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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 (1-2nd year)
- the gross amount of 6000 PLN monthly (3-4th year)

Requirements and regulations: www.mssd.us.edu.pl/kandydat-mssd/

Registration online: www.irk.us.edu.pl

Conditions of recruitment:

The recruitment will be conducted in accordance with the requirements of the National Science Centre (NCN) for the PRELUDIUM BIS 1 competition, under which the future PhD student will be awarded a scholarship. These requirements are:

- a person who does not have a doctoral degree and is not a doctoral school participant may enter the competition;
- the competition is carried out by a commission appointed by the head of the entity in which the research project will be implemented, consisting of the project PI as chairman and at least two persons indicated by him with appropriate scientific or professional qualifications;

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- the commission assesses the candidates on a point scale taking into account the competence to carry out specific tasks in the research project and the candidate's current scientific achievements, on this basis compiling the ranking of candidates according to the following criteria: competence to carry out specific tasks in the research project (70% of the final grade; 3 points very good, 2 points good, 1 point weak; 0 points lack of competence); candidate's scientific achievements, including publications in reputable scientific publications/journals (30% of the final grade; 4 points distinctive, 3 points very good, 2 points no scientific achievements).

The commission will also assess whether there are any formal obstacles to the correct implementation of the project by the candidate, take into account the opinion of the proposed Supervisors and set a minimum point limit allowing the admission of the candidate to the project. As a result of all these activities and based on the result obtained in the course of the qualification procedure, the commission will make the final decision on admission or non-admission to the doctoral school.

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.
- 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.

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- 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 a, which is often used as an approximate measure (proxy) of the abundance of autogenic photosynthesizing plankton. The proposed empirical research will be carried out 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

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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 <u>to implement the following specific</u> <u>objectives</u>:

- 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;

- 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 in cooperation with other employees of the Institute of Oceanology of the Polish Academy of Sciences. Scientific

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supervision will be provided by dr hab. S. B. Woźniak and prof. D. Stramski. 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:

- The work will be carried out under the supervision of dr hab. Sławomir B. Woźniak from Institute of Oceanology, Polish Academy of Sciences (email: woznjr@iopan.gda.pl) and prof. Dariusz Stramski from Scripps Institution of Oceanography, University of California San Diego (USA)
- The scholarship will be paid as part of the OPTYKA-BIS project (NCN, PRELUDIUM BIS 1). The candidate must undergo competitive recruitment for the OPTYKA-BIS project. Information about the competition procedure for the OPTYKA-BIS project: <u>https://www.ncn.gov.pl/baza-ofert/?akcja=wyswietl&id=183177</u>
- 3. Contact to the Secretary of the IEDS Admission Committee +48 32 3689 380, polarknow@us.edu.pl, www.mssd.us.edu.pl

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