

Seasonal change in Antarctic ice sheet movement observed for first time

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Riley Glacier, Palmer Land, Antarctica. Credit: Ian Willis

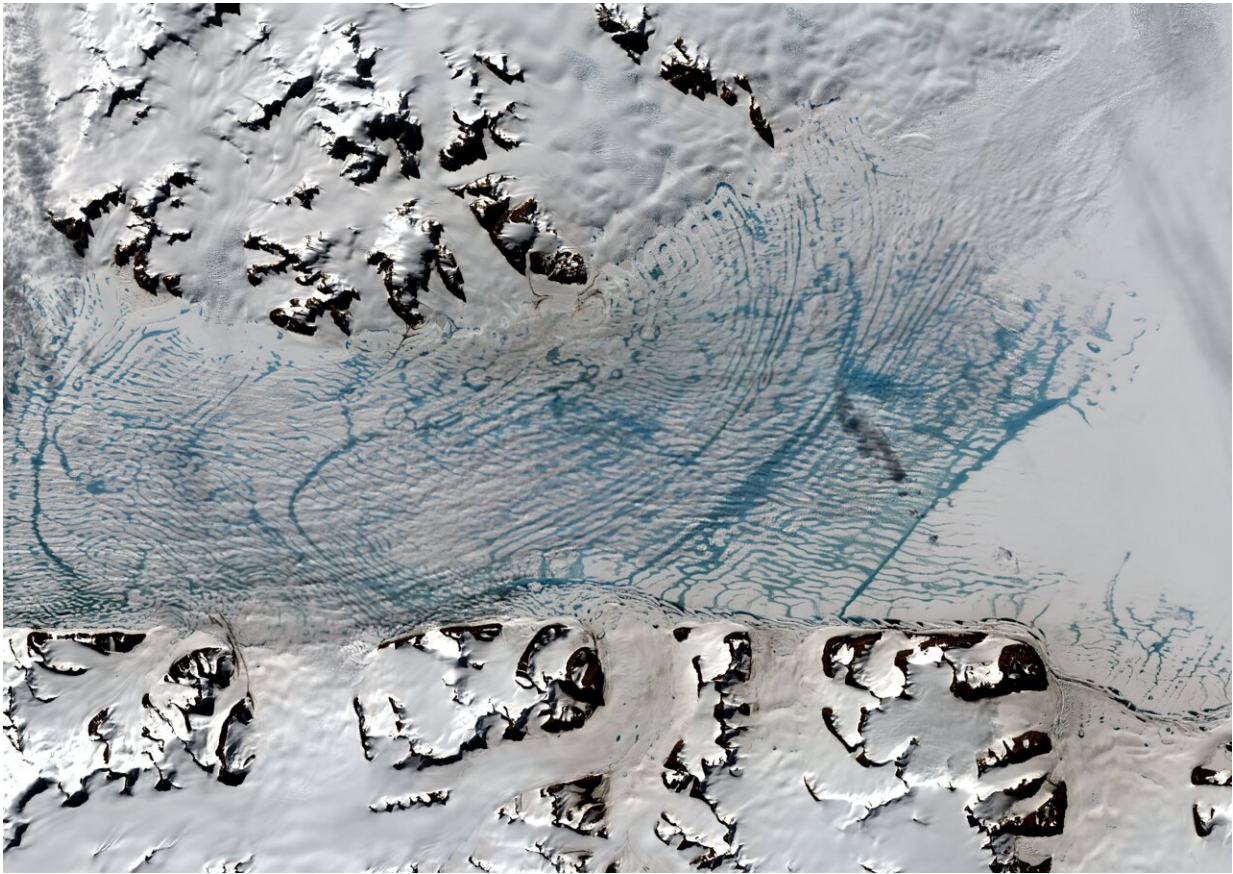
Some estimates of Antarctica's total contribution to sea-level rise may be over- or underestimated, after researchers detected a previously unknown source of ice loss variability.

The researchers, from the University of Cambridge and Austrian engineering company ENVEO, identified distinct, seasonal movements in the flow of land-based ice draining into George VI Ice Shelf—a floating platform of ice roughly the size of Wales—on the Antarctic Peninsula.

Using imagery from the Copernicus/European Space Agency Sentinel-1 satellites, the researchers found that the glaciers feeding the [ice shelf](#) speed up by approximately 15% during the Antarctic summer. This is the first time that such seasonal cycles have been detected on land ice flowing into ice shelves in Antarctica. The results are reported in the journal *The Cryosphere*.

While it is not unusual for ice flow in Arctic and Alpine regions to speed up during summer, scientists had previously assumed that ice in Antarctica was not subject to the same seasonal movements, especially where it flows into large ice shelves and where temperatures are below freezing for most of the year.

This assumption was also, in part, fuelled by a lack of imagery collected over the icy continent in the past. "Unlike the Greenland Ice Sheet, where a high quantity of data has allowed us to understand how the ice moves from season to season and year to year, we haven't had comparable data coverage to look for such changes over Antarctica until recently," said Karla Boxall from Cambridge's Scott Polar Research Institute (SPRI), the study's first author.

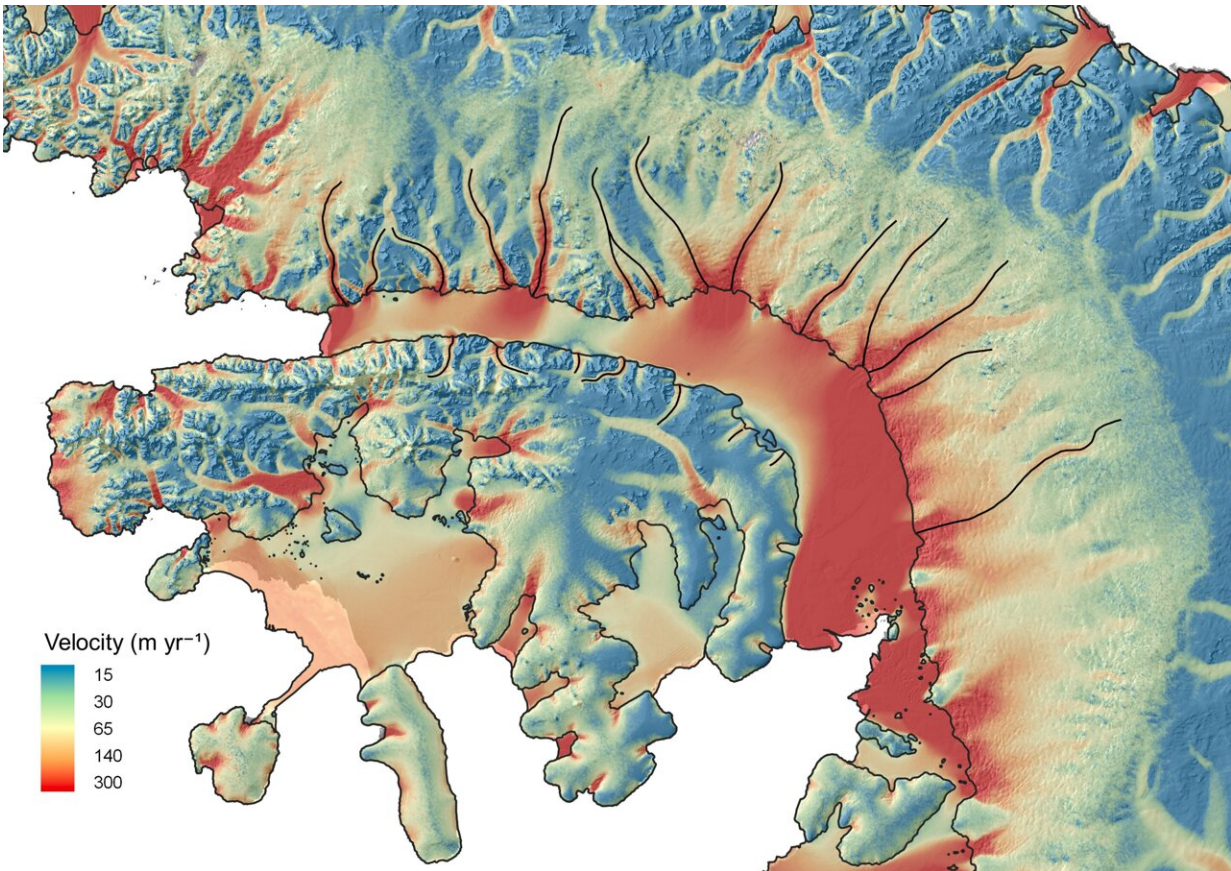


Conchie, Hubert, Saturn, Venus and Uranus glaciers draining into a meltwater-laden George VI Ice Shelf. Credit: Copernicus/European Space Agency/Karla Boxall

"Observations of ice-speed change in the Antarctic Peninsula have typically been measured over successive years, so we've been missing a lot of the finer detail about how flow varies from month to month throughout the year," said co-author Dr. Frazer Christie, also from SPRI.

Prior to the detailed records of ice speed made possible by the Sentinel-1 satellites, scientists wanting to study short-term variations in Antarctic-wide ice flow had to rely on information collected by optical satellites such as NASA's Landsat 8.

"Optical measurements can only observe the Earth's surface on cloud-free days during summer months," said co-author Dr. Thomas Nagler, ENVEO's CEO. "But by using Sentinel-1 radar imagery, we were able to discover seasonal ice-flow change thanks to the ability of these satellites to monitor year-round and in all-[weather conditions](#)."



Ice-flow velocity of Palmer Land, Alexander Island and George VI Ice Shelf, Antarctic Peninsula, derived from Sentinel-1 SAR imagery. Credit: Copernicus/European Space Agency & Antarctic Ice Sheet Climate Change Initiative (AIS_CCI) Programme. Map by Karla Boxall.

Currently, the causes of this seasonal change are uncertain. It could be

caused by surface meltwater reaching the base of the ice and acting like a lubricant, as is the case in Arctic and Alpine regions, or it could be due to relatively warm ocean water melting the ice from below, thinning the floating ice and allowing upstream glaciers to move faster.

"These seasonal cycles could be due to either mechanism, or a mixture of the two," said Christie. "Detailed ocean and surface measurements will be required to understand fully why this seasonal change is occurring."

The results imply that similar seasonal variability may exist at other, more vulnerable sites in Antarctica, such as the Pine Island and Thwaites glaciers in West Antarctica. "If true, these seasonal signatures may be uncaptured in some measurements of Antarctic ice-mass loss, with potentially important implications for global [sea-level rise](#) estimates," said Boxall.

"It's the first time this seasonal signal has been found on the Antarctic Ice Sheet, so the questions it raises regarding the possible presence and causes of seasonality elsewhere in Antarctica are really interesting," said co-author Professor Ian Willis, also from SPRI. "We look forward to taking a closer look at, and shedding light on, these important questions."

More information: Seasonal land-ice-flow variability in the Antarctic Peninsula, *The Cryosphere* (2022). [DOI: 10.5194/tc-16-3907-2022](https://doi.org/10.5194/tc-16-3907-2022)

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