Introduction to Satellite Remote Sensing for Air Quality Applications

Future Satellite Capabilities for Air Quality Monitoring and Webinar Review
5 Weeks Webinar Series: Agenda

Week 1: Fundamentals of Remote Sensing

Week 2: Satellite Imagery

Week 3: Aerosol Data

Week 4: Trace Gas Data

Week 5: Future Capabilities
Session 5 - Outline

• Overview of Future Satellite Capabilities
• Example of Aerosol Product from Geostationary Orbit
• Review of Webinar Series
• Future Training Opportunities

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TEMPO

• Geostationary over North America

• High Temporal Resolution: 1 hour

• High Spatial Resolution: 2.2x4.7km

• Spectral Range: 290-740nm

• Data Products: O₃, NO₂, SO₂, H₂CO, C₂H₂O₂, aerosols, cloud parameters, and UVB radiation

• Expected Launch: 2020
TEMPO footprint (GEO at 100° W)

For GEO at 80°W, pixel size at 36.5°N, 100°W is 2.2 km \times 5.2 km.

<table>
<thead>
<tr>
<th>Location</th>
<th>N/S (km)</th>
<th>E/W (km)</th>
<th>GSA (km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>36.5°N, 100°W</td>
<td>2.11</td>
<td>4.65</td>
<td>9.8</td>
</tr>
<tr>
<td>Washington, DC</td>
<td>2.37</td>
<td>5.36</td>
<td>11.9</td>
</tr>
<tr>
<td>Seattle</td>
<td>2.99</td>
<td>5.46</td>
<td>14.9</td>
</tr>
<tr>
<td>Los Angeles</td>
<td>2.09</td>
<td>5.04</td>
<td>10.2</td>
</tr>
<tr>
<td>Boston</td>
<td>2.71</td>
<td>5.90</td>
<td>14.1</td>
</tr>
<tr>
<td>Miami</td>
<td>1.83</td>
<td>5.04</td>
<td>9.0</td>
</tr>
<tr>
<td>Mexico City</td>
<td>1.65</td>
<td>4.54</td>
<td>7.5</td>
</tr>
<tr>
<td>Canadian tar sands</td>
<td>3.94</td>
<td>5.05</td>
<td>19.2</td>
</tr>
</tbody>
</table>

Assumes 2000 N/S pixels
GOES-R

• Expected Launch: 2016
• Advance Baseline Imager (ABI): 16 Spectral Bands
• Very High Temporal Resolution: 15 min – 30 seconds
GOES-R Spectral Coverage
<table>
<thead>
<tr>
<th>ABI</th>
<th>Current GOES Imager</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spectral Coverage</td>
<td></td>
</tr>
<tr>
<td>0.64 μm Visible</td>
<td>16 bands</td>
</tr>
<tr>
<td>Other visible/near-IR</td>
<td>5 bands</td>
</tr>
<tr>
<td>Bands (&gt;2 μm)</td>
<td>~ 1 km</td>
</tr>
<tr>
<td></td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td>~ 4 km</td>
</tr>
<tr>
<td>Spatial Coverage</td>
<td></td>
</tr>
<tr>
<td>Full Disk</td>
<td>4 per hour</td>
</tr>
<tr>
<td>CONUS</td>
<td>12 per hour</td>
</tr>
<tr>
<td>Mesoscale</td>
<td>Every 30 sec</td>
</tr>
<tr>
<td>Scheduled (3 hrly)</td>
<td></td>
</tr>
<tr>
<td>On-orbit calibration</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
</tbody>
</table>
Global pollution monitoring constellation (2018-2020)

Policy-relevant science and environmental services enabled by common observations

- Improved emissions, at common confidence levels, over industrialized Northern Hemisphere
- Improved air quality forecasts and assimilation systems
- Improved assessment, e.g., observations to support United Nations Convention on Long Range Transboundary Air Pollution
TROPOMI

http://www.tropomi.eu/

Global Coverage at 7 km

OBSERVING OUR FUTURE

TROPOMI
TROPOspheric Monitoring Instrument

SCIENCE WEBSITE
VISIT PUBLIC TROPOMI WEBSITE
Himawari 8

http://himawari8.nict.go.jp/

Launch date: October 7, 2014
Aerosol Data from Himawari-8 by Dr. Aaron Naeger
Review of Webinar Series
Week 1

- Fundamentals of satellite remote sensing
- Satellites, sensors, and orbits
- Spectral, spatial, radiometric, and temporal resolutions
- Advantages and limitations of remote sensing
Week 2

• Visible satellite imagery and air quality applications
• Image information content, feature identification, and image archives
• Near real-time image access exercise

Week 2: Satellite Imagery
Week 3

- Remote sensing of aerosols
- NASA satellite aerosol products
- Aerosol products as a surrogate for PM2.5
Week 4

• Background information on trace gas detection and products
• Applications of trace gas products
Week 5

- Overview of future satellite capabilities
- Example of aerosol product from geostationary orbit
- Review of webinar series
- Future training opportunities
Future Training Opportunity

http://arset.gsfc.nasa.gov/airquality/

Upcoming Trainings

Stay Informed
If you would like information on upcoming trainings please sign up for the listserv:
http://lists.nasa.gov/mailman/listinfo/arset
Upcoming Training

http://arset.gsfc.nasa.gov/airquality/workshops/awma16/

The Practical Use of Satellite Observations for Visibility and Air Quality Analysis

Host: Air & Waste Management Association
Location: Jackson Hole, WY
Date: Monday, September 26, 2016

This course will provide an overview of satellite data and its application in visibility and air quality data analysis. The focus will be on understanding what present satellite measurements can and can't provide, and how to use them. In addition to an overview of satellite data and terminology, we will explore common and achievable uses for satellite data in air quality analysis through a series of case studies. This course will also cover current methods for discovering, acquiring and processing satellite data.
United Nations Sustainable Development Goals

• **Goal 11, Target 11.6, Indicator 11.6.2**
  – Level of ambient particulate matter (PM 10 and PM 2.5)
  – Annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities (population weighted)

• **Goal 3, Target 3.9, Indicator 3.9.1**
  – Population in urban areas exposed to outdoor air pollution levels above WHO guideline values
  – Mean annual levels of air pollution level (fine particulate matter [PM2.5])

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**Upcoming Training**

Satellite Derived Annual PM2.5 Data Sets in Support of United Nations Sustainable Development Goals

Online Webinar Series – January 2017
NO ASSIGNMENTS
All the materials and recordings will be available at


Contact

- Pawan Gupta (pawan.gupta@nasa.gov) for technical questions
- Brock Blevins (brockbl1@umbc.edu) for material access, future trainings, and other logistics