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Contribution of trees to the N_2O budget of Amazon floodplain forest

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Tropical forests are known to emit large quantities of nitrous oxide (N_2O) to the atmosphere due to rapid nutrient cycling as a consequence of high temperatures. The Amazon rainforest, the largest tropical forest in the world, has a well-defined annual water level variation pattern, which regulates the distribution of biological communities according to the intensity and duration of flooding. In the Amazon region, periodically flooded soils occupy a large area, and cover rivers with different types of water (clear, white and black) that, because of their physicochemical characteristics, may influence the production of N_2O. The Amazon rainforest is responsible for 6.5% of the N_2O emitted globally. However, in the Amazon budget of N_2O emission, tree stems have been neglected as a pathway of gas emission, which has been showed as an important source of methane to the atmosphere. We present the first data of N_2O emissions from Amazon floodplain forest, covering different species of trees and different rivers (Amazon, Solimões, Negro and Tapajós rivers) in the Amazon basin. We conducted in situ measurements of N_2O fluxes from soils (N = 130) and tree stems (N = 150) in April and May of 2014, the high water level period. Each site studied was composed of large hummocks with exposed floodplain soil. The soil N_2O emissions (1.42 $\pm$ 1.9 mg N_2O-N m^{-2} h^{-1}; mean $\pm$ SD; average from all soil samples) were twice as high as tree stem emissions (0.595 $\pm$ 0.355 mg N_2O-N m^{-2} h^{-1}, mean $\pm$ SD; average from all trees). Both these emissions combined represent an important source of N_2O from Amazon floodplain forest. Even though tree stems emit two times less, these emissions show a considerable amount of N_2O emitted to the atmosphere, especially when the entire Amazon region is considered. In addition, we found different N_2O emissions between rivers from soils (Amazon $<$ Solimões $<$ Tapajós $<$ Negro) and trees (Amazon $<$ Solimões $<$ Negro $<$ Tapajós), which shows a local influence on production and emission of N_2O, such as soil type, soil and water pH, availability of inorganic N, microbial community, among others. Our results demonstrate that there is a major gap in our understanding of natural N_2O emissions in Amazon forest, and probably in all tropical forests never studied before, with a lack of information about tree emissions. Another important gap presented here, in terms of floodplain forest, is the variation of water level and its well-known influence on the N_2O dynamic. The inclusion of such data in measurement-based estimates and a regular assessment to eliminate current gaps in global N_2O budgets are imperative and indispensable.