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RESEARCH ARTICLE

Observations and modelling of ground temperature evolution in the discontinuous permafrost zone in Nadym, north-west Siberia

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Abstract

We analyze ground temperatures measured daily at depths of 0–10 m in the Nadym region, north-west Siberia (65°18'N, 72°6'E). Nadym is located within the discontinuous permafrost zone and the forest-tundra transition subzone, thus representing an area threatened by permafrost thawing. Soil comprises a 0.4–1.0-m-thick topmost layer of peat with high porosity (~0.9), underlain by layers of mineral soil (sand, clay, loam) with lower porosities of 0.3–0.4. With a numerical heat transfer model, we provide predictions of general permafrost development for the next 300 years. Furthermore, we apply the model with the same time frame, to predict permafrost evolution in two monitoring boreholes (BH) in the Nadym area, BH 1-09 and 3-09 with present (2012–2016) temperatures at the top of the permafrost (TTOP) of –2.0 and 0.0 °C, respectively. Applying a mild warming trend (0.02 °C/yr in mean annual air temperature [MAAT], corresponding to the IPCC representative concentration pathway trend RCP 2.6) does not lead to thawing of permafrost during the applied 300 years of simulation time in BH 1-09, whereas in BH 3-09 thawing has already begun. Applying a strong warming trend of 0.05 °C/yr in MAAT (corresponding to RCP 8.5) leads to gradual thawing of permafrost in both boreholes.