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Contribution of the east–west thermal heating contrast to the South Asian Monsoon and consequences for its variability

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The focus of this paper is to assess the relative role of the north–south and east–west contrasts in atmospheric heating for the maintenance of the South Asian summer monsoon climatology. The juxtaposition of the Eurasian land mass and the Indian Ocean is responsible for the north–south contrast, while the greater diabatic heating above the western Pacific compared to the one over the African and the tropical South Atlantic Ocean region introduces the east–west gradient. With a series of idealized atmospheric general circulation model experiments, it is found that both contrasts contribute to the maintenance of the South Asian monsoon climatology, but their impact varies at regional scales. The surface atmospheric cyclone and precipitation over northern India are mainly due to the north–south contrast. On the other hand, when the Indian Ocean sea surface temperatures are close to their climatological mean values, the low-level cyclone and consequent rainfall activity in the Bay of Bengal and southern India result from the east–west gradient. The physical mechanism relays on the southern part of the upper-level South Asian monsoon high being forced by the east–west diabatic heating contrast via Sverdrup balance. The east–west heating difference controls also the strength of the Tropical Easterly Jet. Finally, the contribution of the El Niño Southern Oscillation to the interannual variability of the Indian monsoon is interpreted as the result of a longitudinal shift of one of the centers of diabatic heating contributing to the east–west contrast.