Synergistic merging of aerial photogrammetry and terrestrial laser scanning data to detect geomorphological changes in Hornsund, Svalbard

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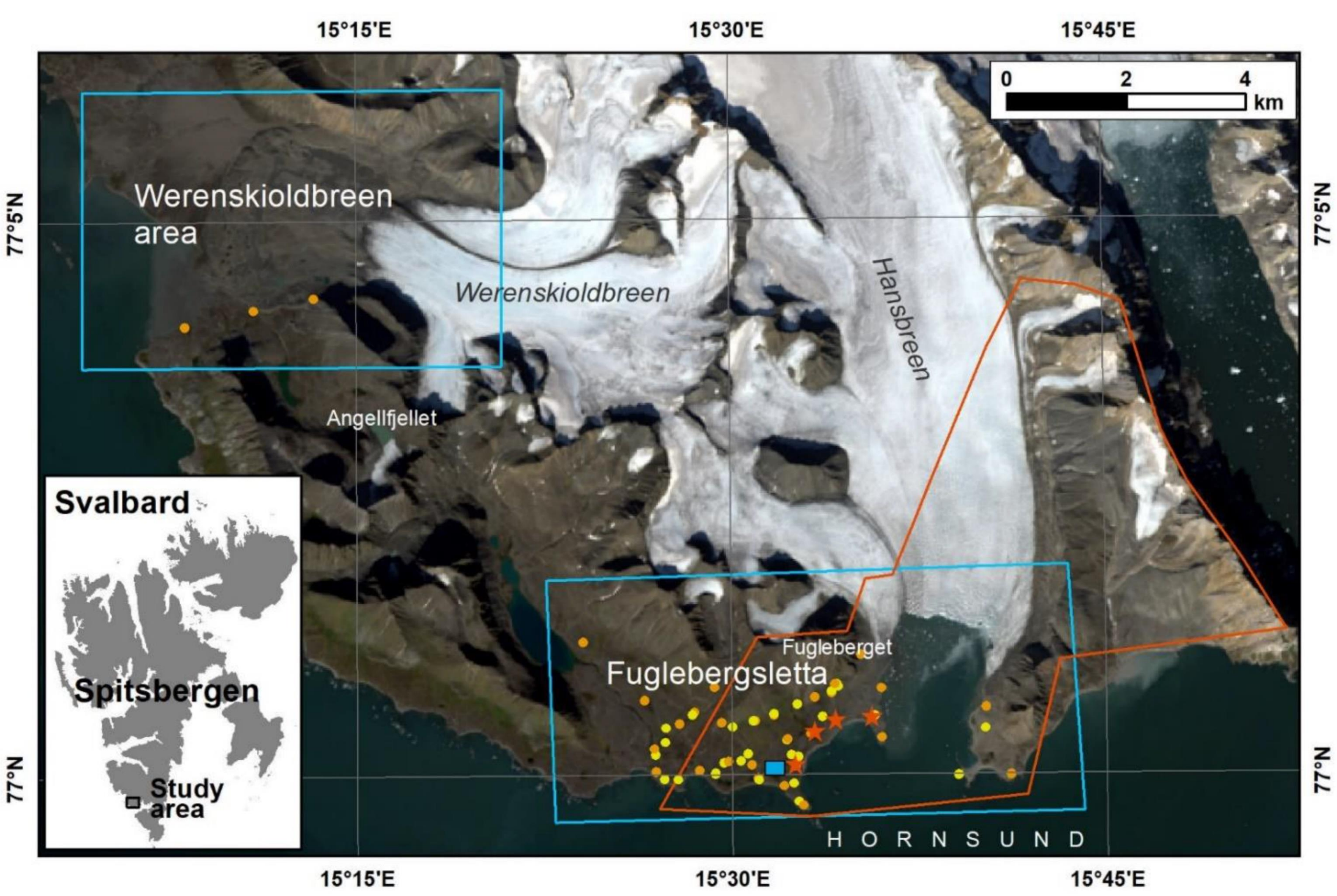
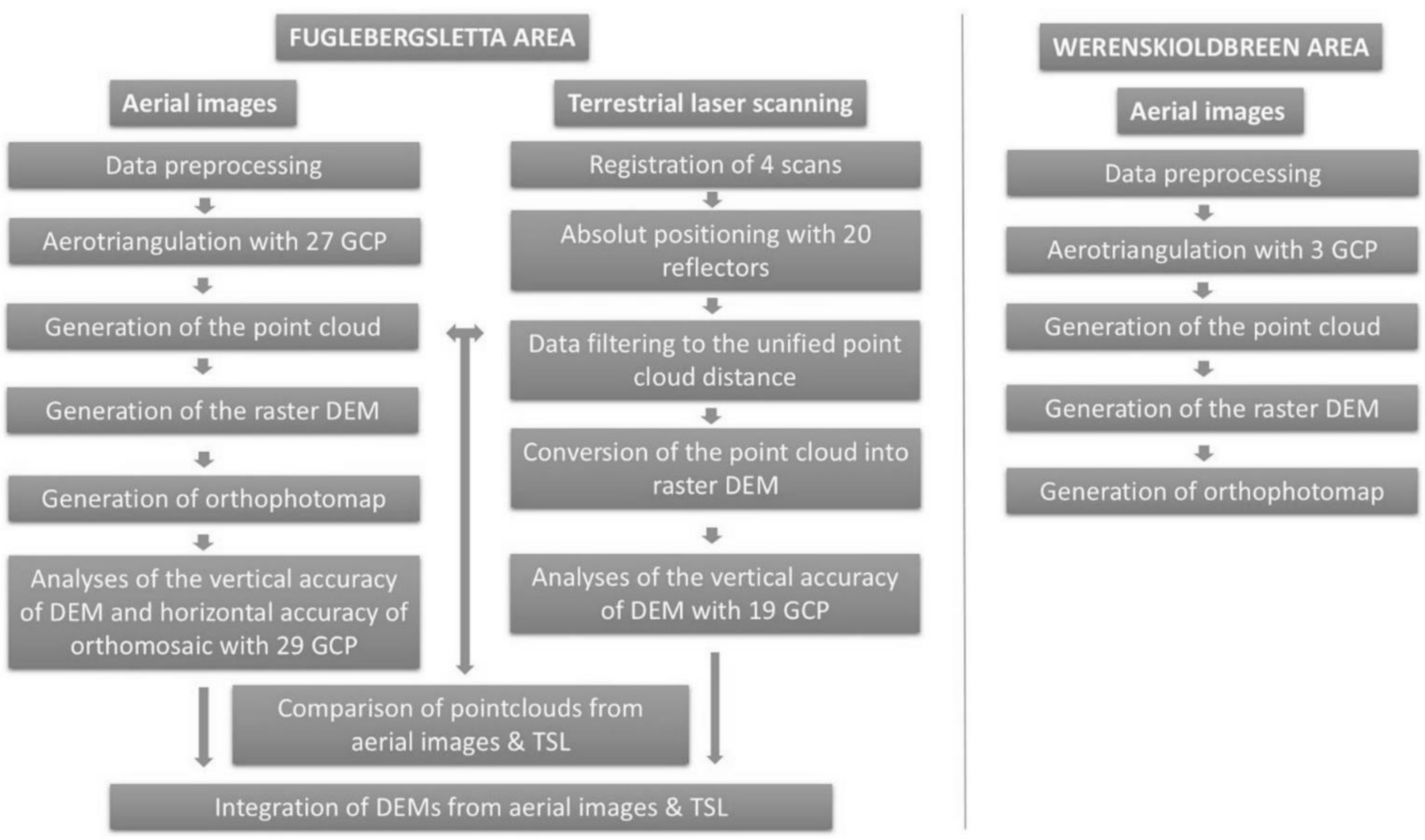
The aim of this study is to evaluate merging of two DEMs derived using aerial image sets and terrestrial laser scanning (TLS) over the Hornsund area, Svalbard.

Study area



The blue outlines represent the extent of aerial imagery acquired during the crewed aircraft campaign in 2020; the red polygon presents the range of data taken by terrestrial scanner Riegl VZ-6000 in 2021;

Methodology



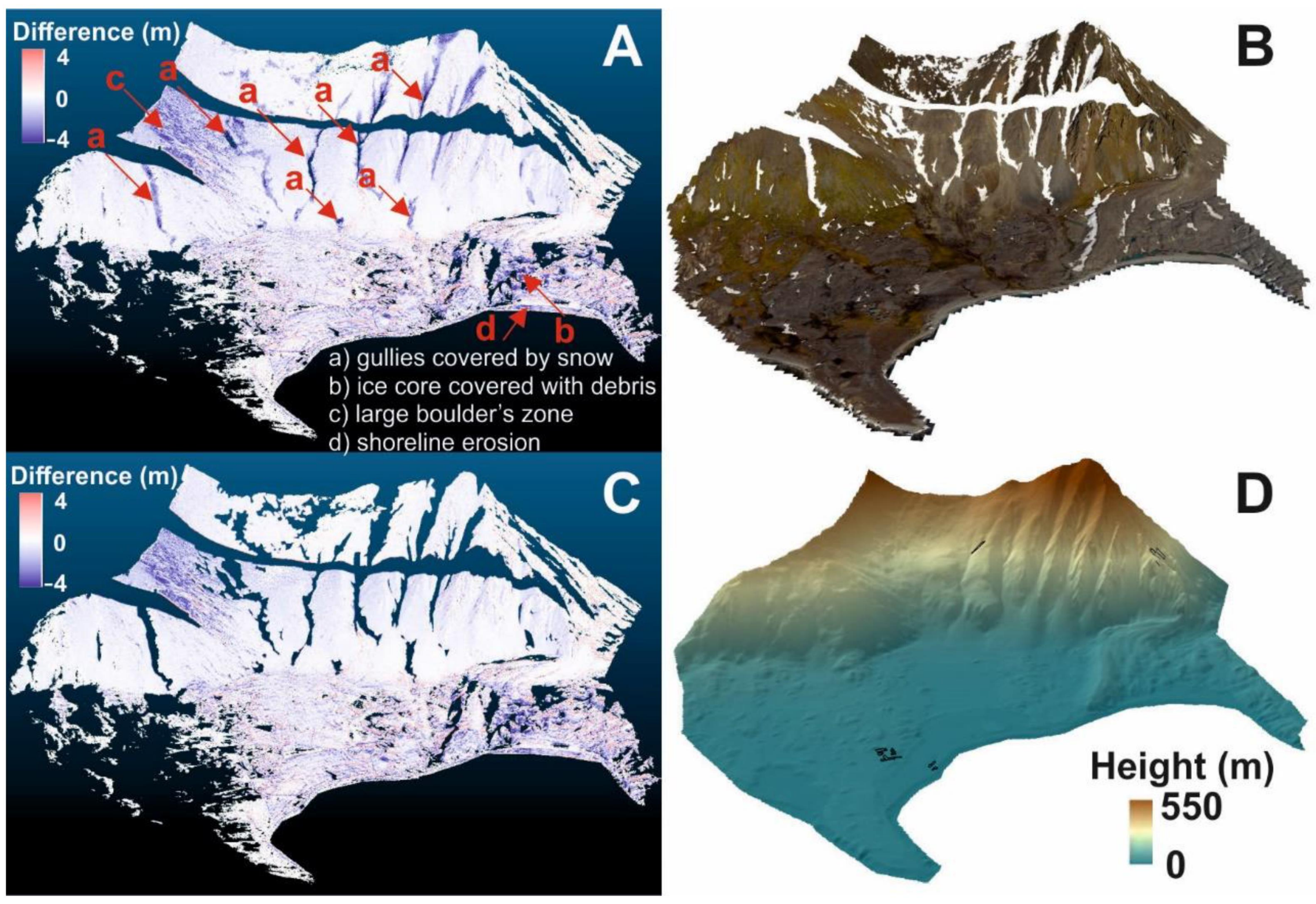
SIOS airborne campaigns

Hyperspectral imager with 32 degrees field of view
- VNIR-1800
  - 186 spectral bands in the range 400-1000 nm
  - 3.26 nm spectral sampling)
  - 1000 m altitude, with ~30 cm ground resolution.

Medium format RGB camera
- PhaseOne IXU-150 RGB camera
  - 800 meter from 1000 m altitude.

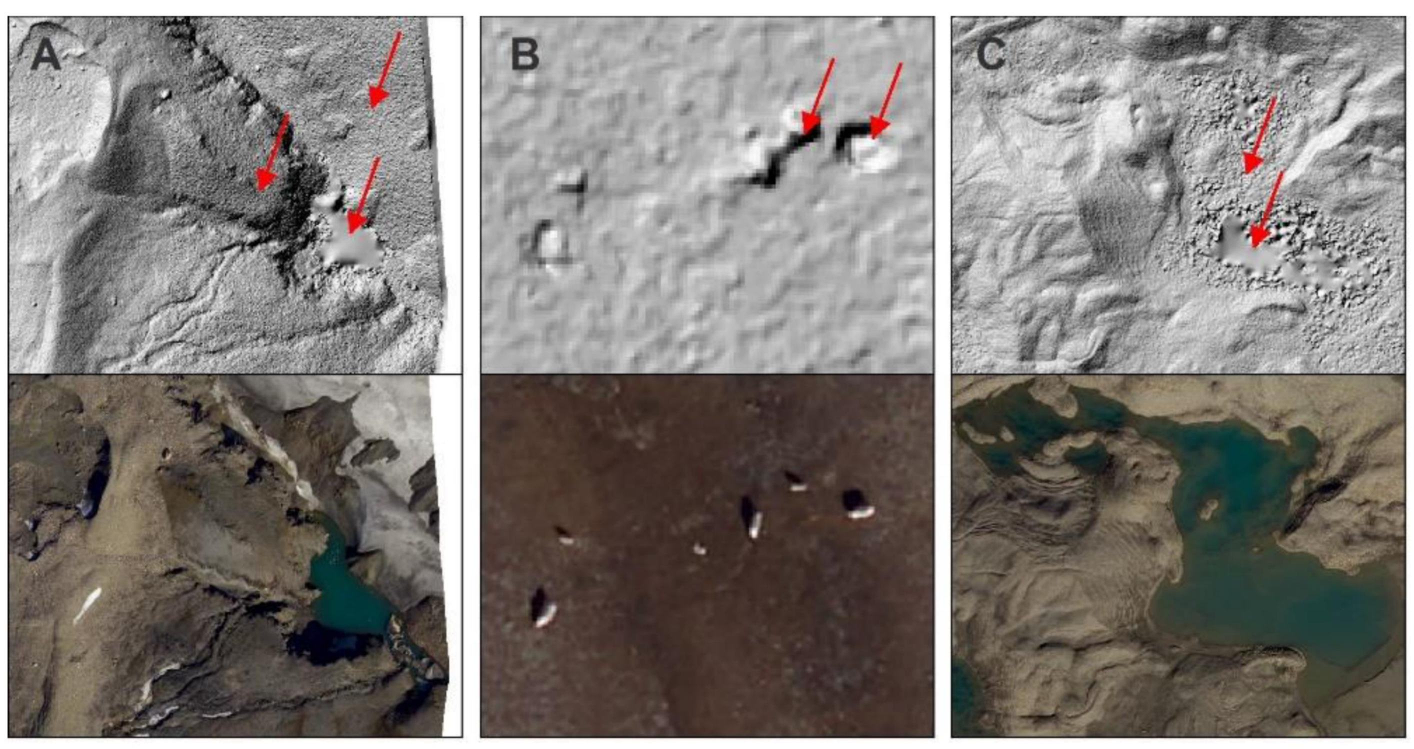
Comparison of point clouds

Comparison of the multitemporal point clouds: aerial-based point cloud from images taken in 2020 and TLS-based point cloud collected in 2021



(**A**) Multiscale Model-to-Model Cloud Comparison (M3C2)-calculated distance between aerial-based and TLS dataset; (**B**) orthomosaic presenting data gaps and snow cover over the land in 2020; (**C**) vertical difference of the point clouds with snow cover area eliminated from further data integration; (**D**) the final DEM integrated from both DEMs.

Source of errors



(A), artefacts generated by reindeer (B) and noises over water bodies (A,C).

Conclusions

The two approaches to acquiring the terrain data discussed in this study are helpful in studying the landform topography and different environmental processes in the Hornsund area. However, both technologies have their limitations. The best vertical accuracy was noted for the aerial-based DEM, SD = 0.14 m; while for TLS SD = 0.31 m.