Effect of microclimate conditions on stone deterioration: implications on vulnerability assessment of cultural heritage and potential impact of climate change

(Proposer: Prof. Claudio Mazzoli)

Recent studies highlight the effects and impact of climate change on cultural heritage sites, along with the significant impact on economies, politics and societies with a negative effect on the actual cultural heritage itself. Following the Strategic Research Agenda for the JPI Cultural Heritage and Global Change, it is more than a fact that the deterioration of cultural heritage sites imposed by environmental changes is currently one of the biggest challenges in conservation research. These challenges include aspects such as building techniques and materials, stability, structures' responses and the need for preventive measures and restoration mitigation strategies, as well as resilience and adaptation methodologies. Reliable vulnerability assessment of cultural heritage requires deep knowledge on damage and dose-response functions of building materials under environmental forcing. Therefore, a combination of data analysis, physical modelling and data assimilation will be used to provide robust estimates of microclimate change indicators and air pollution exposure estimates for targeted sites. Microclimate parameters and relative deviation from local climate time series include ambient and stone surface temperature, precipitation, relative humidity, radiation, concentrations of oxidants and acidic agents, as well as their relevant statistics on medium- and long-term extreme values. Decay will be evaluated and quantified on the monument surface and on test blocks exposed in the field and under weathering laboratory simulations. Thus, assessment and mitigation of air pollution damage on monuments, driven by climate change scenarios, will incorporate dose-response functions of building materials and microclimate deviation functions, in dynamical downscaling of regional-scale modelling that are used as driving fields for finer-scale simulations, providing estimates of climate parameters down to less than 1 km scale. An optimal set of primary and derivative parameters will be identified for quantifying climate and pollution effects, and their medium- and long-term change patterns will be simulated.

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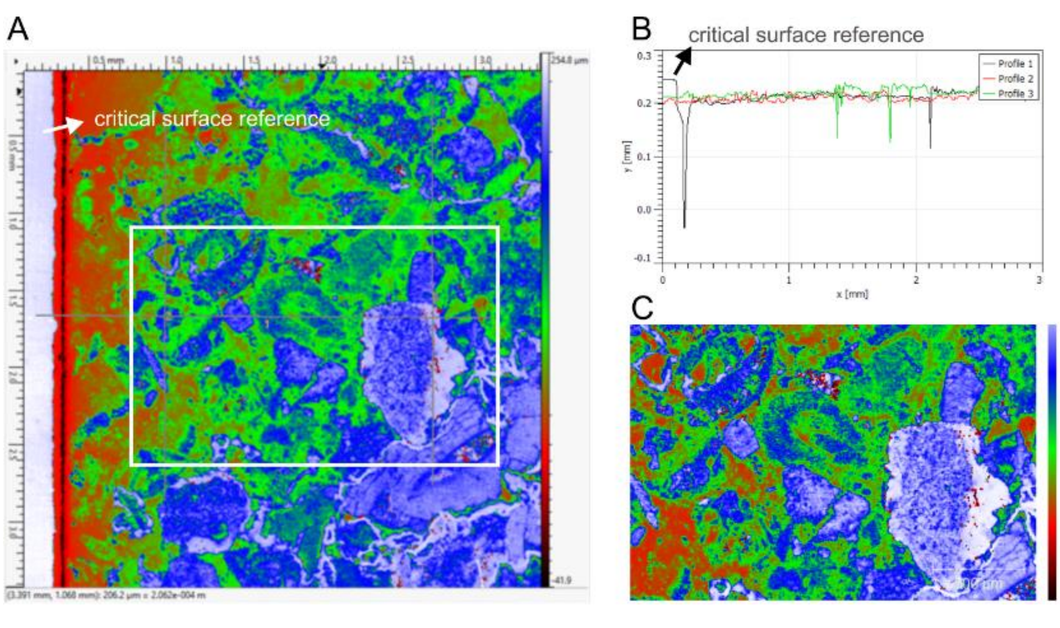

3D surface topography of a limestone obtained by confocal microscopy after 240 wetting cycles in rainwater. Analysed area: 3.5x3.5 mm.