Improved perceptive of the nature and dynamics of the processes controlling the response of Antarctic Ice Sheet

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Abstract

On Antarctica, a massive continental ice sheet covers most of the land area and flows outward toward the coasts through numerous glaciers. Ice shelves are formed where flow rate is high and glaciers spill into somewhat protected waters, forming a long-lasting covering over the water below that can be several hundred meters thick. The Ross Ice Shelf is the largest of these in Antarctica. Unlike seasonal sea ice, ice shelves persist year-round and are significantly thicker, as seen in this photograph where the Ross Ice Shelf meets the seasonally ice-covered Ross Sea. The great ice sheets of Antarctica contain major reservoirs of freshwater. Changes in these ice sheets will induce large changes in global sea level and in freshwater flux to the oceans, which in turn can affect ocean circulation and climate. Although many factors contribute to sea level rise, the Fourth Assessment Report of the Intergovernmental Panel on Climate Change identified the cryosphere as the largest source of uncertainty in predictions of future sea level rise over the 50-200 year time horizon. There is evidence from the geological record of rapid changes in sea level that imply dramatic changes in the Antarctic ice sheets. However the controls on such changes are not well understood. Limitations in our understanding of ice sheet dynamics mean that ice sheet models are currently unable to describe adequately contemporary ice sheet mass loss rates as measured for instance by satellites, or to provide confident predictions of future loss rates on time scales of the next few hundred years. Such predictions are vital for coastal planners concerned with sea defences, and for climate modellers concerned with the behaviour of the meridional overturning circulation. Within the Antarctic, attention focuses particularly on the West Antarctic Ice Sheet (WAIS) and the Amundsen Sea sector, due to the recent acceleration of ice loss and the potentially unstable nature of its grounding line. There are significant gaps in our knowledge of the fundamental processes regulating ice flow and dynamics, and we expect results from this programme will lead to an improved prediction of ice sheet mass loss rates over centennial time scales and better predictive models. These improvements will then be available for use in ocean circulation and sea-level-rise models.

Keywords: Antarctica Ice sheet, flow rate, grounding line