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December 16, 2020 | By Chase Martin

New Study Redefines Understanding of Where Icebergs Put Meltwater into the Southern Ocean

The findings pave the way for large Antarctic icebergs to be used in global climate models

Some icebergs that break off of Antarctica are massive – the size of New York City – but previously these floating cities of freshwater were largely ignored in climate models. A new study by scientists at Scripps Institution of Oceanography at the University of California San Diego and the University of North Carolina Wilmington (UNCW) has provided the first-of-its-kind model for how these icebergs decay as they drift around the frozen continent.

R/V Roger Revelle with a tabular iceberg in the Southern Ocean

Funded by the National Science Foundation, the findings published December 16 in *Science Advances* provide the climate science community with the groundwork to include Antarctic icebergs in global climate models.

Icebergs are of particular interest in climate science because the fresh water they put into the ocean affects currents. The density of water is a major driver of ocean currents, and this density is affected by the temperature and amount of salt in the water. As icebergs melt, the cold fresh water they put into the ocean affects these two variables, which impact ocean currents that are crucial in regulating global climate.

Icebergs vary in shape and size, and previous climate models essentially ignored the massive, tabular icebergs that break off from Antarctica. These icebergs are mostly flat on top, and sometimes as large as 1,000 square kilometers (386 square miles) and 100 stories tall in total.

“We know that large tabular icebergs deliver about half of the freshwater from the Antarctic ice sheets to the Southern Ocean, and their importance in the climate system will likely increase over the coming century,” said Mark England, a researcher at Scripps Oceanography and UNCW and lead author of the study. “We think this an important step forward towards including these giant icebergs in global climate models and being able to incorporate their effects into climate change projections.”

Scientists are seeing more and more icebergs break off of ice shelves as global temperatures increase, including tabular icebergs. Knowing that they survive much longer and that they behave differently than much smaller icebergs, England wanted to accurately bring tabular icebergs into global climate models. The team also included Scripps Oceanography professor Ian Eisenman and Till Wagner, a former Scripps postdoctoral researcher who is now a professor at UNCW.

“In the North Atlantic, icebergs have been systematically monitored since the Titanic sunk more than a century ago, and models have been developed to make operational forecasts of their drift and deterioration over time,” Eisenman said. “But such models really had not been developed for the large tabular icebergs that break off Antarctica and drift in the Southern Ocean, which could be important for future climate change.”

In order to understand how tabular icebergs could affect the global climate system, the researchers needed to develop a model to better capture how these larger, longer-lasting icebergs behave over time. The team used a previous model developed by Eisenman’s lab that includes variables like winds, currents, and sea surface temperature to predict where icebergs will drift over time. Using this information, the team created a new model to predict how frequently large tabular icebergs would break up, and they validated their findings with data from satellite observations of icebergs.

Dubbing a tabular iceberg that initially calves from an ice shelf as a “parent” iceberg, they found that parent icebergs don’t melt much, but instead calve their own smaller “children” icebergs. The parent iceberg essentially acts as a conveyor belt, delivering smaller chunks of ice far away from the Antarctic continent that break off and then melt, injecting cold freshwater into the Southern Ocean.

The researchers stress that these larger icebergs, especially given the possibility of a dramatically increased number of them in the future, need to be taken into consideration when developing climate models in order to avoid inaccurate results.

“Our results show that giant icebergs spread Antarctic freshwater much further from the coast than previous studies have assumed,” Wagner said. “This may have important consequences for the dynamics of the Southern Ocean.”

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