GEOINFORMATICS AND REMOTE SENSING

The effect of geospatial data on high resolution numerical weather prediction modelling.

supervisor: prof. Mgr. Jaroslav Hofierka, PhD.(jaroslav.hofierka@upjs.sk)
study form: full time/external
Annotation: The aim of this dissertation thesis is the reasearch of geospatial data effects on modelling of the atmospheric conditions using existing numerical weather prediction models and the possibilities for their preparation and integration into the prediction model using suitable methods and tools implemented in geographic information systems. This work should be focused on several selected areas in the territory of Slovakia with geographical characteristics that have a significant impact on the modelling of meteorological parameters. These areas will be characterised by a fragmented relief and diverse land cover, where local effects on the weather are significant and the most difficult to model (orographic effects, catabatic flow, local convergent zones affecting convection, frost valleys, water areas). Various remote sensing methods and tools implemented in geographic information systems will be used to prepare the input geospatial data. The input geospatial data will include detailed topography data and physical characteristics of the surface (types of land cover, albedo, thermal emissivity, land surface temperature and greenery fraction). The result of the work should include an evaluation of the impact of detailed geographical data on high-resolution simulations and mapping in the selected case studies and locations for modelling and forecasting with the potential benefits for operational weather forecasts.

Use of geomorphometry and 3D modelling to interpretation of heavy-mineral surface microtexture features from selected localities in the Western Carpathians.

supervisor: doc. Ing. Katarína Bónová, PhD.(katarina.bonova@upjs.sk)
consultant: prof. Mgr. Jaroslav Hofierka, PhD.
study form: full time/external
Annotation: The aim of dissertation thesis is the analysis and evaluation of microtexture features which occur on heavy-mineral surfaces and result from the mechanical weathering processes during the transport. For this purpose, the geomorphometry methods and 3D models from specialised 3D software (e.g., Blender) will be used. These methods will test the possibility of identification, quantification and visualization of specific features of microrelief on the mineral grain surfaces using general geomorphometry techniques (system of morphometric variables). The relation of the formation of individual microtextural features on the surface of transported grains depending on the length of transport of detrital material will also be monitored (relief and watercourses modelling in GIS). The work will be focused on creation of methodology for analysis of microtexture features on heavy-mineral surfaces including the sampling in the field, the sample processing in the laboratory, the creation of DMR and 3D modelling of the mineral grain surfaces, geomorphometric analysis, interpretation of microtextures in relation to their genesis. The results of the research could be applicable in the identification of fluvial sedimentary palaeoenvironments and in the palaeogeographic reconstructions.

Mapping and analysis of dynamic geospatial processes in an urbanized landscape using unmanned aerial systems.
supervisor: doc. RNDr. Ján Kaňuk, PhD. (jan.kanuk@upjs.sk)
consultant: prof. Mgr. Jaroslav Hofierka, PhD.
study form: full time/external
Annotation: Spatial data achieved by unmanned aerial systems (UAS) are increasingly influencing landscape planning and management decisions. Compared to other remote sensing techniques, such as satellite imagery or conventional aerial imagery, UAS data have unquestionable advantages, especially in terms of operational deployability as well as spatial resolution, which plays an important role, especially in built-up areas. Although UAS technologies are not new, their potential for mapping and analysing dynamic processes in urbanized landscapes has not yet been fully exploited. The aim of the dissertation is to map dynamic processes in an urbanized landscape using UAS and to design innovative geospatial tools and workflows for the analysis of changes in the built-up area. The solution of the dissertation will use several sensors placed on unmanned aerial platforms, such as optical sensors recording electromagnetic radiation in different spectral bands and a laser scanner. In this work we want to focus on quantifying the change in the morphological structure of the built landscape (terrain, buildings, vegetation, roads, etc.) over a period of time, which is reflected, for example, in the dynamics of solar radiation distribution and temperature emission for different types of surfaces (during the day and year).The application result of the dissertation will be the assessment of different levels of data quality from UAS in comparison with other types of data (from satellites, conventional airborne missions and ground measurements) and to recommend optimal working procedures for their acquisition and processing. The topic of the dissertation will be solved in cooperation with selected self-governing institutions.

Monitoring and modelling dynamics of fluvial sediment transport using geospatial tools.
supervisor: doc. RNDr. Ján Kaňuk, PhD. (jan.kanuk@upjs.sk)
consultant: Mgr. Miloš Rusnák, PhD.
study form: full time/external
Annotation: The climate change, forest disturbance and river modifications are the most important drivers of changes in the runoff regime in river basins in Slovakia. The symptoms of these changes can be observed, for example, in the increased variability and extremity of the behaviour of the runoff response to various meteorological situations, the prolonged timescale of drought and the change in the seasonal runoff distribution. These changes are also reflected in the transport of sediments. The research of the dissertation will be focused on the direct detection of sediment transport from source to accumulation zones. The main goal of the dissertation will be to identify the trajectory of transport of sediments on selected sections of river channel, calculation of volume changes of in-channel material, bathymetry of channel bed, calculation of gravel bars grain size and riverbed based on remote sensing data using unmanned aerial systems and ground measurements. An equally important part of the dissertation will be the design of innovative methods for modelling the dynamics of fluvial sediment transport and the proposal of a new geoprocessing toolbox. The solution of the dissertation will be based mainly on the use of high-detailed 3D models of the landscape. The expected result of the work will be identifying material transport

links and connectivity of individual zones, which will enable a comprehensive assessment of sediment transport at different scale levels (for river basins of selected watercourses but also for selected river sections). Two unique and different river basins of the Belá and Ondava Rivers are proposed for the solution of the dissertation. In addition to the newly designed tools, the application result of the work will be also the proposal of measures in the management of watercourses in terms of sediment transport, which significantly changes the physical structure of rivers. The obtained results are important for understanding the movement of sediments and the connection of the river channel with the surrounding landscape. Quantification of the amount of transported sediments in the river channels enables to predict of the erosion-accumulation processes in a climate-changing environment.