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Using ApRES to infer tidal melt rates and vertical strain rates at the Filchner-Ronne Ice Shelf

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The Filchner-Ronne Ice Shelf (FRIS) experiences strong tidal forcing known to displace portions of the ice shelf by several meters over a tidal cycle. Such large displacement causes significant variation of the ice-shelf vertical strain rate and basal melt rate on tidal timescales. Inferring these quantities is challenging particularly for the semi-diurnal tidal constituents whose high frequency requires frequent observations.
The recently developed autonomous phase-sensitive radio-echo sounder (ApRES) is capable of collecting observations of the glacier interior at sufficiently short timescales allowing appropriate resolution at all significant tidal constituents. An ApRES records changes in vertical positions of internal ice reflectors, resulting in a measurement of ice-shelf thickness evolution at a Lagrangian point. Here we present a method for the separation of tidal strain thinning and tidal melt thinning contributions, which the total tidal thinning consists of. Further, we discuss how these tidal melt rate and vertical strain rate changes vary spatially across FRIS and how this new class of observations contributes to our current understanding of the dynamics of the FRIS ice-shelf/ocean cavity system.