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Vulnerability of permafrost carbon research coordination network

C. Schädel (1), E. A. G. Schuur (1), A. D. McGuire (2), J. G. Canadell (3), J. Harden (4), P. Kuhry (5), V. E. Romanovsky (6), and M. R. Turetsky (7)

(1) Department of Biology, University of Florida, Gainesville, FL, USA, (2) University of Alaska, Fairbanks, AK, USA, (3) CSIRO, Canberra, ACT, Australia, (4) USGS, Menlo Park, CA, USA, (5) Stockholm University, Stockholm, Sweden, (6) University of Alaska, Fairbanks, AK, USA, (7) University of Guelph, Guelph, ON, Canada

Approximately 1700 Pg of soil carbon are stored in the northern circumpolar permafrost zone, more than twice as much carbon than currently contained in the atmosphere. Permafrost thaw, and the microbial decomposition of previously frozen organic carbon, is considered one of the most likely positive feedbacks from terrestrial ecosystems to the atmosphere in a warmer world. Yet, the rate and form of release is highly uncertain but crucial for predicting the strength and timing of this carbon cycle feedback this century and beyond. Here we report on the first products of a new research coordination network (RCN) whose objective is to link biological C cycle research with well-developed networks in the physical sciences focused on the thermal state of permafrost. We found that published literature in the Science Citation Index identified with the search terms 'permafrost' and 'carbon' have increased dramatically in the last decade. Of total publications including those keywords, 86% were published since 2000, 65% since 2005, and 36% since 2008. The first RCN activity consisted of an expert elicitation that revealed the total effect of carbon release from permafrost zone soils in climate is expected to be up to 30-46 Pg C over the next three decades, reaching 242-324 Pg C by 2100 and potentially up to 551-710 Pg C over the next several centuries under the strongest warming scenario presented to the group. These values, expressed in billions of tons of C in CO_2 equivalents, combine the effect of C released both as CO_2 and as CH4 by accounting for the greater heat-trapping capacity of CH4. However, the higher global warming potential of CH4 means that almost half of the effect of future permafrost zone carbon emissions on climate forcing was expected by this group to be a result of CH4 emissions from wetlands, lakes, and other oxygen-limited environments where organic matter will be decomposing. These results demonstrate the vulnerability of organic C stored in near surface permafrost to increasing temperatures. Future activities of this network include synthesizing information in formats that can be assimilated by biospheric and climate models, and that will contribute to future assessments of the IPCC.