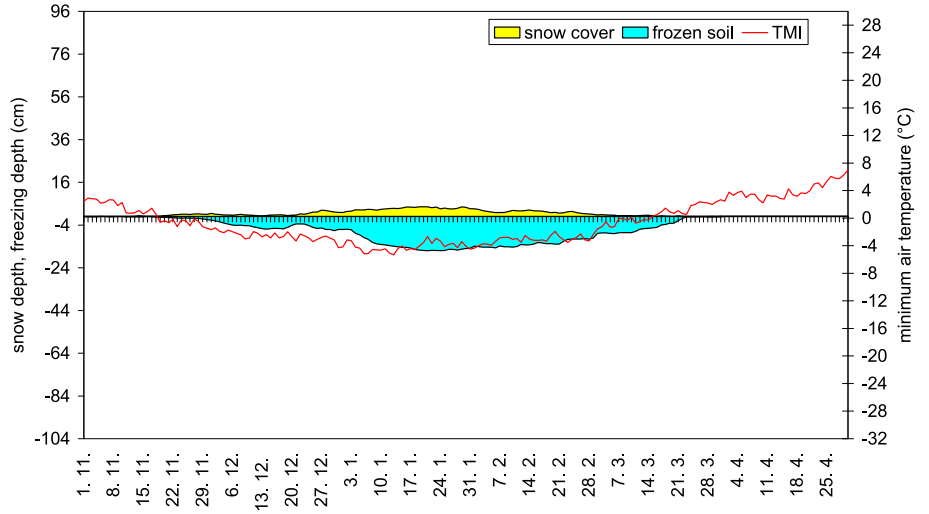


Fig. 7. Depth of soil freezing, depth of snow cover and course of air ground temperature minimum, average values for the period of 1971–2000.

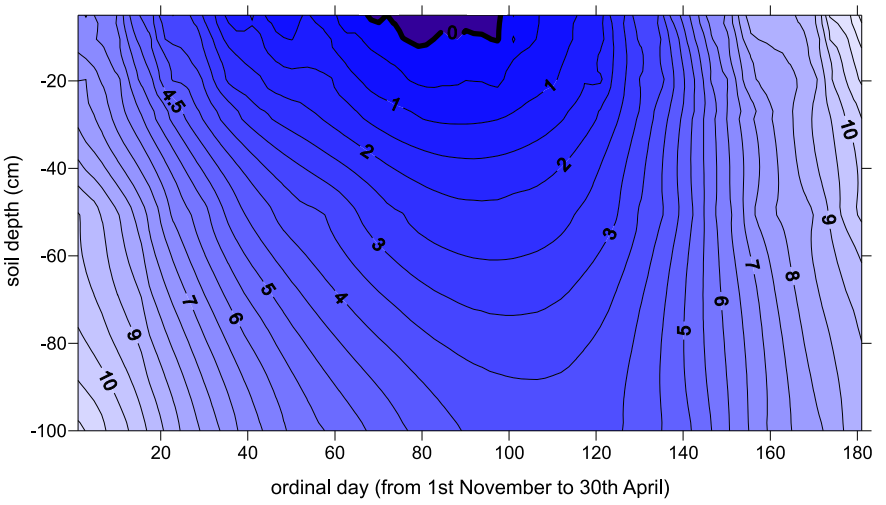


Fig. 8. Interpolation of soil temperature measurement, average values for the period of 1971–2000.

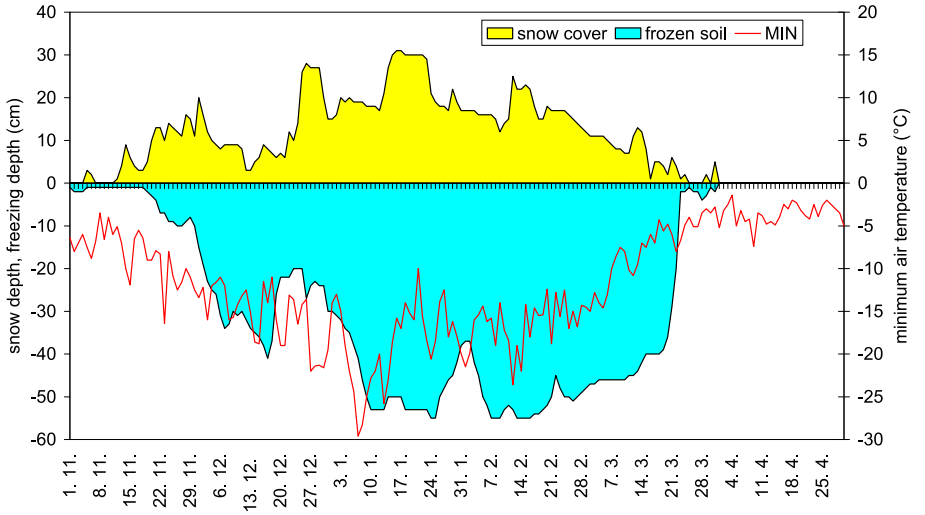


Fig. 9. Maximum depth of soil freezing, maximum depth of snow cover and course of minimum value of air ground temperature minimum for the period of 1971–2000.

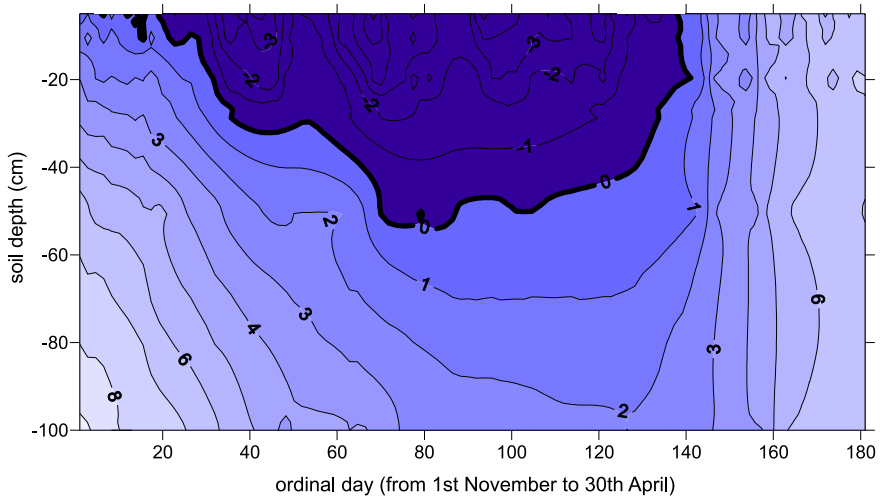


Fig. 10. Course of absolute minimum soil temperature for the period of 1971 to 2000.

Comparison of mean values obtained by both methods showed the most significant differences in freezing period lasting. Freezing period estimated by frost tube started on November 22. The depth of freezing did not reach to 5 cm until December 12. Freezing at 5 cm assessed by the soil temperature interpolation started on January 7 (i.e. 24 day latter). The maximum freezing depths determined by both methods correspond to each other quite well (16 cm by frost tube and 14 cm by soil temperature interpolation).

Figures 9 and 10 present the results of absolute maximum soil freezing depth for the entire evaluated period 1971–2000.

The absolute maxima of soil freezing obtained by both methods correspond to each other very well. Freezing period at 5 cm lasted from November 20 till March 24 in both cases. Also maximum depths of freezing determined by both methods are almost the same (i.e. 54 or 52 cm, respectively). The course of freezing determined by both methods is similar.

## 4. Conclusion

The depth of soil freezing is assessed directly by soil frost tube and indirectly from diagrams of soil temperature course according to 0 °C isotherm. The isotherm was graphically expressed by SURFER software. This program provides only graphical outputs and data set of interpolated isotherms cannot be subsequently obtained. Thus the regression analyses between data series of 0 °C isotherm and soil freezing depth cannot be included into the evaluation.

For comparison of the above mentioned two methods a data of Czech Hydrometeorological Institute agroclimatological station Pohořelice for the period of 1971–2000 were used. The soil type at Pohořelice station is fluvisol stratified (FLi) at floodplain deposits. Three real cold periods (1978–1979, 1984–1985 and 1990–1991) with different course of soil freezing and snow cover depth were chosen for the evaluation. Mean depth of freezing and absolute maximal depth of freezing were also evaluated.

The beginning and the end of freezing period assessed by both methods correspond to each other very well (with maximum several days accuracy). Both methods indicate more freezing periods caused by soil melting and freezing changing during the winter.

The soil freezing depth determined according to the soil temperatures is often lower than that determined by the frost tube. This difference might be caused by the graphic processing, as soil temperatures are measured only at given depths (5, 10, 20, 50 a 100 cm) and depth of zero isotherm is determined just by interpolation of these depths. Absolute daily maximum of freezing for long term period (non freezing depth determination) showed a punctual accordance of both methods.

Soil temperature interpolation method is not suitable when soil freezes just in shallow depths. The first depth of standard soil temperature measurement is 5 cm. Graphical output of the interpolation does not provide extrapolated values to the surface (i.e. 0 cm depth). Also a partial melting in shallow surface layer cannot by expressed by this method.

Frost tube measurement requires manual data collection in daily step while soil temperatures can be measured automatically. Soil temperature interpolation method allows soil freezing estimation without difficulty and time consuming manual measurement.

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