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Tides and ice shelves impacts on ice-ocean interactions in east Antarctica.

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Recent trends in the southern ocean sea ice extent challenge our understanding of the interactions between air, ice and sea in polar regions. The latter is yet a key to the study of climate change and of its upcoming consequences, such as the observed increase in Antarctic Ice sheet melt contributing to sea level rise. Global models used to simulate the future evolution of the earth's climate often neglect several processes or rely on parametrizations due to their coarse spatial and temporal resolution. However, fine scale processes may strongly influence local air-sea-ice heat, water and momentum fluxes, with potential implications on regional to global scales. Here, we propose to evaluate the impacts of fine scale processes on air-sea-ice interactions at seasonal time scales. A particular focus is given to the role of tides and of the representation of ice shelves cavities. To do so, we use a high resolution ocean - sea ice model of the Adélie Land region, in East Antarctica. We perform a series of sensitivity experiments where tides and under ice shelves cavities are removed, first one by one, then together. The representation of ice shelves cavities and interactions with the ocean leads to a warming of the subsurface waters in the neighborhood of the main ice shelves, despite their relatively low melt rate. This warming result in a decrease of sea ice growth on the continental shelf. Tides strongly influence the state of water masses and circulation on the continental shelf, with a residual tide-induced circulation reaching the order of magnitude of the circulation without tides. Surface water becomes warmer when tides are present, which leads to increased ocean - sea ice heat flux. It results in a decrease of sea ice growth concentrated in shallower regions of the shelf, where the amplitude of tidal velocities is large. Ice shelves exhibits an increased basal melt in presence of tides. These increased heat flux from the ocean to ice shelves and sea ice are strongly variable on an interannual scale, which shows that tides impacts depends strongly on water masses and existing circulation. Overall, we argue that tides and ice shelves have a strong impact on east Antarctica's coastal seas and sea ice, with complex interactions that goes beyond current parametrizations.