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**CONTROL ID:** 1805204

**TITLE:** Modeling of Permafrost Dynamics in Northern Eurasia: Implications to Permafrost Carbon Pool

**ABSTRACT BODY:** A recent estimate indicates that the total soil organic carbon is stocked in permafrost contains as much as 50 percent of the global belowground organic carbon pool (Tarnocai et al., 2009). Carbon stocked in permafrost is now regarded as one of the most important carbon-climate feedbacks because of the size of the carbon pool and the intensity of climate change at high latitudes (Schuur et al., 2009). Increasing soil temperatures, and the deepening of the active layer as a result of increasing air temperatures and changing snow dynamics will have implications for the cycling of carbon in peatlands and for the fluxes of carbon and methane to the atmosphere and to the hydrosphere, as biogeochemical processes in peatlands are partly controlled by the freeze/thaw state of the (peat) soil. To investigate how changes in these factors influence permafrost dynamics in the Arctic, we developed a Geophysical Institute Permafrost Lab (GIPL) permafrost dynamics model. This model simulates soil temperature dynamics and depth of seasonal freezing and thawing by solving a non-linear heat equation with phase change numerically.

We assess the changes in permafrost characteristics in Northern regions of Eurasia using a large scale, grid-based permafrost model that simulates the distribution of soil temperature and active layer dynamics, permafrost thawing and freezing, using a five-model composite projection derived from IPCC climate models outputs of future climate for the next century. The model takes into account the geographic distribution of organic soils and peatlands, vegetation cover and soil properties, and is tested against a number of permafrost temperature records for the last century. Despite the slower rate of soil warming in peatland areas and a slower degradation of permafrost under peat soils, a considerable volume of peat (approximately 20% of the total volume of peat in Northern Eurasia) could be thawed by the end of the current century. The potential release of carbon and the net effect of this thawing will depend on the balance between increased productivity and respiration, and will be mitigated by peat moisture.

Consistent with observations for the recent decades and with other model simulations of soil temperatures under future climate conditions, we find a widespread degradation of permafrost in Northern regions by the end of the century. The model results indicate 1,200 cubic km of seasonally unfrozen soils within the two upper meters across 10,800,000 quadratic km 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 cubic km by 2050 and to 9,500 cubic km 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 quadratic km in 2000 to 9,000,000 quadratic km by 2050 and to 6,000,000 quadratic km by the end of current century.

http://permafrost.gi.alaska.edu/users/sergei

**CURRENT SECTION/FOCUS GROUP:** Global Environmental Change (GC)

**CURRENT SESSION:** GC049. Environmental, Socio-Economic and Climatic Changes in Northern Eurasia and their Feedbacks to the Global Earth System

**INDEX TERMS:** 0702 CRYOSPHERE Permafrost, 0706 CRYOSPHERE Active layer, 0429 BIOGEOSCIENCES Climate dynamics, 0428 BIOGEOSCIENCES Carbon cycling.

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