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Evolution of Tidally Modulated Stick-Slip Motion of Whillans Ice Stream, West Antarctica

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Whillans Ice Stream remains the only Antarctic ice stream yet reported where most of the motion occurs as stick-slip. Continued study of this ice stream has revealed a number of other interesting characteristics: the fraction of mean daily motion accomplished by these slips is approximately 90% near the grounding line and decreases upstream; the motion on the ice plain is larger during spring tides than during neap tides, but the slip fraction is constant; and near the grounding line, slip events begin and end more impulsively that farther upstream. Additionally, the mean annual velocity continues to decrease and the slip fraction of daily motion increased from 2003-04 to 2004-05 due to an increase in the slip displacements. Dense grids of GPS receivers and seismometers were established in the mouth of Whillans Ice Stream for approximately one month during the 2004-2005 Antarctic field season to examine further details of these stick-slip characteristics. GPS receivers spaced approximately 25 km apart formed a background grid while a set of mobile receivers were moved to gain a finer resolution picture of the stick-slip phenomenon at specific locations. A majority of the events appear to initiate in a single local and propagate upstream and downstream.