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Competing connections between the Ross Ice Shelf with the Southern Ocean.

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The stability of the Ross Ice Shelf (RIS) is critical to both the East Antarctic Ice Sheet, and the West Antarctic Ice Sheet. Results from a climatological ice shelf-ocean coupled numerical model (ROMS) suggest a new circulation mechanism associated with High Salinity Water (HSSW) production in the Ross Sea Polynya (RSP) that controls oceanic heat access to the RIS cavity. Within the RSP the dense water-saturated water column contracts during winter and causes a seasonal drop in Sea Surface Height (SSH) localised to a convection chimney under the RSP. The SSH gradients of up to 1.5 mm per km are sufficient to generate a barotropic pressure gradient that can counteract the wide scale horizontal baroclinic force and reverse the geostrophic circulation. In water depths between 600 and 800 m north of the western RIS the effect causes the seasonal occurrence of a cyclonic circulation cell with transports greater than 1Sv. Appearing with the beginning of winter sea ice formation in the RSP it significantly changes the dynamics at the ice shelf front.

The new mechanism is described as one element in a framework of oceanographic processes that mitigate the exchange between the deep ocean and the ocean cavity under the RIS. Our study links local circulation features that are known from observation and previous model studies, and for the first time establishes a coherent system of responsible physical forcing processes in the Ross Sea.