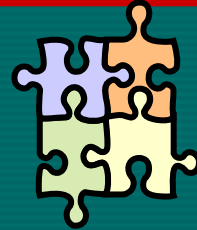


Computer-based Natural Catastrophe Models Supporting a Better Perception of the Economic Impacts of Climate Change

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Reasons



- Climate change impacts on economic sectors
- Natural disasters may cause high losses even though they are *extremely uncertain*
- Measurement / analyses of *economic impact of natural perils*, e.g. storms, earthquakes or floods are general deployed by insurance and reinsurance companies based on professional IT tools embedding geophysical models



Catastrophe Models =NATCAT

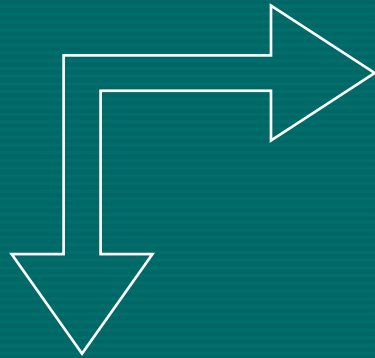
- Climate change generates an increased number of natural catastrophes and their economic impact could be perceived by means of scenarios based on the so called “Natural Catastrophe Models” or “NatCat models” based on data and metadata provided by customized Geographic Information Systems under the European directive INSPIRE (as a general standard).



NATCAT Models

- The aim of NatCat models is to be a main support for the development of strategies in minimizing the expected economic losses and to provide decision makers at several levels as well as the insurance companies with appropriate risk profiles of the affected economic sectors.

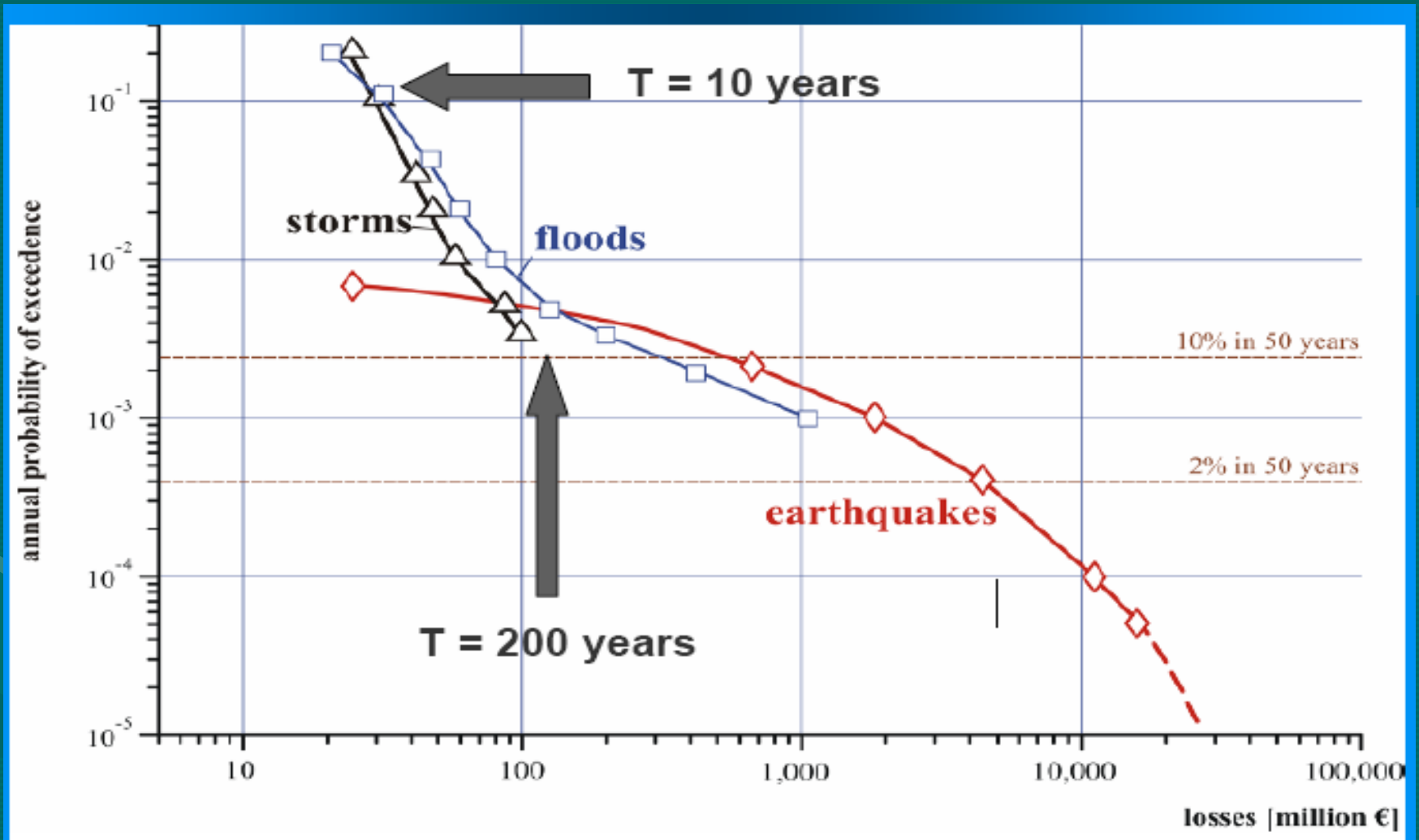
Uncertainty in Catastrophe Model



- *Event uncertainty*
- *Loss uncertainty*
- *Parameter uncertainty*
- *Process uncertainty*
- *Epistemic uncertainty*



NATCAT Model



Sources: DFNK, GFZ





NATCAT Models Evolution

Generally the natural *catastrophe models* (*NatCat models*) were and still are used

- for a better understanding of the nature of risks,
- for modeling the potential or already caused damages,
- for assessing the future loss burden on the community.

NATCAT Models Structure

- inventory module
geophysical
registration of an
insured portfolio
 - hazard module
map, intensity
& frequency
occurrence of
future natural
hazard
 - vulnerability module
damage function linking
natural risk & damage to
the insured entity
 - loss module
loss resulting from
a set of given
damage levels
- 
- 



NATCAT - Modules Description

- inventory module (geophysical registration of an insured portfolio);
- hazard module (a map of locations, intensity and frequency of occurrence of potential future natural hazard);
- vulnerability module (a damage function linking natural risk and damage on the insured object)
- loss module (a loss resulting from given levels of damage).



NATCAT Inventory Module

- The *inventory module* covers the geophysical registration of the whole inventory or insured portfolio classified on type of insurance and insurance coverage.



NATCAT Hazard Module

- The *hazard module* comprises a simplified presentation of the complex meteorological physical and geophysical criteria, i.e. hazard source and attenuation models with attenuation functions, which summarize physical laws, historic and scientific hazard information.



NATCAT Vulnerability Module

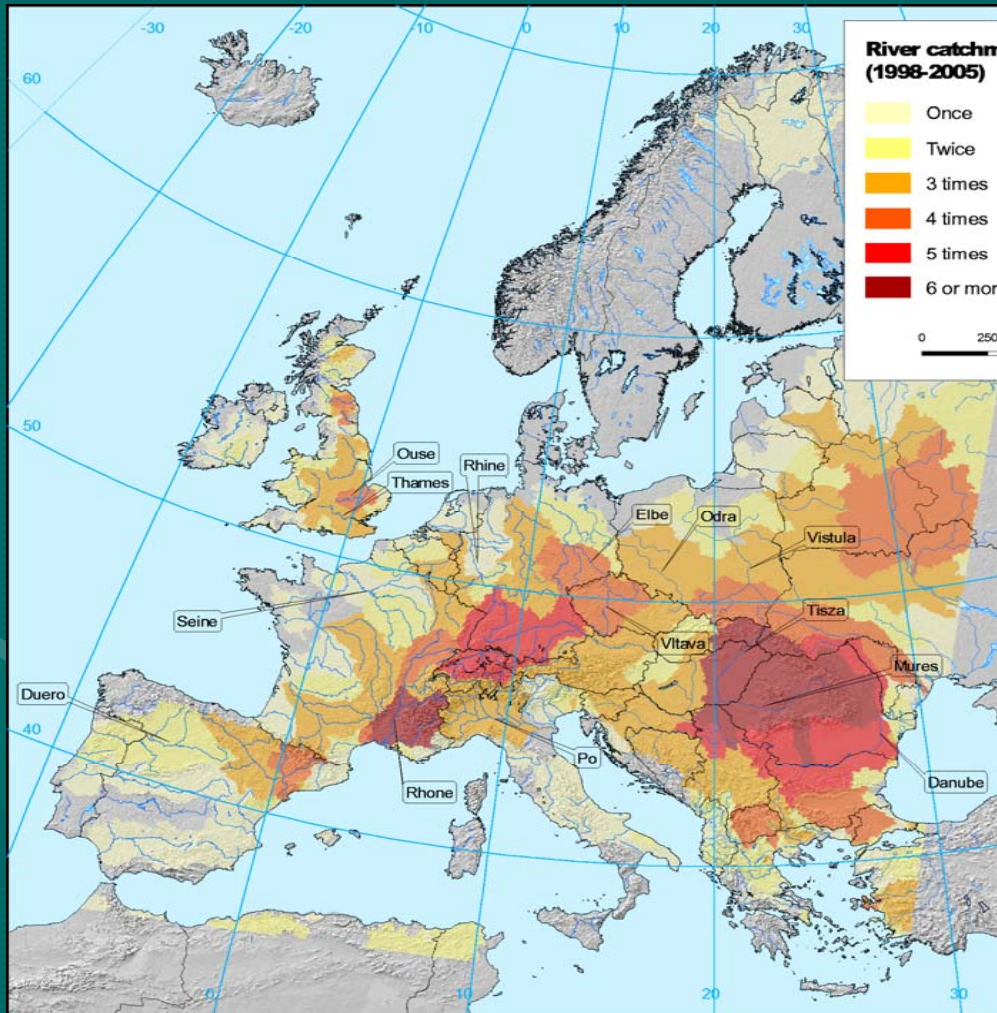
- The *vulnerability module or engineering module or damage module* and integrates modern building codes and engineering analyses in decision making process



NAT Loss Module

- The *loss module or actuarial module* comprises the calculation of the loss resulting from given levels of damage derived from building structures that have been analyzed and characterized as being loss of direct or indirect nature.

Flood NATCAT Model

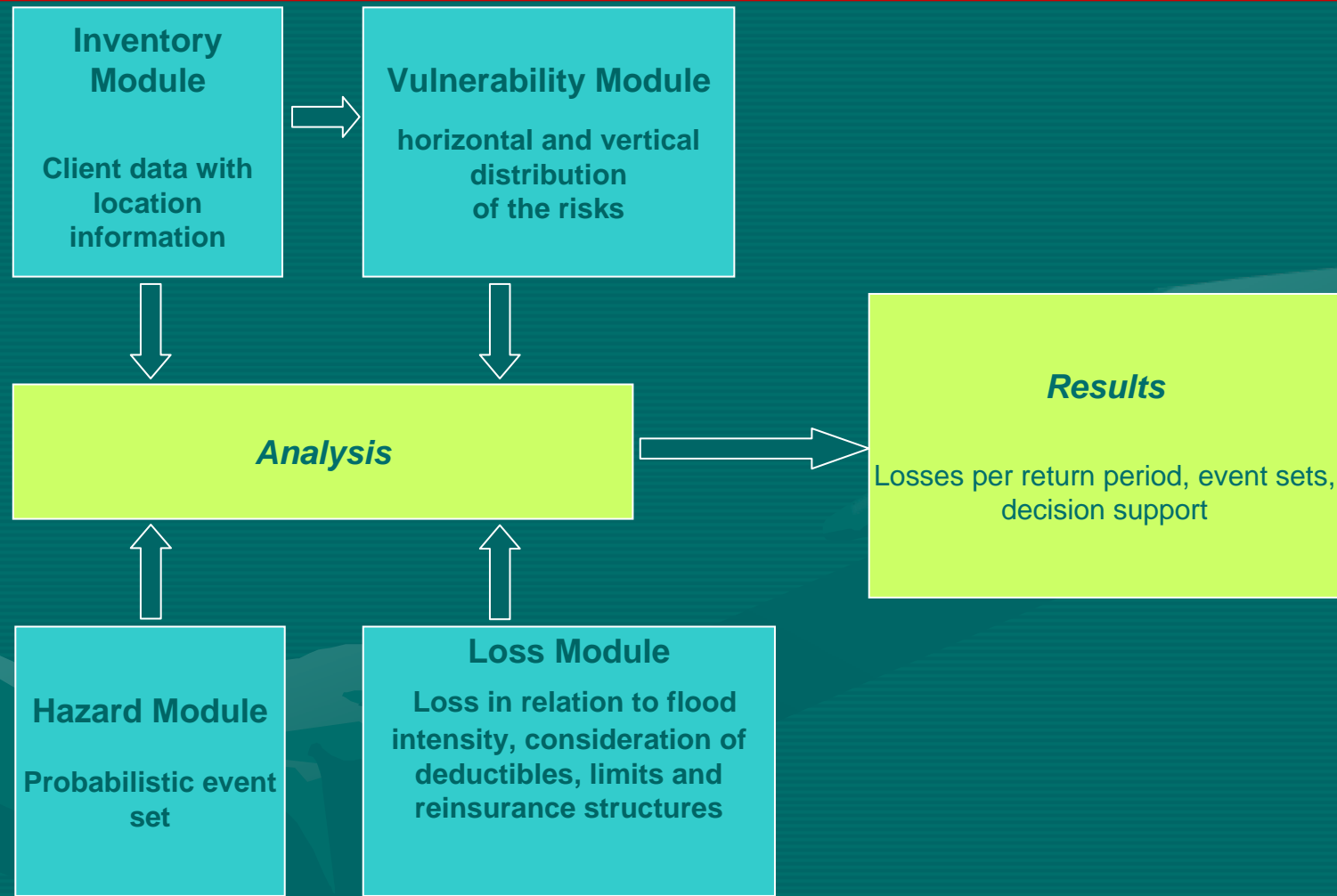


NATCAT Models:

- Zonation
- Deterministic
- Probabilistic



Flood NATCAT Model e.g.



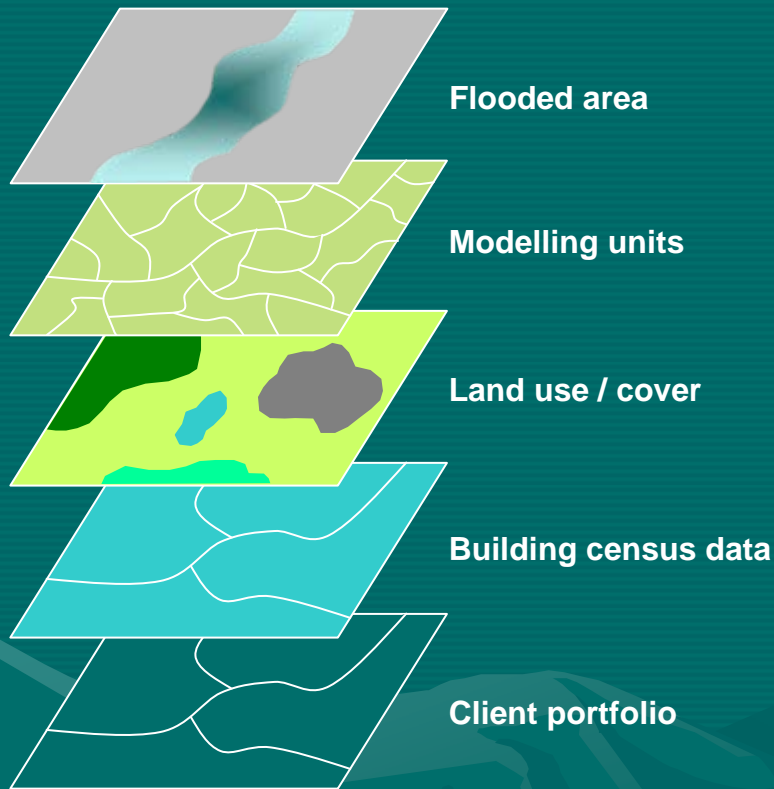


Flood NATCAT Model e.g.

The Hazard Module defines the characteristics of modelled flood events: Water heights, Flood extents, Event frequencies:

- Water heights and flood extents and can be modelled using : Simple GIS approach and Hydraulic modelling techniques
- The probabilistic event set quantifies the entire spectrum of risk by defining a representative subset of all possible future scenarios and their relative frequency
- The historic event set indicate the representativeness

Flood NATCAT Model (GC)



The Vulnerability Module represents the interface between flood maps and client data and has two functions:

- To allow the spatial redistribution of client data into the modelling units
- To complete unknown client data characteristics based on building census information



Flood NATCAT Model e.g.

- The Loss module assigns the degree of loss if a building or an asset is affected
- The loss degree depends on
 - Flood intensity
 - Type of risk (residential, commercial, industrial etc.)
 - Coverage (buildings, contents etc.)
 - Building type and occupancy
- Vulnerability functions have to be calibrated for each country and preferably each client
- The best calibration can be achieved if detailed loss data from recent events exists and is provided by the clients



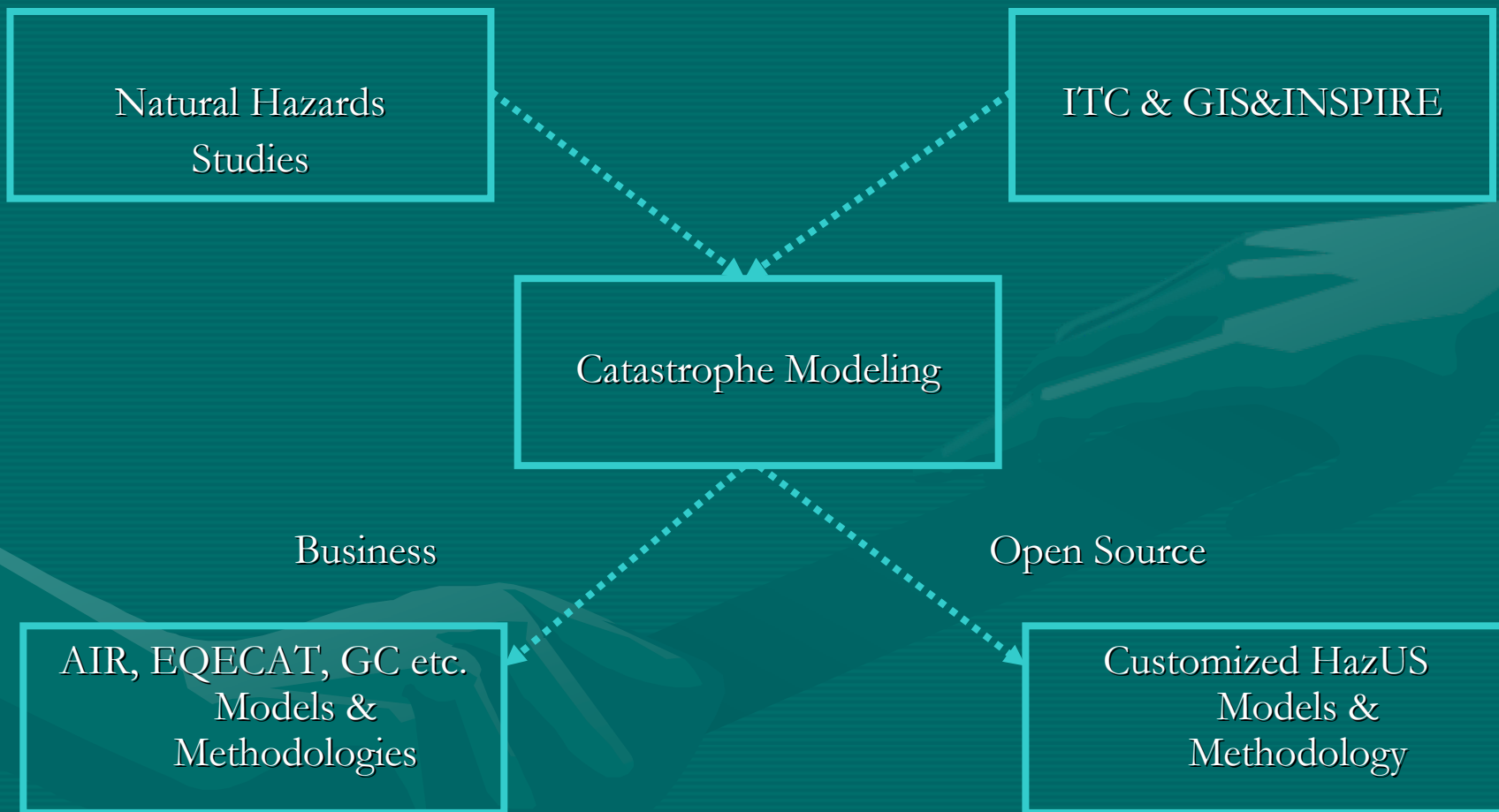
Flood NATCAT Model e.g.

Probabilistic models have two main outputs:

- “Event Set”:
 - frequency and modelled loss for each simulated event used in risk management (e.g. testing of reinsurance structures, multi-peril analyses)
- “EP-Curve” (EP: exceedance probability)
 - probability that loss x is exceeded
 - Either in tabular or graphical format



NATCAT Current Approach





Computer-based NATCAT

- Business Solutions
- Open Source Solutions



Business Solutions

- The best known providers of NATCAT models customized to support the economic analysis of extreme losses: *RMS, AIR, EQECAT Earthquake Commission New Zealand (EQC), AON Re Service, GC, Mathias Raschke.*



Business Solutions RMS

- Company RMS (Risk Management Solutions)
Stanford University, 1988, now DMG
Information, Inc., United Kingdom - supplier of
products and services for the quantification and
management of disasters



Business Solutions AIR

- Company AIR (Applied Insurance Research), 1987, Boston, subsidiary of Insurance Services Office Inc. (ISO) as a modeling firm - provides NATCAT model technology support-related to risks of natural disasters, weather and climate - desktop applications (CLASSIC /2™, CATRADER® , CATMAP® /2) and online applications (CATStation®, AIRProfiler®,™ ALERT™ AIRWeather.



Business Solutions EQECAT

- *EQECAT company*, EQE International 1994, San Francisco, ABS Consulting Group 2001 - provider of state-of-the-art and natural risk management services and software tools
WORLDCAEnterprise



Business Solutions *EQC*

- Earthquake Commission EQC New Zealand - offers a suite of models based on GIS, disaster dynamic model and financial analysis dynamic model.



Business Solutions AON

- AON Re Services - provides geophysical model (HailCalc Europe) to estimate the damage to the areas most threatened in Europe (Germany, Switzerland, Austria, France, Northern Italy, Liechtenstein, Netherlands and Denmark) .



Business Solutions Mathias Raschke

- The Company - provides geophysical model (QuakeRisk) to estimate the damage caused by earthquakes for Bosnia, Herzegovina, Bulgaria, Croatia, Czech Republic, Hungary, Macedonia, Poland, Romania, Serbia, Montenegro, Slovakia and Slovenia.



Open-source for Nat Cat Model

- Federal Agency for Emergency Management in the U.S. (FEMA) instrument widely used - HAZUS “Hazards U.S.”
- HAZUS is available as open source product
- HAZUS may be customized for European users.



Open Source Solution HAZUS

- HAZUS international methodology customization was made for Romania within a research project based on a GIS with metadata on INSPIRE standard



Conclusion 1

- Statistics confirm a trend towards more frequent and more costly natural catastrophes due to both socio-economic development and climate change.
- According to Munich Re, extreme weather-related events represented 84% of the insured losses caused by natural catastrophes in Europe between 1980 and 2008.



Conclusion 2

- Catastrophe modeling is used for decisions making on costs, transfer risk, loss mitigation, portfolio optimization, and as support for developing new strategies for insurance / reinsurance of individuals, firms and companies.
- Computer –based solution range from desktop to on-line application for national and international, public or/and private companies.

Conclusion 3

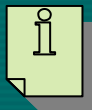
- Modeling techniques and data must be compatible, based on standards - INSPIRE directive and as comprehensive of disasters typology, for long periods of observations.
- Further research is needed in both models and in disaster modelling related to software tools to ensure a safe and simple interface for transparent decision on the mitigation measures on economic damages caused by natural disaster and climate change .

Acknowledgement

This research is supported by

- Romanian Ministry of Education and Research, National R&D Program 2, Contract no. 32143/2008-2011 – *PROSTRACT - Interdisciplinary Research for Economic and Financial Strategies in the case Extreme Events. Natural Hazards and Technological Accidents* -

Thank you very much!



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