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The role of mean ocean salinity in climate

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We describe numerical simulations designed to help elucidate the role of ocean salinity in climate. Using a coupled atmosphere-ocean general circulation model, we study a 100-year sensitivity experiment in which the global-mean salinity is approximately doubled from its present observed value, by adding 35 psu everywhere. The salinity increase produces a rapid global-mean sea-surface warming of 0.8°C within a few years, caused by reduced vertical mixing associated with changes in cabbeling. The warming is followed by a gradual global-mean sea-surface cooling of 0.4°C during the first few decades, caused by an increase in the vertical (downward) component of the isopycnal diffusive heat flux. We find no evidence of impacts on the variability of either the Atlantic thermohaline circulation or the El Niño/Southern Oscillation. The mean strength of the Atlantic meridional overturning is slightly reduced and the North Atlantic Deep Water penetrates less deeply. Nevertheless, our results dispute claims that higher salinities for the world ocean have profound consequences for the thermohaline circulation.

In additional experiments with doubled atmospheric carbon dioxide, we find that the amplitude and spatial pattern of the global warming signal are modified in the hypersaline ocean. In particular, the equilibrated global-mean sea-surface temperature increase caused by doubling carbon dioxide is reduced by 10%. We infer the existence of a non-linear interaction between the climate responses to modified carbon dioxide and modified salinity.