Scientists just found out where the Earth is most sensitive to climate swings - and the news isn't good

By Chris Mooney

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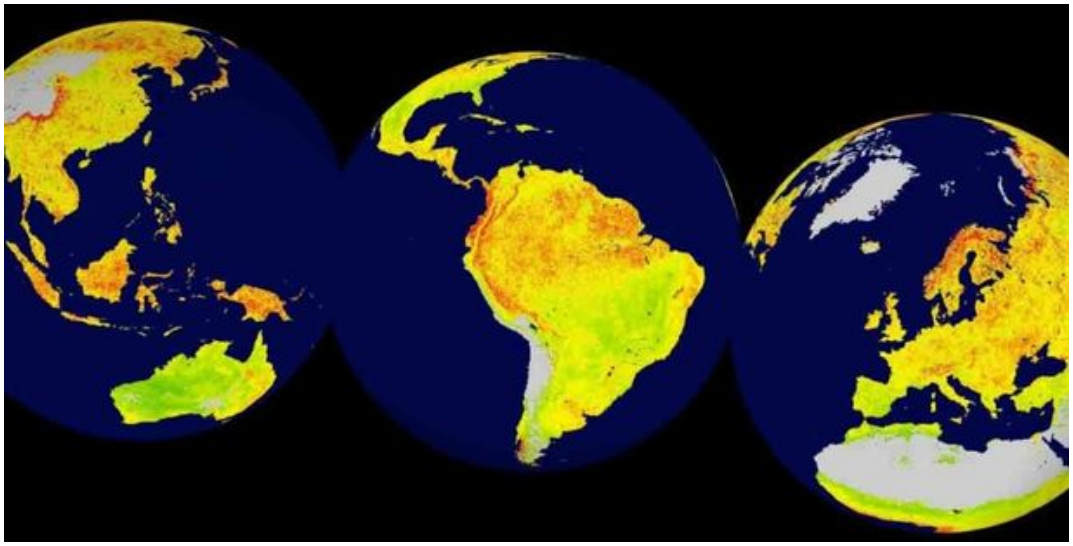

A global snapshot of the Vegetation Sensitivity Index (VSI), a new indicator of vegetation sensitivity to climate variability using satellite data between 2000-2013. Photo / Courtesy Seddon et al

New research published in the journal Nature reaffirms that key regions of the globe that have been a source of major climate worry to researchers - such as the Amazon rainforest and the forests of the global north - are exquisitely sensitive to swings in climate. And it also identifies some new and similarly vulnerable ecosystems that will bear very close watching.

"Understanding how ecosystems are going to respond to climate variability is an important feature that we still don't have a lot of information on," said Alistair Seddon, the study's lead author and a biologist at the University of Bergen in Norway. "And so what our study is doing is providing that perspective at a global scale." Seddon published the study with researchers from the University of Oxford and the Royal Botanic Gardens at Kew in the UK.

The study did not, as so many papers do, focus on what a long-term warming trend could do to these regions. Rather, it sampled how sensitive they are to climate "variability" - defined in the study as monthly changes in temperature, precipitation or water availability, and cloud cover. Changes in these variables were then compared with satellite imagery of the globe, which captured changes in the greenness of vegetation over the 14-year period from 2000 through 2013.

This approach allowed the researchers to identify Earth ecosystems that responded quite sensitively to changes in climate parameters, as opposed to those that did not - deriving a "vegetation sensitivity index" across the planet. "If there's high variability in temperature, and low variability in vegetation, you're scoring low on the sensitivity index," said Seddon. "That's basically the way it works." A highly sensitive ecosystem, in contrast, changes a lot even in response to slight swings in climate variables.

And that's where the research came up with worrisome results. "We find ecologically sensitive regions with amplified responses to climate variability in the Arctic tundra, parts of the boreal forest belt, the tropical rainforest, alpine regions worldwide, steppe and prairie regions of central Asia and North and South America, the Caatinga deciduous forest in eastern South America, and eastern areas of Australia," the researchers reported.

Some of these regions are already key areas of concern for climate researchers. Take, for instance, the boreal or northern forest. There are fears that Arctic warming will worsen wildfires that, in turn, burn through subsurface layers of soil and hasten the thawing of permafrost beneath. This permafrost, in turn, contains massive amounts of carbon that could potentially be emitted to the atmosphere.

Tropical rainforests, and especially the Amazon, are another major worry - they, too, store huge amounts of carbon, but are already being heavily deforested, with concerns that climate change could also increase their vulnerability.

When it comes to such ecosystems, the paper found a "high sensitivity to a combination of cloudiness and temperature

variability in the tropical rainforest regions, particularly in the Amazon and southeast Asia."

"Although the extent to which tropical ecosystems are currently operating at their thermal limits remains uncertain," the study said, "a number of studies have found decreases in tropical forest growth rates and productivity in response to warming, potentially the result of reductions of leaf gas exchange under warmer temperatures."

Other regions identified in the study have received less focus, such as the Caatinga, a highly threatened shrub forest in northeastern Brazil. It has already suffered greatly at the hands of humans. According to the Nature Conservancy, the region is "so altered that only a few ecologically important examples of natural habitat remain" - and now climate variability and change my exacerbate the situation.

Thomas Lovejoy, an ecologist at George Mason University who studies the Amazon rainforest and was not involved in the work, called the newly released study "an important advance."

"But it is by definition an underestimate of sensitivity because biological interactions (like bark beetles in coniferous forests and bleaching events in corals) show major ecosystem impacts can occur on top of and as part of vegetation or ecosystem impacts," Lovejoy said. "All the more reason to limit climate change to 1.5 degrees."

The research is particularly relevant given the expectation that on top of an overall warming trend, variability in key parts of the climate system could also grow in the future. "It is widely projected that as the planet warms, climate and weather variability will increase. Changes in the frequency and severity of extreme climate events and in the variability of weather patterns will have significant consequences for human and natural systems," a recent overview study on the matter put it.

Scientifically speaking, though, it is not always clear why some regions of the Earth exhibit more sensitivity to climate swings than do others. Granted, that seems pretty obvious for tundras or boreal forests - they're rapidly warming, and life in these places has evolved in a much colder regime than the one we're now entering. But in other regions it's more of a mystery - one that the new research, by focusing on key areas of vulnerability, could help to solve.

"Current ecological theory states that, as ecosystems approach critical thresholds (also referred to as tipping points), they become more unstable and respond more acutely to external perturbations. Knowledge of these thresholds is key to the sustainable management of ecosystems and to anticipating irreversible changes and/or ecological collapse," wrote Alfredo Huete, a researcher at the University of Sydney in Australia, in an accompanying commentary on the study in Nature.

"But predicting when and where such transitions will occur remains a challenge," he added. In this regard, the new research just gave scientists many new tips to pursue.

- Washington Post