PERMAFROST THAWING: THE TICKING CARBON TIME-BOMB

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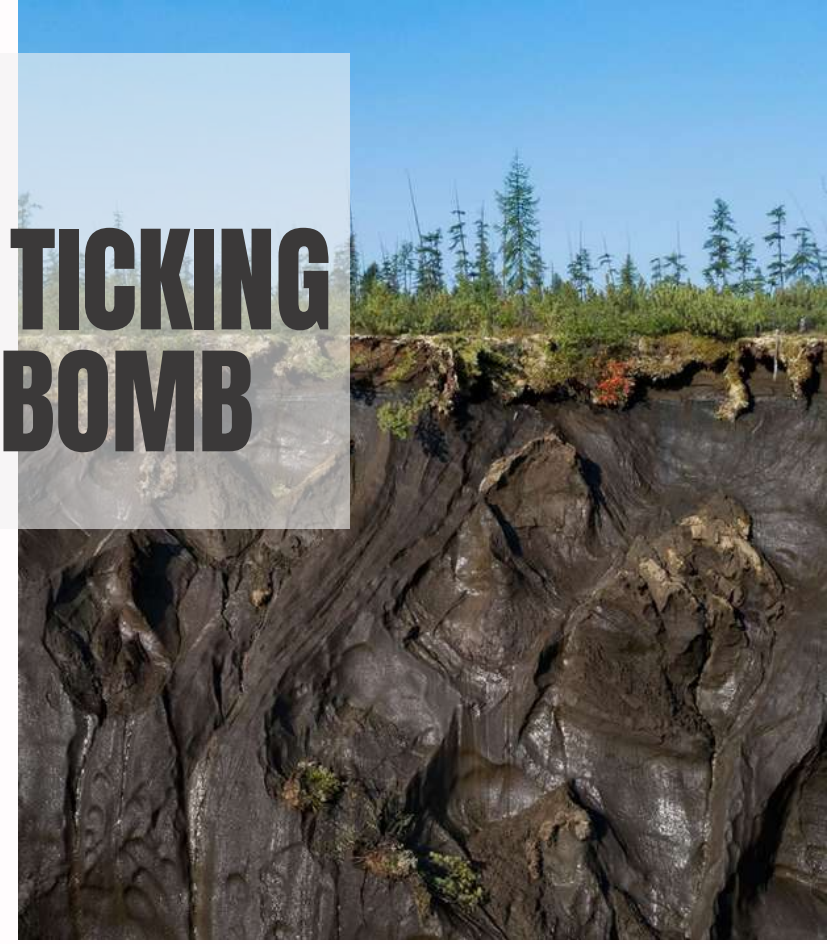


What is permafrost?

Permafrost frost literally translates to permanent frost (ice). It is any sort of ground that has been continually frozen for at least two years and up to hundreds of thousands of years. It can go from a few feet to more than a mile deep beneath the earth's surface.

A fourth of the land in the Northern Hemisphere is covered by permafrost, which can cover huge areas like the Arctic tundra or just one, solitary location like an alpine peak.

Where is Permafrost Located?

Permafrost covers about a quarter of the whole northern hemisphere, an estimated 9 million square miles—nearly the size of USA, China, and Canada combined. Permafrost is also located in Russia's Siberia, Canada, Greenland, and Alaska's Arctic regions. In addition, it can be found in subsea permafrost on the bottom of the Arctic Ocean, on the Tibetan plateau, and in high-altitude regions like the Rocky Mountains. Permafrost can be found below Antarctica and in mountainous areas such as the South American Andes and New Zealand's Southern Alps in the Southern Hemisphere.

How is Permafrost formed?

When ground temperatures fall below 32°F (0°C), water that has been trapped in silt, soil, and the pores, fissures, and fractures of rocks freezes. Permafrost is the term used to describe the state of the ground after at least two years of continuous freezing.

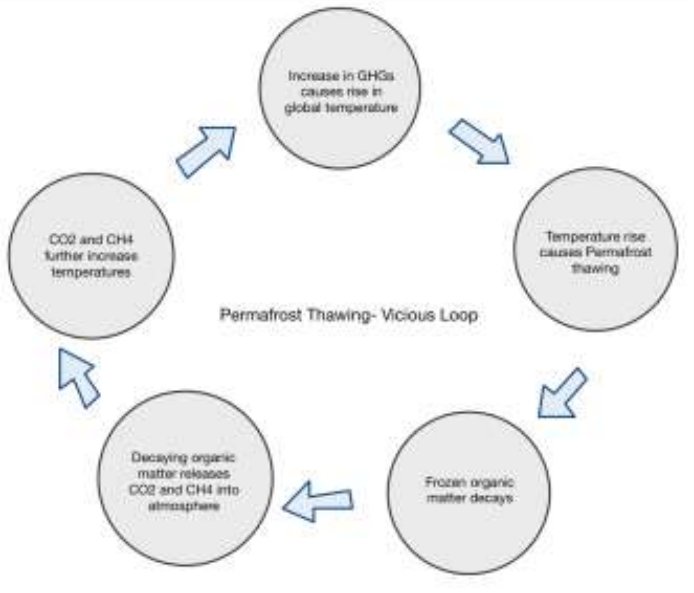
Environmental Impacts of Permafrost Thawing: From Sink to Source:

Carbon dioxide, methane, and other greenhouse gases that contribute to global warming are released into the atmosphere when plants and animals die. The process is effectively stopped by a deep freeze which preserves the remains of the creatures and the gases they would release. The microbial decomposition of those organic components and the emission of greenhouse gases recommences when frozen soil thaws. Permafrost is one of the planet's major reservoirs of greenhouse gases and is packed with fossilised life, from human to woolly mammoth remains. However, these carbon stocks are at danger of release due to global warming. There are several estimates of how much carbon and methane will be released as a result of permafrost melting, and one such study found that between now and 2100, as much as 92 billion tonnes of carbon might be released.

Eventually, a vicious loop may be set off as thawing permafrost releases more of its enormous supply of greenhouse gases into the atmosphere,

warming the climate and melting even more permafrost that emits carbon and methane. This could eventually cause the Arctic to switch from being a carbon sink that absorbs emissions to a carbon source.

According to a recent study, the Arctic permafrost represents a vast reservoir of naturally occurring mercury, a toxic neurotoxin. In fact, it is estimated that permafrost soils contain almost 15 million gallons of mercury, or almost twice as much as is present in the ocean, atmosphere, and all other soils combined. However, once released, that mercury has the ability to enter ecosystems and even food supplies via water or air.

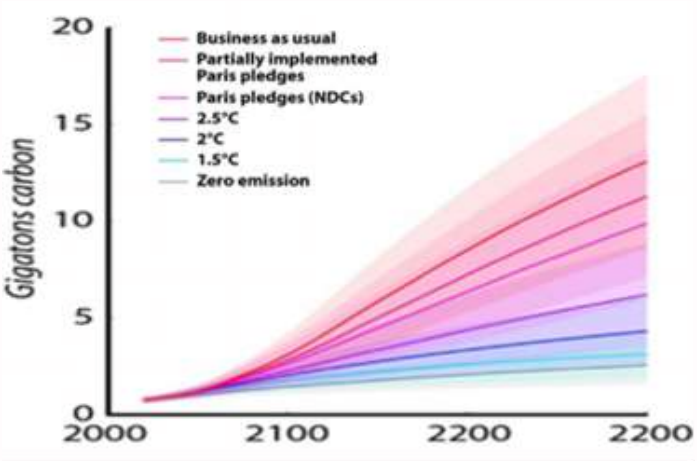


Global Warming!

Long-locked carbon deposits in the permafrost are leaking out. Around 1,700 billion tonnes of organic carbon, almost twice as much as the amount of carbon presently present in the atmosphere, are found in permafrost. Methane is around twenty-five times more potent as a greenhouse gas even though it remains in the atmosphere for only 12 years as opposed to centuries for CO2. Permafrost thawing is a carbon "time bomb".

While temperatures are rising worldwide due to global warming, the Arctic is warming at twice the rate as the rest of the world. Additionally, as below-ground temperatures rise along with surface air temperatures, permafrost begins to thaw.

According to scientists, the amount of frozen ground in the northern hemisphere has decreased from the early 1900s by 10%. According to a recent study, an additional 1.5 million square miles of permafrost may eventually melt away for every 1°C of warming. Even if we achieve the climate goals established during the 2015 Paris climate agreement , more than 2.5 million square kilometres of ice-covered land may still disappear from the planet.



Methane emissions from thawing permafrost. Source: Yumashev et al. (2019)

Damaging ecosystems!

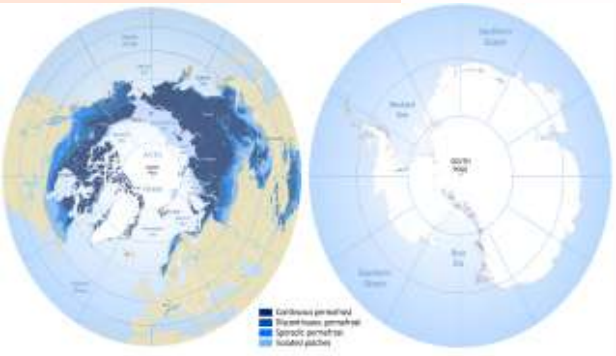
Permafrost thawing also affects natural ecosystems in a variety of ways. It can produce thermokarst, which are characterised by "drunken forests" of crooked trees and small ponds with sagging ground. It can increase soil's susceptibility to landslides and erosion once it has frozen solid, especially along coasts. As this softened soil erodes, it may add new silt to waterways, which may change how rivers and streams flow, deteriorate the quality of the water (including by adding carbon), and have an effect on aquatic life. As there is no frozen buffer to keep the water in place, wetland conditions worsen alongside permafrost. This may result in drier land that is more prone to wildfires, which further expose permafrost to warming. Sea level rise can potentially be a result of permafrost melting. In fact, if all of the permafrost on the planet thaws, it is predicted that sea levels might increase by as much as four inches, more than doubling the risk of flooding.

Dilapidating infrastructure!

The permafrost zone is home to 35 million people who reside in towns and cities that were constructed on top of what was once thought to be permanently frozen ground. The infrastructure these communities rely on, however, becomes more unstable as that firm ground sags. Cities in northern Russia are in disrepair. Roads in Alaska are evolving like roller coasters. Ground swells as a result of subsurface water freezing into ice and expanding. In Canada, it is projected that thawing permafrost costs the Northwestern Territories' public infrastructure tens of millions of dollars annually in damage.

Risk of diseases!

Permafrost has the ability to retain and preserve ancient microbes, much as it does with carbon and other greenhouse gases. It is thought that some bacteria and viruses can remain dormant in the cold, dark confines of permafrost for thousands of years before awakening when the ground warms. Even while the idea of "zombie" pathogens seems terrifying, there are still uncertainties regarding the level of risk that these ancient microorganisms offer. The potential danger was illustrated by a 2016 anthrax epidemic in Siberia, which was connected to a decades-old reindeer carcass revealed by thawing permafrost and contaminated with the bacterium. Human interaction with thawed and redundant zombie microbes will rise as the Arctic is developed and millions of tonnes of permafrost are cleared to mine for precious metals and petroleum.



Permafrost Distribution. Source: Brown et al. (1997)

How do we stop Permafrost from thawing?

The tundra and the permafrost underlying it might seem a million miles faraway to the majority of us. However, regardless of where we reside, the choices we make on every single day ultimately contribute to climate change and have a significant impact on the world's climate. We can help protect the permafrost on the earth and stop the vicious loop of global warming by lowering our carbon footprint, purchasing energy-efficient products, and supporting climate-friendly organisations, laws, and policies. The primary issue with permafrost is that it will continue to melt and release carbon even if human emissions are reduced. Permafrost won't thaw all at once, and the carbon will not be released in one go as a huge puff. Instead, it will slowly leak out over decades or perhaps centuries. According to the IPCC study, the thawing permafrost would have an impact on more than 1,200 communities, 36,000 buildings, and four million people, worldwide. This puts the hard-won Paris climate objectives to keep the increase in global temperatures at well below 1.5C—compared to preindustrial levels under jeopardy from the planet-warming gases leaking from permafrost.