Net Ecosystem Exchange of the Lower Amazon River: from Land to the Ocean and Atmosphere (TROCAS)

Speaker: **Professor Jeffrey Richey**
School of Oceanography, University of Washington
Chair: **Professor Lu Xi Xi**
Department of Geography, NUS
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Abstract

Recent research rejects the traditional perspective that rivers are simply passive pipes exporting material to the ocean. Processes occurring in rivers play a critical role in transporting and recycling carbon and nutrients, not only within watersheds but in their marine receiving waters. This paradigm shift results from new knowledge that rivers and other inland waters outgas immense quantities of CO_2 to the atmosphere. If current estimates of net fluvial fluxes are correct, carbon cycling in rivers essentially relocates and/or mitigates almost all the annual terrestrial sequestration. But the underlying mechanisms that drive carbon fluxes, from land to the lower reaches of major rivers, to the oceans, remain poorly understood. The *TROCAS* project addresses not only the magnitudes but especially the dynamics of carbon, in the vast but essentially uncharacterized ecotone between the upper Amazon, the atmosphere, and the ocean.

TROCAS seeks to unravel the sequence of processes and source(s) of terrestrially-derived organic matter (OM) that culminate in the immense CO_2 outgassing to the atmosphere from tropical rivers worldwide, with an immediate focus on the lower Amazon River. Research is being conducted to examine the dynamics of organic matter (OM) sources and sinks that culminate in the production of elevated pCO_2 over the last 900 km of the Amazon River, framed as *Net Ecosystem Exchange (NEE).* The question is, what is the fate of the organic matter that is consumed and how does consumption relate to outgassing of CO_2? The hypotheses being tested address: (1) The instantaneous isotopic signal of the organic matter being respired within a parcel of water, relative to the outgassed CO_2, over seasonal cycles, (2) if respiration is supported primarily by terrestrially-derived lignocellulose OM, with seasonal contributions from autochthonous materials during low and early-rising water, with differing ages of specific OM fractions relative to bulk OM, and (3) the apparent sources of photosynthetic O_2 (as indicated by $\delta^{18}O$-O_2) in the mainstem, relative to floodplain and tributary sources.

To test these hypotheses, a field study combining cutting edge geochemical, biological, and geospatial analyses to explore the influence of downstream processing on globally-relevant geochemical fluxes was intiated. A unique synchrony of approaches is being utilized; 1) deployment of in situ, instrumented incubator systems, 2) measurement of CO_2 fluxes and ^{13}C isotopes in floating chambers and the incubators using a field-portable isotopic gas analyzer, 3) examination of the OM compounds fueling respiration using time-of-flight (GC-ToF-MS), 4) deployment of Acoustic Doppler Current Profilers (ADCP) to accurately quantify water fluxes in the hydrodynamically-complex study region, and 5) development of a coupled transport/basin hydrology model to provide the quantitative context to integrate results into the evaluation of NEE.

About the Speaker

Jeffrey Richey is a Professor in the School of Oceanography and Adjunct Professor in the School of Environmental and Forest Sciences, Department of Civil and Environmental Engineering, and the Quaternary Research Center, University of Washington. He received his B.A. from Stanford University, MSPH from the University of North Carolina, and PhD from the University of California, Davis. His research involves the biogeochemistry and hydrology of large-scale river basins, how to implement geo-information systems for analysis of complex basins, and "dynamic information frameworks" for international resource management, primarily with the World Bank. He has over 150 publications, multiple conference presentations and invited seminars.

ADMISSION IS FREE – ALL ARE WELCOME

CONVENORS: Dr Karen Lai (karenlai@nus.edu.sg) Dr Sin Harng Luh (geosinhl@nus.edu.sg) Dr Winston Chow winstonchow@nus.edu.sg)
ENQUIRES: Sakinah – 65163559