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# Identifiable decadal signatures of greenhouse gases and particulate atmospheric pollution on the changing hydroclimate

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## Abstract

Can we explain why arid conditions are spreading worldwide? Or why the western US is getting arid since the 1980s while the Sahel has recovered from its prolonged drought? Are these two regional events independent or are they connected by large-scale mechanisms? Based on CMIP5 climate runs and a novel analysis, we found that since 1950, greenhouse gases and particulate pollution have influenced, together, global changes in temperature, precipitation and regional aridity in two distinct ways. Like two songs playing simultaneously out of a noisy background, these two fingerprints – signatures of large-scale mechanisms conducive to regional drying – are statistically identifiable in observations.

One song is loud and clear: The dominant signal is characterized by global warming, intensified wet-dry patterns of precipitation, and progressive large-scale continental aridity – all largely driven by a slowly evolving increase in greenhouse gas emissions. The second and more subtle signal captures a temperature contrast between the Northern and Southern Hemispheres, controlled by the cooling influence of particulate pollution emitted from Europe and North America up until the 1980s. This temperature contrast moved the tropical rain belt southwards, away from the cooler Northern Hemisphere, causing more rainfall over the Western U.S. and less over the Sahel and India. After pollution regulations were put place, the tropical rain belt shifted back northward, bringing less rainfall to the Western U.S. and more to the Sahel. In this presentation, I will explore the impact of aerosol-cloud interactions and of observational uncertainties.

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