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Earth Observations to address Earth's Environment and Climate Challenges (7)

Author: Mr. Bakhtiyar Babashli
Azercosmos, Space Agency of Republic of Azerbaijan, Azerbaijan

Mr. Elman Alaskarov
Azercosmos, Space Agency of Republic of Azerbaijan, Azerbaijan

NOVEL MACHINE LEARNING METHODOLOGIES FOR DAMAGE DETECTION OF FLOOD
EVENTS USING SATELLITE IMAGERY.

Abstract

The frequency of natural disasters has considerably increased in recent years due to global climate change. Floods are more common among these events. There is an increasing role for modern technology in predicting and taking preventive measures against floods, which cause great destruction and damage to the economy. Flood early warning systems are therefore crucial for flood prevention and disaster risk reduction. The ability to predict disasters was confirmed to be extremely useful in reducing damage caused by natural disaster events. The main purpose of the study is to classify flooded areas and identify areas of potential risk. Spatial data obtained from remotely sensed satellite images of the flooded area and 16 factors indicating potentially increased flood risk were used. Various machine learning algorithms Gradient Boosting (GBR), Random Forest (RF), LightGBM (LGBM), XgBoost (XGB) and CatBoost were implemented for classification purposes and the results were compared. The results show that all models show high performance. The minimum AUC for the test data set is 0.89. The CatBoost and LightGBM models performed better results than the other models, with an accuracy of 0.93 and AUC of 0.97 respectively. Data-driven models serve as a reliable tool for mapping flood vulnerability wherever reliable flooding exists. Topographic roughness index (TRI), precipitation, sediment and altitude data were the factors that most affected the results of the image-based and point-based models, respectively. Finally, the locations of areas at high risk of flooding were identified on the basis of satellite images and the classification results of the LightGBM and CatBoost algorithms were adopted as the best predictor. The models proposed in the study show better results in predicting flood-prone areas than traditional machine learning methods (e.g. SVM, decision tree). This can be a useful tool in decision-making to effectively mitigate the potential risks of flood hazards and in risk management, as well as in reducing the losses that may result from an incident. Flood mapping is an important activity for disaster preparedness, disaster mitigation, post-disaster activities and mapping changes in the affected area.