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

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Title of PhD project: Settling dynamics of marine aggregates with complex physical characteristics

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

Requirements:

1. MSc in physics or chemical and process engineering
2. Experience in working in a chemical or physical laboratory
3. Programming skills (e.g. Matlab, R)
4. Proven track record of achievements: conference presentations, participation in research projects, competitions, awards, distinctions, publications
5. Effective communication in speech and writing in English

Tasks description:

1. Participation in the preparation and execution of laboratory experiments utilising high-resolution imaging systems and Particle Image Velocimetry (PIV) methods;
2. Analysis of image data, determination of aggregate settling dynamics, and characterisation of fluid velocity fields, and the interpretation of results;
3. Preparation of scientific articles and research promotional materials with the support of the supervisor;
4. Academic development through literature reviews, and participation in training sessions, workshops, and scientific conferences;
5. Commitment to establishing and maintaining national and international research collaborations;
6. Contribution to the scientific and educational tasks of the department, specifically those related to the activities of the Laboratory of Hydrodynamic Micromodels within the Department of Hydrology and Hydrodynamics at IGF PAS (Institute of Geophysics, Polish Academy of Sciences), where the doctoral dissertation will be conducted.

Summary of a doctoral project:

Billions of tonnes of carbon sink annually to the ocean depths in the form of aggregated organic matter and mineral particles. During their descent as so-called "marine snow", these aggregates undergo fragmentation and remineralisation, thereby influencing the carbon cycle within the ocean–atmosphere system, global climate, and the functioning of marine ecosystems. Understanding these processes constitutes one of the major challenges in environmental sciences. A significant source of uncertainty in quantifying these processes is

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the settling velocity of the aggregates. Estimates based on field measurements provide only point-source information, while simplified sedimentation models are prone to substantial errors. To improve descriptions of aggregate transport, approaches based on the physics of their motion, accounting for their complex structure and properties, are increasingly being utilised. Aggregates are characterised by an irregular, often fractal structure and exhibit complex hydrodynamics that combine the properties of settling rigid solids and soft biological matter. The research planned for this doctoral dissertation aligns with the current trend aimed at integrating aggregate dynamics with their morphological parameters and material properties. The proposed laboratory studies will complement existing *in situ* observations and theoretical models.

The work will involve laboratory experiments focused on analysing the settling dynamics of model aggregates within a fluid column. Experimental conditions will be selected to reflect the sedimentation process of marine snow, taking into account the variations in shape, density, and mechanical properties of the aggregates' biopolymer matrix. The experiments will be conducted using a laboratory setup equipped with high-resolution cameras and a Particle Image Velocimetry (PIV) system, enabling the tracking of particle dynamics and the characterisation of the surrounding fluid flow. The research will be conducted in collaboration with research groups from Poland and abroad, specialising in marine snow phenomena.

The results of this research will contribute to improving methods for estimating sedimentation rates and will help deepen knowledge regarding the interactions between aggregate dynamics, microscale fluid flow, and the ecology of the aggregate microenvironment.

Other information:

The work will be carried out under supervision of: Magdalena Mrokowska, PhD, DSc, Institute of Geophysics, Polish Academy of Sciences

Signature Not Verified
Dokument podpisany przez
Magdalena Mrokowska
Data: 2026.05.27 08:15:03 CEST

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