

## Continental-Scale Carbon and Nutrient Process Modeling

Santa Fe, New Mexico, June 4-5, 2010

### Workshop Participant List:

#### *Organizers*

Wil Wollheim - Univ. of New Hampshire, Plum Island Ecosystems-LTER  
Becca Barnes - USGS, Univ. of Colorado-Boulder, Niwot Ridge-LTER  
Amber Ulseth - Univ. of Wyoming  
Erin Hotchkiss - Univ. of Wyoming  
John Kominoski - Univ. of Georgia, Coweeta-LTER

#### *Invited Participants*

Bob Hall - Univ. of Wyoming  
Ashley Helton - Univ. of Georgia  
Chip Small - Univ. of Minnesota  
Trisha Atwood - Univ. of British Columbia  
Misun Kang - Univ. of British Columbia  
Amy Rosemond - University of Georgia, Coweeta-LTE  
Bill McDowell - Univ. of New Hampshire, Luquillo-LTER  
Takashi Sakamaki\* - Univ. of Ryukyus, Okinawa, Japan  
Rich Alexander – USGS  
Richard Smith - USGS  
Beth Boyer - Pennsylvania State Univ.  
Richard MacKenzie - USDA, Hawai'i  
George Aiken - USGS

\*Foreign citizen participant

## **Process Modeling of Aquatic Carbon and Nutrients at Continental Scales**

**Objectives:** to understand (1) broad-scale loading of C and nutrients, (2) broad-scale fate/processing of C and nutrients, (3) continental-scale model component needs.

### **Friday, June 4, 2010**

- 08:00 – 09:00 Introductions/Overview of Workshop/ASM Meeting Outline – John Kominoski & Wil Wollheim
- 09:00 – 09:30 DOC Processing in Aquatic Ecosystems: Reach-scale Models and a Review of DOC Uptake Rates - Erin Hotchkiss & Amber Ulseth
- 09:30 – 10:00 Spatially distributed carbon modeling: SPARROW Model Application – Rich Alexander & Beth Boyer
- 10:00 – 10:30 Coffee Break
- 10:30 – 11:00 Coarse Organic Matter Loading: (Terrestrial ecosystem models; Other approaches) – Wil Wollheim
- 11:00 – 11:30 DOC Loading: Loading and Processing of Carbon in Forested and Non-Forested Watersheds ) – Peter Raymond, Amy Rosemond, John Kominoski, Becca Barnes
- 11:30 – 12:00 Process Model Component Needs (What do we have? What do we need?) – All
- 12:00 – 13:30 Lunch – reservations at Guadalupe Café (422 Old Santa Fe Trail)
- 13:30 – 16:30 Breakout Groups (i. Loading, ii. Fate, iii. Model Development)  
Leaders: i. Loading = John Kominoski, ii. Fate = Amber Ulseth & Erin Hotchkiss, iii. Continental Scale Model Development = Wil Wollheim & Becca Barnes
- 16:30 – 17:00 Recap/Plan for next day

### **Saturday, June 5, 2010**

- 08:00 – 09:00 Database Assessment (Existing LTER Data, NEON, GLEON, STREON, USGS, EPA) - All
- 09:00 – 10:00 Integrating Global Environmental Change into Aquatic Process Models – All
- 10:00 – 10:30 Coffee Break
- 10:30 – 12:30 Breakout Groups
- 12:30 – 14:00 Lunch – Food vendors at Santa Fe River Festival (West De Vargas Park; between Sandoval and Guadalupe Streets)
- 14:00 – 16:00 Breakout Groups
- 16:00 – 17:00 Summary Reports and Future Directions/Products

**Working Group Outcomes:**

During the 2-day workshop, we discussed the need for continental-scale understanding of carbon (C) and nutrient processing. The objectives of the workshop were to: 1) establish an understanding of why it is important to study C and nutrients in aquatic ecosystems; 2) determine how inland waters regulate C (inputs, processes, and transports); 3) understand the relationship between changes in C inputs on food web structure and C cycling in inland waters; 4) understand the relationships between changes in C inputs and nutrient cycling; and 5) emphasize the need for continental-scale models to make predictions about how global environmental changes will affect food web structure and C cycling in inland waters.

The first day of the workshop consisted of presentations by the workshop organizers and discussion by the entire group. We identified that most empirical data on river networks exists for small, headwater streams (with a few examples of large river research, e.g., Colorado and Mississippi Rivers), whereas most modeling efforts that have US Geological Survey stream gauge data has occurred in larger rivers (near coastal outlets). We then discussed the need to integrate empirical and modeled data along the river network and across the continent in order to increase our understanding of the variation in longitudinal C and nutrient processes that occurs at continental scales (Figure 1).

The second day of the workshop focused on the development of key questions that drive our objectives (see above), and the formation of breakout groups that developed some answers to those key questions. The notes from each breakout group were collated and revised to form a preliminary draft outline of our prospective manuscript.

**Working Group Products:**

We drafted an annotated outline of our prospective manuscript containing a background of the importance of organic C on water quality from headwaters to the continent, a section on the reciprocal relationship between C and nutrients and how both influence food web structure and production, and a final section emphasizing the influences of global environmental changes on C and energy fluxes in inland waters.

The prospective manuscript will focus on providing an overview of the effects of organic C on aquatic ecosystems and their services, discuss the importance of understanding these effects over multiple, policy-relevant spatial scales, and suggest a course of action for achieving this understanding through strategic field monitoring/experiments linked with process-based modeling that accounts for the dynamic and linked nature of aquatic networks.

This manuscript is currently being prepared for submission to *Frontiers in Ecology and the Environment*.

**Figure 1.** Conceptual figure of the importance of continental-scale process-based models for carbon (C) and nutrients. The North American continent contains distinct East-West variation in precipitation and North-South variation in temperature and growing season influence the trophic state (auto- versus heterotrophic) of inland waters that receive organic C inputs that vary in quantity and quality from the surrounding watershed. Organic C and nutrient process dynamics within river networks in these distinct climatic regions of North America will vary in terms of relative terrestrial loading, transformations, and exports. Therefore, a process-based aquatic model for a river network in one region will not adequately represent organic C and nutrient processing in river networks across the continent.

