

Title: The West African
Coastal–Mesopelagic Gateway:
Quantifying Lateral Carbon
Subduction from Tropical Estuarine
Systems to the Atlantic Twilight Zone

Lead Investigator

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Background

While the ocean's biological carbon pump is traditionally modeled as a vertical flux, recent evidence highlights the significance of lateral transport from highly productive coastal margins in sustaining mesopelagic ecosystems.

The West African coastline, characterized by extensive lagoon and mangrove networks, acts as a high-intensity biogeochemical reactor. Systems such as the Lagos Lagoon complex receive substantial terrigenous inputs and

undergo vigorous tidal exchange with the Atlantic shelf.

Despite their productivity, the volume of dissolved organic matter (DOM) and particulate organic carbon (POC) exported from these systems to the tropical Atlantic mesopelagic zone remains poorly constrained. This project establishes an observation framework to bridge the gap between West African coastal carbon exports and the broader objectives of the Joint Exploration of the Twilight Zone Ocean Network (JETZON).

Core Research Question

To what extent does lateral carbon export from tropical West African estuarine systems contribute to the mesopelagic carbon budget and

metabolic demand in the Eastern Atlantic?

Objectives

1. Quantify the net export of organic carbon and nutrients from major lagoon and estuarine outlets along the Nigerian coast.

2. Characterize the periodicity of carbon pulses driven by tidal oscillations and seasonal fluvial discharge.

3. Develop predictive models linking coastal flux data to offshore mesopelagic biogeochemical processes.

4. Integrate regional coastal observations with existing Atlantic deep-ocean datasets maintained by JETZON collaborators.

Methodological Approach

Coastal Source Monitoring

High-frequency sampling of DOM, POC, nutrient stoichiometry, and chlorophyll-a concentrations will be conducted at key estuarine-shelf interfaces to establish a baseline for terrigenous export.

Integrated Observation Strategy

To ensure data continuity in dynamic tropical environments, the project utilizes a multi-platform approach:

1. Multi-spectral satellite remote sensing for monitoring coastal turbidity and sea surface

color.

2. Fixed-point automated sensors deployed on existing maritime and oil-and-gas infrastructure.

3. Systematic water sampling campaigns in collaboration with local maritime stakeholders.

Data Modeling and Flux Estimation

Numerical modeling techniques will be used to synthesize satellite-derived data and field observations, allowing for the estimation of high-frequency carbon export events that are often missed by seasonal sampling.

Oceanic Integration

Coastal export signatures will be correlated with mesopelagic data from the tropical Atlantic to assess

the downstream impact on heterotrophic respiration and carbon sequestration within the twilight zone.

Scientific and Strategic Value

This initiative addresses a critical "missing link" in global carbon models: the lateral transport of

carbon from tropical margins to the deep ocean. For JETZON, this project introduces a vital West African perspective, expanding the network's reach into under-sampled tropical waters and fostering essential regional capacity building and South-North scientific synthesis.