

GeRiCi

Approach, Method and Tool for
"Risks Management related to Climate
Change and its impact on
Infrastructures": the GeRiCi Project

Why GeRiCi?

- Infrastructures designed according to specific events references (i.e. frequency)
⇒ Accepted risk

- References on Specific events are based on past experience with a stable global climate hypothesis

👉 **"The climate change is in progress"**
(ONERC,24/06/2005)

Climate Change modifies the real risk level and challenges conception rules

Why GeRiCi?

- **How can the climate evolution be predicted for the 50 next years ?**

No evolution model is certain, all models lead to "probabilities"

- **Increase of unusual climate events (strength - frequency)**

caused by climate change

- **Increase of their impacts**

urbanisation, increase of trades

 **Risk management direction**

Impacts of unusual climate events (1/7):

Wind



Source : SANEF

**December 1999 Storm in France:
winds from 160 to 200 km/h**

Drought

**Summer 2003 : forest fire close to
A8 motorway near Vidauban (Var)**



Source : ASF/ Escota

Impacts of unusual climate events (2/7):

Snow

Scetauroute/A. Berenguier



**February 2001:
Snowbound traffic on A40, and A8
at Saint-Maximin (South of France)
after copious snowfalls at night.**

©ASF/ Escota



Impacts of unusual climate events (3/7):

Rain & Flood

**8 July 2001:
A1 motorway flooded near Roye (North
of France), following strong storms**



Source : ASF

Slip road flooded with surface water



Source : SANEF

Impacts of unusual climate events (4/7):

Flood in USA



Flood in Bulgaria



Impacts of unusual climate events (5/7):

Hurricane and Bridges



Photo: J. O'Connor (for MCEER)

The easternmost span of the westbound US 90 bridge was thrown north more than 50 feet.

US 90 Eastbound - Pass Christian to Bay St. Louis, Mississippi



Photo: J. O'Connor (for MCEER)

The superstructure units for the bridge were displaced to the north and many dropped off the piers

Impacts of unusual climate events (6/7):

Hurricane and Roads Network



Photo: J. O'Connor (for MCEER)

Many approach spans to Interstate 10 (New Orleans, Louisiana) were underwater. The ramps were used to support emergency operations

Impacts of unusual climate events (7/7):

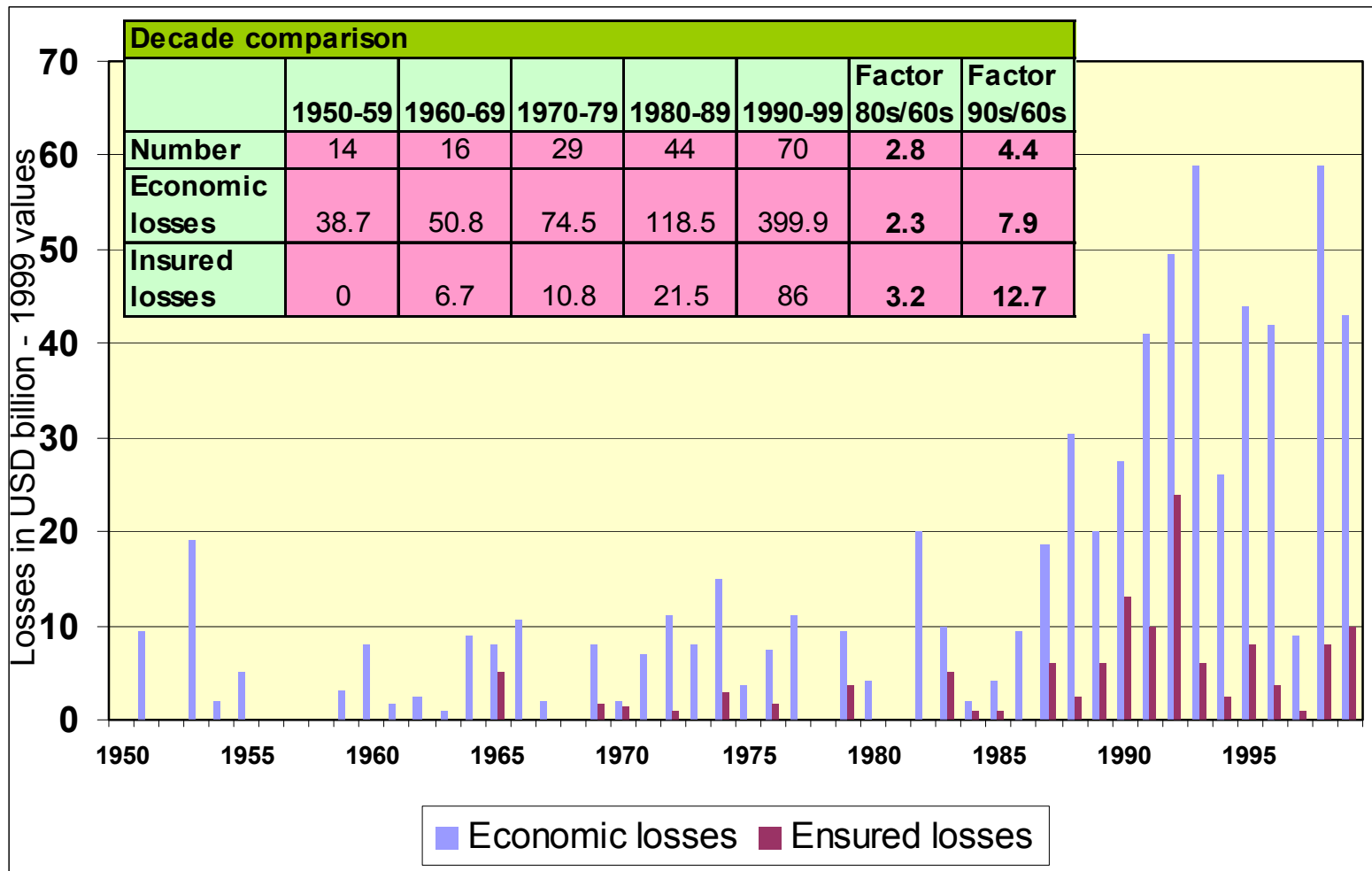
Hurricane and Pavements



Photo: J. O'Connor (for MCEER)

Large masses of asphalt pavement peeled off US-90 Southeast of Slidell, Louisiana

Meteorological Catastrophes



Source: Munich Reinsurance Company

Disasters causing more than 100 hurts and/or 100 MUSD of insured compensation

⇒ An Applied Research Program :

- after a Call for Proposals by RGCU

(French Ministry for Infrastructure - National Network for Urban and Civil Works)

- supported by DRAST

(French Ministry for Infrastructure - Directorate for Scientific and Technical Affairs)

⇒ A network of 7 partners:

- **SCETAUROUTE** Project leader
- **SANEF** } Expectations and needs of
- **ASF** } clients & operating companies
- **BCEOM** Hydraulics Expertise
- **METEO France** Meteorological data
- **LCPC** High-level expertise
- **ESRI** GIS tool

GeRiCi objectives (1/2)

- Design of a Climate Risk Analysis and Management Model for Infrastructures
- Design of a Risk Management Tool:
 - **Short term** action of alert and prevention for operating managers facing an unusual event
 - **Medium term** action to adapt infrastructures to the Climate Evolution
- Propositions of Palliative Measures to mitigate the Risks

GeRiCi objectives (2/2)

Identification of Risk Factors



Climate Factors
(rain, wind,...)



Infrastructure
Intrinsic Factors



Site Factors
(evolution, increase,...)

**Assessment of the Infrastructure sensitivity
(issues at stake)**

**Determination of Risk Levels and their critical
loads**

Adjustment to Climate Data evolution

**Knowledge and Experience Capitalisation for
sustainable relevance of both method and tool**

Risk Analysis

Our consortium works in partnership with a high-level Expert specialised in Risk Management (broad experience in nuclear industry and other industrial sectors).

This partnership enables us to provide a Methodology of high-professional level, specifically adapted to Road/Motorway Sector and Climate Change issues.

The UE: Unwanted Events

A Meteo-France data table detailing strength and frequency of each weather phenomenon:

- **Cold / Frost**
- **Snow**
- **Rain**
- **Floods**
- **Dog days**
- **Wind**

Can be combined in pairs:

- Frost and rain
- Frost and snow
- Rain and wind
- Flood and wind
- etc.

Scope of Expertise

- **7 Domains of Expertise :**

- Pavements
- Bridges
- Equipment
- Little Hydraulics and drainage
- Geotechnics
- Environment
- Big Hydraulics

- **Each domain of Expertise** is structured in:

"Families" (as "sign gantries" for Equipment),

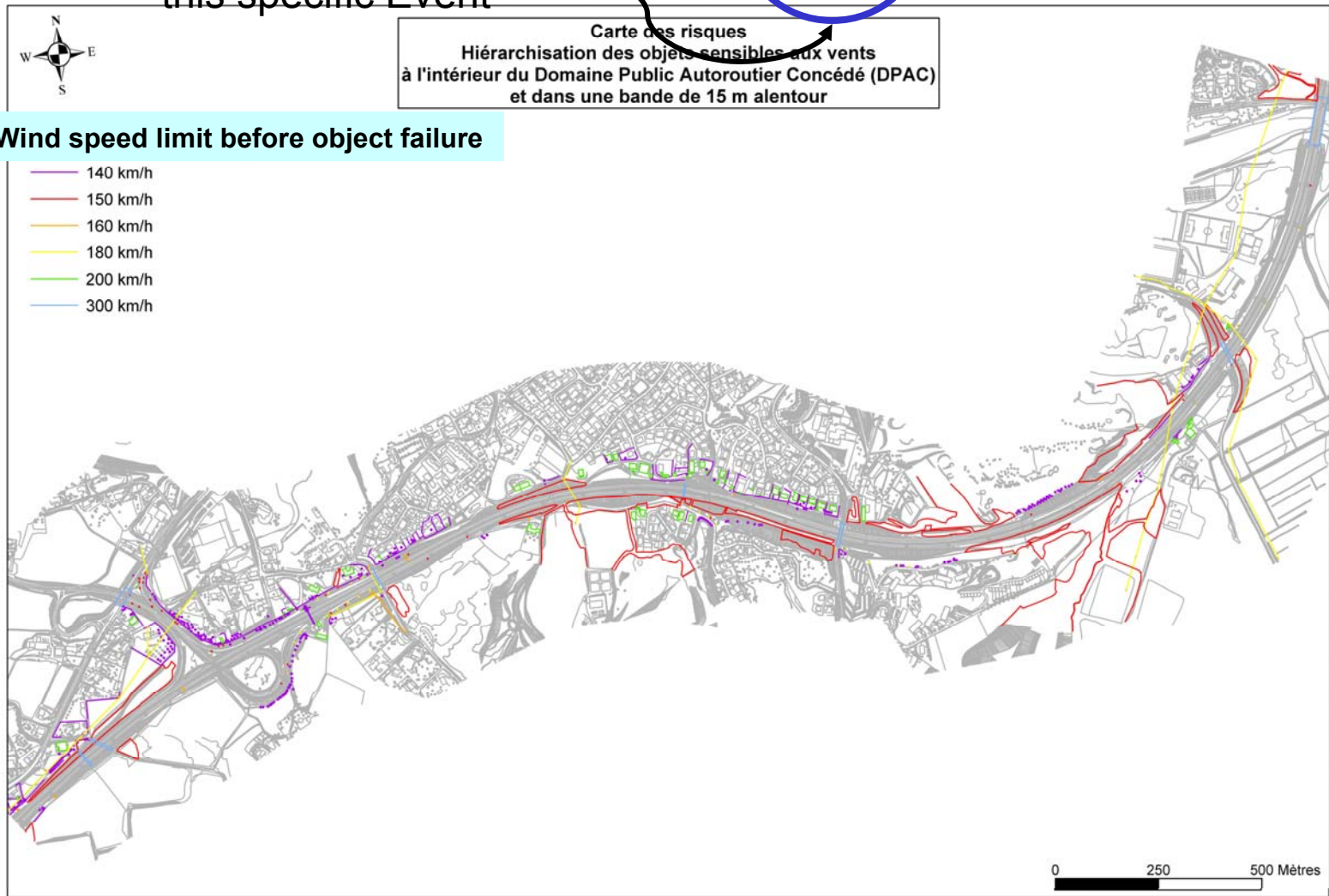
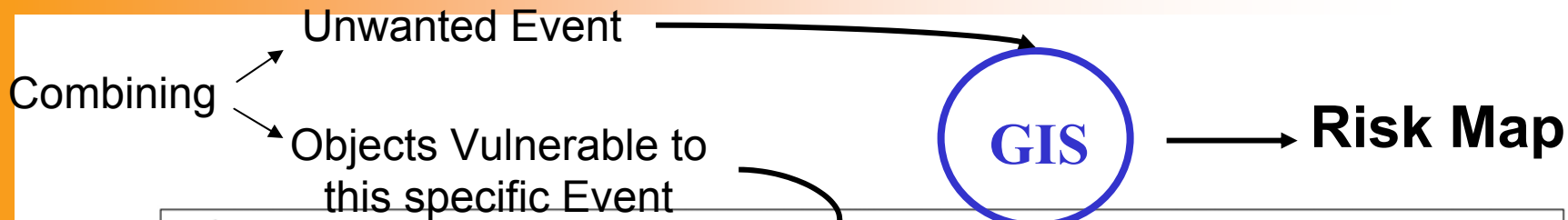
"Sub-families" (as "A type sign gantries"), and

"Objects" (as " A type sign gantry at mileage point X).

Though, each infrastructure to be analysed is fully detailed by objects.

So, an **object** is a unique element, with only one geo-localisation.

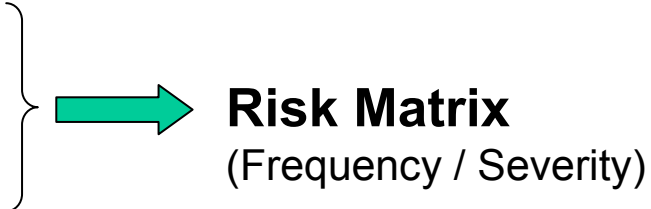
(sign gantry, tree, bridge, canopy, culvert, low point, electric line,...)



Risk maps are analysed in light of their foreseeable consequences on:

- Costs
- Infrastructure's Durability
- Continuity of service to Users
- Users' safety
- Prejudicial effects to Environment

This leads to the identification of critical scenarios:

- Route disruption
 - Disruption of access to sensitive structures
 - People injuries
- 
- Risk Matrix**
(Frequency / Severity)

Example of Risk Matrix:

Risk Frequency	Consequence : Route disruption			
	< 1 h	From 1 h to 24 h	From 1 to 2 days	> 2 days
High	Acceptable	Unacceptable	Unacceptable	Unacceptable
Medium	Acceptable	Acceptable	Unacceptable	Unacceptable
Low	Acceptable	Acceptable	Acceptable	Unacceptable

 Acceptable

 Unacceptable

The way to the tool

- **1st Step**: « risk analysis » methodology
- **2^d Step**: tool programming - risks identification - Climatic risk vulnerability for all infrastructure's objects
- **3^d Step**: **GIS Diagnostic tool** setting up
 - ☛ to keep count in the future of best knowledge in climatic change data and their effects, or infrastructure's modifications, this tool is evolved to be modified easily
- **4th Step**: palliative measures to improve the risk level acceptability
- **5th Step**: **Alert System** for Road Manager (link between Météo France Alert System and GIS tool)

Progress status of the Project (1/2)

- **1st Step**: « Risk Analysis » is completed

- **2^d Step**: in progress. We are :

- Recording all climate event consequences on infrastructure in the world (with more detail in France)
- Creating a Knowledge Database for Operators, with geo-localisation of past critical scenarios and their consequences
- Working with experts to assess the impacts of unusual climate events on objects (and define subsequent research action as necessary)

Progress status of the Project (2/2)

- 3^d Step: GIS Diagnostic tool is in progress. First tests on a 10 kms long motorway section are convincing

- The global approach is now complete and can be used to assist various stakeholders (Ministry Road Direction, Roads Operating Managers, ...)

- The GIS tool will be operational at the end of 2006