Untreated wastewater discharge into New York City urban waterways is a periodic source of both carbon and nitrogen that enhances greenhouse gas emissions from the Hudson River Estuary

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The Hudson River Estuary (HRE) receives significant inputs of untreated wastewater from sewer overflow from New York City (NYC) and other urban areas. These inputs deliver large, concentrated pulses of carbon (C) and nitrogen (N) into the estuary primarily during storm events. We hypothesized that sewage inputs would increase carbon dioxide (CO_2) and methane (CH_4) efflux from the HRE via two mechanisms: (1) direct input of these gases into estuarine surface waters from NYC's wastewater treatment system; and (2) indirect *in-situ* microbial production in response to the C and N additions. To test these hypotheses, CO_2, CH_4, dissolved organic C and inorganic N concentrations were measured in both sewage outflow and in estuarine waters throughout the tidal HRE. Efflux of CO_2 and CH_4 were also quantified from sediment cores sampled from Flushing Bay (FB), which is in close proximity to sewage delivery outlets.

Wastewater discharge was found to both directly input and be a potentially indirect source of CO_2 and CH_4 via microbial respiration in response to C additions. Effluent concentrations of CH_4 (125 ppm) and CO_2 (2200 ρCO_2), were a minimum 3 times greater than in estuarine surface water adjacent to the sewage delivery area and up to 20 times greater than concentrations found during non-discharge conditions as well as regional HRE surface waters. Further, measured C and N nutrient surface concentrations which included dissolved organic C (> 22 ppm), ammonium (>12 ppm), and nitrate (>6 ppm) increased at least +8 times in sewage delivery areas during discharge flow compared to non-flow conditions. Incubation experiments with FB sediment demonstrated that C additions stimulated CO_2 efflux by + 1.25 and CH_4 efflux by +10 times, compared with unamended controls. The magnitude of CH_4 produced was +40 times greater than an identical experiment performed with sediments sampled in a non-sewage outlet area (Saw Mill Creek) with similar salinity. These data warrant study on larger regional scales to assess the broader climate impact likely driven by CH_4 efflux that results from incomplete wastewater treatment discharge in urban estuaries.