“In and Out Air Strategies. From Climate Change to Microclimate. Library, Archives and Museum Preservation Issues”

5-6 March 2009

Bibliothèque nationale de France

http://www.ifla.org/VI/4/pac.htm

http://noahsark.isac.cnr.it/

THE NOAH'S ARK PROJECT
Global climate change impact on the built heritage

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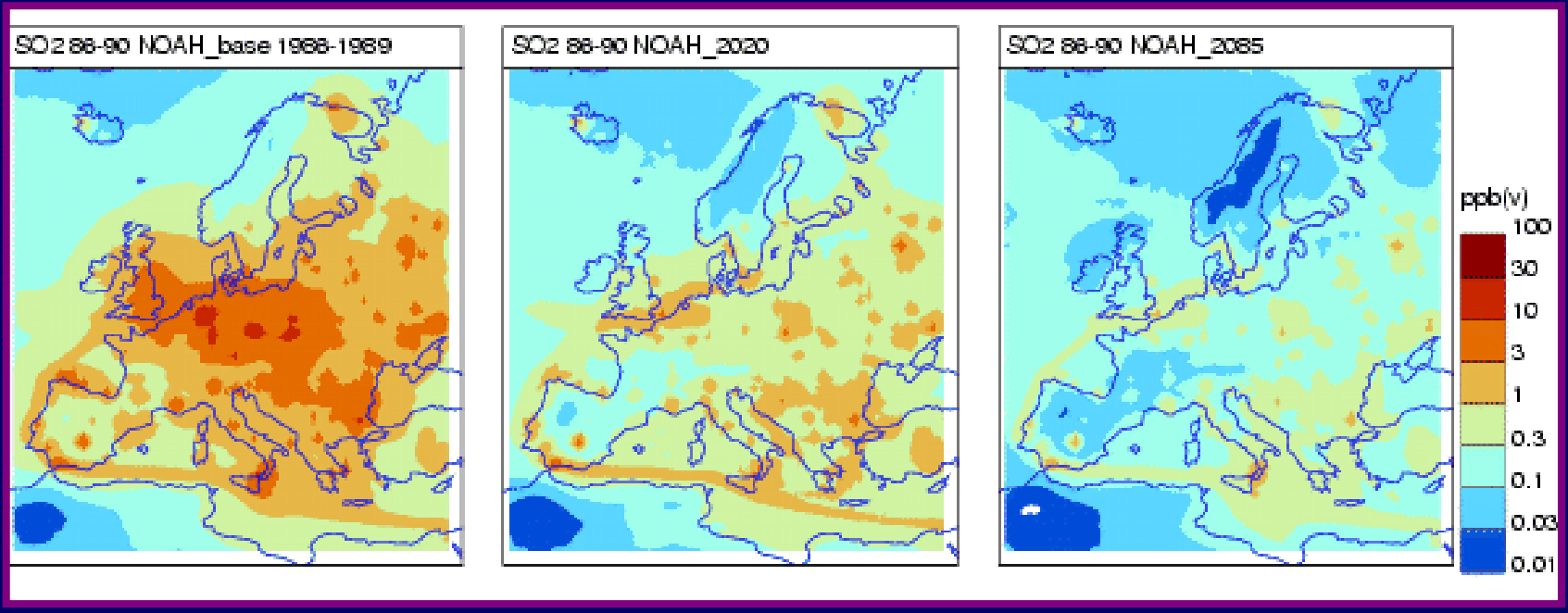
Pollution: *Important decay mechanism in cultural heritage materials*

Declining of acidic Pollutant emissions



Climate is a factor of increasing importance in the weathering of buildings.

Future global climate change impact on built heritage and cultural landscapes

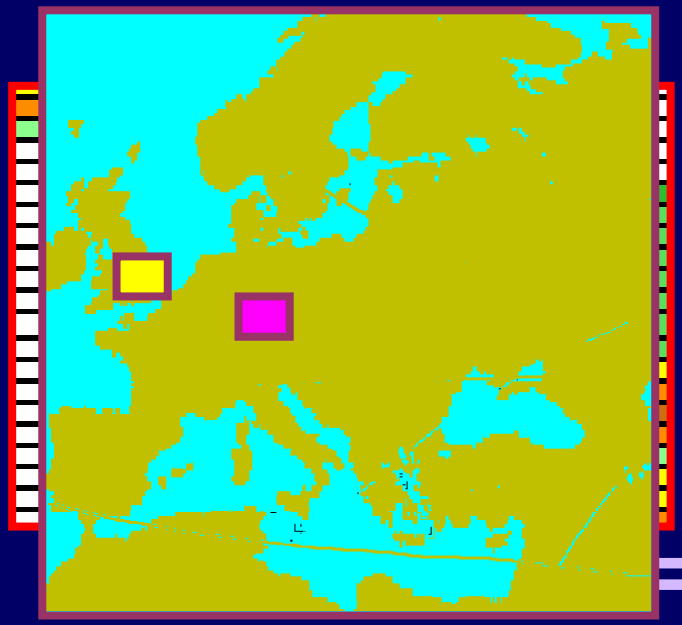
EU project: Partners different countries

HERITAGE CLIMATOLOGIES:
Need to transform traditional meteorological parameters into those relevant to cultural heritage

PROJECT OUTPUT
Data base – maps **- vulnerability atlas**

Parameters: *Temperature, water, combined derived parameters*

Materials: *Stone/masonry materials, wood, metals, glass*

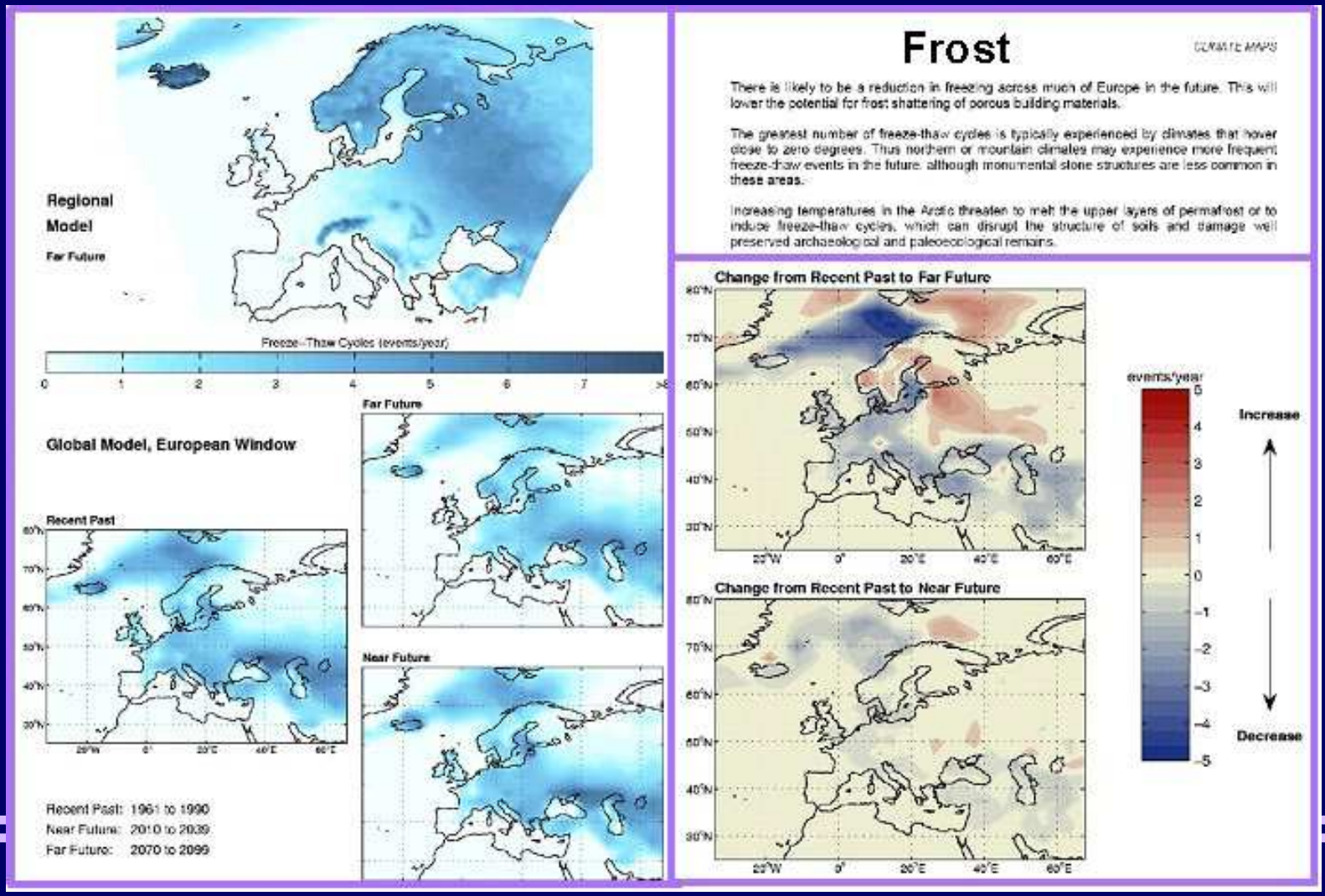


Model: *HadCM3, HadRM3, A2 scenario:* T, RH, precipitation

Europe, and single grid squares:
Central England

Vulnerability atlas: OUTPUT

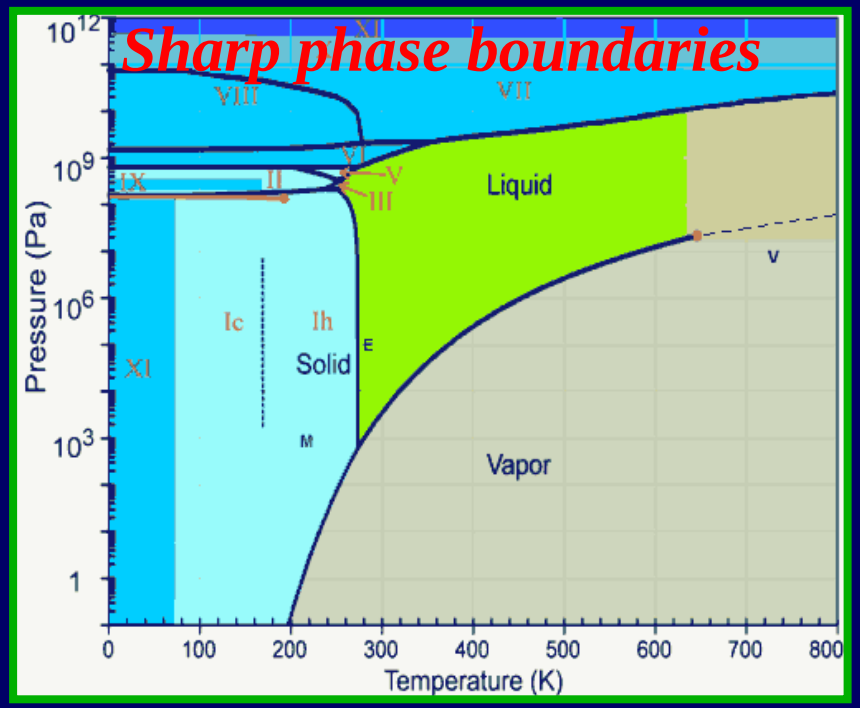
Future projections of potential damage



Amplification via phase change:

Climate change
seems subtle

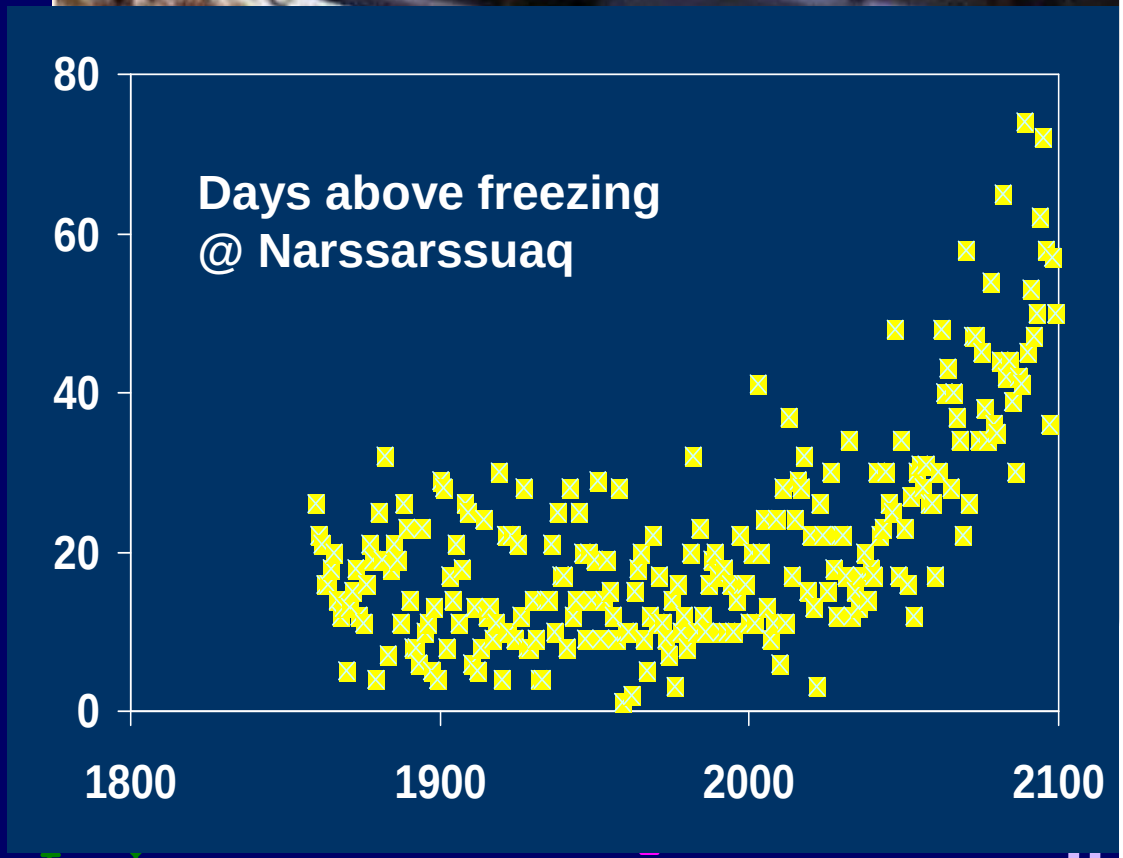
Freeze-thaw and salt crystallisation-dissolution:
phase transitions at precise thermo-hygrometric conditions



Small changes in climate can show big effects – i.e. number of events.

University of East Anglia

Freeze/thaw



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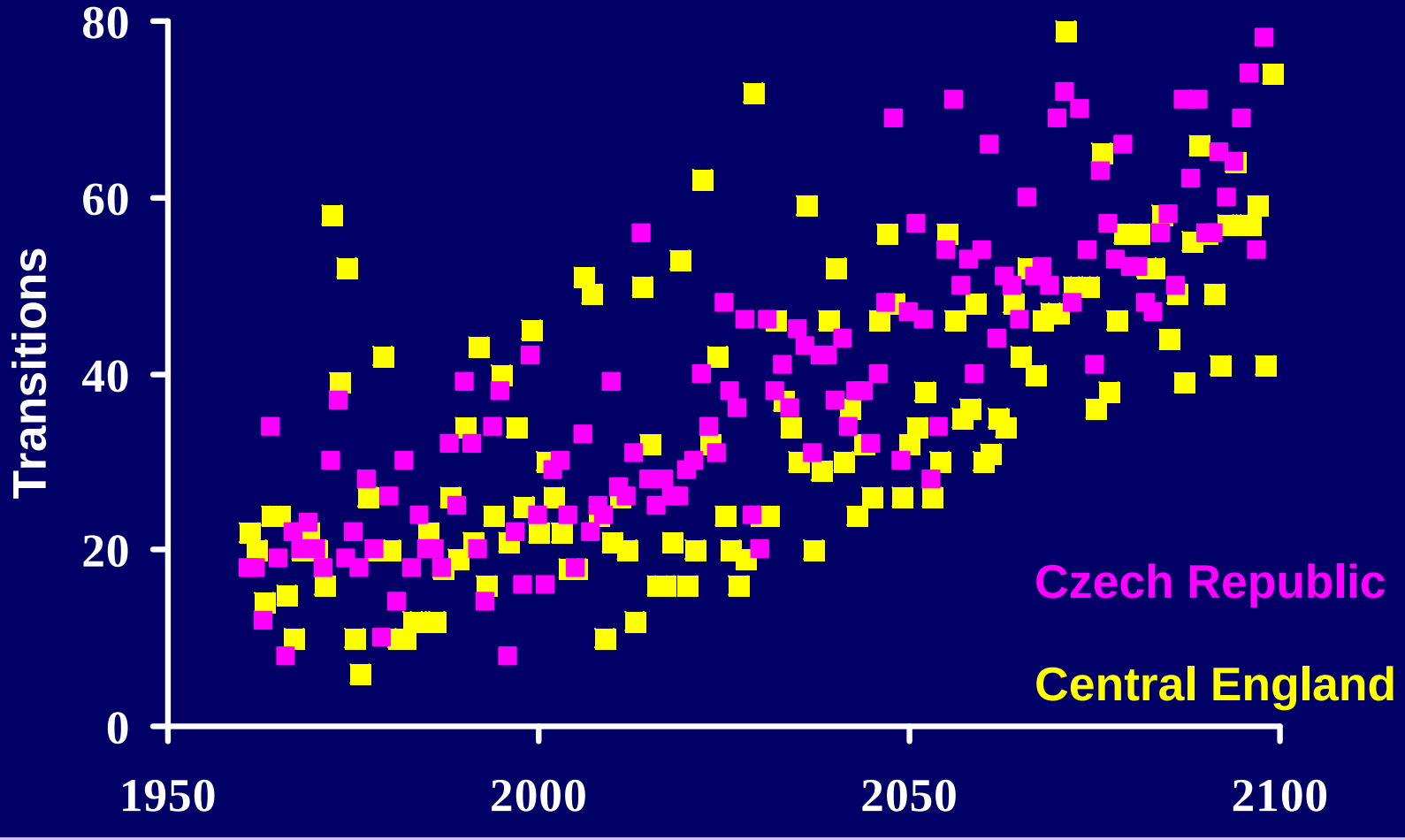
salt crystallisation

Humidity cycles: RH 75.3 % transition for sodium chloride

c2

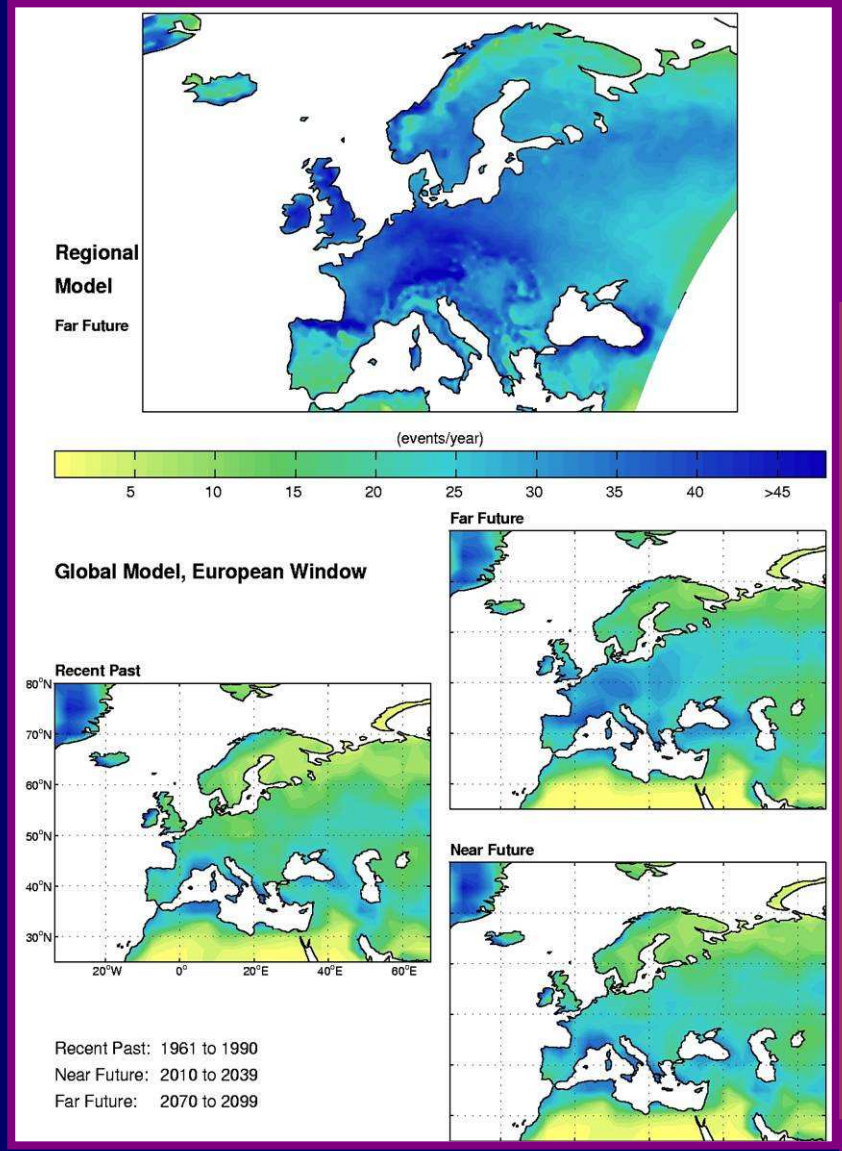


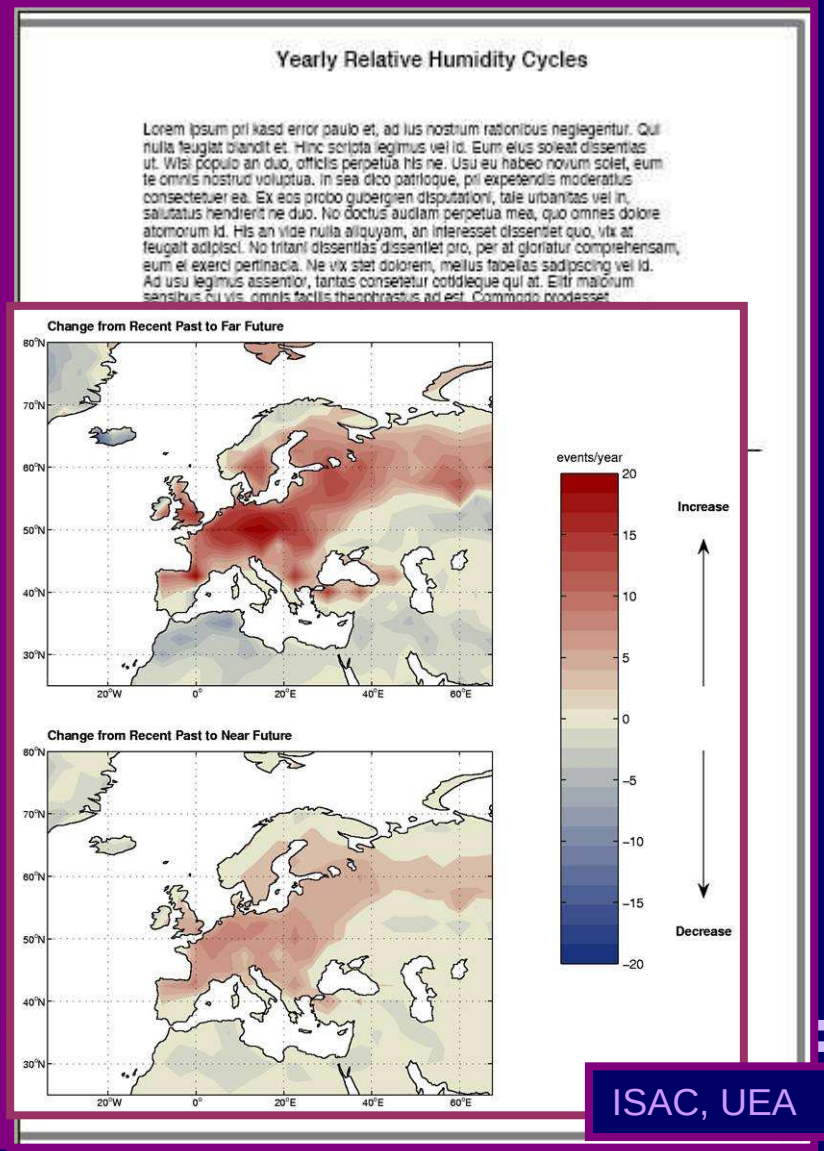
Hadley Model (HCM3a2)

Diapositive 9

c2 c; 14/01/2007

Vulnerability atlas: Salt Crystallisation





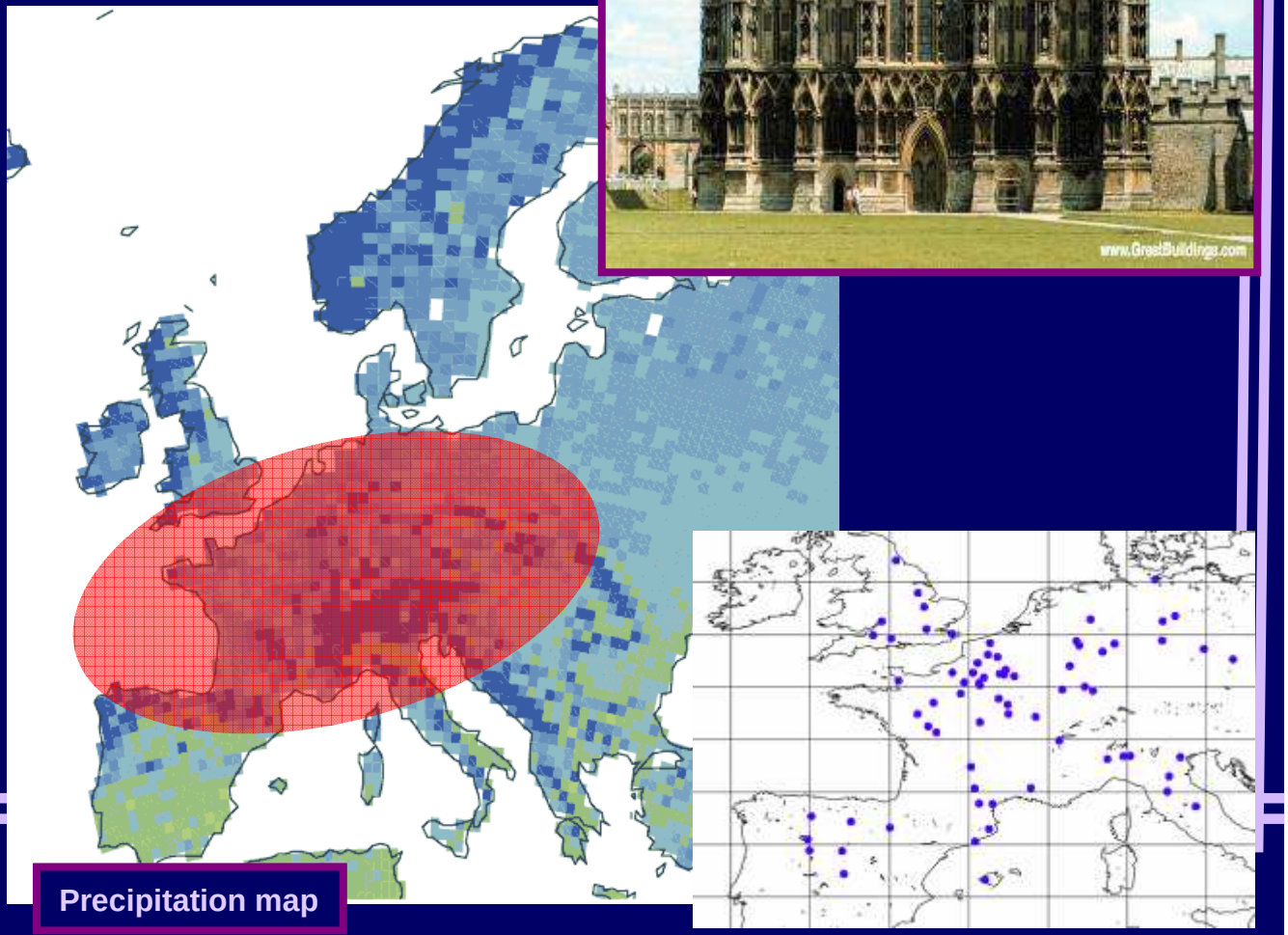
ISAC, UEA

Architectural form

Will salt damage seek out gothic architecture?

Porous stone

Central and Western European area

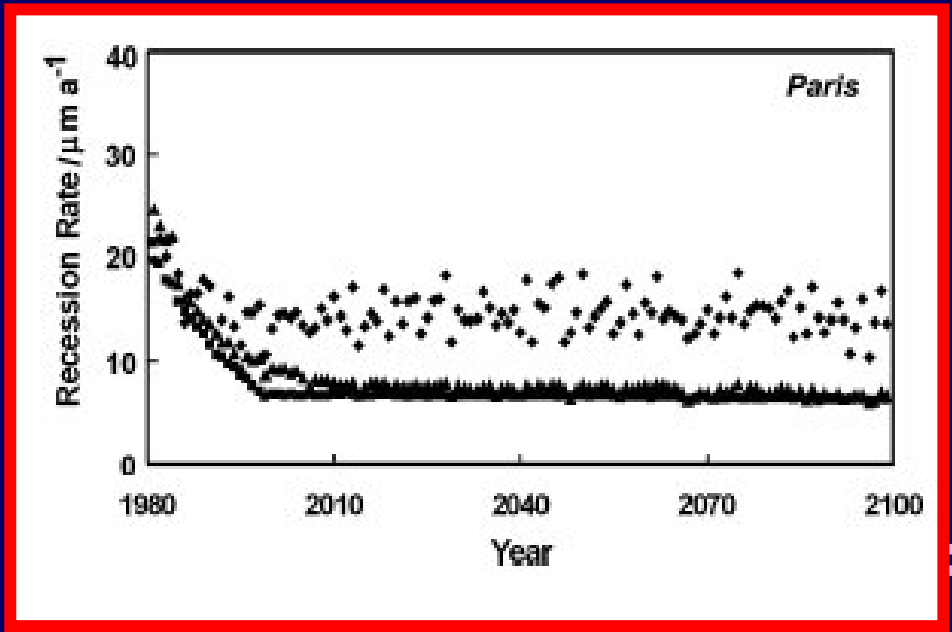


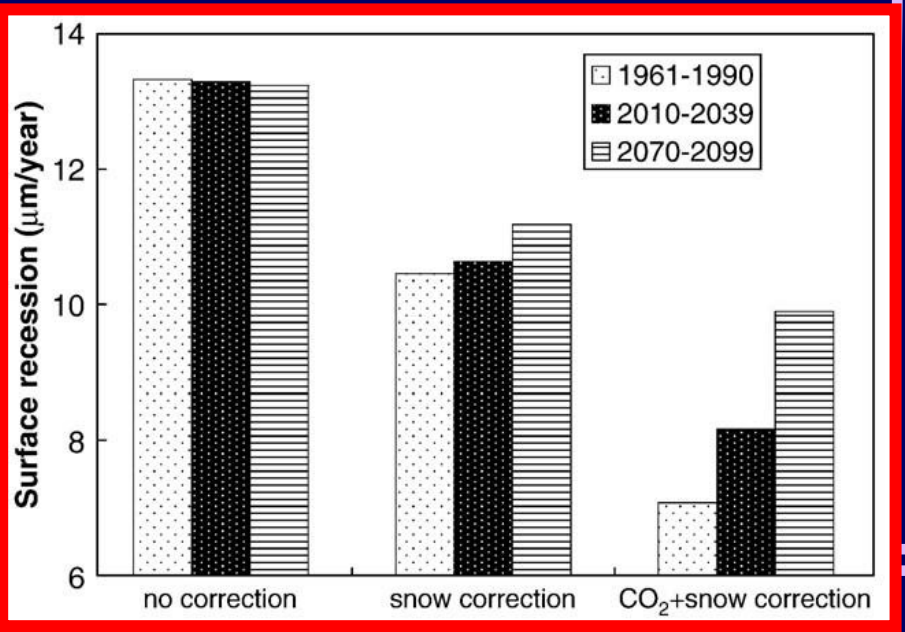
Precipitation map

Surface recession

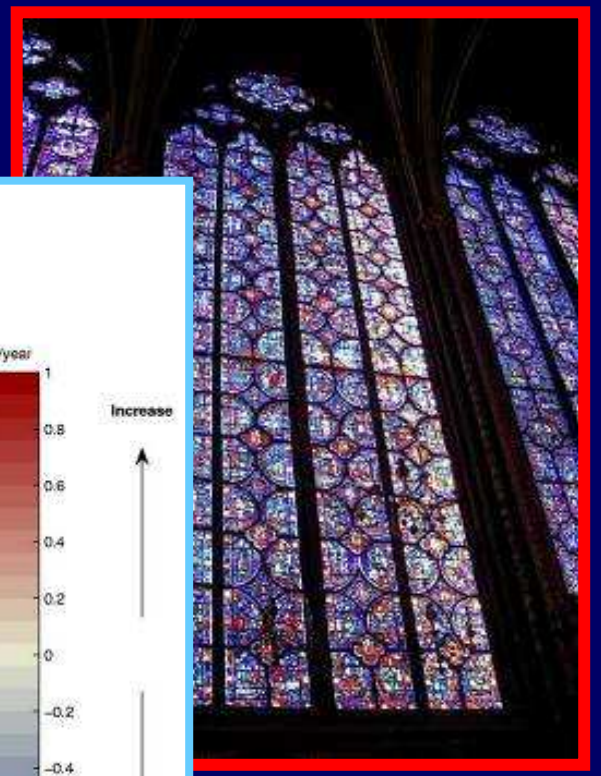
Increase in the karst recession rate of carbonate stone, resulting from the rise in carbon dioxide concentrations.

Total recession rate remain well below the severe rates of attack that occurred in the first half of the 20th century.





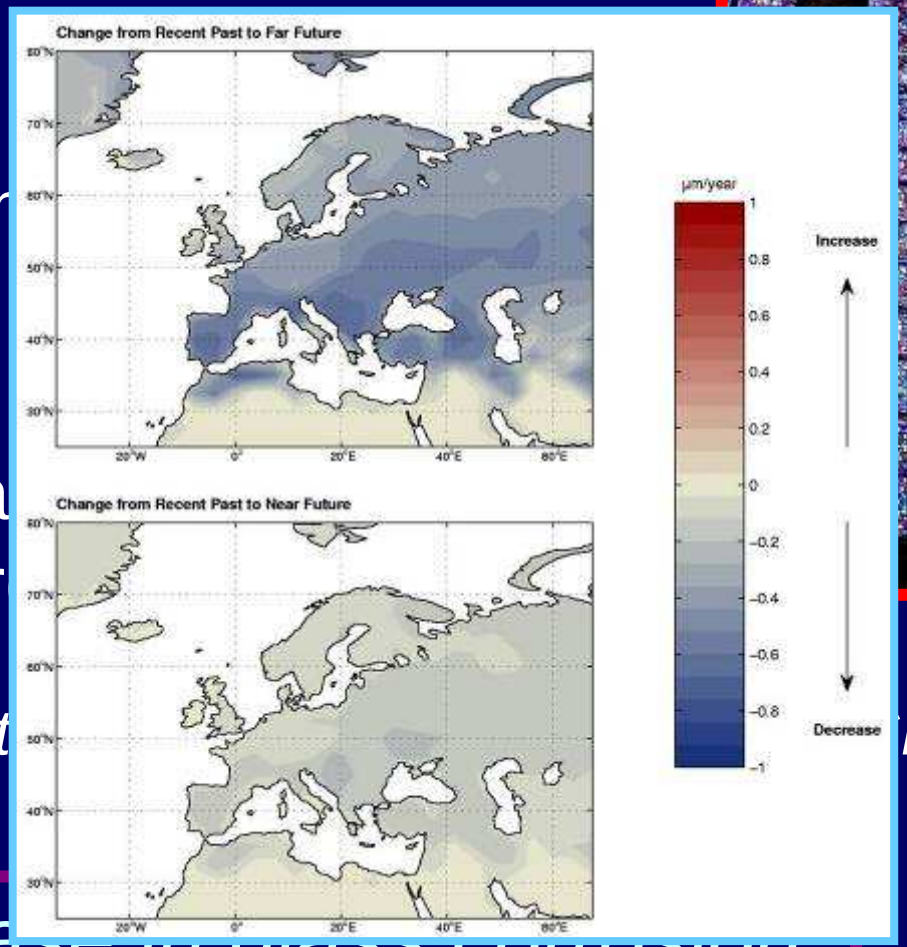
Corrosion of glass



Chemical attack
degradation m

Medieval Glass:
by humidity, a
dust, micro-or

Damage funct *ES)*



Minor decrease in glass corrosion all over Europe

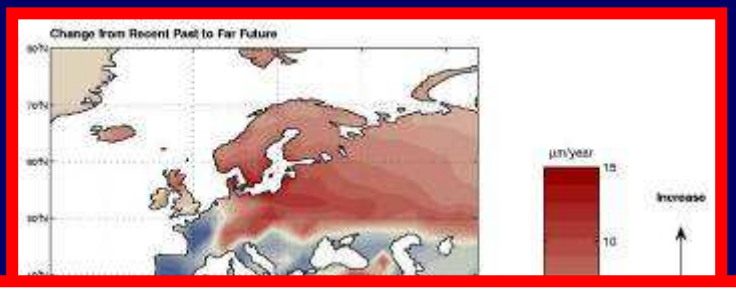
Corrosion of metals

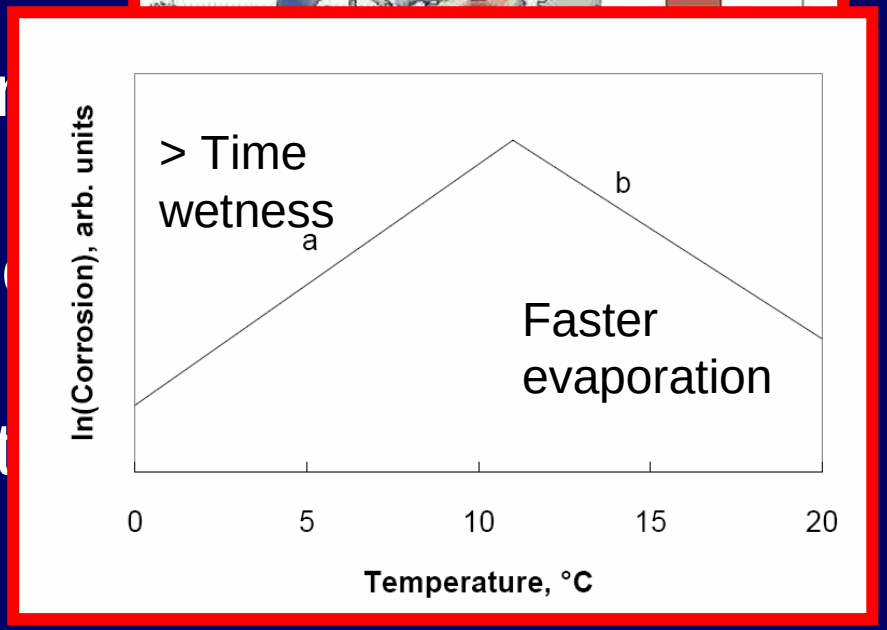
Chemical effects on steel/iron, bronze

Corrosion expected to increase in Northern Europe and to decrease in Southern Europe.

Trend dominated by average annual temperature.

Maximum corrosion effect observed at 10 ^{o}C.





Damage function (MULTI-ASSES)

Wood decay humidity shocks

Swelling-shrinkage of wood main hazard to cultural wooden objects in-doors.

Risk index: quarterly number RH variations which exceed 30% over two consecutive days.

Less stable future climate

Number of events will increase up to 100%

Bio-infestation of wood, outdoors

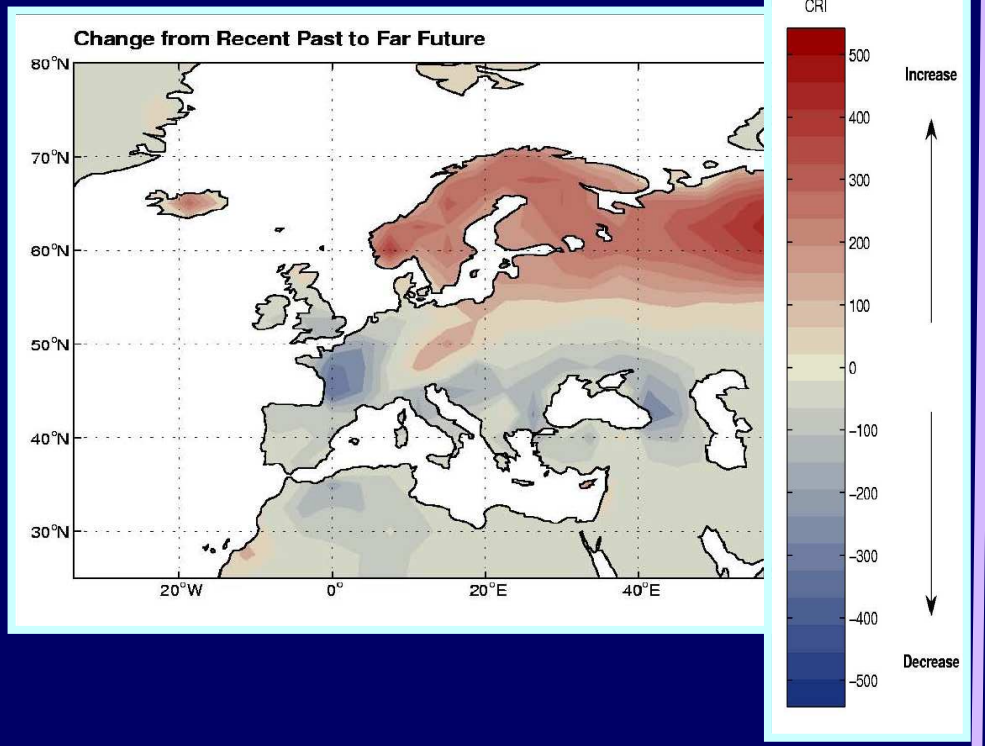
Fungal problems occur in the presence of excess water

Growth is possible between 2-30 ^{o}C

Depends mainly on precipitation pattern and temperature

Indices for fungal growth

Index used in Noah´s ark considers moisture penetration in wood, temperature and precipitation patterns



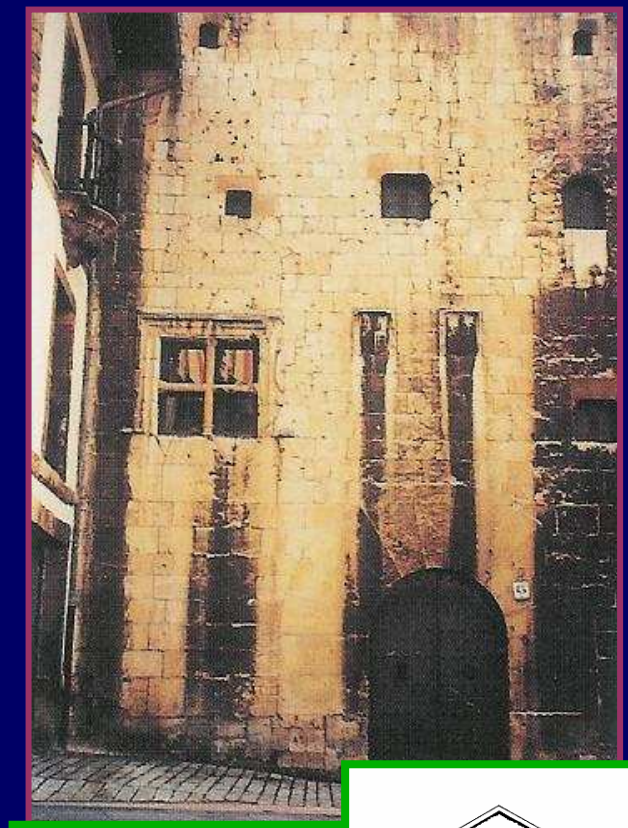
Risk will increase in the North and decrease in the South

Wind driven rain Redistribution processes

Blackening perception

Desire for cleaning increases with the amount of soiling.

…lighter or darker is OK but not like that



Aesthetics of patterns

Grossi and Brimblecombe (2004)

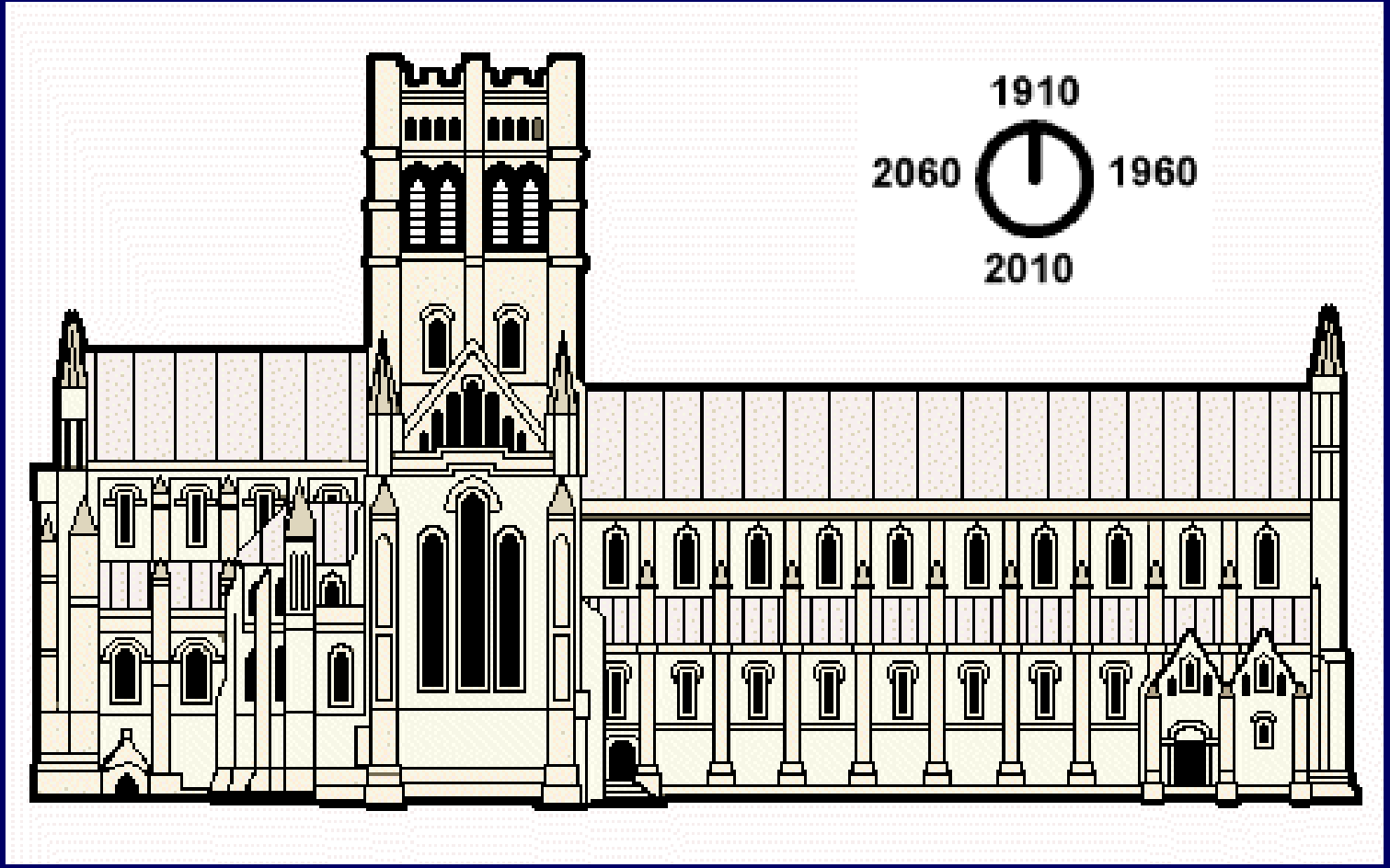
University of East Anglia

Colour change

- Evidence of warming of soot colour e.g. Tower of London
- Sulfation and iron oxidation
- Also likely to be oxidation of diesel soots – possibly both surface organic compounds and the carbon core
- Different biological growth

http://en.wikipedia.org/wiki/Image:Toweroflondon2.jpg

Future yellowing?

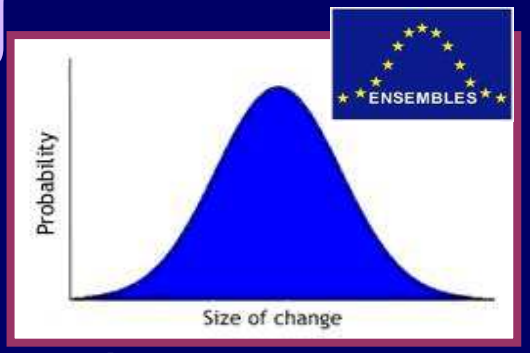


Cathedral of St. John the Baptist (Norwich)

Alison Green (2006)

Present / Future Modelling

Probabilistic projections - ENSEMBLES



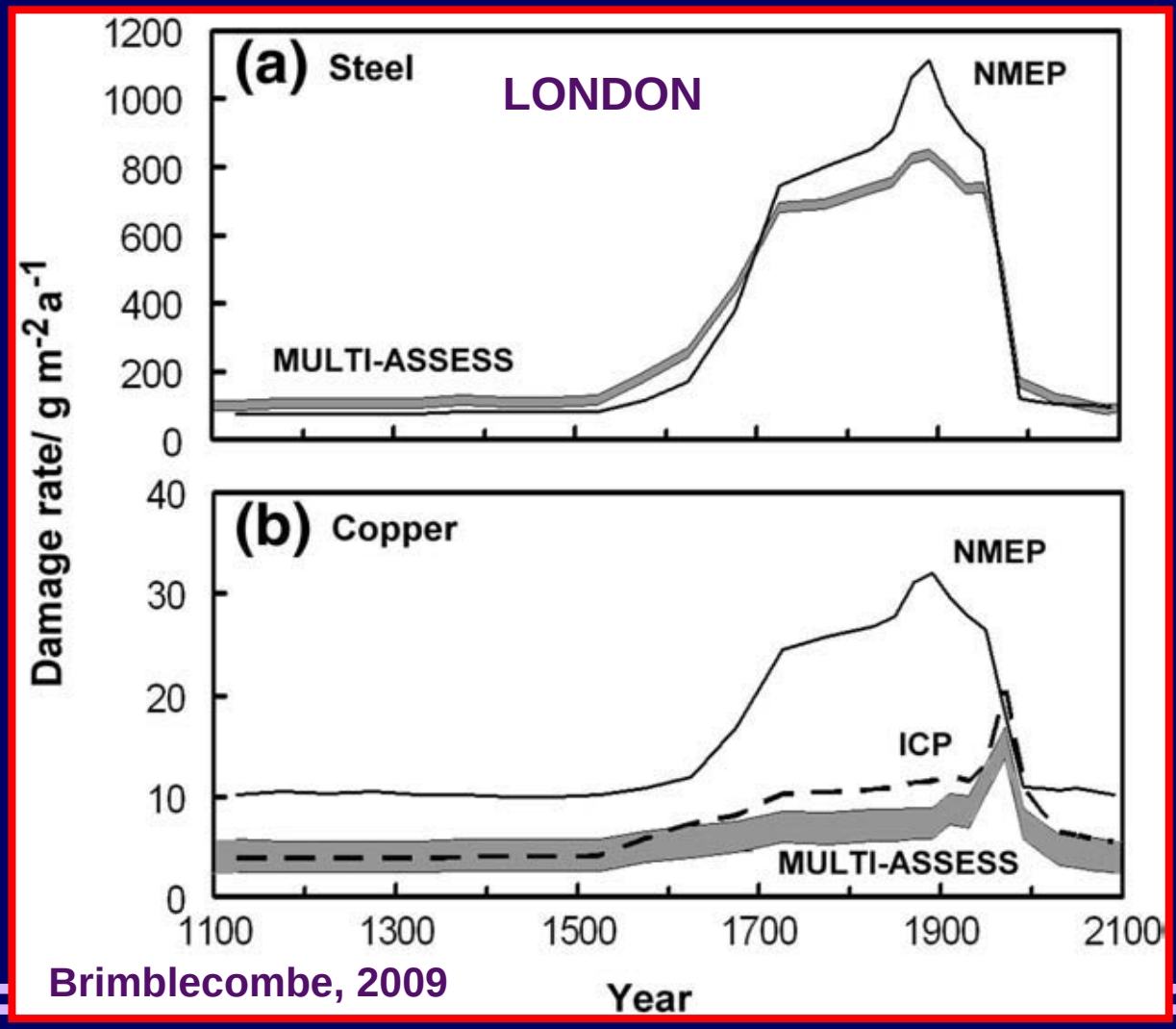
From materials to sites: time and space scaling.
Improve heritage climatology


http://travelwithkids.about.com2.htm

From sites to architectural detail

Mapping the past

Millennium damage / London



Brimblecombe, 2009