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Tropical reforestation: a viable tool for mitigating climate change?

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To achieve the Paris agreement target of limiting global warming to 1.5°C relative to preindustrial, aggressive mitigation strategies and negative emission technologies need to be implemented on a global scale over the next decades. Currently negative emission technologies are hampered by their high cost and scalability. At the same time ongoing deforestation and forest degradation are the second largest source of CO2 emissions. Reduced emissions from deforestation and forest degradation (REDD) are therefore being actively pursued as a relatively cheap and readily available climate change mitigation tool, particularly in the tropics due to the high biomass density potential. The potential magnitude of CO2 and temperature benefits from tropical REDD under an aggressive mitigation scenario, as well as its potential cost per tonne of Carbon (tC) are however poorly quantified. Here we use a fully-coupled Earth System Model (HadGEM2-ES) with interactive CO2 emissions to quantify the maximum potential for temperature and CO_2 benefits from global tropical reforestation by 2100 under the RCP 2.6 scenario. We find a small CO2 (15 ppm) benefit relative to the standard RCP 2.6 control simulation of increasing land use across the whole tropics, but this does not translate to an observable reduction in global or regional temperature. Carbon sequestration is highest during the first 25 years of the reforestation experiment. Assuming that all agricultural land contributes equally to a country's agricultural sector financial output and that reforesting a proportion of this land reduces the financial output of the agricultural sector by the same proportion and does not shift land use to other regions we then calculate the cost of this reforestation based on the contribution of the agricultural sector to the GDP of each country affected. Dividing the cost of stopping all land use in the tropics (913 billion US$ $year^{-1}$) by the carbon benefit in 2100 (28.9 Pg C) amounts to 31 US$$tC^{-1}$. This is cost effective but does not take into account the impact of food supplies necessary after land use change. We conclude that REDD is vital for staying within a 1.5°C target and would be a viable economic tool in conjunction with other measures to tackle climate change, but is a modest negative emissions technology, equivalent to three years of fossil fuel emissions at 2017 rates.