
Machine learning-based riverine litter detection and mapping using Sentinel-2 imagery

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Abstract

Despite the significant role of rivers in the global marine litter problem, riverine litter has received limited attention. Therefore, we aimed to detect riverine litter using middle-scale multispectral satellite images and machine learning (ML), considering the Tisza River (Hungary) as a study area. The Very High Resolution (VHR) images from the Google Earth database were employed to identify riverine litter spots (a mixture of natural and anthropogenic materials). These spots were utilized to calibrate, validate and test five supervised machine-learning algorithms (Decision Tree (DT), Naïve Bays (NB), Support Vector Classifier (SVC), Random Forest (RF), and Artificial Neural Network (ANN)) based on Sentinel-2 images to investigate the spatio-temporal dynamism of riverine litter. According to the results the hydraulic structures (e.g., Kisköre Dam) are the greatest litter trapping points. Although the litter transport is the most intensive during floods, the largest litter spot area was observed in summer at low stages. The developed algorithms demonstrated a good capability to identify litter spots (overall accuracies; SVC: 0.96, ANN: 0.95, RF: 0.94, DT: 0.93, and NB: 0.89); however, litter detection capability was bounded to the pixel size of the Sentinel-2 images. This study is considered as an initial step for the automatic detection of riverine litter, therefore more studies considering larger dataset, more representative small litter spots, and finer spatial resolution images are required.

Keywords: Tisza River, plastic indices, litter transport, Support Vector Classifier, Artificial Neural Network

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