Geophysical Research Abstracts
Vol. 16, EGU2014-5924, 2014
EGU General Assembly 2014

Heterogeneous Data Fusion Methods for Disaster Risk Assessment using Grid Infrastructure

Nataliia Kussul (1,3), Sergii Skakun (1,2), Andrii Shelestov (1,2,3)

(1) Space Research Institute NASU-SSAU, Department of Space Information Technologies and Systems, Kyiv, Ukraine, (2) National University of Life and Environmental Sciences of Ukraine , Kiev, Ukraine, (3) National Technical University of Ukraine "Kyiv Polytechnic Institute", Kiev, Ukraine

In recent years, a risk-oriented approach to manage disasters has been adopted. Risk is a function of two arguments: hazard probability and vulnerability [1]. In order to assess flood risk, for example, aggregation of heterogeneous data acquired from multiple sources is required. Outputs from hydrological and hydraulic models make it possible to predict floods; in situ observations such as river level and flows are used for early warning and models calibration. Remote sensing observations can be effectively used for rapid mapping in case of emergencies, and can be assimilated into models. One point that is mutual for all datasets is their geospatial nature. In order to enable operational assessment of disaster risk, appropriate technology is necessary. In this paper we discuss different strategies to heterogeneous data fusion and show their application in the domain of disaster monitoring and risk assessment. In particular, two case-studies are presented. The first one focuses on the use of time-series of satellite imagery to flood hazard mapping and flood risk assessment. Flooded areas are extracted from satellite images to generate a maximum flood extent image for each flood event. These maps are fused to determine relative frequency of inundation (RFI) [2]. The RFI values are compared to relative water depth generated from the LISFLOOD-FP model. The model is calibrated against the satellite-derived flood extent. The model with different combinations of Manning's parameters was run in the Grid environment at Space Research Institute NASU-SSAU [3], and the optimal set of parameters was found. It is shown that RFI and water depth exhibit the same probabilistic distribution which is confirmed by Kolmogorov-Smirnov test. Therefore, it justifies the use of RFI values for risk assessment. The second case-study deals with quantitative estimation of drought risk in Ukraine based on satellite data. Drought hazard mapping is performed based on the use of vegetation health index (VHI) derived from NOAA satellites, and the extreme value theory techniques. Drought vulnerability is assessed by estimating the crop areas and crop yield to quantify potential impact of a drought on crop production. Finally, drought hazard and vulnerability maps are fused to derive a drought risk map.

[1] N.N. Kussul, B.V. Sokolov, Y.I. Zyelyk, V.A. Zelentsov, S.V. Skakun, and A.Yu. Shelestov, "Disaster Risk Assessment Based on Heterogeneous Geospatial Information," J. of Autom. and Inf. Sci., 42(12), pp. 32-45, 2010.
[2] S. Skakun, N. Kussul, A. Shelestov, and O. Kussul, "Flood Hazard and Flood Risk Assessment Using a Time Series of Satellite Images: A Case Study in Namibia," Risk Analysis, 2013, doi: 10.1111/risa.12156.
[3] L. Hluchy, N. Kussul, A. Shelestov, S. Skakun, O. Kravchenko, Y. Gripich, P. Kopp, E. Lupian, "The Data Fusion Grid Infrastructure: Project Objectives and Achievements," Computing and Informatics, vol. 29, no. 2, pp. 319-334, 2010.