



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

ul. Będzińska 60  
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**Reference No: IEDS/2020/IO PAN/04**

**Proposed title of PhD project: *Variability of inherent optical properties of seawater in relation to the concentration, composition and size distribution of suspended particulate matter in selected fjords of western Spitsbergen***

**Leading unit:** International Environmental Doctoral School associated with the Centre for Polar Studies at the University of Silesia in Katowice (IEDS) – Institute of Oceanology Polish Academy of Sciences

**Mode of study:** full-time

**Degree to be obtained:** PhD in the field of natural sciences, in the discipline of Earth and related environmental sciences

**Duration:** 4 years (8 semesters), from October 2020

**Language:** English

**Scholarship:**

- the gross amount of 5000 PLN monthly (1-2<sup>nd</sup> year)
- the gross amount of 6000 PLN monthly (3-4<sup>th</sup> year)

**Requirements and regulations:** [www.mssd.us.edu.pl/kandydat-mssd/](http://www.mssd.us.edu.pl/kandydat-mssd/)

**Registration online:** [www.irk.us.edu.pl](http://www.irk.us.edu.pl)

**Requirements:**

1. MSc degree (or equivalent) in a field related to the Earth sciences (preferred: oceanography) or in a field related to classic science such as physics or mathematics, allowing for the implementation of tasks in the field of oceanology and sea water optics. A candidate may submit application if receives the MSc Degree till September, 30, 2020.
2. Initial knowledge of research topics within the discipline of oceanology.
3. Knowledge in the field of mathematics, including knowledge of typical statistical tools and methods used in experimental sciences.



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4. Knowledge of English language enabling communication, reading and writing of scientific papers.
5. General predisposition to conduct scientific research, both as a member of a larger team and independent.

**Tasks description:**

1. Participation in the collection of experimental data in marine conditions during research cruises.
2. Participation in laboratory work and experiments regarding the optics of sea waters.
3. Participation in works related to acquiring oceanographic data from existing databases.
4. Participation in theoretical analyzes and modeling of optical processes taking place in the marine environment.
5. Preparation and organization of independent and team research related to the subject of the planned doctoral dissertation, including during selected IOPAN expeditions to the Spitsbergen area.
6. Analysis of the obtained data.
7. Preparation of scientific articles and conference presentations.
8. Regular reporting of work progress.
9. Assistance in other current scientific tasks carried out at the Department of Marine Physics, IOPAN.

**Abstract**

The work is to be carried out as part of a new scientific project that concerns optical properties of marine waters in Arctic regions. Seawater is generally a complex medium which, in addition to chemically pure water, usually includes additional dissolved and suspended substances. In general, these substances can have a different nature (organic and inorganic) as well as different origins (autogenic or allogenic). The ability of seawater to absorb and scatter visible light is precisely described by the quantities called *inherent optical properties*. Unlike dissolved substances that contribute mainly to the light absorption, suspended substances (*suspended particulate matter*) can also effectively scatter light. The composition of suspended particulate matter in coastal regions is usually much more complicated than in open oceanic regions. In such reservoirs, seawater optical properties cannot be effectively described/parameterized using only one quantity - the concentration of chlorophyll  $\alpha$ , which is often used as an approximate measure (proxy) of the abundance of autogenic photosynthesizing plankton. The proposed empirical research will be carried out



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in the western Spitsbergen fjords, which can be an example of particularly *optically-complex waters*. In these waters there may be variable concentrations, composition and properties of suspended matter, both of autogenic and allogenic origin, with significant changes in the proportion between organic and inorganic fractions.

A review of the literature on the subject indicates that the research on the optical properties of suspended particulate matter occurring in coastal Arctic regions was conducted only to a limited extent. It also seems that under the new project it will be possible and advisable to apply concepts and methodologies that have previously been used in research conducted in other marine areas.

The main goal of the project is to precisely characterize the variability of the inherent optical properties of seawater in selected fjords of western Spitsbergen, in relation to the concentration, composition and size distribution of the suspended particulate matter populations found in these waters. The proposed studies are activities in the field of basic sciences. In addition, however, the new results achieved will allow us in the future to increase the accuracy of practical optical methods for studying the marine environment (both *in situ* methods and remote sensing).

As part of the project, field measurements and sampling will be carried out in selected fjords of western Spitsbergen (Hornsund, Isfjorden and Kongsfjorden), during three expeditions of the *r/v Oceania* to the Arctic in years 2021-2023. As part of the research, selected inherent optical properties of seawater as well as biogeochemical and physical properties of suspended matter will be determined. The following quantities will be analysed: spectral values of light absorption, scattering and backscattering coefficients, concentrations of suspended particulate matter and its organic and inorganic fractions, concentrations of chlorophyll *a* and other phytoplankton pigments, as well as size distributions of suspended particulate matter populations. These analyses will be conducted on both original and size-fractionated water samples.

The collected new empirical material will allow to implement the following specific objectives:

- determining the absorption budget and the variability of absorption coefficient by particles in relation to the biogeochemical and physical properties of suspended matter;
- determining the variability of scattering, and backscattering coefficients by particles, and also the variability of backscattering ratio;



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- checking whether in the studied environment it is possible to use ratios of relatively easily measurable optical coefficients to estimate the composition of suspended matter;
- checking the effectiveness of existing so-called *optical pre-classifications* and, if possible, proposing new ones to improve the accuracy of practical interpretation of data from direct and remote optical measurements.

The project will be implemented by a future PhD student and his supervisor (author of this project), in cooperation with other employees of the Institute of Oceanology of the Polish Academy of Sciences. Project results will be presented, among others, in a series of publications in international peer-reviewed journals that will form the basis for preparing a PhD student's dissertation.

**Other information:**

1. The supervisor will be dr hab. Sławomir B. Woźniak, email: [woznjr@iopan.gda.pl](mailto:woznjr@iopan.gda.pl), Institute of Oceanology, Polish Academy of Sciences
2. Contact to the Secretary of the IEDS Admission Committee +48 32 3689 380, [polarknow@us.edu.pl](mailto:polarknow@us.edu.pl), [www.mssd.us.edu.pl](http://www.mssd.us.edu.pl)