Climate Change

TIPPING POINTS:
ARE WE PUSHING THE EARTH TO A POINT OF NO RETURN?

UNIVERSITÄT GREIFSWALD
Wissen lockt. Seit 1456

Permafrost Thaw Accelerates Global Warming

What is Permafrost?

- soil, rock or sediment staying frozen for at least two consecutive years.
- occupies 25% of land in the Northern hemisphere (Fig. 1).
- the active (top) layer (up to 4 m) freezes and thaws with the seasons.
- permafrost can go deeper than 1.500 m.

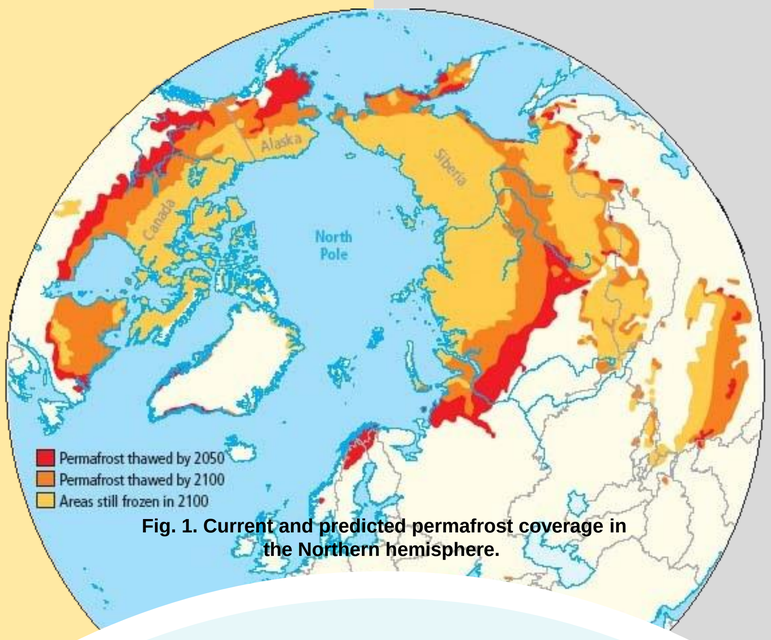

Fig. 1. Current and predicted permafrost coverage in the Northern hemisphere.

Permafrost is Thawing.

- from the late 1970s the average annual temperature in the Arctic has increased by 2°C.
- causes are not local and globally located.
- temperature rise causes the thawing of permafrost (active permafrost degradation).
  - predicted permafrost reduction by 2050 is 15-30% (Fig. 1).
    - a climate tipping point (Fig. 2).

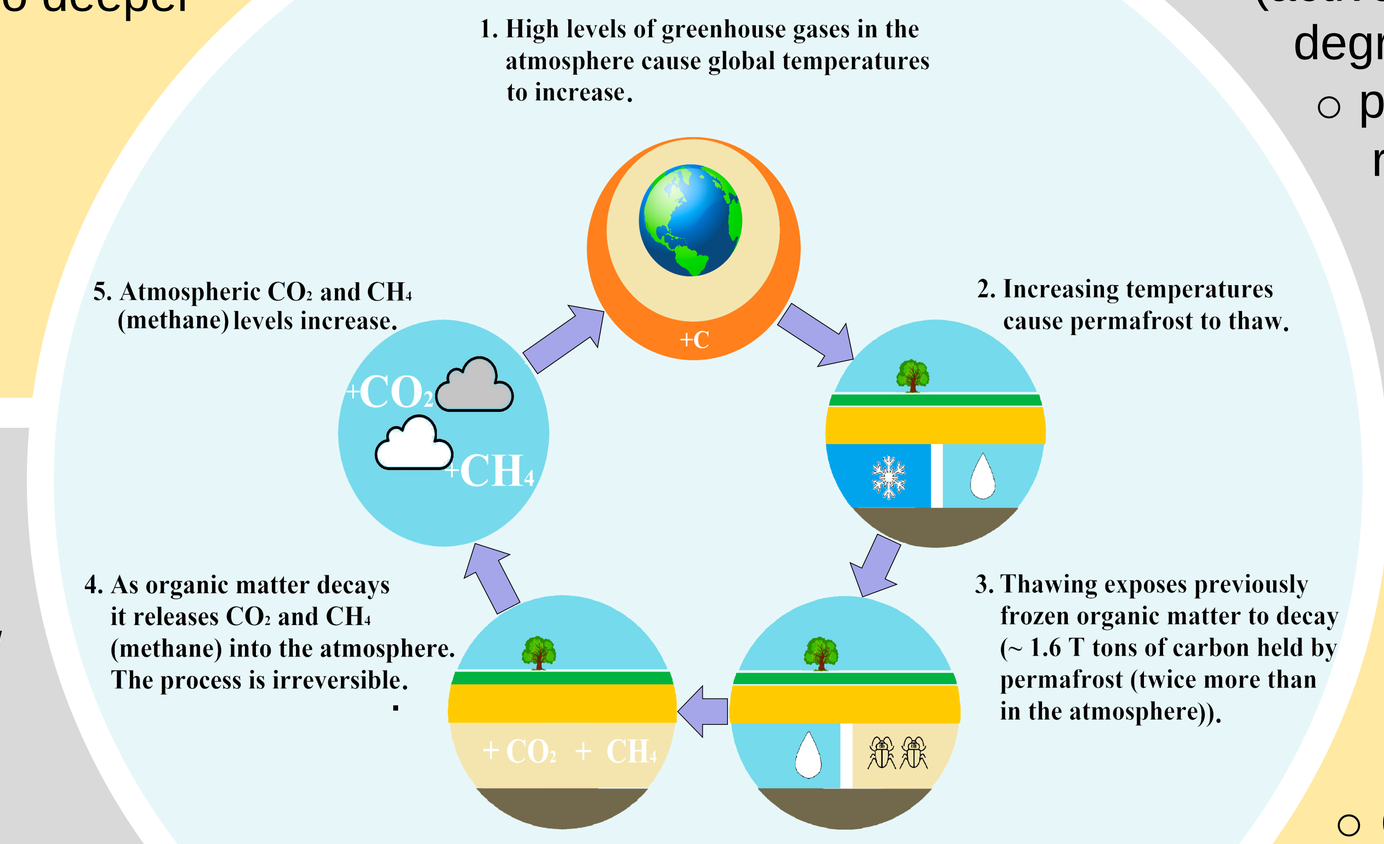

Fig. 2. Reinforcing feedback loop of permafrost and climate change.

Permafrost Thaw Changes the Landscape.

- landscape changes and soil erosion (landslide, treefall, etc.).
- destruction of infrastructure (buildings, pipelines, etc.).
- danger of anthrax outbreaks.
- threat to the Svalbard Global Seed Vault.

Fig. 3. Targeting 1.5 °C.

What Can Be Done?

- globally: Stabilizing the climate at 1.5 °C of warming (Fig. 3).
  - more research to de done.
    - forecasts where and when thawing is likely to happen.
  - international cooperation and regulation.
- strategies to adapt.

Ksenia Cherepanova
M.Sc. LENC
s-kscher@uni-greifswald.de

Aibat Muzbay
M.Sc. LENC
s-aimuzb@uni-greifswald.de

References:

Anisimov, O. (2007). Potential feedback of thawing permafrost to the global climate system through methane emission. Environmental Research Letters, 2(4), 045016.
Biskaborn, B.K. et al. (2019). Permafrost is warming at a global scale. Nature Communications, 10(1).
Fox-Kemper, B. et al. (2021). Ocean, Cryosphere and Sea Level Change. In Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V. et al. (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1211–1362.
Morozov, Y. (2012). Arctic 2030: What are the consequences of climate change? Bulletin of the Atomic Scientists, 68(4), 22–27.
Romanovsky, V. et al. (2002). Permafrost temperature records: Indicators of climate change. Eos, Transactions American Geophysical Union, 83(50), 589.
Turetsky, M.R. et al. (2019). Permafrost collapse is accelerating carbon release. Nature, 569(7754), 32–34.
Vonk, J.E. et al. (2013). High biolability of ancient permafrost carbon upon thaw. Geophysical Research Letters, 40(11), 2689–2693.

Picture sources:

Fig. 1. https://ccin.ca/home/sites/default/files/permafro-st/future/futuremap.jpg;
Fig. 2. Modified from: https://www.ed.ac.uk/sustainability/what-we-do/climate-change/case-studies/climate-research/can-plants-prevent-permafrost-thaw;
Fig. 3. https://media.springernature.com/w580h326/nature-cms/uploads/collections/nature-2017-Targeting-1.5-871a4a372c5c2bff1e6789948b8346fb_right-c9e3921fcd47033bb2064d1655b64ee2.jpg.