Geophysical Research Abstracts,
Vol. 11, EGU2009-12309, 2009
EGU General Assembly 2009

Novel microclimate monitoring and microbial colonisation in sandstones of historic buildings, Glasgow, Scotland

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The impact of our changing climate on the historic built environment of Scotland has received surprisingly little attention. Current projections indicate that Scotland will become notably wetter and warmer over the coming decades. Winter temperatures are predicted to increase by 30C with 15% more precipitation, one result should be more aggressive microbial weathering of the sandstone buildings. In order to understand better and to quantify the damage potentially caused, it is necessary to analyse existing microbial populations but also to characterize conditions within building stones, how they change over diurnal and seasonal cycles, and how they differ from external conditions. In this study, temperature, humidity and moisture sensors were inserted at different depths into representative Scottish sandstones to record parameters key to microbial colonisation and organic weathering. Penetration of photosynthetically active radiation has also been measured. The within-stone data were compared to meteorological conditions recorded by an adjacent weather station. These data have then been compared with analysis of the microbial populations at different depths within the stone, using osmium stained polished blocks. Notably, microbes occur up to 7 mm beneath the outer sandstone surface, with community structure differing with depth. Clearly, different communities experience very different conditions within the stone, reflecting trophic structure, light penetration and microclimate. The sensor data confirm that temperature and water availability all vary within the stone and differ considerably with the external environment. We conclude that the warm and humid microclimate within Scottish building stones promotes microbial colonisation and stone decay and both will increase significantly with the changing climate of Scotland and north-west Europe.