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Contrasting the role of regional and remote circulation in driving the Asian monsoon in HadGEM3-GA7

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Monsoon biases are long-standing and an important problem to solve because nearly half of the world's population is affected by monsoon precipitation and circulation. The effect of local and remote circulation biases on Asian monsoon biases is studied with dynamical nudging using the latest version of the atmospheric component of the HadGEM3 model. Constraining the large-scale circulation substantially reduces oceanic biases in precipitation and circulation, particularly over the extra-tropics. Tropical wet biases may become even stronger because of unconstrained convection. By contrast, model biases over land are less sensitive to nudging due to the prominent role of local planetary boundary layer processes in modulating the low-level circulation. Nudging reduces the seasonal excess (deficit) precipitation over India in winter (summer) by reducing the local cyclonic (anti-cyclonic) biases. Constraining the circulation outside Asia demonstrates that the wet (dry) biases are mostly remotely (locally) controlled in winter (summer) over India. The monsoon biases over China show small changes with nudging, suggesting they are more thermodynamically driven. Monsoon variability is improved over India but not over China in nudged simulations. Despite the remaining errors in nudged simulations, our study suggests that nudging serves as a useful tool to disentangle the contribution of regional and remote circulation in generating the monsoon responses.