Greenland and Antarctica Ice Sheet Mass Changes and Effects on Global Sea Level

Thirteen years of GRACE data provide an excellent picture of the current mass changes of Greenland and Antarctica, with mass loss in the GRACE period 2002–2015 amounting to 265 ± 25 GT/year for Greenland (including peripheral ice caps), and 95 ± 50 GT/year for Antarctica, corresponding to 0.72 and 0.26 mm/year average global sea level change. A significant acceleration in mass loss rate is found, especially for Antarctica, while Greenland mass loss, after a corresponding acceleration period, and a record mass loss in the summer of 2012, has seen a slight decrease in short-term mass loss trend. The yearly mass balance estimates, based on point mass inversion methods, have relatively large errors, both due to uncertainties in the glacial isostatic adjustment processes, especially for Antarctica, leakage from unmodelled ocean mass changes, and (for Greenland) difficulties in separating mass signals from the Greenland ice sheet and the adjacent Canadian ice caps. The limited resolution of GRACE affects the uncertainty of total mass loss to a smaller degree; we illustrate the “real” sources of mass changes by including satellite altimetry elevation change results in a joint inversion with GRACE, showing that mass change occurs primarily associated with major outlet glaciers, as well as a narrow coastal band. For Antarctica, the primary changes are associated with the major outlet glaciers in West Antarctica (Pine Island and Thwaites Glacier systems), as well as on the Antarctic Peninsula, where major glacier accelerations have been observed after the 2002 collapse of the Larsen B Ice Shelf.

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