

Patch based Classification using ResNet for Land Cover changes detection of Batu City

Hisyam Fahmi

Abstract—The purpose of this study is to analyze the variations in land cover in Batu City, East Java Province, Indonesia, utilizing a patch-based classification strategy and deep learning. This study provides a preliminary estimation of land cover change in Batu City. The research also highlights the possibility of using deep learning techniques to analyze land use and land cover (LULC) variations in other urban areas with greater precision and efficiency. The EuroSAT dataset is used to train a classification model for patch labeling using the ResNet-50 architecture. Comparing the land cover of Batu City in 2001 and 2022 allows us to detect LULC changes, with almost 50% of the patch changing. The results indicate that ‘Housing’ and ‘Road’ become the most changed categories, while the vegetation areas decrease in number. The results demonstrate that the ResNet-50 architecture is capable of classifying patches and detecting LULC changes with an accuracy of 88% and an execution time of approximately 126.53 seconds.

Index Terms—Batu City; land cover and land use changes; patch-based classification; ResNet-50.

I. INTRODUCTION

LAND cover changes has become a major concern in the study of natural resource management and the environment, especially in the context of urban areas. Batu City, which is an administrative city located in East Java Province, Indonesia, has experienced rapid growth in the last few decades, resulting in massive changes in land cover. Several studies have been conducted to analyze changes in land cover in Batu City. However, most of these studies are carried out using conventional methods such as visual interpretation [1] or spatial analysis techniques only [2], which can produce relatively low accuracy and take quite a long time.

There are various factors that could potentially drive changes in Land Use Land Cover (LULC) changes. These factors may include the fast-paced growth of urbanization, which could result in urban sprawl, peri-urban migration, and the conversion of agricultural land

to paved areas. Other potential drivers of LULC changes could be industrial areas, transportation networks, educational and cultural facilities, agricultural activities, and tourism. However, it is important to note that the actual changes in LULC changes are often the result of a combination of these different types of development [3].

Typically, researchers analyze changes in LULC by comparing two or more maps created at different times. Both traditional maps and satellite images can be used to explore the causes and effects of LULC changes on society and the environment. Various studies have utilized Landsat imagery to investigate LULC changes to simulate the flood inundation from Brantas River in Batu, Malang [4]. Also the study by Wati et al. [5] that used the Sentinel image to detect the LULC changes in Pasuruan and Probolinggo. Researchers have also examined how LULC changes relate to the biodiversity in Batu. For instance, this study by Albab et al. [6] that analyzed the diversity, composition, and community structure of odonata in the highland and lowland ecosystems and the type of lotic and lentic waters based on the land use analysis.

Beselly et al. [7] analyze the the spatiotemporal variability of LULC changes to highlights the importance of quantitative assessment for sustainable watershed management in the Upper Brantas Basin and its effects on river discharge variation. The study reveals that changes in LULC, particularly cultivated and managed vegetation and urban/built-up area, significantly contribute to river discharge. Specifically, in the upper Brantas Basin, almost half of the increased river discharge was explained by the increase of urban/built-up and the decrease in cultivated and managed vegetation area [8].

However, there is no research that specifically analyzes changes in land cover in Batu City using a patch-based classification approach with deep learning. Therefore, this study aims to fill this research void and contribute to a better understanding of land cover change in Batu City with higher accuracy and a shorter time. In this context, the use of a patch-based classification approach with deep neural network architecture, can be an effective and efficient alternative in analyzing changes in land cover in Batu City. Several studies have been conducted using a deep learning approach, such as research by Wang et al. [9] that used

Manuscript received March 22, 2022. This work was supported in part by funding from Universitas Islam Negeri Maulana Malik Ibrahim Malang.

H. Fahmi is in Mathematics Study Program, Faculty of Science and Technology, Universitas Islam Negeri Maulana Malik Ibrahim, Malang, Indonesia (email hisyam.fahmi@uin-malang.ac.id)