

Changes in the surface velocity of Thwaites Glacier from differential GPS observations

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Thwaites Glacier (TG), which together with Pine Island Glacier (PIG) drains ~5% of the West Antarctic Ice Sheet (WAIS), epitomizes the class of overdeepened ocean-terminating glaciers that would be at risk under a Weertman style retreat scenario, where grounding line retreat of a marine glacier is hypothesized to lead to thickening of ice at the grounding line and result in greater ice flux to the ocean from the higher driving stress creating additional grounding line retreat, and thus a positive feedback. This inherent sensitivity of TG to grounding line retreat is exacerbated by its discharge into a deep embayment with relatively warm water and high accumulation rates, which suggest heightened sensitivity to oceanic influences and synoptic scale meteorology, respectively. Here we present results of a ground-based differential GPS study during the 2007-2008 (17 stations) and 2008-2009 (16 stations) austral summers, where stations were deployed along the 2 central flowlines and on one transverse-to-flow line. Stations were located between 60 km and 335 km from the grounding line and sampled ice velocities from ~65 m/a to ~660 m/a. 9 stations were co-located during both austral summer deployments. 8 of the 9 co-located stations show velocity increases ranging from ~1-1.6%. The only station not exhibiting a velocity increase is located farthest from the grounding line (~335 km) and advected into a zone of slightly lower velocity as indicated by interferometric synthetic aperture radar (InSAR) data. Horizontal advection can only account for velocity magnitude changes ranging from 0.004-0.25%; thus, our observations indicate an acceleration along both central flowlines. Our results also show that TG is continuing to widen in agreement with InSAR observations. These data suggest that TG has not reached a new steady-state, but is continuing to respond to forcing, the source of which cannot be identified from this study alone.