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### ■ Protecting heritage in a changing climate. Results of Noah's Ark project

#### Sommario

I cambiamenti climatici sono attualmente una priorità nell'agenda politica internazionale, ma pochi hanno considerato gli effetti che possono provocare su edifici e monumenti..



Il Progetto Arca di Noè ha studiato come i cambiamenti climatici possono influenzare il patrimonio culturale europeo. Il progetto ha prodotto il primo Atlante di Vulnerabilità che mappa le aree a maggior rischio ai fini della protezione dei beni culturali. Sono state inoltre fornite linee guida che propongono strategie di adattamento finalizzate alla gestione del nostro patrimonio culturale.

#### ABSTRACT

Climate change is high on the international political agenda, with governments increasingly concerned about its impact on people and landscapes. So far, however, few studies have considered the effects of altered weather on important buildings and monuments.

The Noah's Ark Project has studied how climate change might affect European cultural heritage. The Project has created the first Vulnerability Atlas, which maps the climate likely to affect European cultural heritage. As for its policy impact, Noah's Ark has also produced Guidelines offering "adaptation management strategies" for cultural heritage under climate change conditions.

The Noah's Ark Project has studied how the predicted scenarios of climate change translate into conditions that damage the built environment, aiming to highlight areas of Europe where cultural heritage is likely to suffer most, and offer adaptation strategies specific to different materials and structures.

The three-year project began in 2004. It has brought together world-class climatologists and specialists in the protection and conservation of cultural heritage. There are ten partners: research institutes from Italy, Sweden, Poland, the Czech Republic, Spain and Norway; two British universities; an insurance company specialising in churches and historic buildings, and a small environmental assessment company from Spain.

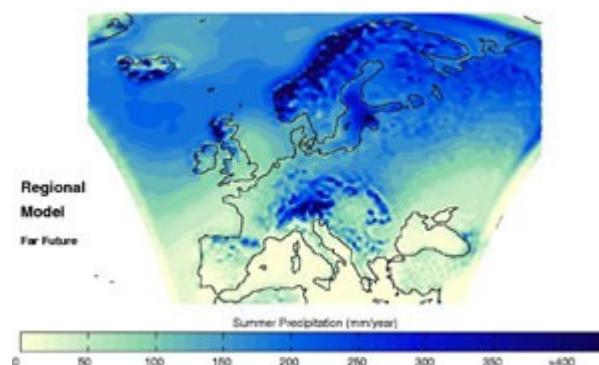
The climate parameters used for mapping the future scenarios were extracted from the General Climate Model (HadCM3) and the Regional Climate Model (HadRM3) of the Hadley Centre (UK). The model output used for mapping relied on A2 scenarios (IPCC SRES Emission Scenarios used in TAR and FAR).



The selected geographical area centered on Europe. Air pollution data of gases such as SO<sub>2</sub>, HNO<sub>3</sub>, O<sub>3</sub> and pH precipitation have been produced for future scenarios: yearly means for 1990, 2020 and 2085 over the European area have been used.

For each climate parameter, thirty-year mean value maps have been plotted using HadCM3, as long periods are more climatologically significant. Mean value maps have been produced for the recent past (1961-1990), near future (2010-2030) and far future (2070-2099), showing how the scenarios for a particular parameter develop. In addition, difference value maps between the far future and recent past, and the near future and recent past, have been produced in order to quantify the changes with respect to the present scenario.

The regional model far future values have also been plotted, but with higher resolution. The far future period is crucial in climate investigations, since it is estimated that the most significant changes will occur in this period.



The Project has created the first Vulnerability Atlas, which maps the climate likely to affect European cultural heritage. The Vulnerability Atlas brings together different types of maps and research outputs for future scenarios, linking climate science to the potential damage to cultural heritage: climate, heritage, damage, risk and multi-risk maps are included.

In addition thematic pages are adopted when the production of maps is not possible and alternative methods are required to investigate the future change of a particular type of damage. In terms of policy impact, Noah's Ark has also produced Guidelines offering "adaptation management strategies" for cultural heritage under climate change conditions.

These adaptation strategies should enable heritage stakeholders, public policy-makers and national heritage organizations to prepare for future climate change pressures. Among the Project's conclusions, it should be emphasised that water appears to constitute the greatest threat to cultural heritage.

Intense rains, flooding, or simply increased rainfall can overload roofing and gutters or penetrate into materials and deliver pollutants to building surfaces. Water is also involved in humidity change, which affects the growth of micro-organisms on stone and wood, as well as determining the formation of salts, which degrade surfaces and influence corrosion.

Furthermore, drier seasons increase the salt weathering of stone and the desiccation of the soils that protect archaeological remains and lend support to the foundations of buildings.

**Reference**

EC Project Noah's Ark (SSI-CT-2003-501837): <http://noahsark.isac.cnr.it/>

**Picture captions:**

1. Noah's Ark Project
2. Milan Cathedral
3. Summer precipitation for the far future (2070-2099) HADRM3 Model

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