NASA MODIS and VIIRS Burned Area Products Update

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GOFC Fire Implementation Team Meeting

November 2016
## MODIS Burned Area Products

### MODIS Collections 5 and 5.1

<table>
<thead>
<tr>
<th>Product</th>
<th>Resolution/Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCD45A1</td>
<td>500-m Monthly</td>
</tr>
<tr>
<td>MCD45A1-based GIS Products (SCF)</td>
<td>Shapefiles + 500-m GeoTIFF</td>
</tr>
<tr>
<td>MCD64A1 (SCF)</td>
<td>500-m Monthly</td>
</tr>
</tbody>
</table>

### MODIS Collection 6

<table>
<thead>
<tr>
<th>Product</th>
<th>Resolution/Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCD64A1</td>
<td>500-m Monthly</td>
</tr>
<tr>
<td>MCD64A1-based GIS Products (SCF)</td>
<td>Shapefiles + 500-m GeoTIFF</td>
</tr>
<tr>
<td>MCD64CMQ (SCF)</td>
<td>0.25° Monthly</td>
</tr>
<tr>
<td>MCD64CDQ (SCF)</td>
<td>0.25° Daily</td>
</tr>
</tbody>
</table>
MODIS C6 BA Product Status

- C6 MCD64A1 operational production began five days ago
- Public release January 2017
July 2002 MCD64A1 Global Browse

http://landweb.nascom.nasa.gov/cgi-bin/browse/browseMODIS.cgi
December 2003 MCD64A1 Global Browse

http://landweb.nascom.nasa.gov/cgi-bin/browse/browseMODIS.cgi
C6 MCD64A1 Improvements

- C6 input data
- 10-day \(\rightarrow\) 8-day averaging window
- Final contextual relabeling phase now guided by neighbor statistics derived from training sample used for spectral classification
  - True small burns much less likely to be discarded
- No region growing in cropland
- Many smaller tweaks and refinements
C6 MCD64 Algorithm

ΔVI*, VI* post
S*, t*, t_f
IQR* pre, IQR* post

change summaries

primary role of active fire map

p(n_b ≤ N|B)
MODIS C6 Burned Area Early Results

• Overall increase in burned area
  – ~25% globally
## MCD64A1 2007

Regional 2007 Burned Area Totals ($\times 10^4 \text{ km}^2 = \text{Mha}$)

<table>
<thead>
<tr>
<th>Region</th>
<th>C5.1</th>
<th></th>
<th>C6</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Global</td>
<td>364.4</td>
<td>460.4</td>
<td>26.3%</td>
<td></td>
</tr>
<tr>
<td>Boreal North America</td>
<td>1.6</td>
<td>1.6</td>
<td>1.1%</td>
<td></td>
</tr>
<tr>
<td>Temperate North America</td>
<td>2.9</td>
<td>4.1</td>
<td>40.6%</td>
<td></td>
</tr>
<tr>
<td>Central America</td>
<td>1.6</td>
<td>2.9</td>
<td>83.5%</td>
<td></td>
</tr>
<tr>
<td>NH South America</td>
<td>3.3</td>
<td>7.3</td>
<td>122.7%</td>
<td></td>
</tr>
<tr>
<td>SH South America</td>
<td>32.3</td>
<td>49.1</td>
<td>51.9%</td>
<td></td>
</tr>
<tr>
<td>Europe</td>
<td>1.0</td>
<td>1.5</td>
<td>49.4%</td>
<td></td>
</tr>
<tr>
<td>Middle East</td>
<td>0.8</td>
<td>1.6</td>
<td>95.8%</td>
<td></td>
</tr>
<tr>
<td>NH Africa</td>
<td>121.8</td>
<td>143.0</td>
<td>17.4%</td>
<td></td>
</tr>
<tr>
<td>SH Africa</td>
<td>123.6</td>
<td>151.1</td>
<td>22.2%</td>
<td></td>
</tr>
<tr>
<td>Boreal Asia</td>
<td>3.4</td>
<td>6.0</td>
<td>77.7%</td>
<td></td>
</tr>
<tr>
<td>Central Asia</td>
<td>12.8</td>
<td>22.1</td>
<td>72.8%</td>
<td></td>
</tr>
<tr>
<td>Southeast Asia</td>
<td>9.9</td>
<td>17.7</td>
<td>79.2%</td>
<td></td>
</tr>
<tr>
<td>Equatorial Asia</td>
<td>0.4</td>
<td>0.7</td>
<td>66.1%</td>
<td></td>
</tr>
<tr>
<td>Australia and NZ</td>
<td>48.8</td>
<td>51.5</td>
<td>5.6%</td>
<td></td>
</tr>
</tbody>
</table>
## MCD64A1 2002

Regional 2002 Burned Area Totals ($\times 10^4 \text{ km}^2 = \text{ Mha}$)

<table>
<thead>
<tr>
<th>Region</th>
<th>C5.1</th>
<th>C6</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global</td>
<td>377.4</td>
<td>458.2</td>
<td>21.4%</td>
</tr>
<tr>
<td>Boreal North America</td>
<td>3.2</td>
<td>3.1</td>
<td>-3.5%</td>
</tr>
<tr>
<td>Temperate North America</td>
<td>1.4</td>
<td>2.1</td>
<td>50.7%</td>
</tr>
<tr>
<td>Central America</td>
<td>0.9</td>
<td>2.4</td>
<td>171.8%</td>
</tr>
<tr>
<td>NH South America</td>
<td>2.2</td>
<td>4.4</td>
<td>98.2%</td>
</tr>
<tr>
<td>SH South America</td>
<td>20.6</td>
<td>36.1</td>
<td>75.2%</td>
</tr>
<tr>
<td>Europe</td>
<td>0.4</td>
<td>0.8</td>
<td>102.3%</td>
</tr>
<tr>
<td>Middle East</td>
<td>0.5</td>
<td>1.3</td>
<td>156.6%</td>
</tr>
<tr>
<td>NH Africa</td>
<td>125.3</td>
<td>136.9</td>
<td>9.3%</td>
</tr>
<tr>
<td>SH Africa</td>
<td>110.7</td>
<td>137.7</td>
<td>24.4%</td>
</tr>
<tr>
<td>Boreal Asia</td>
<td>7.6</td>
<td>10.2</td>
<td>33.8%</td>
</tr>
<tr>
<td>Central Asia</td>
<td>25.0</td>
<td>34.6</td>
<td>38.3%</td>
</tr>
<tr>
<td>Southeast Asia</td>
<td>4.7</td>
<td>8.5</td>
<td>80.3%</td>
</tr>
<tr>
<td>Equatorial Asia</td>
<td>2.4</td>
<td>3.3</td>
<td>38.2%</td>
</tr>
<tr>
<td>Australia and NZ</td>
<td>72.7</td>
<td>76.9</td>
<td>5.7%</td>
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MCD64A1 2006 Annual Area Burned

Area Burned (Mha)

forest  |  shrubland  |  savanna  |  grassland  |  cropland

Global
MODIS C6 Burned Area Early Results

- Overall increase in burned area
  - ~25% globally
- Small burns no longer blindly eliminated
September 2002, MODIS tile h13v09 (eastern Brazil)

C5.1 MCD64A1 2002244 h13v09 17882

C6 MCD64A1 2002244 h13v09 71961

C5.1 MCD64A1

C6 MCD64A1

(4× increase)
MODIS C6 Burned Area Early Results

• Overall increase in burned area
  — ~25% globally
• Small burns no longer blindly eliminated
• Improved (i.e., smaller) temporal uncertainty
Temporal Uncertainty (Global, 2006)
MODIS C6 Burned Area Early Results

• Overall increase in burned area
  — ~25% globally
• Small burns no longer blindly eliminated
• Improved (i.e., smaller) temporal uncertainty
• Mapping of cropland burning somewhat **cosmetically** improved
  — Timing can still be off due to confusion with harvest
Quality/consistency of cropland BA mapping can still be very poor, however. Here’s an example where the C6 product is no better than C5, and probably even worse.
April 2002, MODIS tile h20v11 (southern Africa)
MODIS Collection 6/VIIRS Validation

- Landsat-8 imagery
- CEOS burned area validation protocol
  - Image-pair interpretation
    - Cloud free + within a set time period (~2 months)
    - Widely tested and used in peer reviewed literature
- CEOS “Stage 3”
  - “Product accuracy has been assessed, and the uncertainties in the product well established via independent measurements made in a systematic and statistically robust way that represents global conditions.”
Mali C5.1
Mali C6
VIIRS Burned Area Product Status

• Adapt MCD64 production code to use VIIRS data
  – 750-m versus 375-m bands
• Retain 500-m grid for MODIS compatibility
## VIIRS Burned Area Products

### VIIRS “Collection 1”

<table>
<thead>
<tr>
<th>Product</th>
<th>Resolution</th>
<th>Frequency</th>
</tr>
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<tbody>
<tr>
<td>VNP64A1</td>
<td>500-m</td>
<td>Monthly</td>
</tr>
<tr>
<td>VNP64A1-based GIS Products (SCF)</td>
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<td>0.25°</td>
<td>Monthly</td>
</tr>
<tr>
<td>VNP64CDQ (SCF)</td>
<td>0.25°</td>
<td>Daily</td>
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March 2017 release significantly behind schedule due to input-data implementation delays.
1-km NPP_DSRFIP_L3 daily surface reflectance product used as stand-in for 500-m VIIRS daily surface reflectance.