

# Report Back on Ozone and OMPS Products

L. Flynn

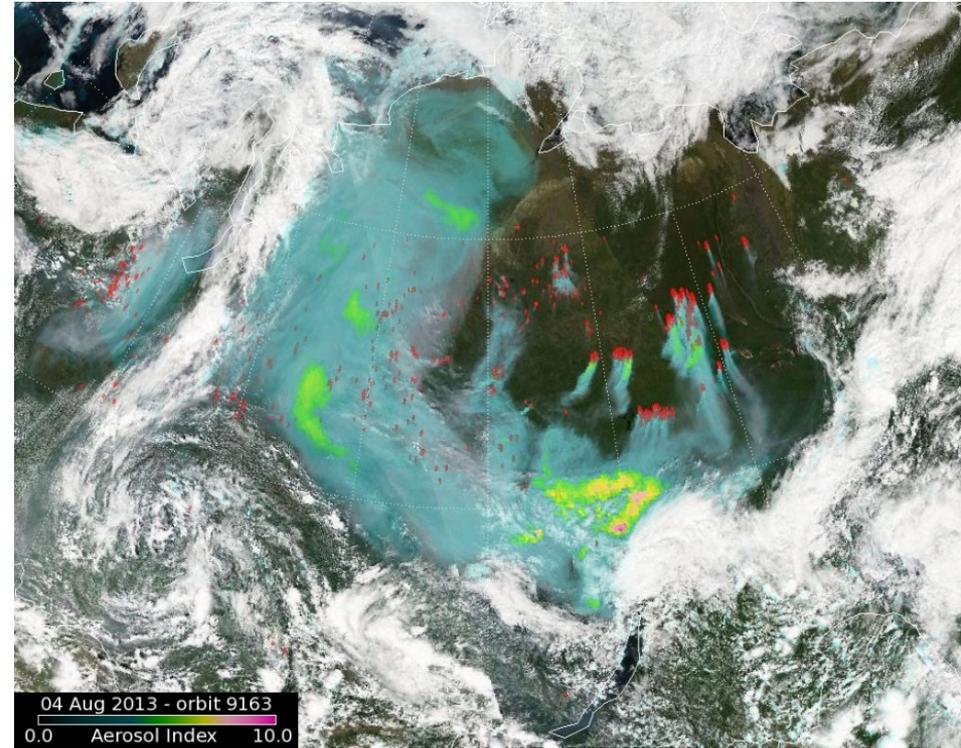
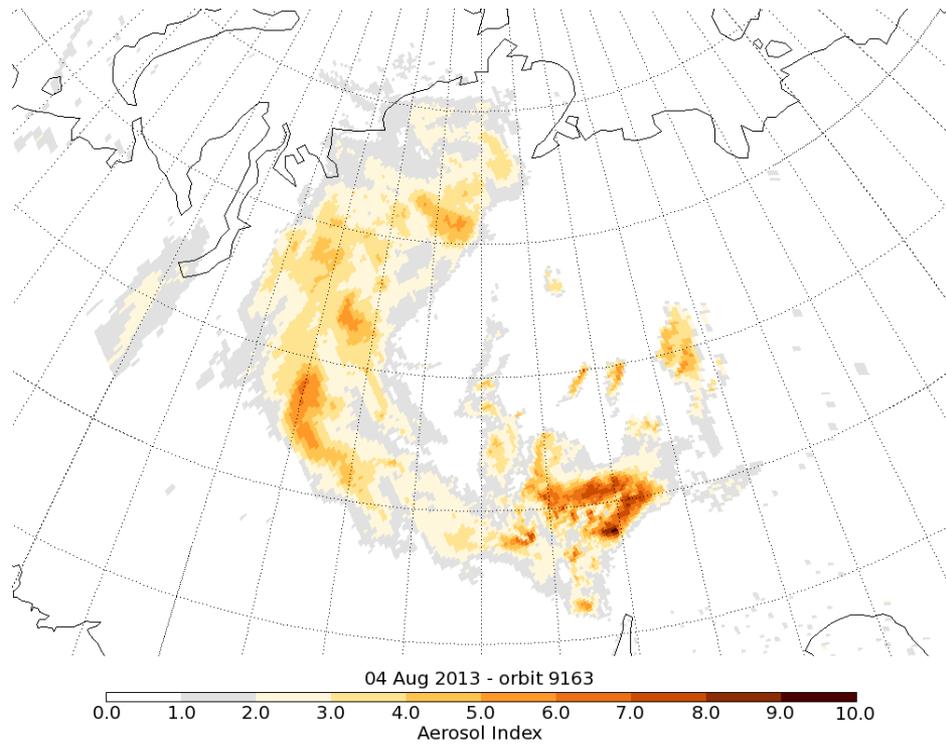
May 16 NOAA STAR JPSS Science Meeting

# Outline

- Aerosol Products
- Atmospheric SO<sub>2</sub> Products
- Blended IR/UV Ozone Products
- SPORT Ozone Anomaly Products
- OMPS Limb Profiler Products
- Ozone Applications
- V8Pro Status
- V8TOz and V2LP Statuses

# High Resolution OMPS Aerosol Index

Wild fires over Russia on August 4, 2013



- Never seen before detail in UV Absorbing Aerosol Index imagery
- Individual smoke plumes can be resolved
- Smaller FOVs would facilitate quantitative interpretation (Absorbing Aerosol Optical Depth, Single Scattering Albedo)

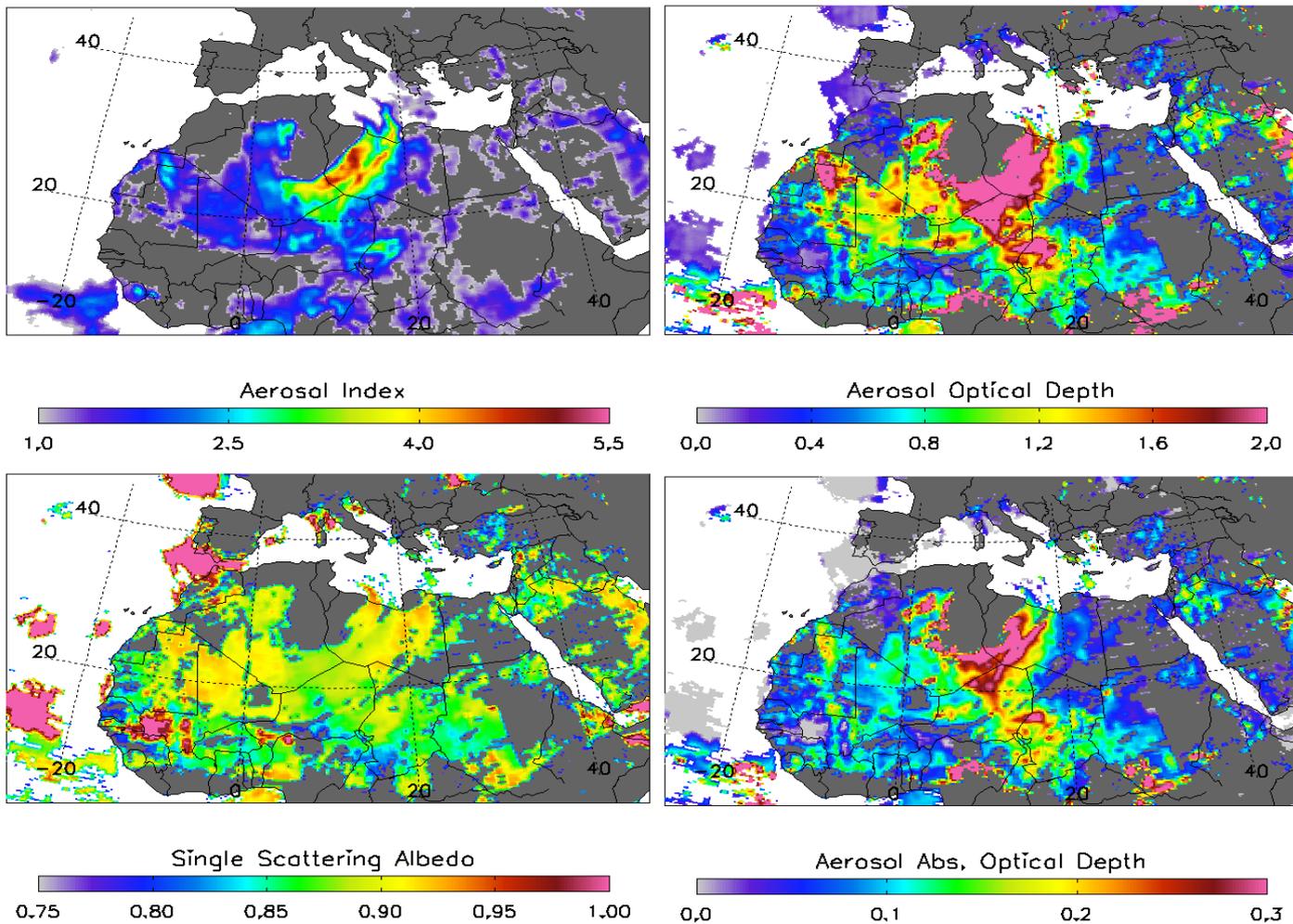
# UV Aerosol Products (O. Torres Presenter)

- The UV Absorbing Aerosol Index is an intermediate product for the total ozone algorithms.
- This OMPS product will continue the 35-year record.
- Aerosol Single Scattering Albedo and Optical Depth can be simultaneously retrieved with OMI algorithms .
- A  $3 \times 12$  km<sup>2</sup> spatial resolution for two near-UV reflectivity channels is recommended for retrieval of aerosol properties from OMPS observations.
- The combination of OMPS and VIIRS observations present a great opportunity for more accurate retrieval of aerosol properties (AOD and SSA) with the possibility of estimating altitudes.

## From qualitative to quantitative aerosol absorption information

Aerosol Single Scattering Albedo and Optical Depth can be simultaneously retrieved.

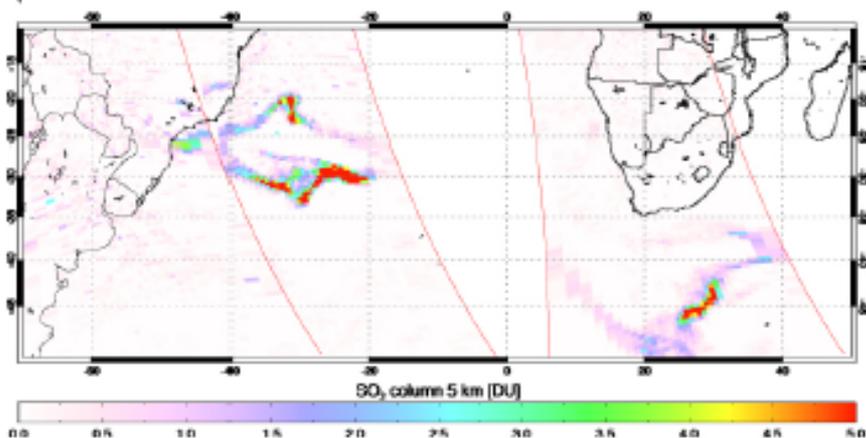
*(Height of absorbing aerosol layer must be prescribed)*



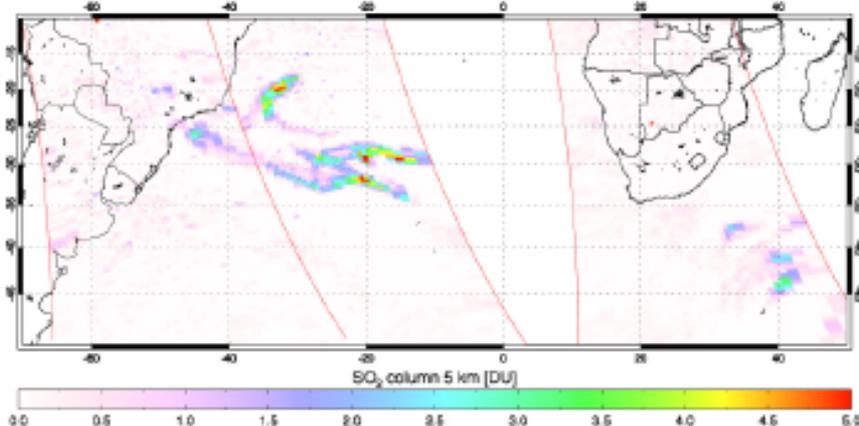
**OMI Retrieved Dust Properties (March 9-2007)**

# S-NPP OMPS LF SO<sub>2</sub>: Copahue (Chile & Argentina), Dec 2012

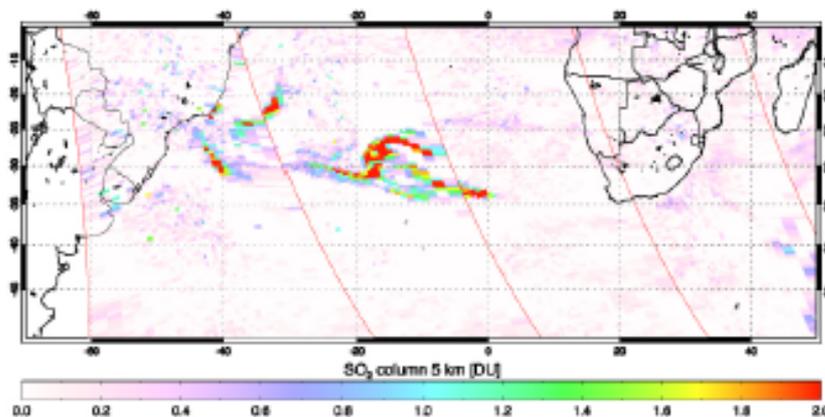
NPP/OMPS - 12/05/2012



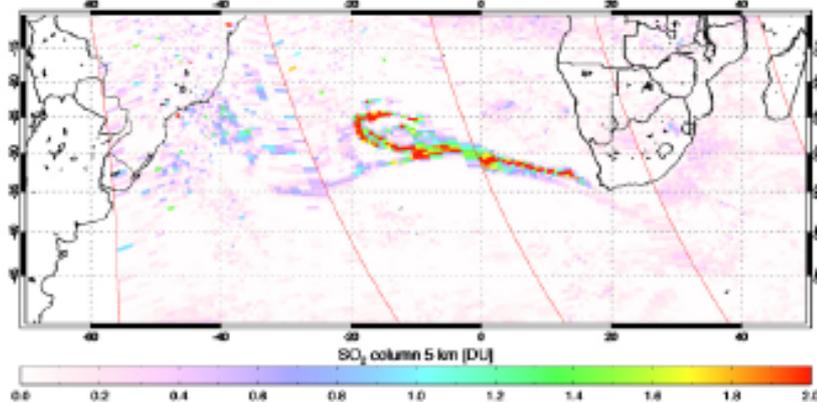
NPP/OMPS - 12/27/2012



NPP/OMPS - 12/28/2012



NPP/OMPS - 12/29/2012



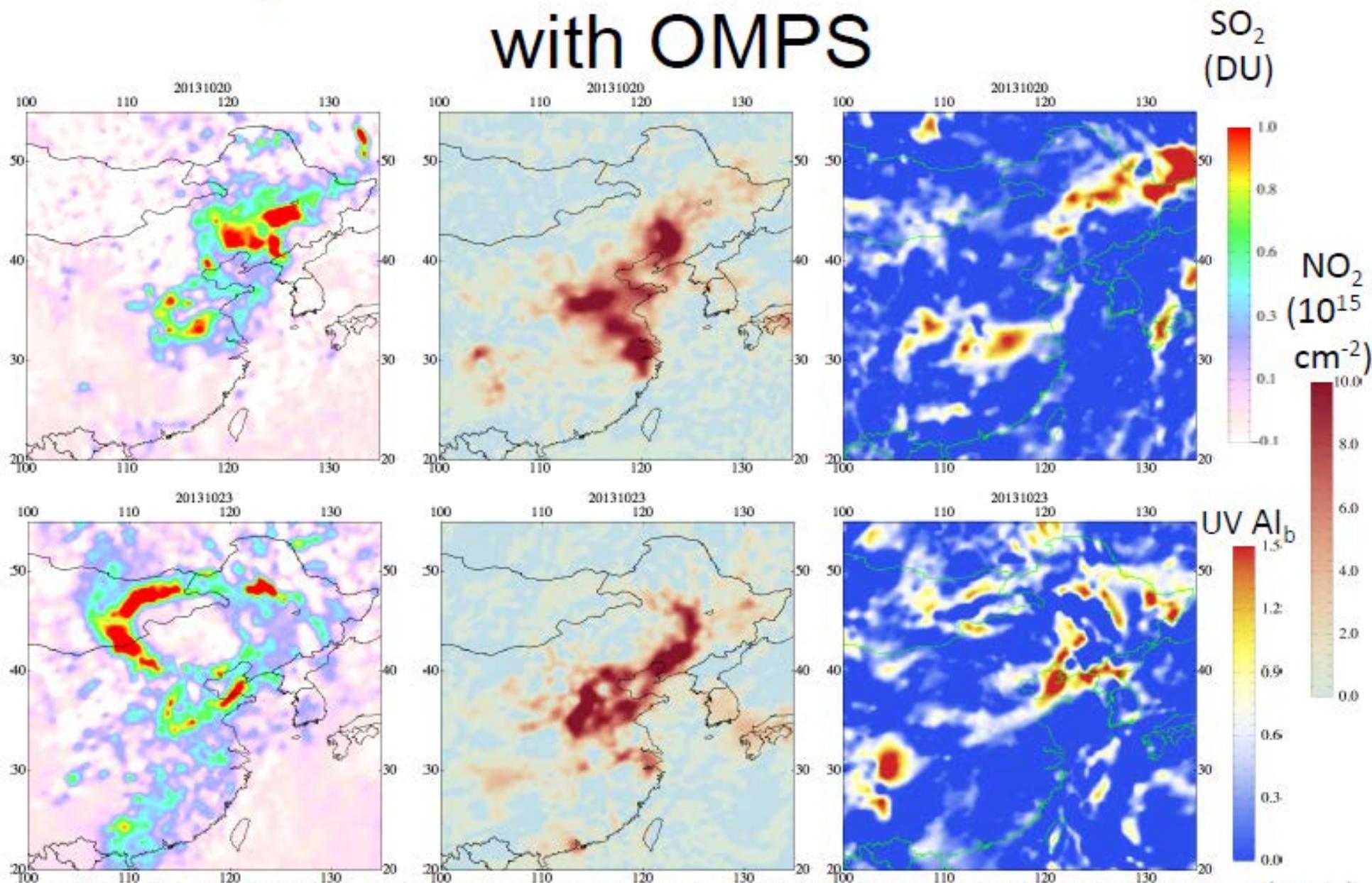
# SO<sub>2</sub> Products (K. Yang Presenter)

- An SO<sub>2</sub> Index is an intermediate product for the total ozone algorithms. It has been found wanting.
- The Version 8 Total Ozone Algorithm provides the input needed by a Linear Fit SO<sub>2</sub> column retrieval algorithm.
- Higher spatial resolution measurements will improve information for hazard and air quality applications.
- Accurate SO<sub>2</sub> estimates are needed to correct ozone estimates – 1 DU of SO<sub>2</sub> is interpreted as 2 DU of O<sub>3</sub> without correction.

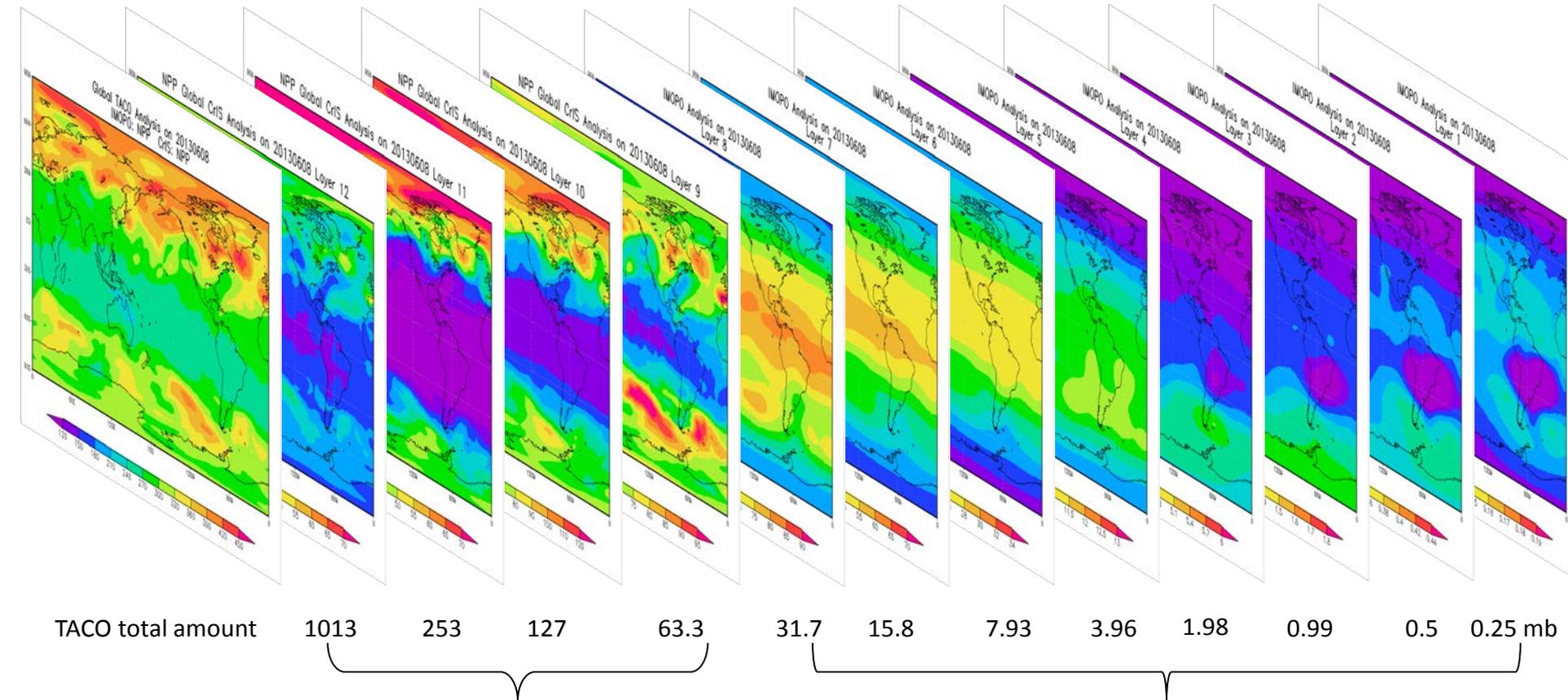
# SO<sub>2</sub> Users

- **VAACs:** The SO<sub>2</sub> products are used to track volcanic eruptions for aviation hazards. This is the most important NRT application.
- **EPA & ARL:** Air Quality forecasts and monitoring (O<sub>3</sub>, SO<sub>2</sub> & NO<sub>2</sub> amounts, aerosol classification)
- **USGS/AID:** Passive volcanic outgassing
- **Atmospheric chemistry and climate change research**
- **MACC II ECMWF**

# Daily Global Pollution Monitoring with OMPS



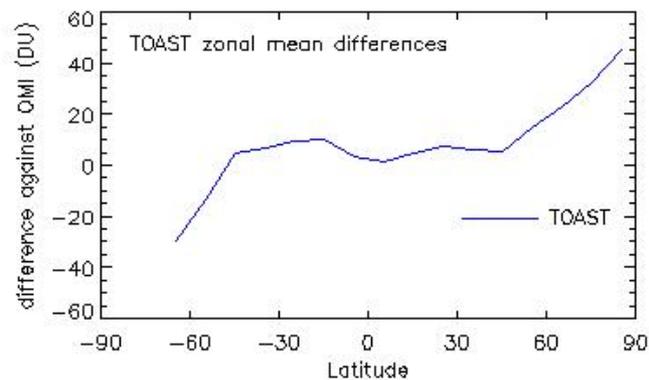
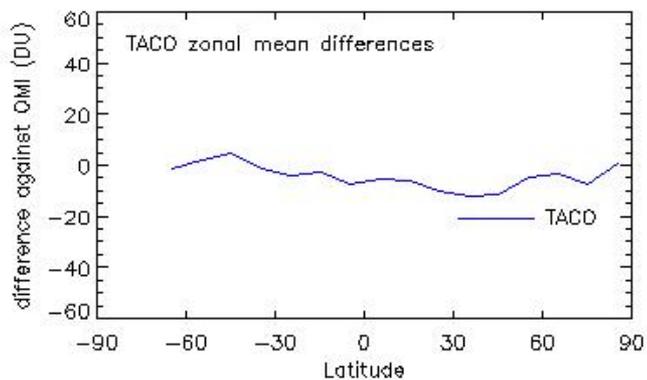
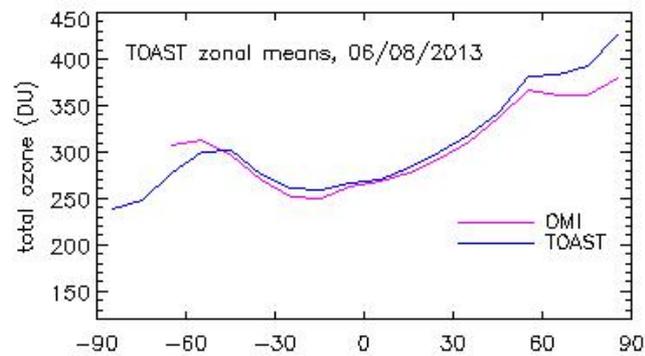
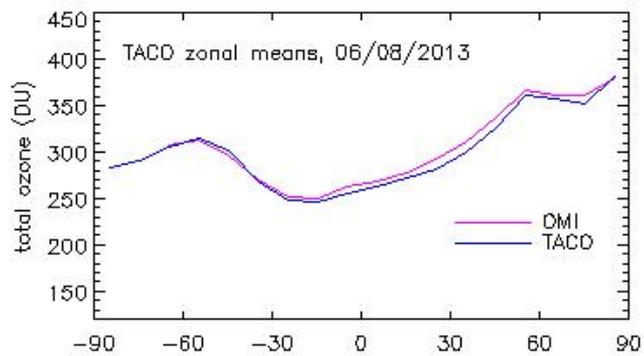
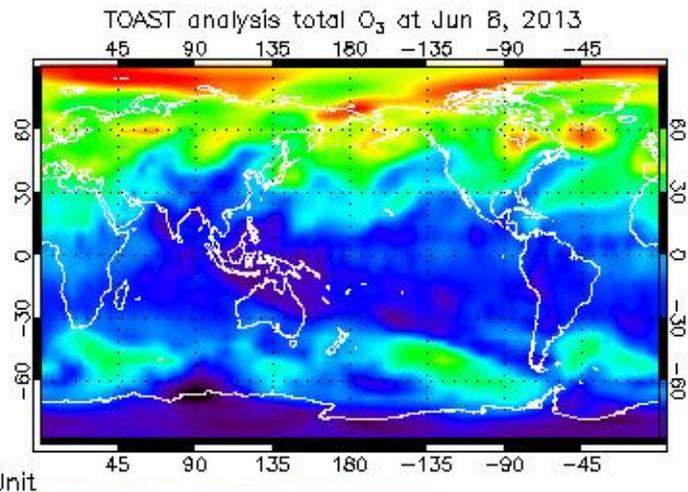
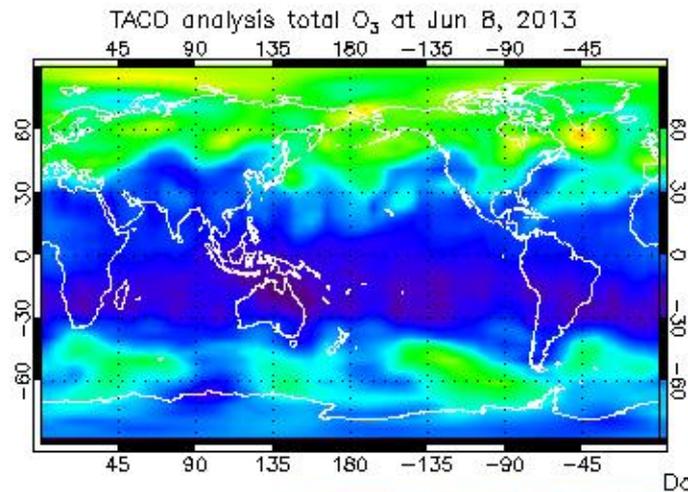
# Composition of Total ozone Analysis for CrIS and OMPS (TACO) products



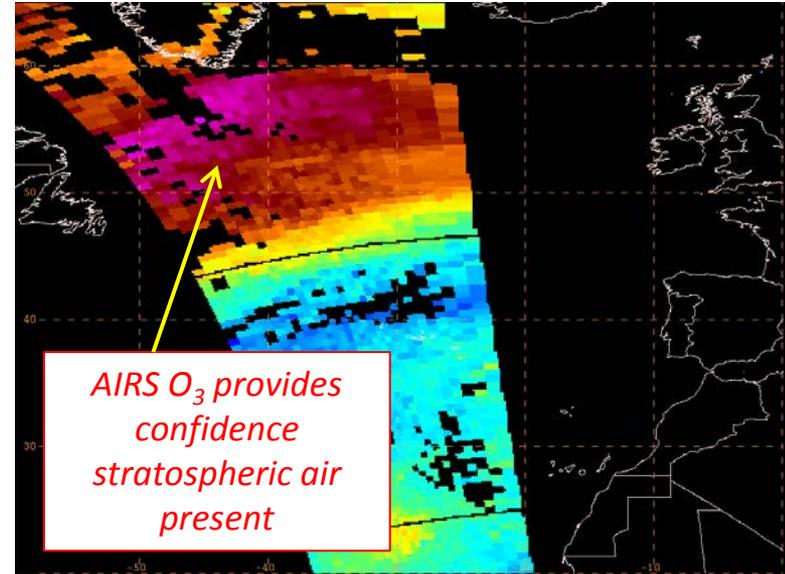
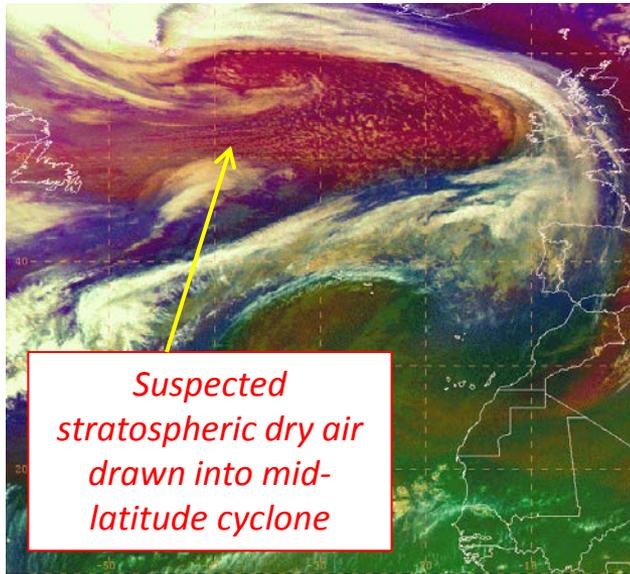
$$TACO = CrIS + OMPS \text{ or } SBUV-2$$

## Combined UV/IR Ozone Products (J. Niu Presenter)

- CrIS and OMPS ozone products will be used to continue the SBUV/2 and HIRS TOAST products.
- Full UV/IR retrievals developed for EOS Aura TES and OMI are proposed for use with CrIS and OMPS. (IASI and GOME-2 algorithms are also under development).
- Orbital update to the analysis can be implemented to improve product timeliness.



# *The Forecast Challenge and Ozone Retrievals*



- SPoRT has worked closely with the GOES-R and JPSS Proving Grounds to develop and transition ozone products in N-AWIPS format to OPC
- OPC has used the Air Mass RGB product to identify stratospheric air, however uncertainty exists about interpreting the new qualitative product
- Legacy AIRS ozone retrievals can be used to increase forecaster confidence in the Air Mass RGB and enhance interpretation

# Infrared Ozone Products for Operational Meteorology (E. Berndt Presenter)

- Ozone anomalies can be used to identify regions of stratospheric air and potential for tropopause folding.
- Maps of ozone deviations from climatology can be used by forecasters to assist in recognition of severe event potential.
- JPSS (IASI, CrIS, GOME-2, OMPS) offers a wealth of total ozone maps in NRT.

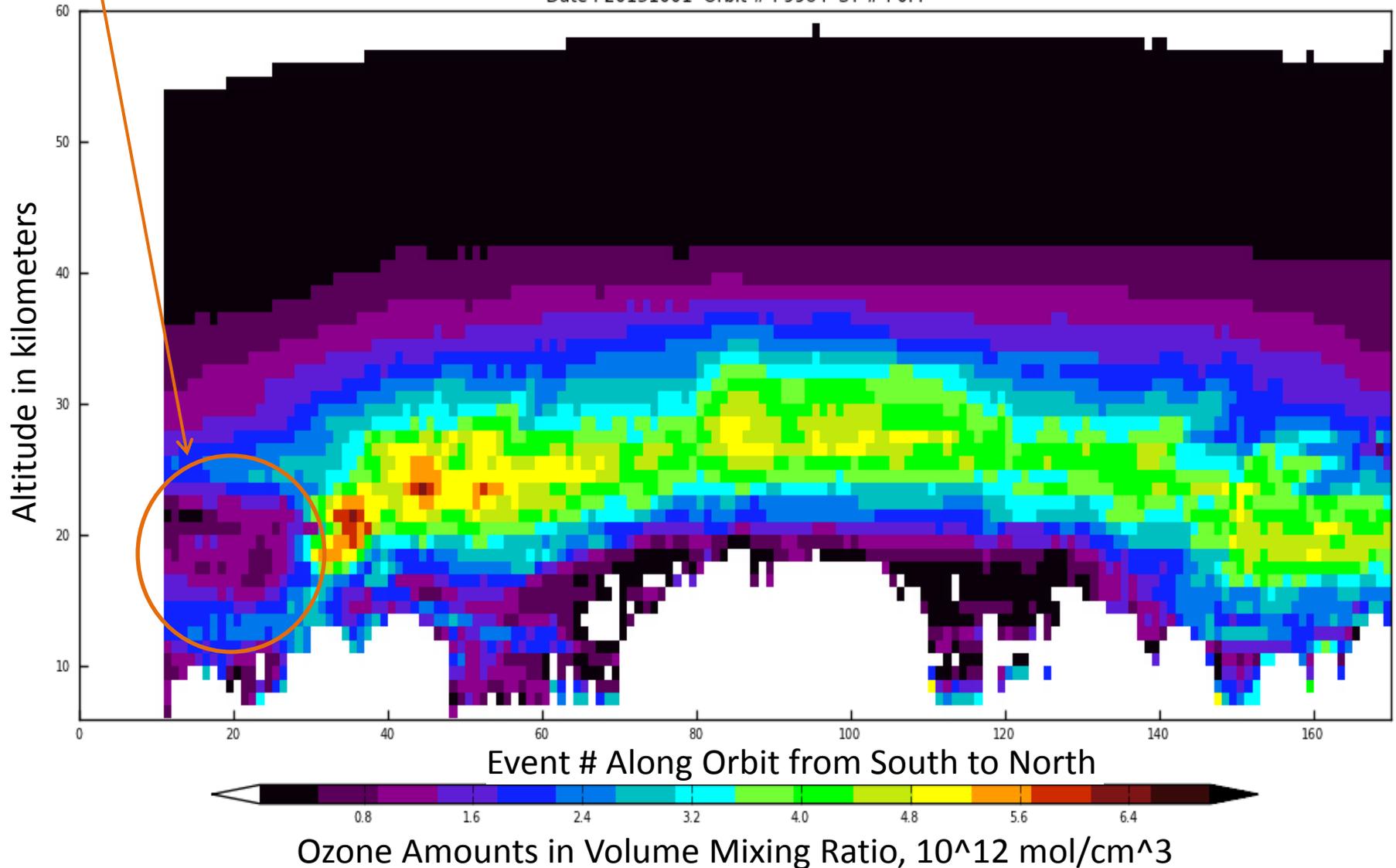
# Center Slit, OMPS Limb Ozone Profile Retrievals for one Orbit on October 22, 2013

High vertical resolution structure  
of the Antarctic Ozone Hole

[ozoneaq.gsfc.nasa.gov/omps/about/](http://ozoneaq.gsfc.nasa.gov/omps/about/)

Ozone Orbital Curtain (Center Slit - Linear Scale)

Figure Generated 2013-10-22 12:18:56  
Date : 20131001 Orbit # : 9984 ST # : 0.4



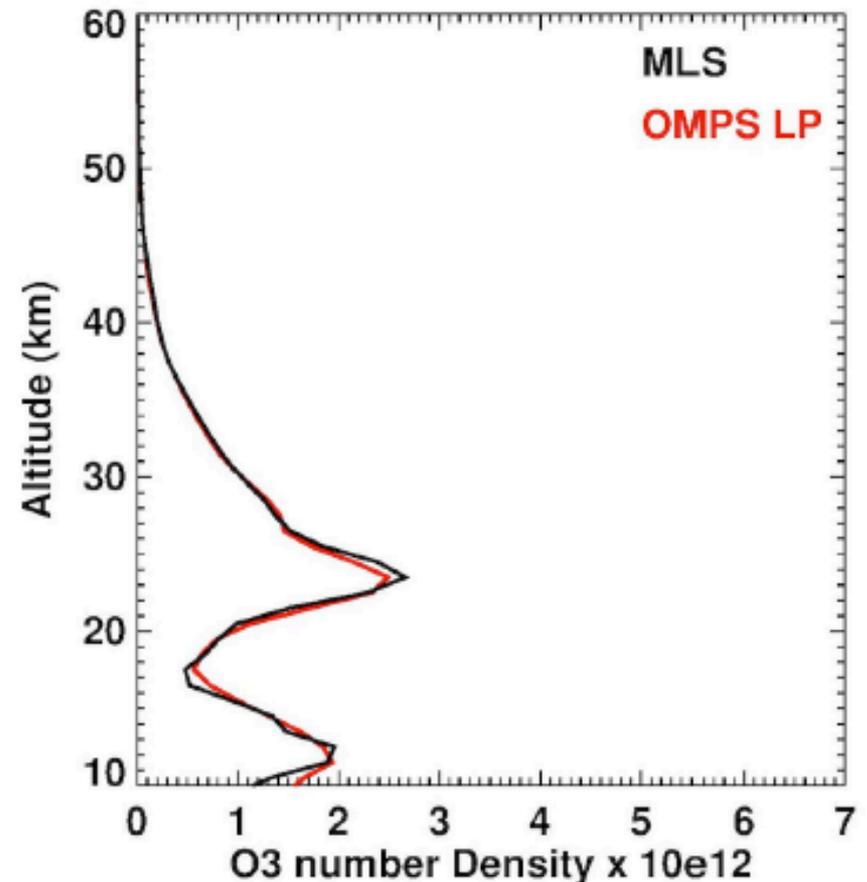
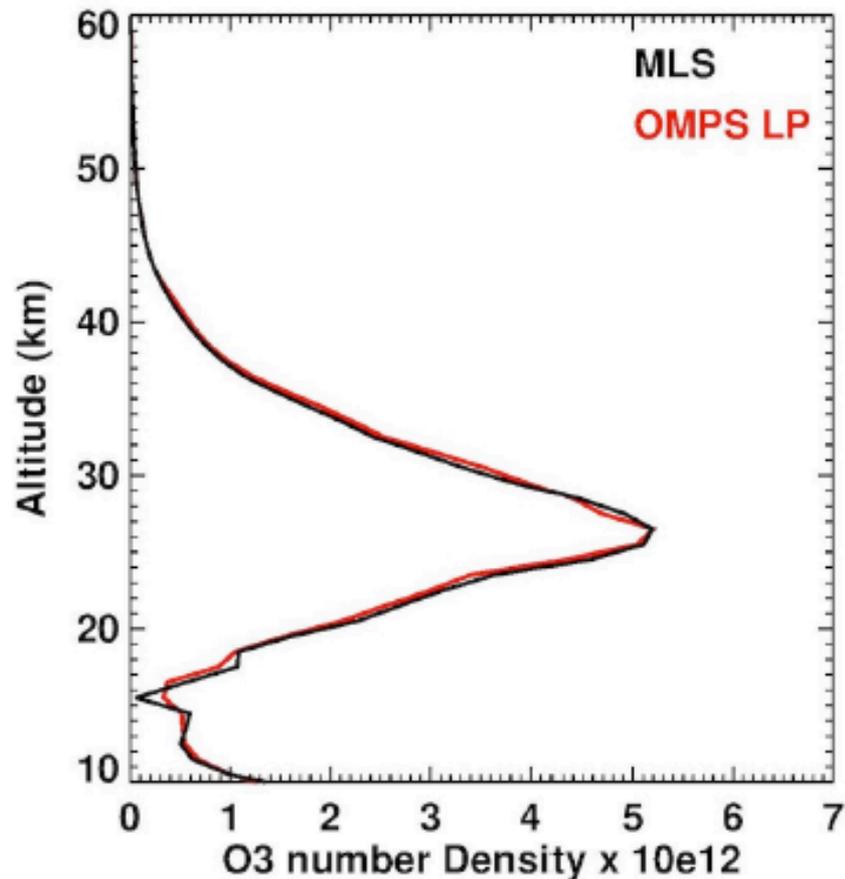
# OMPS Limb Profiler Ozone Profile

- The NASA Ozone PEATE has processed the complete OMPS LP record with the Version 2 retrieval algorithm for all three slits.
- The retrievals combine upper level UV retrievals with lower level Visible retrievals.
- Adjustments for height/pointing errors have been improved.
- The aerosol retrieval is now a separate module. It was able to track the stratospheric dust anomaly produce by the explosion of a meteorite over Russia.

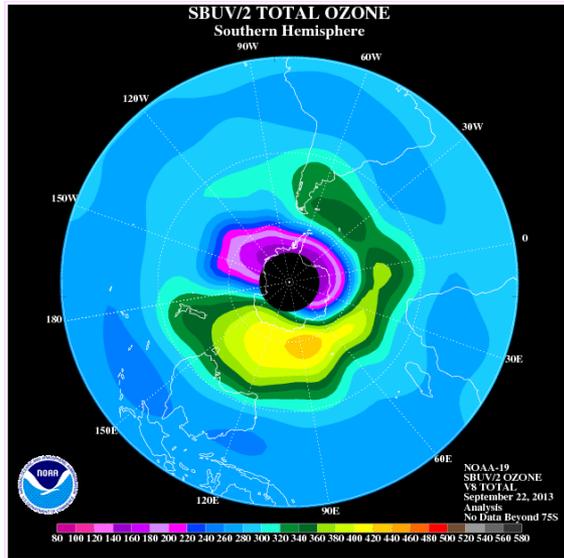
# Sample Limb Profiler Profiles vs. EOS Aurea MLS

Latitude 2°S

Latitude 76°S

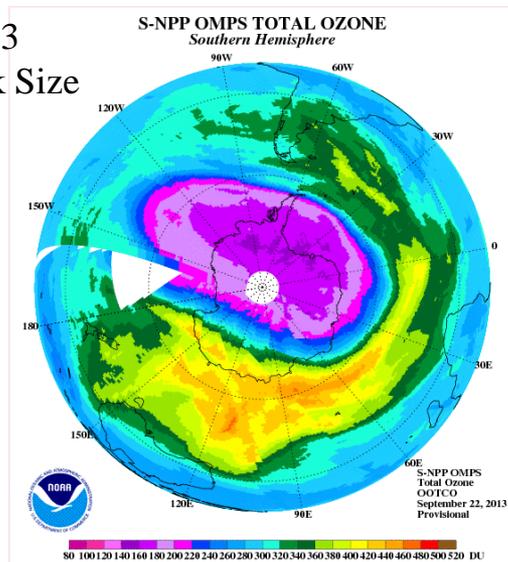


# Day-to-Day Time Scales



- Using the SBUV/2 nadir observations, CPC uses a Cressman Scheme to make a polar stereographic analysis of the Total Column Ozone. (top)
  - Smooths out or misses fine features
- OMPS TC provides full global coverage.
  - Heritage: TOMS and OMI
  - Currently is providing 35 scan positions
  - Has potential of ~100 scan positions with out compromise to S/N ratio
- [www.cpc.ncep.noaa.gov/products/stratosphere/sbu2to/](http://www.cpc.ncep.noaa.gov/products/stratosphere/sbu2to/)
- [www.cpc.ncep.noaa.gov/products/stratosphere/omps/](http://www.cpc.ncep.noaa.gov/products/stratosphere/omps/)

Sept 22, 2013  
Date of Peak Size

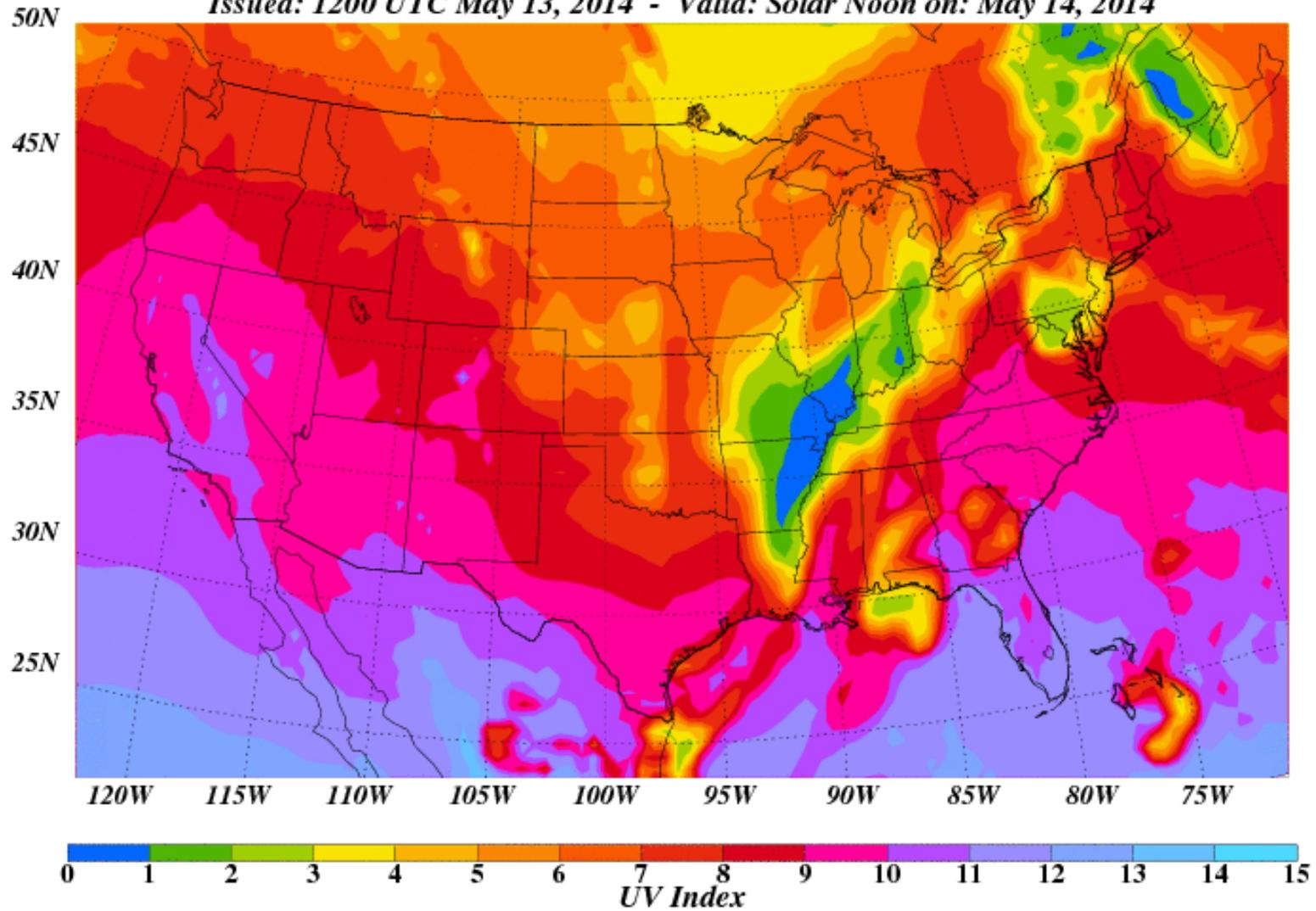


# Ozone Applications at NCEP (C. Long Presenter)

- The OMPS Version 8 nadir ozone profile products will continue the 35-year SBUV(/2) CDR for Ozone Layer monitoring and assume the SBUV/2 product roles in year-to-year Ozone Hole monitoring and NRT assimilation.
- The OMPS Version 8 total column ozone products will continue the TOMS/OMI CDRs. They will assume the roles of EOS OMI in NRT assimilation leading to UV Index Forecasts. Models can make good use of higher spatial resolution.
- The OMPS limb profiles will continue the high-vertical resolution ozone layer monitoring of the EOS Aura MLS and provide new resolution of ozone in the lower stratosphere for NRT assimilation.

# UV INDEX FORECAST

*Issued: 1200 UTC May 13, 2014 - Valid: Solar Noon on: May 14, 2014*



# Nadir Ozone Profile Path Forward (T. Beck Presenter)

- Nadir ozone profile algorithm (V8Pro)
  - ADL implementation completed.
  - Moving forward to implementation in IDPS.
  - Converges POES, CDR and JPSS products.
  - First iteration of soft calibration adjustments has been tested. Additional tuning will follow SDR updates.
  - Refinements for information concentration / outlier detection and smaller FOVs are under development.

# Mapper and Limb Path Forward (L. Flynn Presenter)

- Total column ozone algorithm (V8TOz)
  - Moving forward to implementation in IDPS
  - Converges EOS, MetOp, CDR and JPSS products.
  - An SO<sub>2</sub> module will be adapted from the OMI Linear Fit algorithm.
  - Adaptations for smaller FOVs are in preparation.
  - Refinements for information concentration / outlier detection have to be integrated into Input module.
- Limb ozone profile algorithm (V2LP)
  - The NASA S-NPP Science Team V2LP is in R2O for NDE.

# Summary

- The OMPS instruments are performing well and delivering ozone products to continue the over 30-years of satellite monitoring.
- Validated nadir total column ozone and ozone profiles will be available operationally by fall 2014.
- The limb ozone profiles provide global coverage of the ozone layer with high vertical resolution.
- The OMPS measurements can be used to provide other atmospheric chemistry and composition products at good horizontal resolution.

# Backup slides

SDR Path Forward (Solution Key: **DONE**, **READY**, **KNOWN APPROACH**, **UNKNOWN**, **FUTURE WORK**)

A. OMPS NP Ozone Profile

A.i. Turn on the 253 nm channel in the retrieval algorithm -- **DONE**.

A.ii. First version of the stray light correction. – **March 17 in Mx8.3 DONE**.

A.iii. Improved/tuned stray light correction table -- April (SDR Table Tuning) **Analysis shows more work is needed.**

**Which channels are the best proxies?**

A.iv. **New Day 1 Solar irradiance spectrum and wavelength scale** – May (SDR Table Tuning)

**I recommend that this be a simple -0.115 nm shift relative to Day 0. We would revisit with annual wavelength scale variations and wavelength dependent shifts in the future. (Should this also adjust the radiometric coefficients for the shift/dichroic? Should the solar activity level be picked for the current Mg II 27-day average state?)**

A.v. Proper matchup for Nadir Mapper and Nadir Profiler FOVs – **TTO May 19 in Mx8.4 (EDR only)**.

A.vi. Error in smear subtraction creating offset bias error – **Correct code (in Mx8.5), Change Input Bias to 742 counts.**

A.vii. **Soft Calibration adjustments including dichroic to Day 1 Solar or CF Earth -- May (SDR Table Tuning).**

**A.viii. Annual variations in the wavelength scale correlated with temperature gradients. SDR.**

**A.ix. Adjustments to Day 1 Solar for solar activity. SDR.**

B. OMPS NM Total Column Ozone

B.i. Measurement-based wavelength scale adjustments – **February 19 Mx8.1. DONE.**

B.ii. Revised profile mixing fraction logic – **March 17 in Mx8.3 (EDR only) DONE**

B.iii. **First version of OOR Table for the stray light correction -- May (SDR Table Tuning and Code Change)**

**New Table received. OOR cross-track dependence requires code change.**

**CCR to proceed with this for the Mx8.5 build. It is a change to the code and table dimensions. Minor ATBD and OAD and CDFCB changes.**

B.iv. **New Day 1 Solar irradiance spectra and wavelength scales. Should be set to middle of orbital scale variation.**

**Cross-track dependence is complex.** – May (SDR Table Tuning)

B.v. **Soft Calibration adjustments to Day 1 Solar or CF Earth -- May (SDR Table Tuning)**

**B.vi. Check flagging and logic for total ozone out of range and fill for triplet retrievals. (EDR)**

**B.vii. Possible bandpass changes -- ground to flight, intra-orbit.**

## Algorithm Path Forward

### OMPS NP V8

- C.i. Provide 12 soft calibration adjustments
- C.ii. Change to work with smaller FOVs (just along track)
- C.iii. Put in N-value fitting (Noise reduction, outlier identification and removal, and information concentration)
- C.iv. Add Solar Activity / Scale Factors

### OMPS TC V8

- D.i. Provide 12 soft calibration adjustments
- D.ii. Change to work with smaller FOVs (Interpolate the 35 Cross-track table as needed.)
- D.iii. Put in N-value fitting (Noise reduction, outlier identification and removal, and information concentration)
- D.iv. Put in Linear-Fit SO<sub>2</sub> module. (Eight Granules)