



Climate Feedback Loops: Forests

Key Points and Guiding Questions

SUMMARY

The world's forests are responsible for removing approximately 25% of all human carbon emissions from the atmosphere and are essential for cooling the planet. But that fraction is shrinking as the three major forests of the world – tropical, boreal, and temperate – succumb to the effects of climate feedback loops. The resulting tree dieback threatens to tip forests from net carbon absorbers to net carbon emitters, heating rather than cooling the planet.

Tip # 1: Get familiar with the content.

Tip # 2: Create connections between what viewers say in the discussion and key concepts from the film. Use your knowledge of the presentation to make these connections.

Tip #3: Practice empathy. This content may be hard to understand for some viewers.

FOREST FEEDBACK LOOPS

- **Forests help Cool the Earth** – Through photosynthesis, trees offset warming by removing carbon dioxide, a heat-trapping gas, from the air, and storing carbon in their trunks, roots, branches, leaves and the surrounding soil. As a byproduct, they release oxygen into the atmosphere.
- **Earth is Warming** – Increased carbon dioxide emissions have warmed the globe. Combined with human activity, the warming has resulted in increased fires, diseases, and insects, leading to tree dieback.
- **Forests Store Carbon** – Global forests absorb approximately 25% of all human carbon emissions from the atmosphere. But this percentage is shrinking as the climate warms.
- **Feedback Loops** – As trees burn and decay, they release carbon back into the atmosphere. And with fewer trees left, more carbon dioxide remains in the atmosphere. Both lead to further warming and more tree dieback.
- **Carbon Sink vs. Carbon Source** – If forests release more carbon than they store, they switch from carbon sinks to carbon sources.

TROPICAL FORESTS

- Tropical forests are wet, warm, closed canopy forests. They account for 15-20% of terrestrial carbon sinks.
- Through transpiration, trees release water vapor, naturally cooling and humidifying the surrounding environment. In tropical forests transpiration can cool the region by as much as ten degrees Fahrenheit.
- Deforestation in the Amazon is largely due to the logging industry, human-caused fires, and agricultural expansion. Loss of trees leads to loss of transpiration and drier conditions.
- In the Amazon, over the past two decades, the dry season has extended by several weeks, stressing trees even more and creating an ideal environment for fires to spread.
- Tropical forest feedback loop: drier, warmer climate → fires spread → trees die → carbon is released, less transpiration → climate becomes warmer and drier.

- During extreme droughts, large areas of the Amazon forest burn, resulting in a release of carbon. Frequent droughts and fires could turn the forest from a carbon sink to a carbon source.
- Today, tropical forests absorb one-third less carbon than they did in the 1990s. With the loss of so many trees, the Amazon could flip to emitting more carbon than it stores as soon as the next decade.

BOREAL FORESTS

- The boreal forest encircles the North Pole through Siberia and North America.
- This forest stores approximately two-thirds of all carbon stored in Earth's forests. 75-90% of it is locked away in frozen plant and animal remains deep in the ground.
- The warmer climate is making this forest more vulnerable to insects, disease, and fire. Forest fires have become more severe and more frequent here.
- Fires here strip off the insulating ground cover, preventing it from building up between the frequent burns. Without this protective layer, fires reach deep down, burning the organic matter in the soil and releasing carbon into the atmosphere.
- Boreal forest feedback loop: warming climate → more fires → carbon deep in soil burns → carbon dioxide and methane are released → atmosphere warms further
- Scientists predict that the boreal forest will flip from a carbon sink to a carbon source by the end of this century.

TEMPERATE FORESTS

- Temperate forests make up one-quarter of all forests on Earth.
- Deforestation in the Southeast U.S. is partly due to the wood-pellet industry, which clears forests and sells its products as biofuel, releasing decades of stored carbon back into the atmosphere. The harvesting of forests for the wood pellet industry is expanding to other areas in the U.S., Canada and Malaysia.

- When a tree is logged, one-half to two-thirds of the carbon it stored is released through decay or burning. Today, 17% of global carbon emissions each year is attributable to logging and burning wood pellets for bioenergy.
- Older forests store much more carbon than younger forests. They're also taking up more carbon from the atmosphere. Planting new trees won't make up for the carbon lost by destroying old growth forests.
- Some temperate forests in the northwestern U.S. are less vulnerable to the effects of climate change than other temperate forests. To mitigate climate change, these forests should be protected.
- Many forest species are migrating north to cooler climates. But not all species can do this.
- Preserving and expanding forests, wetlands, and grasslands could help turn warming feedback loops into cooling ones. If we let plants and trees do their job, and stop the use of fossil fuels, we could lower Earth's temperature.

Discussion Questions:

Feedback Loops

What is a positive feedback loop? What is a negative feedback loop?

A positive feedback loop enhances or amplifies the effects of change, producing instability, such as warming creating more warming. A negative feedback loop reduces and or dampens the effect of change, helping maintain balance.

Have you heard of feedback loops before? If so, where?

Can you think of examples of positive and negative feedback loops from your everyday experience?

What is warming the Earth and setting off feedback loops?

Why are feedback loops so important in understanding climate change?

Is it possible to slow, halt, or reverse feedback loops?

Forests

What is an example of how forests become part of a positive feedback loop that produces warming effects?

What is an example of how forests become part of a negative feedback loop that produces cooling effects?

What are other ways that forests affect their surrounding ecosystems?

What percentage of carbon do global forests absorb from the atmosphere?

What percentage of terrestrial carbon sinks do tropical forests account for?

How do tropical forests cool the atmosphere?

What happens when deforestation occurs in the tropical forest? What is the feedback loop that results?

How do droughts in the tropical forest exacerbate the problem?

How much carbon are tropical forests absorbing now compared to the 1990s?

How much carbon does the boreal forest store? Where is it stored primarily?

What is the feedback loop in the boreal forest?

When could the boreal forest flip from being a carbon sink to a carbon source?

What are some of the reasons temperate forests are being deforested?

Which stores more carbon, old or new forests?

Where can we find forests that are less vulnerable to climate change? What should be done with them?

What happens to the stored carbon when a tree is logged?

What percentage of global carbon emissions each year is attributable to logging and burning wood pellets for bioenergy?

How are some tree species reacting to the changing climate?

How can we manage forests and agriculture in ways that help us mitigate climate change and create healthier ecosystems?

Do you have any personal experiences to share related to your understanding of the role trees play in the planet? Have you ever planted or removed a tree? How did it feel?

How do particular images impact your reaction and reception of the messages in the film? What images had the biggest impact on you?

Have you heard anything in the news lately that affirms or contradicts any of the issues presented in this film?

General

Should we focus on reducing emissions of carbon or focus on finding ways to store it? Or both?

Do you think we can continue living the way we have been while also reducing global warming?

How can we manage Earth in ways that help us mitigate climate change? What are some possible positive steps humans can initiate?

What do you feel motivated to do? The film ends with a message of the need to act. While feedback loops mean that one problem can cause many more, they also imply that one solution can trigger many others. What are some possible action steps humans can take?

Why is the content of this film important for the world to know?

Resources:

[Forests and Climate Change: Forcings, Feedbacks, and the Climate Benefits of Forests](#)

[Amazon Drought and Deforestation Feedback Loop](#)

[Feedback Loops of Fire Activity and Climate Change in Canada](#)

[Is the Boreal Forest on the Edge of a Climate Change Tipping Point?](#)

[Drawdown - Solutions to decrease your carbon footprint](#)

[How You Can Stop Global Warming](#)