Object-based Image Analysis for Disturbance and Habitat Land Cover Mapping

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Outline

• A hybrid object-based and pixel-based image analysis technique for Oil/Gas-related disturbance extraction from LANDSAT data
  • Geometric enhancement
  • Image segmentation
  • Well-site extraction
  • Results

• An object-based classification framework for and cover mapping of Torngat caribou habitat mapping in Labrador-Quebec.
  • Image Pre-processing
  • Multi-resolution segmentation
  • Rule-based classification
  • Results
Automatic and rapid Well-site extraction using Landsat data

Study Area: Fort McMurray, Alberta

- Landscape disturbances occur through natural (e.g. fire) and anthropogenic (e.g. seismic lines, well pads) influences.

- In order for resource development projects to be approved a minimum of 65% of the habitat in a species range must remain undisturbed.

- More than 500,000 Well sites only in Alberta SRD, 2010)
Comparison of well site extracted from Landsat-5 TM acquired in May and July, 2011. More well sites are detected in the early season image.

The output of different steps involved in the developed well site extraction method.
Well-site extraction using LSAT data - steps involved in the methodology

Landsat 5 TM image, July 02, 2011 Fort McMurray
Well-site extraction using LSAT data - Results of 3 regions of interest
Using 2 Landsat-5 TM images, Fort McMurray May 15, 2011 and July 5, 2015

The Method is fully automatic and can process a full Landsat image (32400 sq km) in less than 10min: The entire Alberta in less than 4 hrs.

More than 96% of Well pads have been extracted over the 4 ROI sites

False Positive rate is about 20%

Overall accuracy ~ 77%

<table>
<thead>
<tr>
<th>Site</th>
<th>TP</th>
<th>FP</th>
<th>FN</th>
<th>Correctness</th>
<th>Completeness</th>
<th>Quality</th>
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<tbody>
<tr>
<td>ROI 1</td>
<td>489</td>
<td>144</td>
<td>19</td>
<td>77.3%</td>
<td>96.3%</td>
<td>75%</td>
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<tr>
<td>ROI 2</td>
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<td>ROI 3</td>
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<tr>
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<td>96.2%</td>
<td>83.7%</td>
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<tr>
<td>Total</td>
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<td>477</td>
<td>75</td>
<td>79.3%</td>
<td>96.2%</td>
<td>76.7%</td>
</tr>
</tbody>
</table>

Correctness = \( \frac{TP}{TP + FP} \)

Completeness = \( \frac{TP}{TP + FN} \)

Quality = \( \frac{TP}{TP + FP + FN} \)

TP: True Positive
FP: False Positive
FN: False Negative

Landsat-5 Shortwave Infrared-1, July 2011
Torngat Caribou Habitat Classification: Project Area
Torngat Caribou Habitat Classification

~ 20 SPOT-4 Images
Torngat Caribou Habitat Classification

~ 20 SPOT-4 Images Mosaicked

Pan-Sharpened Bands (G, R, NIR, SWIR), 10 m Resolution
Torngat Caribou Habitat Classification

DEM: 20 m horizontal resolution, Re-sampled to 10 m
Torngat Caribou Habitat Classification

Object-based Classification

Data Collection and Pre-Processing
- Normalization
- Mosaicking
- Pan-Sharpening

Multi-Resolution Segmentation
- Level-1
- Level-2
- Level-3

Object-based Hierarchical Classification
- K Nearest Neighbour
- Maximum Likelihood
- Decision Trees
- Support Vector Machine
- Rule-based Classification

Sample Land Covers

Evaluation

Multi-source Data

Segmentation

Classification

Thematic Map

- Coniferous
- Shrub
- Bryoids
- Rock
- Water
- Shadow
- Snow/Ice
Brightness
Standard Deviation_NIR
GLCM-Texture-Homogeneity _NIR
Classification_Water/Shadow
✓ Shadow
✓ Water
✓ Coniferous
✓ Shrub
✓ Bryoids
✓ Rocks
Thank You!