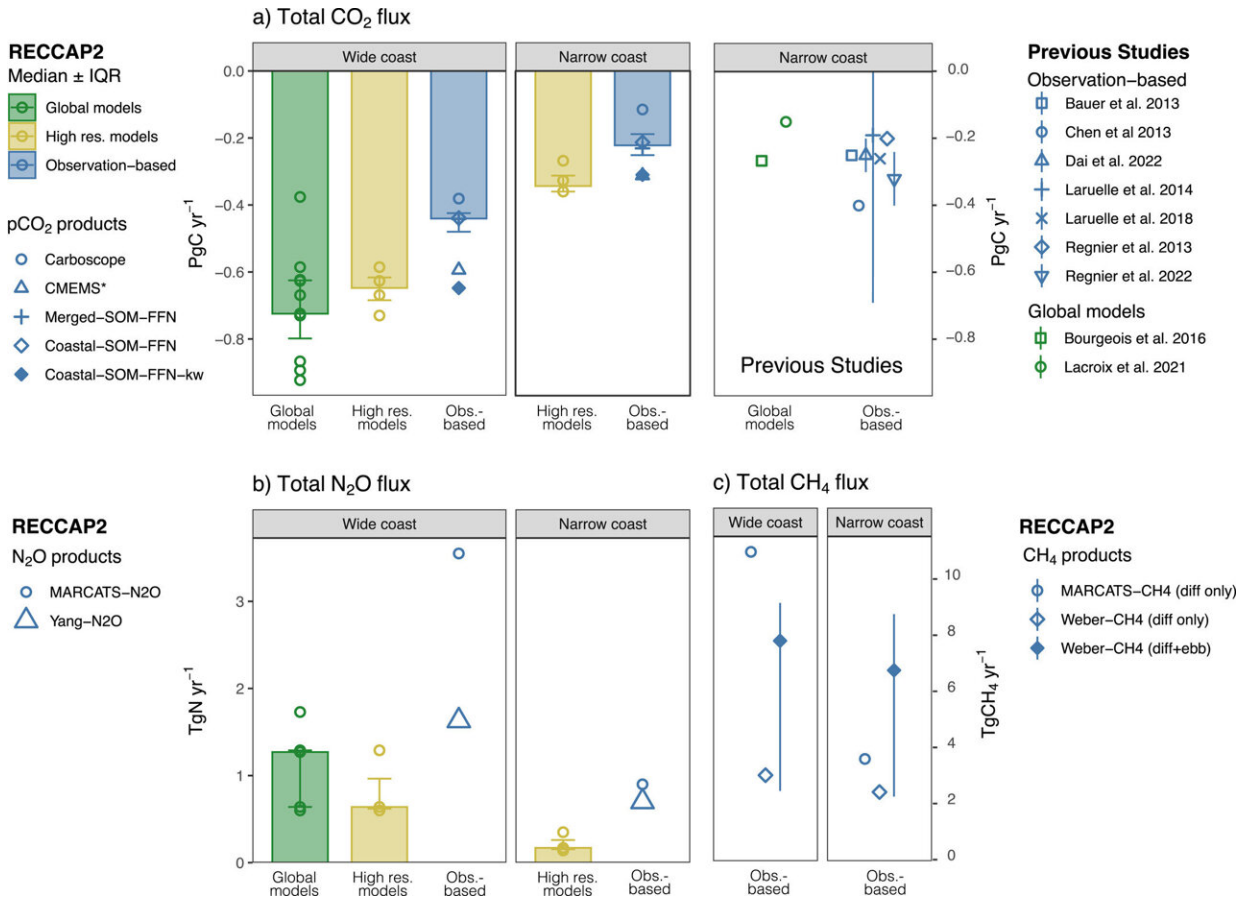
Researchers compare observations versus modeling of coastal carbon cycle

March 4 2024, by Sarah Derouin



Net globally-integrated coastal fluxes of (a) CO_2 [PgC $year^{-1}$], (b) N_2O [Tg N $year^{-1}$] and (c) CH_4 [Tg CH_4 $year^{-1}$] over the wide and narrow coastal oceans. Figure shows individual products and models (symbols) and their median and interquartile ranges. Models are shown for the full ensemble available (11 models for CO_2 and 4 for N_2O) and a subset of higher resolution models (4 models for CO_2 and 2 for N_2O, see Methods and Table 2 for details). Previous estimates available for the narrow coastal ocean are shown on the right of panel a

(see list in Table S2 in Supporting Information S1). Coastal-SOM-FFN-k_w, which is a second version of Coastal-SOM-FFN computed using different wind speed and k_w formulation (filled diamond, see Methods), is not used in the calculation of the pCO_2-product median. Weber-CH4 total flux (diffusive + ebullitive) and diffusive contribution (comparable to MARCATS-CH4 flux) are shown in panel (c). Credit: *Global Biogeochemical Cycles* (2024). DOI: 10.1029/2023GB007803

The coastal ocean helps regulate climate change by acting like a giant sponge for atmospheric carbon dioxide. However, the coastal ocean is also a hot spot that releases nitrous oxide and methane, two other potent greenhouse gases.

In the first phase of the international Regional Carbon Cycle Assessment and Processes (RECCAP) research project, scientists studied ocean carbon cycling but did not consider nitrous oxide and methane emissions. More recently, researchers used limited measurements and statistical gap-filling techniques to estimate these three greenhouse gases' global production and fluxes. The result was a great step forward in understanding the role of coastal oceans in climate, but the extent to which methane and nitrous oxide emissions offset carbon dioxide uptake is still uncertain.

In the second phase of RECCAP, Resplandy et al. analyzed data from 1998 to 2018 on 77.2 million square kilometers of coastal ocean areas. They found that because of seasonal changes, rates of carbon uptake from the oceans appeared about 60% higher in models than seen in observations, with most of the discrepancies in the middle- to high-latitude areas. The researchers also found that the coastal ocean carbon dioxide sink has increased in past decades, but by how much is uncertain, as estimations from modeling and observations differ.

The team noted that the coastal ocean's nitrous oxide and methane emissions counteract a substantial part—about 60%, based on observational estimates—of the carbon dioxide uptake. They note that considering all three greenhouse gases, not just carbon dioxide, is an important part of examining ocean-climate processes.

More information: L. Resplandy et al, A Synthesis of Global Coastal Ocean Greenhouse Gas Fluxes, *Global Biogeochemical Cycles* (2024). DOI: 10.1029/2023GB007803

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