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Mass Loss of the Antarctic Peninsula ice sheet and its peripheral glaciers from 2007 to 2021

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The Antarctic Peninsula (AP), encompassing the ice sheet and its peripheral glaciers, is a highly dynamic component of the cryosphere, disproportionately contributing to sea level rise. However, a large spread remains between the mass changes estimated using gravimetry, altimetry and the input/output method. Among these techniques, the satellite (radar or laser) altimetry method has a resolution of, at best, 1 km, which is too coarse to resolve the complex pattern of changes in the Peninsula. Therefore, we use digital elevation models (DEMs; 30x30 m) to map elevation changes for the entire Peninsula, combining 476 DEMs derived from SPOT5-HRS satellite images (2006-2008) and 2525 strips of the Reference Elevation Model of Antarctica (2020-2022) to provide a comprehensive 14-year record. We bias-corrected each DEM using near-synchronous ICESat/-2 laser altimetry measurements.

Our observations cover 70% of the AP ice sheet and 60% of its peripheral glaciers, including for regions of the Peninsula poorly studied to date and decipher a spatially complex pattern of elevation changes. After correction with different models of firn air content and solid-earth response, we find that between 2007 and 2021, the AP ice sheet lost **-27 ± 9** Gt/yr while its peripheral glaciers lost **-14 ± 2** Gt/yr. For the AP ice sheet, **our new estimate is 4 to 5 times more negative than the one obtained in IMBIE using purely altimetry data** (-6 ± 6 Gt/yr from 2006 to 2018) and in better agreement with gravimetry and the input/output method. Our study highlights the importance of resolving fine scale elevation changes of glaciers and ice sheets.