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THERMAS: the free software to estimate soil thermal properties at any water content from available data on texture, organic carbon content, and bulk density

Tatiana Arkhangelskaya, Alex Topaj, Elena Zakharova

Email: arhangelskaia@gmail.com

Affiliation: Lomonosov Moscow State University

Abstract

THERMAS is Windows-based software that consists of dynamic link library combined with the desktop application. The provided DLL can also be integrated with any external software as a built-in module. THERMAS estimates soil thermal properties, i.e. thermal diffusivity, volumetric thermal capacity, and thermal conductivity at any non zero water content.

THERMAS is based on the newly developed hierarchical pedotransfer functions to estimate the parameters of the water content–thermal diffusivity curve from available soil data: (i) from the textural class name; (ii) from sand, silt, and clay percentages; (iii) from sand, silt, and clay percentages and bulk density; (iv) from sand, silt, clay, and organic carbon percentages (Arkhangelskaya, Lukyashchenko, 2018). PTFs were developed from the data set of 77 undisturbed samples of mineral soils from the European part of Russia. The ranges of sand, silt, and clay within the data set were 1–97, 2–80, and 1–52%; wet bulk density varied from 0.86 to 1.82 g cm⁻³, organic carbon content ranged from 0.1 to 6.5%.

Volumetric thermal capacity is estimated using de Vries model (1963). If data on bulk density or organic carbon content are not available, they are roughly estimated by procedures described in Rawls (1983), Benites et al. (2007), and Ruehlmann & Körschens (2009). Thermal conductivity is obtained by multiplying thermal diffusivity and volumetric thermal capacity.

When using the desktop Windows application, the results of calculations are visualised in the working window and are also logged into a spreadsheet.