



Opportunities and trade-offs of biomass based negative emissions within planetary boundaries

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The Paris Agreement requires “a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of the century” (UNFCCC, 2015). Without a full decarbonization of the energy and land use sector until the second half of this century, negative emission technologies (NETs) are required to achieve net zero greenhouse gas emissions. Integrated assessment studies indicate that bioenergy with carbon capture and storage (BECCS), a land based NET, has the potential to contribute substantially to balancing anthropogenic fossil fuel emissions. However, significant negative emission potentials from BECCS require substantial biomass potentials, which can only be achieved by intensively managed (fertilized and irrigated) large-scale biomass plantations. Additional to direct trade-offs of land and water availability, the implementation of large-scale biomass plantations implies major restructuring of the land surface on top of existing land use and would be accompanied by indirect trade-offs such as changes in moisture and energy fluxes.

In the context of the planetary boundaries framework as proposed by Rockström et al. (2009), BECCS might contribute to reduce the transgression of the planetary boundary (PB) for climate change, but would most likely steer the Earth system closer to the PB for freshwater use and lead to further transgression of the PBs for land system change, biosphere integrity and biogeochemical flows.

This presentation will investigate the opportunities of second generation biomass potentials within the safe operating space for humanity and highlight the multidimensional trade-offs between biomass potentials for BECCS in relation to the PBs. Scenarios of land availability for biomass plantations and land based carbon sequestration were developed with a spatially explicit multi-criterial optimization framework, considering the precautionary need to stay within the safe operating space vis-à-vis the need to sustain food supply.

References:

UNFCCC. Adoption of the Paris Agreement, FCCC/CP/2015/L.9/Rev1, United Nations Framework Convention on Climate Change (2015).

J. Rockström et al., A safe operating space for humanity. *Nature* 461 (7263), 472-475 (2009)

Without a full decarbonization of the energy and land use sector, nes are required to balance sinks and sources according