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Amazon fires drive widespread changes to diurnal cloud regimes and radiation

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The long-lived and widespread nature of smoke, coupled with its ability to perturb the atmosphere simultaneously via aerosol-cloud and aerosol-radiation interactions, has proven a challenge to observe and simulate; as such, the impact of smoke on regional and global scales remains uncertain.

In this study we use an 18-year climatology from multiple instruments onboard AQUA and TERRA satellites to identify and characterise the relationships between aerosol-optical-depth (AOD) and the large-scale properties of the clouds, precipitation, and top-of-atmosphere radiation over the Amazon rainforest during the biomass burning season.

Our analysis provides robust evidence that localised smoke production drives widespread modification to the cloud regime over the region: in the morning (TERRA) cloud liquid water path increases with AOD, whereas in the afternoon (AQUA) convective activity is initially enhanced then supressed when AOD exceeds 0.4. During both time periods there is an increasingly pronounced presence of high-altitude, optically thin, clouds.

The result is a sharp contrast in the cloud-field properties and vertical distribution between low-AOD days and high-AOD days and a pronounced top-of-atmosphere radiative effect of -50 Wm^{-2} (for AOD = 1.4), which persists throughout the day.