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Patterns of volcanic eruptions in connection to sea-level change

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Understanding the relationships between the onset of volcanic eruptions and external forcings, such as solid Earth and ocean tides, can help us to understand the underlying dynamics of volcanic processes and have implications for volcanic monitoring and prediction efforts.

Many studies that explored the relationship between tidal forces and volcanic activity have shown that certain phases of tidal cycles are associated with an increased likelihood of eruptions. At longer-time scales of hundreds of thousands of years, pronounced sea level variations related to ice melting or climatic and astronomical periodic variations have also been associated with pulses of volcanic activity.

Oceans participate in significant redistributions of mass that can affect the stress field within the Earth's crust over different time scales. Considering that most volcanoes lie near, within or beneath the oceans we hypothesize that stresses induced by ocean loading participate in destabilizing volcanic dynamical systems and ultimately contribute to eruption triggering.

In a previous study we analyzed the worldwide number of monthly volcanic eruptions from the Global Volcanism Program and the global mean sea level between 1880 and 2009 using the Singular Spectrum Analysis time-series analysis technique. We found common periodicities and particularly multi-decadal components of similar periodicities of 20, 30 and 50 years present in both time-series.

In this work we further explore the connection between volcanic activity and sea level by mapping the spatial patterns of volcanic eruptions at the previously identified temporal scales of correlation, ranging from the fortnightly tide to cycles of approximately 100 years. Geographical Information System tools are used to create spatial data layers, perform spatial analysis, and provide geographical visualization. The analysis might reveal global conditions and space-time patterns favorable to eruption triggering.

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