



Timing, global aerosol forcing, and climate impact of volcanic eruptions during the Common Era

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Early documentary records report of a mysterious dust cloud that was covering Europe for 12 months in 536-37 CE, which was followed by climatic downturn and societal decline globally. Tree rings and other climate proxies have corroborated the occurrence of this event as well as characterized its extent and duration, but failed to trace its origin.

By using a multi-disciplinary approach that integrates novel, global-scale age markers with state-of-the-art continuous ice core aerosol measurements, automated objective ice-core layer counting, tephra analyses, and detailed examination of historical archives, we developed an accurate volcanic forcing series from bipolar ice-core arrays back into early Roman times. Our study reconciles human and natural archives – demonstrated by the synchronicity of major volcanic eruption dates to historical documentary records and the now consistent response of tree-ring-reconstructed cooling extremes occurring in the immediate aftermath of large volcanic eruptions throughout the past 2,000 years.

These findings have significant implications in multiple research fields including (1) quantification and attribution of climate variations to external solar and volcanic forcing and (2) improvement of reconstructions of climate variations from multi-proxy networks comprising tree-ring and/or ice-core data (e.g., PAGES 2k).