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The Indirect Tropical Ocean Control of the Northern Hemisphere Troposphere/Stratosphere-System in Future Climate Change

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There is increasing model evidence that future climate change is associated with stratospheric dynamical warming and also an equivalent barotropic weakening of the high latitude Northern Hemisphere westerlies between stratosphere and troposphere, which is known as equatorward expansion of the polar vortex. Such changes are associated with a strengthening of the mid-latitude eddy-driven jet in the troposphere and a strong large-scale precipitation change.

Here we show, using atmosphere general circulation model experiments that the Sea Surface Temperature (SST) and in particular its tropical component largely controls future anthropogenic circulation changes of the Northern Hemisphere troposphere/stratosphere-system and the resulting precipitation. The tropical SST drives wave-induced high-latitude stratospheric warming and easterly wind-anomalies in fall, which propagate into the troposphere and persist through mid-to-late winter. Tropical SST also controls the tropospheric response through a wave-induced strengthening of the mid-latitude eddy-driven jet and a weakening of high-latitude westerlies. The strengthening of the mid-latitude eddy-driven jet largely explains the precipitation response to future climate change. In northern high latitudes the precipitation is driven mainly by sea-ice. Our results suggest that realistic simulations of tropical SST are a key to improve and better understand differences among climate models in future climate change.