An New Estimate of Marine Ice under Amery Ice Shelf

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Accreted marine ice is present under Antarctica's Amery Ice Shelf (AIS). This study provides a new estimate of accreted marine ice thickness under the outer AIS using ice penetrating radar (IPR) measurements for ice thickness and elevation collected jointly by China, Australia, and the US during the 2016-2017 and 2017- 2018 austral summers. The hypothesis was that distribution and properties of the marine ice layer can be defined using IPR measurements of the meteoric-marine ice interface and signal ocean forcing beneath the ice. Conditions at the ice-ocean interface, including presence of marine ice, make AIS a compelling analog for Jupiter's moon, Europa. This study estimates the distribution of marine ice by applying the hydrostatic equation. The orthometric height is compared to the height calculated by the hydrostatic equation using the ice thickness from IPR data and the modeled densities of meteoric ice and sea water. The difference between the orthometric height and IPR-derived height, the hydrostatic height anomaly, was calculated. Where the hydrostatic height anomaly was 0-30 m, marine ice was likely present. Where marine ice is present, a derived equation that accounted for presence of marine ice was used to re-estimate the total ice thickness. The difference between the IPR-derived thickness and revised total ice thickness gives an estimate of the thickness of marine ice. A map of marine ice was successfully created. The estimate indicated accretion mainly at the front of the ice shelf, which was consistent with the ice pump mechanism hypothesized to be occurring below AIS.

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