



# Climate for Culture



Climate Modeling

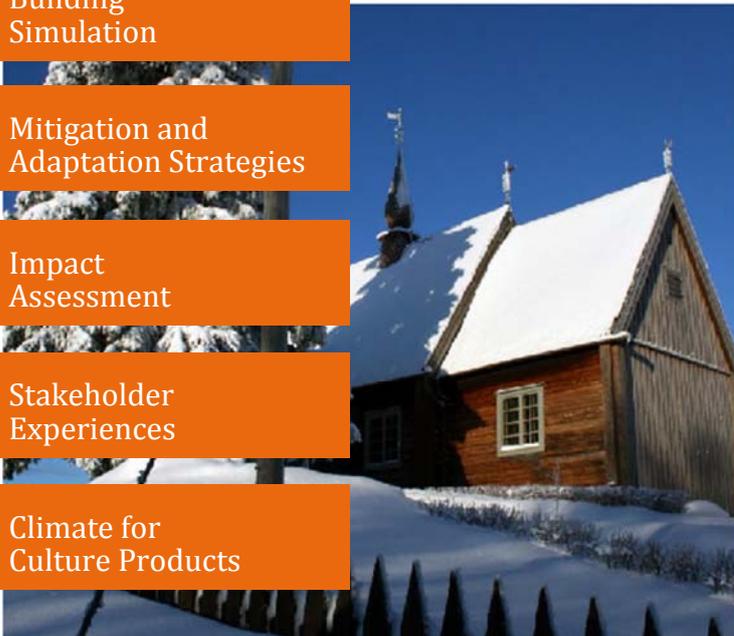
Building Simulation

Mitigation and Adaptation Strategies

Impact Assessment

Stakeholder Experiences

Climate for Culture Products



## Report on awareness and wider societal implications

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The large scale research project Climate for Culture has made contributions and created impact on various levels:

Raising awareness about the importance of cultural heritage for Europe and about the vulnerability of cultural heritage to climate change both at political level as well as at cultural heritage management level and at the level of wider society through various dissemination channels (newspapers, website with video interviews, TV coverage, online surveys, participation and organization of own international conferences, workshops and face-to-face visitor interviews and personal talks).

Climate for Culture was a truly multi- and trans-disciplinary research project involving scientists, heritage managers, restorers, economists, engineers and politicians and thus provided an ideal opportunity for young researchers and the project's 33 PhD students to learn and research in such a trans-disciplinary environment. During this project good contacts could be established within the team which created a European network of cultural heritage scientists in place. They have the strong will to further collaborate in the near future and are well trained in coping with the problems of trans-disciplinary research. This skill is urgently needed in Europe because the grand societal challenges can only be solved through working together with many different disciplines and with the engagement of society and political decision makers but up to now this skill is not well developed.

The main innovation of the project is the introduction of simulation and modelling tools and combining climate modelling and building simulation to develop a methodology to predict the impact of climate change on the outdoor and indoor environments of historic buildings and on the future energy demand needed for climatisation of these buildings. This methodology did not exist before at all and is based on the coupling of a high resolution regional climate model with whole building simulation. A list of 12 main climate indices was defined, then processed from the climate modelling and validated with past meteorological data. The methodology will be made available at the website of the project and it can be used by the whole building sector but also by individual building owners for better planning of sustainable conservation measures, especially how to achieve sustainable climatisation of historic buildings. These findings are based on the vast data collected about the various methods for climatisation of historic buildings all over Europe; it has been discussed by the experts from the project with the heritage owners and assessed in terms of their transferability, usability as well as their energy and preventive conservation performance. This approach even when taking the uncertainties of the different methods into account will give directions and enable better adaptation strategies in the future to preserve European Cultural Heritage.

The partner SMEs have been benefitting from the research and have applied these new results already, e.g. partner, Kybertec and Käferhaus are using EMC control, a new conservation heating control for Temperierung was transferred at St. Renuat Chapel by SME Krah&Grote Measurements supported by partner BSV and Fraunhofer, at castle Linderhof and Schoenbrunn a revitalization of the historic climatization system could be implemented leading to energy saving and better indoor climates. A



virtual testing of a low cost control unit by Kybertec and CTU Prague has been introduced using hygrothermal simulation of Karlstejn Castle.

The energy and preventive conservation performance of different climatization systems was examined via hygrothermal buildings simulation. For example the energy use to reach certain indoor climate target values by means of humidification, dehumidification, conservation heating and controlled ventilation were compared for the outstanding monument of Torhalle Lorsch, Germany.

As a consequence several follow up projects were started, among them a national project in Germany about Temperierung and its effects on building physics and preventive conservation of artefacts by Fraunhofer IBP and Technische Universität München. The group from Eindhoven Technical University, The Netherlands, started a project on collections climate with Krakow University.

A comprehensive report on the use of renewable energy in historic buildings was created by Gotland University and will be available at the website for interested heritage managers and owners.

Another important achievement which is already used by several museums is the software DigiChart (transforming analogue data into digital formats). Partner Jan Radon has gathered the feedback information from beta testers of thermo hygrograph stripe digitizing software which he used to make last improvements. The improved version of **DigiChart** software is released on the website <http://www.climateforculture.eu/index.php?inhalt=furtherresources.software> and can be ordered for free from Dr. Ing. habil. Jan Radon; Engineering Consulting & Software Development at [jradon@kki.pl](mailto:jradon@kki.pl);

The European Standardization Committee has a very strong influence on the heritage conservation field since member states have to implement the European norms. Climate for Culture research has provided the scientific support for drafting the standard CEN-TC 346/WG 4 N0283 "Conservation of cultural property – Procedures and instruments for measuring moisture content in objects and building materials" which is now launched to the public enquiry). The partners Dario Camuffo, Ralf Kilian, Tor Broström and Andreas Weiß have actively contributed to CEN TC 346 with results from Climate for Culture.

Climate for Culture also has made for the first time an in-depth study on the economic benefits of built heritage interiors conservation from climate change damages in Europe.

This study is the most comprehensive and in-depth analysis ever undertaken of the economic benefits of reducing climate change damages to built heritage interiors in Europe. Five European case study countries were selected – Germany, Italy, Romania, Sweden and United Kingdom – and ten case study sites within these countries – Ham House, Knole and St. Joseph & the English Martyrs RC Church (UK), Gotland churches (Sweden), Bronnbach Monastery, Linderhof Palace, Neuschwanstein Castle, and Pergamon Museum (Germany), Black Church (Romania), and Ca'



Rezzonico (Italy). The case studies sites include three different types of built heritage – palaces or manor houses, churches, and museums. Over 4,000 people in the 5 countries were surveyed, using on-line general population surveys to value the conservation of each country's built heritage interiors from climate change damages; in addition, around 2,000 visitors in the 10 individual sites to value the conservation of the interiors of each site were interviewed. Considerable economic benefits both for visitors and the general population have been found associated with the protection of CBHI from climate change damages, across all countries and case study sites. Also heritage conservation values can successfully be transferred with moderate errors between sites, particularly when populations and valuation methodologies are most similar.

Two stakeholder workshops were organized to discuss the Climate for Culture methodology and its results with our stakeholder partners:

- CfC Stakeholder Workshop, 17-18 April 2013, Richmond (UK) with members from the National Trust and the Bavarian Castle Administration
- CfC Stakeholder Seminar at Institut National du Patrimoine in Paris (FR), 13-14 January 2014 with around 150 conservation students, practitioners and architects from France.

Also a training course for young scientists on how to perform climate measurements was organized by Dr. Dario Camuffo in Padova at CNR-ISAC. Regular meetings of the PhD students including also external PhD students enhanced the exchange of knowledge in the field of climate change and cultural heritage and helped to create a European network and research area in this field.

In addition, two main international conferences were organized by the Climate for Culture team to disseminate the results. The international feedback received from leading scientists from the US and other countries underlined the pioneering research of Climate for Culture in the heritage sector. Such a comprehensive research approach is not undertaken anywhere else in the world and maintains the leadership of the European Union.

The international **Munich Climate Conference** entitled "Climate for Collections: Standards and Uncertainties" attracted more than 320 participants from 17 countries. Conservators, curators, conservation scientists, archivists, environmental engineers, architects, and decision-makers from the cultural field examined the burning question of the extent to which all these factors are putting at risk our duty as conservators to pass on undamaged to the next generation the collected heritage of mankind and thus the cultural memory of the earth.

The conference was held in Munich, 7– 9 November 2012, as part of the EC funded Climate for Culture research project, on the occasion of the 75<sup>th</sup> anniversary of the Doerner Institut. The climate conference has also been supported by the VDR which is the German association of restorers and conservators.



The minds of specialists worldwide are occupied with seriously threatened museum standards, high energy costs, the (over)-technologization of buildings and unsuitable museum architecture. At the congress, the debate ranged from specific material constants, historic ventilation and air-conditioning concepts in museums and heritage objects and the development of judicious standards all the way to the effects of climate change on the cultural heritage of the planet.

Partner Doerner and JAS have planned and organized the whole conference including the proceedings of the conference. The publication "Climate for Collections: Standards and Uncertainties" is available for free download (click on the colour tube at <http://www.doernerinstitut.de/en/index.html> or go directly to [http://www.doernerinstitut.de/en/projekte/kuk2013/kuk\\_1.html](http://www.doernerinstitut.de/en/projekte/kuk2013/kuk_1.html)).

In addition 20 posters displayed at the conference are available for download. A hard copy version of the book can be purchased from Archetype Publications <http://www.archetype.co.uk/publication-details.php?id=185>.

The findings from the five years of multidisciplinary research of Climate for Culture on the impact of climate change on historic buildings were presented in 28 lectures at the international conference which took place 9 -10 July 2014 at Munich in the Residence palace. At this final meeting of the project around 160 experts (scientists, conservators, curators, administrators, journalists and politicians) from Europe, the United States, Iran and Taiwan discussed with the Climate for Culture team the newly developed Climate for Culture methodology and its transfer into practice.

In the closing speeches at the evening ceremony in the Emperor's Hall, Director Dr Kurt Vandenberghe from DG Research and Innovation of the European Commission emphasized the responsibility of the European Union and its citizens to protect and sustain our cultural heritage and how important the role of research and innovation is in achieving these goals. He expressed his thanks to the multidisciplinary Climate for Culture team for the substantial contributions they had made. Dr Angelika Niebler, member of the European Parliament, recalled the support of the European Parliament for the inclusion of cultural heritage research in the European research programme Horizon2020. In particular, she explained that the members of the EU Parliament are very pleased to be regularly informed about the progress in research on the preservation of cultural heritage in Europe. In this respect, the Climate for Culture project has been exemplary.