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Satellite remote sensing of COVID-19 lockdown effects upon urban ecosystems

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Abstract:

With more than half of the world's eight billion population living in cities, there have been increasing concerns over the negative impacts of urbanization. Despite numerous efforts, humans have only achieved a limited level of success in restoring the stressed or degraded urban ecosystems. While the COVID-19 pandemic has so far infected over 671 million of people and killed more than 6.73 million population globally (see https://www.worldometers.info/coronavirus), it also dramatically slowed down our economic activities and movement especially during the months of March, April, and May of 2020 when many countries activated lockdown restrictions, triggering perhaps the largest decline of carbon dioxide emissions and natural resource consumption since the Industrial Revolution. In addition to the public health and other negative impacts, the scientific community has shown a strong interest in understanding how the COVID-19 pandemic can positively affect the environment. This paper aims to examine some major advances in Earth observations for tracking the environmental changes in urban areas in connection to the global outbreak of COVID-19. For this purpose, we firstly surveyed peer-reviewed literature paying attention on several essential research design and implementation issues, such as environmental elements, geographic sites, observational scales, remotely sensed data types, and analytic methods. While existing studies were largely based on the data or products from Landsat-8 OLI (Operational Land Imager) and TIES (Thermal InfraRed Sensor), MODIS (Moderate Resolution Imaging Spectroradiometer), and VIIRS (Visible Infrared Imaging Radiometer Suite), we also saw an increasing use of data or products from high-resolution systems or sensors (such as WorldView-3 and Pleiades satellites), NASA's Aura satellite, Sentinel-5, and MOPITT (Measurement of Pollution in the Troposphere). These Earth observation products, along with high-computing and cloud-computing infrastructures, allowed scientists to examine a variety of environmental changes in urban areas such as air pollution, land surface temperature, light pollution, water quality, and vegetation growth during the period of lockdown restrictions. The literature review was followed by a case study we conducted to evaluate the COVID-19 lockdown impacts upon urban heat fluxes and tree growth in New York City (USA). Finally, we identified several major challenges and discussed some future research directions. It is believed that such a literature study examining the positively environmental impacts in connection to the global outbreak of coronavirus disease 2019 through satellite remote sensing can not only help accomplish better research design in the subject but also assist formulating effective strategies and polices to deal with major challenges towards environmental sustainability in large metropolises across the world.

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