High sensitivity of seasonal tropical precipitation to local sea-surface temperature

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Seasonal mean tropical precipitation at any location is controlled by a tangle of local and remote effects, including influences from SSTs across the globe. This, along with uncertainty in precipitation observations, and extremely limited observations of atmospheric circulation, makes understanding the relevant physics challenging. Climate model precipitation biases persisting across multiple generations of models point towards stubborn gaps in understanding and reduce confidence in seasonal forecasts and climate projections. This includes the 'double ITCZ problem': excessive rainfall in the southern tropical Pacific, first reported in 1995. Model ITCZs also tend to be too wide.

Our study shows that in the real world, the sensitivity of tropical precipitation to local sea surface temperature is high, associated with strong shallow circulations. This rests on a novel analysis of observations, unpicking local and remote controls on precipitation, and navigating a path through observational uncertainty. Models with appropriate sensitivity to local sea surface temperature, perform well across many conditions. Improvements in this sensitivity from the fifth to the sixth model intercomparison project are small, highlighting the need for new understanding. By further linking model biases to shallow convection, our results highlight a target process for focused research: accelerating improvements in seasonal forecasts through to multi-decadal climate projections.

Wider Met Office work linking precipitation evaluation between climate, seasonal and weather timescales will also be summarised.