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How strong are the biogeochemical feedbacks between permafrost and the climate system?

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Organic carbon stored in permafrost in the boreal and arctic zone constitutes a large (up to 900 PgC) carbon reservoir, of which a significant fraction may be vulnerable under climate change. Degradation of permafrost can liberate this carbon either as carbon dioxide or as methane depending on the local hydrological conditions, thus constituting a potentially important positive biogeochemical feedback. How strong is this feedback in the global coupled carbon-methane-climate system? Based on on a review of recent observations and modeling studies, I try to estimate quantitative bounds. Obviously the feedback magnitude is time scale dependent. The largest uncertainty, however, arises from changes in hydrological conditions, which are not only dependent on climate change, but also on the large spatial heterogeneity of permafrost surfaces. In this context I furthermore address the observational strategy for an improved quantification of these feedbacks.