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Possible connection between large volcanic eruptions and level rise episodes in the Dead Sea Basin

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The June 1991 Pinatubo volcanic eruption perturbed the atmosphere, triggering short-term worldwide changes in surface and lower troposphere temperatures, precipitation, and runoff. The following winter was anomalously wet in the Levant, with a ∼2-meter increase in the Dead Sea level that created a distinct morphological terrace along the lake's shore. Given the global radiative and chemical effects of volcanogenic aerosols on climatic systems, we tested the hypothesis that the 1991-92 winter shore terrace is a modern analogue to the linkage between past volcanic eruptions and a sequence of shore terraces on the cliffs around the Dead Sea Basin.
Analysis of historical annual precipitation series from Jerusalem showed a significant positive correlation between the Dust Veil Index (DVI) of the modern largest eruptions and corresponding annual rainfall. The DVI was found to explain nearly 50% of the variability in the annual rainfall, such that greater DVI means more rainfall. Other factors that may affect the annual rainfall in the region as the Southern Oscillation Index (SOI) and the North Atlantic oscillations (NAO) were incorporated along with the DVI in a linear multiple regression model. It was found that the NAO did not contribute anything except for increased noise, but the added SOI increased the explained variability of rainfall to more than 60%. The atmospheric effect of the volcanic aerosol cloud produced after the Mt. Pinatubo eruption shows responses in the climate system on a hemispherical to global scale.
Volcanic eruptions with a VEI of 6, as in the Pinatubo, occurred about once a century during the Holocene period at a rate that persisted throughout the last glacial-interglacial cycle, though with large variations in the mean. This occurrence is similar to the frequency of shore terrace build-up during the Lake Lisan desiccation. Sixteen shore terraces, detected using airborne laser scanning data, were interpreted as indicating short-term level rises due to episodes of enhanced precipitation and runoff during the dramatic drop in Lake Lisan's (palaeo-Dead Sea) level at the end of the Last Glacial Maximum. The terraces were compared with a dated time series of volcanogenic sulfate from the GISP2 ice core, and similar numbers of sulfate concentration peaks and shore terraces were found. Furthermore, a significant correlation was found between SO4 concentration peaks and the heights of the terraces. This correlation may indicate a link between the explosivity of past eruptions, the magnitude of stratospheric injection, and their impact on the northern hemisphere water balance. The record of such short-term climato-hydrological effects is made possible by the dramatic desiccation of Lake Lisan. Detailed records of such events, albeit rare because of their vulnerability and short longevity, provide an important demonstration of global climatic teleconnections.