Detection of Deforestation in China and South East Asia using GF-1 time-series Data

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Background

FAO Report: << Global remote sensing survey 2010 update >>

The survey shows the total forest area in 2010 was 3.89 billion hectares, which is around 30 percent of the global land area.

Over half the world’s forests (53%) are in tropical or subtropical climatic domains.

Between 1990 and 2010, there was a net reduction in the global forest area of around 5.3 million ha/year.

The gross reduction in forest land use over the 20-year time period (15.5 million hectares per year) was partially offset by gains in forest area through afforestation and natural forest expansion (10.2 million hectares per year).
Annual change in forest land-use area (1990-2010) by FRA region and climatic domain

Gains
Losses
Net change

South America
Africa
Asia
Europe
North and Central America
Oceania
Forest Cover Change in one District of LAOs
So, it is very important to develop techniques for closely monitoring areas of interest (e.g. deforestation) using remote sensing data (SAR or optical satellite data) to quickly detect changes within forested areas, both logging and fire damage. And produce detailed and timely forest change maps.

For the monitoring of timely forest change, it needs time-series satellite data. At the moment, Sentinel 1 SAR data and GF-1 data are the better choice.

This presentation will focus on the use of GF-1 data.
The Chinese GF-1 satellite is a new high spatial resolution satellite launched on April 26, 2013. It was equipped with two types of sensors. One is the wide field view sensor (WFV sensor); the other is the panchromatic and multispectral sensor (PMS sensor).

The WFV sensor can acquire multispectral image in blue, green, red, and near-infrared bands with 16 meters spatial resolution and 4 days temporal resolution.

The PMS sensor can acquire a panchromatic and multispectral image with 41 days temporal resolution. The spatial resolution of a panchromatic image acquired by the PMS sensor is 2 meters, while the spatial resolution of a multispectral image acquired by the PMS sensor in blue, green, red, and near-infrared bands is 8 meters.
The characteristics of the GF-1 satellite

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<tr>
<th></th>
<th>Panchromatic sensor</th>
<th>Multispectral sensor</th>
<th>WFV sensor</th>
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<tbody>
<tr>
<td><strong>Wavelength (μm)</strong></td>
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<tr>
<td>Panchromatic sensor</td>
<td>0.45—0.90μm</td>
<td>0.45—0.52μm</td>
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<tr>
<td>Multispectral sensor</td>
<td>0.45—0.52μm</td>
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<td>0.77—0.89μm</td>
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<tr>
<td><strong>Spatial resolution (meters)</strong></td>
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<tr>
<td>Panchromatic sensor</td>
<td>2m</td>
<td></td>
<td>16m</td>
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<tr>
<td>Multispectral sensor</td>
<td>8m</td>
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<tr>
<td><strong>Wide swath</strong></td>
<td>60km (2cameras combination)</td>
<td></td>
<td>800km (4cameras combination)</td>
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<tr>
<td><strong>Revisit time</strong></td>
<td>41days</td>
<td></td>
<td>4days</td>
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GF-1 satellite wide field of view (WFV) sensor data were used with the purpose of evaluating the GF-1 satellite’s application capability in forest change monitoring and developing methods of mapping change.
Test Site and Data Processing

Located in Ningming county of Guangxi Province, China. Total area of Ningming is 3698km², forest coverage rate reaches 30%.
4 dates GF-1 data were acquired for the test site and geometrically corrected.
Two dates of GF-1 data were selected with the purpose of forest change monitoring (1 year apart)
Deforestation detection flow chart

1. Satellite Image data
2. GF-1 first time image
3. GF-1 second time image
4. Images preprocessing
5. Optimum band selection
6. Supervised classification
7. Post classification procession
8. Accuracy assessment
9. Deforestation mapping
Deforestation area

Composite image
R: 20150415-B3
G: 20140514-B3
B: 20150415-B2
Optimum bands selection

Deforestation between 20140514-20150415

Image of 20140514 (R:4,G:3,B:2)

Image of 20150415 (R:4,G:3,B:2)

Composite Image 20140514 and 20150514
Feature bands selection

Deforestation between 20140514-20150415
Using the composite image to classify the deforestation area with a supervised classification approach.
Classification and results

--The deforestation area was classified as a single class using a supervised classification approach;
--After post-classification processing, the deforestation map was created.
Deforestation map between 20140514 to 20150415
Summary and future plan

Summary

1. The temporal resolution of GF-1 WFV sensor is 4 days, so it is possible to obtain good quality optical images every year in the subtropical and tropical area.
2. Deforestation areas in GF-1 imagery are very clear and easy to identify. GF-1 imagery is suitable for the detection of forest change over extremely large areas because of the 800km swath coverage.
3. The use of just 3 bands from the 2 date images enabled easy identification and classification of deforested areas.
4. New areas of deforestation are able to be tracked every year across the whole of sub-tropical China using just two cloud free images each year.
Future plan

1. Mapped areas of deforestation need to be properly validated using ground data.
2. The method developed in our study needs to be demonstrated for mapping over large areas.
3. Forest change includes forest loss and forest gain. So far we have focused on deforestation, but future work needs to include mapping of new plantings and regenerated areas.
4. The application potential of Sentinel-2 is similar to GF1 as it will provide the same frequent repeat wide swath data.
Thanks you for your attention!