Royal Netherlands
Meteorological Institute
Ministry of Transport, Public Works and Water Management

The Ozone Monitoring Instrument

Pepijn Veefkind, Dep-Pi
Pieternel Levelt, PI
P.K. Bharthia, US Team Leader
Johanna Tamminen, Co-Pi

& the international
OMI science team

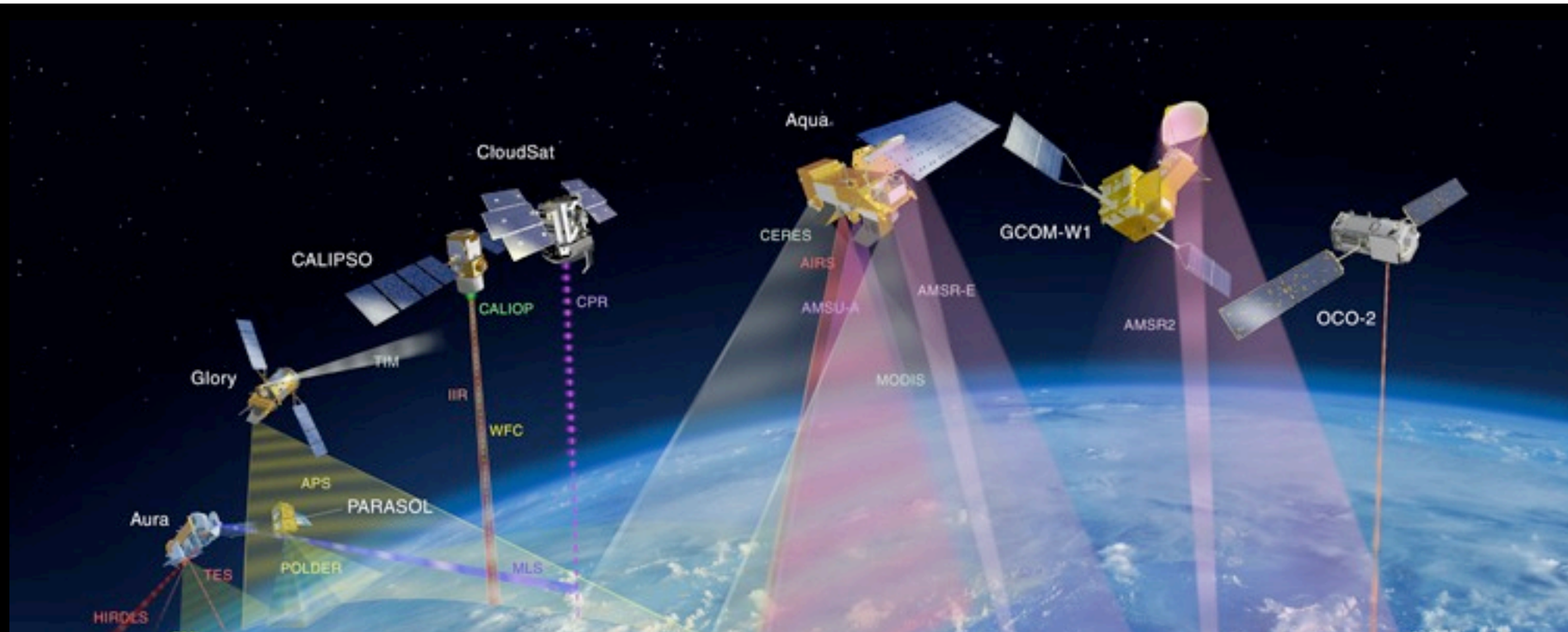
Ozone Monitoring Instrument

	Session 2
10:30 -11:00	Overview Pepijn Veefkind
11:00 - 11:30	Ozone Products P.K. Bhartia
11:30 - 12:00	NO_2 and SO_2 Nick Krotkov

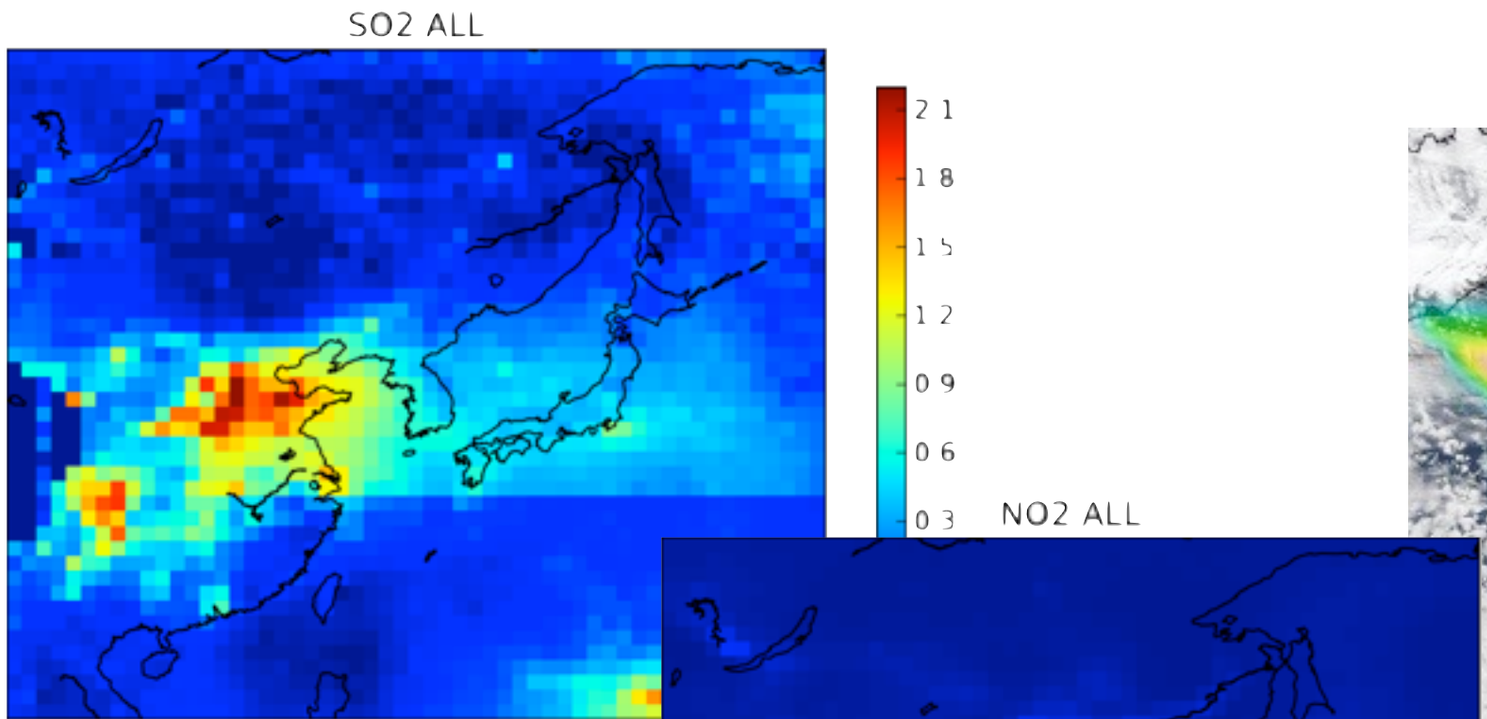
	Session 3
13:30 -13:50	Cloud Products Joanna Joiner
13:50 - 14:10	Aerosol Products Omar Torres
14:10 - 14:30	Surface UVB Tero Mielonen
14:30 - 15:00	HCHO and BrO Thomas Kurosu

OMI Science Questions

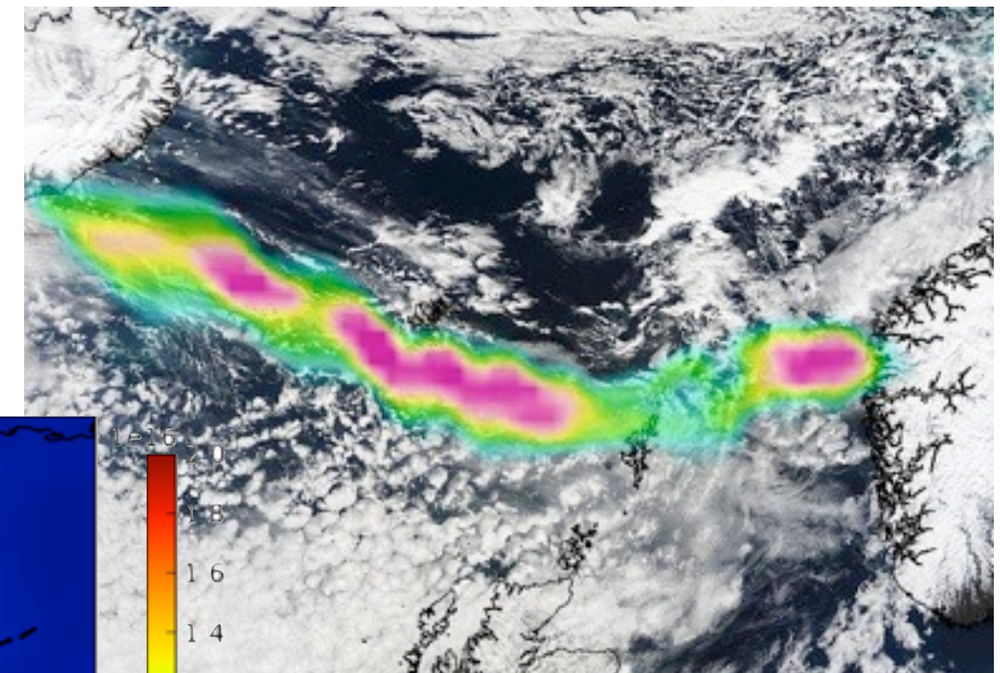
- Is the ozone layer recovering as expected ?
- What are the sources of aerosols and trace gases that affect global air quality and how are they transported?
- What are the roles of tropospheric ozone and aerosols in climate change ?
- What are the causes of surface UV-B change?



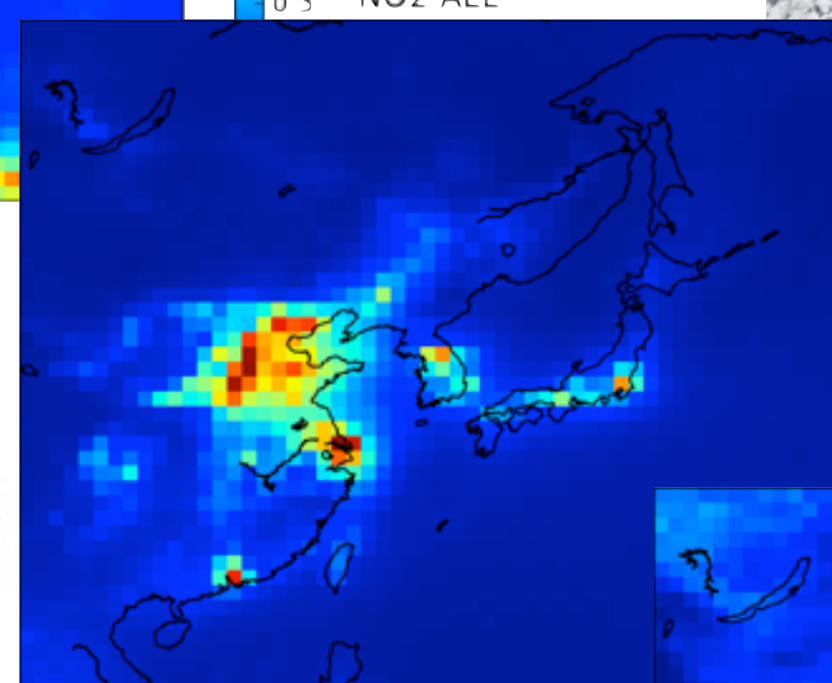
Examples of OMI Data Products



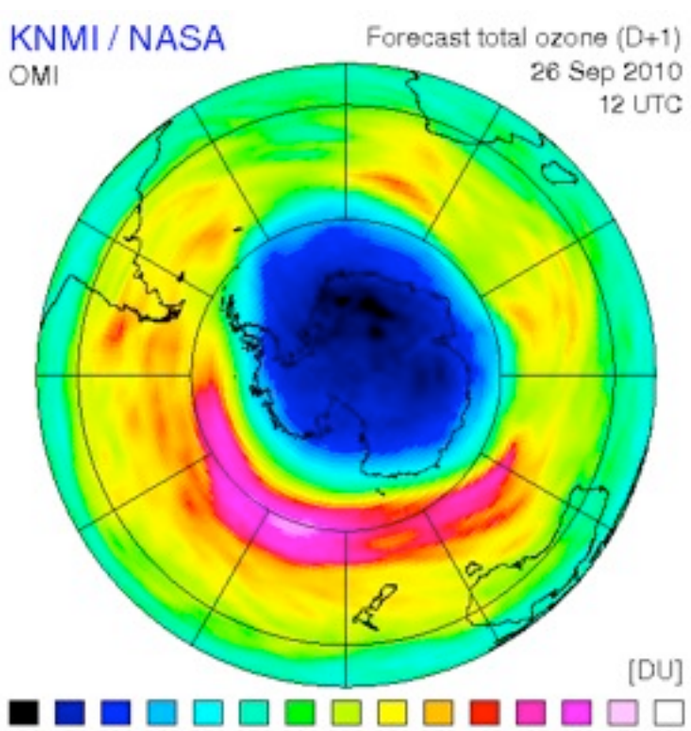
Volcanic Ash, April 2009

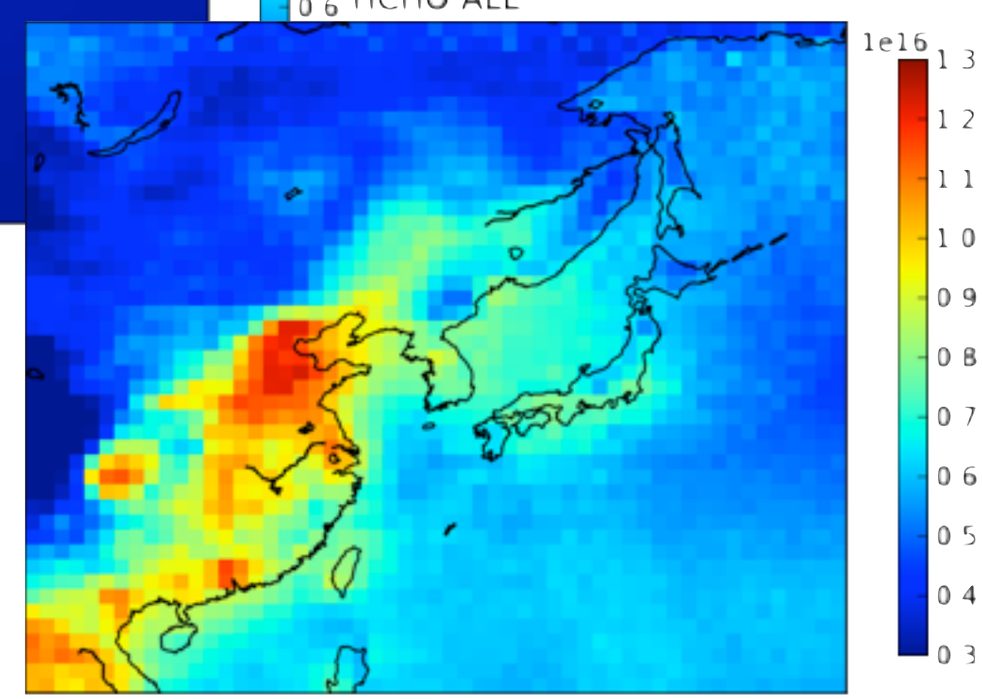


Colin Seftor, SSAI

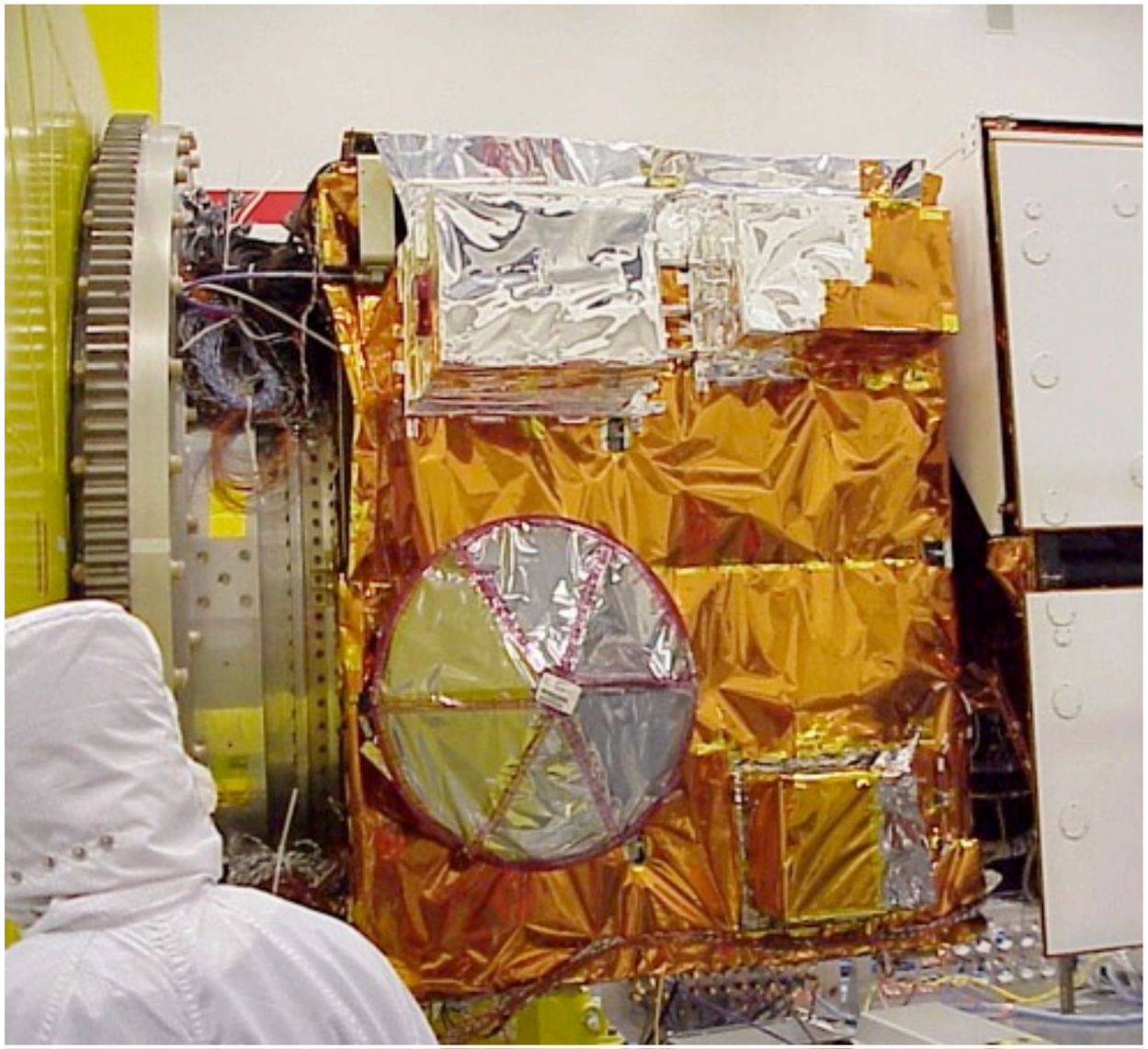


Ozone Sep. 2010





Ozone Monitoring Instrument

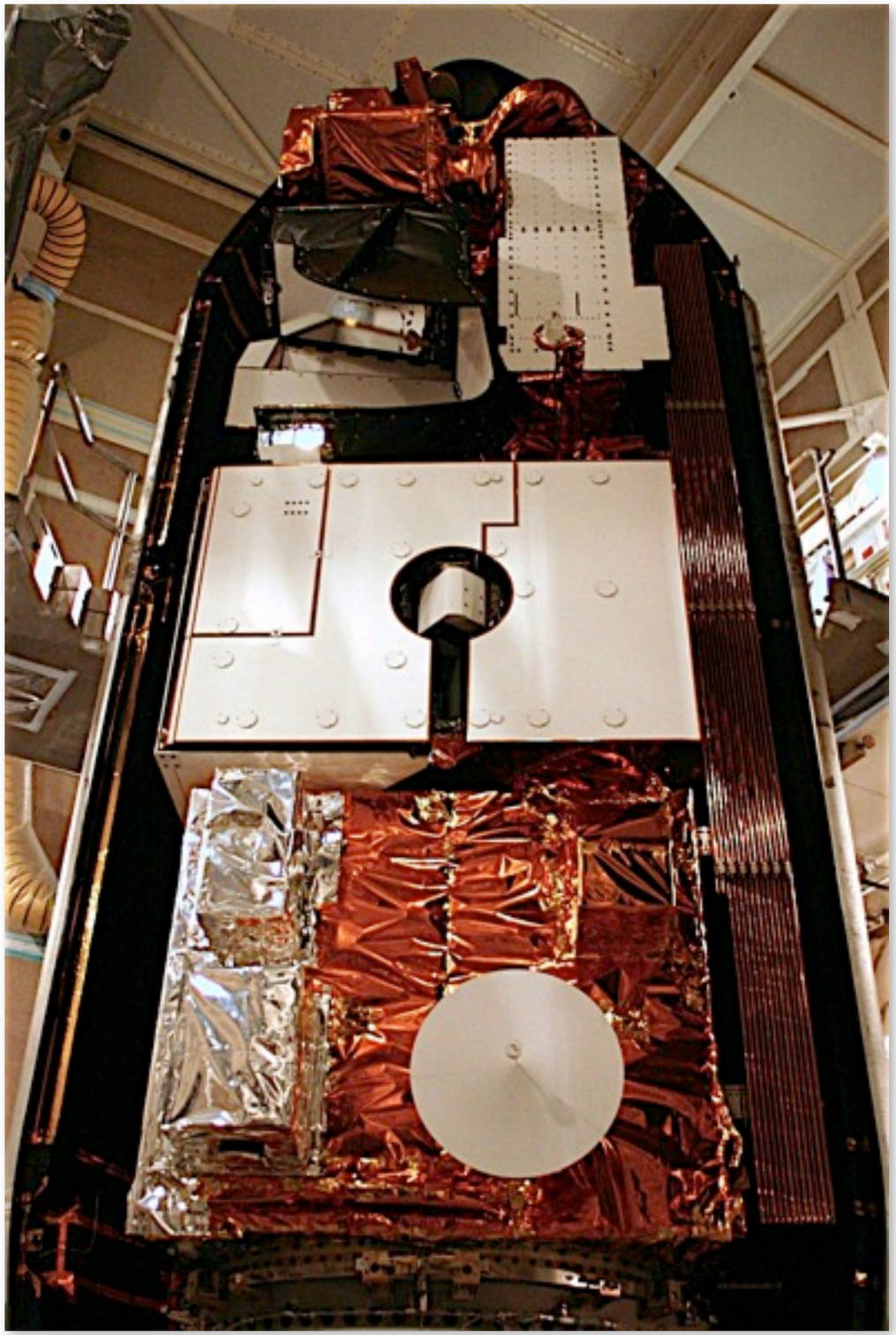


Ozone Monitoring Instrument

Instrument	Imaging spectrometer
Spectral Range	270 - 500 nm
Spectral Resolution	0.45 - 0.63 nm
Spectral Sampling	0.15 - 0.30 nm
Spatial Resolution	13x24 km^2 (nadir)
Swath Width	2600 km
Mass	65 kg
Size	50 cm × 40 cm × 35 cm
Power	66 W
Data rate	0.8 Mbps (average)
Spacecraft	NASA EOS-Aura
Launch Date	15 July 2004
Orbit	Sun synchronous, 13:30 hr
Altitude	705 km
Agencies	NSO (NIVR), FMI
PI Institutes	KNMI, FMI

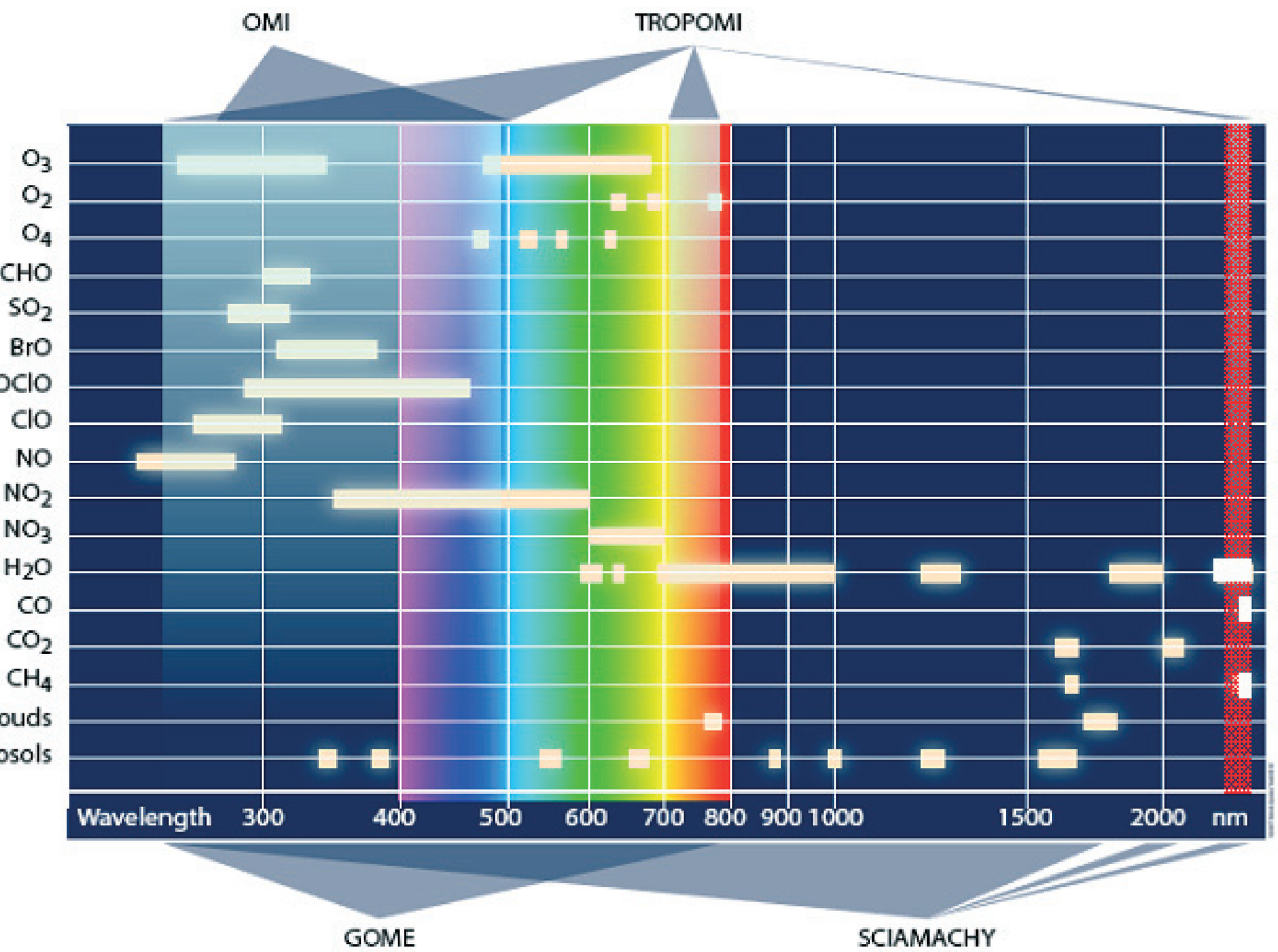
OMI is the Dutch-Finnish contribution to the NASA EOS-Aura Mission and is developed by an international consortium led by Dutch Space and TNO.

The Ozone Monitoring Instrument

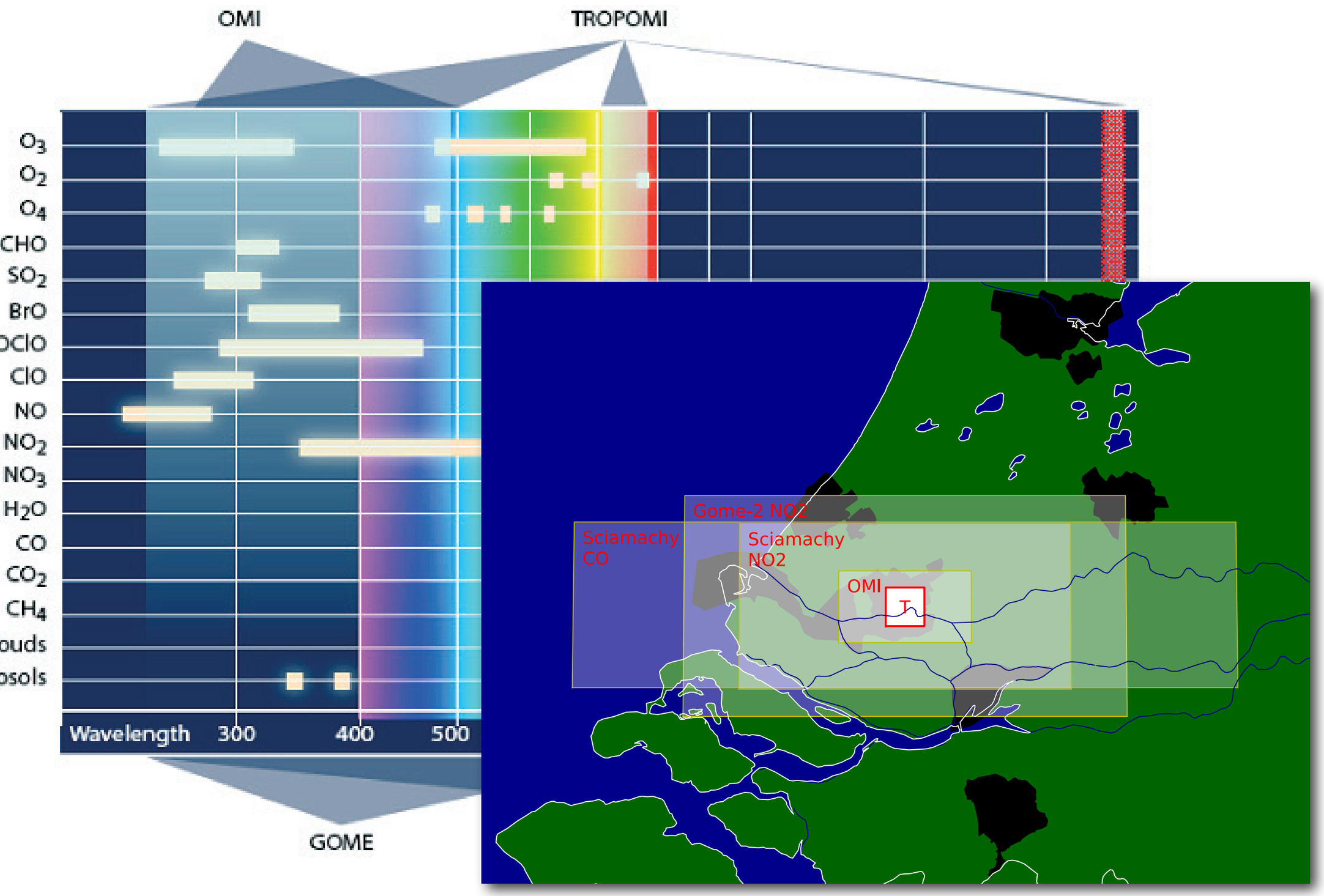


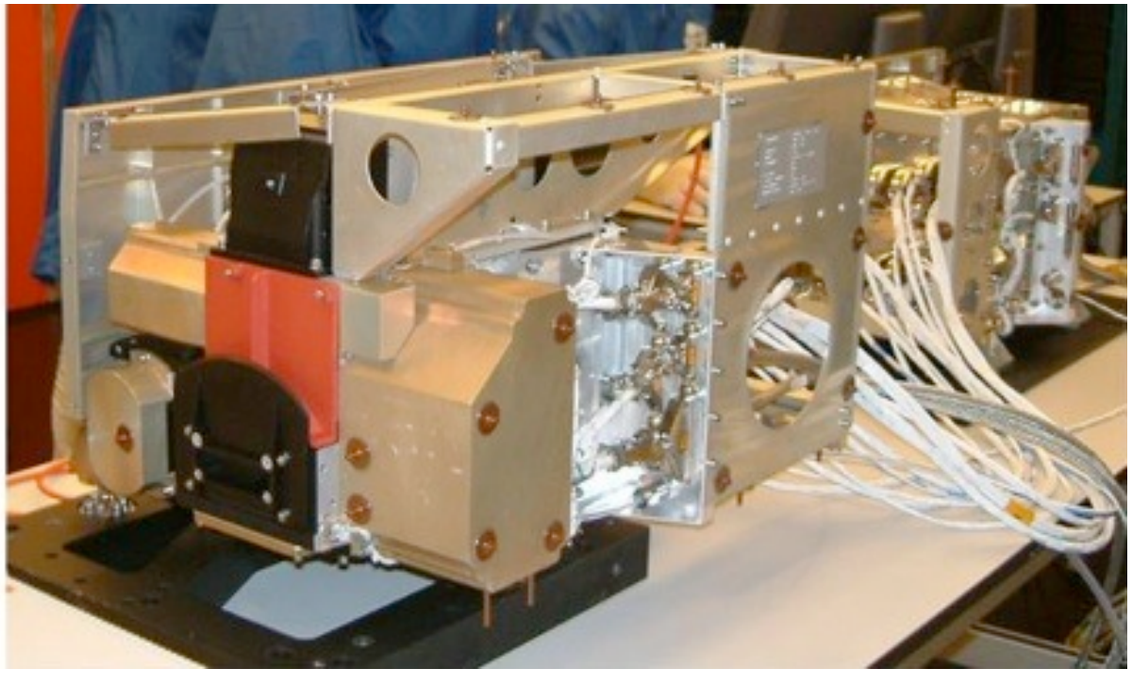
OMI was designed and built by an international consortium, lead by Dutch Space and TNO-TPD

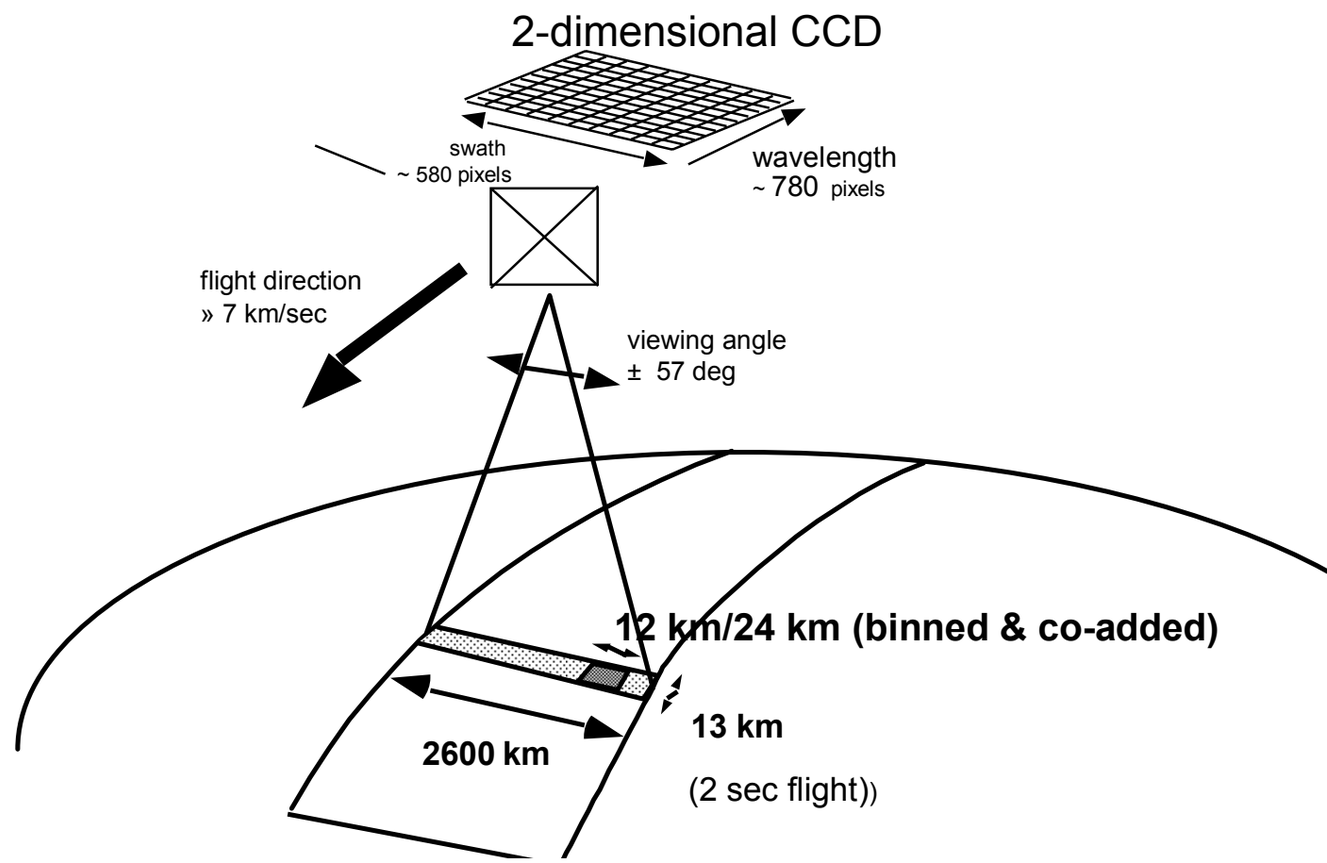
Heritage Instruments



Heritage Instruments

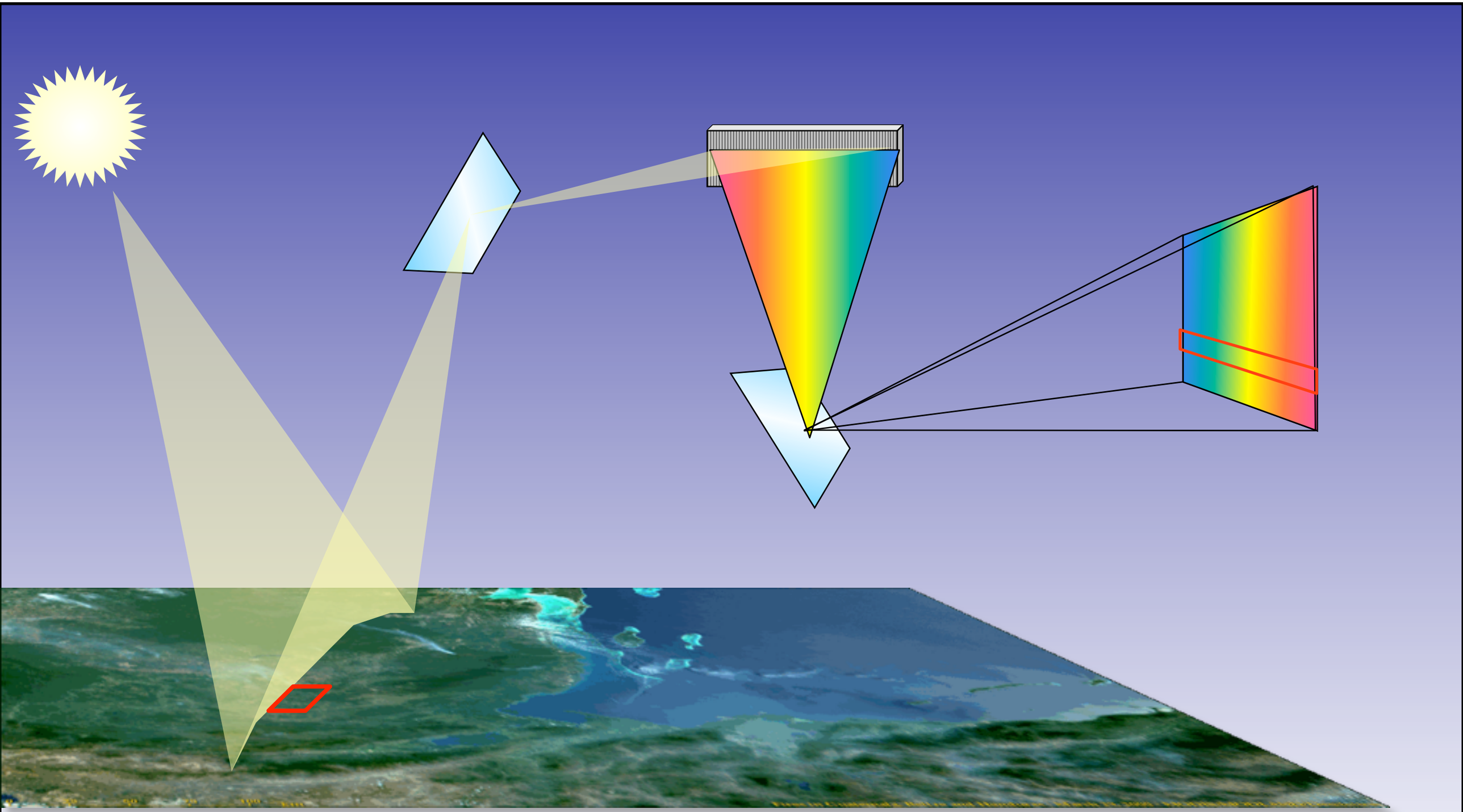


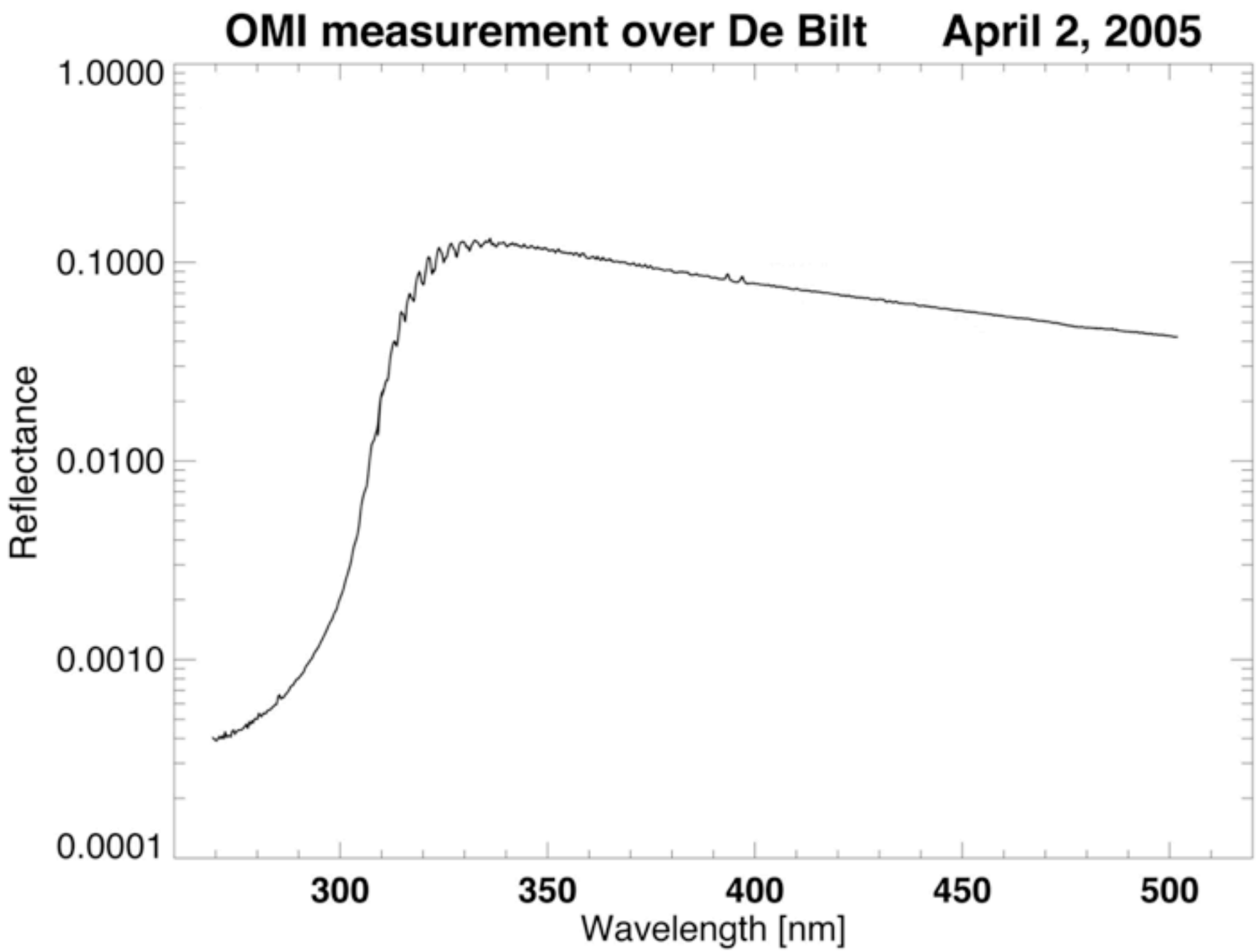




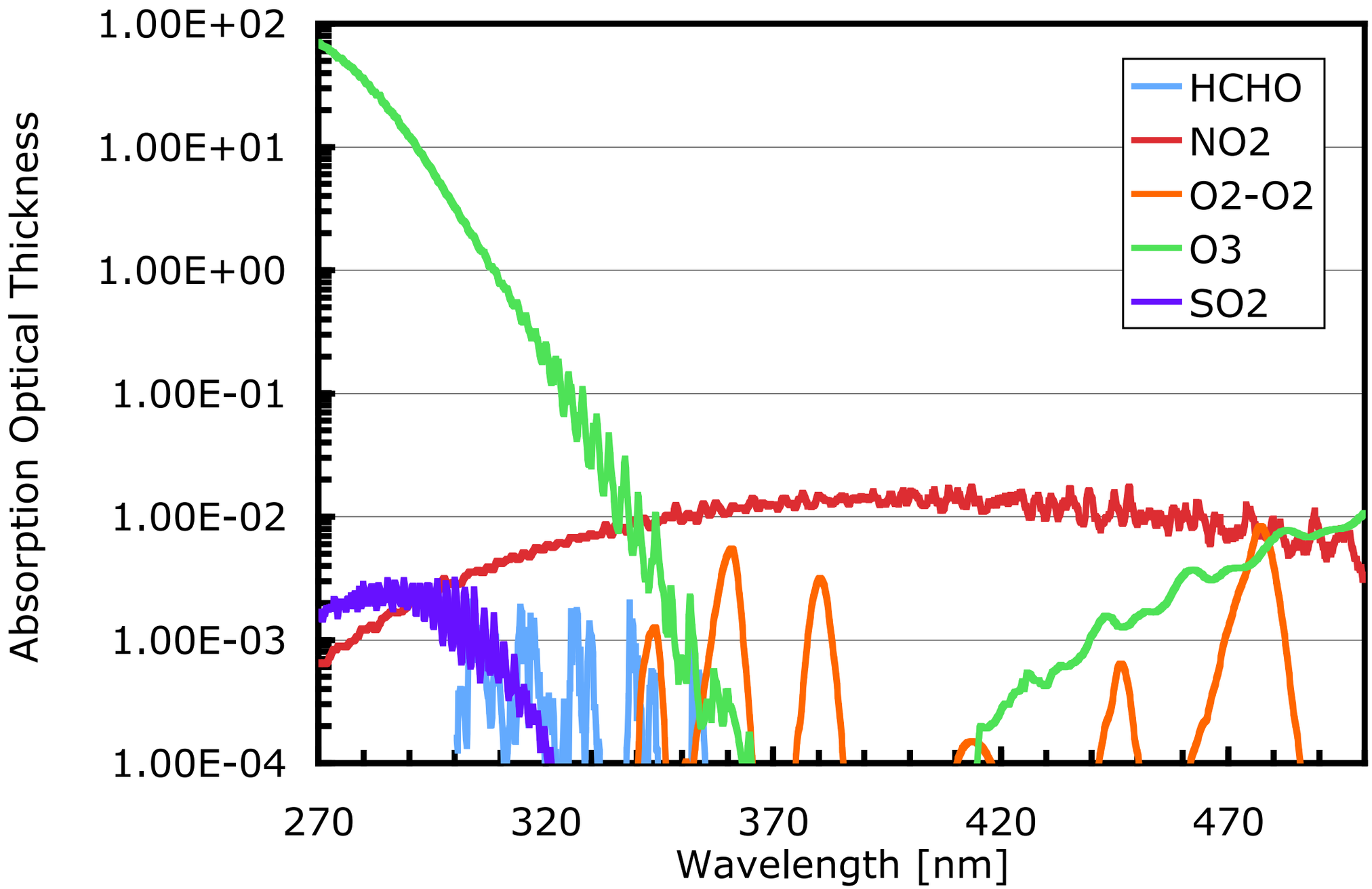
Spectral range, resolution and sampling distances

Channel	Total Range	Full Performance Range	Average Spectral Resolution (FWHM)	Average Spectral Sampling Distance
UV-1	264 - 311 nm	270 - 310 nm	0.63 nm	0.33 nm/pixel
UV-2	307 - 383 nm	310 - 365 nm	0.42 nm	0.14 nm/pixel
VIS	349 - 504 nm	365 - 504 nm	0.63 nm	0.21 nm/pixel

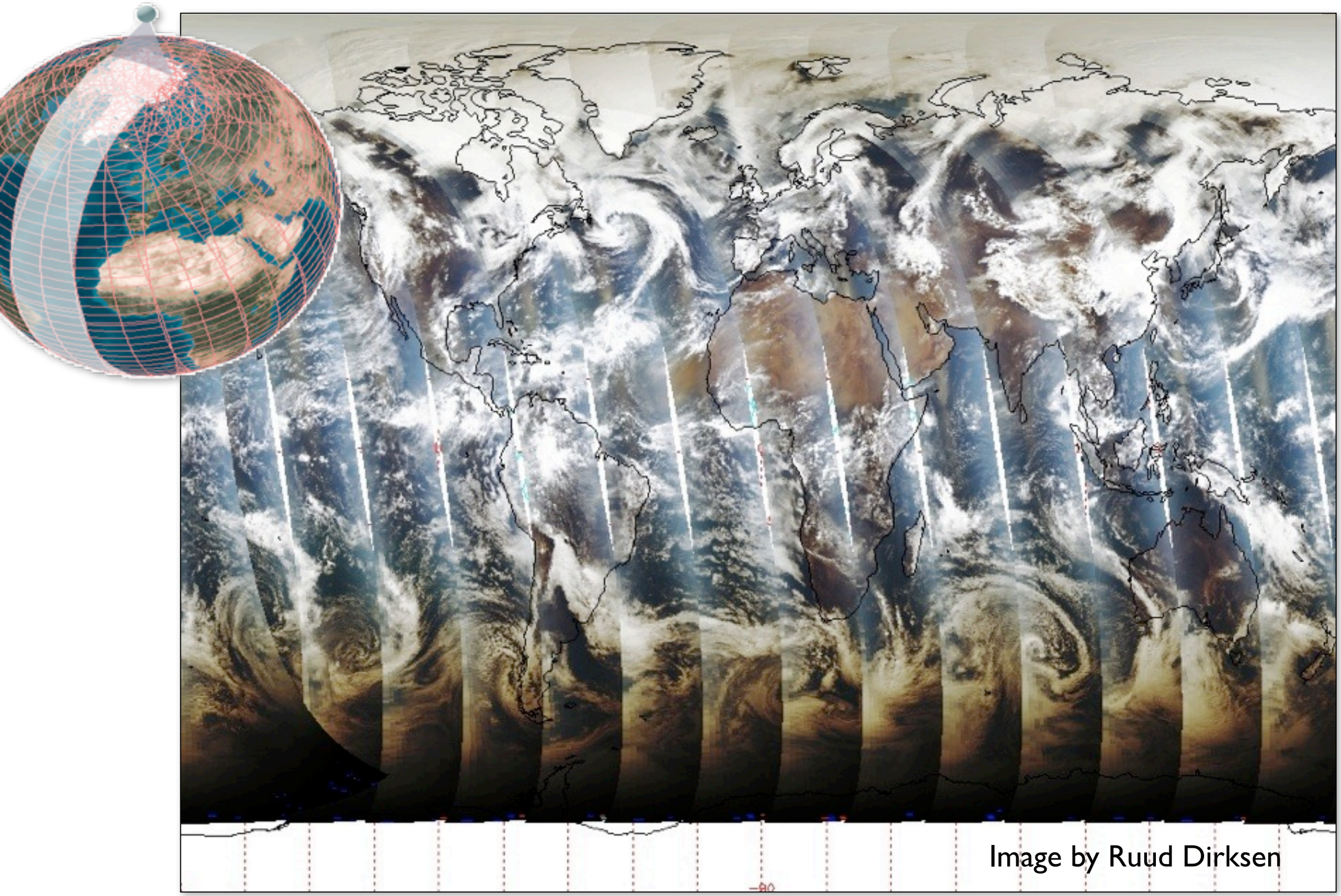




60 spectra of 1200 wavelengths every 2 seconds
1.3 million spectra per day


1.00E+02
1.00E+01
1.00E+00
1.00E-01
1.00E-02
1.00E-03
1.00E-04
Absorption Optical Thickness
270
320
370
420
470
Wavelength [nm]
HCHO
NO2
O2-O2
O3
SO2

Daily Global Coverage

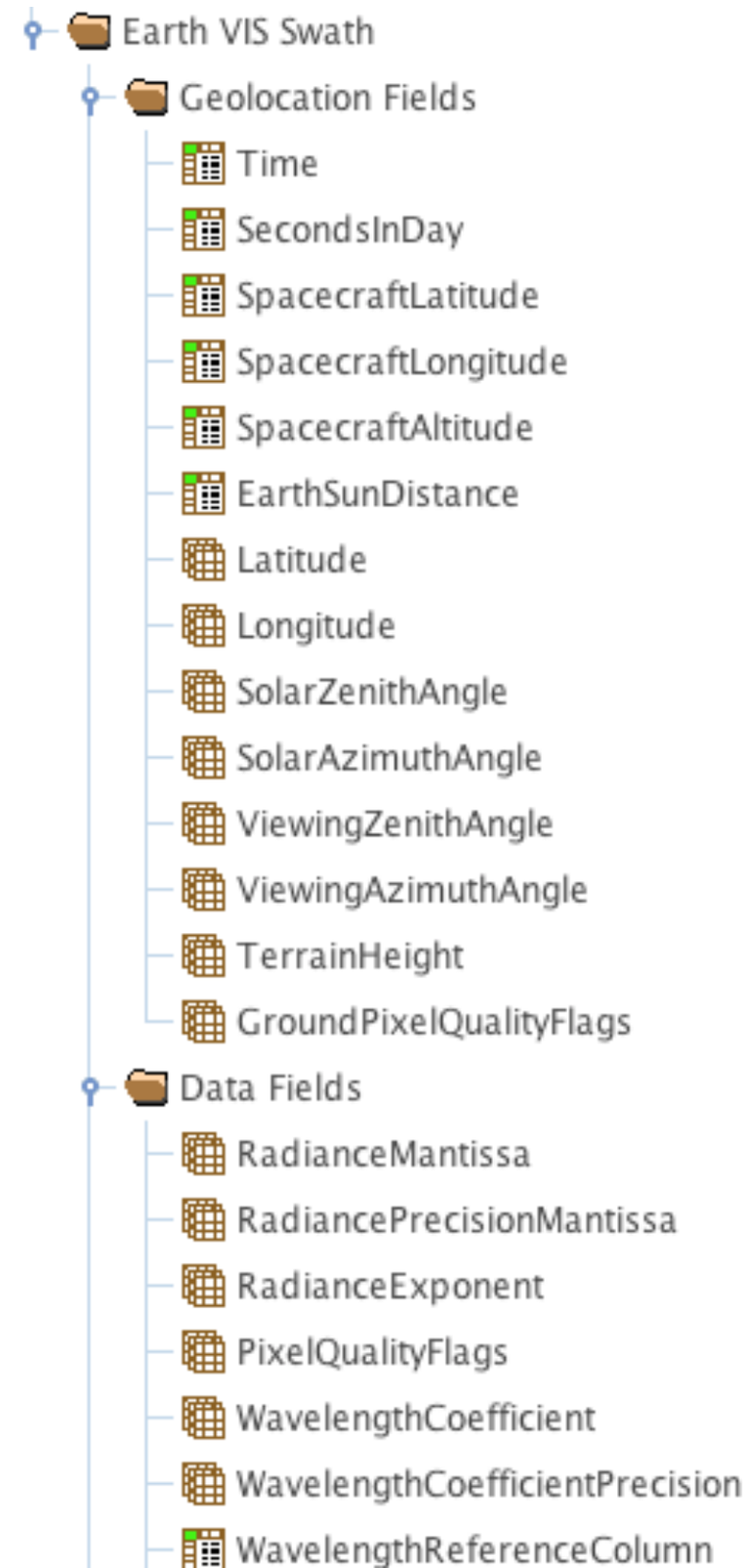


Level 1B Products

- OML1BRUG: Global Mode Earth radiances for the UV-1 and UV-2 channels.
- OML1BRVG: Global Mode Earth radiances for the VIS channel.
- OML1BIRR: Solar Irradiance for all channels.
- OMl1BCAL: Calibration product for all channels.

- OML1BRUZ: Spatial Zoom Mode Earth radiances for the UV-1 and UV-2 channels.
- OML1BRVG: Spatial Zoom Earth radiances for the VIS channel.

http://www.knmi.nl/omi

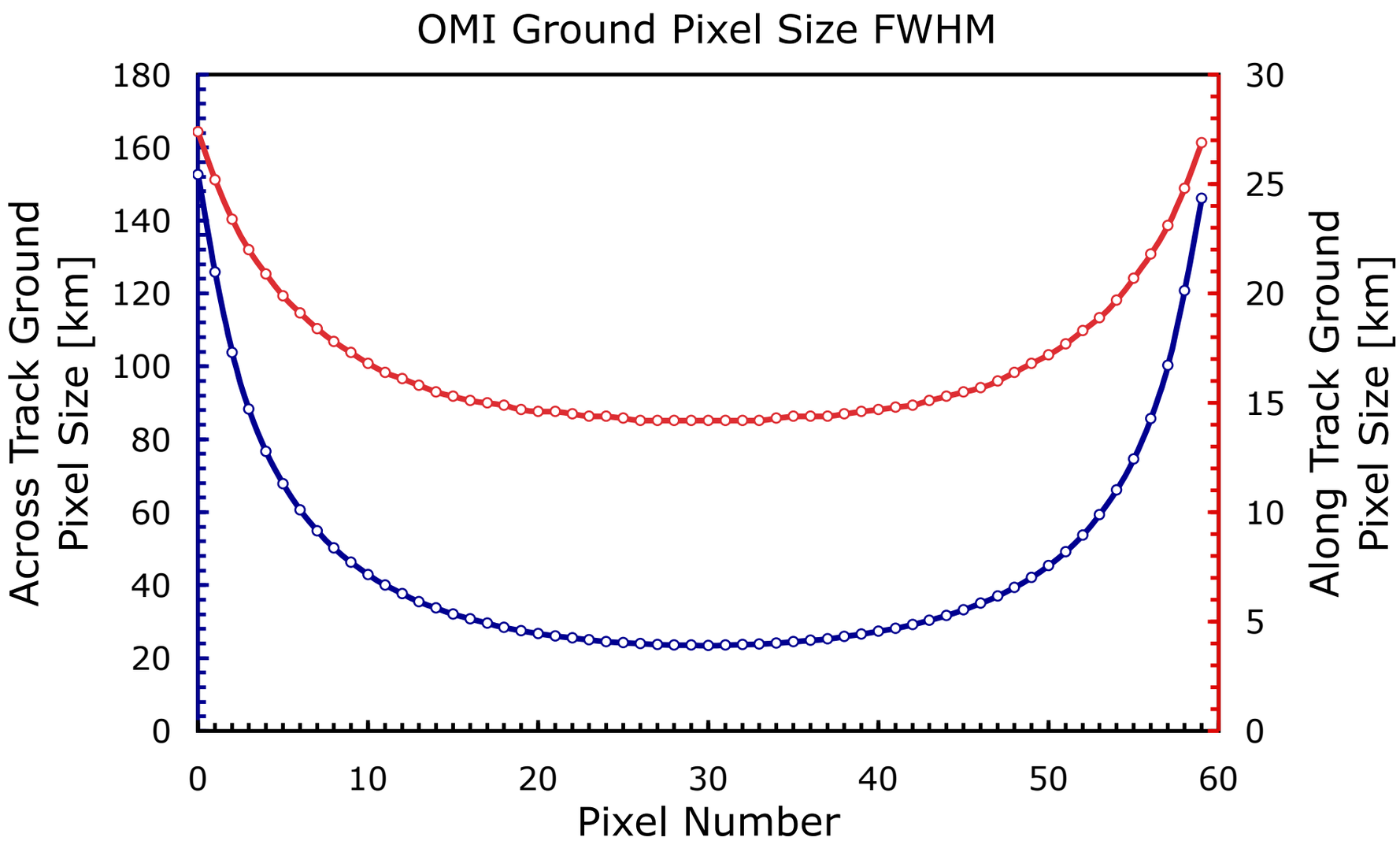


Level 2 Data Products

Product	Accuracy	Remarks
Total Ozone OMTO3, OMDOAO3	2%::0.5% @SZA<75°	
Ozone Profile OMO3PR	10%::5%	Vertical resolution ~6 km
Surface UVB Flux	2%::1% in cloud-free non-polluted areas	30%::5% in other conditions
Cloud Scattering Layer Pressure OMCLDO2, OMCDR	50hPa::10 hPa	For cloud radiance fraction >50%
Aerosol Optical Thickness OMAERUV, OMAERO	20%::5% for elevated smoke or dust	
Aerosol Single Scattering Albedo OMAERUV, OMAERO	0.03::0.01 for elevated smoke or dust	

Product	Accuracy	Remarks
NO_2 OMNO2, DOMINO	$5x10^{14}$::$2x10^{14}$ background 20%::10% polluted	
SO_2 OMSO2	$2x10^{16}$::$1x10^{16}$ polluted 5%::1% volcanic	
HCHO OMHCHO	*little information*	Use spatial/ temporal averages
BrO OMHCHO	*little information*	
OClO OMOCLO	*little information*	
Surface Reflectance	2%	L3, selected wavelengths 330-500nm

Spatial Resolution

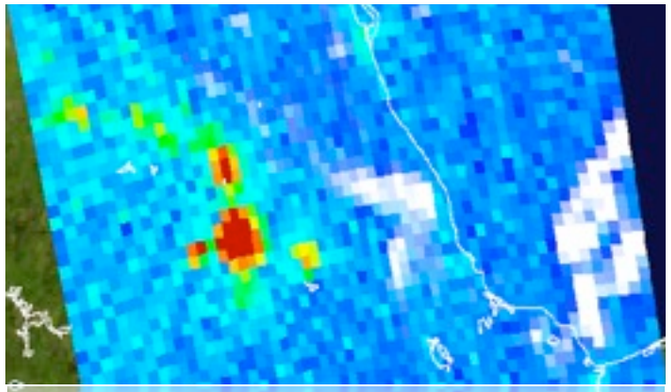


Spatial Resolution	Across Track	Along Track
Minimum	23.5	14.2
Median	32.7	15.4
Mean	46.6	17.0

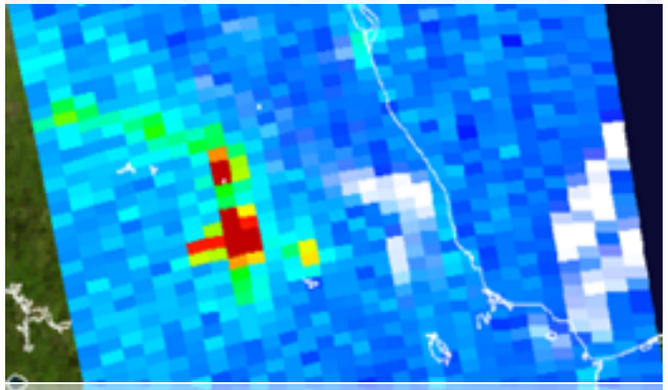
Spatial Zoom's

- OMI measures one day a month in spatial zoom.
- Spatial zoom data have a spatial sampling of 13x12 km^2 and a swath width of ~720 km.
- Some L2 products are not produced for the spatial zoom days.
- Orbit coverages can be viewed at http://www.knmi.nl/omi/research/calibration/instrument_status_v3/daily_reports/

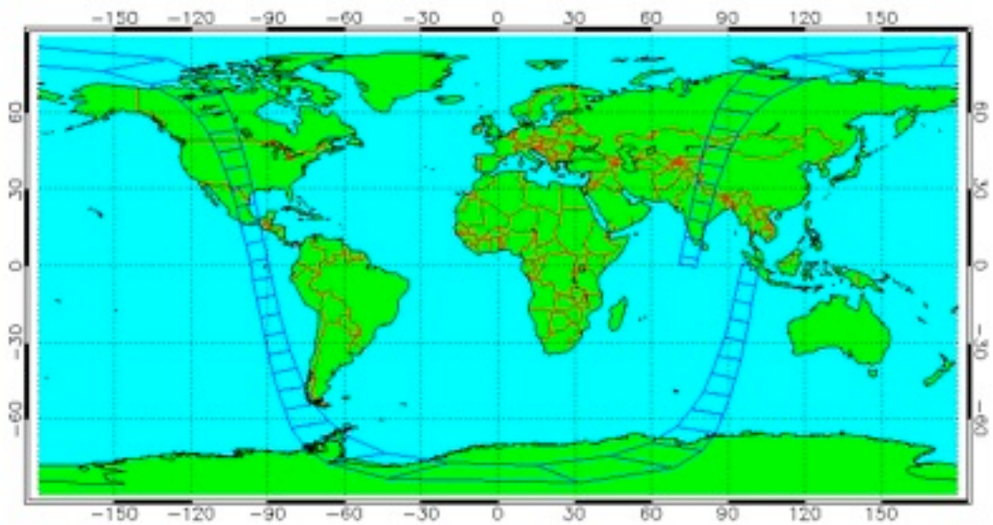
Mexico City
January 20, 2005

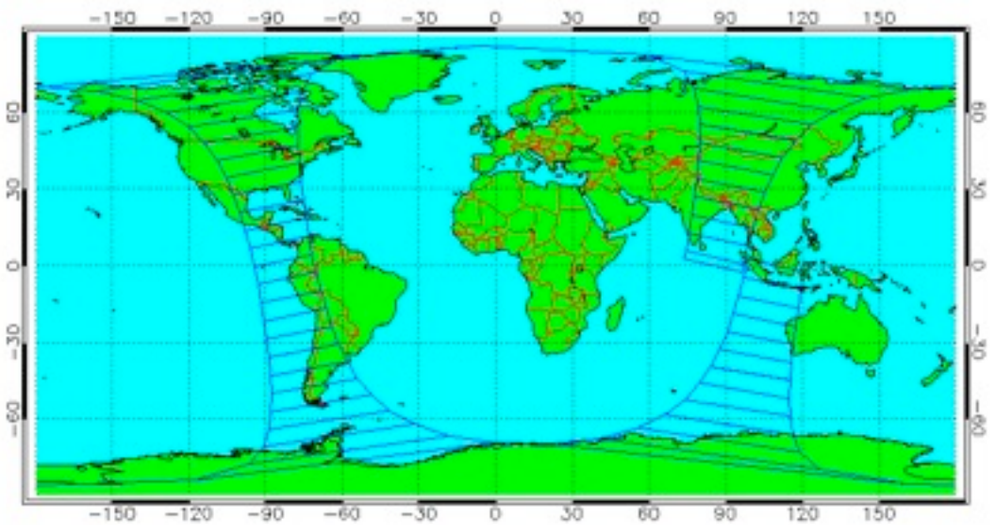


OMI Zoom 12x13 km^2



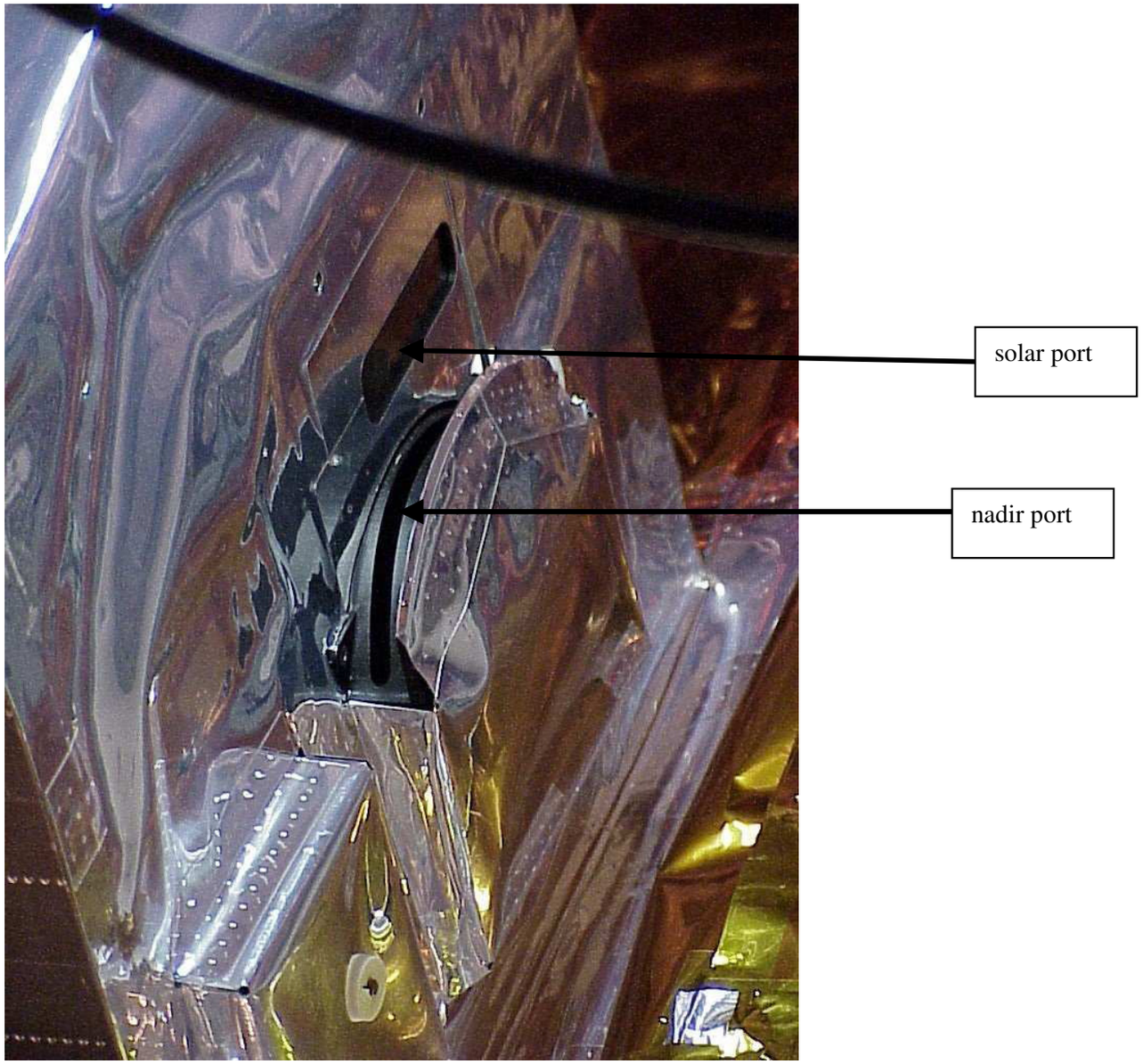
OMI 24x13 km^2





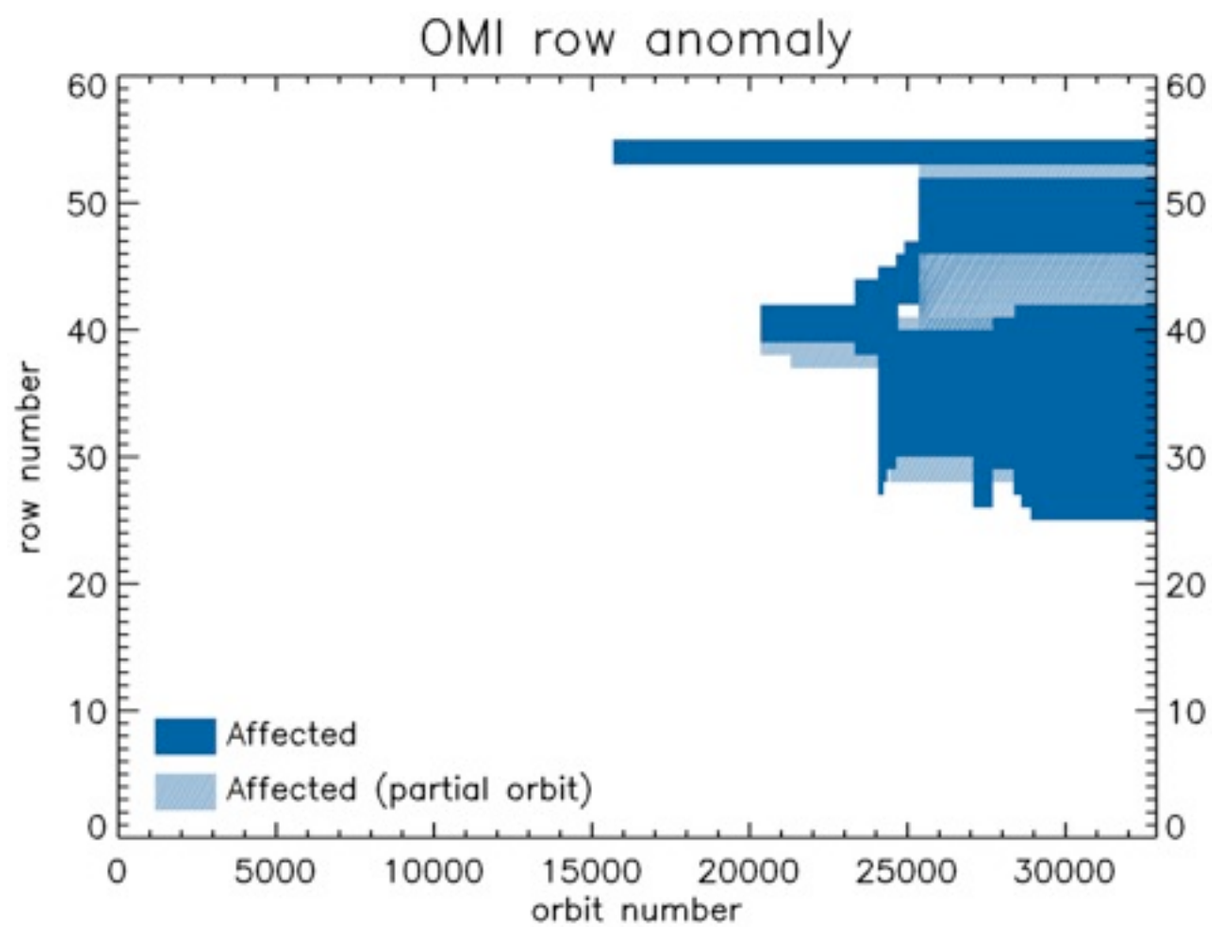
Row Anomaly

- Row anomaly most probable cause is an object blocking a part of the nadir port.
- The first effects of row anomaly were seen in May 2008.
- The row anomaly causes four effects:
  - Multiplicative radiometric error (partly resolved)
  - Spectral shift (resolved)
  - Straylight from the Sun entering the nadir port over part of the orbit
  - Straylight from the Earth



Row Anomaly

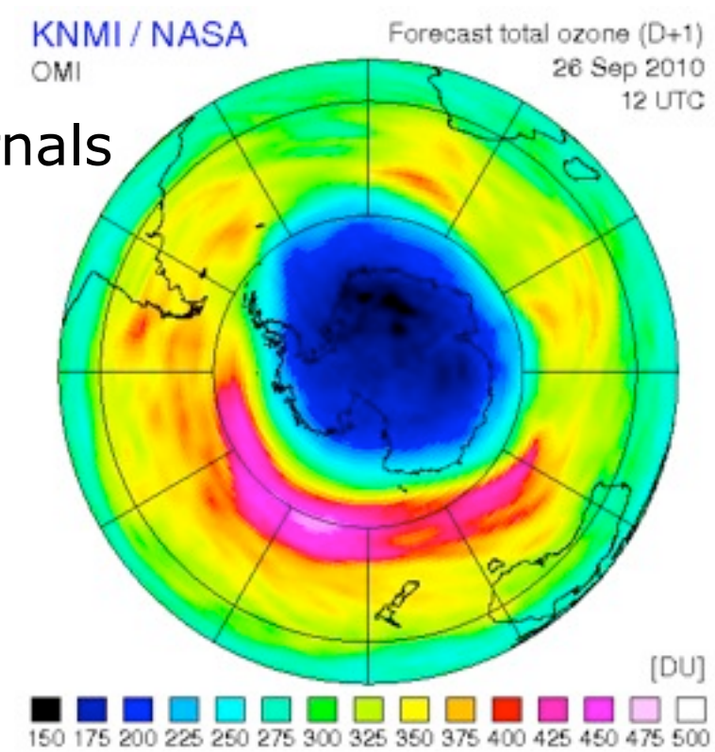
- L2 products respond differently to the row anomaly.
- Flag the affected ground pixels in L1B and higher products.
- Row anomaly pixels have been removed from L3 data.



http://www.knmi.nl/omi/research/product/rowanomaly-background.php

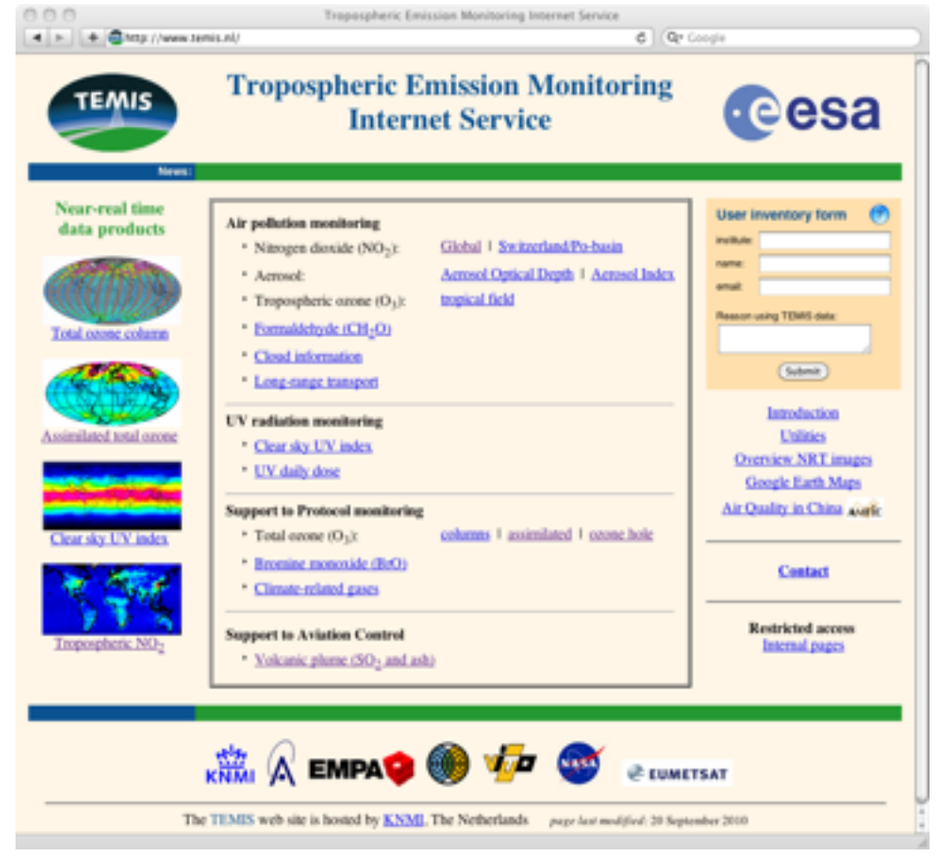
Data Usage

- Scientific Users
  - Google Scholar 865 article hits for 2004-2010
  - 265 in AGU papers, 110 in ACP, 49 in Elsevier Journals
- Operational Users
  - Ozone hole monitoring
  - Air pollution monitoring
- NRT Users
  - NWP Centers (ECMWF, NOAA)
  - Air quality forecasting
  - Air traffic volcanic alerts (VAACs)
  - UV-index warnings



disc.sci.gsfc.nasa.gov
www.temis.nl
omivfd.fmi.fi

http://disc.sci.gsfc.nasa.gov/Aura/data-holdings/OMI/index.shtml



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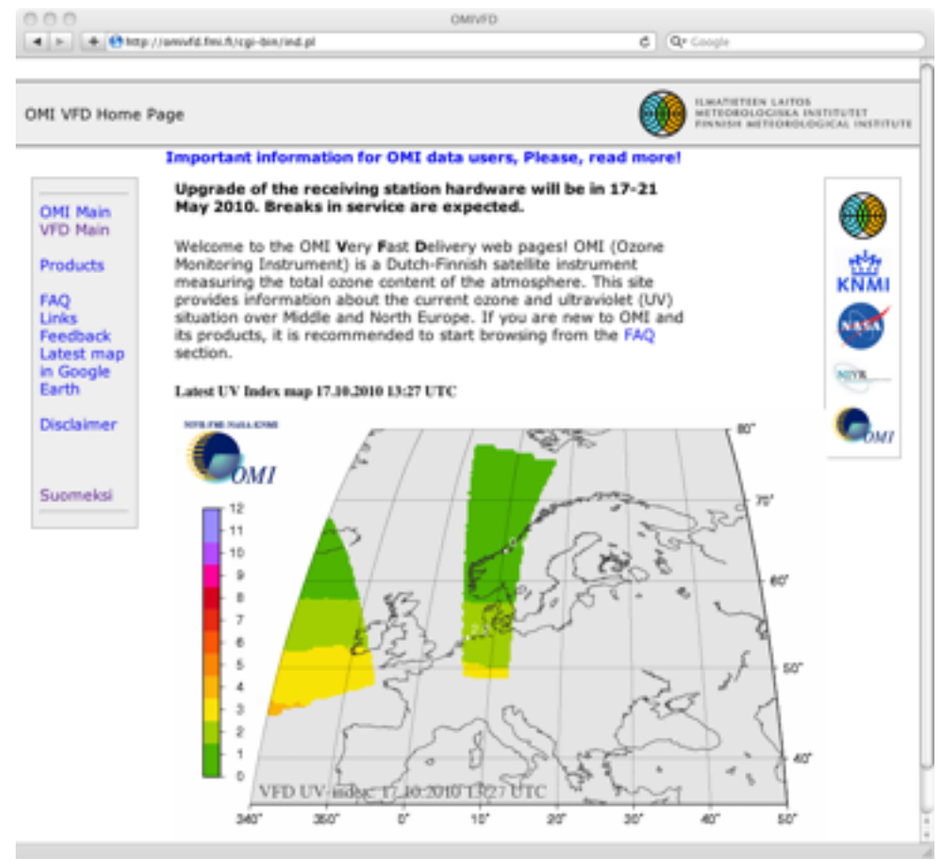
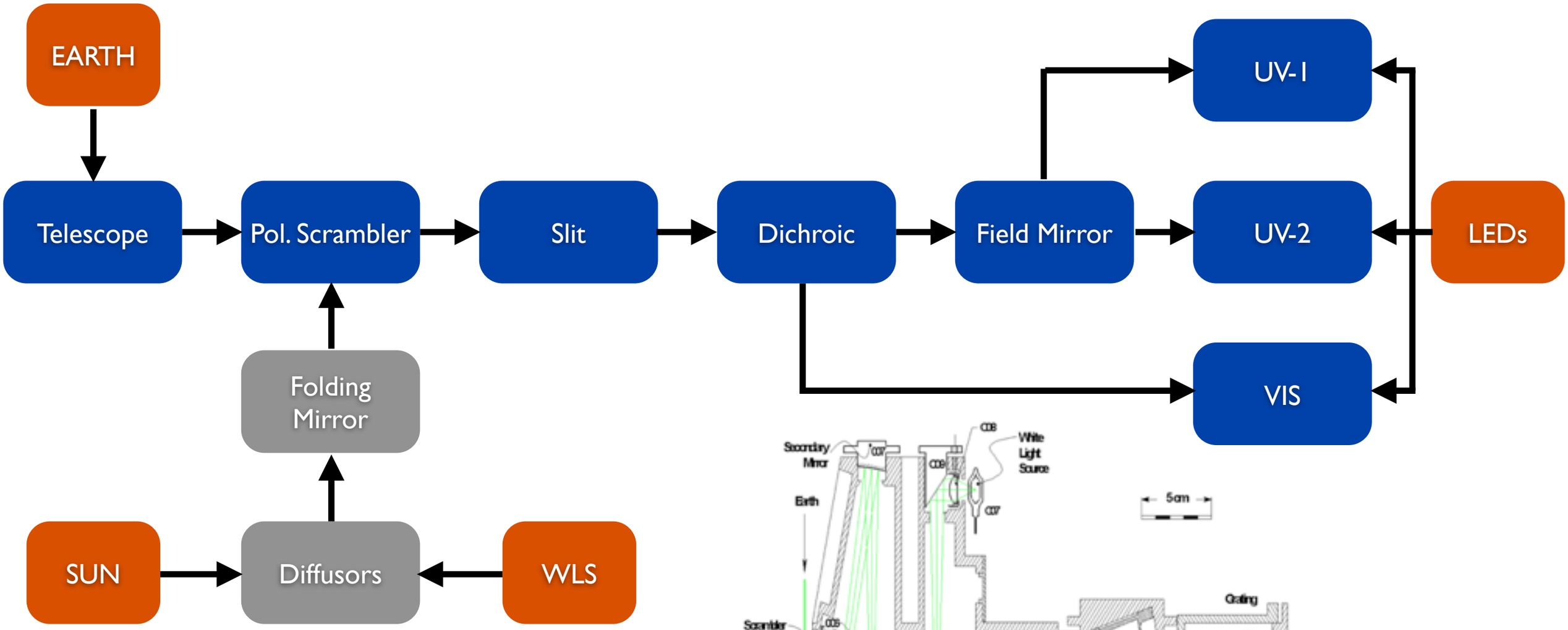
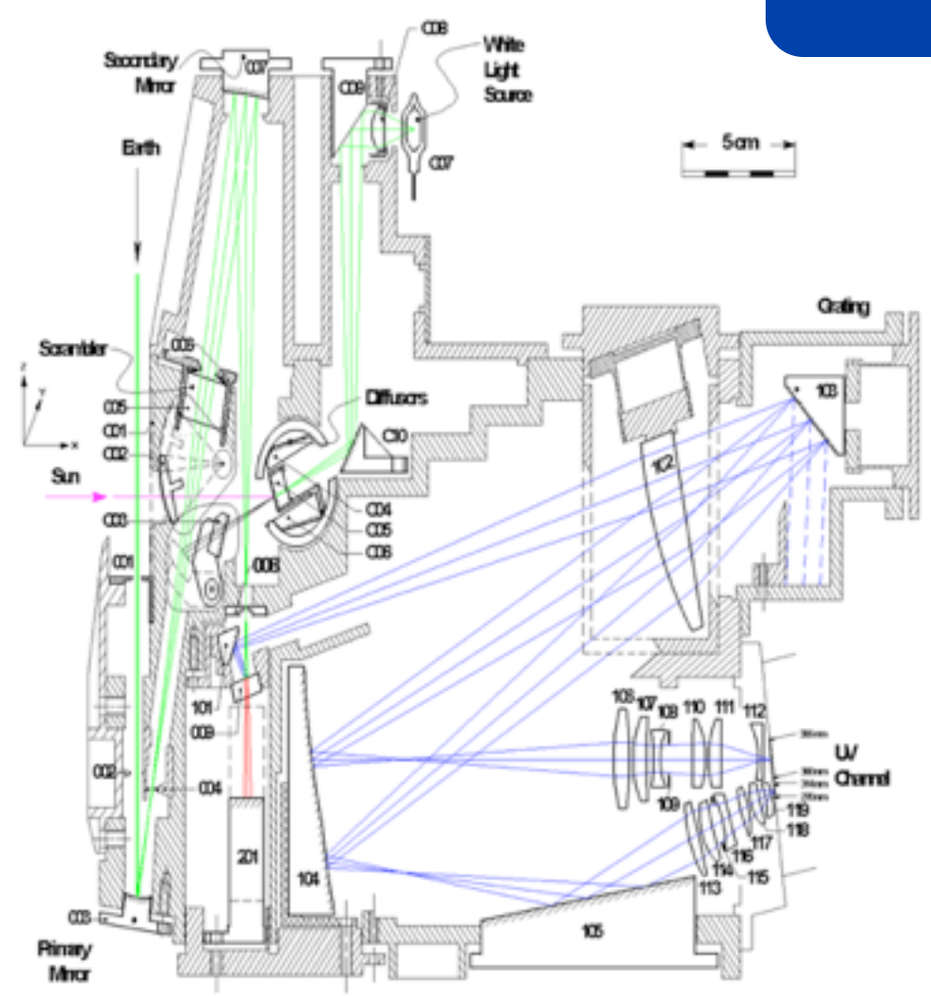


http://omivfd.fmi.fi

Backup

Optical Design

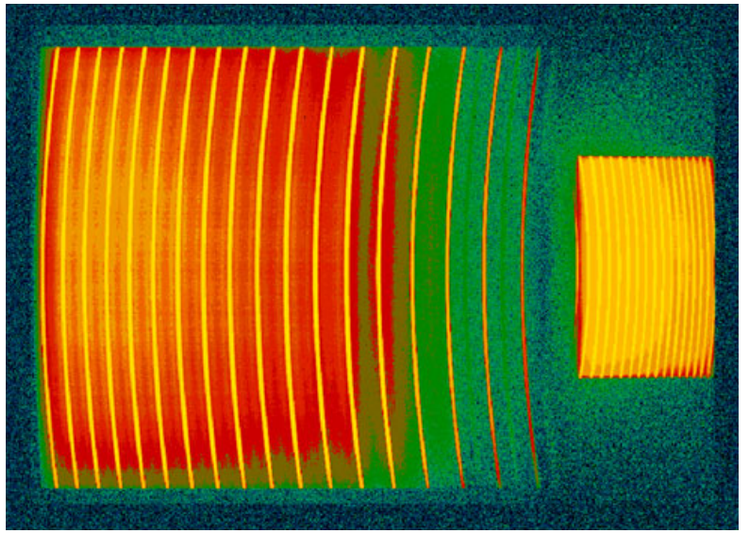




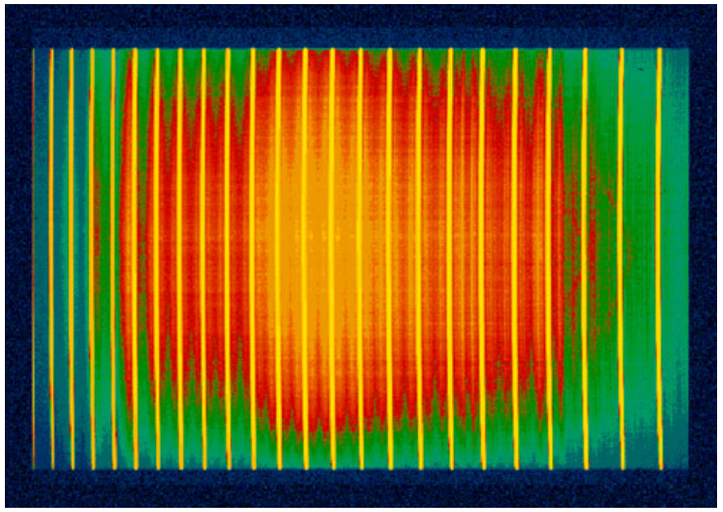
OMI CCD Detectors

- OMI has 2 Frame Transfer CCDs of 780 rows by 576 columns.
- Around the detector modules 10 kg of aluminum shielding has been applied.
- On the CCD 8 detector pixels are binned in the across track direction into one ground pixel.
- In the flight direction 1-4 CCD exposures are co-added.
- Detector temperature is -8 °C.

UV2



UV1



VIS