Could changes in Arctic precipitation slow ice sheet loss and temper sea level rise?

September 9 2015, by Charlotte Hsu

The Greenland Ice Sheet, pictured in 2013. A new UB-led project seeks to better understand how potential changes in Arctic precipitation could affect the ice sheet's health. Credit: Jason Briner

In the Arctic, sea ice is melting and leaving larger sections of ocean

exposed to air and sun. This phenomenon could fuel increased evaporation, leading eventually to more precipitation in far-north latitudes.

Such changes—if they occur—could have important implications for global sea level rise, says Jason Briner, an associate professor of geology in the University at Buffalo College of Arts and Sciences.

Briner is leading a $2.8 million project to understand how rising temperatures and altered Arctic precipitation patterns could affect the Greenland Ice Sheet, the second-largest block of ice on Earth. If it turns out that global warming drives Arctic snowfall, oceans worldwide may not rise as quickly as they otherwise would. That's because increased precipitation could keep more of the world's water locked into the Greenland Ice Sheet as snow and ice.

"When you think about global warming, temperature isn't the only thing that is changing on the planet," Briner says. "The frequency of storms may be changing. Ecosystems are changing. And one of the things that could really change in the Arctic is precipitation.

"This matters because there are two things that affect the health of an ice sheet, and that is temperature and snowfall. If it snows more in the Arctic, it's possible that the Greenland Ice Sheet won't shrink as fast because fresh snow is compacted into ice that contributes to the ice sheet's thickness. It might actually counterbalance some—though certainly not all—of the melting that's happening due to global warming."

The study—funded by the National Science Foundation (NSF)—starts in September and brings together an eclectic team of ice, rock, climate and computer scientists from five institutions: UB; Columbia University; the University of California, Irvine (UC Irvine); the University of Montana;

and the University of Washington (UW). NASA's Jet Propulsion Laboratory (JPL) will also play a role.

Helicopters like this one, pictured in 2013, will shuttle researchers to remote sites in Greenland, where they'll hunt for clues about how the ice sheet changed over the past 8,000 years. Credit: Jason Briner

The partners will research how the Greenland Ice Sheet changed in response to fluctuations in temperature and precipitation over the past 8,000 years. Then, they'll use that history to inform projections of how the ice sheet could react to various possible future changes in temperature and snowfall.

The results will contribute to a vigorous, ongoing scientific debate about how stable the Greenland Ice Sheet is in times of global warming.

"There was a time 6,000 to 4,000 years ago when the Earth was warmer than it is today, and the Greenland Ice Sheet was smaller, but it didn't get much smaller, and the question is why," Briner says. "We want to figure out if increased snowfall may have been part of the answer."

To understand the ice sheet's past, Briner, along with Columbia University researchers including former UB PhD student Nicolás Young, now at Columbia's Lamont-Doherty Earth Observatory, will lead teams in Greenland over the next three summers.

Scientists will set up camp in remote parts of Greenland, which were photographed during a prior research trip in 2011. Credit: Jason Briner

They'll set up camp amid fjords and glaciers in a wilderness as remote as just about any on Earth. There, the scientists will scrutinize boulders, bedrock and ancient lakebeds for clues about how far the ice sheet's borders extended at different times over the past 8,000 years.

To figure out how much snow was falling during the same periods, colleagues at UW will examine data from ice cores—cylindrical ice samples whose layers record the history of snowfall. UW will use computer modeling and ice cores obtained by U.S. and Danish teams over the last few decades to formulate a detailed history of snowfall and temperature across the Greenland Ice Sheet.

Finally, teams from NASA JPL, UC Irvine, and the University of Montana will leverage the data on precipitation, temperature and ice sheet extent to create computer simulations that evaluate how natural variations in snowfall and climate—including periods of warming—influenced ice sheet size over the last 8,000 years.

Dating boulders is one technique that researchers will use to determine ice sheet size at different points in history over the past 8,000 years. When ice sheets grow, they push dirt and boulders across the landscape. These materials are left behind when the ice sheet recedes, creating a record of the ice sheet's past extent. Here, a UB researcher examines a boulder in Greenland in 2013 as part of a previous research project. Credit: Jason Briner

The models will also project into the future; using history as a guide, they'll predict how the Greenland Ice Sheet could respond to changes in the modern world. The projections will explore different scenarios, assessing how varying potential combinations of snowfall and temperature increases could alter the ice sheet.

The work will not draw conclusions about how much the world will

warm in coming years or how much snow will fall; but by studying the ice sheet's sensitivity to climate change, the research will enable scientists who do make predictions about temperature and precipitation to better understand how their predicted changes will impact Greenland and sea level rise.

Layers of mud in cylindrical samples called sediment cores reveal information about the geological history of an area, such as when an area was near a glacier or not. Researchers will be taking such samples from lake bottoms in Greenland as part of an effort to determine the Greenland Ice Sheet's size at various points over the past 8,000 years. Credit: Jason Briner

"We're not just dreaming this up that snowfall could increase in the future," says Briner, a member of RENEW (Research and Education in eNergy, Environment and Water), a Community of Excellence at UB that harnesses faculty strengths across disciplines to tackle complex environmental challenges.

"We've all heard about how the Arctic sea ice is shrinking, and as it does, more of the Arctic Ocean is available for evaporation. That sets up a situation where it's very possible that this system could start generating a lot more snow."

Provided by University at Buffalo

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