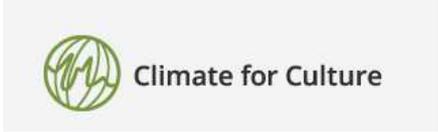



Modelling Climate Change Impact on Cultural Heritage

EU PROJECT 2009 - 2014



»Damage risk assessment, economic impact and mitigation strategies for sustainable preservation of cultural heritage in the times of climate change«



Main questions

- What will be the effects of climate change on cultural heritage in Europe and Mediterranean?
- What mitigation strategies are necessary to prevent damage to movable and immovable cultural heritage?
- What will it cost us, if we do not react in time?

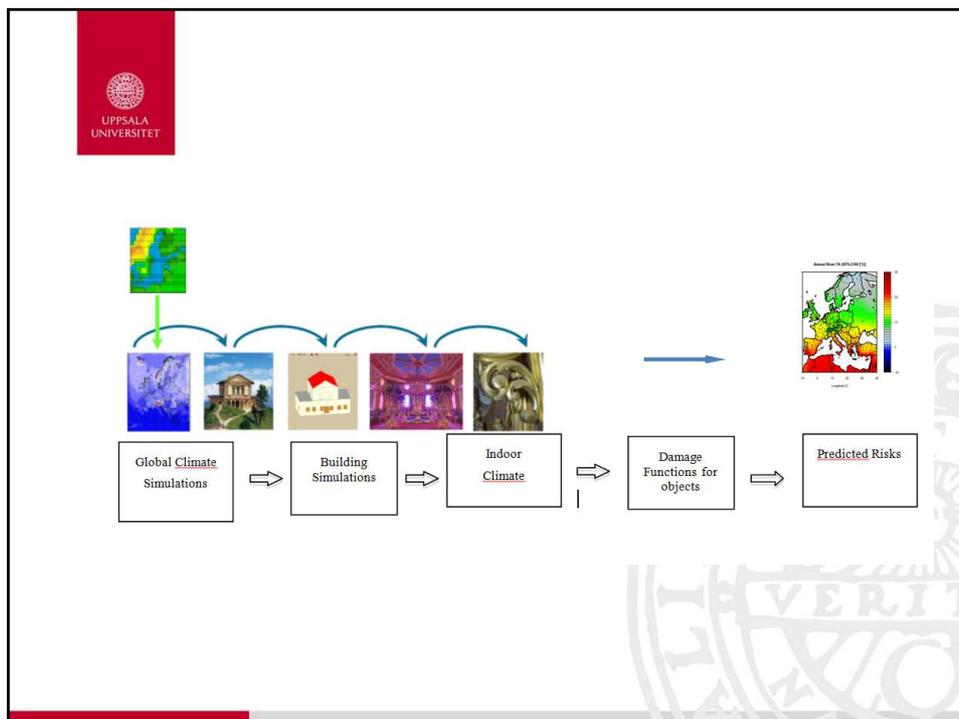

Climate for Culture




Climate for Culture



- **Large scale integrated project**
overall budget 6,55 Mio €
EC contribution: 5 Mio €
- **Duration**
November 2009 - October 2014
- **27 Partners**
from Europe and the Mediterranean
- **A multidisciplinary team**
Natural sciences, humanities, economics, cultural sciences, restoration / conservation practice, engineers, heritage owners, SMEs and industry, decision makers



Climate change modeling and simulations

Two scenarios

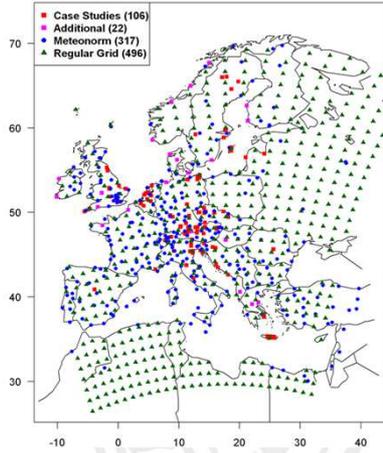
- A1B
 - a CO₂ emission increase is assumed until 2050 and a decrease afterwards
- RCP4.5
 - Representative Concentration Pathway (RCP) 4.5, a stabilization scenario and assuming that climate policies are invoked to achieve the goal of limiting emissions, concentrations and radiative forcing.



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Climate change modeling and simulations

Value	Unit
Temperature	° C
Relative Humidity	%
Normal Rain	mm
Wind Speed	m/s
Wind Direction	degree
Global Radiation	W/m2
Diffuse Radiation	W/m2
Global Counterradiation	W/m2
Cloud Coverage	%
Ground Temperature	° C
Ground Reflectance	-
Air Pressure	Pa

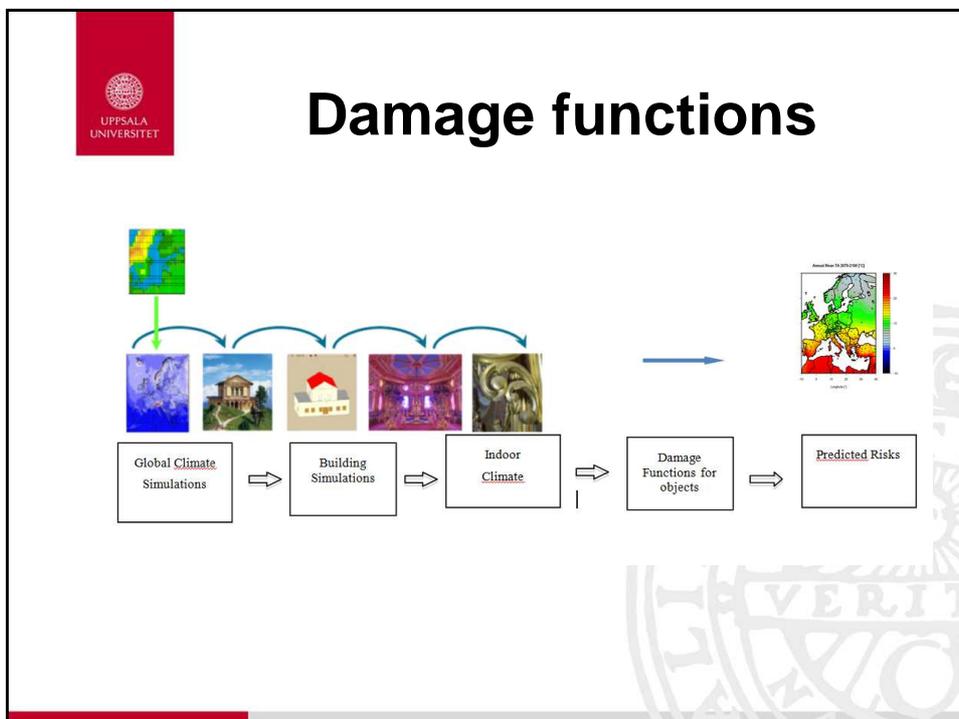
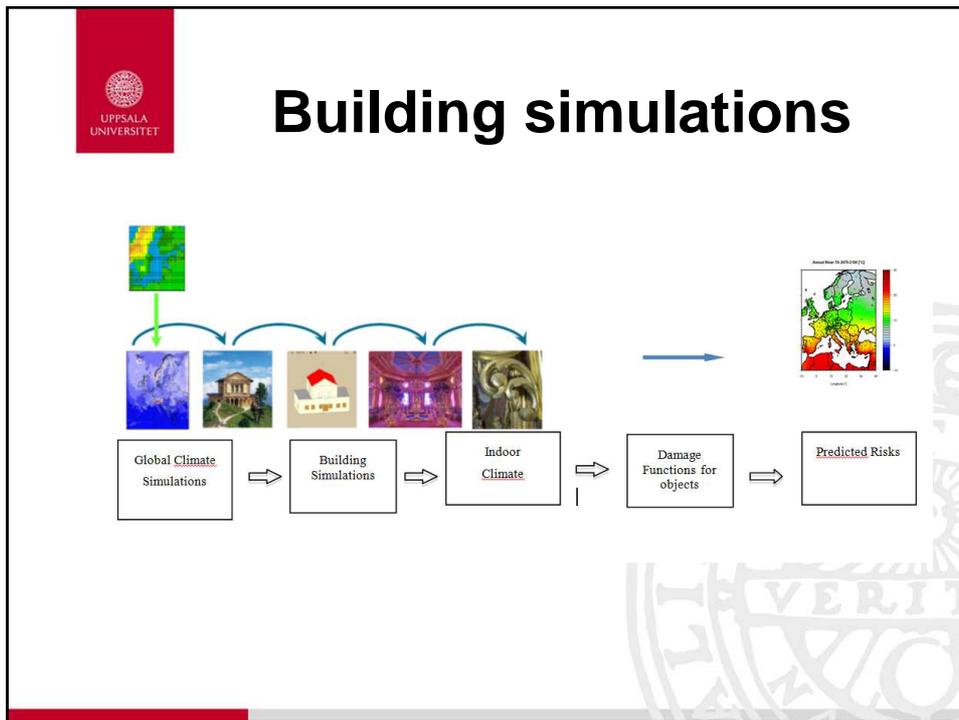




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Climate change modeling and simulations

- Now, we have a prediction of the future outdoor climate
- Next step is to edict the future indoor climate





Damage functions

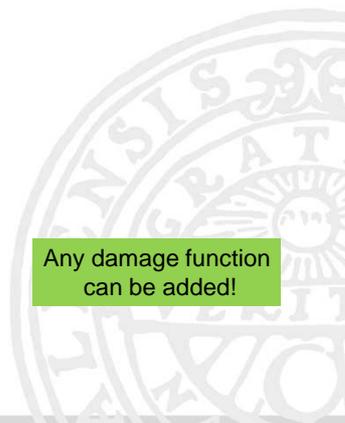
- Mechanical damage to
 - wood
 - painted wood
- Chemical damage to
 - paper
 - textiles
 - photographic material
- Biological damage
 - mould growth
 - insects

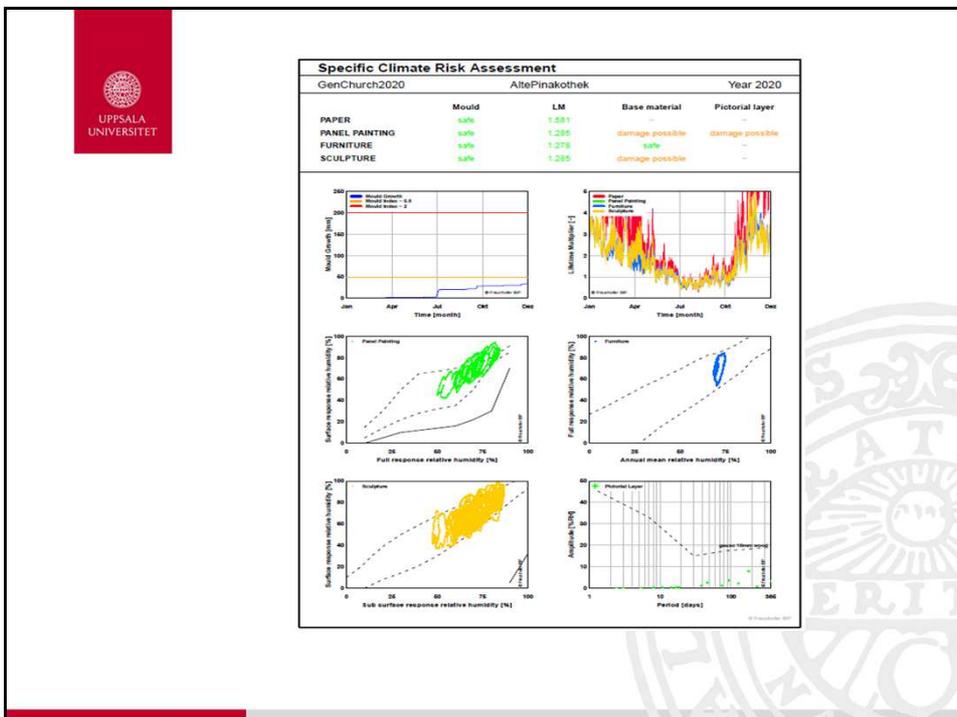
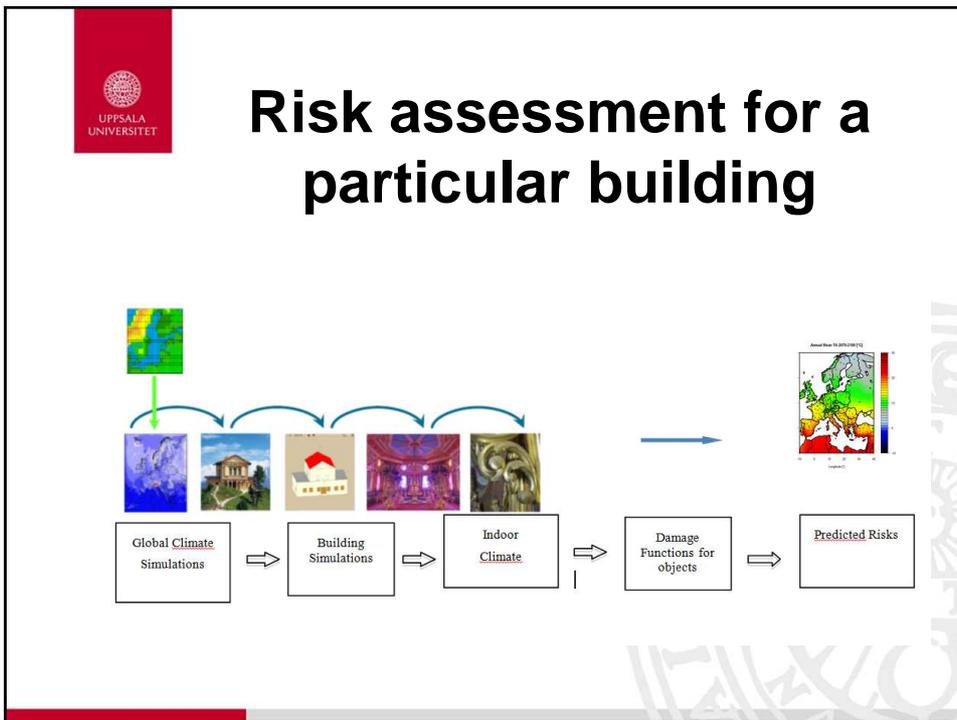


Damage functions

- Mechanical damage to
 - wood
 - painted wood
- Chemical damage to
 - paper
 - textiles
 - photographic material
- Biological damage
 - mould growth
 - insects

Any damage function
can be added!





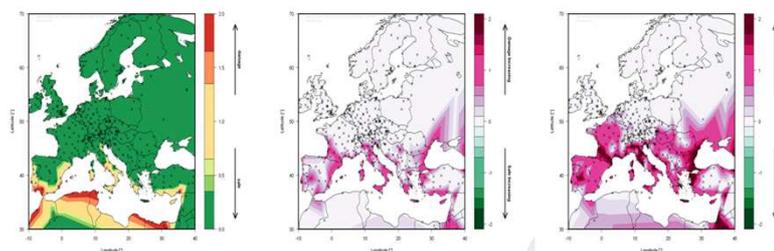


Generic buildings

Type of climate control	Building category			
	Heavy, high moisture buffering capacity (MBP)	Heavy, low MBP	Lightweight, high MBP	Lightweight, low MBP
No climate control (TF)	Risk assessment (RA)	RA	RA	RA
Conservation heating (HAM)	Energy demand (ED) / RA	ED / RA	ED / RA	ED / RA
Intermittent heating	ED / RA	ED / RA	ED / RA	ED / RA
Permanent heating	ED / RA	ED / RA	ED / RA	ED / RA
Cooling	ED / RA	ED / RA	ED / RA	ED / RA
Temperature and humidity control	ED / RA	ED / RA	ED / RA	ED / RA



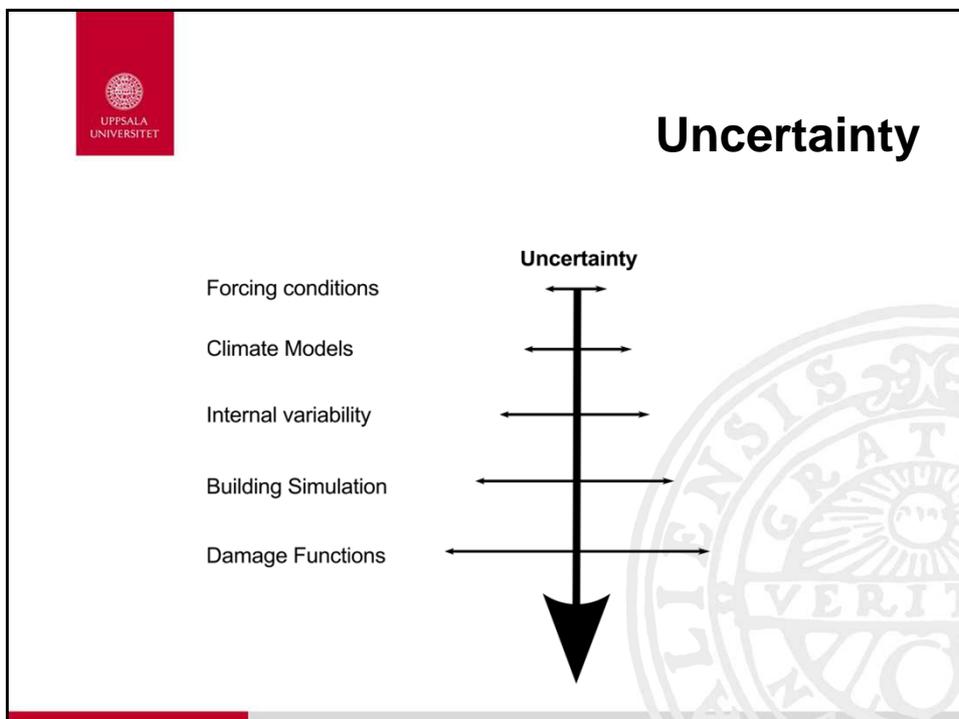
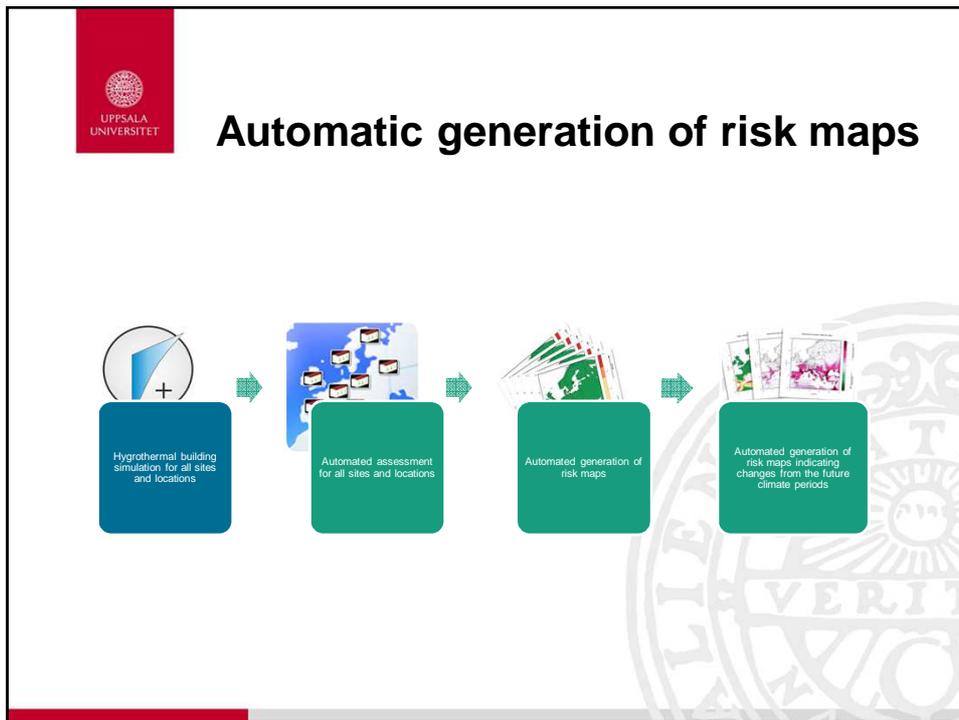
European Risk Maps

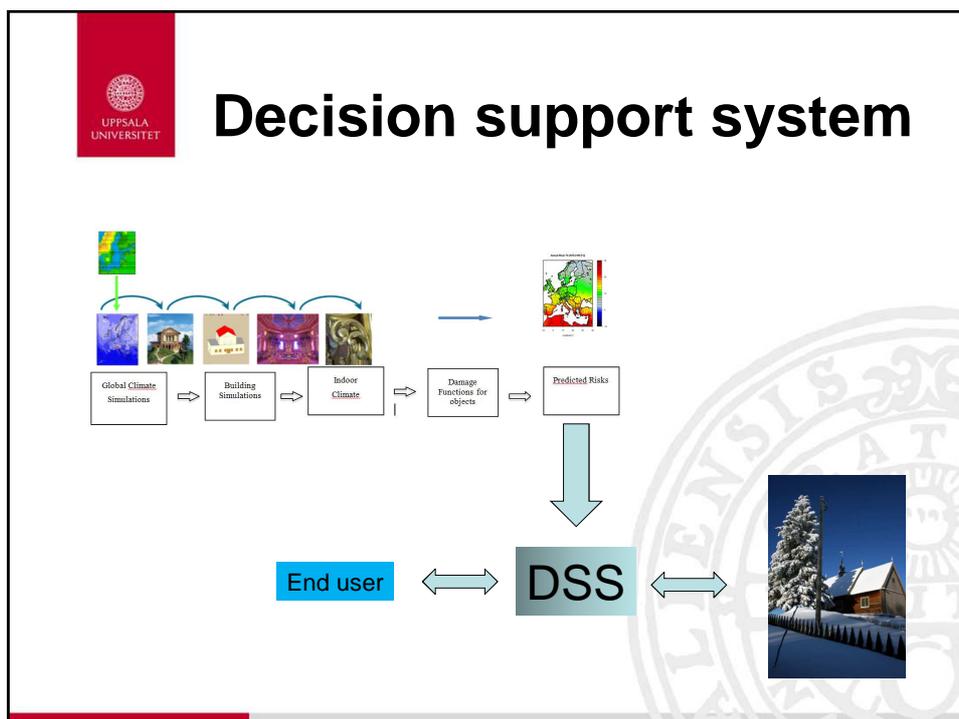


Recent Past

Recent Past to Near Future

Recent Past to Far Future





 **Conclusion**

- A new method has been presented to assess outdoor and indoor risks to cultural heritage buildings.
- The final level of uncertainty in the risk maps is high as for most of these simulations regardless whether a deterministic or a probabilistic approach is used.
- But these risk maps based on state-of-the-art scientific knowledge are valuable tools to indicate trends of future risks to cultural heritage.
- The risk maps can play an important role as a decision tool helping to better plan mitigation and adaption measures at various levels and thus using resources more sustainably.



Questions to stakeholders.....

- How can we use this method towards a sustainable management?
- How could this have an effect on policies and practice
- What results are needed and useful?
- What is a reasonable time scale?

