Measurements of permafrost table elevations, thaw depth and soil surface subsidence at the Ayach-Yakha CALM site

(Galina Mazhitova)

The method I use to measure permafrost table elevations, thaw depth and soil surface subsidence is a common instrumental leveling, most CALM people are probably familiar with. I have a state geodetic benchmark (*geodezicheskaya piramida* in Russian) in some 100 m from my site. So far I could not obtain the catalogue containing elevations a.s.l. for such benchmarks, therefore I use relative, not a.s.l. elevations. The benchmark is a concrete block put deeply in the ground. There is a small ledge on the block surface to put a scale (measuring rod, *nivelirnaya reika* in Russian) on it.

Annually (September) repeated survey, i.e. determining elevations of all grid nodes using a common leveling procedure, would allow me to calculate both surface subsidence and amounts of permafrost table downward/upward movement. However, the common procedure includes putting a scale on a soil surface. The standard scale is rather heavy. At my site there is a dense moss layer underlain by peat layer with site-average thickness 12 cm. Putting of a heavy scale on the moss/peat surface necessarily causes the surface deformations. Amount of the deformations may vary from year top year depending on soil moisture content and moss condition (turgor). Therefore, I had a feeling that the measurements could contain errors comparable with subsidence values in many grid nodes (2-5 cm).

To avoid/reduce the above-mentioned errors I started to use a slightly different, but equally simple procedure (**Figure**). Now I penetrate a graduated steel rod (a common CALM instrument) to the soil until it reach permafrost surface and then put the scale on the rod. The rod is supplied with a 10 x 5 cm pad to better support the scale. Thus, permafrost table elevations are obtained by "direct" measurements, thaw depths are read from the graduated rod as usual, and soil surface elevations, as well as subsidence values are calculated.

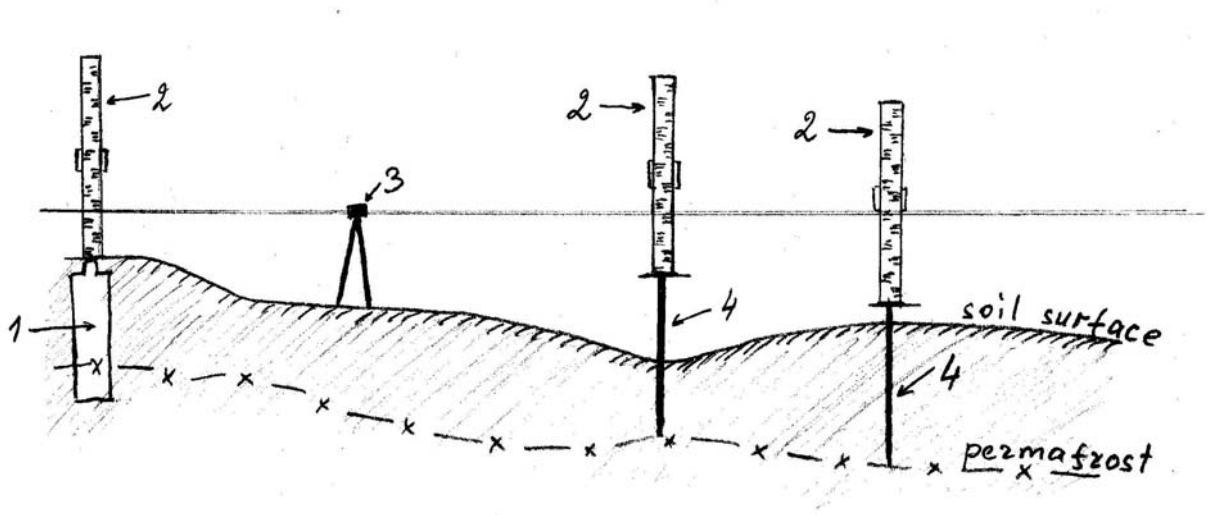

Figure:

- **1** geodetic benchmark
- **2** scale (measuring rod, *reika*) in different positions
- **3** leveling instrument (2H-10KL, Russia)
- **4** graduated steel rod in different positions

Calculations:

P, cm = ***A - B – C***
where
P - node specific permafrost table elevation i
A - elevation of the "beam" of leveling instrument
B - reading taken from the scale
C - length of the steel rod

E, cm = ***P + al***
where
E – node specific soil surface elevation
P – permafrost table elevation at the same node
al – active layer depth (taken as a common reading from the rod)

S, cm = ***E1 – E2***
where
S - node specific soil surface subsidence
E1 - node specific soil surface elevation in September previous year
E2 - node specific soil surface elevation in September this year

A scale put on a rod, even when the rod is supplied by a special pad to support the scale, is a somewhat shaky design. I have two rods, a shorter and a longer ones, and choose between them depending on thaw depth at a particular node. However, it is always possible to construct a stronger device. Dr. Nikolai Uhkov from Magadan, who used to work for Georgy Perlshtein developed such a device (Photo). I have a detailed description of it given me as a gift by the author, however, I can not distribute it as it is patented. The idea is to attach a tube to a scale, so that a rod could move freely within the tube, as well as it can be fixed in necessary position.

Naturally, at the CALM sites with a firm mineral surface there is no need for complications, and a common leveling procedure (i.e. determining elevations of the soil surface) accompanied by thaw depth measurements should work well.