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Comment on esd-2021-85

Jessica Gurevitch (Referee)

Referee comment on "Exploration of a novel geoengineering solution: lighting up tropical forests at night" by Xueyuan Gao et al., Earth Syst. Dynam. Discuss.,
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This is an interesting and creative approach to carbon capture, enhancing the natural process of photosynthesis by forest trees by extending lighting to nighttime. Unfortunately there are two major flaws with this approach. The Earth system is currently facing two major catastrophic changes: climate change and rapid, profound and extensive biodiversity loss. The first major problem with this proposed geoengineering solution to atmospheric carbon reduction is the effects that eliminating night in tropical forests would have on global biodiversity. Humans are intimately interconnected with the lives of other organisms, and threats to biodiversity have very large implications for human well-being as well. Over hundreds of millions of years, organisms, ecological communities, and ecosystems have evolved in response to the day/night regimes in different parts of our planet. Although humans are largely diurnal, and city-dwellers may be unaware of life in forests at night, there is a rich and central role of nighttime activities for many other living things. Tropical forests are the repository of a large proportion of Earth's biodiversity, and many of the organisms in the tropics are nocturnal or crepuscular, with organisms and interactions occurring in darkness. Bats, jaguars, moths, many fish, reptiles and amphibians, hunt, mate compete and otherwise interact at night. Bats pollinate tropical trees and lianas at night, resulting in the ability of these plants to reproduce. No reproduction, no trees, no forest. Migrating birds often travel at night, using the stars for direction. Plants use daylength to initiate and regulate reproduction and other physiological functions. While the authors devote a single sentence to "impacts on local wildlife" this casual dismissal displays either disinterest or ignorance of the magnitude of threats to global biodiversity, particularly in the tropics. In addition to nixing night, the disruption, disturbance and habitat fragmentation that would result from installing lights throughout tropical forests and throughout the forest canopies would be unimaginably huge. This would greatly exacerbate the negative impacts of the night-removal proposed. I recommend a simple google search of "nocturnal animals in tropical rainforests" to learn more. One could spend a lifetime learning about tropical forests at night. The second major issue is, would this even work? As mentioned in the paper, depletion of local soil nitrogen (and phosphorus) and water could greatly curb the promise of turbo-charged photosynthesis. Even with increased rainfall, water deficits at small scales—the scales of

the root systems of trees—may occur, particularly if rainfall occurs in intense storms, increasing runoff (another possible problem, which admittedly is also a problem with anthropogenic climate change). Are these lights going to work flawlessly for long periods of time, or are panels going to break, malfunction, be lost in storms and fires, be stolen, and be lost as deforestation continues throughout the tropics? Seems pretty certain that these things will occur and that they are not taken into account in these models. In short, this is a creative approach to “thinking outside the box” about reducing the enormity of the impacts of climate change, but too few things have been taken into account to fully understand the limitations to the predicted successes and even more important, the very dangerous potential consequences of eliminating night in tropical forests.

A specific comment: [Abstract] Plants do not “primarily” conduct photosynthesis during the daytime, they only conduct photosynthesis during daylight.