



Impacts of Land cover change and agricultural management on the South Asian regional climate

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Increasingly intensive crop management and land use change has substantially altered the South Asian land surface. Regional areas classified as semi-arid to arid are now intensively irrigated, while forested domains have been cleared for extensive crop rotations, particularly as food demands increase. Such changes serve to alter the surface energy balance and fluxes of heat and moisture with the overlying atmosphere, potentially modulating the South Asian Summer monsoon, and thus affecting annual rainfall for nearly 60% of South Asian agricultural holdings. As such, these land surface changes are identified as a regional climate forcing alongside anthropogenic greenhouse gas (GHG) emissions. This paper describes ongoing work to quantify the independent and combined regional impacts of a) land conversion from natural vegetation to agricultural systems, b) intensive management relating to large-scale irrigation and cropping patterns, and c) increasing GHG forcing on South Asian climate dynamics. To explore these interactions, we conduct global climate model experiments, using the NASA GISS ModelE2.1, that vary over: land use configurations, inclusive of natural vegetation, conversion to croplands and cropping calendars; time-varying 20th century irrigation; and historical GHG forcing. Preliminary results suggest that while the introduction of intensive management (i.e. irrigation) can weaken components of the monsoon system, intraseasonal impacts of the combined forcings can be highly varied, with implications for monsoon variability and, additionally, crop management. We suggest future work to: better quantify model sensitivities to the managed land surface; better represent major features of time-varying agricultural land management; and understand the South Asian regional interactions between climate change, particularly rising Indo-Pacific sea surface temperatures, and agricultural land management.