Modelling the impact of tidal currents on ocean circulation beneath Filchner-Ronne Ice Shelf

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A modified version of the Miami isopycnic coordinate ocean circulation model (MICOM) is applied to the southern Weddell Sea and the ocean cavity beneath Filchner-Ronne Ice Shelf (FRIS). The model is used to investigate the response of ocean circulation to significant tidal activity which, until now, has been neglected in 3-D models of the region. Beneath FRIS, tides are the primary source of motion with mean tidal current speeds varying from a few cm/s to 50 cm/s, with peak speeds about twice this during spring tides. Strong tidal currents occur in the relatively shallow regions near Ronne Ice Front, the broad channel south of Henry Ice Rise and close to grounding lines. The model shows that as the water column shallows, intense vertical mixing creates a well-mixed water column that is separated from the deeper stratified water column by a tidal front. Tidal fronts form a barrier to lateral exchange, forcing the mean currents to go around these well-mixed regions, thus modifying the circulation pattern. Elsewhere, tidal mixing continues to enhance water mass modification and the flow of heat up through the stratified water column, increasing basal melting. These initial results show that if ocean circulation, together with the evolution of water mass properties and basal melting patterns are to be effectively modelled, the inclusion of tidal forcing in ocean circulation models is essential.