B54D-02: The influence of tides on biogeochemical dynamics at the mouth of the Amazon River

Friday, 15 December 2017
16:15 - 16:30
New Orleans Ernest N. Morial Convention Center - 386-387

Copy and pasted text document 1.txt

- *Plain-Language Summary (Optional)*

A major barrier to computing the flux of constituents from the world's largest rivers to the ocean is understanding the dynamic processes that occur along tidally-influenced river reaches. Here, we examine the response of a suite of biogeochemical parameters to tide-induced flow reversals at the mouth of the Amazon River. Continuous measurements of pCO_2, pCH_4, dissolved O_2, pH, turbidity, and fluorescent dissolved organic matter (FDOM) were made throughout tidal cycles while held stationary in the center of the river and during hourly transects for ADCP discharge measurements. Samples were collected hourly from the surface and 50% depth during stationary samplings and from the surface during ADCP transects for analysis of suspended sediment concentrations along with other parameters such as nutrient and mercury concentrations. Suspended sediment and specific components of the suspended phase, such as particulate mercury, concentrations were positively correlated to mean river velocity during both high and low water periods with a more pronounced response at 50% depth than the surface. Tidal variations also influenced the concentration of O_2 and CO_2 by altering the dynamic balance between photosynthesis, respiration, and gas transfer. CO_2 was positively correlated and O_2 and pH were negatively correlated with river velocity. The concentration of methane generally increased during low tide (i.e. when river water level was lowest) both in the mainstem and in small side channels. In side channels concentrations increased by several orders of magnitude during low tide with visible bubbling from the sediment, presumably due to a release of hydrostatic pressure. These results suggest that biogeochemical processes are highly dynamic in tidal rivers, and these dynamic variations need to be quantified to better constrain global and regional scale budgets. Understanding these rapid processes may also provide insight into the long-term response of aquatic systems to change.

Plain Language Summary

Rivers supply the world's oceans with sediments and dissolved material that shape the coastline and drive elemental cycles. Most estimates of the flux of material from rivers to the ocean are based on measurements made upstream of any tidal influence on river flow. For large rivers, the region where tides alter flow but do not introcuce salty marine waters represent a large gap in our knowledge and quantification of aquatic processes such as carbon cycling. In the case of the Amazon River, this gap represents a reach of the river that is nearly 1,000 km long. Here, we performed a series of measurements at the mouth of the Amazon River to determine variability in geochemical parameters throughout tidal cycles. Suspended sediment concentrations were directly linked with river velocity, with the lowest levels observed during river flow reversal (i.e. incoming tide) and the highest levels observed at outgoing tide with max river velocity. Other parameters such as the concentration of carbon dioxide showed a similar relationship with river velocity, suggesting that biological activity also responds to changing flow conditions. These results suggest that tidal river dynamics need to be considered when evaluating mass flux from large rivers.

Authors

Nicholas D Ward *
Pacific Northwest National Laboratory

Henrique O Sawakuchi
CENA Center for Nuclear Energy in Agriculture

Vania Neu
Universidade Federal Rural da Amazônia

Aline de Matos Valerio
INPE National Institute for Space Research

Diani Less
Universidade Federal do Oeste do Pará

Victor Guedes
Universidade Federal Rural da Amazônia

Jordana Wood
Pacific Northwest National Laboratory

Daimio C Brito
Universidade Federal do Amapá

Alan C Cunha
Universidade Federal do Amapá

Milton Kampel
INPE

Jeffrey E Richey
University of Washington

Scientific Team: TROCAS

Find Similar

View Related Events

Day: Friday, 15 December 2017