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A Simple Mechanism to explain the Zonal Dipole Pattern of Surface Salinity across the Atlantic and Pacific Tropics within a Global Warming Scenario

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Climate Change elicits robust responses from the ocean-atmosphere system, the most famous of all being an increase in global mean surface temperatures. A consequence of this effect is the increased amount of moisture in the atmosphere through enhanced evaporation (precipitation) at low (high) latitudes, leading to a stronger hydrological cycle. Ocean salinity can be used as an indirect quantity in measuring the strength of freshwater transport and is also a useful alternative diagnostic for evaluating the different routes of moisture transport.

For this presentation, we analyse sea surface salinity (SSS) anomalies within a transient CO2 scenario and offer an explanation to the possible mechanisms to the patterns illustrated.

Data is taken from the CHIME ocean-atmosphere coupled model with a transient spin-up run of increasing CO2 concentration at 1% per year.

Results of ocean meridional mass transport at 24N mapped onto salinity S and temperature T space reveal water masses (especially near the surface) within the Atlantic (Pacific) become progressively warmer and saltier (warmer and fresher) with increased CO2 concentration. Comparisons of SSS anomaly maps at different stages of CO2 evolution support this view of an evolving dipole pattern of salinity across the Tropics, and mirror similar results shown by Boyer et al 2005 and Schmitt et al 2008. Similar maps for global surface precipitation reflect these same features, however changes are predominantly limited to the equatorial regions. Due to this dipole pattern of SSS we can infer a net transport of freshwater from the Atlantic to the Pacific.

By hypothesising that this net freshwater is transported by the equatorial Easterly Winds via central America, direct computations of zonal freshwater transport through this region illustrate an increase in westward transport of moisture from the Atlantic to the Pacific. We discuss in detail whether this increased transport of water is sufficient to explain the freshening of the Pacific Basin through a freshwater budget transport calculation for the region.