GC020-04 - Carbon and beyond: Interactive global change impacts on Amazon biogeochemical cycles

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Abstract

The Amazon is at the center of an intensifying conversation about multiple anthropogenic impacts, both direct (e.g. land use change) and indirect (climate and hydrologic change). Thus far, research has focused primarily on the cycling and storage of carbon (C) and its implications for global climate. Missing is a holistic consideration of the interactions between these anthropogenic impacts and the full suite of climate forcing agents originating in the basin, including other greenhouse gases (methane, nitrous oxide), biogenic volatile organic compounds (BVOCs), black C, transpiration and albedo. Doing so is complicated by the very large variation in biophysical, ecological, cultural and political factors across the large area of the basin. Here, we synthesize the current understanding of 1) the nature, extent, rates and drivers of all major anthropogenic changes, and 2) their expected magnitude and direction of effect on each major climate forcing agent. Studied anthropogenic impacts span a range of scales and include deforestation, agricultural conversion, hydrologic and climatic regime change, reservoir construction, fire, mining/oil extraction, hunting, severe storms and others. We identify key knowledge gaps and identify likely impacts on the net climate forcing effect of the region.

We conclude that the current net positive radiative forcing of non-CO_2 agents in the Amazon (in particular methane, nitrous oxide and black C) is likely be equal to or greater than the more often considered CO_2climate impact. If unchecked, the majority of anthropogenic change agents are likely to further increase net radiative forcing from the region, both by reducing C uptake and increasing emission of other agents. Most significant rate and response uncertainties are associated with 1) methane production in seasonally inundated areas and effects of temperature/hydrologic change 2) patterns and radiative forcing impacts of BVOCs, 3) impacts of spatially/temporally variable phenomena such as severe storms and 4) biogeochemical and ecological resiliency of freshwater systems. Given the large contribution of these less-recognized forcing agents, a continuing focus on a single metric of climate service is incompatible with understanding and managing the biogeochemistry of climate in a rapidly changing Amazon.

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