Satellite Support for MIRAGE-mex

MOPITT, MODIS, MISR, AIRS, OMI, TES, GOES, CALIPSO, SCIAMACHY……

Satellite Data Support for MIRAGE

- **The satellite perspective provides the more general temporal and spatial context to the aircraft and ground-based measurements**
- **Some satellite instrument products are available in near-real time and this can assist in campaign flight planning**
- **Some were previously done for TRACE-P and INTEX-A/ICARTT**
- **Other data will be available after the campaign and will be useful in the subsequent scientific analysis**
- **Several groups are already preparing to support INTEX-B and similar support for MIRAGE may be possible by beginning expedited data processing earlier**

Available Data Sets

The following instrument groups have indicated a willingness to provide data during MIRAGE:

- **SCIAMACHY, Andreas Richter, University of Bremen: Near real time maps, and data if needed, of NO2, H2O, HCHO, cloud properties and possibly SO2. Data would be made available through the U. Bremen webpage in a similar way to the support for ICARTT**
- **MOPITT, David Edwards, NCAR: Near real time maps and data of CO together with an assimilated forecast product. Data would be made available through the NCAR webpage in a similar way to the support for INTEX-A**
- **AIRS, Wallace McMillan and Juying Warner, UMBC: Near real time maps and data of CO. Data would be made available through the UMBC webpage in a similar way to the support for INTEX-A**
- **OMI, Kelly Chance, Smithsonian: TBD. Near real time data (O3, NO2, etc)**
- **MISR, Ralph Kahn, JPL: Aerosol**
- **MODIS, Allen Chu, NASA GSFC: Aerosol optical depth. IDEA near real time products from direct broadcasting at CIMSS University of Wisconsin, Madison covers the outflow region north of Mexico City. Using NOAA bent pipe or other MODIS DB (i.e., Texas) is planned to cover the whole area of Mexico. High resolution (5km, 2km, or 1km) AOD products may be available.**
- **TES???**

Satellite Products:

Satellite Sensor	Products	Spatial resolution Km^2	Field Contact At Houston
SCIAMACHY	NO2, CO, H2O, SO2 (column)	30 x 60	Daniel Jacob
MOPITT	CO (column)	22 x 22	Louisa Emmons
AIRS	CO (column)	50 x 50	Wallace McMillian
OMI	Absorbing AOD, O3 (Trop), NO2, CH2O, CHOCHO	13 x 24 52 x 48 (O3) 26 x 48 (NO2)	Daniel Jacob
MISR	AOD, RGB	10 x 10	Jens Rademann to contact MISR team
MODIS	AOD, fire, RGB	10 x 10	Brad Pierce
TES	O3 (profile), CO (column), HNO3 (Upper Trop)	0.5 x 5	Daniel Jacob
GOES	AOD, fire, single color	4 x 4	Wallace McMillian
CALIPSO	Aerosol profile	5 x 5	Jens Rademann to contact CALIPSO team

Satellite Sensor Overpass and Data availability

Satellite Sensor	Overpass Time	Swath Width	Data Availability
SCIAMACHY	10:00 a.m.	960 km	Near real time
MOPITT	10:30 a.m.	600 km	Near real time
AIRS	1:30 p.m.	1,650 km	Near real time
OMI	1:40 p.m.	2,600 km	Near real time (O3 only)?
MISR	10:30 a.m.	360 km	Near real time
MODIS	10:30 a.m. & 1:30 p.m.	2,330 km	Near real time
TES	1:40 p.m.	5.3 x 8.5	Near real time?
GOES	Hourly	Full disk	Near real time
CALIPSO	1:31 p.m.	Point	48 hours

The "A-Train"

- Aura has joined Aqua as the second member of the "A-Train." Aura and Aqua will fly within 15 minutes of each other on nearly the same orbit track.
- In 2005 Aura and Aqua will be joined by three small satellites, CALIPSO, Cloudsat and the CNES PARASOL which will fly close behind Aqua.
- In 2007 OCO will join the front of the 'A-Train'
- The joint measurements by these six satellites within ~40 minutes will provide an unprecedented sensor system for Earth observations

Equator crossing times shown - Aura is 15 minutes behind Aqua but its orbit track is slightly to the west so the equator crossing time is only 8 minutes different.

Example SCIAMACHY Web pages from ICARTT

http://www.doas-bremen.de/intexb.htm

University of Bremen IUP DOAS

Tropospheric NO_2 from SCIAMACHY and GOME for ICARTT

News Introduction Data References Links Contact Acknowledgements

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GROUND-BASED
AIRBORNE
DATA PRODUCTS

Navigate

Up
ICARTT
CONTRACE-2
MINOS

News:

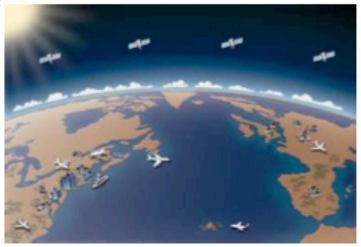
06 July 2004:

- SCIAMACHY back to measurement
  Shortly after yesterday's CCA MCMD check error, recovery back to measurement was initiated. The transfer to HEATER mode started at 13:25 UTC and today in orbit 12286 (July 6th, 10:22 UTC) the MPS schedule was resumed. We expect that detectors 1-6 will reach stable temperatures tomorrow, July 7th, at about 13:30 UTC. Detectors 7 & 8 require about 16 hours more time to stabilize.

05 July 2004:

- Transfer to R/W WAIT mode
  In orbit 12269, (July 5th, 05:52 UTC), a CCA MCMD check error has occurred and has sent us to R/W WAIT. SCIAMACHY had the last error of this kind 6 months ago in January 2004, i.e. the frequency is compliant with the estimate of 2-3/year.
  Hopefully SCIAMACHY is running in normal mode by tomorrow.
- HCHO has been added to the NRT trace gases

Introduction:



The ICARTT (International Consortium of Atmospheric Research on Transport andTransformation) is combining several regional research projects, independently developed by different international groups in the US and in Europe, to develop a better understanding of the evolution of anthorpogenic emission injected into the atmosphere. The major participants of the consortium are NOAA with the New England Air Quality Study - Intercontinental Transport and Chemical Transformation (NEAQS - ITCT 2004) program, NASA with the Intercontinental Chemical Transport Experiment - North America (INTEX-NA) earth science mission and on the european side the Intercontinental Transport of Ozone and Precursors - North Atlantic Study (ITOP).

The regional projects are involving several aircraft missions in the area of the NE-US, the North Atlantic and Western Europe to study local air quality. Joining the efforts by coordinating the single missions, will provide information about the pathways of intercontinental transport of pollution and about the chemical transformation, the aging of the air masses, as they pass from the US over the Atlantic to Europe.

Therefore three main objectives are:

- to study the regional air quality to constrain the emission source strength and the regional pathways of pollution in the northeastern United States and the Maritime Provinces of Canada.
- to investigate major intercontinental transport events, which are connected to uplifting of pollution near the source region due to the warm conveyor belt. But also investigation of boundary layer outflow mechanisms.
- a detailed analysis of the radition balance, in particular to measure separately the direct and indirect radiative effects of aerosol pollution in plumes.

In support of ICARTT, the Institute of Environmental Physics at the University of Bremen with support from NOAA and NASA is providing near real time images of tropospheric NO2 from SCIAMACHY and GOME measurements. The plots are meant as quick look analysis and numbers will change in post campaign analysis.

Currently, only NO2 data is available, but more trace species will be added soon.

More details on the analysis procedures can be found in the references given below.

Data:

The data products for the ICARTT campaign, currently NO_2 and H_2O, are directly accessible via the calendar below.

These plots are produced automatically and are based on SCIAMACHY raw data. Usually, plots should be available with a delay of one day. If you experience any problems, please contact Andreas Heckel.

In addition all currently processed data products from SCIAMACHY can be found in the SCIAMACHY Data Archive of IUP / ife Bremen.

May 2004						
Mo	Tu	We	Th	Fr	Sa	Su
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

June 2004						
Mo	Tu	We	Th	Fr	Sa	Su
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

July 2004						
Mo	Tu	We	Th	Fr	Sa	Su
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

August 2004						
Mo	Tu	We	Th	Fr	Sa	Su
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

September 2004						
Mo	Tu	We	Th	Fr	Sa	Su
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26

October 2004						
Mo	Tu	We	Th	Fr	Sa	Su
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24

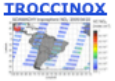
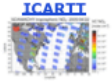
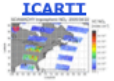
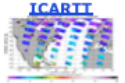
November 2004						
Mo	Tu	We	Th	Fr	Sa	Su
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

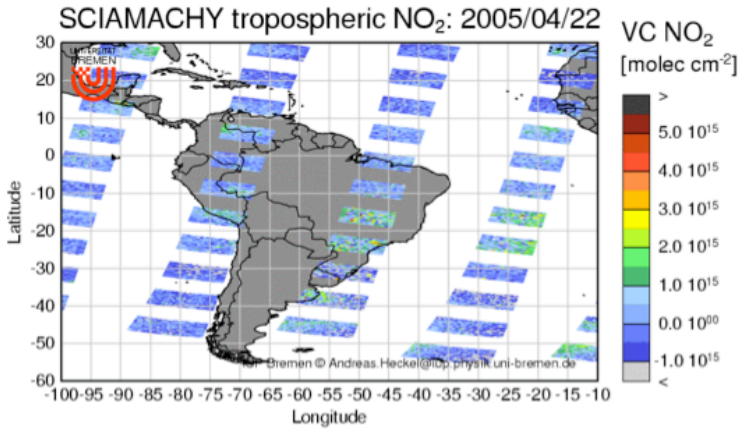
December 2004						
Mo	Tu	We	Th	Fr	Sa	Su
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26

SCIAMACHY NRT Products

SCIAMACHY NRT Products

2005/04/21 BACK 2005/04/23

TROCCINOX	ICARTT	ICARTT	ICARTT	ICARTT
				Sorry, no data yet.
NO_2	NO_2	East Coast NO_2	H_2O	HCHO



Example MOPITT Web pages from INTEX

http://www.eos.ucar.edu/mopitt

TERRA MOPITT Support for the INTEX Field Campaign

MOPITT Support for the INTEX Field Campaign

Each Day contains six products:

- Overpass Predictions
- Forecast Images
- Assimilation Images
- Daily Images
- Global 3-Day Images
- INTEX Region 3-Day Images
- Downloadable Data

Additional Materials:

- Science Log - highlights features or provides scientific narrative about the data. Updated often.
- Movies - animated view of the field project experiment (mpeg format).

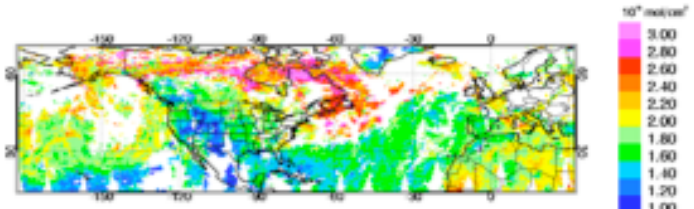
May 2004						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

June 2004						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

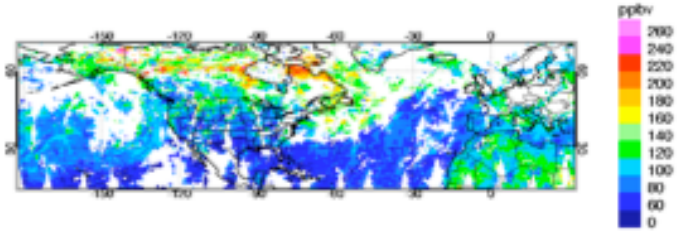
July 2004						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

3-Day Field Project Region Plots for 2004-07-12 through 2004-07-14

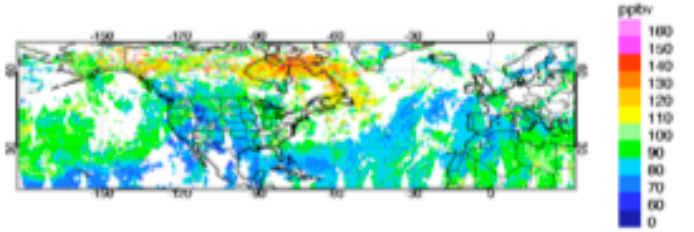
MOPITT CO (V3) Column Jul 12, 2004-Jul 14, 2004



MOPITT CO (V3) 700hPa Jul 12, 2004-Jul 14, 2004



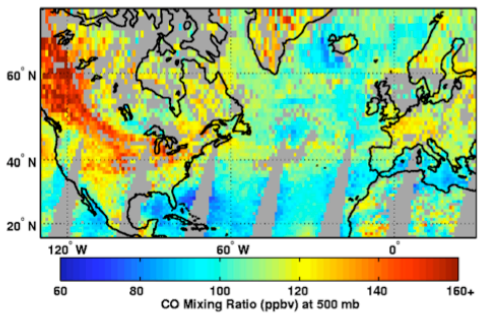
MOPITT CO (V3) 350hPa Jul 12, 2004-Jul 14, 2004



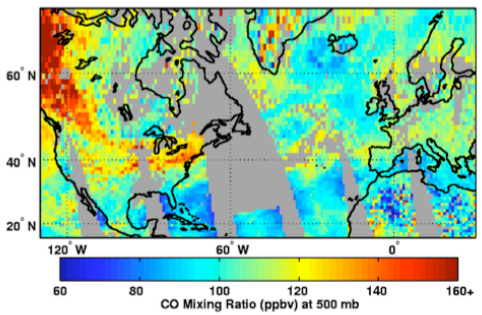
Example AIRS Web pages from INTEX

UMBC INTEX Page: AIRS CO 20040624 (YYYYMMDD), Julian Day 176

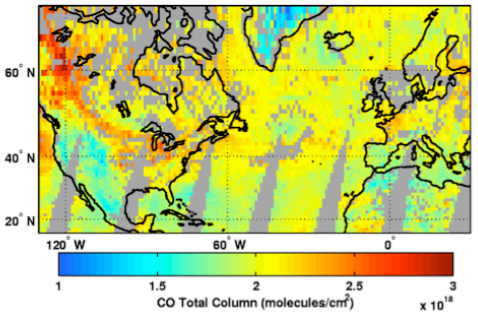
Local AM (descending) AIRS CO at 500 mb on 20040624



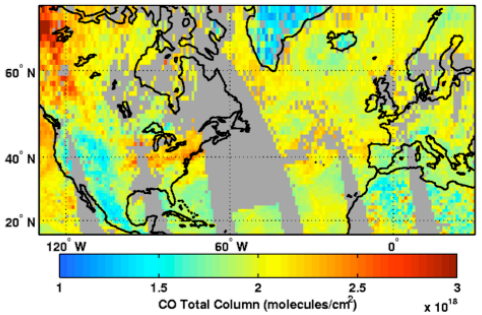
Local PM (ascending) AIRS CO at 500 mb on 20040624



Local AM (descending) AIRS CO Total Column on 20040624



Local PM (ascending) AIRS CO Total Column on 20040624



This quicklook data is for the exclusive internal (INTEX flight-planning and evaluation) use of authorized INTEX participants. External, public dissemnation of this data is permitted only with the express written consent of the PI, Dr. W. Wallace McMillan (UMBC).
20040624 AM NetCDF data (gridded 500mb and Total Column)

This quicklook data is for the exclusive internal (INTEX flight-planning and evaluation) use of authorized INTEX participants. External, public dissemnation of this data is permitted only with the express written consent of the PI, Dr. W. Wallace McMillan (UMBC).
20040624 PM NetCDF data (gridded 500mb and Total Column)

Return to UMBC/AIRS CO INTEX page

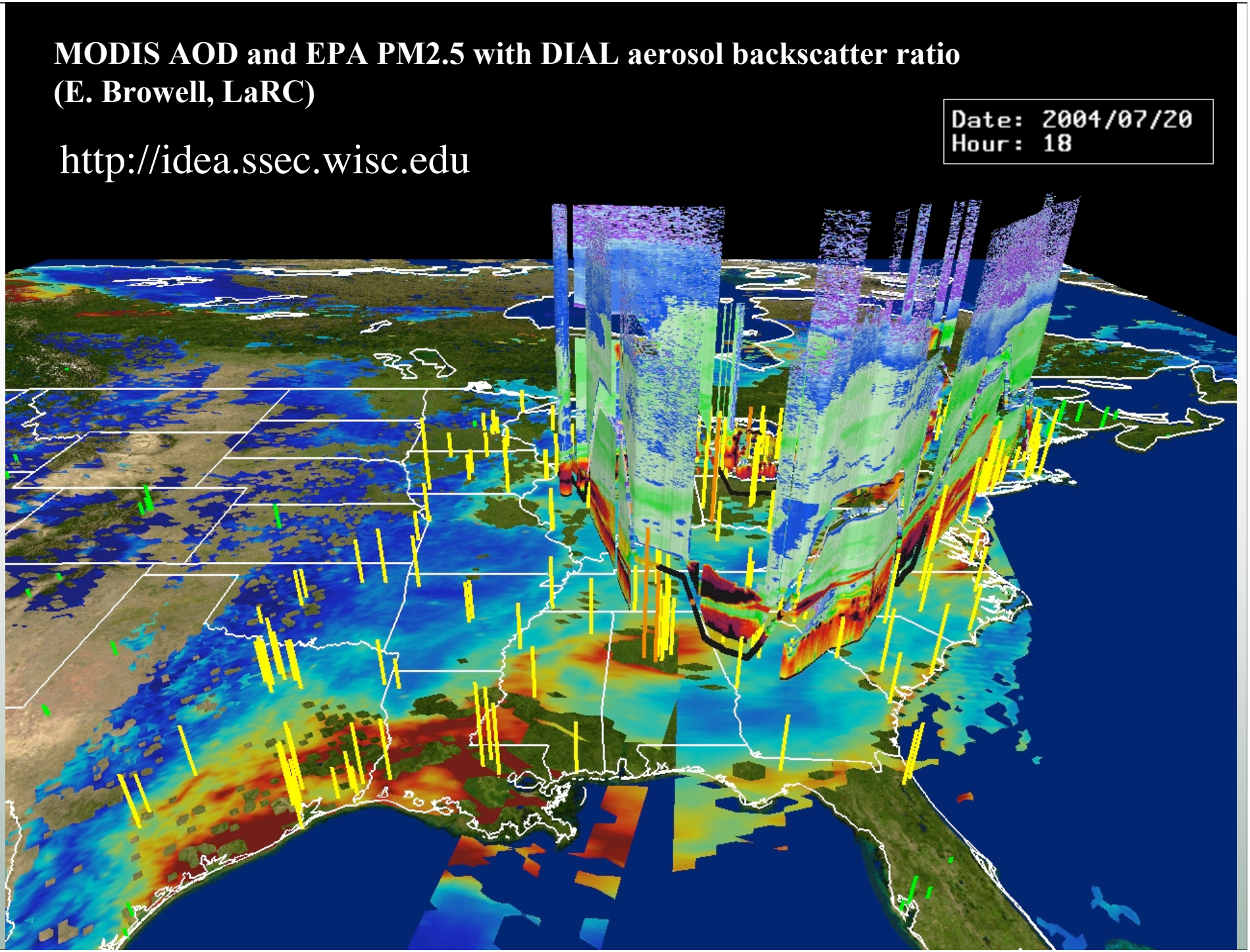
Mail to: Wallace McMillan

Last modified 29-Jun-2004 at 1023 EDT

http://physics.umbc.edu/~mcmillan

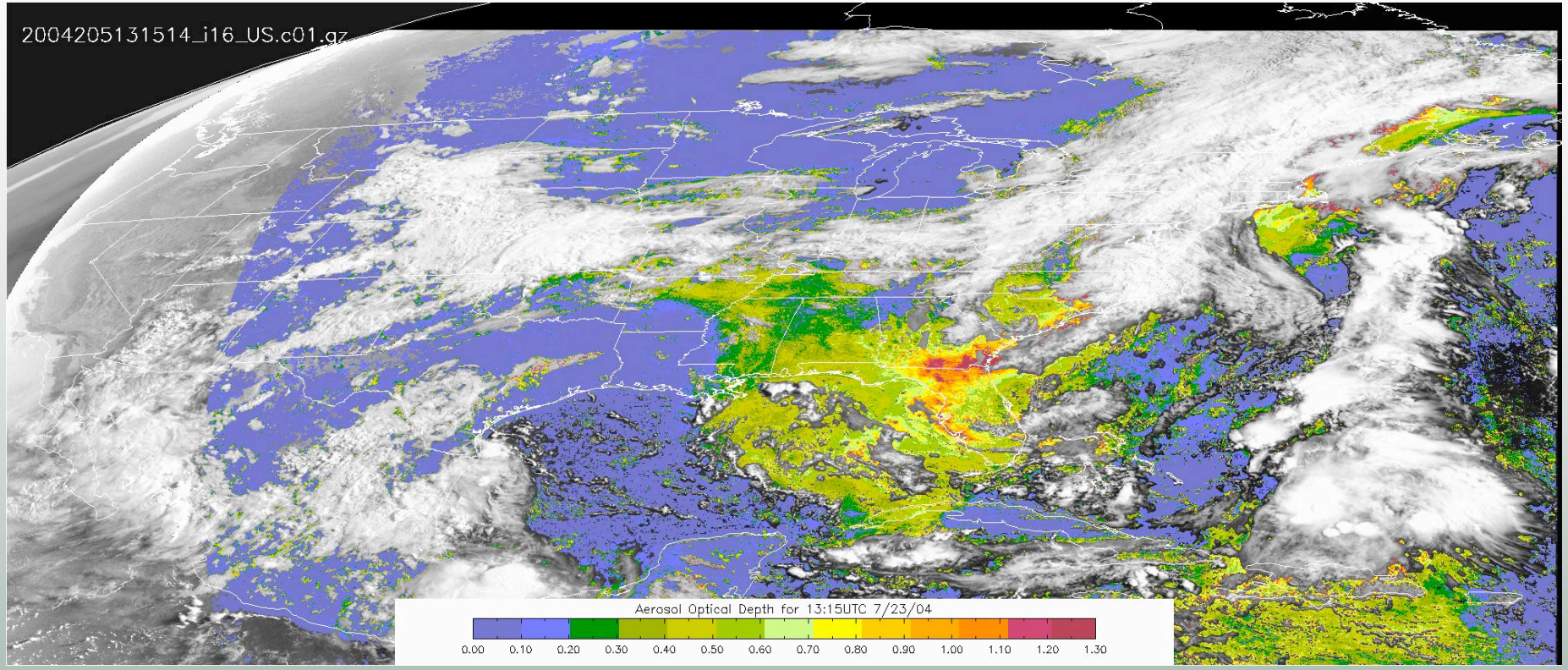
MODIS AOD and EPA PM2.5 with DIAL aerosol backscatter ratio
(E. Browell, LaRC)

http://idea.ssec.wisc.edu

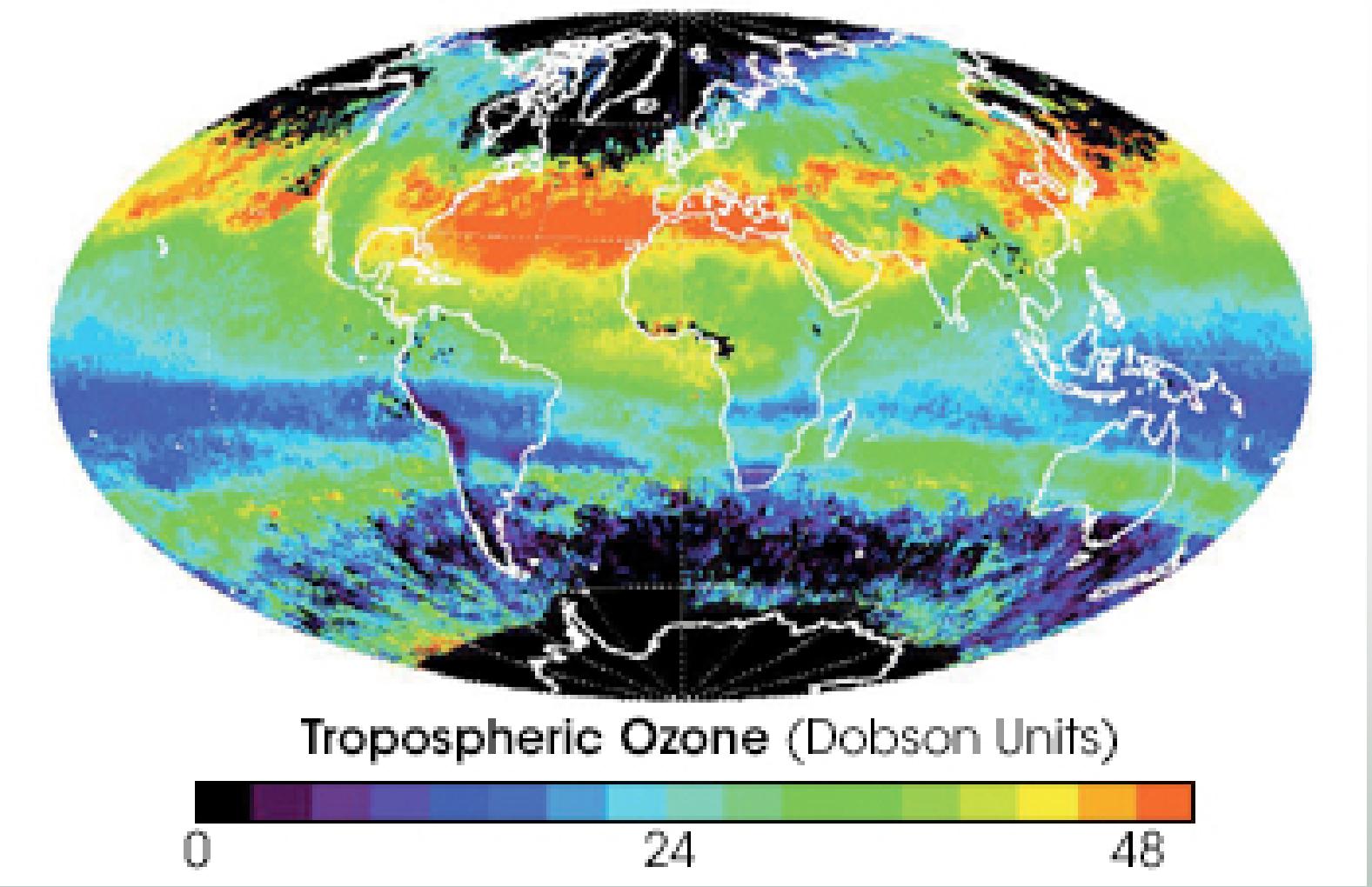


GOES Aerosol and Smoke Products (GASP) derived by a single channel (0.67 μm) retrieval algorithm, which provide hourly aerosol optical depth image over the US at 4 km resolution, most suitable for flight planning.

http://www.gis.ssd.nesdis.noaa.gov/GASP/viewer.htm

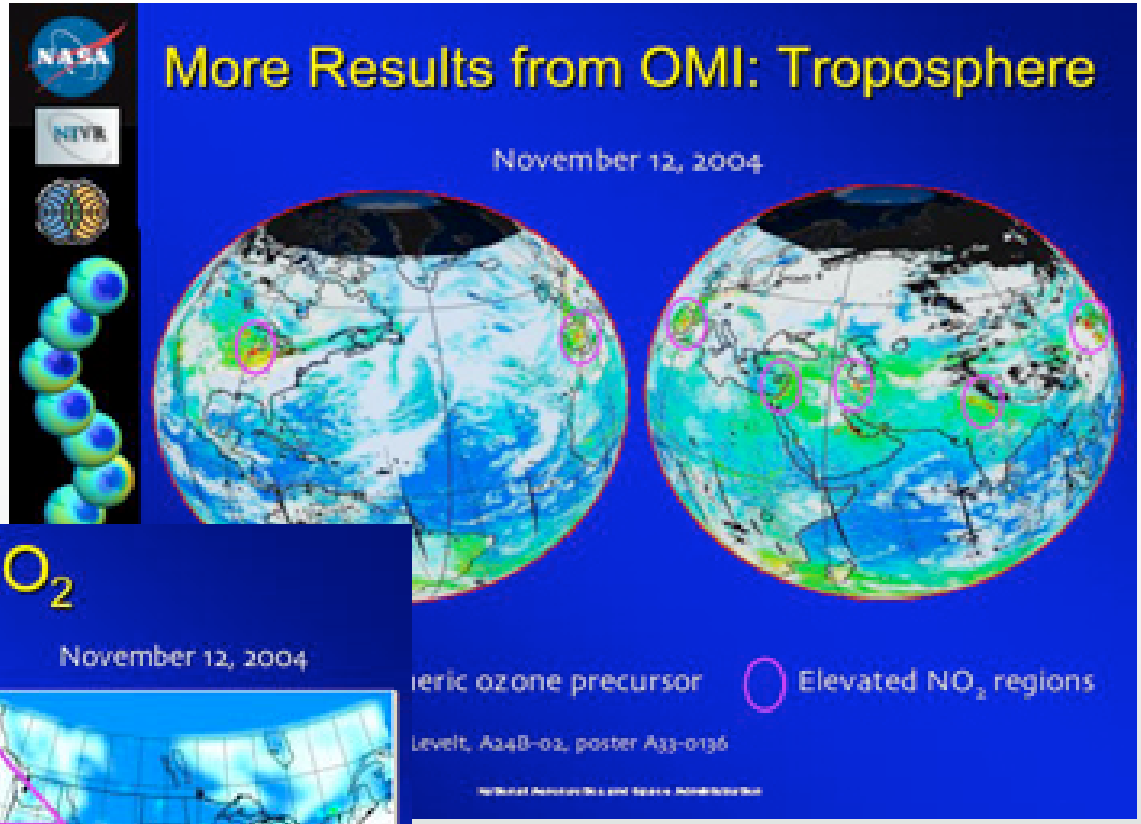


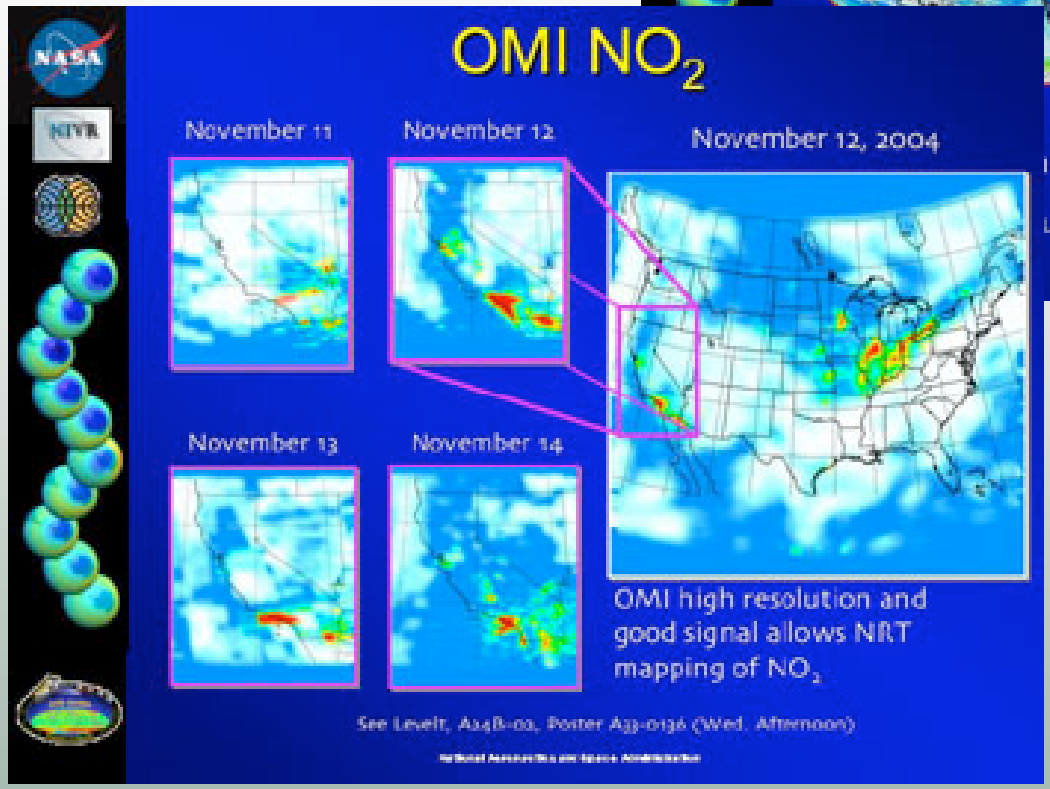
Tropospheric Ozone from OMI



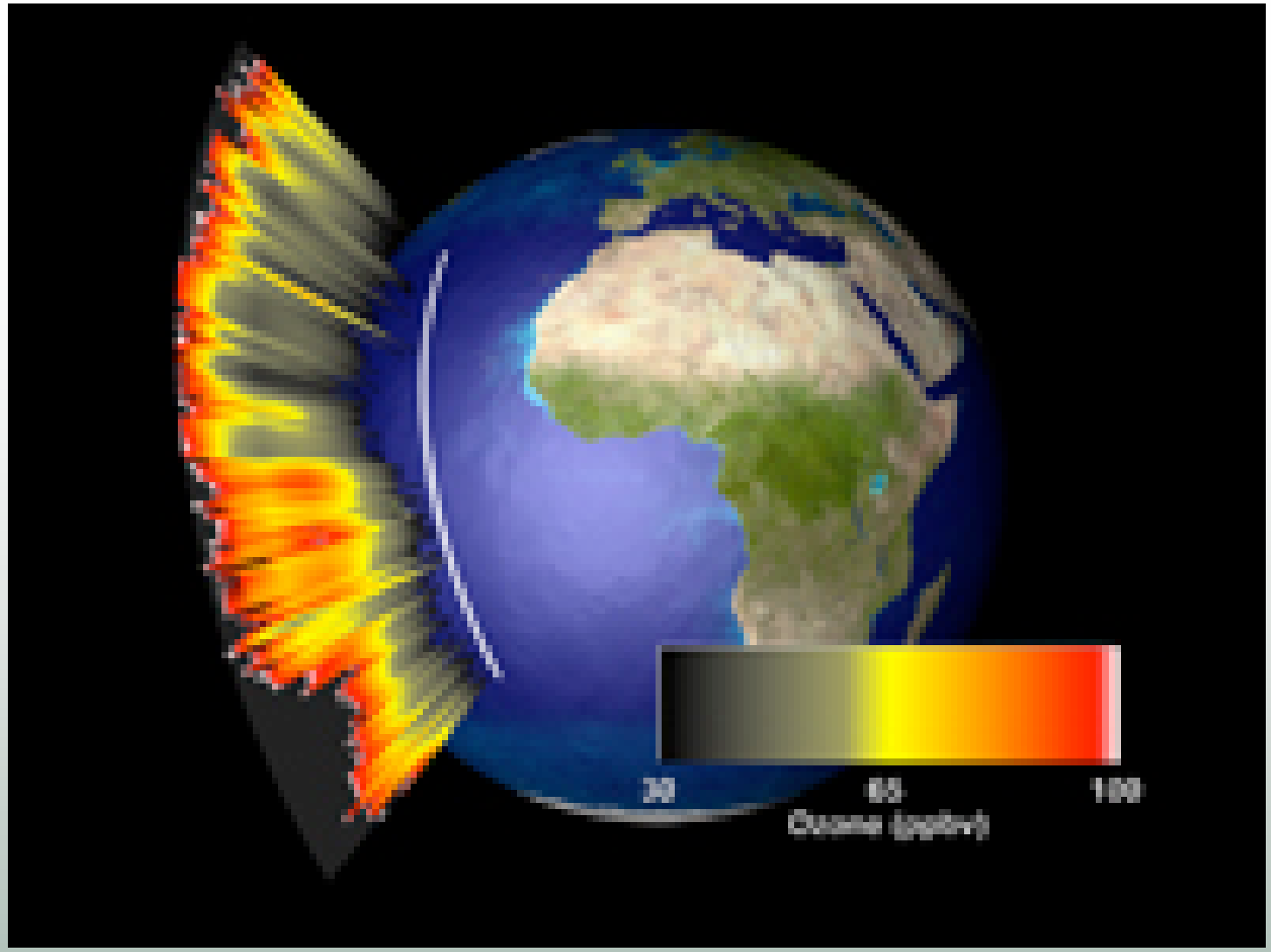
This monthly average map was made by subtracting the stratospheric ozone column from TOMS column ozone. The stratospheric column is calculated using UARS MLS measurements. Higher quality tropospheric ozone maps on a daily basis will be produced from OMI and HIRDLS data. (Image courtesy S. Chandra and J. Ziemke, NASA GSFC).

Tropospheric NO2 from OMI





TES Ozone Profile



Complete List of OMI and TES Products

OMI Data Products

Product Name	Units	Accuracy Abs::Rel [1]	Temporal Resolution	Horizontal Resol.::Cover[1] [2]	Vertical Resol.:: Cover
Radiances	Watts/cm^2/sr	3%::1%	once/day	13 x 24 km::G D	NA
Total Ozone	DU [3]	3%::1.5%	once/day	13 x 24 km::G D	Column
Ozone Profile	ppmv	10%::10%	once/day	13 x 48 km::G D	6 km::20-45 km
Tropospheric Column Ozone	DU[3]	25%::10%	once/day	52 x 48 km::60S-60N D	Column
Surface UVB Flux	watt/m^2	10%::10%	once/day	13 x 24 km::GD	Surface
Cloud Scattering Layer Pressure[4]	hPa	100hPa::30hPa	once/day	13 x 24 km::D	Surface
Aerosol Optical Thickness [5]	Dimensionless	0.1::0.05 30%::10%	once/day	13 x 24 km::G D	Column
Aerosol Single Scattering Albedo	Dimensionless	0.1::0.05	once/day	13 x 24 km::GD	Column
SO_2	mol/cm^2	3x10^{16} (50%)::2x10^{16} (20%) non-volcanic 30%::20% volcanic	once/day	13 x 24 km::G Daylight	Column
NO_2	molecules/cm^2	2x10^{14}::2x10^{14} background 30%::20% polluted	once/day	26 x 48 km:GD	Column
HCHO	molecules/ cm^2	35%::25%	once/day	13x24 km::GD	Column

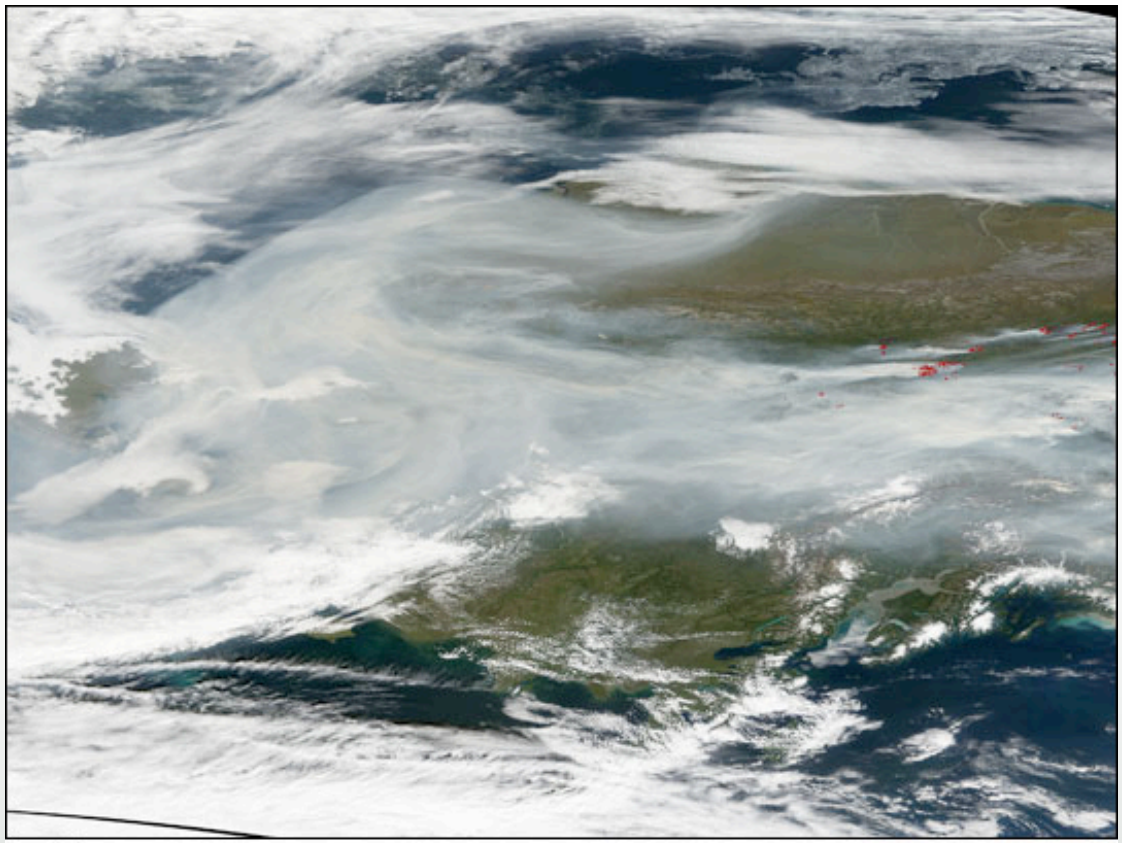
TES Data Products

Product Name	Units	Accuracy Abs::Rel	Temporal Resolution	Horizontal Resol.::Cover[1]	Vertical Resol.:: Cover
Level-1B Radiances [@ 10 µm]	W/m^2/sr/cm^{-1}	1%::1%	1/(2 day)	5.3 x 8.5 km::GN 53 x 169 km::GL	
				5.3 x 8.5 km::GN	
Temperature Profile	K	2 K::1 K	1/(2 day)	53 x 169 km::GL	2-6 km::0-34 km
H_2O mixing ratio	%v	3%::3%v 3%::3-20 ppbv	1/(2 day)	5.3 x 8.5 km::GN 53 x 169 km::GL	2-6 km::0-34 km
O_3 mixing ratio	ppbv		1/(2 day)	5.3 x 8.5 km::GN 53 x 169 km::GL	2-6 km::0-34 km
CO mixing ratio	ppbv	3%::10 ppbv	1/(2 day)	5.3 x 8.5 km::GN 53 x 169 km::GL	2-6 km::0-34 km
CH4 mixing ratio	ppbv	3%::14 ppbv	1/(2 day)	5.3 x 8.5 km::GN 53 x 169 km::GL	2-6 km::0-34 km
HNO_3 mixing ratio	pptv	5%::25 pptv	1/(2 day)	53 x 169 km::GL	2-6 km::5-34 km
NO_2 mixing ratio	pptv	5%::500 pptv	1/(2 day)	53 x 169 km::GL	2-6 km::10-34 km
Surface Temperature	K	1 K:: 1 K	1/(2 day)	533 x 8.5 km::GN	NA::sfc

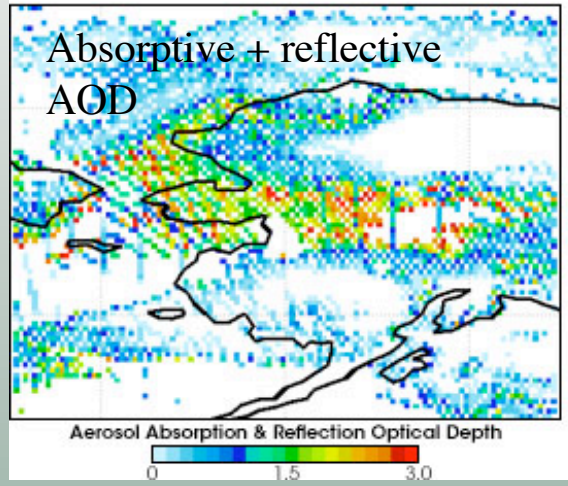
1 GN represents Global Coverage (nadir view); GL represents Global Coverage (limb view);

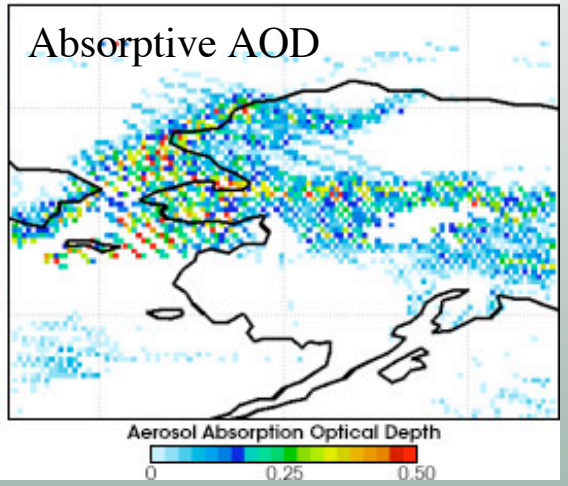
2 NA = not applicable

3 Values for clear skies, northern mid-latitudes & mid-troposphere



True Color



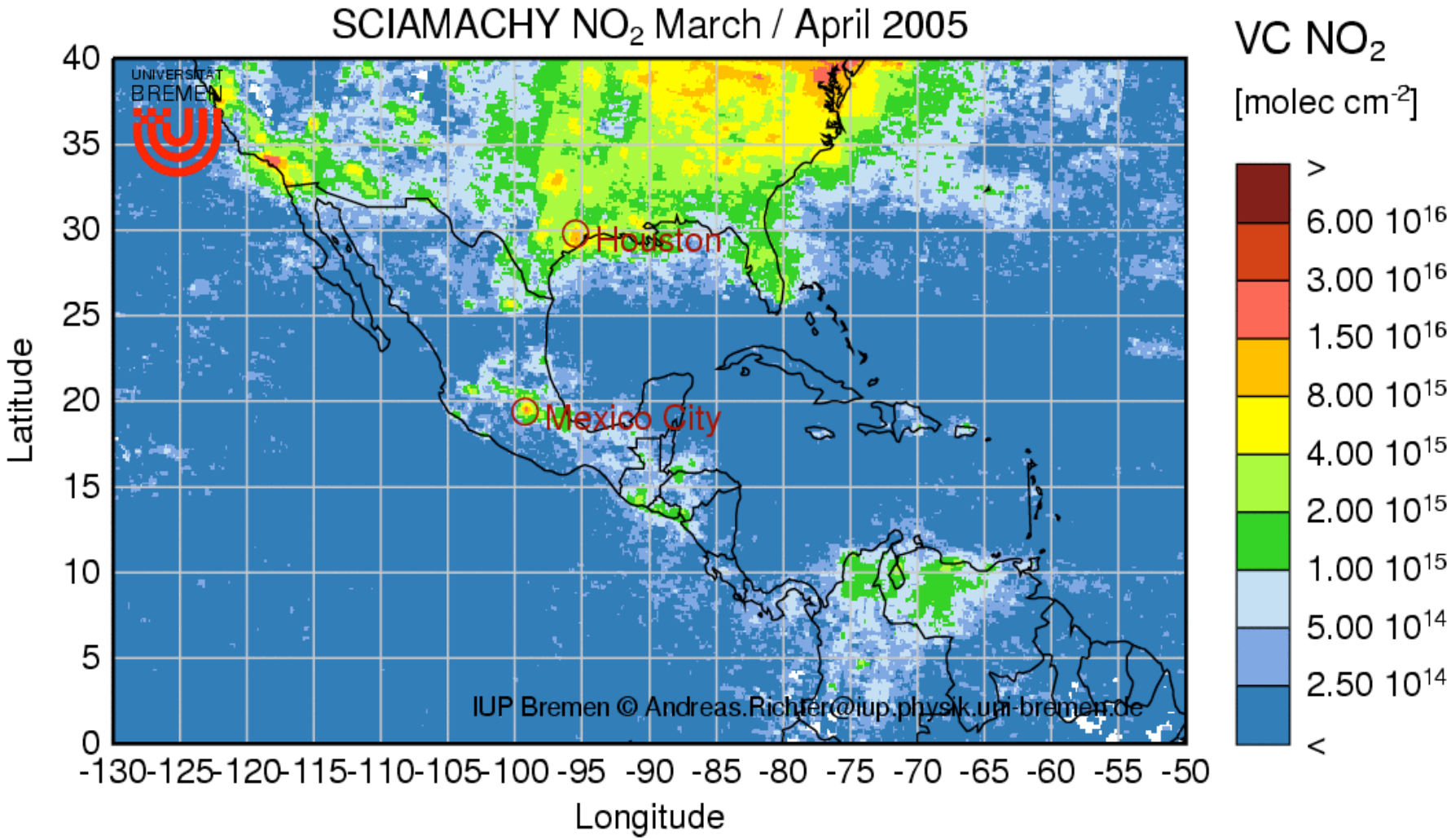


Absorbing aerosol (e.g., black carbon) optical depth from OMI (UV spectrum)

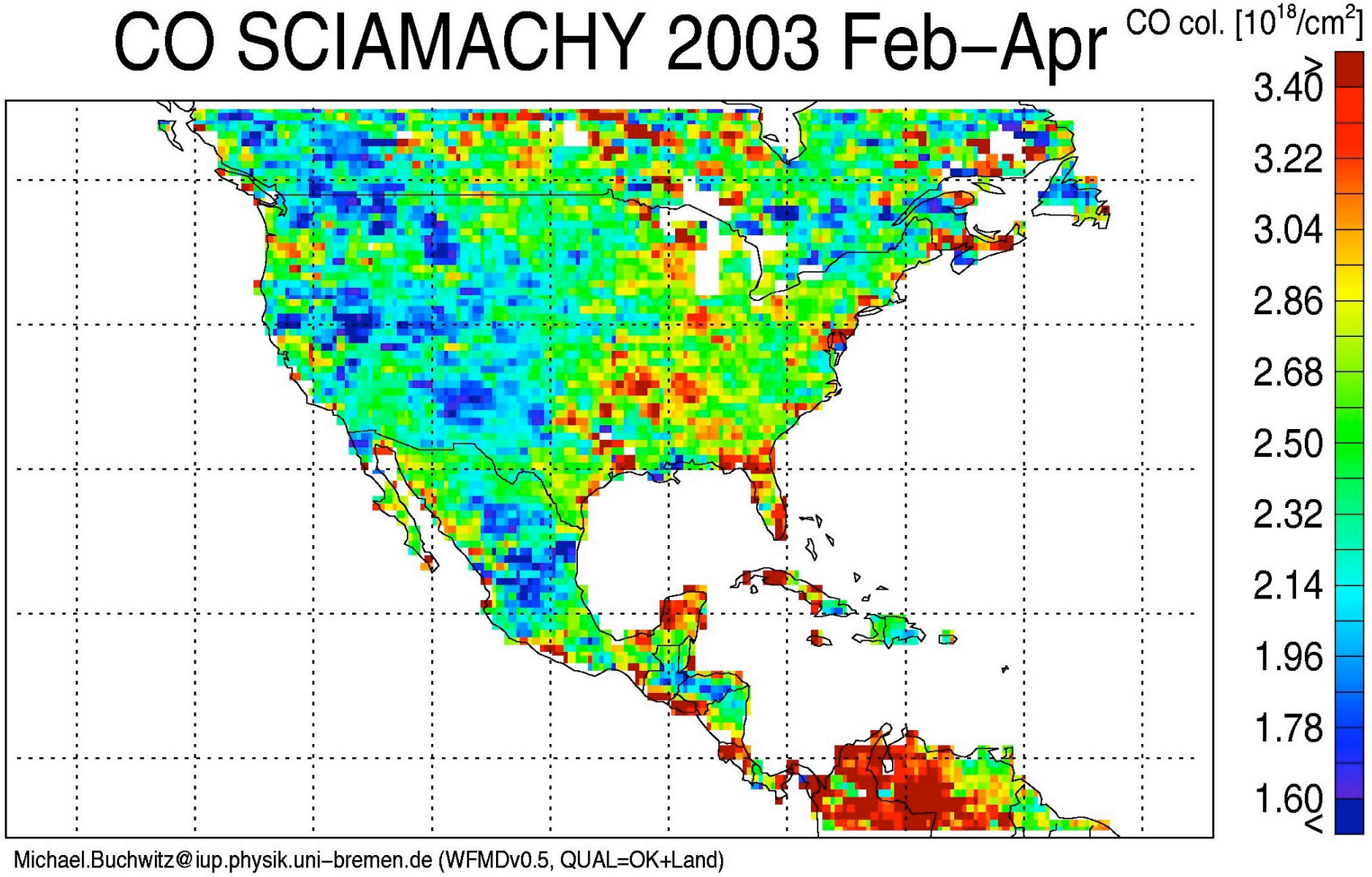
Alaskan fires, August 2004

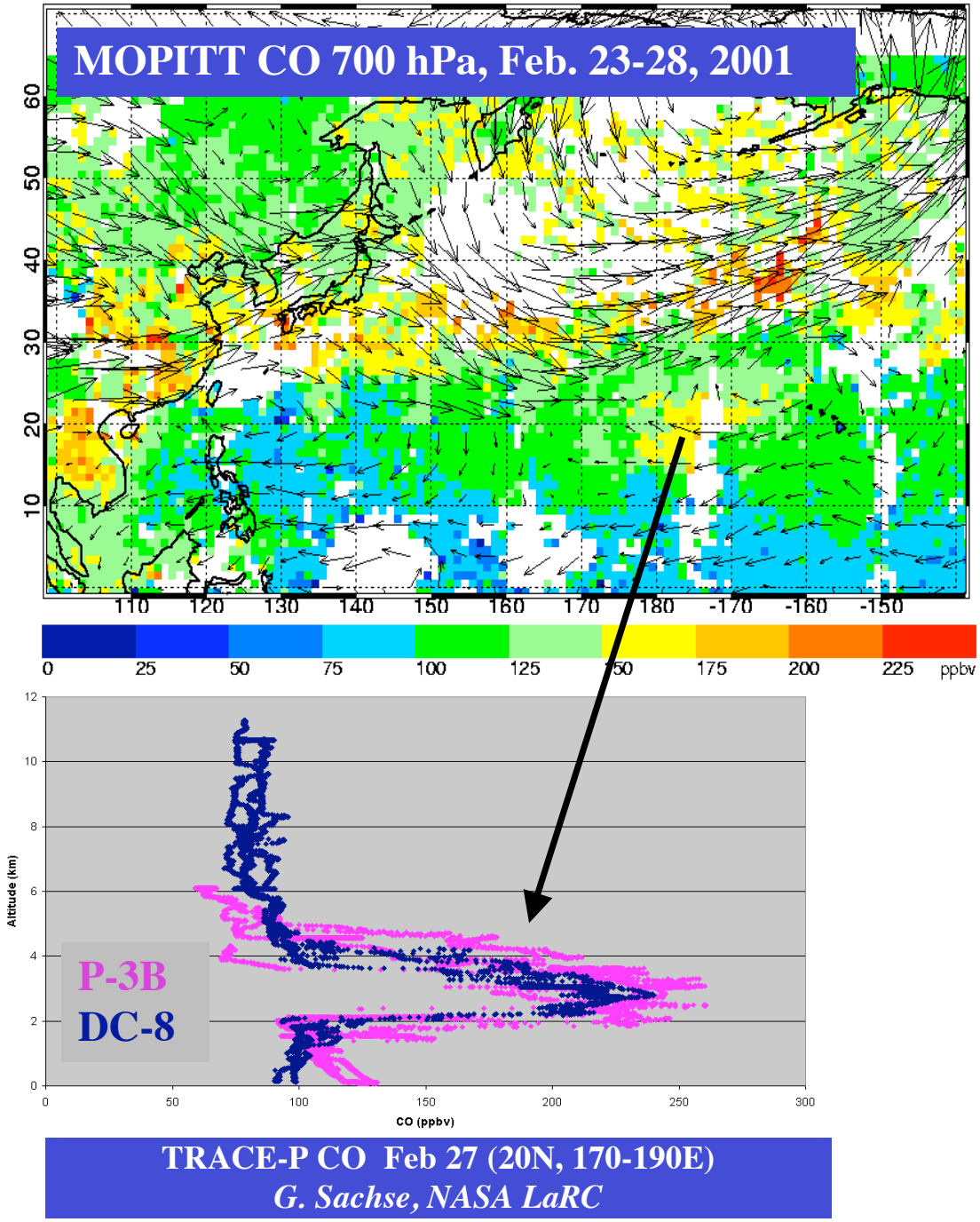
MODIS RGB

NO2 from SCIAMACHY



CO from SCIAMACHY

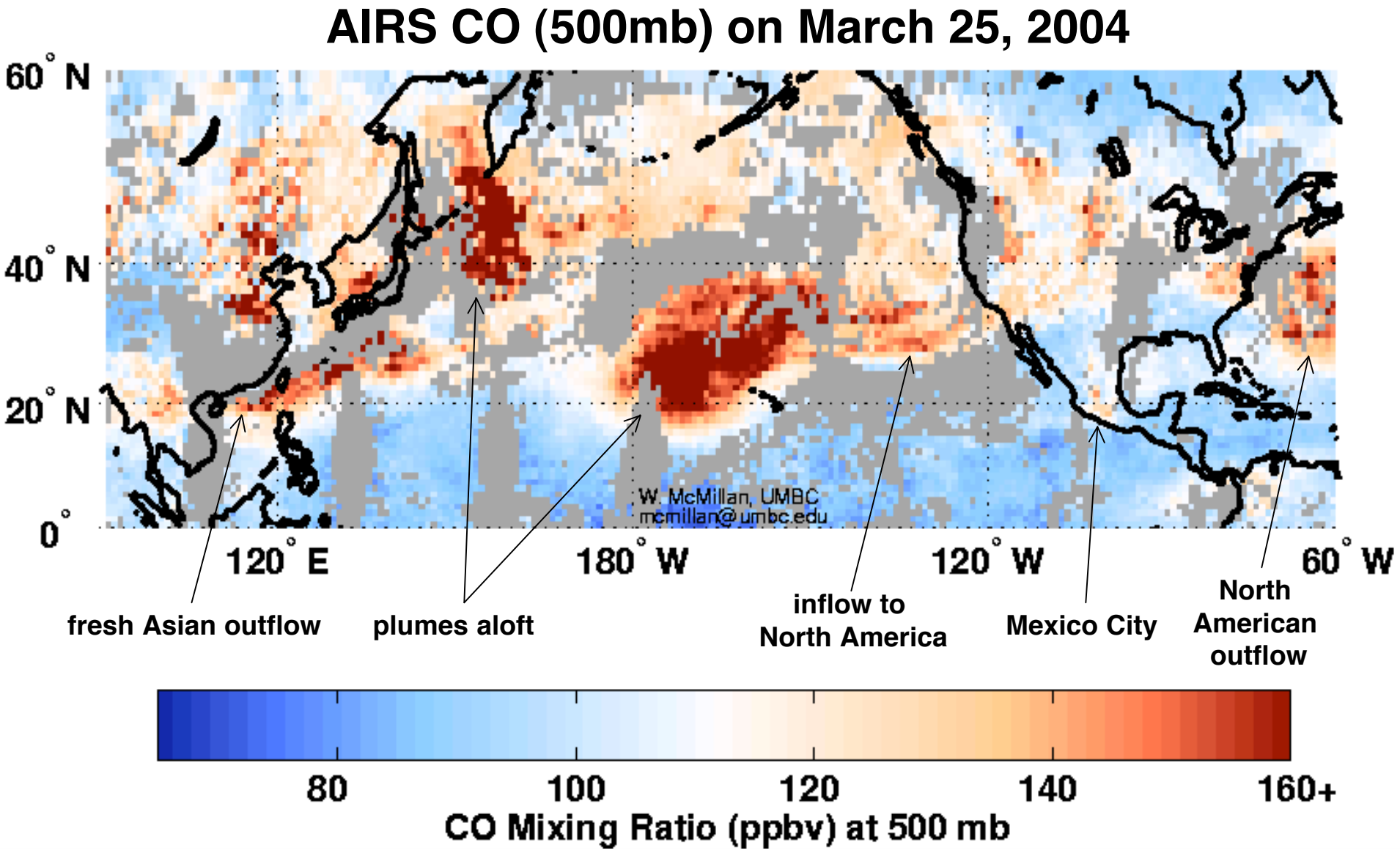


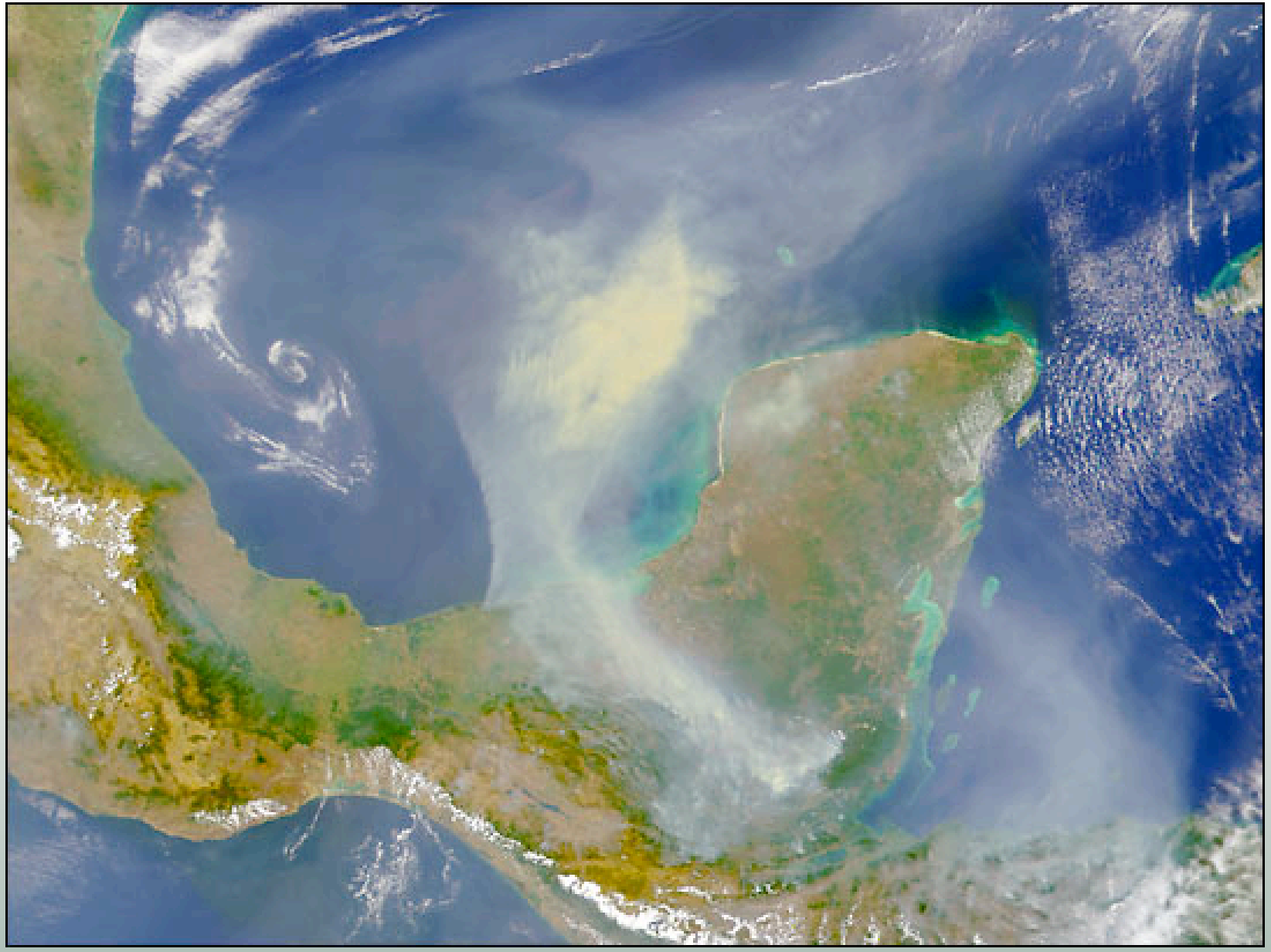


CO Plumes Observed During TRACE-P

- The NASA/GTE TRACE-P aircraft campaign was conducted over the western Pacific during Feb-Apr, 2001
- Goal to study the outflow of Asian pollution resulting from biomass burning and industry
- MOPITT data over the western Pacific were provided to TRACE-P in near-real-time for use in flight planning

Asian CO Transport to North America and local CO enhancement near Mexico City





MODIS March Monthly Mean AOD (2000 - 2005)