COURSE UNIT DESCRIPTION

Course unit title	Code
Atmospheric Bioaerosols	

Annotation
Aerosols of biological origin (bioaerosol) are an important part of the Earth system. Their role is significant in the interaction between the biosphere (especially the atmosphere), climate and public health. Bacteria, microscopic fungal spores, pollen and other particles of biological origin are important organs, mostly responsible for plant reproduction and spread in ecosystems. They can also cause or exacerbate human, animal and plant diseases. Bioaerosol can affect the hydrological cycle and climate as particles become nuclei of cloud droplets, ice crystals and precipitation. The issue of bioaerosol dispersal is closely linked to society's actual topics, including human activities, agricultural or other types of land use, in order to effectively mitigate or adapt to climate change. During the study period the sources of biological aerosols and the atmospheric microbiome, the abundance, composition and effects of bioaerosol on natural systems and human health are analysed. Attention is paid to the identification of bioaerosol, the principles of transportation and transformation processes are studied, the interaction with climate and chemical processes in the atmosphere is clarified. This creates an environment for active discussion that allows for a better understanding of the role of bioaerosol in ecosystems.

Lecturer(s)	Department, Faculty
Coordinating: prof. dr. Ingrida Šaulienė **Other:** Assoc. prof. dr. Laura Šukienė Dr. Martynas Kazlauskas Dr. Ilona Kerienė	Šiauliai Academy

Study cycle	Type of the course unit
Second cycle studies	Compulsory

Mode of delivery	Semester or period when it is delivered	Language of instruction
Blended learning	1 semester	Lithuanian/English

Requisites	
Prerequisites: basics of biology, ecology, geography	**Co-requisites (if relevant):**

Number of ECTS credits allocated	Student's workload (total)	Contact hours	Individual work
5	140	48	92

Purpose of the course unit: programme competences to be developed
To provide knowledge about bioaerosol, its role in the atmosphere and its interaction with terrestrial and marine ecosystems, to develop an understanding of how global and regional changes in land use, climate and biodiversity will affect the abundance and properties of atmospheric bioaerosols that may affect vegetation development and disease spread. Subject-specific competencies to be developed: knowledge of the latest achievements and prospects related to bioaerosols and their role in the Earth system, taking into account their identification and characterization, transport and transformation processes, as well as interactions with climate, health and terrestrial and marine ecosystems, scientific and practical problems.

Developed general competence: the ability to share information and arguments, critically reflect on the information received, skills to find effective ways to protect ecosystems problems, work independently and in a team.		
Learning outcomes of the course unit	**Teaching and learning methods**	**Assessment methods**
– Will be able in a multidimensional environment to solve complex problems arising from the peculiarities of the dispersion of pollutants of biological origin.	Interactive lecture, group work, discussions	Test. Oral presentation
– Will be able to make informed choices and reasoned approaches to shape solutions to both human health and ecosystems, and even with only partial information.	Workshops, expert method, case analysis	Practical work report
– Will deepen the ability to share information and improve by attending meetings, seminars or conferences.	Group work, individual work, analysis of scientific literature	Oral presentation

Course content: breakdown of the topics	**Contact hours**							**Individual work: time and assignments**	
	Lectures, e.learning	Tutorials	Seminars, e.learning	Workshops	Laboratory work	Internship/work placement	**Contact hours, total**	**Individual work**	**Assignments**
European environmental policy on biological pollutants	2						2	6	Analysis of study material
Characteristics of bioaerosol				2			2	8	Preparation for the seminar. Analysis of scientific literature. Preparation of the oral presentation. Repetition of lecture material.
Emission sources of natural and anthropogenic origin			2	2			4	6	Lecture material repetition. Preparation for practical work according to the agreed topics. Writing a practical work report.
Technologies for the detection of bioaerosol in the atmosphere				4			4	8	Literature collection and analysis
Particle identification methods and standards				4			4	12	Lecture material repetition. Preparation for practical work according to the agreed topics. Writing a practical work report.
Physical and chemical transformation of particles			2	2			4	6	Lecture material repetition.
The formation of cloud nucleus				2			2	6	Lecture material repetition.
Dispersion modeling	2			4			6	8	Collection and analysis of material for workshop
Forecast models	2		2	2			6	6	Lecture material repetition. Preparation for workshop.
The role of bioaerosols in ecosystems				2			2	8	Lecture material repetition. Preparation for practical work according to the agreed topics. Writing a practical work report.
Effects of bioaerosol particles on human health			4	4			8	8	Organization of a seminar. Analysis of scientific literature. Preparation of the oral presentation.
Public information systems on biological pollution				4			4	10	Analysis of scientific sources and practice cases
Iš viso	6	0	10	32	0	0	48	92	

Assessment strategy	Weight %	Deadline	Assessment criteria
Oral presentation	30	8 and 11 week of semester	Assessment includes activity during all seminars (30%) and assessment of the student's individual report (70%): Activity 3 points. The student was ready for the analysed topic, engages in discussions, answers questions, formulates problems and questions, makes critical remarks; 2 points. The student participates in discussions, answer questions, formulates problems and questions; 1 point. The student participates in discussions, answers questions; 0 points. The student is inactive. Evaluation of presentation: 25% presentation visualization; 35% of content is relevant to the topic; 20% student speech fluency; 20% ability to answer audience questions.
Practical work report			The evaluation of practical work consists of: Assessment of readiness for work 3 points. The student knows the purpose and results to be achieved, having regard to the object of research, studied research methods. 2 points. The student reads the aim of the work, knows the object of research, has studied research methods. 1 point. The student reads the aim of the work, superficially knows the object and methods of research. 0 points. The student is not ready for work. Work report 3 points. The scientific basis of the analysed problems is presented, the original research results are systematised, statistical data analysis methods are applied, if possible, the conclusions are argued with the research results. 2 points. The scientific basis of the analysed problems is not provided, the original research results are presented, statistical data analysis methods are applied, if possible, the conclusions are argued with the research results. 1 point. The scientific basis of the analysed problems is not provided, the research results are not systematized enough, the conclusions are argued with the research results. 0 points. Report not submitted. Work defense evaluation 4 points. The student knows the scientific background related to the work, uses this knowledge to analyse the information obtained at work, can discuss even in cases when has partial information. 3 points. The student knows little about the scientific problems related to the work, analyses the results of the work based only on the data and experience of his / her research, can discuss professionally, and has partial information. 2 points. The student knows little about the scientific problems related to the work, analyses the results of the work based only on the data and experience of his / her research, is unable to discuss with partial information. 0 points. The student does not defend the work.
Test	30	During exam sesion	Consists of 30 open-ended and closed-ended questions (of varying difficulty, from comprehension to assessment). Evaluated as follows:

			Excellent knowledge and skills. Assessment level. 9.5-10 points. Very good knowledge and skills. Assessment level. 8.5-9 points. Good knowledge and skills, there may be minor mistakes. Level of synthesis. 7.5-8 points. Average knowledge and skills, there are mistakes. Level of analysis. 6.5-7 points. Knowledge and skills are below average, there are (substantial) mistakes. Level of knowledge application. 5.5-6 points. Knowledge and skills still meet the minimum requirements. Lots of mistakes. Level of knowledge and understanding. 4.5-5 points. Minimum requirements not met. 0-4.4 points.

Author	Publishing year	Title	Issue of a periodical or volume of a publication; pages	Publishing house or internet site
Required reading				
Després, V., Huffman, J. A., Burrows, S. M., Hoose, C., Safatov, A., Buryak, G., ... & Jaenicke, R.	2012	Primary biological aerosol particles in the atmosphere: a review.	*Chemical and Physical Meteorology 64.* (1), 15598,	https://doi.org/10.3402/tellusb.v64i0.15598
Fröhlich-Nowoisky, J., Kampf, C. J., Weber, B., Huffman, J. A., Pöhlker, C., Andreae, M. O., ... & Pöschl, U	2016	Bioaerosols in the Earth system: Climate, health, and ecosystem interactions.	Atmospheric Research, 182, 346-376	https://doi.org/10.1016/j.atmosres.2016.07.018
Sofiev, M., & Bergmann, K. C. (Eds.).	2012	Allergenic pollen: a review of the production, release, distribution and health impacts.	ISBN 978-94-007-4881-1	https://www.springer.com/gp/book/9789400748804
Recommended reading				
Pöschl, U.	2005)	Atmospheric aerosols: composition, transformation, climate and health effects.	Angewandte Chemie International Edition, 44(46), 7520-7540.	https://doi.org/10.1002/anie.200501122
Šaulienė, I., Šukienė, L., Daunys, G., Valiulis, G., Vaitkevičius, L., Matavulj, P., ... & Sofiev, M..	2019	Automatic pollen recognition with the Rapid-E particle counter: the first-level procedure, experience and next steps.	Atmospheric Measurement Techniques, 12(6), 3435-3452.	https://doi.org/10.5194/amt-12-3435-2019
Clot, B., Gilge, S., Hajkova, L., Magyar, D., Scheifinger, H., Sofiev, M., ... & Tummon, F...	2020	The EUMETNET AutoPollen programme: establishing a prototype automatic pollen monitoring network in Europe	Aerobiologia, 1-9.	https://doi.org/10.1007/s10453-020-09666-4
Huffman, J. A., Prenni, A. J., DeMott, P. J., Pöhlker, C., Mason, R. H., Robinson, N. H., Fröhlich-Nowoisky, J., Tobo, Y., Després, V. R., Garcia, E., Gochis, D. J., Harris, E., Müller-Germann, I., Ruzene, C., Schmer, B., Sinha, B., Day, D. A., Andreae, M. O., Jimenez, J. L., Gallagher, M., Kreidenweis, S. M., Bertram, A. K., and Pöschl, U	2013	High concentrations of biological aerosol particles and ice nuclei during and after rain	Atmos. Chem. Phys., 13, 6151–6164	https://doi.org/10.5194/acp-13-6151-2013