Pattern-based Assessment of 2001/2006 Land Cover Change over the Entire U.S.

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Introduction

We present a post-classification change detection method geared toward assessing land cover change on continental scale. Instead of tracking transitions of land cover classes on pixel-by-pixel basis the method measures the change in local patterns defined on a 5 x 5 km square scenes (see illustration below). A pattern in a scene is represented by a 2D histogram of land cover classes and clump sizes and the level of change is measured as the dissimilarity between motifs of scene patterns at two time points the Jensen-Shannon similarity measure. The methodology is applied to the National Land Cover Dataset (NLCD) to obtain a 2001-2006 change map of the conterminous U.S.

Methods

Fig.1 shows co-registered scenes at two time points; land cover change is visible. Fig.2 shows (in random colors) clumps - contiguous groups of same-category pixels. Each pixel is assigned two variables - land cover category (one of 26 possible) and clump size category inherited from a clump to which it belongs (one of 14 possible). Clump size categories are categorized clump sizes. Fig.3 shows histograms of scenes pixels with respect to the two variables.

Comparison of different measures of change between scenes

In addition to JSS other methods of scene change are: JSSs which uses only histograms of land cover classes and capture only changes in class composition of the scene, and the fraction of unchanged pixels (f) which measures percentage of pixels in the scene that did not change land cover label. All measures have values between 0 and 1 but yield different values for the same pair of scenes. Figure to the right shows comparison of the values of these measures in urban environment (Fig.A) and rural environment (Fig.B).

Change map

Map of 2001-2006 pattern-based land cover change over the conterminous U.S. is 1045 x 1612 grid with each pixel representing a value of JSS similarity (1-JSS) between the same local scene in 2006 and 2001. The smaller the similarity the bigger the change. Most of the U.S. experienced little land cover change pattern change on continental scale. Instead of tracking transitions of land cover classes on pixel-by-pixel basis the method measures the change in local patterns defined on a 5 x 5 km square scenes (see illustration below). A pattern in a scene is represented by a 2D histogram of land cover classes and clump sizes and the level of change is measured as the dissimilarity between motifs of scene patterns at two time points the Jensen-Shannon similarity measure. The methodology is applied to the National Land Cover Dataset (NLCD) to obtain a 2001-2006 change map of the conterminous U.S.

Locations denoted by the letter A correspond to urban growth in the cities of Las Vegas, NV and Phoenix. Pattern change map clearly shows expansion of Las Vegas.

Locations denoted by the letter B coincides with the Great Salt Lake in Utah. The change is due to the lake retreated from its 2001 levels to expose more "barren land" in 2006.

Locations denoted by the letter C corresponds to urban growth in the cities of Kansas City, St. Louis, Indianapolis, and Columbus. These cities experienced some moderate level of urban development in their suburbia. Indianapolis is shown.

Linear features on the change map correspond to rivers and their surroundings. In particular, letter E denotes the Rio Grande river in New Mexico. The portion of the Rio Grande river and the associated change in land cover between 2001 and 2006 are shown. The changes can be explained by fluctuating water levels.

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