

**Subject card**

<b>Subject name and code</b>	Satellite Information Systems - lecture, PG_00204950						
<b>Field of study</b>	Oceanography						
<b>Date of commencement of studies</b>	October 2026	<b>Academic year of realisation of subject</b>			2027/2028		
<b>Education level</b>	Master's studies	<b>Subject group</b>			Obligatory subject group in the field of study Optional subject group Subject group related to scientific research in the field of study		
<b>Mode of study</b>	full-time studies	<b>Mode of delivery</b>			at the university		
<b>Year of study</b>	2	<b>Language of instruction</b>			Polish		
<b>Semester of study</b>	4	<b>ECTS credits</b>			1.0		
<b>Learning profile</b>	academic	<b>Assessment form</b>			credit		
<b>Conducting unit</b>	Laboratory of Physical Oceanography -> Department of Physical Oceanography and Climate Research -> Faculty of Oceanography and Geography -> Rector						
<b>Name and surname of lecturer (lecturers)</b>	Subject supervisor		dr Maciej Markowski				
	Teachers						
<b>Lesson types</b>	<b>Lesson type</b>	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	<b>Number of study hours</b>	15.0	0.0	0.0	0.0	0.0	15
	E-learning hours included: 0.0						
	Additional information:  Multimedia-based lecture. If necessary, the lecture can be conducted by using on-line method.						
<b>Learning activity and number of study hours</b>	<b>Learning activity</b>	Participation in didactic classes included in study plan		Participation in consultation hours		Self-study	SUM
	<b>Number of study hours</b>	15		1.0		9.0	25
<b>Subject objectives</b>	Introducing students with the physical and technical foundations of acquiring information from satellite-based techniques. Particular emphasis will be placed on satellite systems used for Earth observation in the context of conducting environmental analyses.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[OCEANMU2-W04] has an in-depth understanding of the latest research trends in oceanography, as well as the possibilities for practical application of related achievements; evaluates their usefulness and limitations in solving scientific research problems, and critically analyzes and assesses their applicability	The student knows and understands in-depth the latest trends in oceanographic research using satellite remote sensing devices and systems	[SW4] test/exam - oral or written
	[OCEANMU2-W03] has an in-depth understanding of research methods used in oceanography and related sciences, and interprets their mechanisms and interrelationships across different spatial and temporal scales	The student knows and understands in-depth research methods used in the work of an oceanographer to describe and interpret phenomena and processes occurring in the aquatic environment using satellite data	[SW4] test/exam - oral or written
	[OCEANMU2-W01] knows and understands in-depth specialized terminology used in oceanography and related sciences (in Polish and a selected foreign language)	The student knows and understands in-depth specialized terminology related to satellite remote sensing methods used in oceanography, in particular microwave techniques.	[SW4] test/exam - oral or written
Subject contents	<p><b>1. Physical fundamentals of electromagnetic wave interaction with the sea surface and water column</b></p> <ul style="list-style-type: none"> <li>Interaction of electromagnetic radiation with the sea surface: reflection, scattering, absorption, and the impact of sea state on the satellite signal.</li> <li>Influence of the marine atmosphere (aerosols, water vapour, clouds) on the propagation of solar and microwave radiation in oceanographic observations.</li> </ul> <p><b>2. Remote sensing of the marine environment and development of remote sensing methods</b></p> <ul style="list-style-type: none"> <li>History and evolution of marine and oceanographic satellite observations: from optical radiometry to radar interferometry and altimetry.</li> <li>Scope and capabilities of modern satellite systems in sea monitoring.</li> </ul> <p><b>3. Optical methods and remote sensing instruments in marine research</b></p> <ul style="list-style-type: none"> <li>Optical and hyperspectral radiometers used in coastal waters observations: characteristics, sensitivity, limitations in the marine environment.</li> <li>Acquisition of satellite and aerial imagery over the sea: impact of viewing angle, surface noise, and optical variability of water.</li> </ul> <p><b>4. Thermal, radar, and lidar sensors used in physical oceanography</b></p> <ul style="list-style-type: none"> <li>Application of thermal and microwave sensors in the analysis of sea surface temperature, evaporation, frontal structures, and current dynamics.</li> <li>Radar SAR systems and lidar bathymetric techniques in monitoring wave activity, sea currents, sea ice, and characterising the coastal zone.</li> </ul> <p><b>5. Preparation, analysis, and interpretation of satellite data for marine and coastal areas</b></p> <ul style="list-style-type: none"> <li>Processing and analysis of satellite imagery: creation of spatial layers, spectral feature extraction, identification of water masses, blooms, and hydrodynamic phenomena.</li> <li>Classification of marine imagery (supervised and unsupervised) and comparison of methods in the context of change detection in the marine environment.</li> </ul>		
Prerequisites and co-requisites	Knowledge of the basics of satellite remote sensing and GIS		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
		51.0%	100.0%
Recommended reading	Basic literature	<ul style="list-style-type: none"> <li>Robinson I., 2010. Discovering the Oceans from Space: The unique applications of satellite oceanography, Springer-Verlag, Berlin and Heidelberg</li> <li>Emery W., Camps A., 2017, Introduction to Satellite Remote Sensing. Atmosphere, Ocean, Land and Cryosphere Applications, Elsevier</li> <li>Hejmanowska B., Wężyk P. (red.), 2020, Dane satelitarne dla administracji publicznej, Polska Agencja Kosmiczna</li> </ul>	
	Supplementary literature	<ul style="list-style-type: none"> <li>Berizzi F., Martorella M., Giusti E., 2016, Radar Imaging for Maritime Observation, CRC Prss, Taylor &amp; Francis Group 348 s.</li> <li>Martin S., 2004, An introduction to Ocean Remote Sensing, Cambridge University Press, 426 s.</li> <li>Chapman R., Gasparovic R., 2022, Remote sensing physics: an introduction to observing earth from space, Wiley, Hoboken USA, 468 ss.</li> <li>Chang N.-B., Bai K., 2018, Multisensor data fusion and machine learning for environmental remote sensing, CRC Press, Boca Raton, 508 ss.</li> <li>Adamczyk J., Będkowski K., 2007, Metody cyfrowe w teledetekcji. Wyd. SGGW, Warszawa</li> <li>Sanecki J. (red.), 2007, Teledetekcja: pozyskiwanie danych, Wydawnictwa Naukowo-Techniczne, Warszawa</li> </ul>	
	eResources addresses		

Example issues/ example questions/ tasks being completed	Assessment criteria: Knowledge of <ul style="list-style-type: none"> <li>• physical processes occurring in the sea that can be studied using satellite methods</li> <li>• satellite techniques used to study specific processes in the sea sea</li> <li>• surface properties that enable remote detection of the phenomena discussed in the lecture</li> <li>• satellite data processing stages necessary to obtain specific environmental information from satellite data</li> <li>• spatial data analysis methods used in the analysis of satellite data in oceanography</li> </ul>
Work placement	Not applicable

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