

National Aeronautics and Space Administration



Stratospheric Aerosol and Gas Experiment **SAGE III on ISS**

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

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SSAI / NASA LaRC



The SAGE-III/ISS Breakdown



Data collection began:

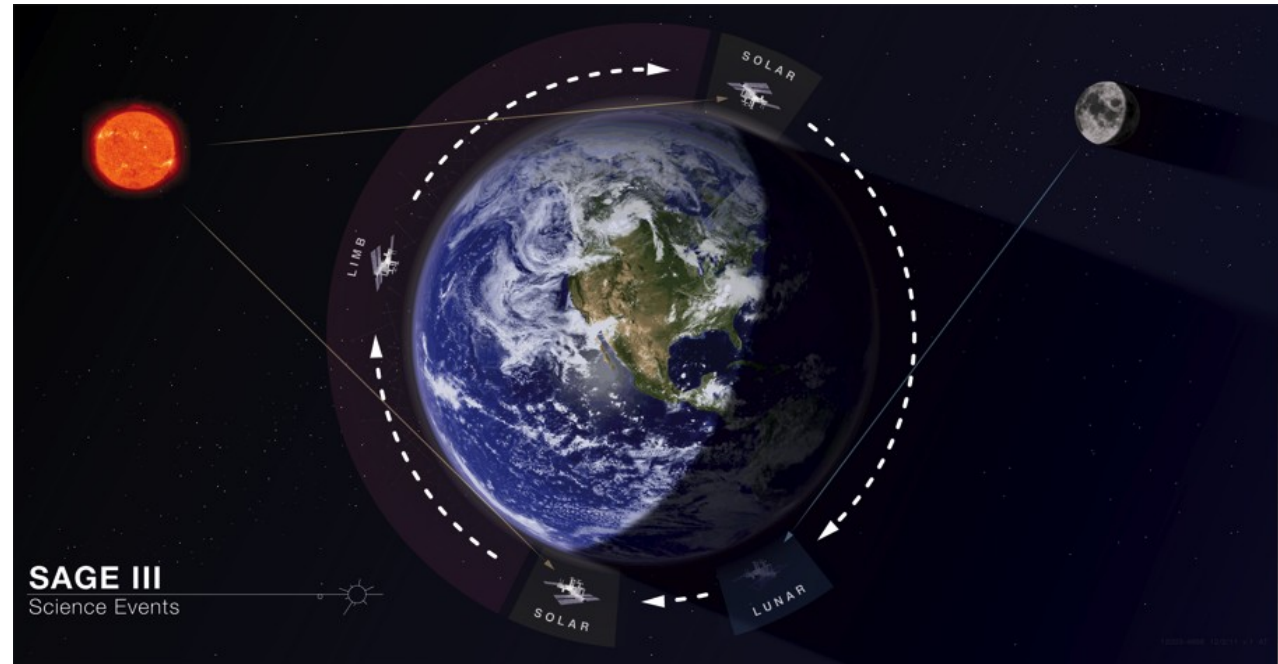
- 2017-06-07

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

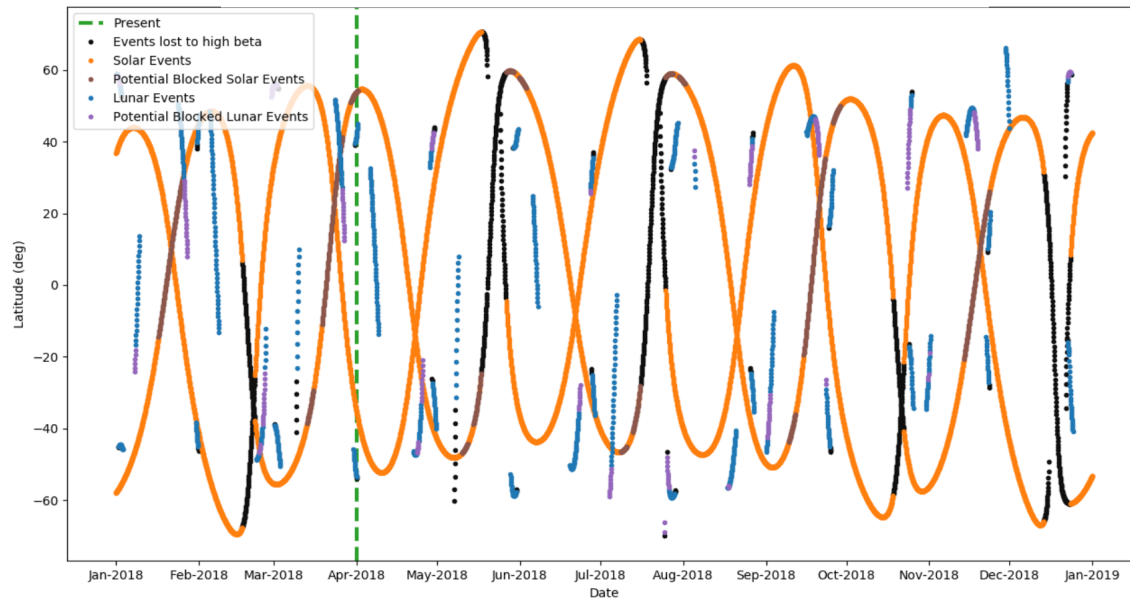
- When/where has a degree of flexibility



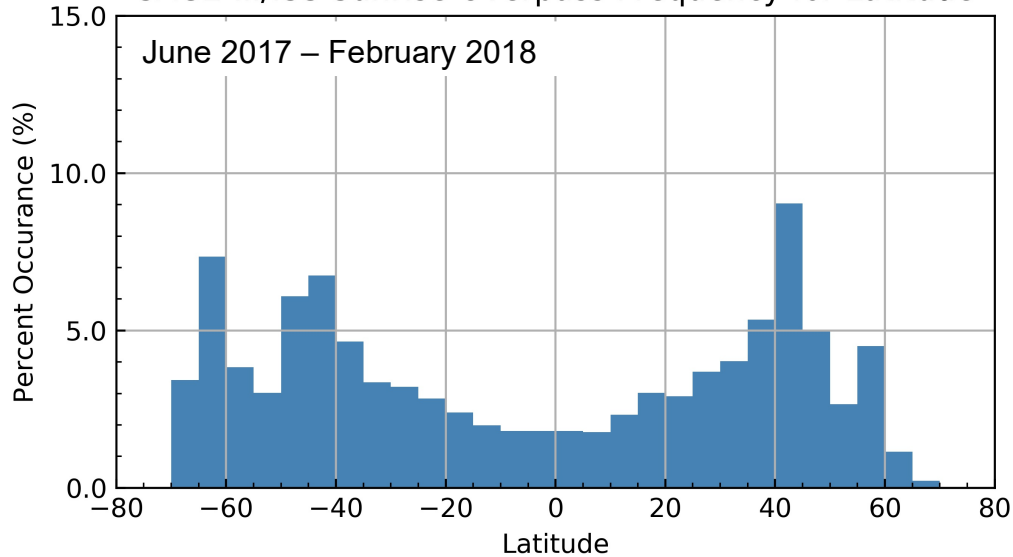
ISS Orbit & Overpass Frequency



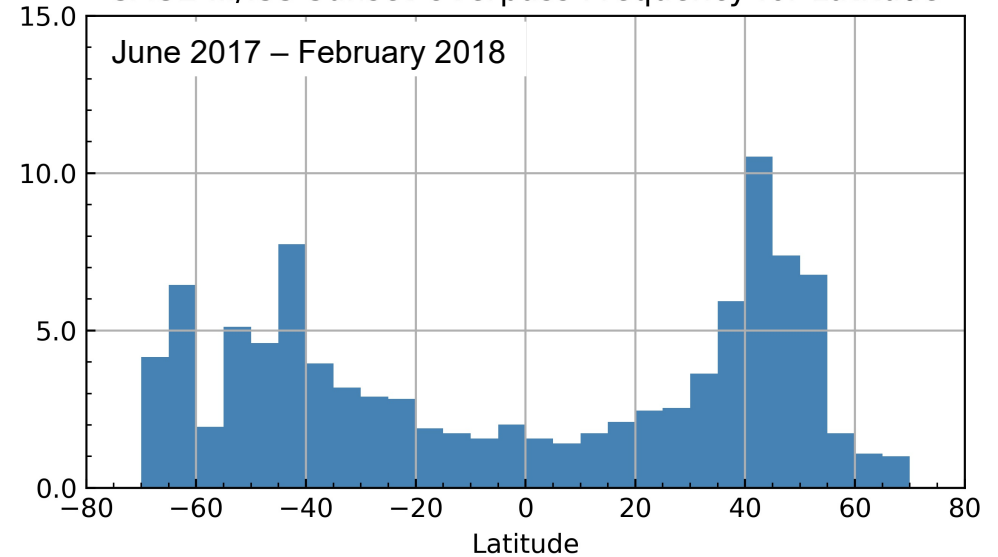
Event Latitudes for 2018



SAGE-III/ISS Sunrise Overpass Frequency for Latitude

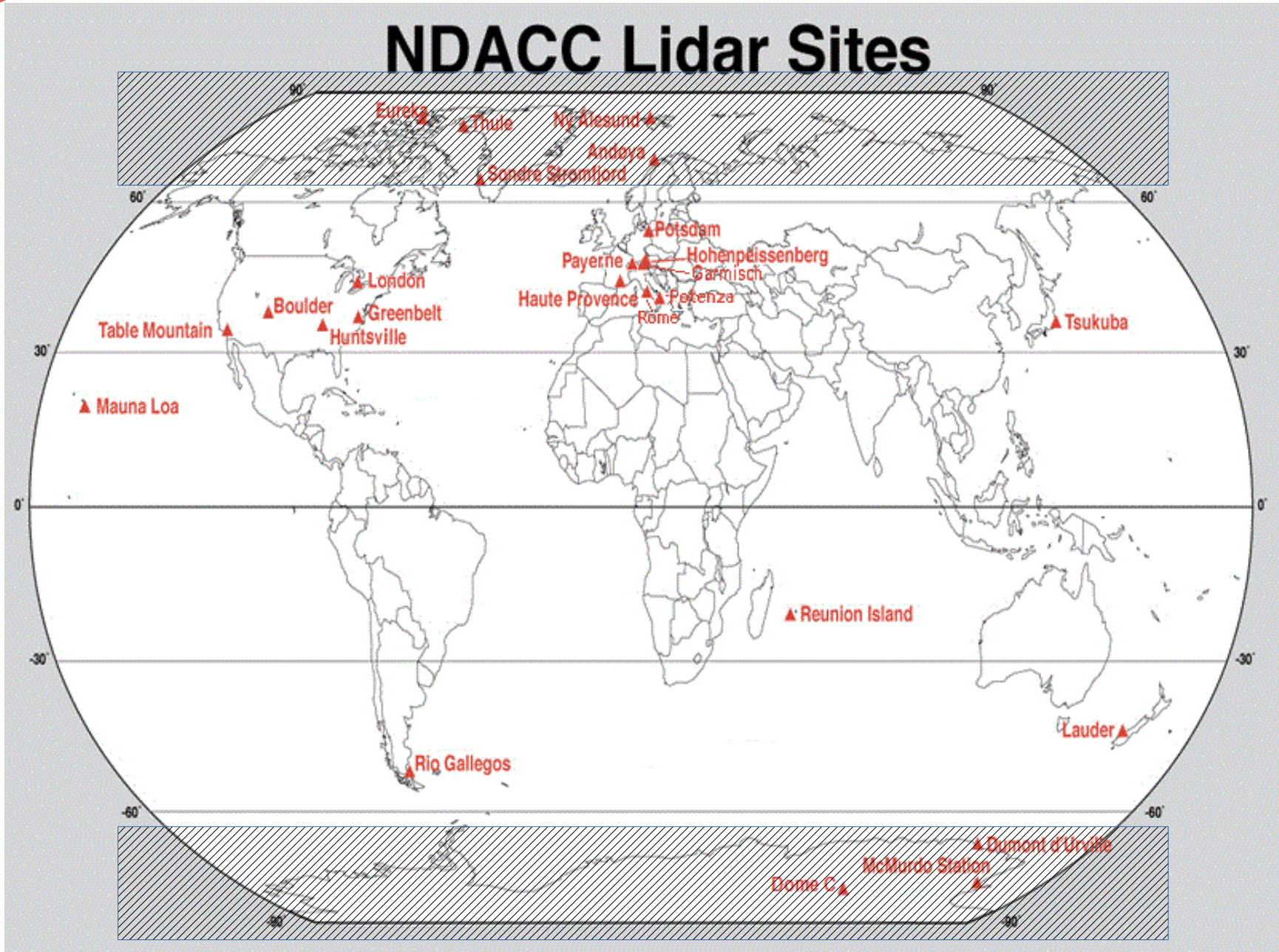


SAGE-III/ISS Sunset Overpass Frequency for Latitude





NDACC LIDAR Site Map





Standard Data Products



Product	Event Type	Vertical Range & Resolution [km]	Precision [%]	Wavelengths (nm)
Spectral Transmission	Solar	0* – 100, 0.75	0.1	280-1040, 1550
Aerosol Ext./Optical Depth	Solar	0* – 40, 0.75	5	384, 447-450, 520, 601, 676, 756, 869, 1018-1023, 1550
Ozone [cm ⁻³]	Solar	0* – 50, 0.75	5	282-294, 562-595, 608-621
Water Vapor [cm ⁻³]	Solar	5* – 45, 0.75	10	920-971
Nitrogen Dioxide [cm ⁻³]	Solar	TP+2 – 45, 0.75	10	433-450
Ozone [cm ⁻³]	Lunar	15* - 45, 1.5	5	378-679
Nitrogen Dioxide [cm ⁻³]	Lunar	20 – 45, 1.5	10	378-679
Nitrogen Trioxide [cm ⁻³]	Lunar	25 – 45, 1.5	15	378-679

* Or cloud-top; ** at 600 nm

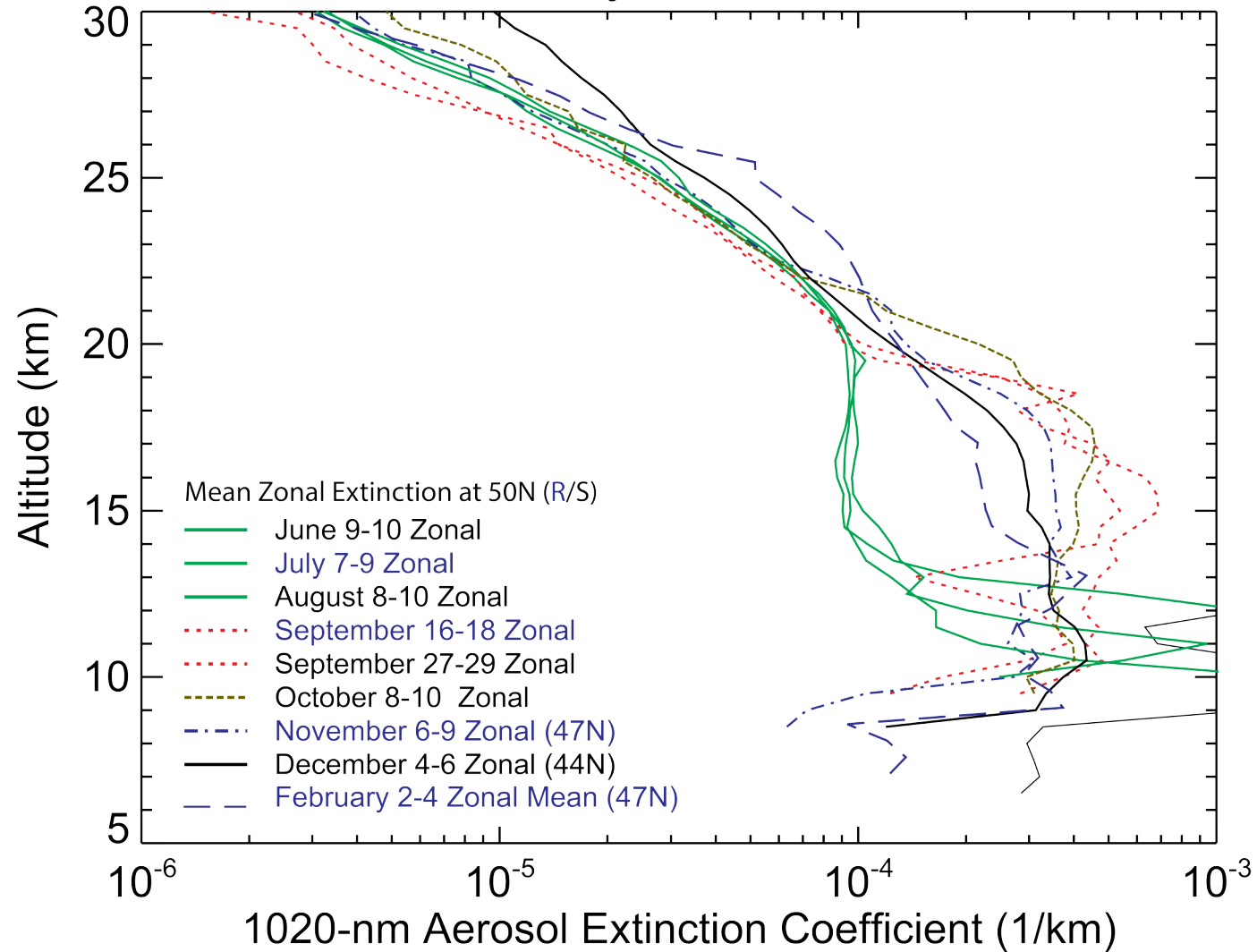


Mother of Pyrocbs

We see her too!



Canadian Pyrocumulus Event





Validation Criteria



Collocation criteria:

- Latitude: $\pm 5^\circ$ (site dependent)
- Longitude: $\pm 10^\circ$
- Time: ± 24 h
- Locations: global

Resolution requirements:

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

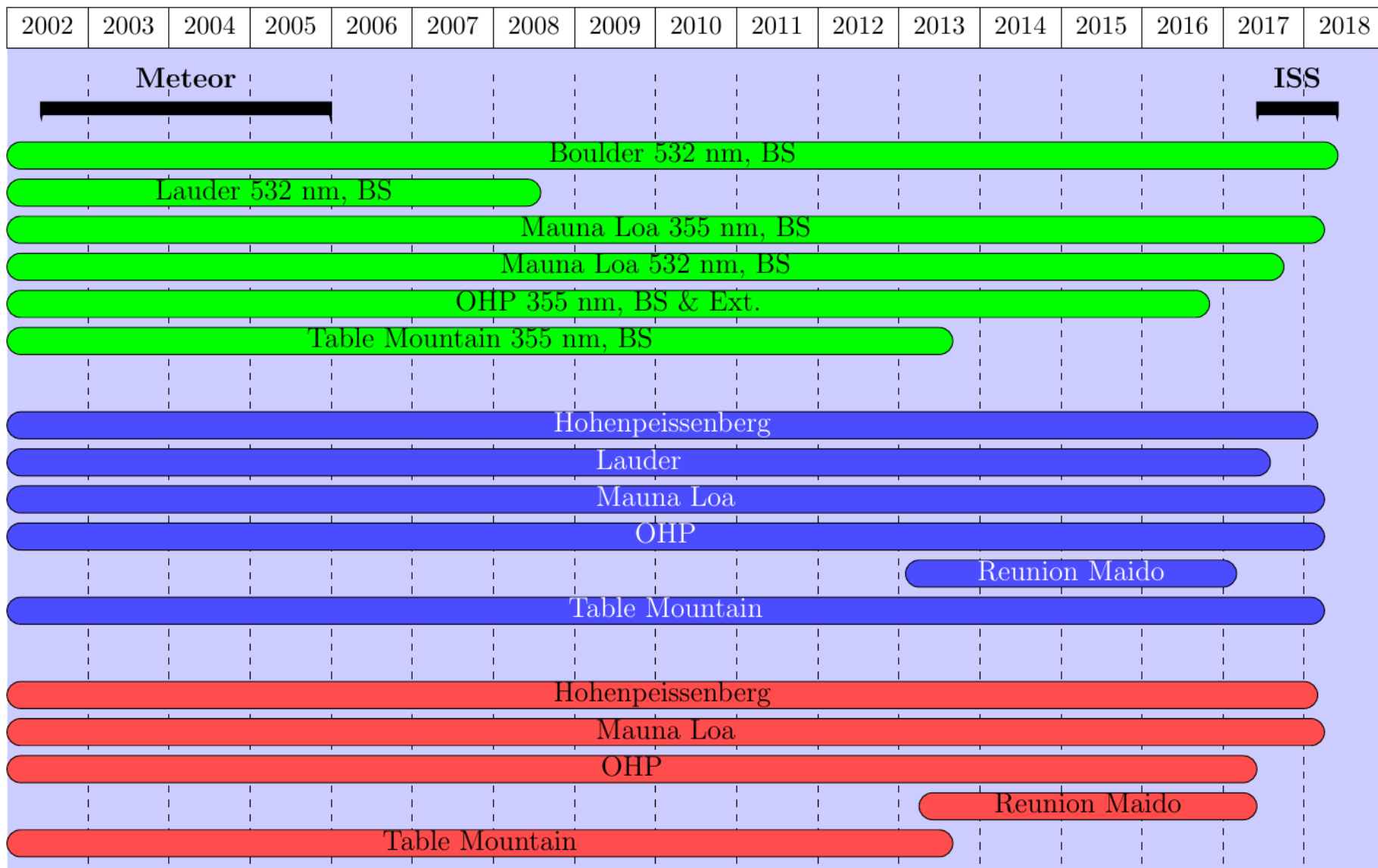
Science products (UTLS and up):

- 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

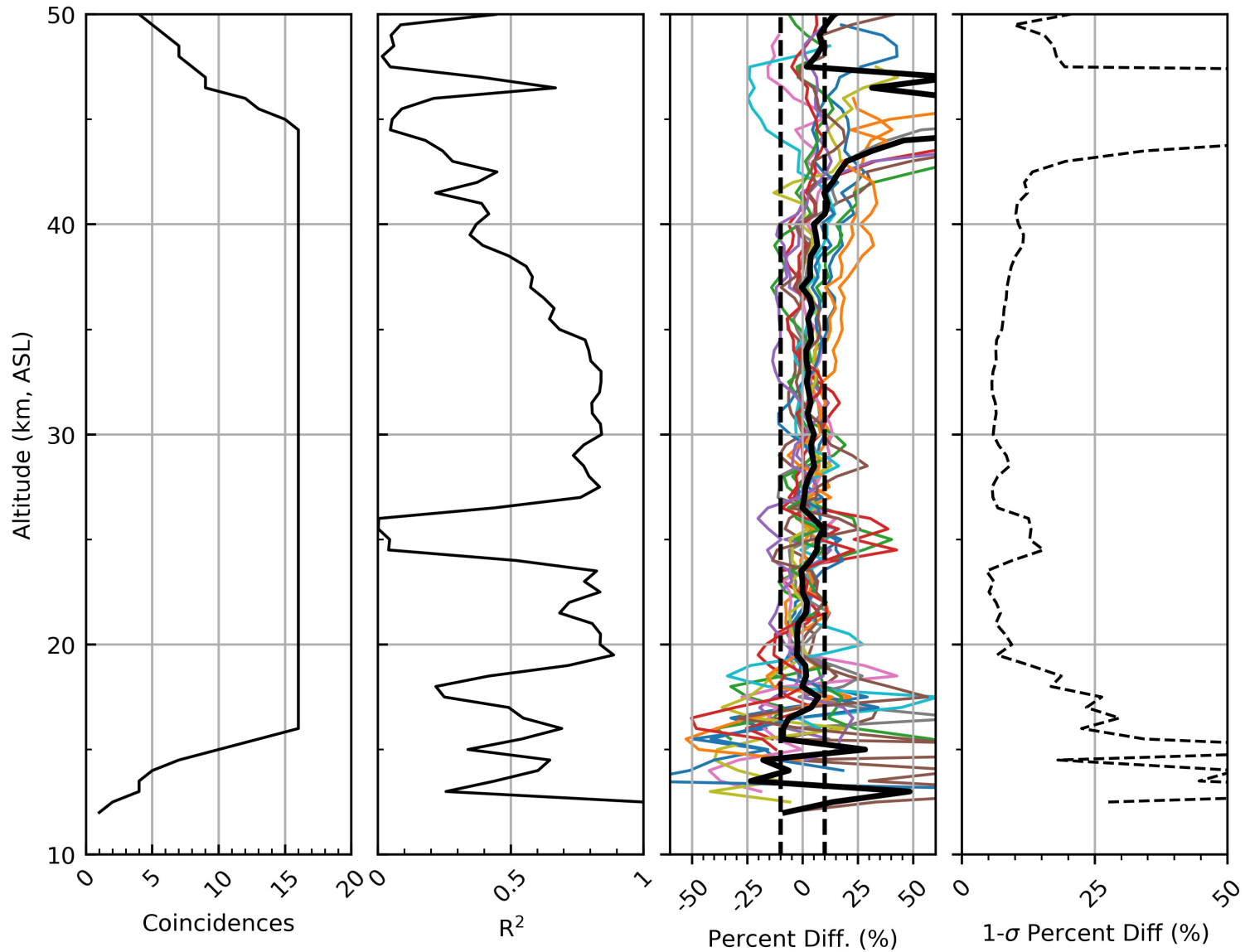




Using LWG Data: Hohenpeissenberg



Hohenpeissenberg Aerosol O₃

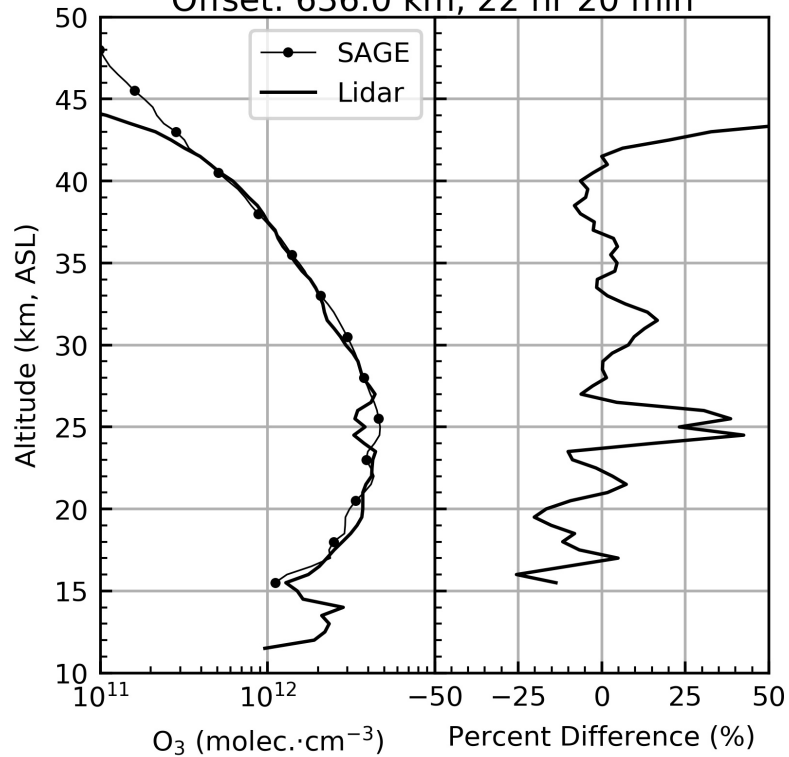




Location Matters

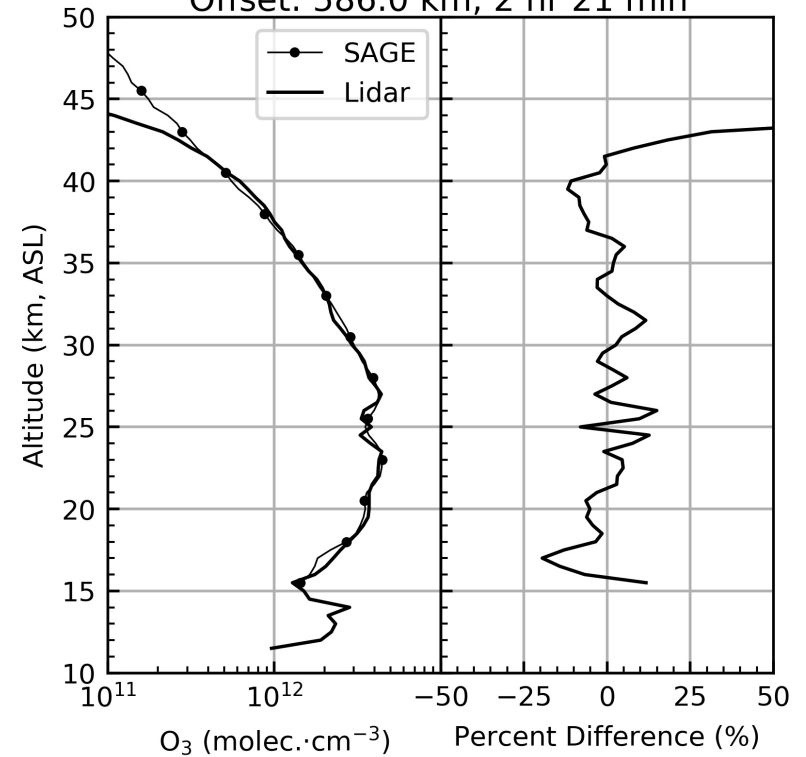


Hohenpeissenberg Aerosol O₃: 2017-07-06 03:23 UTC
Offset: 636.0 km, 22 hr 20 min



400 km south

Hohenpeissenberg Aerosol O₃: 2017-07-07 04:06 UTC
Offset: 586.0 km, 2 hr 21 min



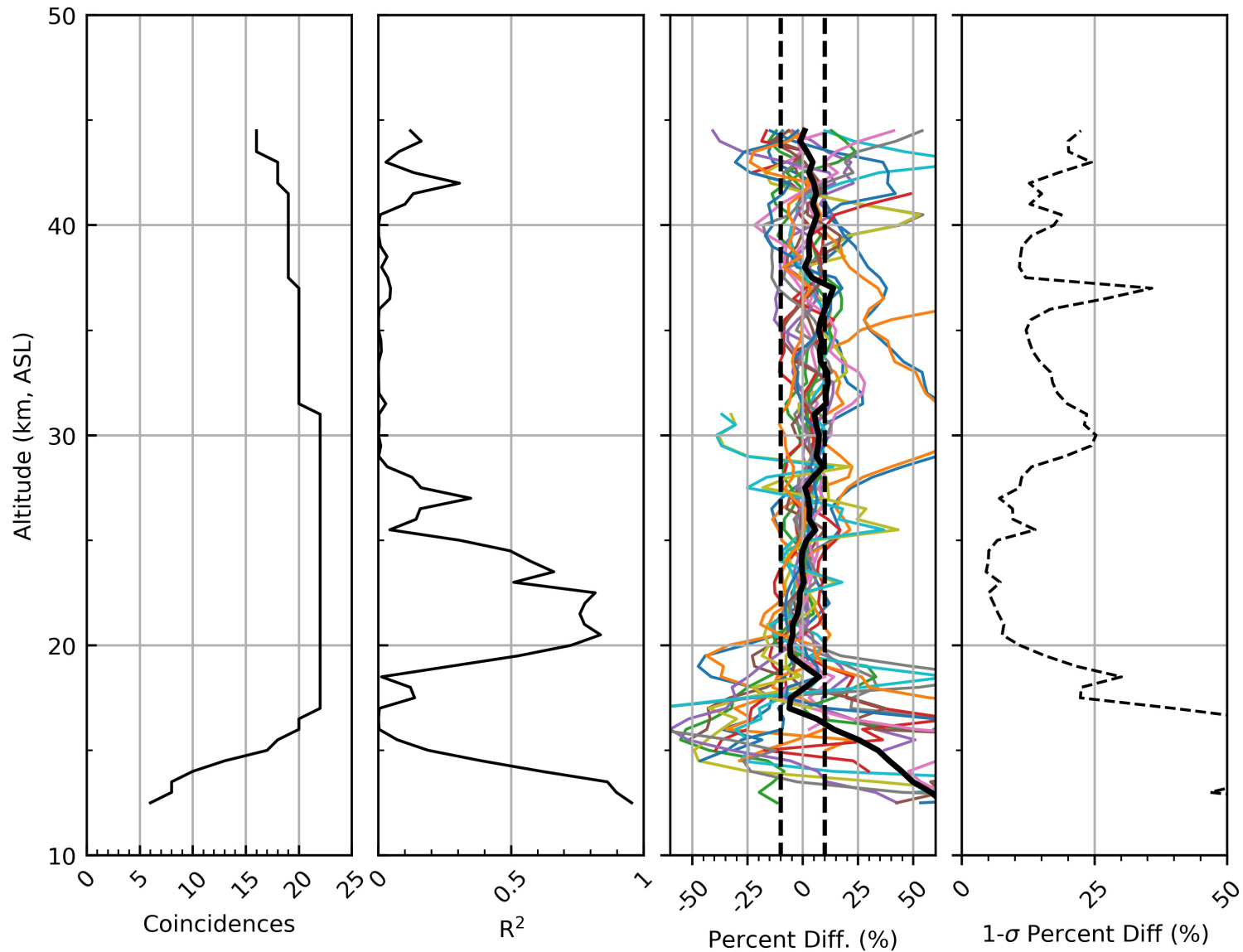
580 km east



Initial Usage, OHP



OHP Aerosol O₃

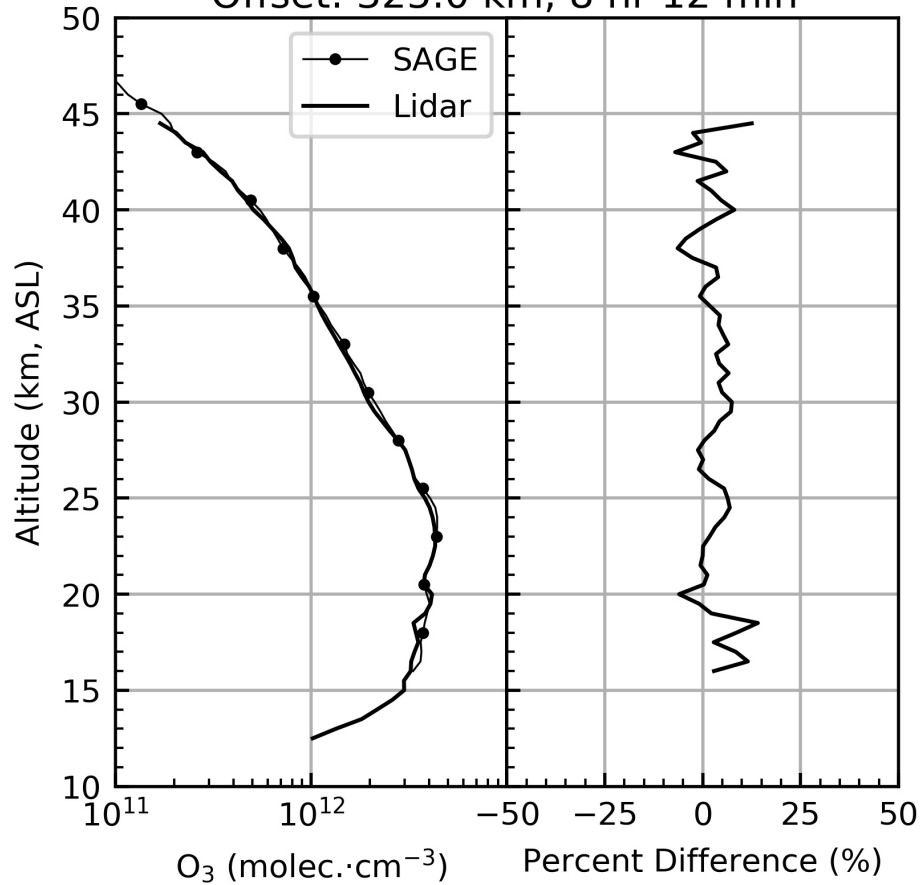




Location Matters

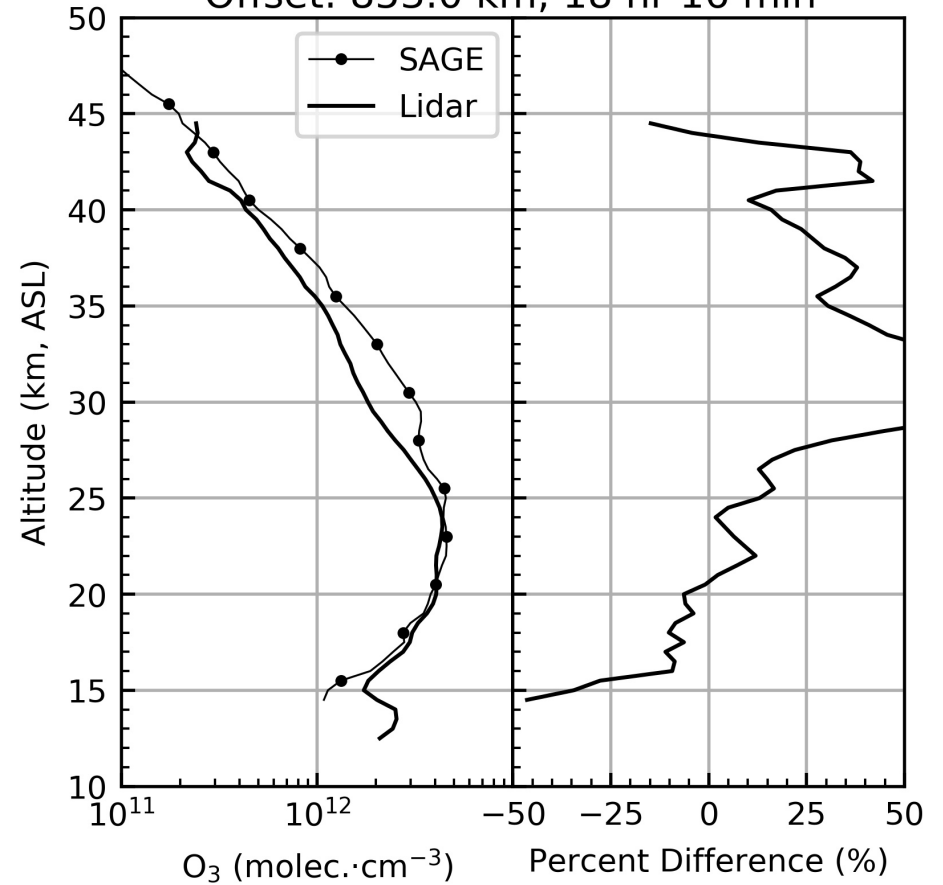


OHP Aerosol O₃: 2017-11-14 06:18 UTC
Offset: 325.0 km, 8 hr 12 min



200 km south

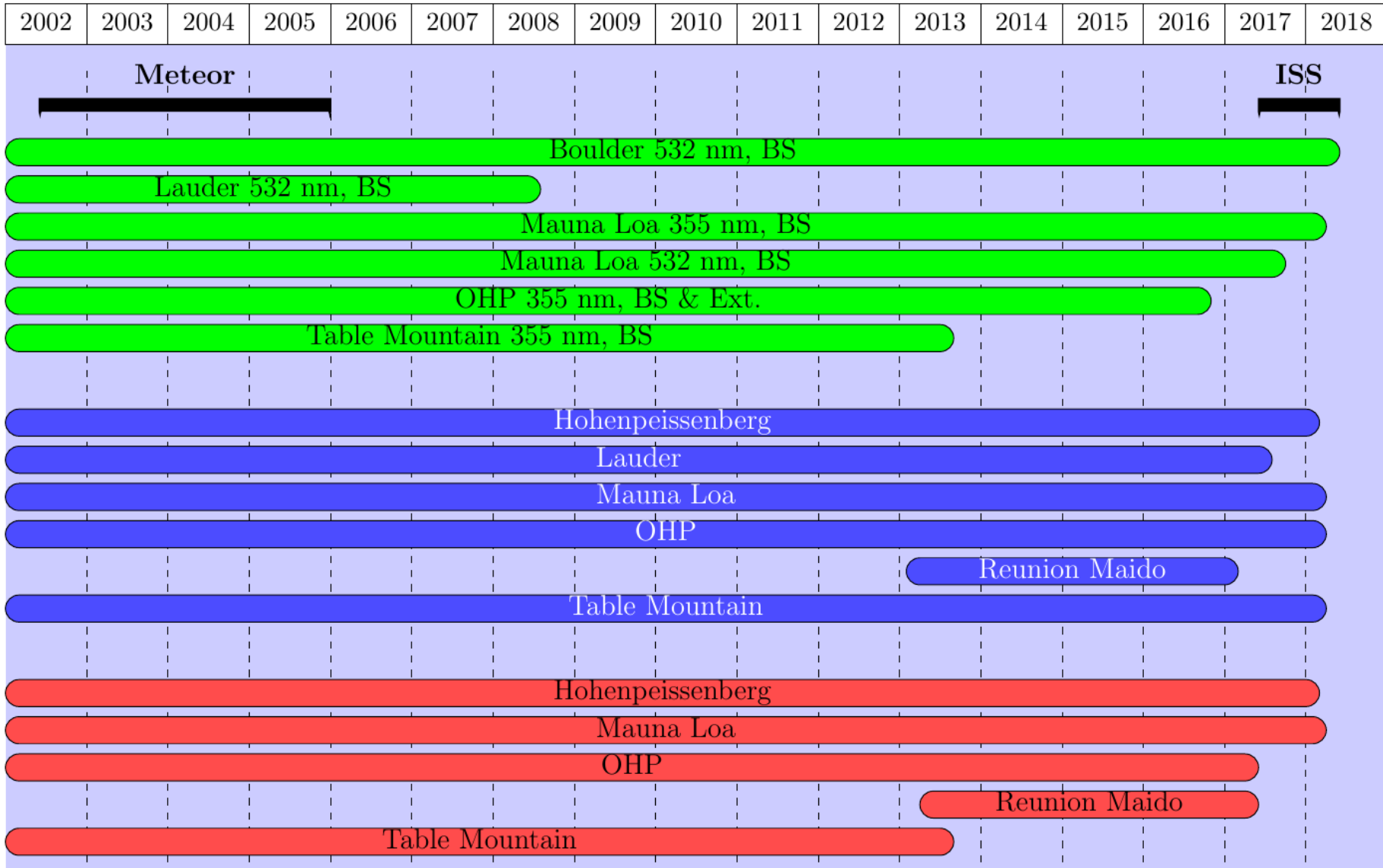
OHP Aerosol O₃: 2017-11-30 15:37 UTC
Offset: 853.0 km, 18 hr 16 min



500 km south



LWG helps inform latitude tolerance





How can you help?



Hey, we need to get in on this!





Validation Measurement Locator

<https://sage.nasa.gov/validation/>



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/>



Temporal selector

Event-type selection

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

Orbit number

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

to



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

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.

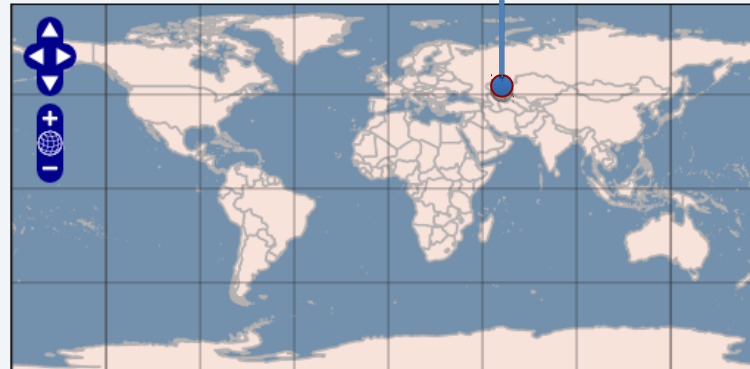
Use: '+' for north latitudes or east longitudes; use '-' for south latitudes or west longitudes. Example: +40.68, -74.04

To cross the anti-meridian, left must be greater than right. Example: (left) +148.64, (right) -115.73

Top

Left Right

Bottom



0 event(s) found.
(0.00 seconds)

Event selection status

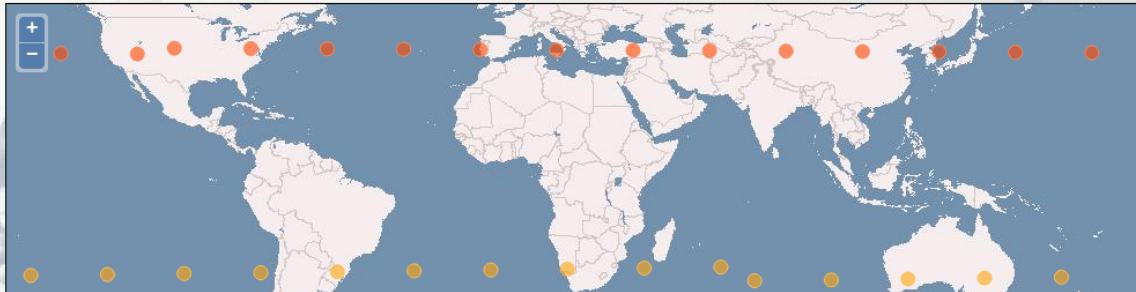


Validation Measurement Locator

<https://sage.nasa.gov/validation/>



Occultation Type	Temporal constraints	Spatial constraints
<ul style="list-style-type: none"> ● Sunrise ● Sunset 	2017-11-30T00:00:00.000000Z to 2017-11-30T23:59:59.999999Z	Global (no constraints)



Display **30** events Search:

Event ID	Cycle ID	Event Date	Occult type	Az	EI	Lat	Lon	Solar Beta	Lunar Beta	LPhase	SZA	Altitude	ISS Orbit
875410	20171126	2017-11-30 00:46:44	Sunrise	17.89	-19.49	-26.95	63.83	16.83	-48.46	130.15	90.00	404.46	8754
875420	20171126	2017-11-30 00:10:57	Sunset	162.04	-19.46	37.93	-113.60	16.90	-48.52	129.83	90.00	399.05	8754
875510	20171126	2017-11-30 02:19:24	Sunrise	17.65	-19.49	-27.24	40.51	16.61	-48.22	130.98	90.00	404.49	8755
875520	20171126	2017-11-30 01:43:36	Sunset	162.28	-19.46	38.06	-136.86	16.68	-48.29	130.66	90.00	399.03	8755
875610	20171126	2017-11-30 03:52:04	Sunrise	17.42	-19.49	-27.52	17.20	16.39	-47.95	131.81	90.00	404.51	8756
875620	20171126	2017-11-30 03:16:16	Sunset	162.51	-19.46	38.18	-160.11	16.46	-48.03	131.49	90.00	399.01	8756
875710	20171126	2017-11-30 05:24:45	Sunrise	17.19	-19.50	-27.81	-6.11	16.17	-47.65	132.63	90.00	404.53	8757
875720	20171126	2017-11-30 04:48:55	Sunset	162.74	-19.46	38.31	176.64	16.24	-47.74	132.31	90.00	398.98	8757
875810	20171126	2017-11-30 06:57:25	Sunrise	16.95	-19.50	-28.09	-29.43	15.95	-47.32	133.47	90.00	404.56	8758
875820	20171126	2017-11-30 06:21:35	Sunset	162.98	-19.46	38.43	153.39	16.02	-47.42	133.15	90.00	398.96	8758
875910	20171126	2017-11-30 08:30:05	Sunrise	16.71	-19.50	-28.37	-52.74	15.73	-46.96	134.30	90.00	404.58	8759
875920	20171126	2017-11-30 07:54:14	Sunset	163.22	-19.47	38.55	130.13	15.80	-47.08	133.98	90.00	398.94	8759
876010	20171126	2017-11-30 10:02:45	Sunrise	16.48	-19.51	-28.65	-76.06	15.51	-46.58	135.14	90.00	404.60	8760
876020	20171126	2017-11-30 09:26:54	Sunset	163.46	-19.47	38.67	106.88	15.57	-46.71	134.81	90.00	398.91	8760
876110	20171126	2017-11-30 11:35:25	Sunrise	16.24	-19.51	-28.92	-99.37	15.28	-46.17	135.97	90.00	404.62	8761
876120	20171126	2017-11-30 10:59:33	Sunset	163.69	-19.47	38.79	83.63	15.35	-46.31	135.65	90.00	398.89	8761
876210	20171126	2017-11-30 13:08:05	Sunrise	16.00	-19.51	-29.20	-122.69	15.06	-45.74	136.81	90.00	404.64	8762
876220	20171126	2017-11-30 12:32:12	Sunset	163.93	-19.47	38.91	60.39	15.12	-45.89	136.49	90.00	398.87	8762
876310	20171126	2017-11-30 14:40:45	Sunrise	15.75	-19.51	-29.47	-146.00	14.83	-45.28	137.65	90.00	404.66	8763
876320	20171126	2017-11-30 14:04:52	Sunset	164.18	-19.47	39.02	37.14	14.90	-45.44	137.33	90.00	398.85	8763



Starting the Conversation

<https://sage.nasa.gov/validation/>



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

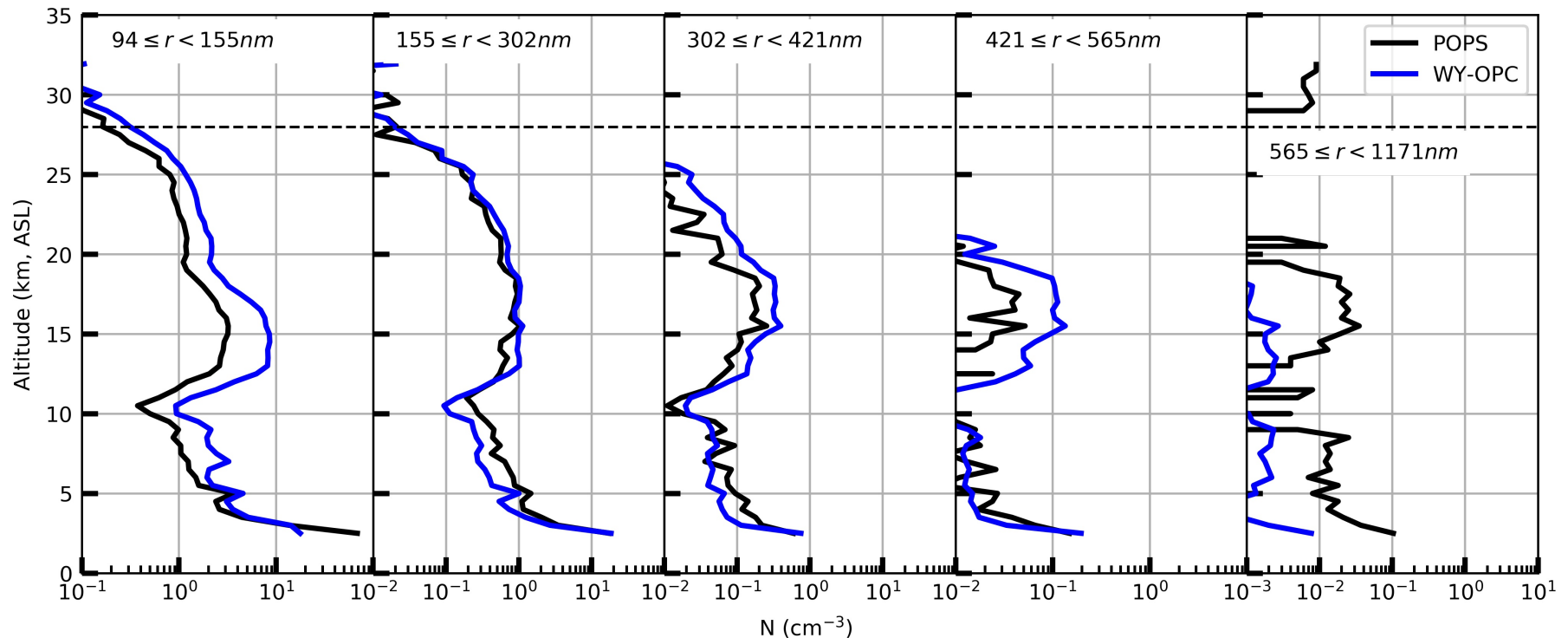


Aerosol Validation

A Particular Challenge...



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



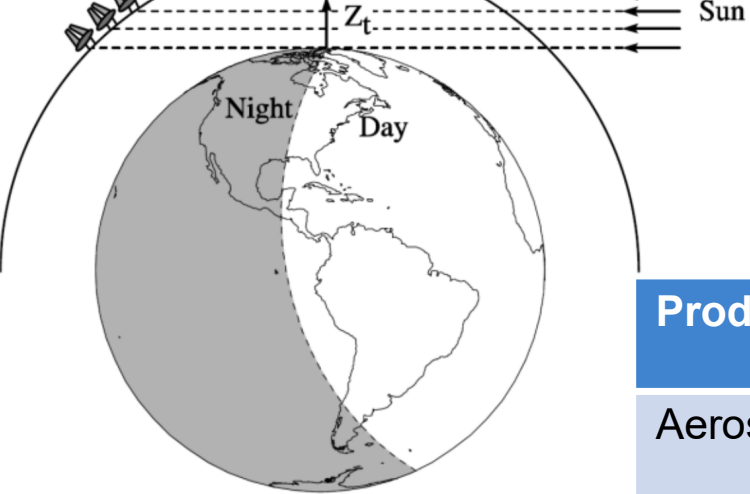
* Printed Optical Particle Spectrometer

Data courtesy of Terry Deshler (University of Wyoming) and Troy Thornberry (NOAA)



Questions





Product	Event Type	Wavelengths (nm)
Aerosol Ext./Optical Depth	Solar	384, 447-450, 520, 601, 676, 756, 869, 1018-1023, 1550
Aerosol Ext./Optical Depth	Lunar	NA
Ozone	Solar	282-294, 562-595, 608-621
Ozone	Lunar	378-679
Nitrogen Dioxide	Solar	433-450
Nitrogen Dioxide	Lunar	378-679
Water Vapor	Solar	920-971
Water Vapor	Lunar	NA

Product	Event Type	Vertical Range & Resolution [km]	Precision [%]	Accuracy Goal [%]	Wavelengths (nm)
Spectral Transmission	Solar	0* – 100, 0.75	0.1	0.1***	
Aerosol Ext./Optical Depth	Solar	0* – 40, 0.75	5	5	384, 447-450, 520, 601, 676, 756, 869, 1018-1023, 1550
Ozone#	Solar	0* – 50, 0.75	5	5	282-294, 562-595, 608-621
Water Vapor#	Solar	5* – 45, 0.75	10	10	920-971
Nitrogen Dioxide#	Solar	TP+2 – 45, 0.75	10	10	433-450
Ozone#	Lunar	15* - 45, 1.5	5	6	378-679
Nitrogen Dioxide#	Lunar	20 – 45, 1.5	10	10	378-679
Nitrogen Trioxide#	Lunar	25 – 45, 1.5	15	10	378-679