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ITCZ breakdown in the moist atmosphere

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The effects of moisture on the ITCZ breakdown are investigated using an intermediate complexity atmospheric circulation model, the quasi-equilibrium tropical circulation model (QTCM1), on an aqua-planet. The dry simulation shows
consistent result as those using simple dynamic models except a stronger initial
heating rate is needed to boost deep convection. This is due to the design of QTCM1 that only includes barotropic and the first baroclinic mode in the vertical.

In moist simulations, the most intriguing result is the formation of the tail at the southwest of the vortex during and after ITCZ breaks. In the eastern north
Pacific, this phenomenon is often observed in summer and fall. The tail which can be seen as a new but weaker ITCZ extends for more than 60 degrees in longitude and may last for more than 2 weeks in an idealized simulation. It may explain the quick re-formation of the ITCZ in the eastern Pacific. Our study shows that strong surface convergent flow induced by vortices which were either generated within the ITCZ through barotropic instability or propagated from the east would create a tail in a moist atmosphere. Strong surface wind speed is a necessary condition to create enough evaporation that supports the convection within the tail.

Other factors that may influence the lifetime of the tail is the sea surface temperature and the passing of Kelvin wave. An experiment coupled with mixed layer ocean shows that the tail dissipates a few days faster. The passing of Kelvin wave will suppress the convection in the tail completely. This may explain the absence of the tail in some of the events in the real atmosphere.