The ABI (Advanced Baseline Imager) on the GOES-R series

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CIMSS, Madison, WI
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Overview

• GOES-14
• ABI (Advanced Baseline Imager)
  – Temporal
  – Spatial
  – Spectral
  – Imagery
• Summary
  – More information
GOES-12/14 (Around eclipse period)

GOES-12
NO DATA DUE TO ECLIPSE

GOES-14
1 OCT 09 05:45 UTC BAND=4
GOES-14: Sample “1-min” imagery

Visible data from the recent NOAA Science Test, lead by Hillger and Schmit
GOES-14: Sample “5-min” imagery

“Water vapor” data from the recent NOAA Science Test, lead by Hillger and Schmit
GOES-14: Sample “5-min” imagery

IR window data from the recent NOAA Science Test, lead by Hillger and Schmit
Overview

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• ABI (Advanced Baseline Imager)
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# The Advanced Baseline Imager: ABI

<table>
<thead>
<tr>
<th></th>
<th>ABI</th>
<th>Current</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Spectral Coverage</strong></td>
<td>16 bands</td>
<td>5 bands</td>
</tr>
<tr>
<td><strong>Spatial resolution</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.64 μm Visible</td>
<td>0.5 km</td>
<td>Approx. 1 km</td>
</tr>
<tr>
<td>Other Visible/near-IR Bands</td>
<td>1.0 km</td>
<td>n/a</td>
</tr>
<tr>
<td>Bands (&gt;2 μm)</td>
<td>2 km</td>
<td>Approx. 4 km</td>
</tr>
<tr>
<td><strong>Spatial coverage</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full disk</td>
<td>4 per hour</td>
<td>Scheduled (3 hrly)</td>
</tr>
<tr>
<td>CONUS</td>
<td>12 per hour</td>
<td>~4 per hour</td>
</tr>
<tr>
<td>Mesoscale</td>
<td>Every 30 sec</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Visible (reflective bands)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On-orbit calibration</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>On-orbit calibration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>On-orbit calibration</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
There are two anticipated scan modes for the ABI:
- Full disk images every 15 minutes + 5 min CONUS images + mesoscale.
  or - Full disk every 5 minutes.
ABI can offer Continental US images every 5 minutes for routine monitoring of a wide range of events (storms, dust, clouds, fires, winds, etc). This is every 15 or 30 minutes with the current GOES in routine mode.
Mesoscale images every 30 seconds for rapidly changing phenomena (thunderstorms, hurricanes, fires, etc). Current GOES cannot offer these rapid scans while still scanning other important regions.
4 JUNE 2005
23:00:00.000 UTC

Concept of flex mode scanning animation

Figure courtesy of J. Li, CIMSS
Figure courtesy of K. Bedka and W. Feltz
Figure courtesy of K. Bedka and W. Feltz
## ABI Visible/Near-IR Bands

<table>
<thead>
<tr>
<th>Future GOES imager (ABI) band</th>
<th>Wavelength range (μm)</th>
<th>Central wavelength (μm)</th>
<th>Nominal subsatellite IGFOV (km)</th>
<th>Sample use</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.45–0.49</td>
<td>0.47</td>
<td>1</td>
<td>Daytime aerosol over land, coastal water mapping</td>
</tr>
<tr>
<td>2</td>
<td>0.59–0.69</td>
<td>0.64</td>
<td>0.5</td>
<td>Daytime clouds fog, insolation, winds</td>
</tr>
<tr>
<td>3</td>
<td>0.846–0.885</td>
<td>0.865</td>
<td>1</td>
<td>Daytime vegetation/burn scar and aerosol over water, winds</td>
</tr>
<tr>
<td>4</td>
<td>1.371–1.386</td>
<td>1.378</td>
<td>2</td>
<td>Daytime cirrus cloud</td>
</tr>
<tr>
<td>5</td>
<td>1.58–1.64</td>
<td>1.61</td>
<td>1</td>
<td>Daytime cloud-top phase and particle size, snow</td>
</tr>
<tr>
<td>6</td>
<td>2.225–2.275</td>
<td>2.25</td>
<td>2</td>
<td>Daytime land/cloud properties, particle size, vegetation, snow</td>
</tr>
</tbody>
</table>

Schmit et al, 2005
# ABI IR Bands

<table>
<thead>
<tr>
<th>Band</th>
<th>Wavelength (μm)</th>
<th>Central Wavelength (°C)</th>
<th>Temporal Resolution</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>3.80–4.00</td>
<td>3.90</td>
<td>2</td>
<td>Surface and cloud, fog at night, fire, winds</td>
</tr>
<tr>
<td>8</td>
<td>5.77–6.6</td>
<td>6.19</td>
<td>2</td>
<td>High-level atmospheric water vapor, winds, rainfall</td>
</tr>
<tr>
<td>9</td>
<td>6.75–7.15</td>
<td>6.95</td>
<td>2</td>
<td>Midlevel atmospheric water vapor, winds, rainfall</td>
</tr>
<tr>
<td>10</td>
<td>7.24–7.44</td>
<td>7.34</td>
<td>2</td>
<td>Lower-level water vapor, winds, and SO₂</td>
</tr>
<tr>
<td>11</td>
<td>8.3–8.7</td>
<td>8.5</td>
<td>2</td>
<td>Total water for stability, cloud phase, dust, SO₂ rainfall</td>
</tr>
<tr>
<td>12</td>
<td>9.42–9.8</td>
<td>9.61</td>
<td>2</td>
<td>Total ozone, turbulence, and winds</td>
</tr>
<tr>
<td>13</td>
<td>10.1–10.6</td>
<td>10.35</td>
<td>2</td>
<td>Surface and cloud</td>
</tr>
<tr>
<td>14</td>
<td>10.8–11.6</td>
<td>11.2</td>
<td>2</td>
<td>Imagery, SST, clouds, rainfall</td>
</tr>
<tr>
<td>15</td>
<td>11.8–12.8</td>
<td>12.3</td>
<td>2</td>
<td>Total water, ash, and SST</td>
</tr>
<tr>
<td>16</td>
<td>13.0–13.6</td>
<td>13.3</td>
<td>2</td>
<td>Air temperature, cloud heights and amounts</td>
</tr>
</tbody>
</table>

Schmit et al, 2005
Visible and near-IR channels on the ABI

The ABI visible and near-IR bands have many uses.
While there are differences, there are also many similarities for the spectral bands on MET-8 and the Advanced Baseline Imager (ABI). Both the MET-8 and ABI have many more bands than the current operational GOES imagers.
ABI bands via NWP simulation (CIMSS AWG Proxy Team)

ABI band data for 2005 June 04 22:00 UTC

J. Oktin et al., CIMSS
Simulated Advanced Baseline Imager (ABI) bands shown; in the legacy AWIPS.
1-min Simulated ABI
‘mesoscale’ loop
Full disk simulation

ABI band 15 (12.3um) June 26 2008 at 20:00UTC.
AWG Proxy ABI Simulations of Hurricane Katrina

NOAA/NESDIS STAR and GOES-R Imagery Team
Corresponding current Imager bands of Hurricane Katrina
Three ABI water vapor bands

Current GOES

Future GOES

Images from J. Feltz
Nocturnal Fog/Stratus Over the Northern Plains

“ABI” 4 minus 11 μm Difference
ABI image (from MODIS) shows greater detail in structure of fog.
Nocturnal Fog/Stratus Over the Northern Plains

GOES-10 4 minus 11 μm Difference
ABI image (from MODIS) shows greater detail in structure of fog.
GOES-12 and GOES-R ABI
Simulation of Grand Prix Fire/Southern California
GOES-R ABI will detect SO2 plumes
Water Vapor Band Difference convolved from AIRS data
sees SO$_2$ plume from Montserrat Island, West Indies

Current GOES Imager
No skill in monitoring

Current GOES Imager can not detect SO$_2$

Figure courtesy of Kris Karnauskas
Overview

• GOES-14
• ABI (Advanced Baseline Imager)
  – Temporal
  – Spatial
  – Spectral
  – Imagery
• Summary
  – More information
Current attributes: defined to be 1

"Information volume"
Improved attributes with the Future GOES Imagers

"Information volume"
<table>
<thead>
<tr>
<th>~ Band Center (um)</th>
<th>GOES-6/7</th>
<th>GOES-8/11</th>
<th>GOES-12/N</th>
<th>GOES-O/P</th>
<th>GOES-R+</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.47</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>0.64</td>
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<td>0.86</td>
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<tr>
<td>1.6</td>
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<tr>
<td>1.38</td>
<td></td>
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<tr>
<td>2.2</td>
<td></td>
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<tr>
<td>3.9</td>
<td></td>
<td>!</td>
<td>!</td>
<td>!</td>
<td>!</td>
</tr>
<tr>
<td>6.2</td>
<td></td>
<td>!</td>
<td>!</td>
<td>!</td>
<td>!</td>
</tr>
<tr>
<td>6.5/6.7/7</td>
<td>14km</td>
<td>8</td>
<td>4</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>7.3</td>
<td></td>
<td>!</td>
<td>!</td>
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<td>8.5</td>
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<td>9.7</td>
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<td>10.35</td>
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<td>11.2</td>
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<tr>
<td>12.3</td>
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<tr>
<td>13.3</td>
<td></td>
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</tr>
</tbody>
</table>

Box size represents detector size
More information

GOES-R:
- http://www.goes-r.gov
- http://www.meted.ucar.edu/index.htm
- http://cimss.ssec.wisc.edu/goes_r/proving-ground.html

GOES and NASA:

UW/SSEC/CIMSS/ASPB:
- http://cimss.ssec.wisc.edu/goes_r/awg/proxy/nwp/
- http://cimss.ssec.wisc.edu/goes/abi/
- http://cimss.ssec.wisc.edu/goes/abi/wf
- http://cimss.ssec.wisc.edu/goes/blog/
- http://www.ssec.wisc.edu/data/geo/

AMS BAMS Article on the ABI (Aug. 2005)
Google Earth

- Sample ABI simulated data are available in Google Earth format:
  - http://cimss.ssec.wisc.edu/goes/abi/loops/links.html
Summary

• The ABI on GOES-R will improve over the current instrument in many aspects (spatial, temporal, spectral), plus improved image navigation and registration and radiometer performance.

• These improvements will greatly assist a host of applications.

• Thank you for your time.

• Contact information:
  – tim.j.schmit@noaa.gov
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• The views, opinions, and findings contained in this presentation are those of the authors and should not be construed as an official National Oceanic and Atmospheric Administration or U.S. Government position, policy, or decision.