Impacts of ice-shelf melting on Southern Ocean water mass transformation from E3SM simulations

Objectives

- Explore the potential impacts of explicitly resolved ice-shelf melt fluxes on Southern Ocean sea-ice and ocean processes

Approach

- Use E3SM's novel capability of simulating heat and freshwater exchange within ice-shelf cavities to compare simulations with and without ice-shelf melt fluxes
- Apply new water mass transformation (WMT) analysis tools to characterize thermodynamic processes related to sea-ice formation and melting and Southern Ocean overturning in E3SM

Impact

- Ice-shelf melt fluxes lead to stronger upper-ocean stratification, trapping warm, intermediate ocean waters at depth

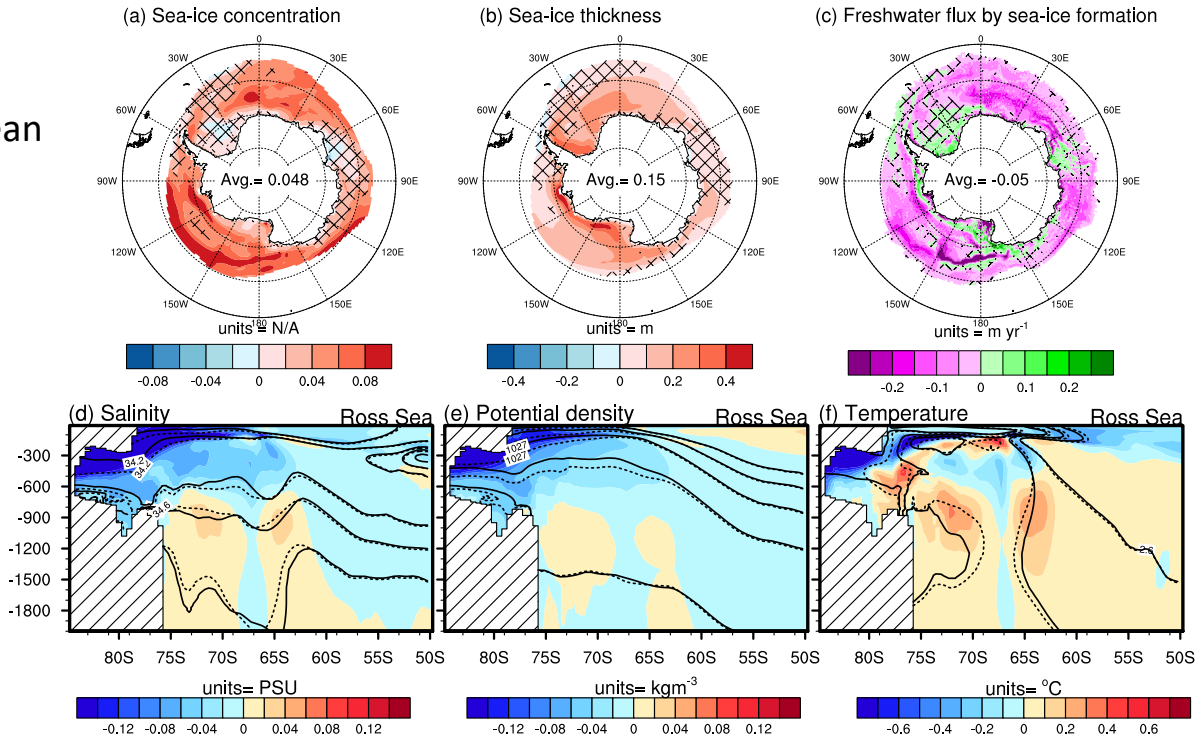

Fig. Differences between ISM and Ctrl simulation (ISM-Ctrl) in mean sea-ice concentration (a), sea-ice thickness (b), freshwater flux by sea-ice formation (c), vertical cross section of differences in zonally averaged salinity (d), potential density (e), ocean temperature (f) for Ross Sea.

- Ice-shelf melt fluxes lead to increased Antarctic sea-ice, similar to recently observed trends, and implying an increased role of sea-ice in Southern Ocean overturning circulation
- Demonstrated the use of E3SM for investigating feedbacks between Antarctic ice-shelf melting, sea-ice formation and melting, and S. Ocean overturning and circulation

Jeong H., Asay-Davis X., Turner A., Comeau D., Price S., Abernathey R., Veneziani M., Petersen M., Hoffman M., Mazloff M., Ringler T., 2020. Impacts of ice-shelf melting on water mass transformation in the Southern Ocean from E3SM simulations, J. Clim., (accepted)