Examining spatial and temporal dynamics of pCO2 in the North Sea using ocean color satellite data

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The coastal oceans play a significant role in the global ocean carbon cycle being responsible for ~20% of all marine CO2 uptake. Understanding coastal carbon dynamics is thus crucial for accurately quantifying the global carbon sink and for e.g. supporting blue carbon accounting and climate mitigation efforts. The North Sea is equipped with a dense network of in-situ measurements of water partial pressure of CO2 (pCO2) and offers a unique opportunity to advance our understanding of the complex biological and physio-chemical processes that drive coastal air-sea CO2 dynamics.

Here, we combined high-resolution satellite observations of ocean colour from the ESA Ocean Colour Climate Change Initiative (OC-CCI) and sea surface temperature with in situ pCO2 observations from the Surface Ocean CO2 Atlas (SOCAT) database to study the spatial and temporal variability of pCO2 and its driving mechanisms in the North Sea. We applied regionally-optimized retrieval algorithms to estimate key biological drivers of pCO2 in the North Sea, including chlorophyll-a, suspended particulate matter, and particulate organic carbon concentrations.

Our findings suggest the presence of distinct biogeochemical regions within the North Sea, detectable from remote sensing data, shaped by primary productivity, river plume inputs, and sediment dynamics, with varying impacts on pCO2 dynamics from local enhanced CO2 uptake to CO2 degassing. With our study we advance the knowledge on coastal carbon dynamics and demonstrate a framework that can be applied beyond the North Sea in coastal regions globally.

Keywords
Coastal Carbon Cycle; North Sea; Ocean Colour; Satellite Remote Sensing; Primary Production

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