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The Influences of Climate Forcers and Agricultural Activities on the South Asian Summer Monsoon

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South Asia is one of the most heavily populated regions in the world with about 1.7 billion inhabitants. The diversity of human activities in the region make delineating the sources and magnitude of regional emissions complex. The major combustion sources in South Asia – predominantly anthropogenic – include wildfires and the burning of agricultural residues, garbage, biofuels, and fossil fuels. But regional aerosol loading is also heavily influenced by natural aerosols, primarily dust transported from as far as the Arabian Peninsula. Past studies have examined how irrigation expansion along with greenhouse gas (GHG) forcing have altered the surface energy budget, thereby affecting the transport of water vapor and altering South Asian Summer Monsoon (SASM) rainfall variability. However, there are still limited modelling studies that consider anthropogenic effects from anthropogenic aerosol loading in combination with irrigation and GHGs and how these factors collectively induce variability in the SASM. Using the NASA GISS-E2.1 model, this study elucidates the role of intensive agricultural activities on SASM, both at the onset of the Green Revolution (i.e., 1960s) and at present, isolating the individual roles of irrigation, anthropogenic aerosols, and GHGs. Specifically, we examine the impacts on SASM by using sensitivity runs to quantify how anthropogenic emissions from agriculture, urbanization as well as long- and short-term forcers have affected SASM from 1960-2014 using prescribed- and coupled-ocean runs. Understanding the roles of each of these influences on SASM can help to develop more effective climate interventions in the region and predict how SASM will influence and interact with the changing regional and global climate.