Abrupt thaw methane accelerates permafrost carbon feedback

Walter Anthony, K. et al. (2018), *Nature Communications*, doi:10.1038/s41467-018-05738-9

Background: The impact of deep, abrupt thaw (e.g. thermokarst lakes) on the permafrost carbon feedback (PCF) is not yet incorporated in state-of-the-art land models, which so far focus on gradual thaw of near-surface permafrost.

Analysis: Gradual thaw (CLM) and abrupt thaw (AThaw) model data were combined with field observations, ^{14}C dating, and recent historical satellite and airborne remote sensing quantification of thaw.

Findings:

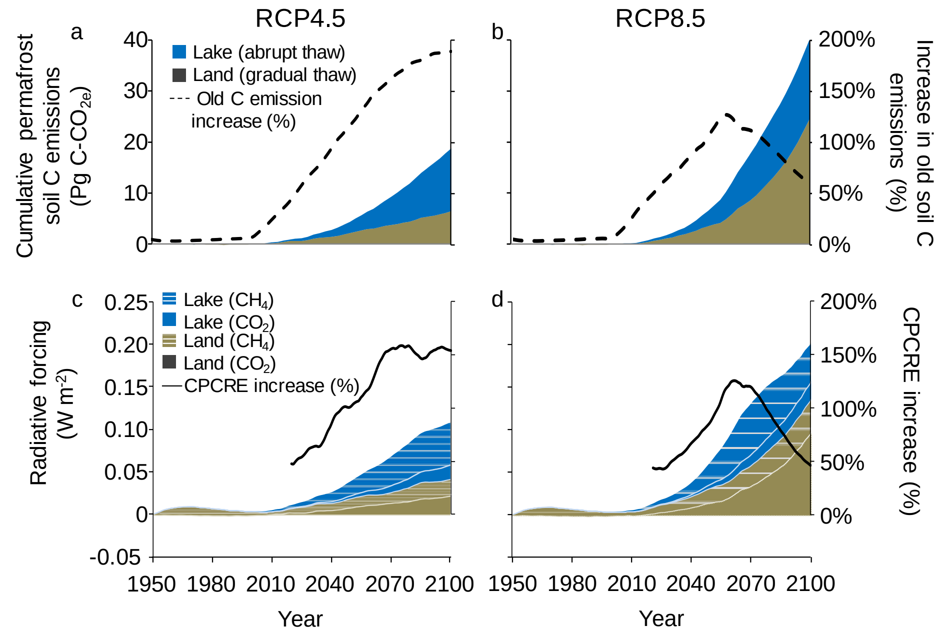
(1) Abrupt-thaw methane (CH_4) emissions more than double 21st century radiative forcing from circumpolar permafrost-soil carbon fluxes.

(2) Abrupt-thaw contribution to the PCF is larger under RCP4.5 than RCP8.5, implying a stronger headwind towards climate mitigation efforts.

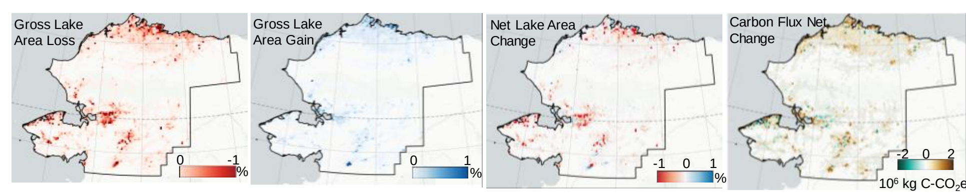
(3) Permafrost soil carbon emissions to the atmosphere in NW Alaska remained positive during 1999-2014 despite net lake area loss because exceedingly high CH_4 emissions associated with a small area of thermokarst lake formation (gross lake area gain) outweighed the small flux changes associated with more widespread lake drainage.

Significance:

These findings demonstrate the need to incorporate abrupt-thaw processes in earth system models for more comprehensive projection of the PCF this century.



Circumpolar permafrost carbon emissions and radiative effect (CPCRE) from gradual thaw (land) versus abrupt thaw (lakes) from 1950 to 2100.



Lake area change and carbon flux implications in the permafrost region of NW Alaska for 1999-2014 determined with Landsat satellite trend analysis.

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