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A slice through time — securing timelines of past climate, global volcanism and human societies

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Major efforts have been made in recent decades to decipher the climate of the past and its drivers with the help of proxy archives. Reconstructions of past climate variations are of immediate societal relevance because they serve as a baseline for anthropogenic climate change, and help us understand how past societies coped (or failed to cope) with extreme climate events. Good paleoclimatology, however, relies on ever more precise and accurate dates. While many proxy archives provide continuous year-by-year sequences going back many thousands of years, ambiguities in their interpretation introduce time uncertainty which increases over time. As a consequence, natural climate variability is underestimated when time-uncertain climate reconstructions are combined.

Through the use of "*Miyake events*" — novel time markers that are accurate to the year, globally distributed and detectable in different climate archives — it has recently become possible to better date and synchronize some of these climate archives, notably the polar ice-core records. The revised dating of ice cores from both Greenland and Antarctica combined with technological advances based on real-time continuous flow analysis techniques has shed new light on a prominent impact of volcanic eruptions on past climate and human societies. In this talk, I will highlight how we can date ancient eruptions, (sometimes to the season), geochemically identify their provenance and quantify their climate impact potential through emissions of sulfuric gases using large networks of ice cores. Case studies include prominent eruptions from Vesuvius or Santorini as well as eruptions largely unknown to the general public, for example from Alaska. I will discuss linkages to precisely dated proxies (e.g. tree-rings) and documentary records to demonstrate the accuracy of the new ice-core chronologies and to delineate climatic and societal responses to external shocks caused by major volcanic eruptions. In my concluding remarks, I will show how such lessons from the past can help to improve our understanding of past natural climate variability and to quantify global risks arising from volcanic activity in the future.