Effect of fire on Amazon forest carbon and structure

Supervisors

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Project description

The aims of this PhD project are to 1) improve understanding of the environmental controls of fire, 2) quantity how old-growth Amazonian forests are affected by fire, 3) provide information for climate models on the increased risk of carbon loss due to fire. Results from long-term Amazon basin-wide permanent plot data indicate that mature tropical forests are gaining carbon, resulting in a substantial carbon sink (~0.5 PgC yr^{-1}) that has slowed the rise of atmospheric [CO_2] due to fossil fuel burning. At the same time, the number of fires in Amazonia is increasing as a result of more intense dry seasons, deforestation, and fire escape from deforested areas. This increase in fire frequency and extent has resulted in degradation of forest structure, changes in species composition, and increased carbon emissions from the Amazon Basin. However, there is essentially no information about the mechanisms that modulate firehow climate and vegetation interact to affect fire propertiesand how variation in fire properties ultimately affects Amazon forests.Improving understanding of how fire interacts with forests and changes in regional climate will help to predict the long-term fate of Amazon forest carbon storage, understand long-term fire effects, improve vegetation models,and improve planning for conservation and Reducing Emissions from Deforestation and forest Degradation (REDD+).

The studentship will involve a combination of field data collection, laboratory analysis of charcoal properties, and analysis of large vegetation and climate datasets. The field-based component will focus on forest structure measurements, fire evaluation, and charcoal sampling in Amazonian forests. The lab analysis will consist of quantification of fire burn intensity using reflected light microscopy measurements of charcoal recovered from soil in burned forests. The analysis component will use the field and lab data to statistically evaluate the interaction between fire, climate, and forests. The student must be numerically competent and have a desire to work both in the laboratory and under challenging field conditions. The studentship has the potential to evaluate a number of exciting and critical questions, including:

1) How does fire intensity and extent vary in Amazonian forest?

2) What environmental factors contribute to this variation (e.g., seasonal drought, pre-burn biomass stocks, topography)?

3) Based on forest permanent plot data, what are the changes in forest structure and carbon storage due to fire,

and due to different intensities of fire?

4) How does this information improve estimates of future forest degradation and carbon sequestration under a climate with more intense dry seasons?