



Observational evidence for volcanic impact on sea level and the global water cycle

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It has previously been noted that there are drops in global sea level (GSL) following some major volcanic eruptions. However, observational evidence has not been convincing as there is substantial variability in the global sea level record on periods similar to those at which we expect volcanoes to have an impact. To quantify the impact of volcanic eruptions we average monthly GSL data from 830 tide gauge records around 5 major volcanic eruptions. Surprisingly, we find that the initial response to a volcanic eruption is a significant rise in sea level of 9±3 mm in the first year after the eruption. This is followed by a drop of 7±3 mm in the period 2-3 years after the eruption relative to pre-eruption sea level. These results are statistically robust and no particular volcanic eruption or ocean region dominates the signature we find. Neither the drop nor especially the rise in GSL can be explained by models of lower oceanic heat content. We suggest that the mechanism is a transient disturbance of the water cycle with a delayed response of land river runoff relative to ocean evaporation and global precipitation that affects global sea level. The volcanic impact on the water cycle and sea levels is comparable in magnitude to that of a large El Niño-La Niña cycle, amounting to about 5% of global land precipitation.