Factsheet # 12

Land use/land cover (LULC) from high-resolution near infrared aerial imagery: costs and applications

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What is a LULC?

Land cover describes natural and built objects covering the land surface, while land use documents human uses of the landscape. Remote sensing imagery captures characteristics of the Earth’s surface, but it takes an interpreter’s knowledge about shape, texture, patterns, and site context to derive information about land use activities from information about land cover. LULC classifications typically utilize some modification of the Anderson hierarchical system, with generalized LULC classes described at Levels I & II and more detailed classifications for Levels III & beyond.

What are the traditional methods of LULC Mapping?

Traditional classification methods have used Landsat satellite imagery (Fig. 1a) to produce LULC maps (e.g., 2001 National Land Cover Database) by assigning individual pixels to a specific class based on spectral signature (Fig. 1c). The spatial resolution of this imagery is 30m, meaning that anything on the ground less than 30m in size, or 900m² (9,688ft²) will be generalized to the main class represented in that pixel. 9,688ft² is larger than most parcels in Seattle so detail beyond Anderson Level I or II cannot be obtained. This is now an accepted principle that this moderate resolution is not appropriate for LULC mapping in urban areas.

What are the new methods of LULC Mapping?

A new classification method called Object Based Image Analysis (OBIA) appears to work best on high-resolution satellite and aerial imagery as well as LiDAR data (e.g., 1m NAIP; Figs. 1b & 2). This form of feature extraction allows for use of additional variables such as shape, texture, and contextual relationships to classify features (Fig 1d). This method can be used on free publicly-available high-resolution nationwide NAIP imagery, which can be classified at Anderson Level III and higher to achieve very detailed LULC maps for urban-based planning, management, and scientific research.

What are the traditional applications of LULC?

- Natural resource management
- Urban planning
- Water quality protection

- Public health studies
- Natural hazard assessments
- Military/Law enforcement use

![Figure 1. Comparison between a Landsat 30m pixel resolution image (a) classified using per-pixel method (c), and a National Agricultural Imagery Program (NAIP) 1m pixel resolution image (b) classified using Object Based Image Analysis method (d). Note the higher image detail in the OBIA classification and the greater number of classes possible. The forest cover in (c) is 31.74 % or 9.75 km² as compared to (d) where forest cover is estimated at 23.54 %, or 7.23 km². However, also note that (c) estimates 0% forest cover in or near urban areas versus (d) attributes 13.91 km² of forest cover in or near urban areas, thus, the OBIA method captures finer details in area and spatial distribution of canopy cover, in non contiguous, heterogeneous canopies such as urban forests.

![Figure 2. Historical aerial photos classified using OBIA methods. Landscape metrics were used to quantify spatial and temporal changes in two classes from a LULC classification: 1) forest canopy cover and 2) impervious surface areas are presented in the bar graph.

COSTS: Estimated cost is $100/m². This cost is based on an initial investment of algorithm development for a 100m² area. There are no remote sensing data costs associated with the project as WA state has current (2009) high-resolution multispectral imagery collected through the federal NAIP program. Field work or high-resolution oblique photography is required to validate the accuracy of the LULC maps. Costs will increase as areas to be mapped grow larger in extent and as transportation to assess sites increases in distance.

THE KEY ISSUE:
Washington State and Seattle lack current, high-resolution, land use/land cover maps.