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Grounding-zone flow variability of Priestley Glacier, Antarctica, in a diurnal tidal regime

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Dynamics of polar outlet glaciers vary with ocean tides, providing a natural laboratory to understand basal processes beneath ice streams, ice rheology and ice-shelf buttressing. We apply Terrestrial Radar Interferometry to close the spatiotemporal gap between localized, temporally well-resolved GNSS and area-wide but sparse satellite observations. Three-hour flowfields collected over an eight day period at Priestley Glacier, Antarctica, validate and provide the spatial context for concurrent GNSS measurements. Ice flow is fastest during falling tides and slowest during rising tides. Principal components of the timeseries prove upstream propagation of tidal signatures $>$ 10 km away from the grounding line. Hourly, cm-scale horizontal and vertical flexure patterns occur $>$6 km upstream of the grounding line. Vertical uplift upstream of the grounding line is consistent with ephemeral re-grounding during low-tide impacting grounding-zone stability. On the freely floating ice shelves, we find velocity peaks both during high- and low-tide suggesting that ice-shelf buttressing varies temporally as a function of flexural bending from tidal displacement. Taken together, these observations identify tidal imprints on ice-stream dynamics on new temporal and spatial scales providing constraints for models designed to isolate dominating processes in ice-stream and ice-shelf mechanics.