Connections between the spheres of glaciology, oceanography, and tectonics.

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Recording and analyzing natural-source seismicity in Antarctica can lead to insights on the the tectonic setting of the continent as well as the flow dynamics of glaciers. These two fields have been generally separate in their goals and techniques, but increasingly high-resolution measurements of local, regional, and global seismicity has allowed us to gain insights into glacier processes and oceanic processes in detail and dimension that was not possible before. With the advent of dense recording networks and high-sensitivity stations, allied to new processing techniques, we can monitor glacier flow behavior and high temporal resolution. We can monitor oceanographic processes such as sea ice formation and iceberg calving and ice shelf fracture at high temporal resolution.

In this talk I will survey results on the flow of ice streams in West Antarctica in which the motion of the glaciers can be measured by geodetic-quality GPS receivers. In addition, processes at the base of the glacier can be estimated by recording seismic emissions. Stick-slip behavior of Whillans Ice Stream and of David Glacier (in East Antarctica) are due to different but related phenomena – spatial changes in bed friction between the ice and the underlying rock or sediments. These two glaciers are at opposite ends of the glaciological flow spectrum (Whillans is broad and relatively flat, with ice boundaries, where David Glacier is narrow, steep, and has rock walls); nevertheless the presence of seismicity at the base can be used to determine flow properties and build more-accurate numerical models of the systems than would be possible without the measurements of those small earthquakes.

David Glacier has been proposed as a location where active erosion of a bedrock valley can be observed through seismic means. I survey the connection between glaciology and geomorphology in the context of this glacier, as well as in the context of similar phenomena in Greenland.

References

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