Indentify Landcover Types by Satellite Remote Sensing Data

Introduction/Business case

Suppose Xianwei and Yifei started a consulting firm providing GIS services for public sectors. One day, the Southeast Michigan Council of Governments wants a map from them made by NASA's satellite sensing raster data(landsat 1-8), indicating the landcover type of Detroit and its surroundings in 2021 and compare it with the landcover map of ten years ago to analyze the changes in urban area, lake/river shorelines and vegetation coverge.

To accomplish this landcover type map, three individual maps calculated by three indexes are created. Then combine three maps (NVDI indicates vegetation coverage, MNDWI indicates waterbody, MBI indicates urban and baresoil) to get the final map.

Methodology

It is essential to select the appropriate seasonal stateline sensing data. During winters, snow on roofs, barelands, and vegetation affects the reflectance, leading to a distortion on MBI and NDVI index, while frozen waterbody affects the accuracy of MNDWI index.

Step1-Raster calculate Vegetation coverage by NDVI index:
NDVI = (Red-NIR)/(Red+NIR)
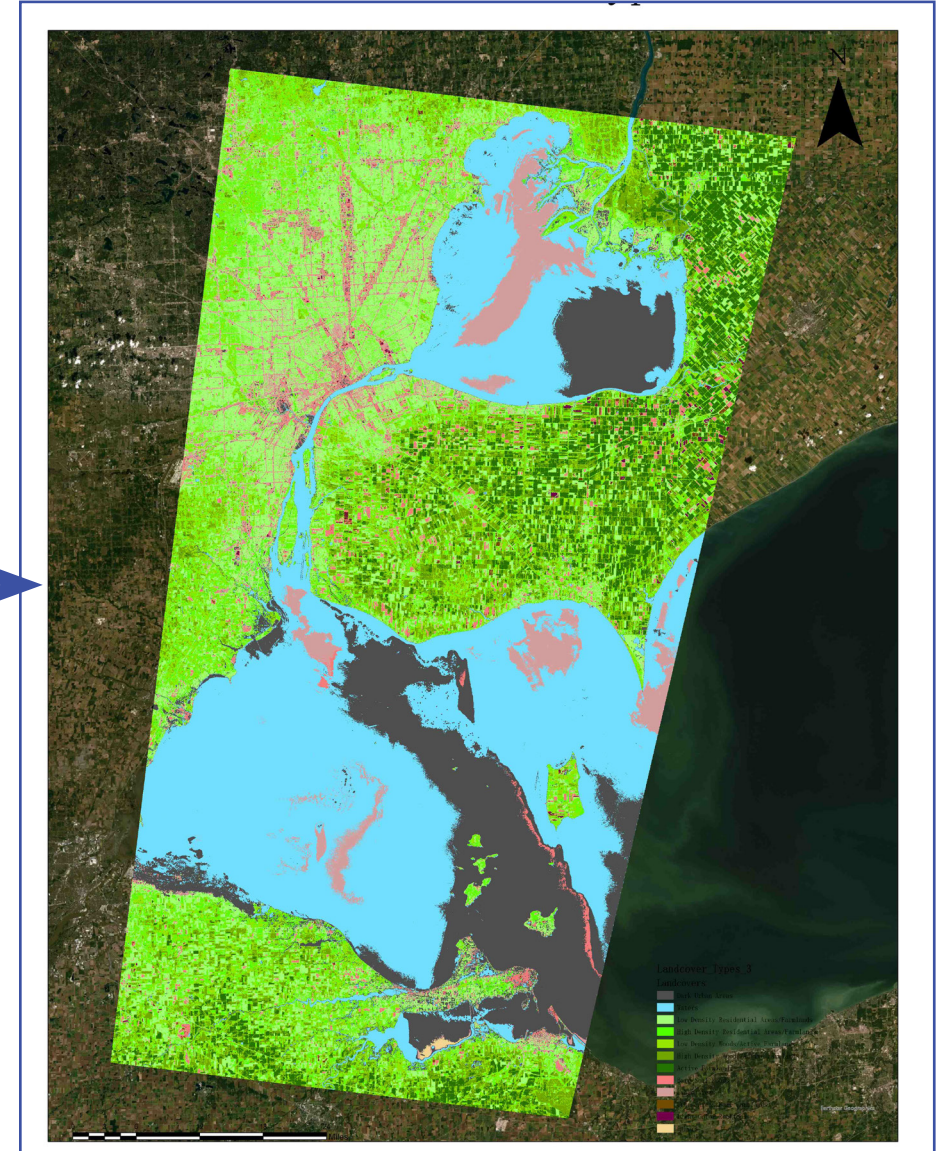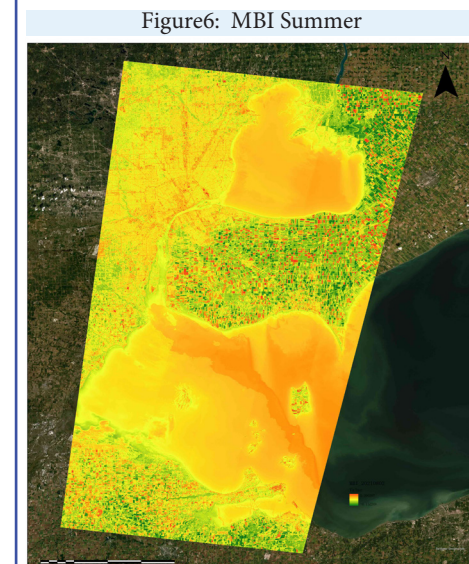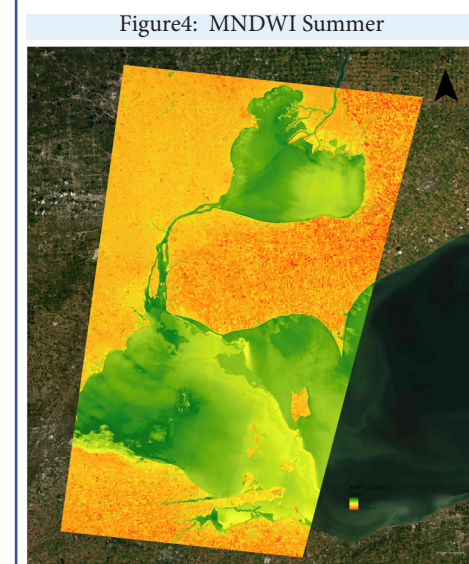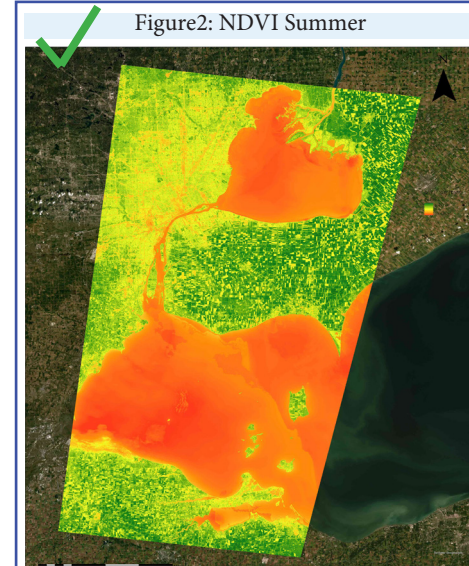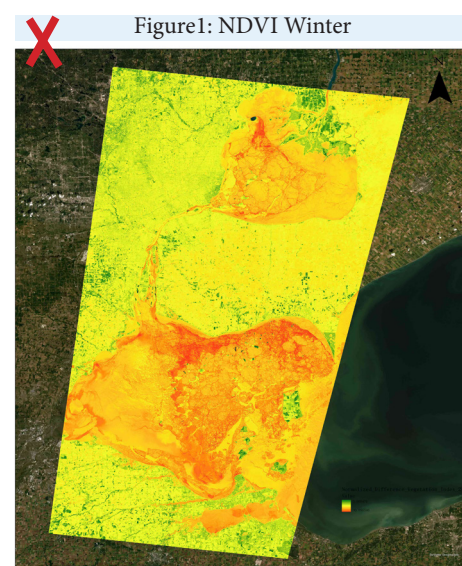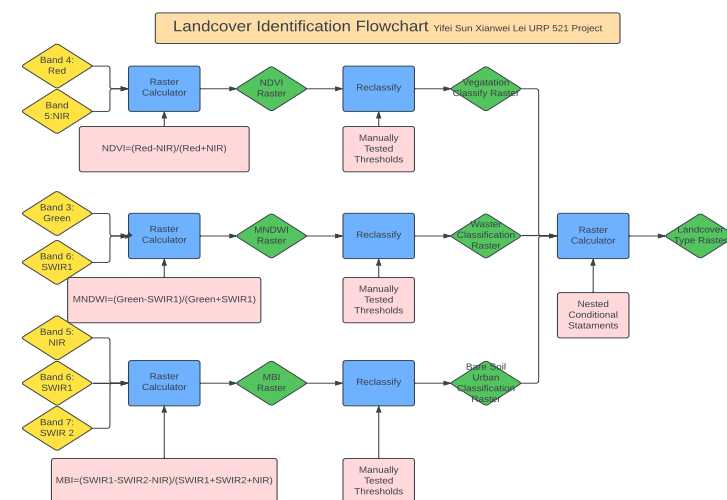*Step2*-Raster caculate Waterbody coverage by MNDWI index:
MNDWI = (Green-SWIR1)/(Green+SWIR1)
Step3-Raster caculate Urban/bare soil coverage by MBI index:
MBI = (SWIR1-SWIR2-NIR)/(SWIR1+SWIR2+NIR)
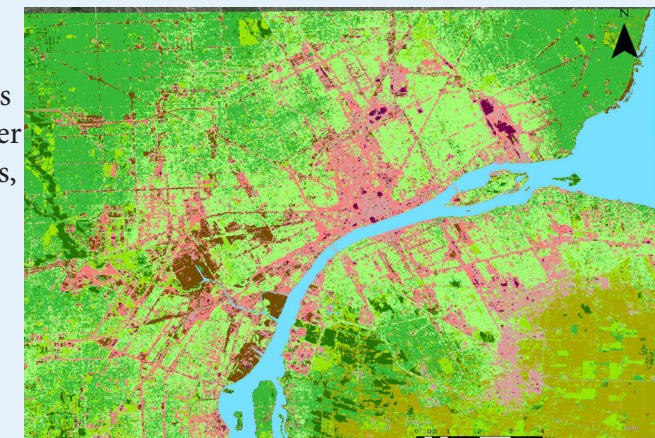*Step4*-Reclassify index maps by manually tested thresholds
Step5-Combine maps by nested conditional statements.

Landcover Identification Flowchart Yifei Sun Xianwei Lei URP 521 Project

References List:
Nguyen, Can T., Amnat Chidthaisong, 2021. "A Modified Bare Soil Index to Identify Bare Land Features during Agricultural Fallow-Period in Southeast Asia Using Landsat 8" Land 10, no. 3: 231.
Akumu, C.E.; Amadi, E.O.; Dennis, S. Application of Drone and WorldView-4 Satellite Data in Mapping and Monitoring Grazing Land Cover and Pasture Quality: Pre- and Post-Flooding. Land 2021, 10, 321.
Landsat 1-8, 2021, NASA's Satellite Program, https://landsat.gsfc.nasa.gov/satellites/landsat-8/
Aerial Imagery, Detriot and sourrdings, Data and Maps of SEMCOG, https://semcog.org/data-and-maps
Earth Expoler, 2021, USGS, https://earthexplorer.usgs.gov

Figure1: NDVI Winter ✗

Figure2: NDVI Summer ✓

Figure3: MNDWI Winter

Figure4: MNDWI Summer

Figure5: MBI Winter

Figure6: MBI Summer

Machine Learning - Identfication Wizard

SEMCOG also considered utilizing machine learning methods to map landcover types to reduce cost and time by manually specifying the satellite map with the corresponding landcover type to train Arcgis to recognize different landcover types on complicated satellite images.

However, due to insufficient number of samples, machines fail to identify smaller bare lands, like roads, and those bare soil among vegetations. Eventually, Xianwei and Yifei's firm defbeats the AI and obtains this order from SEMCOG.