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Glaciology and recent behavior of the West Antarctic Ice Sheet

The West Antarctic Ice Sheet (WAIS) contains enough water to increase the global sea level by about 15 feet. It is the only marine ice sheet (i.e., one with much of its base located well below sea level) that survived the end of the last Ice Age when global temperatures increased by 10 degrees Fahrenheit about 15,000 years ago. Since late 1960s glaciologists have been pointing to its potential for rapid collapse, which could be triggered by climate warming. However, rigorous assessments of future WAIS evolution are hindered by limited understanding of ice sheet glaciology. These limitations are largely due to the fact that direct scientific observations of ice sheet behavior cover barely half a century, with decent spatial coverage spanning just the last 20 years. Moreover, many hydrological and mechanical processes controlling ice sheet evolution take place beneath thick ice and require expensive and logistically challenging drilling to constrain.

Even at the present time there are significant differences in how various parts of WAIS behave. WAIS consists of three major drainage basins emptying into three different marine basins: Ross Sea, Weddell Sea, and Amundsen Sea. While the Ross Sea sector is experiencing strong growth and the Weddell Sea drainage basin is approximately in balance, the Amundsen Sea sector has been loosing mass. This regional mass loss has recently led to speculations that WAIS is already experiencing an irreversible collapse. However, continuing observations and improvements in ice sheet models are needed to verify this claim. The difficulty with interpreting WAIS behavior and predicting its future is well illustrated by the recent discovery that this ice sheet was significantly smaller than today just several thousand years ago and then grew back to its modern configuration. This finding overturns the long-standing assumption that WAIS is today as small as it has been for at least the last 120,000 years.

The future contribution of WAIS to sea level changes is still shrouded in uncertainty. WAIS is large enough that it has its own internal dynamics which is driven by interactions between hydrological, mechanical, and geological processes taking place beneath the ice sheet. These internal dynamics may amplify, dampen, and/or complicate ice sheet response to climate changes. This "it's complicated" conclusion is not likely to grab headlines but, in my opinion, reflects well the current state of glaciological knowledge of WAIS.

Biography: Dr. Slawek is Full Professor of Earth Sciences at the University of California, Santa Cruz since July 2000. He is a Fellow of the Geological Society of America since 2010. Slawek holds Ph.D. in Geology from CalTech and two M.Sc. degrees, in Civil Engineering and Geology, from CalTech and Northern Illinois University, respectively. He authored and co-authored nearly 100 peer-reviewed publications on ice sheet and glacier dynamics, permafrost properties, and polar microbial habitats. His research has been funded by NSF, NASA, DoE, and Sloan Foundation. Cumulatively, Slawek did nearly 3 years of field work in Antarctica, Iceland, Greenland, Alaska, and Arctic Canada. In 2006 the Advisory Committee on Antarctic Names named after him a mountain glacier on the highest mountain in Antarctica, the Vinson Massif.