Subglacial flood event observed using *in situ* GPS data, CryoSat-2 altimetry, and MODIS image differencing on the Whillans Ice Plain, West Antarctica

Matthew R. Siegfried[1], Helen A. Fricker[1], Mackenzie W. Roberts[1], Theodore A. Scambos[2]

[1]Scripps Institution of Oceanography, University of California, San Diego
[2]NSIDC/CIRES, University of Colorado, Boulder

The Whillans Ice Plain (WIP), at the confluence of the Whillans and Mercer Ice Streams on the Siple Coast, West Antarctica, has been observed to have a dynamic subglacial hydrological system, including subglacial lakes that fill and drain on sub-annual to decadal cycles. The initial data from the ICESat mission (2003-2009) provided a precise, yet spatially and temporally discontinuous, time-series of lake activity for nine subglacial lakes in the area. Here, we use an array of moderate-rate GPS units to monitor the subglacial hydrology on WIP during and after the ICESat/CryoSat-2 altimetry gap, assess the efficacy of CryoSat-2's Synthetic Aperture Radar-Interferometric (SIN) mode data for investigating active subglacial lakes, and tie the ICESat and Cryosat-2 datasets together through these in situ observations. Simultaneous ice-surface elevation measurements over Subglacial Lake Mercer (SLM) from GPS data and SIN-mode data reveal a subglacial lake drainage event lasting from August 2012 until March 2013, which is independently confirmed through MODIS image differencing. This event is similar in magnitude to the only previously documented SLM lake drainage (~$30 m^3 s^{-1}$ sustained over 6-8 months in 2005), but the GPS (at 30-second intervals) and CryoSat-2 data (at monthly intervals) have improved the temporal resolution of previous observations of WIP subglacial floods by orders of magnitude. This increase in both the temporal and spatial resolution at which we map subglacial water allows for a better mechanistic understanding of the subglacial hydrological system on a decelerating ice stream, and enables us to track the movement of subglacial drainage water downstream.