Stratospheric Aerosol and Gas Experiment
SAGE III on ISS

SAGE-III Aerosol and Ozone Products: Using NDACC Lidar Data as Validation Toolset

Travis N. Knepp
SSAI / NASA LaRC
Data collection began:
- 2017-06-07

Detector:
- 809x10 pixel CCD
- 280 – 1040 nm
- 1550 (±15) nm

Operational Modes:
- Solar Occultation (SO)
- Lunar Occultation (LO)
- Limb Scatter (LS)

Occultation data collections dictated by orbital mechanics
- Sunrise/Sunset – local time
- Moonrise/Moonset – nighttime species

LS observations will be made on a regular basis
- When/where has a degree of flexibility
ISS Orbit & Overpass Frequency

Event Latitudes for 2018

SAGE-III/ISS Sunrise Overpass Frequency for Latitude

June 2017 – February 2018

SAGE-III/ISS Sunset Overpass Frequency for Latitude

June 2017 – February 2018
NDACC LIDAR Site Map
# Standard Data Products

<table>
<thead>
<tr>
<th>Product</th>
<th>Event Type</th>
<th>Vertical Range &amp; Resolution [km]</th>
<th>Precision [%]</th>
<th>Wavelengths (nm)</th>
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<td>Ozone [cm⁻³]</td>
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<td>Lunar</td>
<td>25 – 45, 1.5</td>
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<td>378-679</td>
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* Or cloud-top; ** at 600 nm
Mother of Pyrocbs
We see her too!

Canadian Pyrocumulus Event

Mean Zonal Extinction at 50N (R/S)
- June 9-10 Zonal
- July 7-9 Zonal
- August 8-10 Zonal
- September 16-18 Zonal
- September 27-29 Zonal
- October 8-10 Zonal
- November 6-9 Zonal (47N)
- December 4-6 Zonal (44N)
- February 2-4 Zonal Mean (47N)
Validation Criteria

Collocation criteria:
- Latitude: ±5° (site dependent)
- Longitude: ±10°
- Time: ±24 h
- Locations: global

Resolution requirements:
- Time: ideally 4-6 h (10-12 acceptable)
- Vertical: ideally < 0.5 km

Science products (UTLS and up):
- Aerosol backscatter (ideally extinction)
- Ozone number density
- Water vapor (operational, released in next version)
- Temperature profile (research product)
## Known Overlap with ISS

as of April 2018

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### SAGE-III
- Meteor
- Boulder 532 nm, BS
- Lauder 532 nm, BS
- Mauna Loa 355 nm, BS
- Mauna Loa 532 nm, BS
- OHP 355 nm, BS & Ext.
- Table Mountain 355 nm, BS

### Aerosol
- Hohenpeissenberg
- Lauder
- Mauna Loa
- OHP
- Table Mountain

### Ozone
- Hohenpeissenberg
- Mauna Loa
- OHP
- Reunion Maida
- Table Mountain

### Temperature
- Hohenpeissenberg
- Mauna Loa
- OHP
- Reunion Maida
- Table Mountain
Using LWG Data: Hohenpeissenberg

Hohenpeissenberg Aerosol O₃

Altitude (km, ASL) vs. Coincidences

R² vs. Percent Diff. (%) vs. 1-σ Percent Diff (%)
Location Matters

Hohenpeissenberg Aerosol $O_3$: 2017-07-06 03:23 UTC
Offset: 636.0 km, 22 hr 20 min

Hohenpeissenberg Aerosol $O_3$: 2017-07-07 04:06 UTC
Offset: 586.0 km, 2 hr 21 min

400 km south

580 km east
Initial Usage, OHP

OHP Aerosol $O_3$

[Graph showing data on OHP Aerosol $O_3$]
Location Matters

OHP Aerosol \( \text{O}_3 \): 2017-11-14 06:18 UTC
Offset: 325.0 km, 8 hr 12 min

OHP Aerosol \( \text{O}_3 \): 2017-11-30 15:37 UTC
Offset: 853.0 km, 18 hr 16 min

200 km south

500 km south
LWG helps inform latitude tolerance

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<th>ISS</th>
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How can you help?

Hey, we need to get in on this!
The SAGE III/ISS Validation Measurement Locator is a web application intended to assist the correlative and validation measurement community for pre-mission field campaign planning activities

- Up to three weeks of advanced measurement predictions provided
  - Predictions change due to reboost events, so recheck as overpass approaches

- Web application provides temporal and geospatial search criteria

- A downloadable report for import into other applications is available
Validation Measurement Locator
https://sage.nasa.gov/validation/

Step 1: Select an occultation event type

The subset options include being able to select the mission and event types (solar, lunar or limb-scatter).

Choose Event Type:  ☐ Sunrise ☐ Sunset ☐ Moonrise ☐ Moonset ☐ Limb-scatter

Step 2: Select a temporal range (optional)

Use the temporal options to narrow your search to a specific temporal domain. If you do not make a temporal selection, the default is to search the complete range of time in which the satellite has acquired data. If you limit your search to a specific time domain, the search will return all available data that intersect with your selected time range.

Calendar dates

Calendar dates

The SAGE3/ISS instrument (will begin) nominal operations on TBD. The dates reflected in the calendar will represent the range in which the instrument has been in data acquisition mode.

From 2016-06-22 to 2017-02-11
Validation Measurement Locator
https://sage.nasa.gov/validation/

Geospatial selector

Step 3: Select a geospatial range (optional)
Use the geospatial options to narrow your search to a specific geospatial area. If you do not make a geospatial selection, the default is to search the whole globe. If you limit your search to a specific area, the search will return all available data that intersect with your selected area.

User-defined bounding box

Modify the geospatial fields to specify your area of interest, or use your mouse directly on the map to draw a bounding box by clicking and dragging. The map uses latitude/longitude bounds (north, south, east, and west) to define the area of a box. If you use the mouse to draw the area on the map, the fields are filled in automatically, based on the box drawn.

Latitudes and longitudes are in Decimal Degrees (DD) format.
Use: ‘+’ for north latitudes or east longitudes; use ‘-‘ for south latitudes or west longitudes. Example: +40.68, -74.04
To cross the anti-meridian, left must be greater than right. Example: (left) +148.64, (right) -115.73

Event selection status

0 event(s) found.
(0.00 seconds)
# Validation Measurement Locator

[https://sage.nasa.gov/validation/](https://sage.nasa.gov/validation/)

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![Validation Measurement Locator](https://sage.nasa.gov/validation/)

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## Event List

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SAGE-III science team already selected via ROSES:
- have variety of focus areas

If you are collecting data already…
- can operation be shifted by hours or a day
  - does this flexibility exist?

What do you need from us to schedule operation during overpass?
- weekly e-mail/bulletin for your site?
- SAGE-III data available: https://eosweb.larc.nasa.gov/project/sageiii-iss/sageiii-iss_table

What would we like?
- quick release data products (within a month)
- coincident data collection
Aerosol Validation
A Particular Challenge...

POPS* and Wyoming OPC Profiles (0.5 km vertical resolution) 2017-11-09

*Printed Optical Particle Spectrometer

Data courtesy of Terry Deshler (University of Wyoming and Troy Thornberry (NOAA)
Questions
<table>
<thead>
<tr>
<th>Product</th>
<th>Event Type</th>
<th>Wavelengths (nm)</th>
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<td>----------------------------------------</td>
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<td>----------------------------------</td>
</tr>
<tr>
<td>Spectral Transmission</td>
<td>Solar</td>
<td>0* – 100, 0.75</td>
</tr>
<tr>
<td>Aerosol Ext./Optical Depth</td>
<td>Solar</td>
<td>0* – 40, 0.75</td>
</tr>
<tr>
<td>Ozone#</td>
<td>Solar</td>
<td>0* – 50, 0.75</td>
</tr>
<tr>
<td>Water Vapor#</td>
<td>Solar</td>
<td>5* – 45, 0.75</td>
</tr>
<tr>
<td>Nitrogen Dioxide#</td>
<td>Solar</td>
<td>TP+2 – 45, 0.75</td>
</tr>
<tr>
<td>Ozone#</td>
<td>Lunar</td>
<td>15* - 45, 1.5</td>
</tr>
<tr>
<td>Nitrogen Dioxide#</td>
<td>Lunar</td>
<td>20 – 45, 1.5</td>
</tr>
<tr>
<td>Nitrogen Trioxide#</td>
<td>Lunar</td>
<td>25 – 45, 1.5</td>
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