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Observational evidence of fire-driven changes to tropical cloudiness

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Anthropogenic fires in the tropics emit smoke aerosols that affect cloud dynamics, meteorology and climate (Tosca et al., 2013). We developed a new technique to observationally quantify the cloud response to biomass burning aerosols using aerosol retrievals from the Multi-angle Imaging SpectroRadiometer (MISR) and non-coincident cloud retrievals from the MODerate resolution Imaging Spectroradiometer (MODIS) from collocated morning and afternoon overpasses. The Global Fire Emissions Database, version 3 and Level 2 data from scenes acquired between 2006 and 2010 were used to quantify changes in cloud fraction from morning (10:30am local time) to afternoon (1:30pm local time) in the presence of varying fire-aerosol burdens. This temporal offset allowed for analysis of the evolution of clouds in the presence of aerosols, something that previous methods using coincident observations could not produce. We controlled for large-scale meteorological differences between scenes using reanalysis data from the ERA-interim product and matching scenes with fire smoke to those with no smoke and similar initial (morning) meteorological conditions. Elevated aerosol optical depths (AODs) reduced cloud fraction from morning to afternoon in the Southeast Asia, Central America and northern Africa burning regions. In mostly cloudy conditions, aerosols significantly reduced cloud fraction, but in clear skies, cloud fraction increased. These results support the general hypothesis of a positive feedback loop between anthropogenic burning and cloudiness in tropical regions, and are consistent with previous studies linking smoke aerosols to convective cloud reduction.

Tosca, M.G., J.T. Randerson and C.S. Zender (2013), Global impact of smoke aerosols from landscape fires on climate and the Hadley circulation, Atmos. Chem. Phys., 13, 5227-5241, doi: 10.5194/acp-13-5227-2013.