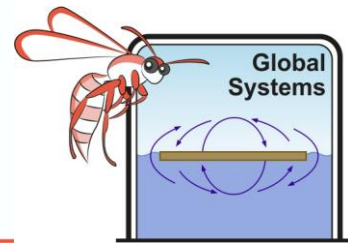


Permafrost - Teacher Background



Permafrost is frozen rock, soil and organic materials. It occurs at high altitudes and high latitudes and acts as a long-term carbon sink. Permafrost can vary in thickness from 1 meter to 1,500 meters. It occupies 25% of the land in the Northern Hemisphere occurring in a belt of land stretching from Siberia to China and in North America. In the Southern Hemisphere it is found in Antarctica, the Antarctic mountains and in the Andes Mountains. Ground must remain frozen for two consecutive years to be classified as true permafrost. Presently most of the permafrost has remained continuously frozen since the last Ice Age. More shallow permafrost was added during cold periods about 6,000 years ago and about 400 years ago.

Permafrost can be used as a proxy thermometer as it melts and freezes in response to changes in air temperature. Canadian studies have suggested that there is a distinct time lag between atmospheric warming and melting due to the great depth of permafrost.

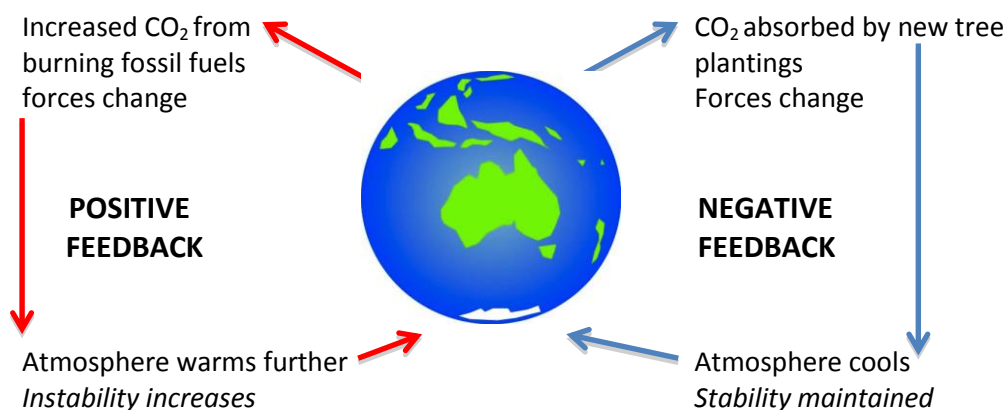


Current changes to permafrost and climate change

There are two major problems that will occur if global warming forces permafrost melting:

1. Increased volumes of stored methane and carbon dioxide will be released into the atmosphere. These are greenhouse gasses (or aerosols) and will cause increased melting.
2. Movement of the soil causing disruption of infrastructure such as pipelines, roads and buildings and of increased erosion and changes in water table and geomorphology.

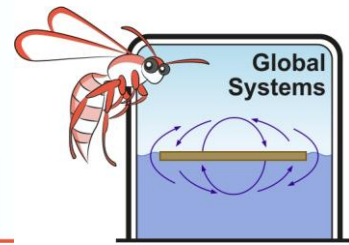
Feedback loops and climate change



Climate is the result of many systems working together. To be stable, systems need to be self-regulating. Feedback loops permit systems to modify their response to change (forcing factors) to return to stable conditions.

Positive feedback amplifies the effect of the forcing factor. E.g. If a child cries from fear shouting at them will only increase the fear and crying. Increased temperatures will melt permafrost and release methane and carbon dioxide. These are greenhouse gasses and will cause further heating of the atmosphere. The system becomes increasingly unstable.

Permafrost - Teacher Background



Negative feedback reduces the effect of the forcing factor helping the system to return to normal. E.g. If a child cries from hunger, giving them food means they will no longer be hungry and will no longer cry. If the atmosphere is becoming warmer due to increased carbon dioxide, planting trees will absorb some of the forcing carbon dioxide, will reduce temperature rise and will work towards returning the system to stability.

Interesting fact: Methane clathrates in the ocean

Methane clathrates are also held under great pressure in ocean deeps. Warming will decrease water pressure and release these reserves. Geologists have suggested that one of the factors causing major extinctions such as the “Great Dying” between the Permian and Triassic times, was exacerbated by the release of methane clathrates from the sea. Enormous volcanic basaltic rock outpourings from vents built up the The Siberian Traps. Volcanic activity would have been accompanied by venting of huge volumes of carbon dioxide forcing global warming. Warm seas could no longer retain methane and it would have entered the atmosphere causing further lethal global warming. This was the greatest extinction of all time. 96% of all marine species died and 70% of all terrestrial species. It was the only known mass extinction of insects.