

Final Progress Report
Sustainability Science Program
Term: February 1, 2014 – August 1, 2014

Name:
Fábio Pereira

Your field(s):
Hydrology and meteorology.

Your degree program, institution and graduation date:
Post-doctoral Research Fellow, Harvard Kennedy School, December 2013

Faculty host at Harvard name and department:
Prof. Paul Moorcroft, Organismic and Evolutionary Biology Department

Description of SSP-related research activity:

Conceptual evaluation of surface hydrology in the Tapajos River Basin and implications of climate and land use change for hydropower operations

Abstract:

This research aims to understand the implications of climate and land-use change for hydropower operations of the Tapajos River Basin in Brazil. By implementing a large scale distributed hydrological model in conjunction with a coupled biosphere-atmosphere model, the research explores the implications of climate and land-use change for hydropower operations. An evaluation of short-, medium- and long-term changes in evapotranspiration, soil moisture, and surface runoff due to the replacement of native vegetation with agricultural lands and their implications for the hydropower in the Tapajos River Basin is expected as the outcome of this research.

Identification of the problem you address:

Agricultural expansion and other land use transformation is continuing in the Amazon and surrounding regions as global demand for food and biofuel increases and regional economies expand. Given that, this research will rigorously quantify the key sustainability thresholds for the hydrologic functioning of the Amazon basin and surrounding regions under different land transformation and climate change scenarios, focusing on its impacts on the hydropower.

Key question asked about the problem:

This project asks, with modeling studies projecting a warmer and drier environment for the Amazon, will the planned hydroelectric power plants in the Tapajós basin meet the growing demand for electricity in Brazil?

The methods by which you answered that question:

That question is intended to be answered by means of numerical modeling. A constrained modeling framework that aims at interfacing the output from the coupled biosphere-atmosphere simulation (ED2-BRAMS) with a hydrologic model (MGB-IPH) has been developed and will be used to assessing hydropower implications of changes in precipitation and runoff.

Principle literature upon which the research drew:

Hydrological sciences including water based management and policy issues that impact on economics and society; Social science perspectives on hydrological problems; Physical, mathematical and methodological aspects of hydrological processes; Modeling, observing, and forecasting of hydrological processes, including their interactions with the lower atmosphere.

Empirical data acquisition description:

The necessary digital elevation model (DEM) for the entire Amazon basin has been downloaded and properly preprocessed. This elevation map is being used to prescribe the river routing as well as lateral fluxes of water through the Tapajós basin. In addition to the elevation map, daily precipitation time series spanning from 1 January 2001 to 31 December 2012 have freely been obtained from Brazilian databases for a little over than 50 rain gauge stations in the Amazon basin.

Geographical region studied:

Tapajós River Basin, one of the main tributaries of the Amazon River.

Recommendations that might be relevant for your problem:

To build bridges with universities and governmental institutions that hold recent and historical data over the Amazon basin; to participate in scientific conferences and meetings with local authorities to keeping up with the latest developments in our research field and how they can meet the needs of the current status of the region studied.

A description of the final product(s) you have/are aiming to produce:

As outcome of this research, it is expected an article in the Journal of Hydrology.

Description of major other intellectual or professional advancement activity(ies) over the past academic year:

- *Phd thesis* → The interplay between atmosphere, hydrology and land use by environmental modelling
- *Research article* → PEREIRA, F. F.; DE MORAES, M. A. E. ; UVO, C. B. Implementation of a two-way coupled atmospheric-hydrological system for environmental modeling at regional scale. Hydrology Research, v. 45, p. 504, 2014.

Please list citations for reports, papers, publications and presentations that built on your fellowship research:

NA

Please describe any collaborative activities with other SSP Fellows that you are involved with.

- Judson Valentim and Rachel Garrett → Consistency checks of land-use database used for long-term climate simulations.
- Eunjee Lee → To gather and preprocess all rainfall stations over the Amazon basin for model verification and validation; To carry out trend analysis of annual and seasonal rainfall time series collected before and after reducing Amazon deforestation;
- Fabio Farinosi → To provide insights on urban hydrology; To assist in building relationships between flood events and convective rainfall by using statistical procedures such as principal component analysis.

Principal collaborators outside Harvard (list name and institution):

Bruno Collischonn, Agência Nacional de Águas (ANA)

List any awards or grants that you have received this year for the current or coming year.

NA

If you are moving to a new position, please list your contact information there:

January 2015:

Universidade Federal de Santa Catarina - UFSC

Centro Tecnológico - CTC

Departamento de Engenharia Sanitária e Ambiental

Campus Universitário

Trindade – Florianópolis – SC

Zip code: 88040-900

pereira.farias.f@gmail.com