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Deforestation and climate change: The multiple pressures over Amazonian forests

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Amazonia is under significant stress from both deforestation and climate change. Multiple pieces of evidence show that the links between the hydrological and carbon cycles are fast changing. Deforestation is increasing in Amazonia, and in 2021, about 13,35 km² of forests were converted, a value 22% larger than 2020. On the deforestation side, the government's recent public policies favor illegal occupation of public lands and invasion of indigenous territories protected by the Brazilian constitution. Deforestation brings forest degradation to the edges of deforested areas, increasing carbon emissions. The impact of climate change is less clear, with changes in the hydrological cycle and increased temperature, promoting forest degradation that makes parts of the Amazon Forest become a carbon source.

The Amazonian forest is a very complex system with multiple anthropogenic and climate change pressures. It is hard to know where a possible Amazonian tipping point could be and which variables or values could be the indicators for this possible tipping point. The role of intensified climate extremes is another critical variable, with Amazonia under increased intense droughts/inundation cycles in the last 30 years. Remote sensing measurements show that vapor pressure deficit is increasing for both perturbed Eastern and at the pristine Northern Amazonia. Several different studies show that the carbon uptake by undisturbed forests is not equilibrating the carbon emissions by deforestation for parts of Amazonia. CO_2 emissions associated with deforestation are increasing. The MapBiomas system provides detailed land-use change maps linked to meteorological information to apportion carbon emissions to forest degradation or deforestation. The role of soil emissions is not fully quantified for the overall Amazonia. We are developing a basin-wide system using big data strategies with machine learning, artificial intelligence, and other advanced techniques to address drivers for land-use changes in Amazonia and carbon and methane emissions and sinks. Flooded areas in Amazonia show significant methane emissions, and the effects of increasing floods and droughts cycles have an important impact on methane emissions. First results will be presented, with CO_2 and CH_4 ground-based and

remote sensing measurements in Amazonia, coupled with MapBiomas land-use change maps.