Deforestation in the Amazon may be decreasing the frequency of thunderstorms in South America

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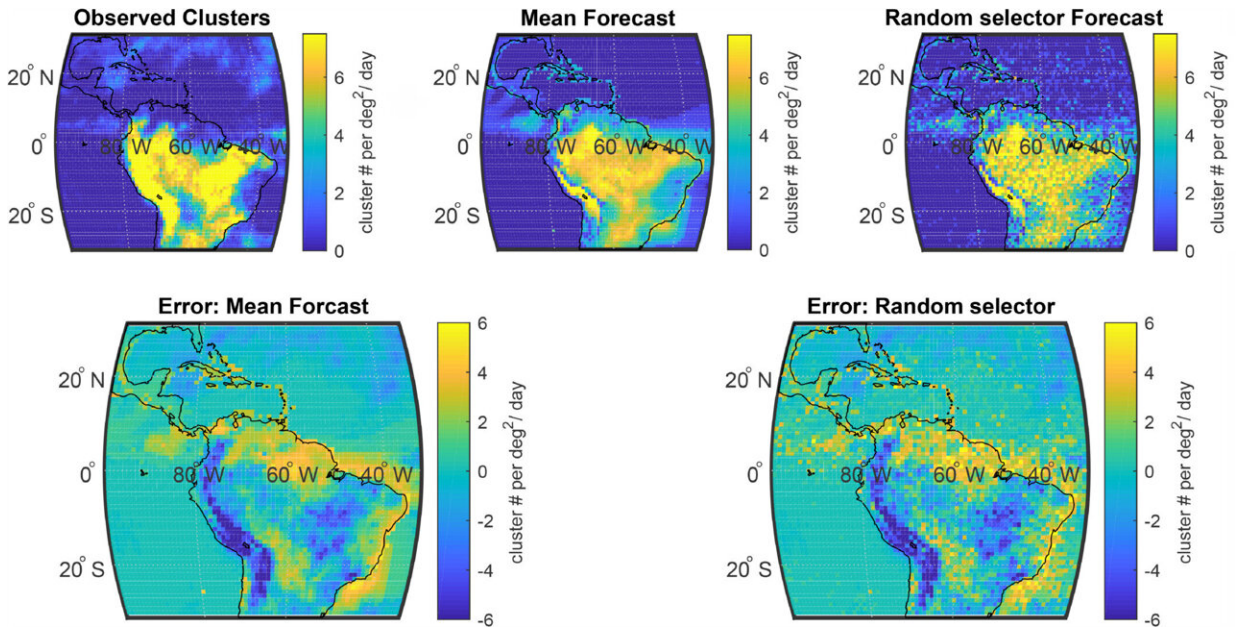

Comparison of the forecasting schemes of monthly mean number of clusters for Tropical America in January 2019 and their errors. Top left is the observed number of clusters from WWLLN, top center is the result of the mean scheme, top right is the result of the random selector scheme. Bottom left is the error of the mean scheme, bottom right is the error of the random selector scheme (Error = forecast – observations). Credit: *Quarterly Journal of the Royal Meteorological Society* (2023). DOI: 10.1002/qj.4518

For the first time, researchers from Tel Aviv University have determined that due to the ongoing deforestation in the Amazon basin in recent decades, the number of thunderstorms in the region has decreased significantly, and the area over which they occur has shrunk.

According to the researchers, this is a surprising finding: "In most areas of the world, global warming has resulted in an increase in the number of thunderstorms, but in this study, we discovered that precisely in those areas where deforestation has increased the number of storms actually decreased, even with rising temperatures."

"These findings are worrying because a decrease in the amount of storms leads to a decrease in the amount of rain, which in turn causes further damage to the forests. This is a dangerous feedback loop, which could severely damage the forests that provide the Earth with a significant portion of the oxygen in the atmosphere and absorb a large portion of the carbon dioxide emitted by us into the atmosphere."

The research was led by Prof. Colin Price and graduate student Raam Beckenshtein from the Department of Geophysics at the Porter School of the Environment and Earth Sciences at Tel Aviv University. The research was published in the *Quarterly Journal of the Royal Meteorological Society*.

Prof. Price explains, "The Amazon tropical rainforests are the largest in the world and play a critical role in regulating the Earth's climate. These forests are often called 'the lungs of the Earth,' because through the process of photosynthesis the forests produce a significant portion of the oxygen in the atmosphere and absorb a large amount of its carbon dioxide—a greenhouse gas that makes a significant contribution to climate change."

"In addition, the rainforests themselves produce their own rain: the trees

emit water vapor via evaporation into the air that eventually condenses and forms clouds and rain above the rainforests. Hence, the forests influence the local and regional rainfall."

The researchers point out that these important processes are currently in danger due to the extensive activity of deforestation in the Amazon, i.e., cutting down trees for wood and clearing areas for agriculture, infrastructure development, mining, etc. In fact, in the 30 years between 1990 and 2020, forests whose total area is larger than the entire continent of Europe were destroyed in the Amazon basin.

To sum up, the destruction of rainforests impacts global oxygen levels while increasing the greenhouse gases in the atmosphere and disrupting natural rainfall patterns that may lead to further drought in some areas. In addition, the trees that have been cut down are often burned, releasing additional carbon dioxide into the air and contributing to global warming.

In this study, the first of its kind, the researchers sought to track changes in the extent of thunderstorms in the Amazon basin in recent decades. In the absence of thunderstorm data from the Amazon going back decades, the researchers built an empirical model based on climatic parameters from the European Center ERA5, which has collected data on global climate since 1940, along with thunderstorm data collected through a worldwide network of lightning detection sensors called WWLLN—the Worldwide Lightning Location Network.

Prof. Price explains, "Lightning is the result of a huge electric field that is discharged all at once, producing radio waves that can be received thousands of kilometers away. The sensors of the WWLLN network are deployed in 70 research institutions worldwide, and they receive and map, in real-time, lightning everywhere on the surface of the Earth."

"Here at Tel Aviv University, on the roof of the Geophysics building, we have one of the sensors that pick up radio waves from thunderstorms that occur in our region, in Africa, India, and even South America. Cross-referencing the information from the various stations accurately determines the location and time of each lightning strike, and thus a global map of lightning strikes over time is obtained."

Using the empirical model, the researchers examined the relationship between the frequency and distribution of thunderstorms in South America, and changes in temperature in the Amazon region since the 1980s. A statistical analysis of the data revealed surprising findings: despite the increase in regional temperature resulting from global warming, there was a decrease of approximately 8% in the number of thunderstorms over this period.

The researchers say, "When we examined these findings in depth, we discovered that the areas of decline in the number of thunderstorms overlap to a large extent with areas where extensive deforestation was carried out. This is the first time that a connection between thunderstorms and deforestation has been established."

"We estimate that the loss of each megaton of carbon in the Amazon—equivalent to about a million large trees cut down—results in a 10% decrease in the number of thunderstorms."

Prof. Price concludes, "In this study, we examined trends in thunderstorm activity in the Amazon basin in recent decades. We expected to find an increase in the number of storms due to global warming, as has been observed in many regions of the world, but to our surprise, we found the opposite trend: a decrease of 8% over 40 years."

"Further analysis revealed that most of the decrease was observed precisely in those areas where the rainforests were replaced by

agriculture or other human activity. The decrease can be explained by the fact that the absence of forests significantly reduced the moisture in the air, which is the source of energy and moisture needed for the formation of thunderstorms."

"The result is fewer thunderstorms, fewer clouds, less rain, and consequently less forest growth. This creates a dangerous feedback loop that can cause the forests to dry out and significantly reduce the vital contribution of the 'lungs of the Earth' to oxygen production and carbon dioxide absorption."

More information: Raam Bekenshtein et al, Is Amazon deforestation decreasing the number of thunderstorms over South America?, *Quarterly Journal of the Royal Meteorological Society* (2023). DOI: 10.1002/qj.4518

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