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Study the Impact of Spatial Resolution of Satellite Images on the Urban Vegetation Phenology Detection

Jiaqi Tian and Xiaolin Zhu

Department of Land Surveying and Geo-Informatics, The Hong Kong Polytechnic University, Hong Kong, China (JT: jackie.tian@connect.polyu.hk; XZ: xiaolin.zhu@polyu.edu.hk)

Numerous investigations of urbanization effects on vegetation spring phenology using satellite images reach a same conclusion that vegetation spring phenology in urban area occurs earlier than surrounding rural area. Nevertheless, the magnitude of this rural-urban difference is quite different among these studies, which implies large uncertainties. One possible reason is that the satellite images used in these studies have different resolutions from 30m to 1-km. In this study, we investigated the urbanization effects on vegetation spring phenology using satellite images at different spatial resolutions. To be exact, we first generated a dense 10m NDVI time series through integrating Sentinel-2 and Landsat-8 images by data fusion method, and then upscaled the 10m time series to coarser resolutions from 30m to 8-km to simulated images at different resolutions. After that, to quantify urbanization effects, vegetation spring phenology at each resolution was extracted respectively by TIMESAT and the difference between rural and urbanized area was calculated using urban extent map derived from NPP VIIRS nighttime light data. Our results reveal: (1) vegetation spring phenology in urbanized area is always earlier than rural area no matter which spatial resolution from 10m to 8-km is used; (2) difference of vegetation spring phenology between rural and urban areas is amplified with spatial resolution, i.e. coarse satellite images overestimate the urbanization effects on vegetation spring phenology; (3) the underlying reason of this overestimation is that pixels in coarser images are more mixed which leads to reduction of vegetation fractions in each pixel. This study indicates that spatial resolution is an important factor that affects the accuracy of the assessment of urbanization effects on vegetation spring phenology. We suggest that satellite images with a finer spatial resolution of 90m, or vegetation fraction in mixed pixels higher than 60% are more appropriate for future studies to explore urbanization effects on vegetation spring phenology.