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Robust Late 21st Century Shift in the Regional Monsoons in RegCM-CORDEX Simulations

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We use an unprecedented ensemble of regional climate model (RCM) projections over seven regional CORDEX domains to provide, for the first time, an RCM-based global view of monsoon changes at various levels of increased greenhouse gas (GHG) forcing. All regional simulations are conducted using RegCM4 at a 25km horizontal grid spacing using lateral and lower boundary forcing from three General Circulation Models (GCMs), which are part of the fifth phase of the Coupled Model Inter-comparison Project (CMIP5). Each simulation covers the period from 1970 through 2100 under two Representative Concentration Pathways (RCP2.6 and RCP8.5). Regional climate simulations exhibit high fidelity in capturing key characteristics of precipitation and atmospheric dynamics across monsoon regions in the historical period. In the future period, regional monsoons exhibit a spatially robust delay in the monsoon onset, an increase in seasonality, and a reduction in the rainy season length at higher levels of radiative forcing. All regions with substantial delays in the monsoon onset exhibit a decrease in pre-monsoon precipitation, indicating a strong connection between pre-monsoon drying and a shift in the monsoon onset. The weakening of latent heat driven atmospheric warming during the pre-monsoon period delays the overturning of atmospheric subsidence in the monsoon regions, which defers their transitioning into deep convective states. Monsoon changes under the RCP2.6

scenario are mostly within the baseline variability.