Root-zone soil water content and temperature at snow covered and snow-free sites in southern boreal Finland

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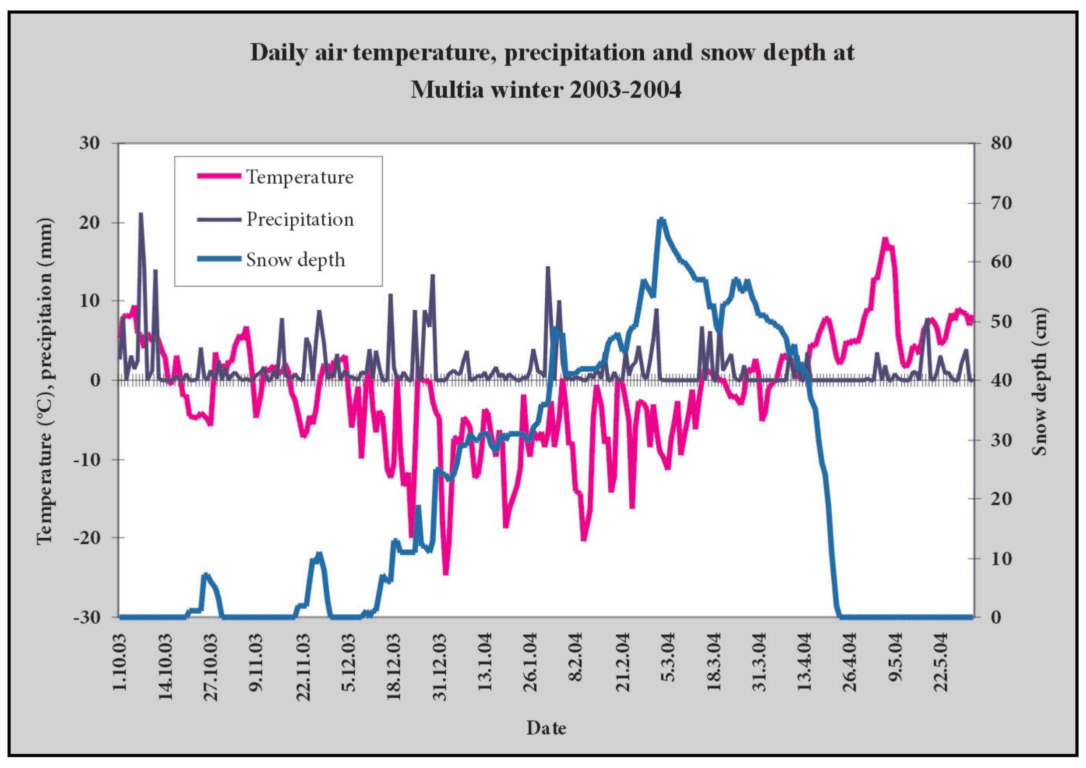
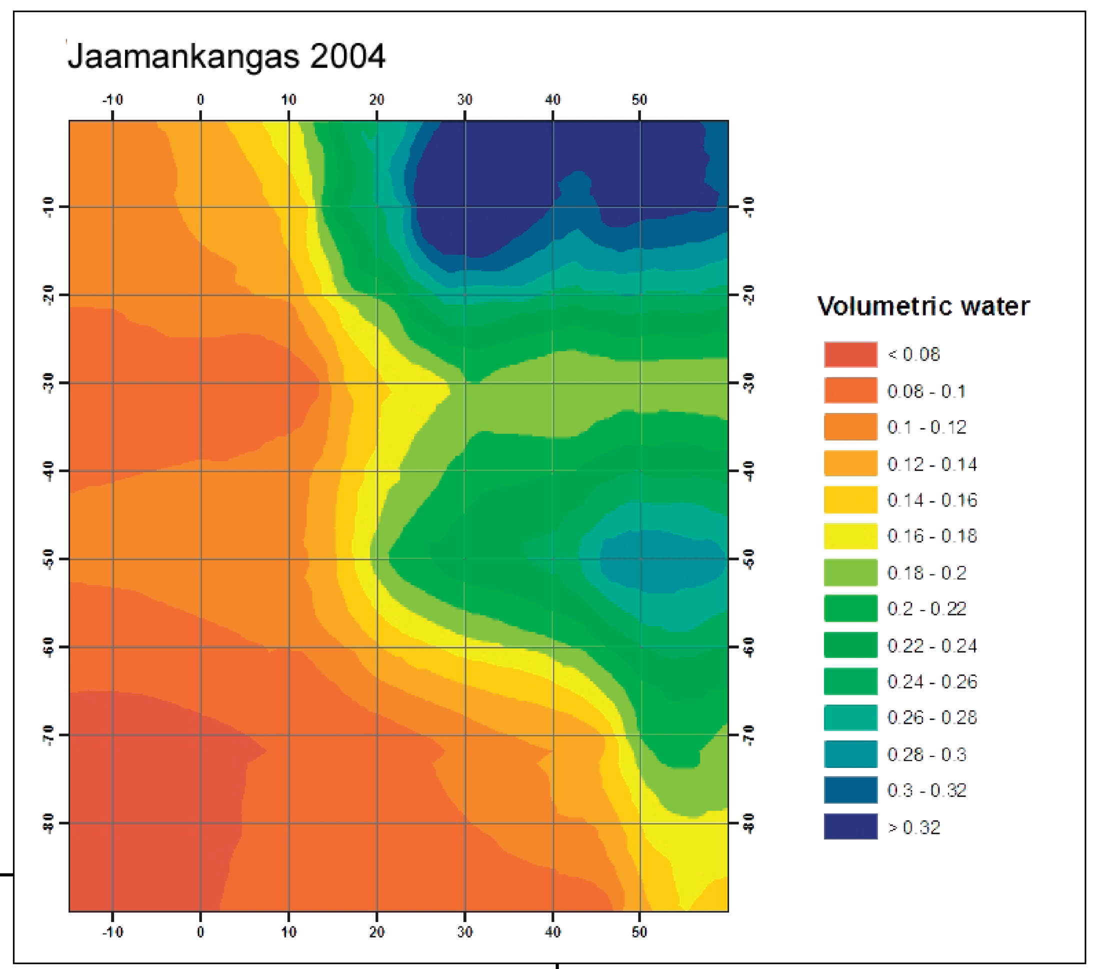
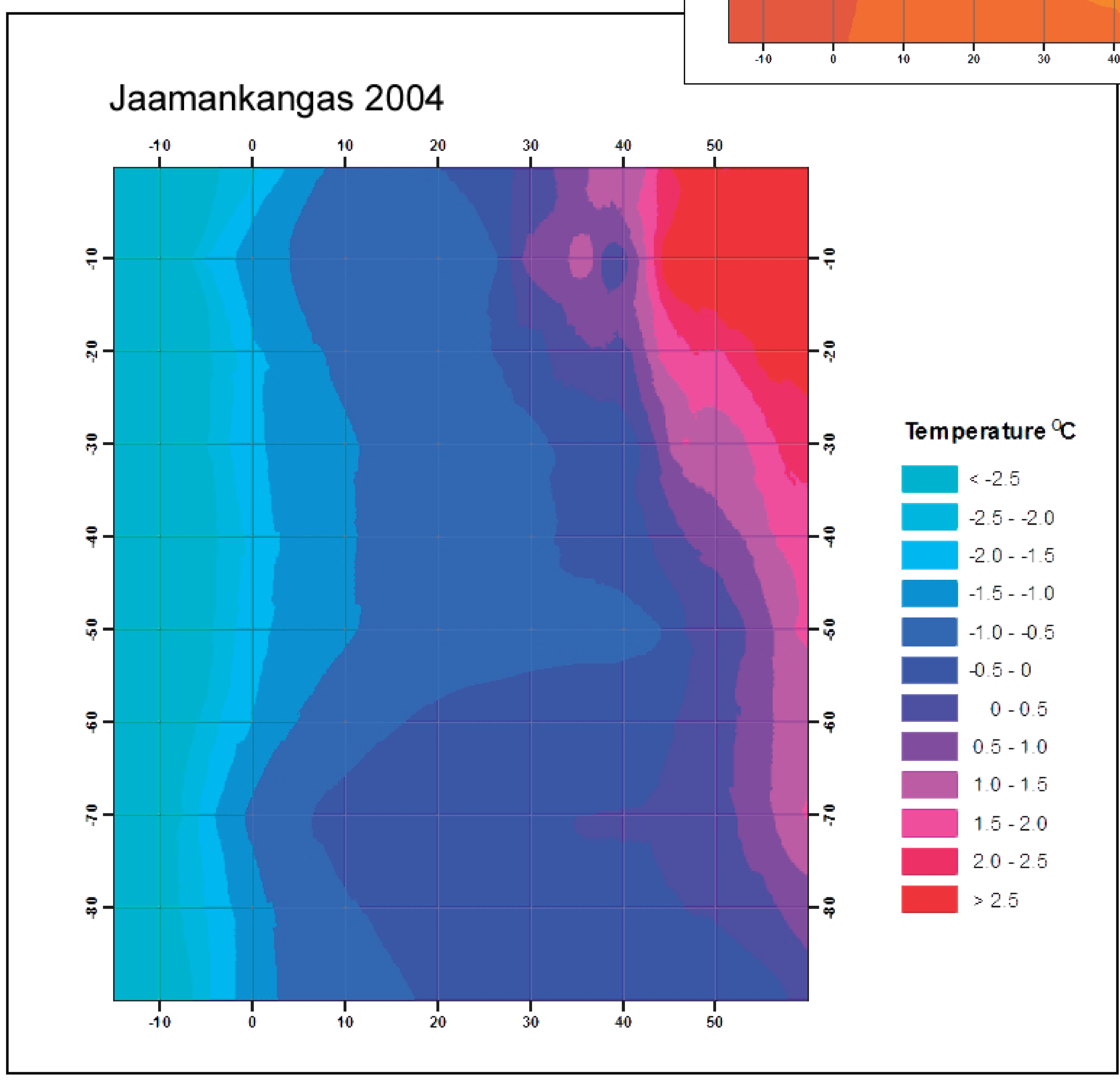
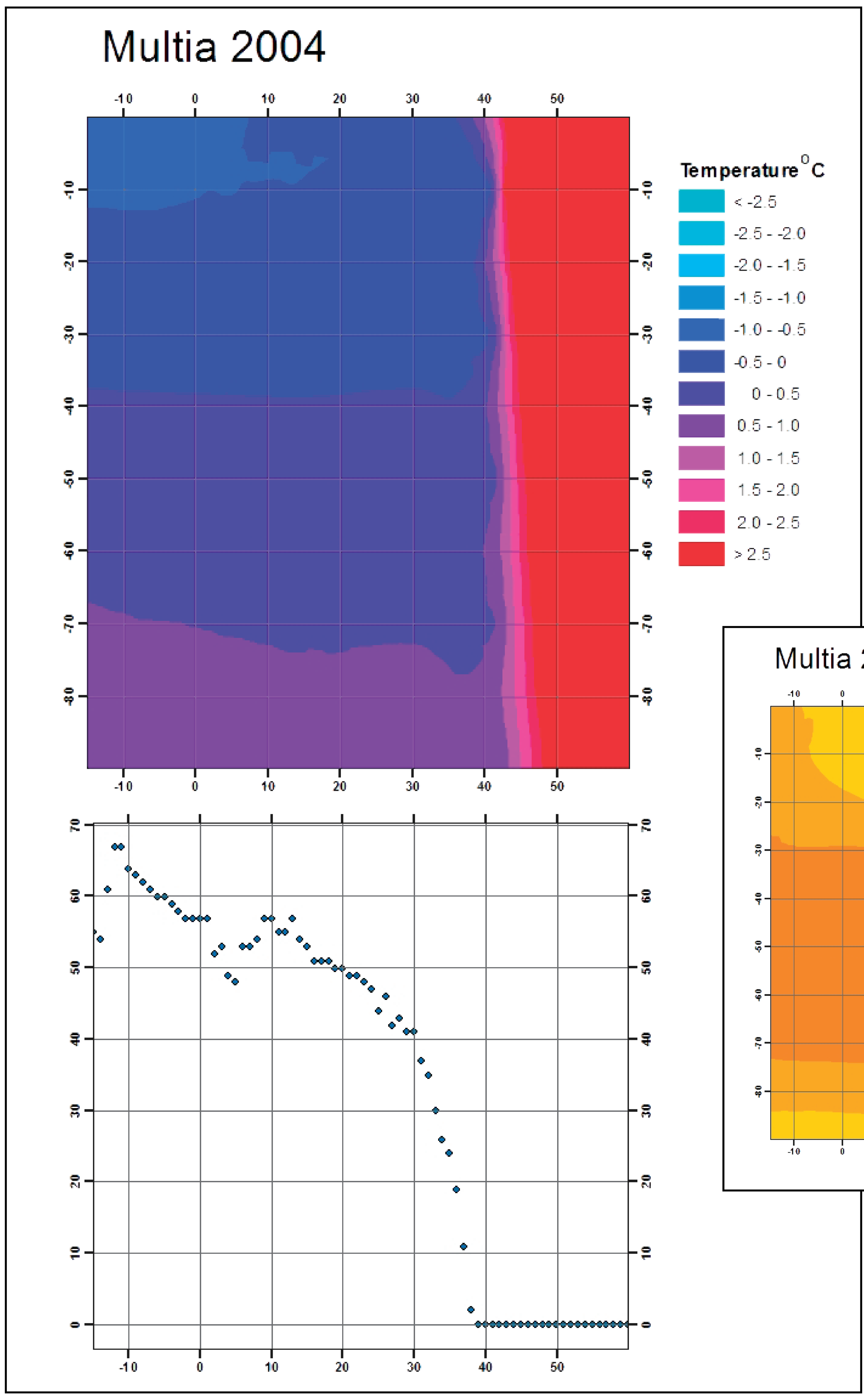
In cold climate of Fennoscandia soils experience ephemeral freezing and snow cover. Snowmelt impacts on run-off and solute transport, but also the presence of a snowpack governs the length of a growing season. Limited information, however, is available on the response of frozen soil to air temperature rise in spring in contrasting conditions, with and without snowpack. We studied time series of soil temperature and unfrozen soil water content during thawing of frozen soil in spring 2004 and 2006 at two sites differing in texture and hydraulic features in mid-boreal climate of Finland. We describe the changes in soil temperature and water content after constant rise of air temperature (T_{air}) above 0°C in spring (denoted as 0 in the x-axis of the graphs.

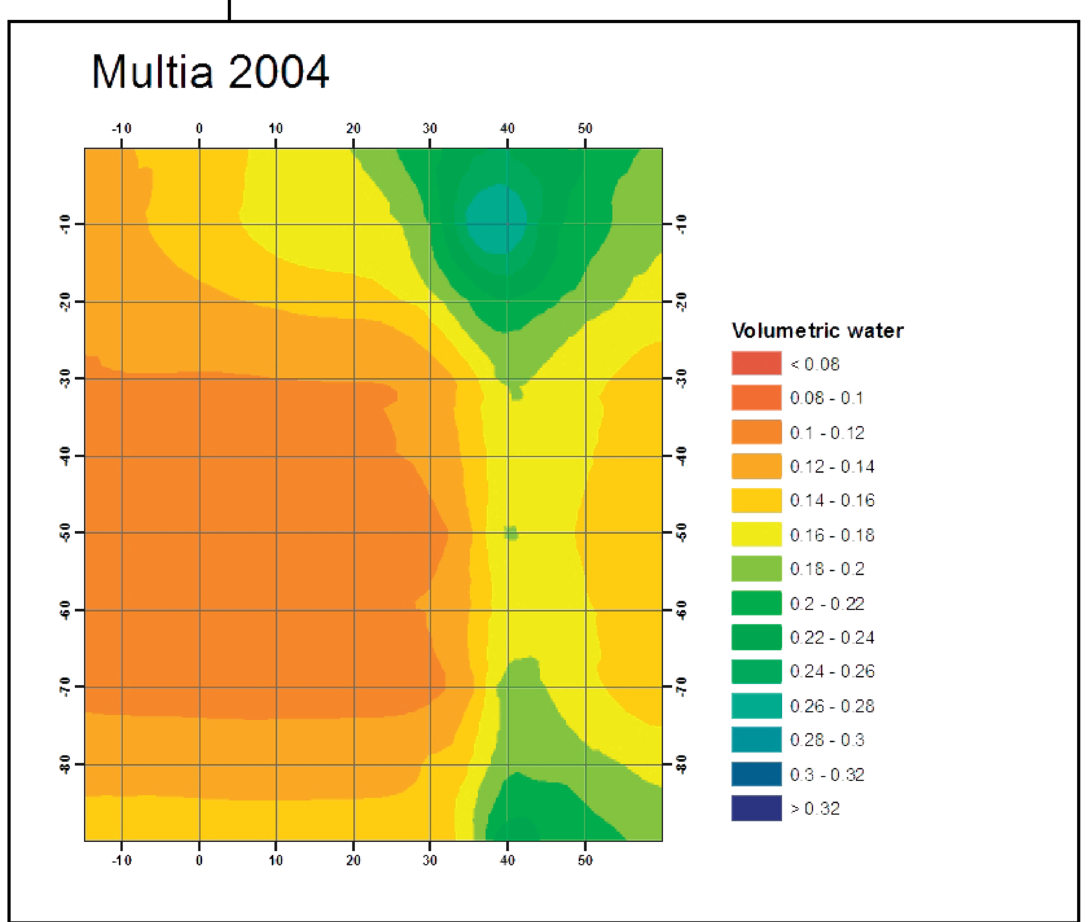


Jaamankangas site, located on ice-marginal end-moraine and is composed of sandy stratified materials and covered by forest dominated by Norway spruce (*Picea abies* L. Karst.), was kept clean of snow through winter. The mid-boreal Multia site, located on a drumlin, i.e. elongated moraine ridge and composed of coarse-textured till and carries forest stand dominated by Norway spruce, got natural snow cover. Soil water content recorded with CS615 TDR-probes and soil temperature with T107-sensors and automatically controlled and stored with CR10X data-loggers (Campbell Scientific, Logan UT). The instrumentation was made at soil depths of 10, 30, 50, 70, and 90 cm and the timing of daily measurements was set as follows; 03, 06, 09, 12, 15, 18 and 21 UTC, respectively.









We found that after constant rise of T_{air} above 0°C in spring, the soil was frozen for a month at all depths of the soil sequence at Jaamankangas site. Only T_{10} increased above 0°C after a month. After 20 days with constant rise of T_{air} above zero, the soil θ_v at 10-, 30- and 50-cm-depths showed an increase. At Multia site, the rise in T_{air} above 0°C resulted in unimpeded infiltration of meltwater released from snowpack into the frozen soil. Hence unfrozen soil water is available for roots concurrently with melting of snowpack. The lack of snow results in subzero soil temperature and lack of water for at least three weeks after the T_{air} has risen above 0°C.

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