

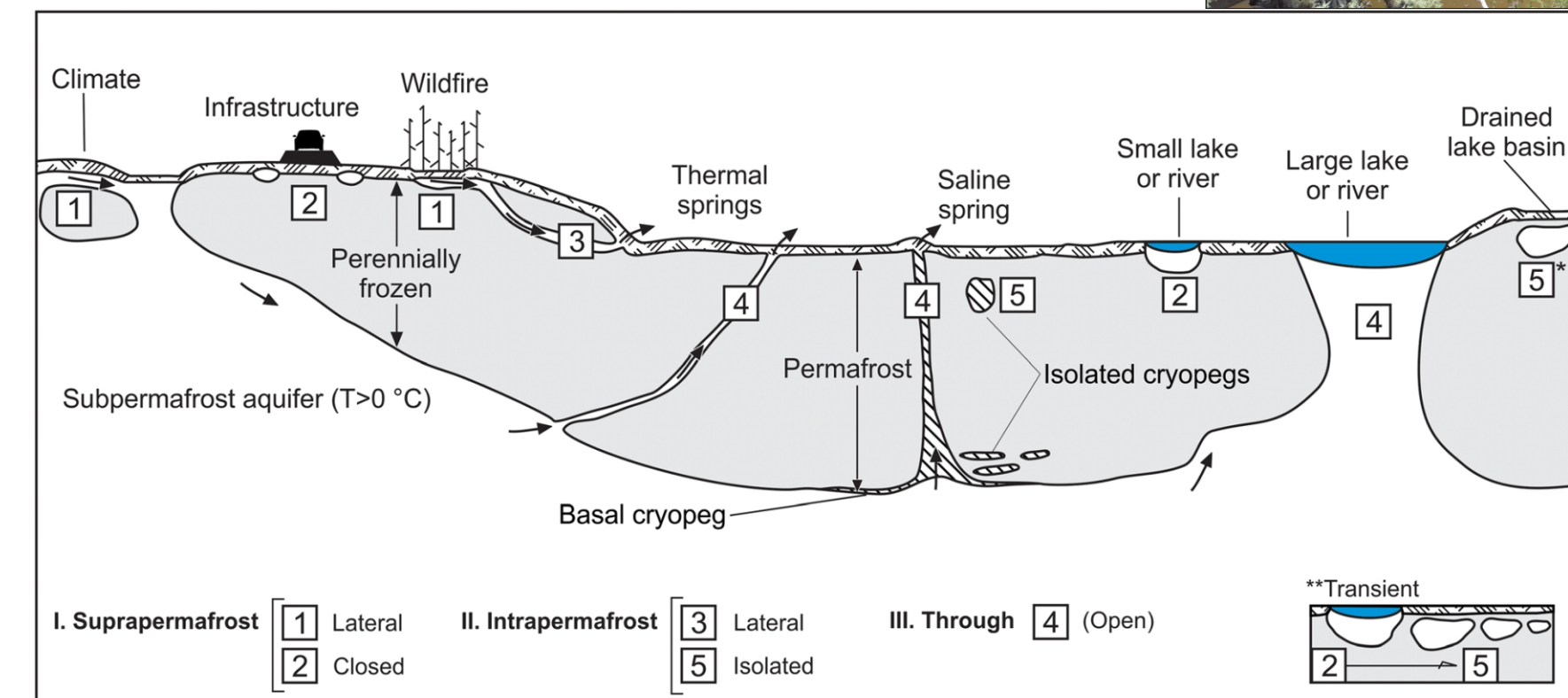
Taliks within continuous permafrost environments are vital for sustaining river streamflow within small watersheds

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1. Introduction. Permafrost and taliks

- **Permafrost** - soil or rock and included ice and organic material that remains at or below 0°C for at least two consecutive years.
- Approximately 15% of the Northern Hemisphere and more than 60% of Russia is underlain by permafrost.
- The permafrost table is practically impermeable. It significantly affects river streamflow generation in many different ways.



Talik configurations, hydraulic connectivity, and mechanisms/features associated with talik formation (O'Neil et al., 2020)

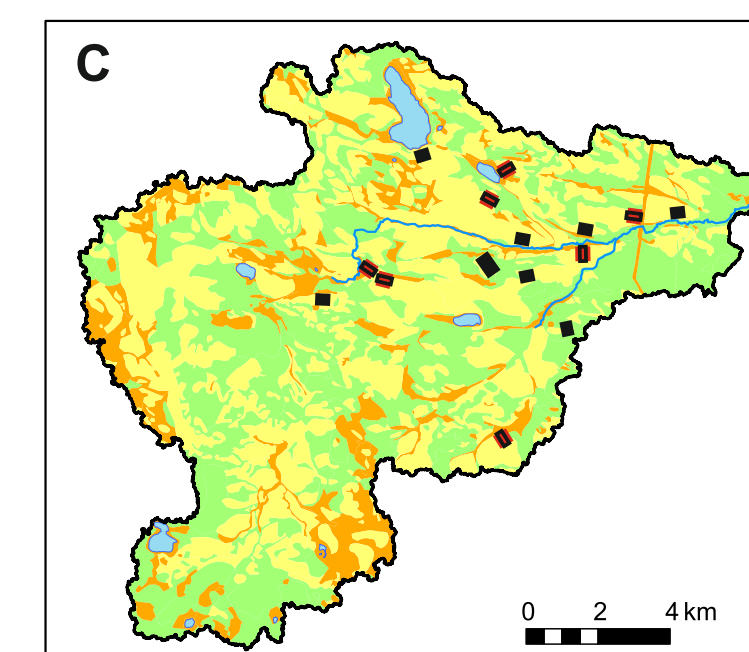
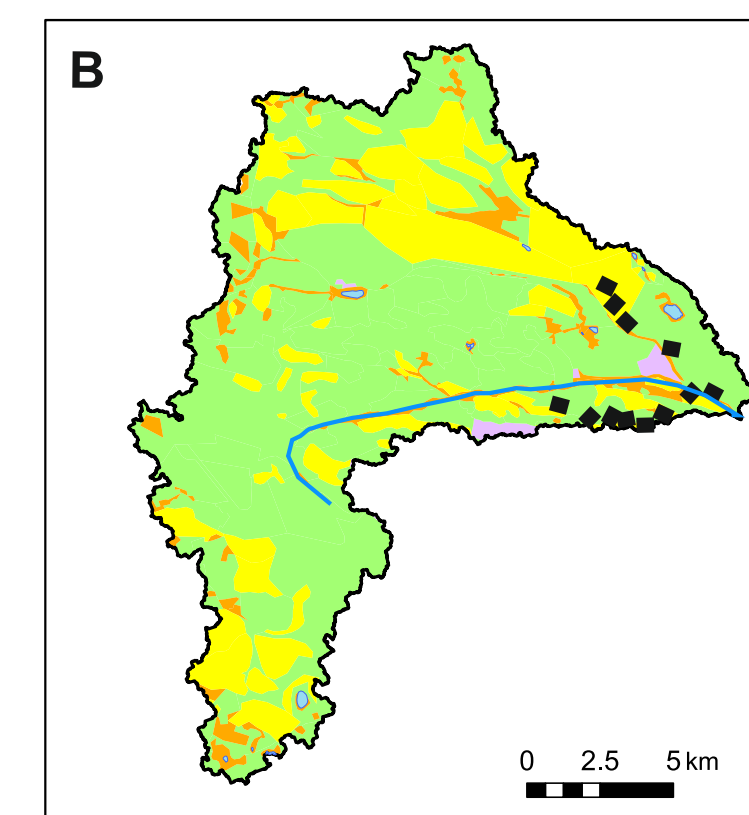
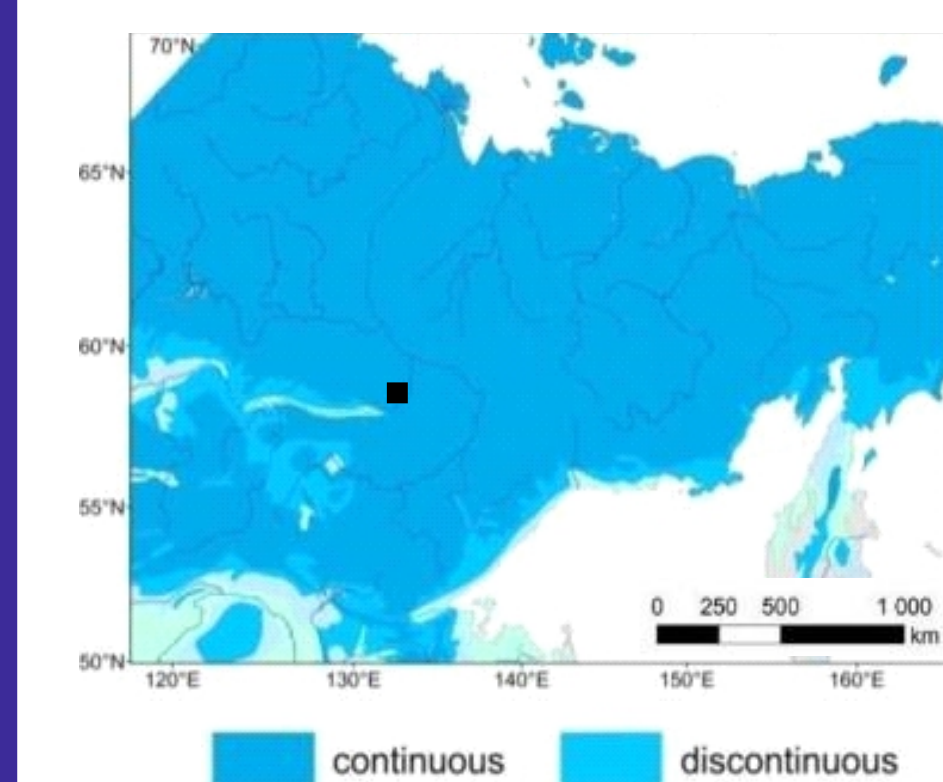
- **Talik** - an unfrozen section of ground found above, below, or within a layer of permafrost.
- Groundwater flow is restricted to the active layer and taliks within permafrost.
- Climate change will lead to talik formation within permafrost

2. Research aim

investigate the relationship between suprapermfrost subaerial talik aquifers and streamflow generation using the example of two small watersheds in the continuous permafrost zone of Eastern Siberia, Russia.

3. Study sites: two small watersheds in Siberia

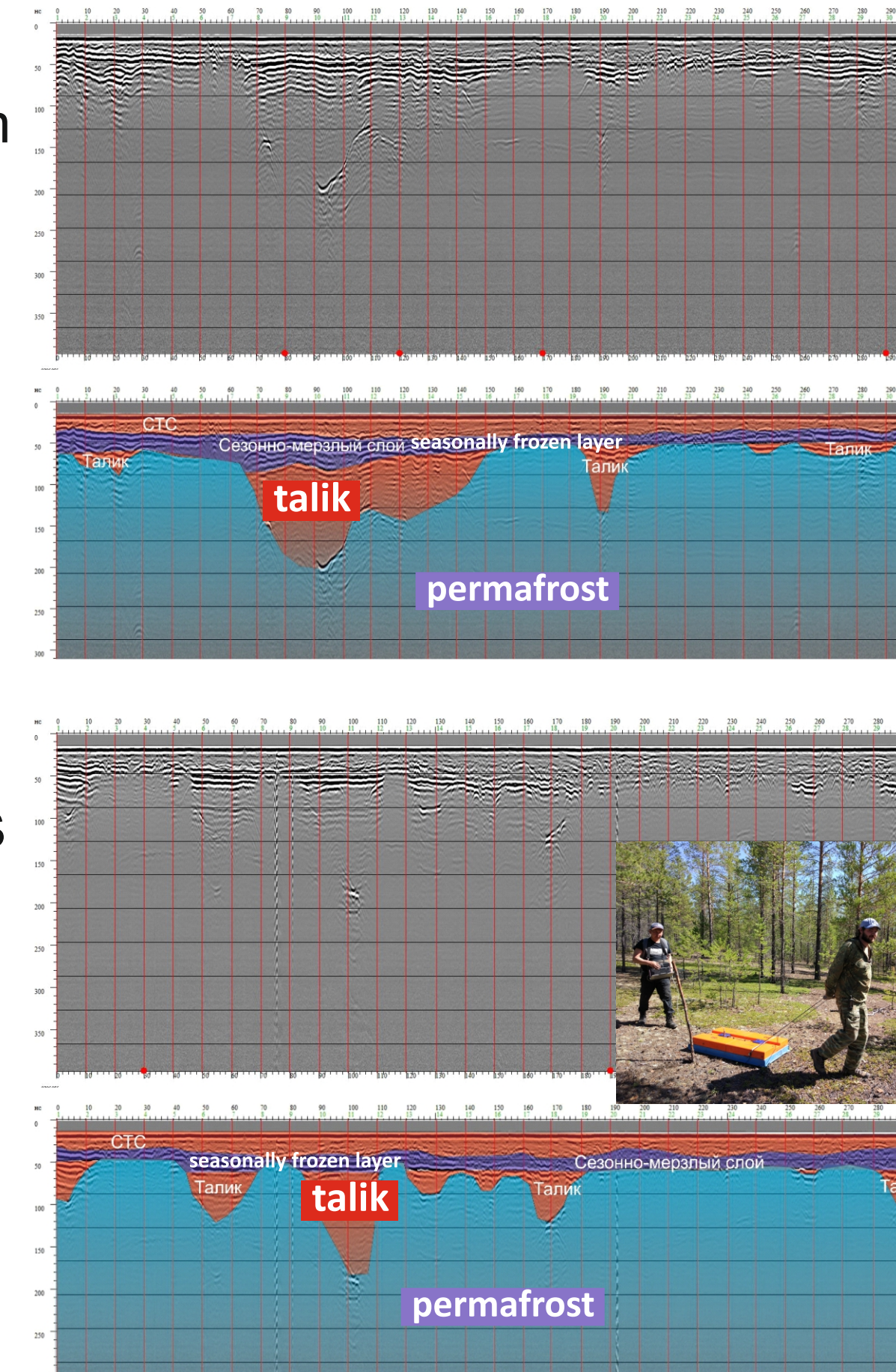
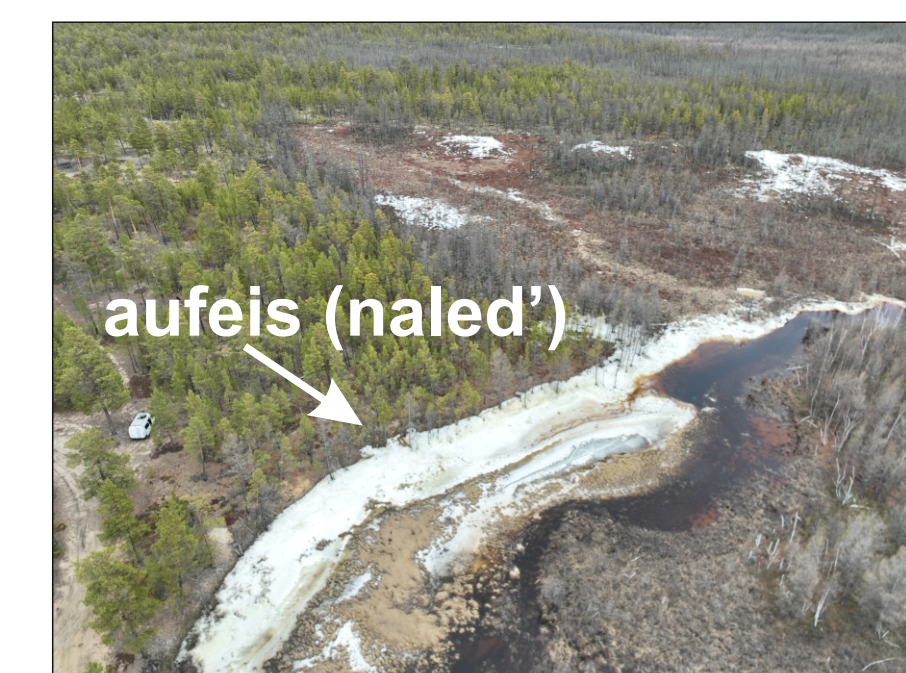
| | Shestakovka | Mark hinka |
|--------------------|-------------|------------|
| Area, sq.km | 170 | 227 |
| Altitude, m a.s.l. | 233 | 203 |
| Slope, ° | 7.2 | 7.5 |
| Larch forest, % | 42 | 66 |
| Pine forest, % | 41 | 26 |
| Mire, % | 15 | 7 |



A - two watersheds on the satellite image, B - landscape map of the Shestakovka R. watershed, C - landscape map of the Markhinka R. watershed 1 - larch forest, 2 - pine forest, 3 - mire, 4 - lake, 5 - settlement, 6 - river, 7 - profile with talik, 8 - profile, no talik

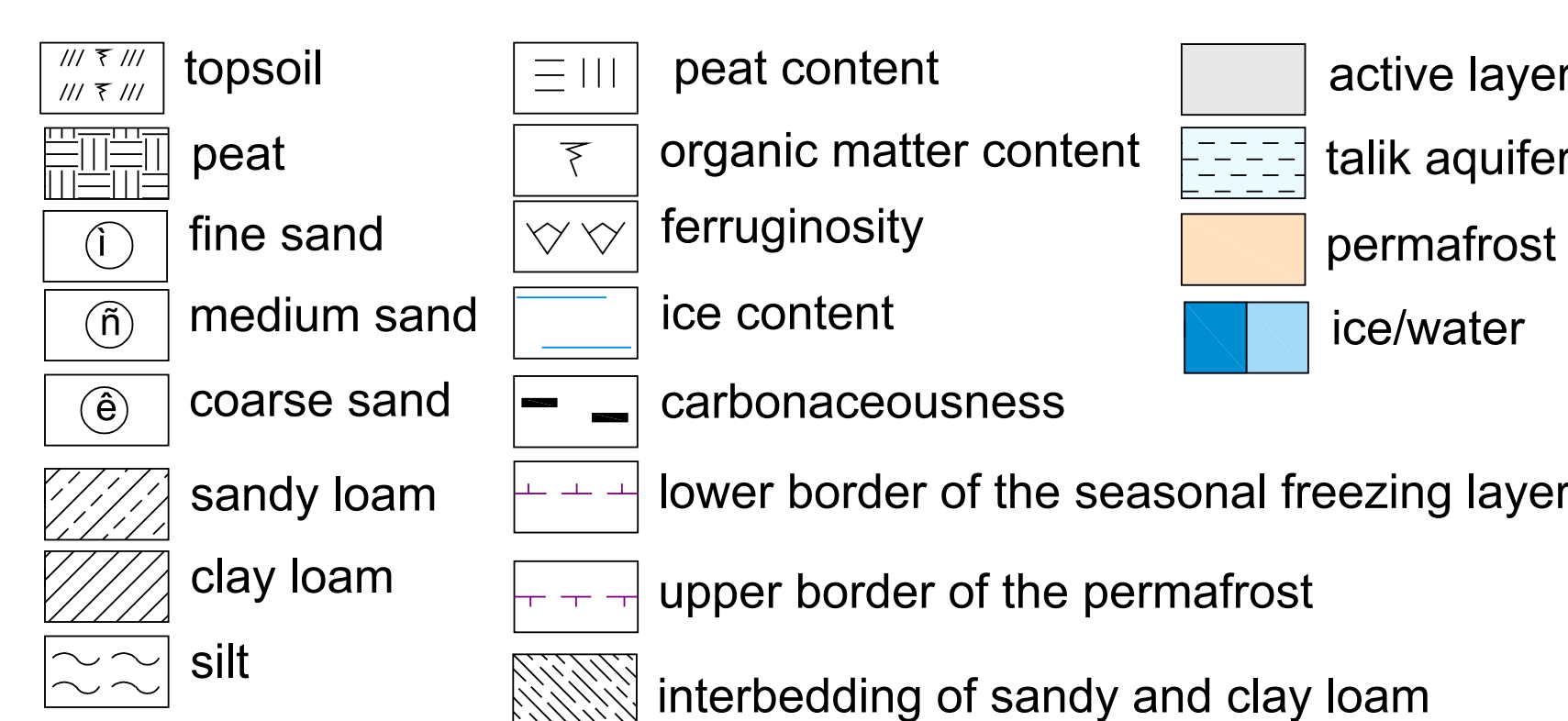
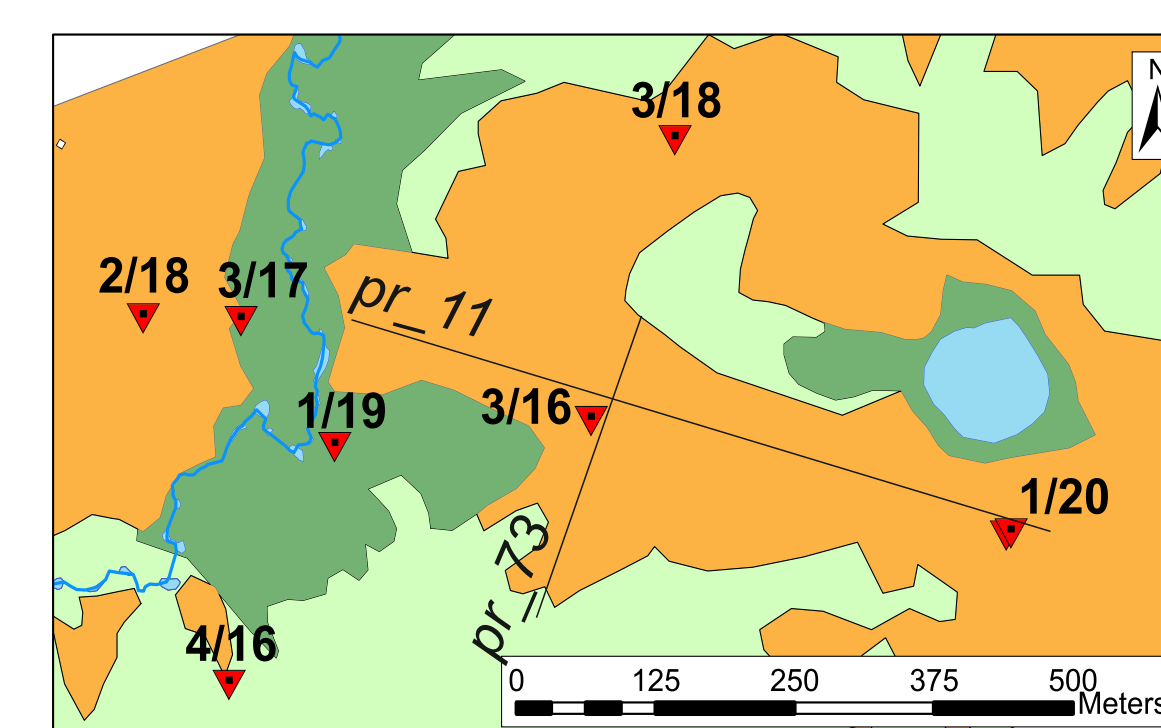
4. Taliks at the Shestakovka river basin

- taliks were presence at 7 GPR profiles out of 15, 1360 m out of 5950 m
- taliks have length up to hundreds of m and thickness from 1 to 20 m
- taliks are found in the pine forests on well-drained slopes composed of sandy sediments
- the thickness of the seasonally frozen layer above suprapermfrost taliks is 1.7–2.5 m.
- based on assumption that profiles are representative for the pine forest, taliks occupy 23% of pine forests and 9.5% of the basin area

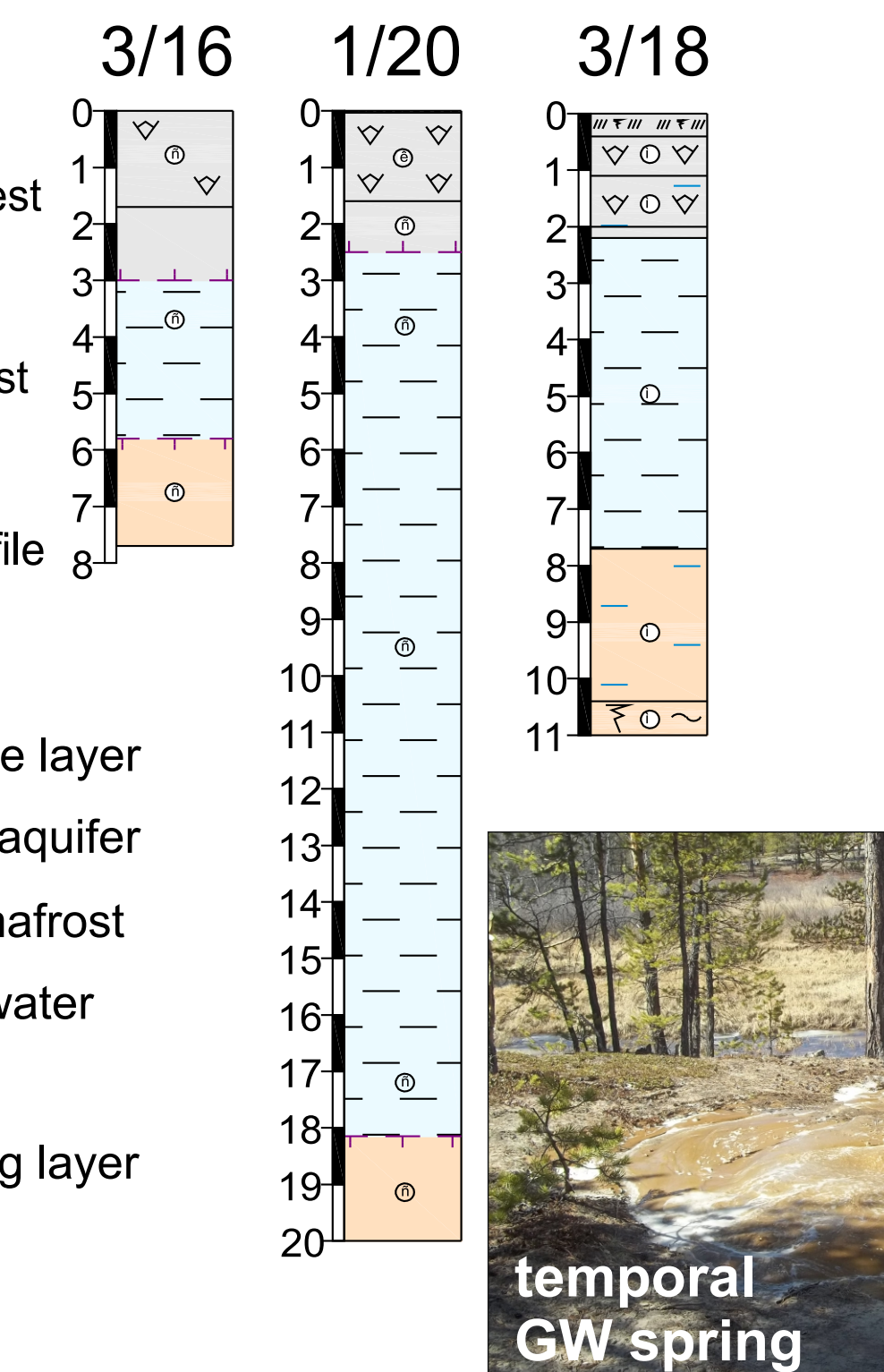


5. Drilling showed that taliks are aquifers

Landscapes and boreholes at the key site

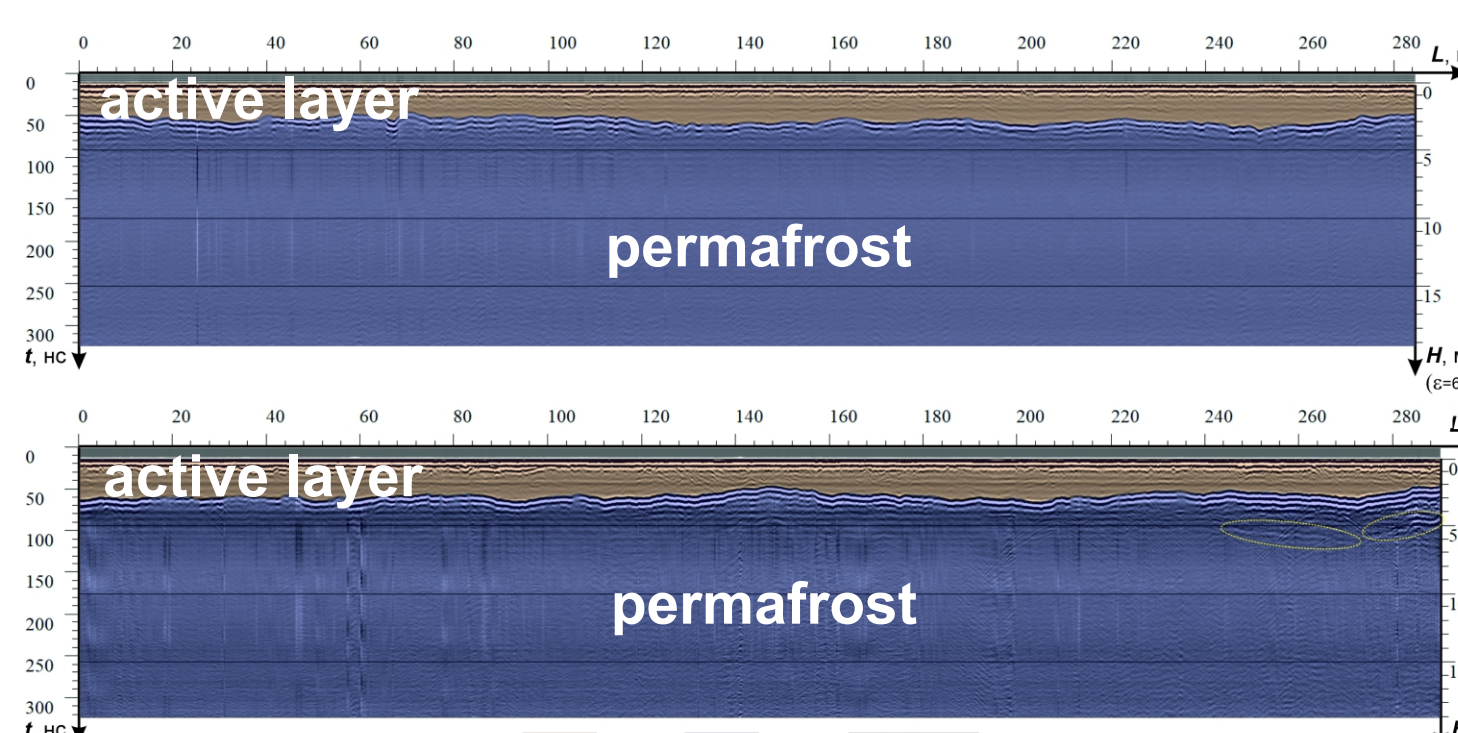


Geological sections of taliks



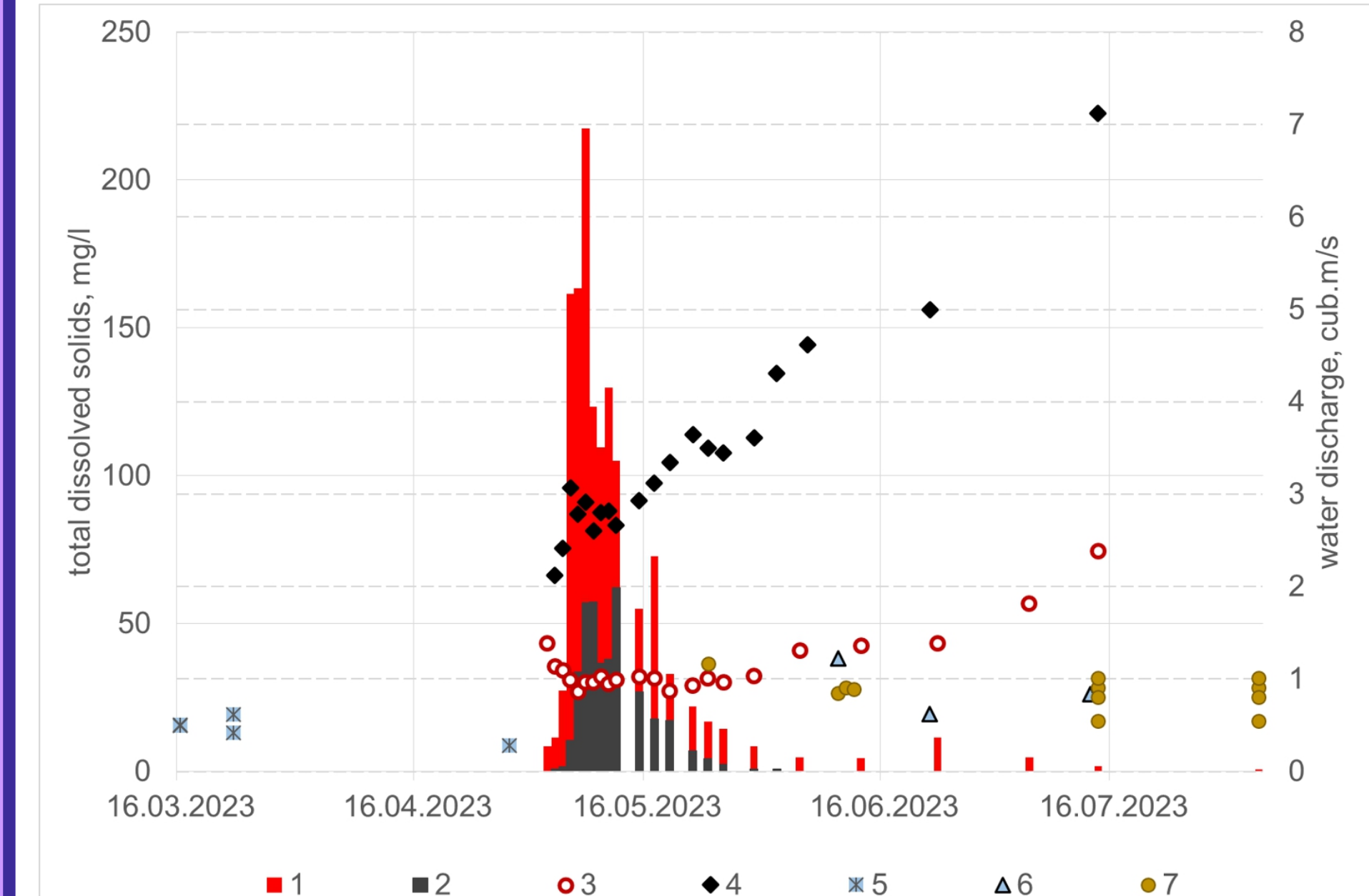
6. No taliks at the Markhinka river basin

- taliks were absent at all 12 GPR profiles
- drilling up to permafrost table at 7 profiles showed interlayers of sandy loam and loam here that could be reason of the talik absence



7. Taliks and river streamflow

Water discharges and TDS of **Shestakovka** and **Markhinka** rivers in 2023



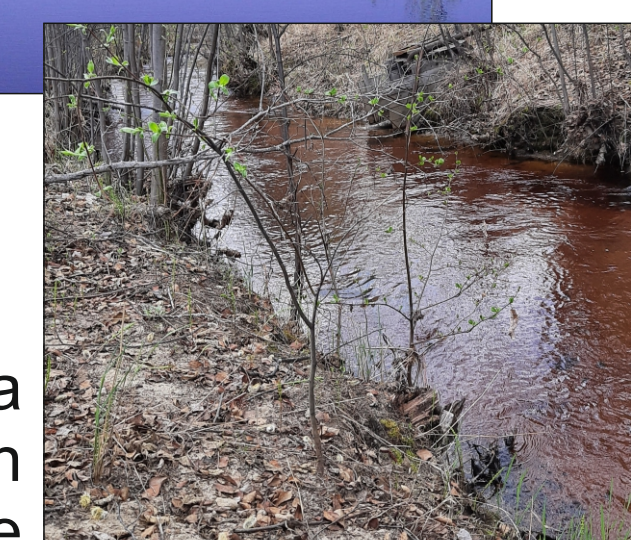
1 - Shestakovka R discharge, 2 - Markhinka R. discharge, 3 - total dissolved solids (TDS) of Shestakovka R, 4 - TDS of Markhinka R, 5 - TDS of snow, 6 - TDS of rain water, 7 - TDS of talik groundwater

Mean hydrological characteristics for **Shestakovka** and **Markhinka** rivers, 1960-1987

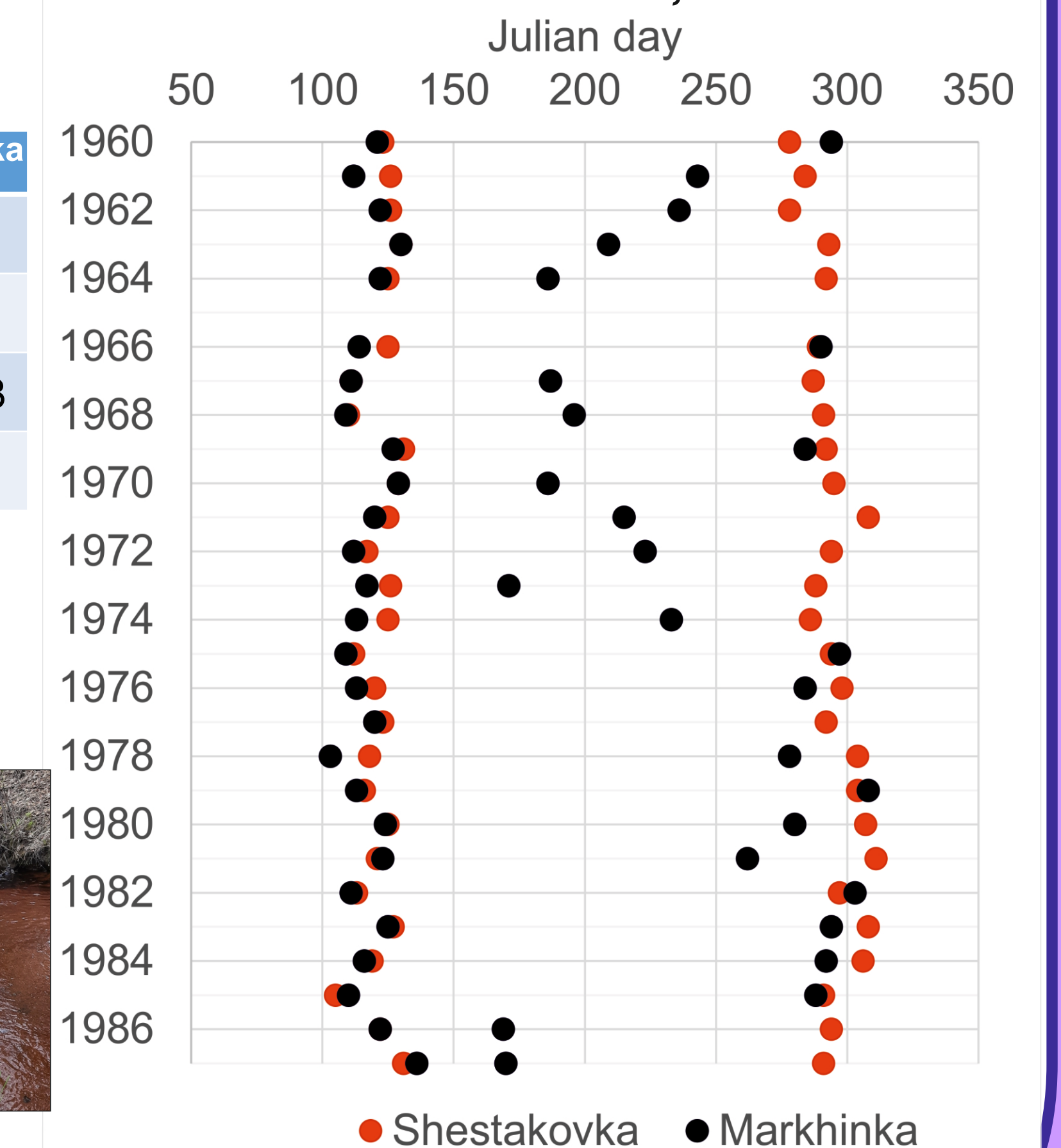
| | Shestakovka | Markhinka |
|--------------------------|-------------|-----------|
| Runoff depth, mm/year | 17 | 3.3 |
| Maximum discharge, m³/s | 1.98 | 0.96 |
| Date of flow initiation | May 2 | Apr 28 |
| Date of flow termination | Oct 19 | Sept 9 |



Shestakovka is flowing in June



Dates of flow initiation and termination for **Shestakovka** and **Markhinka** rivers, 1960-1987



8. Conclusions

- Water-bearing taliks, with thicknesses up to 20 m occupy appr. 10% of the Shestakovka catchment and are confined to gentle slopes composed of sandy deposits, often covered with sparse bearberry pine forests.
- During the low-water period, the Shestakovka river flow is supported by the recharge of groundwater from taliks.
- In the absence of taliks in the Markhinka basin due to different geology, the river flow usually stops after the spring flood
- Our study highlights the significant role of subaerial suprapermfrost talik aquifers in generating river runoff within the continuous permafrost environment. Considering the pronounced climate change occurring in the region, taliks may play an increasingly crucial role in the near future.