2024 年度　傾斜的研究費（全学分）科研費チャレンジ　研究報告書

【研究費区分】:（※①科研費チャレンジ（A）②科研費チャレンジ（B）から該当するものを記入してください）②科研費チャレンジ（B）

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【研究課題名】: Comparative study of hydrodynamic processes in large and small estuaries

【研究実績の概要（400 字程度で記入。図，グラフ等の使用も可。）】

・Ashtamudi estuary (India):

Hydrographic surveys combined with water and sediment sampling for microplastic (MP) analysis were conducted along the longitudinal profile of the Ashtamudi estuary, India, during neap (28 Aug. 2024) and spring (05 Sep. 2024) tides of the wet season. Similar data for the dry season was already collected in March 2024. Vertical profiles of salinity, turbidity, chlorophyll-a, and related parameters were measured using a CTD probe with an optical sensor, alongside water and sediment sampling for MP analysis.

Results indicate that estuarine hydrodynamics, driven by tidal cycles, seasonal freshwater inflows, and anthropogenic pressures, influenced vertical salinity stratification and suspended sediment concentration (SSC). During the dry season, salinity stratification was observed during neap tides, whereas spring tides induced vertical mixing. In contrast, the wet season exhibited weaker salinity gradients due to persistent freshwater input. SSC followed similar tidal and seasonal dynamics, with higher concentrations near the bottom and peak values during spring tides due to intensified mixing in both seasons. However, SSC during spring tide in the wet season was slightly lower due to dilution from monsoonal inflows.

The distribution pattern of MP was closely linked to these hydrodynamic processes. Surface accumulation of MPs occurred during neap tides in the dry season due to limited mixing, while spring tides enhanced vertical dispersion. MP abundance declined in the wet season, influenced by stormwater runoff and freshwater inputs, which facilitated surface transport during neap tides and bottom accumulation during spring tides. MP size distribution showed depth-dependent variability: smaller particles dominated the bottom layers under low-energy conditions, while larger particles remained suspended under high-energy conditions. Fragmented MPs were the most prevalent type, followed by fibers and beads. Fiber concentrations were notably higher in the wet season, indicating possible inputs from aquaculture and textile-related sources.

Fourier Transform Infrared (FT-IR) spectroscopy identified high-density polyethylene (HDPE), nylon, and polystyrene (PS) as the dominant polymers, sourced from packaging, fishing gear, and industrial waste.

These findings highlight the need for improved waste management strategies to mitigate MP pollution, particularly from land-based sources and aquaculture activities. Further research integrating long-term

hydrodynamic monitoring and ecological assessments can aid in developing effective pollution control strategies.

・**Bidyadhari and Matla River estuaries, India (in collaboration with IIT Kharagpur, India):**

Hydrographic surveys were conducted in the middle to upstream regions of the Bidyadhari and Matla River estuaries, which flow through the Ganges Delta, during neap tide (30 Aug. 2024), intermediate tide (1 Sep. 2024), and spring tide (3 Sep. 2024). Vertical profiles of salinity, turbidity, chlorophyll-a, and other parameters were measured using a CTD probe with an optical sensor. The survey, covering approximately 50 km across both estuaries, was conducted in highly turbulent waters with strong currents, presenting challenging and hazardous conditions. Data analysis is currently in progress.

・**Chikugo River estuary (Japan):**

A hydrographic survey, combined with water and sediment sampling for MP analysis, was conducted during a spring tide (31 March 2025) at 14 km upstream of the Chikugo River estuary, where a well-developed estuarine turbidity maximum (ETM) has been previously reported. Surveys were performed across low tide, flood tide, high tide, and ebb tide. Vertical profiles of salinity, turbidity, chlorophyll-a, and other parameters were measured using a CTD probe with an optical sensor. Despite the highly turbulent waters and strong winds, the survey was successfully completed. Data analysis is currently ongoing.

・After completing the analysis, the results from all three estuaries will be compared. Existing data from the Tanintharyi River estuary in Myanmar will also be included for comparative analysis.

（※研究の全体の目的・意義に照らし，どのように達成されたかも含め記載すること。）

【本支援を用いた研究基盤整備の達成状況について】

・A specific methodology has been developed for sampling microplastics from both the surface and near-bed waters of the highly turbid and turbulent Chikugo River estuary using a vacuum pump. The on-boat procedure involves collecting approximately 23 liters of water per sampling event, filtering the turbid water, and concentrating it to a volume of less than 500 milliliters for further analysis.

・A collaborative research initiative aligned with the objectives of the KAKENHI proposal was launched in partnership with IIT Kharagpur (India), successfully completing field surveys during one season. Additional seasonal surveys in the Bidyadhari and Matla River estuaries will be conducted in continued collaboration with the research partner.

・A salinity sensor was installed 15 km upstream from the mouth of the Ashtamudi estuary to monitor long-term temporal variations in bottom salinity at 20-minute intervals. Additionally, a water level sensor was placed downstream to record long-term changes in water level, also at 20-minute intervals.

・A collaborative research project on the Cochin estuary in Kerala was discussed with the Cochin University of Science and Technology (CUSAT), India, with plans to include it in the upcoming KAKENHI proposal submission.

【外部資金への応募状況】

・The KAKENHI proposal was not accepted; however, a revised version with substantial improvements is being prepared for resubmission this year.

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【研究分担額】

（研究代表者・分担者名,所属,金額（円））

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