Atmospheric carbon dioxide causing global greening making some areas warmer and some colder

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Credit: Wikipedia.

(Phys.org)—A small team of researchers with the Directorate for Sustainable Resources in Italy and Ghent University in Belgium has found evidence that shows some parts of the planet are becoming cooler and others warmer due to an increase in localized greening. As the team

notes in their paper published in the journal *Science*, much of the increase in greening is due to an increase of atmospheric carbon dioxide.

In addition to causing the atmosphere to heat up in general, the increase in atmospheric carbon dioxide is also causing many parts of the planet that were already green to become greener, the researchers report. That greening, they suggest, causes some regional areas to become slightly warmer and others cooler. But it is not just atmospheric carbon that is contributing to the greening. Nitrogen used in fertilizers makes its way into natural ecosystems, causing changes. The land is also changed by human activities.

In an area that is generally warm, an increase in leaf cover can lead to localized cooling due to plant transpiration (water evaporating) which condenses in the air, the researchers report. In cooler places, the impact can be the opposite—in boreal regions (tree covered) and colder places, local temperatures can rise slightly due to less sunlight being reflected back from the surface.

To come to these conclusions, the researchers studied satellite data for the period 1982 to 2011, which allowed them to assign a leaf area index (LAI) to various parts of the Earth's surface. In mapping the entire planet, the group found that for approximately 60 percent of all plant areas, an increase in greening has mitigated global warming by approximately 14 percent. For colder areas, greening has led to a rise in air temperatures of approximately 10 percent. They also found that the impact could be more dramatic during extreme weather conditions—by up to five times, for example, during warm and dry periods or cold and wet periods.

The researchers suggest their findings indicate that changes to vegetation clearly have an impact on local climate, and thus should be taken into consideration as mitigation and adaptation strategies are developed to

deal with a warming planet.

More information: Giovanni Forzieri et al. Satellites reveal contrasting responses of regional climate to the widespread greening of Earth, *Science* (2017). DOI: 10.1126/science.aal1727

Abstract
Changes in vegetation cover associated to the observed greening may affect several biophysical processes, whose net effects on climate are unclear. Here, we analyze remotely sensed dynamics in leaf area index (LAI) and energy fluxes to explore the associated variation in local climate. We show that the increasing trend in LAI contributed to the warming of boreal zones through a reduction of surface albedo, and to an evaporation-driven cooling in arid regions. The interplay between LAI and surface biophysics is amplified up to five times under extreme warm-dry and cold-wet years. Altogether, these signals reveal that the recent dynamics in global vegetation have had relevant biophysical impacts on the local climates and should be considered in the design of local mitigation and adaptation plans.

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