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Tree-ring dationg of colonized moraine surfaces in deglacierized areas of Greater Caucasus Mountains

Olimpiu Traian Pop (1), Ionela Georgiana Răchită (1), Daniel Germain (2), Zurab Rikadze (3), Iulian Horia Holobâcă (1), Tamar Khuntselia (3), Mircea Alexe (1), Mariam Elizbarashvili (3), George Gaprindashvili (3), Kinga Ivan (1), and Levan Tielidze (4)

(1) Babes-Bolyai, Faculty of Geography, Laboratory of Dendrochronology, Cluj-Napoca, Romania
(2) University of Quebec at Montreal (UQAM), Institute of Environmental Sciences, Department of Geography, Montreal, Canada
(3) Ivane Javakhishvili Tbilisi State University, Faculty of Exact and Natural Sciences, Department of Geography, Tblisi, Georgia
(4) Ivane Javakhishvili Tbilisi State University, Vakhushti Bagrationi Institute of Geography, Department of Geomorphology,Tblisi, Georgia

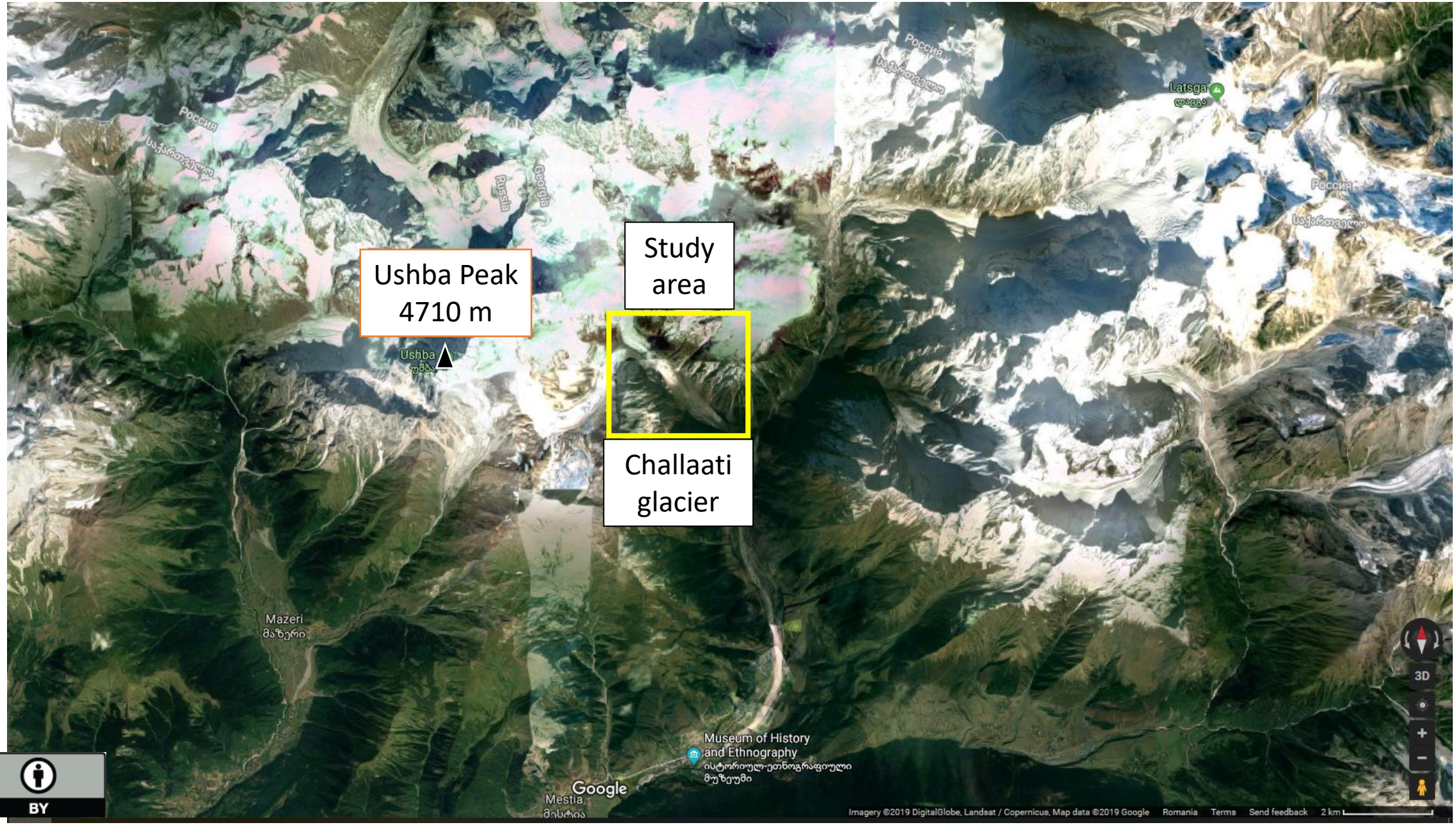
Dendrochronological dating offers the possibility to reconstruct minimum ages of the moraines with a yearly resolution, providing a detailed chronology for glacier dynamics.

Tree-ring dating relies on the assumption that the age of the oldest tree represents an estimate of the minimum age of the moraine resulting from the glacier movements.

Caucasus Range is one of the most heavily glaciated areas of temperate zone, but field evidences and historical records point out that mountain glaciers are already in accelerated decline in response to climate warming.

The main purpose of our study is to document historical changes of the Challaati glacier, located in Mestiachala river basin.

Location of study area (Challaati glacier, Great Caucasus Mts., Georgia)



Methodology

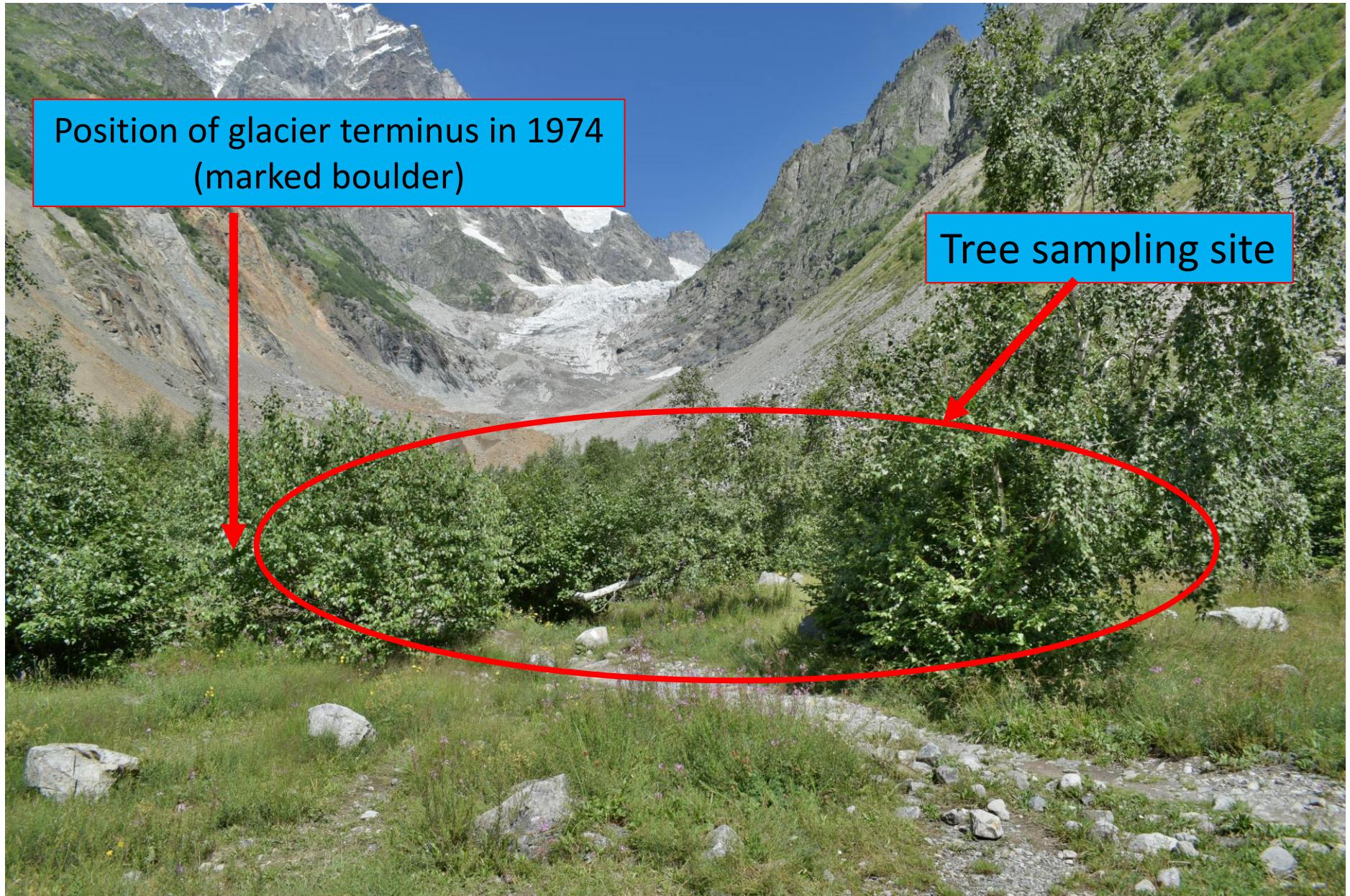
- Field survey investigations (GPS records, geomorphological field mapping
- Tree-ring dating

Methodological steps

- **Geomorphological mapping and GPS records** of the present-day position of glacier terminus;
- **Tree sampling and tree-ring analyses**
  - 120 living coniferous trees (*Pinus sylvestris, Abies nordmanniana, Picea orientalis*) growing on glacier forefield have been sampled with Pressler increment borers;
  - In order to estimate the ecesis period, 16 living broadleaved trees (*Betula ssp*.) and coniferous trees (1 *P. sylvestris* and 1 *P. orientalis)* sampled in a site with documented period of glacier terminus presence (year 1974);
  - Tree-ring width measurements (LINTAB 5 measurement station ant TsapWIN Scientific software, Rinntech, 2019)
  - Visual and statistical crossdating of the chronologies (COFECHA, TsapWIN softwares)
  - Determination and application of tree-age corrections:
    - reconstruction of the number of missing rings to the pith (pith offset estimation);
    - the determination of age-height relationships for the study site (tree age estimation at the coring height corresponding with years a sapling needs to grow to breast height);
    - the determination of the ecesis, which is related to the period from the stabilization of the moraine surface to the germination and establishment of the first trees.

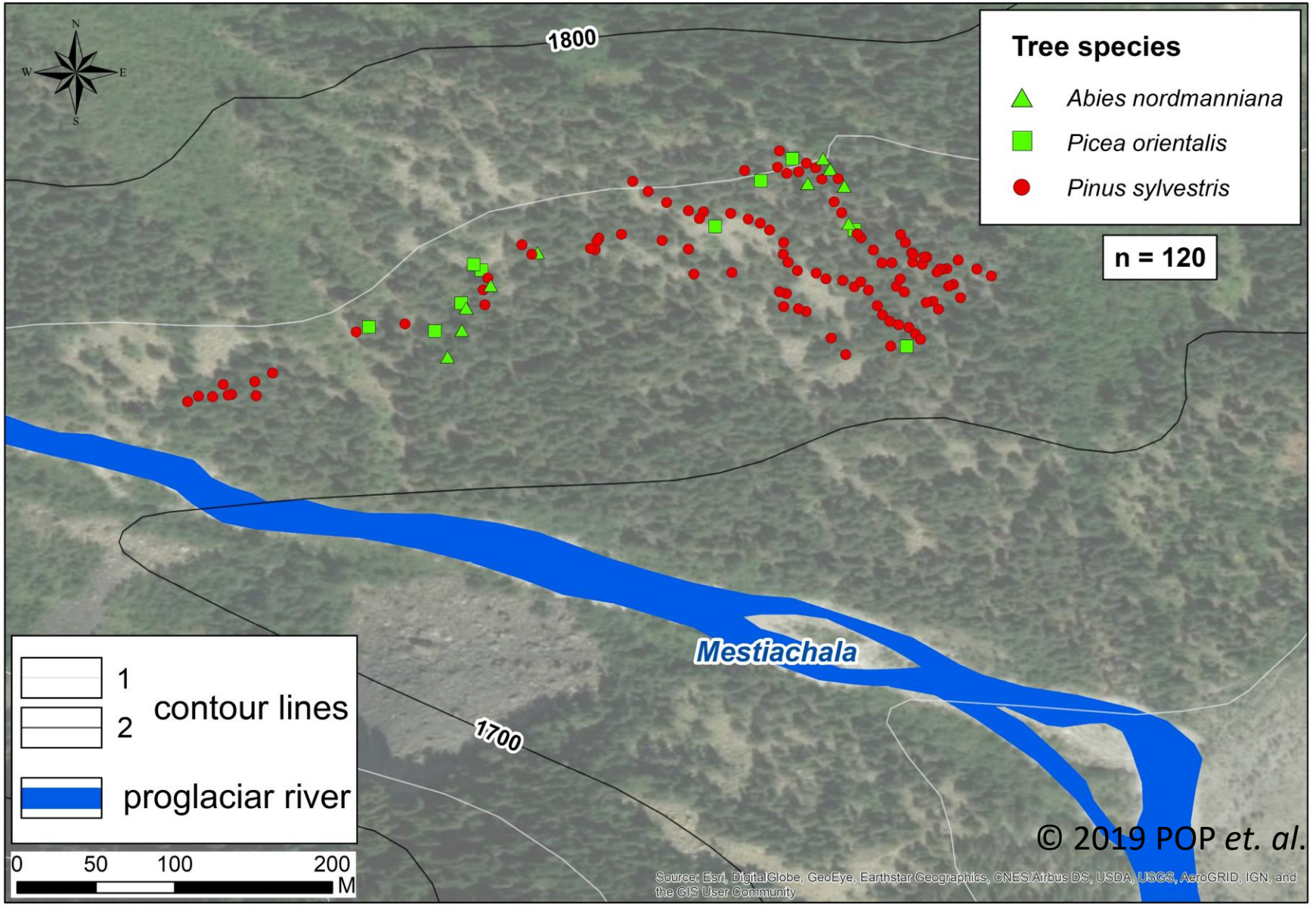
Dating the moraine colonized periods

Assessing the ecesis period



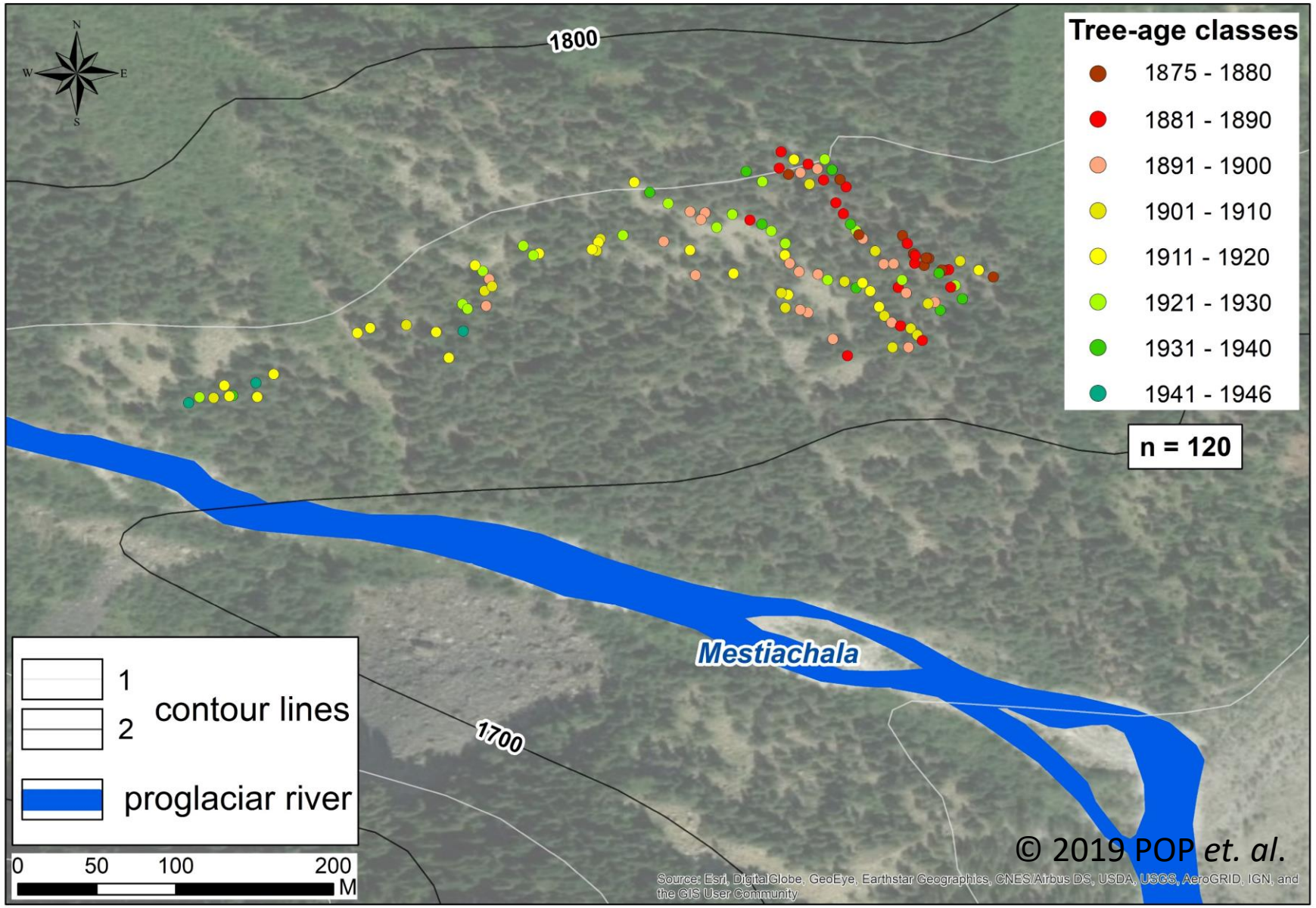
Results

Spatial distribution of tree species



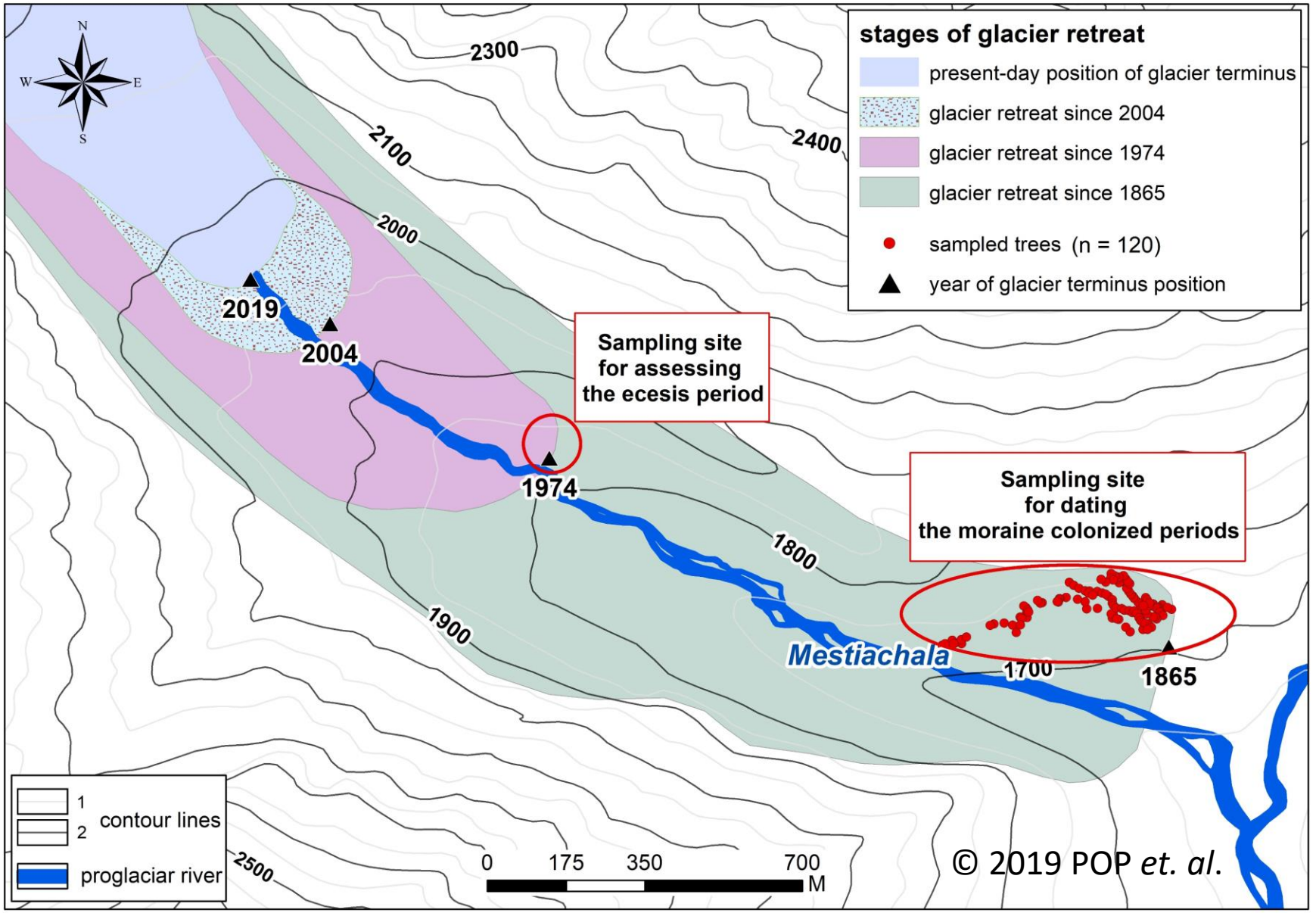
Results

Reconstructed tree ages



Results

Reconstructed moraine colonized periods



Concluding remarks and perspectives

- Tree-ring analyses coupled with historical documents, GPS records and geomorphological mapping of glacier forefield allowed us to reconstruct multiple stages of Challaati glacier recession and also to calculate the retreat rates since the end of LIA period.

- The present study highlights the usefulness of tree-ring dating coupled with field survey investigations to improve our knowledge and understanding of glacier forefield changes, but also to provide a robust dataset useful for the modelling the retreat of glaciers at various scales in Greater Caucasus Mts.

- A further application of this type of studies in other similar sites of Georgian Greater Caucasus Mts. will bring new and valuable insights for the assessment of spatial reconstruction of glacier retreat and the periods when deglacierized areas become exposed to denudational hillslope and fluvial processes.

Thank you for your attention!