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

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Title of PhD project: The role of wind waves in mixing and transport of suspended material in the ocean surface layer.

The leading unit: Institute of Oceanology, Polish Academy of Sciences

Requirements:

1. MSc in physics, mathematics, physical oceanography or related field.
2. MSc thesis related to the subject of the doctoral project will be an advantage. Otherwise, documented practical experience related to this subject.
3. Additional advantages: experience in satellite data analysis and in observational data analysis, (co)authorship of scientific papers and conference presentations.
4. High motivation for scientific work.
5. Practical skills: programming; data processing and visualization; typesetting of scientific texts; Matlab.
6. Good skills in speaking and writing in English.

Tasks description:

1. Participating in data collection (in the laboratory and in the field) and in data processing
2. Preparing of a database of existing and new observational data on Stokes drift and Langmuir circulation (with accompanying wind and wave forcing)
3. Numerical modelling of material transport in the ocean mixed layer
4. Preparing a parametrization of material transport based on observational data and modelling results.
5. Analysis of frazil ice transport in coastal polynyas.
6. Preparing of publications and conference presentations, presenting the results at international conferences.

Summary of a doctoral project:

Wind waves and wave-generated currents (Stokes drift, Langmuir circulation) are an important component of the dynamics of the ocean surface layer. One of the crucial aspects of these processes is transport of material suspended in water (pollution, plankton organisms, frazil ice crystals, etc.). Wave-generated currents significantly modify the net speed and direction of the material transport, as well as the material's dispersion rates and distribution within the water column. Despite practical relevance of these processes, many of their aspects remain poorly understood. In particular, there are no satisfactory parameterizations for estimating the probability density of sizes of Langmuir cells, or for extimating the horizontal velocity within the surface convergence zones of those cells – and thus in areas where the concentration of the transported material tends to be the highest. The goals of this doctoral project are: (i) analysis of statistical relationships between the features of the Langmuir

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circulation (its vertical range, velocity of upwelling and downwelling currents, horizontal velocity) and its wind and wave forcing; (ii) formulation of parametrizations for predicting Stokes- and Langmuir-induced material transport in a wide range of conditions; (iii) analysis of the role of waves in the dynamics of coastal polynyas. The project will be based on the analysis of *in situ* and satellite data, as well as numerical modelling.

Other information:

The work will be carried out under supervision of: dr hab. Agnieszka Herman, prof. IOPAN (agaherman@iopan.pl), Institute of Oceanology PAN

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IEDS admissions details: https://www.mssd.us.edu.pl/en/admission-2025-2026/