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PRODEM: An annual series of summer DEMs (2019-2023) for the marginal areas of the Greenland Ice Sheet

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Surface topography within the marginal zone of the Greenland Ice Sheet continually evolves in response to varying weather, season, climate and ice dynamics. However, existing ice sheet Digital Elevation Models (DEMs) usually rely on multi-year data, obscuring these changes over time. We have here developed an annual series (2019-2023) of summer DEMs in 500m resolution for the Greenland ice sheet marginal zone, referred to as PRODEMs. Encompassing all outlet glaciers from the Greenland ice sheet, these PRODEMs result from fusing CryoSat-2 radar altimetry and ICESat-2 laser altimetry using a regionally-varying Kriging method. Validated through leave-one-out cross-validation, they demonstrate accurate representation of surface elevations within the spatially varying prediction uncertainties with a median value of 1.4m.

The PRODEMs capture the recent annual evolution in summer surface topography of all outlet glaciers from the Greenland ice sheet. We observe a general lowering of surface elevations compared to ArcticDEM, but the spatial pattern of change is highly complex and with annual changes superimposed. The PRODEMs offer detailed insights into marginal ice sheet elevation changes, temporally as well as spatially, making them valuable for researchers and users studying ice sheet dynamics under changing environmental conditions.