Land Cover/Land Use Classification and Change Detection Analysis with Astronaut Photography and Geographic Object-Based Image Analysis

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For over fifty years, NASA astronauts have taken exceptional photographs of the Earth from the unique vantage point of low Earth orbit (as well as from lunar orbit and surface of the Moon). The Crew Earth Observations (CEO) Facility is the NASA ISS payload supporting astronaut photography of the Earth surface and atmosphere. From aurora to mountain ranges, deltas, and cities, there are over two million images of the Earth's surface dating back to the Mercury missions in the early 1960s. The Gateway to Astronaut Photography of Earth website (eol.jsc.nasa.gov) provides a publically accessible platform to query and download these images at a variety of spatial resolutions and perform scientific research at no cost to the end user. As a demonstration to the science, application, and education user communities we examine astronaut photography of the Washington D.C. metropolitan area for three time steps between 1998 and 2016 using Geographic Object-Based Image Analysis (GEOBIA) to classify and quantify land cover/land use and provide a template for future change detection studies with astronaut photography.

GEOBIA is a branch of Geographic Information Science (GIS) that emphasizes the partitioning of images into image-objects to create an understanding of the spatial, spectral, and temporal information of a region. Each image is segmented based on image features: texture, geometry, and spectral properties that make each image-object unique. GEOBIA segmentation and feature extraction techniques performed on true-color (RGB) datasets, such as astronaut photography, can enhance their usefulness as foundational maps for change detection studies. Individual segments are identified using the US Geological Survey's Multi-Resolution Land Characteristics Consortium (MRLC) classification system, and a post-classification change detection analysis yields from-to information of land cover/land use change.

According to the US Census Bureau, over 80,000 people have moved to the Washington D.C. metropolitan area in the last five years (US Census Bureau 2016). Growth is expected to continue to increase and the city has a Comprehensive Plan [link to: https://plandc.dc.gov/] to guide future growth and development, starting in 2006 to present. Using a change detection analysis with astronaut photography will create a low cost visualization and measure for urban growth and support future planning for Washington D.C.'s urban environment, particularly combined with other regularly acquired remotely sensed data from other platforms, such as Landsat. As acquisition of astronaut photography is constrained only by the ISS orbital dynamics, viewing conditions (eg cloud cover), and crew availability to take imagery, the handheld digital camera dataset can fill temporal and spatial resolution gaps inherent in more traditional orbital sensor systems. Application of established GEOBIA techniques using the

US Census Bureau. 2016. Quick Facts District of Columbia. https://www.census.gov/quickfacts/table/

MRLC system ensures that land cover classification products from astronaut photography can be incorporated into established time-series analysis workflows using other sensor data.

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