New study sheds new light on forests' role in climate and water cycle

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Forests, which cover a third of Earth's land surface, are pivotal in carbon storage and the water cycle, though the full scope of their impact remains to be fully understood. In a new study published in *Nature*

Communications, researchers from Stockholm University and international colleagues provide new insights into the complex role forests play in the climate system and water cycle.

The research, involving scientists from 11 institutions across five countries, including Sweden, the UK, Finland, Germany, and Brazil, highlights the intricate relationship between forests, particularly their emission of organic gases, and the formation of reflective clouds that could influence global temperatures.

Comparing boreal and tropical forests

The unique aspect of this study is its focus on both boreal and tropical forests, which constitute 27% and 45% of the Earth's forested area, respectively. These ecosystems differ in their emissions and cloud formation processes, leading to varying impacts on the forest-cloud-climate feedback loop.

"This study, utilizing long-term data from diverse forest environments in Finland and Brazil, marks the first time observational evidence has been presented for these interactions in tropical rainforests," says lead author Sara Blichner, postdoctoral scientist at the Department of Environmental Sciences at Stockholm University.

Under-representation of forests in climate models

The study emphasizes the need for improved climate models to accurately represent these complex interactions. "Our findings suggest that current models may underestimate the impact of forests on cloud formation and climate, especially in tropical regions, which are crucial due to high amount of solar radiation these areas receive at these latitudes," Blichner explains.

However, Blichner stresses that while the study highlights areas for improvement in climate modeling, it does not undermine the overall reliability of these models. "Climate models are highly trustworthy in representing the main processes of climate change. Our research aims to refine these models, reducing uncertainties in future climate projections," she asserts.

Natural particles and global warming

The research also points out that as man-made particle emissions decrease due to air quality policies, the natural particles from forests become increasingly significant. These feedbacks are more potent in cleaner air environments and could play an important role in moderating global warming.

This collaborative study underscores the need for continued research and improvement in climate modeling to better predict future climate scenarios. Additionally, the findings highlight that these types of effects must be considered when assessing forest conservation as a key strategy in climate change mitigation.

About forest emissions and climate regulation

Forests release substantial amounts of organic gases, particularly noticeable as the distinctive scent of a pine forest on a warm day. These gases, once released into the atmosphere, contribute to particle formation.

Clouds are composed of minuscule water droplets and each of these droplets nucleate around a particle in the air. An increase in atmospheric particles results in clouds with more droplets, enhancing their reflectivity of sunlight and leading to cooler surface temperatures.

As climate change raises temperatures, forests are anticipated to emit more of these gases, thereby creating more particles and potentially more reflective clouds.

More information: Process-evaluation of forest aerosol-cloud-climate feedback shows clear evidence from observations and large uncertainty in models, *Nature Communications* (2024). DOI: 10.1038/s41467-024-45001-y

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