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Climate change and feedback loops: Have we reached the point of no return?

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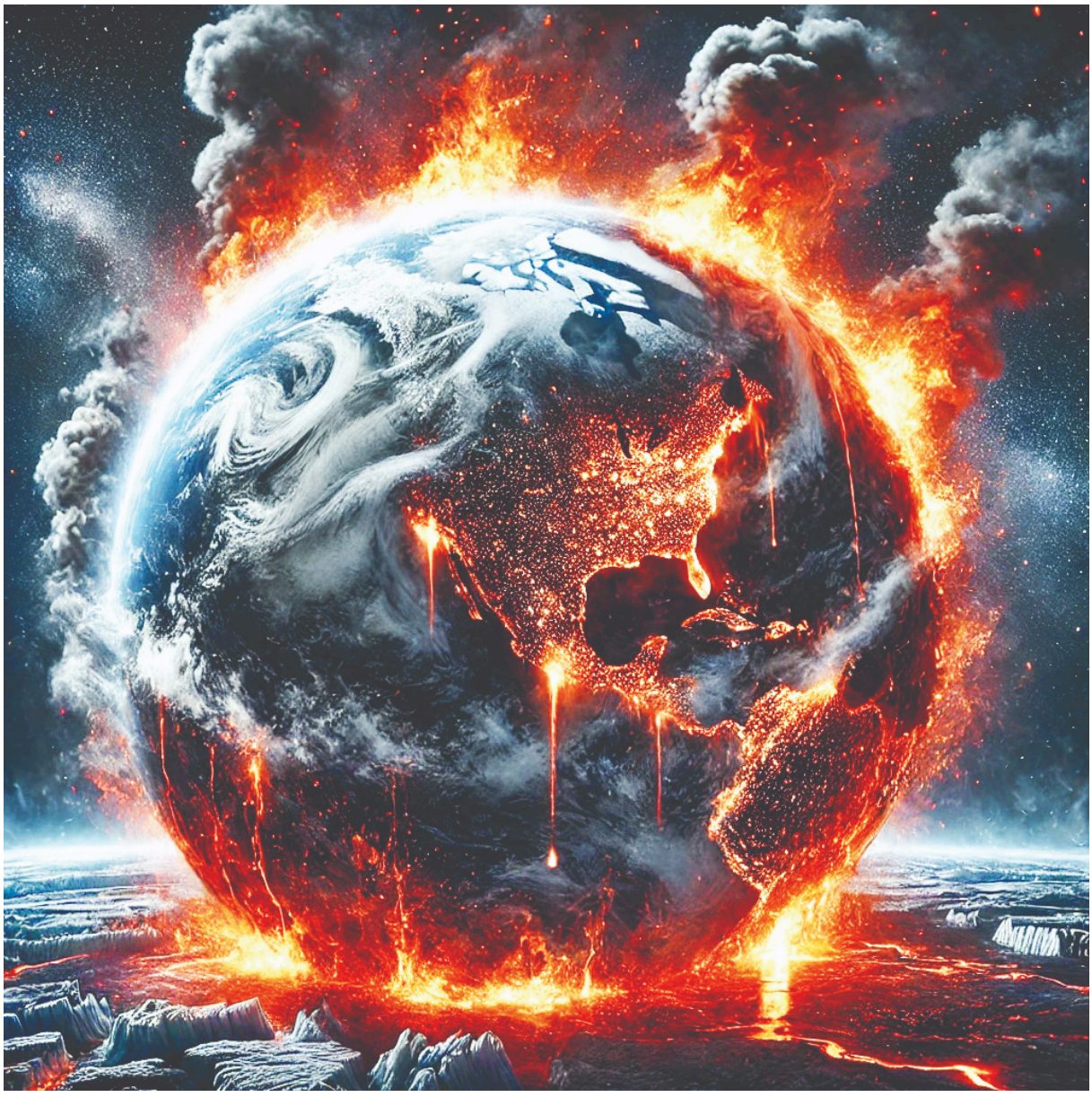

By Acharya Prashant

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Where do we currently stand on climate change?

We are seeing catastrophic long-term shifts in temperature and weather patterns, driven by human activities such as burning fossil fuels, deforestation, and industrialization. These activities release greenhouse gases, trapping heat in the Earth's atmosphere and leading to a rise in global temperatures. Stronger hurricanes, longer droughts, more intense heatwaves, and unpredictable rainfall patterns have become the new normal.

Our planet is heating up faster than ever, and 2024 made that clearer than any year before. According to NASA, 2024 was officially the hottest year on record, with global temperatures soaring 1.3°C above the 20th-century average. Greenhouse gases reached record levels this year, with carbon dioxide in the atmosphere increasing from 278 ppm in 1750 to more than 420 ppm in 2024. Ocean heat last year was the highest ever recorded. Given the trends, ocean warming will continue, and what's even more scary is that it is irreversible. With greenhouse gas concentrations reaching new highs, the world felt the impact of extreme weather, rising seas, and shrinking ice caps.

The oceans absorbed more heat than ever, expanding and pushing sea levels even higher. Antarctica's sea ice shrank to near-record lows, and glaciers continued to melt at alarming rates. UNESCO estimates that since 1975, the world's glaciers have lost around 9,000 gigatons of ice—enough to already seriously raise sea levels and disrupt freshwater supplies.

What are feedback loops?

The discourse on climate change highlights pronounced symptoms — rising temperatures, melting glaciers, and severe weather. However,

beneath these symptoms lie complex natural processes that drive and reinforce these outcomes. Enter climate feedback loops, which quietly but powerfully shape the trajectory of global warming. To understand the underlying dynamics of global warming, we must first investigate these self-reinforcing feedback loops.

Feedback loops are natural processes that, once started, reinforce the phenomenon that caused them. They amplify warming by furthering the changes that initiated them. Unfortunately, strong feedback loops are propelling climate systems toward more instability. Once started, they're almost impossible to reverse, much like a boulder gaining momentum as it rolls down a slope.

Some of the most significant feedback loops include:

1. Ice-Albedo Feedback: As ice and snow melt, darker land or ocean water surfaces absorb more solar radiation, further warming the Earth. In the Arctic, this has accelerated ice loss, with the potential for ice-free summers by 2030—a consequence that would notably reduce Earth's albedo and exacerbate warming.

2. Permafrost Thawing: Thawing permafrost releases methane, a powerful greenhouse gas, which in turn raises temperatures and leads to further thawing. This feedback includes glacier melting in Greenland and Antarctica as well. Thawing permafrost in Siberia is releasing ancient methane. It not only contributes to rising sea levels but also destabilizes ocean circulation, climate, and biodiversity.

As in the legend of Pandora, who opens a box that is better left shut, releasing evils into the world, she cannot put them back once they are out. The permafrost is the shut box. Methane is the hidden danger inside. Once the permafrost thaws, methane is released. This warming opens more "boxes," and like Pandora, once started, this process is hard to reverse.

3. Water Vapor Feedback: Warmer temperatures accelerate evaporation, increasing the amount of water vapor (a greenhouse gas) in the air, which traps more heat, further amplifying warming.

4. Forest Fires and Dieback: Increased temperatures intensify heatwaves and droughts, which lead to more forest fires. Forest loss reduces carbon absorption and contributes to CO_2 levels, which further raises temperatures. Forest ecosystems are crashing. Shifting rainfall and rising heat are increasing tree deaths. As the forests die, they unleash their trapped carbon and can no longer soak up more, feeding the warming cycle. The Amazon rainforest, once a "carbon sink," is now releasing more CO_2 than it soaks up in some regions.

5. Ocean Heat Absorption Feedback: Warmer oceans absorb less CO_2, reducing their role as carbon sinks, which leads to more atmospheric CO_2 and further warming.

6. Drought and Wildfire Feedback: Rising temperatures increase the frequency of droughts, which lead to more wildfires. Wildfires release CO_2 and reduce vegetation cover, which further increases atmospheric CO_2 and global temperatures.

7. Soil Carbon Release Feedback: Warmer temperatures speed up soil breakdown of organic matter, freeing more CO_2 and methane. This continues to warm the Earth and quickens soil erosion.

8. Ocean Stratification Feedback: Warmer surface waters suppress deep ocean mixing, reducing nutrient circulation. This destabilizes marine ecosystems and slows down the ocean's ability to take up CO_2, increasing atmospheric greenhouse gases.

9. Ice Sheet Instability Feedback: Thawing glaciers and ice sheets release freshwater into the ocean, which can disrupt ocean currents, such as the Atlantic Meridional Overturning Circulation (AMOC). This can lead to extreme weather patterns and the further destabilization of ice sheets.

The ongoing deterioration of biodiversity underscores the urgency. Species are disappearing at unprecedented rates—not as part of their natural life cycles, but as a result of unregulated consumption, shortsighted development, and a refusal to examine our real needs. This pursuit of limitless growth is destabilizing ecosystems, without reflection of ever-greater consumption.

Purely technical or political solutions will not work

To truly understand the causes of the climate crisis, we must move beyond physical symptoms and examine the human level of consciousness. The climate change of our planet, in Vedanta's vision, reflects not just ecological imbalance, but the fragmentation within. If we mistake destruction for development, we must inquire: What kind of consciousness generates this illusion?

This is not one more global issue—it is the overarching challenge of our time. The way forward demands more than policy or technology; it demands a profound shift in how we live, think, and are connected to the planet.

Vedanta teaches that our outer destruction of the world mirrors an inner disconnection. Driven by a sense of lack, we seek fulfillment through accumulation. When Earth can no longer satisfy this appetite, we look to other planets, calling that escape "progress." But true transformation begins within, with self-reflection and an honest examination of the desires that fuel insatiable consumption.

The Bhagavad Gita offers timeless advice: right action arises only from self-knowledge. Lasting solutions will not only arise from innovation but from a deeper understanding of who we are. As we turn inward, we encounter the ultimate source of this crisis—the ego, which constantly seeks wholeness outside itself.

When consciousness observes itself without resistance, a profound shift becomes possible. Perhaps this inward awakening holds the key. But time is slipping. The feedback loops we've triggered may soon close the window for meaningful change. For now, it remains open—but not for long.

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