Cultural journey through time and space

Climate change is endangering centuries-old murals and frescos, paintings, furniture and textiles. Can this deterioration be halted? Researchers are searching for solutions in the “Climate for Culture” EU project.

Text: Monika Weiner

The royal lodge on Schachen.
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Research can be heavy going – especially when the object of study is 1,868 meters up. The hike to the royal alpine lodge on Schachen takes three hours. Ralf Kilian would be able to find the way in his sleep. He has been marching up it regularly – originally to attach sensors, later to read their measurements. What an atmosphere for climatology: a fairy tale castle from 1001 Arabian Nights. Ludwig II, King of Bavaria, had the building constructed at the end of the 19th century for extravagant oriental parties. The upper floor of the wooden house is festooned with tinted glass windows, Persian carpets, golden chandeliers, fans of ostrich plumes and even a fountain.

Kilian and his colleagues from the Fraunhofer Institute for Building Physics IBP in Holzkirchen, Germany, have been using more than a dozen sensors to measure the relative humidity and temperature in the Turkish Room of the royal abode over the years. Highly sensitive glass sensors – developed by the Fraunhofer Institute for Silicate Research ISC in Würzburg – in addition detect atmospheric pollutants and microorganisms. In order to be able to compare measurements in the interior against the external conditions, a weather station was constructed in the garden that regularly transmits information about wind, sunshine, precipitation and temperature. “With the help of these data, we can precisely document and evaluate changes to the interior conditions over the course of the year,” reports the researcher.

The surprising outcome: despite the rough conditions high up in the Wetterstein Mountains, the relative humidity in Schachenhaus remains stabile most of the time at 40-70% – within the range considered acceptable for museums and collections. The murals, carpets and furniture are actually quite well preserved. Lucky thing. Other historic buildings like Linderhof Castle that the researchers have also investigated are in much worse shape. The plaster is crumbling, and paint and gilding are becoming detached from the underlying surface. The cause of this is the drastically increased humidity resulting from the breath and perspiration of thousands of visitors. The measurements taken in the royal Bavarian castles are small but important pieces of the puzzle for the EU’s Climate for Culture project. 27 teams from 14 countries in the EU as well as Egypt have examined more than 100 cultural monuments – including Skokloster Castle in Sweden, a Slovenian fort in Brežice, an English manor house in Knole, a private Venetian villa and a Norwegian wooden-pillared church in Garmo. Florian Antretter from the Fraunhofer Institute used specialized software named WUFI®Plus to create simulations of the interior climate based ofnthe measurement data at these various locations. The results document how different climatic conditions affect the state of buildings and art objects throughout Europe.

With the help of the enormous database that resulted, the researchers are now able to peer into the future. The goal of the Climate for Culture project is to predict what effects climate change will have on cultural treasures. The concentration of carbon dioxide in the atmosphere has been climbing ever since the beginning of the industrial revolution due to the combustion of fossil fuels. The models developed by climatologists demonstrate that these greenhouse gases produce extreme weather, a rise in sea level and a shifting of climatic zones. The initial changes are already being observed – an indication that the simulations are valid – and are expected to intensify in future. However, climate change can have quite different effects regionally. The models developed by researchers at the Max Planck Institute for Meteorology in Hamburg demonstrate that it will become hotter and dryer in the Mediterranean region, but considerably wetter in northern Europe, especially between the North Sea and the Baltic above 55th degree latitude. Risk maps of Europe worked out by the international interdisciplinary research team show what these prognoses mean in detail, down to a resolution of 10 km x 10 km. Detailed climate predictions of hourly temperature and humidity up to the year 2100 can be called up for every one of the more than five hundred grid points.

Coupled with the indoor climate simulations of the WUFI software, the consequences of climate change can be predicted in detail. “The combined model provides us with prognoses about what temperature and humidity values will predominate within the interior of an historic building at a particular place,” explains Prof. Klaus-Peter Sedlbauer, head of IBP. “If the climate models for southern England predict a three-degree rise in average temperature and an increase in humidity of ten percent, then

Combating harmful substances in museums together

What kind of environmental loads are art objects in museums exposed to? How do you create an interior climate that prevents damage? How can artistic treasures that have already been attacked be cleaned? Experts from the Forschungsallianz Kulturerbe (a cultural heritage research alliance of Fraunhofer, Leibniz institutions and the Prussian Foundation of Cultural Property) presented their findings at the Symposium on Air Pollution in Museums that took place not long ago in Dresden.

Experts from twenty-four Fraunhofer Institutes, the research museums of the Leibniz Association, as well as institutions from the Stiftung Preußischer Kulturbesitz have been working together in the interdisciplinary alliance since 2008. The objective is to recognize hazards to which unique manuscripts, paintings, and sculptures preserved in museums are exposed early on and to develop preventative strategies and methods of restoration. This should incorporate knowledge from both the natural sciences and humanities.

In future, the Staatlichen Kunstsammlungen Dresden (state art collections of Dresden) and the Sächsische Landesbibliothek – Staats- and Universitätsbibliothek Dresden (Saxony state libraries in Dresden) will be collaborating with the Forschungsallianz Kulturerbe. A corresponding Memorandum of Understanding has been signed by Fraunhofer President Reimund Neugebauer.

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Linderhof Castle.
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the software sends a warning of a heightened risk of mold based on the data gathered in the project, for example. In southern Europe, where conditions will become dryer, there is instead a threat of damage from objects drying out."

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The model even permits travel through time and space. With the click of a mouse, the scientists can catapult the Church of St. Margaretha in the Bavarian village Roggersdorf today into the year 2050 and move it to Provence or to a Norwegian fjord. The simulation program promptly provides values for temperature and humidity in the interior resulting from this displacement in time and space. The type of construction is also taken into account. The church, with its thick walls and small windows, creates a different interior climate than a building that is flooded with light such as Schönbrunn castle. All of the information resulting from these virtual journeys has been collected by the researchers into a database. It will be available online in late 2014. "Owners of castles and administrators of museums and collections can enter their location as well as select the characteristics of their buildings, then receive predictions about what climate changes are expected up to the year 2100 and what consequences these will have, all without charge," explains Dr. Johanna Leissner, coordinator of the EU project. At the same time, the database provides recommendations about how art objects can be protected from deteriorating, and how much it would cost if increased heating or cooling is necessary.

These results are especially useful for those considering renovations, emphasizes Leissner: "If costly steps are going to be taken, then the interior conditions should be stabilized to preclude further damage." The administration responsible for state castles, gardens and lakes in Bavaria already intends to use the results of the project for renovations planned in Linderhof.

At the royal lodge on Schachen, everything will remain as it is. The Turkish room will remain in pristine condition. The double-walled construction of the wooden structure and its seclusion have a positive effect on the interior climate. The influence on the interior climate from the large numbers of visitors in Neuschwanstein is not present on Schachen – the trade-off of the climb is not worth it for everyone. ■