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Detecting human influence in observed changes in precipitation

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Human induced changes to the precipitation could cause some of the most serious impacts of climate change, with potential consequences for water resources, health, agriculture and ecosystems. However, quantifying and understanding the drivers of changes to precipitation is challenging due to its large spatial and temporal variability, the lack of long-term observational records over much of the globe and the counteracting affects of greenhouse gases and aerosols. Nevertheless, detection and attribution studies have shown that human influence has changed both global and regional precipitation over the latter half of the 20th century.

Using climates models to derive fingerprints of external forcing, we are able to show that greenhouse gas warming has driven large scale changes in precipitation. Greenhouse gas forcing is detectable in observed changes to zonal mean precipitation over land (Polson et al., 2012a). It has also been shown to have caused the intensification of the water cycle, enhancing existing patterns of the precipitation in the tropics and subtropics, over both land and ocean (Polson et al., 2012b). While at global scales, the influence of greenhouse gases is detectable in observations, separating the response of precipitation to anthropogenic aerosol forcing is more difficult. However, in some regions the influence of aerosols dominate, making it possible to detect aerosol forcing. Observed precipitation in the monsoon regions underwent substantial changes during the second half of the twentieth century, with drying from the 1950s to mid-1980s and increasing precipitation in recent decades. Climate model simulations are used to derive fingerprints of individual climate forcings (i.e. greenhouse gas, anthropogenic aerosol, and natural) and detection and attribution methods applied to determine which, if any, have driven these changes to monsoon precipitation. Even when accounting for internal variability of the climate, a clear signal of anthropogenic aerosol forcing is detectable in the observed changes, with aerosols causing an overall decrease to monsoon precipitation over the second half of the 20th century.

Polson, D., G. C. Hegerl, X. Zhang, and T. J. Osborn, 2013a: Causes of Robust Seasonal Land Precipitation Changes. J. Climate, 26, 6679–6697.

Polson, D., G. C. Hegerl, R. P. Allan, and B. Balan Sarojini 2013b: Have greenhouse gases intensified the contrast between wet and dry regions?, Geophys. Res. Lett., 40, 4783-4787doi:10.1002/grl.50923.