

**Strengthening tropical Pacific zonal temperature gradient linked with increasing West Indian Monsoon rainfall**

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**Abstract**

The changes in the Indian summer monsoon rainfall under anthropogenic climate change would have a large socio-economic impact. The thermodynamic effect of the climate change on future monsoon rainfall is well understood with an overall increase in precipitation as the atmosphere moistens. Understanding the dynamical effect of climate change especially from the changes in the drivers of the monsoon remains challenging. Here we show that the observed western Indian monsoon rainfall has an increasing trend over the last 120 years. We find this observed trend is connected with the trend in the tropical Pacific zonal sea surface temperature (SST) gradient, where the western tropical Pacific or the warm pool region of the Pacific Ocean is warming faster than the eastern side. Applying a storyline approach to the future evolution of the zonal tropical Pacific SST gradient in 38 global climate models from the latest Coupled Model Intercomparison Project phase 6, we find a consistent connection in the models between the western Indian monsoon rainfall change and the strength of the change in the zonal tropical Pacific SST gradient under global warming. The models which warm more in the western compared to the eastern side of the tropical Pacific have higher rainfall increases over western India during the monsoon season. This link is associated with an anomalous easterly wind coming from the western tropical Pacific and converging over western India, leading to higher rainfall in both observations and models. This result suggests that future changes in the western Indian monsoon rainfall would depend on the changes in the strength of the zonal gradient of the tropical Pacific Ocean SST.

**Keywords**

Indian monsoon, tropical Pacific zonal SST