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Gaining Perspective on Methane Dynamics in Waters of the Lower Columbia River and its Estuary

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The Columbia River (CR) delivers water (~7000 m^3/s) to its estuary that is highly super-saturated in methane [CH_4] (typically >100x atmospheric equilibrium). We have examined the estuarine mixing behavior of dissolved [CH_4] during three cruises (Fall 2008-09, Spring 2008) and demonstrated it to be highly non-conservative in all cases. A significant source of dissolved [CH_4] exists within the brackish and freshwater portion of the estuary and time series monitoring has demonstrated that the tides act as an effective bellows to transport dissolved methane laterally from suboxic and anaerobic peripheral environments into the river and its estuary. Although atmospheric exchange is traditionally viewed as the dominant fate of supersaturated methane in estuaries, results from incubation experiments we conducted provide evidence that methylotrophy is an active 'sink' for it in the tidally modulated lower CR and estuary. Notably, the presence of significant salt in estuarine samples (and even the addition of salt to freshwater samples) suppresses the oxidation rate. To obtain high resolution spatial and temporal maps of [CH_4], we recently constructed and successfully deployed a shipboard continuous flow 'Fast Methane Analyzer' system. The findings from this mapping work will be presented in this talk and put into general perspective with our overall research goal: to quantify the relative importance of a physical (i.e., atmospheric gas exchange) versus biological (i.e., microbial oxidation) fate for this potent greenhouse gas. Ultimately this work will allow us to assess how the balance of these competing sink terms for [CH_4] operating at the land-sea interface of major fluvial systems will respond to changes in estuarine hydrology driven by factors such as climate and human development.

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