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Glacier elevation change estimates: decoding the systematic differences between radar altimetry and DEM differencing

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Measuring glacier mass change worldwide is essential to document the impact of climate change, understand glacier-related hazards and assess the contribution of the cryosphere to sea-level rise. Over the last two decades, three remote-sensing techniques have been used to measure glacier mass change: digital elevation model (DEM) differencing, altimetry and gravimetry. The Glacier Mass Balance Intercomparison Exercise (GlaMBIE, ESA-funded) aims to compile, homogenize and combine these regional glacier mass change observations.

One intriguing outcome from the first GlaMBIE phase (2022–24) was a systematic difference of region-wide elevation change measured using ASTER DEM differencing (dDEM) and CryoSat-2 radar altimetry. In most cases, dDEM resulted in more negative values in all glacier regions with an average regional difference of 0.08 ± 0.07 m w.e. yr-1 (The GlaMBIE Team, 2025). The work presented here is part of the second GlaMBIE phase (2025–27). It aims at describing in more detail and understanding the differences between these two techniques. We focus on major Icelandic ice caps as test sites as they present a good coverage for both techniques and are also covered with high resolution, precise dDEM data (e.g., airborne lidar

in 2013 and Pléiades in 2020 for Hofsjökull ice cap).

Our preliminary results indicate that the differences between published ASTER (Hugonnet et al., 2021) and CryoSat-2 (Jakob and Gourmelen, 2023) estimates are also found at ice cap and glacier scale. Next, we plan to compare the methods over the exact same period, and evaluate them using accurate validation data. We will also test the sensitivity to the software used to generate the DEMs, to alternative processing of CryoSat-2 data, and to the post-processing of the data (altimetry and DEMs) to find the key reasons for the systematic difference.