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Title: The Radiative Trap: How River Water Modulates Equatorial Ocean Heat Uptake

Abstract: Large river discharges and copious rainfall give rise to a shallow, fresh surface layer in parts of the equatorial ocean that mediates air-sea interaction. While the dynamical effects of freshwater are well known, the thermodynamic effects of specifically riverine input remain unclear. We use in situ data and satellite-derived products to show, for the first time, that riverine input modulates the equatorial heat budget through bio-optical properties: Freshwater from major rivers carries nutrients, supporting phytoplankton growth and thereby elevating Chl-a concentrations. Once distributed by wind-driven currents and eddies in the open ocean, this river water absorbs more shortwave radiation in the top few meters, making the surface warmer than in surrounding oligotrophic waters. Heat-budget analyses based on in situ observations in the north Bay of Bengal, hundreds of kilometers from the river mouths, show that mixed-layer temperature tendencies align with radiative trapping associated with riverine optical water types rather than with canonical open-ocean water types. Other mooring data, located thousands of kilometers downstream of the Amazon and Congo rivers, show similar behavior. Altogether, these results reveal the fundamental linkage among land hydrology, ocean biology, and equatorial sea surface temperature, and emphasize the need to represent the bio-optical effects of riverine water in current models.

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