Reforestation's cooling influence -- a result of farmer's past choices

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Decisions by farmers to plant on productive land with little snow enhances the potential for reforestation to counteract global warming, concludes new research from Carnegie's Julia Pongratz and Ken Caldeira. Previous research has led scientists and politicians to believe that regrowing forests on Northern lands that were cleared in order to grow crops would not decrease global warming. But these studies did not consider the importance of the choices made by farmers in the historical past. The work, with colleagues from the Max Planck Institute for Meteorology and the University of Hamburg, will be published August 2 by *Geophysical Research Letters*.

The Earth has been getting warmer over at least the past several decades, primarily as a result of the emissions of carbon dioxide from the burning of coal, oil, and gas, as well as the clearing of forests.

One strategy for slowing or reversing the increase in atmospheric concentrations of carbon dioxide is to regrow forests on abandoned agricultural land. But the proposal has been difficult to evaluate, because forests can either cool or warm the climate. The cooling effects come from carbon dioxide uptake. When forests grow, they absorb the greenhouse gas carbon dioxide from the atmosphere, and store the carbon in plant biomass and litter in branches, trunks, roots, and soils. This carbon dioxide absorption has a cooling influence on our planet's temperature.

The warming effect comes from the absorption of solar radiation.

Forests are often darker than agricultural lands because they absorb more solar radiation. More importantly, forests in the spring often have snow-free and highly absorbing trees, at a time when fields and pastures are still snow-covered and reflective. As a result, forests generally absorb more sunlight than fields or pasture, and this increased absorption of sunlight has a warming influence, with this effect felt most strongly in the snowy areas of the world.

Previous studies that have attempted to understand the balance between cooling and warming from regrowing a forest considered unrealistic and highly idealized scenarios. The study by Pongratz and colleagues for the first time evaluated the climate cooling potential of reforestation taking historical patterns of land-use conversion into consideration.

Pongratz and colleagues found that farmers generally chose to use land that was more productive than average, and therefore richer in carbon. Furthermore, farmers generally chose to use land that was less snowy than average. While this result is not in itself surprising, its implications for the cooling potential of reforestation previously had been ignored. Regrowing forest on these productive lands can take up a lot of the greenhouse gas carbon dioxide, and therefore have a strong cooling influence. Because these lands are not very snowy, regrowing forests would not absorb very much additional sunlight. The net effect of the historical preference for productive snow-free land was to increase the climate cooling potential for reforestation on this land.

"Taking historical factors into account, we believe that we have shown that reforestation has more climate cooling potential than previously recognized," Pongratz said. "We are still not yet at the point where we can say whether any particular proposed reforestation project would have an overall cooling or warming influence. Nevertheless, broad trends are becoming apparent. The cooling effect of reforestation is enhanced because farmers in the past chose to use productive lands that are largely

snow free."

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