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Reassessment of the mass balance of the Abbot and Getz sectors of West Antarctica

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Large discrepancies exist in mass balance estimates for the Getz and Abbot drainage basins, primarily due to previous poor knowledge of ice thickness at the grounding line, poor coverage by previous altimetry missions and signal leakage issues for GRACE. This is particularly the case for the Abbot region, where previously there have been contrasting positive ice sheet basin elevation rates from altimetry and negative mass budget estimates.

Large errors arise when using ice thickness measurements derived from ERS-1 and/or ICESat altimetry data due to poor track spacing, ‘loss of lock’ issues near the grounding line and the complex morphology of these shelves, requiring fine resolution to derive robust and accurate elevations close to the grounding line. This was exemplified with the manual adjustments of up to 100 m required at the grounding line during the creation of Bedmap2. However, the advent of CryoSat-2 with its unique orbit and SARIn mode of operation has overcome these issues and enabled the determination of ice shelf thickness at a much higher accuracy than possible from previous satellites, particularly within the grounding zone.

We present a reassessment of mass balance estimates for the 2007-2009 epoch using improved CryoSat-2 ice thicknesses. We find that CryoSat-2 ice thickness estimates are systematically thinner by 30% and 16.5% for the Abbot and Getz sectors respectively. Our new mass balance estimate of 8 $\pm$ 6 Gt yr^{-1}for the Abbot region resolves the previous discrepancy with altimetry.

Over the Getz region, the new mass balance estimate of 7.56 $\pm$ 16.6 Gt yr^{-1}is in better agreement with other geodetic techniques. We also find there has been an increase in grounding line velocity of up to 20% since the 2007-2009 epoch, coupled with mean ice sheet thinning rates of -0.67 $\pm$ 0.13 m yr^{-1} derived from CryoSat-2 in fast flow regions. This is in addition to mean snowfall trends of -0.33 m yr^{-1}w.e. since 2006. This suggests the onset of a dynamic instability in the region and the possibility of grounding line retreat, driven by both surface processes and ice dynamics.