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ORIGINAL RESEARCH ARTICLE

Total suspended particulate matter in the Porsanger fjord (Norway) in the summers of 2014 and 2015

Jagoda Białogrodzka [a,b,*], Małgorzata Stramska [a,b], Dariusz Ficek [c], Marzena Wereszka [a]

[a] *Department of Earth Sciences, Szczecin University, Szczecin, Poland*
[b] *Institute of Oceanology, Polish Academy of Sciences, Sopot, Poland*
[c] *Department of Environmental Physics, Pomeranian University in Słupsk, Słupsk, Poland*

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Summary High-latitude fjords, very vulnerable to global change, are impacted by their land and ocean boundaries, and they may be influenced by terrestrial water discharges and oceanic water inputs into them. This may be reflected by temporal and spatial patterns in concentrations of biogeochemically important constituents. This paper analyses information relating to the total suspended matter (TSM) concentration in the Porsanger fjord (Porsangerfjorden), which is situated in the coastal waters of the Barents Sea. Water samples and a set of physical data (water temperature, salinity, inherent optical properties) were obtained during two field expeditions in the spring and summer of 2014 and 2015. Bio-optical relationships were derived from these measurements, enabling optical data to be interpreted in terms of TSM concentrations. The results revealed significant temporal variability of TSM concentration, which was strongly influenced by precipitation, terrestrial water discharge and tidal phase. Spatial distribution of TSM concentration was related to the bathymetry of the fjord, dividing this basin into three subregions. TSM concentrations ranged from 0.72 to 0.132 g m^{-3} at the surface (0–2 m) and from 0.5 to 0.67 g m^{-3} at 40 m depth. The average mineral fraction was estimated to be 44% at surface and 53% at 40 m.

* Corresponding author at: Department of Earth Sciences, Szczecin University, Mickiewicza 16, Szczecin 70-383, Poland. Tel.: +48 58 73 11 600; fax: +48 58 55 12 130.
E-mail addresses: jbialogrodzka@iopan.gda.pl, jagoda.bialogrodzka@gmail.com (J. Białogrodzka).
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1. Introduction

Important oceanic processes, such as the export of carbon and other biogeochemically important material are closely associated with the spatial and temporal variability of suspended particulate matter. The quantity and quality of suspended matter in the water column govern light transfer in surface waters and its availability to primary production, strongly influencing the euphotic depth (Kirk, 2011; Mobley, 1994). In extreme situations, the within-day variability of total suspended matter (TSM) in coastal waters may encompass several orders of magnitude due to the combined effects of physical (*e.g.*, terrestrial water runoff, tidal mixing, aerial deposition of dust) and biological processes (*e.g.*, biological production, aggregation, Montes-Hugo et al., 2012). The high-latitude fjords are among the regions where TSM dynamics is still poorly understood. This is because of the relatively large number of fjords, in which conditions can differ significantly. Traditional shipboard surveys have been sporadic and so far supplied very limited biogeochemical data sets in only a few fjords. In addition, because regional coastal algorithms are non-existent, a quantitative interpretation of the ocean colour data provided by satellite sensors in such locations is not possible.

In general, delivery of suspended matter to Arctic fjords involves four major processes (Syvitski, 1989): (1) ice-contact processes associated with tidewater glaciers, (2) rafting by icebergs and sea ice, (3) fluvial discharge of sediment and (4) exchanges of water masses, for example, as a result of oceanic inflows. To extend knowledge of TSM concentrations in high-latitude fjords, *in situ* experiments were carried out in the Porsanger fjord (Porsangerfjorden), one of the largest fjords in northern Norway (Fig. 1). There are no glaciers around the Porsanger fjord, so one would expect TSM concentrations in this fjord to be lower than, for example, in some Greenland and Spitsbergen fjords, where glaciers are present. Nevertheless, it is important to collect information in all types of fjords in order to understand more about how TSM concentrations (both organic and mineral fractions) vary across different time and spatial scales in the Arctic and to enable future extrapolation of this knowledge to large-scale and global estimates.

This paper describes the preliminary results of experiments carried out in the Porsanger fjord. The primary objective was to develop and validate local bio-optical relationships for estimating TSM concentrations from *in situ* optical data and to describe the spatial and temporal variability of TSM concentrations in the Porsanger fjord based on water samples and optical surveys. Traditionally, laboratory biogeochemical analyses of discrete water samples collected at sea have been used to determine the concentrations of suspended material in seawater. However, such analyses are time-consuming and difficult to apply on a large scale. More recently, optical instruments have become popular tools for ocean monitoring (Zaneveld et al., 1994). Unlike classic laboratory analyses of discrete water samples, *in situ* optical measurements provide information about the marine environment at larger spatial and temporal scales. This was the approach taken in the present research.

2. Study region

There are a great many fjords along the Norwegian coast with large variations in topography and dynamics. This paper focuses on the Porsanger fjord, which is located in the in the vicinity of the Barents Sea (Fig. 1) (*ca* 70.0–71.0°N, 25.0–26.5°E). Approximately 100 km long and 15–23 km wide, it has a maximum depth of more than 230 m and extends south-westwards from the northern tip of Norway (North Cape – Nordkapp). It is surrounded by mountains (Fig. 2) that rise to altitudes of more than one thousand metres (Mt. Cahkarassa, 1139 m) on the south-western side

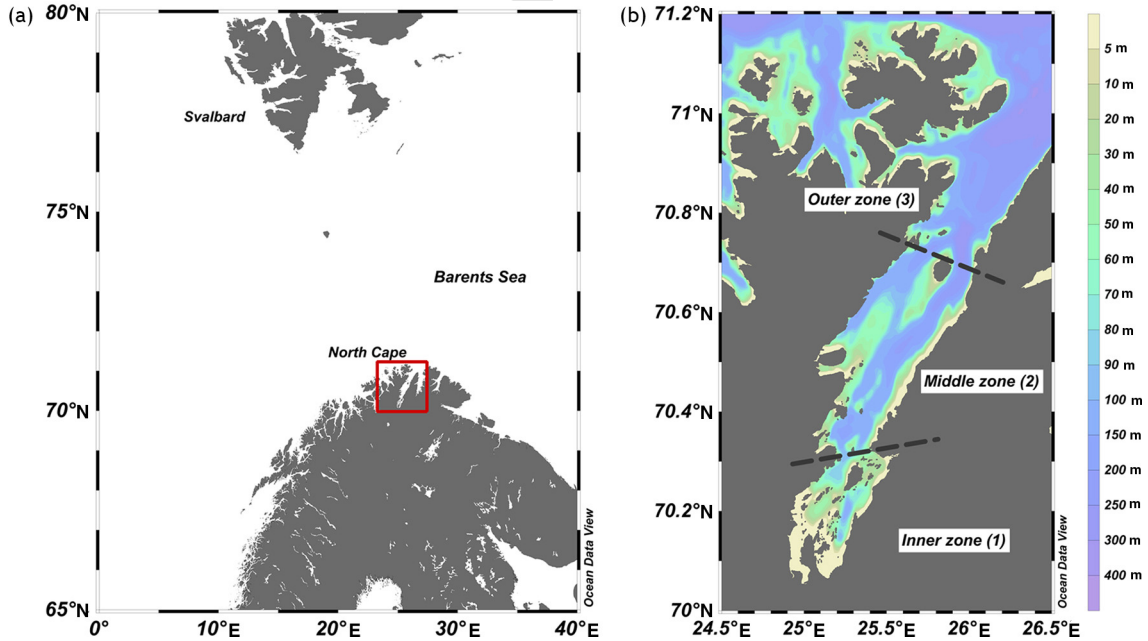

Figure 1 Geographical location of the Porsanger fjord (left panel, red rectangle); fjord bathymetry showing the three subregions investigated (right panel).

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