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Contribution of trees to the N2O budget of Amazon floodplain forest

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Tropical forests are known to emit large quantities of nitrous oxide (N2O) 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 N2O. The Amazon rainforest is responsible for 6.5% of the N2O emitted globally. However, in the Amazon budget of N2O 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 N2O 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 N2O 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 N2O emissions (1.42 $\pm$ 1.9 mg N2O-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 N2O-N m-2 h-1, mean $\pm$ SD; average from all trees). Both these emissions combined represent an importante source of N2O from Amazon floodplain forest. Even though tree stems emit two times less, these emissions show a considerable amount of N2O emitted to the atmosphere, especially when the entire Amazon region is considered. In addition, we found different N2O 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 N2O, 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 N2O 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 N2O dynamic. The inclusion of such data in measurement-based estimates and a regular assessment to eliminate current gaps in global N2O budgets are imperative and indispensable.