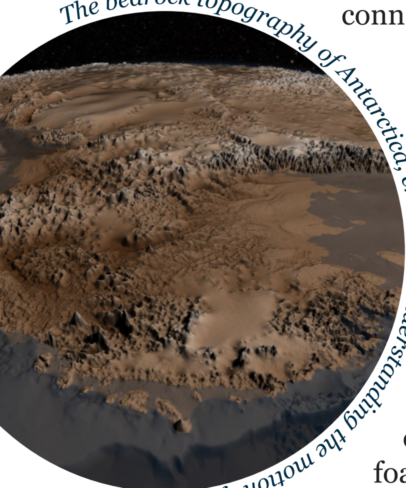
Ice, Water and Earth in Antarctica

Prof. Natalya Gomez *joined the MSI as a faculty member in Fall 2015. Her group's research models the interactions between ice, water, climate and planetary interiors, and how these connections change planets surfaces through time. These models are applicable to both the Earth and other rocky, icy planets and moons in the Solar System.*

What question were you trying to answer?

I wanted to understand and model how the ice, water and solid Earth in Antarctica are connected and influence each other.



The bedrock topography of Antarctica, critical to understanding the motion of ice sheets

In particular, I wanted to know whether retreat of the Antarctic Ice Sheet in response to climate warming, and its contribution to future sea level rise was sensitive to the structure of the Earth's interior below the ice sheet. The Earth rebounds in response to removing ice mass from the continent, much like a memory foam mattress would. This uplifting of the bedrock below the ice sheet in turn feeds back onto how the ice itself flows off the continent and into the ocean. I wanted to know whether this effect is significant or not for the type of rapid ice loss we may see in the next hundreds to thousands of years.

Why did you find this question interesting?

My research bridges the gap between the communities that study the solid Earth and sea level changes, and those that study ice sheet evolution. This problem is a perfect example of why bridging that gap is important. It will take an interdisciplinary approach to refine predictions of future ice loss, if the answer requires in-depth knowledge of the solid Earth as well as the ice sheet.

What did you find?

My results suggested that knowing the structure of the solid Earth hundreds of kilometers below the Antarctic Ice Sheet may be needed in order to accurately predict how the ice sheet itself will evolve in response to future climate changes.

What does doing your research look like?

Sitting behind a computer, developing complex numerical models and running simulations on high performance computing equipment, and standing in front of a white board or talking over Skype, screen sharing with colleagues around the world in other disciplines.

What role did collaboration play in your research?

A very important role! I started out as an expert in sea level change, but the types of problems I work on require collaboration with people who specialize in measuring and modeling ice sheets, ocean circulation and climate change. This is one of the reasons I love my field of research — my colleagues and I get to learn a lot from each other.

Why this is important

The fate of the polar ice sheets in a progressively warming world is a focus of climate research and a concern for policy makers and the general public. Our models include two geophysical elements that are not adequately reflected in computer simulations of Antarctic Ice Sheet collapse — the gravitational pull of the ice sheet on surrounding water, and the viscous flow of the mantle beneath the bedrock that the ice sits on. We show that the combination of bedrock uplift and sea-surface drop associated with ice-sheet retreat reduces ice sheet mass loss relative to a simulation without these effects included. The degree to which this stabilization occurs is dependent on the structure of the Earth's deep interior, which is currently poorly known. Improving measurements and models of that structure may be needed to constrain projections of future ice loss and sea level change.

This understanding of planetary-scale processes may provide insights into the evolution of other planets and moons and the interpretation of the measurements we make of those bodies.

Gomez, **Natalya**, David Pollard, and David Holland (2015b), *Sea-level feedback lowers projections of future antarctic ice-sheet mass loss*, Nature Communications 6, 8798 EP