

Evidence essay · Land and freshwater

When the ground moves beneath the ruler

Elín Bjarnadóttir · 3 September 2026

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ABSTRACT

An unchanged thaw-depth reading can conceal movement of both the ground surface and the thaw boundary. Through a deliberately simplified example, this essay distinguishes surface-relative depth from elevation measured against an external reference. It draws on active-layer monitoring guidance to discuss marked sampling locations, repeat readings, probe refusal, lower bounds, and the importance of recording seasonal timing. A cited satellite-radar study extends the discussion to spatial observations without equating radar displacement with a thaw probe. Seasonal heave and subsidence must also be separated from persistent settlement before comparisons are interpreted. The essay recommends preserving linked records of depth, surface movement, point identity, reference conventions, and method changes, while making clear that no particular site's subsidence is established by the explanation.

Keywords: active layer · thaw depth · ground subsidence · reference elevation · probe refusal

Adapted from the Still North field journal. Original article. A source-based editorial text, not a report of original Still North research. Examples and imagery are illustrative.

A thaw probe measures downwards from the ground surface. That sounds obvious until the surface itself moves. If ice-rich ground settles, the same measured distance to frozen soil can describe a different boundary elevation. Repeating a number is not always the same as repeating a physical condition. A long record needs a clear account of what its ruler is attached to.

This is a question about measurement repeatability, not a claim that a particular monitoring site is subsiding. It matters whenever seasonal thaw, frost heave, settlement, or changing vegetation makes a reference point less fixed than it looks. The task is to preserve the useful local reading while recognising what it cannot establish alone.

Depth and elevation tell different stories

Consider a deliberately simplified example. In one year, the ground surface is at an arbitrary elevation of 100.00 metres and the thaw boundary at 99.50 metres. A probe reads 50 cm. Next year, both surface and boundary are 5 cm lower. The probe still reads 50 cm, although the thaw boundary is now lower relative to the original reference. These are illustrative numbers, not measurements from Still North.

A surface-relative depth remains valuable for roots, soil processes, and seasonal comparisons. A stable external elevation reference adds information about surface movement. Neither number should quietly replace the other. If a programme changes from one reference convention to another, it should document the transition and, where possible, measure both over an overlapping period.

The reference needs scrutiny too. A nearby marker embedded in moving ground is not automatically stable. Survey design, benchmark installation, and the material supporting the benchmark require appropriate expertise. A coordinate recorded to many decimal places cannot by itself prove that the physical point has remained fixed or that its elevation is known equally precisely.

Return to a sampling design, not a convenient patch

The Circumpolar Active Layer Monitoring protocol describes spatially organised measurements because thaw depth can vary over short distances. It recommends marked locations and notes that duplicate readings can help assess robustness. If an observer moves to easier ground after meeting a stone, the change must follow the protocol and remain recorded, rather than becoming an invisible improvement to the result.

Probe refusal is not an unambiguous diagnosis. Rock, a hard layer, or the limit of the available rod can prevent a valid boundary measurement. Record why a reading is uncertain or unavailable. A rod that reaches its full length without resistance establishes a lower bound on thaw depth at that point, not an exact depth equal to the rod's length.

Timing is another moving reference. The seasonal thaw maximum does not necessarily occur on the same calendar date every year. A late-summer visit can be practical and consistent without always catching the actual maximum. Repeated visits or temperature records can help interpret the seasonal stage; where those are unavailable, describe the reading as what was observed on its date.

Seasonal movement is not automatically permanent loss

Near-surface freezing and thawing can produce a seasonal heave–subsidence cycle. Longer-term settlement may be superimposed on that cycle. Comparing a spring elevation in one year with an autumn elevation in another can therefore mix seasonal movement with persistent change. Comparable seasonal windows and a sufficiently long record help separate the two.

A 2025 study by Barbara Widhalm and colleagues examined satellite-radar-derived seasonal subsidence in Arctic lowlands. The authors found relationships with

moisture conditions, while identifying challenges involving atmospheric corrections, temperature information, and spatial resolution. Radar can extend the view beyond a few points, but its displacement estimate is not simply a remotely read thaw probe.

Keep enough context for the next observer

A useful handover retains point identity, coordinates and their precision, date, probe method, reference surface, vegetation and disturbance notes, refusal codes, and any surveyed movement. Paired observer readings can reveal differences in technique. They should not be averaged before checking whether both people measured the same thing. A consistent mistake can be repeatable without being accurate.

Our Open observations guide explains the value of preserving raw records and method changes. Permafrost and freshwater sets out why ground change matters to water pathways. The best annual comparison may be two linked records rather than one: how far thaw extended below that year's surface, and how the surface itself moved.

References

1. Circumpolar Active Layer Monitoring protocol
(www2.gwu.edu)
2. 2025 study by Barbara Widhalm and colleagues
(tc.copernicus.org)