Międzynarodowa Środowiskowa Szkoła Doktorska
przy Centrum Studiów Polarnych
w Uniwersytecie Śląskim w Katowicach

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**IEDS/2026/IO/02**

# Adaptive optical algorithms for estimating selected physical and biogeochemical properties of particulate matter suspended in coastal Arctic waters of western Spitsbergen

**The leading unit:**
Institute of Oceanology of the Polish Academy of Sciences (IOPAN) in Sopot

**Requirements:**

1. Completed a second degree studies (Master's degree) in a field related to earth sciences, or physics, or mathematics, enabling the candidate's participation in the implementation of research tasks in the field of in oceanology, particularly those involving marine optics.
2. Ability to work in a research team.
3. Knowledge of English sufficient to communicate, read scientific papers, present scientific results, and independently prepare manuscripts for scientific publications.

**Tasks description:**

1. Analyzing empirical data collected in the database of the Marine and Atmospheric Optics Laboratory at the IOPAN for the development of adaptive optical algorithms, which are the goal of the doctoral project.
2. Conducting data and literature searches/queries that could significantly expand the ongoing analyses.
3. Preparing applications for additional funding to conduct extended research and analyses within the proposed topic.
4. Preparing, organizing, and conducting complementary field studies.
5. Developing adaptive optical algorithms in line with the main goal of the doctoral project.
6. Preparing scientific articles and conference presentations regarding the achievements of the doctoral project.
7. Regularly reporting on progress.
8. Assisting with other daily scientific tasks performed by members of the Marine and Atmospheric Optics Laboratory at the IOPAN.

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**Summary of a doctoral project:**

Arctic coastal waters, including the fjords of western Spitsbergen, generally belong to the category of optically-complex waters, also known as Case 2 waters (according to the original classification proposed by Morel and Prieur, 1977). For such waters, it is not possible to parameterize their optical properties as a function of a single factor – the concentration of the basic phytoplankton pigment, chlorophyll *a*. Arctic coastal waters are characterized, among other things, by significant variability in the composition of suspended particulate matter, including variable proportions of organic and inorganic fractions. The development of practical formulas and algorithms for the interpretation of various optical measurements conducted in such waters, both *in situ* and remotely, remains an important and open research issue. A review of the current world literature on the subject suggests, among other things, the possibility of developing and applying new, more accurate, so-called adaptive optical algorithms for estimating selected physical and biogeochemical properties of matter suspended in seawater (see e.g. Stramski et al., 2023). The proposed research topic is intended to enable the practical application of data and fundamental knowledge previously collected by the Marine and Atmospheric Optics Laboratory at IOPAN, concerning the variability of the optical properties of suspended matter in the specified Arctic region, depending on the concentration, composition, and selected characteristics of the particle size distribution of suspended matter (see Woźniak et al., 2024 a and b). The main current goal is to develop new, adaptive algorithms for the interpretation of optical measurements conducted in the coastal waters of western Spitsbergen. These algorithms are intended to enable more accurate estimation of quantities characterizing suspended matter, such as the mass concentration of suspended particulate matter (SPM), the concentration of organic and inorganic fractions of particulate matter (POM, PIM), the concentration of particulate organic carbon (POC), and the concentration of chlorophyll *a* (Chl*a*).

**Other information:**

The work will be carried out under supervision of dr hab. Sławomir B. Woźniak, professor at the IOPAN (e-mail: woznjr@iopan.pl), representing the Marine and Atmospheric Optics Laboratory from the Marine Physics Department of IOPAN.

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