Overview of hazard monitoring and analysis in France

Department of International Affairs
Meteo-France

1st Technical Workshop on Standards for Hazard Monitoring, Databases, Metadata and analysis Techniques to Support Risk Assesment

10 to 14 June 2013

Speaker: Quoc-Phi DUONG

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Major hazards in France

- A major hazard can be of **natural** or **human** origin
- It is characterized by **infrequency** and **serious damage** (human, envirnomental, economic, cultural stakes)
- 8 natural major hazards and 4 technological major hazards identified in France:

Natural hazards	Technological hazards
Floods	Nuclear risk
Earthquakes	Industrial risk
Volcanic eruptions	Transportation of hazardous substances
Landslides	Dam failure
Avalanches	
Forest fires	
Cylones	
Storms	

- Classification of events through a damage scale:

Levels of seriousness of damage

Category		Human damage	Material damage
0	Incident	No injuries	Less than €0.3M
1	Accident	1 or more injured	Between €0.3 and €3M
2	Serious accident	1 to 9 deaths	Between €3 and €30M
3	Very serious accident	10 to 99 deaths	Between €30 and €300M
4	Disaster	100 to 999 deaths	Between €300 and €3,000M
5	Major disaster	1000 dead or more	€3,000M or more

Source : Special environmental inspection mission (mai 1999)

Plan of the presentation

- Overview of the French policy to reduce risks from disasters
- Approaches developed to monitor and analyze the following natural hazards:
  - Flooding
  - Coastal flooding
  - Avalanches
  - Forest fires
  - Meteorological hazards (including drought, heat waves and cold spells)
- Conclusion

The French Policy to reduce the risks from disasters

1.Knowledge of phenomena, hazards and risks

- Inventory of **historical events through databases**, **mapping of vulnerable areas**
- research to understand the phenomena and anticipate their behavior
- technical studies to improve nowcasting and short term forecasting

The French Policy to reduce the risks from disasters

1.Knowledge of phenomena, hazards and risks

2.Monitoring

- observation networks to detect and forecast hazards

- a population warning system to broadcast information efficiently

- The Vigilance map of Meteo France forecasts 6 meteorological hazards for the next 24 hours and also flooding and waves/coastal flooding in cooperation with other agencies

The French Policy to reduce the risks from disasters

1.Knowledge of phenomena, hazards and risks

2.Monitoring

3.Safety information and public education

- The citizen has the **right to be informed** of the major risks he is exposed to through various means:
  - documents identifying all major risks by town, their consequences on safety and persons and the existing safety measures (DDRM, DICRIM)
  - the Ministry of Sustainable Developpement website
  - Maps of areas prone to hazards widely available

- Inscription in secondary and high school programs

The French Policy to reduce the risks from disasters

1.Knowledge of phenomena, hazards and risks

2.Monitoring

3.Safety information and public education

4.Taking into account risks in spatial planning and city development

- Two goals:
  - avoiding an increase of challenges in areas at risk
  - reducing vulnerability in urban environment

- PPR (Plan for the Prevention of foreseeable hazards) and PLU (Local Development Framework) regulate spatial planning and city development.

The French Policy to reduce the risks from disasters

1.Knowledge of phenomena, hazards and risks

2.Monitoring

3.Safety information and public education

4.Taking into account risks in spatial planning and city development

5.Mitigation

- Reducing intensity of hazards or vulnerability of structures through training of stakeholders (architects, civil engineers, entrepeneurs,…)

The French Policy to reduce the risks from disasters

1. Knowledge of phenomena, hazards and risks
2. Monitoring
3. Safety information and public education
4. Taking into account risks in spatial planning and city development
5. Mitigation
6. Preparing for crisis

- Safety measures are established and executed in case of crisis, depending on the magnitude or the spatial extent of the hazard:
  - ORSEC: organisation of a Civil Defence Response on large areas
  - Local Disaster Plan: first response under the responsability of the mayor at town level

The French Policy to reduce the risks from disasters

1.Knowledge of phenomena, hazards and risks

2.Monitoring

3.Safety information and public education

4.Taking into account risks in spatial planning and city development

5.Mitigation

6.Preparing for crisis

7. Feedback

- Post disaster review on important events (for example, storm Xynthia 2010)

- Annual report on disasters edited by the Ministry of Sustainable Development

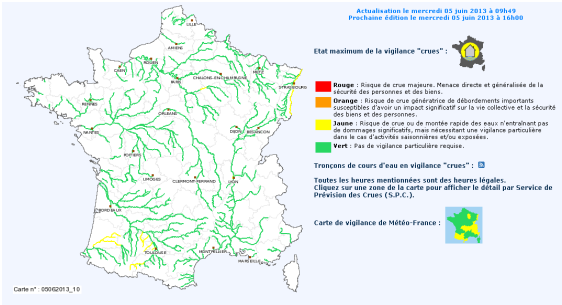
- CAT-NAT procedure:
  - special compensation procedure for natural disasters,
  - data on damage accessible through the French State reinsurance company (CCR)

Flooding Hazard

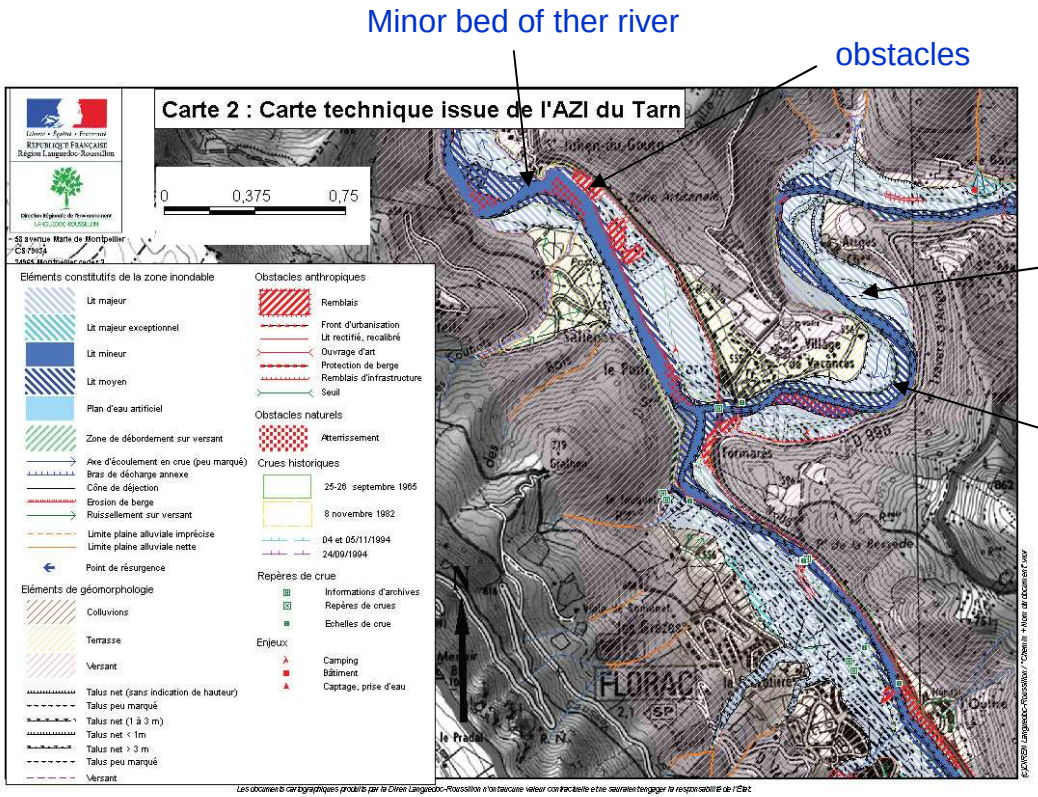
- Definitions:

Slow flooding	Flooding of plains	the river comes slowly out of its riverbed and floods the lowland for a relatively long period
	Flooding by rising natural water tables	On water-saturated land, water sometimes comes to the surface and causes a spontaneous flood
Fast flooding	The rapid formation of torrential flow	When heavy rainfall occur on a whole watershed, water quickly concentrates into the river, causing flash floods
	Stormwater runoff	Limited rainfall infiltration in urban areas increases runoff and may lead to important and rapid water flows in the streets.

- Hazard monitoring and data archival are operated by SCHAPI (Hydrometeorological Service and Support to Flood Forecasting)
- Warnings are disseminated through a Vigilance flood map of waterways



Hazard analysis: Atlas of floodplains (AZI)

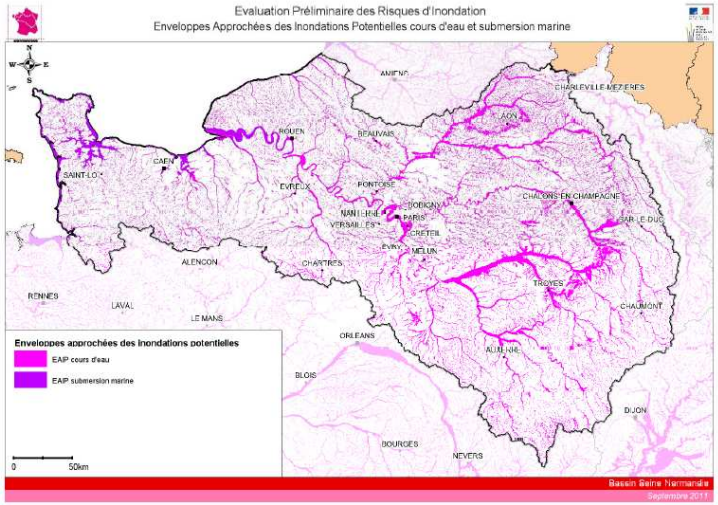


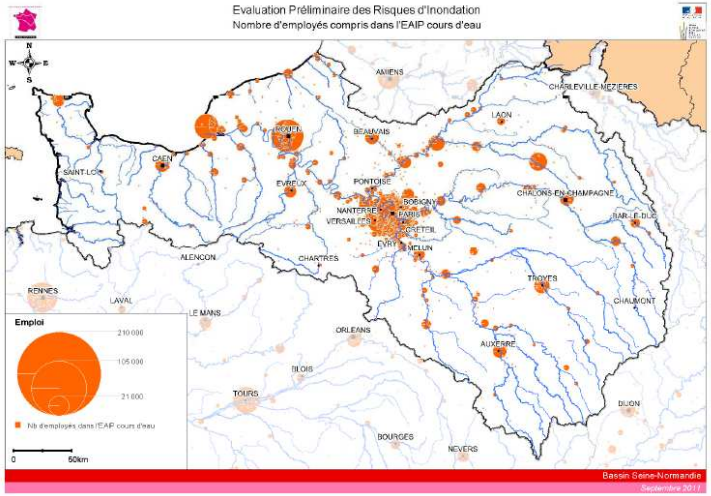
- **Informative** maps at 1: 25 000 from regional offices of the Ministry of Ecology
- Analysis by a hydrogeomorphological method:
  - Analysis of historical floods
  - photo-interpretation and field investigation
  - no mathematical model

Preliminary Flood Risk Assessment

1) Assessing the enveloppe of extreme events at 1:100 000 (from AZI but also other sources)

2) Quantifying the possible negative consequences of flooding to human health, environment, cultural heritage and economic activity **within** the enveloppe





- Takes into account river flooding and coastal flooding
- Climate change hypotheses:
  - No change for river regimes**,**
  - **+1 m** for sea level

- Six socio-economic indicators:
  - Population,
  - number of hospitals,
  - number of jobs,
  - area of single storey housing,
  - area of construction,
  - Area of notable built heritage exposed.

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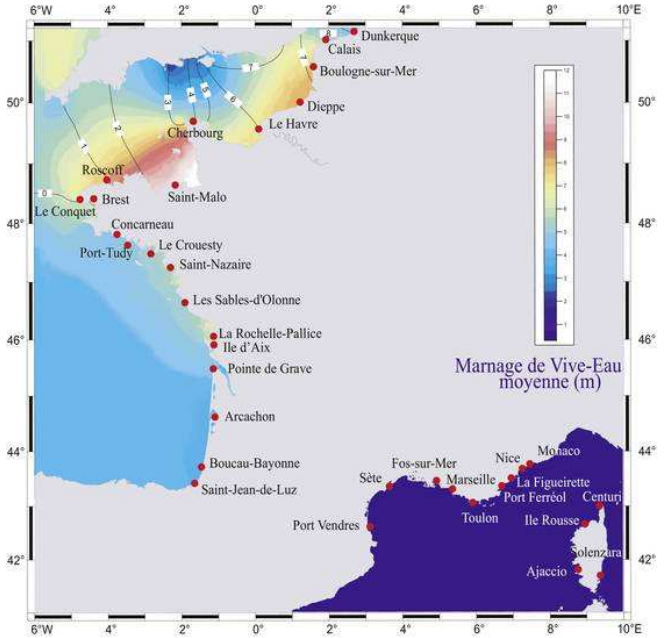
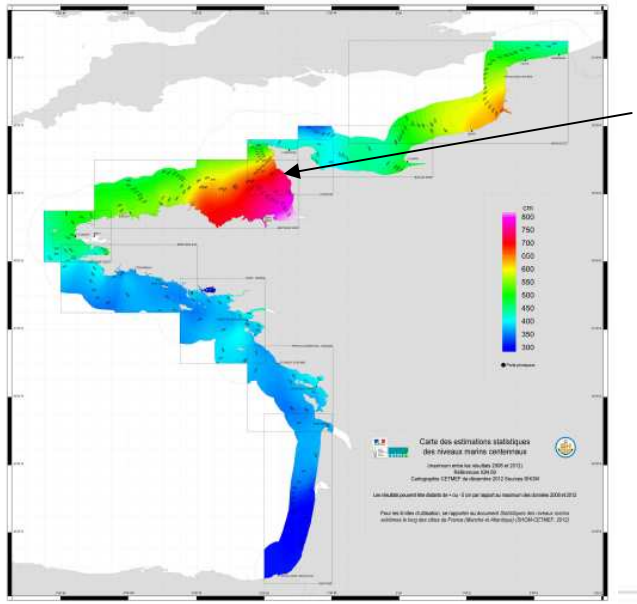
Coastal flooding

- Coastal flooding is due to the conjugated effects of high tide, storm surge, waves and wind
- Monitoring:
  - The tide gauge network is operated by the French Navy's Hydrographic and Oceanographic Department (SHOM)
  - Since 2011, warnings on waves/coastal floodings are issued by Météo-France through its Vigilance map
- Hazard analysis:
  - Statistics on centennial maximum sea levels were estimated by CETMEF (Centre for Marine and river technical studies)-SHOM





Bay of Mont Saint-Michel

Avalanches

- Warnings on risks of avalanche issued by Météo-France through its Vigilance map
- Observation and mapping of avalanche areas are under the responsability of other agencies

Commune : 65017 - ARAGNOUET
N° site : 003 Pour information, nom actuel du site CIMETIERE
Nombre total d'événements : 7

Historique :

Dates				Altitudes				Dépôt			Caractéristiques					
date 1	date 2	heure	tranche horaire	altitude départ	altitude arrivée	versant opposé	zone plane	longueur (m)	largeur (m)	hauteur (m)	A	B	C	D	E	F
22/02/11 13:00	23/02/11 09:00			2000	1200			30	6	2.0	4	4	9	2	2	2
12/02/09 00:00	16/02/09 00:00			2200	1500			60	8	1.0	8	3	2	5	2	2
01/11/08 00:00	02/11/08 00:00			2000	1350			5	3	1.5	4	4	2	2	2	2
04/02/84 00:00	04/02/84 00:00	00:00	Jour	2450	1320						2	5	2	5	2	2
15/01/81 00:00	15/01/81 00:00		Soir	1700	1400						2	5	2	5	2	5
Remarques: L'avalanche s'arrête au-dessus de la RN 129.																
19/12/80 00:00	19/12/80 00:00		Soir	1650	1260						9	9	5	9	9	9
Remarques: L'avalanche s'est arrêtée à la Neste d'Aragnouet.																
01/02/78 00:00	01/02/78 00:00	00:00	Jour	1500	1300			10	4	3.0	2	4	2	2	2	2
Remarques: Route obstruée sur 10 m de longueur; 3-4 m de largeur; 3 m de haut.																

	Météo 3 jours précédents					Météo 4h précédentes						Causes			
date 1	hauteur de neige	vent fort	direction vent	redoux	pluie	neige	pluie	vent fort	ciel clair	nuages	brouillard	naturelle	involontaire	artificielle	inconnue
22/02/11 13:00	51-100	?		X	X	X	X	?	?	?	?	X			
12/02/09 00:00	?	?		?	?	?	?	?	?	?	?	X			
01/11/08 00:00	21-50			X	X	X						X			
04/02/84 00:00	21-50			X	X				X			X			
15/01/81 00:00	21-50				X		X					X			
19/12/80 00:00	51-100				X		X					X			
01/02/78 00:00	>100	X	err				X	X		X		X			

	Victimes			Dégâts ou lieux atteints						Constat			
date 1	néant	blessés	morts	néant	construction	poteaux	forêt	routes	cours d'eau	visibilité	alerte bd évènt	date	Observation
22/02/11 13:00	X							X		B	O	24/02/11	Non diffusable
12/02/09 00:00	X			X						B	N	16/02/09	Non diffusable
01/11/08 00:00	X			X						B	N	04/11/08	Non diffusable
04/02/84 00:00	X			X									
15/01/81 00:00	X			X									
19/12/80 00:00	X			X									Non diffusable
01/02/78 00:00	X			X									Non diffusable

Monitoring of 5000 couloirs: archival of the characteristics of the events: date, snow cover, altitudes of departure and arrival, type of avalanche, description of the deposit, …

Mapping of the maximum enveloppe of past avalanches
(at 1: 25 000)

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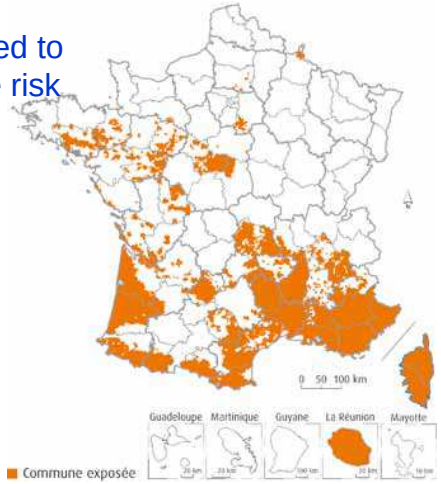
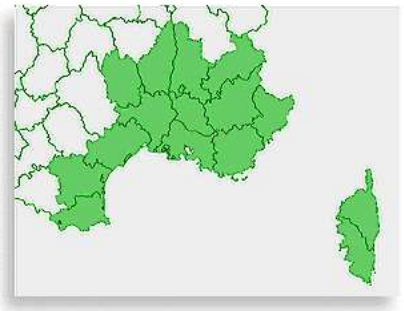
Forest fires

- **Definition:** fire affecting a forest area greater than 1 hectare
- **Monitoring:**
  - Météo France network + 300 dedicated automatic weather stations in the South
  - Météo-France provides forecasts of forest fire risk based on the Weather Fire Index (automatic index derived from forecasts of meteorological conditions and soil water content) but **also** the experience of the forecaster !
- **Hazard analysis:**
  - a database (Prométhée) on historical forest fires in the South (15 *départements*) exists since 1973
  - Comprehensive statistics on forest fire are accessible through Promethée

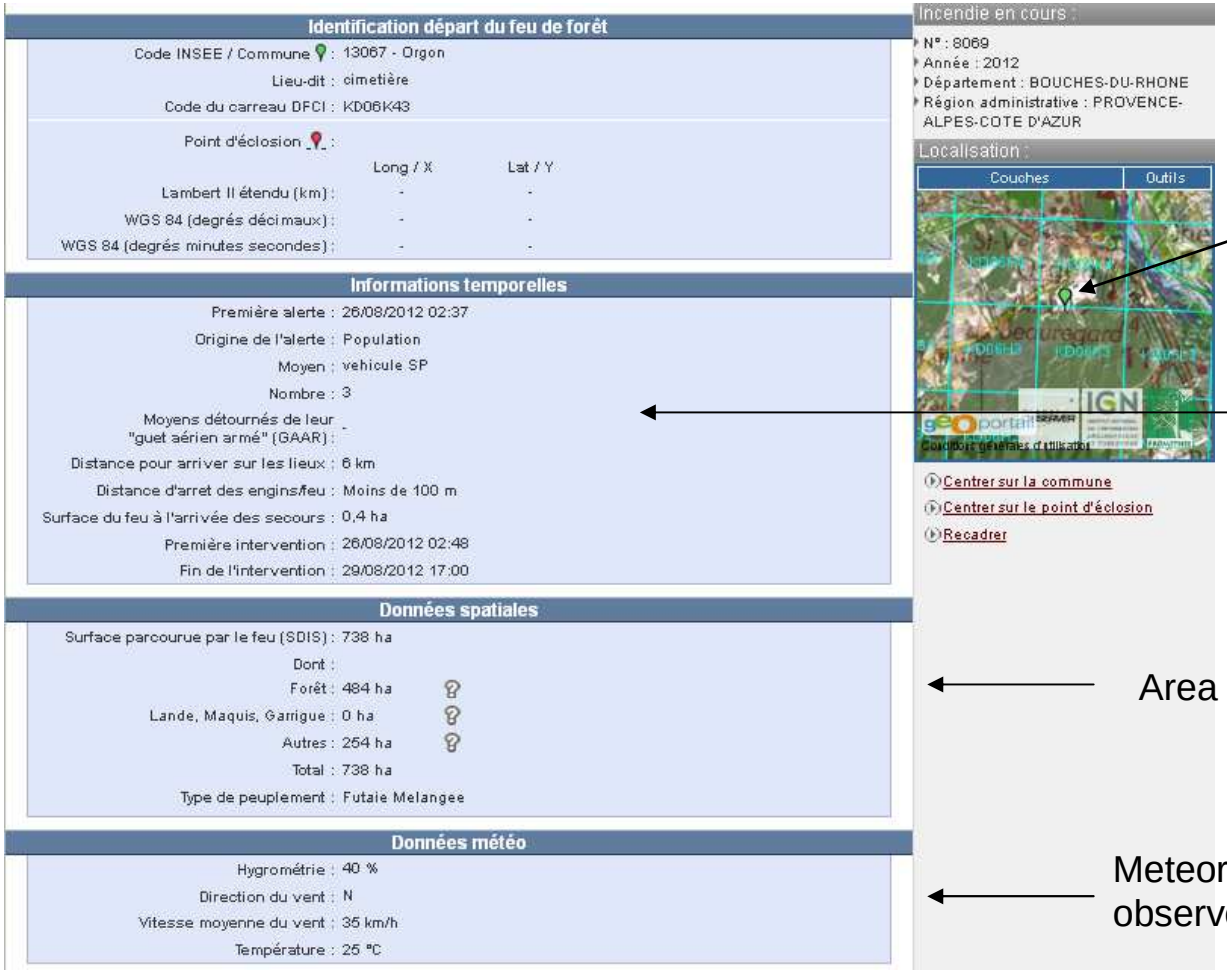
Areas exposed to the forest fire risk





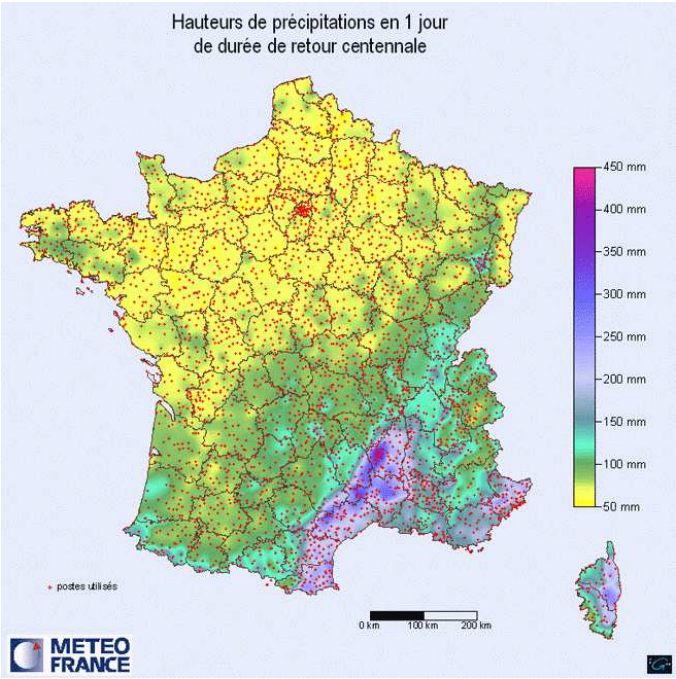
The 15 *départements* in the South where WFI is used

Example of data on a forest fire



The climatological database of Météo-France

- The climatological database archives:
  - Observation data from the meteorological network
  - Model reanalyses
  - Meta data for stations
- Extreme values for wind, rainfall and snow are estimated for return periods from 2 to 100 years

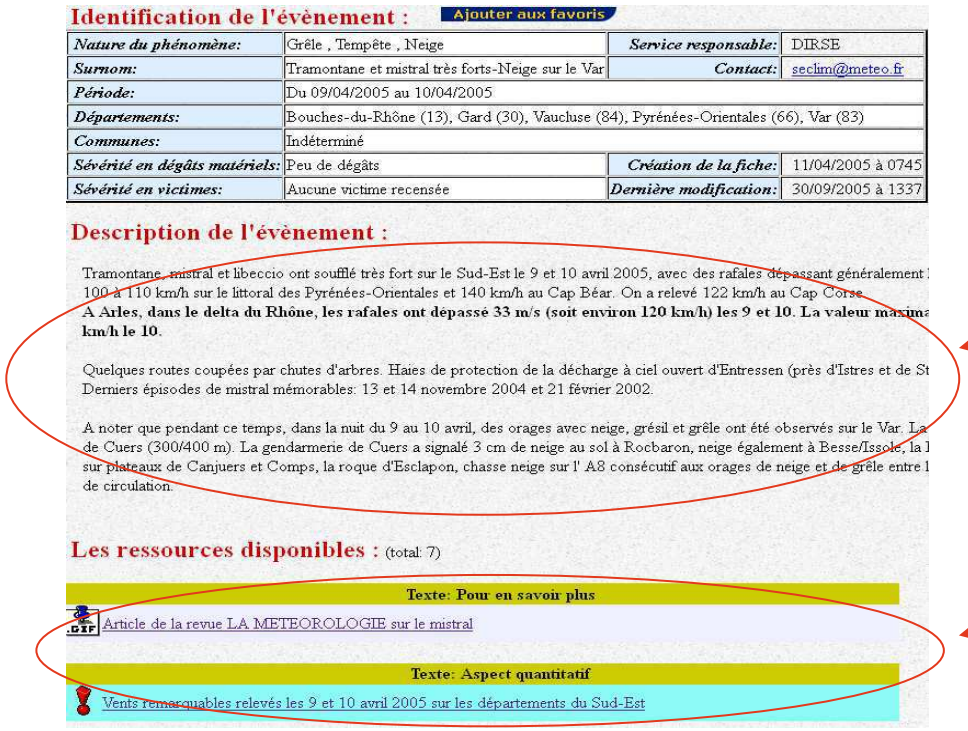


Centennial 1-day rainfall map

The data base of remarkable events

- Internal data base maintained by Météo-France
- Selection of events is based on subjective criteria, so the data base is **not** comprehensive
- It includes non only meteorological events but also other natural events

Example of an event:



Identification de l'évènement : Ajouter aux favoris

Nature du phénomène:	Grêle , Tempête , Neige	*Service responsable:*	DIRSE
Surnom:	Tramontane et mistral très forts-Neige sur le Var	*Contact:*	seclim@meteo.fr
Période:	Du 09/04/2005 au 10/04/2005		
Départements:	Bouches-du-Rhône (13), Gard (30), Vaucluse (84), Pyrénées-Orientales (66), Var (83)		
Communes:	Indéterminé		
Sévérité en dégâts matériels:	Peu de dégâts	*Création de la fiche:*	11/04/2005 à 0745
Sévérité en victimes:	Aucune victime recensée	*Dernière modification:*	30/09/2005 à 1337

Description de l'évènement :

Tramontane, mistral et libeccio ont soufflé très fort sur le Sud-Est le 9 et 10 avril 2005, avec des rafales dépassant généralement 100 à 110 km/h sur le littoral des Pyrénées-Orientales et 140 km/h au Cap Béar. On a relevé 122 km/h au Cap Corse.
A Arles, dans le delta du Rhône, les rafales ont dépassé 33 m/s (soit environ 120 km/h) les 9 et 10. La valeur maxima km/h le 10.

Quelques routes coupées par chutes d'arbres. Haies de protection de la décharge à ciel ouvert d'Entressen (près d'Istres et de St
Derniers épisodes de mistral mémorables: 13 et 14 novembre 2004 et 21 février 2002.

A noter que pendant ce temps, dans la nuit du 9 au 10 avril, des orages avec neige, grésil et grêle ont été observés sur le Var. La de Cuers (300/400 m). La gendarmerie de Cuers a signalé 3 cm de neige au sol à Rocbaron, neige également à Besse/Issole, la l sur plateaux de Canjuers et Comps, la roque d'Esclapon, chasse neige sur l' A8 consécutif aux orages de neige et de grêle entre l de circulation.

Les ressources disponibles : (total: 7)

Texte: Pour en savoir plus

Article de la revue LA METEOROLOGIE sur le mistral

Texte: Aspect quantitatif

Vents remarquables relevés les 9 et 10 avril 2005 sur les départements du Sud-Est

Description of the event :
- meteorological context
- non meteorological context
- consequences

Additional ressources:
- data tables
- satellite or radar images
- newspapers articles
- etc…

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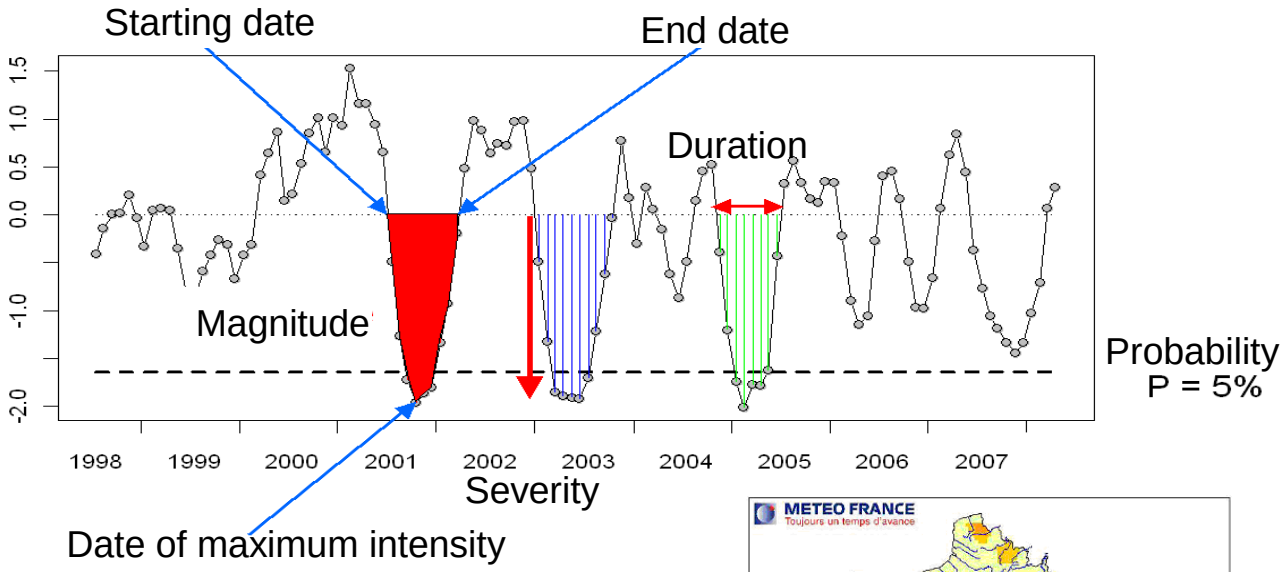
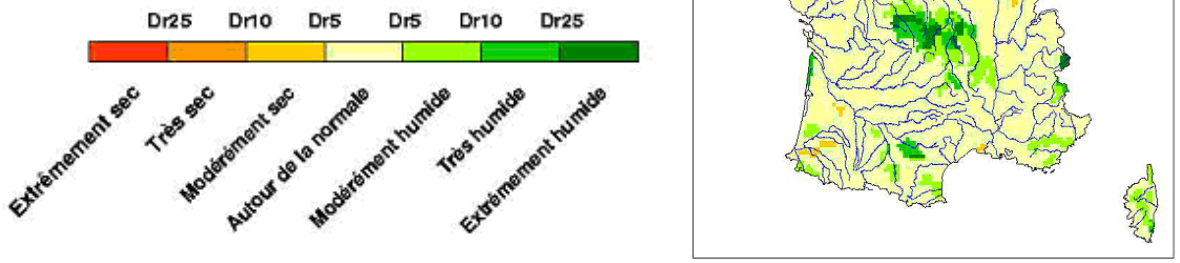
Drought

- **Définition:** a water deficit of (at least) one component of the hydrological cycle (rainfall, soil water content, river flow)
- **Climatological data** from Safran-Isba-Modcou (SIM) reanalyses (8kmx8km grid, starting from 1958)
- Three indicators derived from SIM reanalyses to monitor **three types of drought**: meteorological, agricultural and hydrological.
- Example: the Standardized Precipitation Index (SPI) (recommended by WMO since 2009):
  - Principle: for a given month, the cumulative rainfall is compared to the normalized rainfall distribution for the same calendar month (reference period: 1971-2000)
  - SPI value is directly linked to the return period of the event

Characteristics of a drought event





Map of drought situation for November 1959 to January 1959 characterized with SPI3months. The colors refer to the return period of the drought.

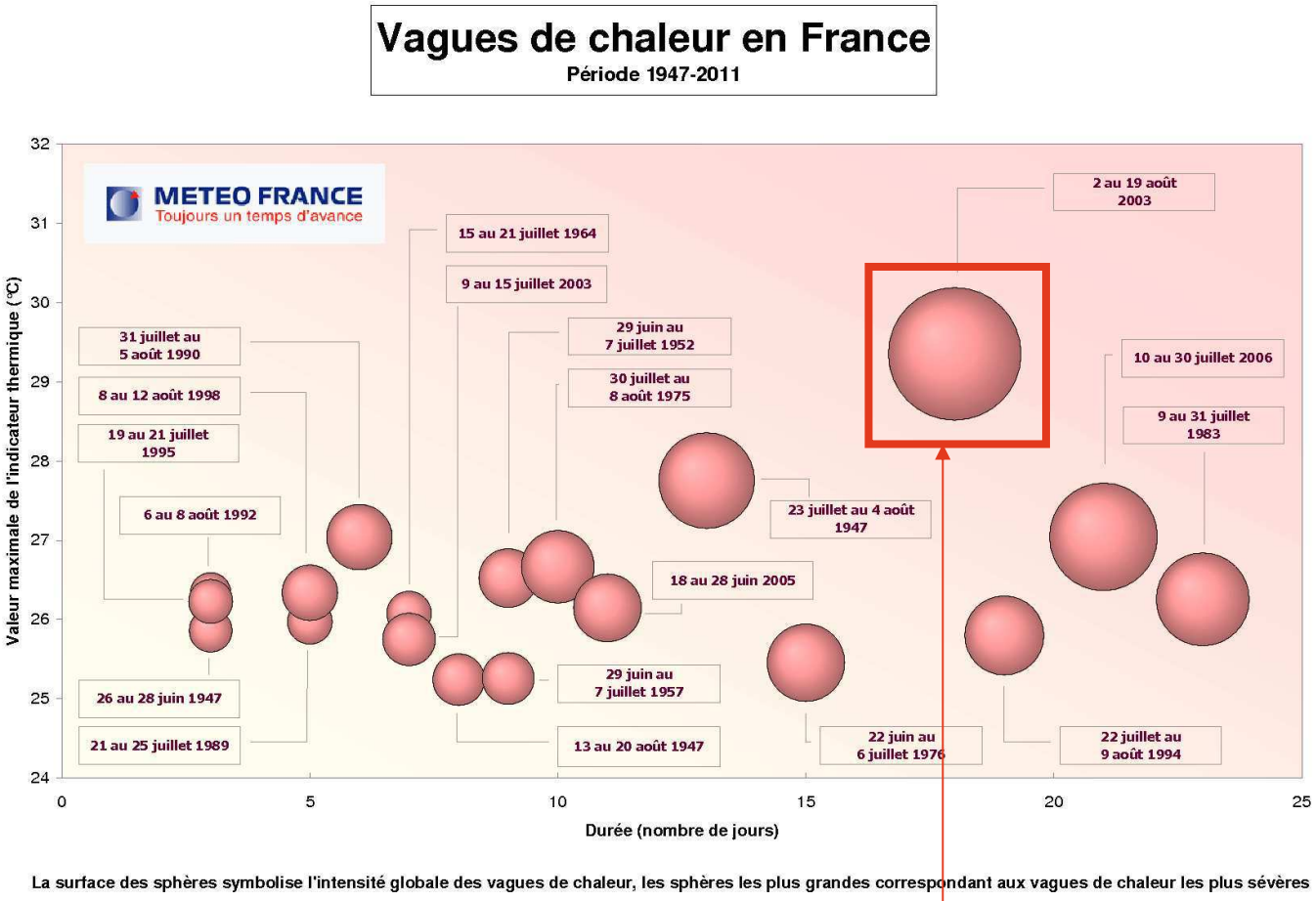
Heat waves

- No official definition

- For sanitary purposes, the biometeorological indicators (IBMx, IBMn) are monitored during the season since 2004:
  - IBMx : moving average of TX over 3 days
  - IBMn: moving average of TN over 3 days
- Warnings are issued when (IBMx, IBMn) exceed thresholds
- Thresholds defined to detect a heat wave vary locally
- Thresholds may evolve with population adaptation

- Météo-France uses a index : (TX+TN)/2 averaged on 30 metropolitan stations to identify heatwaves on a **national** scale
- A heat wave is identified when index is above 26℃
- Similarly, in winter a cold spell is identified when index is below -3℃

Heatwaves since 1947



Summer 2003 heat wave was exceptional

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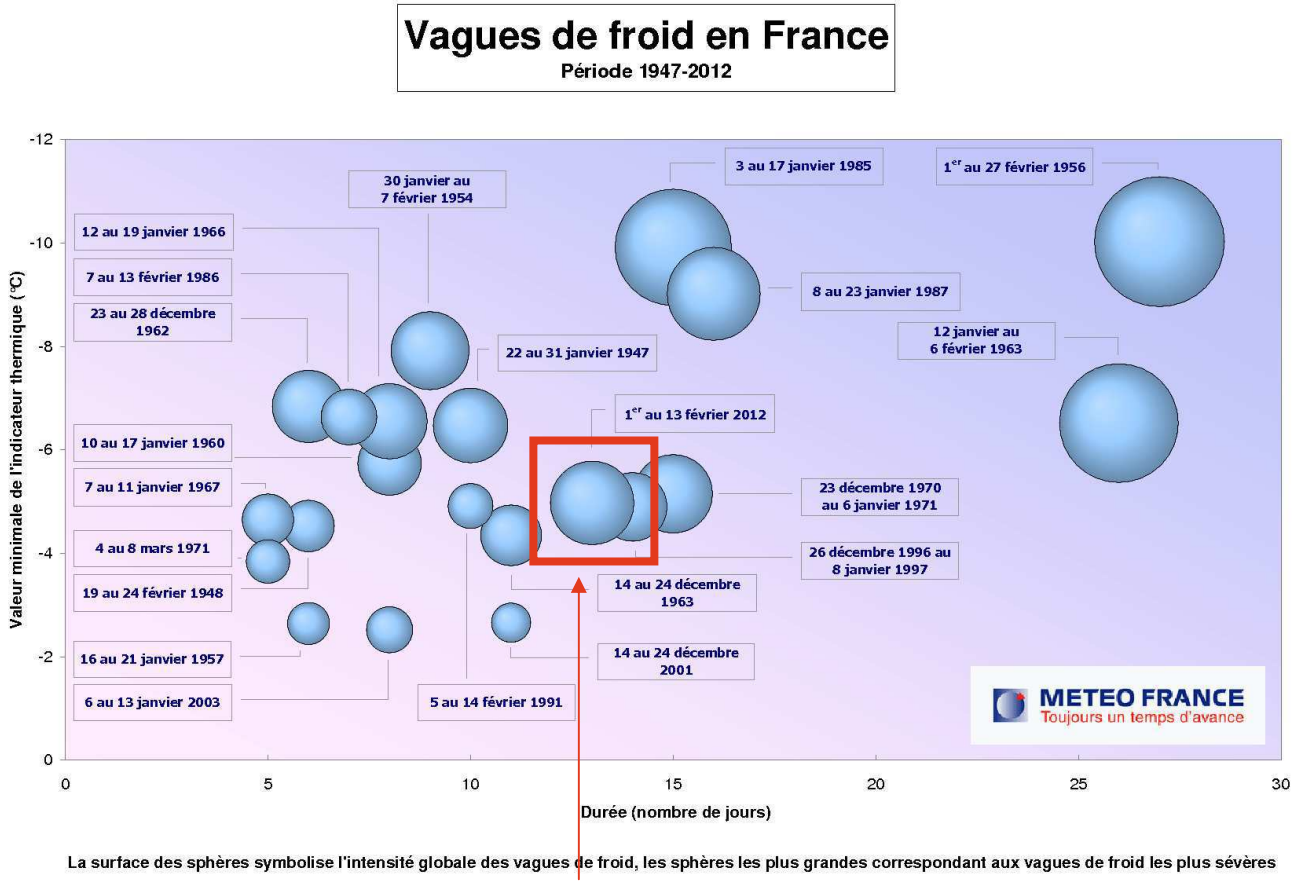
Cold waves since 1947



2012 cold spell was not so exceptionnal

Conclusions and perspectives

- Monitoring networks for different hazards are operated by various agencies
- Hazard analyses often involve the cooperation of different agencies
- Analysis and mapping are based on return period calculations but **also** on inventories of historical events:
  - Data series sometimes too short for an accurate assessment of rare (i.e. centennial or more) events
  - Existence of unstandardized but useful data on ancient events
- Interactive maps on hazards are available to the public

- Maps on vulnerability are being developped
- Different projects are being implemented to assess the effects of climate change on hazards

Thanks for your attention

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