

Continuing the Whillans Ice Stream subglacial lake record with GPS

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The synthesis of multiple remote sensing missions over the Antarctic ice sheet have shown patterns of localized elevation change that are attributed to the surface expression of water flux into and out of subglacial lakes. The ICESat mission provided a precise, yet discontinuous, time-series of the elevation of these dynamic features from 2003 to 2009. To continue monitoring during the gap between the ICESat and ICESat-2 missions and to learn more about the relationship between subglacial lakes and ice sheet dynamics, we deployed twelve on-ice Global Position System (GPS) units on several subglacial lakes on the Whillans Ice Stream, Siple Coast, Antarctica. Here we evaluate the efficacy of GPS observations over subglacial lakes using 22 days of high-rate GPS data from seven sites (four on subglacial lakes, two on hypothesized flow paths away from a subglacial lake, and one on a local high point). We process the data using both double differencing (DD) and precise point positioning (PPP) methods to find that, although the DD baselines approach 100 km, DD processing techniques provide a more robust solution than any PPP implementation. We also investigate how the advection of a GPS unit downstream can contribute to a spurious signal in the vertical component. Assessing how well our data collection and processing methods capture subglacial lake dynamics is critical to determining how to effectively monitor these features remotely and ultimately to establishing the role of sub-ice hydrology within ice sheet dynamics.