Status Report
on
OMI and GOME-2

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With material from
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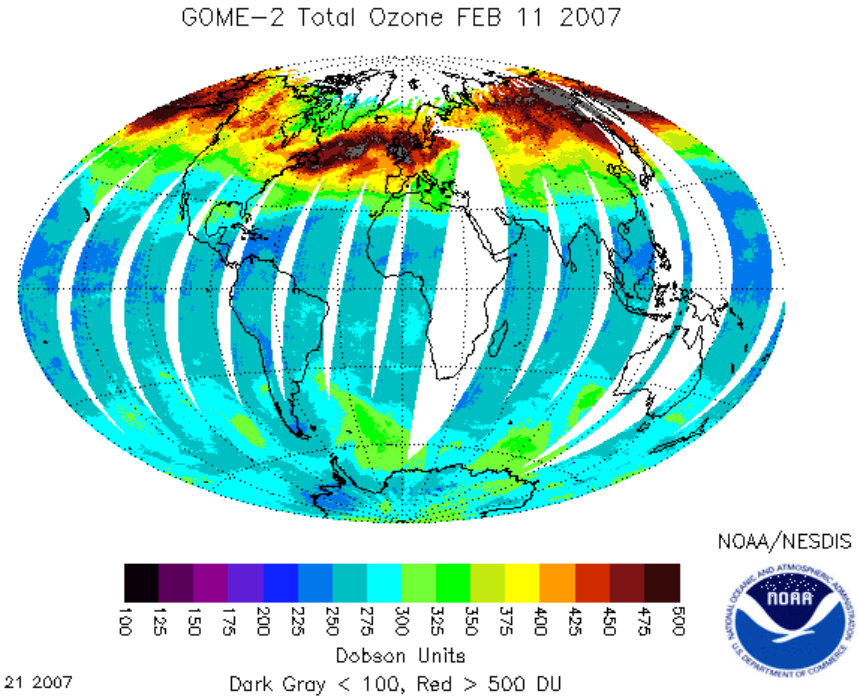
Status of OMI NRT Processing

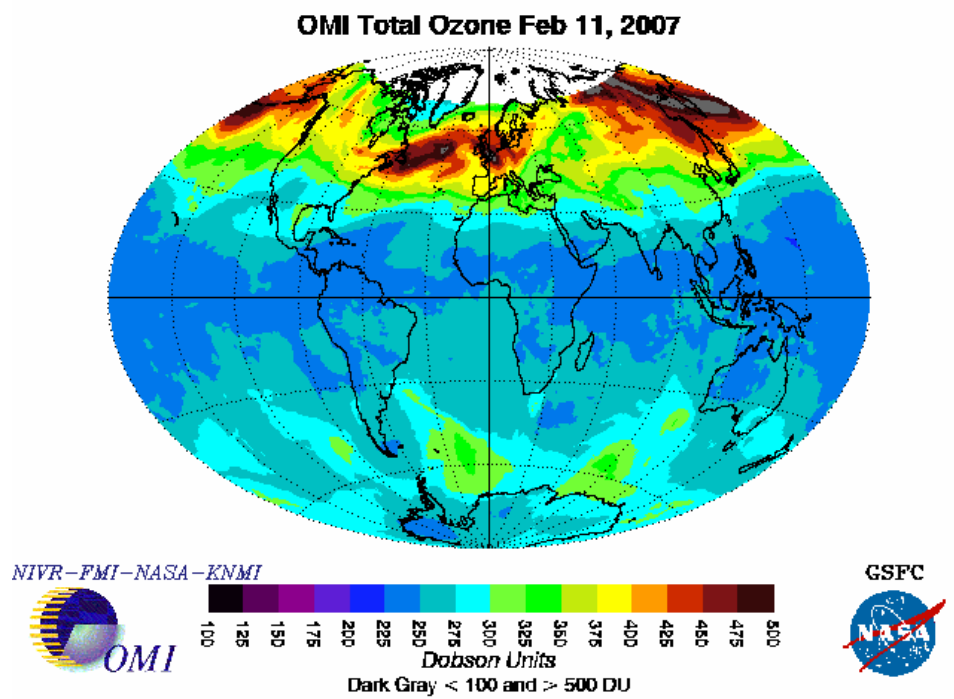
- OMI Science Team Meeting will take place June 5 – 8 at UMBC (South Campus 5 – 6; Main Campus 7 – 8)
- OMITO3 and OMDOAO3 both available
  - OMITO3 has Aerosol and SO2 Indices
- OMISO2 Available
- OMINO2A Agreement in place for staging
- Discussions on Ozone Profiles from the V8 algorithm or from a reduced KNMI algorithm as NRT solutions

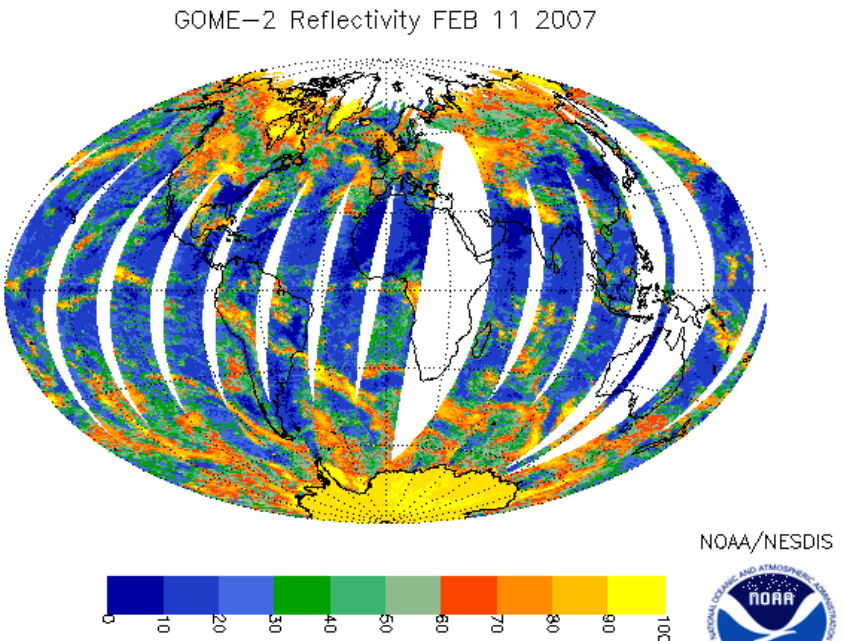
Initial Evaluation of GOME-2

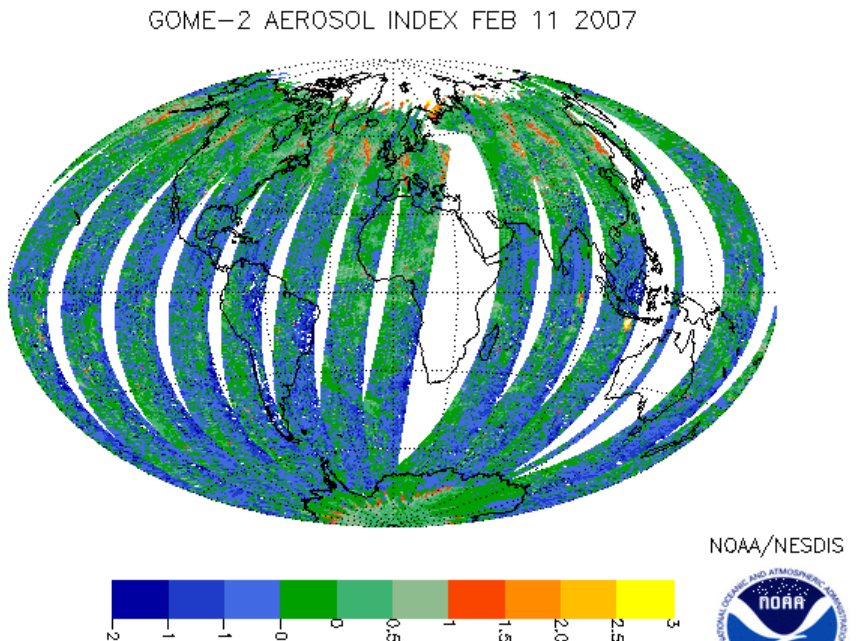
- V8 and DOAS TOZ Algorithms are providing comparable products
  - Minor check of SZA needed
- V8 GOME-2 TOZ products have been compared to OMI and SBUV/2
  - Reflectivity values are ~5% high for GOME-2
    - From comparisons of Max/Min and Ice reflectivity
  - B-pair TOZ is ~3% high
  - A-pair TOZ is poorly calibrated and D-Pair TOZ has other problems
  - SO2 channels have drifts and shifts during orbits; possibly related to polarization corrections or Band 1B/Band 2B calibration offsets
  - Aerosol Index has slight offset but proper variation and wavelength dependence at 345, 360, and 372 nm
  - Initial recommendation:

GOME-2 One Day

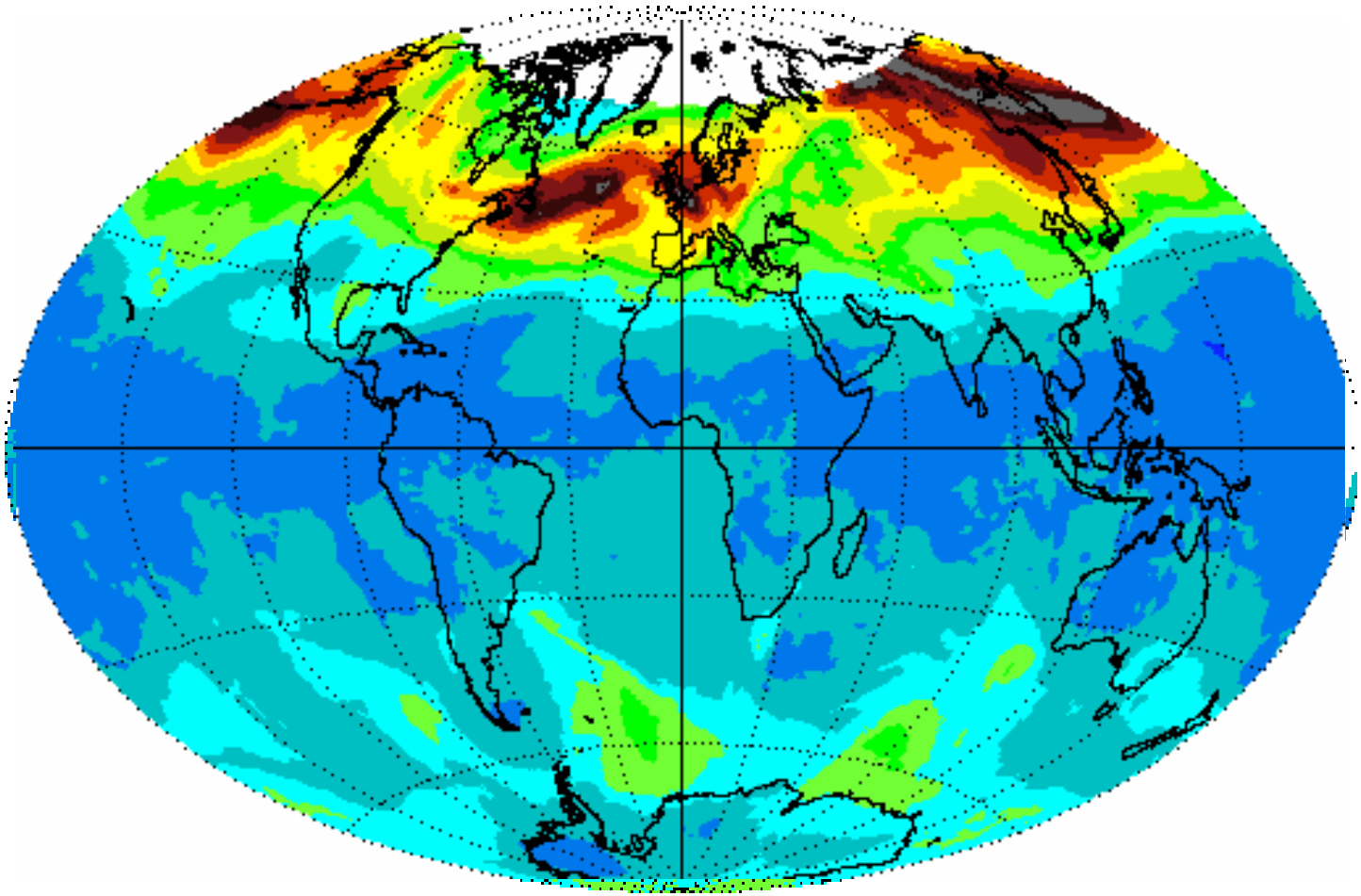




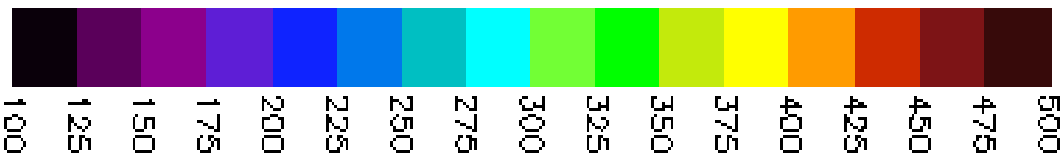




Comparison of OMI and GOME-2



NOAA/NESDIS

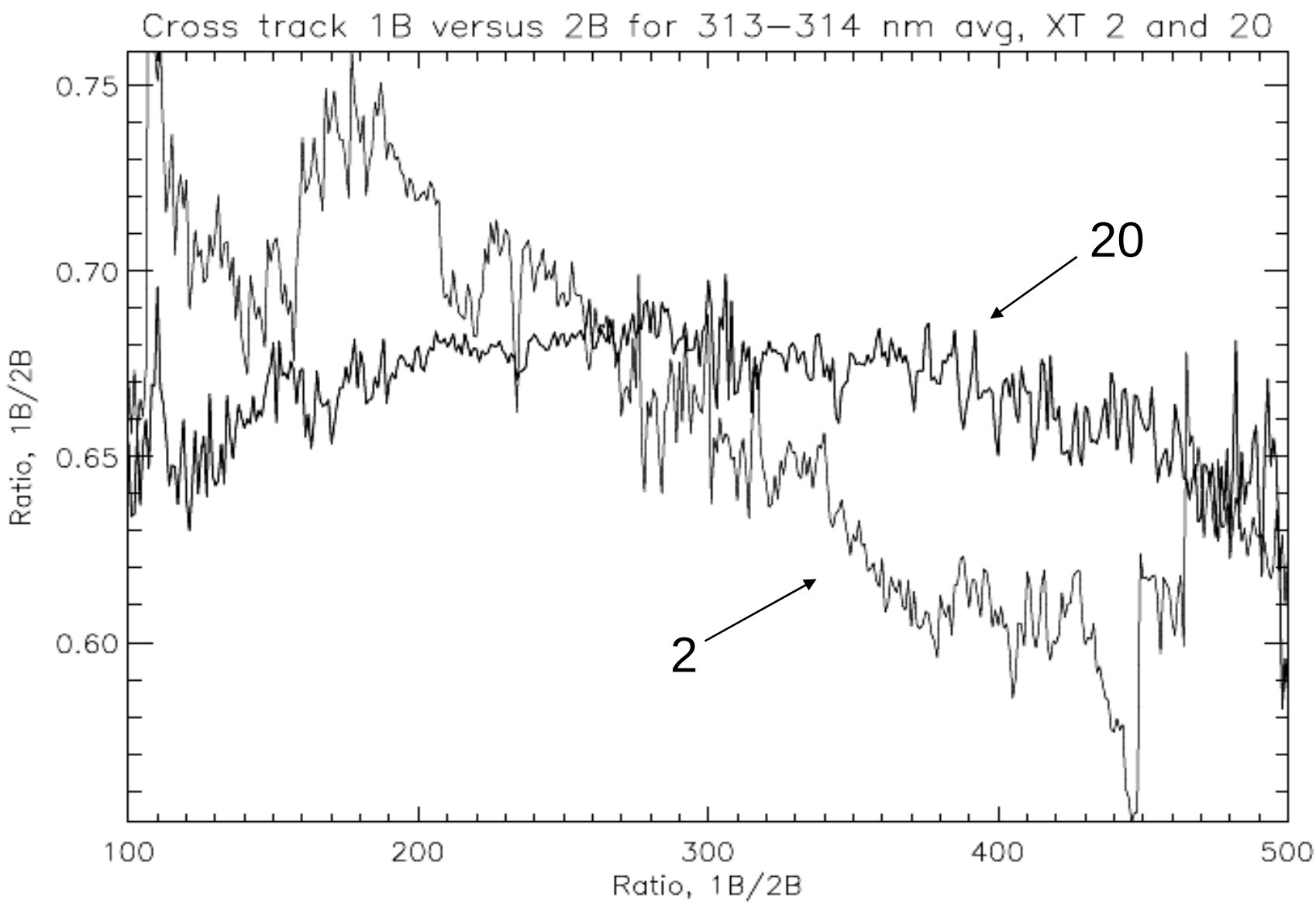


Dobson Units

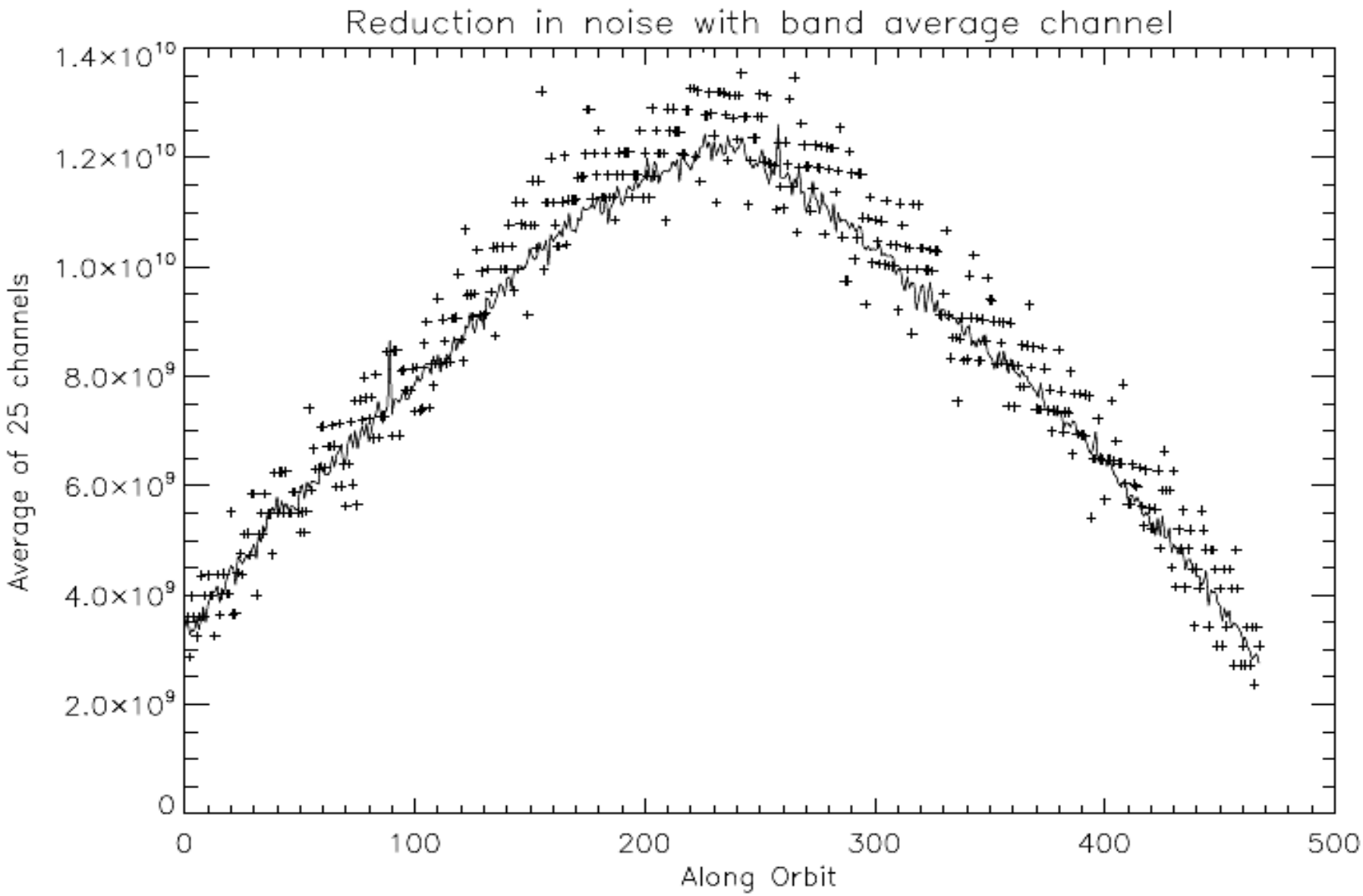
Dark Gray < 100, Red > 500 DU

GEN:Feb 21 2007

GOME-2 Band 1B/Band 2B



Initial Evaluation of GOME-2 Profile Channels



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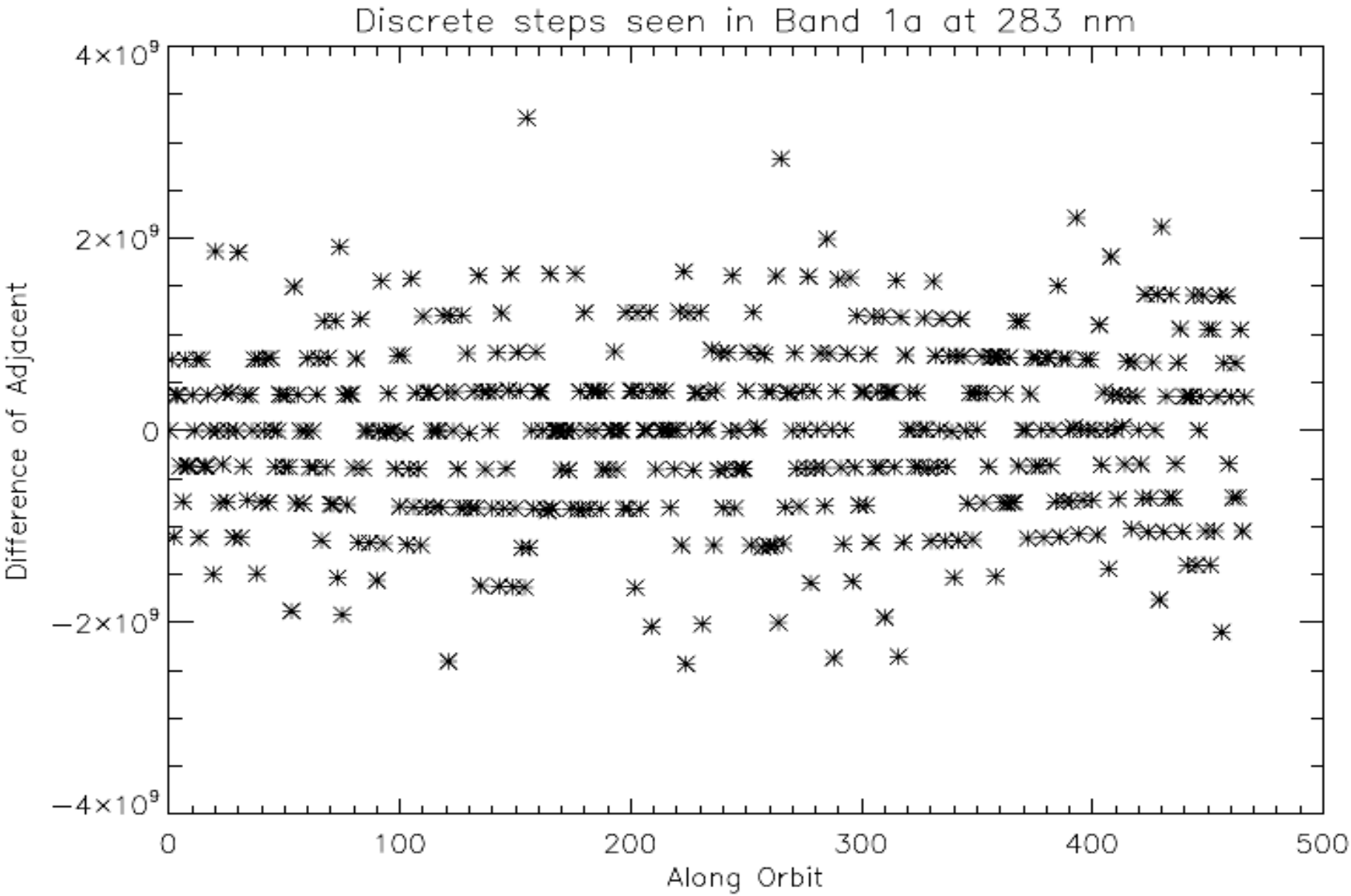
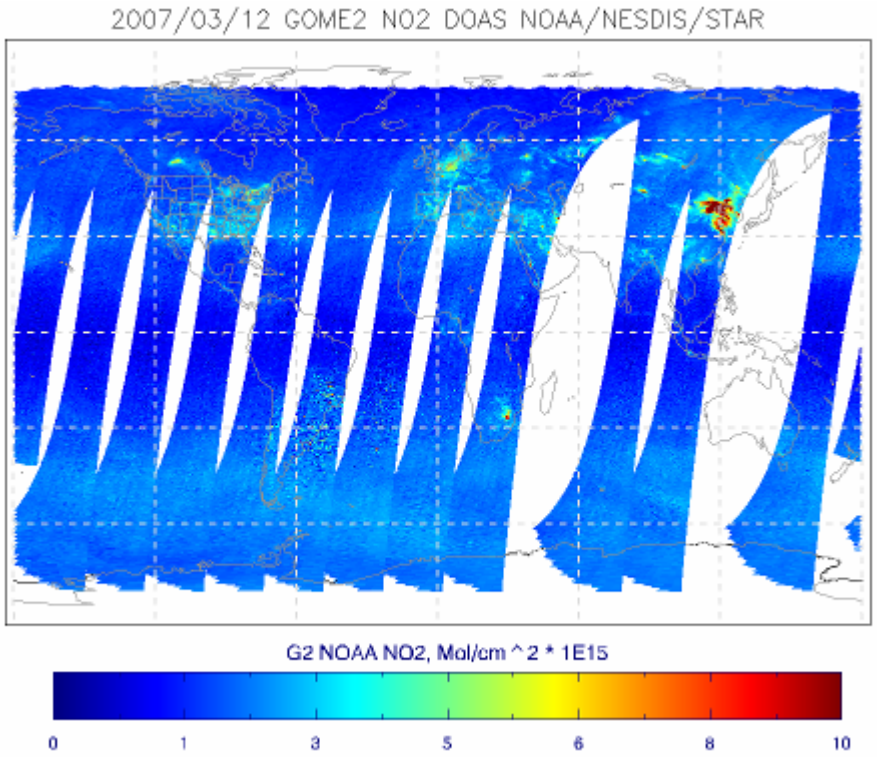
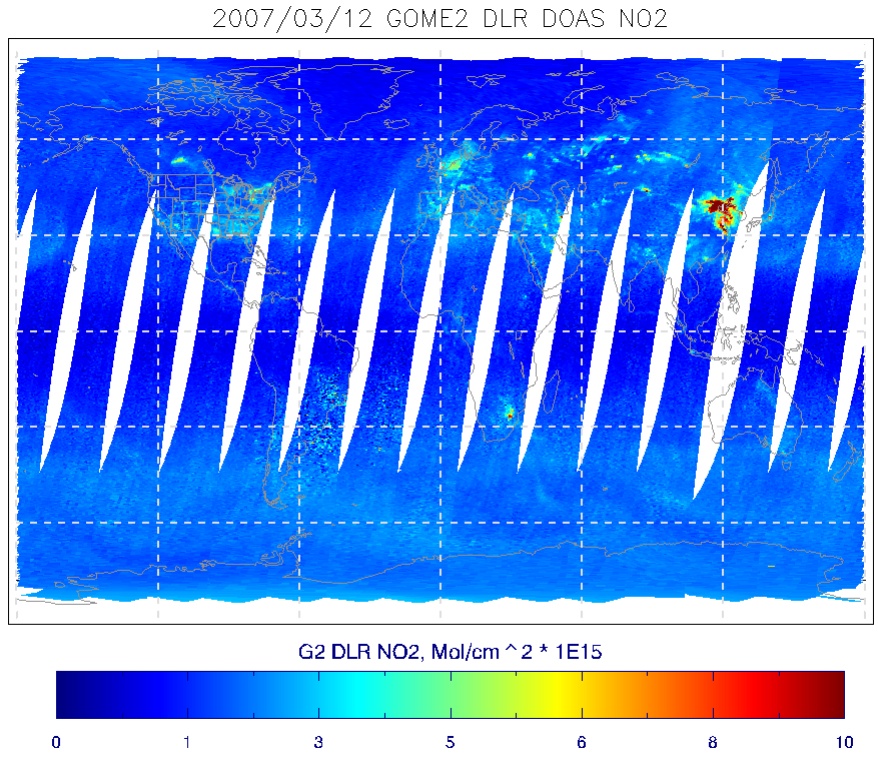


MetOP-1 GOME-2 NO2 Retrievals (Preliminary Results)





- Science code obtained from Harvard (Kelly Chance)
- Science code modified to run on GOME-2 1B by Trevor Beck. NOAA processing has two missing orbits
- NOAA map (left) compares well with the one provided by DLR (top right)

Background

Outline

- SZA and geolocation choices
  - SZA at Ground, 70KM, 30KM, 20KM?
  - Geolocation at ground …
  - Sat View angle, Azimuth, SZA, Sun glint?
- SOI turns off at 3.5 path length
- AI turns off for C-pair?
- Change Channels
  - 331.3 to 332.7 to avoid O3 absorption
  - 360 to ? to avoid ring
- Scan bias in 322.4 nm residual? Split in SH. (and in shorter channels)
- Solar shift calibration
- 331 Reflectivity runs high Max, Min, Ice, cross-track
- Residuals at 345, 360, 372, follow linear with offset
  - High vs low reflectivity?
- B-Pair is …
- A-pair and D-pair are?
  - 313 nm has problems in calibratation

Step 3 Changes

- Figure with TOZ3-TOZ2 Jump at 70SZA where A pair turns on. Plot of 312.6 nm residual (and 313.4)

GOME-2 V8 TOZ Evaluation Plan

- Reflectivity of Ice (Antarctic and Greenland), Maximum and Minimum
- Aerosol Index average and comparisons to OMI
- B-Pair Ozone at the Equator
- 313 nm residuals at the Equator
- Cross-track consistency at the Equator (Note lines)
- Comparison to CMDL Dobson Stations
- TOZ Comparisons to SBUV/2, OMI and

MetOP-A GOME-2 NO_2 Retrievals for Air Quality Applications

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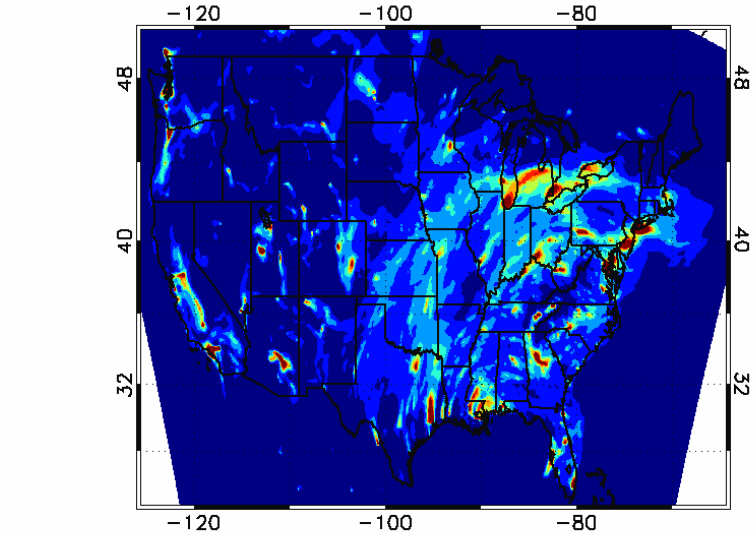
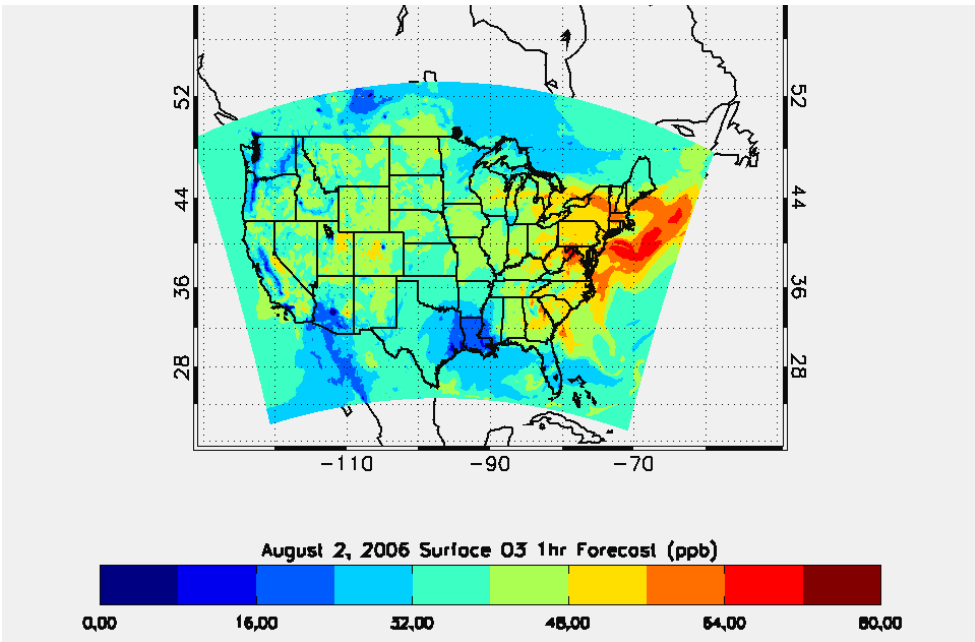
NOAA/NESDIS/STAR

GOME-2 Products and Applications

Product	User	Example Application
NO2 (425 – 450 nm)	EPA NWS	• Assessments •Constrain NOx emissions in air quality forecast model •Verification of precursor forecast fields
H2CO (337.5 – 359 nm)	EPA NWS	• Assessments •Constrain isoprene emissions in air quality forecast model •Verification of precursor forecast fields
Ozone (325 – 335 nm)	NWS	• Ozone forecast improvements
Aerosol optical Depth (absorption vs scattering) (multiple bands in the UV)	EPA NWS NESDIS	• PM2.5 Monitoring •PM2.5 and ozone forecast improvements •Hazard Mapping System
Volcanic SO2 (315 – 326 nm)	NESDIS	• Hazard Mapping System

- NO_x ($NO + NO_2$) emissions contribute to the production of ozone
- NOx concentrations show diurnal variations due to temporal variation in emissions as well as due to photochemistry
- Forecast models tend NOT to have this variability included due to lack of timely observations
- Near real time observations of NO_2 can be used to constrain emissions in the model

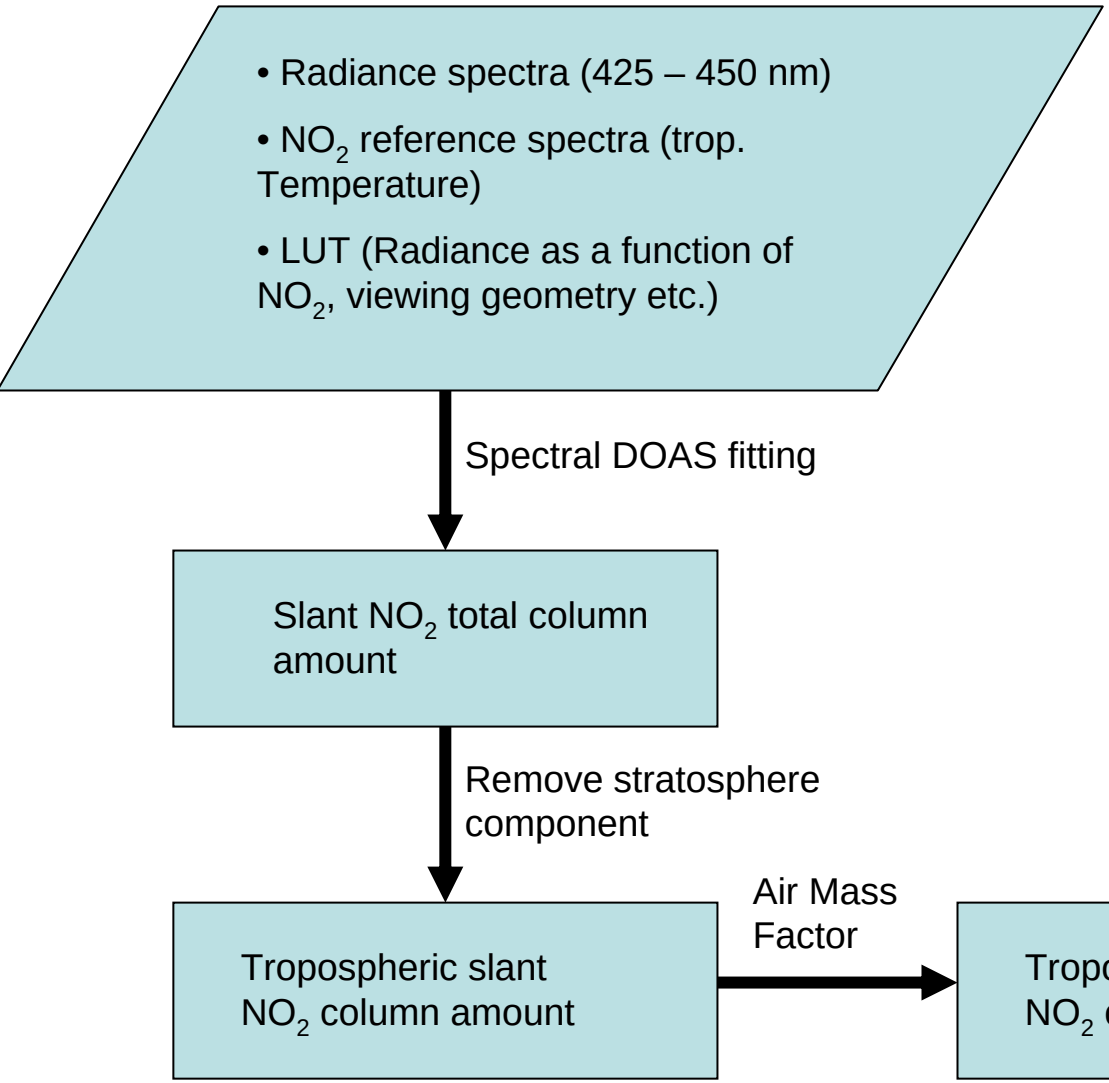




Project Timeline

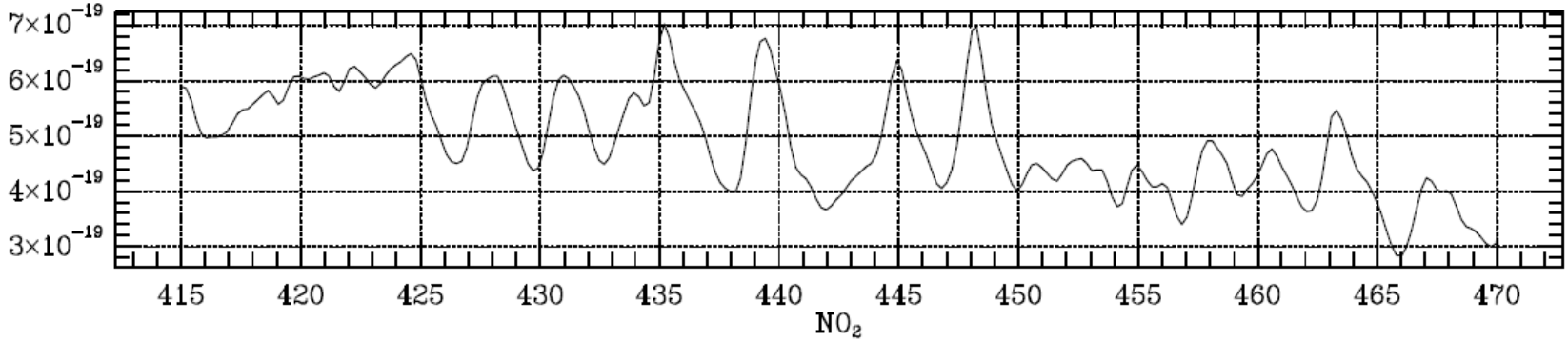
- JCSDA funding obtained in FY06
  - Work delayed due to delay in MetOP-A launch
- MetOP-A launched on October 19, 2006
  - NESDIS started obtaining 1B files early March 2007
- STAR hired Trevor Beck as FTE to work on GOME-2 in March 2007
- Preliminary slant NO_2 column product developed. Algorithm development work underway
- GOME-2 NO_2 product to become operational in 2008

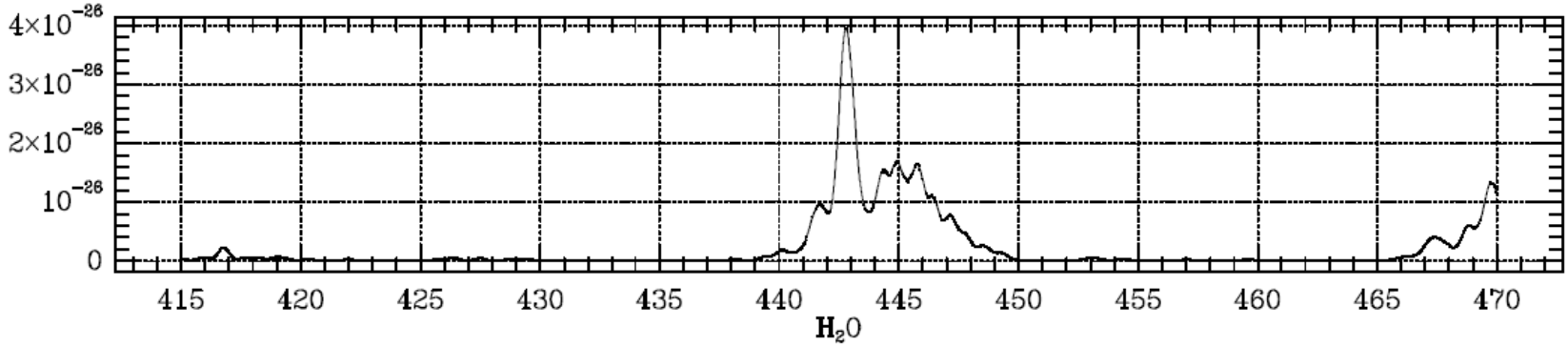
NO_2 DOAS Retrieval Method

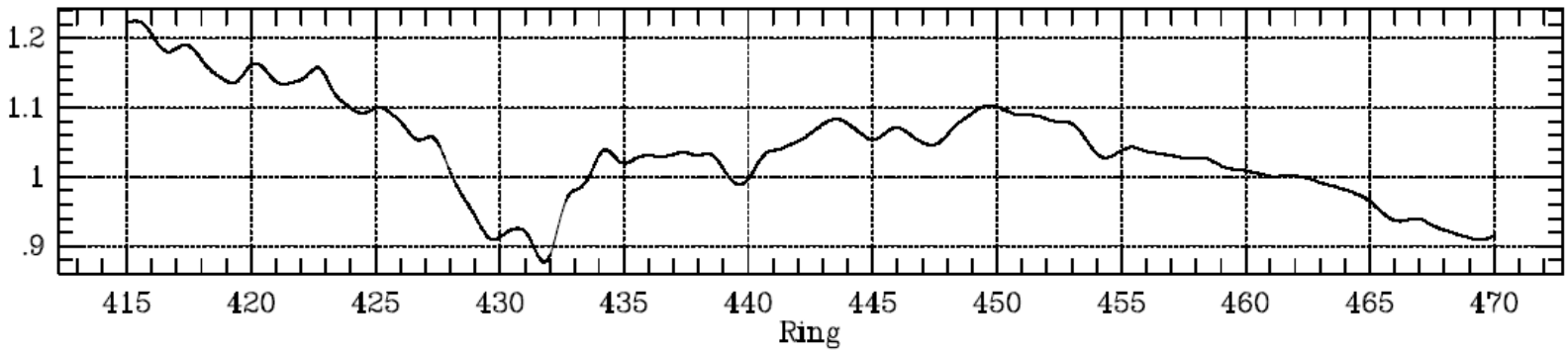


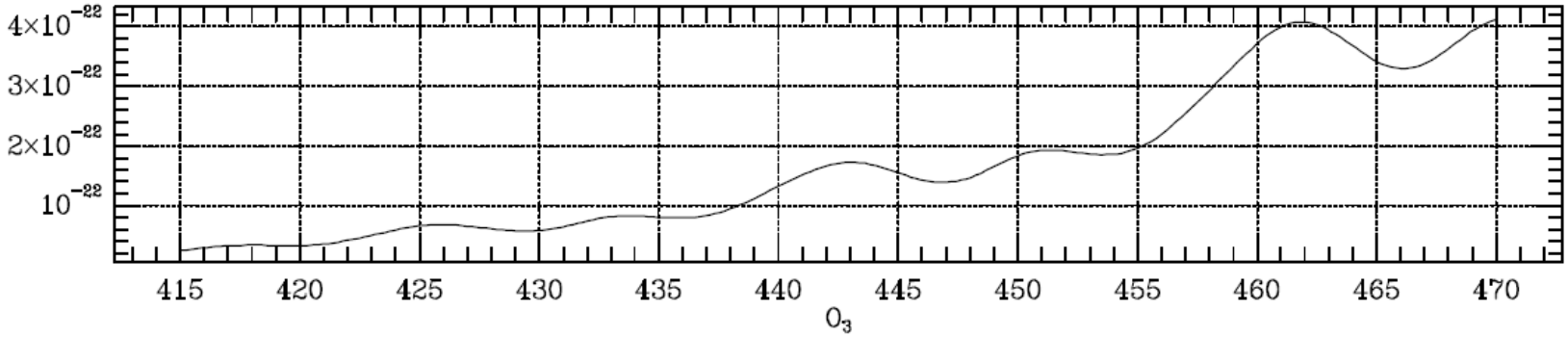
Assumptions and Limitations:

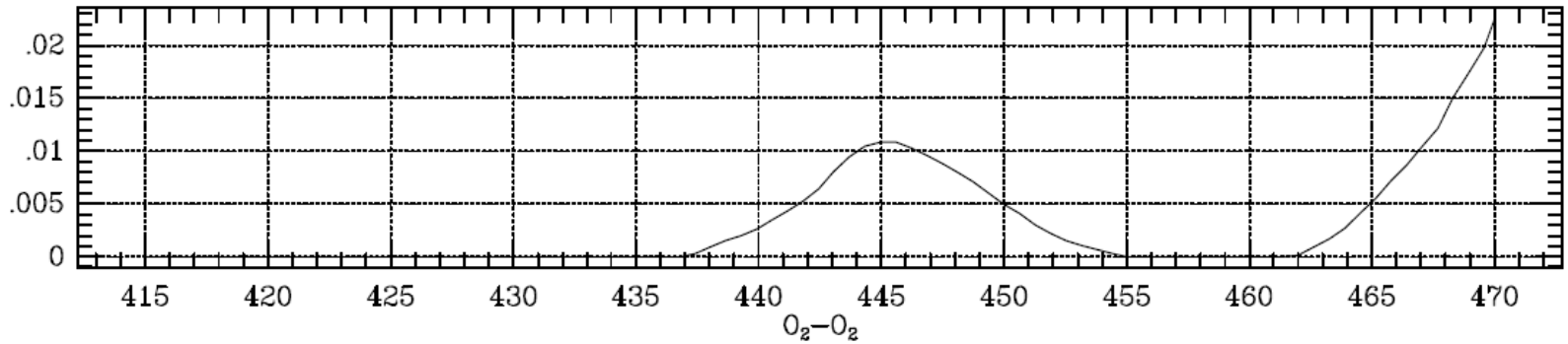
- Vertical profile of NO_2 assumed
- Account for interference from ozone, Raman scattering, water vapor absorption, O_2-O_2 absorption
- To remove stratosphere component, assume Pacific ocean is unpolluted and all observed NO_2 is in the stratosphere and that this amount is longitudinally invariant or bring information from models
- Determine air mass factor using LIDORT
  - knowledge of surface reflectivity
  - knowledge of cloud fraction and optical depth
  - knowledge of NO_2 vertical profile

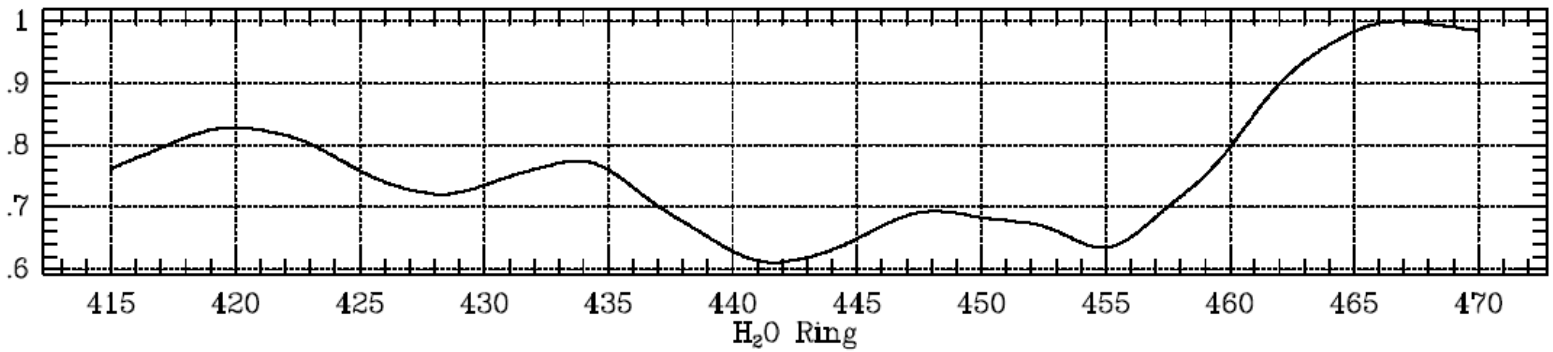

7×10⁻¹⁹
6×10⁻¹⁹
5×10⁻¹⁹
4×10⁻¹⁹
3×10⁻¹⁹
415 420 425 430 435 440 445 450 455 460 465 470
NO₂


4×10⁻²⁶
3×10⁻²⁶
2×10⁻²⁶
10⁻²⁶
0
415 420 425 430 435 440 445 450 455 460 465 470
H₂0


1.2
1.1
1
.9
415 420 425 430 435 440 445 450 455 460 465 470
Ring

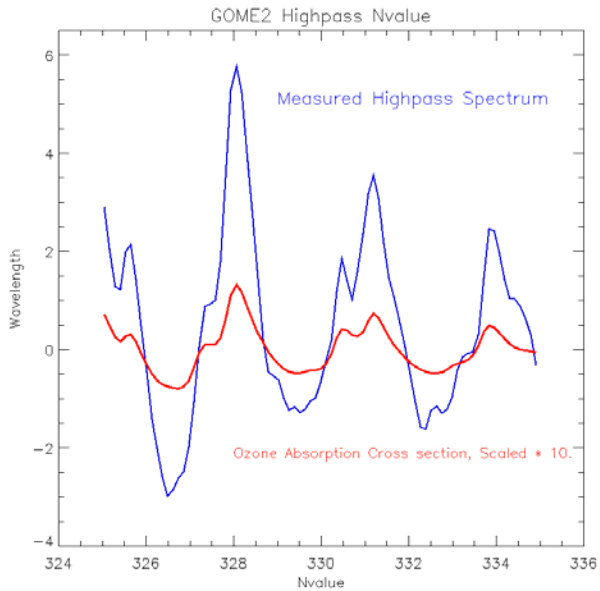

4×10^-22
3×10^-22
2×10^-22
10^-22
415 420 425 430 435 440 445 450 455 460 465 470
O3


.02
.015
.01
.005
0
415 420 425 430 435 440 445 450 455 460 465 470
O2–O2

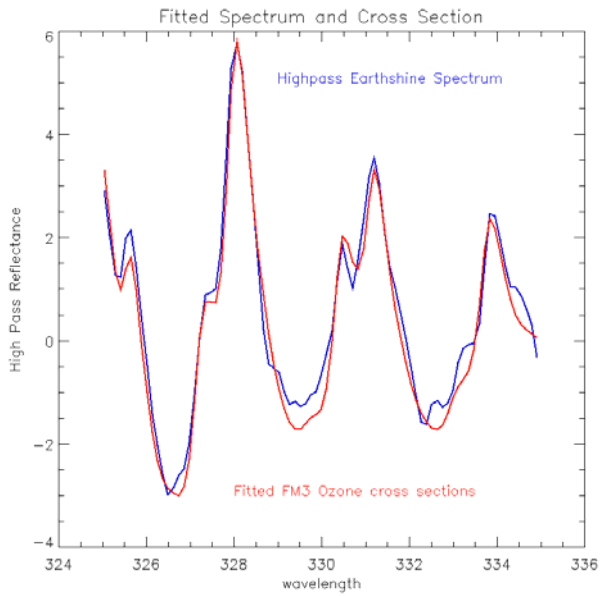

1
.9
.8
.7
.6
415 420 425 430 435 440 445 450 455 460 465 470
H20 Ring

Example of Spectral Fitting

Before fitting



After fitting



Air Mass Factor (AMF)

AMF = Slant column/Vertical column

(1) Start with known NO_2 vertical column density, surface albedo, etc.

(2) Using LIDORT (or any other RTM), compute the radiance spectra in the NO_2 window

(3) Run DOAS on the simulated spectra to obtain slant column density

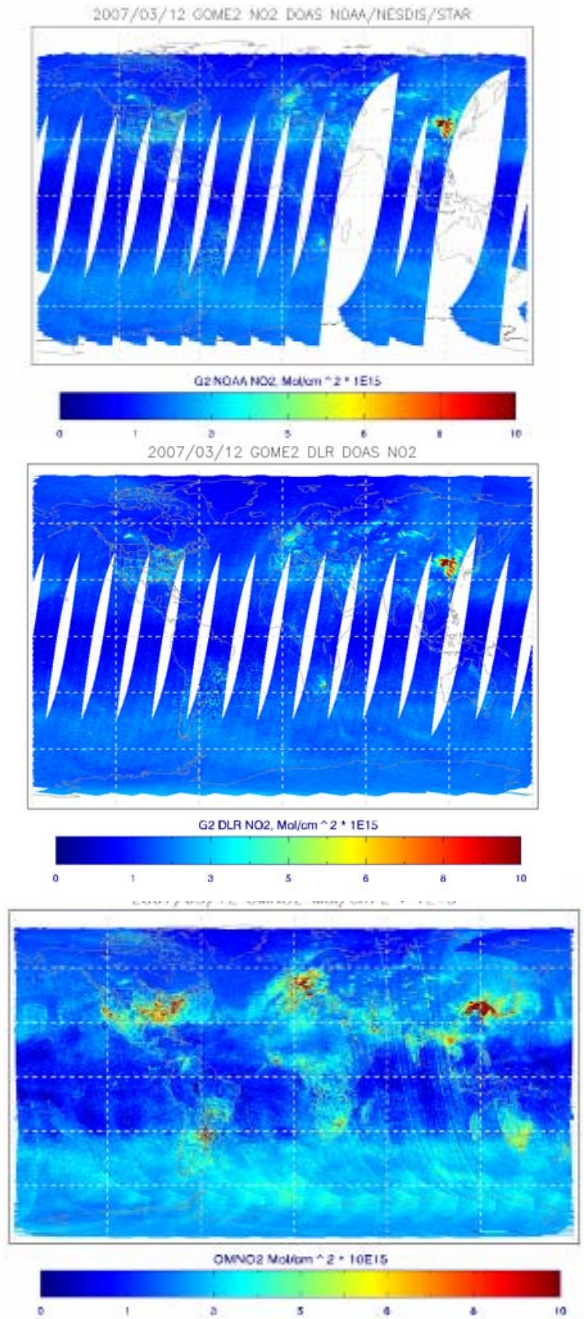
(4) Divide slant column density with vertical column density to obtain AMF

NO_2 Retrievals in Cloudy Pixels

- Approach 1
  - Retrieve NO_2 amount above the cloud and add a climatological ghost NO_2 amount for below cloud atmosphere
- Approach 2
  - Obtain cloud fraction, cloud optical depth, cloud height from satellite measurements and compute AMF for cloudy atmosphere
    - Ideal because tropospheric NO_2 plume is likely below the cloud or mixed with cloud

NO_2 from GOME-2 for March 12, 2007

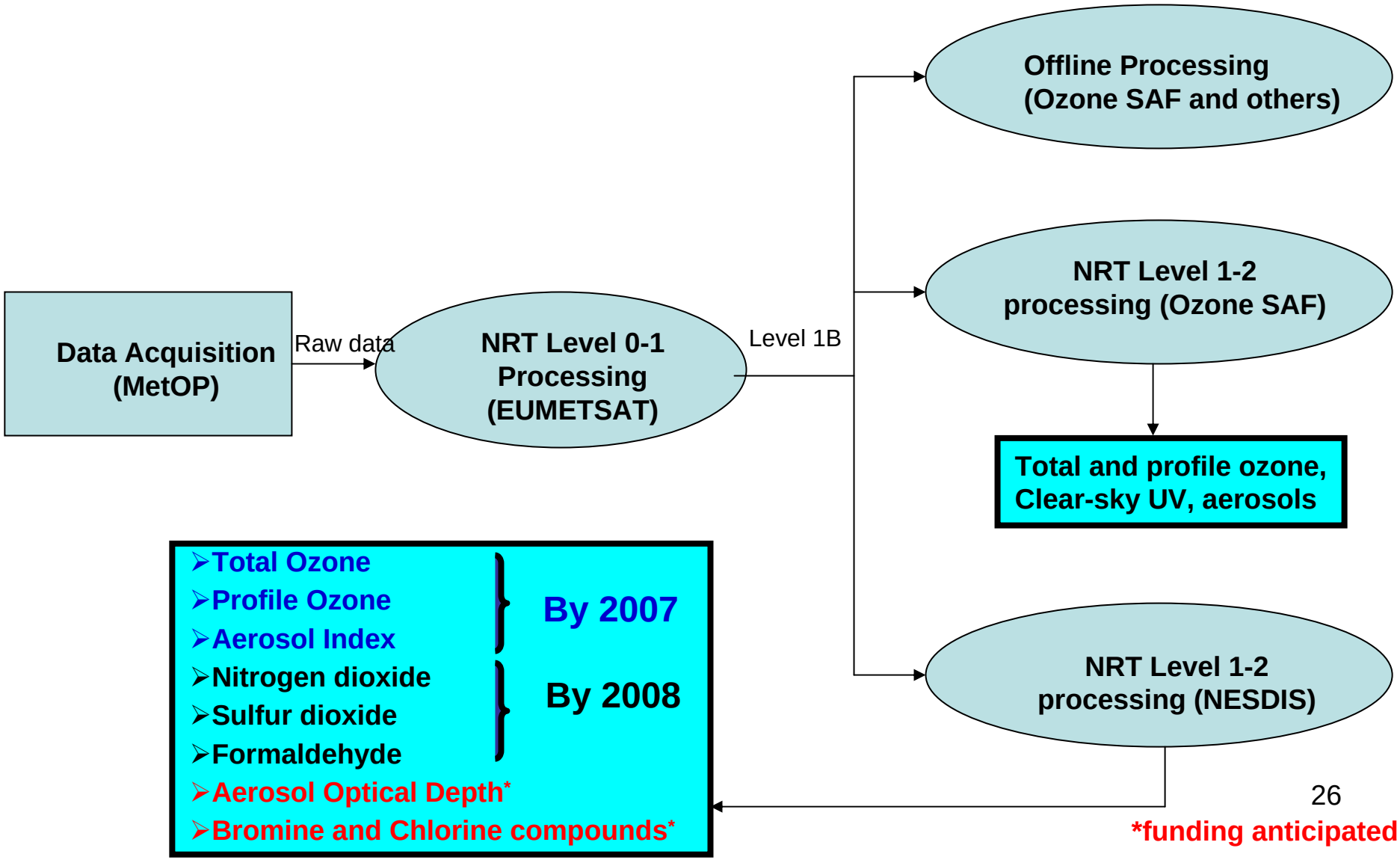
- STAR GOME-2 NO_2 retrievals agree with DLR retrievals (top and middle panels). *Slant column amounts are converted to vertical column densities using geometric air mass factor (i.e. just path length)*
- OMI NO_2 product shown in the bottom panel is vertical column density and much higher than GOME-2 because of using actual air mass factor and also adjustments made for retrieval efficiencies
- As expected, OMI NO_2 amounts show higher concentrations over east Asia, western Europe, and eastern U.S.



Future Activities

- FY07
  - Complete the algorithm development activity
    - Test different approaches to remove stratospheric component from total column to obtain tropospheric amount
    - Test different approaches to obtain NO_2 vertical profile information (*a priori*) for air mass factor calculation
    - Begin preliminary analysis of the data by comparing with OMI and ground-based Brewer spectrometer data
- FY08
  - Expand the algorithm development work to derive H2CO and SO_2
  - Begin operational implementation of NO_2 product
  - Work with NWS and EPA in GOME-2 data utilization studies

Near Real Time Products from GOME-2 at NESDIS



*funding anticipated