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Dynamical Mechanisms for Regional Tropical Precipitation Change during the Mid-Holocene

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A series of model experiments were designed for better understanding of the tropical climate responses to insolation forcing during the Mid-Holocene, 6ka. During this time slice, summer insolation at the high Northern latitudes is stronger than the present due to larger obliquity, while winter insolation in the tropics is weaker due to the precessional shift of perihelion relative to vernal equinox. Therefore the resulting insolation forcing in the summer is highly asymmetric and positive, whereas in the winter it is rather symmetric to the equator and negative.

When using constant 6-ka summer and winter averaged solar forcings in which there is no seasonal variation, the precipitation changes resemble those simulations under global warming scenarios, with same and opposite signs, for summer and winter forcing respectively. Further examinations also indicate that the mechanisms for global warming can also be applied in these experiments. However, when the more realistic seasonal variations were used for solar forcing, the precipitation changes due to the solar warming and cooling in the previous experiments subdued, resulting in a very different spatial pattern of precipitation changes. Our analysis indicates that the ocean feedback plays an important role in regulating the precipitation. The solar forcing is cancelled out by the surface heat flux associated with the ocean memory two seasons ago. More detailed mechanisms will be discussed.