COURSE OF DOCTORAL STUDIES

Course title	Field of science (branch) code	University / Faculty	Institute / Department
Applications of Remote Sensing in Geosciences	Natural Sciences (Physical Geography) N 006	Vilnius University / Faculty of Chemistry and Geosciences Klaipėda University	Institute of Geosciences / Department of Hydrology and Climatology Marine Research Institute

Study methods	Number of credits allocated	Study methods	Number of credits allocated
Lectures	1	Seminars	2
Individual work	6	Consultations	1

Course annotation

Objectives: provide exposure to students in gaining deeper knowledge on the basics of remote sensing, characteristics of satellite sensors, and remote sensing applications in geography, meteorology and oceanography. The main focus is placed on image acquisition, data collection, processing and appropriate data set manipulations. Also this course is designed for geographic information systems (GIS) in imagery analysis.

Main topics:

Introduction into remote sensing. Basic techniques for remote environmental monitoring. Surface and orbital remote sensors. Orbits of Earth satellites, their characteristics. Electromagnetic (EM) radiation properties. Radiative transfer theory. Emissivity and reflectivity of different surfaces. Passive and active remote monitoring systems. Satellite and aerial remote systems. Camera and scanning systems. LIDAR laser scanning system. Image filtering methods. Analysis and interpretations of aerial information.

Basic principles of radar. Synthetic aperture radar (SAR). Scatterometry and altimetry. Remote sensing applications in the atmosphere and hydrosphere. Water vapour, cloud systems and precipitation. Global net radiation. Remote sensing of severe weather. Remote sensing in surface hydrology and the marine environment, basics of satellite oceanography. Analysis of satellite data: ocean colour, sea surface (SST) and land surface (LST) temperature etc., difference between satellite sensors channels and sensor types. Difference in data retrieved from open ocean and coastal areas as well as from surface water bodies.

The use of photogrammetric techniques in geo- and environmental science. Remote sensing for vegetation and the land use. Application of hydro-acoustic data. Remote sensing applications for climate and global change studies.

Earth Observation Programme, Sentinel missions, key products / data and applications. Copernicus Open Access Hub, Copernicus Services. EUMETSAT Data Centre.

Required readings

Sabins F.F, Ellis J.M. 2020. Remote Sensing: Principles, Interpretation, and Applications, 4th Edition. Waveland Press, Inc.

Purkis S.J., Klemas V.V. 2011. Remote Sensing and Global Environmental Change, 1st edition. Blackwell Publishing Ltd, UK

Robinson I. S. 2010. Discovering the Oceans from Space, The unique applications of satellite oceanography, Springer, p. 638.

Campbell J. B., Randolph H. Wynne 2011. Introduction to Remote Sensing, The Guilford Press, New York, Guilford Press. Fifth edition, ISBN-13: 978-1609181765

Chuvieco E. 2016. Fundamentals of Satellite Remote Sensing: An Environmental Approach, Second Edition. p. 267.

Liu J G and Mason P J, 2009. Essential image processing and GIS for remote sensing, Wiley-Blackwell, ISBN: 978-0-470-510131-5

ESA. 2013. SENTINEL-2 User Handbook. ESA Standard Document. European Commision: https://sentinel.esa.int/documents/247904/685211/Sentinel-2_User_Handbook

Recommended data and educational data sources (bases) and data access nodes

"Copernicus" open access hub: https://scihub.copernicus.eu/dhus/#/home
NASA's OceanColor Web: https://oceancolor.gsfc.nasa.gov/
NASA Earth observatory: https://earthobservatory.nasa.gov/
The EUMETSAT image library: https://www.eumetsat.int/website/home/Images/ImageLibrary/index.html
EUMeTrain Online Training Library: https://training.eumetsat.int/mod/url/view.php

MSG Channels Interpretation: http://oiswww.eumetsat.org/WEBOPS/msg_interpretation/index.php
Ordering AVHRR and VIIRSdata: https://www.class.ngdc.noaa.gov/
Ordering MODIS data: https://ladsweb.modaps.eosdis.nasa.gov/search/
Ordering SEVIRI data: http://www.eumetsat.int/
Landsat Data Access: https://landsat.usgs.gov/landsat-data-access
Introduction to Satellite Oceanography:
http://solab.rshu.ru/media/1127/SOLab_lectures_Bertrand_Intro1_english.pdf

Consulting lecturers name, surname	Degree	The most important works in the field of science (branch) have been published during the last 5 years
Gintautas Stankūnavičius	dr.	Valiuškevičius G., Stonevičius E., Stankūnavičius G., Brastovickytė-Stankevič J. 2018. Severe floods in Nemunas River Delta. Baltica, 31(2), 89–99. https://doi.org/10.5200/baltica.2018.31.09. Stonevicius E., Stankunavicius G., and Rimkus E. 2018. Continentality and oceanity in the mid and high latitudes of the Northern hemisphere and their links to atmospheric circulation. Advances in Meteorology, https://doi.org/10.1155/2018/5746191. Basharin D. and Stankūnavičius G. 2018. The long-term 20th century re-analysis features over the North Atlantic-Eurasia region. Boreal Environmental Research, 23, 139–148. Stankūnavičius G., Basharin D.V., Skorupskas R., Vivaldo G. 2017. Euro-Atlantic blocking events and their impact on surface air temperature and precipitation over the European region in the 20th century. Climate Research, 71, 203–218. https://doi.org/10.3354/cr01438 Basharin D.V., Polonsky A.B., Stankunavicius G. 2016. Projected precipitation and air temperature over Europe using a performance-based selection method of CMIP5 GCMs. Journal of water and climate change. 7 (1), 103-113, doi:10.2166/wcc.2015.081 Jarmalavičius D., Šmatas V., Stankūnavičius G.; Pupienis D., and Žilinskas G. 2016. Factors controlling coastal erosion during storm events. In: Vila-Concejo, A.; Bruce, E.; Kennedy, D.M., and McCarroll, R.J. (eds.), Proceedings of the 14th International Coastal Symposium (Sydney, Australia). Journal of Coastal Research, Special Issue, No. 75, pp. 1112 - 1116. Coconut Creek (Florida), ISSN 0749-0208.
Diana Vaičiūtė	dr.	Vaičiūtė D., Bučas, M., Bresciani M., Dabulevičienė, T. et al., 2021. Hot moments and hotspots of cyanobacteria hyperblooms in the Curonian Lagoon (SE Baltic Sea) revealed via remote sensing-based retrospective analysis. Science of the Total Environment 769, 145053. Zilius, M., Vybernaite-Lubiene, I., Vaiciute, D., Overlinge, D., et al., 2020. Spatiotemporal patterns of N2 fixation in coastal waters derived from rate measurements and remote sensing, Biogeosciences Discuss., https://doi.org/10.5194/bg-2020-419. Dabuleviciene T., Vaiciute D., Kozlov I.E., 2020. Chlorophyll-a Variability during Upwelling Events in the South-Eastern Baltic Sea and in the Curonian Lagoon from Satellite Observations. Remote Sensing 12(21), 3661. Overlingė D., Kataržytė D., Vaičiūtė, D., Gyraite G., Gečaitė I., Jonikaitė E., Mazur-Marzec, H., 2020. Are there concerns regarding cHAB in coastal bathing waters affected by freshwater-brackish continuum? Marine Pollution Bulletin 159, 111500. De Santi, F., Luciani G., Bresciani M., Giardino C., Lovergine F.P., Pasquariello G., Vaiciute D., De Carolis G., 2019. Synergistic Use of Synthetic Aperture Radar and Optical Imagery to Monitor Surface Accumulation of Cyanobacteria in the Curonian Lagoon. Journal of Marine Science and Engineering 7(12), 461. De Keukelaere, L., Sterckx, S., Adriaensen, S., Knaeps, E., Reusen, I., Giardino, C., Bresciani, M., Hunter, P., Neil, C., Van der Zande, D. and Vaiciute, D. 2018. Atmospheric correction of Landsat-8/OLI and Sentinel-2/MSI data using iCOR algorithm: validation for coastal and inland waters. European Journal of Remote Sensing 51(1), 525-542,

		Kari, E., Kratzer, S., Beltrán-Abaunza, J.M., Harvey E.T. & Vaičiūtė D. 2017. Retrieval of suspended particulate matter from turbidity – model development, validation, and application to MERIS data over the Baltic Sea. International Journal of Remote Sensing, https://doi.org/10.1080/01431161.2016.1230289. Vaičiūtė, D., Bresciani, M., Bartoli, M., Giardino, C., Bučas, M. 2015. Spatial and temporal distribution of coloured dissolved organic matter in a hypertrophic freshwater lagoon. Juornal of Limnology 74(3): 572-583.
Inga Dailidienė	dr.	Rukšėnienė, V., Dailidienė, I., Kelpšaitė-Rimkienė, L., Soomere, T., 2017. Sea surface temperature variations in the south-eastern Baltic Sea in 1960–2015. Baltica, Vol. 30 (2), 75–85. Dabulevičiene, T., Kozlov, I.E.,Vaičiute, D., Dailidiene, I. 2018. Remote Sensing of Coastal Upwelling in the South-Eastern Baltic Sea: Statistical Properties and Implications for Coastal Environment. Remote Sensing. Submitted to section: Ocean Remote Sensing, 10, 17-52. Galiniene, J., Dailidiene, I., Bishop, S.R., 2019. Forest management and sustainable urban development in the Curonian Spit. European Journal of Remote Sensing. SI52(2), 42-57. Kozlov, I.E., Krek, E.V., Kostianoy, A.G., Dailidiene, I. 2020. Remote Sensing of Ice Conditions in the Southeastern Baltic Sea and in the Curonian Lagoon and Validation of SAR-Based Ice Thickness Products. Remote Sensing, 12(22), 3754.
Approved by the Doctoral Committee for Physical Geography (N006) on 9th of March 2021, protocol no. (4.20 E) 610000-KT-24		
Committee Chairman assoc. prof. dr. D. Pupienis		