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Seasonal to multi-annual speedup and slowdown of Greenland outlet glaciers inferred from time-dependent remote sensing observations

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The rate of ice flux from the Greenland Ice Sheet to the ocean depends on the ice flow velocity through outlet glaciers. Ice flow velocity, in turn, evolves in response to multiple geographic and environmental forcings at different timescales. For example, velocity may vary daily in response to ocean tides, seasonally in response to surface air temperature, and multi-annually in response to long-term trends in climate. The satellite observations processed as part of the NASA MEaSUREs Greenland Ice Sheet Velocity Map allow us to analyse variations in ice surface velocity at multiple timescales. Here, we decompose short-term and long-term signals in time-dependent velocity fields for Greenland outlet glaciers based on the methods of Riel et al. (2018). Patterns found in short-term signals can constrain basal sliding relations and ice rheology, while the longer-term signals hint at decadal in/stability of outlet glaciers. We present example velocity time series for outlets including Sermeq Kujalleq (Jakobshavn Isbrae) and Helheim Glacier, and we highlight features indicative of dynamic drawdown or advective restabilization. Finally, we comment on the capabilities of a time series analysis software under development for glaciological applications.