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A new feedback from the hydrological cycle on the rate of climate change

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Coupled climate models generally predict an intensified hydrological cycle in response to global warming. Observations suggest that this intensification has already begun: globally-integrated precipitation has steadily increased in recent decades. But changes in evaporation and precipitation may themselves affect sea surface temperature (SST), giving a possible feedback on the resulting rate of climate change.

We recently proposed a specific mechanism by which the above feedback could operate. Changes in the spatial patterns and/or intensities of evaporation and precipitation lead to changes in salinity gradients (and compensating temperature gradients) on constant-density surfaces in the ocean. Modified heat transports result, which alter the vertical thermal structure of the ocean, and hence the SST.

In this study we investigate the sign, magnitude and linearity of the above feedback in the low-latitude ocean on decadal timescales. We run coupled General Circulation Model sensitivity experiments with constant greenhouse gas forcing, in which the surface fresh water flux is artificially boosted or suppressed by applying a multiplying factor between 0 and 2. We find that the resulting SST anomaly scales linearly with multiplying factor in this range. For a multiplying factor of 1.1, which is of the order projected to exist at the time of CO_2 doubling, we estimate a negative SST anomaly of magnitude around 0.1°C. We conclude that an intensification of the hydrological cycle is likely to contribute a weak negative feedback to low-latitude climate change.