

**Interim Progress Report**  
**Sustainability Science Program**  
**Term: September 1, 2013 – August 1, 2014**

**Name:**  
Eunjee Lee

**Your field:**  
Atmospheric Sciences

**Your degree program, institution and graduation date:**  
Sc.D., Atmospheric Sciences, MIT, 2011

**Faculty host(s) at Harvard name and department:**  
Prof. Paul Moorcroft, Organismic and Evolutionary Biology

**Description of SSP-related research activity:**

Evaluating the Amazonian water cycle components using ED and EDBRAMS modeling framework

**Abstract:**

Shifts in the water cycle of the Amazonia and its surrounding regions are a key to understanding regional impacts of climate and land-cover changes, because the hydrologic changes will potentially affect rain-fed agriculture and the hydroelectric power generation in Brazil. Among the water cycle components, precipitation from EDBRAMS modeling framework is evaluated against the Tropical Rainfall Measuring Mission (TRMM) satellite-driven observation data over the Amazonia and against five rain-gauge data at Obidos, Belterra, Itaituba, Matupa and San Jose Do Rio Claro in the Tapajos River basin. Total Water Storage Change (TWSC) anomalies were compared with the Gravity Recovery And Climate Experiment (GRACE) satellite observation at the Parana River basin. Our results indicate that modeled EDBRAMS precipitation from 2001 to 2009 reproduces the patterns observed by the TRMM satellite over the Amazonia, and replicates five rainfall ground measurements. Furthermore, as compared to the Global Land Data Assimilation System (GLDAS)/NOAH model, our stand-alone version of ED model shows a better agreement of TWSC with the GRACE measurement from 2002 to 2008. The Nash-Sutcliff model efficiency coefficient improved from 0.50 (GLDAS/NOAH vs. GRACE) to 0.65 (ED vs. GRACE) at the Parana River basin. Our evaluation study affirms the capabilities of ED and EDBRAMS modeling framework in simulating the Amazonian hydrology, which are crucial to our on-going project of investigating sustainable thresholds with various land-cover and climate change scenarios.

**Key question asked about the problem:**

Does a stand-alone version of the ED model and the EDBRAMS coupled model framework replicate the Amazonian water cycle components?

**The methods by which you answered that question:**

Both the stand-alone version of Ecosystem Demography (version 2: ED2) and the modeling framework, EDBRAMS, which couples ED to a regional climate model, the Brazilian Regional Atmospheric Modeling System (BRAMS).

**Principle literature upon which the research drew:**

Land-cover and land-use changes (e.g., the deforestation in Amazon), regional impacts of climate change on water resources (particularly regarding the Amazonian hydrology and hydropower generation), terrestrial biosphere modeling and evaluation.

**Empirical data acquisition description:**

The rain gauge observation data were obtained from the Brazilian National Meteorological Institute (Instituto Nacional de Meteorologia (INMET)) website (<http://www.inmet.gov.br/portal/>). The satellite-based precipitation data, the Tropical Rainfall Measuring Mission (TRMM), were from the data portal of the mission's website ([http://trmm.gsfc.nasa.gov/data\\_dir/data.html](http://trmm.gsfc.nasa.gov/data_dir/data.html)). The total water storage data from the Gravity Recovery And Climate Experiment (GRACE) satellite was obtained from Dr. Shin-Chan Han at NASA Goddard.

**Geographical region studied:**

The Amazon and its surrounding areas.

**Recommendations that might be relevant for your problem:**

NA

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

Submitting an abstract for the American Geophysical Union (AGU) meeting (Dec, 2014). Final product will be a journal article.

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

NA

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

Livino, A., J. Briscoe, E. Lee, P. Moorcroft, and J. Kelman (2014), Climate Change as a Challenge to Decision-Makers in the Management of the Brazilian Hydropower Systems, *The International Journal on Hydropower & Dams*, 21, 4, 57-61.

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

I work with Fabio Pereira and Fabio Farinosi as a team. Fabio Pereira uses the EDBRAMS model output as the input for his model. Fabio Farinosi plans to analyze the EDBRAMS model outputs for the flood risk analysis of his SSP project.

**Principal collaborators outside Harvard:**

NA

**List any awards or grants that you have received this year for the current or coming year. Please provide details regarding title of award, financial amount, and date of award:**

NA

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

NA