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OMI, TROPOMI and more…

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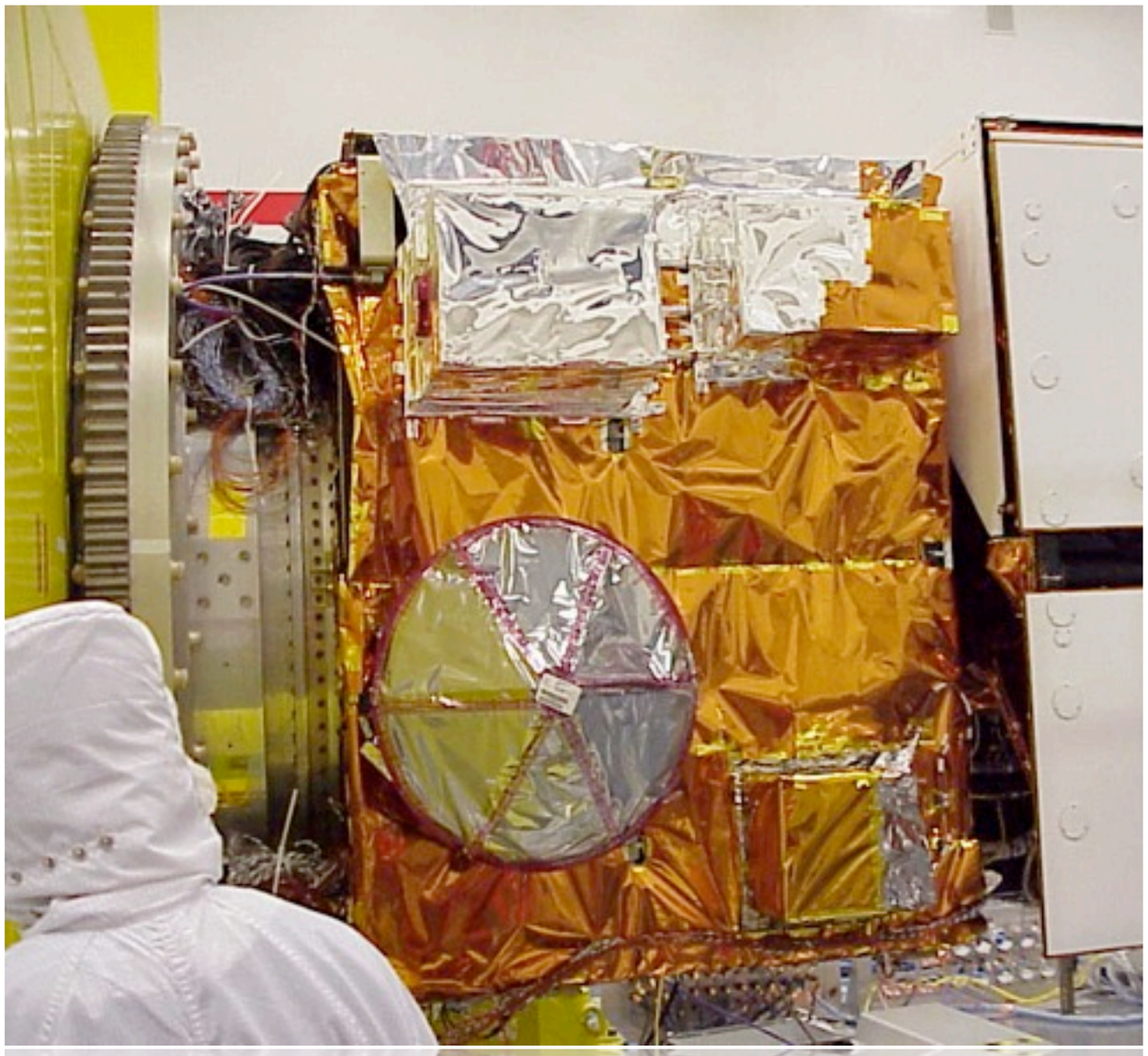
OMI

TROPOMI

Ozone Monitoring Instrument



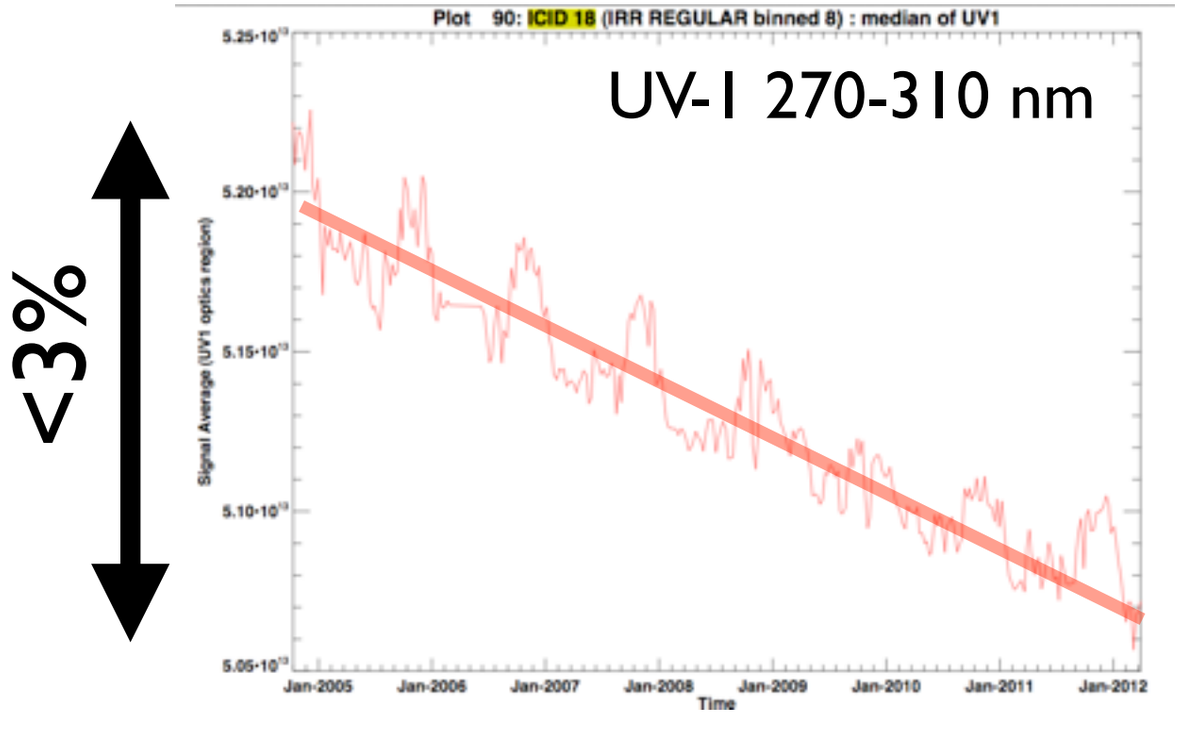
Ozone Monitoring Instrument

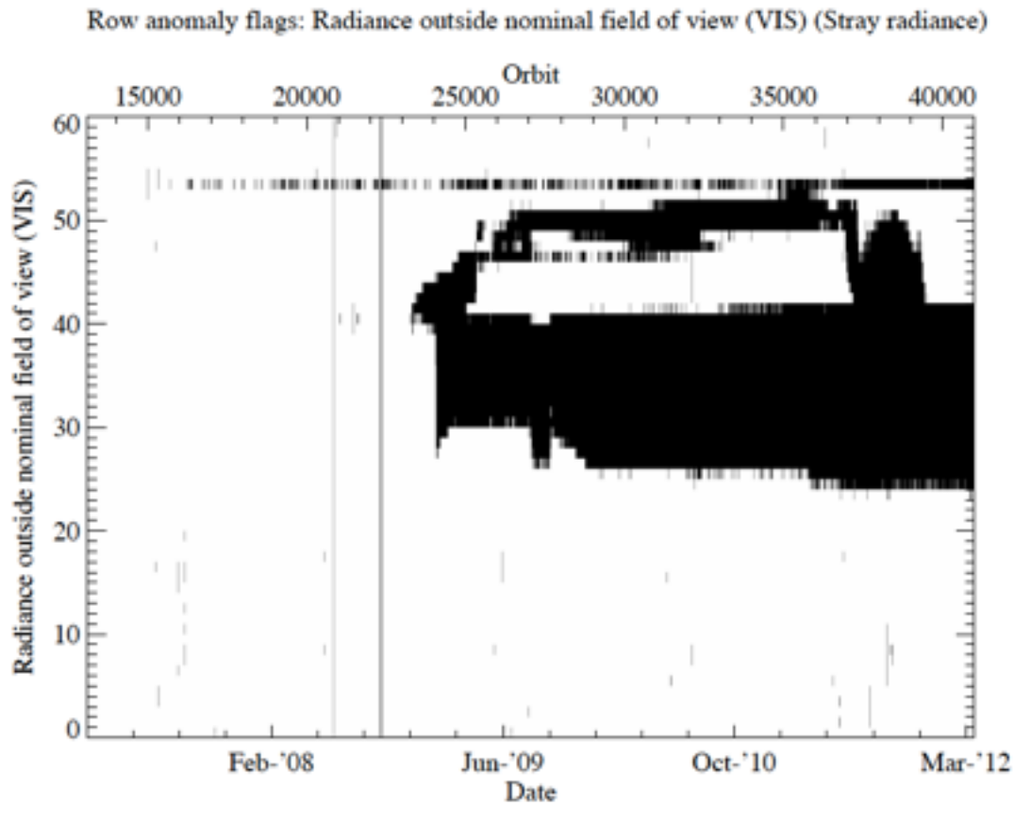
Instrument	Imaging spectrometer
Spectral Range	270 - 500 nm
Spectral Resolution	0.45 - 0.63 nm
Spectral Sampling	0.15 - 0.30 nm
Spatial Resolution	13x24 km^2 (nadir)
Swath Width	2600 km
Mass	65 kg
Size	50 cm × 40 cm × 35 cm
Power	66 W
Data rate	0.8 Mbps (average)
Spacecraft	NASA EOS-Aura
Launch Date	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.

OMI Status

- In orbit since July 2004 (>7.5 yrs)
- Radiometrically extremely stable
- Row anomaly unpredictable
- Objective is to have overlap with TROPOMI





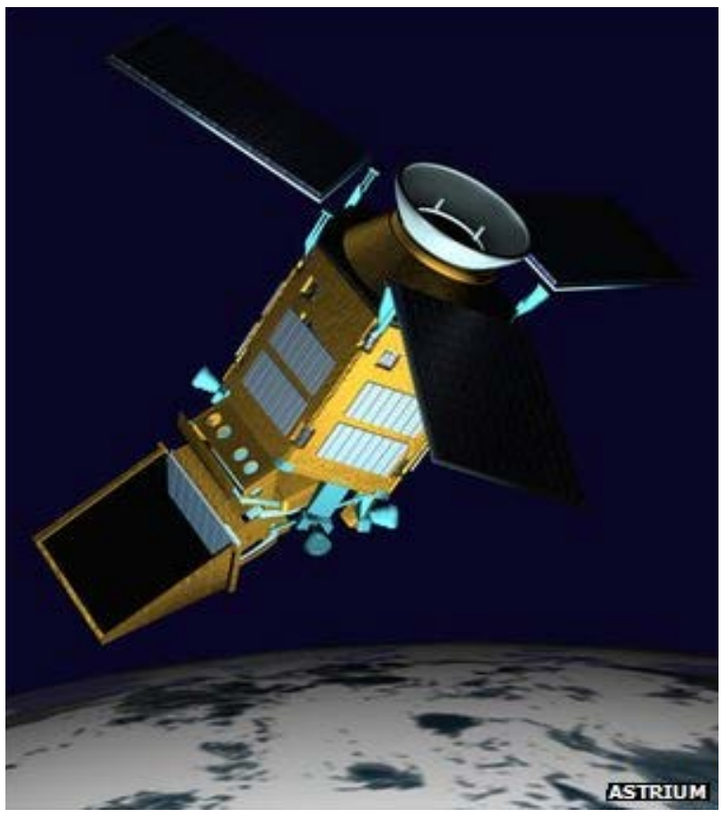
sentinel-5 precursor

GMES ATMOSPHERE MISSION IN POLAR ORBIT

- The ESA Sentinel-5 Precursor (S-5P) is a pre-operational mission focussing on global observations of the atmospheric composition for air quality and climate.
- The TROPOspheric Monitoring Instrument (**TROPOMI**) is the payload of the S-5P mission and is jointly developed by The Netherlands and ESA.
- The planned launch date for S-5P is 2015 with a 7 year design lifetime.

TROPOMI

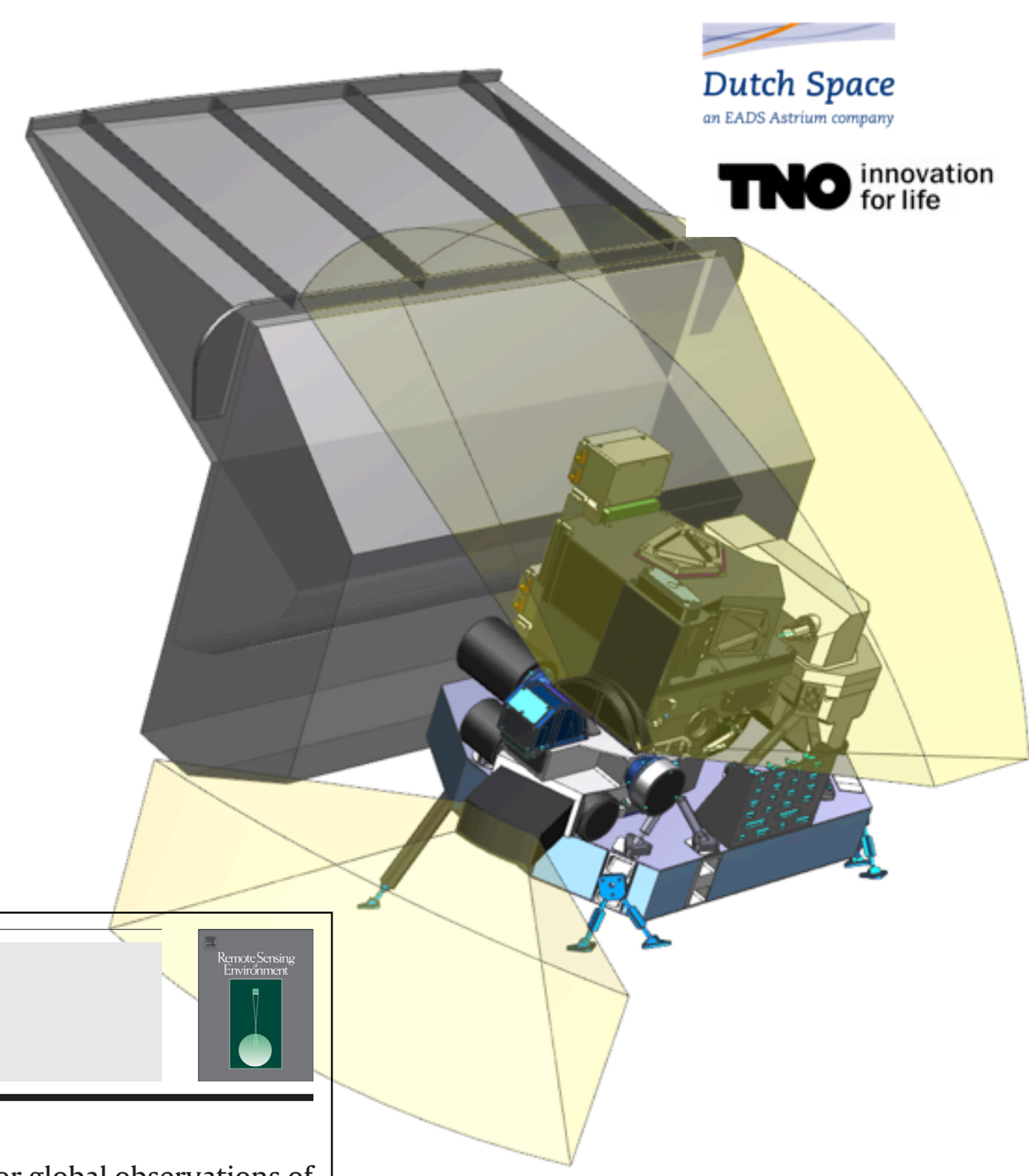
- UV-VIS-NIR-SWIR nadir view grating spectrometer.
- Spectral range: 270-500, 675-775, 2305-2385 nm
- Spectral Resolution: 0.25-1.1 nm
- Spatial Resolution: 7x7km^2
- Global daily coverage at 13:30 local solar time.



CONTRIBUTION TO GMES

- Total column O_3, NO_2, CO, SO_2,CH_4, CH_2O,H_2O,BrO
- Tropospheric column O_3, NO_2
- O_3 profile
- Aerosol absorbing index, type, optical depth

- Mass ~200 kg
- Average power ~150W
- Level 1B size is approx. 20 GByte /orbit:
  25x data volume of OMI



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TROPOMI on the ESA Sentinel-5 Precursor: A GMES mission for global observations of the atmospheric composition for climate, air quality and ozone layer applications

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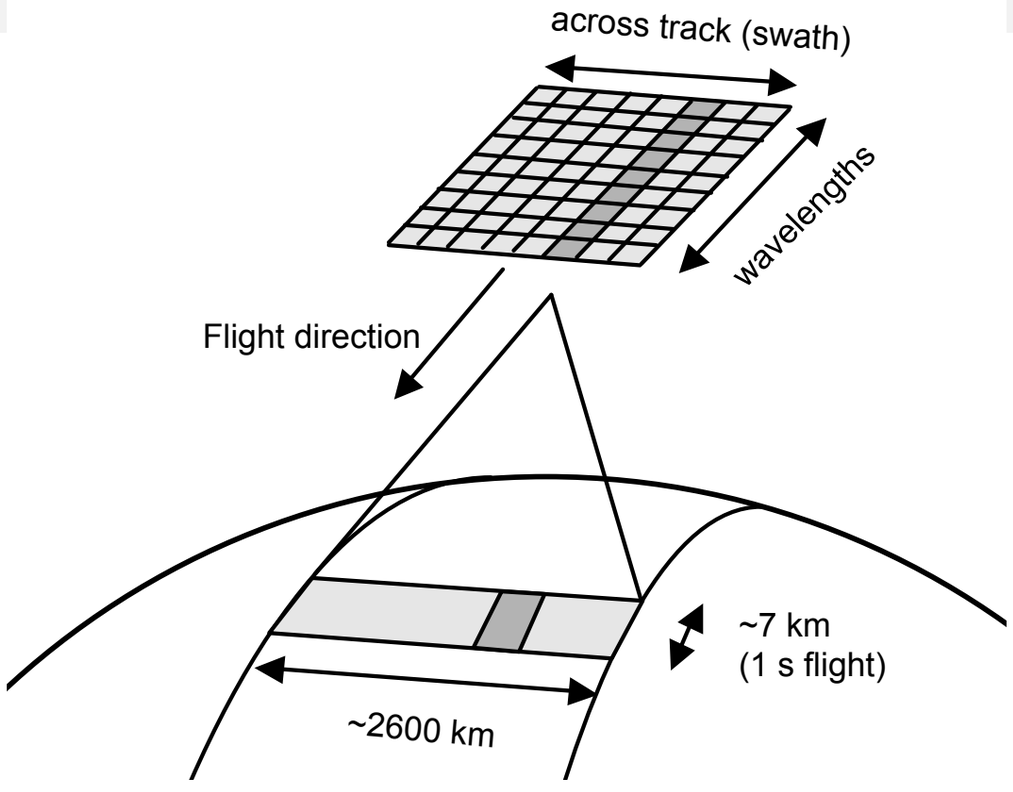
http://dx.doi.org/10.1016/j.rse.2011.09.027

TROPOMI

TROPOMI Spectral Bands

Spectrometer	UV		UVIS		NIR		SWIR
Band ID	1	2	3	4	5	6	7
Spectral range [nm]	270-300	300-320	310-405	405-495	675-725	725-775	2305-2385
Spectral resolution [nm]	0.5	0.5	0.55	0.55	0.5	0.5	0.25
Spectral sampling [nm]	0.06	0.06	0.2	0.2	0.1	0.1	<0.1
Spatial sampling [km^2]	21 x 28	7 x 7	7 x 7	7 x 7	7 x 7	7 x 1.8	7x7
Detector binning factor	16	4	4	4	4	1	1
Minimum Signal-to-noise	100 (1	100-1000(1	1000-1500(1	1500 (1	500	100-500	100 -120 (2



KNMI Ozone Data Sets

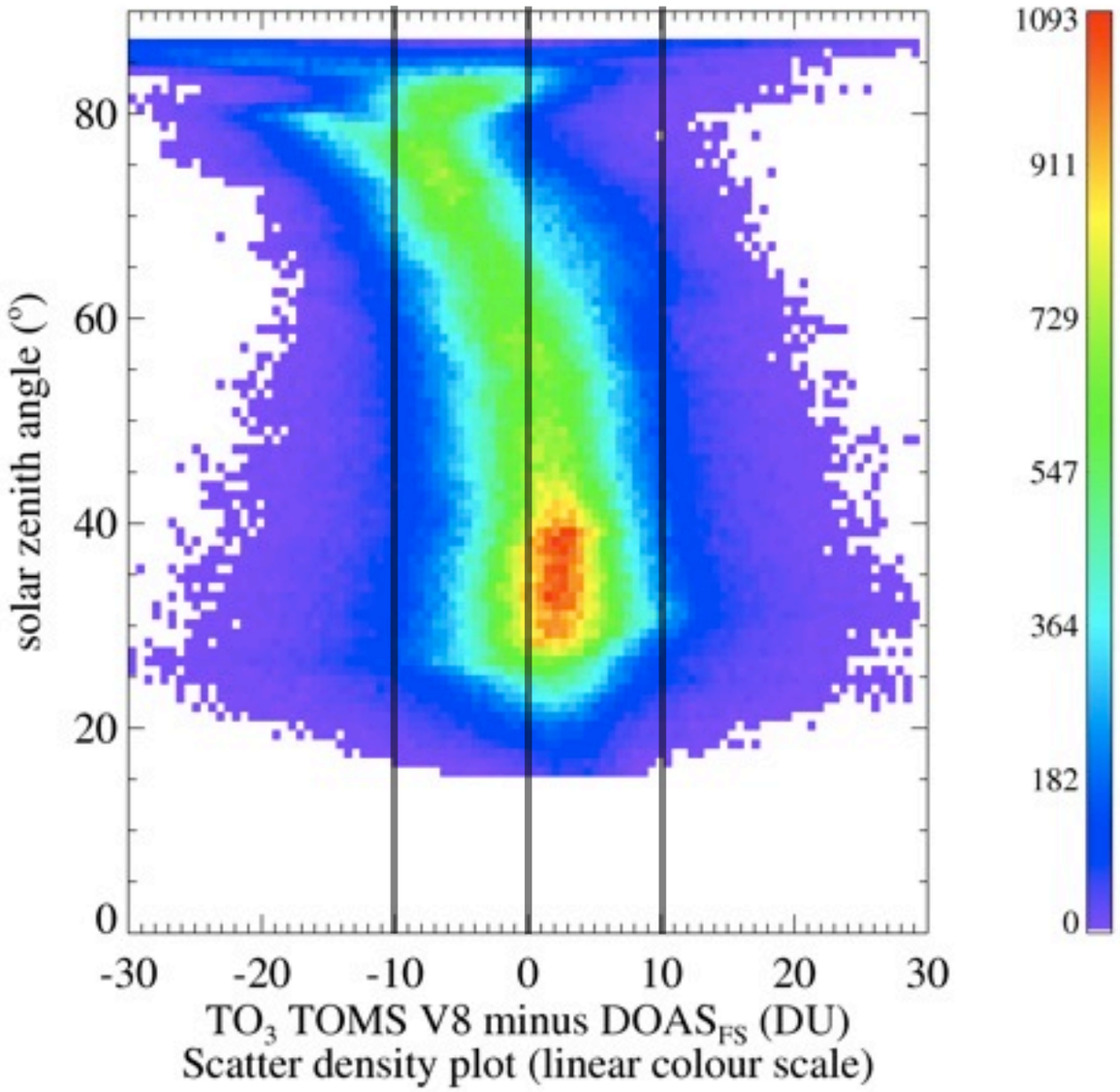
Data Set	Sensor	Offline	NRT	VFD	Assim.	URL
OMI DOAS OMDOAO3	OMI	✔	✔	✔	✔	http://www.temis.nl http://disc.sci.gsfc.nasa.gov
TOSOMI	SCIAMACHY		✔		✔	http://www.temis.nl
GOME-2 Based on GDP4	GOME-2				✔	http://www.temis.nl
OMI Profile OMO3PR	OMI	✔				http://disc.sci.gsfc.nasa.gov
GOME-2 OPERA	GOME-2	✔	✔			http://www.temis.nl
MSR	Various				✔	http://www.temis.nl
OPERA ECV	GOME 1-2 OMI	✔				

OMI DOAS New Version 1.2.3

- **OMI row anomaly flags implemented**
- **Cross section Brion-Malicet-Daumont, instead of Bass-Paur**
- **Fit of spectral shift to improve the spectral calibration**
- **Updated treatment of snow/ice covered pixels**

- Updated surface albedo climatology (now based on 5 years OMI data, instead of 3)
- Improved cloud pressure and fraction data
- Effective temperature stored as float instead of integer
- Added the orbit phase data field

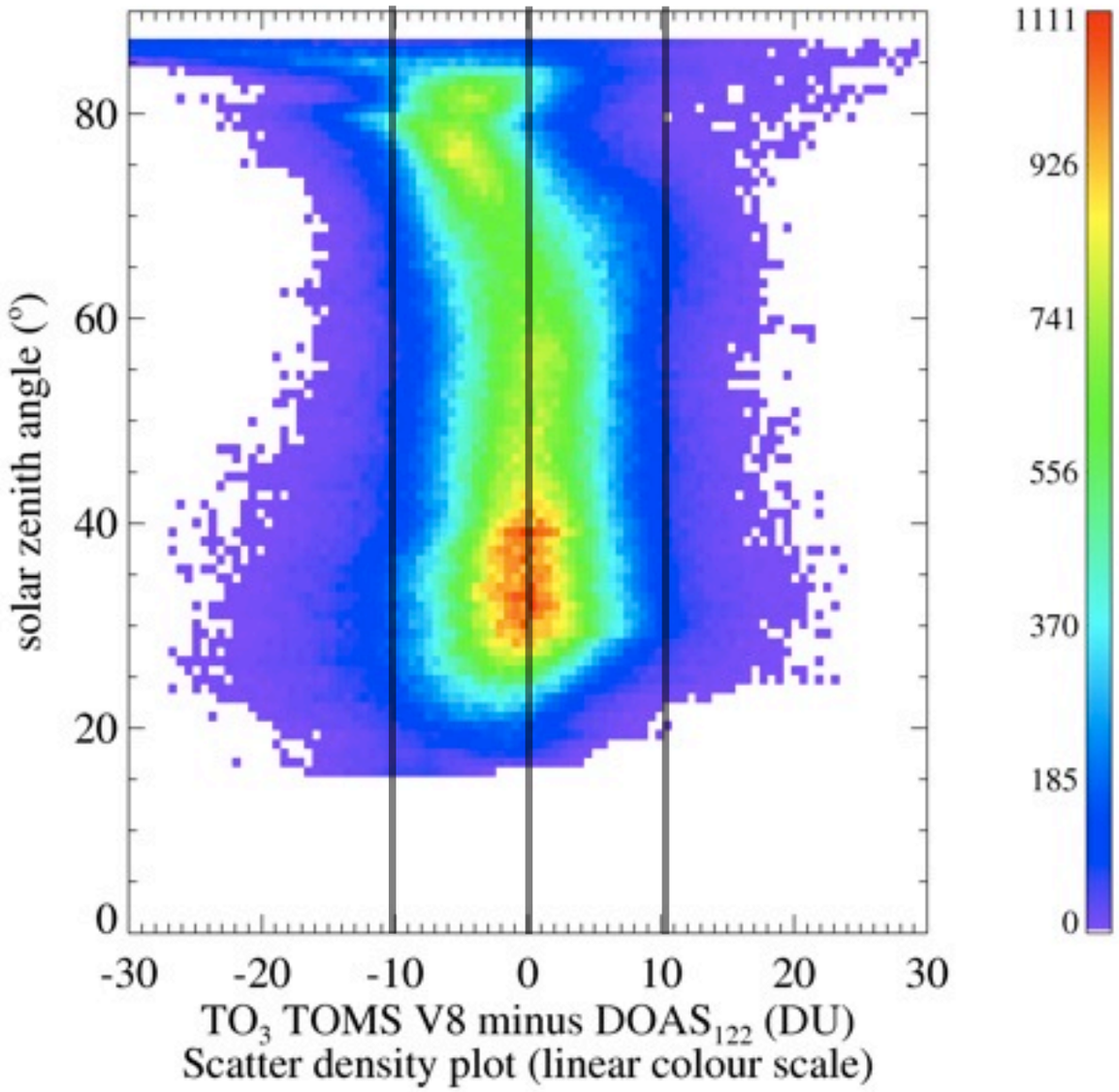
OLD OMDOAO3



OMI-TOMS data from Forward Stream (10003)

OMI-DOAS data from Forward Stream (10003)

NEW OMDOAO3

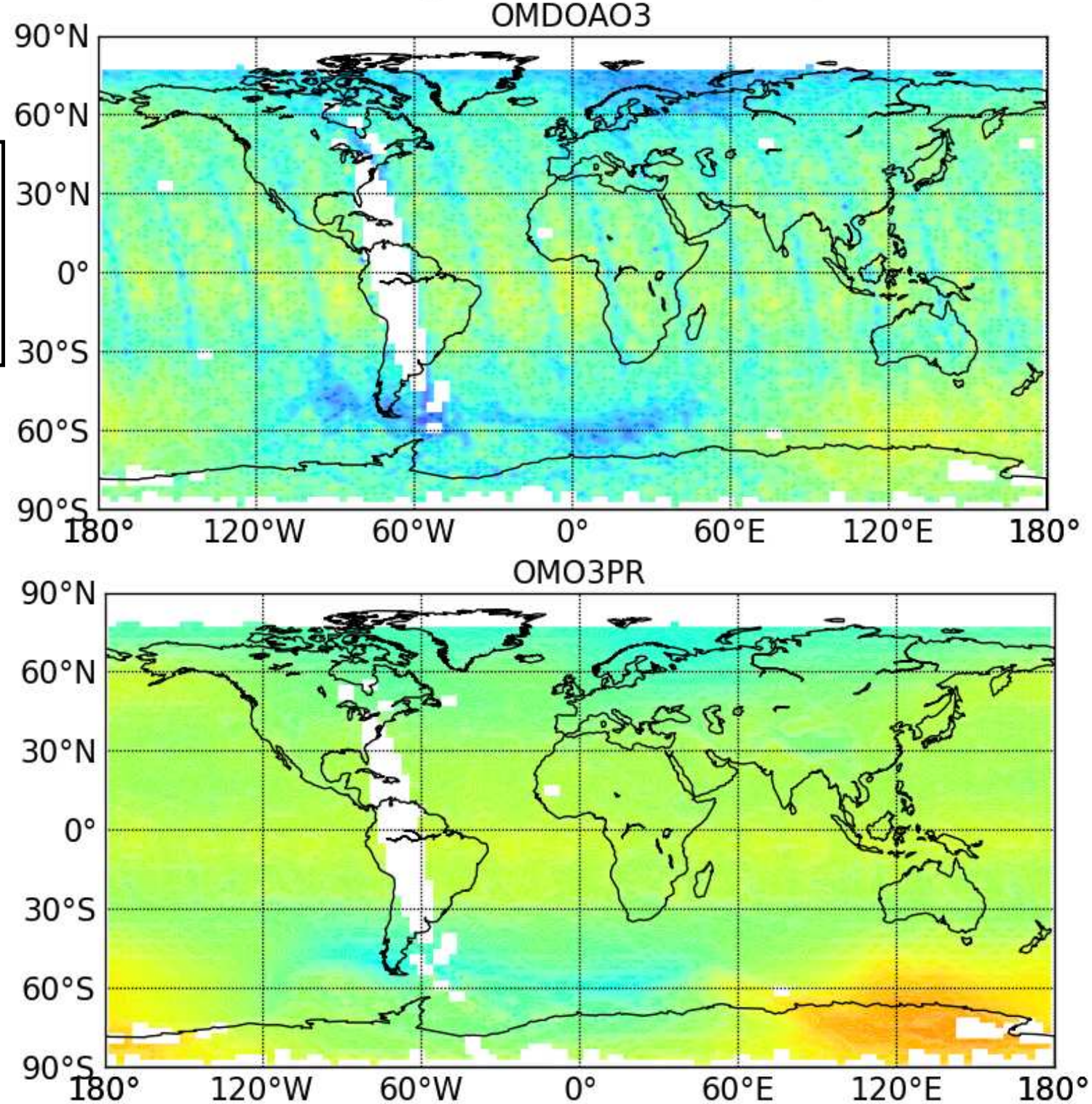


OMI-TOMS data from Forward Stream (10003)

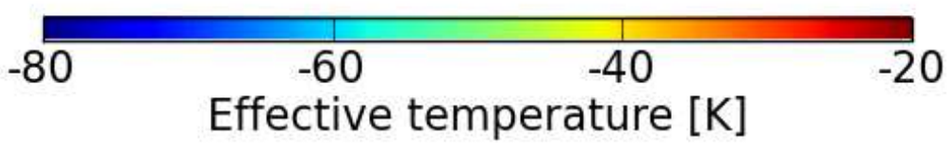
OMI-DOAS data from PGE 1.2.3

Ozone Weighted Temperatures

DOAS
fit



ECMWF Temp
+
Retrieved
profiles



Orbits 6546-6559, 2005-10-08

DOAS Developments

- Improved fitting function that better represents the ozone absorption cross section temperature dependence.
- Improve fitting function to reduce the temperature sensitivity.
- Wider fit windows to improve precision of the fit.

Function	Center [nm]	Width [nm]	Temp. Sens. [%/K]
G	334.0	5	0.033
H	334.2	5	-0.0049
I	331.0	17.7	-0.0061

Multi Sensor Reanalysis (MSR) of total ozone

Ronald van der A, Marc Allaart, Henk Eskes (KNMI)

1979

MSR version 1 (1978-2008):

1984

- 14 total ozone data sets from TOMS, SBUV, GOME, SCIAMACHY and OMI are corrected by comparison with Brewer and Dobson data (WOUDC)
- These corrected data sets are assimilated with TM-DAM (sub-optimal Kalman filter). Output given on a regular grid every 6 hours.

1989

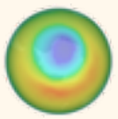
1994

Planned improvements for MSR version 2 (1978-2012):

1999

- New versions of most level 2 data sets.
- New Cariolle scheme in TM with chlorine content dependence.
- Improving data assimilation scheme (e.g. error handling).
- Improving level 2 correction (e.g. including multiplicative factor).
- Adding FY-3 data ?

2004



macc Monitoring atmospheric composition & climate

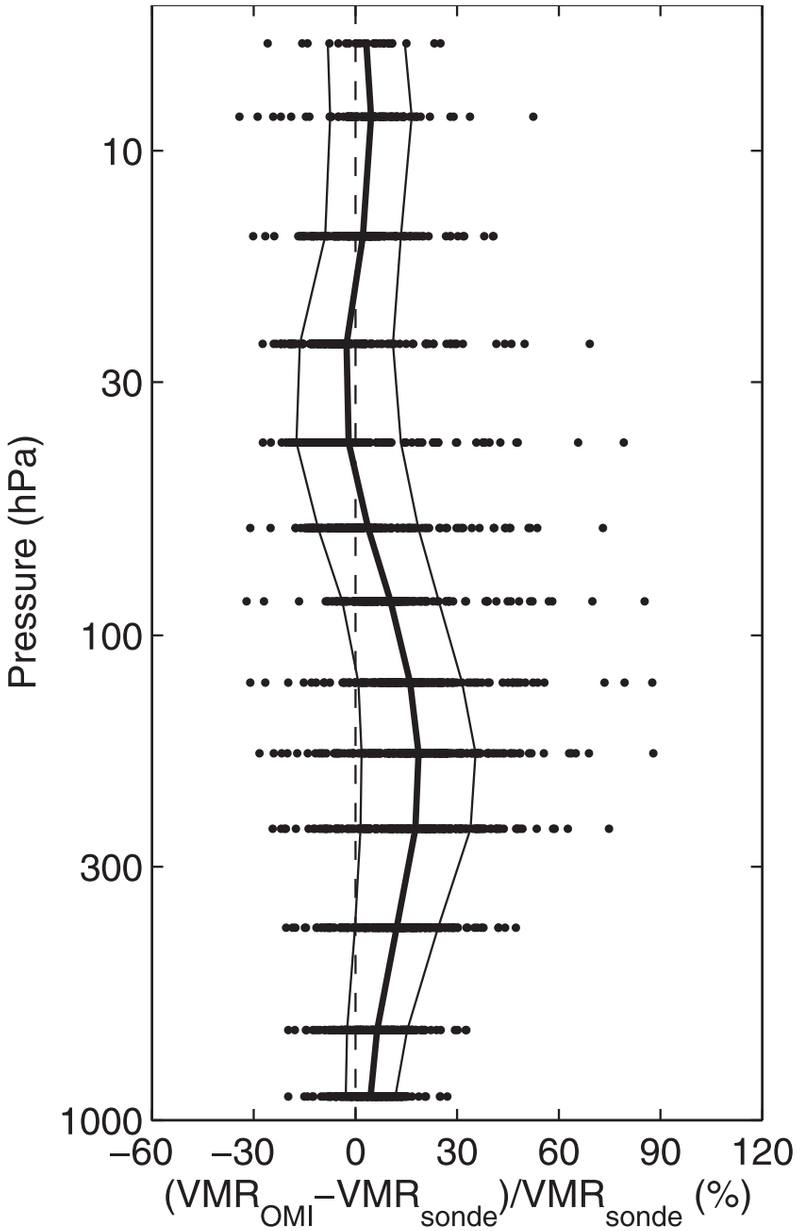
2009

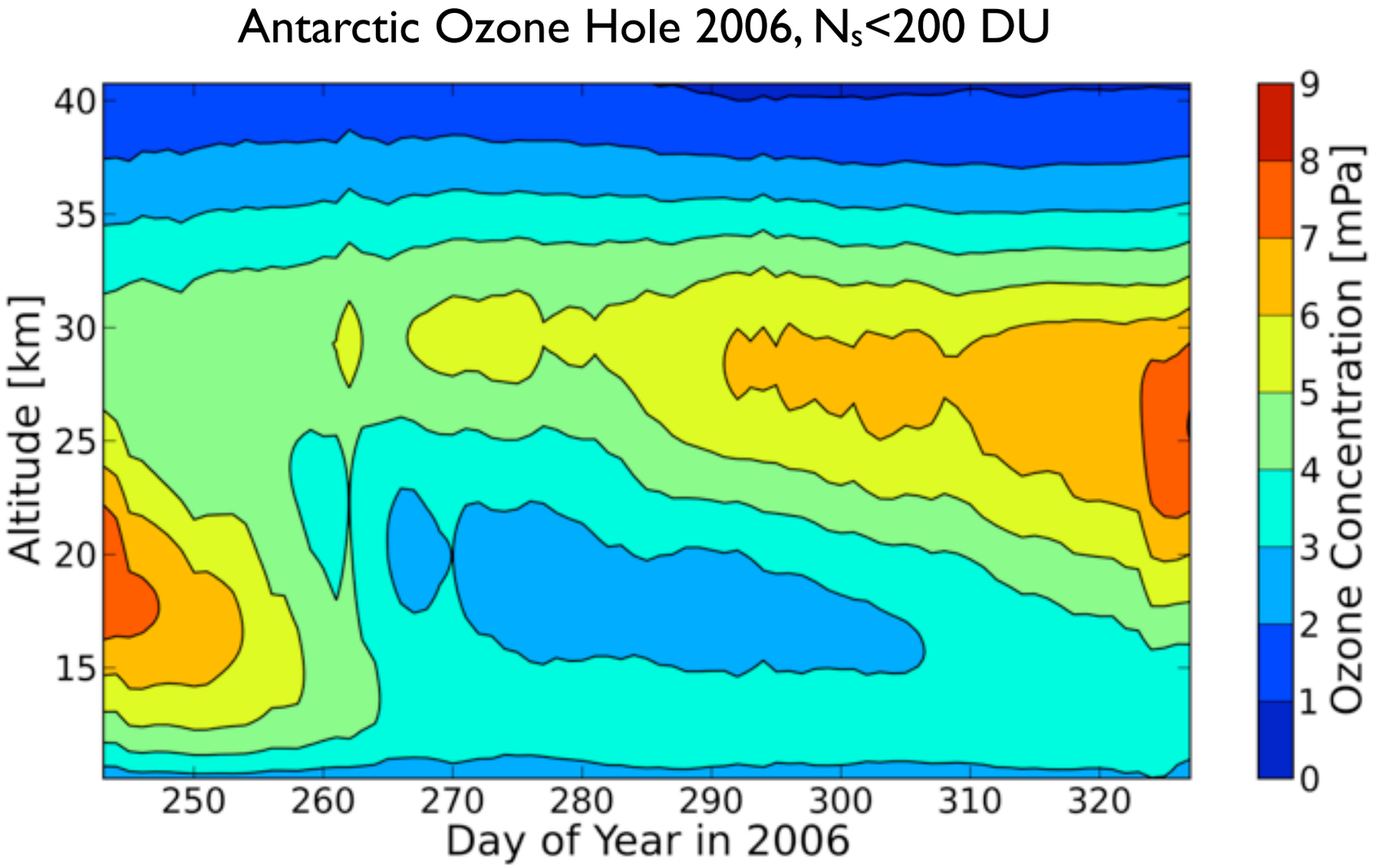
http://www.temis.nl/macc

OMI Ozone Profiles | OMO3PR

- Optimal estimation retrieval with online radiative transfer.
- Spectral range is 270-330 nm
- Ozone profile is retrieved in 18 layers.
- A priori is based on McPeters-Logan-Labow climatology and a 6 km correlation lenght
- DFS for ozone is between 5 and 7
- Full OMI data set is processed

OMI Ozone Profiles



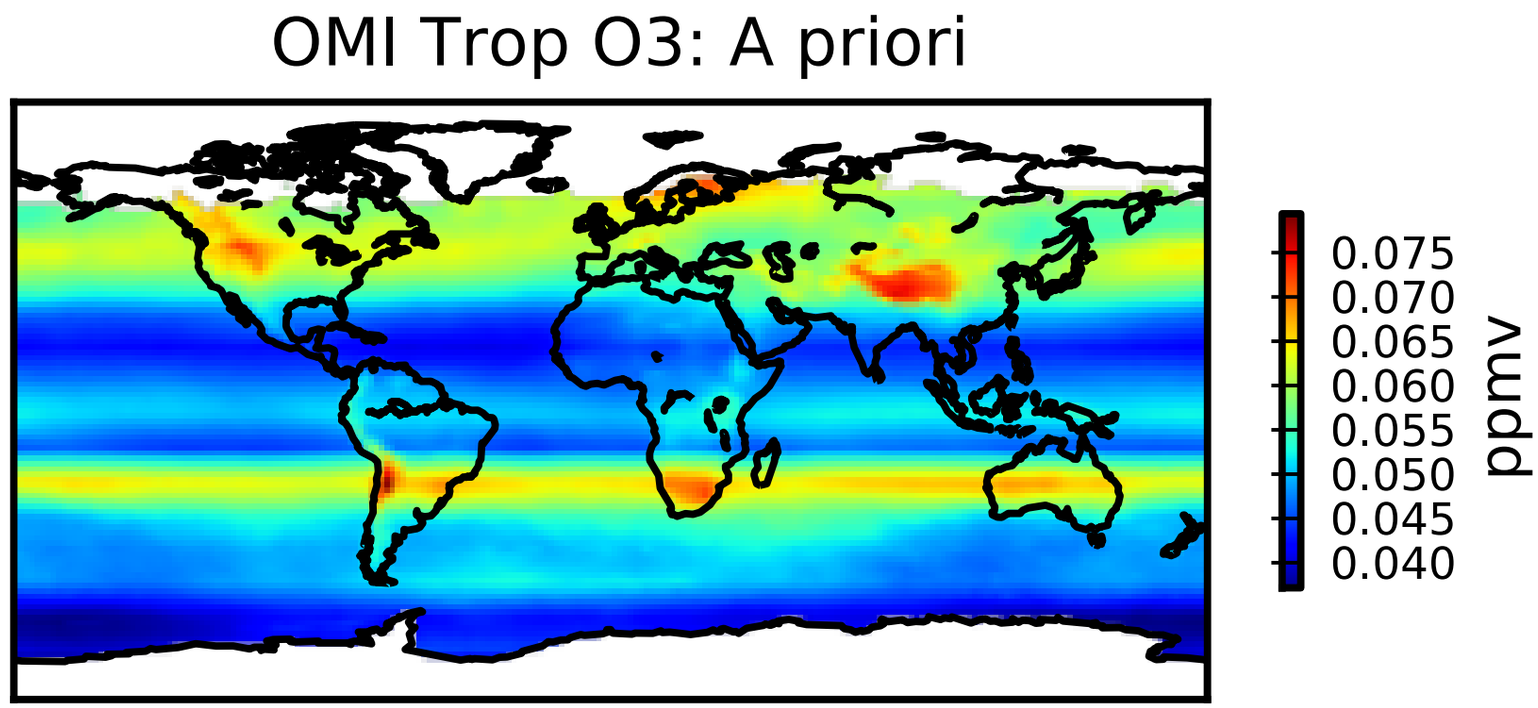


Stratospheric accuracy ~20%,
tropospheric high bias 30-60%.

Kroon, M., de Haan, J. F., Veefkind, J. P., Froidevaux, L., Wang, H., Kivi, R. and Hakkarainen, J.: Validation of Operational Ozone Profiles from the Ozone Monitoring Instrument, J. Geophys. Res., doi:10.1029/2011JD015617, 2011.

OMI Ozone Profile Enhancements

- Reduce the oscillations.
- Increase the DFS by reducing the number of stray light and albedo fit parameters.
- Improve the a-priori ozone climatology.
- Reprocessing will improve the DFS.



DISAMAR

Determining Instrument Specifications and Analysis Methods for Atmospheric Retrieval

- Improve speed, i.e. DISMAS forward model
- Data products ease of use
- Optimize tropospheric information content

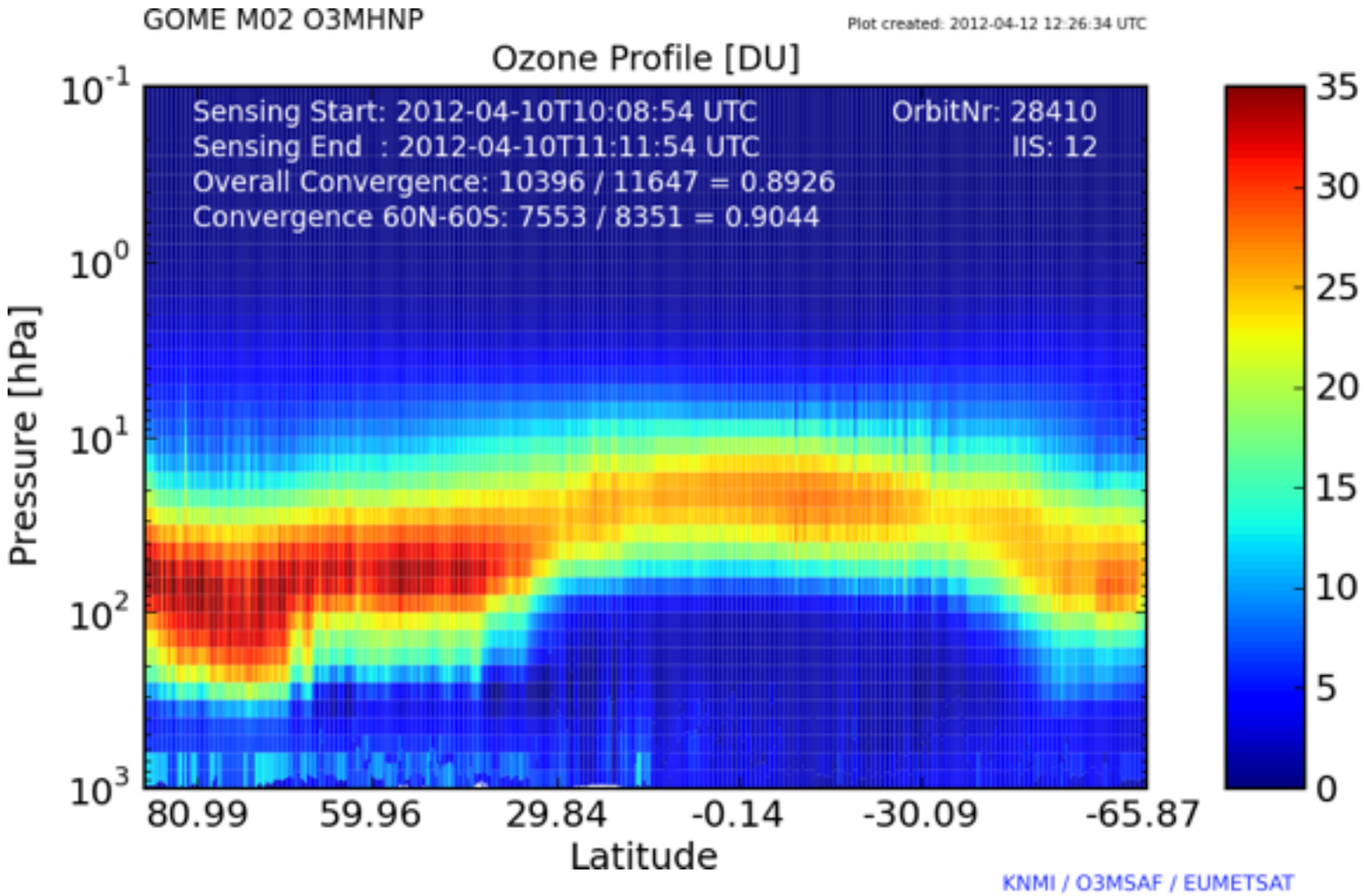
RT-Model
Labos (LBL)
DISMAS
Single scat.
LUT

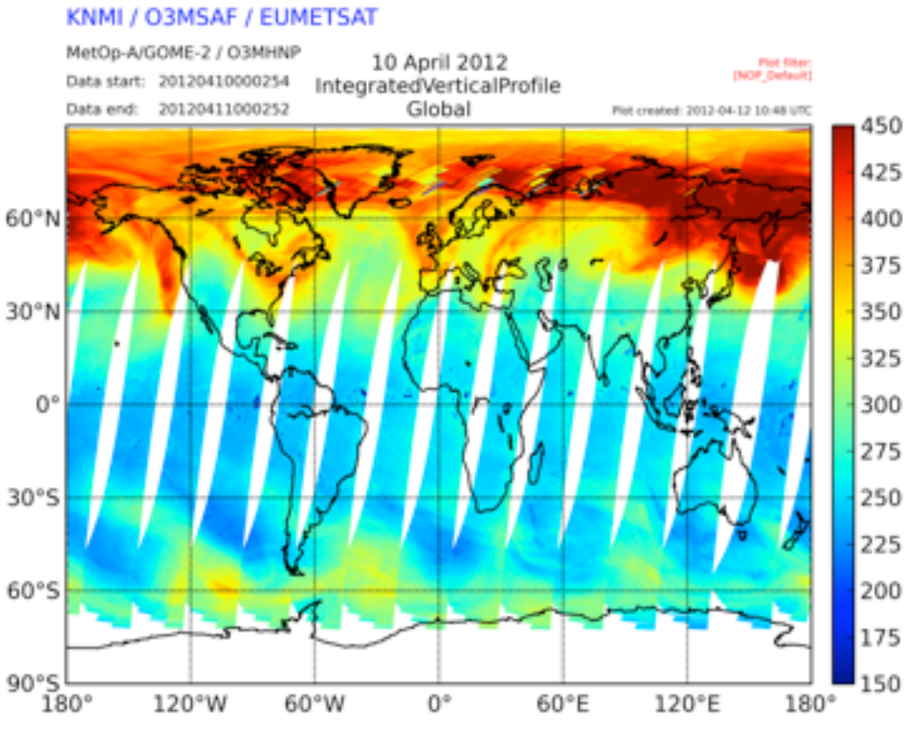
Inst.-Model
Spectral cov/res/ samp
Mult./Add Errors
SNR
Sinusoidal errors

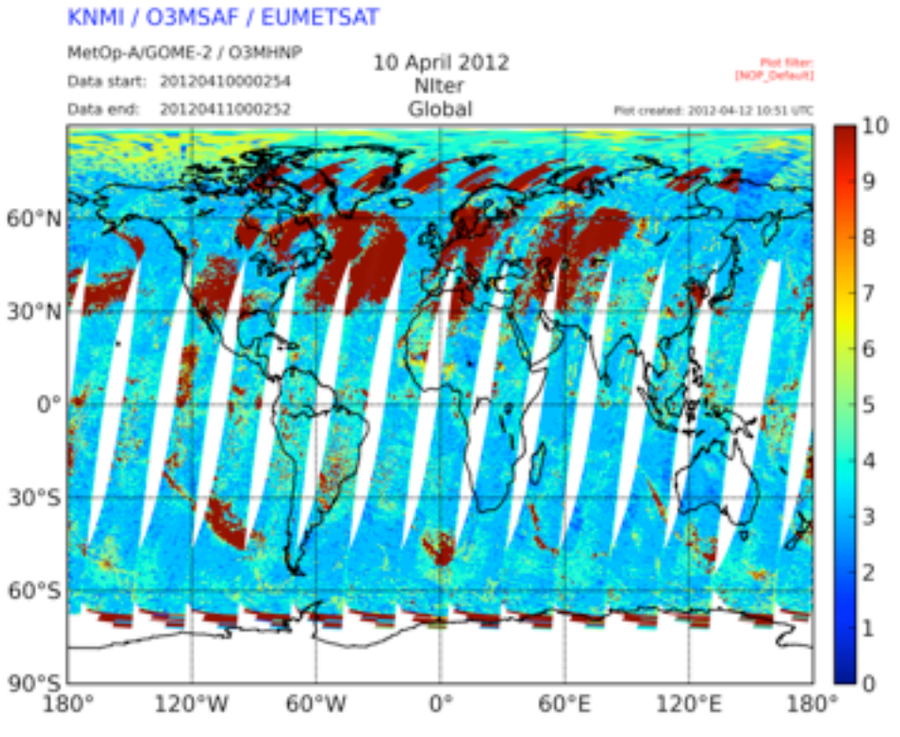
Retrieval
Optimal Estimation
DOAS
AAI

Support
Python input I/F
OMI GOME-2 input
HDF5 output gen.

GOME-2 Ozone Profiles



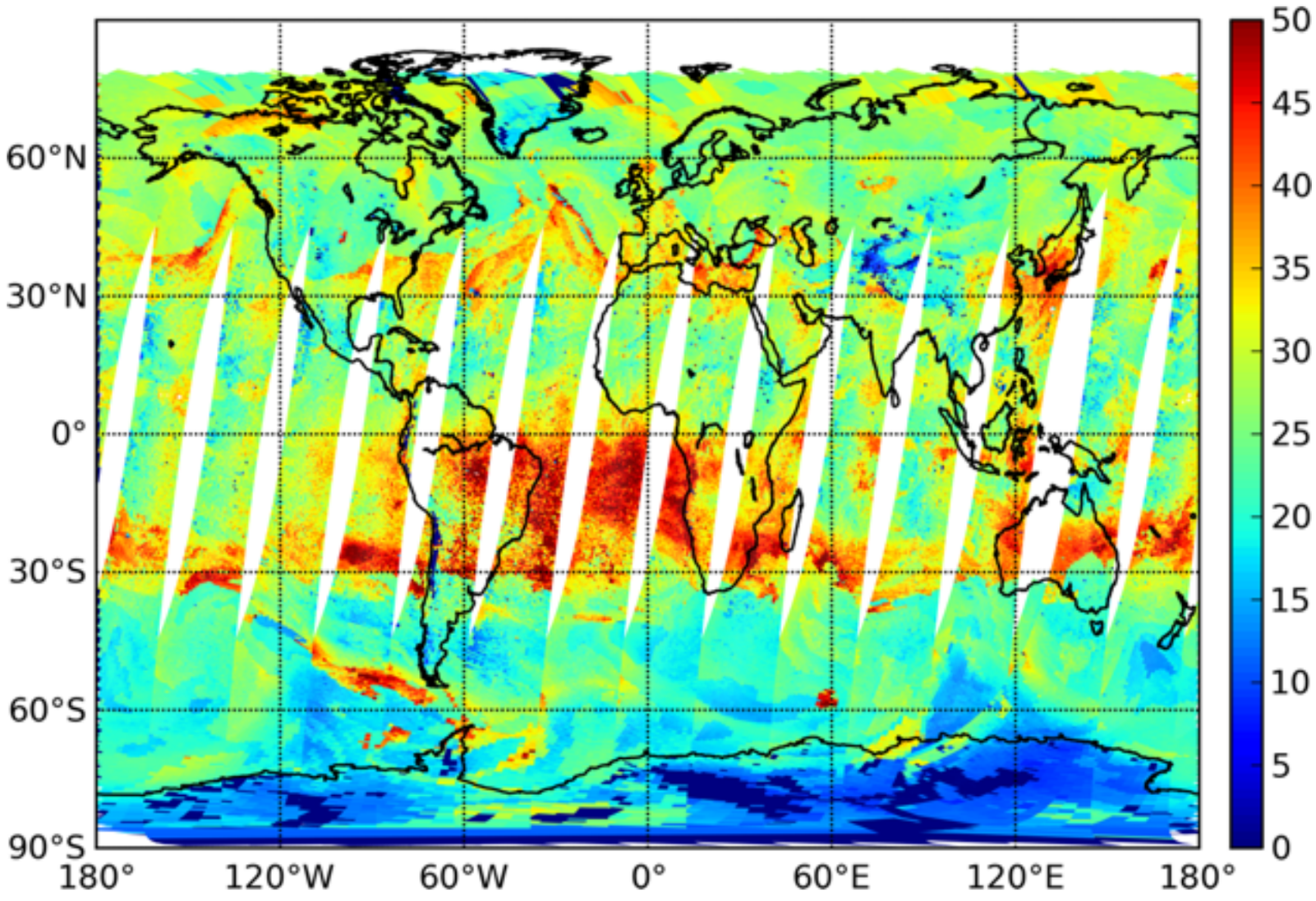




GOME-2 Ozone Profiles

Tropospheric Column [DU]

2010-10-09



Summary

- OMI is radiometrically very stable. If the row anomaly remains as is, it can run for many years.
- TROPOMI on the Sentinel 5 Precursor is the next generation European atmospheric composition sensor.
- KNMI is maintaining several ozone data sets from different sensors and is improving the retrieval algorithms.
- The focus of KNMI is to produce long-term datasets in calibration with international partners.

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