PROJECT TITLE: Quantifying the human footprint in hydrological processes in the Amazon and implications for its role as carbon sink

DTP Research Theme(s): Changing Planet

Lead Institution: University of Bristol

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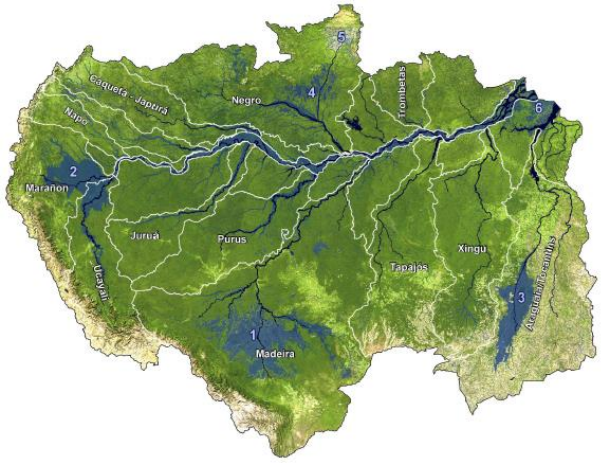
Project keywords: deforestation; rainforest; hydrology; carbon cycle; vegetation; modelling.



The Amazon River basin and its main tributaries (source: Castello, L., et al. 2012. DOI: 10.1111/conl.12008)

Deforestation from 1984 to 2008 in Southern Amazon (Para state). Satellite (Landsat) mosaics (source: Google Earth)

Project Background

The Amazon rainforest is one of the primary carbon sinks and the largest river basin in the world. The ever-growing deforestation in the Amazon has been causing irreversible environmental impacts on regional and global levels. The spatial and temporal patterns of deforestation are still largely unquantified but critical to understanding changes in Earth's biodiversity and climate. The conversion of natural rainforests to pastures and crops is the main starting point for incremental disruptions in the equilibrium of ecosystem and hydrological processes. Water fluxes under these circumstances are, however, not well represented in hydrological models that rely on ill parameterisation and the stationarity of the hydrological responses. Instead, mechanisms in these models should be holistically integrated using principles that govern both water and carbon cycles. This will reduce model equifinality and provide novel and meaningful assessments in the regions under rapid and intense land-cover change, such as the Amazon.

Project Aims and Methods

This project aims to unveil the understanding of hydrological processes and synergy with gross primary production (GGP) in Amazon catchments via the development and integration of principles common to vegetation and hydrological modelling. The guiding components of this PhD project will be well connected but also self-contained with high flexibility to allow emphasis on aspects that align with your skills and interests as follows:

- Generation of bespoke datasets based on a wide range of sources, such as remote sensing, atmospheric reanalysis and large-sample watershed-scale hydrometeorological datasets;

- Data analyses that can range from statistical time series analysis and machine learning to the application of first principle theories to reveal underlying relationships between stream dynamics and water consumption by plants;
- Development of a modelling framework based on existing model schemes and theories on optimal carbon and water allocation. This framework will help to quantify losses in GPP and changes in hydrological patterns and processes due to land-use change in those catchments in the Amazon that underwent an intense land-use change over the past decades.

Candidate requirements

You should be eager to learn and develop innovative ideas, with excellent analytical skills, experience in numerical modelling and coding (e.g. R and Python), and with a background in Physical Geography, Earth/Environmental Sciences, Engineering or similar disciplines that has involved the use of data analysis and numerical modelling. As we value a diverse research environment, we welcome and encourage applications from under-represented groups.

Training

You will have the opportunity to participate in overseas conferences that provide a wide range of training activities (e.g. EGU General Assembly) and engage with early career and senior researchers in the field. During your PhD studies, we will continuously assess what areas you require training and make sure you have the necessary skills to accomplish your project goals and develop a wide range of transferrable skills for your future career. These will be complemented with relevant training provided by the University's Advanced Computing Research Centre and the Personal and Professional Development (PPD) programme.

Background reading and references

Amigo, I., 2020. When will the Amazon hit a tipping point? Nature 578, 505–507, https://doi.org/10.1038/d41586-020-00508-4

Coxon, G, et al., DECIPHeR v1: Dynamic fluxEs and ConnectIvity for Predictions of HydRology, Geosci. Model Dev., 12, 2285–2306, https://doi.org/10.5194/gmd-12-2285-2019, 2019

Nobre, C, et al., Land-use and climate change risks in the Amazon and the need of a novel sustainable development paradigm. PNAS. 113, https://doi.org/10.1126/sciadv.aba2949, 2016.

Nóbrega, R, et al. Ecosystem services of a functionally diverse riparian zone in the Amazon–Cerrado agricultural frontier, Global Ecology and Conservation, https://doi.org/10.1016/j.gecco.2019.e00819, 2020.

Useful links

Personal and professional development course directory:

http://www.bristol.ac.uk/doctoral-college/current-research-students/ppd/course-directory/

University of Bristol School of Geographical Sciences Website:
http://www.bristol.ac.uk/geography/
http://www.bristol.ac.uk/geography/courses/postgraduate/

University of Bristol School of Geographical Sciences Prospectus:
http://www.bristol.ac.uk/study/postgraduate/2022/sci/phd-geographical-sciences/

How to apply to the University of Bristol:
http://www.bristol.ac.uk/study/postgraduate/apply/
The application deadline is Monday 09 January 2023 at 2359 GMT.

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