GOES-R AWG Land Team: NDVI Algorithm
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1 CICS/UMD
NDVI Product Team

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Outline

- Executive Summary
- Algorithm Description
- ADEB and IV&V Response Summary
- Requirements Specification
- Validation Approach
- Validation Results
- Summary
Executive Summary

- This NDVI Algorithm generates Normalized Difference Vegetation Index
- The NDVI product has been moved from Option 1 to Option 2 list.
- Algorithm development and validation is performed with MSG SEVIRI.
- Versions 4 and 5 were delivered. CUTR has been conducted.
- Validation tool has been developed and applied to common datasets.
- NDVI Algorithm Package at 100% maturity will be delivered later this year
Algorithm Description
Algorithm Summary

- This ABI NDVI Algorithm generates the Option 2 product of Normalized Difference Vegetation Index.

- NDVI is derived at TOA

- Standard two-channel algorithm, uses ABI bands 2 (0.64µm) and 3 (0.86µm)

- NDVI is generated hourly
• Chlorophyll absorbs solar radiation in the red region of the spectrum
• Mesophyll structure of green leaves increases reflectance in the near infrared
• Difference or normalized difference of VIS and NIR reflectance is indicative of the vegetation condition
NDVI Algorithm

- Top of the atmosphere NDVI is defined as:
  \[ \text{NDVI} = \frac{R_{\text{nir}} - R_{\text{vis}}}{R_{\text{nir}} + R_{\text{vis}}} \]

- ABI ch.2 and 3 data will be used
- Retrievals are performed over land surface
- Retrievals require:
  - Clear-sky conditions
  - Daylight
  - No snow cover
NDVI Algorithm Output

False color composite

Derived NDVI map

MSG SEVIRI  April 12, 2007, 12:15 UTC
Algorithm Changes from 80% to 100%

- Metadata output will be added
- Quality flags will be added
- Scheduled delivery is in September 2010
ADEB and IV&V Status

- No reviews have been received for NDVI Product
- Therefore not actions have been taken so far
## Requirements

<table>
<thead>
<tr>
<th>Product</th>
<th>Observational Requirement</th>
<th>Accuracy</th>
<th>Precision</th>
<th>Latency</th>
<th>Horizontal Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>NDVI</td>
<td>Full Disk</td>
<td>0.04</td>
<td>0.04</td>
<td>60 min</td>
<td>2 km</td>
</tr>
</tbody>
</table>

In 2009 the observational requirement was changed from CONUS to Full Disk.
Qualifiers

NDVI product has the following qualifiers.

- Solar zenith angle < 70 degrees
Validation Approach
NDVI Validation: Accuracy

- NDVI is a radiance-based parameter
- NDVI accuracy is defined by radiance measurement accuracy
- For instrument noise equivalent of 0.1% in ch.2 and 3, NDVI accuracy is ~ 0.004
NDVI Validation: Precision

- Spatial and temporal change in NDVI should be consistent with variation of the state of the vegetation cover.

- Precision criterion: Low (lack of) high-frequency (day-to-day) changes in NDVI.
NDVI Validation: Details (1)

- **Method**: Evaluate daily change of NDVI
  » NDVI precision specification: 0.04

- **Approach**: Compare NDVI estimates made in cloud-clear conditions at the same time of the day (same geometry) on two consecutive days
NDVI Validation: Details (2)

- Quantitative measures
  - Daily RMS change of NDVI

- Validity criteria:
  - Daily RMS change of NDVI below 0.04
Validation Results
NDVI Maps from Common Dataset

MSG SEVIRI
11.45 UTC
August 2006
Large day-to-day variation in derived NDVI values may be due to
Missed clouds
Cloud shadows
Other factors (coregistration, variable aerosol, etc.)
Mean daily variation of derived NDVI

- Mean daily change of NDVI over full disk is below 0.04
- NDVI estimates over deserts are more consistent than over densely vegetated areas

MSG SEVIRI
11.45 UTC
Validation Results Summary

<table>
<thead>
<tr>
<th>Surface type (location)</th>
<th>Precision (requirement)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desert</td>
<td>0.012 (0.04)</td>
</tr>
<tr>
<td>Mixed vegetation</td>
<td>0.039 (0.04)</td>
</tr>
<tr>
<td>Savannah</td>
<td>0.048 (0.04)</td>
</tr>
<tr>
<td>Tropical forest</td>
<td>0.087 (0.04)</td>
</tr>
<tr>
<td>Overall</td>
<td>0.032 (0.04)</td>
</tr>
</tbody>
</table>

MSG SEVIRI Common Dataset, August 2006
Summary

• The ABI NDVI Algorithm has been developed to provide monitoring of vegetation cover properties with GOES-R ABI

• Version 5 of the algorithm has been delivered. 100% Algorithm Package is scheduled for delivery in September 2010

• Overall NDVI product is close to meeting the precision specification

• More conservative cloud mask over densely vegetated areas may improve NDVI precision. Cloud shadow flags may also help.