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Impacts of ENSO and IOD on Snow Depth over the Tibetan Plateau: Roles of Convections over the Western North Pacific and Indian Ocean

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This is a consensus that snow over the Tibetan Plateau (TP) modulates the regional climate significantly. Possible causes for the interannual variability of snow over the TP, however, are under debate, especially regarding the independent roles of El Niño-Southern (ENSO) and Indian Ocean dipole (IOD). Based on in-situ observational data analyses and model simulations, our study shows that impacts of ENSO and IOD on snow depth (SD) over the TP are different during early winter. In particular, ENSO mostly affects SD over the eastern TP, while IOD affects SD over the central-western TP. Both above-normal snowfall and cold temperature anomaly contribute to deeper-than-normal SD, with the former playing a more important role. Diabatic cooling of the suppressed convection over the western North Pacific that related to the positive phase of ENSO could excite an anomalous cyclonic circulation and strong cold temperature anomalies over the eastern TP. There is an enhanced moisture transported over the eastern TP from the tropics due to the anomalous cyclonic circulation; along with strong cold temperature anomalies, resulting in above-normal snowfall in the eastern TP. On the other hand, anomalous convection over the western Indian Ocean related to the positive IOD could generate a wave-train propagating northeastward and induce an anomalous cyclonic circulation over the central-western TP. The associated anomalous circulation transports extra moisture from the tropics to the central-western TP, providing conditions favorable for more snowfall over the central-western TP. Opposite conditions tend to occur during negative phases of ENSO and IOD.