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Impact of un-modelled oceanic mass variations on Antarctic ice mass changes derived from GRACE

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The estimation of regional mass changes from GRACE satellite gravimetry data is affected by leakage-in from mass signals outside the region of interest. In the case of Antarctica, oceanic mass variations, e.g. due to variations of the Antarctic Circumpolar Current (ACC), are a distinct source of leakage. Based on the Atmosphere and Ocean De-aliasing Level-1b (AOD1B) products, high-frequency mass changes in the ocean and the atmosphere are reduced from the GRACE monthly solutions.

However, residual mass signals due to errors and limitations of the utilised models may still bias regional mass change estimates of the entire Antarctic Ice sheet and of individual drainage basins. While the present AOD1B RL05 product incorporates non-tidal oceanic mass variations modelled by OMCT (Ocean Model for Circulation and Tides), the upcoming AOD1B RL06 products will use simulated bottom pressure fields from the Max-Planck-Institute for Meteorology Ocean Model (MPIOM). One difference between both models is their spatial coverage. In contrast to the OMCT, the model domain of the MPIOM does not include the ocean areas beneath the Antarctic ice shelves. These un-modelled ocean mass changes close to the coastline are an additional source of signal leakage requiring particular attention when deriving Antarctic ice mass changes.

In the present study we assess the impact of residual oceanic mass change on Antarctic mass balance estimates based on analyses using AOD1B products of different releases. We then focus on the quantification of ocean mass changes beneath the two largest ice shelves in Antarctica, namely the Filchner-Ronne Ice Shelf and the Ross Ice Shelf. By using AOD1B RL05 products signal leakage stemming from the un-modelled ocean mass variations beneath these ice shelves is assessed. Finally, we demonstrate how sensitivity kernels used in a regional integration approach may be adapted to account for this additional source of leakage.