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Drainage basins and glacier catchments for the Greenland Ice Sheet

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The drainage divides of ice sheets separate the overall glaciated area into multiple sectors and outlet glaciers. These catchments represent essential input data for partitioning glaciological measurements or modelling results to the individual glacier level. They specify the area over which basin specific measurements need to be integrated.

The delineation of drainage basins on ice sheets is challenging due to their gentle slopes accompanied by local terrain disturbances and complex patterns of ice movement. Therefore, in Greenland the basins have been mostly delineated along the major ice divides, which results in large drainage sectors containing multiple outlet glaciers. In [1] we developed a methodology for delineating individual glaciers that was applied to the Northeast Greenland sector and proposed slightly changed separations between 79N and Zachariae basins driven by the ice flow lines. In the present study the method is extended to the entire Greenland Ice Sheet.

We present a fully traceable approach that combines ice sheet wide velocity measurements by Sentinel-1 SAR and the 90 m TanDEM-X global DEM to derive individual glacier drainage basins for the entire Greenland Ice Sheet with a modified watershed algorithm. We delineate a total of 335 individual glacier catchments, a result triggered by the number and location of the selected seed points.

The resulting dataset will be made publicly available online and is extensible by even more granular delineations of individual tributaries upon request. The proposed approach has the potential to produce catchment areas also for the entirety of the Antarctic Ice Sheet.

[1] Krieger, L., D. Floricioiu, and N. Neckel (Feb. 1, 2020). "Drainage Basin Delineation for Outlet Glaciers of Northeast Greenland Based on Sentinel-1 Ice Velocities and TanDEM-X Elevations". In: Remote Sensing of Environment 237, p. 111483.

