EGU21-5589, updated on 28 Oct 2021
https://doi.org/10.5194/egusphere-egu21-5589
EGU General Assembly 2021

Uncertainties in Mass Balance Estimation of the Antarctic Ice Sheet Using Input-output Method

Yijing Lin and Yan Liu
Beijing Normal University, College of Global Change and Earth System Science, China (linyijing@mail.bnu.edu.cn; liuyan2013@bnu.edu.cn)

Input-Output method (IOM) is a common method for estimating ice sheet mass balance, which shows ice dynamics in mass loss to analyze the response of ice sheet to climate change. However, compared with the altimetry method and the gravity method, the mass balance estimation using IOM has relatively large uncertainty. Assessing the impact of the uncertainties of each component in IOM on the mass balance estimation is conducive to effectively lowering uncertainty in the Antarctic mass budget estimate but of which there has been little quantitative analysis. We assess the uncertainty in the mass balance due to methodological differences in IOM, compare the differences of surface mass balance (SMB, input) in diverse versions and at different spatial scales, and evaluate the uncertainty in ice discharge (FG, output) due to data uncertainty in ice thickness, ice velocity and grounding line. Results showed that the SMBs at different scales are more divergent than that in different versions, resulting in a variation of 216.7 Gt yr^{-1} in Antarctica, of which the Antarctic peninsula accounts for 55.1%, followed by East Antarctica. The largest variation in FG due to uncertainty in the location of the grounding line is observed, where a 1 km retreat and a 1 km advance of the Antarctic grounding line would respectively result in FG reductions of 82.8 Gt yr^{-1} and 272.7 Gt yr^{-1}, which are significant in all regions, with the FG corresponding to a 1 km retreat of grounding line in the islands being closer to the multi-year average SMB of the islands. The difference in Antarctic FG due to different ice thickness products is 124.4 Gt yr^{-1}, consistent with the trend in the thickness of ice shelves, and that due to different ice velocity products is only 18.7 Gt yr^{-1}. Within the same margin of error, systematic errors in ice thickness and ice velocity result in an order of magnitude higher difference of FG than random errors.