EGU22-4418
https://doi.org/10.5194/egusphere-egu22-4418
EGU General Assembly 2022

Inter-annual river patterns change detection using machine learning

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River patterns in the tropics usually exhibit seasonal changes because of strongly seasonal rainfall and its impact on geomorphological processes. However, studies on tropical rivers are much less than those on temperate rivers, and so these seasonal patterns have not been quantified. To fill some of this research gap, this paper employs machine learning methods using Sentinel-2 multispectral remote sensing images to classify geomorphological units in Bislak River, Laoag River and Abra River in west Luzon, the Philippines. In this study, we firstly designed a workflow for river pattern classification, which was validated for the three rivers at different spatial and temporal scales. Then, 5.5 years of river patterns, defined using three morphological units, in the three rivers were generated for further geomorphological analysis. The classification results were analysed in terms of both spatial and temporal aspects. The results show a variety of relationships between channel width and each landform unit (wetted channel; exposed sediment bar; vegetated bar). The analysis shows that channel width has an impact on the area occupied by vegetation (the bigger the river, the stronger the correlation between channel width and vegetation). We present a way to analyse interactions between geomorphic units at seasonal scales using time series of correlations. The rivers were divided into sub-reaches based on observed patterns of water frequency and confinement, and then temporal analysis was undertaken for each sub-reach. This analysis used Ensemble Empirical Mode Decomposition (EEMD) which decomposed the time series and precipitation. The EEMD results indicate that areas occupied by water and vegetation commonly show synchronised fluctuations with precipitation, while sediment bars have an anti-phase oscillation with precipitation. The results suggests that deviations from periodic consistency in patterns may reflect the influence of extreme events and/or human disturbance. Correlation results show that the total area of unvegetated bars is usually the most stable landform unit in all three rivers, and that the vegetated area changes less in narrower channels. Confinement, due to hillslope and terrace topography, and the impact of fault are also considered. The methods for generating time series of landform unit data and time series analysis used here provide a framework for analysis of tropical rivers that are subject to regular, frequent and dynamic changes of planform.