

TOAST total ozone maps using CrIS and OMPS LP profiles

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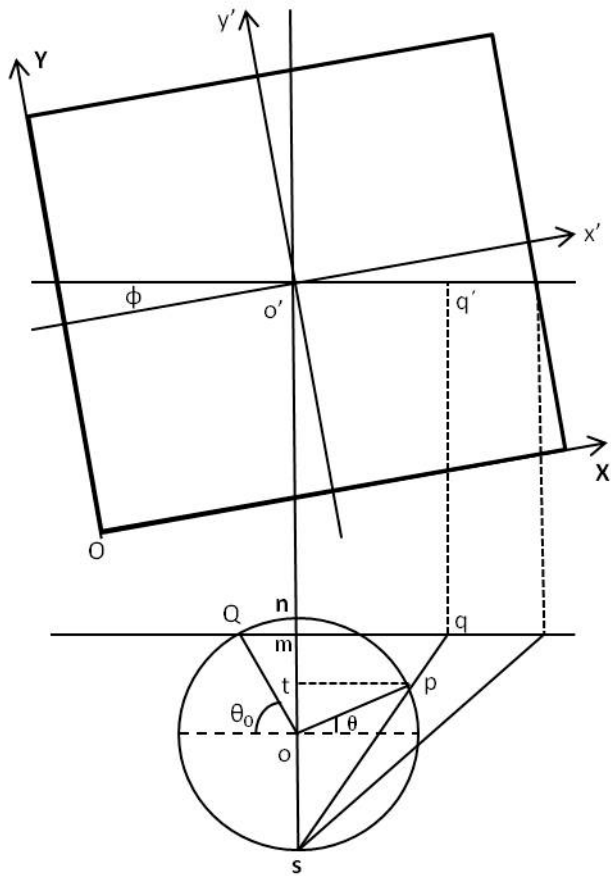
TOAST objective analysis

- **Basic consideration:**

1. IR obs. possess higher sensitivity to tropospheric ozone
2. UV obs. possess higher sensitivity to stratospheric ozone
3. Mix the IR and UV retrieved O₃ may increase O₃ accuracy
4. Fill in the UV observation gaps

- **Basic procedures:**

1. Convert IR and UV O₃ pressure scale into same pressure scales.
2. Transform coordinate from geographic into stereographic.
3. Objective analysis.
4. Analyzed global ozone data are transformed back to the geographic coordinate with 1° × 1° resolution.



$$X = \cos \theta \cdot \cos \phi \cdot \frac{\sin \theta_0 + 1}{\sin \theta + 1} \cdot \frac{Re}{mesh} + \frac{N-1}{2} \quad (1)$$

$$Y = \cos \theta \cdot \sin \phi \cdot \frac{\sin \theta_0 + 1}{\sin \theta + 1} \cdot \frac{Re}{mesh} + \frac{N-1}{2} \quad (2)$$

mesh=24,384/(N-1) km, $\theta_0=60^\circ$; N is mesh grid number;

For CrIS N=245; for OMPS N=65

Fig 1. coordinate transformation from geographic to Stereographic.

$$C = WE \quad (3)$$

$$W = \frac{R^2 - d^2}{R^2 + d^2} \quad (4)$$

Any initial value on the grid within radius R and the origin point A determined circle will be corrected by the sum of the initial value with correction value C, where E is the difference between observation and the initial value at A, W is a weighting factor.

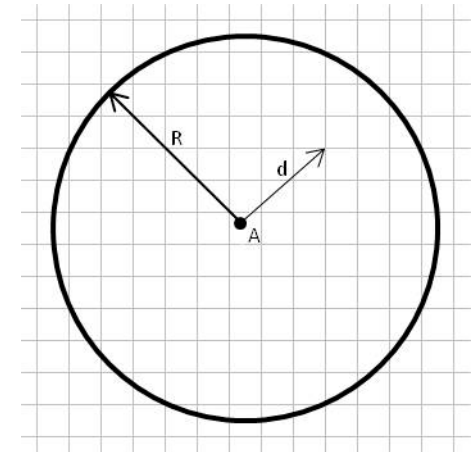


Fig 2. scheme of objective analysis

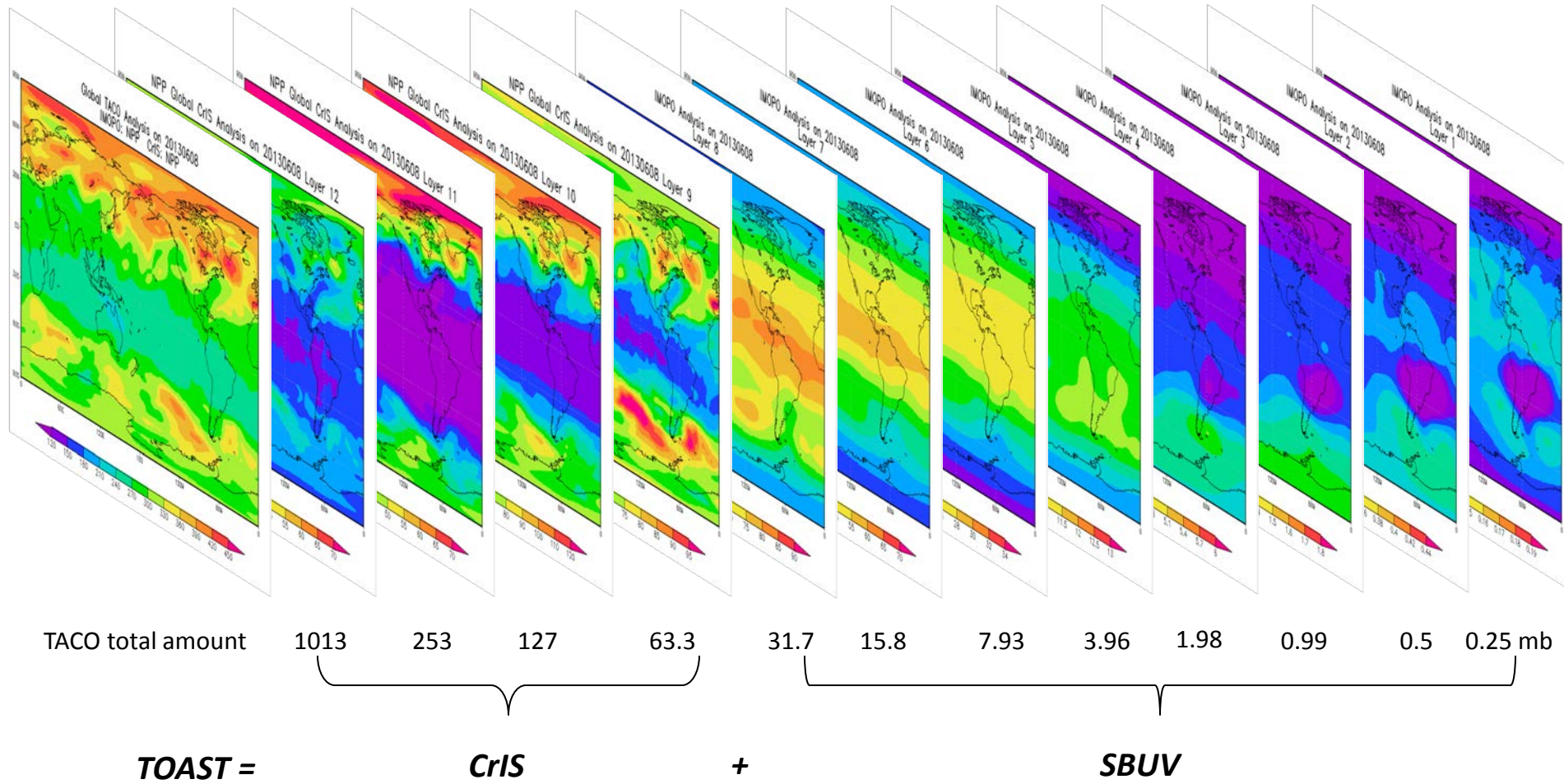
S-NPP provides following ozone sensors

- CrIS IR full global day and night profiles
- OMPS NP nadir view vertical profiler
- OMPS NM full daily total ozone for sunlit Earth
- OMPS LP limb view vertical profiles

The current TOAST was developed in 2014

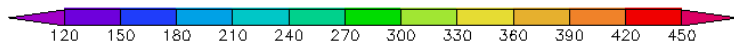
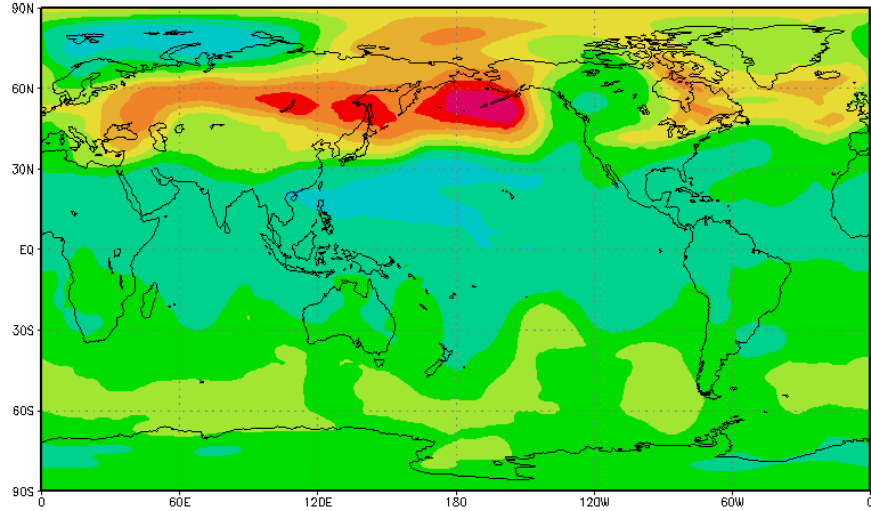
- **T**otal **O**zone from **A**nalysis of CrIS and SBUV2 in **S**tratosphere and **T**roposphere
- **TOAST** will use CrIS + OMPS NP when OMPS NP is at NDE.
- **TOAST** will use CrIS + OMPS LP when OMPS LP is at NDE.

Current operational TOAST using CrIS and SBUV-2 (06-08-2013)

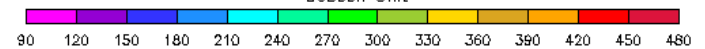
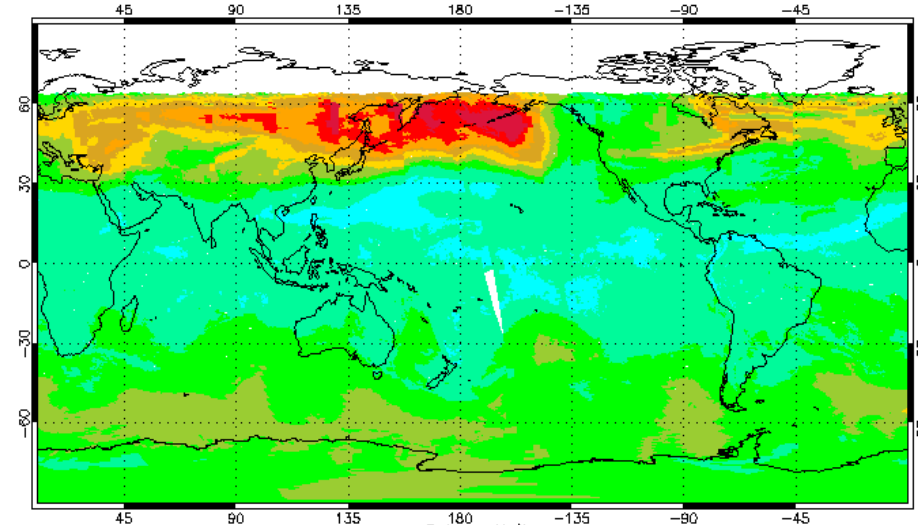


2016 Total column density of ozone from current TOAST and V8TOZ

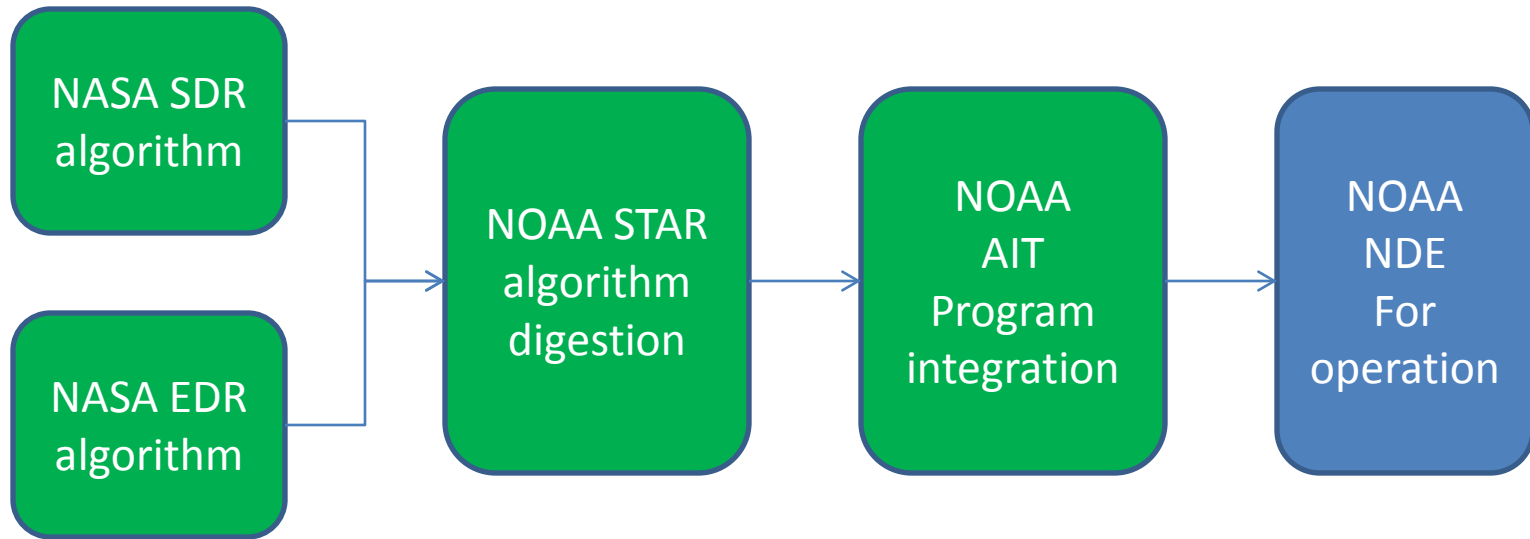
Global TACO Analysis on 2016001
SBUV/2: N19 CrIS: NPP



OMPS V8TOZ O3 (DU) 2016001



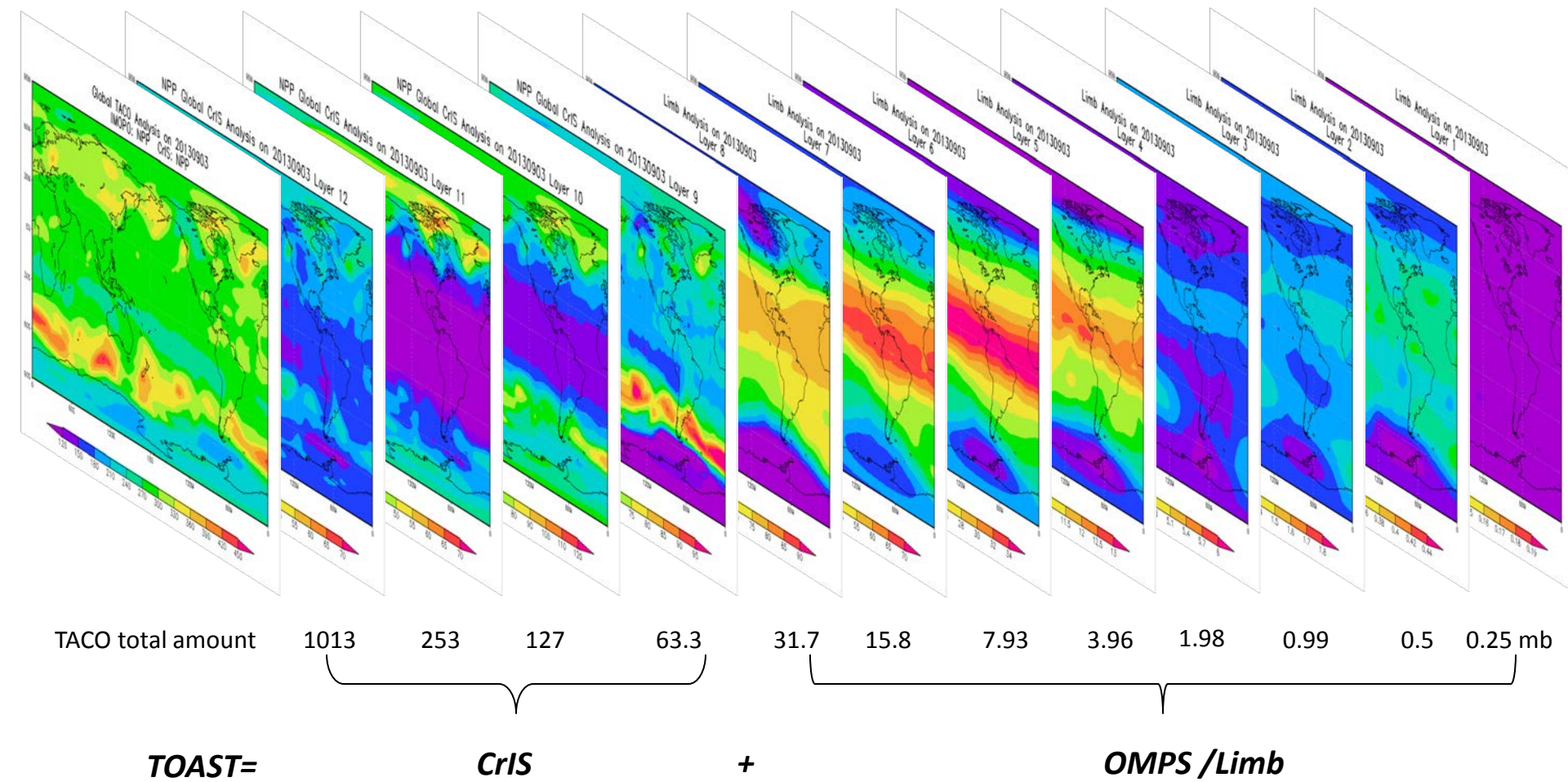
Limb processing algorithm status



Completed
work

Remaining
work

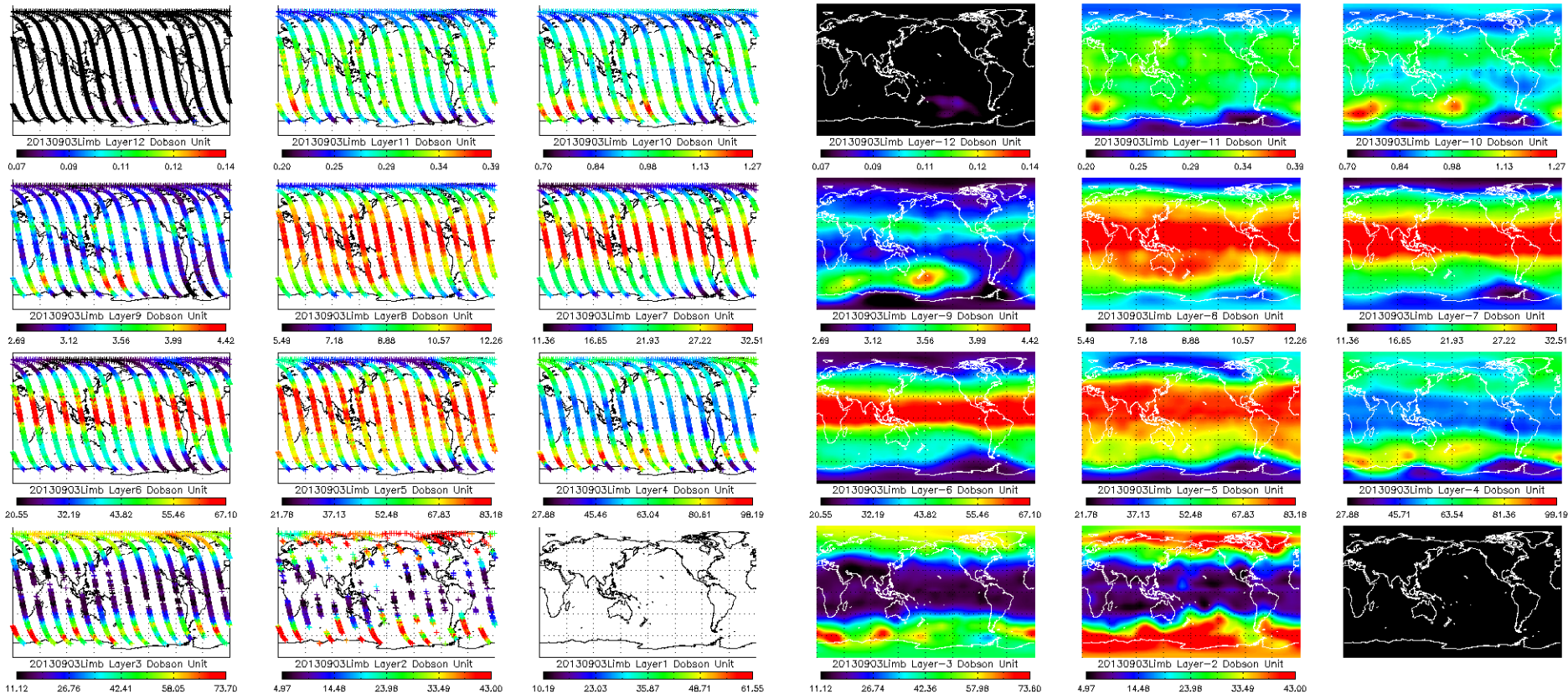
Last year demonstrated: TOAST using CrIS and Limb (09-03-2013)



Last year demonstrated: Limb Layer reformed vs. analyzed (09-03-2013)

Layer reformed Limb input

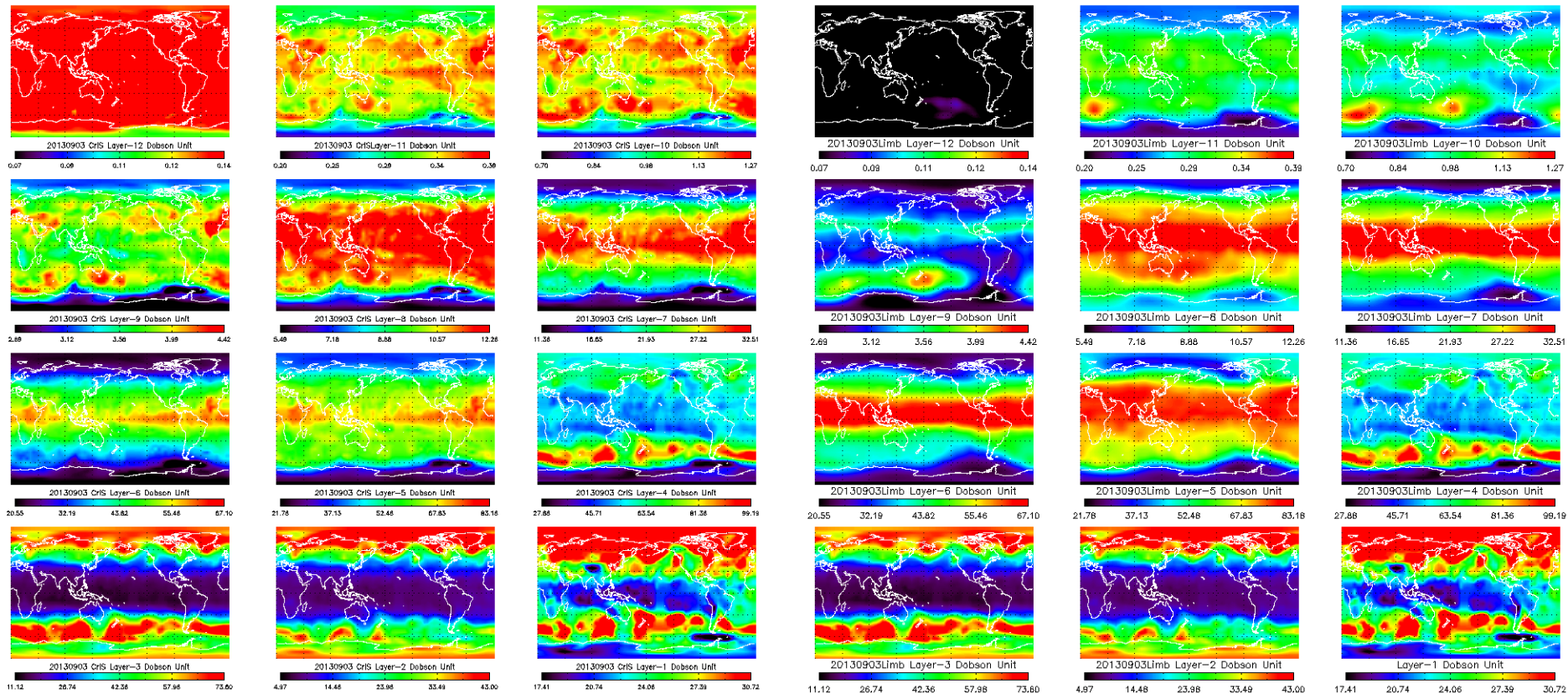
Limb TOAST analyzed



Last year demonstrated: Analyzed 12 Umkehr O₃ layers (09-03-2013)

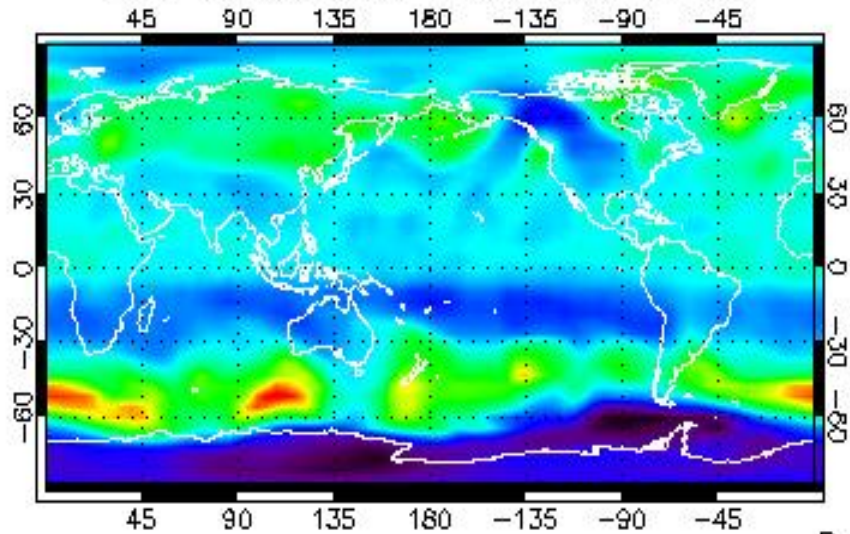
CrIS

CrIS + Limb

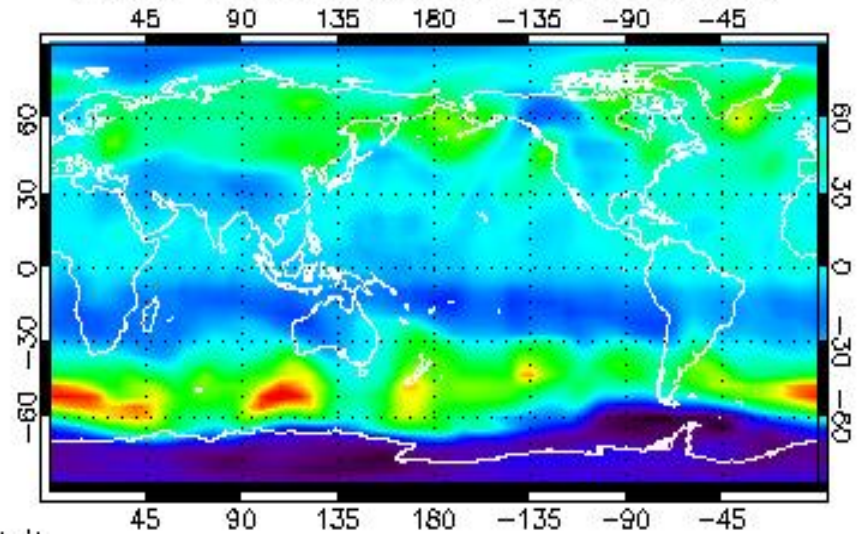


Last year demonstrated:

Limb-TOAST analyzed total O₃ at 20130903



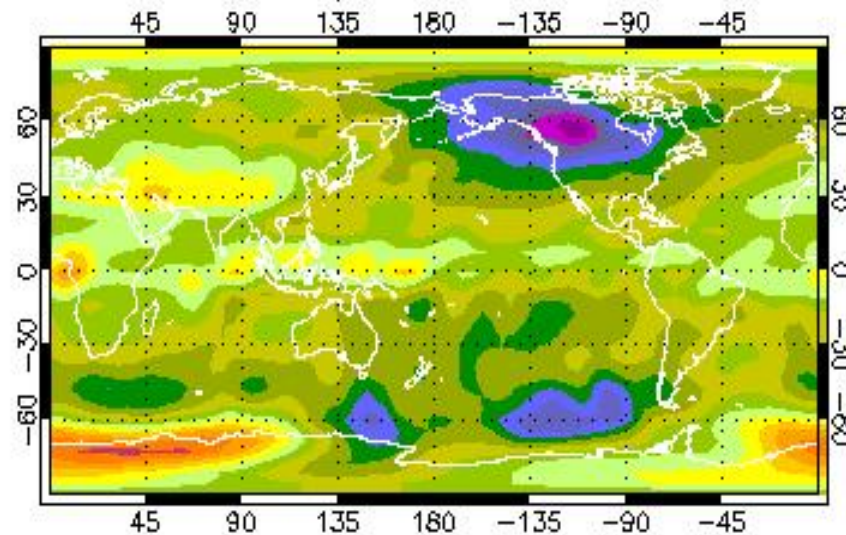
SBUV2-TOAST analyzed total O₃ at 20130903



Dobson Unit

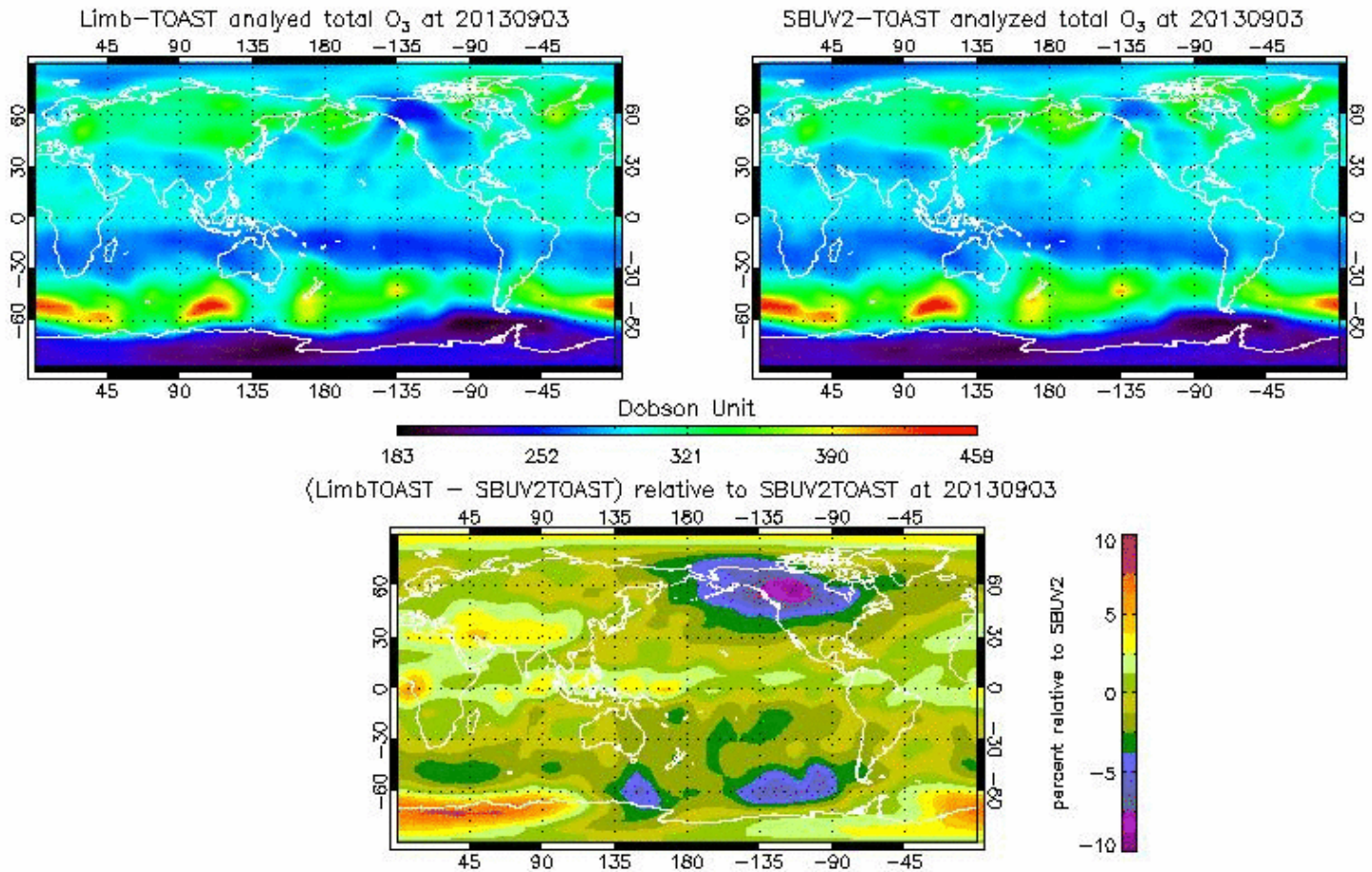
183 252 321 390 459

(LimbTOAST - SBUV2TOAST) relative to SBUV2TOAST at 20130903

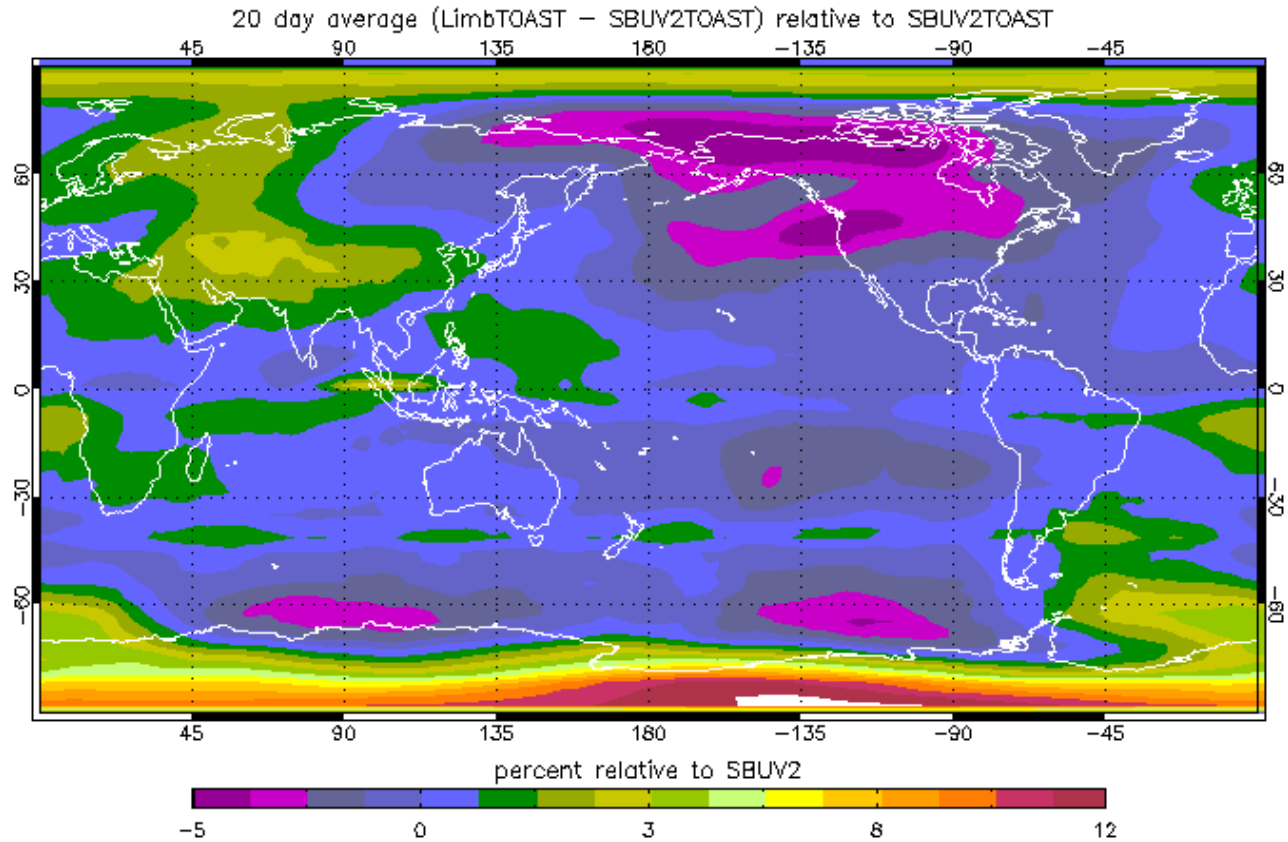


percent relative to SBUV2
10
5
0
-5
-10

Last year demonstrated: 20 days analyzed maps and the relative differences.



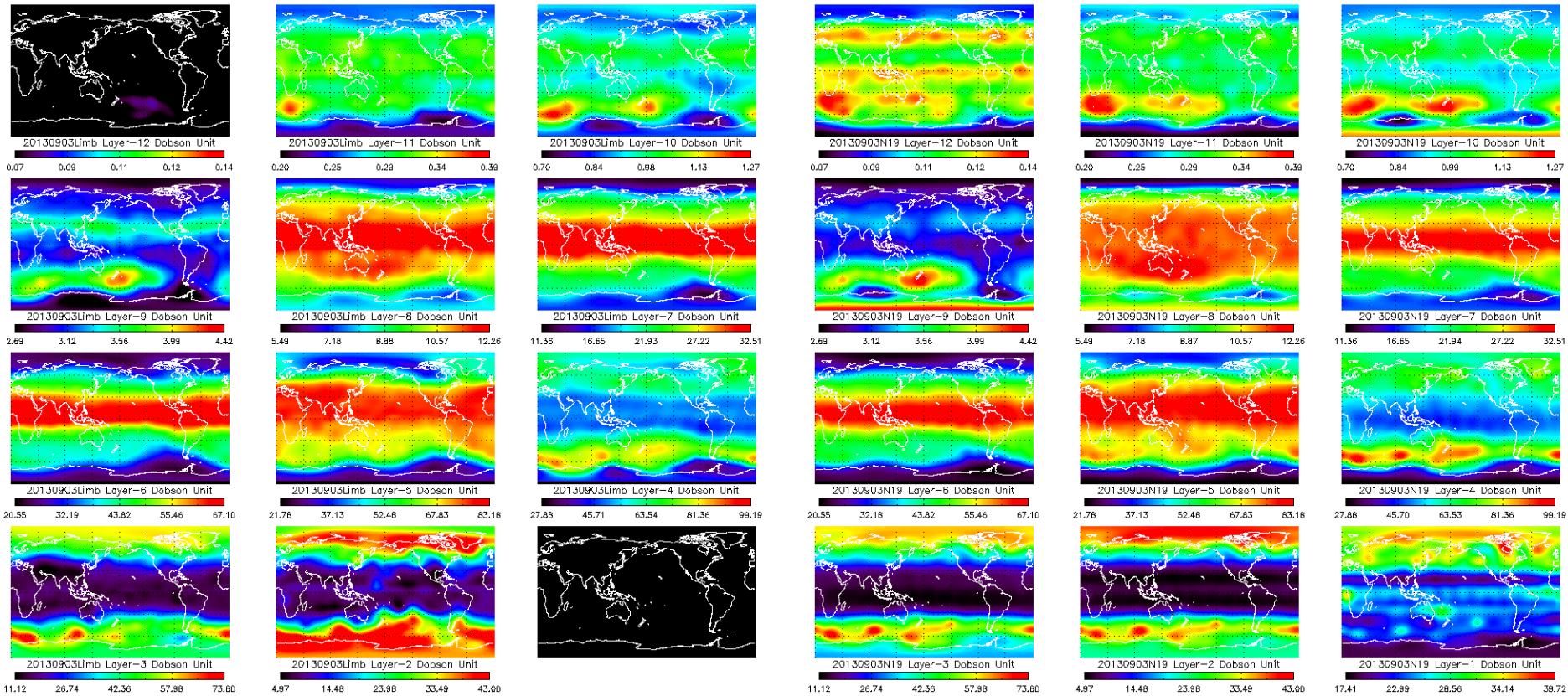
**Last year demonstrated:
20 day average of the relative differences to current version
from 09-03-2013 to 09-22-2013**



Analyzed 12 Umkehr O₃ layers 09-03-2013

Limb

SBUV



What we have achieved

- OMPS Limb TOAST and SBUV/2 TOAST show similar global patterns and values in the upper layers (comparison need to introduce retrieval averaging kernels)
- Limb analysis algorithm functions well from the comparison of the EDR input and analyzed figures
- 20 days of total column Ozone analysis have been conducted
- The averaged relative differences shows Limb TOAST total amount analysis has $\pm 5\%$ differences relative to current operational version (SBUV/2 TOAST).

The upcoming TOAST (CrIS + OMPS/Limb)

Baseline products:

- 12 layers global $1^\circ \times 1^\circ$ layer VCD O₃ maps
- Eight layers of Limb global $1^\circ \times 1^\circ$ layer VCD maps at pressure level of 31.7, 15.8, 7.93, 3.96, 1.98, 0.99, 0.50, 0.25 mb
- Four layers of CrIS global $1^\circ \times 1^\circ$ layer VCD maps at pressure level of 1013, 253, 127, 63.3 mb.

Based on operational request we could:

- Provide 21 layer (V8 layers $\sim 3\text{km}$) the same analyzed maps
- Provide 61 Limb layers of analyzed maps

Summary

- The TOAST algorithm for CrIS + Limb has been developed and tested using NUCAPS and NASA Limb Profiler daily data products.
- The OMSP Limb Profiler SDR and EDR processing algorithms have been successfully transferred from NASA to NOAA, and have completed code and security review, they are ready for implementation the next builds at NDE.

THANKS

SBUV 12-layer vs. analyzed 09-03-2013

SBUV-2 input

TOAST SBUV-2 analyzed

