Mapping Land Cover Change in a Coastal Area of Binh Thuan, Vietnam Based on Object- Oriented Methodology

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In this poster, we examine the proposed decision tree to sub-images (figure 6) before applying to the whole study area. The process of classification includes several steps: sub-setting images, segmentation, building a class hierarchy (decision tree), classifying, manually editing, merging categories.

1. Sub-set images

2. Segmentation: a procedure of sub-dividing a image into separate regions. Depending on criteria of homogeneity and heterogeneity in color and shape, different algorithms will be applied and evaluated to find the optimal results - for example, an equal weight applied to shape and color.

3. Decision tree: is constructed based on object characteristics, band ratios, and other reference data (Digital Surface Model – DSM, for instance).

Conclusion

We are now approaching our final prelim results with both pre and post – change detection procedures. The PCA can extract and highlight the changes quickly and easily (figure 10), while the classified map-overlay (post-change detection) shows much more changes (figure 11). A further analysis will be applied to examine how sand dominant processes happened during 2011-2013, to evaluate the variation of vegetation cover between different periods of dry season, and the accuracy of our results.

References


Acknowledgements

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Data Preparation

Introduction

This poster presents the workflow applying object-oriented classification for mapping land cover, and analyzing land cover change using WorldView-2 images. Our main strategy for this project is using some of objects' characteristics, and different band-ratio indices to make a decision-tree for identifying some land cover types, such as forest, agriculture, bare land, sand surfaces, and urban. Agriculture here is quite complicated with mixture of several land use: rice fields, shrimp fields, saltwells or salt sea salt fields.

Our case study is a small area near the coast, in the North of Binh Thuan Province, Vietnam (shown in figure 1). Images were acquired in May 2011 and February 2015 as in the end and middle of dry season respectively.

About Study Area (1): Binh Thuan province is located in southern center with a 192 km coastline. This area is characterized as the driest area of the whole country: annual temperature is around 26-27°C, and rainfall is 500 – 600mm per year (or even below 250mm per year); dry season lasts 6 months, from November to April. Sixty percent of this area are subject to desiccation processes - one type of land degradation in arid and semi - arid areas. One-fourth of Binh Thuan's surface is sand, and mobile sand dunes along the coastline, sand tracking processes, which occur and disperse widely, and enhanced by long-lasting droughts, cause vegetated areas and removes topsoil. The study area is located in the North of Binh Thuan, which has experienced rapid changes in land use due to economic transition. This type of human activity affects to soil productivity, and also enhances sand-dominant processes. Learning how human impacts to the change of land use is expected to help for protecting land, and preserving soil fertility.

Brief Description of WorldView-2 (5): WorldView-2 is one of the commercial satellites owned by the Digital Globe for Earth Observation mission. WorldView-2 was launched on October 8, 2008, provides total of 9 spectral bands at very high resolution, including 1 panchromatic band of 0.46m resolution and 8 multispectral bands of 1.84m resolution. Eight multispectral bands are: coastal, blue, green, yellow, red, red edge, near-infrared 1, and near-infrared 2. Repeat interval is 1.1 day. Currently, Digital Globe is granting up to 4000 km² of very higher resolution imagery for non-commercial research.

Table 1. A brief explanation of 4 indices applied in the project (21/09)

<table>
<thead>
<tr>
<th>Band</th>
<th>Description</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>NDVI</td>
<td>Normalized Difference Vegetation Index</td>
<td>Vegetation cover and vegetation health</td>
</tr>
<tr>
<td>NDSI</td>
<td>Normalized Difference Soil Index</td>
<td>Soil dominates background and environmental materials</td>
</tr>
<tr>
<td>NDWI</td>
<td>Normalized Difference Water Index</td>
<td>Water body that larger than one pixel</td>
</tr>
<tr>
<td>NHFD</td>
<td>Normalized Homogeneous Feature Difference</td>
<td>Classifying areas which contrast against the background, which can be identified as made.</td>
</tr>
</tbody>
</table>

Table 2. Values extracted from 4 indices

<table>
<thead>
<tr>
<th>No.</th>
<th>Method</th>
<th>2011</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NDVI</td>
<td>-0.05</td>
<td>-0.03</td>
</tr>
<tr>
<td>2</td>
<td>NDSI</td>
<td>0.097</td>
<td>0.089</td>
</tr>
<tr>
<td>3</td>
<td>NDWI</td>
<td>0.032</td>
<td>-0.024</td>
</tr>
<tr>
<td>4</td>
<td>NHFD</td>
<td>0.045</td>
<td>0.037</td>
</tr>
</tbody>
</table>

Some Notes for Classification Procedure

1. Shadowed area: In this case study, we did not observe any significance of shadow effect. However, if the shadow effect is obvious, it is necessary to involve object-spatial relationship (neighborhood for instance) as one of indicators in the decision tree.

2. Effectiveness of band ratios: Dispers of using objects' characteristics (shape, or color), applying band ratios can be considered as a good approach to categorize objects into layer due to their specific spectral information. However, values of those indices are quite sensitive and depend much on the pre-processing procedure.

3. Segmentation procedure: This procedure requires a lot of time consuming and analyst's experience. Too small or too large sub-divided regions may lead to long time processing or missing data.

4. Decision tree: Constructing decision tree to classify objects into eight categories is very important, but it is not an easy mission. Each object has its own specific characteristics, but also shares some common ones with others. More indicators may be helpful but costs a lot.

Figure 7. Some type of land cover, 2011 image

Figure 8. A simplified decision tree describes the classification process (2)

Figure 9. An example of extracting water layer of 2012 image

Figure 8. Extracting values to represent different land type (black color from 4 indices NDVI, NDSI, NDWI and NHFD)

Figure 4. Land map compares images of VNDSI, NDSI, NDWI and NDVI

Figure 5. Building map features using WorldView-2/3 images to improve land cover classification

Figure 6. 2012 and 2015 sub-images (true color: 5-3-2).

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Classification

Conclusion

We are now approaching our final prelim results with both pre and post – change detection procedures. The PCA can extract and highlight the changes quickly and easily (figure 10), while the classified map-overlay (post-change detection) shows much more changes (figure 11). A further analysis will be applied to examine how sand dominant processes happened during 2011-2013, to evaluate the variation of vegetation cover between different periods of dry season, and the accuracy of our results.