Geophysical Research Abstracts,
Vol. 11, EGU2009-13095, 2009
EGU General Assembly 2009

Fate of permafrost soil organic carbon under future climate in ORCHIDEE

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Arctic soils hold enormous quantities of organic carbon: both actively cycling carbon in surface layers, as well as buried frozen carbon in deeper deposits (e.g. Yedoma, loess, peat). The primary limit to decomposition of permafrost carbon is the cold temperature, thus it could act as a positive feedback to global warming. To explore questions about the magnitude, vulnerability, and timescale of this feedback, we have added a permafrost module to the ORCHIDEE terrestrial biosphere model. This calculates the vertical distribution of soil organic carbon, as well as the concentrations and surface fluxes of carbon dioxide, methane and oxygen. Soil decomposition rates are controlled by temperature and oxygen availability, and soil temperature is affected by organic matter, both through latent heat release during decomposition and modification of soil thermal diffusive properties; thus there are multiple local feedbacks between soil organic matter and soil temperature. We present control simulations and future scenarios of the fate of soil organic matter and the emissions of CO2 and CH4 in permafrost regions under global warming.