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Classification of land-sea shifts in tropical precipitation using temperature and moisture change

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Changes in tropical precipitation under climate change are dominated by shifts in precipitating features. Previous work has shown that meridional change is driven primiarily by the hemispheric contrast of surface temperature change and radiative forcing. What drives zonal changes is less clear, but important to understand because large shifts of precipitation onto and away from land have the potential to cause large changes in water availability.

We present a simple compositing scheme based on earlier mean field theory that places climatological precipitation amounts into bins determined by surface temperature and humidity. When temperature and humidity change under climate change, shifts in precipitation are predicted as the location of the warmest and moistest regions changes. The prediction is successful in representing changes in the CMIP5 model mean and large aspects of changes in most of the individual CMIP5 models. Once the shifts are accounted for, we can more easily see how the result of well-known "thermodynamic" and "dynamic" changes in the atmosphere lead to the "rich-get-richer" paradigm wherein the most heavily precipitating bins increase their precipitation the most in a warmer climate.

We emphasise that our method is a classification and not a prognostic theory: it shows us the extent to which temperature, moisture and precipitation change are linked. However, it is important not only because it demonstrates that these variables may represent a coupled problem, but also intriguingly, because there is a small group of models for which the method has no skill at all. This suggests that very different processes dominate shifts in precipitation there, giving a focus for future research.