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A data-driven approach to understanding the equilibria behaviour of salt mixtures in built cultural heritage

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Salt weathering is a complex and active area of research, with implications for tangible cultural heritage worldwide. A preventive conservation approach is often taken to limit salt crystallisation cycles, which requires an understanding of the relative risks of scenarios and their respective heritage characteristics, salts present, and the climate, including climate change. Equilibrium relative humidity is an important property that indicates this risk: typically, it is represented by specific RH% and temperature derived from a single salt. The behaviour of single salts does not accurately represent the behaviour of salt mixtures, which are far more common in cultural heritage contexts. To address this, 11412 salt mixtures present in the built environment have been analysed using the ECOS/Runsalt model to predict their mixture-based mutual relative humidity of crystallisation and deliquescence points, the salt mixture composition, as well as the relative humidity of crystallisation and deliquescence for individual salts in the mixtures. This dataset, although sampled primarily from Belgian cultural heritage sites, is representative of the general classes of salt mixtures found in the built environment globally. This analysis represents an important step in developing a generalised statistical method for parameterising environmental time series data for salt weathering risk within climate change scenarios, as well as progressing fundamental knowledge on the behaviour of salt mixtures in built cultural heritage.