‘Little Ice Age’ maxima and glacier retreat in northern Troms and western Finnmark; northern Norway

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1. KEY CONCLUSIONS

- This poster presents ~200 years of change in mountain glacier and ice cap extent in northern Troms and western Finnmark, northern Norway. This is achieved through geomorphological mapping, lichenometric dating, and remote sensing using both satellite imagery and aerial orthophotographs.
- Lichenometric dating in the Rotsund Valley revealed that the Little Ice Age (LIA) maximum occurred as early as AD 1814 (±39 years); before the early-20th century, LIA maximum, proposed on the nearby Lyngen peninsula[1], but younger than the maximum LIA limits in southern and central Norway (ca. 1750)[2].
- Between the LIA maximum and AD 1989, a small sample of glaciers with ‘dated’ LIA limits (n = 15) shrunk a total of 3.86 km^2 (39%).
- Between AD 1989 and 2018, glaciers of northern Troms and western Finnmark (n = 219) shrank by ~35 km^2 (35%), with 90% of mapped glaciers within the study area now <0.5 km^2.

2. STUDY AREA

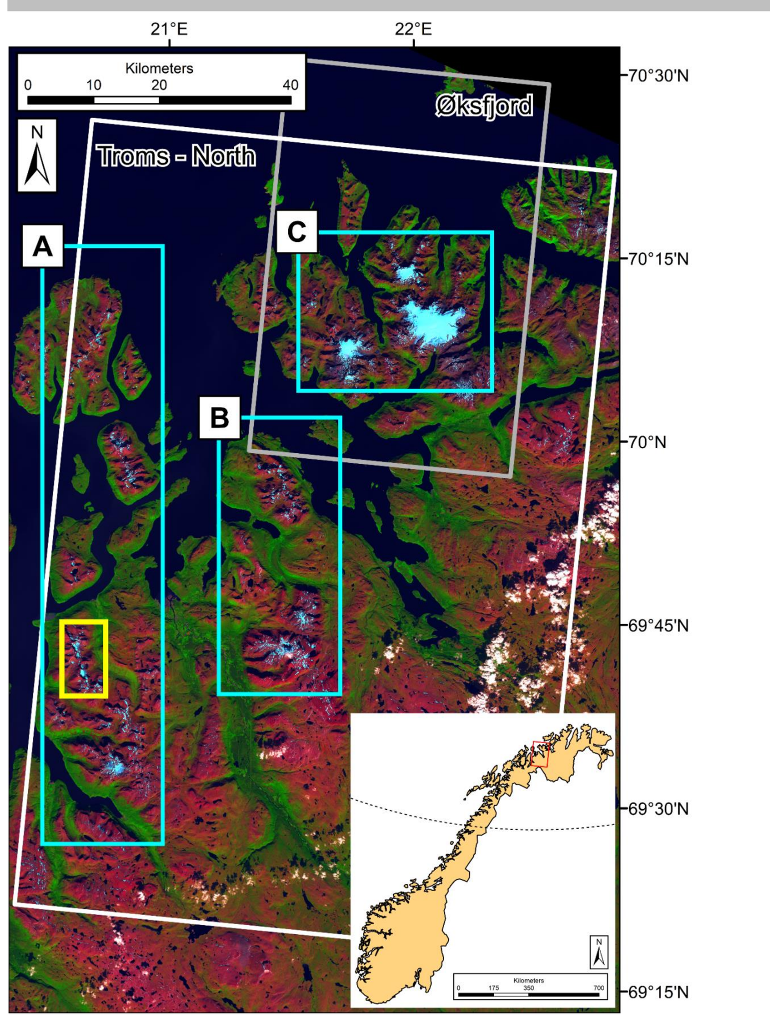

Figure 1 (Left): Study area location in Troms county, northern Norway. The white rectangle shows “Region 3 – Troms North” the grey rectangle shows “Region 2 – Øksfjord”[3]. The blue rectangles indicate the three glacial regions, defined as A, B, and C. The yellow rectangle shows the field site within the Rotsund Valley.

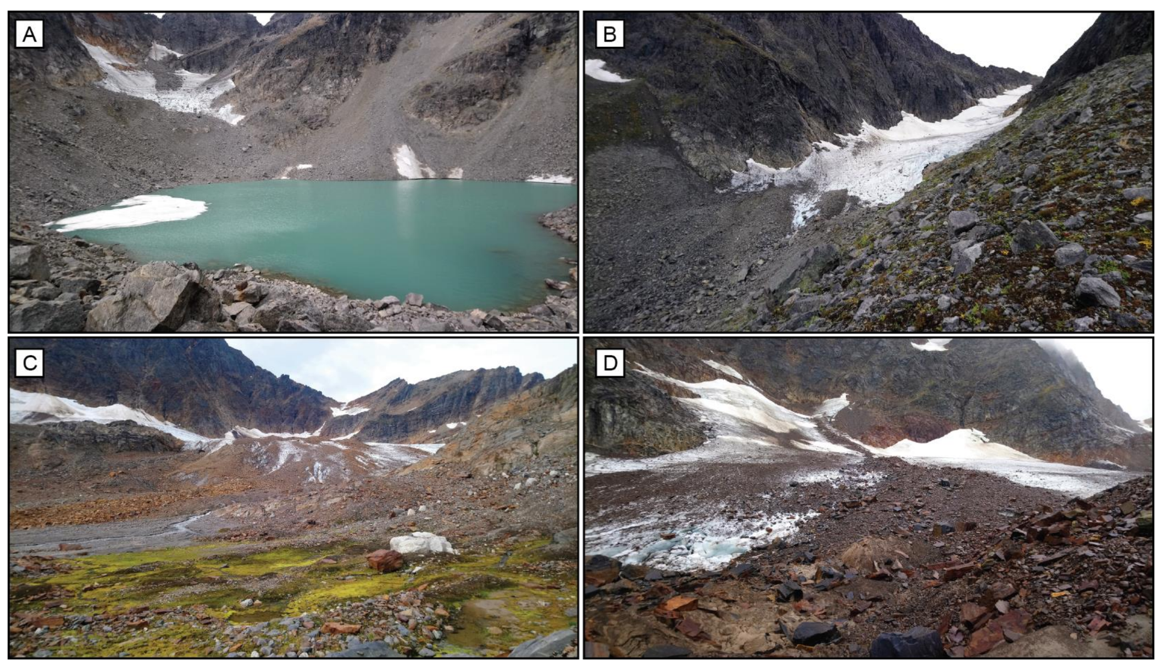

Figure 2: Photographs of the four glaciers (within the Rotsund Valley) visited in the field; A: 115, B: 117, C: 121, D: 123.

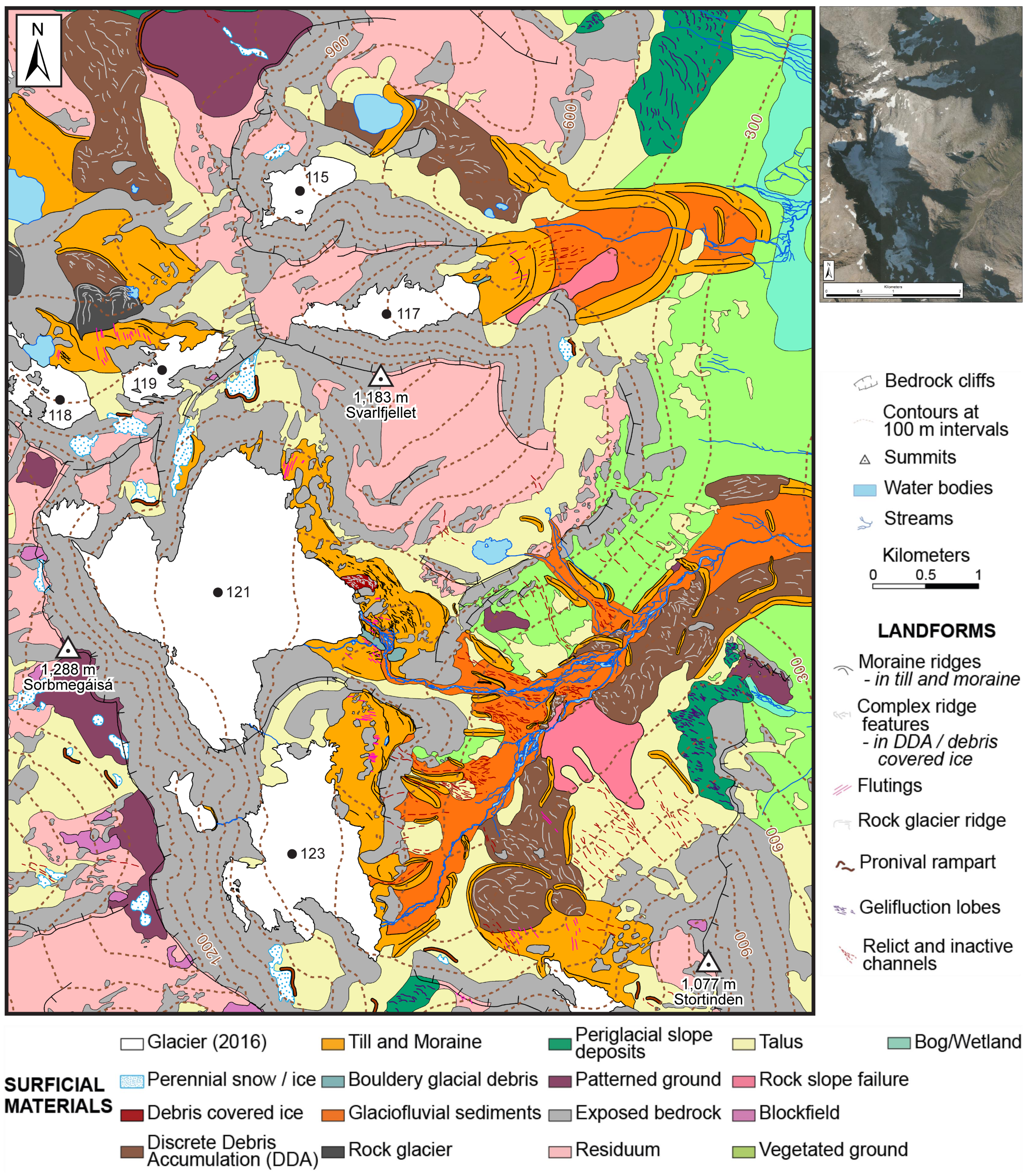

Figure 3: Geomorphological map of the field site within the Rotsund valley (location shown in Fig. 1 and glacier forelands shown in Fig. 2).

3. RESULTS

- In the field-site (see yellow rectangle on Fig. 1), 26 features were mapped and broadly classified as ‘landforms’ or ‘surficial materials’ (Fig. 3).
- LIA maximum moraines (M1; Fig. 4) within the Rotsund Valley are dated by lichenometry to between AD 1814 (±41 yrs.) and 1877 (±34 yrs.).
- The reconstructed LIA glacier area decreased from 10.0 km^2 at LIA maximum, to 6.2 km^2 in AD 1989, indicating that the glaciers of northern Troms and western Finnmark may be experiencing an increased rated of shrinkage since LIA maximum, compared to their southern counterparts[4].
- Of the five glaciers that exhibit glacier loss of >50% between LIA maximum and AD1989, all are fronted by at least one proglacial lake.
- Over the period of satellite observation AD 1989-2018, total mapped glacier area has progressively decreased by 35.36 km^2 (35%) from 101.9 km^2 in AD 1989, to 66.4 km^2 in AD 2018 (e.g. Fig. 5).
- Observed glacier shrinkage indicates an area reduction of ~1% yr^{-1} between AD 1989 and 2018, with the largest period of glacier shrinkage between AD 1994 and 1999 (net areal reduction of 14.0 km^2 or 15%).

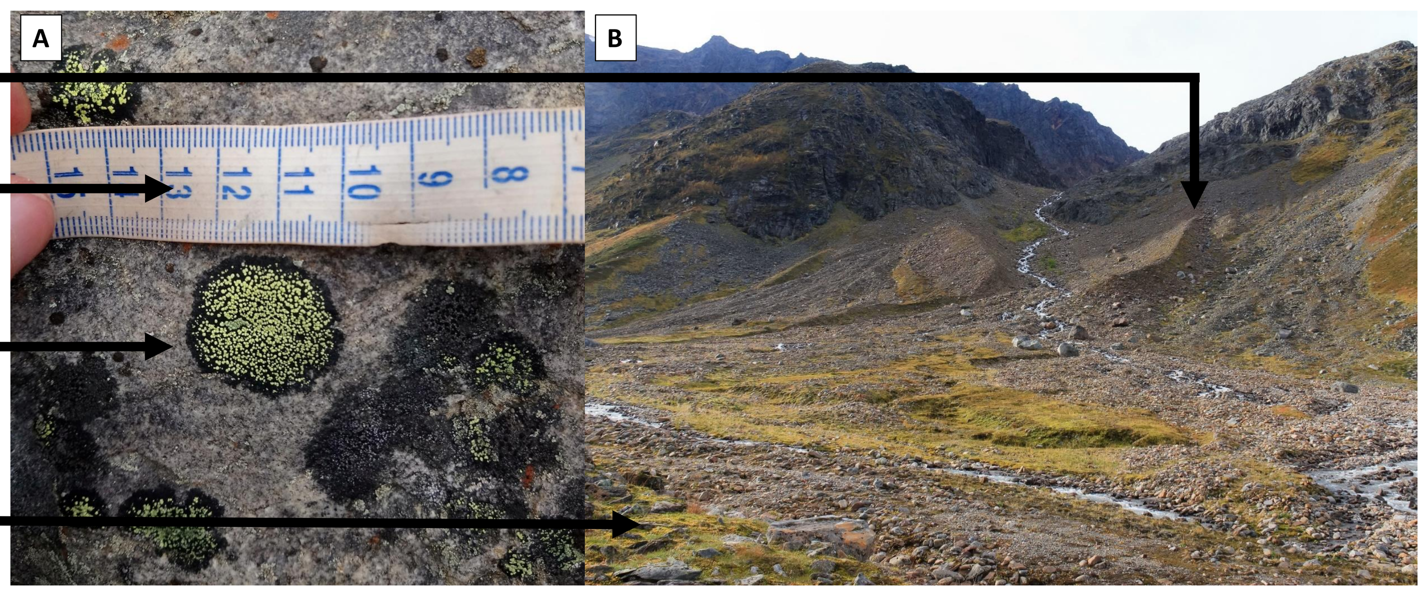

Figure 4: (A) Lichens growing on a boulder which is part of a moraine in the Rotsund Valley; (B) the foreland of glacier 121/123 with the LIA maximum moraine of glacier 121 distinctly visible.

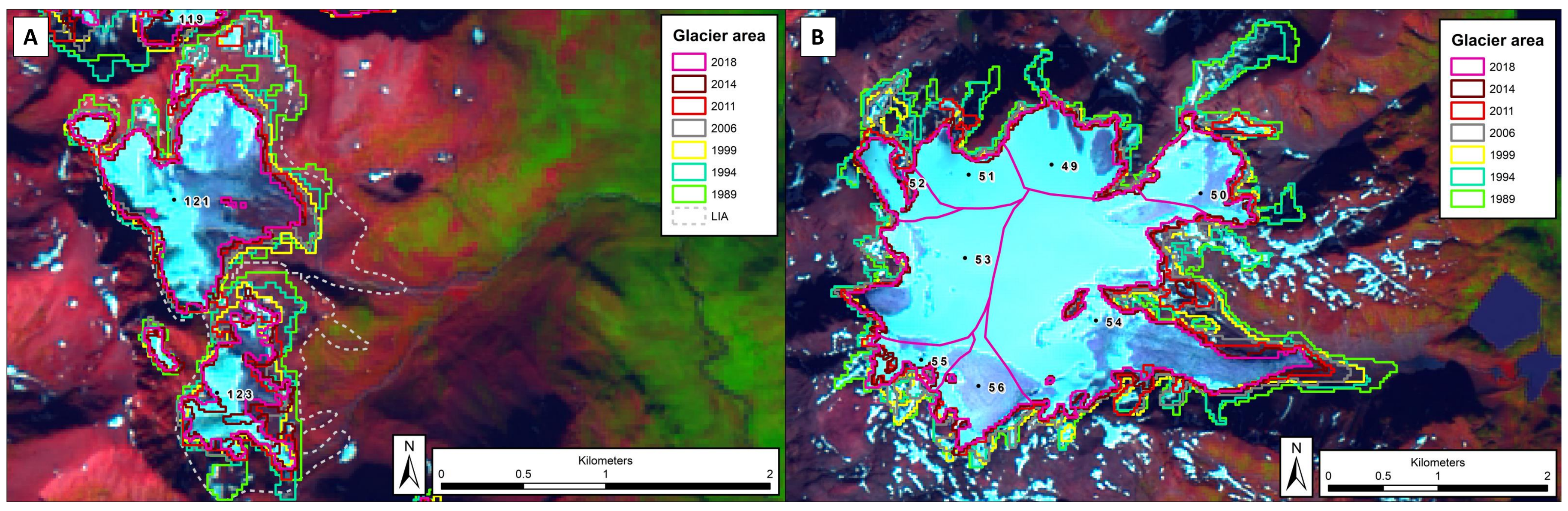

Figure 5: (A) Changes in glacier area in the Rotsund Valley (glaciers 121 and 123) from LIA maxima to AD 2018, and the Langfjordjøkelen ice cap from AD 1989 to 2018.

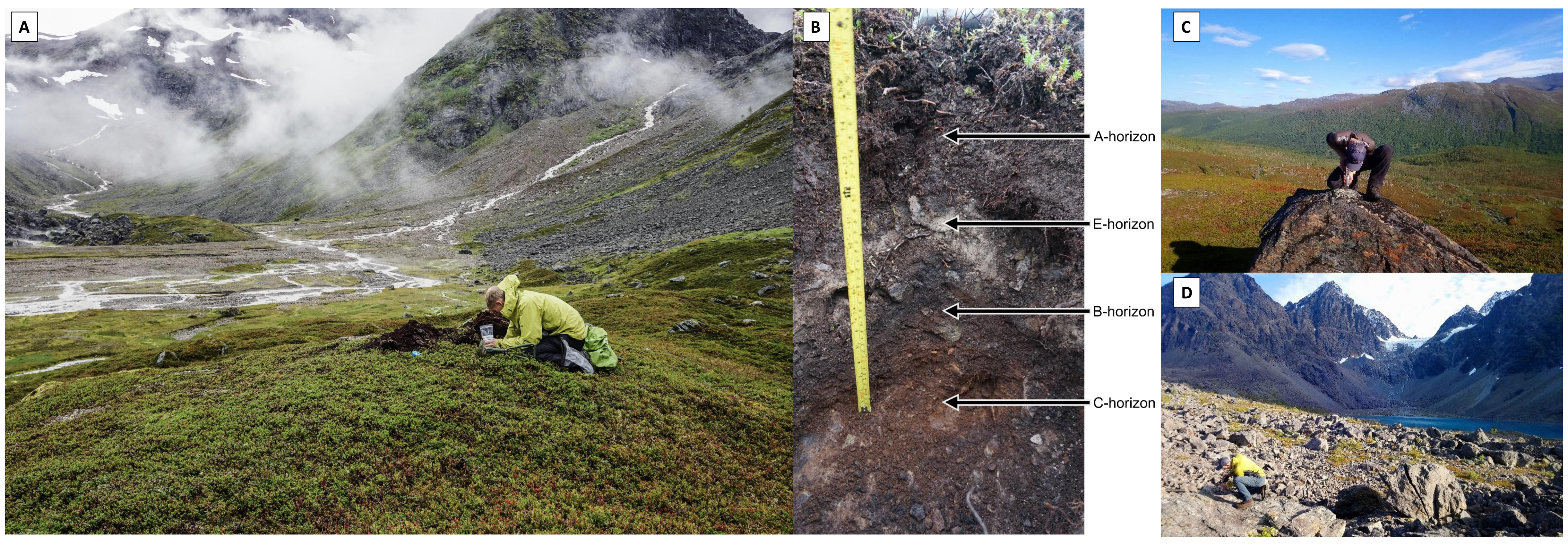

Figure 6: (A) JRL collecting soil samples from an undated moraine in the foreland of glaciers 121/123 (Fig 3) within the Rotsund Valley; (B) Example of a soil profile from an undated moraine in the Rotsund Valley; (C) JRL taking Schmidt hammer R-value readings in the foreland of glaciers 115/117) within the Rotsund Valley; (C) JRL taking Schmidt hammer R-value readings at Strupskardet (an additional site on the Lyngen Peninsula, with independent age control[5]).

4. FUTURE WORK

Our aim is to build on the work presented above and expand our glacial chronology to enable reconstructions focusing on the early to mid-Holocene glacial history of the Rotsund Valley (Fig. 6). To do this, we are focussing on the following research questions:

1. Do Schmidt hammer R-values and/or soil profiles show a trend in relation to apparent moraine ages?
2. Can we use independently dated moraines from a nearby foreland (Strupskardet)[5] to calibrate Schmidt hammer dating and soil chronosequences?
3. How have cirque glaciers of northern Troms evolved throughout the early to mid-Holocene in northern Troms?

5. References

1. Ballantyne, C.K., 1990. The Holocene glacial history of Lyngshalvøya, northern Norway: chronology and climatic implications. *Boreas*, **19**(2), 93-117; **2**. Nesje, A., Bakke, J., Dahl, S.O., Lie, Ø. and Matthews, J.A., 2008. Norwegian mountain glaciers in the past, present and future. *Global and Planetary Change*, **60**(1-2), 10-27; **3.** Andreassen, L. M., Winsvold, S. H., Paul, F. and Hausberg, J. E., 2012. Inventory of Norwegian glaciers. Edited by L. M. Andreassen and S. H. Winsvold. Oslo: Norwegian Water Resources and Energy Directorate; **4.** Baumann, S., Winkler, S. and Andreassen, L. M. (2009) Mapping glaciers in Jotunheimen, South-Norway, during the “Little Ice Age” maximum, *The Cryosphere*, **3**, 231–243; **5.** Bakke, J., Dahl, S.O., Paasche, Ø., Løvlie, R. and Nesje, A., 2005. Glacier fluctuations, equilibrium-line altitudes and palaeoclimate in Lyngen, northern Norway, during the Lateglacial and Holocene. *The Holocene*, **15**(4), 518-540.