

Icequake Scaling and Periodicity at a Rift on the Ross Ice Shelf, Antarctica

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The Ross Ice Shelf (RIS) is the largest ice shelf in the world. It is fed from ice flowing off the continent of Antarctica. The ice shelf is affected by tides, so its motion can be described as a combination of long term flow as well as short term tidal variations. Within the ice shelf there are large rifts which are oriented roughly perpendicular to the flow direction. These rifts are zones of weakness that accommodate much of the deformation of the ice shelf. During this deformation, icequakes can occur. Icequakes produced here show a higher *b-value* in the Gutenberg-Richter scaling relationship than continental earthquakes. We investigate icequakes on the east side of rift WR4 in the RIS. Our model suggests a maximum icequake slip depth that is ~ 7.8 m below rift surface mélange due to water saturation, where the slip area can only grow laterally along the fracture planes, providing a control on icequake size and depth. We use remote sensing and geodetic tools to quantify surface movement on different time scales and find that the majority of icequakes occurred during falling tides. We additionally utilize time series power spectrum analysis to compute the dominant frequencies at which icequakes and GPS vertical motion occur. This analysis indicates that occurrence of icequakes is strongly associated with the tidal cycle and exhibits two peaks in activity at ~ 24 hours, ~ 12 hours, and ~ 8 hours.

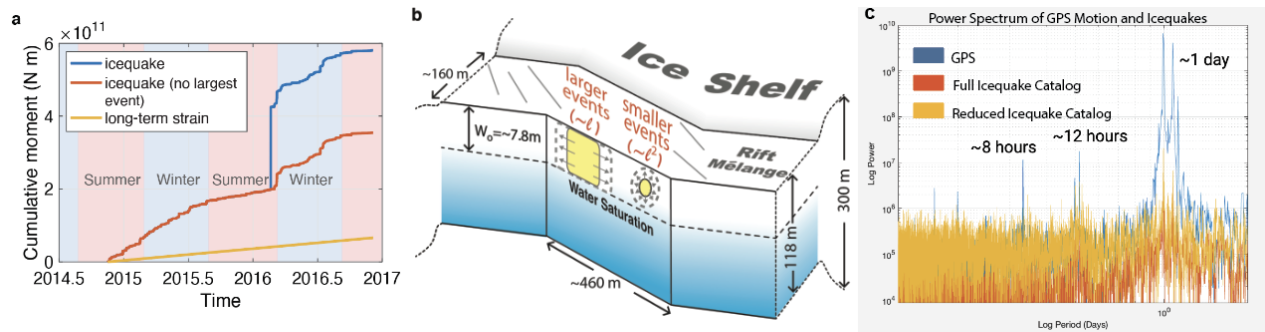


Figure 1. (a) Cumulative icequake seismic (red and blue) moment and the strain energy due to long-term rift opening (yellow). **(b)** Conceptual model of the icequake scaling. The width of the rift is 160 m. For smaller events, slip area grows with length square (l^2), but the slip area cannot grow past W_0 , the brittle-ductile transition at ~ 7.8 m depth. Slip area grows laterally with a length scale (l) for events with magnitude $M_W > -0.4$. **(c)** The power spectrum of GPS vertical motion, full icequake catalog, and reduced icequake catalog (only those icequakes with measurable magnitude).