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Comments: Photosynthesis is temperature-dependent, so that CO₂ fertilization has physical limits - pdf attached

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Identification of Optimum Temperatures

for Photosynthetic Production in Subtropical Coastal Ecosystems: Implications for CO₂ Sequestration in a Warming World

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Key Points:

The first study to identify optimum temperatures for photosynthetic production in subtropical coastal ecosystems is presented

The optimum temperature range for photosynthesis of 24.1°C to 27.4°C is often exceeded under the current climate

Predicted future global warming will result in rapid decline net ecosystem exchange in Australian subtropical coastal ecosystems

Abstract Terrestrial ecosystems are often thought to be effective sinks of anthropogenic CO₂ emissions with biosphere greening considered unequivocal evidence of this process. Increasing atmospheric concentrations of CO₂ along with other greenhouse gases are however, responsible for global warming. As temperature increases, the rate at which biomes sequester CO₂ may decline as the optimum temperature for photosynthetic production is exceeded, thereby reducing their potential to sequester CO₂. Here we present evidence from 3 years of direct measurements of CO₂ exchanges over subtropical coastal ecosystems in eastern Australia that the optimum temperature range for photosynthesis of 24.1°C to 27.4°C is routinely exceeded. This causes a rapid decline in photosynthetic production made worse when soil water content decreases. As climate change continues, both rising temperatures and predicted decline in rainfall will see these coastal ecosystems ability to sequester CO₂ decrease further rapidly. We suggest similar research is needed urgently over other terrestrial ecosystems.

Plain Language Summary Emissions of CO₂, primarily from the combustion of fossil fuels, have long been considered to result in an enhanced greening of terrestrial ecosystems through CO₂ fertilization. However, increases in atmospheric CO₂ along with other greenhouse gases have caused global warming. As air temperatures increase, the optimum temperature at which ecosystems sequester CO₂ from the atmosphere may be exceeded and CO₂ uptake by ecosystems declines. This results in more CO₂ including from anthropogenic emissions remaining in the atmosphere where it may cause further warming and climate change. Here we present the first direct measurements of CO₂ exchange over three subtropical coastal ecosystems in Australia. We find that the optimum temperature range for photosynthetic production (CO₂ sequestration from the atmosphere) of 24.1°C to 27.4°C is often exceeded and that predicted future warming will result in a rapid decline in the ability of the coastal ecosystems to sequester CO₂.