Anthropogenic aerosols and the weakening of the South Asian summer monsoon

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an integral component of the Earth's hydrological cycle, the South Asian summer monsoon is critical for the well-being of over one-fifth of the world's population. Observations show that South Asia underwent a widespread drying during the second half of the twentieth century, but it is still largely unclear whether this prolonged shift was due to natural variations or human activities. Here we use a series of perturbation experiments with a state-of-the-art climate model, which realistically simulates the observed historical trend when driven with all known climate forcings, to investigate the South Asian monsoon response to natural and anthropogenic factors, with particular focus on aerosols and greenhouse gases. We find that the observed precipitation decrease is very likely to be of anthropogenic origin, and can be attributed almost entirely to aerosols. The drying is a robust outcome of a slowdown of the tropical meridional overturning circulation, which is fundamentally driven by the need to counteract the aerosol-induced energy imbalance between the northern and southern hemispheres. In contrast, greenhouse gases give rise primarily to a weakening of the equatorial zonal overturning circulation. These results provide compelling evidence of the prominent role of aerosols in shaping regional climate change over South Asia.

Volatiles (H_2O, CO_2, S, Cl, F) in primary magmas of Kliuchevskoy volcano (Kamchatka)

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We carried out a melt and fluid inclusion study to estimate the amount of volatiles (H_2O, CO_2, S, Cl, F) in primary magmas of Kliuchevskoy volcano in Kamchatka. Volatiles in melt inclusions were analyzed by EMP (S, Cl), SIMS (H_2O, F) and FTIR (CO_2, H_2O). Fluid inclusions were studied criometrically. More than 400 melt and fluid inclusions in olivine (Fo_{92-67}) were studied. We found that diffusive H_2O loss from inclusions, redistribution of CO_2 between melt and fluid and sulfide immiscibility inside inclusions preclude straightforward interpretation of volatile concentration in glasses of primitive MIs (Ol-host Fo>85) as representative for primary melts. Careful selection of the least modified after entrapment melt inclusions allowed us to define the most plausible range of volatile concentrations in primitive Klyuchevskoy magmas (minimum-maximum, average, wt. %): H_2O=2.8-3.6, 3.2; S=0.13-0.23, 0.16; Cl=0.02-0.13, 0.08; F=0.022-0.051, 0.032. A minimum CO_2 content in primitive melts is estimated from density of CO_2 fluid inclusions in primitive olivines to be 3500 ppm. Inclusions in more evolved olivines (Fo<80), which were trapped shortly before eruption, reflect variable extent of magma degassing and were nearly undisturbed by the later processes of melt modification after entrapment.

The concentration of volatiles in Kliuchevskoy melts are similar to those estimated in other, much less productive Kamchatkan volcanoes [3]. Given the large productivity of this volcano (on average 60 Mt /year), the flux of volatiles from Kliuchevskoy volcano is however very high during the Holocene (e.g. H_2O flux amounts at 3.27 Mt/year). The high volatile flux may indicate a large part of subducting plate delivered fluids focused to the source of Kliuchevskoy and/or perhaps additional contribution of volatiles from serpentinites in the subducted plate.

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