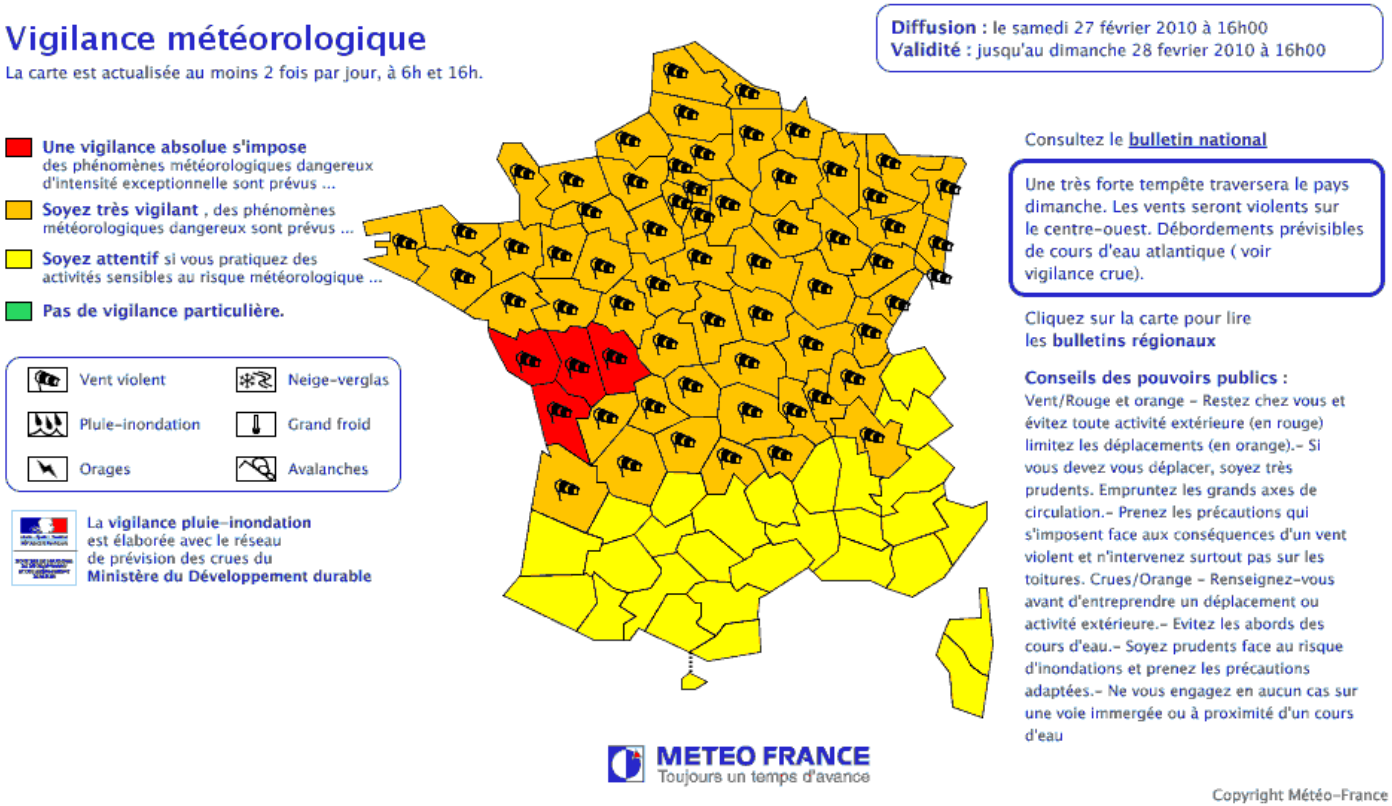
Severe weather forecast for D / D+1

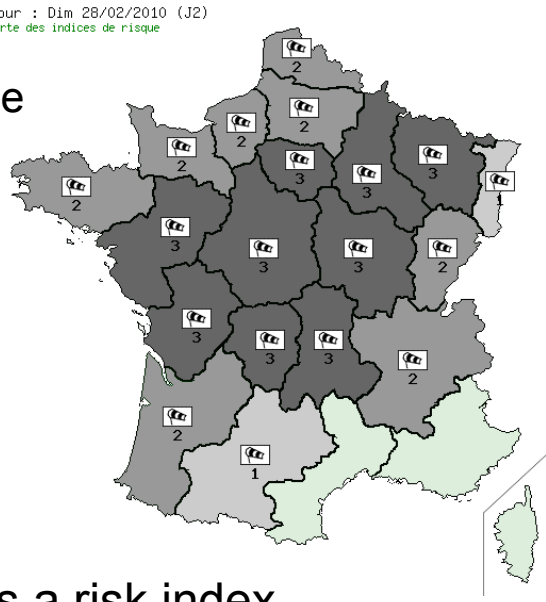
- The French « Vigilance » watch map
  - 4 watch levels (colours), for 8 dangerous phenomena, for each administrative unit (department)
  - Operational since 2001, this system is well known (89% in 2010) and has proved generally successful



- **Watch map as a routine production :**
  - **Published twice a day,**
  - **Exceptional production may be initiated outside these hours**
- **A process involving national and regional levels**
- **In case of an orange or red level on at least one department, follow-up bulletins until the end of event**
- **MF Management « on call » 7d/24h**

Severe weather forecast for D+2/D+3

- Estimation of the risk of severe weather :
  - Which would imply an orange or red level at 24 hours range
  - 4 dangerous phenomena :
    - **- Violent winds,**
    - **- Heavy rain*, and not flood (hydrological services)**
    - **- Violent thunderstorms,**
    - **- Snow/ice.**



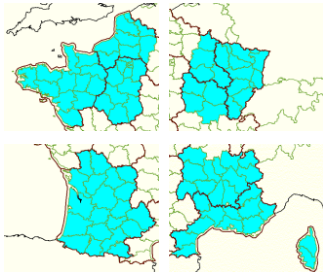
- For each day (D+2, D+3), at the scale of administrative regions (more significant than departments)
- For each zone and phenomenon, the forecaster chooses a risk index from :
  - 0 : no risk
  - 1 : unlikely
  - 2 : likely
  - 3 : certain

Internal production since November 2007, modified in 2010 (scale and colors)

- **=> Quantify the risk => Calibrated risk**
  - Percentage of forecasts for each index which actually correspond to severe weather events

Principle of the calibrated risk

- **Use of past forecasts, (since Dec. 2004 over ¼ of France).**
- **Comparison to a reference (vigilance level, FA, missed events)**
- **Example : how much is a weak risk,**
  - **Over the *northwestern* regions,**
  - **For the *violent wind* parameter,**
  - **At range *D+2* ?**



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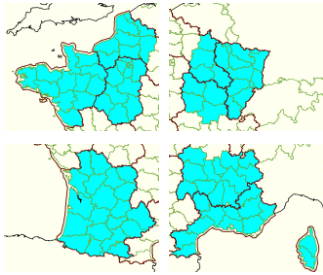

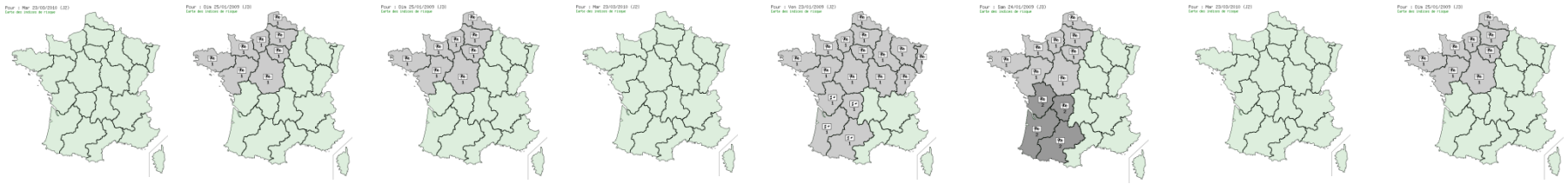

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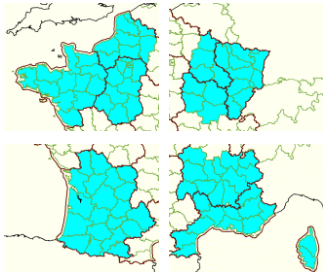

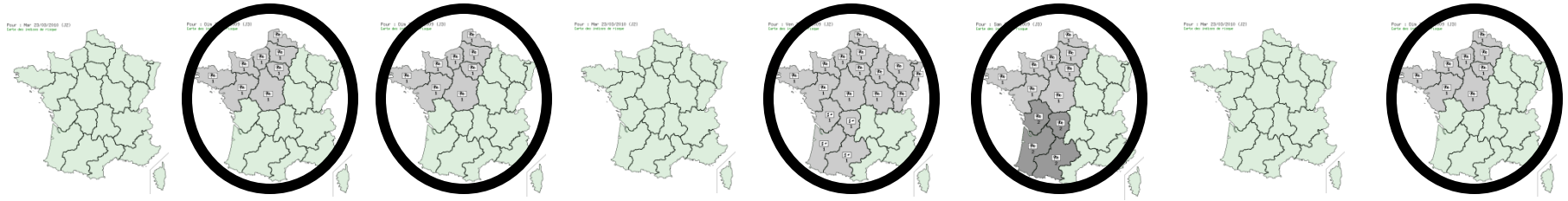

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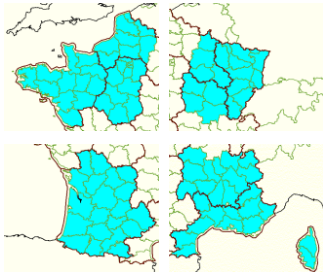
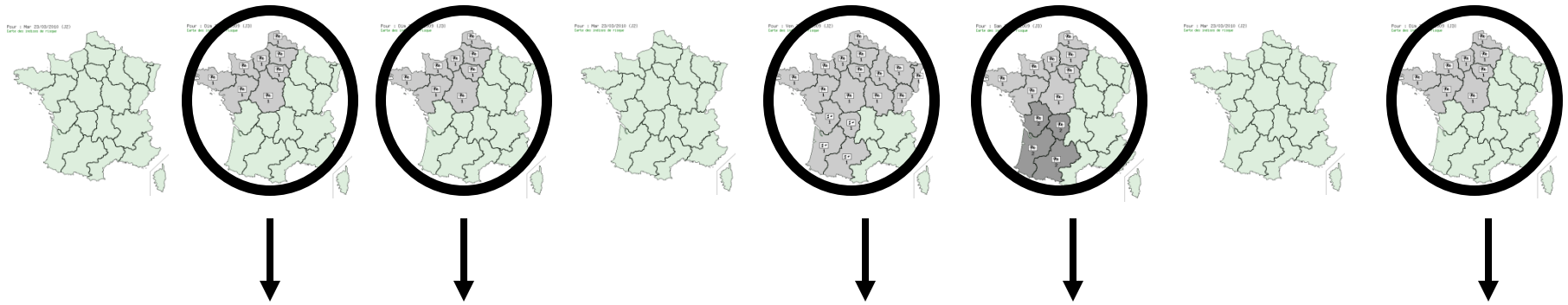




nothing **nothing** **nothing** **Orange level event** **nothing**

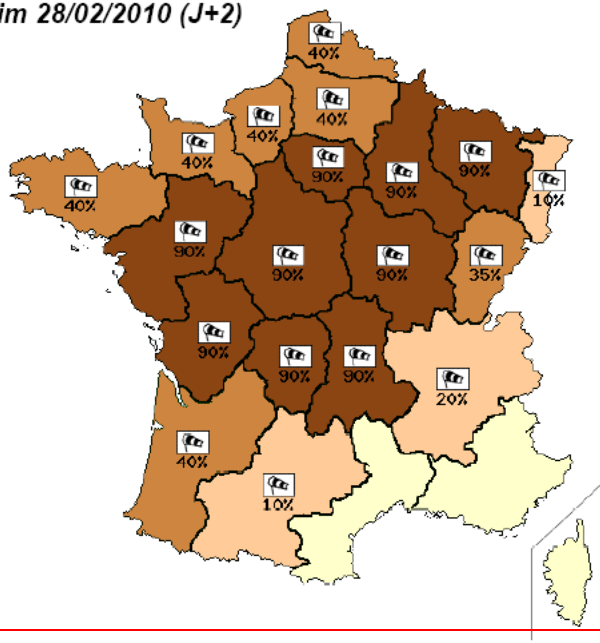
=> 20 %

Internal production issued on 2010/02/25

➤ ***Prévision anticipée des phénomènes remarquables élaborée le Ven 26/02/2010 :***

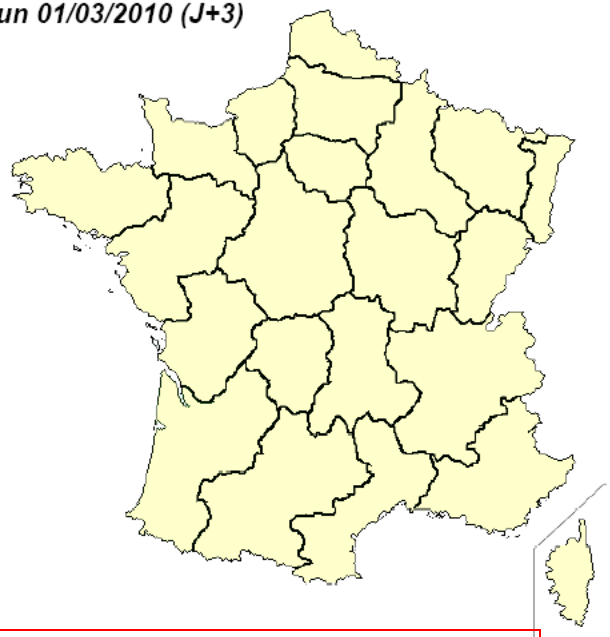
Pour le :
Dim 28/02/2010 (J+2)

For D+2



Pour le :
Lun 01/03/2010 (J+3)

For D+3



Echelle des risques:

- *Risque quasi nul.*
- *Risque faible. (<= 30%).*
- *Risque moyen. (30% - 70%).*
- *Risque élevé. (> 70%).*

- **A calibrated final product**
- **Available on an internal Webpage**

Scale of risks :

- ***Almost no risk***
- ***Weak risk <=30%***
- ***Medium risk (30-70%)***
- ***High risk >70%***

Commentaires :

Passage de l'onde de tempête sur le pays selon un axe Vendée/Charentes Ardennes/Lorraine, en passant par les régions du Centre et de l'Ile-de-France.
Les rafales de vent les plus fortes attendues dans un premier temps sur le littoral atlantique de l'ordre de 130 km/h généralisé s'étendront rapidement aux régions de l'intérieur avec des valeurs comprises entre 100 et 130 km/h selon un axe Vendée/Charentes, Touraine, Ile-de-France, Champagne-Ardennes et Lorraine.

Comment

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Results and feedback

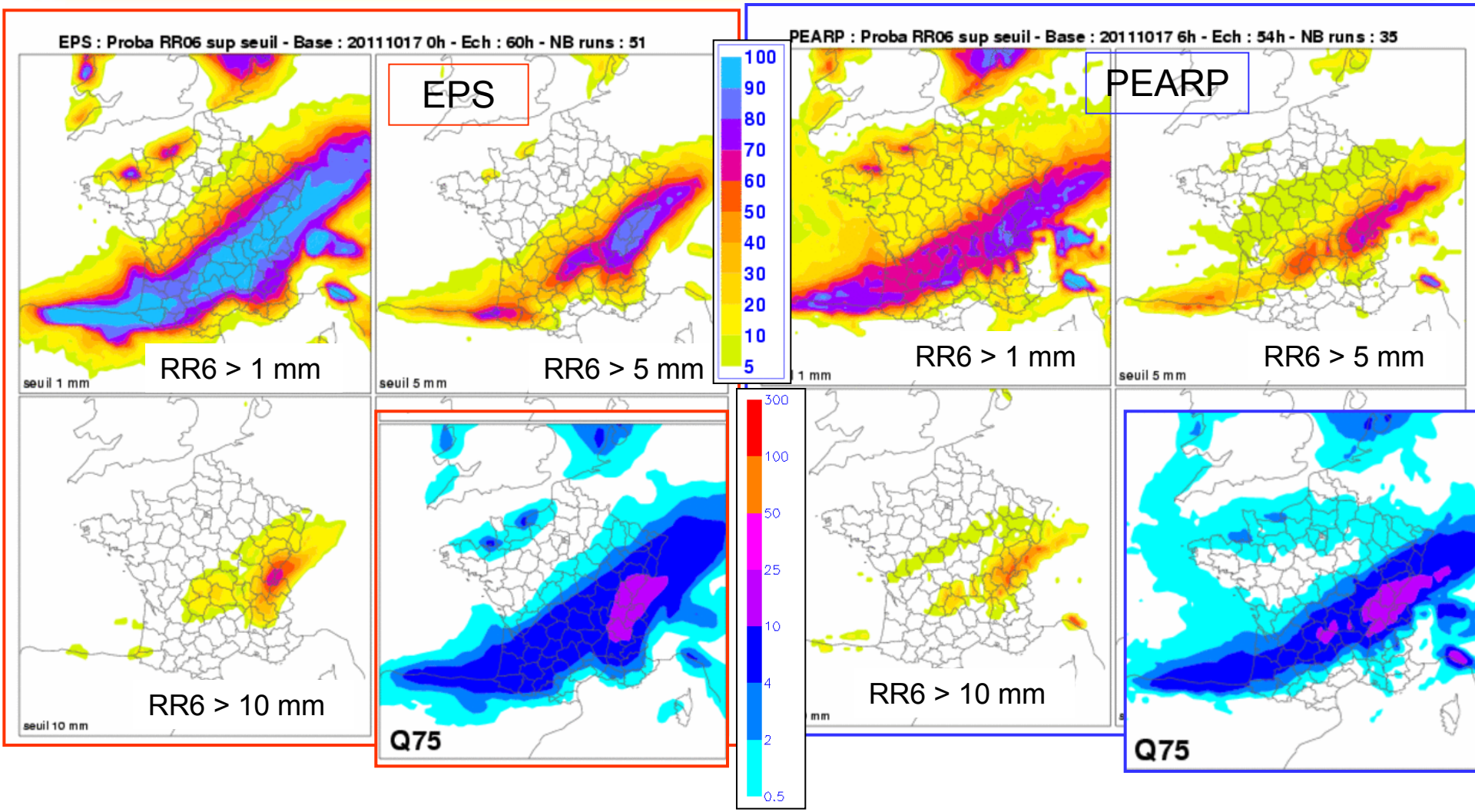
- Results
  - Capacity to produce relevant information about severe weather events more than 24 hours ahead
  - The forecast reliability is established and will obviously improve day by day
  - The scale of administrative regions seems to be relevant at this range
- Feedback from partners
  - A test production has been held since March 2010 with a few governmental services in order to evaluate the potential usefulness of this type of forecast
  - The national hydrological service is very interested : relevant, useful, interest of confirmation of the risk from D+3 to D+2, interest of no risk
  - The civil protection services don't know how do use this information in their operational work which is focused on the next 24 hours
  - The test is still going on, with other services (CMVOA).

Good results for the main severe weather events in 2010

An internal Website for forecasters

- National forecasters use more and more ensemble products :
  - In addition to deterministic products (multi-model approach)
  - To evaluate the uncertainty of forecast
  - Especially to evaluate **the risk of severe weather events**
- They compare ensemble products from different sources
  - Météo-France (PEARP)
  - ECMWF (EPS)
  - NCEP
  - CMC
- Products are available on an internal Website « Prévisibilité » (*Foreseeability*)
  - Probabilities
  - Percentiles
  - Spaghetti diagrams
  - Postage stamp maps

Case 1 : Probabilities and percentiles of RR6 for 19 October 12h (D+2)



- Probabilities and percentiles are complementary products
- Some differences between EPS and PEARP forecasts

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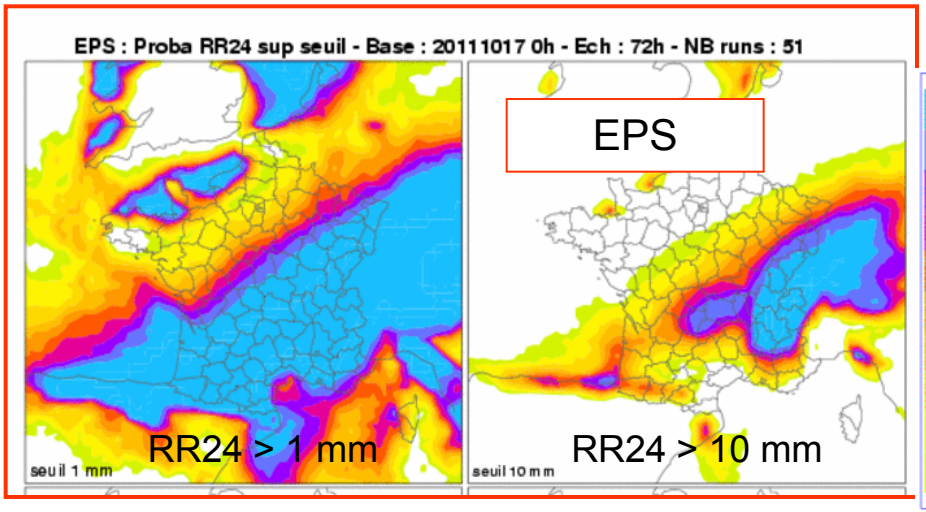
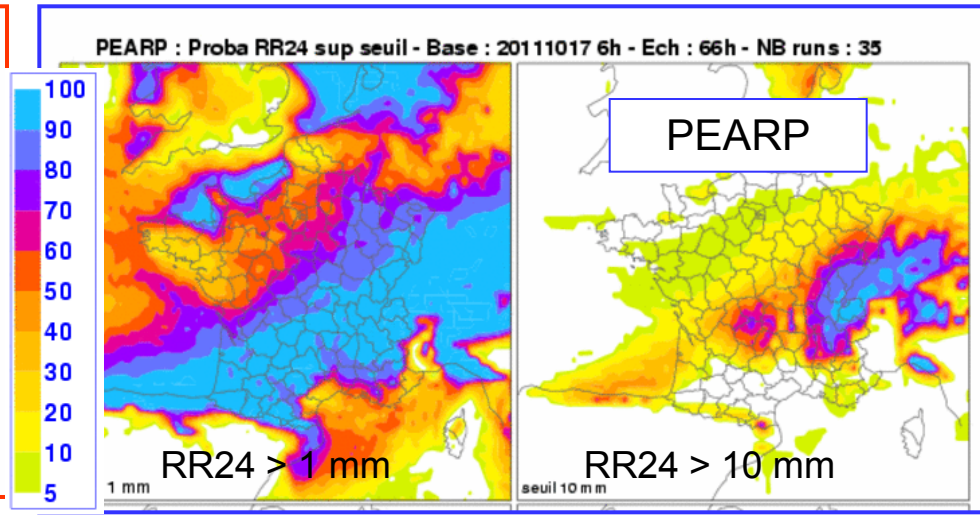
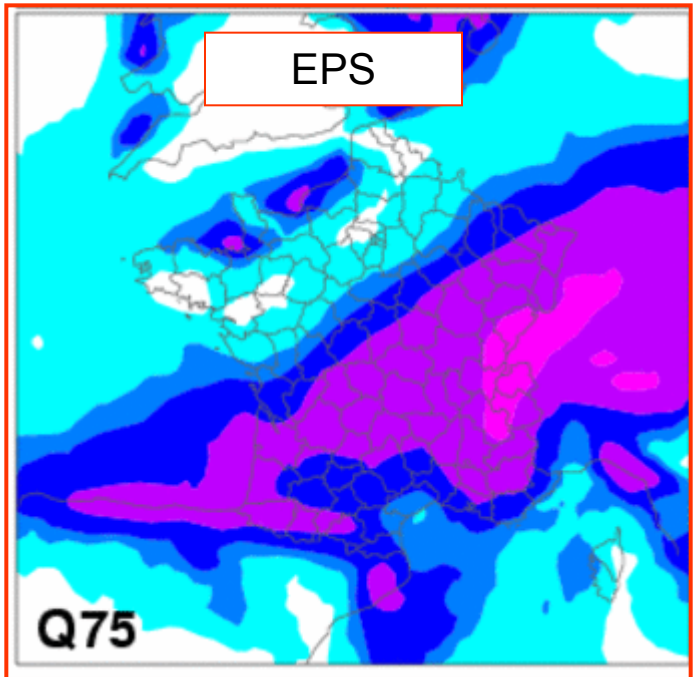
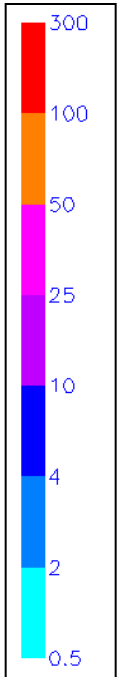
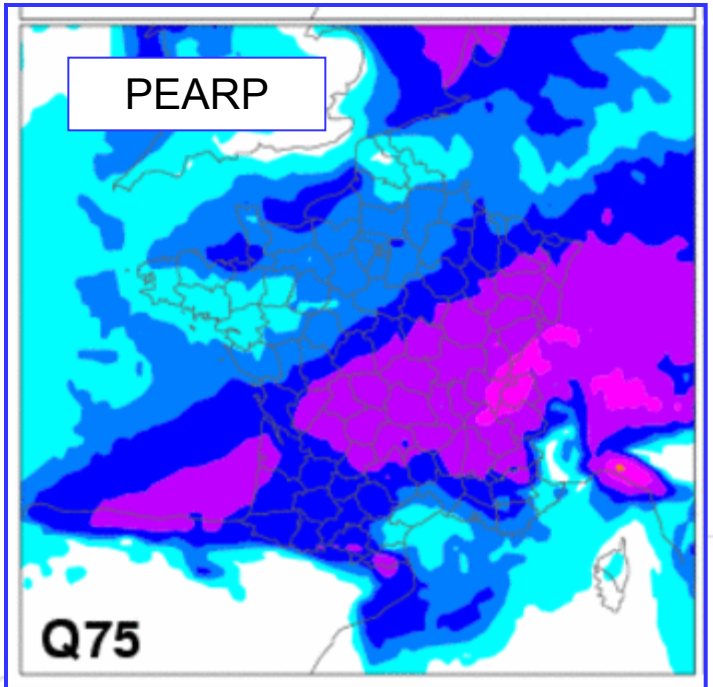
Case 1 : Probabilities and percentiles of RR24 for 20 October 0h (D+2/D+3)



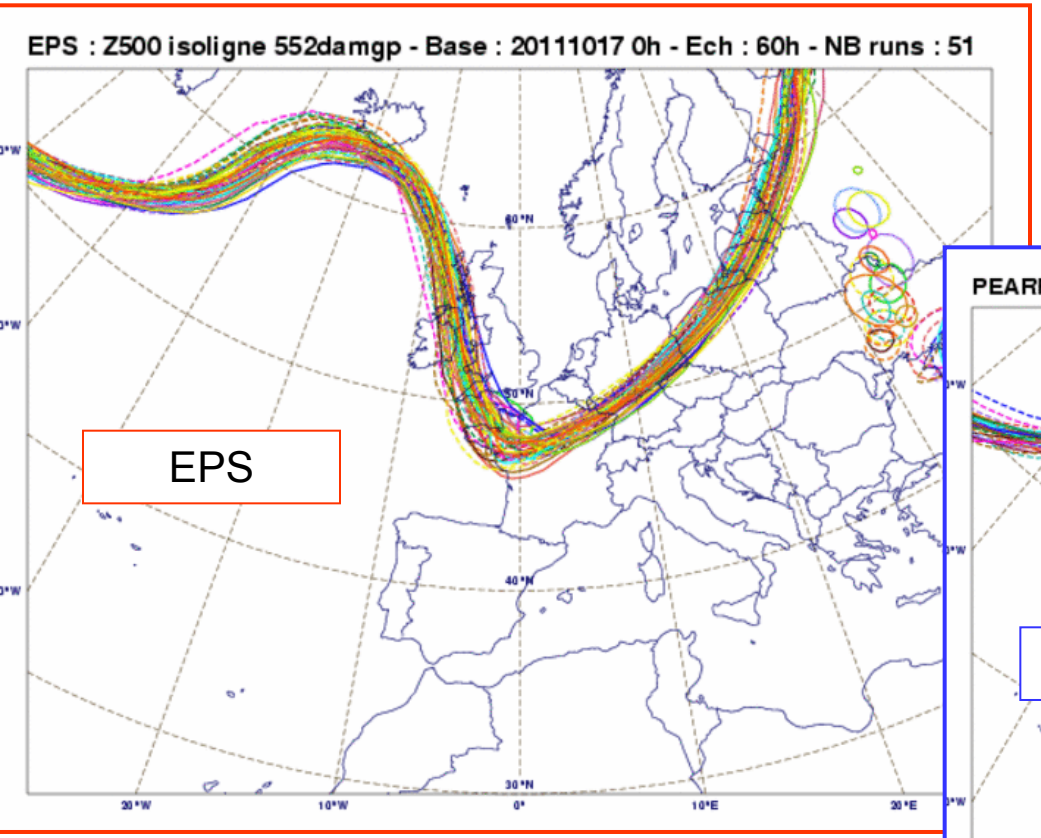




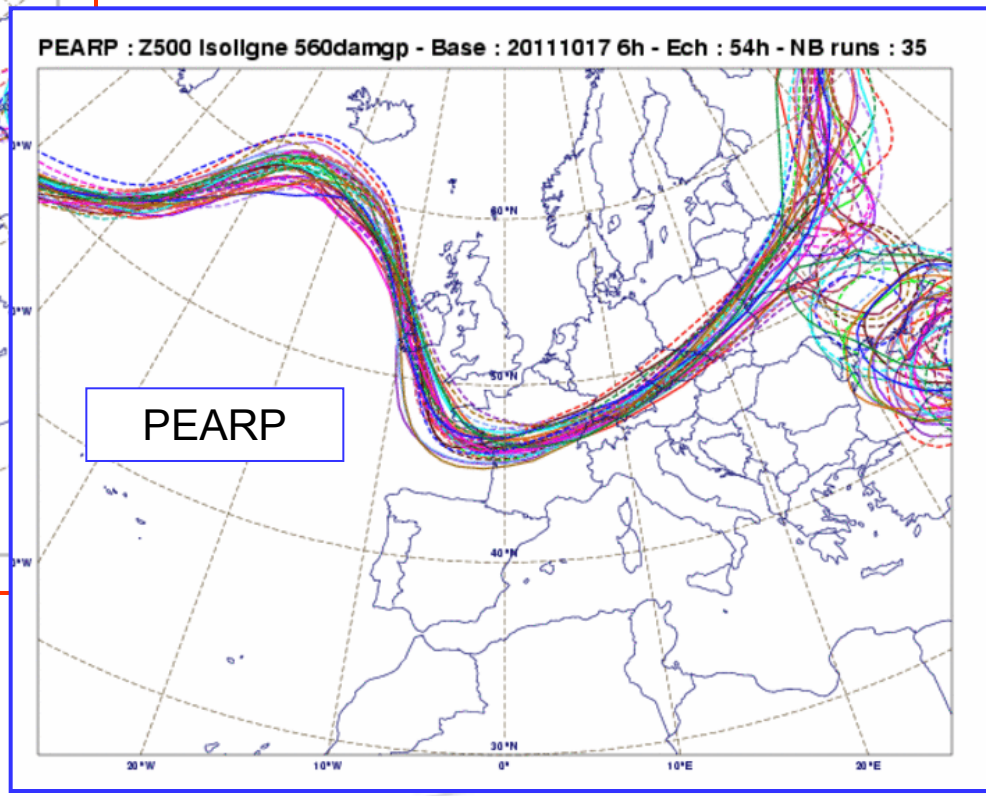




Case 1 : Spaghetti diagrams Z500 for 19 October 12h



Spaghettis Z500 give a good estimation of the spread of each ensemble model



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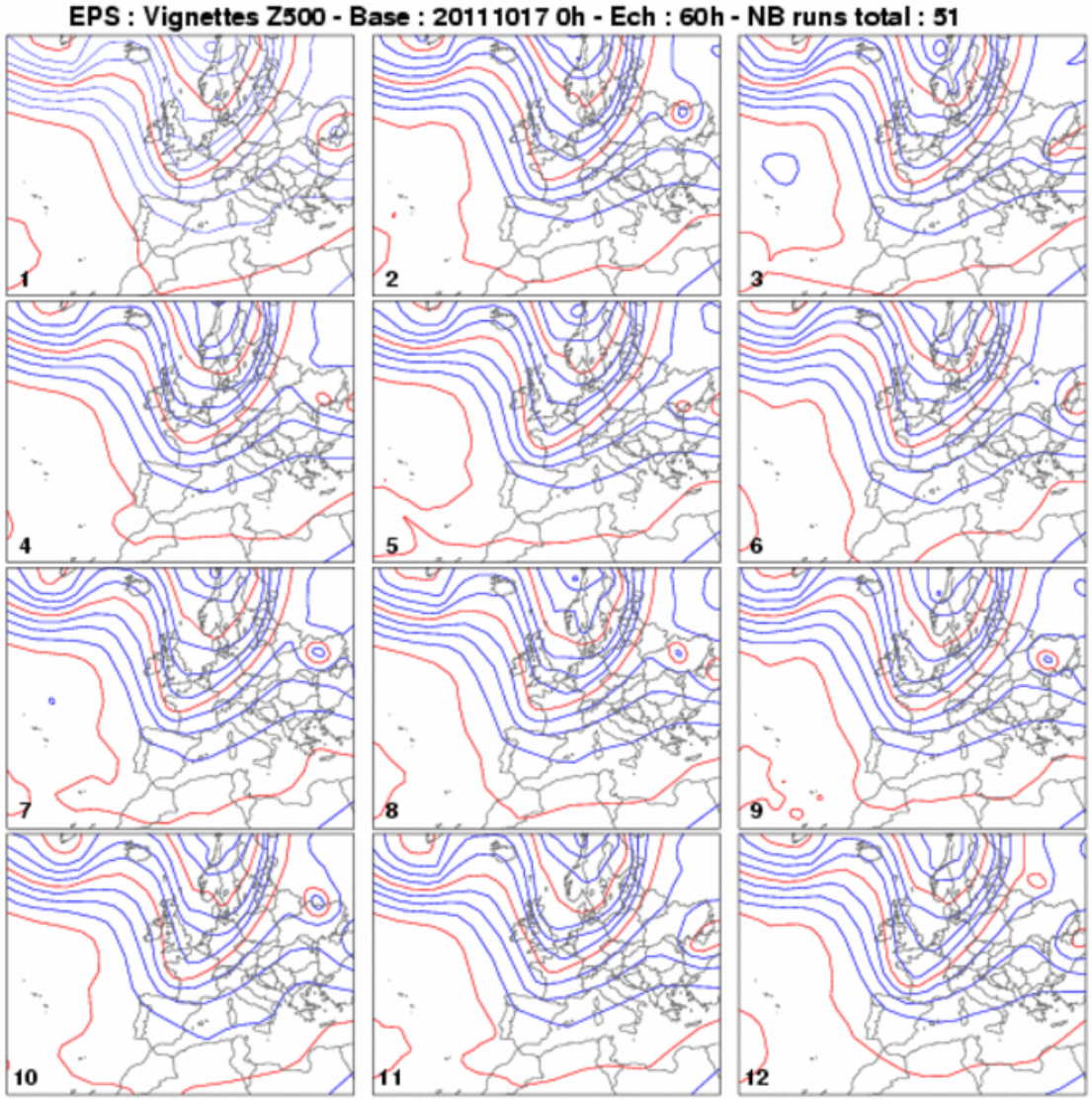
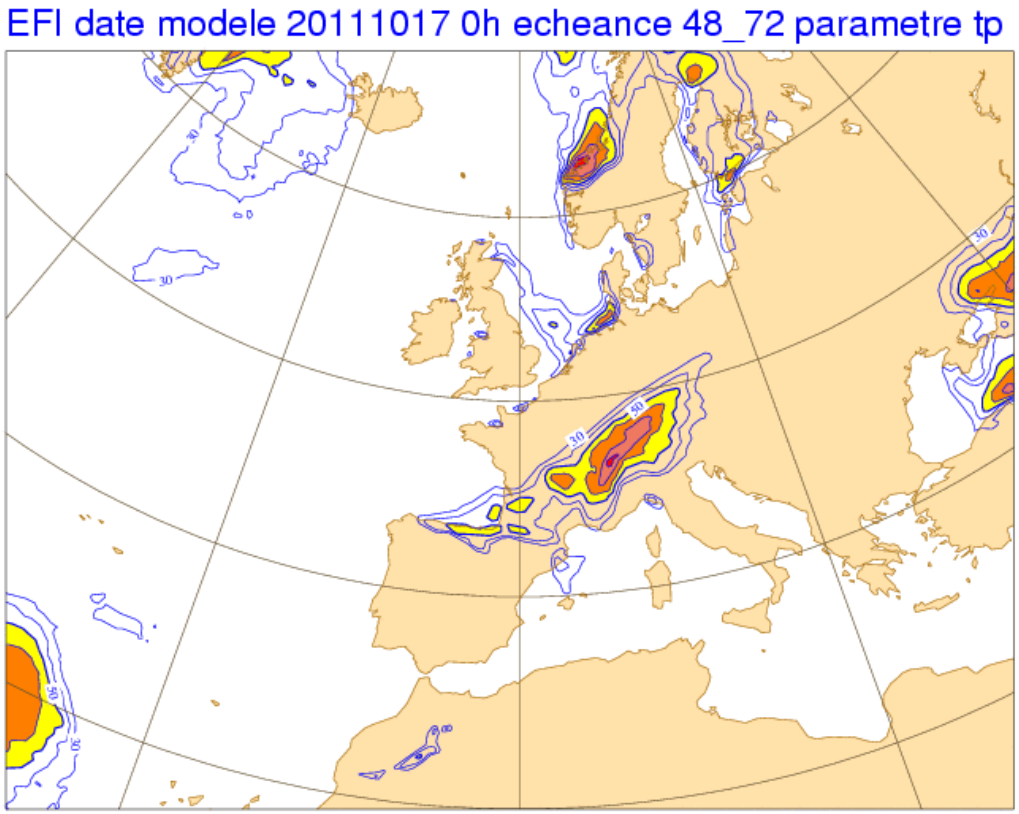
Case 1 : Postage stamp maps for 19 October 12h



- Quick look on the EPS members
- Can help to see alternative scenarios

Case 1 : EFI for 19 October



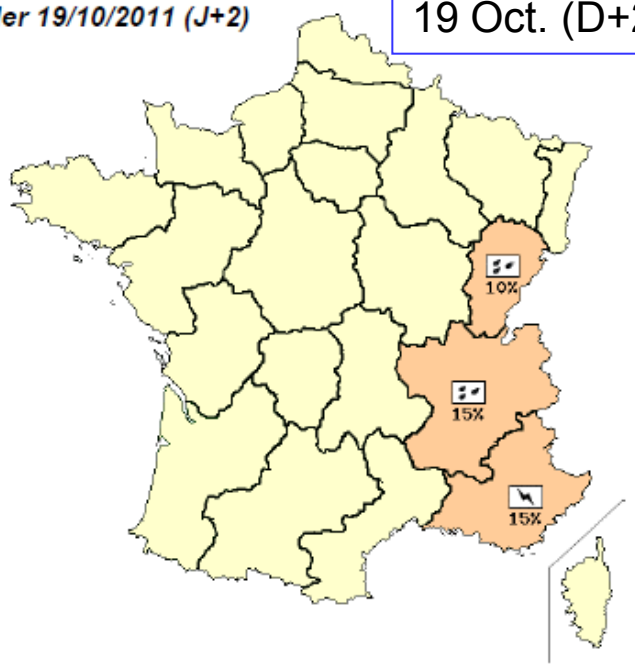
- EFI must draw the attention
- EFI doesn't give absolute values, nor probabilities
- It is necessary to validate with other plots

Case 1 : Severe weather forecast for D+2

➤ *Prévision anticipée des phénomènes remarquables élaborée le Lun 17/10/2011 :*

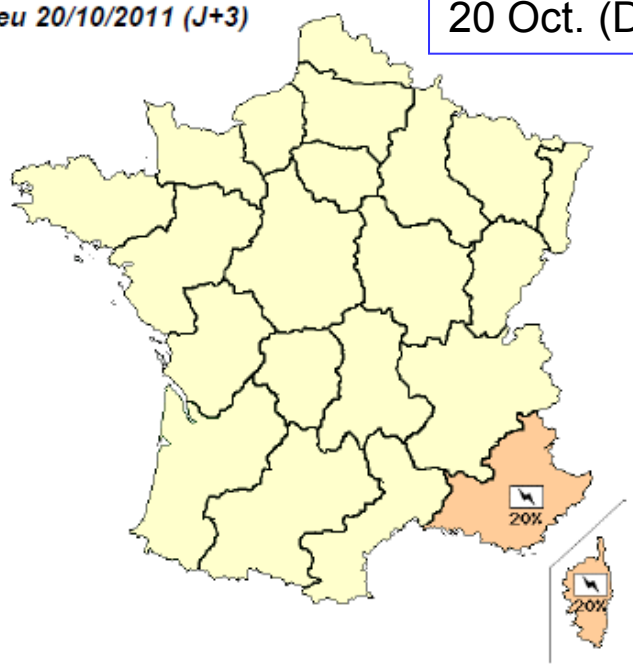
Pour le :
Mer 19/10/2011 (J+2)

Forecast for
19 Oct. (D+2)



Pour le :
Jeu 20/10/2011 (J+3)

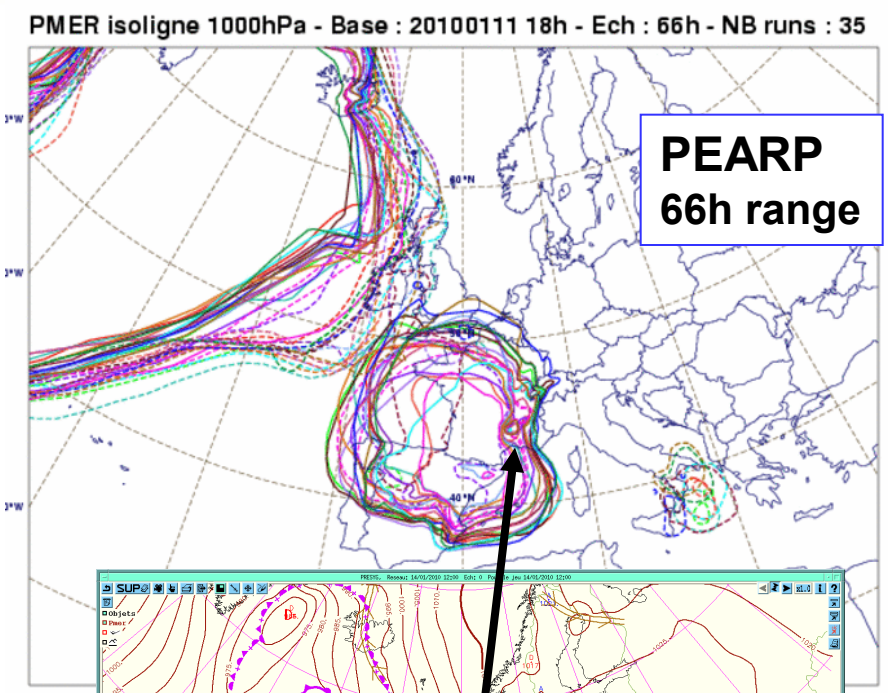
Forecast for
20 Oct. (D+3)

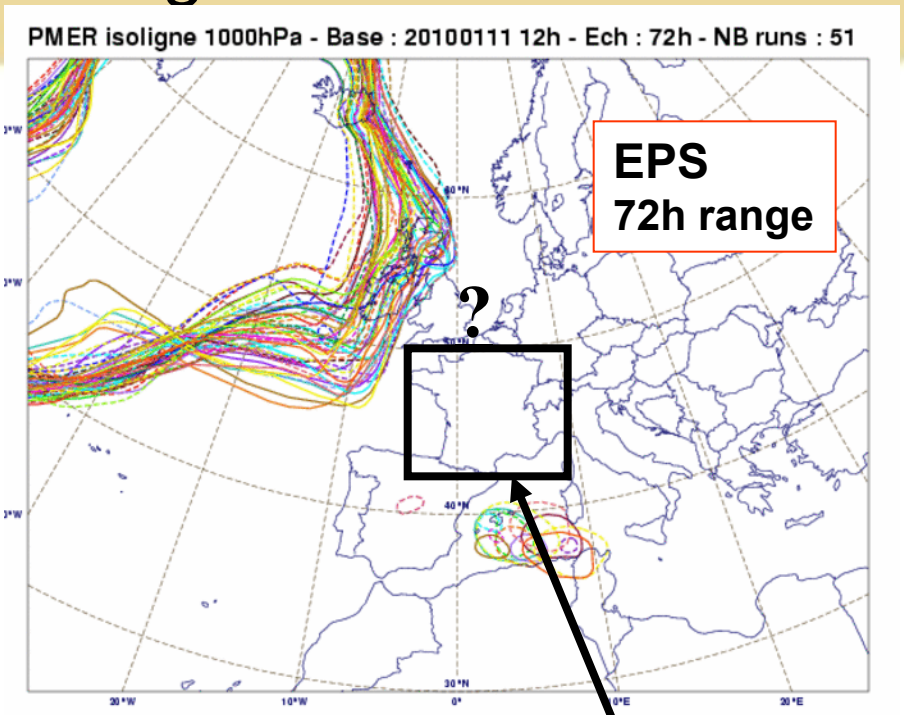


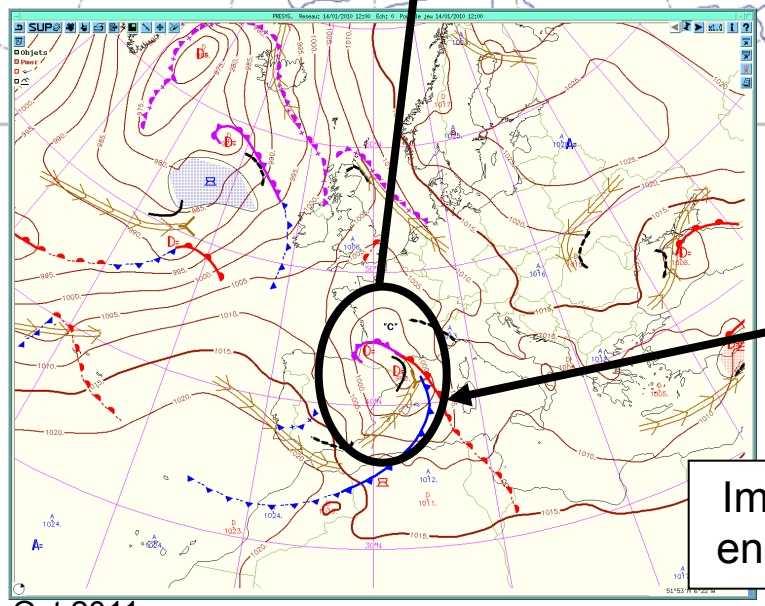
Commentaires :

Passage d'une perturbation assez active sur le pays mercredi, pouvant donner de bons cumuls de pluie sur le centre-est.
A surveiller aussi le risque orageux sur le sud-est dans la nuit de mercredi à jeudi.
Pour l'instant, les valeurs prévues sont toutefois peu préocupantes dans les 2 secteurs.

Case 2 : Spaghetti diagrams MSLP







- Bad information in EPS at D+2 : depression not forecasted by any of the 51 runs
- Good information in PEARP

Importance of a human expertise to compare the multi-ensemble products and choose the most likely scenario

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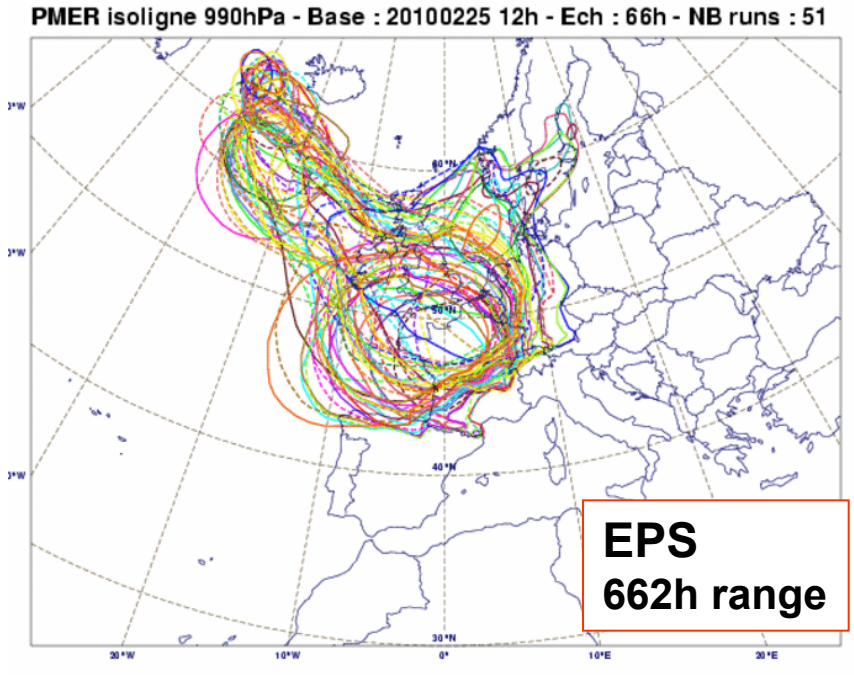
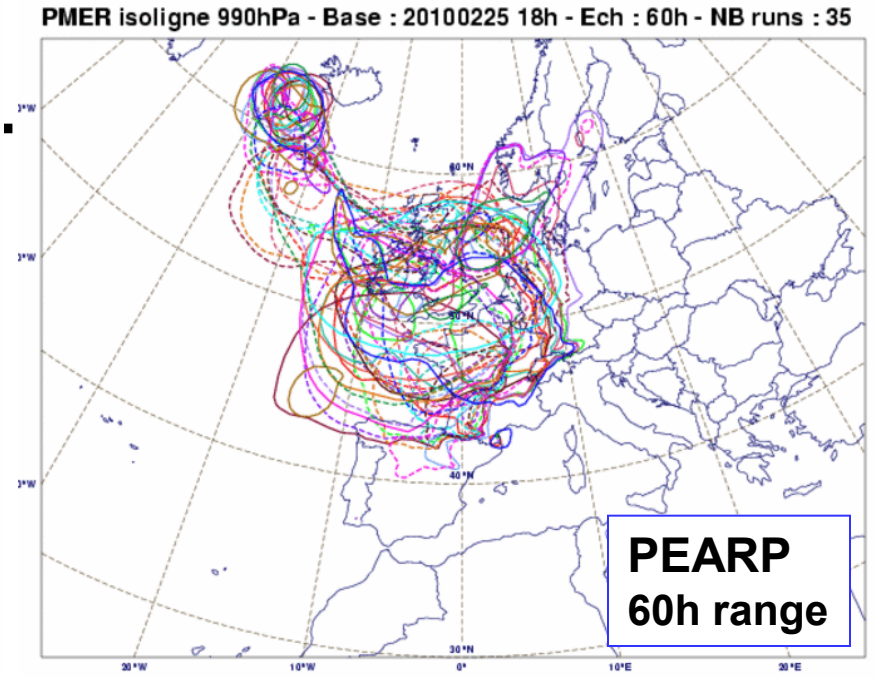
Case 3 : Spaghettis MSLP for 28 February 2010
Storm *Xynthia*

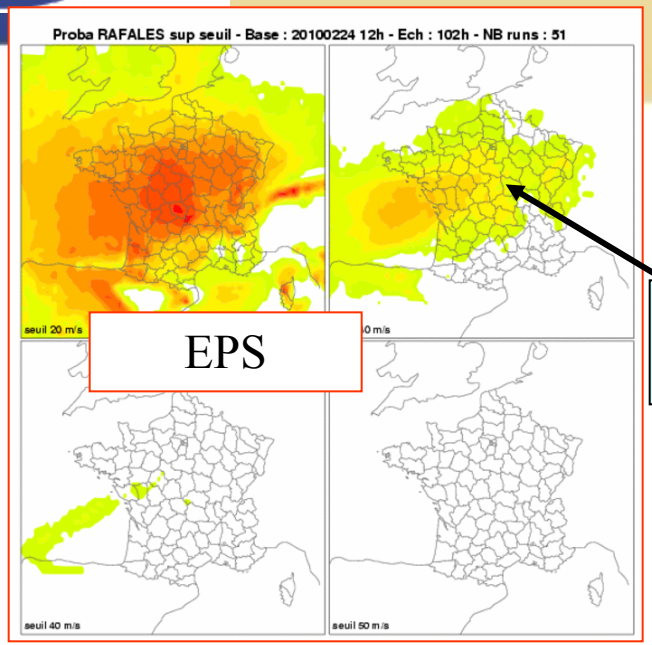




66h range with EPS, 60h range with PEARP, D+2 :

A little more spread with PEARP, but both models in agreement for location of the depression

Case 3 : Good forecast at D+3

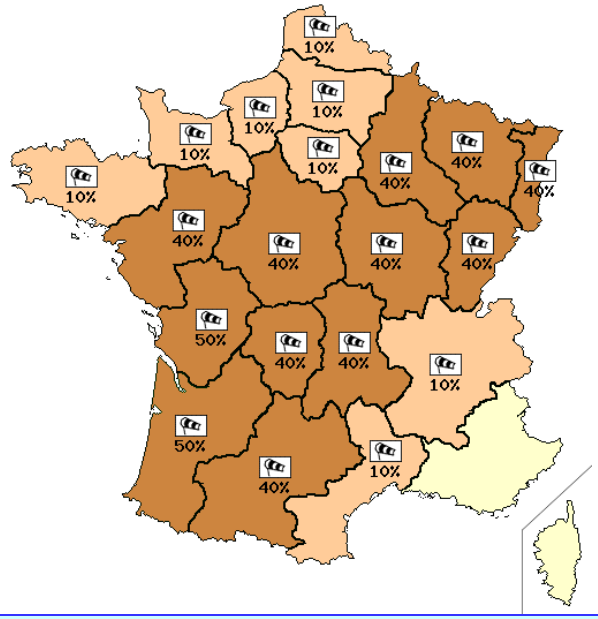


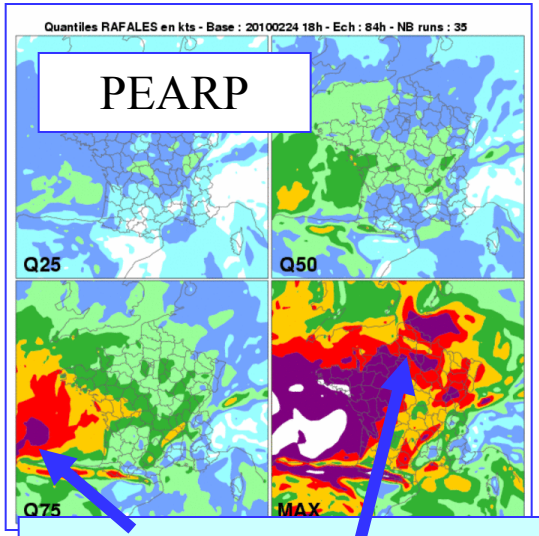
EPS

Signal at D+3

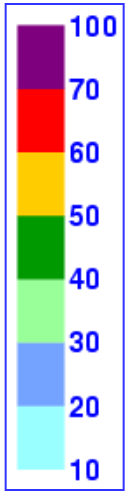
Around 40% risk of wind gusts reaching 30 m/s (110 km/h) in EPS

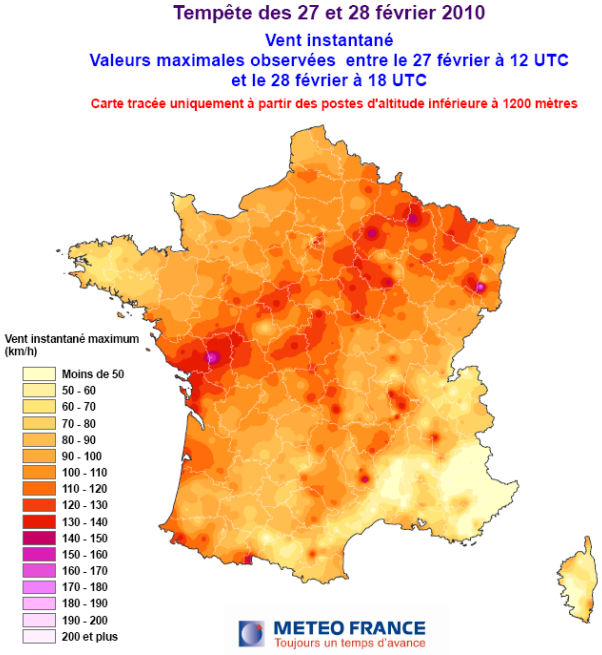
Severe weather forecast map for D+3





PEARP



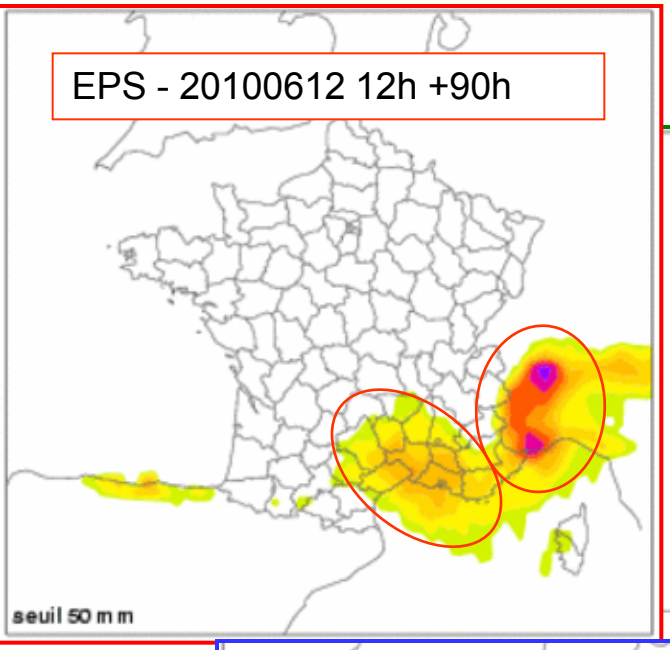


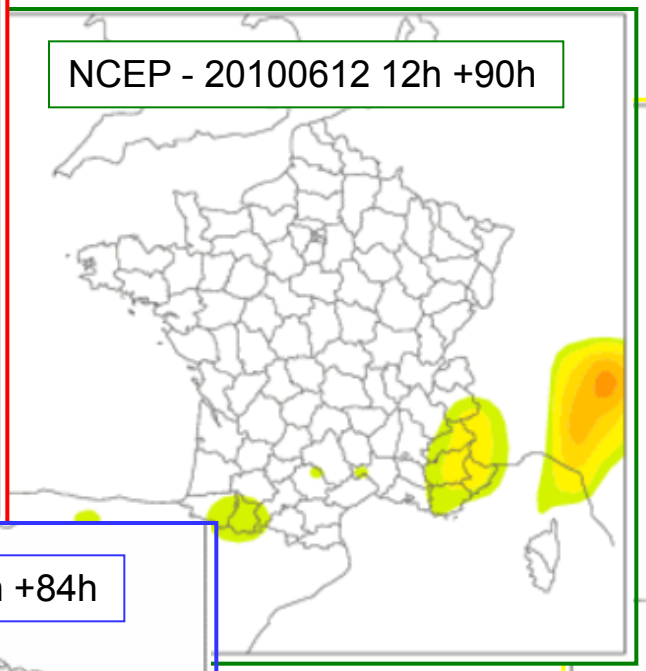
Q75 around 60 kt (110 km/h) with PEARP, not so clear with EPS ;

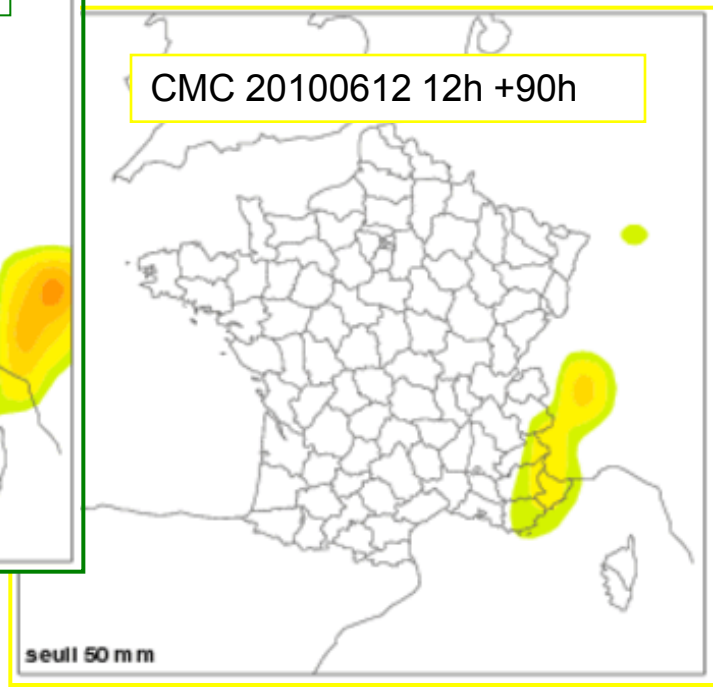
Qmax > 70 kt (130 km/h), excessive but « informative ».

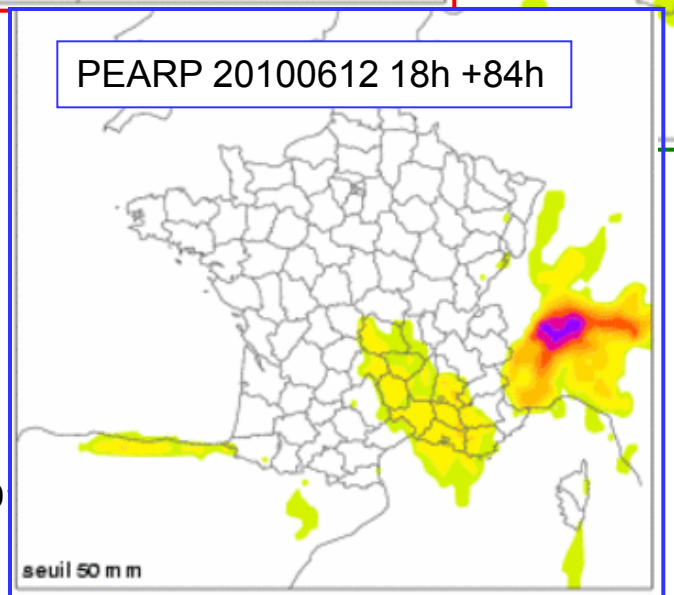
Case 4 – Rain event, 15 June 2010 (1)

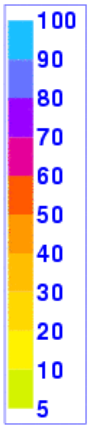
Probabilities of RR24 > 50mm for 15/06 6h to 16/06 6h











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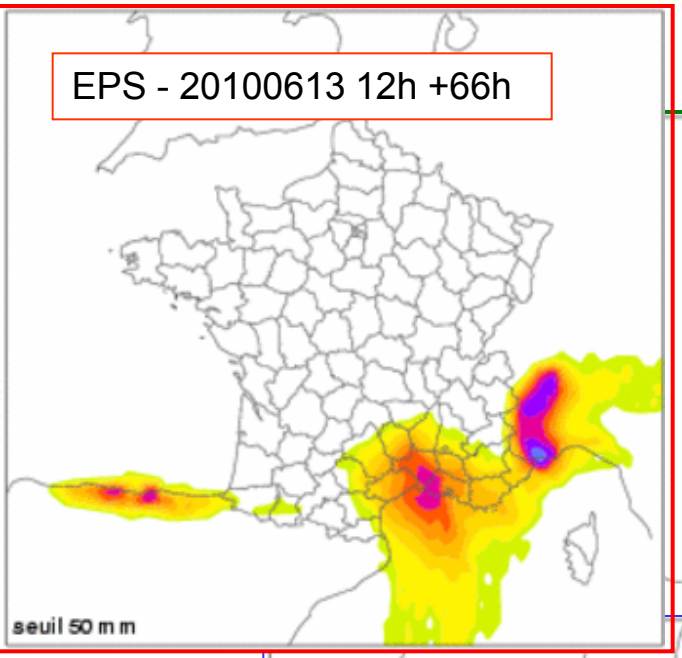
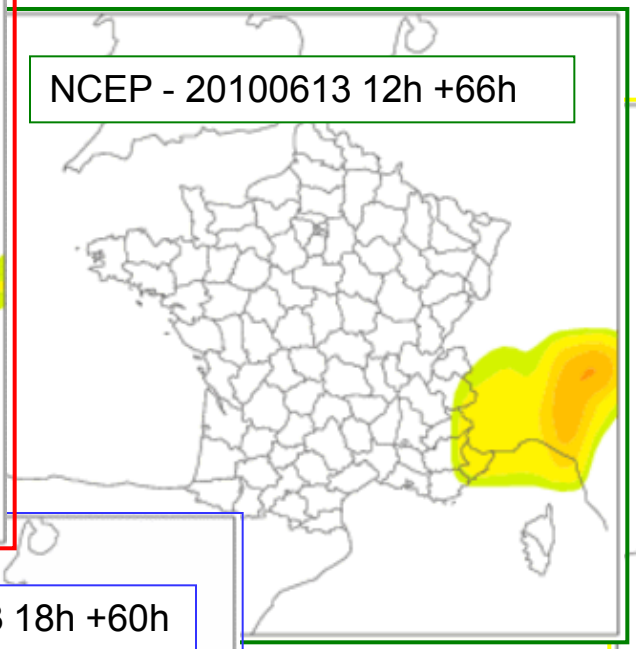
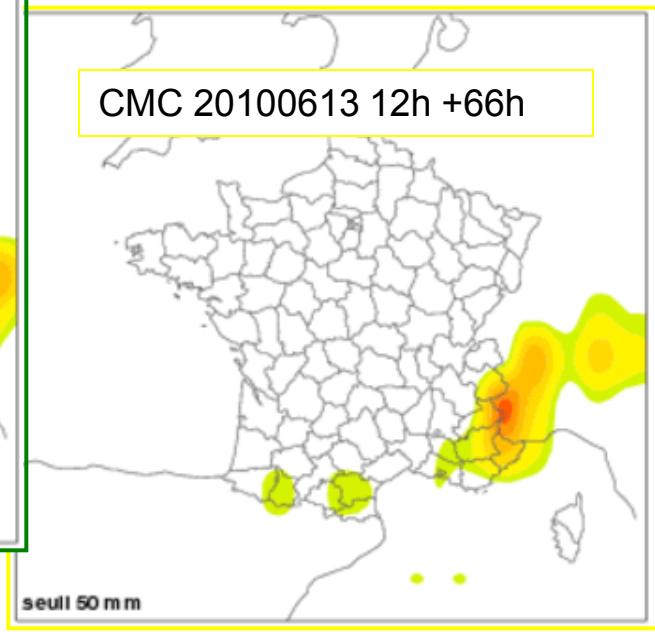
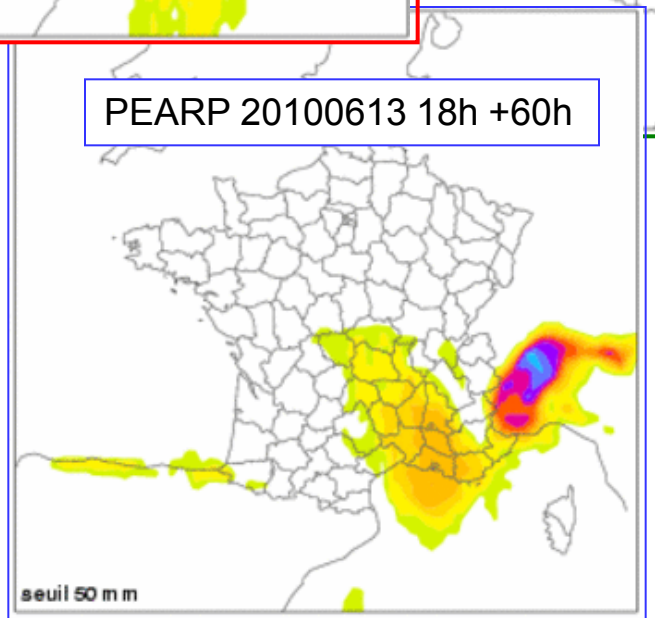
Case 4 : Rain event, 15 June 2010 (2)

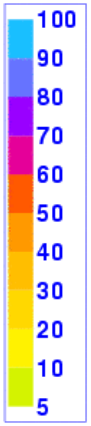
Probabilities of RR24 > 50mm for 15/06 6h to 16/06 6h











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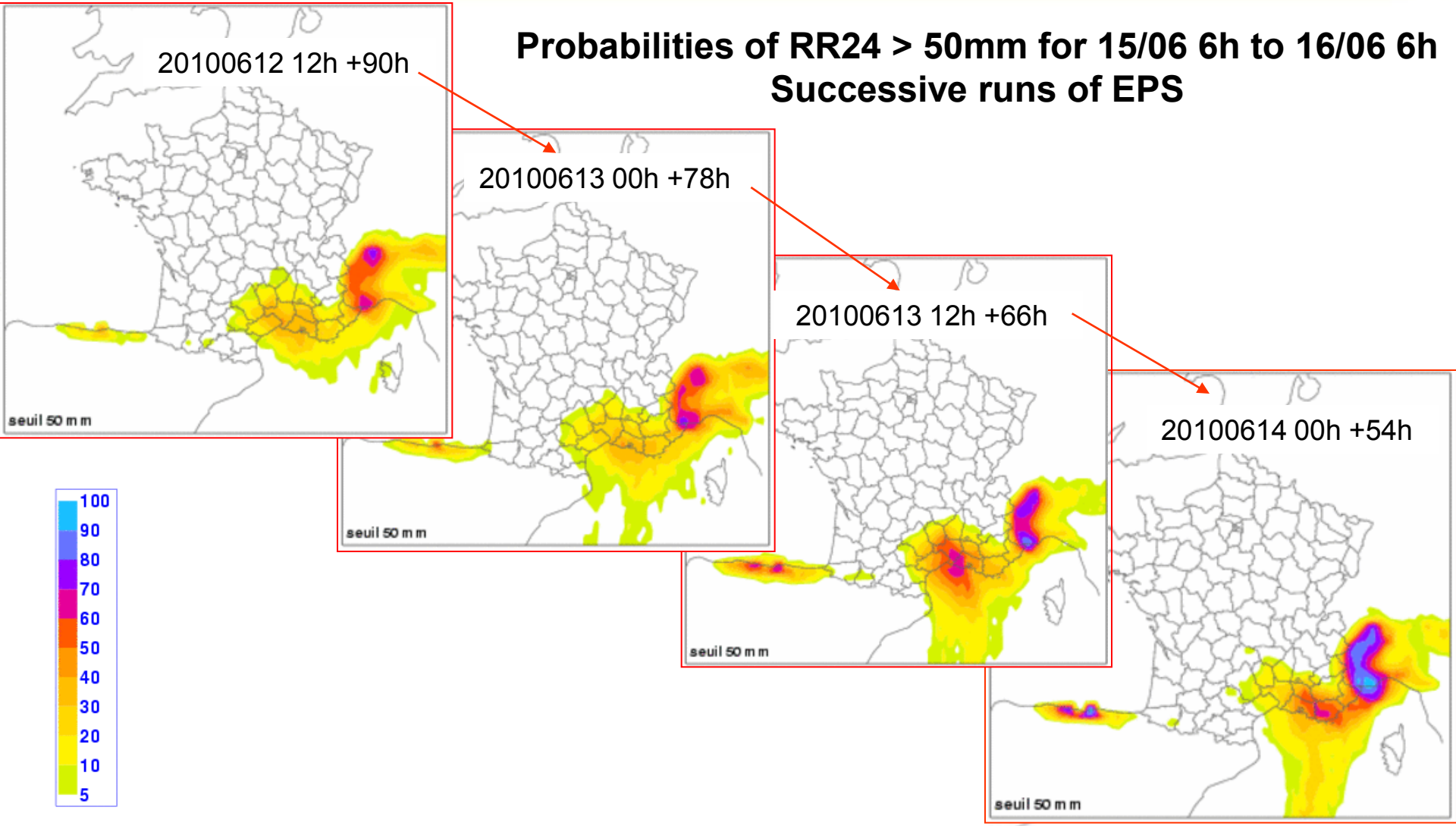
Probabilities – Rain event, 15 June 2010 (3)

Probabilities of RR24 > 50mm for 15/06 6h to 16/06 6h
Successive runs of EPS



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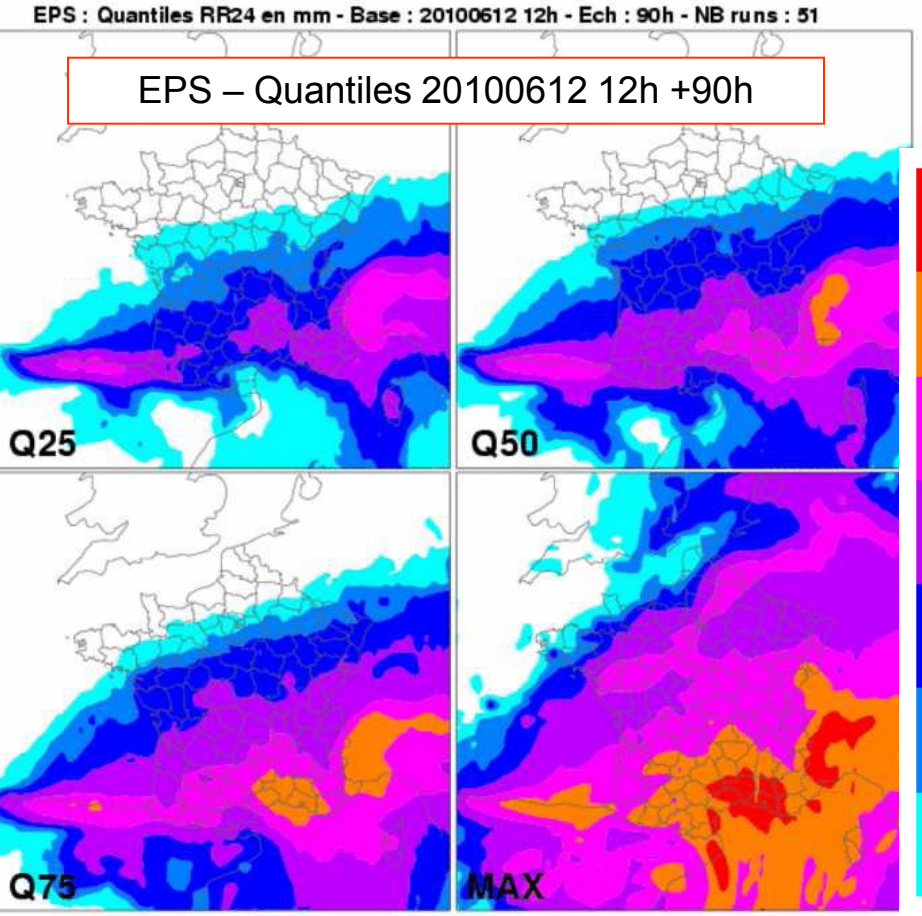
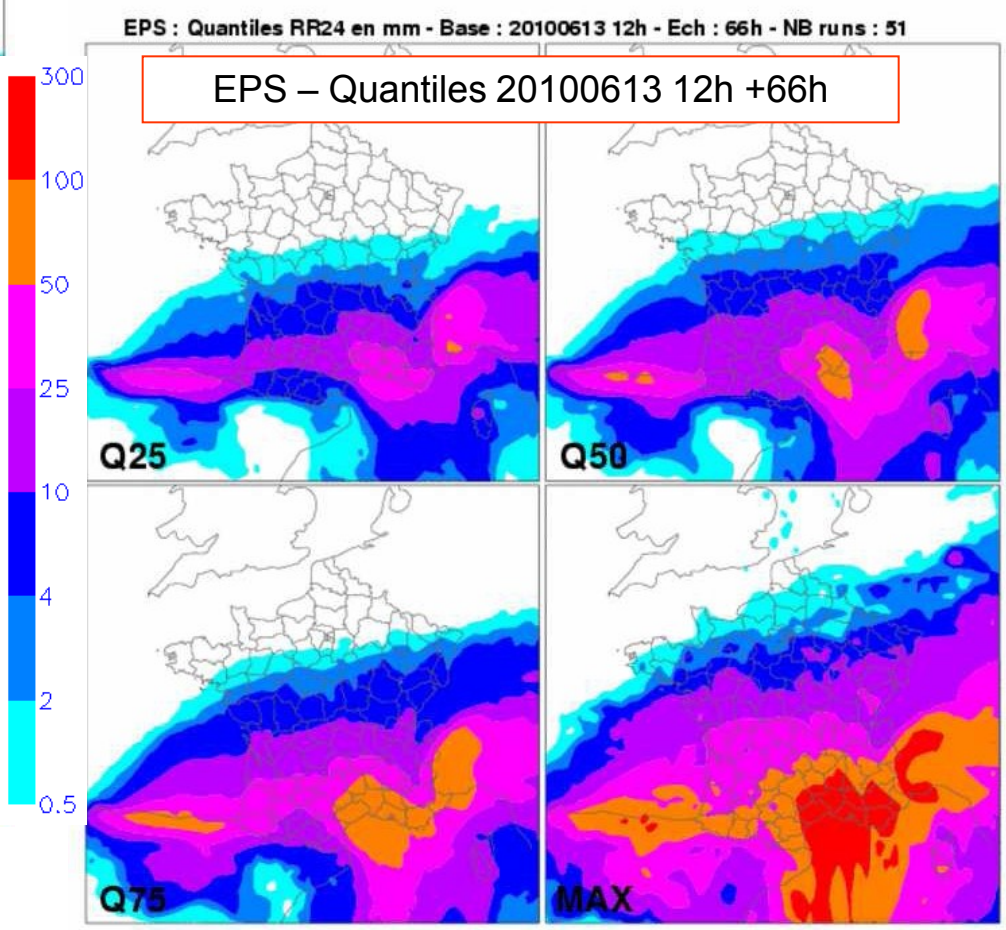
Percentiles – Rain event, 15 June 2010 (1)





- Q75 charts are often used for severe weather forecast
- In this case, no value>100 mm in EPS Q75 (better than PEARP)

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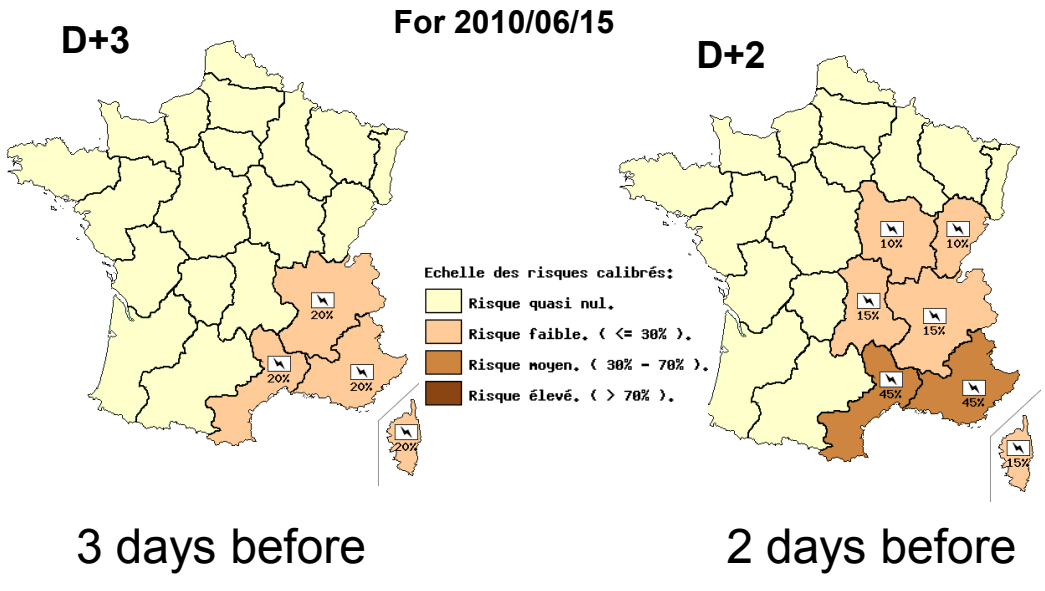
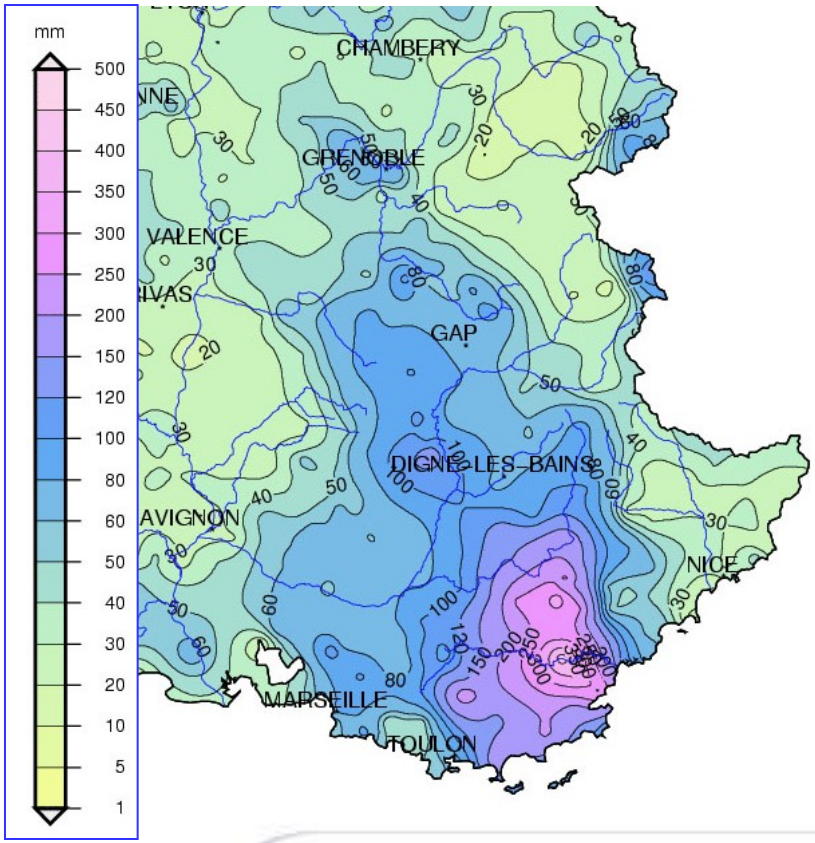
Extreme rain event on Var, 15 June 2010

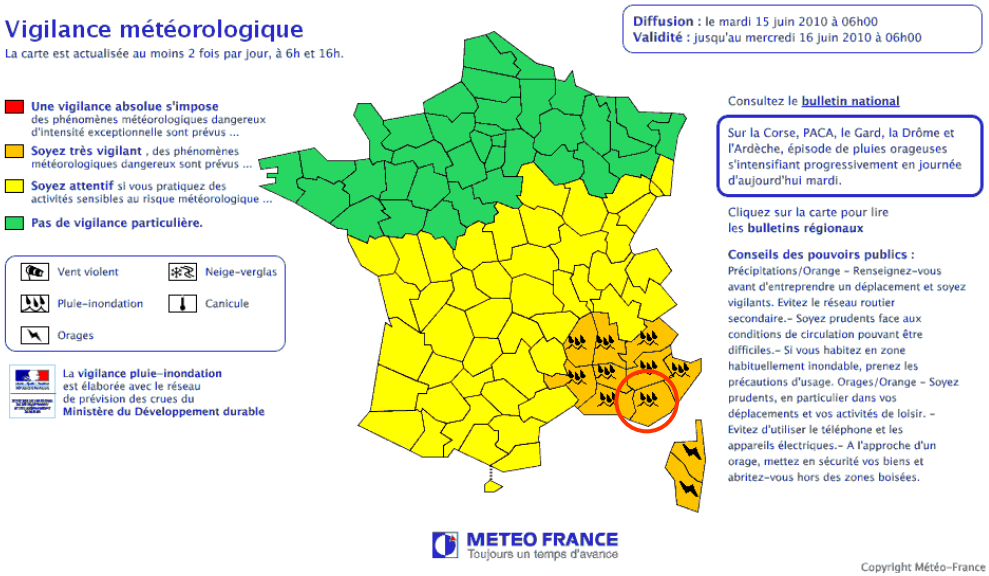


3 days before

2 days before

Total amount of rain over 2 days from 14 June 6h to 17 June 6h





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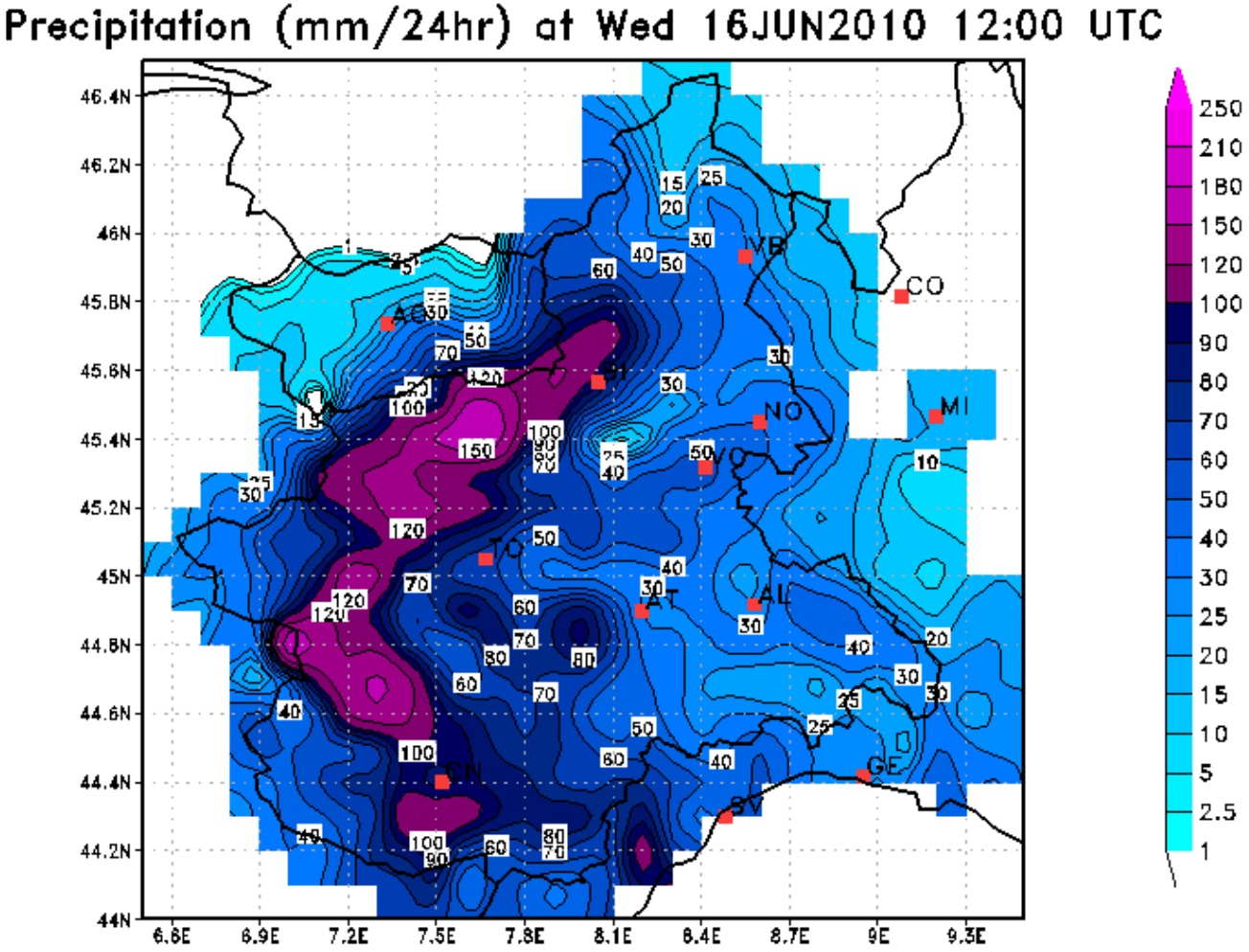
Extreme rain event on Italy, 15 June 2010



Total amount of rain from 15 June 12h to 16 June 12h

Source : Massimo Milelli, ARPA Piemonte

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Outline

Use of ECMWF products at Météo-France :

- Severe weather forecast for D+2 and D+3
- **Medium and extended range forecast**
- Feedback on ecCharts
- Tropical cyclone forecast

Thanks to Nicole Girardot, Fabrice Guillemot and Bruno Mornet

Medium range forecast for D+4 to D+9

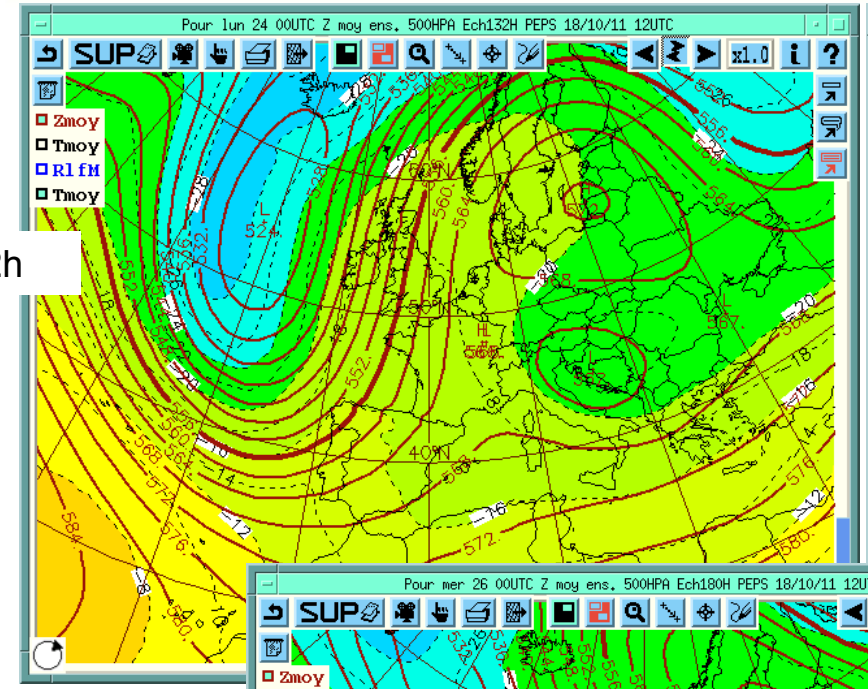
- Synoptic elements are unpredictable at medium range => Forecast at supra-synoptic scale
- Medium range forecast is based mainly on EPS products :
  - Ensemble mean, probabilities (precip, wind, humidity…) ⟶ to define the most likely scenario
  - Spaghetti diagrams Z500 ⟶ spread (uncertainty)
  - EFI charts ⟶ risk of severe weather for D+4
  - Other products : EPSplumes and EPSgrams (local products)
- Comparison between different models & runs :
  - EPS 12 & EPS 00
  - IFS for D+4 and D+5
  - EPS monthly forecast
  - NCEP 12 & NCEP 00
- Mixing different kind of information, with the experience of the forecaster

  => synthesis of the most likely scenario and confidence

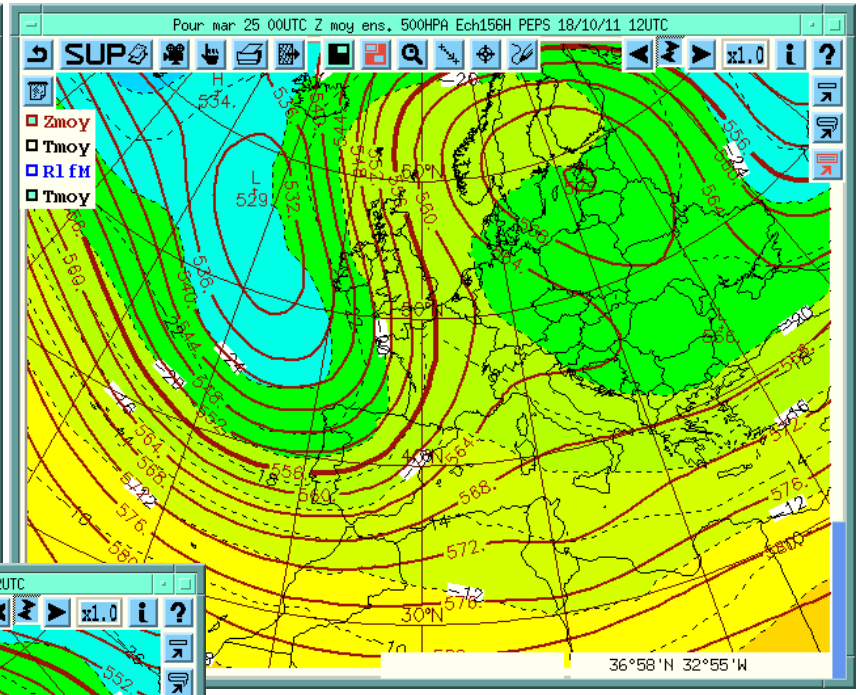
  => use of weather symbols, risk symbols and confidence index.

Use of ensemble mean Z&T500 at D+4/D+5

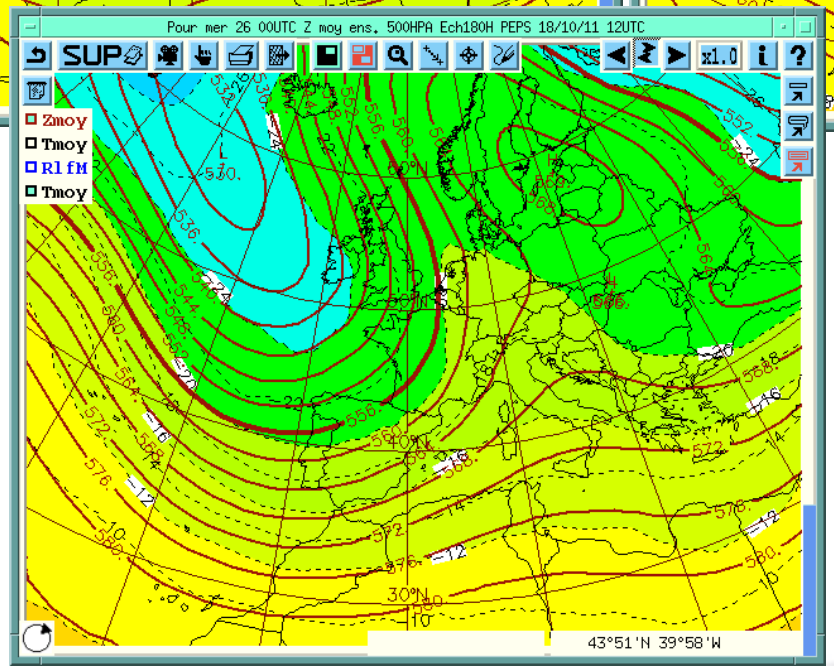
132h



156h



180h



Products available on Synergie workstations

Oct 2011

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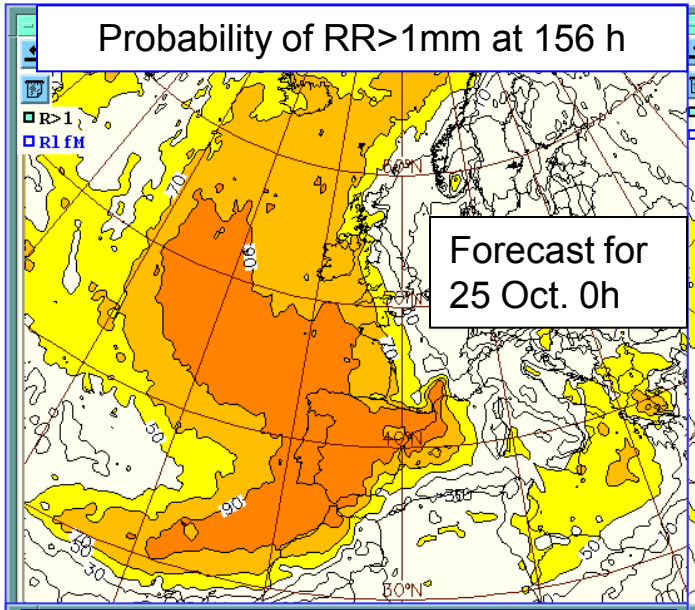
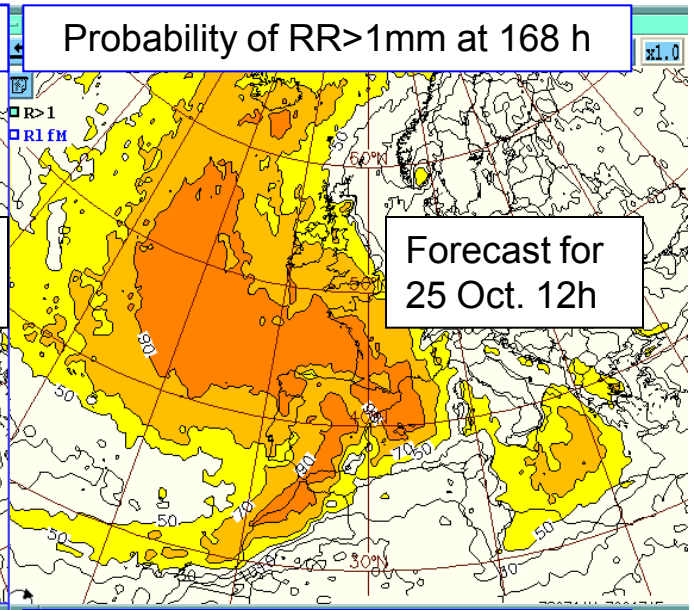
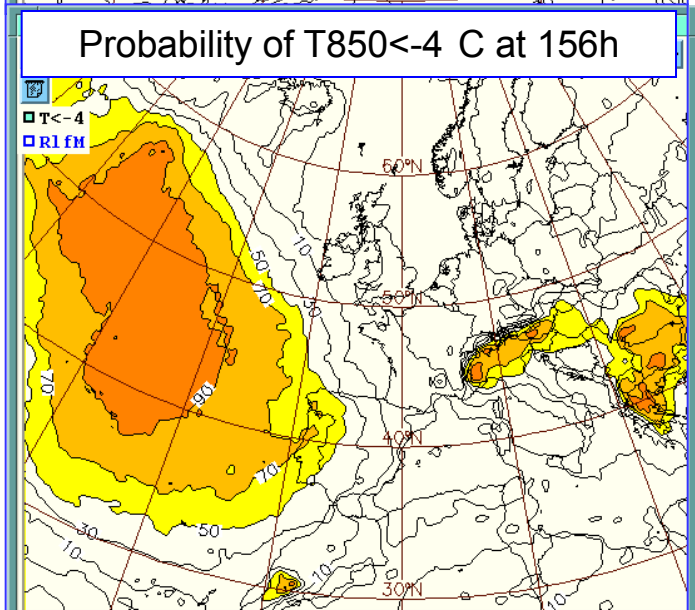
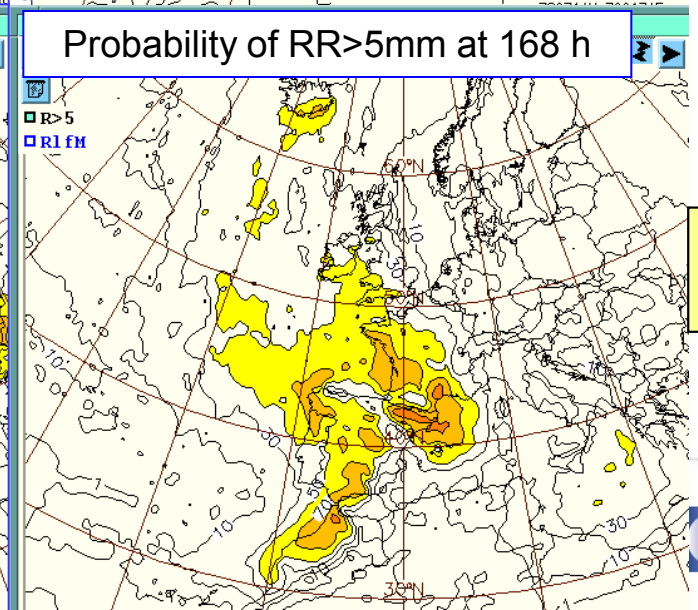
Use of probabilistic products









The activity of weather disturbances can be estimated by probabilistic products of rain risk

Raw probabilities are calculated as follow :
Proba 24h (precip.>1mm) = nb members (precip>1mm) / total nb members

Products available on Synergie workstations

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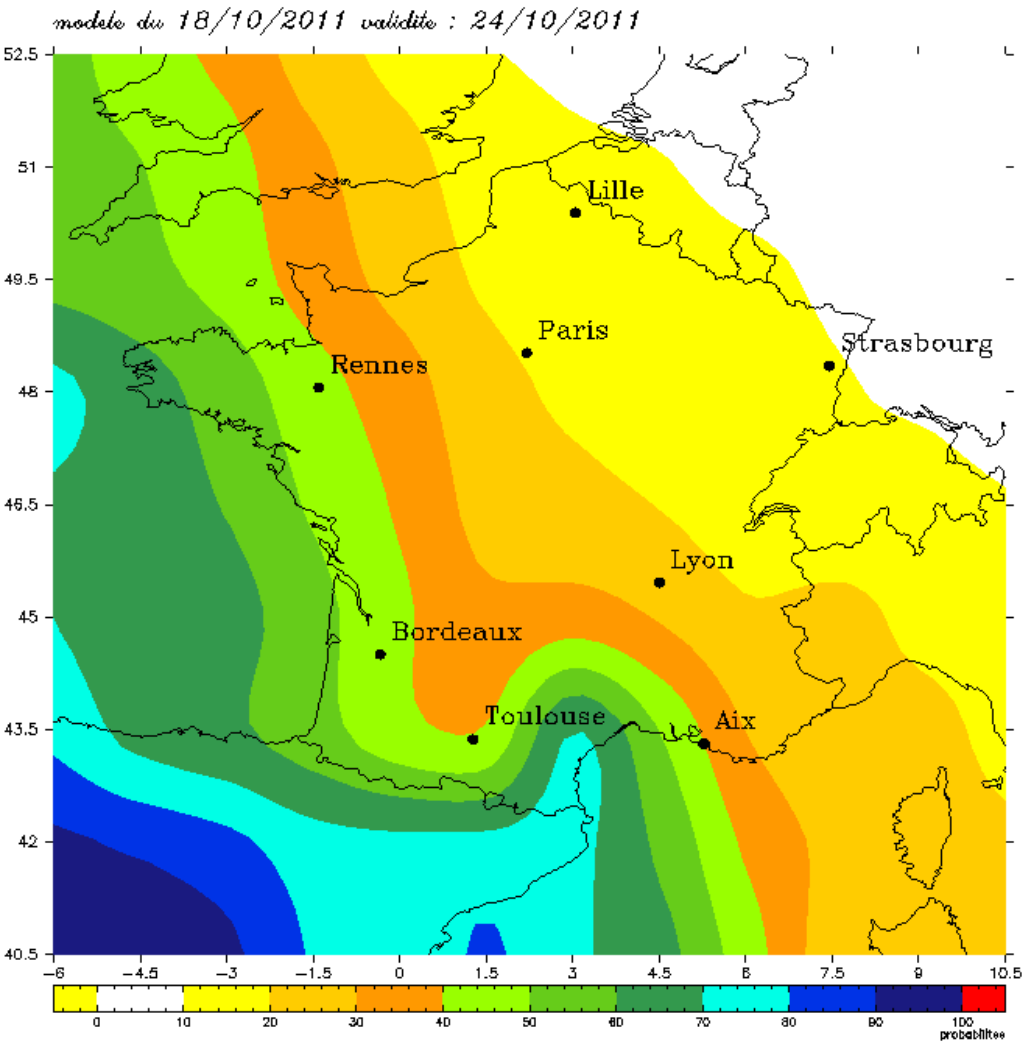
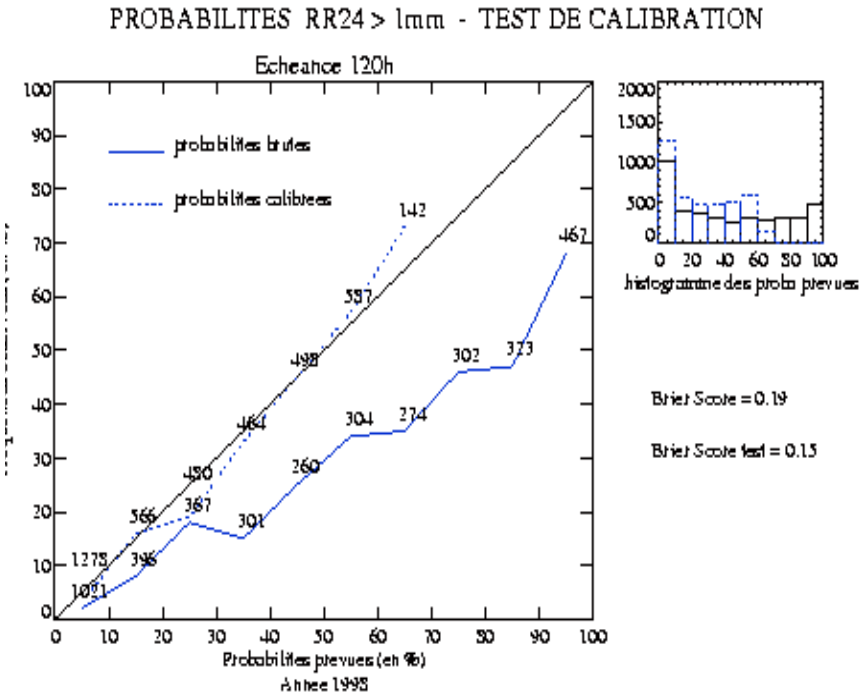
Use of calibrated probabilistic products (1)

Example of calibrated probabilities of RR24>1mm for 156h



- Calibrated probabilities : related to the observations
- Interactive probabilities : choice of the threshold
- Products available on the internal Website



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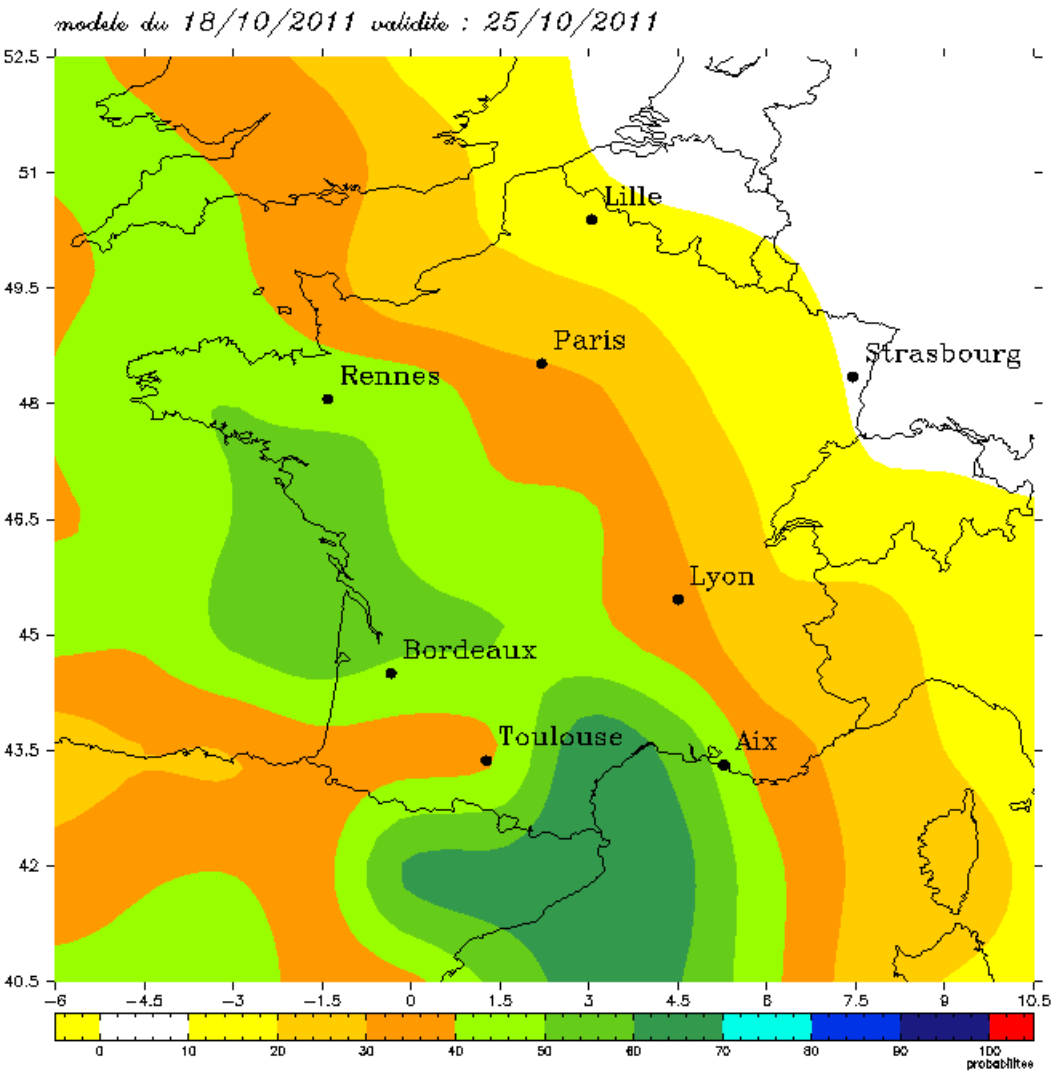
Use of calibrated probabilistic products (2)

Example of calibrated probabilities of RR24>5mm for 168h



- Calibrated probabilities : related to the observations
- Interactive probabilities : choice of the threshold
- Products available on the internal Website

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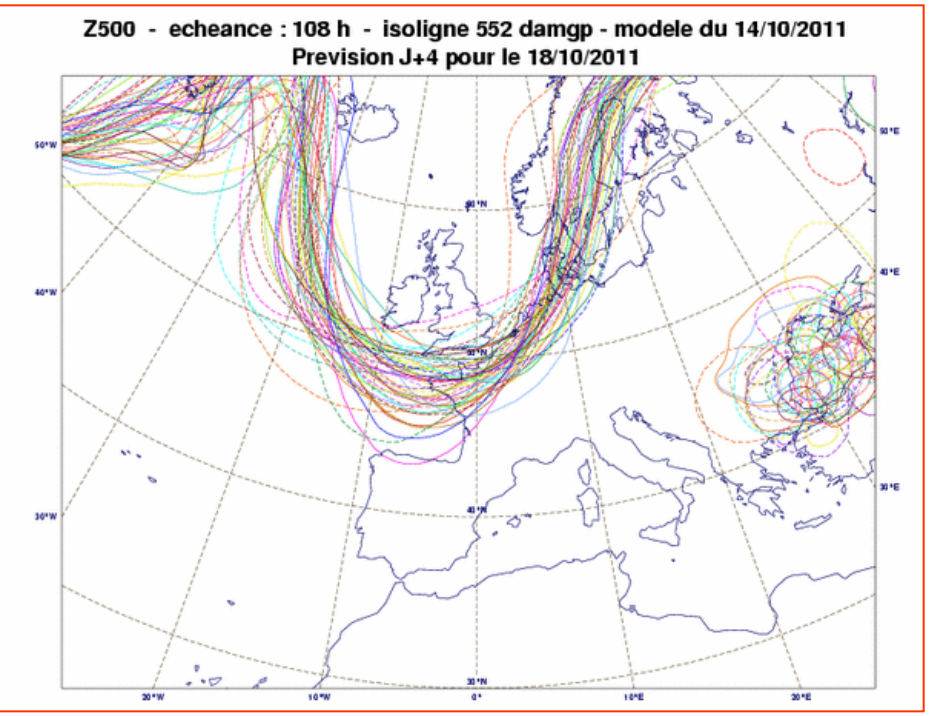
Toujours un temps d'avance

Spread and confidence index

- The spread indicates the « uncertainty » (« envelope of solutions »):
  - Low spread : great confidence, small error
  - High spread : weak confidence, but not necessary large error !
  - Spread can depend on the parameter
  - The uncertainty increases generally with the range, but not always
- EPS products used to analyse spread :
  - Spaghetti diagrams Z500 (geopotential)
  - EPSplumes, EPSgrams (local products)
- Confidence index used for D+4, D+5 and D+6/D+7 :
  - Global index for general public : a subjective measure of “uncertainty”
  - Scale from 1 (very weak confidence) to 5 (very strong confidence)
  - First, the index is obtained by analysing objectively the spread and the stability concerning the supra-synoptic scenario, and also the uncertainty of the weather forecast (ex : uncertainty with warm blocks in altitude concerning low level clouds)
  - Second, subjective adjustments taking account of the range (comparison with the average confidence index for this range).

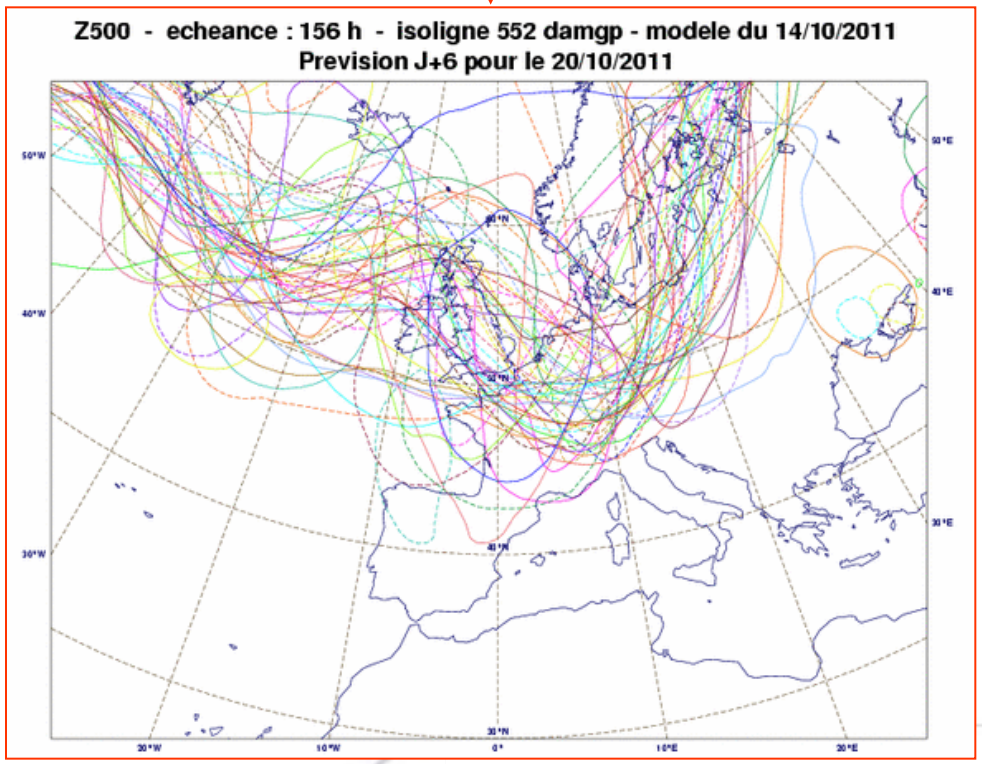
EPS spaghettis Z500 (1)



Example of low spread for D+4

The spaghettis Z500 give a good estimation of the spread

Example of high spread for D+6



Products available on the internal Website

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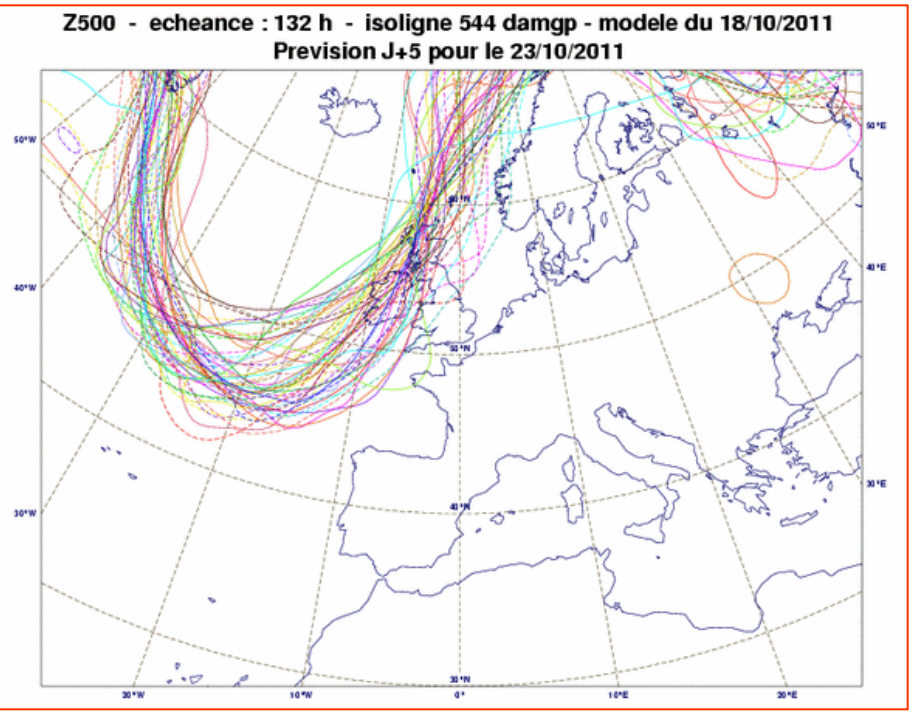
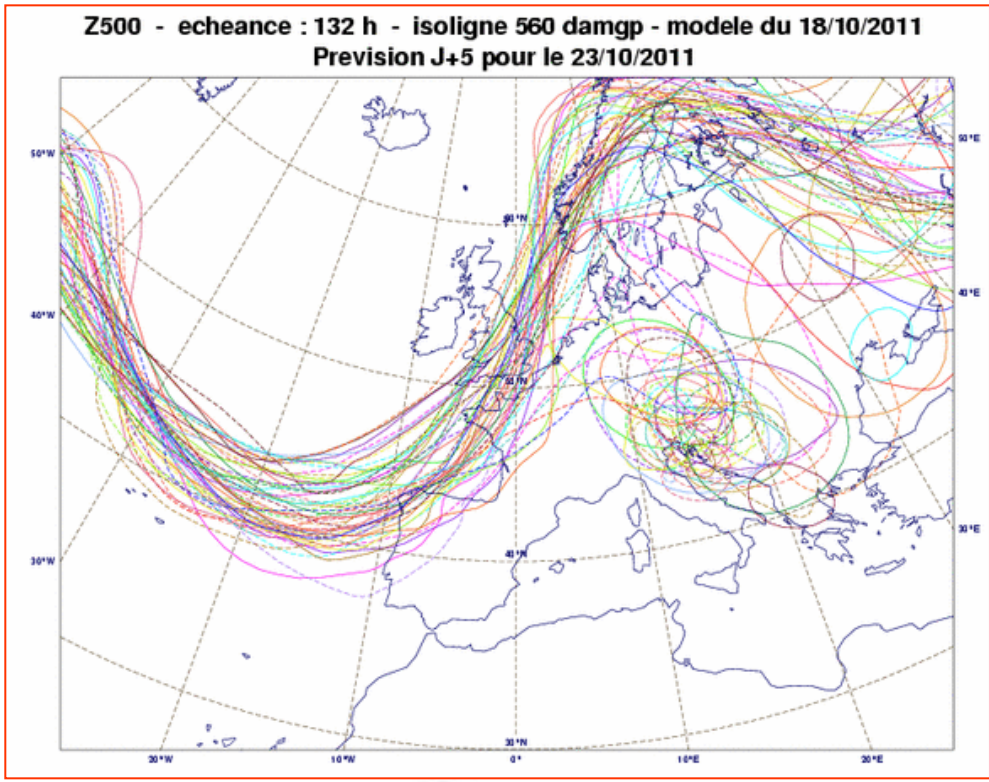
EPS spaghettis Z500 (2)



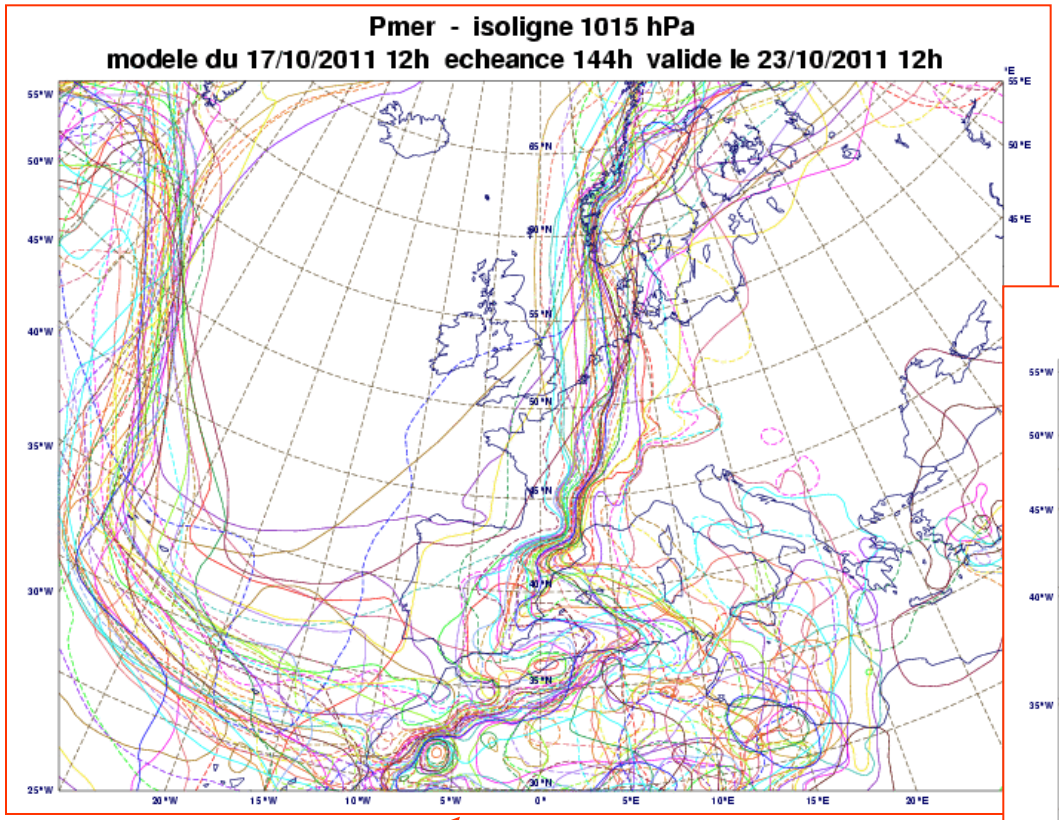
Isoline 544

Interactive sphaghettis : choice of the isoline to display

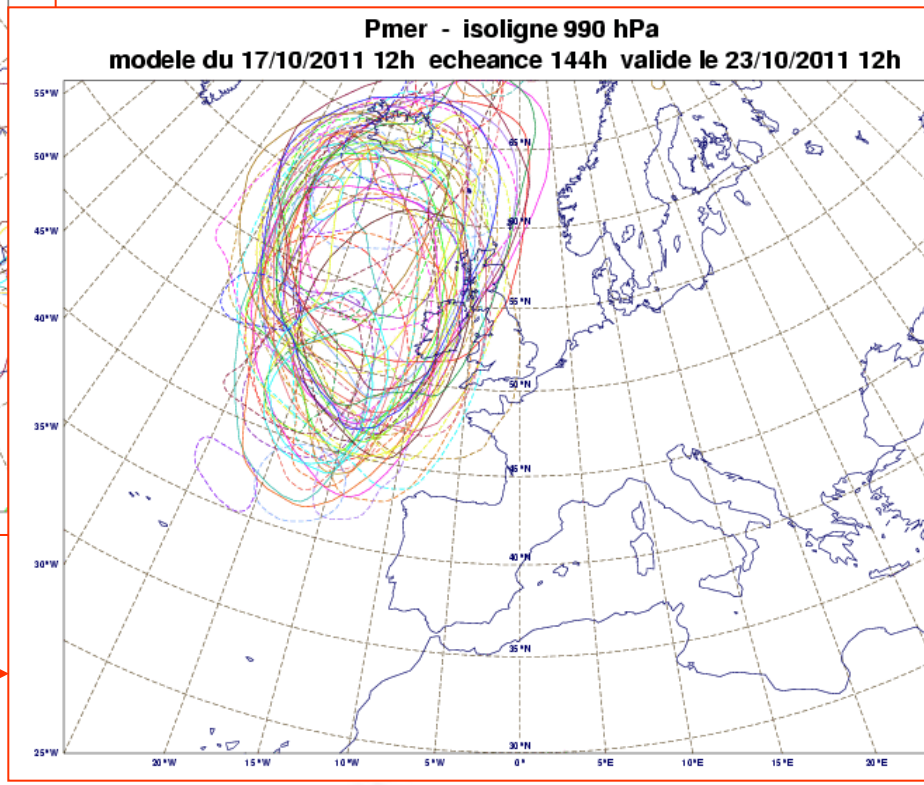
Isoline 560



EPS spaghettis MSLP



Interactive sphaghettis : choice of the isoline to display



Isoline 1015 hPa

Isoline 990 hPa

Products available on the internal Website

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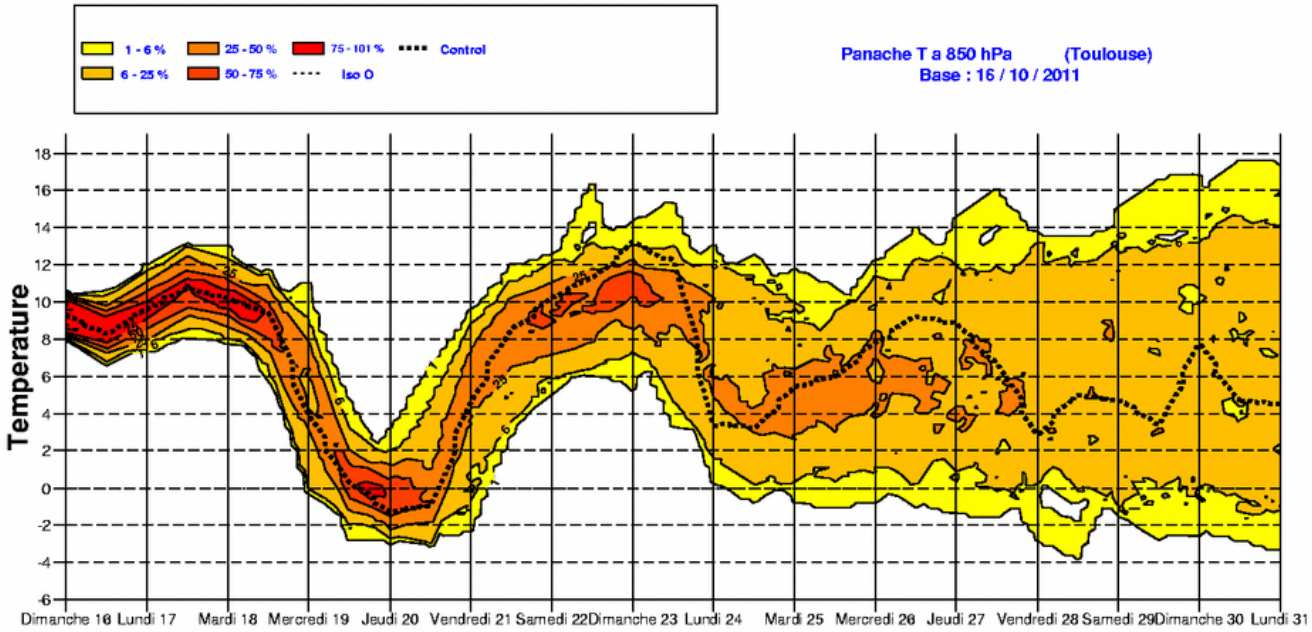
EPSplumes : local products

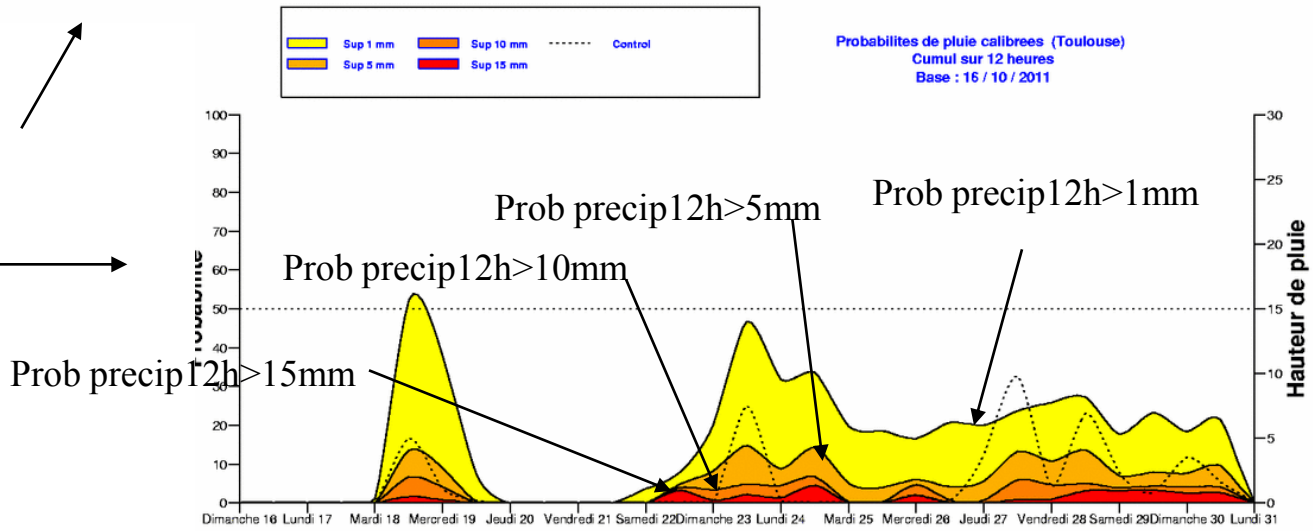


Time evolution of probabilities : on one point, Toulouse on this example

Products available on the internal Website

Probabilities of 850 hPa temperatures

Calibrated probabilities of precipitations



Oct 2011

EPSgrams : local products

2 m minimum temperature

(statistical adaptation)

2 m maximum temperature

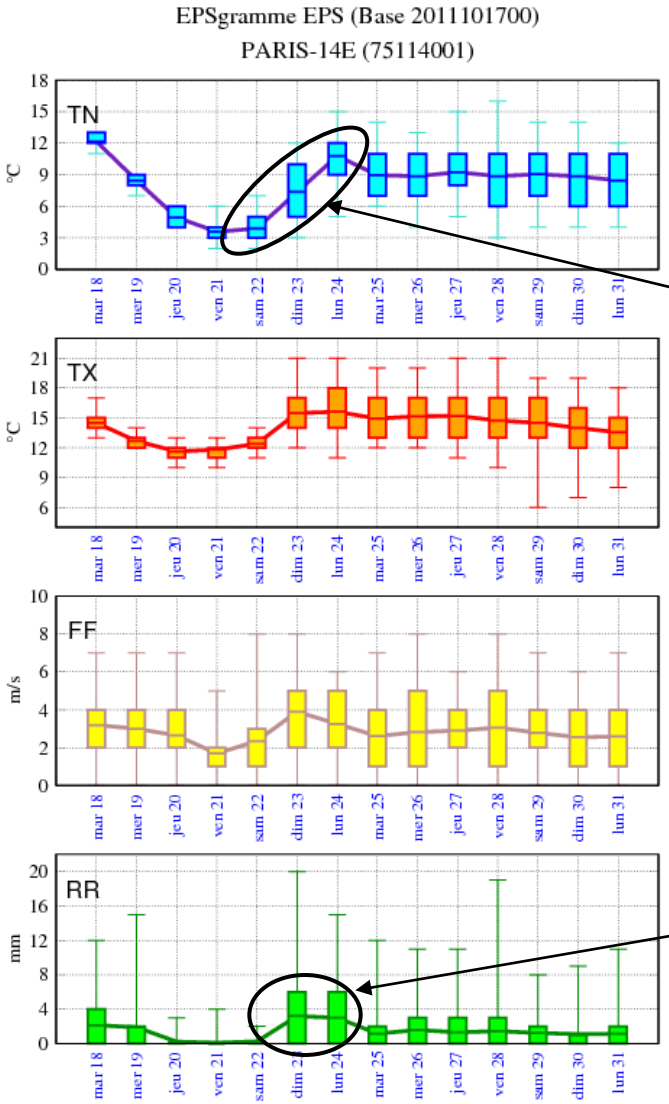
(statistical adaptation)

10 m Wind Speed

(statistical adaptation and calibration)

Total precipitations

(calibrated)



Products available on the internal Website

Increase of temperatures, especially the minimum

High reliability in precipitation occurence

Oct 2011

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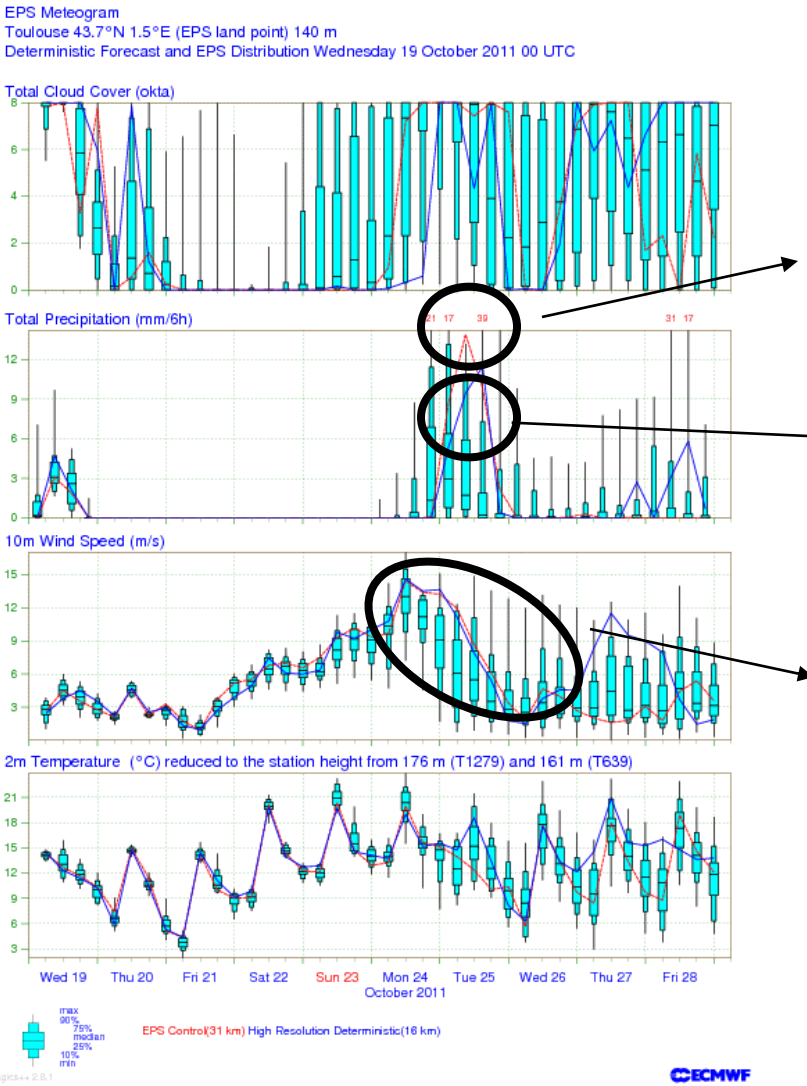
EPSgrams : local products

Total Cloud Cover

Total precipitations

10 m Wind Speed

2m Temperature



risk of heavy rain

high reliability in precipitation occurence

decrease of wind speed

Products available on ECMWF Website

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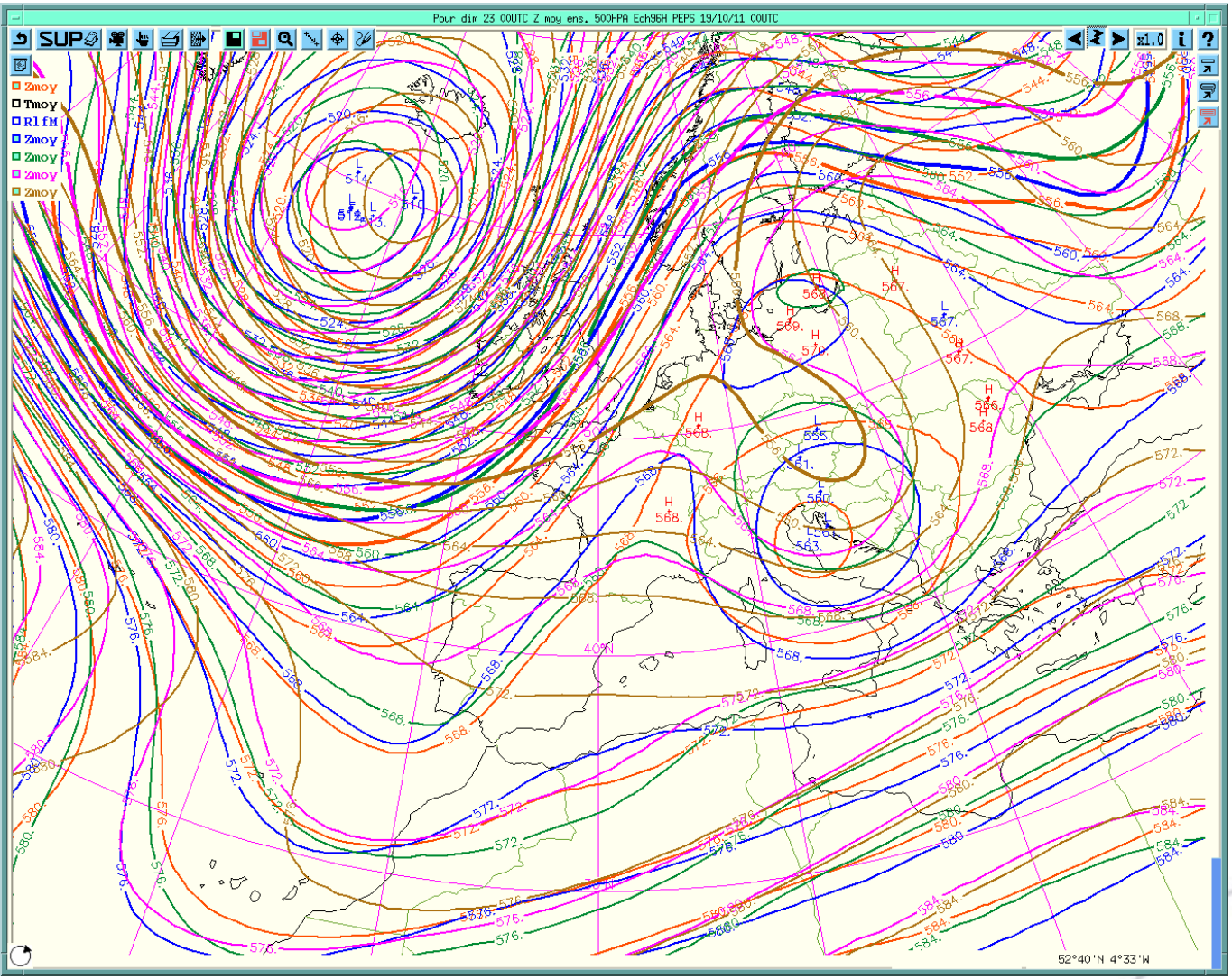
Stability of EPS runs

Example of 5 successive runs of EPS for Z 500 (Synergie workstations)



- Comparison of successive EPS runs for a defined field : ensemble mean ZT500, T850, MSLP
- A good stability indicates a good confidence
- A low stability generally indicates a low predictability
- But a significative change on the last run can indicate a relevant change in forecast.

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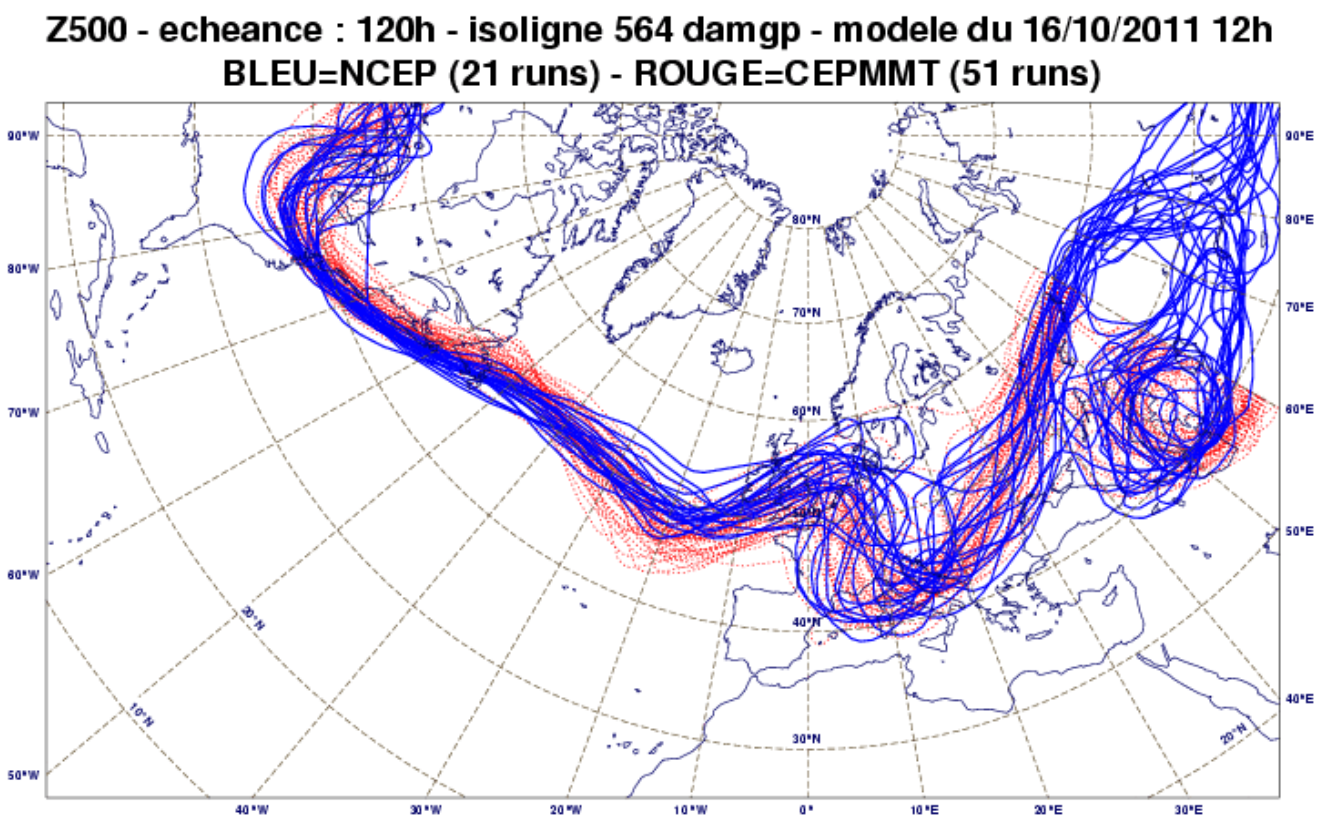
Coherence between EPS and NCEP

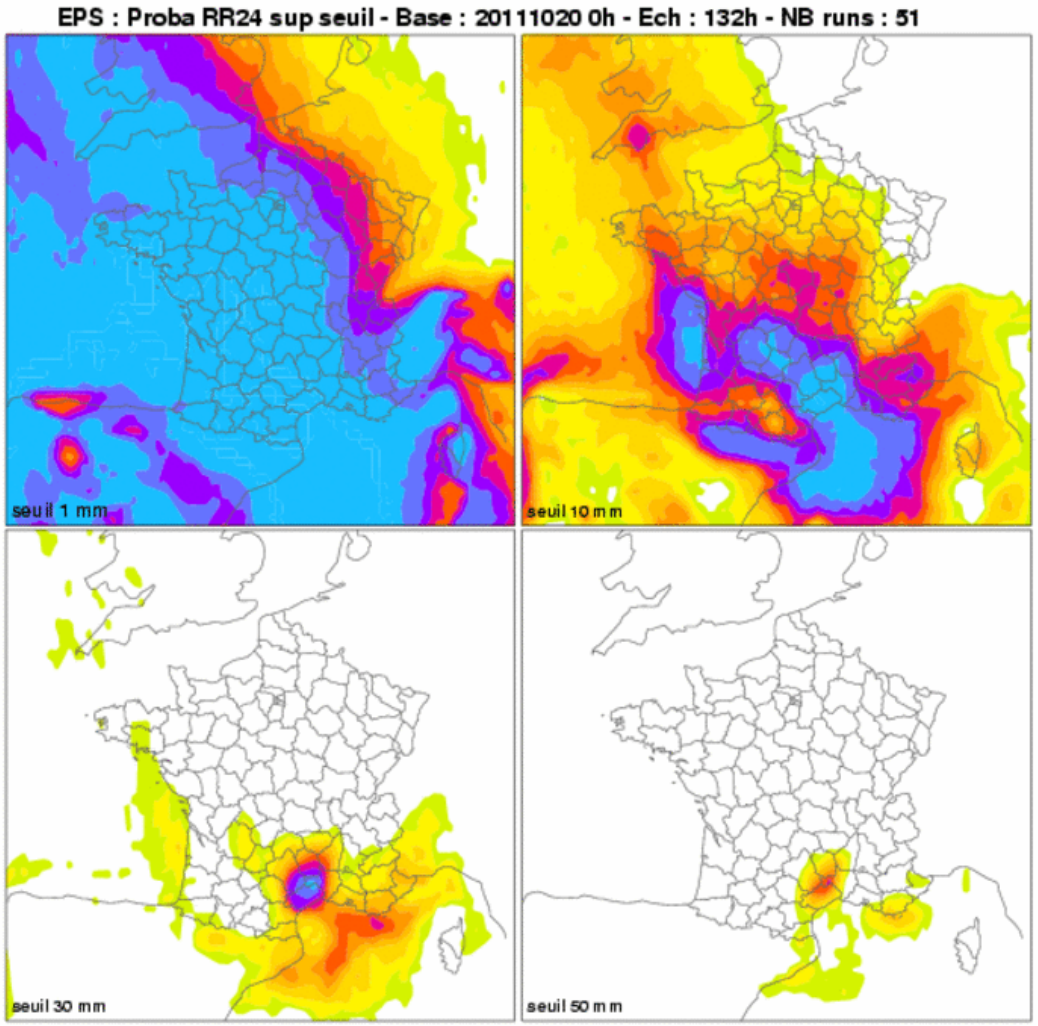
Blue : NCEP Red : ECMWF



Product available on the internal Website

- Comparison between EPS and NCEP spaghettis Z500
- Coherence between both spaghettis can confirm the analysis of the EPS spread.

Forecast for 24-25 October 2011



Proba RR24 for 25 at 12hUTC

Base 20 0h

D+4/D+5

Products available on the internal Website

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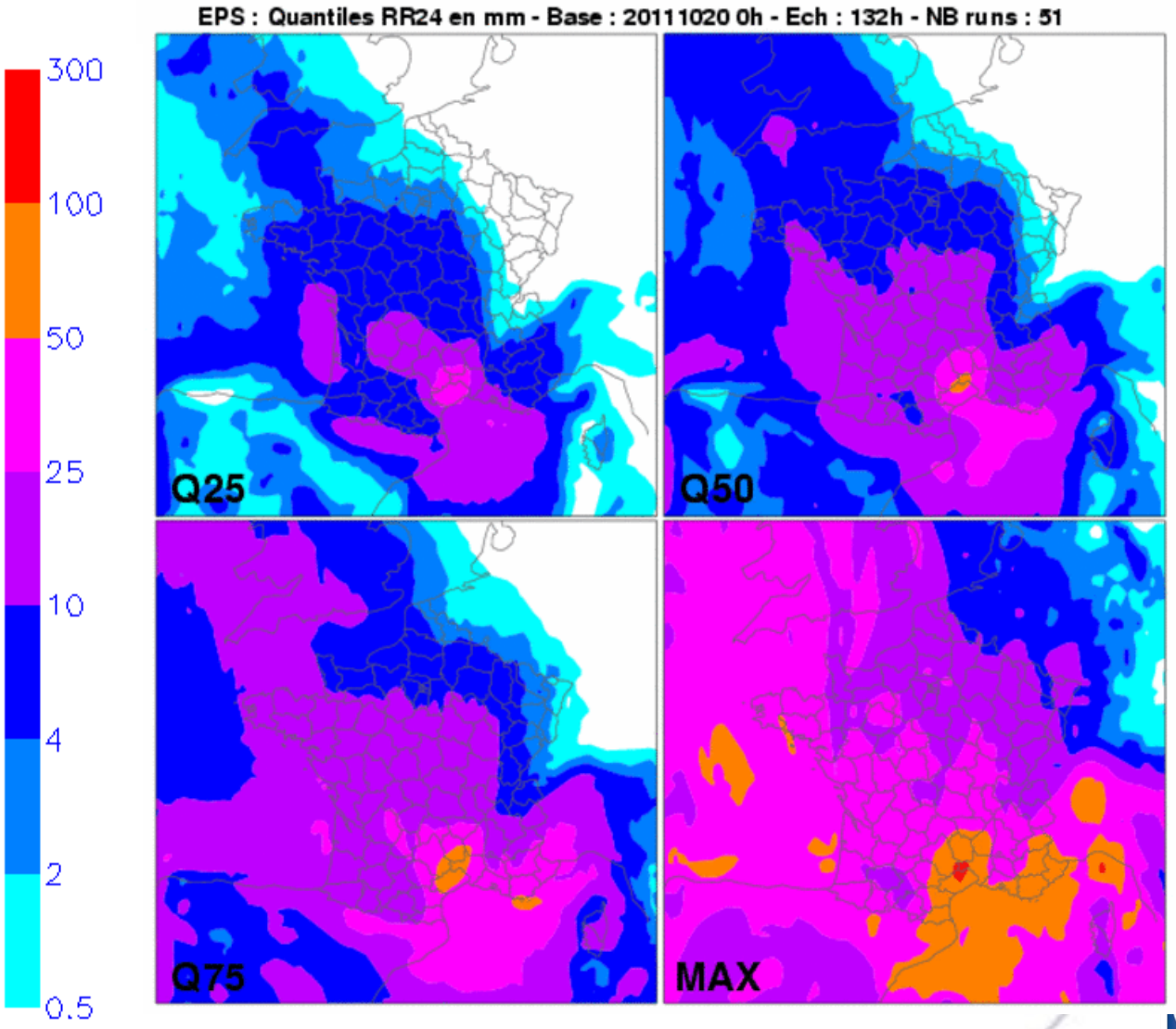
Forecast for 24-25 October 2011



Quantiles RR24
for 25 at 12hUTC

Base 20 0h

D+4/D+5

Products available on the internal Website

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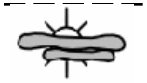
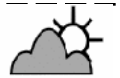
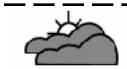
Symbols used for D+4 to D+7

Weather symbols

	**Mainly sunny, clear or slightly cloudy sky (summer)**
	**Still weather with some haze or fog in the morning**
	**Mainly foggy, thick low clouds (winter)**
	**Unsettled weather without rain**
	**Mainly cloudy sky**
	**Mainly cloudy sky with some rain**
	**Unsettled weather with sparse showers**
	**Unsettled weather with showers**
	**Mainly rainy weather**
	**Heavy rainfall**

Risk symbols

	**High risk of thunderstorms (generalized)**
	**Local risk of thunderstorms**
	**Risk of thunderstorms on mountain**
	**Risk of snow on plain**
	**Risk of snow on mountain**

Wind symbols

	**Moderate wind** (gusts <35-40 kt) For D4 and D5
	**Strong wind** (gusts >=40 kt)

Oct 2011

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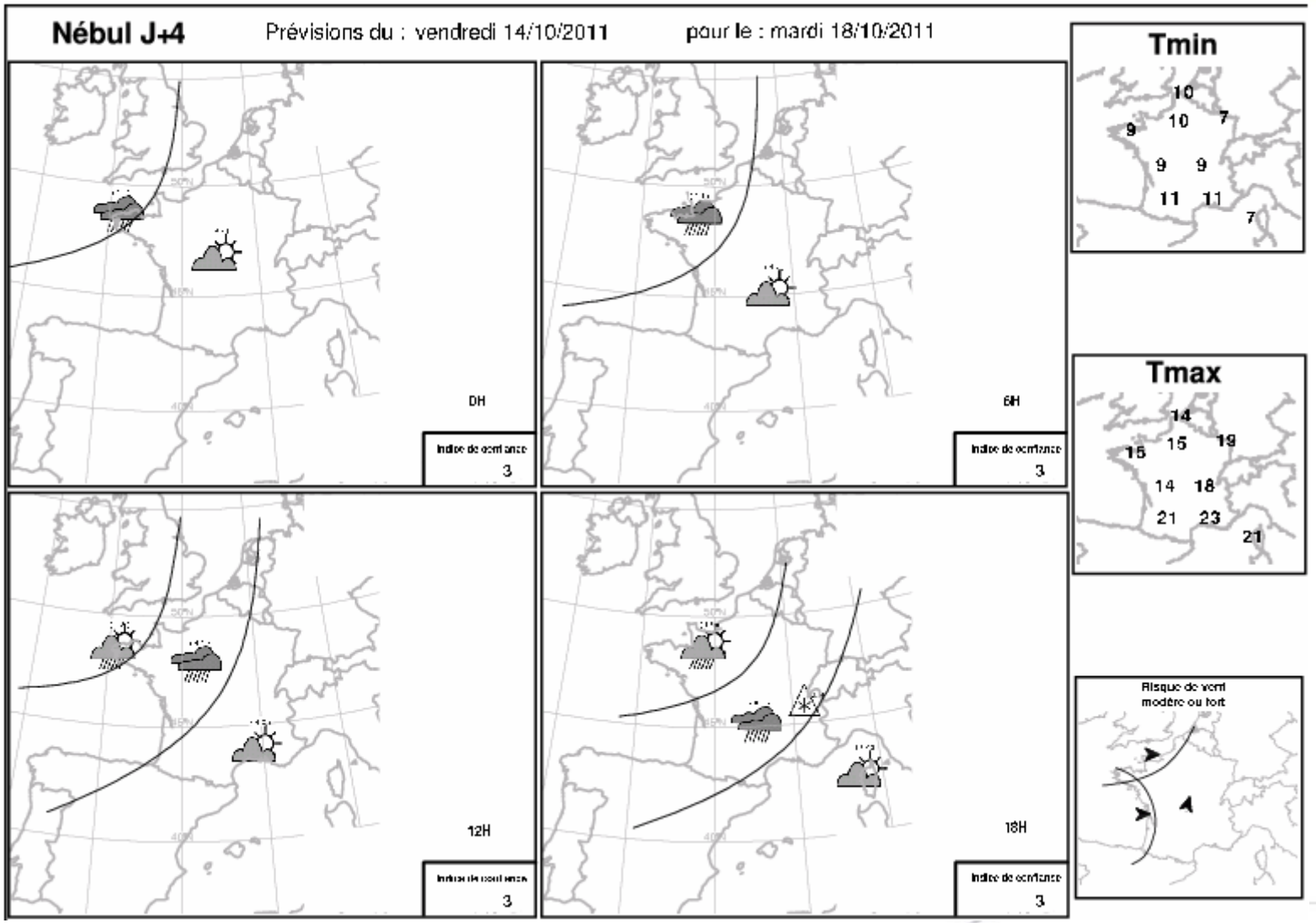
Example of internal production for D+4



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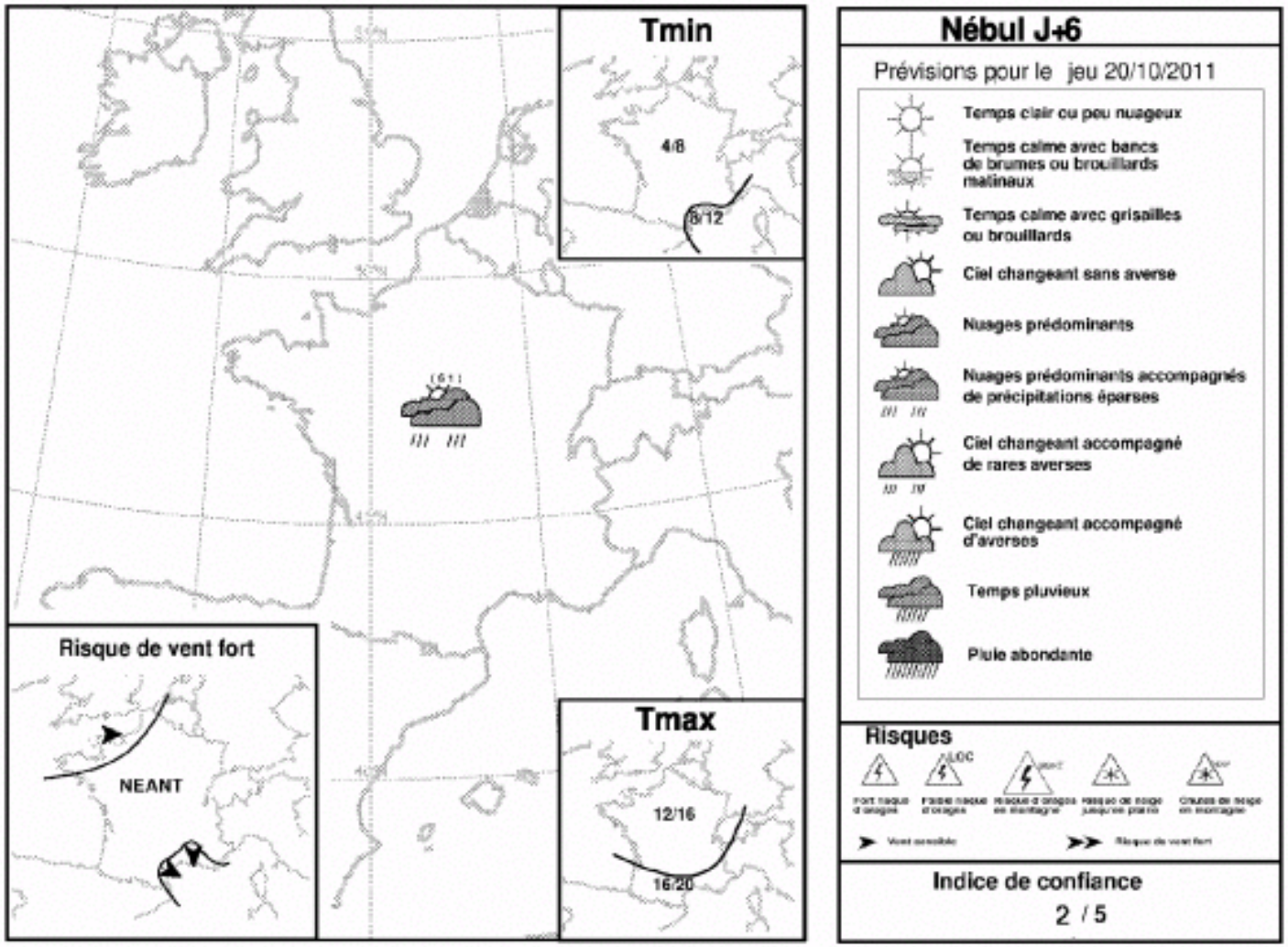
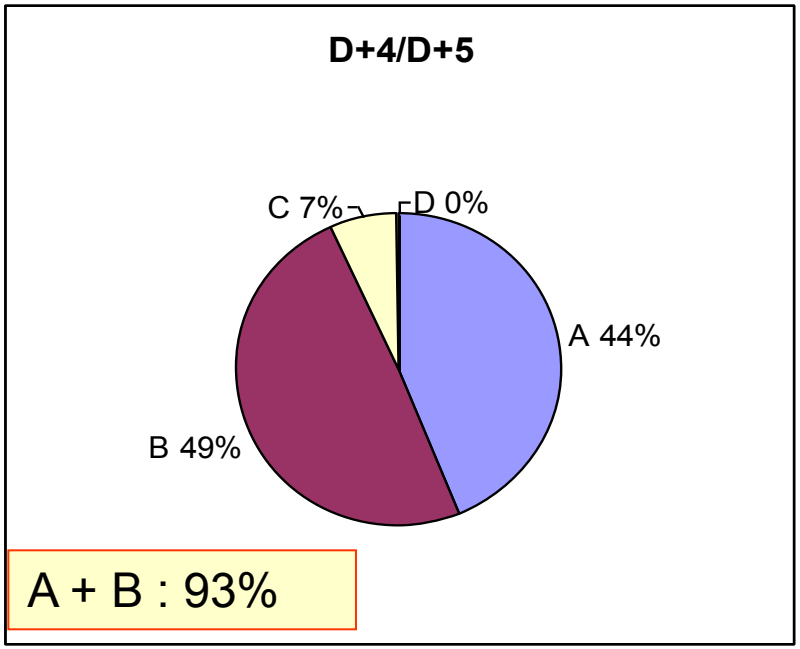
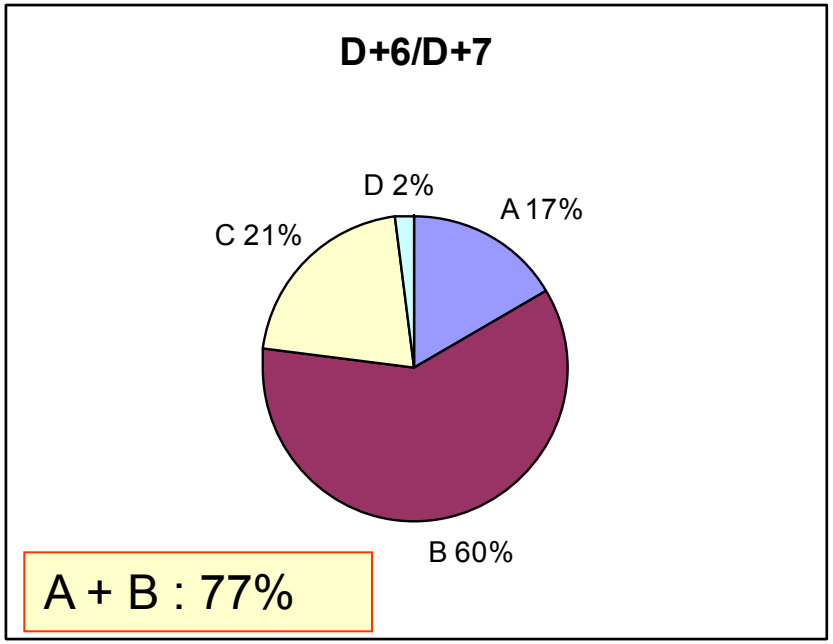
Example of D+6



EPS medium range forecast verification

Subjective verification of EPS ensemble mean (Z500 and MSLP) over the period Oct 2010 / Sept 2011 (last year) :





Supra-synoptic mark given by forecasters (forecast/analysis) :

A : Very good B : Good

C : Bad D : Very bad

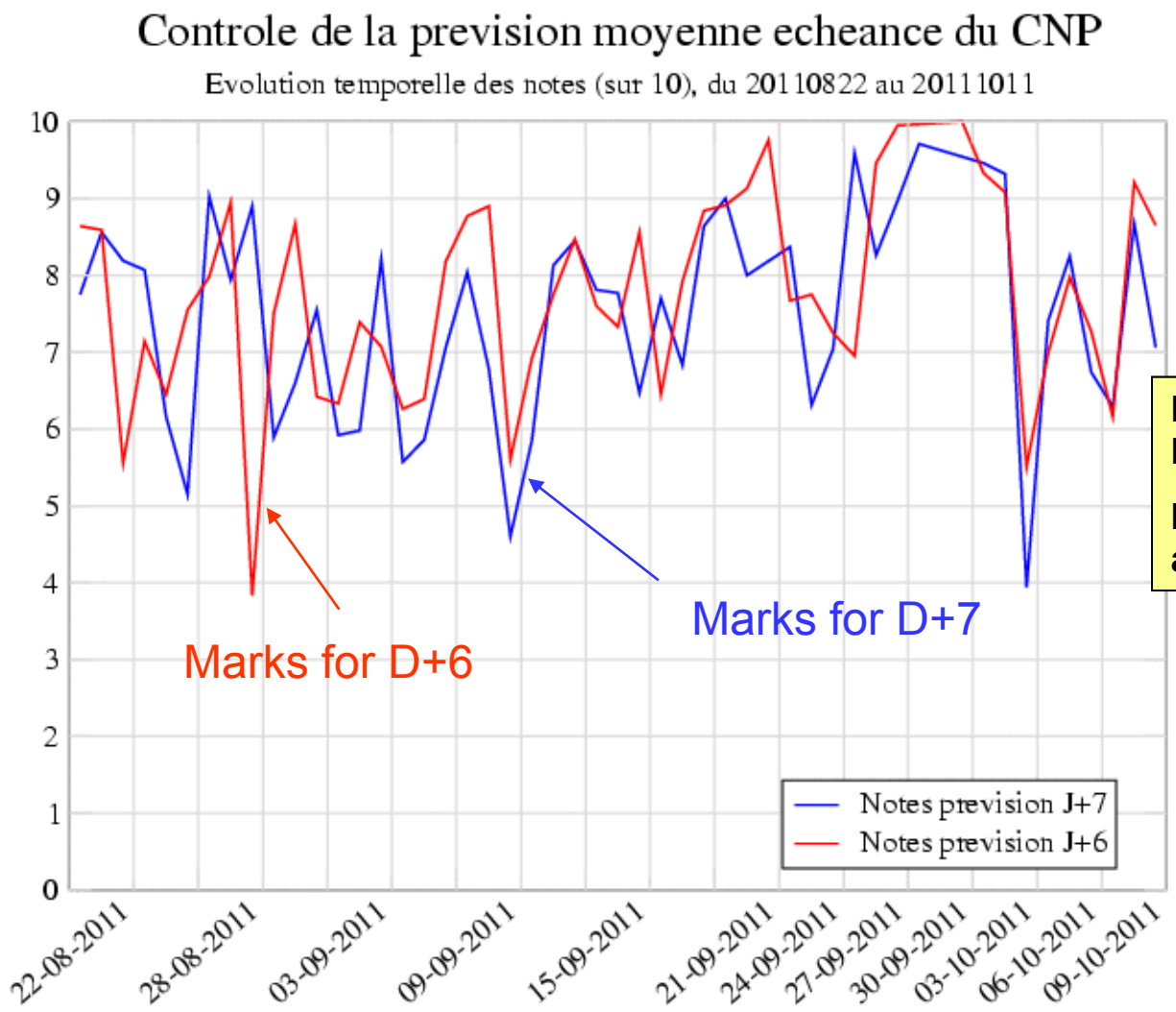
Automatic forecast verification for D+6/D+7

Automatic verification of weather charts issued for D+6/D+7, compared to analysed weather charts

- Analysis for each area of weather forecast :
  - Average of 2 marks : one for cloudiness, one for precipitations
  - Malus (negative) for snow, thunderstorms, nature of precipitations, frequency of greyness

  → Final mark for the area
- Medium range mark over France :
  - Average of all marks, taking account of the number of departments in each area
  - Malus (negative) for wind if necessary
- Rules for giving marks :
  - Marks are given between 0 (failed forecast) and 10 (perfect forecast)
  - An error in cloudiness forecast is less strictly marked than an error in precipitations forecast
  - The mark given for a non-detection is as strict as for a false alert.

Automatic forecast verification for D+6/D+7
(from 22 Aug.2011 to 11 Oct. 2011)



Forecasts issued by the National Forecast Centre

Daily marks for D+6 (red) and D+7 (blue) forecasts

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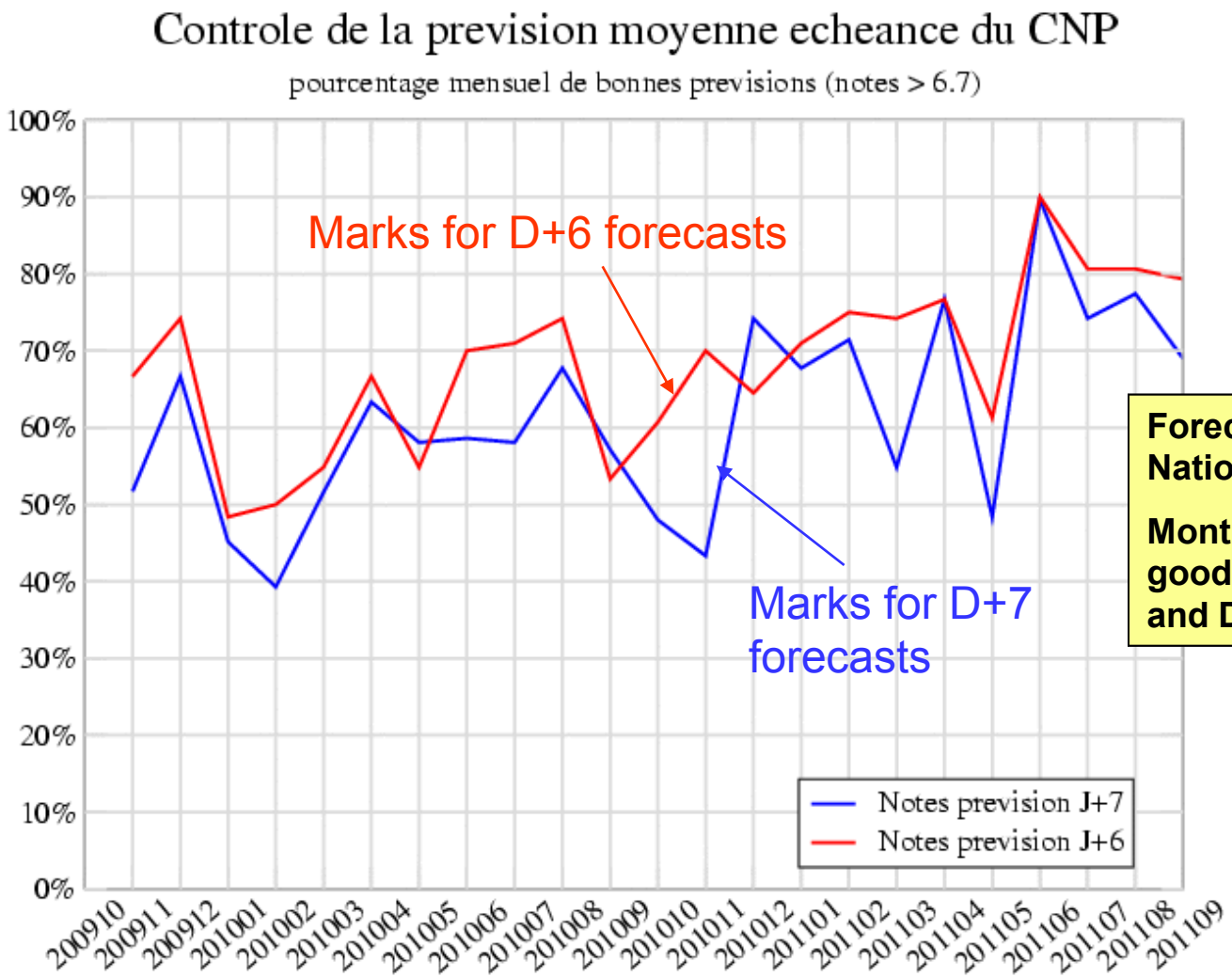
Automatic forecast verification for D+6/D+7

(from Oct. 2009 to Sept. 2011)



Forecasts issued by the National Forecast Centre

Monthly percentage of good forecasts for D+6 and D+7 (marks > 6.7)

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Conclusion on medium range forecast

- Good signal for the large scale, got from the EPS products, complemented by IFS and other ensemble products
- Good interpretation of the forecasters :
  - Based on production of weather symbols
  - Also for severe weather events
- Interest of a human interpretation :
  - Synthesis of global and local data
  - Synthesis of the most likely weather-type
  - To bring out risk of dangerous phenomena (strong winds, snow, thunderstorms, heavy rain)

Outline

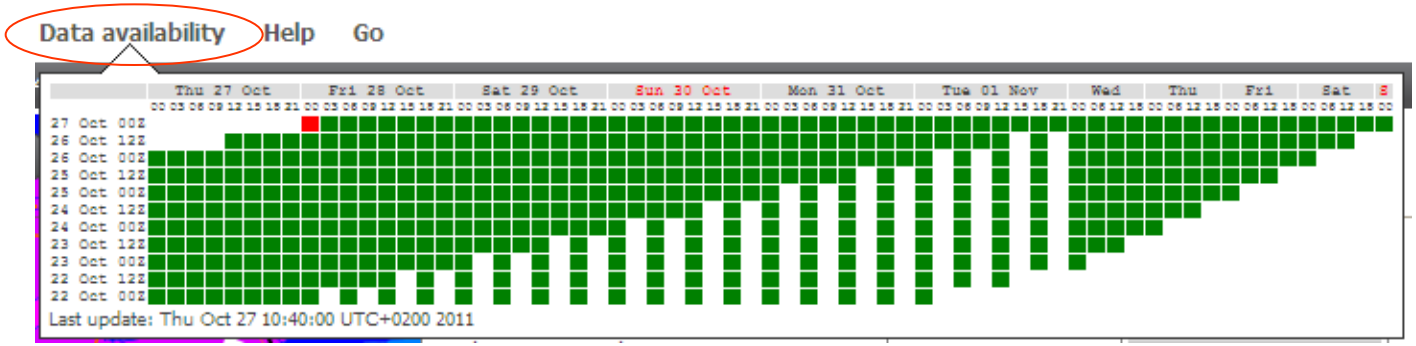
Use of ECMWF products at Météo-France :

- Severe weather forecast for D+2 and D+3
- Medium and extended range forecast
- **Feedback on ecCharts**
- Tropical cyclone forecast

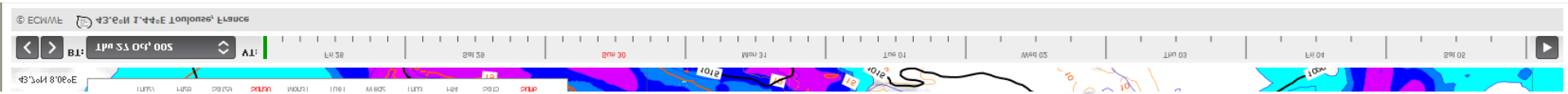
Thanks to Thierry Dupont, Nicole Girardot, Philippe Caroff, Matthieu Plu, Ghislain Faure

Feedback on ecCharts (1)

- Forecasters of the National Forecast Center have tested the new ECMWF Website ecCharts/Forecasters during Summer 2011
  - Test by almost 20 forecasters
  - 11 forecasters filled an evaluation form
- Interesting tools
  - Map navigation and zoom tools
  - Data availability menu



  - Time navigator (change of valid time or base time), but too slow



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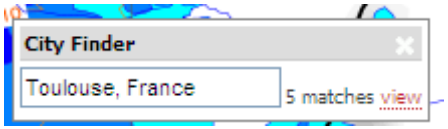
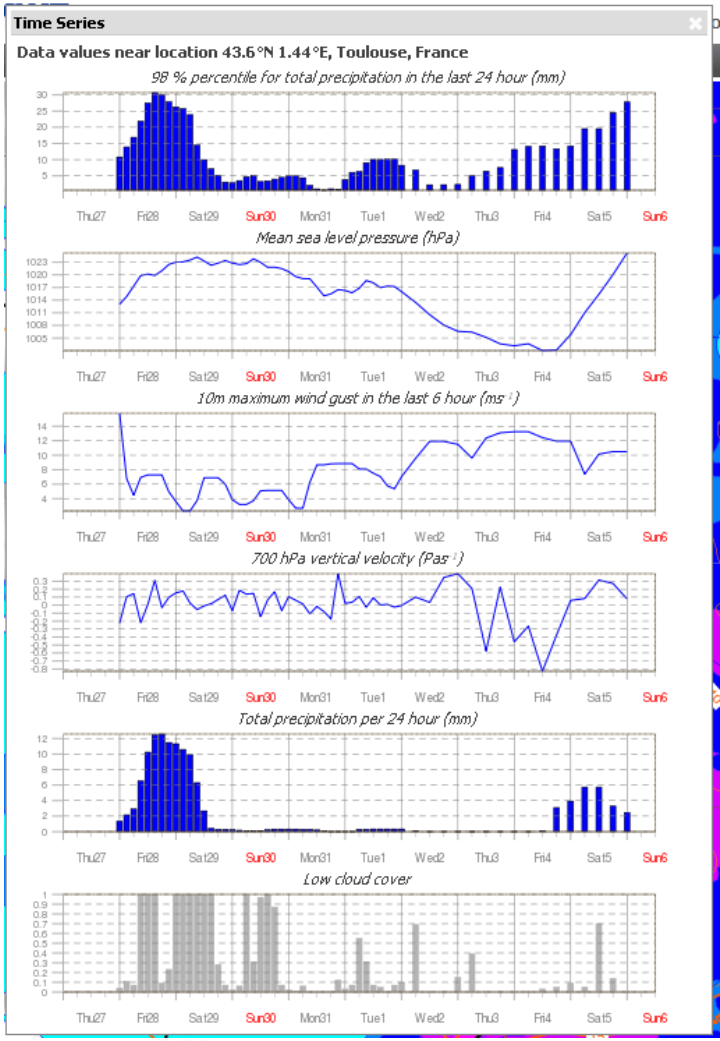
Feedback on ecCharts (2)

- Interesting tools and products
  - City-finder
  - Time series
  - Meteograms
  - Interactive probabilities maps
  - Principle of layers
- Tools which should be improved :
  - Animation : it sould be possible to choose the step and start/end of the animation loop
  - Layers : it should be possible to adjust the transparency of the layers, and to display isolines (instead of colors)
  - Bigger characters in the menus





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Feedback on ecCharts (3)

- Missing tools and products :
  - Spaghetti diagrams (Z500 and MSLP)
  - Vertical profiles and cuts
  - Superposition of several runs
  - Several display windows

- Conclusion :
  - Several interesting tools and products
  - Complementary to other tools (Synergie workstation, internal Website)
  - Needs to be improved for operational forecasting (display speed, other products)

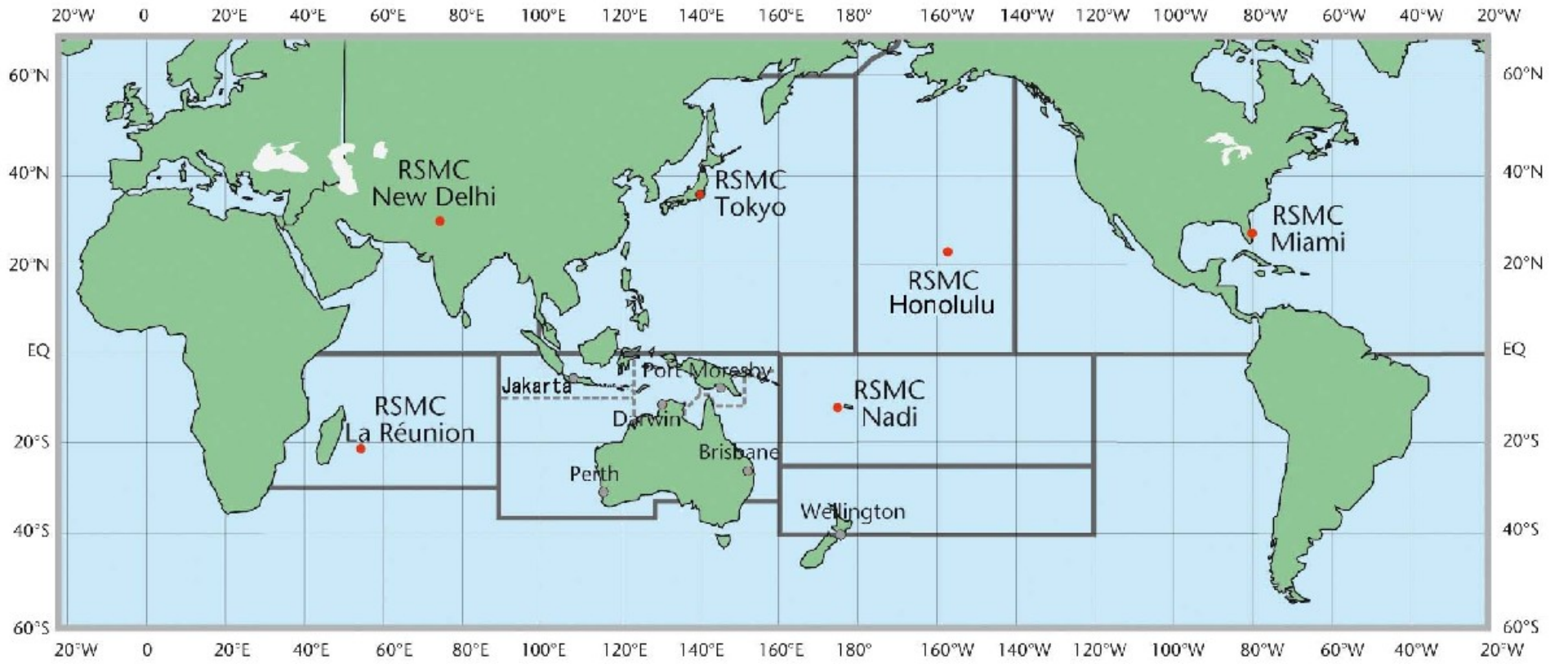
Outline

Use of ECMWF products at Météo-France :

- Severe weather forecast for D+2 and D+3
- Medium and extended range forecast
- Feedback on ecCharts
- **Tropical cyclone forecast**

Thanks to Thierry Dupont, Nicole Girardot, Philippe Caroff, Matthieu Plu, Ghislain Faure

Tropical cyclone watch in the world



A specific organization, under control of World Meteorological Organization (WMO) for managing a major natural hazard : 6 RSMC (Regional Specialized Meteorological Centres) and 6 TCWC (Tropical Cyclone Warning Centres).

Oct 2011

RA = Regional Associations

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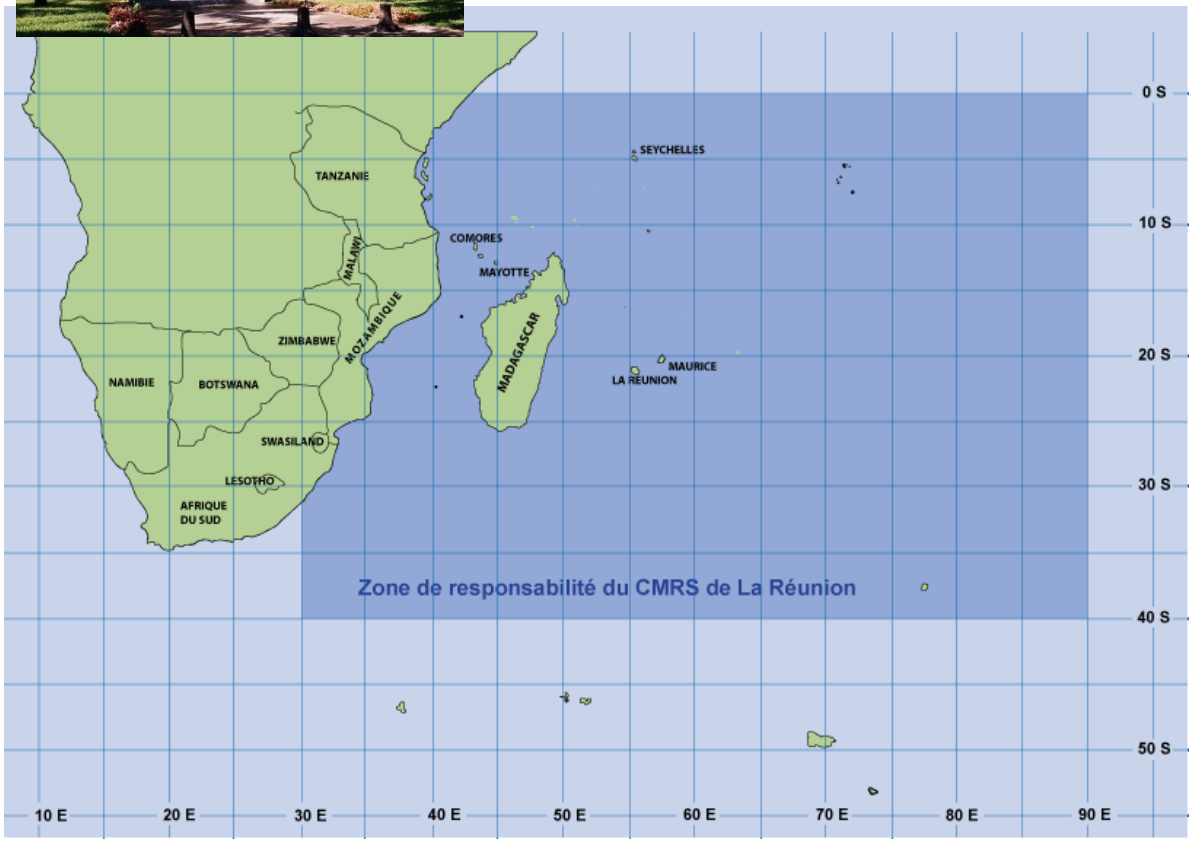
The RSMC / Tropical Cyclones of La Réunion

- An international responsibility of Météo-France
  - towards the 15 countries members of the Tropical Cyclone Committee for the South-West Indian Ocean,
  - with a view to reducing the loss of life and mitigating the damage to property caused by tropical cyclones.



The 3 main missions of the RSMC of La Réunion

- **Operational :** to issue informations on all tropical disturbances tracking in the area
- **Research :** to improve the numerical models and to develop tools adapted to TC forecast
- **Training :** organization of training courses, forecasters' exchanges

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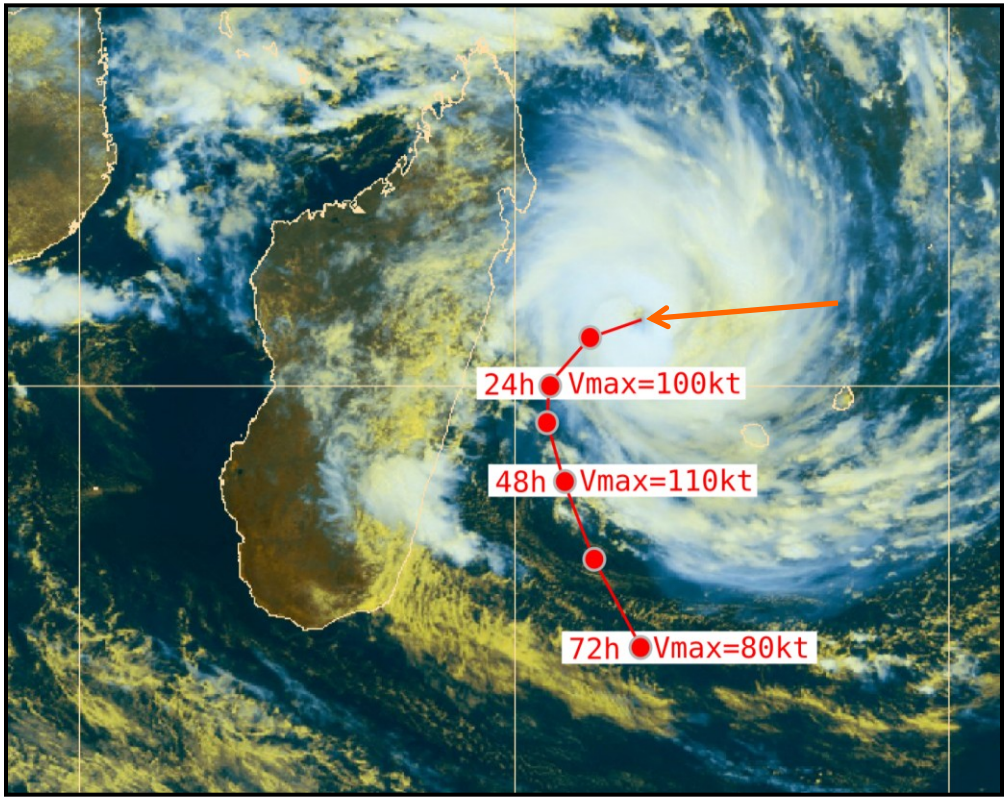
Tropical cyclone forecast : challenges

- Challenges of tropical cyclone forecast :
  - Cyclogenesis
  - Future track
  - Intensity evolution
  - Consequences (distribution of strong winds, heavy rainfall, cyclonic swell and storm sturge)
- The RSMC of La Réunion (Météo-France) sends tropical cyclone track and intensity forecasts (up to 120 hours range now) to the meteorological services
- National meteorological services issue forecasts and warnings at national scale.



GAEL, 06/02/2009, 06 UTC
10 minutes average wind~ 80 kt

Track forecast is an essential data element !

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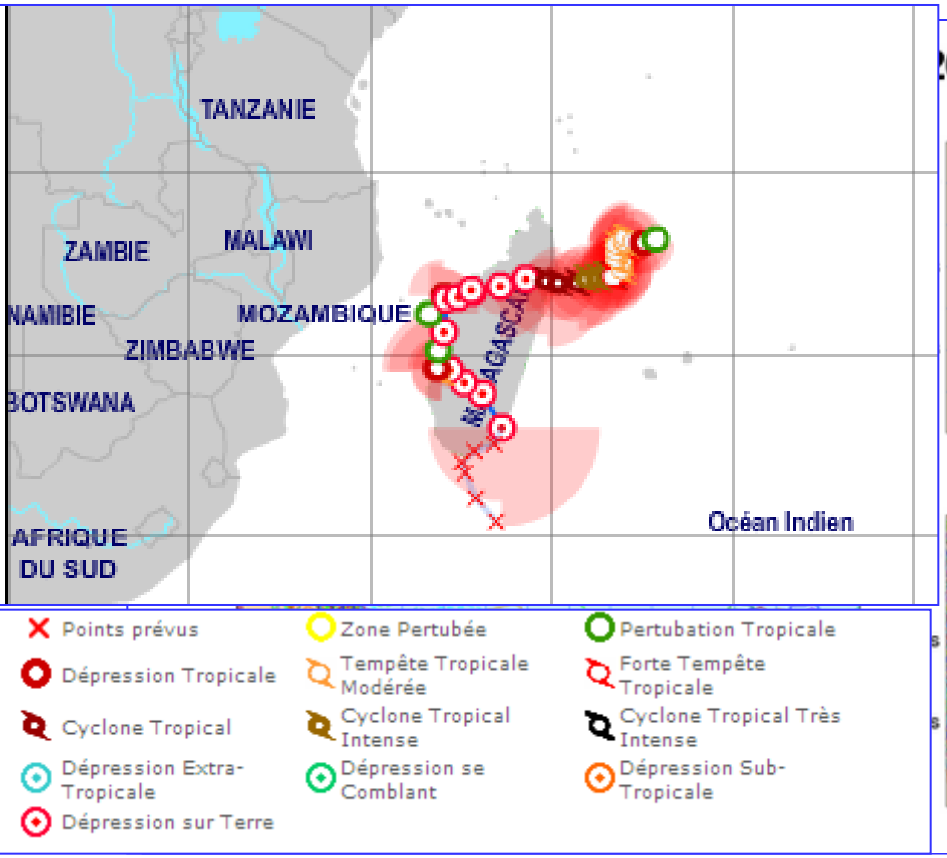
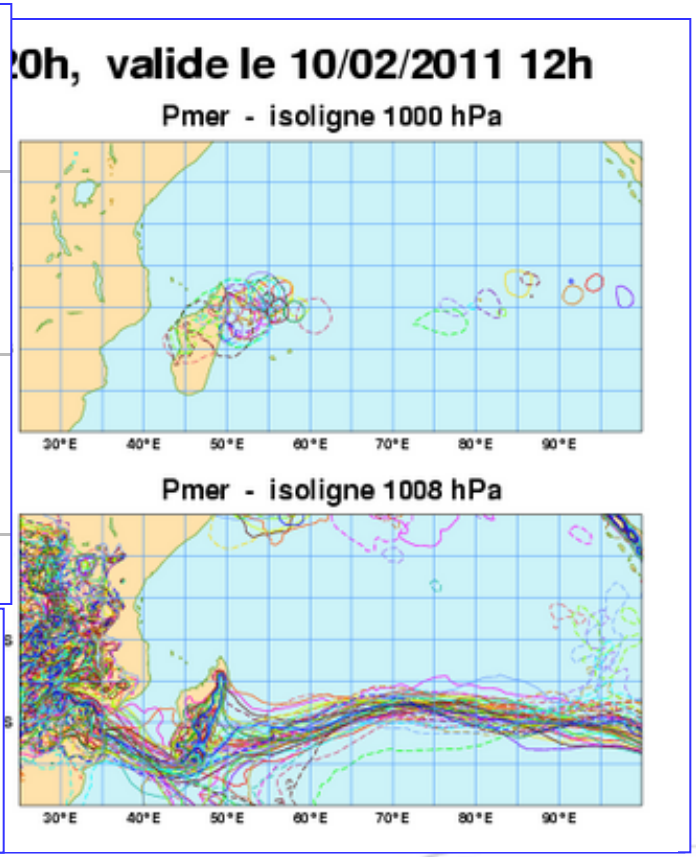
Use of spaghetti diagrams for cyclogenis forecast

- EPS spaghettis MSLP, base 5 February 2011 12h
- Cyclogenesis of TC Bingiza





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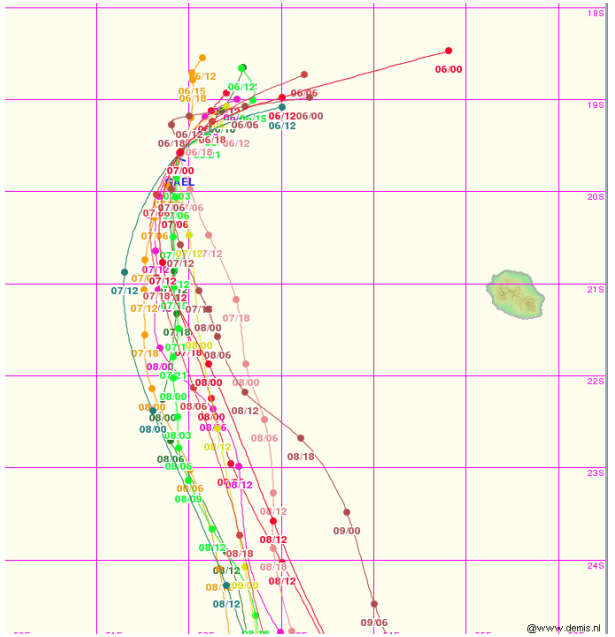
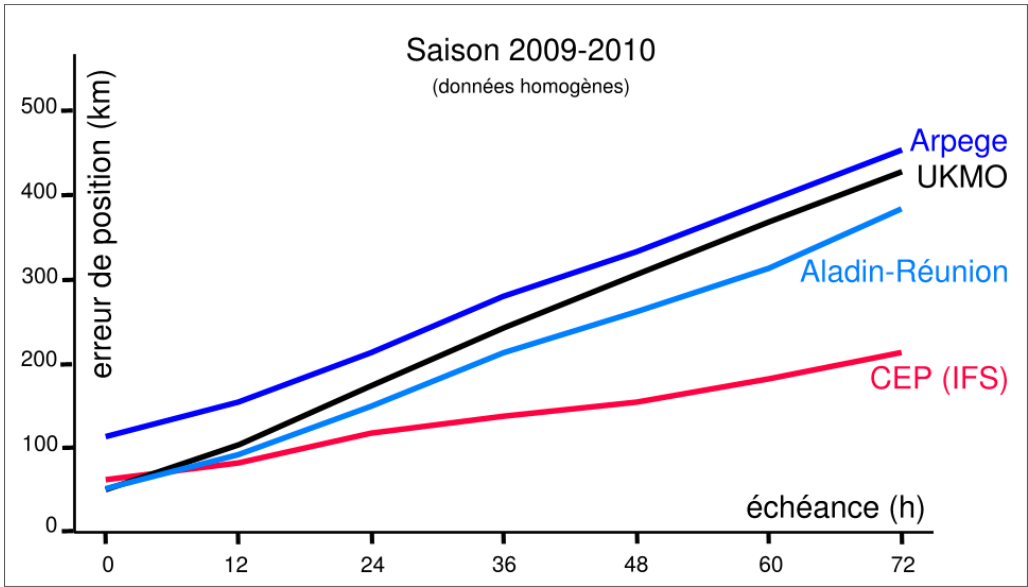
Tropical cyclone track forecast

- The main tool for track forecast : NWP
- Models available for TC forecast :
  - Arpege, Aladin-Réunion
  - IFS (ECMWF), UK-MetOffice
  - US models : GFS, GFDN, JTWC consensus
- Ensemble products :
  - EPS (CEPMMT), PEARP, NCEP, CMC, MOGREPS (UKMO) since last



- In spite of huge improvements, deterministic track forecasts remain tainted with important errors



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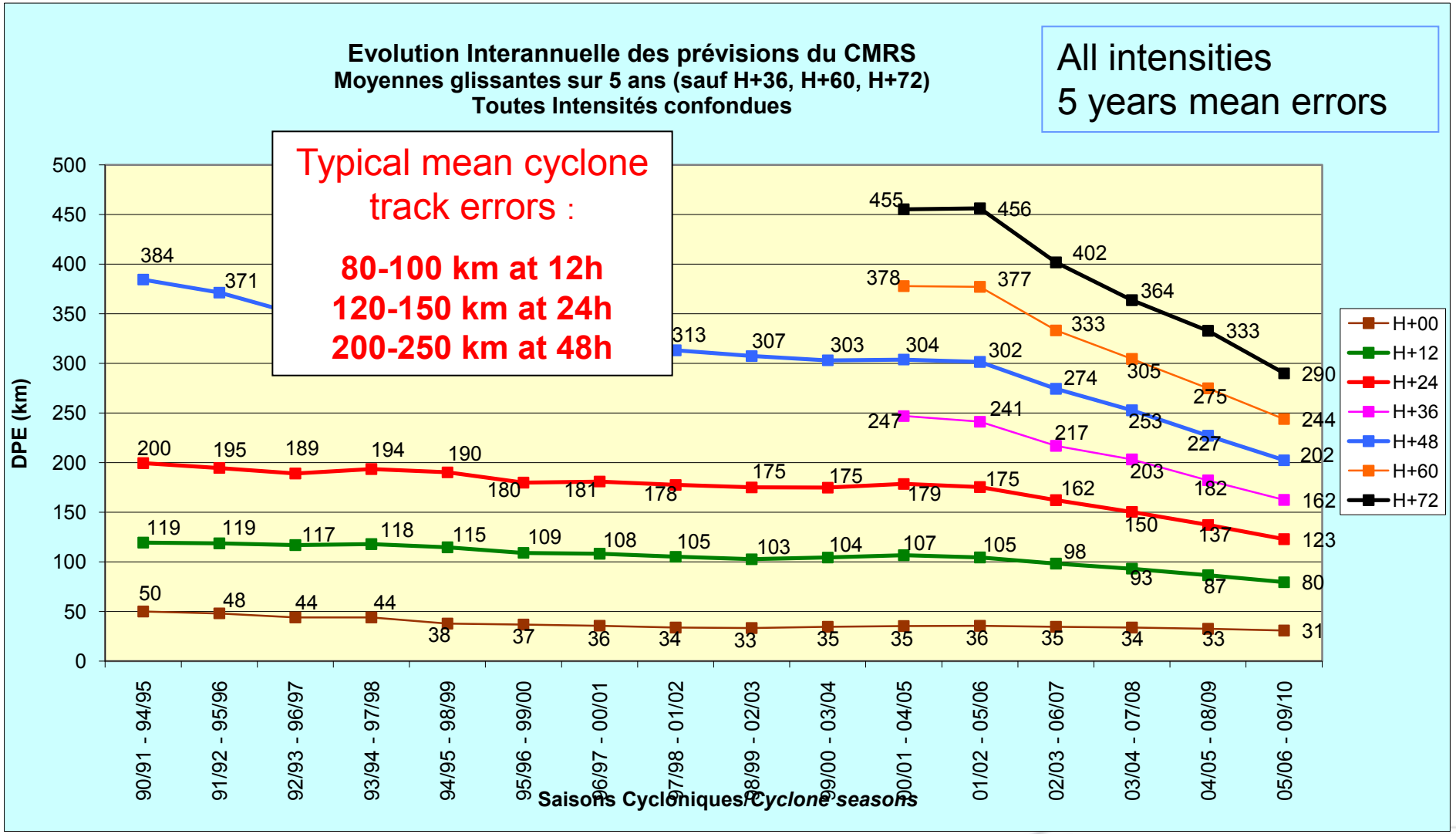
Tropical cyclone track forecast errors (RSMC of La Réunion)



Conclusion : the quality of track forecast remains a limiting factor ⟶ importance of a warning system.

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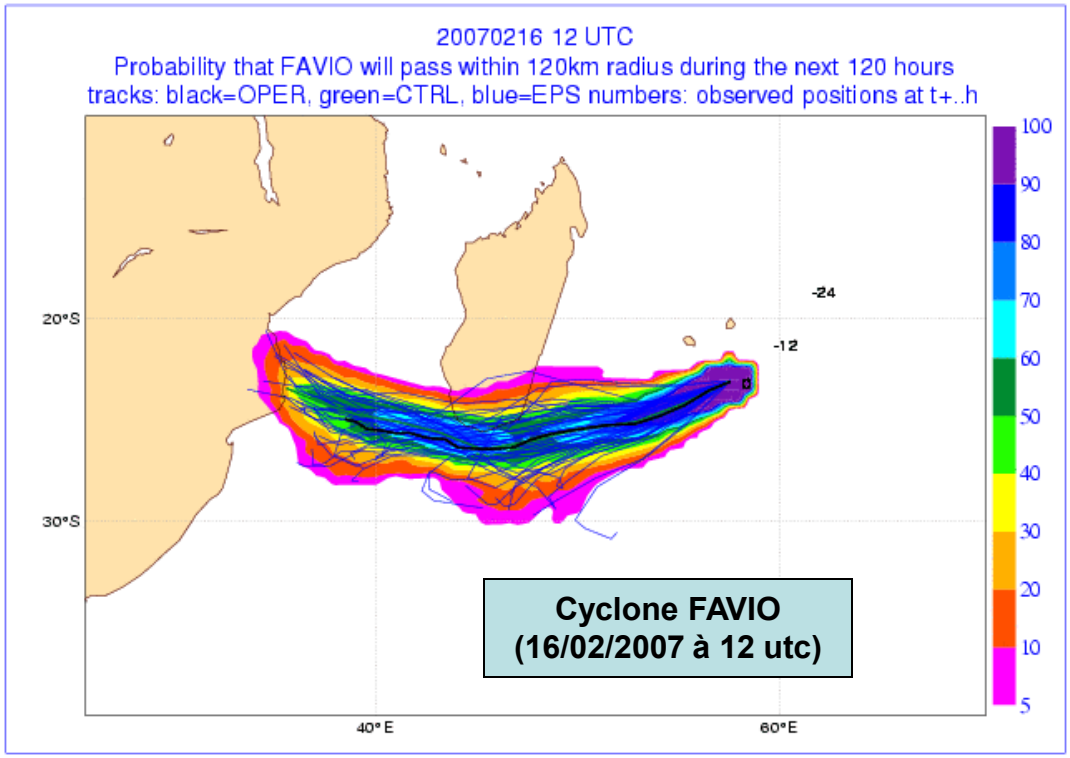
The ensemble prediction : a tool for a better estimation of the forecast uncertainty

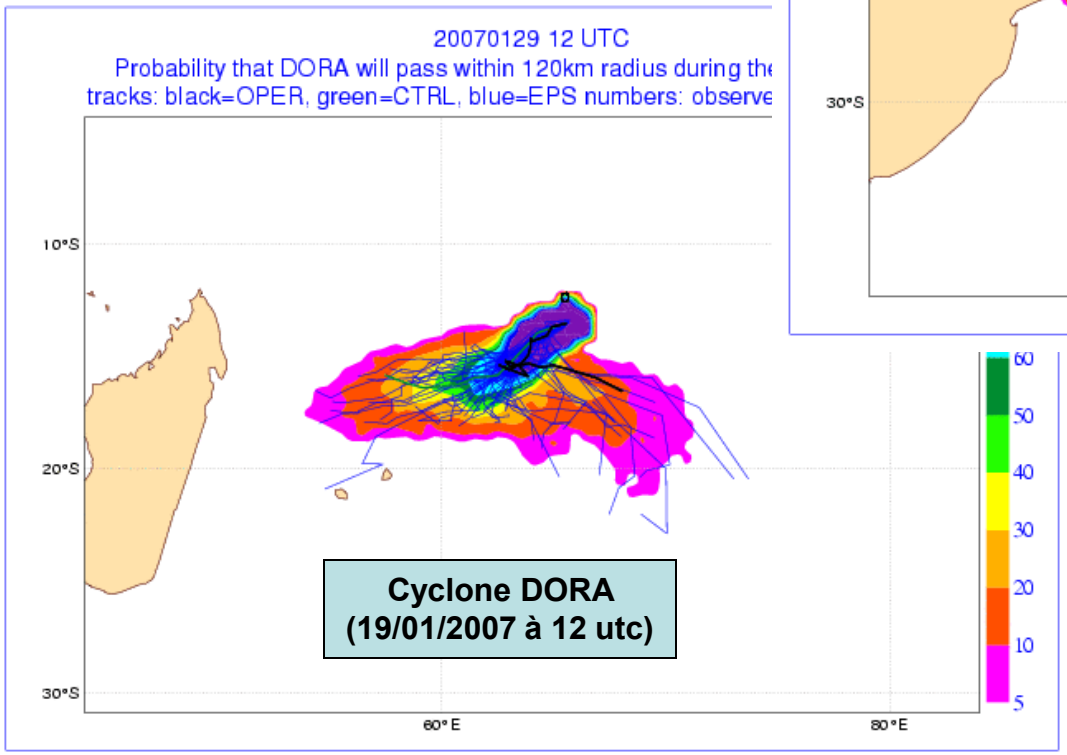
The EPS products have been proved reliable :

- for track forecasts
- and also for an estimation of the forecast uncertainty.

Both are important for risk managers and public agencies.



Cyclone FAVIO (16/02/2007 à 12 utc)



Cyclone DORA (19/01/2007 à 12 utc)

On line forecasts from different ensembles including EPS are available on an external Website for the South West Indian Ocean Meteorological Centres.

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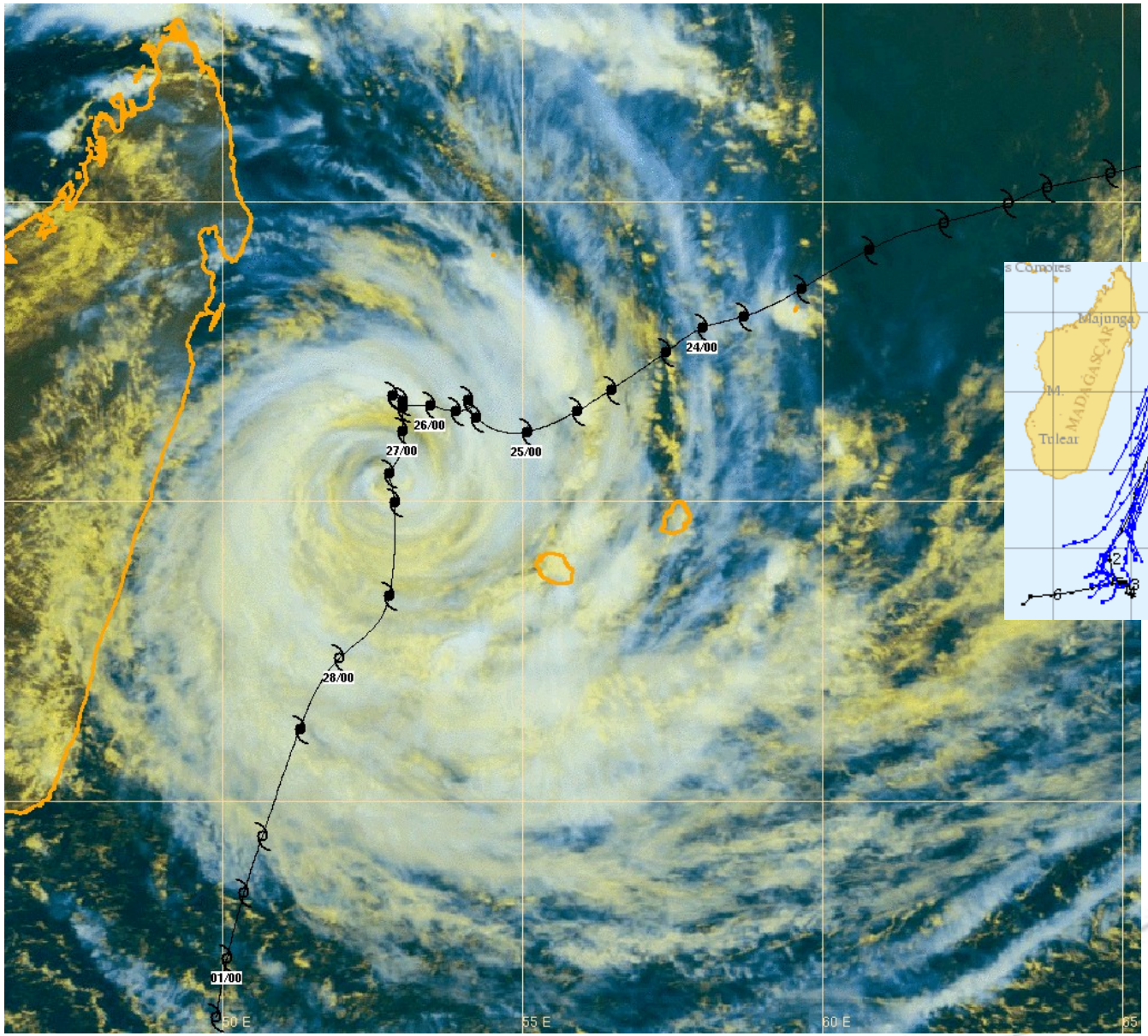
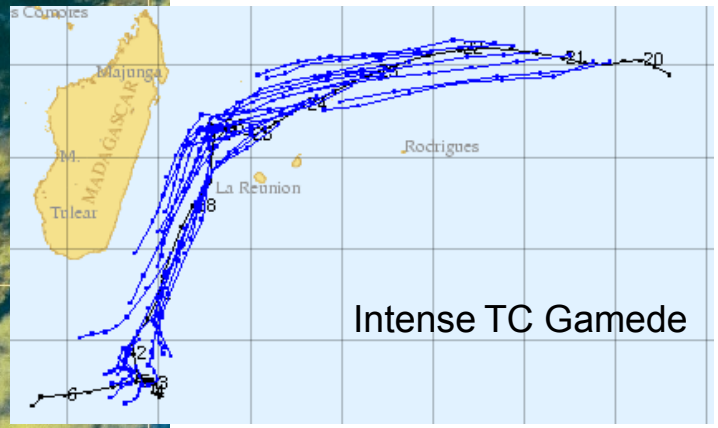
Track of TC GAMEDE from 24th February to 1st March 2007





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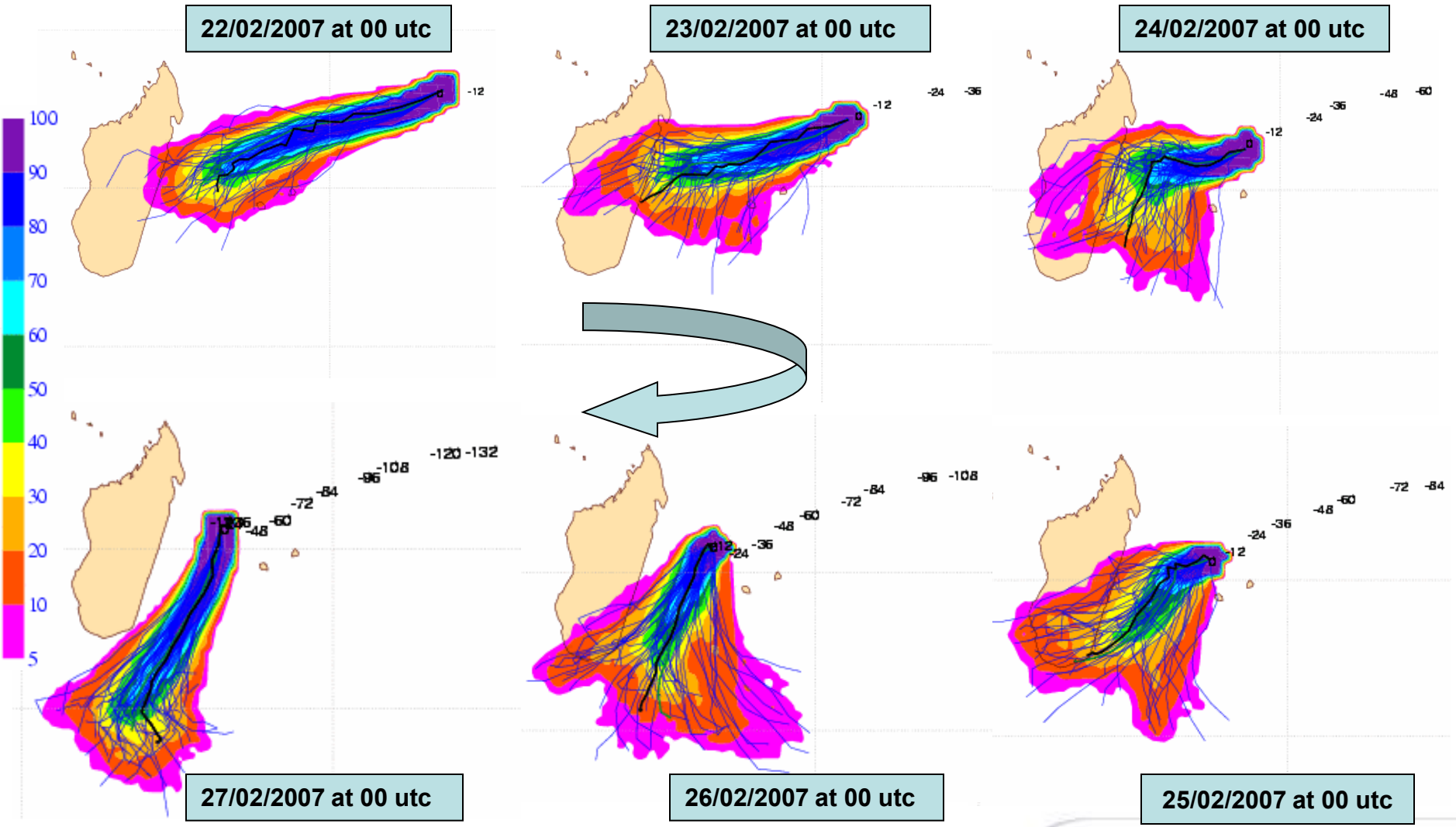
Forecast tracks from the ECMWF ensemble prediction for TC GAMEDE (22-27 February 2007)



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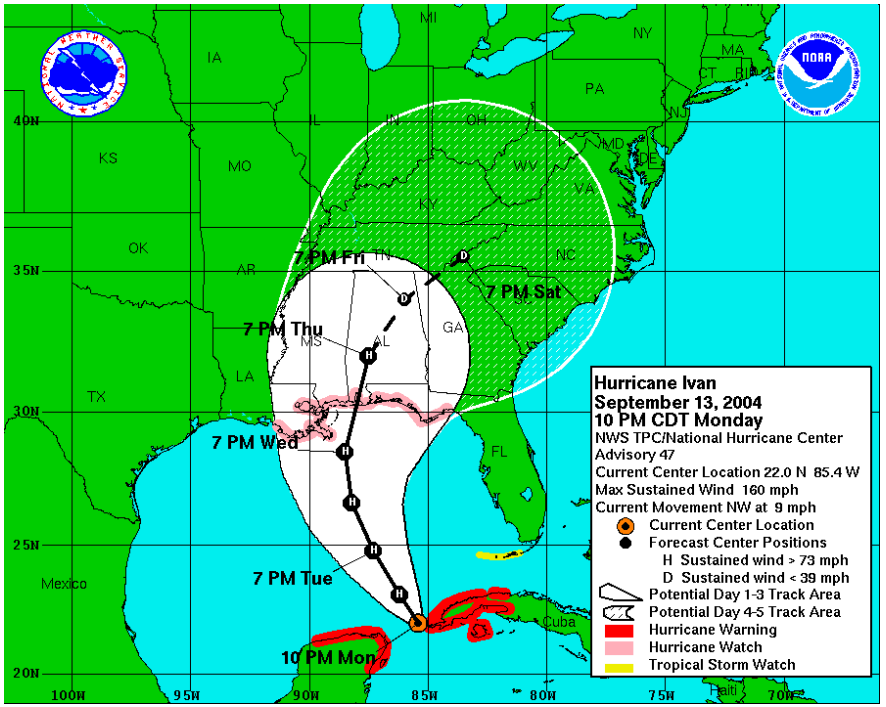
Ensemble-based uncertainty circles around track forecasts

- Several tropical cyclone forecast centres issue an uncertainty information around their official track forecasts :
  - generally using the climatological distribution of position error
  - such methods are not able to convey an information that is case-dependent
- Therefore, the RSMC of La Réunion has developed a new technique :
  - to measure and to display the uncertainty around its official track forecast until to 3 days lead time
  - with uncertainty circles based on EPS.



Thierry Dupont[2], Matthieu Plu[1], Philippe Caroff[2] and Ghislain Faure[1], 2011 : Verification of ensemble-based uncertainty circles around tropical cyclone track forecasts, *American Meteorological Society, Weather and Forecasting, Volume 26, Number 5 (October 2011).*
(1) Laboratoire de l'Atmosphère et des Cyclones
(2) Service de prévision cyclonique (DIRRE/CYC

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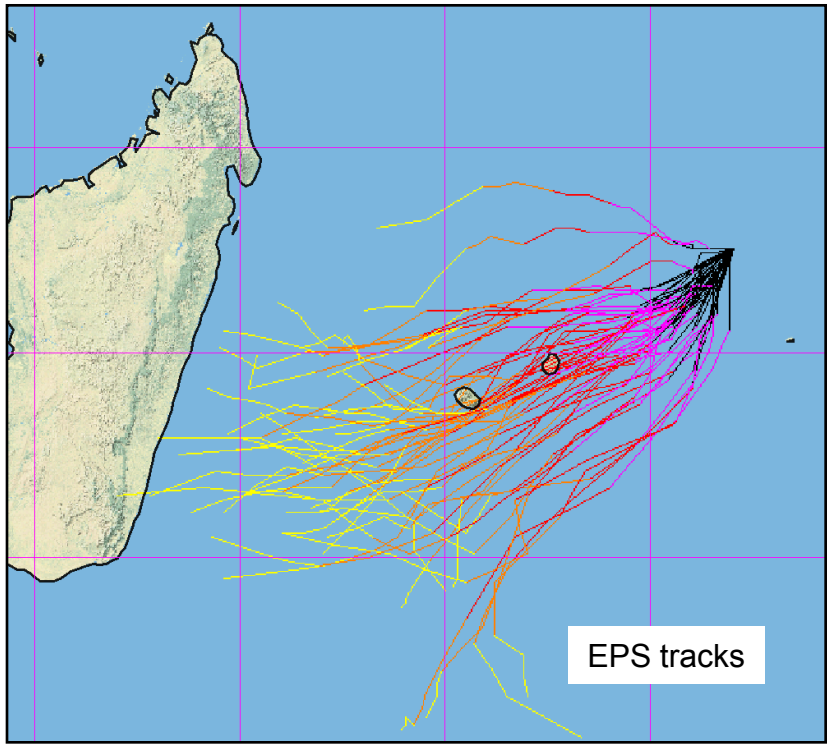
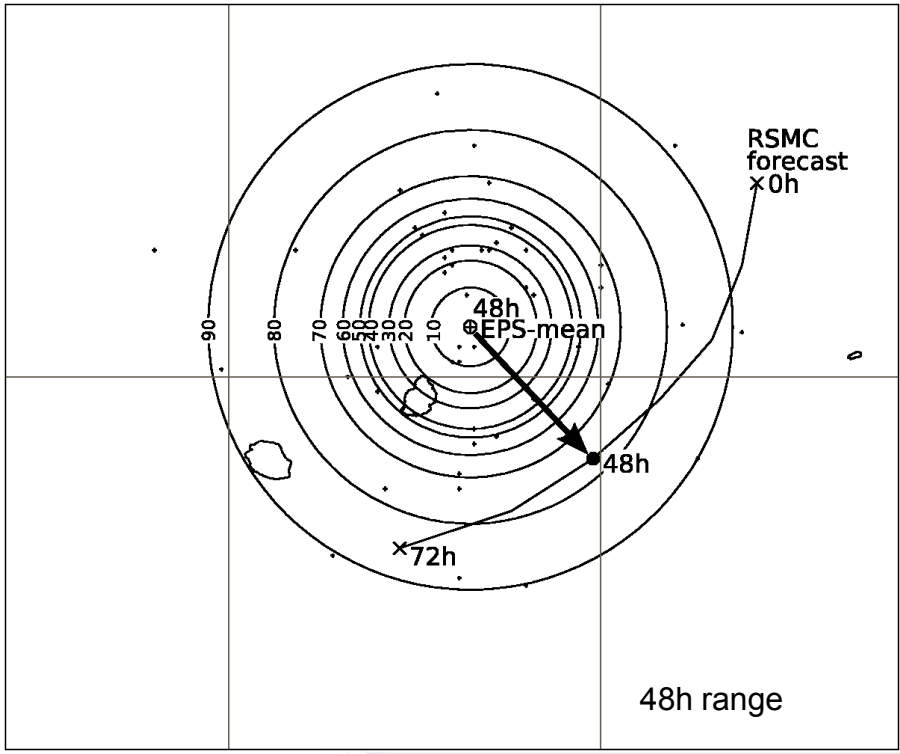
Construction of uncertainty circles

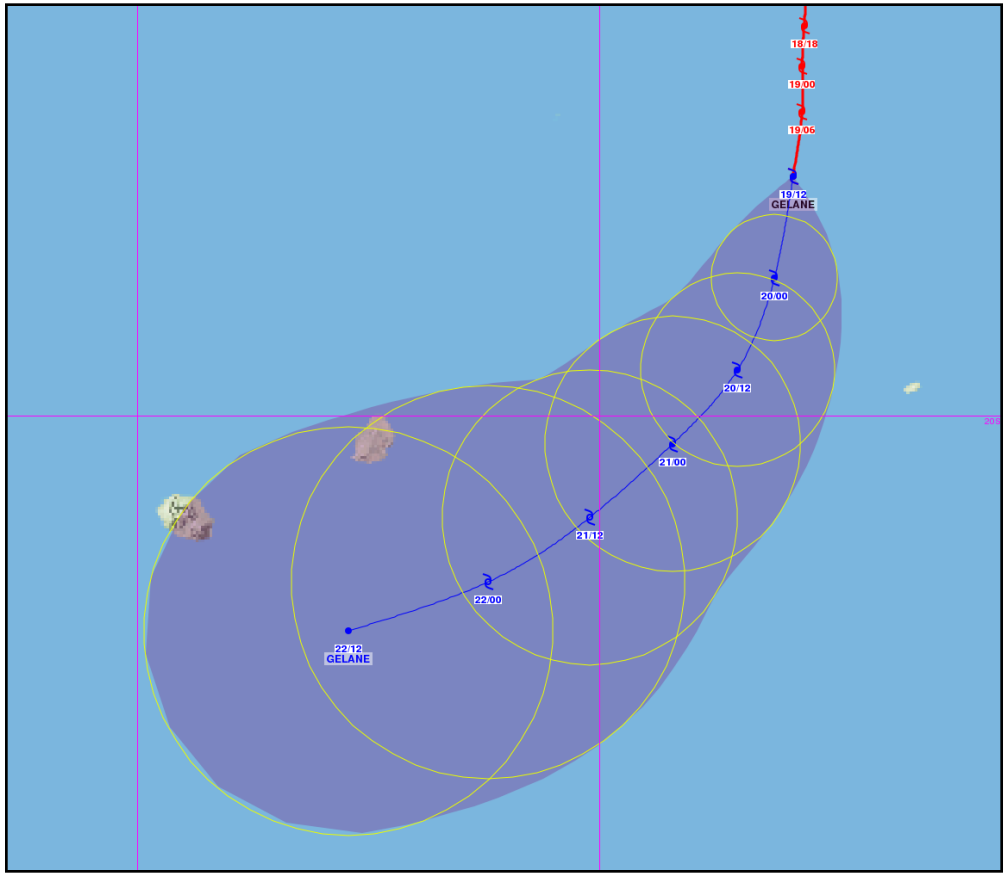
- For each range of EPS forecast :
  - Radius from EPS-mean position is calculated as x% of the EPS members are inner the circle (EPS forecast accuracy was calibrated at first)
  - This probabilistic circle is translated around RSMC forecasted position.





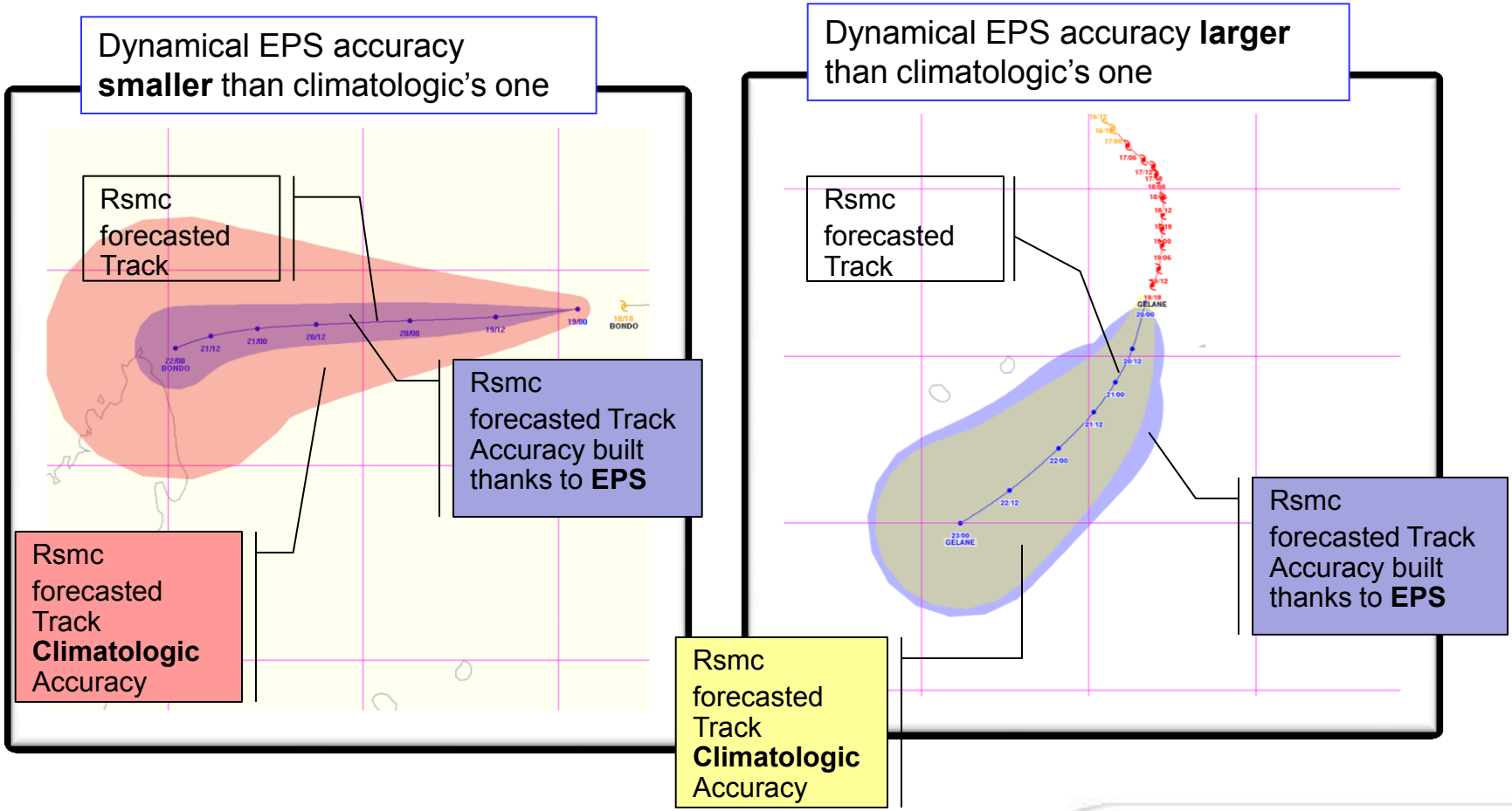
Construction of uncertainty cones

- The uncertainty circles correspond to calibrated probabilities of 75% (calibration with Brier scores)
- The succession of circles form an uncertainty cone :



Graphic Production of the uncertainty circles

- CXML file with RSMC position and calibrated EPS accuracy is produced and vizualized thanks to Synergie Cyclone.



Verification of EPS-based uncertainty circles

- The verification of this technique has showed that the probabilistic forecasts have better scores than the climatology
- Secondly, the skill of uncertainty circles - built by fixing the calibrated probability at 75% - at detecting the small and the large error values is assessed :
  - At least until the 3-days term for large errors
  - Only until 2-days lead time for small radii
- The forecaster will keep the choice of the cone size
- Perspectives :
  - To evaluate and compare other ensemble forecasts (PEARP, MOGREPS…)
  - Other forms than a circle ? Ellipsis …
  - Towards a strictly probabilistic approach ? …

Thank you for attention