Big or little? Patterns of change on the Ross Ice Shelf

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Comparison of surface velocities measured during the Ross Ice Shelf Geophysical and Glaciological Survey (RIGGS, 1973 to 1978) and velocities measured via feature tracking between two Moderate-resolution Imaging Spectroradiometer (MODIS) mosaics (compiled from 2003-4 and 2008-9 images) reveals widespread slowing and minor areas of acceleration in the Ross Ice Shelf (RIS) over the ~30 year interval. The largest changes (-13 ma^{-2}) occur near the Whillans and Mercer Ice Streams grounding line in the southernmost part of the ice shelf. Speed has increased over the interval (up to 5 ma^{-2}) between the MacAyeal Ice Stream grounding line and the shelf front, and along the eastern part of the shelf front. Here, a well-tested model of the ice shelf is used to discern between longer and shorter time scale transients in ice shelf flow. Changes in ice thickness observed using ICESat laser altimetry are used to test various model outcomes. The observed transients represent a combination of ongoing response to ice stream discharge variations and resulting shelf thickness changes over the past millennium and while faint impressions of past events are evident, the modern signal is dominated by shorter time scale events, including the stagnation of Kamb Ice Stream ~160 years ago, recent changes in basal drag on the Whillans Ice Stream ice plain and, apparently, iceberg calving. Details in embayment geometry, for example the shallow sea floor below Crary Ice Rise, modulate the spatial pattern of ice shelf response to flow perturbations.