



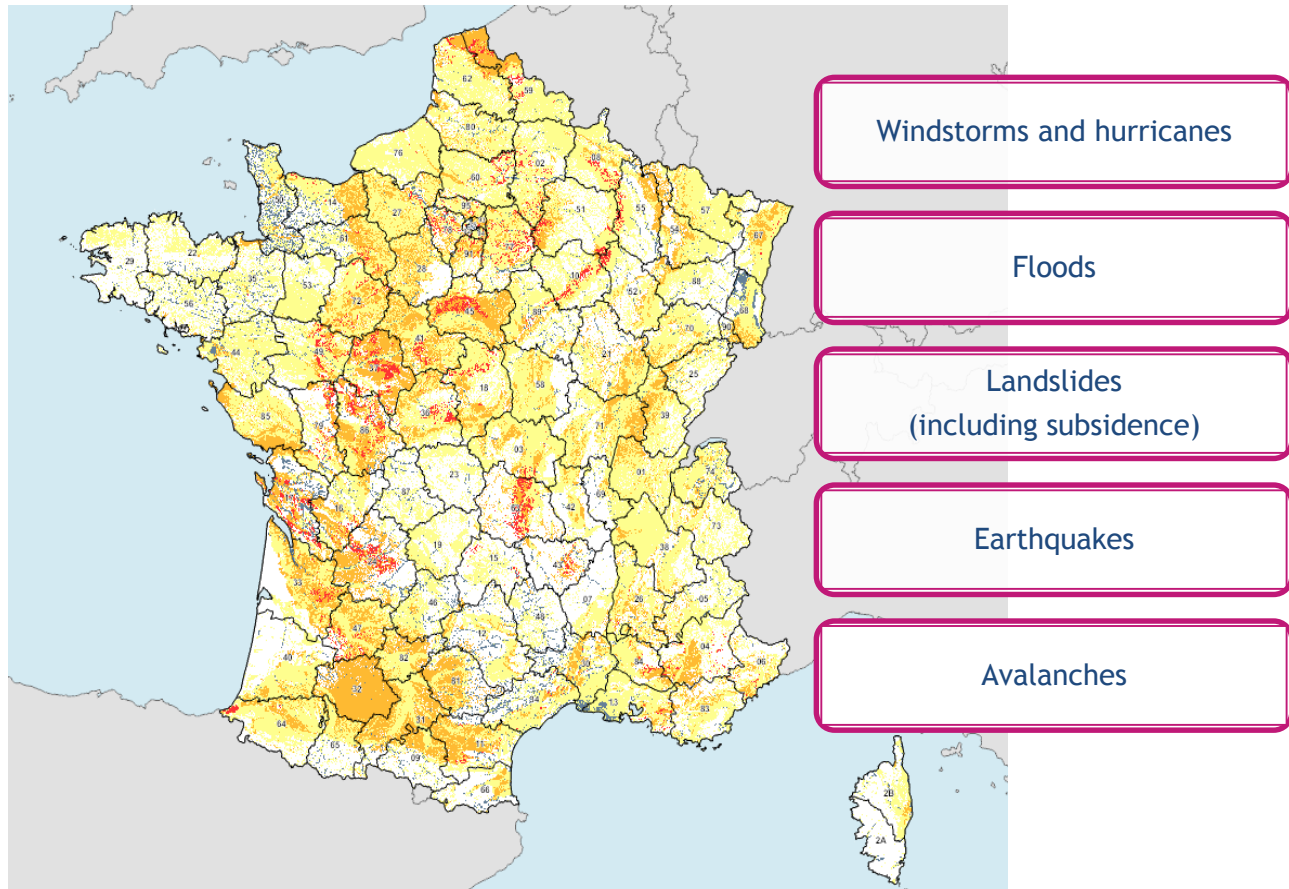
www.ccr.fr

Investigating the Impacts of Climate Change on Flood Risk

Flood Risk & Insurance
London, 9 November 2016

D. Moncoulon
Head of modelling team

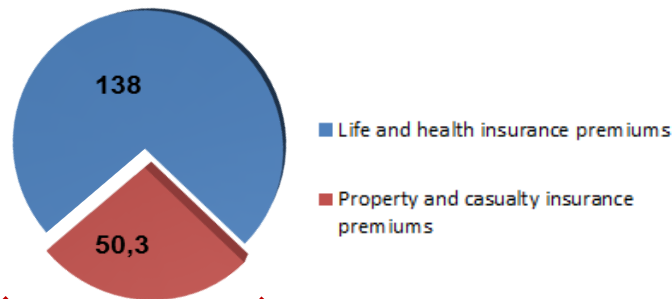
What perils impact France?



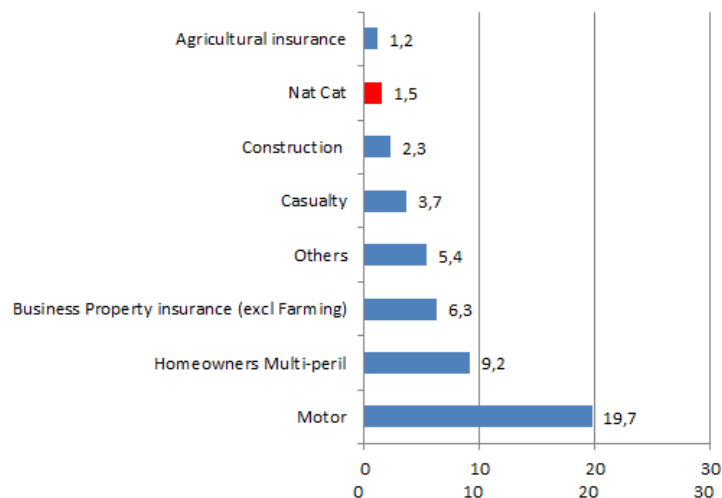
Insurance Market in France

Key Figures

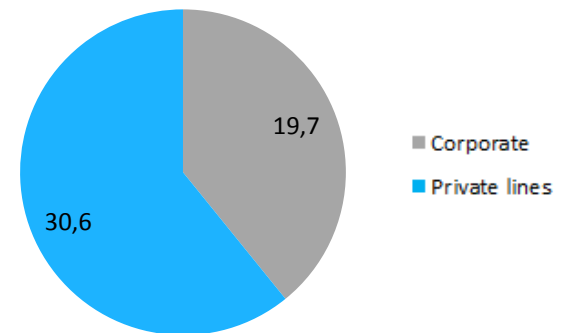
Combined premiums 188,3 billion EUR in 2014



Property and casualty insurance premiums in billion EUR



Property and casualty insurance premiums in billion EUR

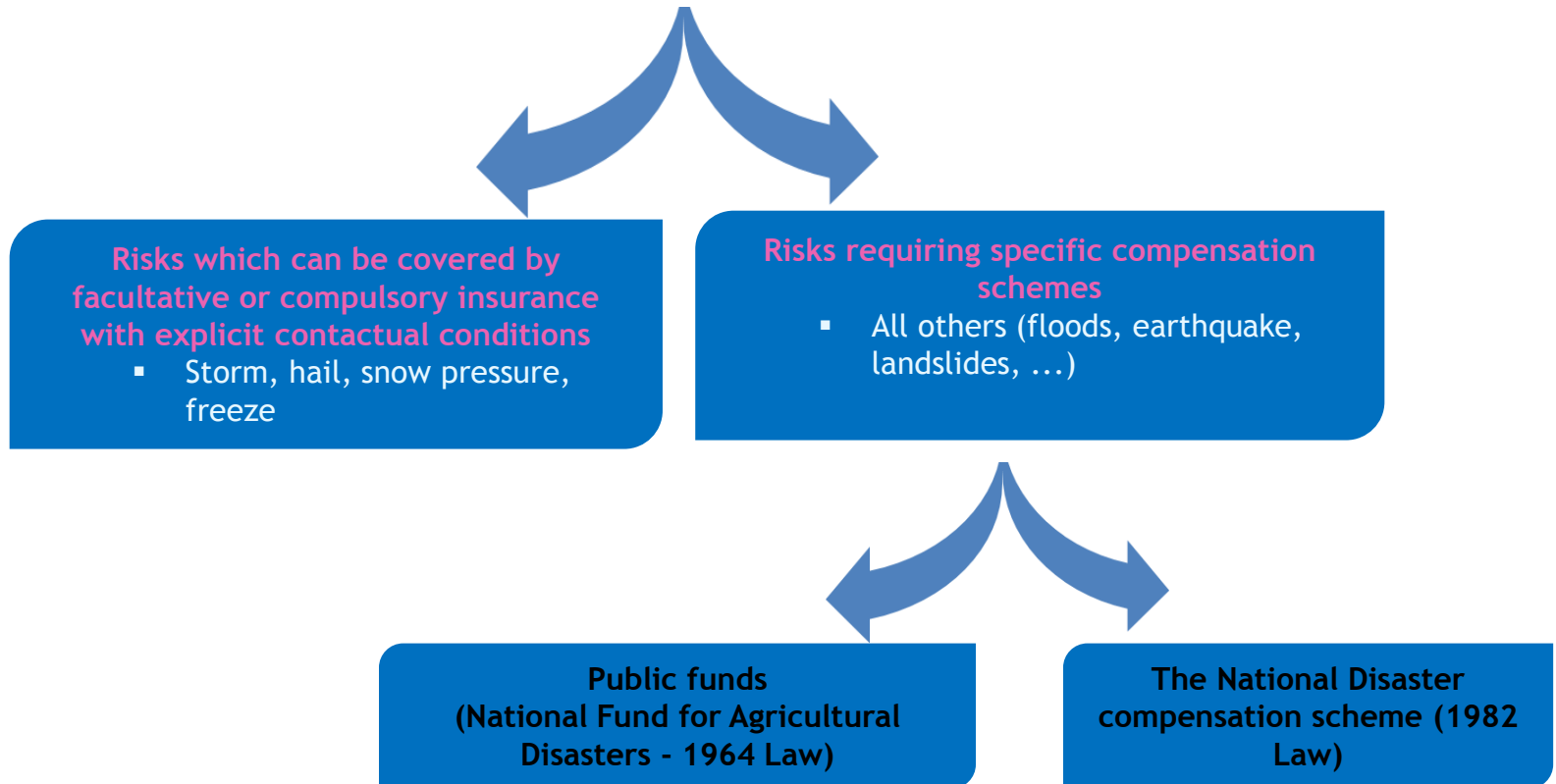


Source : French Federation of Insurance Companies (FFSA)



Natural perils-what kind of cover?

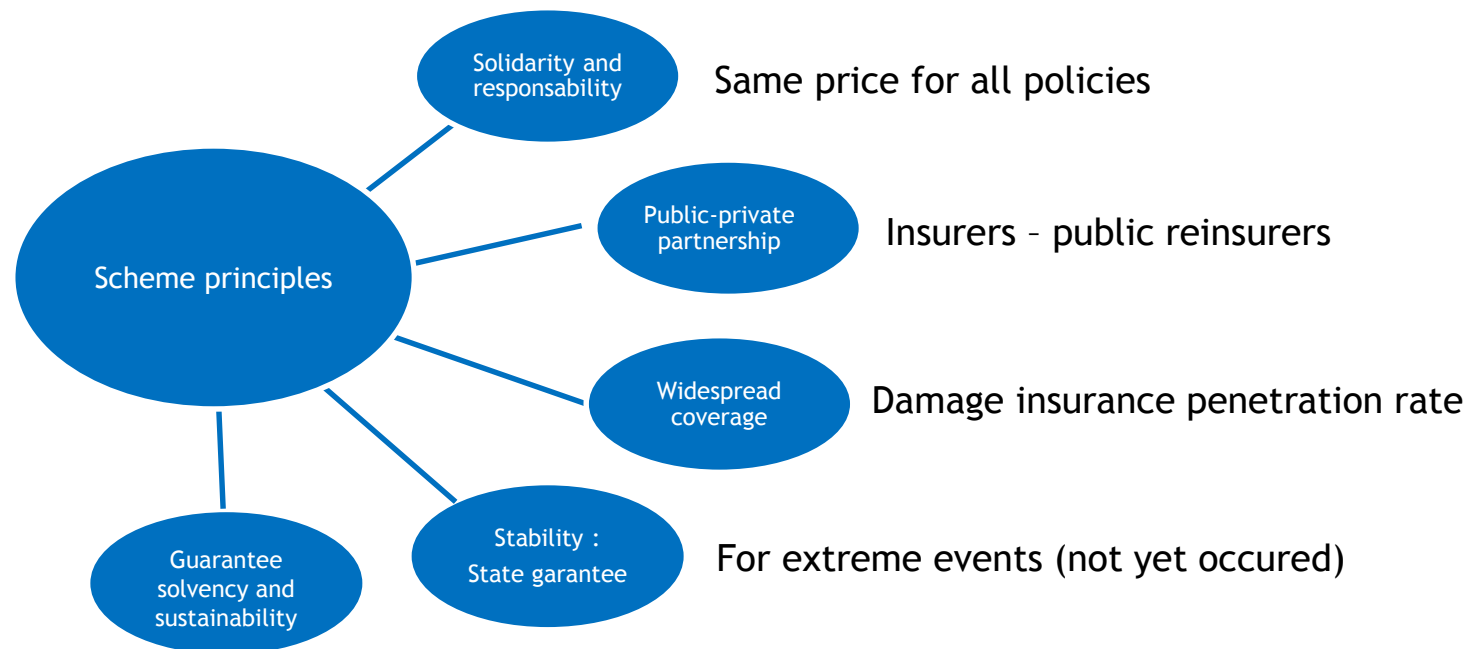
France has split natural hazards in two types



Why perils are covered under specific compensation schemes:
Lack of statistics and large mutualisation, risk of accumulation and anti-selection

French Natural Disaster Compensation program

- Created in 1982 as a public - private partnership
- Insured - insurers - public reinsurance - unlimited state guarantee
- Covers traditionally non-insurable perils: lack of knowledge, potential huge impacts



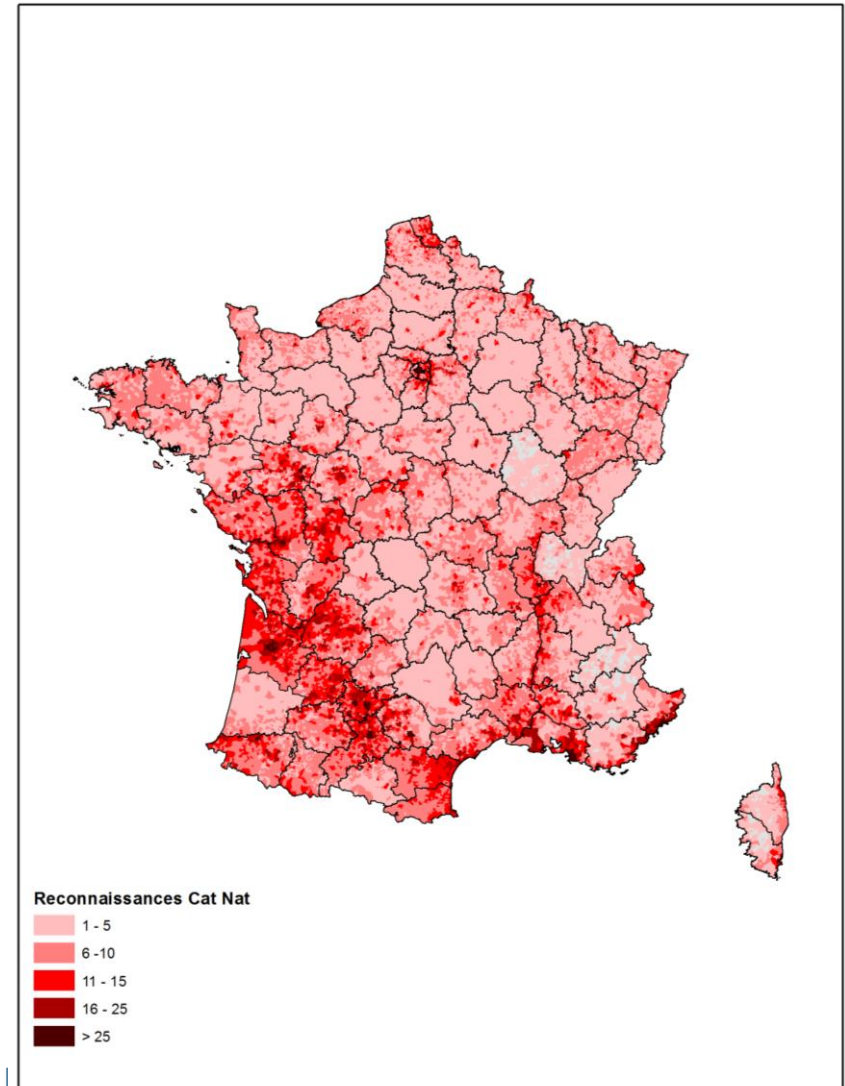


What is CCR?

- Caisse Centrale de Réassurance (CCR), a public reinsurer
 - Natural Disaster compensation scheme
 - Impact models for flood, drought, storm surge
- In France, the Nat Cat scheme covers the insured losses:
 - Following a municipal-level recognition
 - For direct damages and business interruption on property
- Main losses are due to floods, droughts, storm surges and cyclonic winds

Flood in France

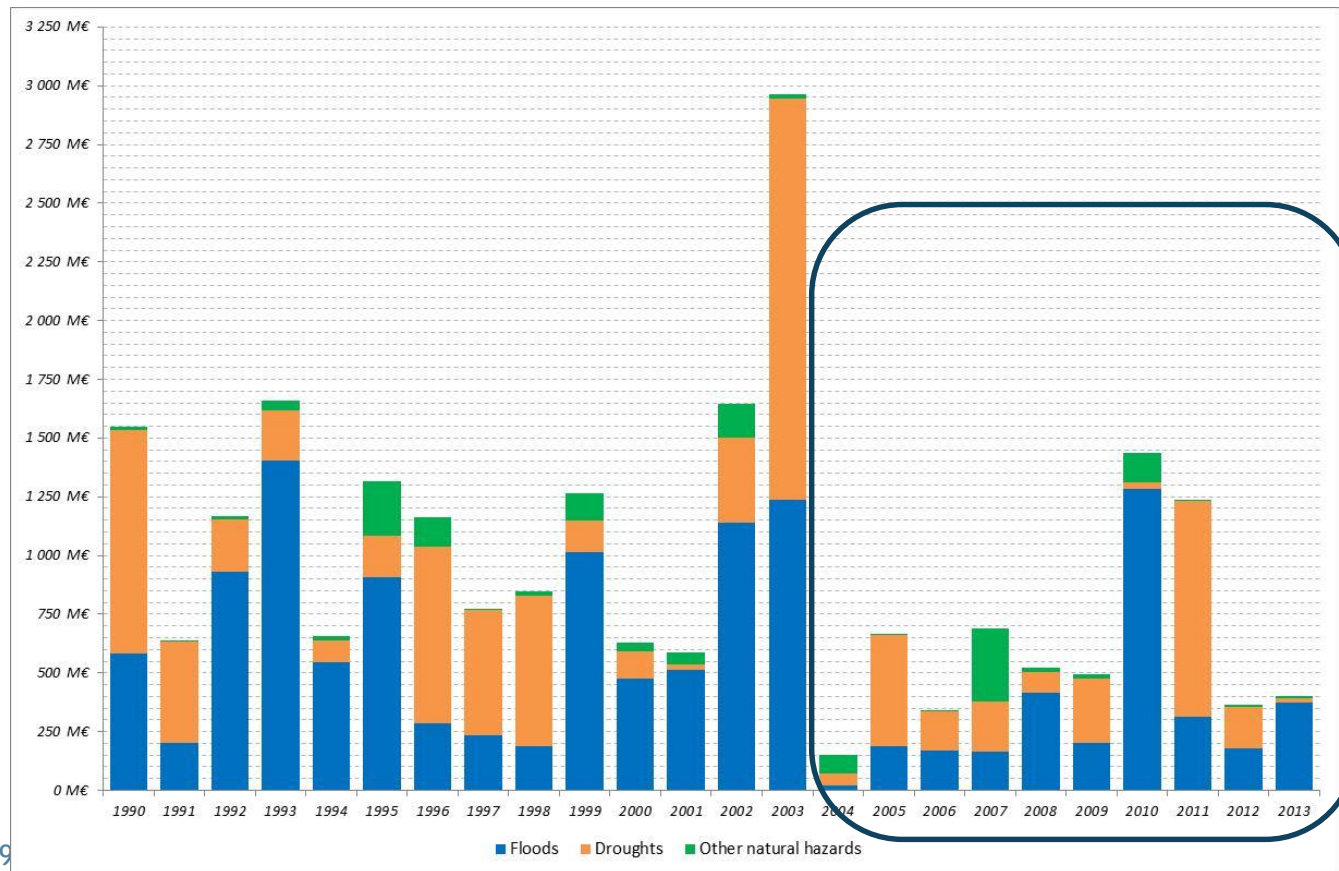
- Nat Cat in France covers events with a >10 years return period
- Nat Cat premium : 1,4 b€ - insured values : 15 900 b€
- >95% of French communes were concerned by at least one official recognition for natural disasters



Insured losses in France

○ Decreasing trend for insured losses in France

- Highest losses (2003) is due to combined flood and drought
- Seine floods in may 2016 represent the most expensive flood event





Objectives of this study

- What are the mid-term trends ?
- Is it possible to quantify the respective impact of hazard and vulnerability on the evolution of losses ?
- Is there any correlation between climatic catastrophes ? (we will focus on flood and drought)
- So far:
 - Modelers provide independent models for different perils
 - Models are calibrated on the basis of the recent past

Modelling in CCR

Hydrological
Model

*Flood
Storm surge*

Weather
Model

*Cyclones
Agro
Storms*

Geological
Model

*Subsidence
Earthquake*

Anthropological
Model

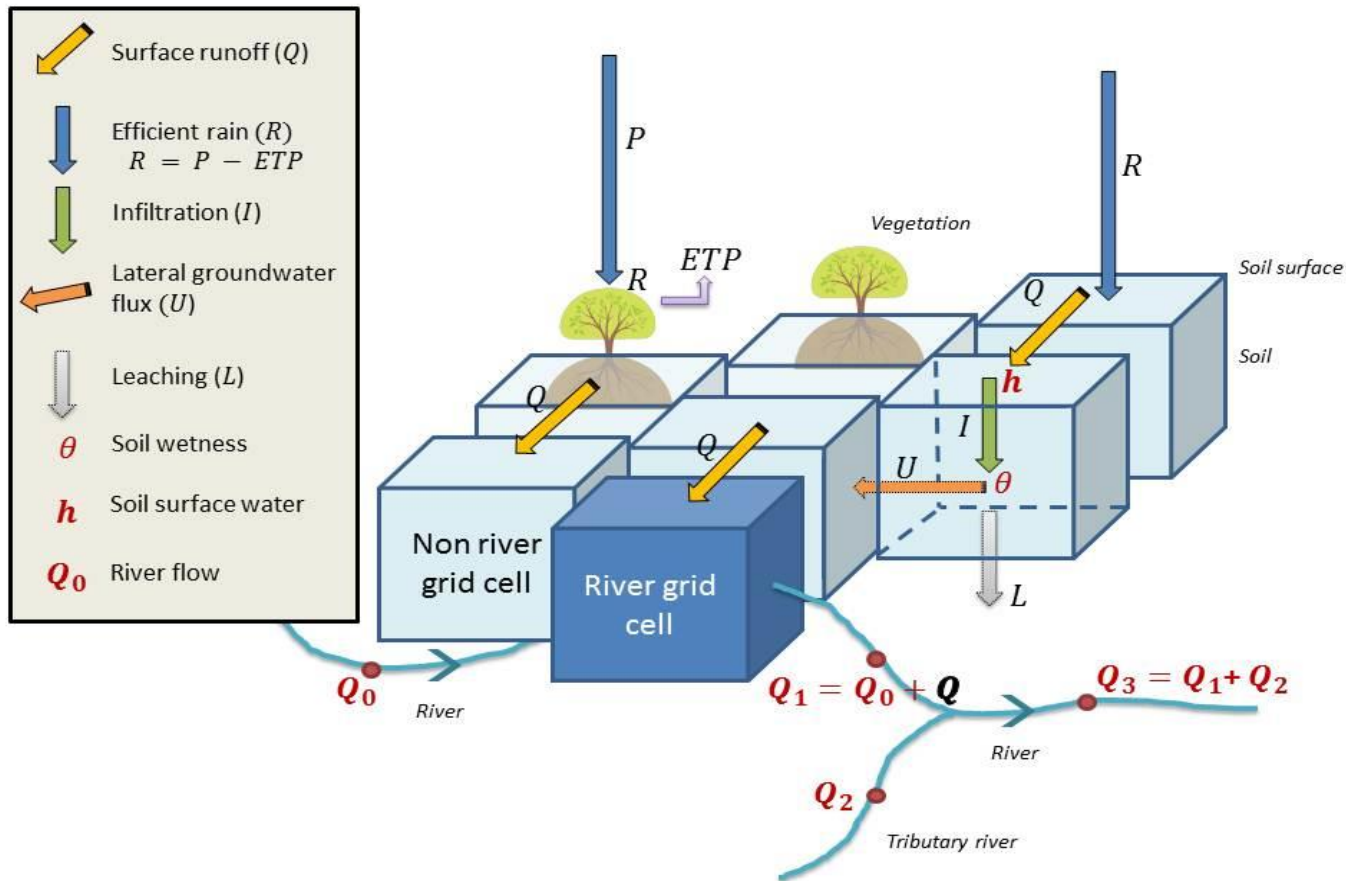
*Terrorism
Nuclear Liability*

Remote sensing - Historical research- Climate change

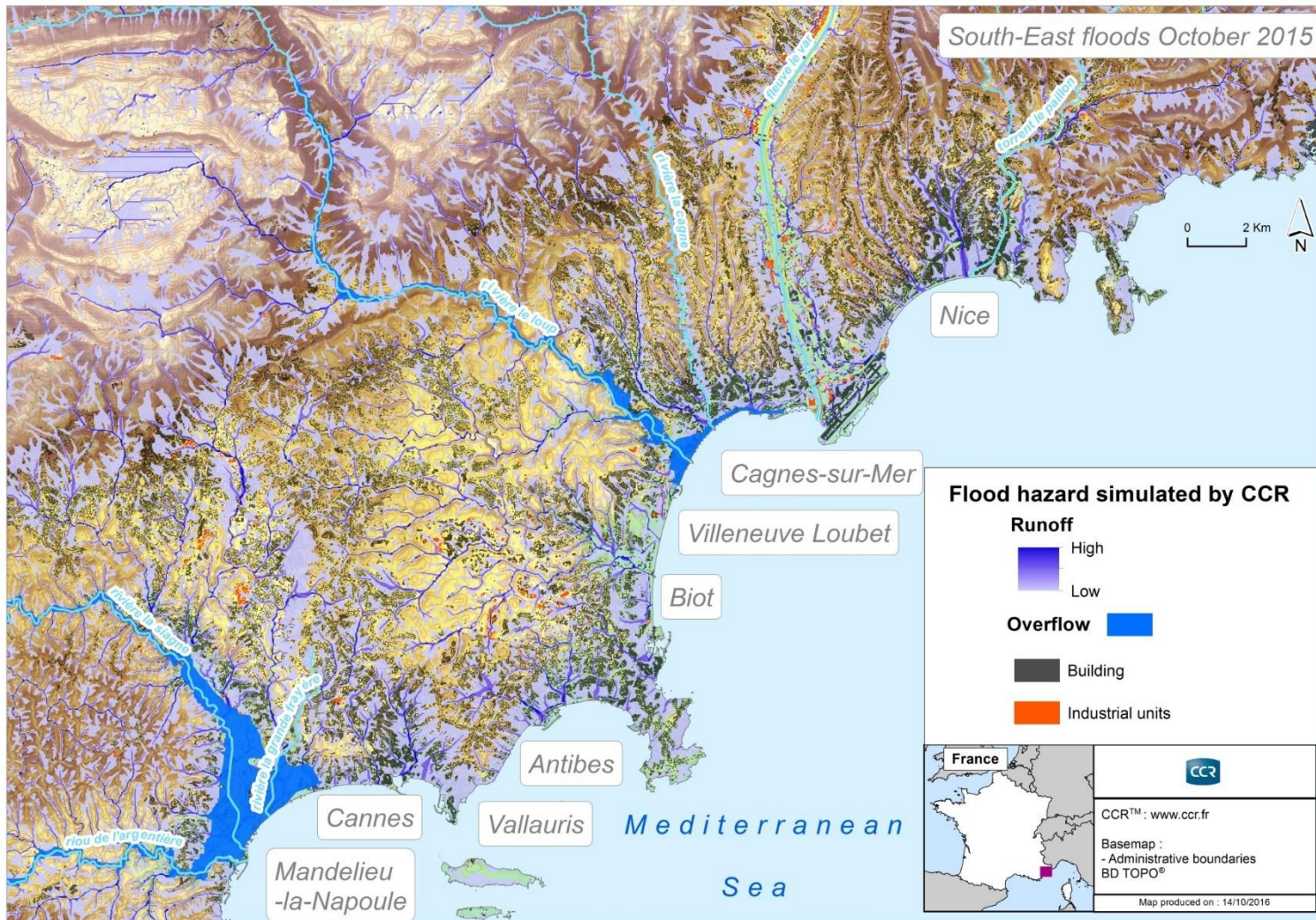
Partnerships



The flood hazard model



The flood hazard model

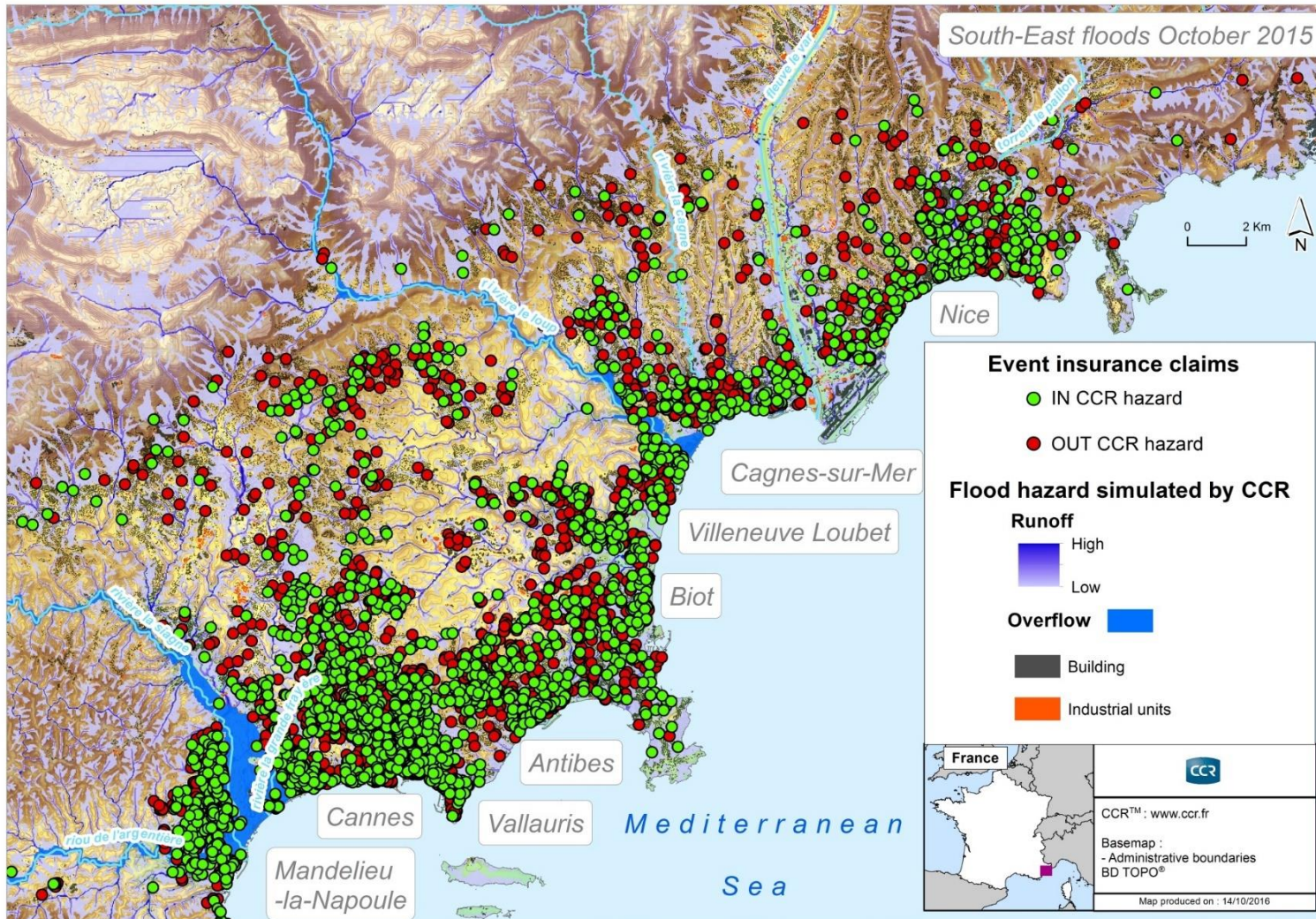


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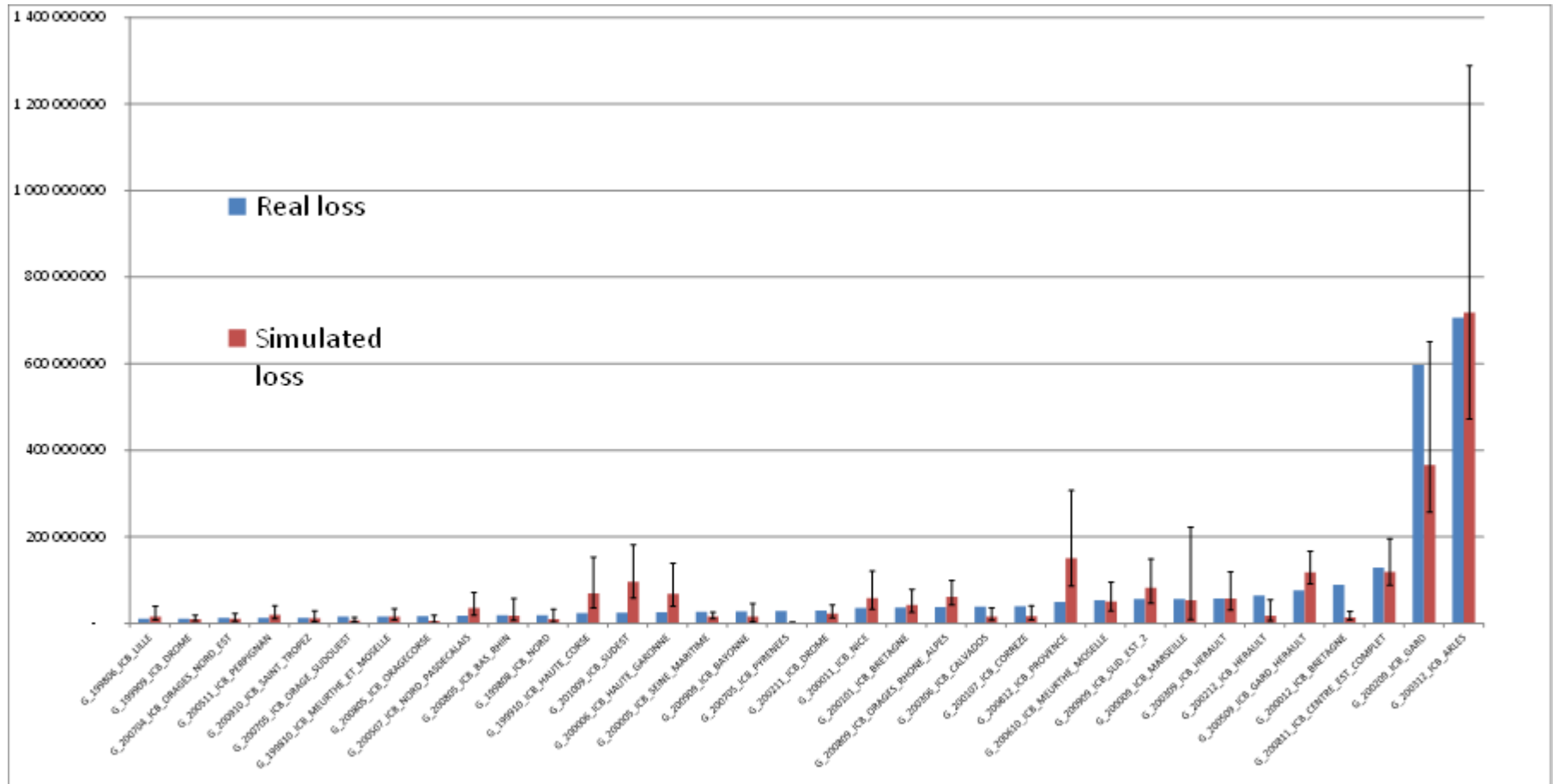
Floor risk & Insurance, London



The vulnerability model

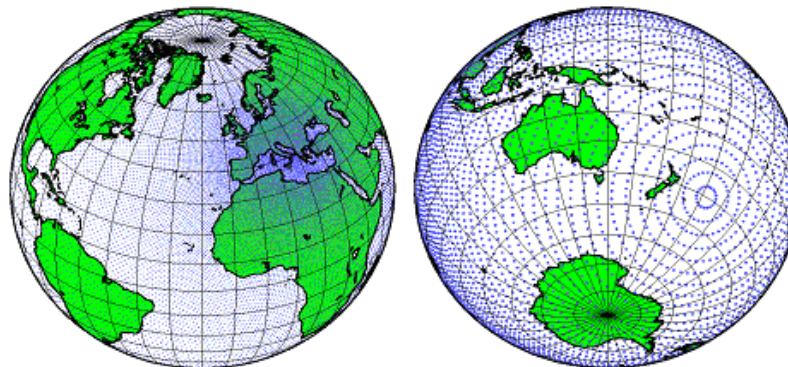


The damage model



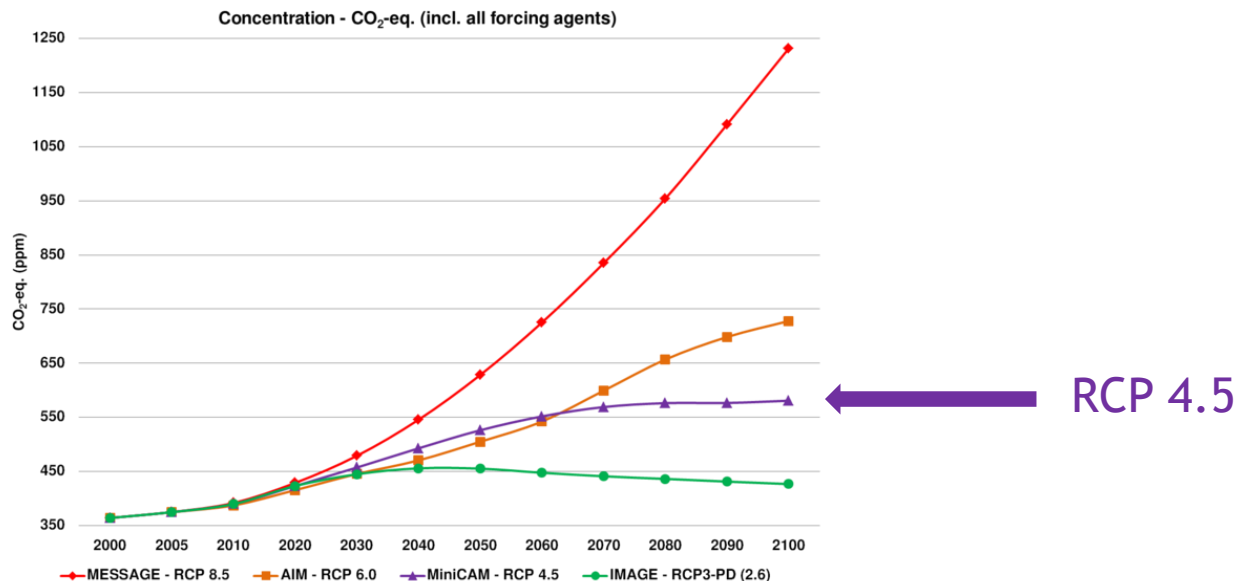
The ARPEGE-Climat model

- Used by Météo-France to perform the Coupled Model Intercomparison Project
 - An atmospheric global model for the entire Earth system
 - Associated with an oceanic model
- Resolution of 20km over Europe and 250km on the opposite
- Includes the soil-vegetation-atmosphere SURFEX (Le Moigne et al., 2012)



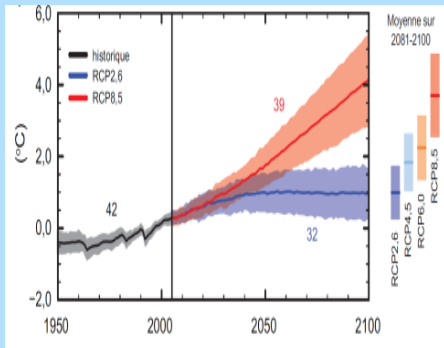
The ARPEGE-Climat model

- The ARPEGE-Climat model simulates 200 year of hourly rainfall, wind speed, atmospheric pressure and soil wetness index
- According to different initial conditions :
 - Constant : year 2000 conditions
 - Future : year 2050 conditions according to the RCP 4.5



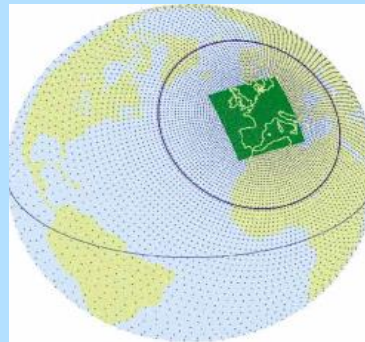
Coupling both models

Météo France



Initial conditions
[2000 or 2050]

« ARPEGE-Climate »



200 x 1 single year
[2000 or 2050]

CCR

Rainfall



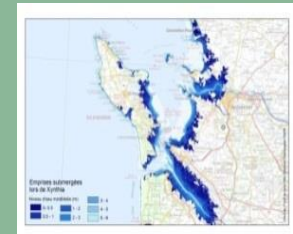
Flood model



Soil
water content

Drought model

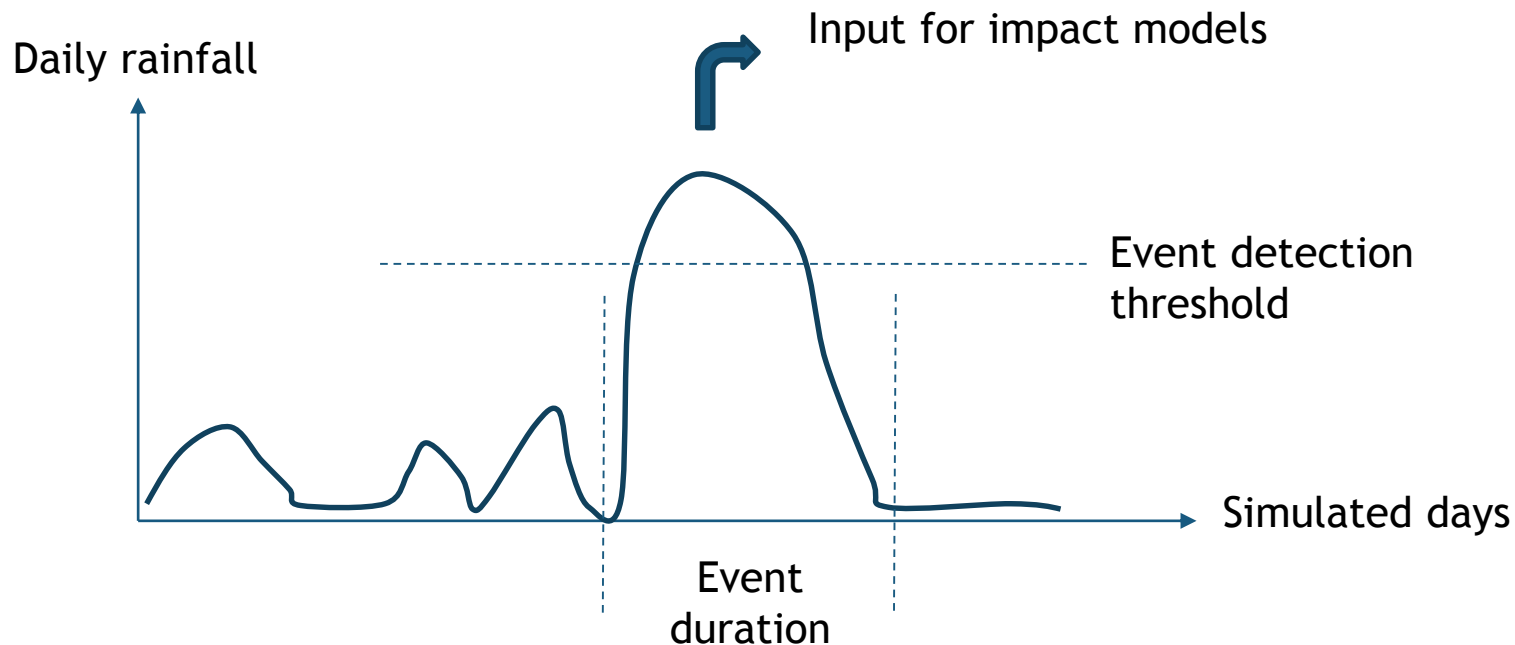
Wind
Atm. pressure



Storm surge model

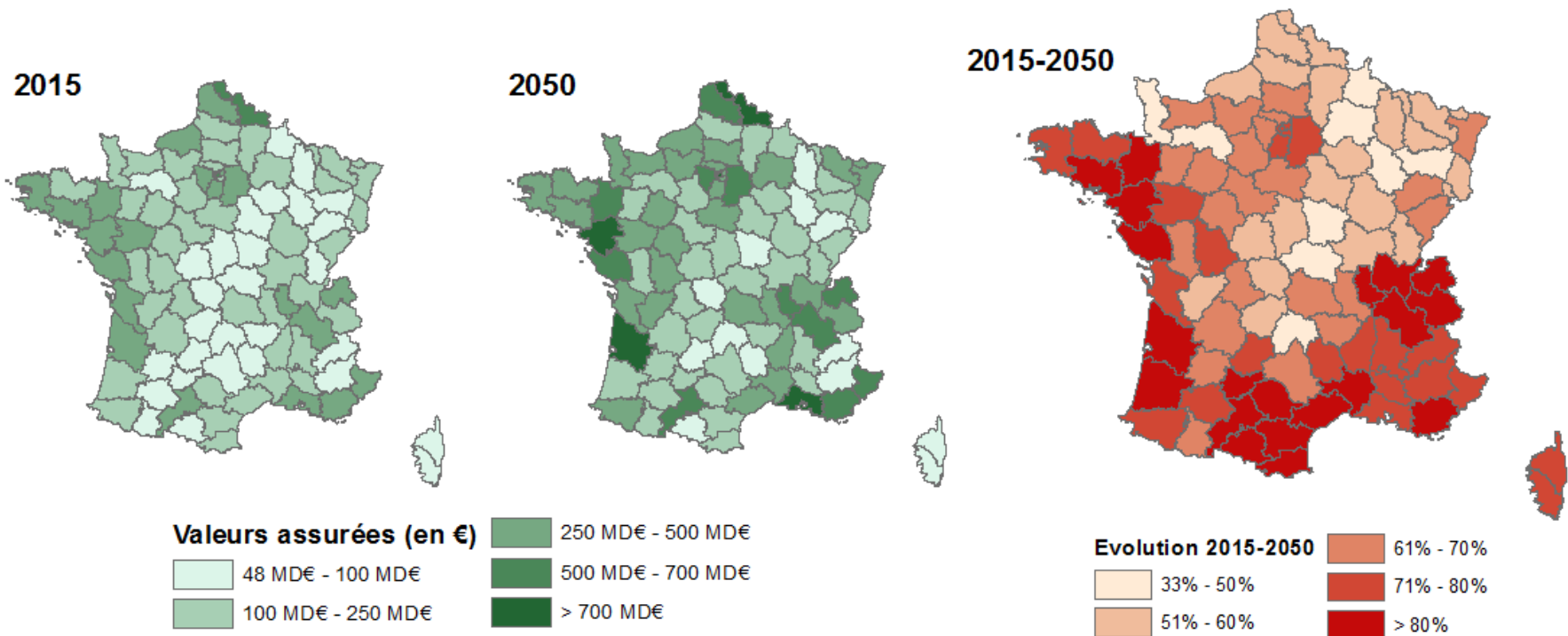
Detecting events

- Detection of Nat Cat events :
 - 10-yrs return period threshold
 - 72h rainfall (small watersheds) and 10-days rainfall (large watersheds)



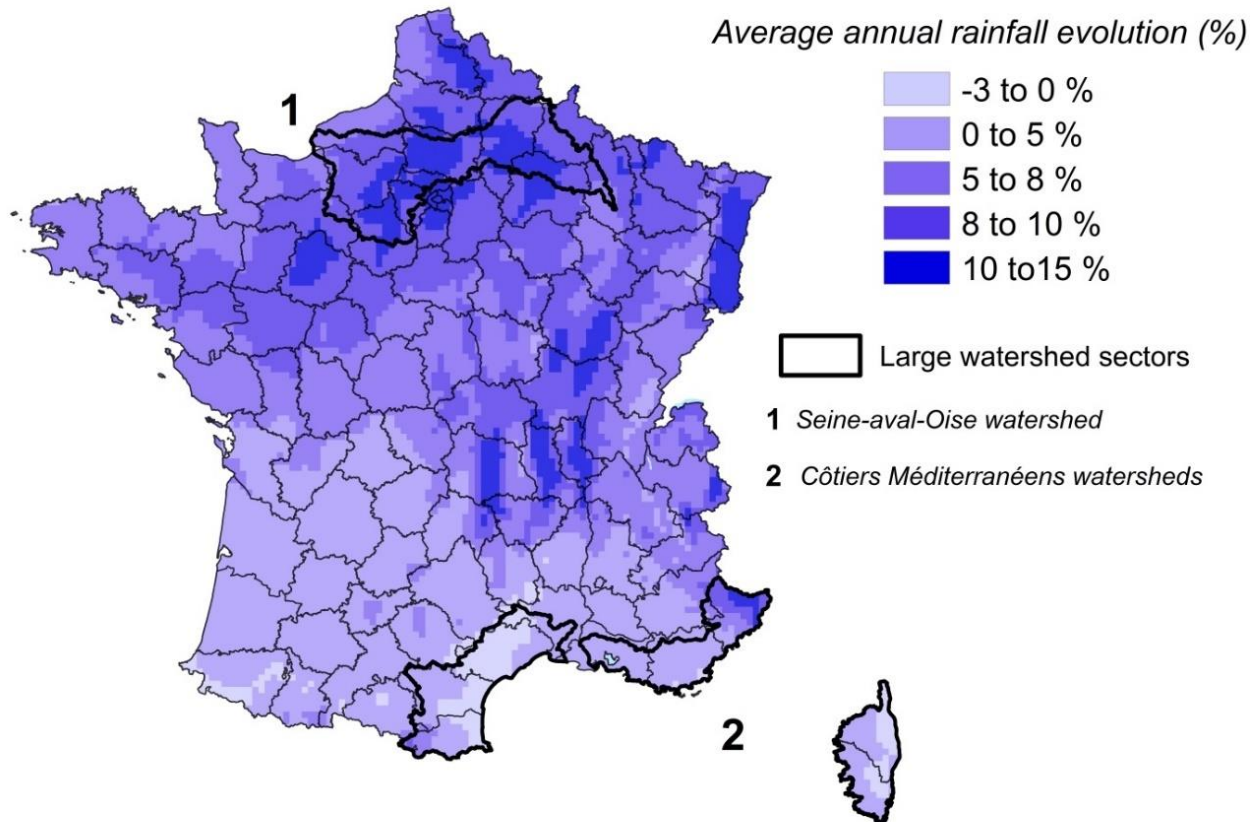
Evolution of vulnerability in 2050

- The evolution of the financial exposure is strongly correlated with :
 - The number of individual and professional risks
 - The insured values per risk



Results for floods

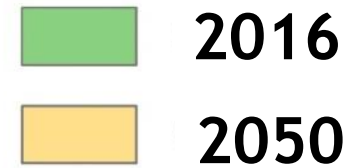
- We compare the average annual rainfall in 2000 and 2050



Results for floods



Flood hazard maps
50-ys return period

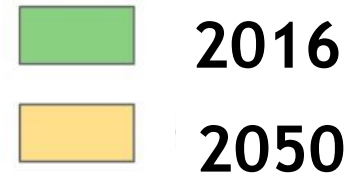


Source : Scan 25 IGN

Results for storm surge floods



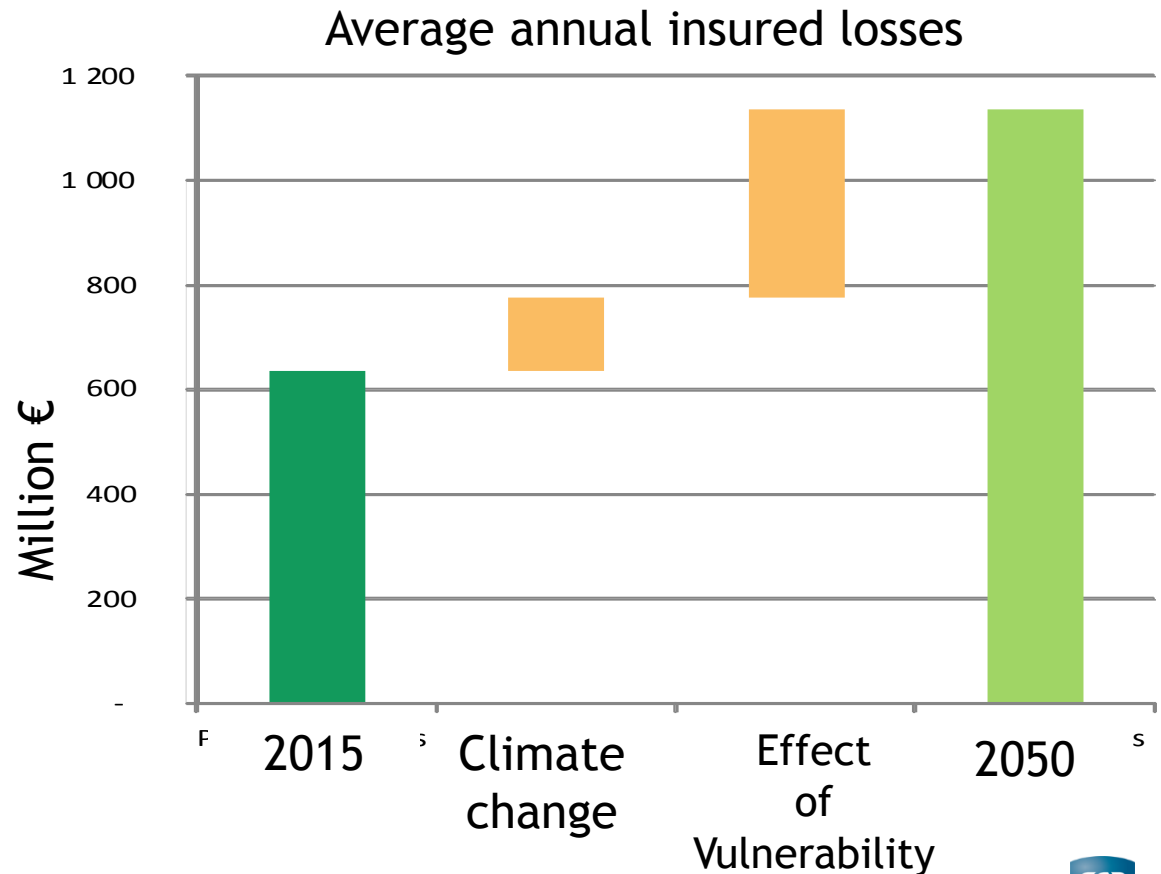
Storm surge hazard maps
50-ys return period



Source : Scan 25 IGN ©

Results for floods

- Impact of climate change : +20%
- Vulnerability : +65%



Results for all perils

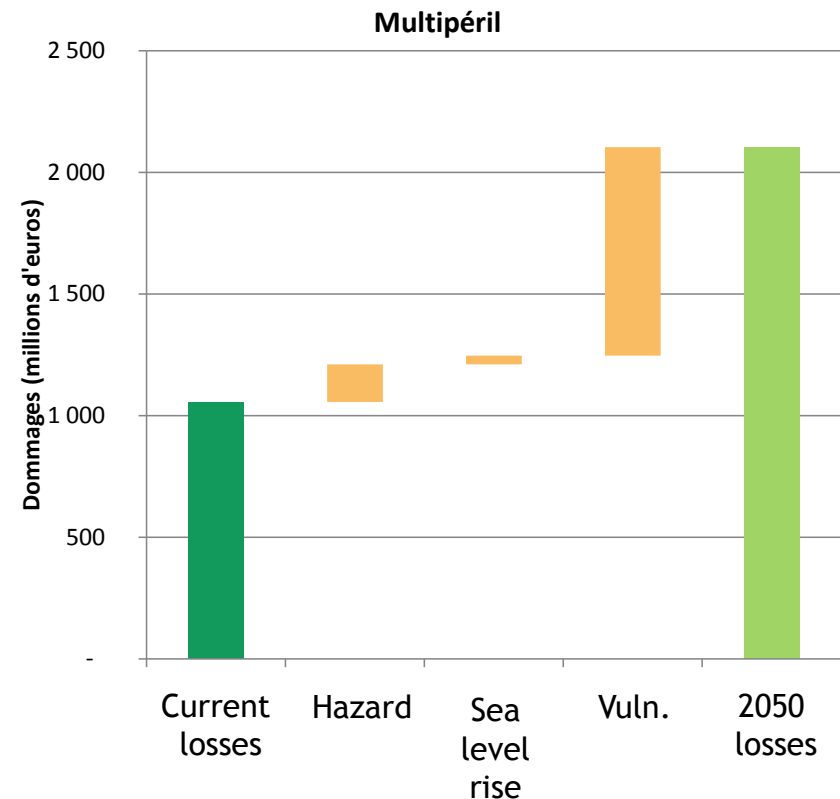
The damages for flood, drought and storm surge would rise by 100% between 2015 and 2050

○ Impact of climate change : +20%

- Rise of frequency and intensity of flood events
- Significant impact of sea water level rise
- More droughts in the South of France

○ Vulnerability : +80%

- Insured values
- Population rise in the coastal areas





Conclusion

- At the French scale,
 - New building in at-risk areas and increase of insured values will be the most important issues in the future, perhaps more than climate change itself
- Next steps of this study
 - Increase the number of simulated years
 - Test the RCP 8.5 scenario
 - Compare two atmospheric models



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