CONTROL ID: 1498502

TITLE: Possible Future Changes in Permafrost and Active Layer Thickness in Northern Eurasia and their Relation to Permafrost Carbon Pool

ABSTRACT BODY: Recent observations indicate a warming of permafrost in many northern regions with the resulting degradation of ice-rich and carbon-rich permafrost. Permafrost temperature has increased by 1 to 3 deg C in northern Eurasia during the last 30 years. To assess possible changes in the permafrost thermal state and the active layer thickness we implemented the GIPL2 (Geophysical Institute Permafrost Lab) transient model for the entire Northern Eurasia for the 1981-2100 time period. Input parameters to the model are spatial datasets of mean monthly air temperature, snow properties or SWE, prescribed vegetation and thermal properties of the multilayered soil column, and water content. The climate scenario was derived from an ensemble of five IPCC Global Circulation Models (GCM) ECHAM5, GFDL21, CCSM, HADcm and CCCMA. The outputs from these five models have been scaled down to 25 km spatial resolution with monthly temporal resolution, based on the composite (mean) output of the five models, using the IPCC SRES A1B CO2 emission scenario through the end of current century. Historic ground temperature measurements in shallow boreholes (3.2 m in depth) from more than 120 weather stations located within the continuous, discontinuous, and sporadic permafrost zones were available for the initial model validation and calibration. To prescribe the thermal properties we used the map of soil characteristics for whole of Russia (Stolbovoi & Savin, 2002) and the map of Soil Carbon Pools, CO2 and CH4 emissions (Tarnocai et al., 2009) and also the soil structure descriptions available for some locations. We estimated dynamics of the seasonally thawed volume of soils within the two upper meters for the entire North Eurasia. The model results indicate 1,200 km3 of seasonally unfrozen soils within the two upper meters within 10,800,000 km2 of northern Eurasian permafrost domain during the last two decades of the 20th century. Our projections have shown that unfrozen volume of soil within two upper meters increases to 3,500 km3 by 2050 and to 9,500 km3 by the last decade of the 21st century due to active layer deepening. According to this specific climate scenario, the area of permafrost with active layer shallower than 2 m in depth could decrease from 10,800,000 km2 in 2000 to 9,000,000 km2 by 2050 and to 6,000,000 km2 by the end of current century.

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