

Thanks to climate change, the Arctic is turning green

By Chris Mooney analysis



Using 29 years of data from Landsat satellites, researchers at Nasa have found extensive greening in the vegetation across Alaska and Canada. Photo / Cindy Starr-Nasa's Goddard Space Flight Centre

Earlier this month, Nasa scientists provided a visualisation of a startling climate change trend - the Earth is getting greener, as viewed from space, especially in its rapidly warming northern regions.

And this is presumably occurring as more carbon dioxide in the air, along with warmer temperatures and longer growing seasons, makes plants very, very happy.

Now, new research in *Nature Climate Change* not only reinforces the reality of this trend - which is already provoking debate about the overall climate consequences of a warming Arctic - but statistically attributes it to human causes, which largely means greenhouse gas emissions (albeit with a mix of other elements as well).

The roughly three-decade greening trend itself is apparent, the study notes, in satellite images of "leaf area index" - defined as "the amount of leaf area per ground area," as Robert Buitenwerf of Aarhus University in Denmark explains in a commentary accompanying the study - across most of the northern hemisphere outside of the tropics, a region sometimes defined as the "extratropics".

Granted, there are a few patches in Alaska, Canada and Eurasia where greening has not been seen.

Starting from this set of observations, the researchers, led by Jiafu Mao of Oak Ridge National Laboratory but including 18 others from multiple institutions in the United States, France, and China, conducted what scientists call a "detection and attribution" study.

This is an experiment in which differing sets of climate model runs are used to determine whether a particular event or change - ranging from an extreme heat wave, to a coral bleaching event, to a major trend like Arctic greening - is more likely to happen in simulations that include human greenhouse gas emissions, than it is to happen in those that do not.

Sure enough, the greenhouse-gas filled computer simulations looked much more like the satellite observations than did simulations that only included natural variability. The study therefore concludes that "the trend of strengthened northern vegetation greening . . . can be rigorously attributed, with high statistical confidence, to anthropogenic forcings, particularly to rising atmospheric concentrations of greenhouse gases".

While this formal detection and attribution appears to be new, the report is at least the third study in the past several months alone to highlight northern hemisphere greening and to reinforce this basic conclusion. It's one that has often been celebrated by climate change sceptics and contrarians who have long contended that global warming won't be all bad, and that plants might help offset any global warming trend.

"We first find this kind of human fingerprint . . . particularly the greenhouse gas impact, on this kind of enhanced vegetation growth," says Mao, the study's lead author.

The researchers also dove in more closely to try to determine precisely why so much greening is happening in the Northern Hemisphere's colder latitudes. Sure enough, the overall trend was tied to warmer temperatures, although in areas where greening was missing, declining precipitation trends seemed to partly explain the result as well. (The study did not discuss whether growing wildfires in northern forests may also be countering greening in some areas.)

Another factor enhancing plant growth, meanwhile, seems to be more human-induced falling of nitrogen out of the atmosphere, as we have amped up the global nitrogen cycle with our fertilisers and our fossil fuels (nitrogen also can enhance plant growth).

In his accompanying essay evaluating the research, Aarhus University's Buitenwerf praises the study but notes that in some ways, the current satellite-based approach represents a blunt instrument. An examination of total leaf area, he notes, doesn't record whether a particular area has changed its type of vegetation, say from smaller tundra shrubs to small trees.

Buitenwerf also notes that the science is less clear about what is happening in the global tropics and in the Southern Hemisphere, where greening trends are either less apparent, or more difficult to explain.

Still, the subtext of all of this research is clear - a key fraction of all the greenhouse gases that humans pour into the atmosphere each year is pulled back into plants through the process of photosynthesis. This is happening even as the overall warming of the planet may, by lengthening growing seasons and moistening the atmosphere, further stoke plant growth. They don't call it the "greenhouse effect" for nothing.



US President Barack Obama visited the Exit Glacier in Seward, Alaska last year. Photo / AP
The key question then becomes how much this process can offset overall global warming over time. And that's quite unclear.

There's a lot, after all, that we don't understand. For instance, a recent National Oceanic and Atmospheric Administration report found that while Arctic tundras have indeed been greening over the past 30 years, in the past two to four years, that trend has reversed itself.

"Although we already identify this kind of human impact on this historical vegetation growth, for the future, it's hard to predict," says Mao. He said he is not sure to what extent the greening trend will continue, as "disturbances" like wildfires might counteract it, or plants may become "acclimated to this kind of high temperature."

Still, the trend is already prompting more optimistic assessments of our climate future in some quarters. Arctic greening was recently cited, in a major report by the US Geological Survey, as the central reason that Alaska, despite worsening wildfires and more thaw of permafrost, might still be able to stow away more carbon than it loses over the course of the 21st century.

It is clear, then, that greening is emerging as a factor with the potential to blunt some of the worst impacts of human greenhouse gas emissions. But thus far, researchers do not seem to be arguing that it's enough to counterbalance the entire human-induced warming trend.

"While we are perhaps lucky that CO₂ has this effect on plant physiology, in addition to being a greenhouse gas, it is not our 'get out of jail free' card when it comes to our ongoing emissions of CO₂," climate scientist Richard Betts of the UK's Hadley Centre wrote recently.

Instead, global greening is perhaps better taken as yet another indicator, visible from space, of how much we are causing the Earth to change.

"Given the strong evidence provided here of historical human induced greening in the northern extratropics, society should consider both intended and unintended consequences of its interactions with terrestrial ecosystems and the climate system," the new study concludes.

- [Washington Post](#)