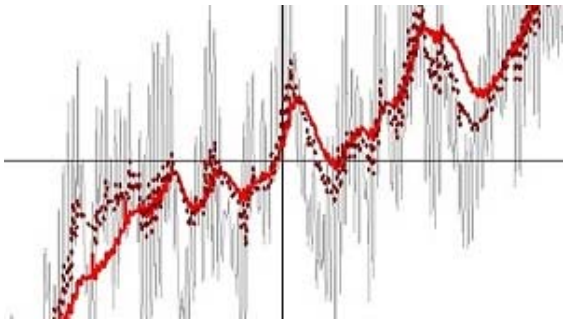
Climate for Culture project: first results

THURSDAY, 15 MARCH 2012 12:34



In the face of global climate change, the project **CLIMATE FOR CULTURE** is investigating the potential impact of climate change on Europe's cultural heritage assets – particularly on historic buildings and their interiors.

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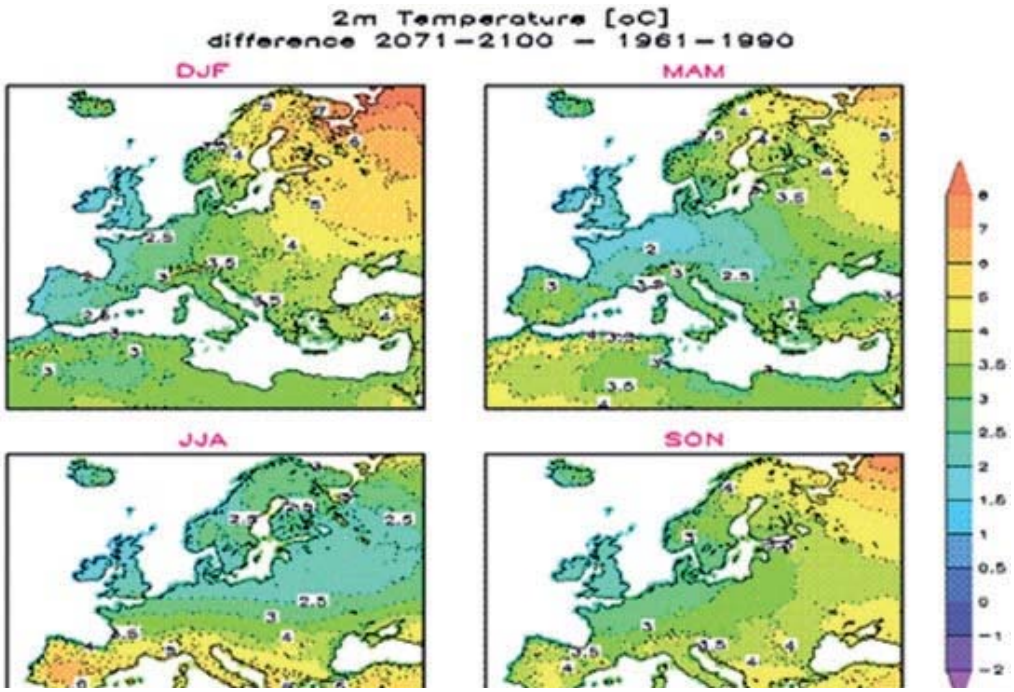
The **Climate for Culture project** (**http://www.climateforculture.eu**), funded by the European Union from 2009 to 2014, involves 30 partners from all over Europe and Egypt assessing the potential of climate change to cause damage to cultural heritage. One of the key elements of the project is the use of computer high-resolution simulation models of future climate conditions in different parts of Europe and neighbouring Mediterranean regions up to the year 2100, and how this may alter the structure and stability of historic buildings and the collections within. Armed with this information, the project aims to identify the cultural heritage most at risk in particular regions, so as to encourage the development of strategies to mitigate the effects of climate change, including through policy makers and the Intergovernmental Panel on Climate Change (IPCC) reports. Furthermore, the project provides insight into the possible socio-economic impact of climate change, given the importance of cultural heritage to Europe's economy.

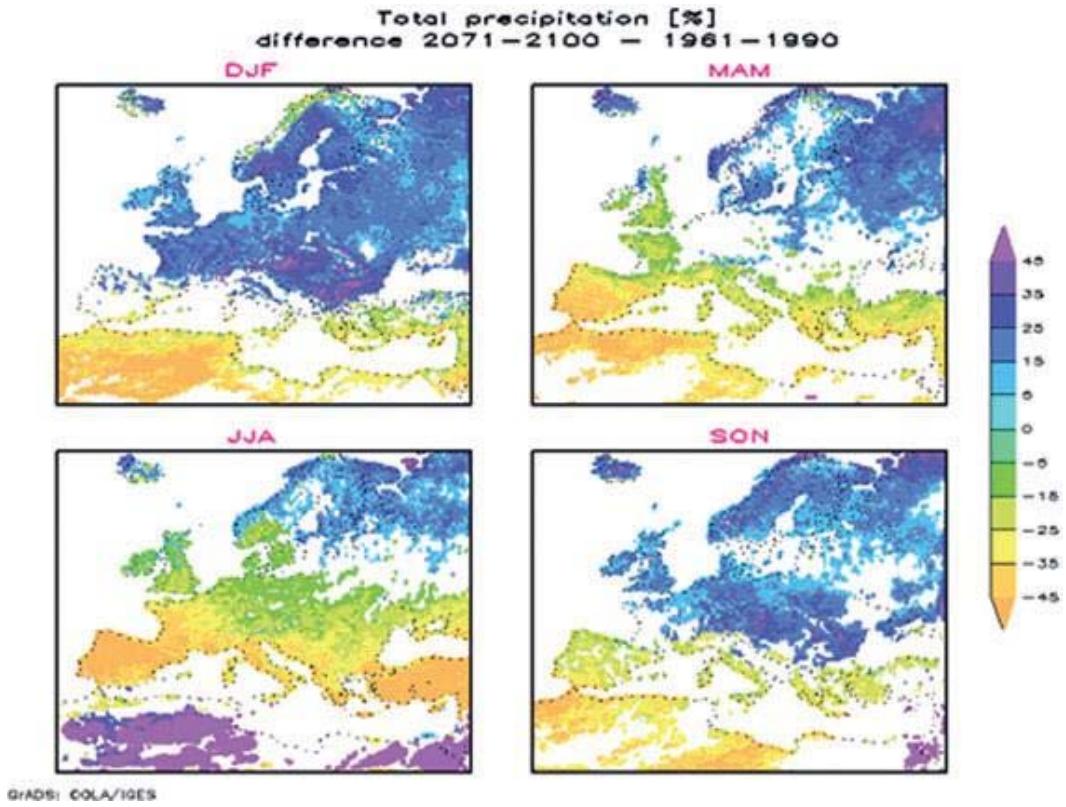
In order to identify the most substantial risks, the Climate for Culture project has taken the innovative approach of correlating high resolution climate change scenarios with building simulation models. The first Work Package of the project, led by the Max Planck Institute of Meteorology in Hamburg, Germany, aimed to create high resolution climate evolution scenarios for assessment of damage to both movable and immovable cultural heritage. The starting point was to use two emission scenarios known technically as A1B and RCP4.5. from the IPCC reports AR4 and the future AR5. Both scenarios are calculated with the spatial resolution of up to 10x10 km grid size and for timeframes spanning the years 1960 – 1990, 2020 – 2050 and 2070 – 2100.

In this context, a first set of climate indicators with a temporal resolution of 1h could already be produced for the A1B emission scenario, allowing investigators to make initial statements on changing indoor conditions of historic buildings with building simulation programmes.

Images 1 and 2: Projected changes of temperature and total precipitation for Europe and the neighbouring Mediterranean regions, period 2070 – 2100



Climate for Culture project image 1



Climate for Culture project image 4

Images 1 and 2 show the projected changes of temperature and total precipitation for Europe and the neighbouring Mediterranean regions for the future time period 2070 – 2100. One predicted change, for example, is a temperature increase of 1,5-2°C in the winter months for countries such as Germany, the Netherlands, Belgium and most of the French inland. Based on actual measured data these projections were validated using different hygrothermal building simulation programmes.

St. Margaretha's Church, Roggersdorf

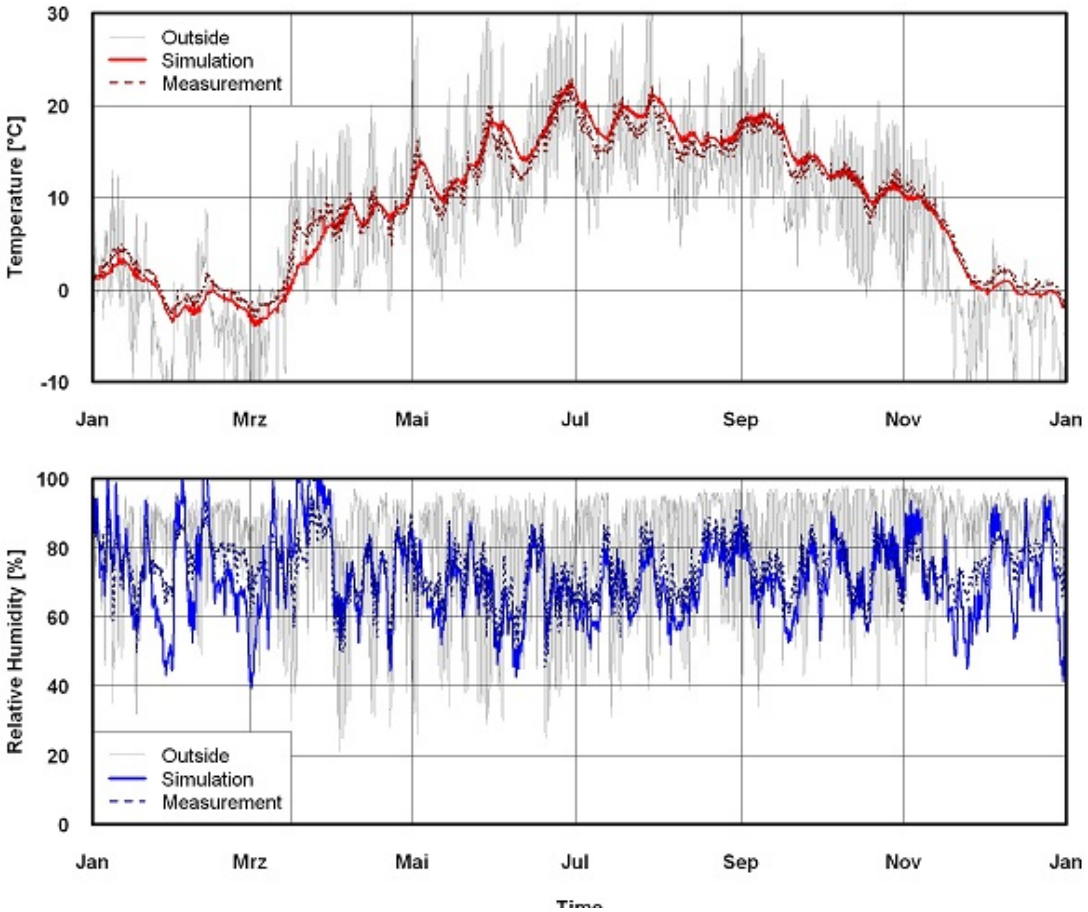
Image 3 (left): St.Margaretha's Church, Roggersdorf, Germany

This approach made it possible to model the indoor climate of the unheated church St. Margaretha in Roggersdorf, Germany (see image 3), which is serving as a case study under current and projected climate change conditions. This was achieved using the building simulation software WUFI®plus (Wärme und Feuchte instationär - Transient Heat and Moisture) (see image 4).

simulated model of St. Margaretha's Church, Roggersdorf

Image 4 (right): simulation model of St. Margaretha Church, Roggersdorf, using WUFI®plus software

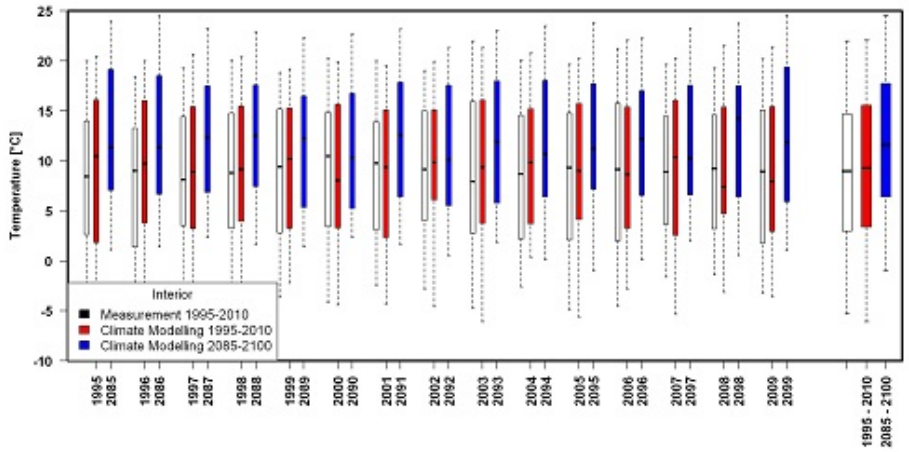
Available measurements allow the simulated parameters to be reconciled (see images 5 and 6 for indoor temperature and relative humidity - two of the parameters being considered within the project).



Simulation versus actual measurements for outside temperature and precipitation

Images 5 & 6 (above): difference between actual measured and simulated indoor climate

The consistency between the simulation results compared with actual measurements enabled a first use of predicted climate parameters. We then applied statistical analysis using box plots, in order to confirm the consistency between actual measured indoor temperatures and actual and projected outdoor climate data.



simulated indoor climate

Image 7 (left): simulated indoor climate

Image 7 shows the respective simulated indoor climate as a box-and-whisker diagramme, with the white whiskers showing the temperature of the actual measured outdoor climate data for the time period 1995-2010, the red whiskers showing the temperature with projected climate data for the period 1995-2010 and the blue whiskers showing the climate modelling for 2085-2100. This analysis helps to validate the climate modelling approach by showing that the data measured is highly congruent with the projected data. Most importantly, the models provide more precise knowledge on temperature change and enable a more confident prediction of significantly higher indoor temperatures for the period 2085-2100.

These results on the changing thermal environment, calculated by using building simulation software and high resolution climate modelling, allow a first assessment of the influence of climate change on historic buildings – using an unheated church as a model. With further use, this method will support more reliable predictions on temperature and humidity levels as well as projections of other parameters such as daily fluctuation, freeze/thaw cycles or differences between day and night.

The next step in the Climate for Culture project will be to assess predicted changes in the indoor environments of selected case studies. During the next Mid-Term-Assessment meeting scheduled to take place from 7 to 9 May, 2012 in Prague, the process will be evaluated and future steps for mitigation and adaptation strategies further developed.

Bibliographic Information

Publisher:	Heritage Portal
Keywords:	• Built Heritage • Collections • Environment • Technology
User Tags:	computer simulation models, climate change
User Tags:	• Belgium • France • Germany • Other (specify)

Link: Climate for Culture