

Project title: **Fire-vegetation-climate interactions**

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Abstract

Fire is a key process for vegetation structure in all major biomes. Highest fire occurrence however happens in the tropical zone. There, the interactions between vegetation, fire and atmosphere influence the stability of the ecosystems but also the regional climate. A strong feedback between fire and vegetation can lead to alternative stable states of vegetation: grasslands promote the fire occurrence leading to higher tree mortality and a closed canopy of forests excludes fire occurrence due to the lower flammability of fuels and a more humid microclimate. The atmosphere has the potential to further amplify the vegetation-feedback, however in previous simulations the tropical rainforest have been surprisingly stable. A grass world simulation with the fully coupled MPI-ESM leads to higher temperatures and lower precipitation in the tropics. If a simulation with dynamic vegetation is initialized with this climate state the rainforest recovers quickly and only locally the climate shows indications of this strongly disturbed initialization.

Two factors that are strongly controlled by humans might however destabilize the tropical rainforests:

- 1) an increasing fraction of pastures can increase the flammability of vegetation of the ecosystems
- 2) additional human ignitions can lead to higher fire occurrence.

Here we will employ the model framework to assess for the first the limits of the tropical rainforest stability for an increased flammability of vegetation and increased human fire activity. Due to the feedbacks between fire and vegetation but also vegetation and atmosphere a coupled global Earth system model is the only suitable tool to address this question.