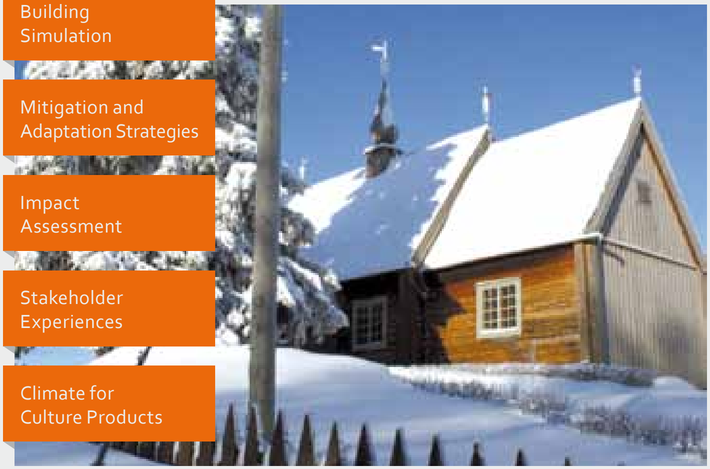
Final Public Report

Climate for Culture



- Climate Modeling
- Building Simulation
- Mitigation and Adaptation Strategies
- Impact Assessment
- Stakeholder Experiences
- Climate for Culture Products

BUILT CULTURAL HERITAGE IN TIMES OF CLIMATE CHANGE

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Final publishable summary report

Executive Summary

Climate change combined with worldwide energy and resource deficiency problems are serious threats of our time. However, little studies are published how climate change affects our built cultural heritage. For a sustainable management of our cultural heritage, it is vital to know how the future changing climate will influence the indoor climates in buildings. Cultural heritage is a non-renewable resource of intrinsic importance to our identity: therefore there is a need to develop more effective and efficient sustainable adaptation and mitigation strategies in order to preserve these invaluable cultural assets for the long-term future. More reliable assessments will lead to better prediction models, which in turn will enable preventive measures to be taken, thus reducing energy and the use of resources.

In order to assess the most substantial risks of changing climate conditions on historic artefacts in Europe and the Mediterranean, the large-scale integrated EU-Project CLIMATE FOR CULTURE has taken for the first time ever, the approach of correlating high resolution regional climate modelling with whole building simulation tools to produce scenarios of future indoor climates in historic buildings. Up to now the use of modelling and simulation tools for the cultural heritage sector is not yet widely used because research in this field is still lacking. With the further development and adaptation of whole building simulation and inverse modelling Climate for Culture made substantial contributions to the enhancement of these methods in the management of cultural heritage buildings.

For the simulation tools, huge amount of T and RH data are needed which are however mostly only available in analogue form because recordings of temperature and humidity are still performed with analogue thermo-hygrographs in many museums and historic buildings: Thus a software algorithm has been developed to convert analogue into digitalized data. The software DigiChart can be downloaded for free at the Climate for Culture website.

When the Climate for Culture methodology is transferred also to the modern building sector, more efficient and sustainable adaptation and mitigation measures can be planned for example optimal climatisation strategies requiring less energy and using alternative energy sources. The risks to the building and to the interiors with valuable artefacts resulting from the outdoor and indoor environment have been assessed by damage functions based partly on newly developed laser interferometry (Digital Holographic Speckle Pattern Interferometry) investigations and by assessments of corrosive environments with highly sensitive glass sensor dosimeters from previous EU projects.

A comprehensive set of data from more than 100 historic buildings have been collected in a database and from this the concept of generic buildings has been developed. By using generic buildings, information about how indoor climate conditions change due to the changing outdoor climate can be obtained easily and quickly. So the high resolution climate projections for Europe and the Mediterranean can be visualised and show the impact of climate change in the various regions which are summarized in 55,650 climate and risk maps of future climate induced risks to historic buildings and their interiors.

A further innovation of the project lies in the elaboration of a more systematic and reliable damage/risk assessment which is deduced by correlating the projected future climate data with whole building simulation models and new damage assessment functions. Thus not only the impact on historic buildings and future energy demands can be evaluated, but also the possible effects on the related indoor climates in which the valuable works of art are kept. The Climate for Culture methodology is

then integrated into a decision making support software which provides building owners online information on how to adapt buildings to climate change.

Also for the first time, a comprehensive and in-depth analysis of the economic benefits associated with reducing climate change damages to built heritage interiors in Europe was undertaken which investigated attitudes, preferences and values for the protection of heritage assets from future climate change related impacts. This was done on the basis of two main questionnaires, one for the visitor surveys on selected sites in the United Kingdom, Sweden, Germany, Romania and Italy and one for representative general population surveys in those five countries.

Description of the project context and the main objectives

Climate Change is one of the most critical global challenges of our time. For many decades numerous scientists from all over the world have been researching this topic and complex climate models suitable for making future climate projections have been developed. Climate change in itself is not the main concern; more important is its impact on the planet. But there is not so much information available on how the changing climate affects mankind and its environment. Although many studies have been conducted to explore the impact of climate change on economy, biodiversity and agriculture or on fresh water availability, only little is known whether and how climate change influences our cultural heritage. Within the European funded project Climate for Culture running from 2009 until 2014, a multidisciplinary research team consisting of 27 partners from the EU and Egypt, performed research to make substantial contributions to estimate the impacts of climate change on the indoor environments in historic buildings and their vast collections in Europe and the Mediterranean.

For this purpose, the CLIMATE FOR CULTURE project has coupled for the first time ever climate modelling with whole building simulation tools: The high resolution climate change evolution scenarios provide the necessary climate indices for different periods in the past (1961-1990), near (2021-2050) and far (2071-2100) future. Here the regional climate model REMO with the high spatial resolution of approx. 10x10 km has been further developed over the whole of Europe and the Mediterranean. A set of climate indices was defined and calculated from the climate simulation which is then used in whole building simulation tools to assess future projections of outdoor climate changes on the indoor environments in historic buildings and its impacts on cultural heritage items in Europe and Egypt. In addition, predictions for seal level rise until 2100 produced from the climate models identifies the sites most at risk in Europe. By coupling of climate modelling with building simulation future indoor climates in historic buildings and energy demands for climatisation can be calculated; thus suitable mitigation strategies can be developed and tested. Valuable collections in historic buildings from different climate zones are included for in-situ investigation of contemporary and past problems and for the projection of future demanding issues.

Figure 1 shows the overall Climate for Culture methodology.

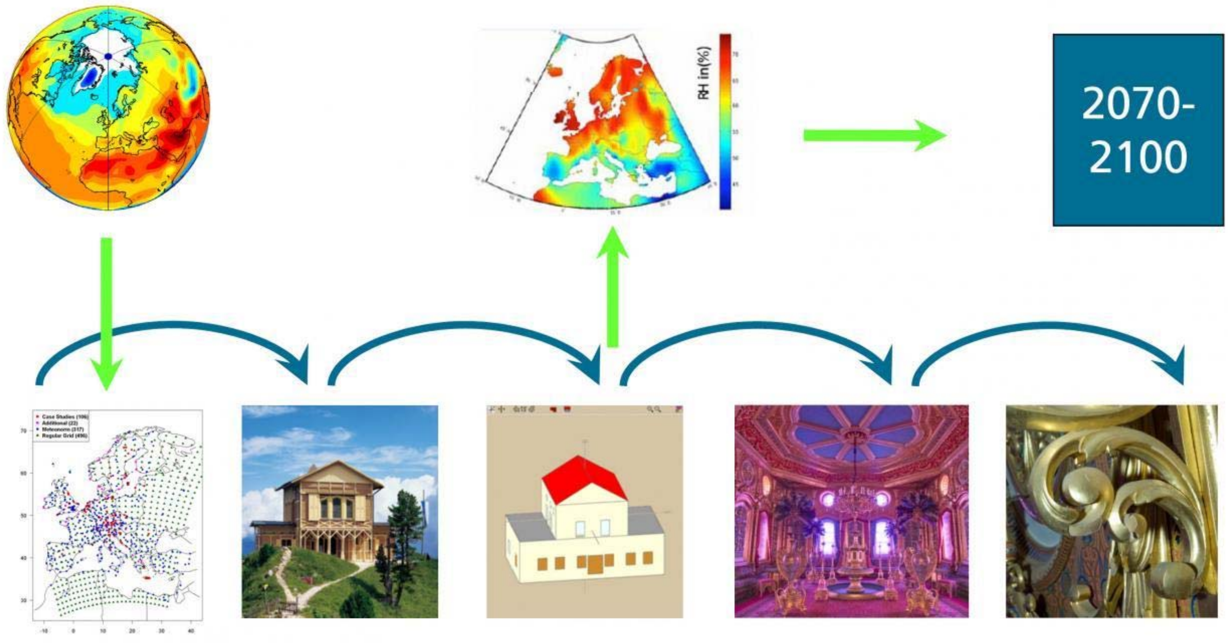

Figure 1: The Climate for Culture methodology

From the global climate model → to high resolution regional climate simulation → to case study historic buildings → to whole building simulation / generic buildings → to indoor environments and → to risk assessment of individual cultural heritage items.

For the high resolution climate simulations within the Climate for Culture project two scenarios were investigated, the A1B scenario and the very recent RCP4.5 scenario of the IPCC assessment report 5 (AR5). The mid-line A1B scenario assumes a greater CO_2 emission increase until 2050 and a decrease afterwards. In the recent past the global circulation model community launched the climate runs driven by the new AR5 IPCC emission scenarios which served for the second phase. RCP 4.5 stands for Representative Concentration Pathway (RCP) 4.5 and is a scenario of long-term, global emissions of greenhouse gases, short-lived species, and land-use-land-cover which stabilizes radiative forcing at 4.5 Watts per meter squared (W m-2, approximately 650 ppm CO_2 equivalent) in the year 2100 without ever exceeding that value. For the development of the whole building simulation tools, sets of climate indices were defined (see Table 1).

The test datasets were prepared for the period of 1950 to 2100. The calculations made for the period of 2001 to 2010 are based on the A1B IPCC scenario. Modelled climate data needed to be verified and processed to be suitable for building simulation. New methods and modules for the simulation tools had to be developed, implemented, tested and used. The successful application of suitable simulation tools allows computational testing of active and passive adaptation and preservation strategies. In a large study several building simulation tools were tested and two - Hambase and WUFI Plus - proved to be suitable to model temperature and the change in relative humidity fluctuations due to moisture buffering. Simulation models for case study buildings were developed in the course of Climate for Culture, e.g. Linderhof Palace, the Kings House on the Schachen, the church of Roggersdorf in Germany and Amerongen Castle in the Netherlands. Those case study building models were used to produce the first results, derive suggestions for software development and improvement and to apply also different active and passive measures that are specific for preventive conservation in the model.

Table 1: List of climate indices used in the building simulation tools

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 Counter radiation	W/m2
Cloud Coverage	%
Ground Temperature	°C
Ground Reflectance	-
Air Pressure	Pa

The development of the building simulation models is also based on real data from historic buildings collected as case studies. For this purpose a survey with a specially designed, questionnaire was performed to set up a range of case studies from all over Europe and Egypt. The questionnaire covers up to now over 100 case studies in eleven countries. Parameters like type of building, specific site-related factors, available indoor and outdoor climate data, observed damages and suitability for other work packages are reviewed and are transferred into a *Climate for Culture* database which has several layers of information. The list of case study buildings is continuously updated and further extended.

Based on the climate data received from the high-resolution regional climate model a climate classification map over all of Europe and Northern Africa was produced. The climate map is derived from an overlay of temperature and humidity for the baseline climate 1960-1990 since temperature and humidity changes have a great influence on most degradation processes of materials. The climate zones were established to organize the collection of crucial data from various historic buildings: For each climate zone, a zone leader was appointed to be responsible for harmonized data collection.

The case study buildings serve for the development of the whole building simulation tool including a generic building model and for the assessment of the effects of climate change. Therefore, in situ investigations of existing problems are carried out which are then be used for the projection of future challenging issues using whole building simulation and different situ monitoring technologies. The in situ measurements are performed by laser speckle interferometry which was developed in a previous EU project (Laseract) and by 3D microscopy. The two methods have been already successfully applied at the test site at Fraunhofer Institute for Buildings Physics in Holzkirchen (Germany) and at several case study sites in Croatia and Crete and show good complementarity. Further investigations by glass dosimeter sensors from the previous EC project AMECP to assess the corrosivity impact of indoor and outdoor conditions at cultural heritage sites throughout Europe have also been carried out at case study sites in Crete and Croatia and Germany. These examinations allow a much more precise and integrated assessment of the real damage impact of climate change on cultural heritage at regional scale. In terms of climatisation of historic buildings a survey of the state of the art has been finalized and has been used to develop appropriate mitigation/adaptation strategies. This means that active and passive measures were discussed and defined which resulted in the implementation of humidistat heating and equal sorption control as well as an absolute humidity control algorithm in WUFI®Plus. In addition different existing and new microclimate control approaches have been considered in the Hambase and MATLAB/Simulink environment.

The main innovation however, is the first ever use of a combination of climate modelling and building simulation tools to better predict the influence of the changing outdoor climate on the indoor environment in historic buildings up to 2100 and to calculate the future energy demand for environmental control in historic buildings. By using an automated procedure an assessment of the damage potential in various climate zones is performed. The project focuses on gradual changes of climate change and does not take into account extreme events; this was explicitly excluded by the 2008 call for proposals of the European Commission. Since recordings of temperature and humidity are still performed with analogue thermo-hygrographs in many museums, a software algorithm has been developed by Jan Radon to convert analogue into digitalized data. The software DigiChart can be downloaded for free at the Climate for Culture website. The project also examines a broad range of mitigation and adaptation measures: How to control indoor and microclimates energy efficiently and how revitalisation and enhancement of historical climatisation systems can lead to sustainable solutions for historical buildings. The Climate for Culture methodology is integrated into a decision making support software which provides building owners information on how to adapt buildings to climate change. Also for the first time, a comprehensive and in-depth analysis of the economic benefits associated with reducing climate change damages to built heritage interiors in Europe was undertaken which investigated attitudes, preferences and values for the protection of heritage assets from future climate change related impacts. This was done on the basis of two main questionnaires, one for the visitor surveys on selected sites in the United Kingdom, Sweden, Germany, Romania and Italy and one for representative general population surveys in those five countries

All these different aspects add up to the holistic approach that the Climate for Culture team has chosen for the task of projecting future impact of global climate change on cultural heritage, identifying the most important risks and developing sustainable mitigation strategies.

Main S & T results/foregrounds

The main scientific and technological results of the CLIMATE FOR CULTURE project are:

- Climate evolution for damage assessment of movable and immovable cultural heritage objects in the near and far future
- Enhancement of simulation and modelling tools in the cultural heritage sector
- Adaptation and further development of software tools for whole hygrothermal building simulation for the specific tasks of historic buildings (indoor climate and energy demand)
- Assessing the effects of climate change high resolution climate evolution scenarios (based on regional climate model simulations) by connection with whole building simulation models to identify the most urgent risks for the whole of Europe and the Mediterranean Sea.
- Simplified classification of historic buildings in Europe in order to develop adequate risk scenarios
- In situ non-destructive monitoring of cultural objects with DHSPI, 3D Microscopy, Glass sensor measurements and Free Water sensor measurements using scientific results from various previous EU projects
- Analysis of the collections of movable cultural assets in historic buildings throughout Europe
- Retrospective investigation of climate induced damage processes and state of preservation of works of art over the past centuries for more than 200 art objects
- Development of a new damage risk assessment methodology for preventive conservation
- Development of a new and powerful platform independent software tool
- Development of a software tool (DigiChart) to convert analogue thermohygrograph readings into a digitized version

- New and energy saving approaches to microclimate control for mitigation of climate change impacts
- Development of easy to read outdoor and indoor climate risk maps for decision makers in the different climate zones throughout Europe
- Assessment of the socio-economics of climate change impact on cultural heritage for decision makers and interested public
- Improving the climate management of major European institutions taking part in the project by direct knowledge transfer
- Correlating the past climate data and the whole building simulation models with the results from glass sensor measurements (EU project AMECP), the in situ monitoring of defects in the cultural objects itself (EU project LASERACT) in combination with Free Water Sensor measurements.
- Including precious collections in historic buildings from various European regions as well as UNESCO World Heritage Sites as case studies for in situ assessment of existing problems, retrospective investigations on the state of preservation and for the projection of future challenging issues.
- Conducting a much more precise and integrated assessment of the real damage impact of climate change on cultural heritage at regional scale by taking results of real case studies into account.
- Developing and adapting sustainable and appropriate mitigation/ adaptation strategies, also from previous EU projects on the basis of these findings simultaneously.
- Conducting training activities for all the research fields covered in the project

Description of the potential impact (including the socio-economic impact and the wider societal implications of the project so far) and the main dissemination activities and the exploitation of results

Potential impact

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. Renatus 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 thermos-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;

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. Around 2,000 visitors in the 10 individual sites were interviewed to value the conservation of the interiors of each site. Additionally about 4,000 people in those 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. 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 75th 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). 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.

Main Dissemination activities

The Climate for Culture project team and especially the coordinator have been extremely active to disseminate the research findings and about the topic of climate change and cultural heritage from the start of the project and far beyond the project`s lifetime.

The most important dissemination activities are described below:

The Kick-Off meeting in November 2009, the yearly meeting in Visby in September 2011 and the final meeting in July 2014 were organized partly as a conference open to the public focussing on the whole Climate for Culture project (all presentations of the final meeting are available at CfC website).

Two further conferences were organized highlighting two very important topics of the project:
The Linderhof conference in December 2010 was devoted to the topic of climate control in historic buildings. The Climate for Collections conference 2012 was focusing on the pivotal question about the tolerable ranges of temperature and relative humidity in present and future indoor environments and to what extent collections will be damaged and how this can be prevented in the most sustainable way with energy efficient solutions (the conference proceedings are available at CfC website).

At the International Air Quality conference (IAQ) in Prague in 2014 Climate for Culture was invited as keynote lecture given by the coordinator and at the international advanced training course "Materials and Techniques for the Restoration of Monuments" at Aristoteles University in Thessaloniki in 2014.

Two main Stakeholder Workshops were performed – one in the UK at Ham House in 2013 and one in Paris in 2014 to discuss the methodology and main results and possible improvements with restorers, conservators, heritage managers and students.

Climate for Culture was also of interest for media and TV: Two major film-reports (2011 and 2014) by the Bavarian Radio were recorded at sites of the project – in Italy (Venice) and in Germany (Linderhof Palace and church St. Margareta in Roggersdorf) and were diffused in Germany and in some other countries. Several newspapers including DER SPIEGEL (2010) and DIE WELT (2011) had articles about the Climate for Culture project.

On a regular basis the Climate for Culture team has informed political decision makers about the progress of the Climate for Culture project: Members of the European Parliament, Members of the Committee of the Regions and the Social and Economic Committee, members of the European Commission (DG EAC, RTD, Environment), national ministries, local authorities, the European Heritage Heads Forum and Europa Nostra.

The next important dissemination will take place in 2015: A session devoted to cultural heritage under climate change was successfully co-initiated by Climate for Culture for the scientific international conference accompanying the next climate conference COP 21 in Paris. The conference will take place from 7-10 July 2015 in Paris entitled: Our common future under climate change.

First results of Climate for Culture have been already published in numerous publications throughout the project's lifetime (November 2009 – October 2014), amongst them:
- 31 peer-reviewed papers
- 26 articles in an edited book or book series
- 78 papers in proceedings of a conference/workshop
- 4 university publications/scientific monographs
- 9 master thesis/dissertations.

Moreover a vast amount of more than 200 other dissemination activities have been conducted in the 5 years of the project. Further publications and dissemination activities are planned to publish and to promote the final outcomes of Climate for Culture to the scientific community as well as to various stakeholder groups, like heritage owners, political decision makers and the general public. The respective lists in the electronic forms of the European Commission will be continuously updated for the next two years.

Exploitation

The main exploitable outcomes of Climate for Culture are:
- Analysis and Decision making support system (ADSS), which consists of three main parts:
    - Specification of the interests
    - Risk assessment and risk maps
    - Expert decision system (exDSS)
- Climate for Culture Database
- "DigiChart" software for digitizing of thermo-hygrograph charts

It has been agreed among the project partners to exploit them as follows:

Analysis and Decision making support system (ADSS)

- The basic tool will be freely available from 2015 on (after registration)
- It will be available via the Climate for Culture website
- ExDSS software will be exploited as open source software
- ExDSS will be freely available via http://cfc.exdss.org/dss/riskcon

Climate for Culture Database

- The CfC Database will be hosted by TUE
- TUE will also enhance its functions when something new is available
- Core data will be made accessible for CfC members
- The owner of the building has to be informed and asked about publications.
- Data that is not meant to be published may be published anonymous.
- Use of the database will be open access, also for externals
- The data, also new data from external sources outside the project from 2015 onwards, can be used for research by CfC partners according to the rules above
- Climate analysis for the future (inverse modelling, transfer functions) is not automatically available within the CfC Database. It has to be done manually by the owner of the data / building himself.
- A guideline how to do this will be made available by TUE and linked to the CfC Database

"DigiChart" software for digitizing of thermo-hygrograph charts

- The software can be downloaded from www.climateforculture.eu, installed and used free of charge
- It will be hosted by Fraunhofer and maintained by RSD