

Disentangling the mechanisms of ENSO response to tropical volcanic eruptions

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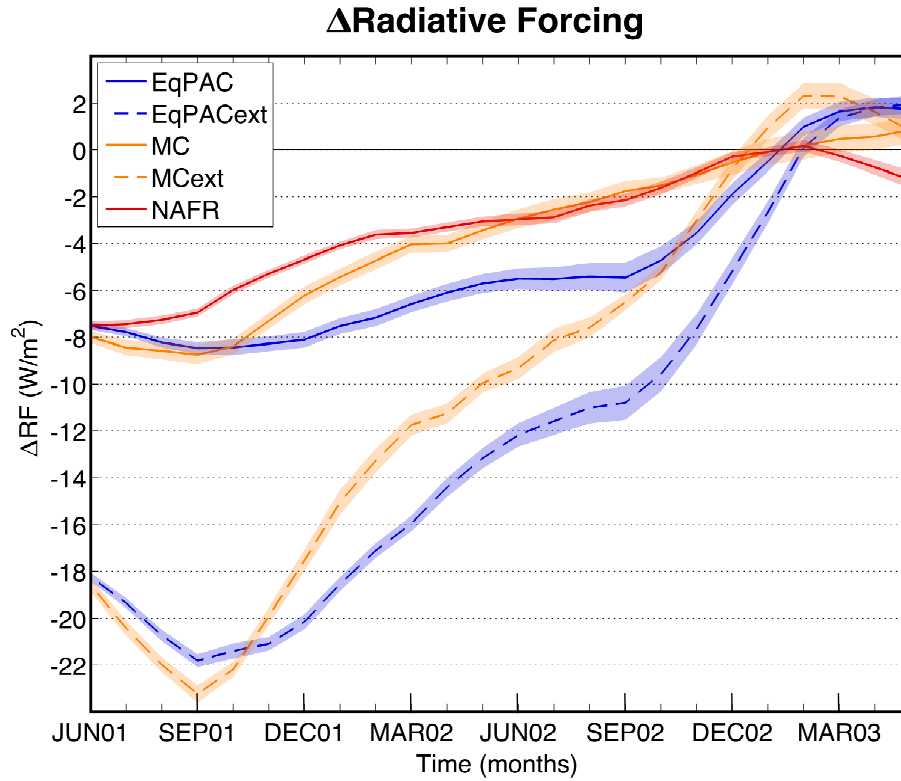


Figure S1. Radiative forcing. Changes in the net radiative forcing at the top of the atmosphere for each ensemble experiment relative to the no-volcano case. Shading represents twice the standard error of the mean (approximate 95% confidence intervals).

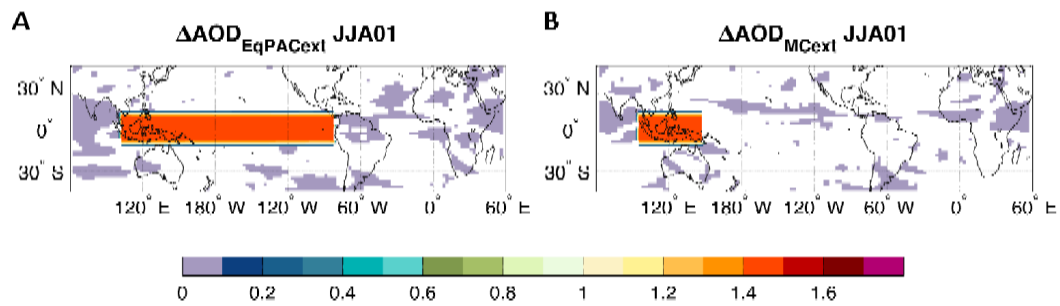


Figure S2. Volcanic forcing in extreme experiments. Anomalies in aerosol optical depth (at 550 nm) in the extreme Maritime Continent – MC experiment (A) and the extreme Equatorial Pacific – EqPAC experiment (B) for the summer (June to August – JJA) following the imposed changes in AOD relative to the no-volcano simulations.

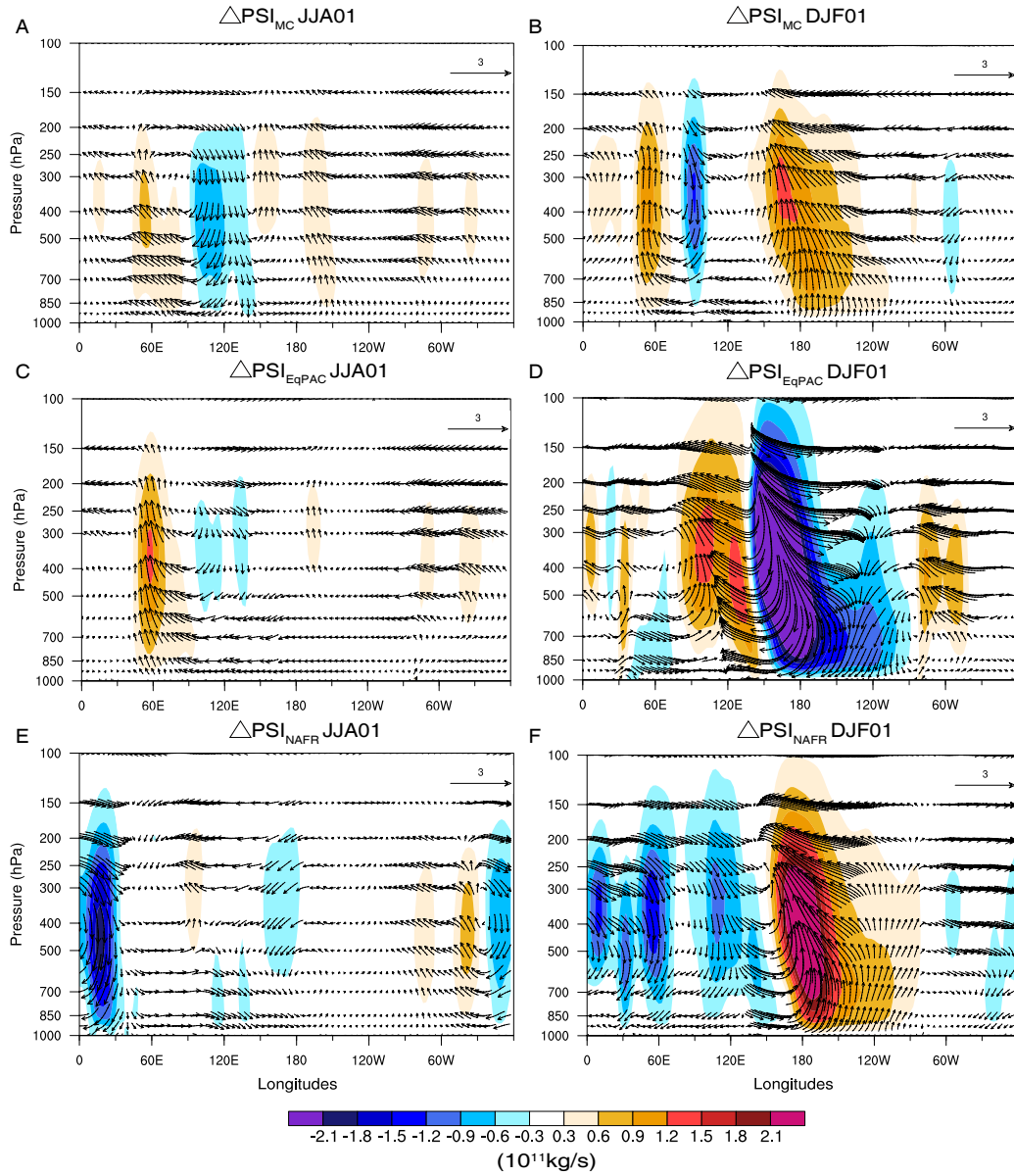


Figure S3. Walker Circulation response in the first post-eruption year. Changes in the zonal stream function (10^{11} kg/s) and vertical winds (m/s) averaged over the Equatorial Pacific (5°S – 5°N) for the first summer (June to August – JJA; left) and winter (December to February – DJF; right) following the AOD imposed anomalies above the Maritime Continent – MC (A – B), the equatorial Pacific – EqPAC (C – D) and the tropical and northern Africa – NAFR (E – F) relative to the no-volcano simulations.

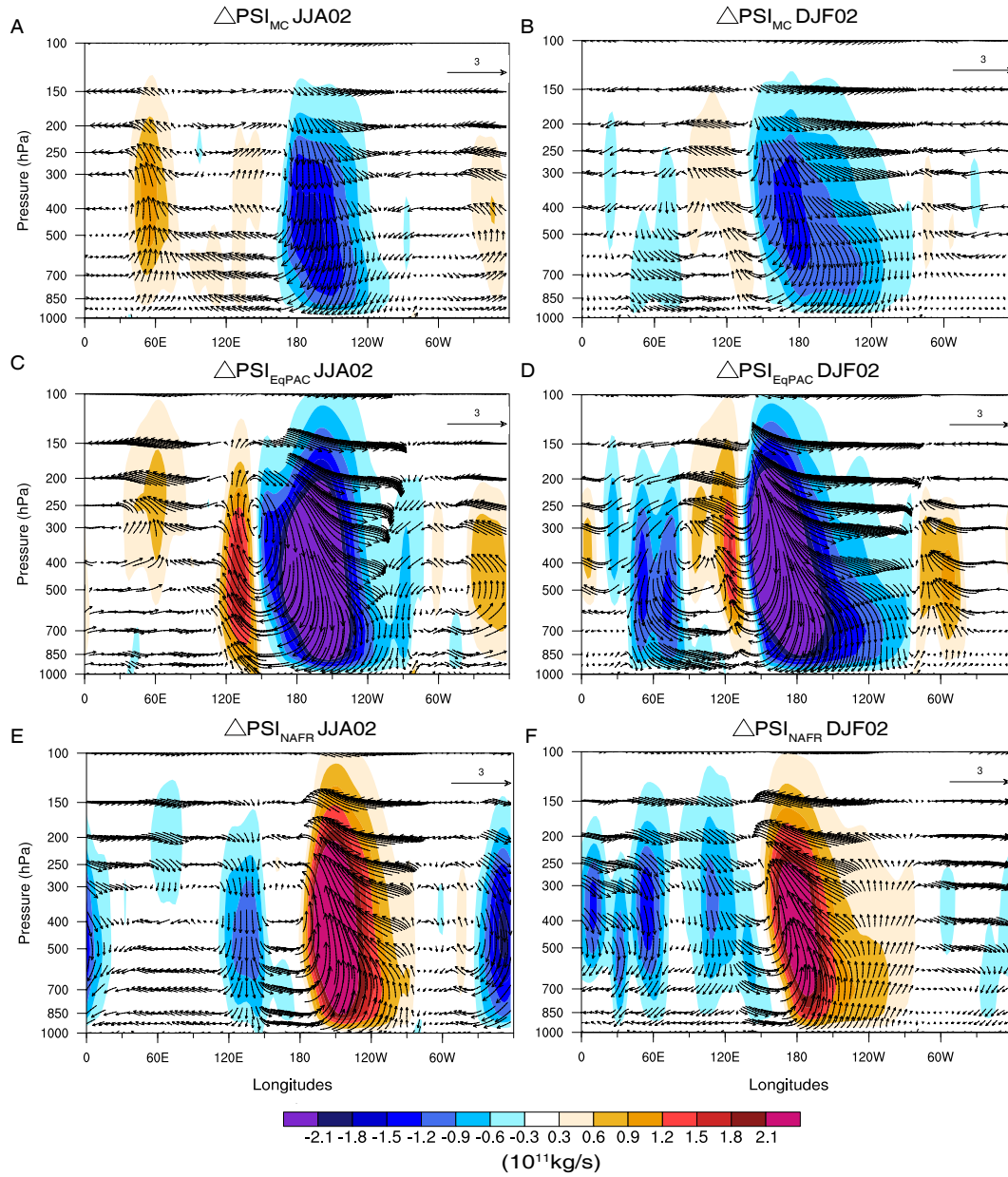


Figure S4. Walker Circulation response in the second post-eruption year. Changes in the zonal stream function (10^{11} kg/s) and vertical winds (m/s) averaged over the Equatorial Pacific (5°S – 5°N) for the second summer (June to August – JJA; left) and winter (December to February – DJF; right) following the AOD imposed anomalies above the Maritime Continent – MC (A and B), the equatorial Pacific – EqPAC (C and D) and the tropical and northern Africa – NAFR (E and F) relative to the no-volcano simulations.

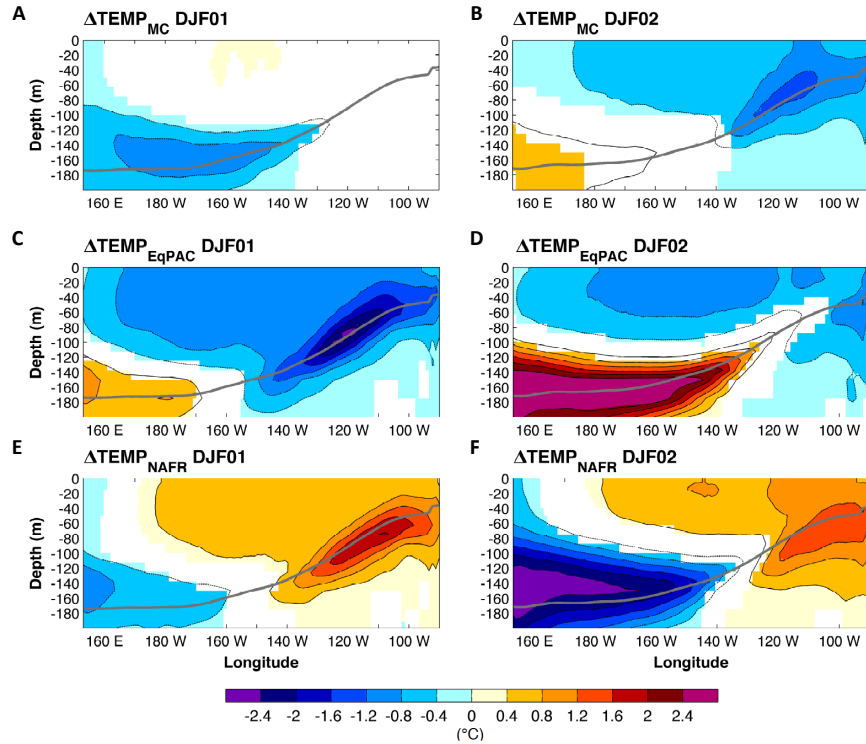


Figure S5. Thermocline response in the first and second post-eruption winter. Ocean temperature ($^{\circ}\text{C}$) anomalies in the Equatorial Pacific ($5^{\circ}\text{S} - 5^{\circ}\text{N}$) for the first (left) and second (right) winter (December to February – DJF) following the AOD imposed anomalies over the Maritime Continent – MC (A and B), the equatorial Pacific – EqPAC (C and D) and the tropical and northern Africa – NAFR (E and F) relative to the no-volcano simulations. Only values that are significantly different at the 5% level using a t test are shaded. The contours follow the color bar intervals (solid for positive and dashed for negative anomalies; the zero line is omitted). The bold grey line shows the climatological thermocline depth for the no-volcano members (as defined using the 20°C isotherm).

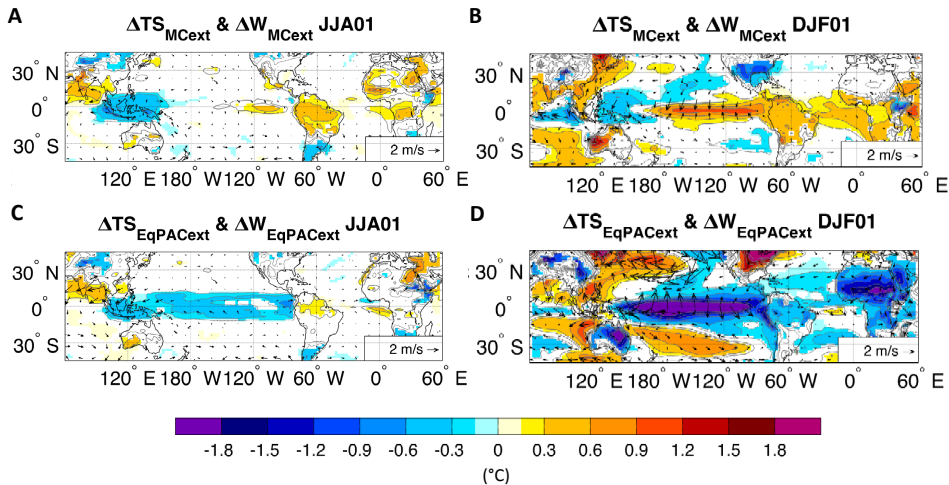


Figure S6. Surface air temperature and wind response for the extreme experiments. Changes in surface temperature ($^{\circ}\text{C}$, contours and shadings) and wind (m/s, arrows) in the summer (June to August – JJA; left) and winter (December to February – DJF; right) following the AOD imposed anomalies for extreme experiments (MC extreme – A and B; and EqPAC extreme – C and D) relative to the no-volcano case. Only temperature values that are significantly different at the 5% level using a local (grid-point) t test are shaded. The contours follow the colorbar intervals (solid for positive and dashed for negative anomalies; the zero line is omitted).

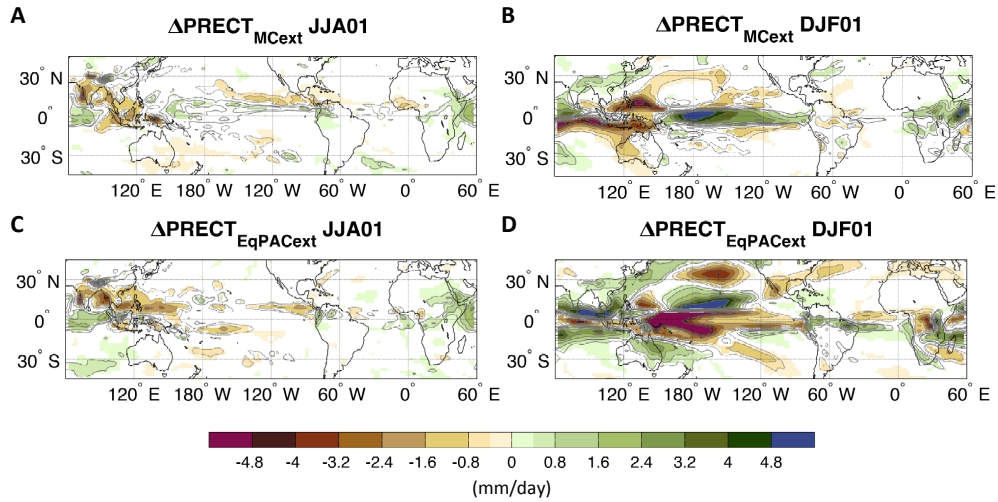


Figure S7. Rainfall response for the extreme experiments. Changes in precipitation (mm/day, contours and shadings) in the summer (June to August – JJA) and winter (December to February – DJF) following the AOD imposed anomalies for extreme experiments (MC extreme – A and B; and EqPAC extreme – C and D) relative to the no-volcano case. Only temperature values that are significantly different at the 5% level using a local (grid-point) t test are shaded. The contours follow the colorbar intervals (solid for positive and dashed for negative anomalies; the zero line is omitted).

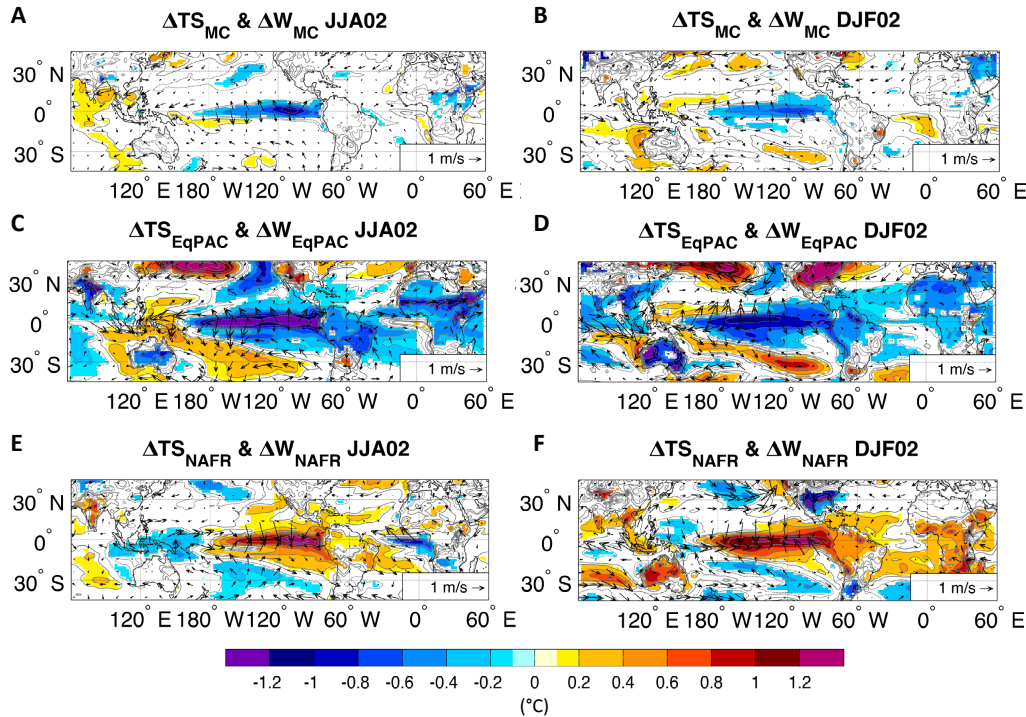


Figure S8. Surface air temperature and wind response in the second post-eruption year. Changes in surface temperature (°C, contours and shadings) and wind (m/s, arrows) in the summer (June to August – JJA) and winter (December to February – DJF) following the AOD imposed anomalies above the Maritime Continent – MC (A and B), the equatorial Pacific – EqPAC (C and D) and the tropical and northern Africa – NAFR (E and F). Only temperature values that are significantly different at the 5% level using a local (grid-point) t test are shaded. The contours follow the colorbar intervals (solid for positive and dashed for negative anomalies; the zero line is omitted).