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Projected salinity changes under global warming conditions

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The response of salinity to global warming in climate projections and the associated mechanisms involved in the surface and subsurface salinity changes in global oceans are investigated. The study is based on the medium resolution (MR) Max-Planck-Institute Earth System Model (MPI-ESM) in its Coupled Models Intercomparison Project Phase 5 (CMIP5) configuration. Previous studies suggest the pattern of salinity changes in the upper ocean over the past 50 years are indicative of the coherent changes in the evaporation (E) minus precipitation (P). The broad-scale warming of surface ocean induces long-term changes in the freshwater forcing, however, its effect on global ocean salinity and associated surface and interior changes still require further understanding. In this study an attempt is made to understand the mechanisms driving the changes in salinity in oceanic conditions under high green house gas emissions by using RCP (Representative Concentration Pathway) 8.5 scenario, for the period 2081-2100, in comparison to the historical run, for the period 1986-2005, which is representative of the present oceanic conditions.

The sea surface salinity shows increased salinity changes in the tropical and sub-tropical Atlantic and decreased salinity or basin-wide freshening in the Pacific and Indian Ocean which is coherent with the freshwater flux changes. Major freshwater flux influence on salinity changes is found in the Atlantic Ocean, equatorial Pacific and the South Pacific Ocean. On examining the salinity changes on isopycnals we note that the heave-driven changes contribute to an increase in salinity changes in the upper 500 meters of the global ocean especially in the equatorial and tropical ocean basins. Sub-surface salinity changes associated with heaving is more prominent in the tropical and sub-tropical Atlantic than in Pacific or Indian ocean basins. Whereas in the North Pacific, between the latitudes 10°N-30°N, the salinity changes along the isopycnals dominate the total salinity changes in the region. Another factor contributing to the salinity changes is the lateral migration of surface density outcrop locations. Although our analysis suggests that the salinity changes are partially driven by migration in specific regions especially in the mode waters, we notice certain changes that are not attributed to migration or surface flux changes. The circulation changes, associated with the lateral and vertical displacement of isopycnals, on longer time scales lead to changes in advective pathways. This may provide more insight into the salinity changes. Further analysis is carried out to examine and understand these changes.