



## **Contrasting impacts of two types of ENSO on the boreal spring Hadley circulation**

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The possible influences of two types of ENSO (i.e. the canonical ENSO and the ENSO Modoki, EM) on the Hadley circulation (HC) during the boreal spring are investigated during 1979~2010. The El Niño events are featured with a symmetric pattern in equatorial zonal mean sea surface temperature anomalies (SSTA), with a maximum around the equator. In contrast, the zonal mean SSTA associated with El Niño Modoki events shows an asymmetric structure with the maximum around 10°N. The contrasting underlying thermal structures correspond with the ENSO and EM have opposite impacts on the simultaneous HC. In El Niño years, a symmetric anomalous meridional circulation is seen, with enhanced rising around the equator and anomalous descent at about 15°N and 20°S. In contrast, an asymmetric equatorial meridional circulation is observed for El Niño Modoki years, with anomalous rising around 10°N and descent at about 10°S and 20°N. The contrasting meridional circulation anomalies within the ENSO and EM are due to their different meridional SSTA structure. This result is further theoretically explained, indicating the anomalous meridional circulation is subjected to the meridional SSTA gradient. Moreover, the observed results are reproduced in numerical experiments driven by anomalous warming in the eastern and central Pacific. Thus we conclude that the anomalous HC linked to the ENSO and EM is induced by the accompanying meridional gradient in zonal mean SSTA.