# A new perspective on the temperature inside tropical forests

January 23 2024

Researchers compiled data from hundreds of temperature sensors installed inside tropical forests across the world. Credit: Eduardo Maeda

Tropical forests host up to half of the planet's biodiversity but up to now, ecological studies over tropical forests often relied on large scale datasets depicting open-air temperatures—that is, the temperature outside the

forests, which can be several degrees different from the temperatures inside the forest. This limitation imposed a large barrier in our understanding on how species will respond to climate change.

The research coordinated at the University of Helsinki and the Finnish Meteorological Institute and led by associate professor Eduardo Maeda from the University of Helsinki, has now achieved a major step to overcome this limitation. The results have been published in the journal *Nature Communications*.

## Hotspots of microclimate refugia

Temperature is a fundamental factor defining the survival, growth, and reproduction rate of species living inside tropical forests.

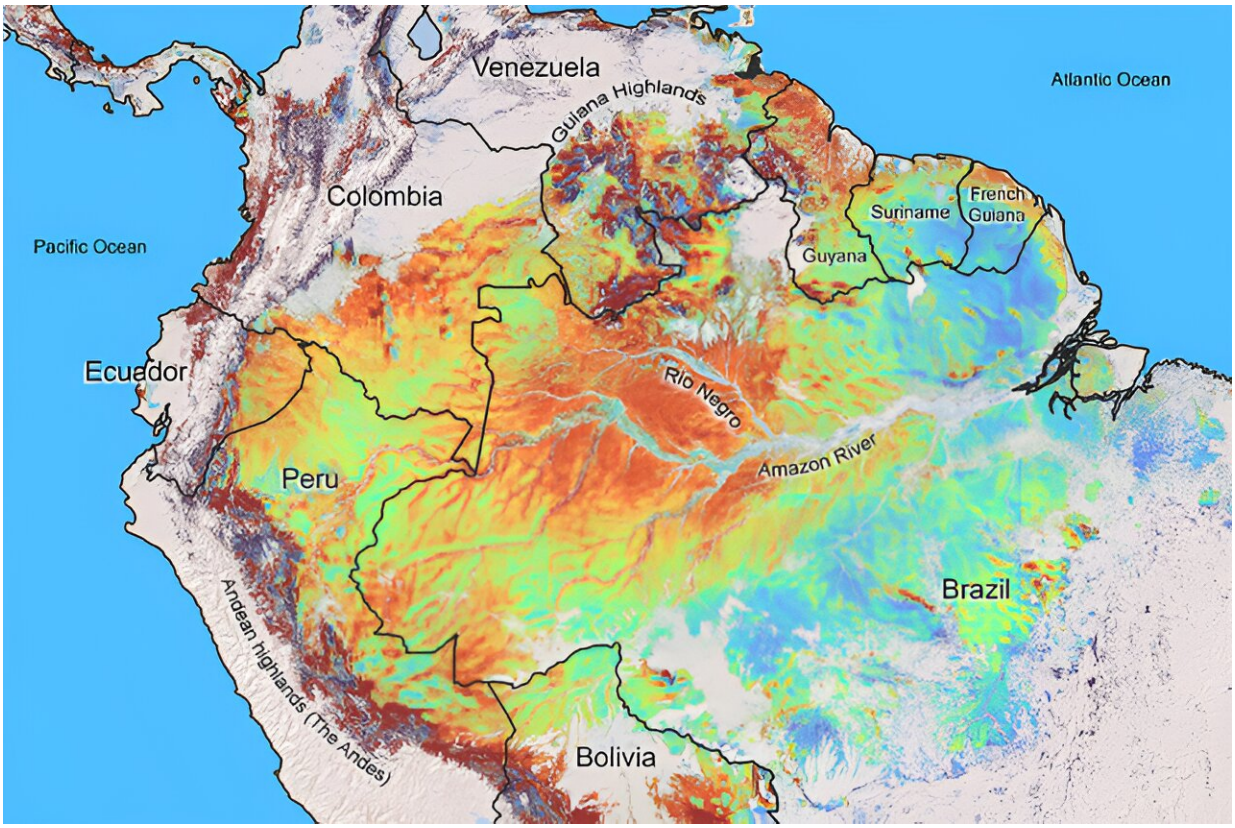
The new study provides maps of temperature inside forests that can be used by ecologists to massively improve the reliability of species distribution models.

"Maps help to predict with higher confidence how species will respond to climate change, such as to where species are more likely to migrate," says Maeda.

Furthermore, we are able to identify hotspots of microclimate refugia (i.e., areas that can maintain stable and cool microclimates). These areas are likely to be more and more important in a warming future—with highly detailed maps provided by this study, we can now indicate to policymakers where these areas are, so they can be more efficiently preserved.

Building on an extensive international collaboration effort, the researchers compiled data from hundreds of temperature sensors installed inside tropical forests across the world. The study also used

satellite data that provided information on different characteristics of the forests, such as the height of the trees and the leaf density. All this information were combined in a machine learning algorithm that was able to estimate temperatures inside tropical forests throughout the entire planet.




The map shows the variation in temperature differences on the South American continent. Credit: Ismaeel et al., 2024. Image editing: Jani Närhi/University of Helsinki

The result of this study demonstrates an amazing variability in the temperatures experienced inside forests, which were not visible from other available datasets. For example, the differences between

temperatures inside and outside forests are larger in regions with a distinct dry season (e.g., in southern Amazon forest).

Areas with lower rainfall are usually associated with higher temperatures, but this study demonstrate that the deep roots of tropical trees can still access water reserves, thus maintaining their "air conditioning" function in the ecosystem.

"We already knew that temperatures inside forest differ substantially from those outside forests. Our study shows that those differences are evident not only in terms of magnitude (i.e., the absolute difference between temperature inside and outside forest) but also in terms of spatial and temporal heterogeneity," says Maeda.

Along the same lines, temperatures inside the forests can be affected by many other anthropogenic disturbances, such as selective logging or fires. Without having a baseline of the expected temperatures, we would not know how these disturbances are impacting the climate conditions inside forests.

**More information:** Ali Ismaeel et al, Patterns of tropical forest understory temperatures, *Nature Communications* (2024). DOI: 10.1038/s41467-024-44734-0.
www.nature.com/articles/s41467-024-44734-0

Provided by University of Helsinki