Geophysical Research Abstracts
Vol. 20, EGU2018-5223, 2018
EGU General Assembly 2018

The far reach of ice-shelf thinning in Antarctica

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Floating ice shelves, which fringe most of Antarctica's coastline, regulate ice flow into the Southern Ocean. Their thinning or disintegration can cause upstream acceleration of grounded ice and raise global sea levels. So far the effect has not been quantified in a comprehensive and spatially explicit manner. Here, using a finite-element model, we diagnose the immediate, continent-wide flux response to different spatial patterns of ice-shelf mass loss. We show that highly localized ice-shelf thinning can reach across the entire shelf and accelerate ice flow in regions far from the initial perturbation. As an example, this 'tele-buttressing' enhances outflow from Bindschadler Ice Stream in response to thinning near Ross Island more than 900 km away. We further find that the integrated flux response across all grounding lines is highly dependent on the location of imposed changes: the strongest response is caused not only near ice streams and ice rises, but also by thinning, for instance, well-within the Filchner-Ronne and Ross Ice Shelves. The most critical regions in all major ice shelves are often located in regions easily accessible to the intrusion of warm ocean waters, stressing Antarctica's vulnerability to changes in its surrounding ocean.