Geophysical Research Abstracts
Vol. 21, EGU2019-18358, 2019
EGU General Assembly 2019

Modelling tidal modulation of the Filchner-Ronne Ice Shelf: explanations and conundrums

Sebastian Rosier and Hilmar Gudmundsson
Northumbria University, Newcastle-upon-tyne, United Kingdom (sebastian.rosier@northumbria.ac.uk)

An extensive network of GPS sites on the Filchner Ice Shelf show strong tidal modulation of horizontal ice flow at a range of frequencies. One particularly puzzling feature of these observations is a distinct response across the entire ice shelf at a fortnightly (Msf) frequency that is not present in the tidal forcing. The presence of this Msf signal implies a nonlinear mechanism must be responsible but reproducing this signal, which also exists on the neighbouring ice streams even far upstream of the grounding line, has proven very difficult with our current understanding of ice dynamics. Thus, finding the missing ingredient that allows us to successfully replicate these remarkable observations can yield improvements into large scale ice sheet models - and indeed these attempts have already started. However, we cannot begin to use these observations without first finding the mechanism responsible to generate them and previous conceptual studies using simplified geometries have taken us as far as we can hope. We will present the first large-scale viscoelastic modelling study to explore these processes using a realistic geometry and test all mechanisms that have been put forward to explain how tides might affect ice shelf flow. Our results show that tidal motion of the grounding line is the only proposed mechanism that can generate a sufficiently strong Msf response of the ice shelf and that this mechanism is sensitive to the ice-flow stress exponent. Furthermore, the higher frequency tidal motion that causes twice-daily flow reversals at the ice front is generated through a purely elastic response to basin-wide tidal perturbations in the ice shelf slope. We also find that if it were not for the presence of large ocean tides beneath the Filchner Ice Shelf its mean velocity would be reduced by $\sim$21%.