EGU2020-12574
https://doi.org/10.5194/egusphere-egu2020-12574
EGU General Assembly 2020

World's potential energy production from microalgae on marginal land

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Petrochemical fuel usage abuse has caused the depletion of oil reservoirs and increasing environmental problems such as greenhouse gas emission and global warming. Therefore, it is necessary to develop greener and sustainable alternatives. Carbon dioxide is the main contributor to the global warming crisis. Biomass energy has received the most attention in many integrated assessment model studies and the latest IPCC reports. Among various existing carbon capture technologies, microalgae-based biological carbon capture is one of the promising and lower energy consumption technologies.

Microalgae rise as 3rd generation bioenergy feedstock due to its attractive higher carbon dioxide fixation efficiency, higher biomass productivity, and relatively easy pretreatment processes for various biofuel extractions. Besides, microalgae have a low demand for water quality and soil fertility compared to traditional energy plants. It means growing microalgae on the marginal land (non-fertile land that is not suitable for agriculture) could be a promising agent for bioenergy production and CO_2 mitigation.

The study is aimed to evaluate the potential energy production from microalgae on marginal land. We combined geospatial data with climate, soil, and terrain to estimate the marginal land of each country. By using Williams and Laurens' model (2010), we calculated the annual microalgae areal biomass yields for different latitudes and evaluated annual potential energy production from microalgae on marginal land. It is estimated that microalgae may generate up to 67.9 billion tons of coal equivalent of potential energy per year on the total marginal land. By replacing fossil fuels, there will be emission reduction potential 290.6 billion tons of carbon dioxide.