

The Changing Face of the of Former Soviet Cities: Elucidated by Remote Sensing and Machine Learning Techniques

Armen Poghosyan

Skolkovo Institute of Science and Technology, Space Center, Russian Federation (a.poghosyan@skoltech.ru)

Despite remote sensing of urbanization emerged as a powerful tool to acquire critical knowledge about urban growth and its effects on global environmental change, human-environment interface as well as environmentally sustainable urban development, there is lack of studies utilizing remote sensing techniques to investigate urbanization trends in the Post-Soviet states. The unique challenges accompanying the urbanization in the Post-Soviet republics combined with the expected robust urban growth in developing countries over the next several decades highlight the critical need for a quantitative assessment of the urban dynamics in the former Soviet states as they navigate towards a free market democracy. This study uses total of 32 Level-1 precision terrain corrected (L1T) Landsat scenes with 30-m resolution as well as further auxiliary population and economic data for ten cities distributed in nine former Soviet republics to quantify the urbanization patterns in the Post-Soviet region. Land cover in each urban center of this study was classified by using Support Vector Machine (SVM) learning algorithm with overall accuracies ranging from 87 % to 97 % for 29 classification maps over three time steps during the past twenty-five years in order to estimate quantities, trends and drivers of urban growth in the study area. The results demonstrated several spatial and temporal urbanization patterns observed across the Post-Soviet states and based on urban expansion rates the cities can be divided into two groups, fast growing and slow growing urban centers. The relatively fast-growing urban centers have an average urban expansion rate of about 2.8 % per year, whereas the slow growing cities have an average urban expansion rate of about 1.0 % per year. The total area of new land converted to urban environment ranged from as low as 26 km² to as high as 780 km² for the ten cities over the 1990 – 2015 period, while the overall urban land increase ranged from 11.3 % to 96.6 % over the study period. Thus, after some initial developments following the breakup of the Soviet Union the growth rate in the urban core decreased gradually constrained by the availability of suitable land, while the urban expansion rates in the outer peripheral region were characterized with a robust urban growth rates across the study area. The rapid urban expansion observed in the former Soviet cities impairs environmentally sustainable characteristics such as compactness, better integrated land uses with abundant parks and greenbelts, low social polarization, as well as reliable public transit systems in some urban centers after the disintegration of the Soviet Union. The urban expansion rates considerably outpaced the urban population growth rates in all ten cities during the last quarter of a century, thus indicating that the urban growth is becoming more expansive with all cities experiencing significant decreases in overall urban population densities.