JPSS STAR (J-STAR)

JPSS-CPO TIM

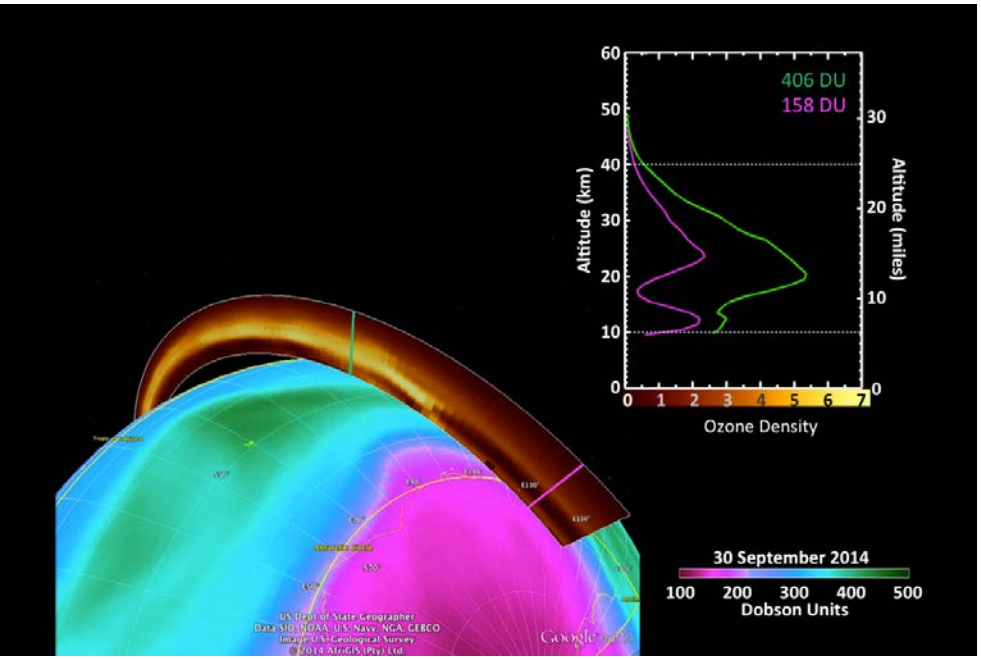
OMPS PRODUCTS SUMMARY FOR NOV. 18TH MEETING

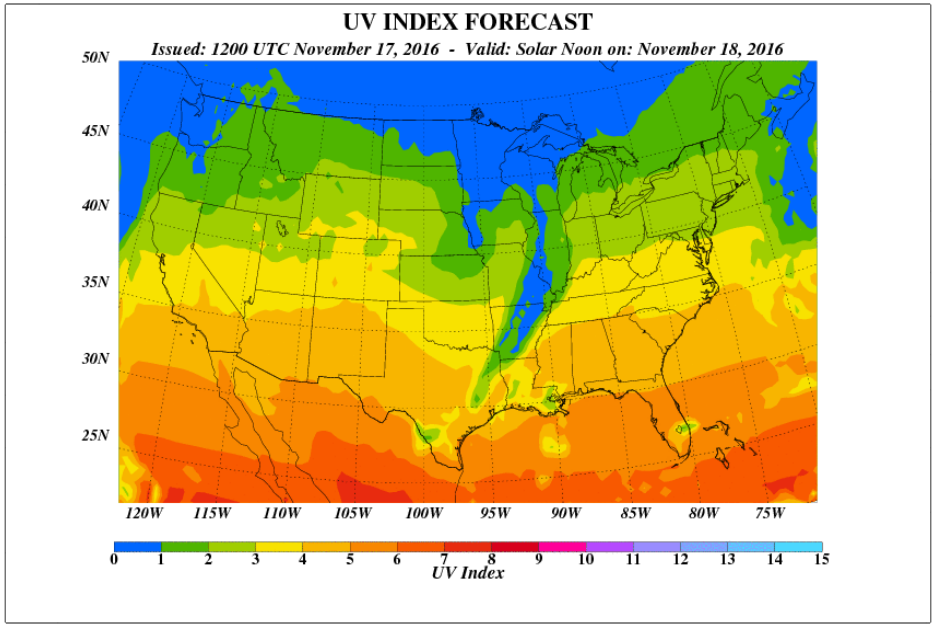
LARRY FLYNN

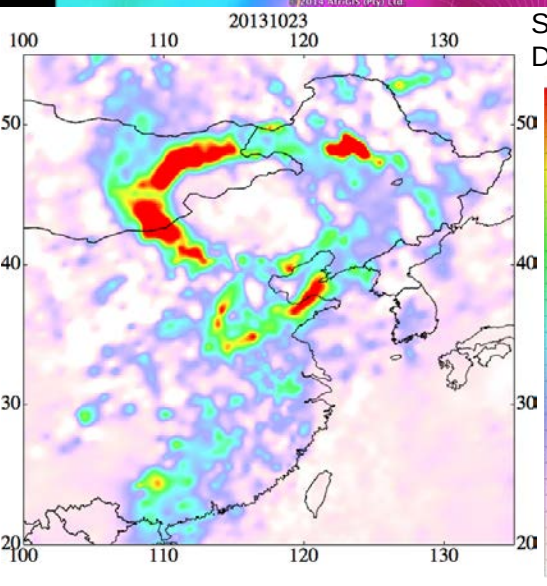
OMPS Products (S-NPP), JPSS-1, JPSS-2

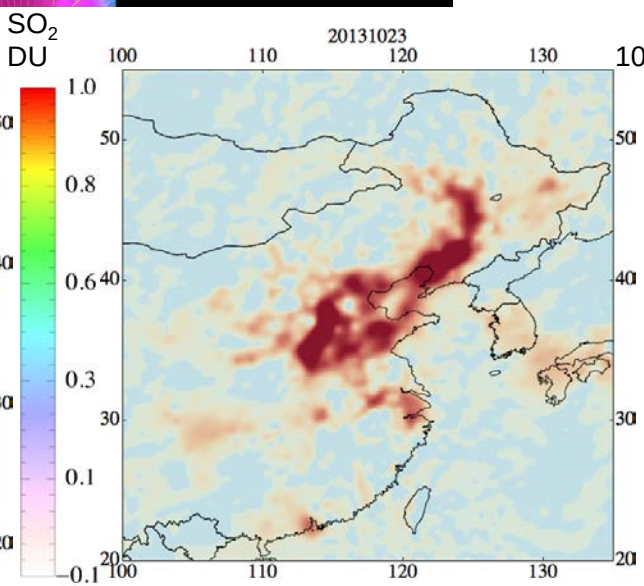
- Operational Near-Real-Time Products (Reprocessing will produce Climate Data Record extensions)
  - Total Column Ozone, UV Absorbing Aerosol Index, Total Column SO_2
    - (50x50) 17x17 km^2 resolution at Nadir
    - Full coverage of the sunlit Earth once per day.
  - Nadir Ozone Profile
    - Nadir orbital track at (250x250) 50x250 km^2 resolution
    - Vertical resolution from 7 to 10 km in the middle and upper stratosphere
  - Limb Ozone Profile (Only on S-NPP and JPSS-2)
    - Nadir orbital track with 150 km reporting
    - Vertical resolution of 3 km in the stratosphere
- Daily Global and Regional Products
  - Daily global maps for Total Column Ozone, UV Absorbing Aerosol Index & Effective UV reflectivity
  - OMPS Total Column SO_2 will be used in the hazards warning system in place of OMI
    - http://satepsanone.nesdis.noaa.gov/pub/OMI/OMISO2/index.html
  - Ozone products are used to create UV Index Forecasts
    - https://www.epa.gov/sunsafety/uv-index-1
  - Limb Ozone products are used to create orbital profile curtain plots
- Research products
  - OMPS Nadir Mapper total column and tropospheric NO2
  - OMPS Nadir Profiler daily Mg II Index
  - OMPS Limb Profiler stratospheric aerosol profile

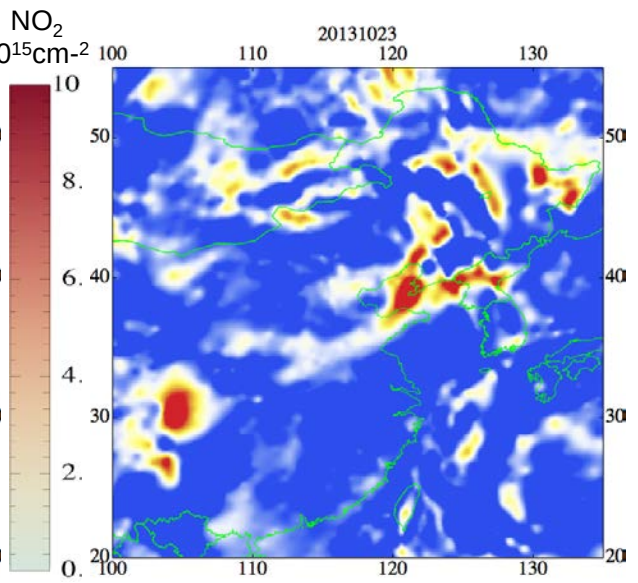
Sample Plots



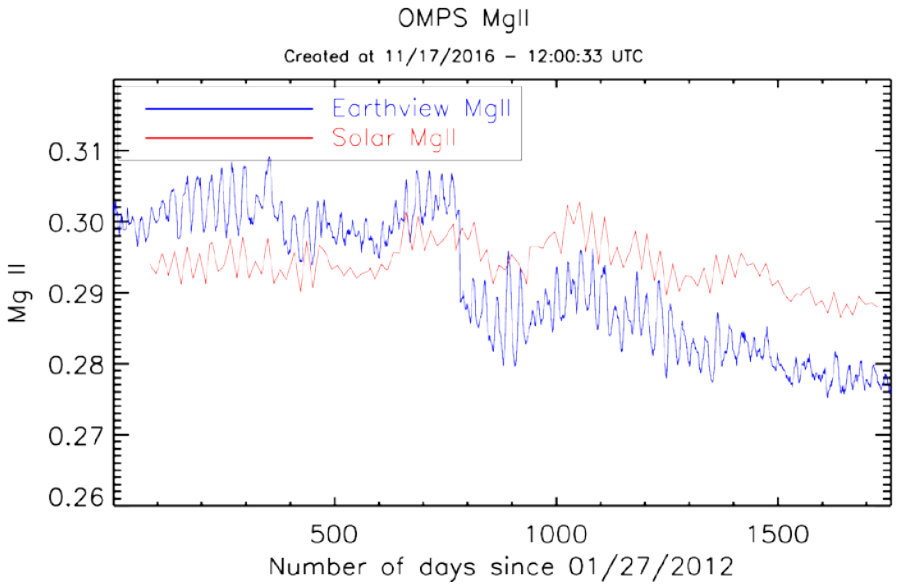


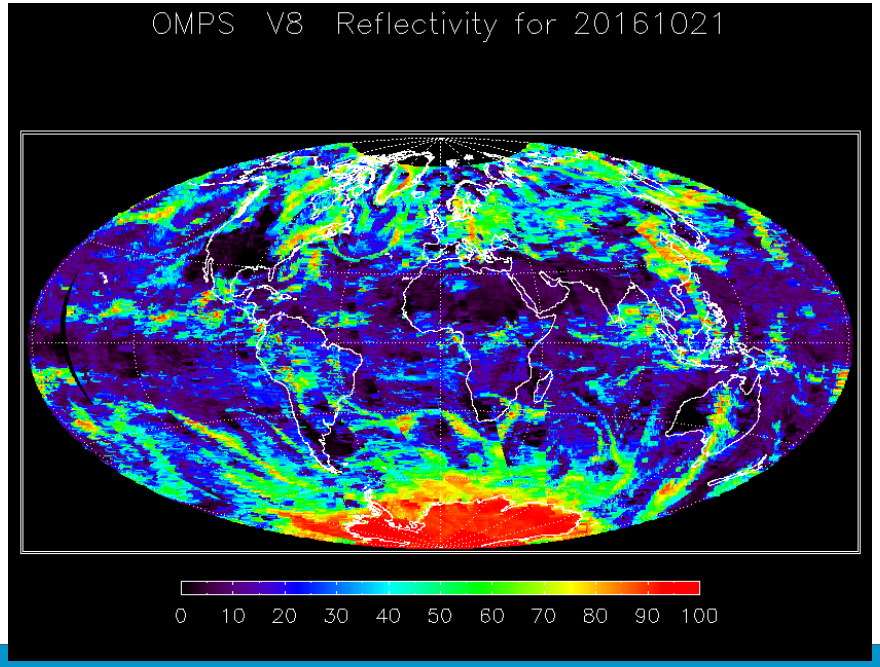




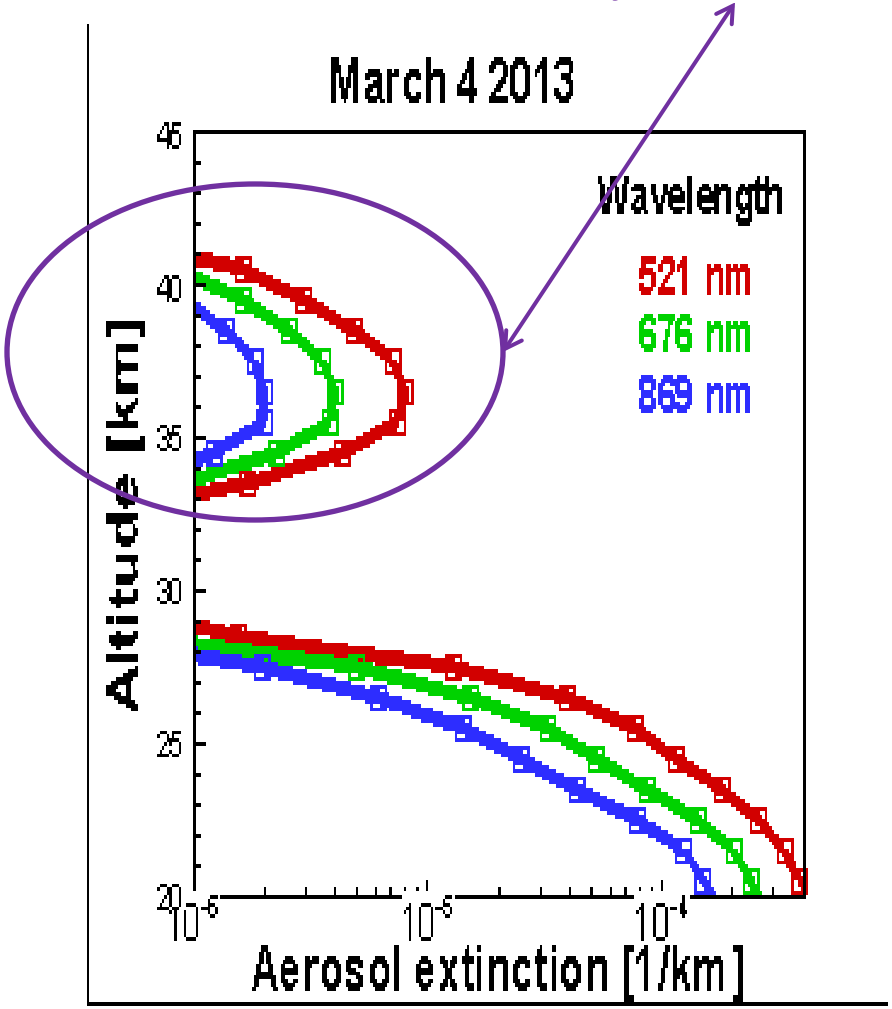


More Sample Plots



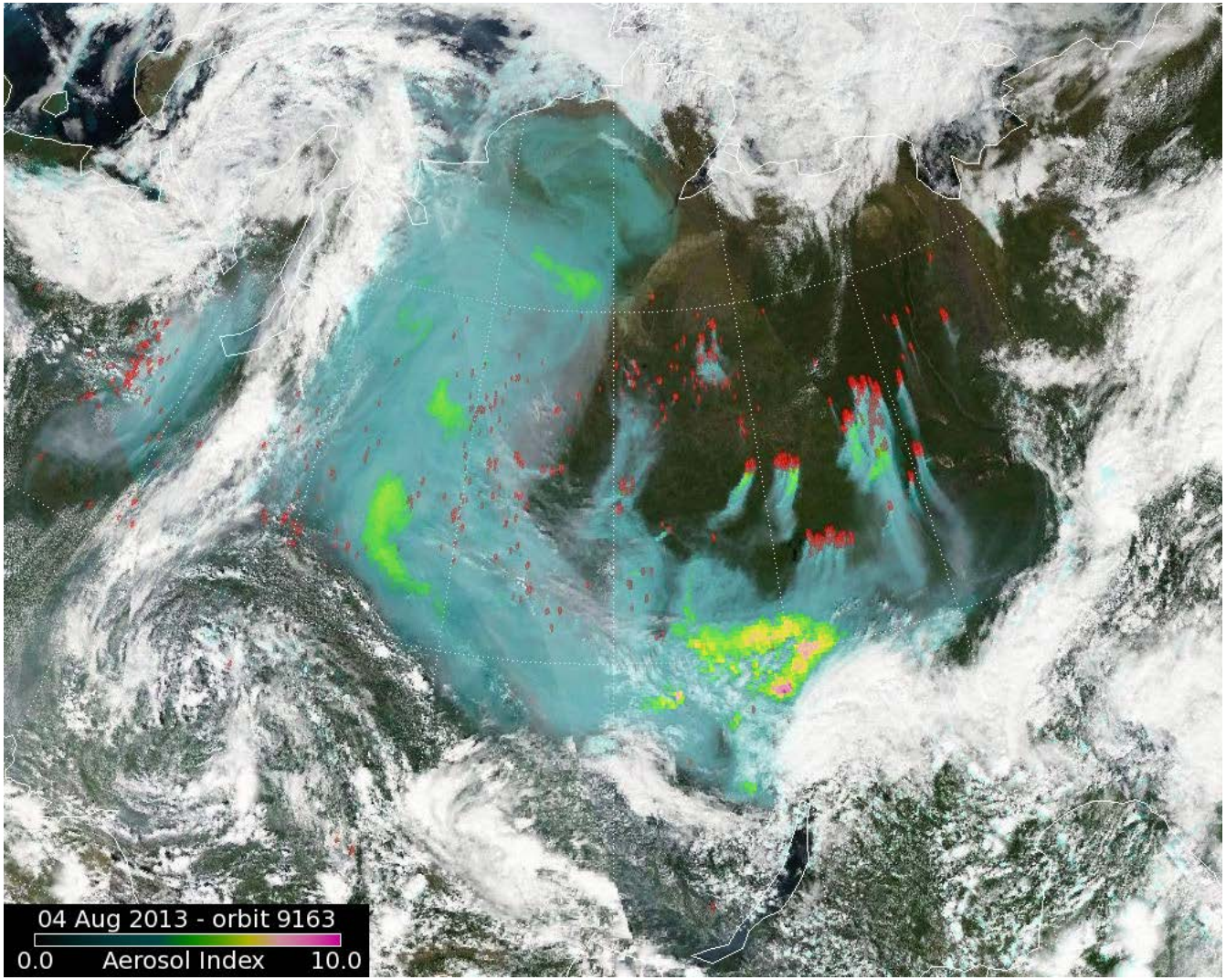


Dust from the Russian Chelyabinsk Meteor



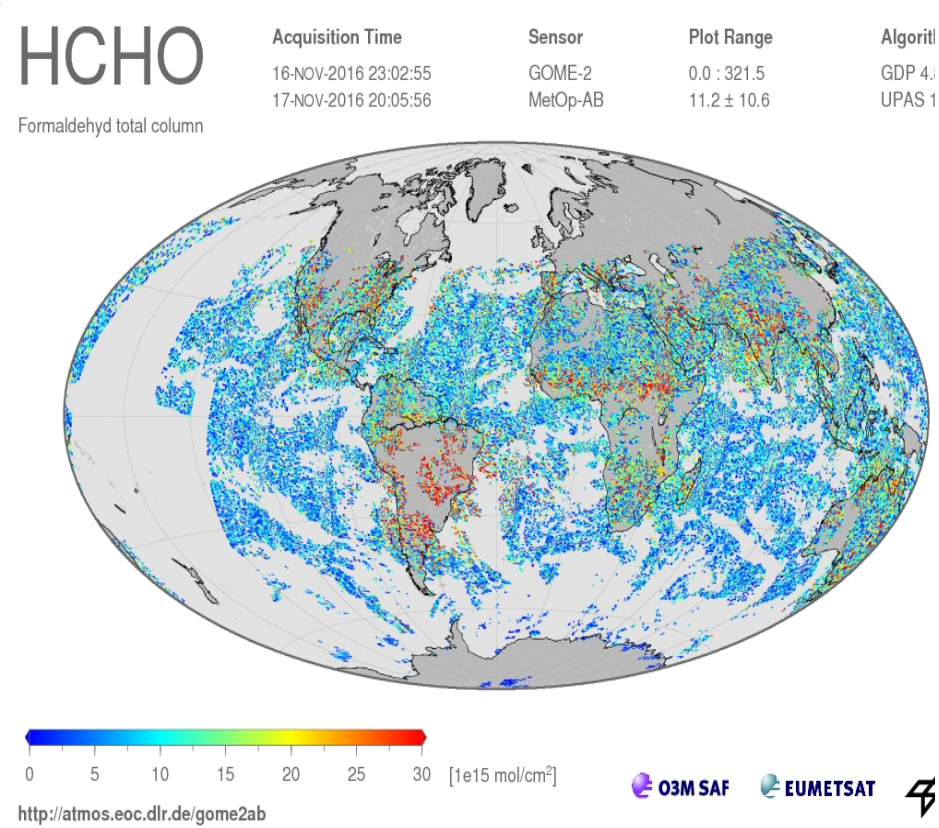
From a talk by Nick Gorkavyi

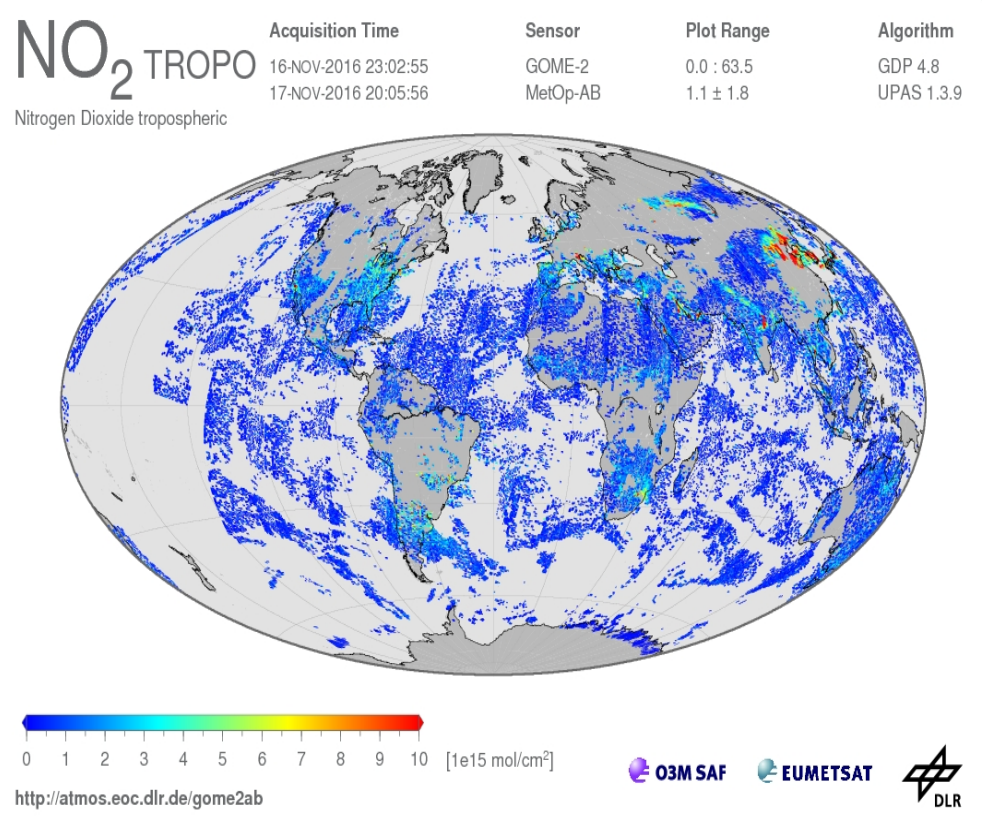
OMPS UV Absorbing Aerosol Index in high resolution mode.



Other BUV Instruments

- NOAA has access to the MetOP GOME-2 measurements and products
  - https://atmos.eoc.dlr.de/gome/product.html
- NOAA will have access to the TEMPO products (US GEO)
- NOAA will have access to the TROPOMI products.





TEMPO Science Traceability Matrix

Table D.2-3 TEMPO STM[1] clearly links science questions with instrument and investigaton requirements.

Science Questions	Science Objective	Science Measurement Requirement: Observables	Science Measurement Requirement: Physical Parameters	Instrument Function Requirements: Parameter	Req.	Predicted	Investigation Requirements
Q1. What are the temporal and spatial variations of emissions of gases and aerosols important for AQ and climate? **Q2.** How do physical, chemical, and dynamical processes determine tropospheric composition and AQ over scales ranging from urban to continental, diurnally to seasonally?	-High temporal resolution measurements to capture changes in pollutant gas distributions. - High spatial resolution measurements that sense urban scale pollutant gases across GNA and surrounding areas. - Measurement of major elements in tropospheric O_3 chemistry cycle, including multispectral measurements to improve sensing of lower-tropospheric O_3, with precision to clearly distinguish pollutants from background levels	Spatially imaged & spectrally resolved, solar backscattered earth radiance, spanning spectral windows suitable for retrievals of O_3, NO_2, H_2CO, SO_2 and $C_2H_2O_2$ at spatial scales comparable to regional atmospheric chemistry models. Multispectral data in suitable O_3 absorption bands to provide vertical distribution information. Spectral radiance measurements with suitable quality (SNR) to provide multiple measurements over daylight hours for solar zenith angle < 70°. Spatially imaged, wavelength dependence of atmospheric reflectance spectrum for solar zenith angles <70°.	Relevant absorption bands for trace gases & windows for aerosols	Spectral Range	290-690 nm	290-690 nm	1-year mission lifetime (minimum) On-orbit Calibration FOR encompasses CONUS and adjacent areas GEO Longitude: Preferred: 100W Acceptable: 75W – 137W GEO Bus Pointing: Control <0.1° Knowledge <0.04° Provide near-real-time products to user communities within 2 hrs to enable assimilation into chemical models (NOAA & EPA) and use by smart-phone applications Archive and distribute TEMPO science data products
				Spectral Resolution	0.6 nm	0.6 nm	
				Spectral Sampling	0.2 nm	0.2 nm	
			Baseline Trace gas column densities (10^{15} cm^{-2}), unless noted, hourly @ 8×4.5 km^2				
			Species / Precision	Band	Signal to Noise (hourly)		
			O_3:0-2 km: 10 ppbv	O_3:Vis (546-648 nm)	958	1254	
			O_3#: FT: 10 ppbv	O_3: UV (303-345 nm)	1122	1635	
			O_3#: SOC: 5%				
			O_3#: Total: 3%				
			NO_2#: 1.00	423-451 nm	1233	1910	
			H_2CO# (3/day): 10.0	327-354 nm	487	2094	
			SO_2# (3/day): 10.0	305-345 nm	1297	1820	
			$C_2H_2O_2$# (2/day): 0.40	433-457 nm	1350	2331	
			Baseline Aerosol/Cloud properties hourly @ 8×4.5 km^2				
			Property / Precision	Band	Signal to Noise		
			AOD#: 0.05	354, 388 nm	1000	1596	
			AAOD#: 0.03				
			AI#: 0.2				
			CF#: 0.05	346-354 nm	600	1608	
			CTP#: 100 mb				
			Solar irradiance spectrally resolved over spectral range	Albedo Calibration			
				λ-dependent	< 1%	0.5%	
				λ-independent	< 3%	2.0%	
Q3. How do episodic events affect atmospheric composition and AQ?	- Observe aerosol optical properties with high temporal and spatial resolution for quantifying and tracking evolution of aerosol loading.						
Q4. How does AQ drive climate forcing and climate change affect AQ on a continental scale?	- Determine the instantaneous radiative forcings associated with O_3 and aerosols on the continental scale.						
Q5. How can observations from space improve AQ forecasts and assessments for societal benefit?	- Integrate observations from TEMPO and other platforms into models to improve representation of processes in the models and construct an enhanced observing system.	No additional observable requirements	No additional physical requirements	Spectral Accuracy	<0.02 nm	<0.02 nm	
				Polarization Factor	<5% UV, ≤20% Vis	≤4% UV, ≤20% Vis	
				Geolocation Accuracy	4.0 km	2.8 km	
				FOR	CONUS	GNA	
Q6. How does intercontinental transport affect AQ?	- Quantify the flow of pollutants across continental boundaries; Join a global observing system.	No additional observable requirements	No additional physical requirements	Imaging Time	1 hr	1 hr	
				IFOV: N/S×E/W *	2×4.5 km^2	2×4.5 km^2	
				GSD E/W *	4.0 km	4.0 km	
				MTF: N/S×E/W	0.3×0.3	0.50×0.46	

[1]FT=Free Troposphere (2km-tropopause), SOC=Stratospheric Ozone Column, AOD=Aerosol optical depth, AAOD=Aerosol absorption optical depth, AI=Aerosol index, CF=Cloud Fraction & CTP=Cloud Top Pressure, Albedo=Radiance/Irradiance, FOR=Field Of Regard, IFOV=Instantaneous Field Of View, GSD=Ground Sample Distance. *Projected to 36.5°N,100°W from GEO 100°W. # Threshold Products at 8×9km^2 and 80-minute intervals instead of hourly.

S5P TROPOMI Level-2 Products (operational)

Species	Characteristics	expected accuracies
Ozone -O3	vertical profile	10-30 % (6 km res.)
	total column	3.5 –5 %
	tropospheric column	25%
Nitrogen dioxide -NO2	total column	<10%
	tropospheric column	25-50%
Sulphur dioxide-SO2	SO2enhanced	30 %
	total column	30 –50 %
Formaldehyde-HCHO	total column	40 –80 %
Methane-CH4	total column	1.5 %
Carbon monoxide -CO	total column	<15 %
Cloud	optical depth, fraction, height	<20 % (all parameters)
Aerosol	UV absorption index	~1 AAI
	layer height	< 100 hPa
Surface UV	spectral irradiance, UV index	TBD

JPSS and GOES-R Atmospheric Chemistry/Composition Product Capabilities

Prepared by Shobha Kondragunta and Lawrence E. Flynn

NESDIS/Center for Satellite Applications and Research

NESDIS Satellite Products Relevant to Atmospheric Chemistry and Climate

SNPP and JPSS

- Aerosol Optical Depth
- Aerosol Detection
  - Dust, smoke, volcanic ash
- Ozone, SO2, (NO2)
- SO2, N2O, CH4, CO, CO2, Nitric Acid
- Fire hot spots
- Fire emissions
- Fire burned area

GOES-R

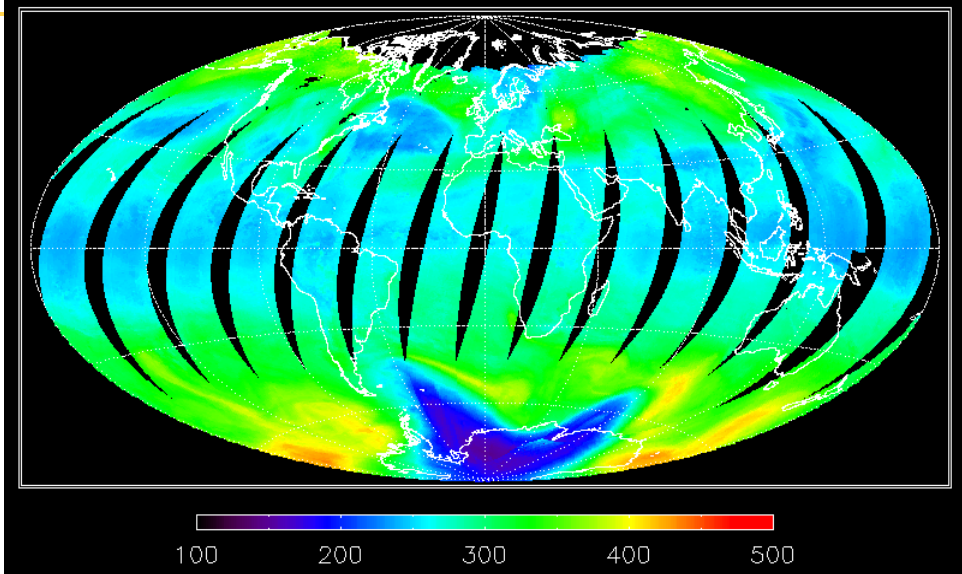
- Aerosol Optical Depth
- Aerosol Detection
  - Dust, smoke, volcanic ash
- Ozone at 10% accuracy – *probably not very useful*
- Fire hot spots
- Fire emissions
- Fire burned area

OMPS Products

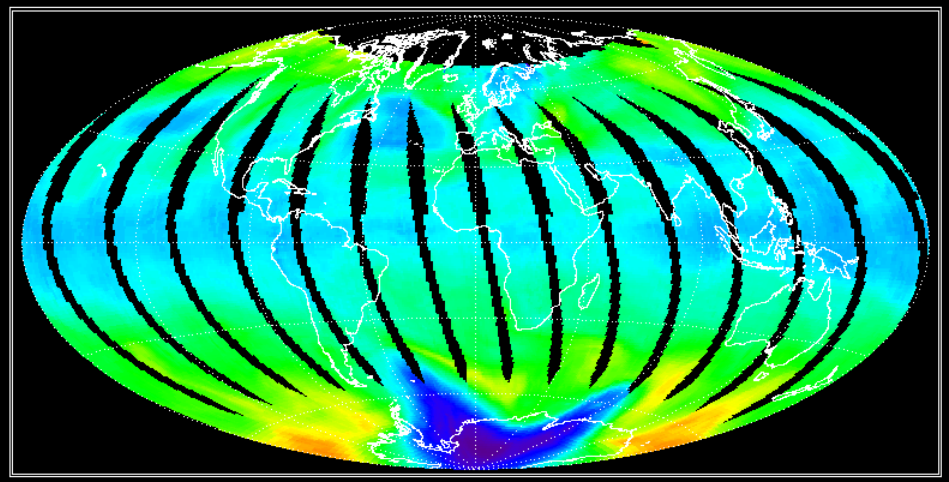
- Nadir Mapper Daily Global Products
  - Climate-quality Total Column Ozone (climate, monitoring, assimilation, UV Index)
  - UV-absorbing Aerosol Index (Smoke, Dust, Volcanic Ash)
  - Column SO2 for Hazards and Air Quality (inventory, forecasts, campaigns)
- Nadir Ozone Profile Products
  - Ozone vertical profiles for middle and upper stratosphere (Climate monitoring, assimilation)
  - Solar Mg II index and spectral variations (Solar UV spectra)
- Limb Ozone Profile Products
  - High vertical resolution stratospheric Ozone profiles (Ozone hole, monitoring)
- Research Products
  - Nadir Mapper Column NO2
  - Limb Profiler High vertical resolution stratospheric Aerosol profiles

Comparisons among Total Column Ozone Products from MetOp-B GOME-2 (NOAA Version 8 algorithm), NASA EOS Aura OMI (NASA Version 8.6 algorithm) and S-NPP OMPS-NM (NOAA Version 8 algorithm) for November 2, 2014.

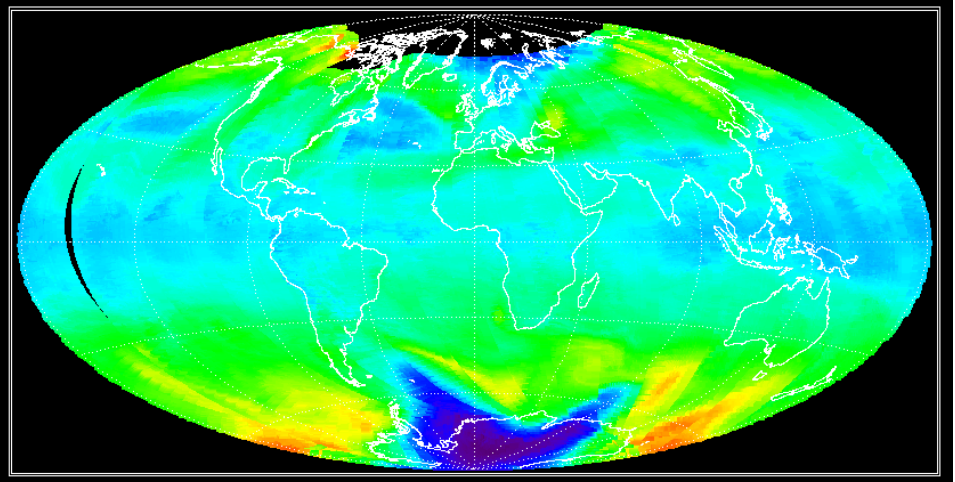
Metop_B GOME-2 Total Ozone for 20141102



OMI Total Ozone for 20141102

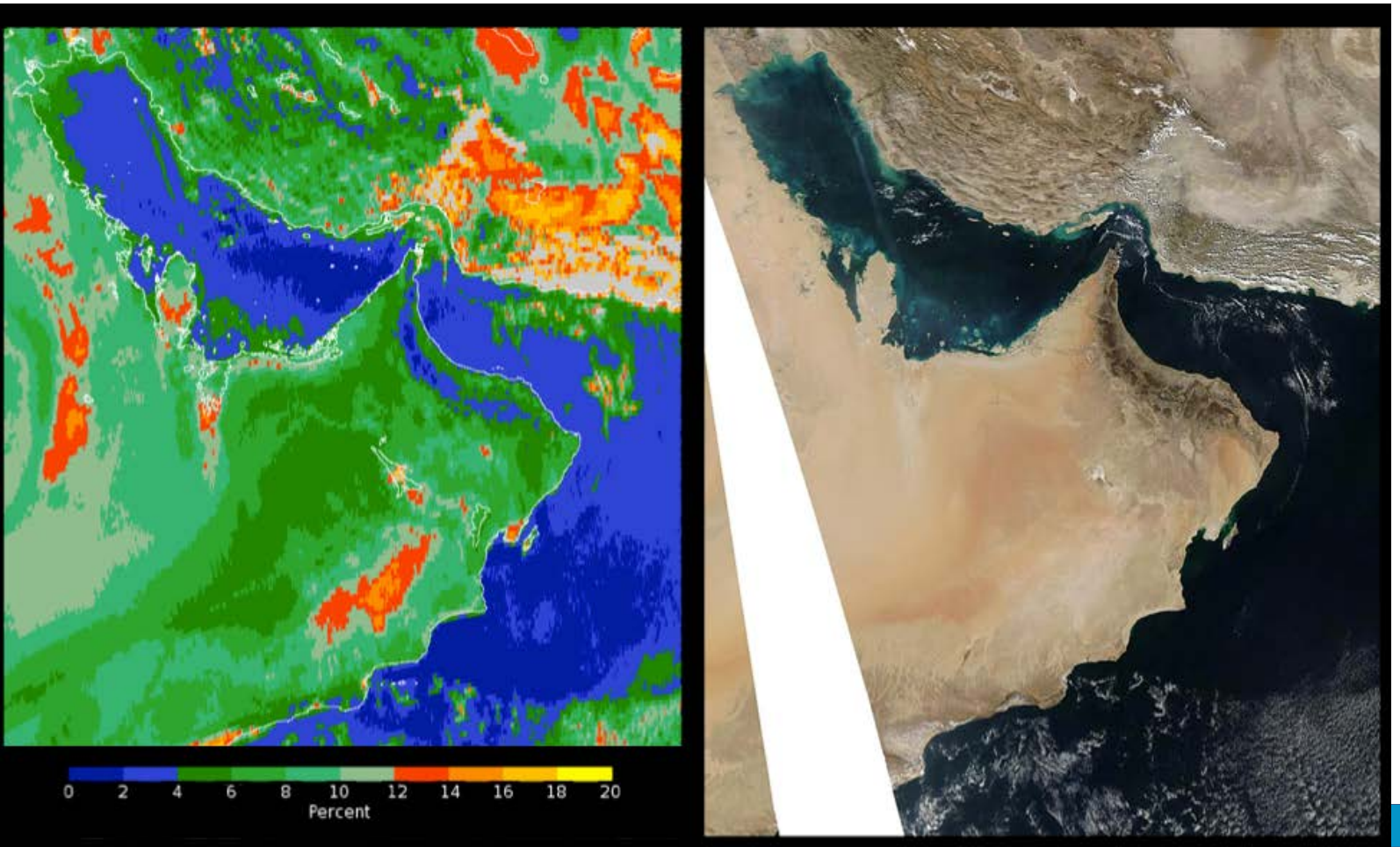


OMPS V8 Total Ozone for 20141102



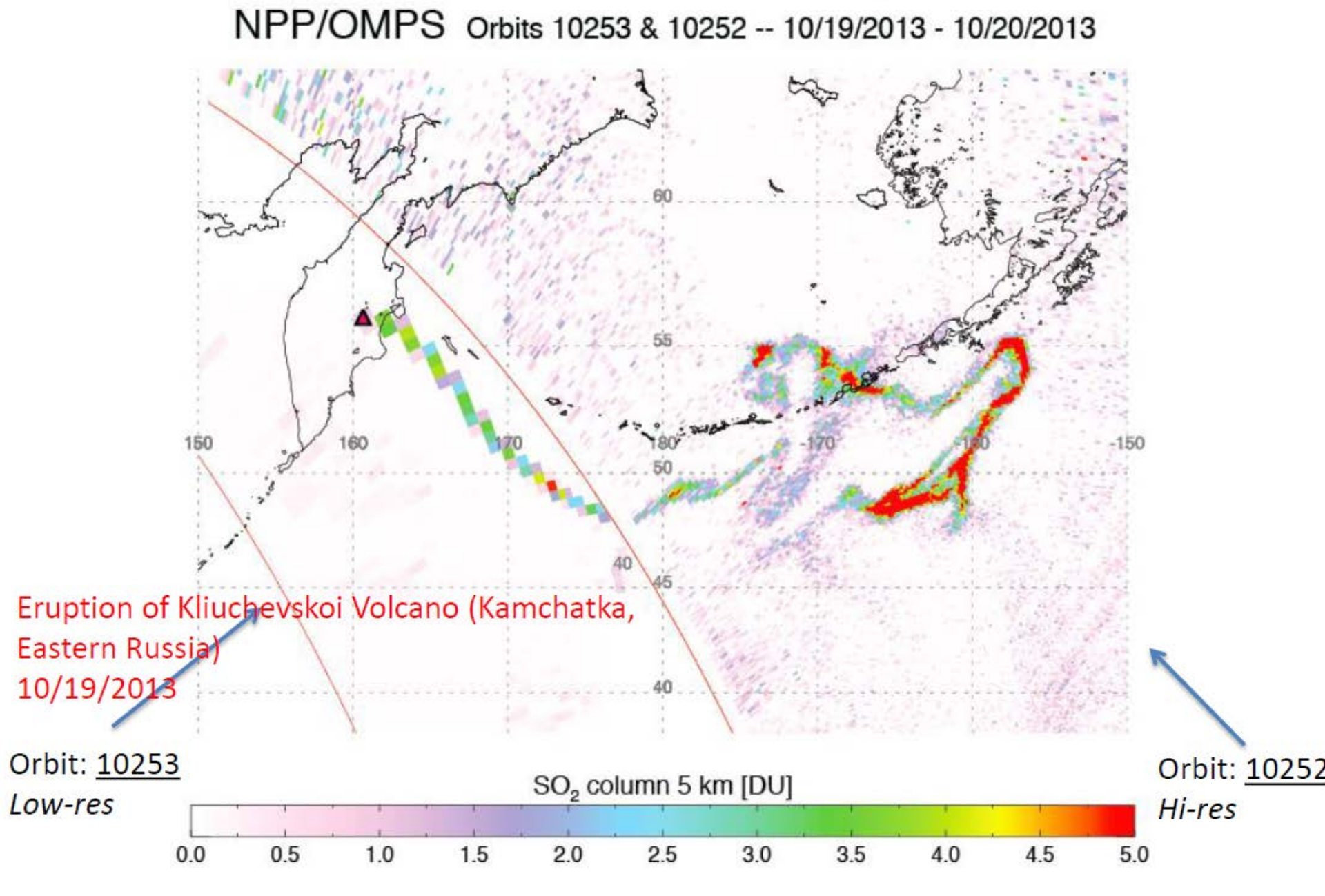
High-Spatial-Resolution Capabilities

The image on the left shows a false color map of the OMPS effective reflectivity (from a single Ultraviolet channel at 380 nm) over the Arabian Peninsula region for January 30, 2012 when the instrument was making a set of high-spatial-resolution measurements with 5×10 km^2 FOVs at nadir. The color scale intervals range from 0 to 2 % in dark blue to 18 to 20 % in yellow. The image on the right is an Aqua Moderate Resolution Imaging Spectroradiometer (MODIS) Red-Green-Blue image for the same day.



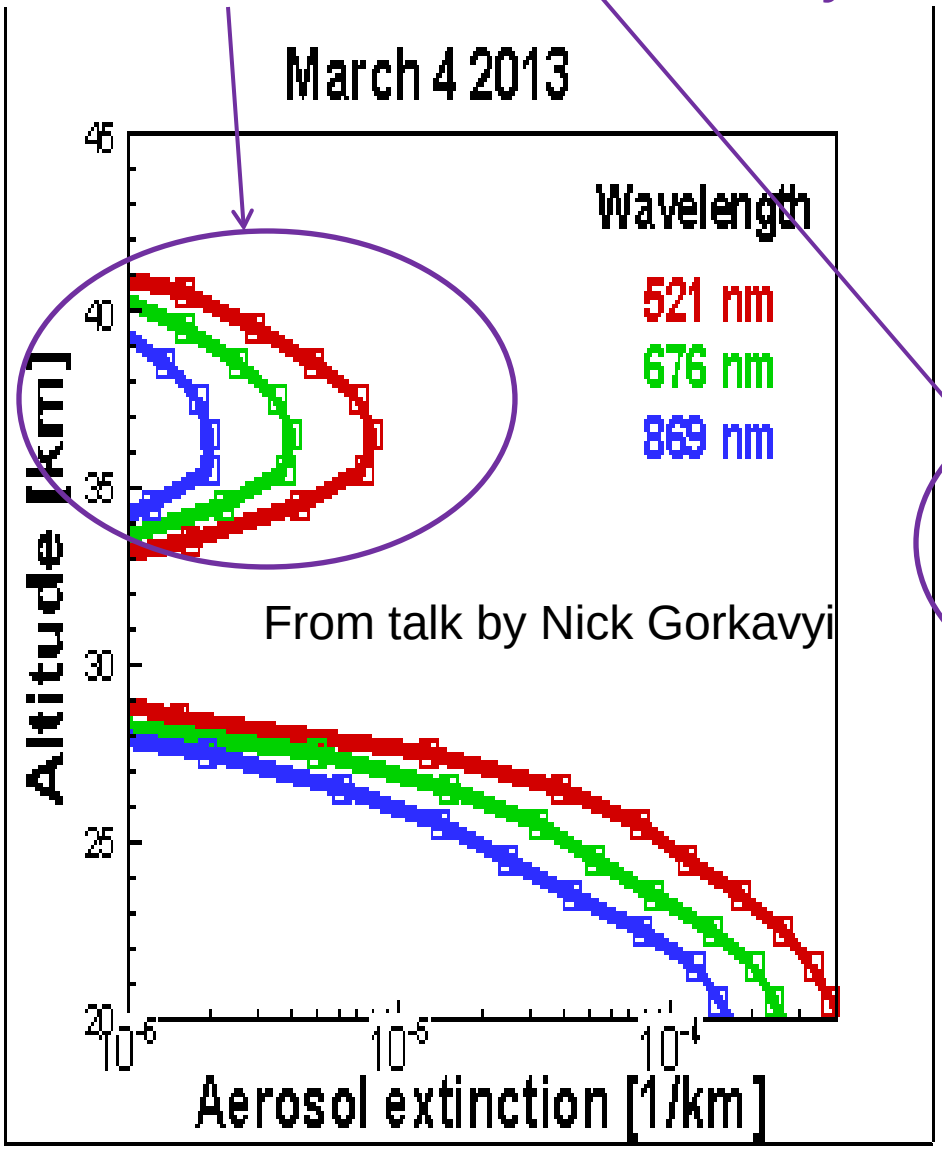
The OMPS Nadir Mapper instrument is very stable, extremely flexible, and has excellent SNRs.

Near-Real-Time OMPS SO_2 Product



Limb Aerosol Extinction Retrievals

Dust from the Russian Chelyabinsk Meteor



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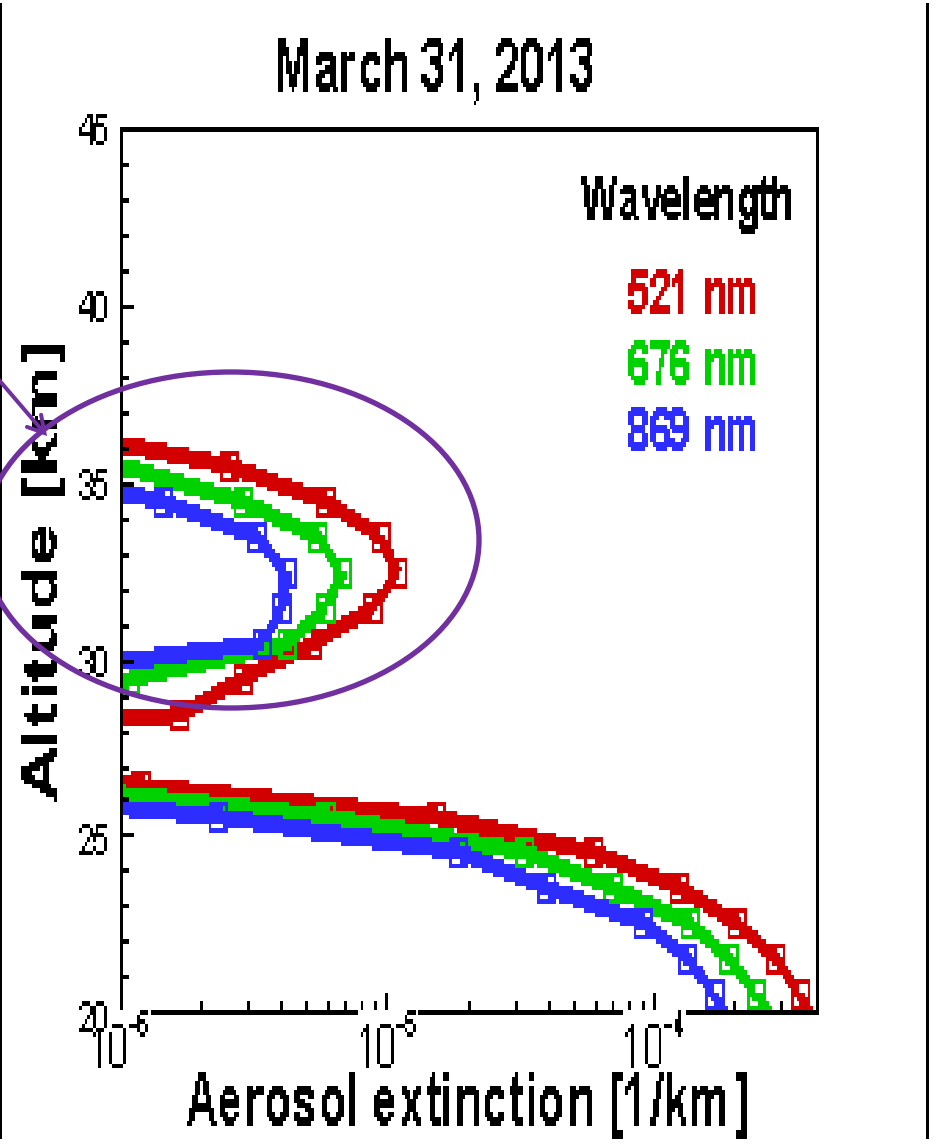

OMPS NM measurements can be used to make state-of-the-art SO_2, NO_2 and Aerosol retrievals for air quality and hazard applications. Examples below are for Asia for 10/20/2013 (top) & 10/23/2013 (bottom)