Anthropogenic aerosols reduced global land monsoon precipitation

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Abstract

Changes in monsoon precipitation have profound social and economic impacts as more than two-thirds of the world's population lives in monsoon regions. Observations show a significant reduction in global land monsoon precipitation during the second half of the 20th century. Understanding the cause of this change, especially possible anthropogenic origins, is important. Here, we compare observed changes in global land monsoon precipitation during 1948-2005 with those simulated by 5 global climate models participating in the Coupled Model Inter-comparison Project-phase 5 (CMIP5) under different external forcings. We show that the observed drying trend is consistent with the model simulated response to anthropogenic forcing and to anthropogenic aerosol forcing in particular. We apply the optimal fingerprinting method to quantify anthropogenic influences on precipitation and find that anthropogenic aerosols may have contributed to 102% (62-144% for the 5-95% confidence interval) of the observed decrease in global land monsoon precipitation. A moisture budget analysis indicates that the reduction in precipitation results from reduced vertical moisture advection in response to aerosol forcing. Since much of the monsoon regions, such as India and China, are experiencing rapid developments with increasing aerosol emissions, our results imply a further reduction in monsoon precipitation in these regions in the future if effective mitigations to reduce aerosol emissions are not deployed.

Keywords: global monsoon, precipitation, detection and attribution, aerosol forcing