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EARTH'S PULSE, CITY'S BREATH: LEVERAGING COPERNICUS MISSION DATA, MACHINE LEARNING GUIDES SUSTAINABLE URBAN GROWTH

Abstract

The urban heat has become a major concern in our modern times, rendering summers increasingly intolerable in cities worldwide. This study explores the utilization of Earth Observation data coupled with supervised learning techniques to detect cities, analyze their growth and evolution, and understand how actions can be taken to enhance their effects. Urban growth is inevitable, but we have the opportunity to guide it in a sustainable direction by leveraging insights from our algorithms.

The primary aim of this study is to detect cities from Sentinel-1 satellite images and segment them into polygons using a Convolutional Neural Network (CNN) developed specifically for this purpose. This segmentation allows for precise analysis of urban growth in recent years. Furthermore, by training the same CNN on a different dataset, we can determine vegetation within cities and analyze its proportion and evolution.

We also utilize the combination of frequency bands from Sentinel-1 to obtain relevant indices, such as NDVI and NDWI, to detect vegetation and water bodies, which are factors contributing to cooler environments within cities.

Once these data are collected, we juxtapose them with Landsat 8 data on ground floor temperature to correlate the evolution of green spaces with temperature variations in cities. Additionally, we enhance our analysis by incorporating an extra dataset: the average heat absorption of cities measured through spectrophotometry. This provides a metric indicative of the heat retained by a city from solar radiation, essentially acting as an urban 'heat trap'.

From our analyses conducted in SBIC EuroSpaceHub, we developed an algorithm capable of predicting the strategic locations to deploy green spaces or breathing technologies using tree architecture, similar to Dubai, to refresh the surroundings areas. Moreover, we can identify the greenest cities and understand their patterns, with the aim of applying these insights to our urban environments.

In conclusion, our approach aims to identify strategies for cooling cities based on our analysis, recognizing the multifaceted nature of temperature dynamics. By prioritizing the strategic development of green spaces according to specific patterns, we anticipate a decrease in significant electricity consumption during summer by minimizing the reliance on cooling systems such as air conditioning. Additionally, this initiative aims to mitigate air pollution, safeguard against urban flooding through soil renewal, and

ultimately improve the overall quality of life in large cities. Our goal is to initiate a virtuous cycle towards a greener urban environment.