ЦЕНТЪР ЗА ОБУЧЕНИЕ – БАН

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Basic Information:

Course Title: APPLICATION OF SAR DATA TO STUDYING GEODYNAMIC PROCESSES AND NATURAL DISASTERS

Lecturer: Prof. DSc Mila Atanasova-Zlatareva Phone: (+3592) 979 3965
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Total Teaching Hours: 30 Hours

Annotation:

The course is designed for PhD students with research interests in geodesy, geophysics, seismology, geology and related areas in the field of Geosciences, aimed at studying problems affecting geodynamics and deformation processes of the Earth's crust and monitoring and assessment of areas affected by natural disasters.

The main objective of the course is to provide knowledge in the field of remote sensing, with an emphasis on the application of synthetic aperture radar data. Satellite observations provide detailed information on surface deformations due to natural and anthropogenic causes within large areas. These observations are essential for understanding and monitoring the deformations of the Earth's crust and the movements of tectonic plates. In recent decades, InSAR has proven to be a valuable tool for detecting and monitoring changes in the Earth's surface due to seismic, volcanic, tectonic processes, hydrological and other anthropogenic activities and has allowed the prediction of a wide range of natural hazards. Local, but often intense, hazards include landslides, mudflows, subsidence or collapse of the soil due to natural or human induced removal of surface materials or fluids. Subsidence of the earth's surface due to anthropogenic processes, such as groundwater, salt, gas, oil and coal extraction, is another global geohazard that affects large areas, causing damage to infrastructure and increasing the risk of flooding.

Flooding is another common hazard in various regions, caused by precipitation, melting snow and ice, as well as the collapse of natural or human-made walls of reservoirs. Forest fires and agricultural fires are common in many regions of Bulgaria. For each of the mentioned hazards, radar satellite data can provide us with valuable information in assessing the damage after the events, as well as in assessing the risk of future events through a better understanding and monitoring of the ongoing processes. InSAR results enable us to conduct global scale measurements of critical but otherwise inaccessible areas, leading to a better understanding and prediction of changes on the Earth's surface.

The course covers basic theoretical concepts, methodology used in SAR data processing, research and various applications of the method. In addition to acquiring basic theoretical knowledge, the course offers practical classes that include the implementation of specific

scientific research tasks.

Course content:

Topic 1: 1. Basic concepts in remote sensing and theoretical foundations in interferometry.

Topic 2: Acquisition of data from synthetic aperture radars - ESA repository and mirror repositories.

Topic 3: Research methods. Basic InSAR method and its further developed modifications.

Topic 4: Interferometric processing of SAR data. Application of SNAP software. Generation of interferograms. Creation of displacement maps for the studied area.

Topic 5: Creation and analysis of time series of interferograms for recording ground displacements for long time intervals. Integration and interpretation of the obtained results.

Topic 6 Determination of coseismic deformations using the DInSAR method.

Topic 7: Applications of SAR data for the study of geodynamic processes of natural and anthropogenic origin.

Topic 8: Method for determining glacier velocity based on SAR data

Topic 9: Applications of SAR data for monitoring affected areas and assessing the consequences of natural disasters (floods and fires)

Teaching and assessment methods

The training is carried out through lectures and exercises. During the course, each doctoral student prepares a project with the application of SAR data. The course ends with a presentation and defense of the completed project and a discussion.

Competencies acquired as a result of training (3–5 points)

At the end of the training, doctoral students will acquire basic knowledge about the possibilities of applying SAR data for the study of geodynamic processes and assessment of disaster consequences. They will develop skills in analyzing the results obtained from the processed SAR data, assessing geo-risk and investigation of the spatial and temporal distribution of the deformations of the Earth's crust.

Literature:

1. Braun Andreas, Veci Luis, Sentinel-1 Toolbox; SAR Basics Tutorial (2021) https://step.esa.int/docs/tutorials/S1TBX%20SAR%20Basics%20Tutorial.pdf
2. Flores, A.; Herndon, K.; Thapa, R.; Cherrington, E. The SAR Handbook: Comprehensive Methodologies for Forest Monitoring and Biomass Estimation; SERVIR Global Science Coordination Office: Huntsville, AL, USA, 2019.
3. https://gis1.servirglobal.net/TrainingMaterials/SAR/SARHB_FullRes.pdf
4. Hanssen R F (2005) Satellite radar interferometry for deformation monitoring: a priori assessment of feasibility and accuracy Int J Appl Earth Observ Geoinf 6(3–4):253–260 ESA Tutorials https://step.esa.int/main/doc/tutorials/
5. Атанасова М.(2011) Основни принципи и приложение на метода InSAR. Геомедия, 1, януари, 2011, ISSN:1313-3365, 20-22
6. Атанасова, М. (2023) Мониторинг на скоростта на леда на ледниците на остров Ливингстън чрез времеви серии SAR данни, XI Национална геофизична конференция, НИГГГ БАН, CD, https://doi.org/10.48368/bgs-2023.1.N14
7. Atanasova-Zlatareva M., Nikolov H. (2024) Complex analysis of co-seismic deformations using SAR satellite data: application for the Balkan Peninsula, Proceedings Volume 13195,Microwave Remote Sensing: Data Processing and Applications III; 131950N (2024) https://doi.org/10.1117/12.3031731
8. Atanasova-Zlatareva M., Nikolov H., Ivanov A. (2022) Monitoring of coastal landslides using Sentinel-1 imagery. Proc. SPIE 12267, Image and Signal Processing for Remote Sensing XXVIII, 122670C (2022), 12267, SPIE Remote Sensing, 2022, Berlin, Germany, 2022, DOI:10.1117/12.2636221, 1-10 https://doi.org/10.1117/12.2636221

9. Nikolov H., Atanasova M., Using Information Obtained from Sar Data to Assess Flood Affected Areas in the Area of Bregovo, Bulgaria. Proceedings FIG e-Working Week 2021Smart Surveyors for Land and Water Management - Challenges in a New Reality Virtual, 21–25 June 2021, FIGNET, 2021, ISBN:978-87-92853-93-6, ISSN:2307-4086
10. https://fig.net/resources/proceedings/fig_proceedings/fig2021/papers/ts03.2/TS03.2_nikolov_atanasova_11007.pdf

Additional information (optional) (e.g., special requirements, laboratory equipment, prior knowledge)