Margin Fluxes with Large Land/Ocean Exchange

Wade McGillis, Chair
Ajit Subramaniam, Rapporteur
Jim Ammerman, Rutgers
Jim Bauer, VIMS
W.-J. Cai, UGA
Arthur Chen, Taiwan
Paula Coble, USF
Tim Eglinton, WHOI
Zhang Fei Liu, ODU
Helga Gomes, Bigelow
David Ho, LDEO
Chuck Hopkinson, MBL
Andy Jacobson, NOAA, Boulder
Ferial Louanschi, ISMAL
Laura Lorenzoni, USF
Frank Millero, The Univ of Miami
Ray Najjar, Penn State
Sybil Seitzinger, Rutgers
Jason Sylvan, Rutgers
Wendy Wang, UMD
Jerry Wiggert, The ODU
Jennifer Williams, PSU
Boris Wawrik, Rutgers
C.S. Wong, IOS

Margin Fluxes with Large Land/Ocean Exchange

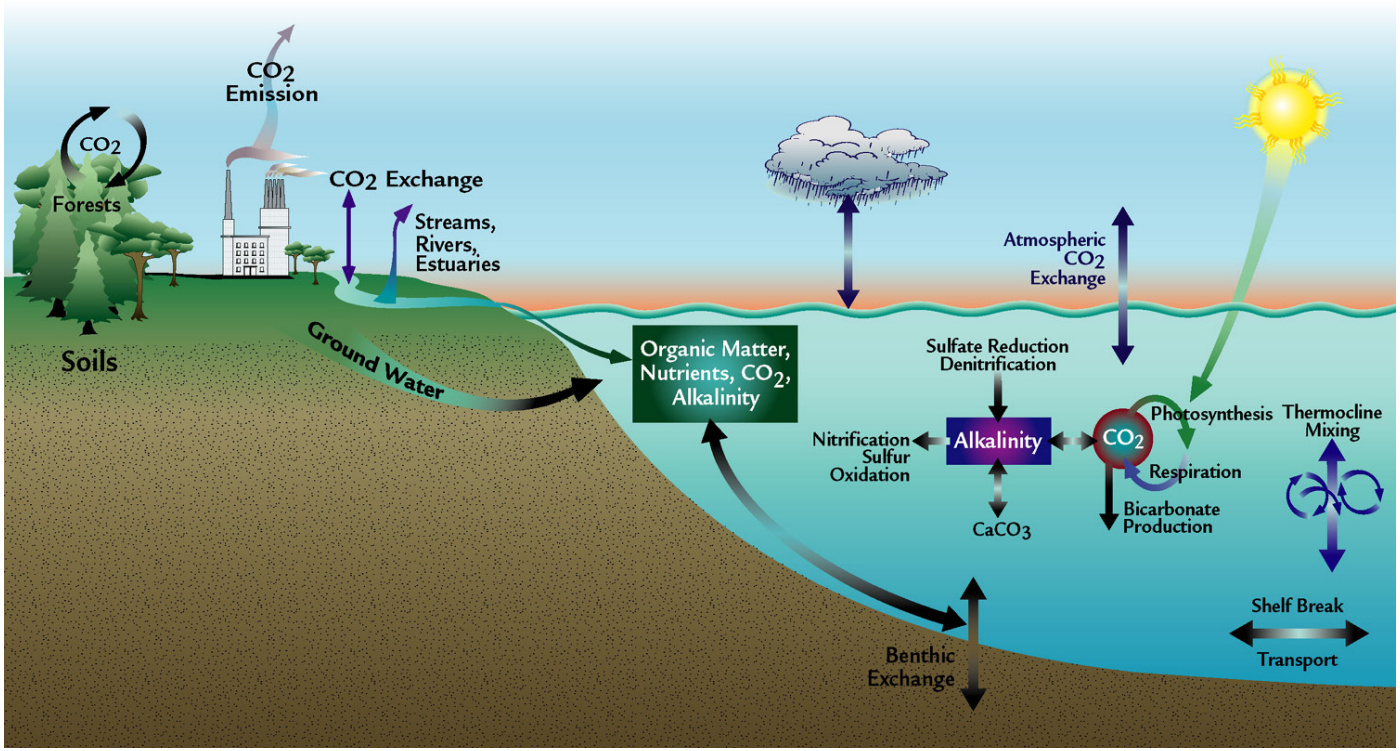
Premise:

Understanding the environments with large interactions between the ocean and inland terrestrial systems.

Domain:

Rivers
Estuaries
River plumes
Mangroves
Salt marsh
Sea grass
Peat
Ground water
Kelp beds
Lagoons

Land, Air, Water Carbon and Nutrient Cycle



Margin Fluxes with Large Land/Ocean Exchange

What are the key unknowns in this area?

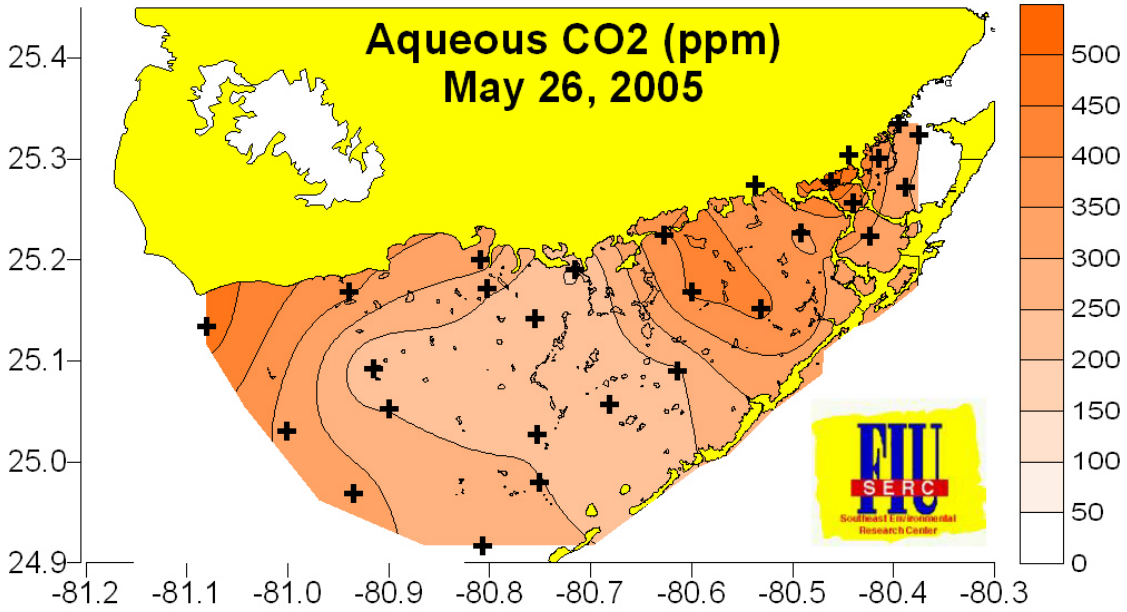
- What is the residence time of water? (rate of water mass to system; how long does it stay there, and how fast does it leave).

- There is a large uncertainty in the seasonal, inter-annual variability and the latitudinal variability in both lateral and vertical carbon and nutrient fluxes. Can this be quantified and modeled.

Examples:

Florida bay has large summer time and winter time changes on a seasonal cycle. But it is necessary to: [1] understand the present system; [2] understand the seasonality; [3] get a baseline environmental characterization; and [4] predict and observe how it changes with climate and land use.

Florida Bay: it seems there is a large sequestration in the mangrove but there is super saturation in the waters transported off shore.



• Taro Takahashi has performed a synthesis of the American Coastal air-sea carbon dioxide fluxes. This method relies on a wide range of observations and a correct understanding of the surface exchange coefficient. Preliminary conclusion: because of the large surface area, the North American vertical carbon dioxide flux may be dominated by the Gulf of Mexico. The Gulf of Mexico may dominate the entire United States air-sea coastal flux if it is a source of carbon dioxide to the atmosphere.

• There are significant gradients of the ecosystem vegetation inland to the off shore.

•Sea grasses will change – will it increase with increasing CO_2? Invasive species need to be considered.

• Will diversity decline or increase.

• How will anthropogenic changes impact the ecosystem and hence change the biogeochemistry of the margins. Human impact due to development – light limited, eutrophication.

• How do the ecosystems influence the biogeochemistry of the margins now. How will this change in the future?

• We don't know the full story of the natural cycle – currently speculations are plants take up carbon in one place and release it next door. The complete earth system cycle needs to be conducted. The complete fate and cycle of carbon, air-to-leaf-to-roots-to-water-to-shelf-transport-to-ocean transformations, needs to be studied.

Margin Fluxes with Large Land/Ocean Exchange

What observations and modeling studies are needed to improve our understanding?

Studies are needed to quantify the present physical, chemical, and biological differences between tropical and high latitude rivers.

Arctic Region

• Arctic rivers are the most vulnerable to climate change. Present programs in Arctic rivers suffer from undersampling and covering the wide range of important biogeochemical and ecosystem variables.

• 50% of the soil carbon is in the rivers draining to the Arctic.

• Arctic river research is necessary for studying of the Arctic Ocean.

• NAO phase is related to the freshening of the Arctic. But this study is very undersampled. It is so important that the resourceful nature of the scientists are relying on schools for daily sampling.

Temperate to Tropical Regions

• POC – there is speculation that 70% is coming from SouthEast Asia. However, more research activity is needed to confirm this system and if there are major changes taking place.

• 70% of all organic carbon and nutrients (POC, DOC, DIN, DIP, DON, DOP, PP, PN, TSS, PC) are coming in from the tropical latitudes.

• There are very few measurements.

• The largest river in Indonesia – Kapuas – no data what so ever. The pCO_2 is reported to be 50,000 ppm. This also means there is a significant amount Methane, etc.

• Nature of the organic matter and its reactivity along a latitudinal gradient should be monitored.

• Remote sensing – can it alleviate in situ studies? Needs ground truthing.

• Need land in the ocean models so that the variability from rivers are parameterized appropriately in the ocean biogeochemical models. River end members need to be studied at the appropriate temporal scale (what is this scale?)

• Need an observational system to support this – that will provide seasonal and interannual data. The river fluxes and loadings are nonlinear and a single event can supply a disproportionate amount of loading. Episodic events can drive the entire system.

Margin Fluxes with Large Land/Ocean Exchange

How reliable are current predictions?

poor

What are the major barriers to predictions?

- carbon and nutrients need to be known
- biogeochemical fluxes need to be known
- lack of comprehensive sampling program
- concern that present sampling programs are mitigating

Margin Fluxes with Large Land/Ocean Exchange

What information does the scientific community need to provide for policy discussions? What questions do we need to be prepared for?

- Impact of land use and land use changes on biogeochemical cycles;
- Anthropogenic and natural cycles (land use and climate change);
- Water management – water use and water quality;
- The impact of these processes on the ocean;
- We need to develop a baseline to study how they will affect future changes;
- Nitrate loads are being managed now to reduce phytoplankton in order to increase light for SAV, but, managers need to know how to implement nutrient loading targets.

Margin Fluxes with Large Land/Ocean Exchange

How can OCB best contribute to progress in this area?

- **Address the above issues and advocate this science activity.**
- **Make the land water exchanges an important priority because it is a key driver for coastal carbon processes, budgets, and the ability to perform predictions.**
- **Without this science activity, it jeopardizes: National security; Food security; Recreation; Economy; and how the ocean works.**
- **Gulf of Mexico – regional alliances for addressing research questions – nutrients and water quality. OCB can facilitate the collaboration with states and local entities. Tie in with the observing systems, leverage the state investments.**

Margin Fluxes with Large Land/Ocean Exchange

• **In order to tackle river dominated coastal margins, international collaborations are essential. OCB can also help in interactions with international groups. Encourage interactions with Russia for studying the Siberian permafrost. This will help with linkages to other freshwater drainage to the Arctic Ocean.**