NATIONAL CONSORTIUM FOR REMOTE SENSING EDUCATION, RESEARCH, AND APPLICATIONS

IndianaView

PROJECT FACT SHEET

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Project Title: Urban dynamics monitoring in Indianapolis using time series of Landsat data from 1998 to 2017

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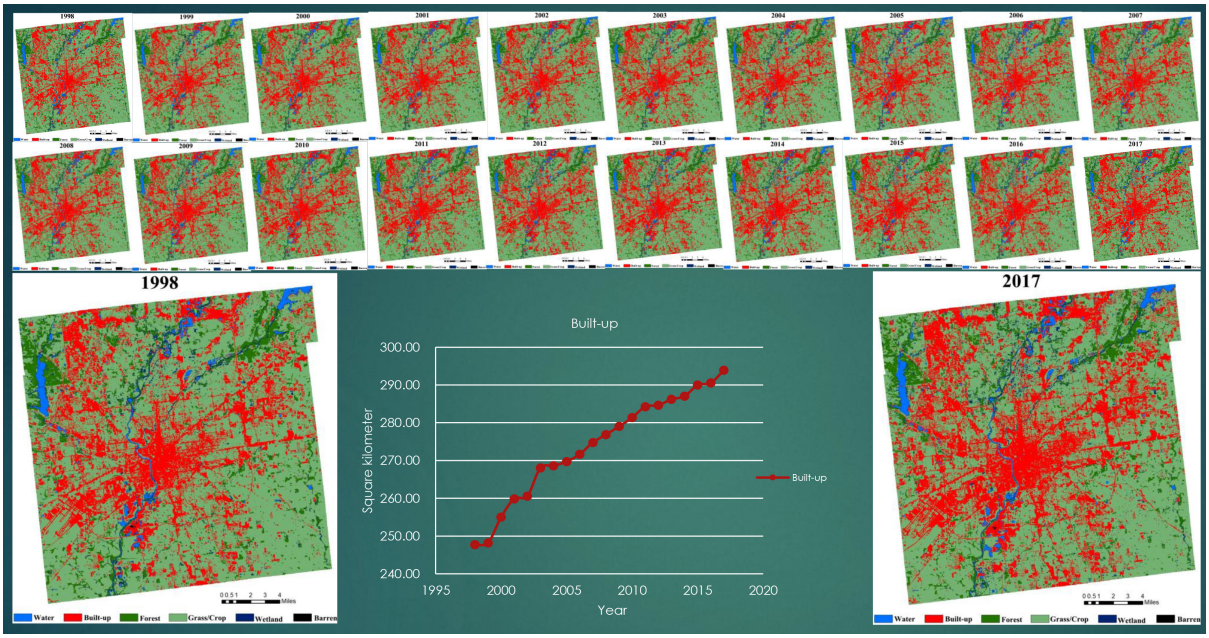

Figure 1. The annual land use and land cover maps for Marion County from 1998 to 2017 and the graph for the change of Built-up area

Project Description: Urbanization and associated land use and cover changes have important implications to human settlements, activities, and public health. Monitoring the spatio-temporal pattern land use and land cover (LULC) changes in Indianapolis metropolitan area is helpful for its future urban planning and economic development. Traditional methods of satellite remote sensing tended to analyze a few images in selected dates. These methods have two disadvantages. One is that the selection of image is limited by rain, haze, fog, cloud, shadow, or other climatic / environmental conditions. The other is that selected images cannot fully show the phonological characteristics of a study area. In order to solve these two problems, this project employs Landsat time series images from 1998 to 2017 for Indianapolis to detect its urban dynamics over the period of twenty years. The chosen features for image classification included not only solar reflectance values but also Normalized Difference Built Index (NDBI), Normalized Difference Vegetation Index (NDWI), Normalized Difference Water Index (NDWI), and Land Surface Temperature (LST), which are sensitive to urban LULC changes. Data gaps caused by Landsat-7 Scan Line Corrector error and contaminated pixels influenced by cloud, fog and shadow were masked out during pre-processing. In the image-processing stage, the algorithm of Continuous Change Detection and Classification (CCDC), a seasonal regression method, was applied to extract useful variables from the chosen features for each pixel. The variables were input into the random forest classifier for machine learning. Based on training data, the classifier generated classification rules and produced 20-year images. Then, a temporal filtering was employed to correct classification errors. In order to show the efficiency of the method, the raw reflectance value is also directly input into the classifier, as a control set. The validation data was collected from fieldwork and Google Earth to judge whether CCDC can outperform over traditional methods of image classification

Accomplishments: The new method improved mapping accuracy and consistency. The annual land use and land cover map for Indianapolis were generated from 1998-2017, whose overall accuracy was 92%. With the maps and the statistics (Figure 1), we can provide a few suggestions for the urban planning and environmental management.

FOR FURTHER READING:

Zhang, L., & Weng, Q. (2016). Annual dynamics of impervious surface in the Pearl River Delta, China, from 1988 to 2013, using time series Landsat imagery. ISPRS Journal of Photogrammetry and Remote Sensing, 113, 86-96.