# CLIMATE CHANGE THREATENS METHANE CYCLE - ENVIRONMENT

**NEWS:** Recent research highlights a growing concern that climate change may significantly disrupt the methane cycle within the Amazon rainforest. This cycle involves the production, consumption, and release of methane ($CH_4$), a potent greenhouse gas, into the environment.

## WHAT'S IN THE NEWS?

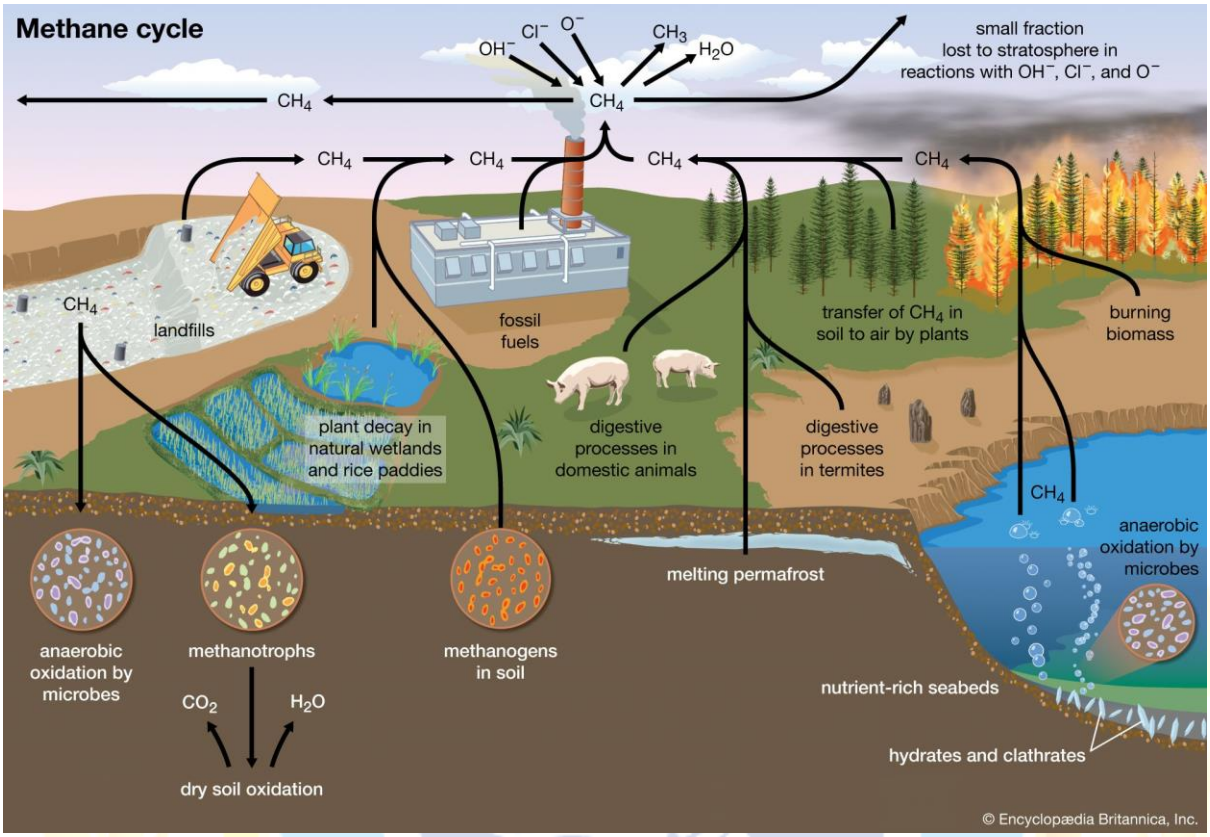
### Key Highlights of the Research on Methane

- **Amazon Floodplains**: Floodplains in the Amazon are significant contributors, accounting for up to 29% of global wetland methane emissions. Climate change heightens the activity of methane-producing microbes in these areas.
- **Upland Forests as Sinks**: Upland forests in the Amazon act as methane sinks, although their capacity to absorb methane has decreased by 70% under warmer and drier conditions, indicating a reduced ability to mitigate methane emissions.
- **Methanotrophic Microorganisms**: The study emphasizes the role of methanotrophic microorganisms that consume methane. These organisms help regulate methane levels in the environment.
- **Isotope Analysis**: Analysis of isotopes revealed that both aerobic and anaerobic methane-consuming microbes are active in the Amazon's floodplains, showcasing the intricate methane cycling processes occurring in this region.

### Understanding the Methane Cycle

- **Sources and Sinks**: Methane is released into the atmosphere from natural sources like wetlands and from human activities such as landfills, livestock farming, and fossil fuel exploitation. It is then either consumed by methanotrophs in the soil or broken down in the atmosphere.
- **Cycle Dynamics**:
    - **Creation**: Methane generation begins in the soil, produced by microbes known as methanogens.
    - **Consumption**: Methanotrophs, which require oxygen and reside in the upper layers of soil, consume methane as their primary food source, releasing some back into the atmosphere.
- **Atmospheric Cleaning by Hydroxyl Radicals**:
    - **Methane Oxidation**: Methane in the atmosphere is primarily removed by oxidation, a process facilitated by hydroxyl radicals (OH). These radicals, often referred to as the "cleanser of the atmosphere," break down methane into smaller molecules, ultimately converting it to $CO_2$ through various chemical reactions.

- **Further Processing**: Methane that moves from the troposphere to the stratosphere continues to be processed and removed, ensuring a natural cleansing of this potent greenhouse gas from the air.




## How Can Global Warming Affect the Methane Cycle?

- In an ideal world, sources of methane would equal sinks like in the case of CO2, but human activities increase global atmospheric concentrations of methane, which are rising.
- Scientists worry as the earth heats up, but more methane will be released from soils or other sources and magnify the problem of global warming.
- Ice crystals of methane form in cold, oxygen-poor marine sediments. Clathrate is also entrapped in permafrost, the permanently frozen soil in arctic and subarctic latitudes. .
- Clathrate ice-also called methane hydrate-is white, solid, like water ice. But this ice contains water molecules which freeze around molecules of methane. Clathrate deposits were once sinks where the methane was sequestered.
- But with global warming, some of the deep, frozen sediments melt, emitting methane, which then evaporates into the atmosphere.
- Since CH4 is a green gas, it means that more heat is trapped in the atmosphere, thus warming the Earth more.

## How Does Methane Cycle Disruption Affect Global Climate?

- Methane is the next biggest cause of climate change after carbon dioxide ($CO_2$).
- It has a global warming potential 28 times that of carbon dioxide per 100 years.
- Even small quanta of methane add up to a great deal because of the high global warming potential; already, carbon dioxide emissions have slowed down during the Covid-19 lockdowns of 2020 as indicated by the data from the United States National Oceanic and Atmospheric Administration, but atmospheric methane shot up.
- Methane is the primary precursor gas to a toxic atmospheric pollutant: tropospheric ozone.
- Tropospheric ozone is calculated to cause around 1 million premature respiratory deaths annually worldwide
- Globally, additional methane emissions account for half of the growth in tropospheric ozone that has been quantified over the last few decades.
- Higher levels of methane emissions decrease the amount of hydroxyl radicals (OH) in the atmosphere, which are natural purifiers for atmospheric pollutants. With fewer hydroxyl radicals, other atmospheric pollutants are likely to survive longer and contribute to further lowering air quality.
- Methane causes losses to staple crops of an average 10% to 15% yearly by adding to the increase in atmospheric temperatures that on average results in the formation of tropospheric ozone.
- Methane's contribution to climate change and public health also led to annual losses of about 400 million work hours worldwide due to extreme heat.
- Methane-induced climatic change also causes ecosystem disruption, species distributions changed, biodiversity lost, and ecological interactions destabilized, affecting plant and animal health.

Source: https://www.downtoearth.org.in/climate-change/climate-change-threatens-to-alter-methane-emissions-in-the-amazon-study-reveals