Severe weather events…
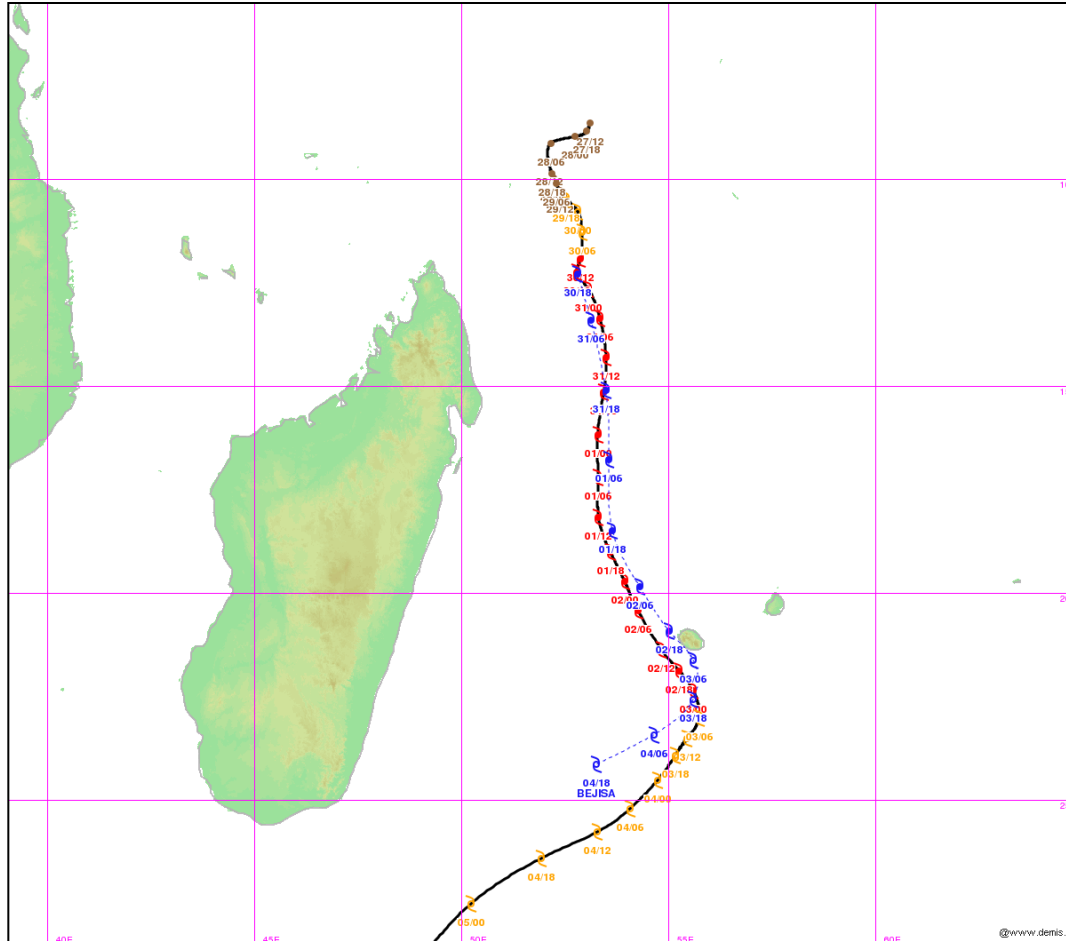# …from a NMS perspective

François Lalaurette(*)

UEF meeting, Reading 4-6 June 2014

(*) with credits to F. Bénichou, P. Brovelli, M. Mayoka, E. Cloppet, A. Floutard, JL Brenguier, J. Stein … et al.

METEO FRANCE
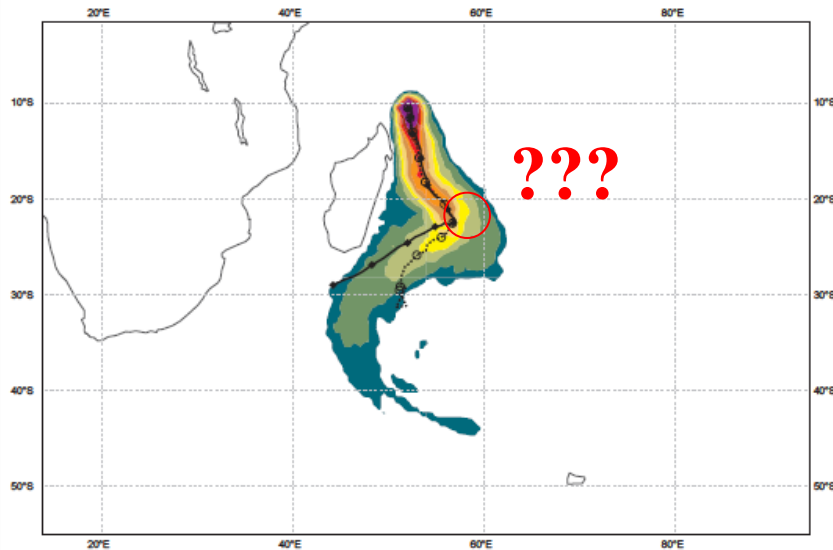Toujours un temps d'avance

ECMWF products at their best: TC Bejisa (31/12/2013 00UTC 66h forecast)

ECMWF products (almost) at their best: TC Bejisa (29/12/2013 00UTC EPS forecast)

(more in N. Girardot's presentation)

METEO FRANCE
Toujours un temps d'avance

Severe weather: the Vigilance

METEO FRANCE
Toujours un temps d'avance

Same display for the general public, the media and civil safety authorities

9 events

- Wind gusts
- Storms
- Heat waves
- Cold
- Avalanches
- Snow/ slippery roads
- Rain -floods
- Floods
- Waves - surges

4 levels

	Level 4
red	
orange	Level 3
yellow	Level 2
green	Level 1

Basic principles

→ Valid period : **24 hours** .

→ Scaled for departements (counties)**.**

→ **Forecasts issued for the timing and intensity.**

→ **multiple events are possible**

9 out of 10 persons in France know the vigilance system

From Vigilance to Emergency plans and actions

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

Based on Météo-France warnings, civil authorities can decide to trigger emergency plans (ORSEC, PIZ…)

METEO FRANCE
Toujours un temps d'avance

The waves-surges vigilance events

Météo-France and SHOM observation and modelling systems (waves, tides and surges) provide input to the forecasters
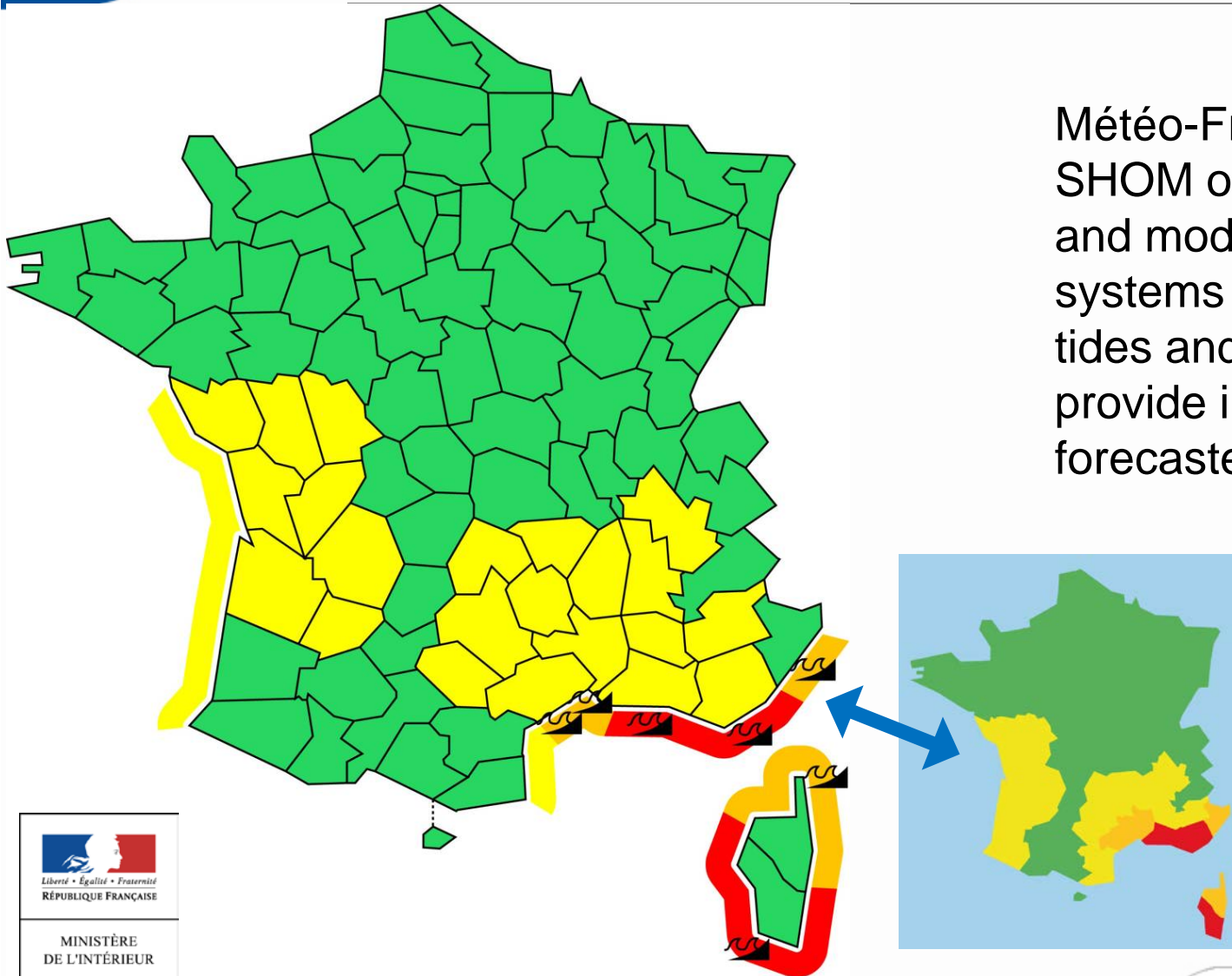
Vigilance from a 12-years perspective
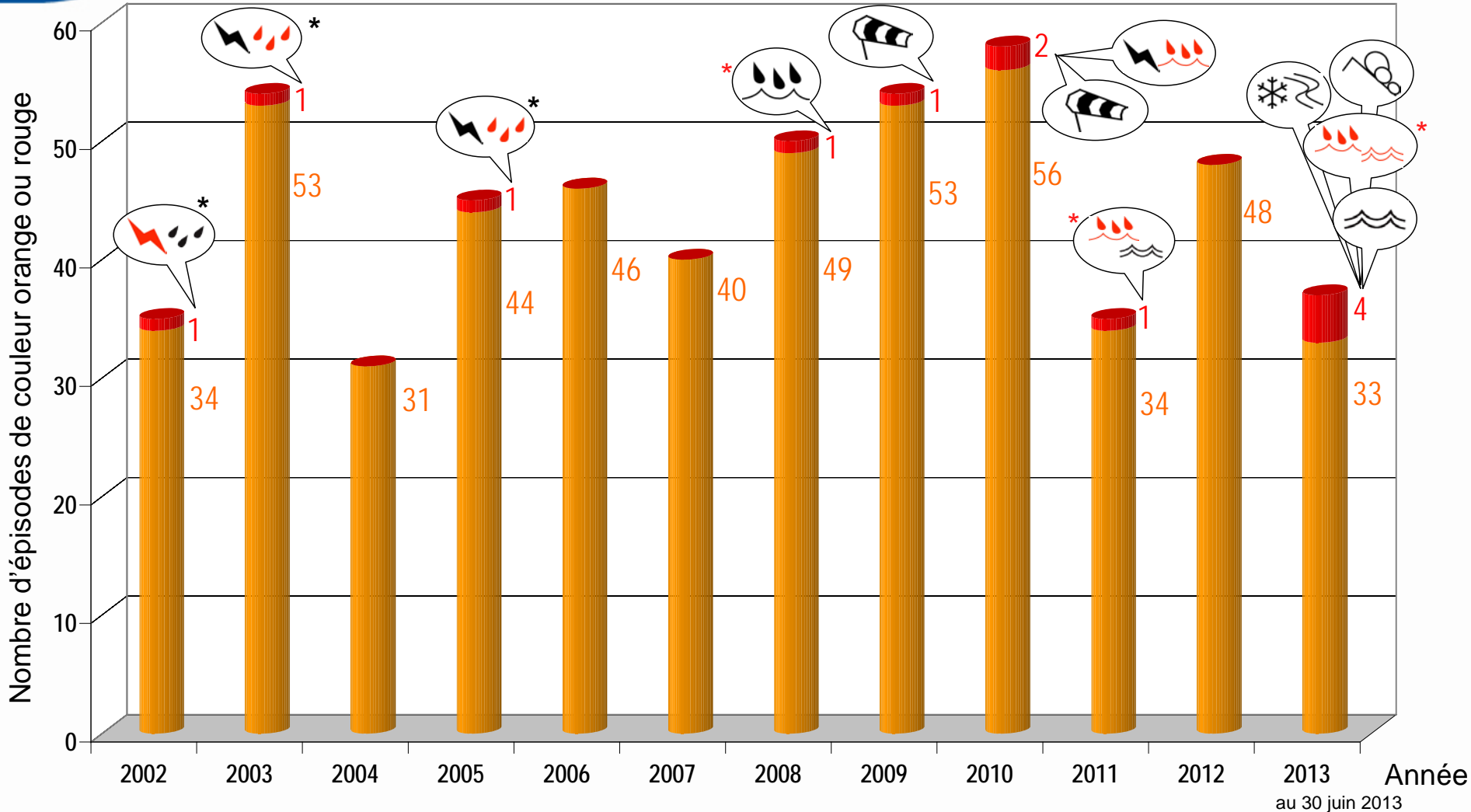
Pour les épisodes présentant de multiples aléas, le pictogramme affiché sur la carte est présenté en rouge sur le graphe.

*Remarque : Orange fortes précipitations + Rouge crues = Rouge pluie-inondation

*Jusqu'à la fin de l'année 2007, Météo-France a utilisé ce pictogramme pour les fortes pluies.

12 Red vigilance cases (up to 1er September 2013)

3 for storms :
- **9 September 2002**
- **3 September 2003**
- **6-7 September 2005**

2 pour wind gusts :
- **24 January 2009 (*Klaus*)**
- **27-28 February 2010 (*Xynthia*)**

1 for avalanches :
- **15-16 January 2013**

4 for rain-floods :
- **2-3 November 2008**
- **7 September 2010**
- **3-4 November**
- **18-19 June 2013**

1 for floods :
- **6-7 March 2013**

1 for snow-slippery roads:
- **12 March 2013**
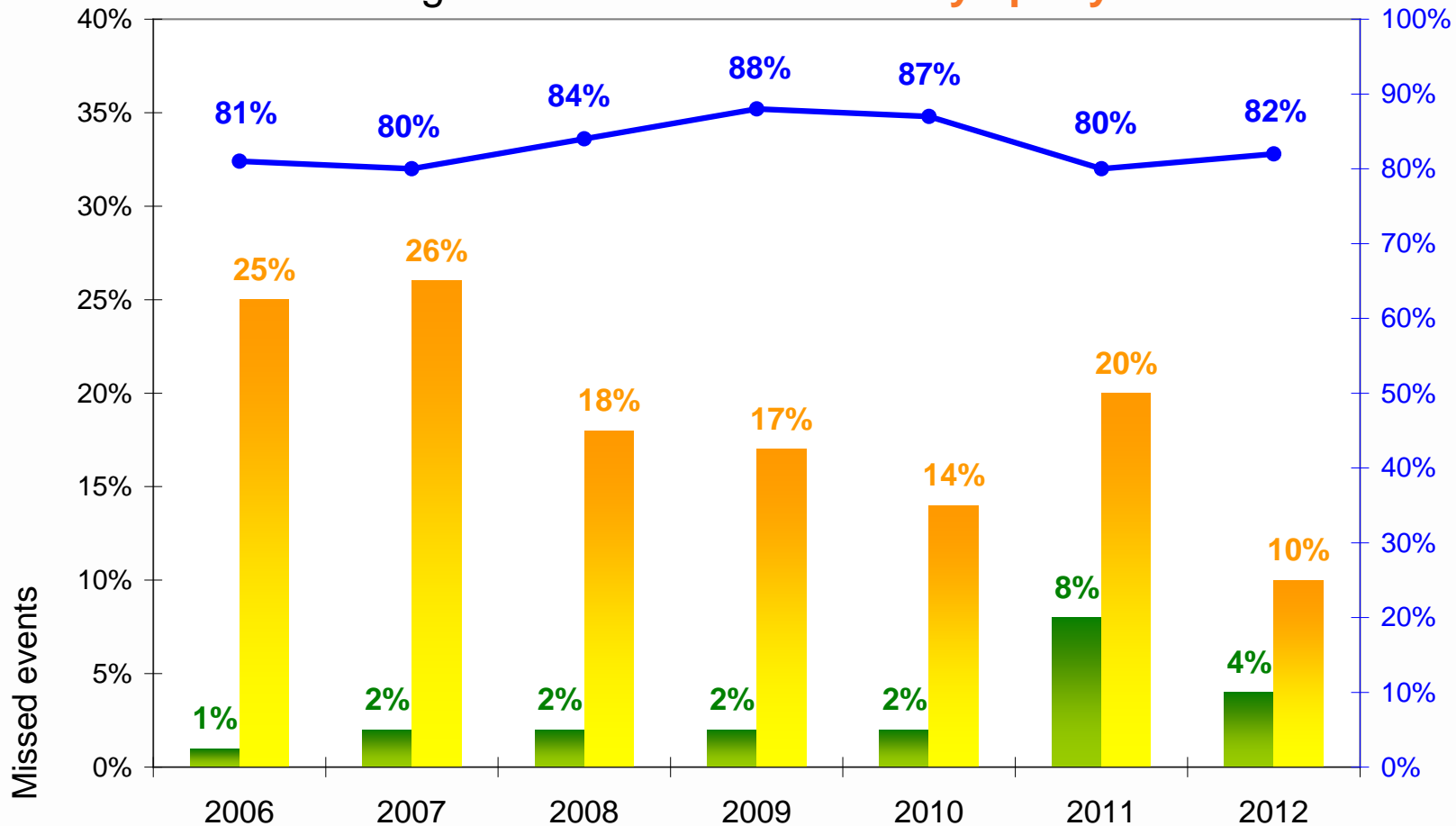
METEO FRANCE
Toujours un temps d'avance

5. Total number of orange events from 2002 to 2011
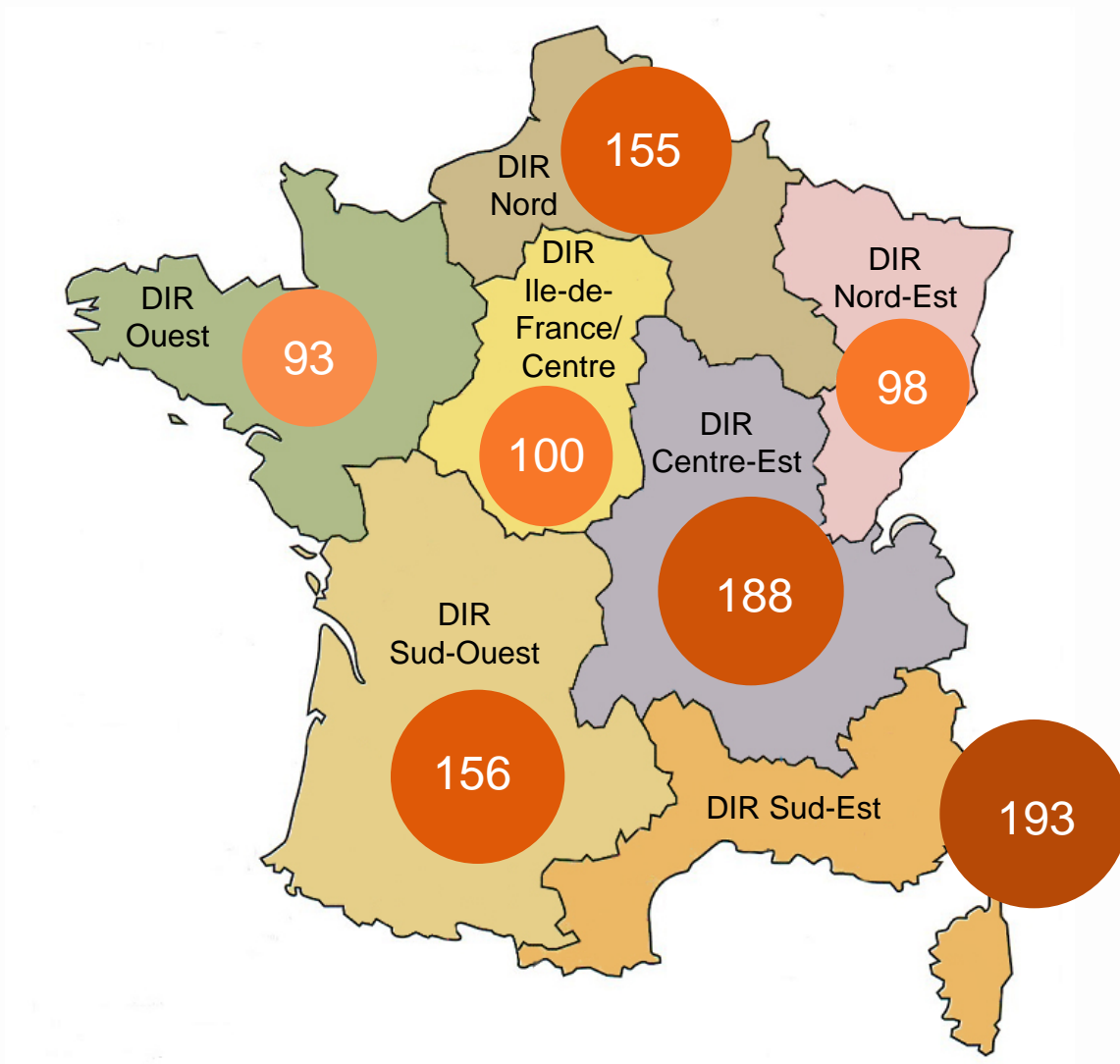
A few facts about vigilance

Orange is activated **about 90 days per year**

Legend:
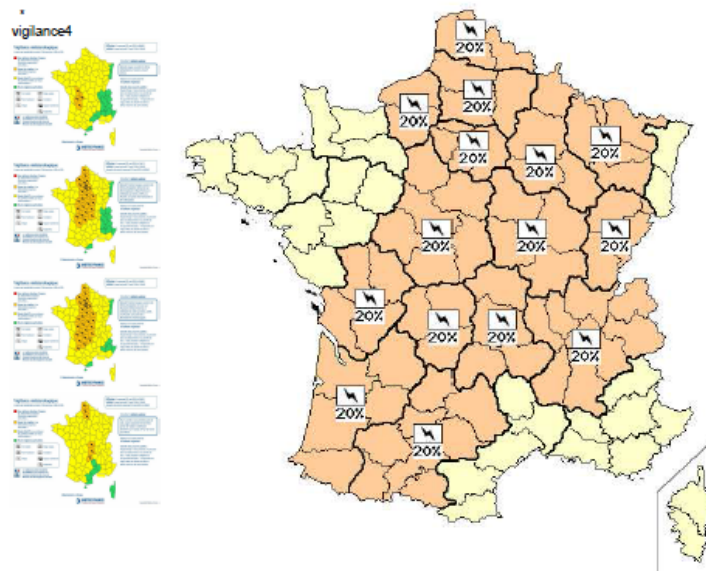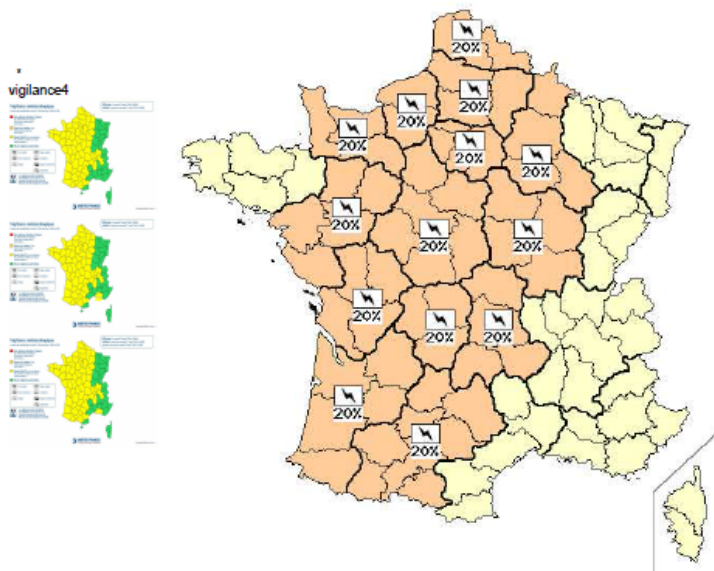- Ratio of orange vigilance activated more than 3h in advance
- Rate of missed events
- False alarms

METEO FRANCE
Toujours un temps d'avance

Early vigilance (up to 6 days in advance, for public authorities only)

Severe events and numerical (weather) prediction models

- Wave/ surges models
- Aviation developments
- Road models
- Hydrology
- Progress we made: 2 cases

METEO FRANCE
Toujours un temps d'avance

Waves and surges
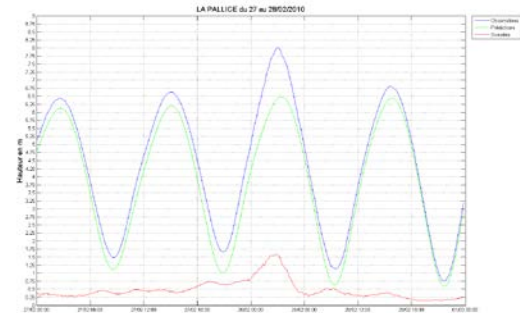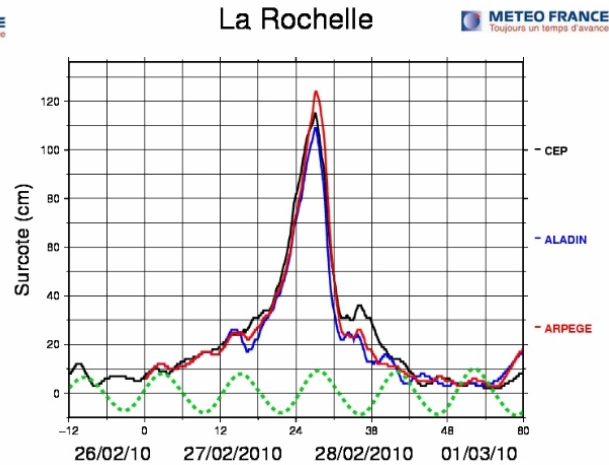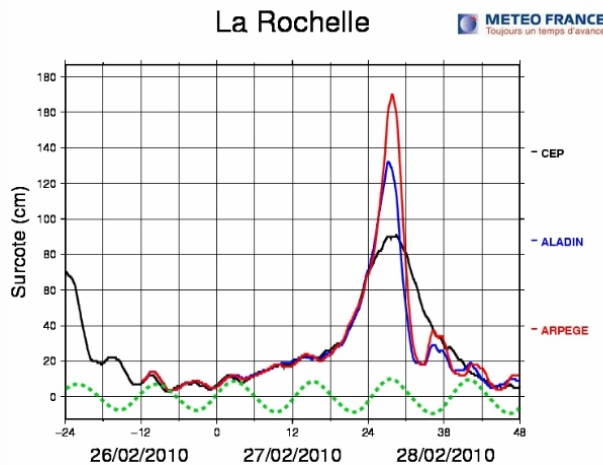
Observed levels in La Rochelle

Operational data available during Xynthia at la Rochelle.
Left, 27 February 00 UTC model. Right, 27 February 12 UTC model.

Results from the Homonim (SHIOM/Météo-France project)
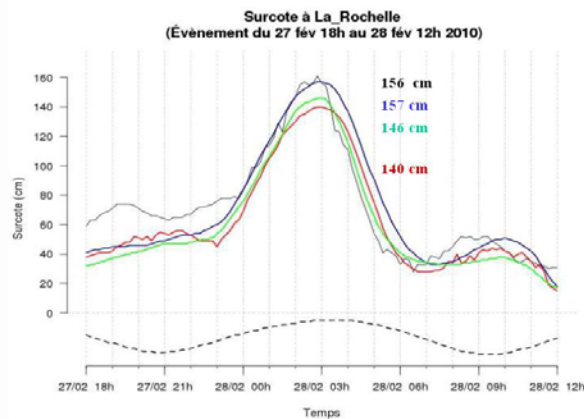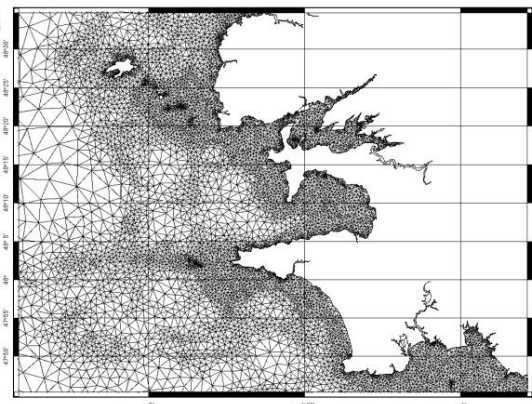
Pic de surcote modélisé/observé pour **Xynthia** (cm)

Sites/Modèles	M-F 2010	M-F 2013	Hycom	Obs	« Gain »
Le Verdon	119	118	119	115	0%
La Rochelle	139	146	157	156	94 %
Sables d'Olonne	103	107	120	159	30%
St Nazaire	105	100	123	119	71 %
Le Crouesty	73	75	85	107	35 %
Dunkerque	68	77	77	100	28 %

Model developments for aviation
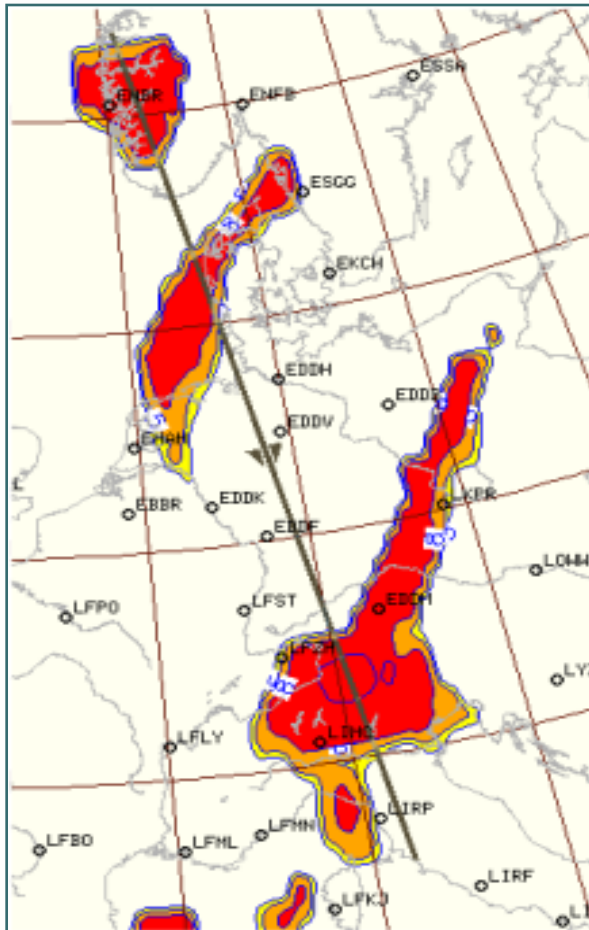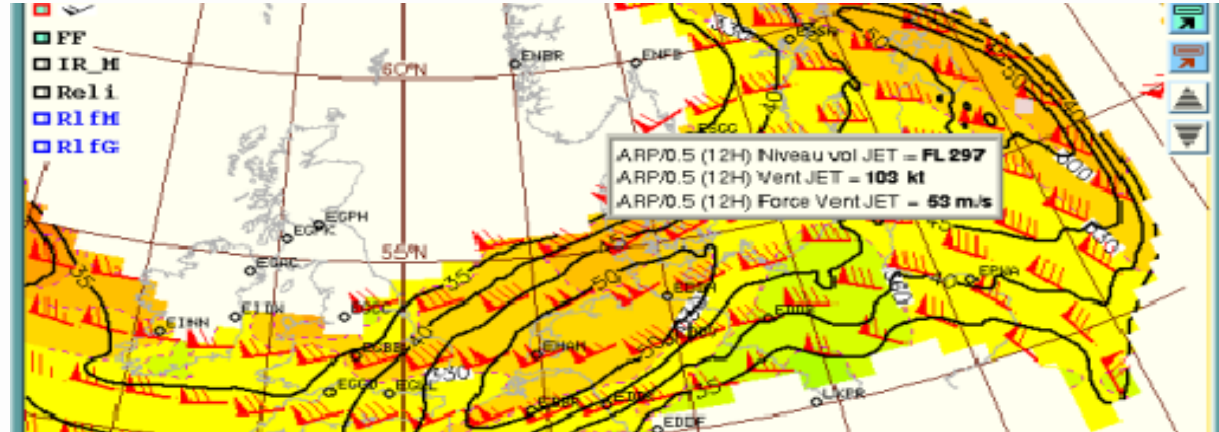
Jet stream

Icing indices

Icing indices

METEO FRANCE
Toujours un temps d'avance
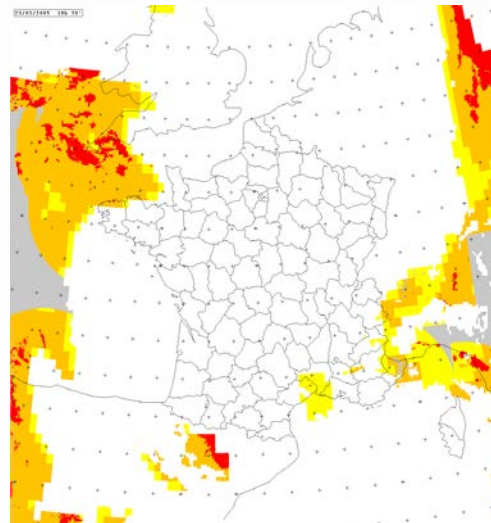
EYJAFJÖLL event using Mocage
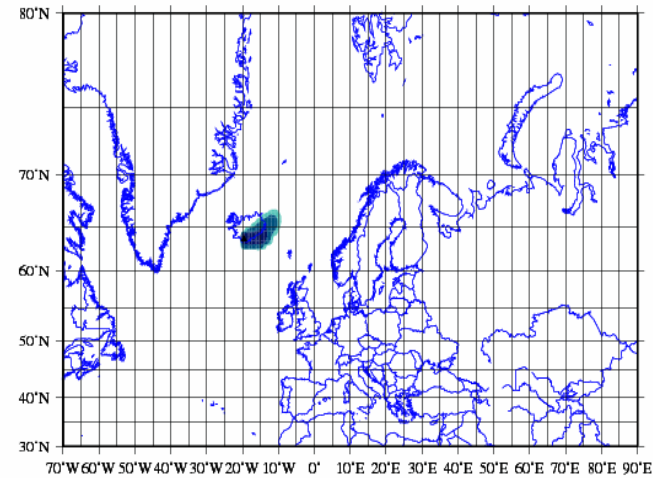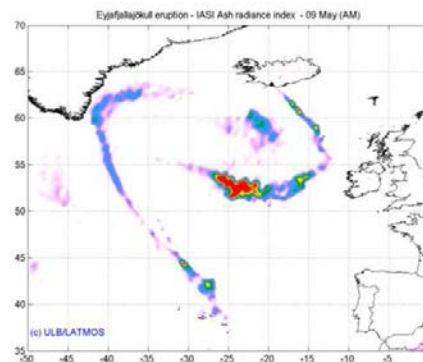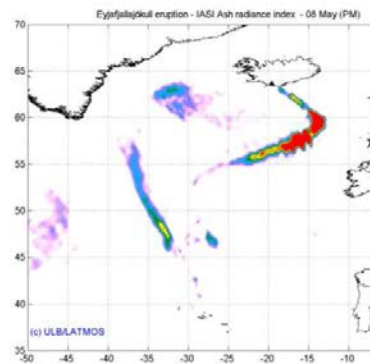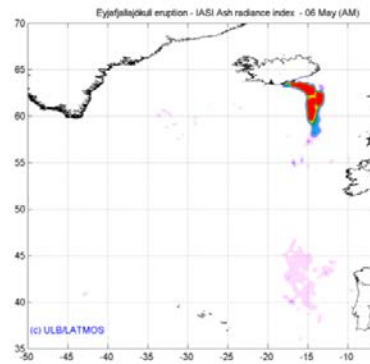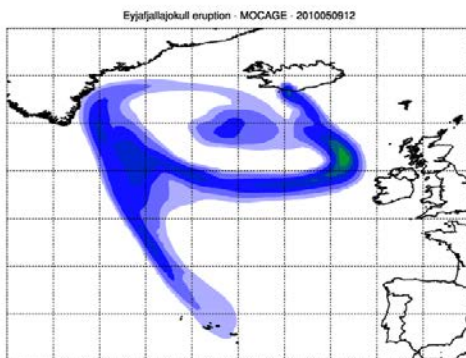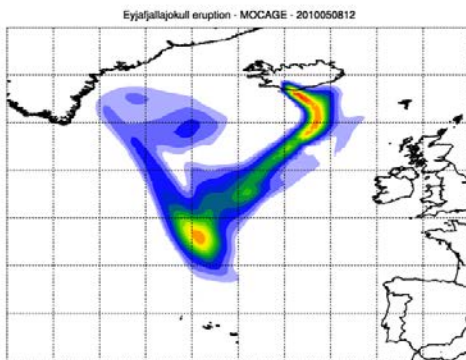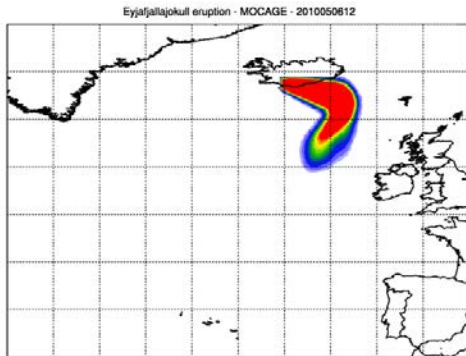
Up : animated picture from the model

Left : Model/ Observations comparison

SESAR WP11.2

YEARS   6 MONTHS   DAYS   HOURS   MINUTES

Long Term

Mid/Short Term

Execution

BDT   SBT   SBT   SBT   SBT   SBT   RBT

Business Development Trajectory

Shared Business Trajectory

Reference Business Trajectory

Tactical Actions

Negotiation on
- Schedules
- Airspace
- Routes
- Resources

Local Capacity Mgt
- Traffic Balancing
- Real-Time Queue Mgt
- Tactical De-confliction

- Forecasts
- Airline Plans
- Scedule Dev.
- Military Exercises
- Major Events
- Airspace Design

Plan Refinement
- Arrival Capacity
- Departure Planning
- Impacting Events

METEO FRANCE
Toujours un temps d'avance

Impact based on EPS

EPS members

Prévision MET Probabiliste

Using a probability
enveloppe

**Overestimation of the impact on
capacity**

*Steiner et al., 2010: Translation of ensemble weather
forecast into probabilistic air traffic capacity impact*

OPTIMA : modelling the weather on the raods

1 Km road segments

Observations combined from Meteo-France and Motorway agencies

Updates every 5 minutes

Customised products

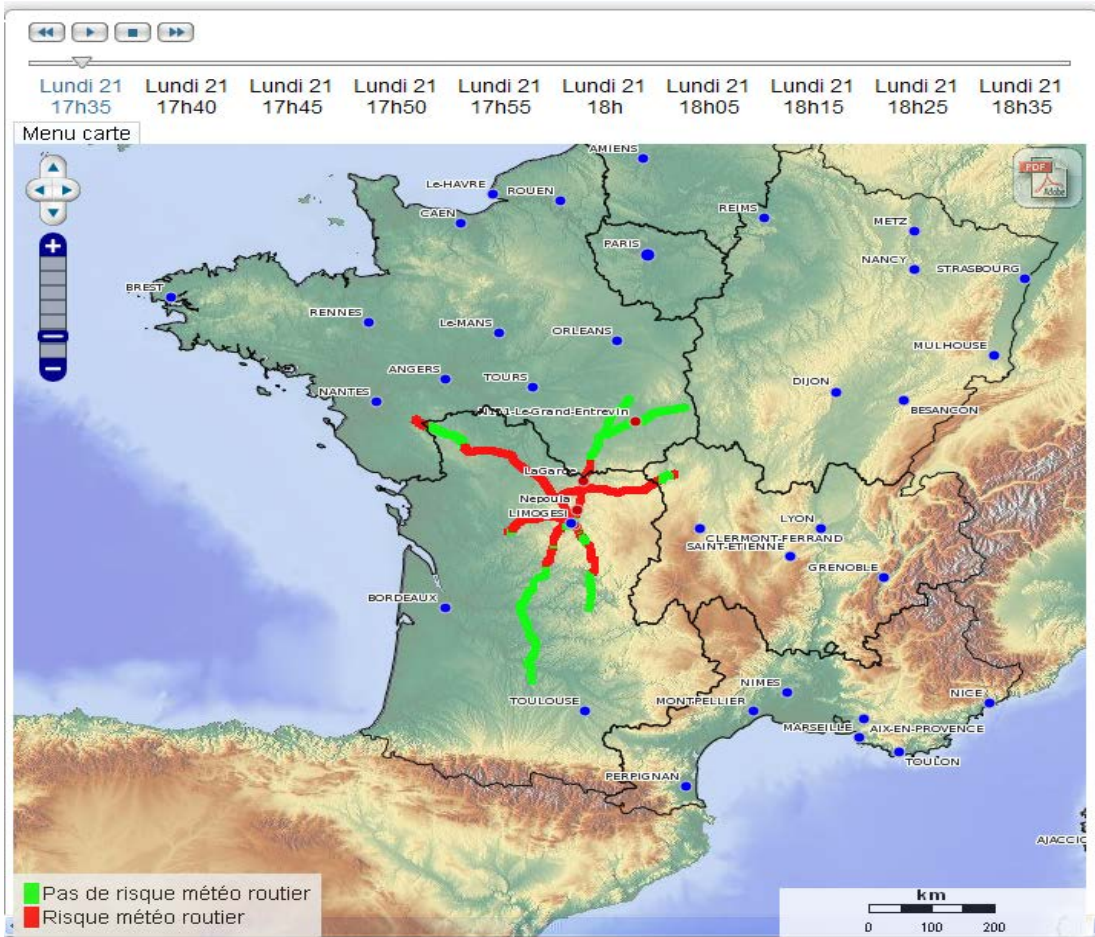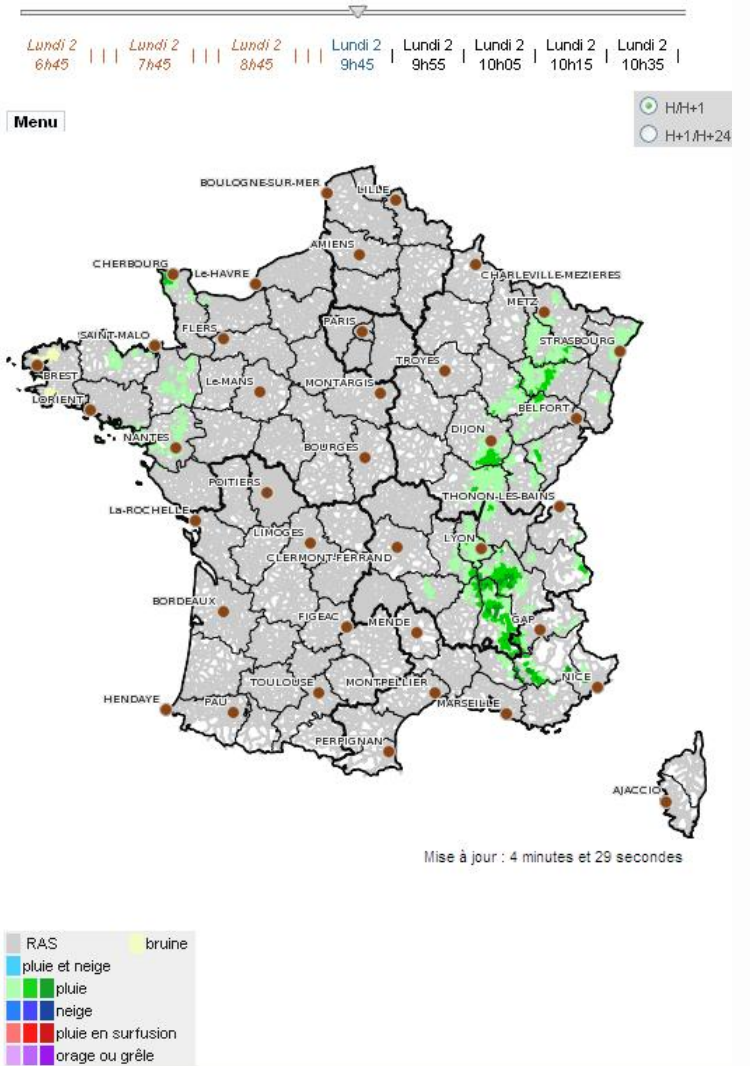# Developments for the road model

Snow on the road

Cum

Atlantic
Ocean

Mediterranean
Sea
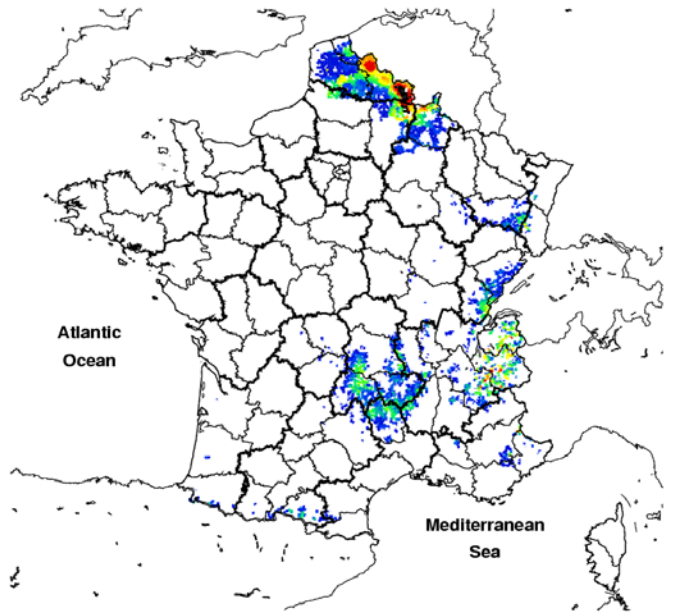
06/03/2012 01 h local

Forecast

Decision making

Road forecasts
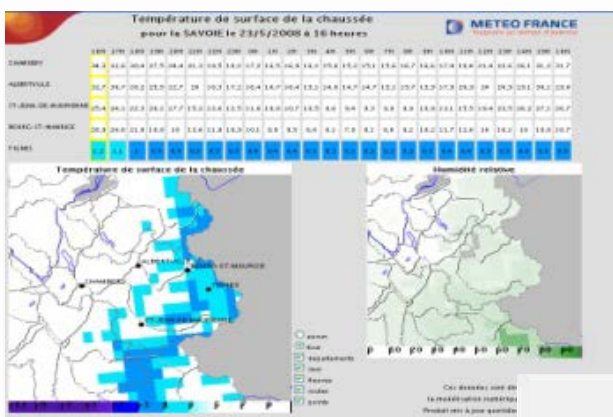
Nowcasting applications

Radar network
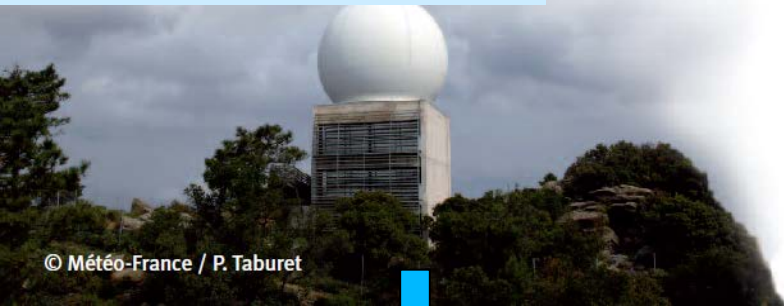
© Météo-France / P. Taburet

Calibrated radar rain data

Return period

Base : l'observation radar

2 classes (intense, très intense selon durée de retour 10 ou 50 ans)
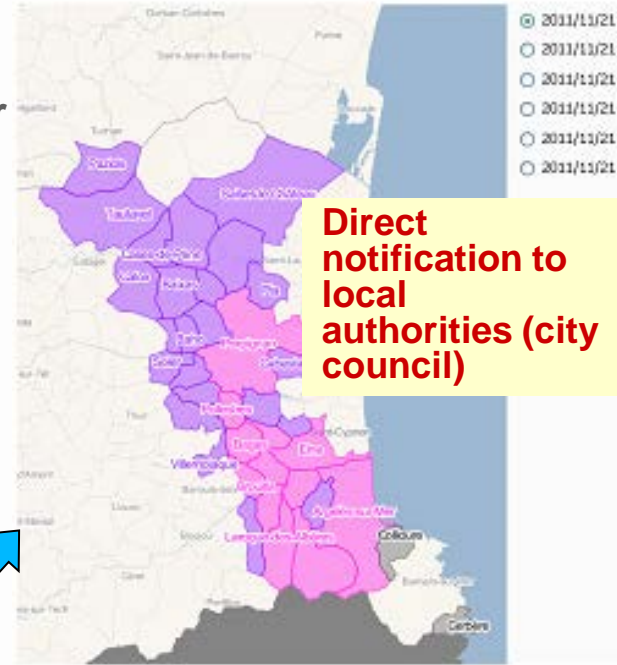
Return period

APIC

Direct notification to local authorities (city council)
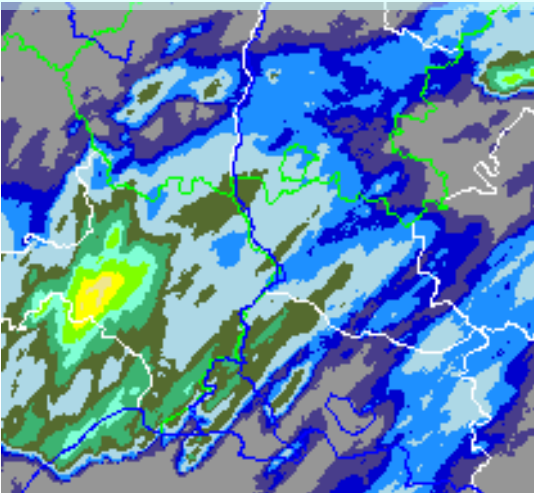
Sms, audio message, email,

Mayor

METEO FRANCE Toujours un temps d'avance

Arome-PI: coupling NWP and nowcasting
New
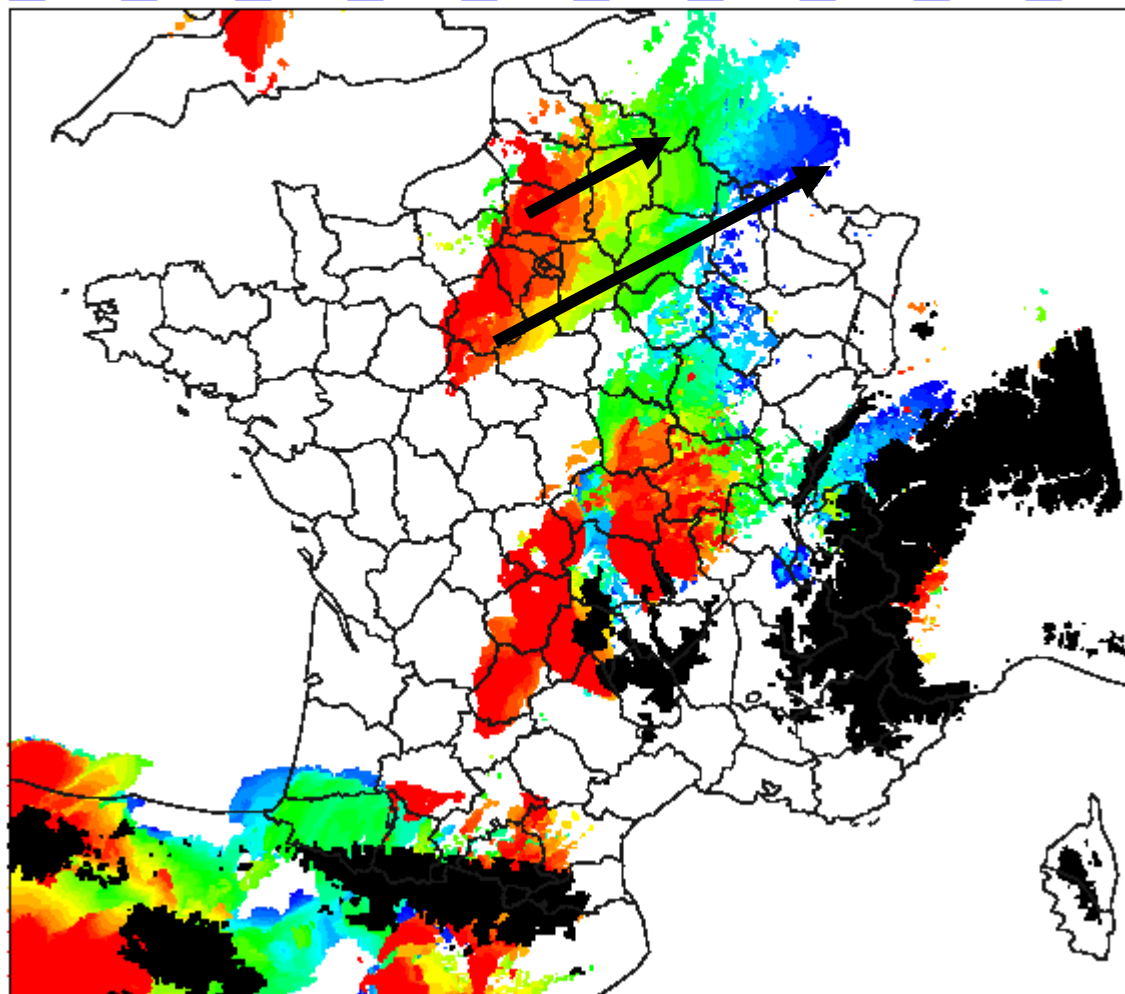

IRO du 20120628 reseau 15 UTC
rafales superieures a 50kt
pour toutes les echeances de 0 (rouge) a 420mn (bleu):

| 7h | 6h | 5h | 4h | 3h | 2h | 1h30 | 1h | 0h30 | 0h |
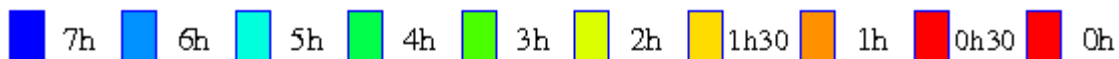
Code de couleur par échéance

One map, multiple forecast times

Storm-induced gusts (IRO)

Permet de voir l'évolution du phénomène de façon rapide

Animation sur un réseau modèle
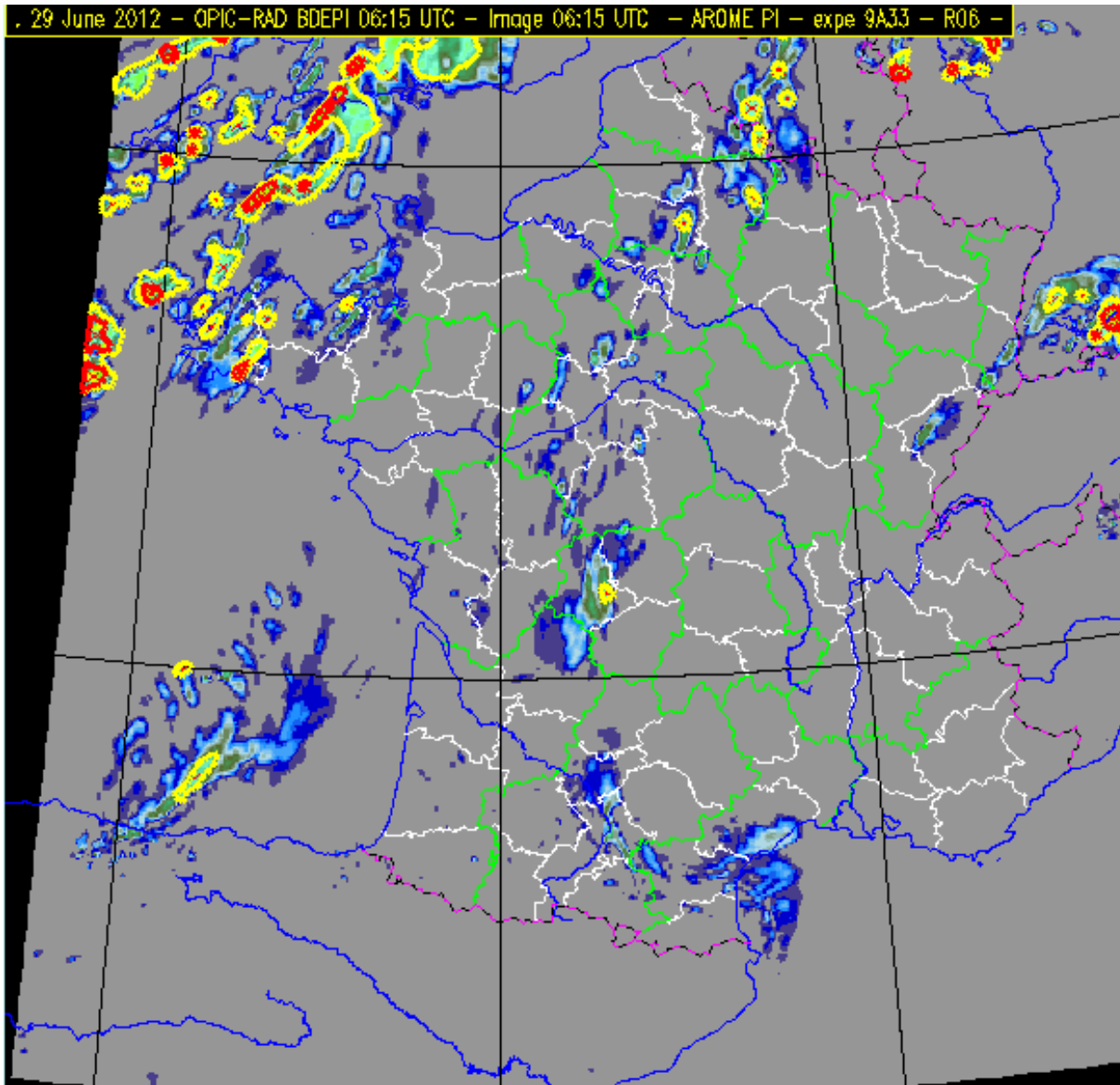
Animation sur un réseau toutes les échéances

Permet de reconnaître des **schémas conceptuels** de la convection proposés par AROME (supercellules, bow echos, MCS, …)

NWP applications for hydrology

Couplage Arome / TopModel déterministe

Couplage Arome / TopModel probabiliste

Couplage EPS / Modcou

Exemples de développements de GCRI
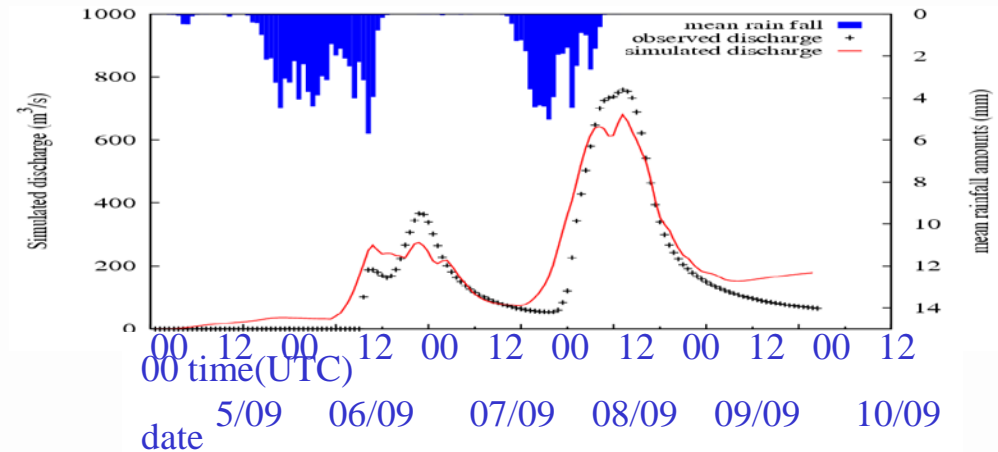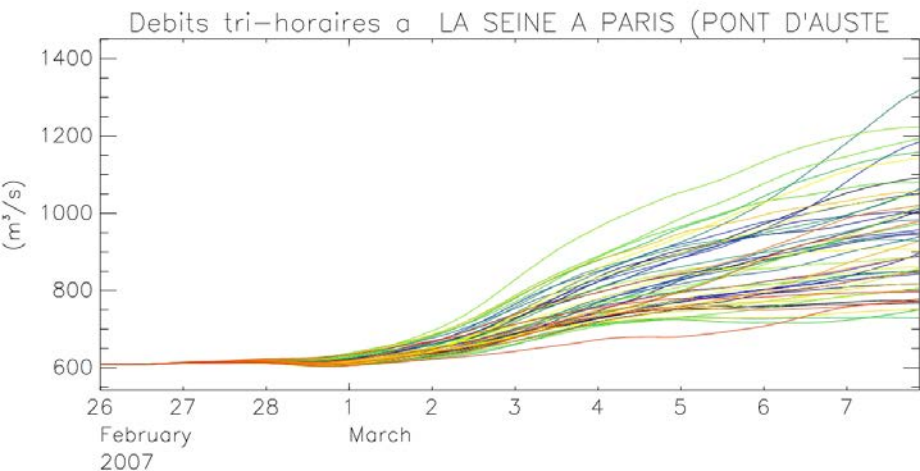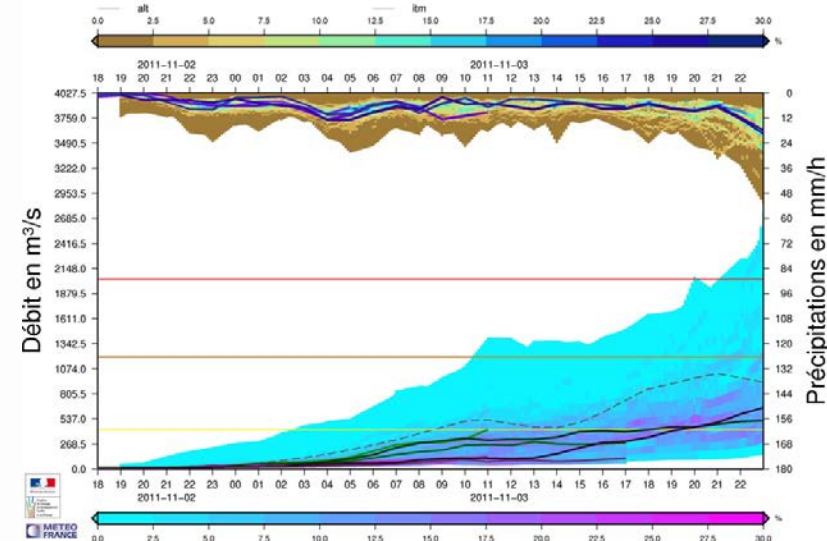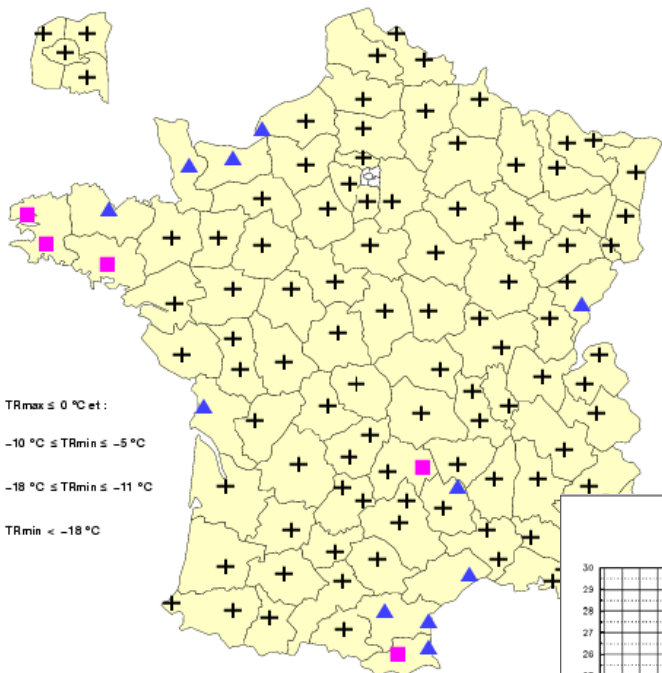
Produits 'Grand-froid' (Tempé. Ressenties)

Produits 'Canicule' (Indicat.biométéo)

METEO FRANCE — Toujours un temps d'avance

TEMPERATURES RESSENTIES PREVUES POUR LE JEUDI 5 SEPTEMBRE.

TRmax ≤ 0 °C et :
- ● −10 °C ≤ TRmin ≤ −5 °C
- ▲ −18 °C ≤ TRmin ≤ −11 °C
- ■ TRmin < −18 °C
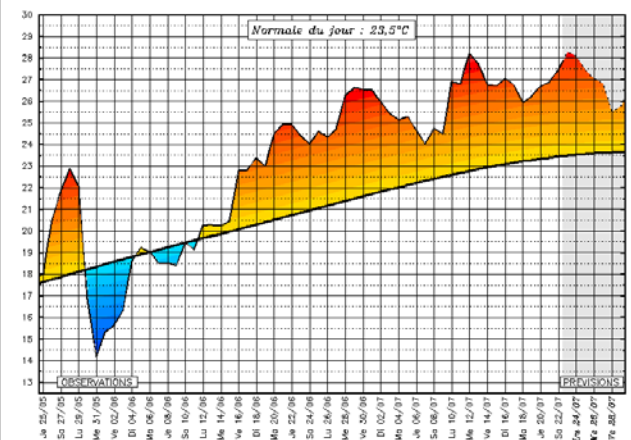
Carte produite le 05/09/2013 09:58 UTC.

AQUITAINE

Département	Ville Seuils	Param	J-1		J		J+1		J+2		J+3		J+4		J+
DORDOGNE (24)	Bergerac	Tn/Tx	15.6	30.6	14.9	38.0	19.0	37.0	27.0	30.0	23.0	35.0	19.0	26.0	19.0
		IBMn/IBMx	16.5	35.2	20.3	35.0	23.0	34.0	23.0	30.3	20.3	29.7	19.0	28.3	19.3
	20/36	Ecart seuil	-4	-1	0	-1	+3	-2	+3	-6	0	-6	-1	-8	-1
		Humidite		35		28		39							
GIRONDE (33)	Bordeaux	Tn/Tx	18.1	32.2	20.0	38.0	24.0	38.0	28.0	34.0	20.0	29.0	20.0	29.0	20.0
		IBMn/IBMx	20.7	36.1	24.0	36.7	24.0	33.7	22.7	30.7	20.0	28.7	20.0	29.3	20.7
	21/35	Ecart seuil	0	+1	+3	+2	+3	-1	+2	-4	-1	-6	-1	-6	0
		Humidite		30		24		35							
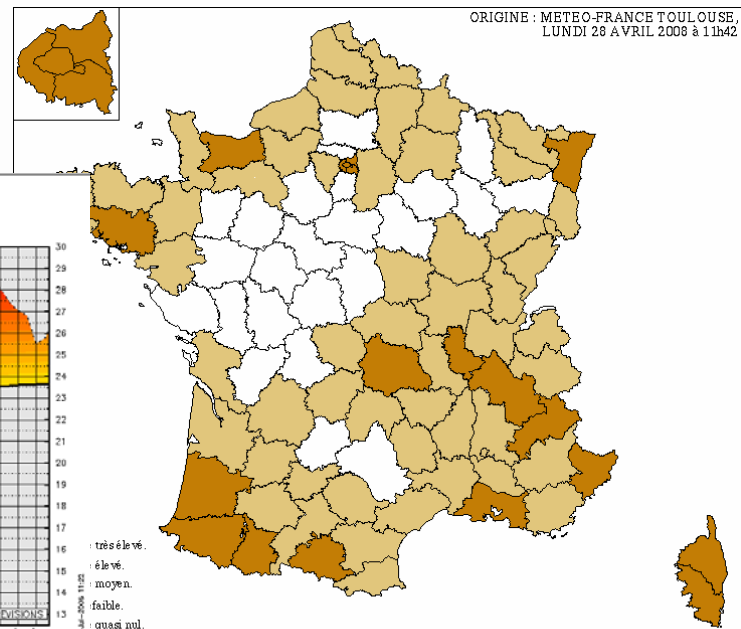
ORIGINE : METEO-FRANCE TOULOUSE, LUNDI 28 AVRIL 2008 à 11h42

: très élevé.
: élevé.
: moyen.
: faible.
: quasi nul.

e risque biométéorologique nuit/jour du 03 mai.

TEMPERATURES MOYENNES OBSERVEES ET PREVUES POUR LA REGION SUD-EST

Normale du jour : 23,5°C

OBSERVATIONS / PREVISIONS

Progress we made: Great storms

AROME 30h forecast
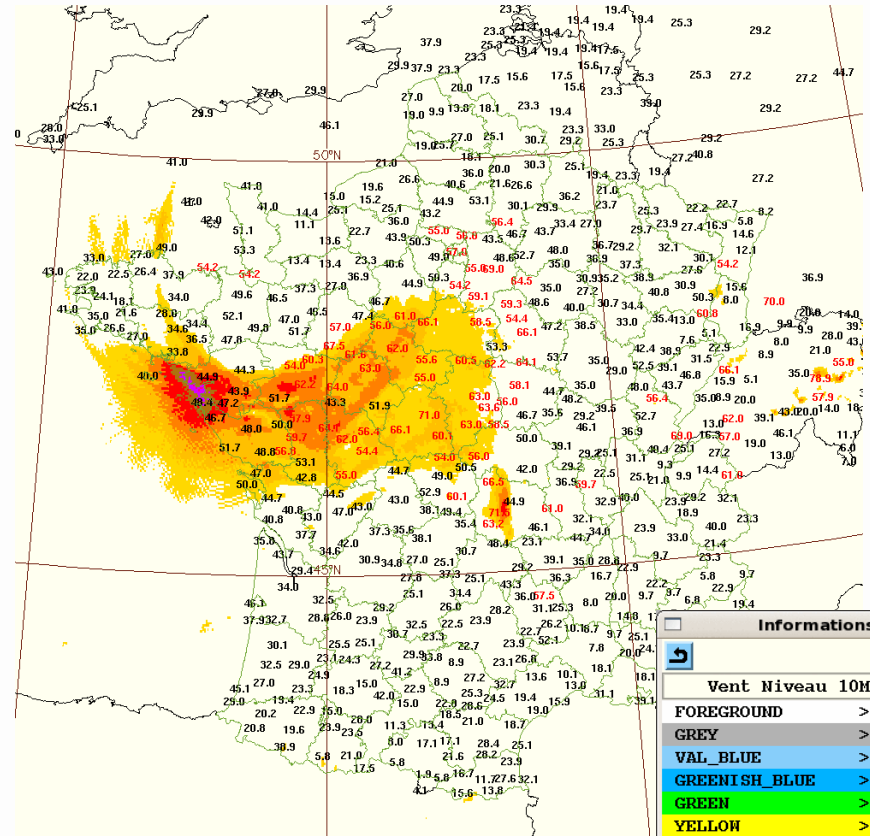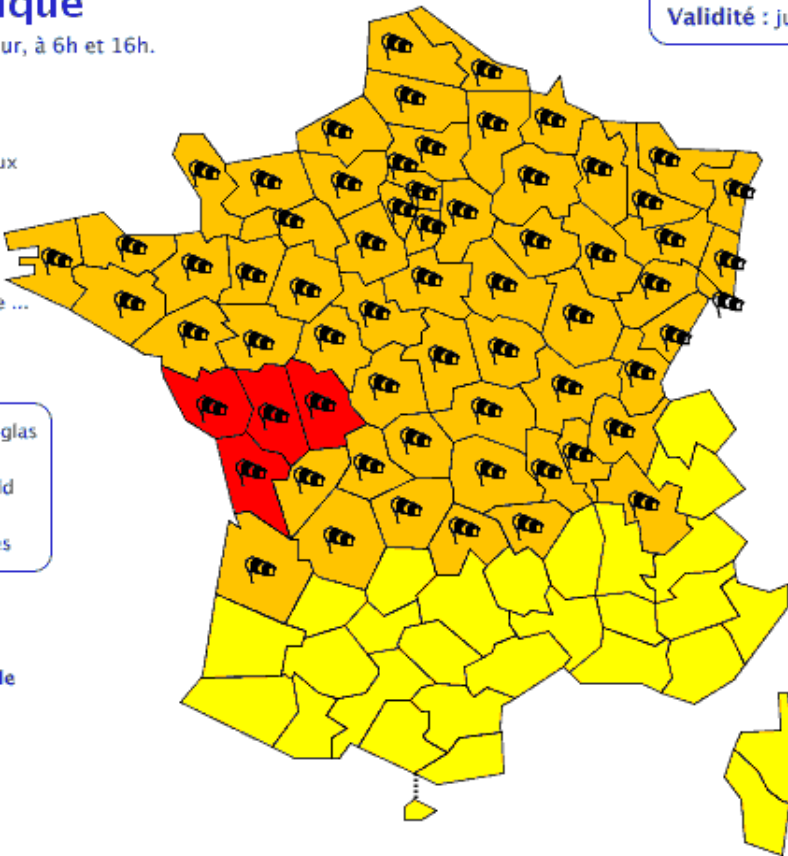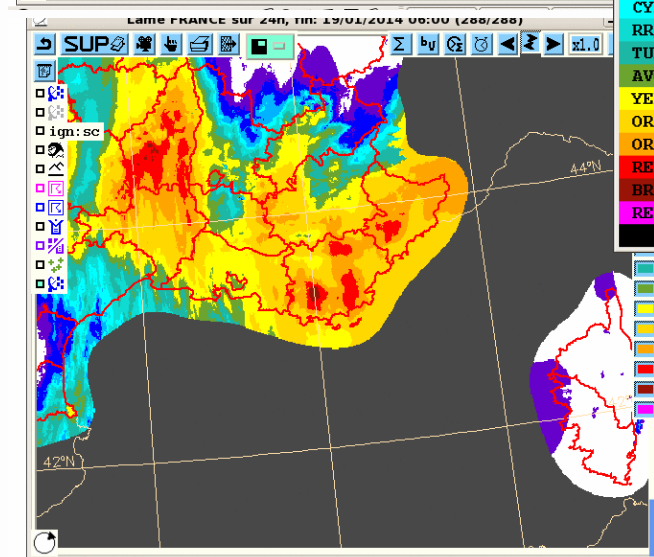

Gusts > 100 km/h
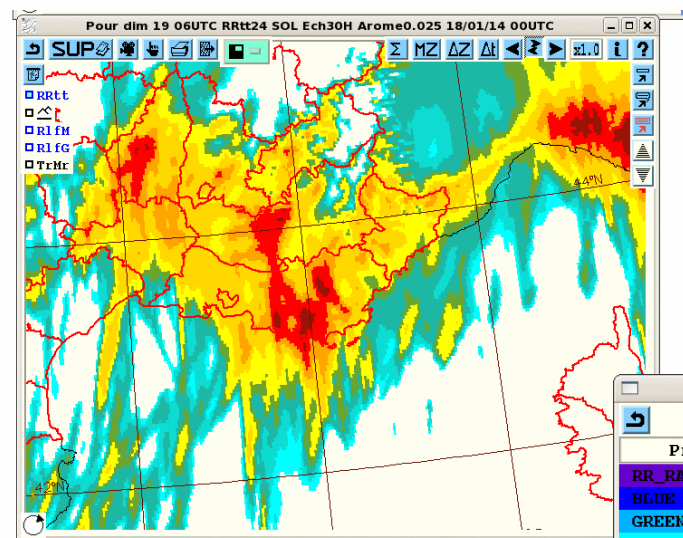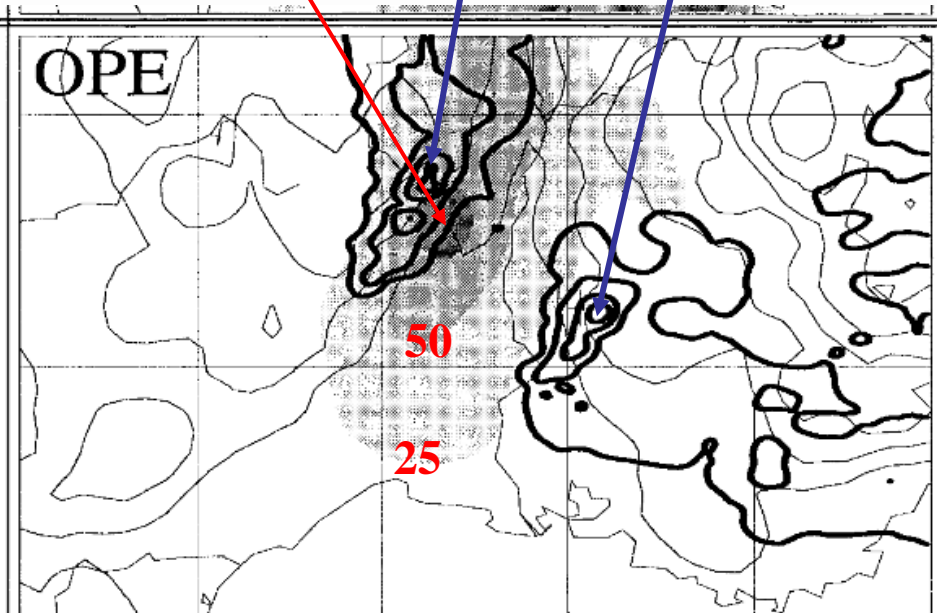
Then… and now.!

Vaison la Romaine : 22/09/1992
PERIDOT 35 km forecast

Var : 19/01/2014
AROME 2.5 km forecast

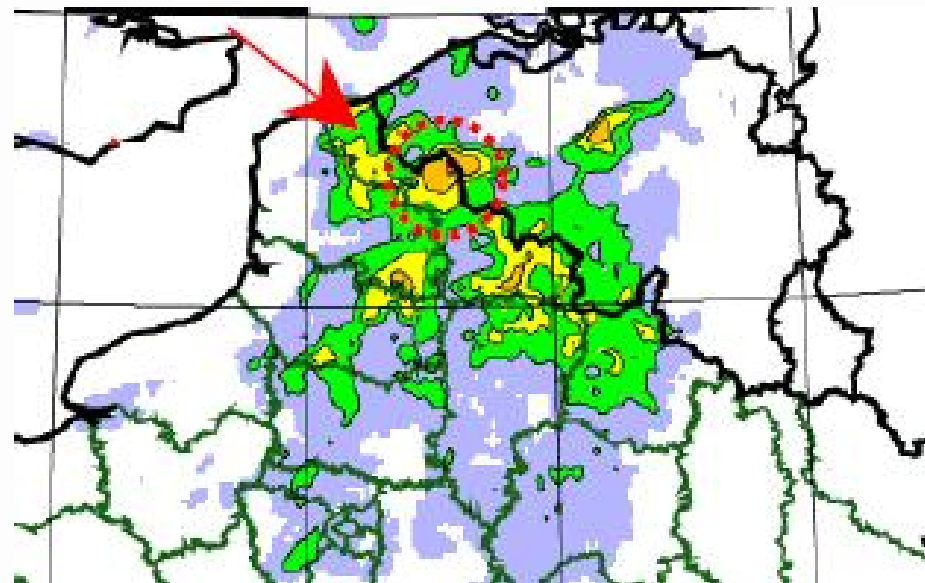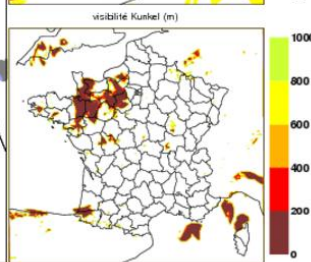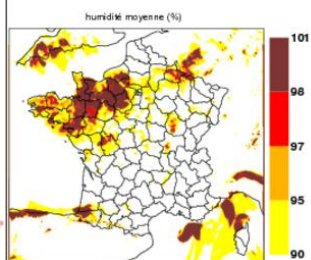**Observation 200 mm**

Observed amounts 300 mm in Vaison-la-Romaine
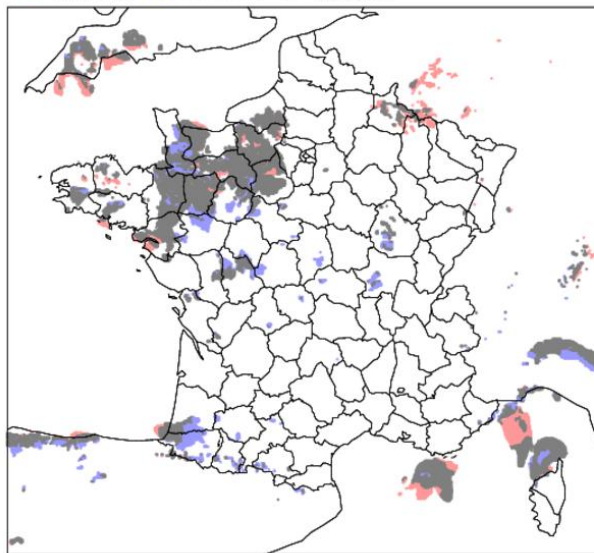
Maximum = 65 mm

NWP diagnostics for tornadoes

Tornade de Leers
(3/1/2014, vers 1500 UTC)
« Significant Tornado Parameter »
Arome réseau de 1200 UTC le 3, prévision pour 1400 UTC

diagnostic de brouillard AROME du 20140414 03UTC éch 04
pour le lundi 14 avril 2014 07UTC

Where are we going from there

- A new, more customer oriented organisation is being planned
- Ensembles at all scales (Arome, Arpege, ECMWF) should become the basis for our forecasts
  - Not only in « full probabilistic » display, but also for identifying the « most likely » and the « low probability, high impact alternatives »
- The role of the forecasters is likely to evolve from a « data producer » to become
  - A model expert monitoring the system in real time
  - An expert/advisor for the end-user helping him making the best use of the forecasts

METEO FRANCE
Toujours un temps d'avance