AIRS CO Update and Validation: V6- vs. V5+

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AIRS Science Team

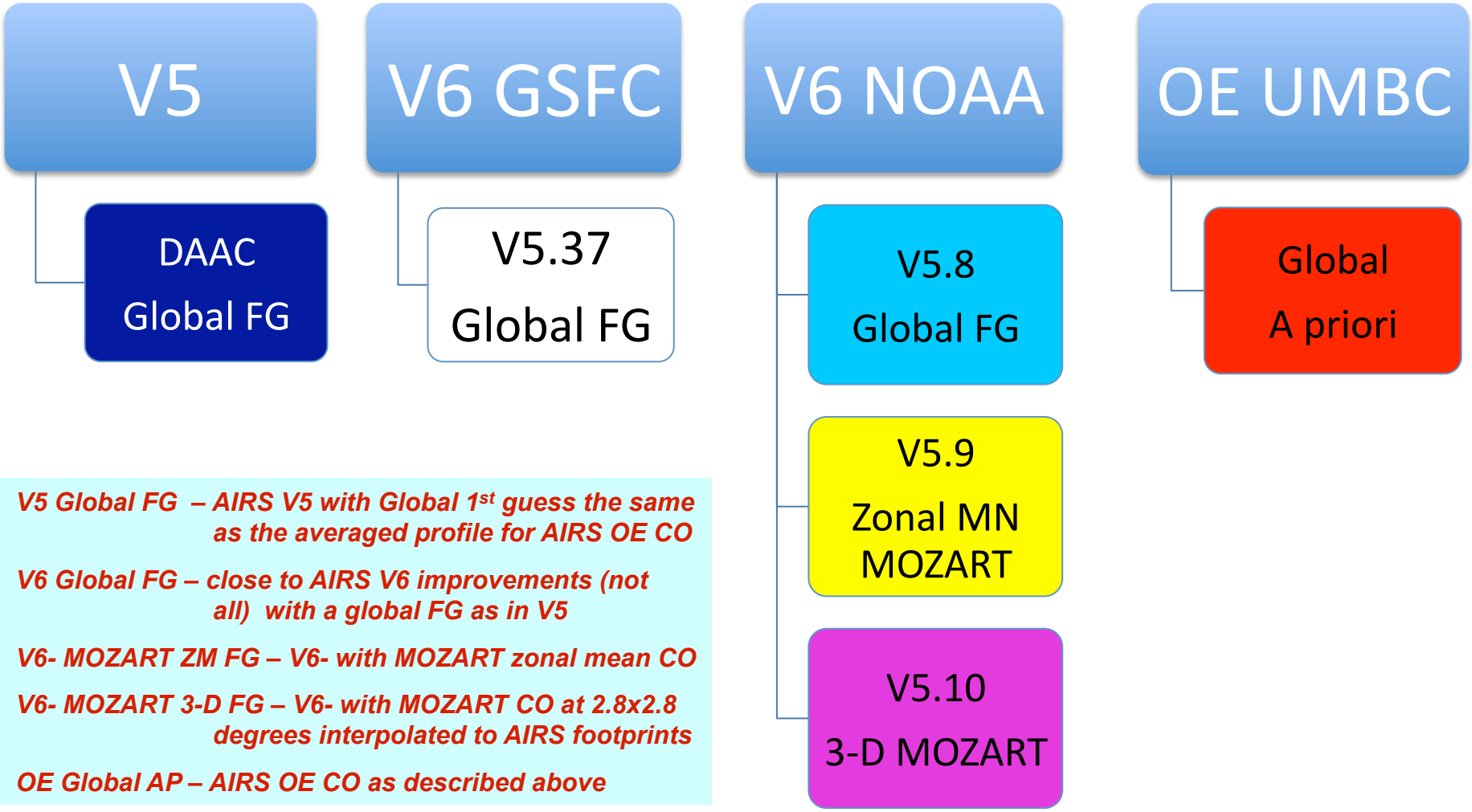
Aura Sensor Teams

NASA Tropospheric Chemistry Field Campaign team

NOAA/GMD

NASA/GSFC/Ozone Sondes

Various Versions Under Testing



V5 Global FG – AIRS V5 with Global 1st guess the same as the averaged profile for AIRS OE CO

V6 Global FG – close to AIRS V6 improvements (not all) with a global FG as in V5

V6- MOZART ZM FG – V6- with MOZART zonal mean CO

V6- MOZART 3-D FG – V6- with MOZART CO at 2.8x2.8 degrees interpolated to AIRS footprints

OE Global AP – AIRS OE CO as described above

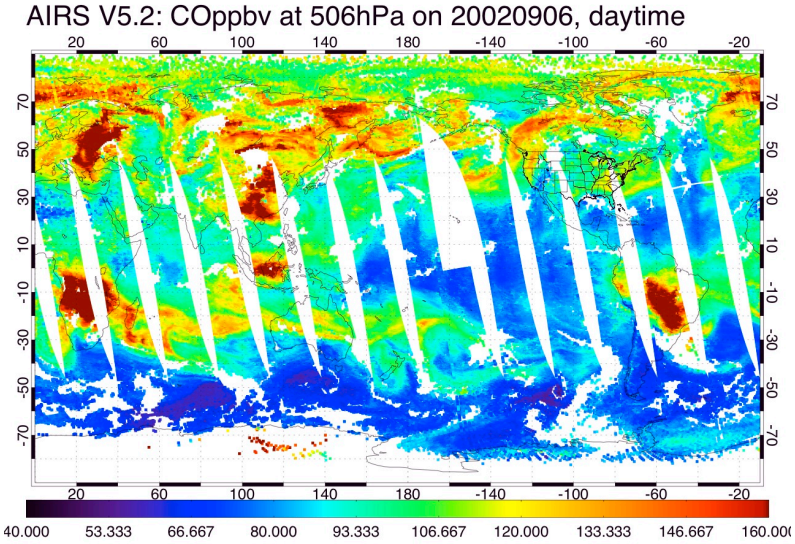
NOAA V6 implemented

Table 1: Status and NOAA Plans for the Implementation of GSFC/JPL Changes To AIRS V5 Leading to AIRS V6

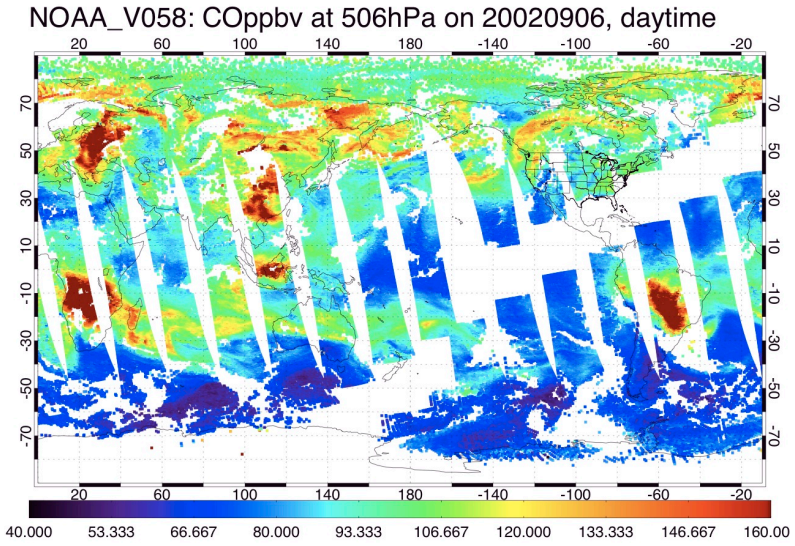
Description of change	Status	Notes/Plans
Simultaneous SW surface emissivity, SW reflectivity, Ts retrieval (3 e, 3 r functions)	Not implemented	requires volunteers to implement and test code and retrievals
LW emissivity retrieval (6 LW functions, more channels, new step, retrieval module)	Not implemented	Same as above
Change hinge points (39) for emissivity/reflectivity to always be 39 points	Not implemented Trivial – namelist change	Same as above
Emissivity multiplicative (1-e) instead of linear perturbation of e	Not implemented	Probably will do
ECMWF climatology startup state - monthly climatology of T(p), q(p), o3(p), Ts, at 1x1deg.	Not implemented	Have partial code from Evan Use of ECMWF climatology has been shown to improve retrieval QA and products (cross training by maddy)
Neural Network startup state - Stochastic Cloud-clearing Neural Network (SCCNN) from Bill Blackwell	Not implemented	Do we want this capability?
OLR Model (AER)/single footprint cloudy-OLR (related to next item)	Not implemented	Do we want this capability? We have the code (.f90 mess), which enables calculation of OLR as function of CO2, CH4, N2O, etc. Volunteers?
9 spot cloud-fraction, cloud height retrievals	Not implemented	Do we want this capability?
New GSFC QA for V6	Not implemented	No plans to follow unless
		all red becomes green.
Simultaneous T(p), SW reflectivity, SW emissivity and Ts, (3 e, 3 r functions using mostly stratospheric/UT LW IR channels and lower troposphere/surface sounding SW IR channels))	Partially implemented (John mentioned his code had bugs … needs testing)	Have code from John – volunteers?
SW Rho initialization/rho multiplicative (50+ channels in SW using linear least squares fit of CCR spectra – calc. to single rho function)	Implemented but not used	Good idea for AIRS but probably won't work for IASI due to higher noise in SW– marginal if not negative impact in either AIRS/IASI retrieval
V10 and V11 (frequency shift) RTAs	Implemented in airsb103.exe Needs implemented in comp_rad.exe and related routines.	Needs some testing of preprocessor to produce yoffsets, version control of L1C code/coefficients from UMBC/JPL.
IR Tuning (recalculation using V5 clear, ocean, night dataset)	Implemented	GSFC is currently testing this (takes 5 min to recalculate)
CO2NCV off, N2O channels removed from T(p)	Implemented	Need an operational climatology for CO2 to mitigate trends/regional biases in products – volunteers?
Regression improvements (yield trends, more training)	Implemented	Still working on it, and might require a surface regression update – current results look better than V5
Convective/Stability parameters	Implemented	Fengying delivered upgrade (July 24, 2010) and is working on modifications.
Various bug fixes, improvements	Implemented	

- V5 TO V6 Without Changing the FG
- V6- NOAA used for FG tests
- V6 improvements other than CO FG reduces CO VMR at 500hPa.

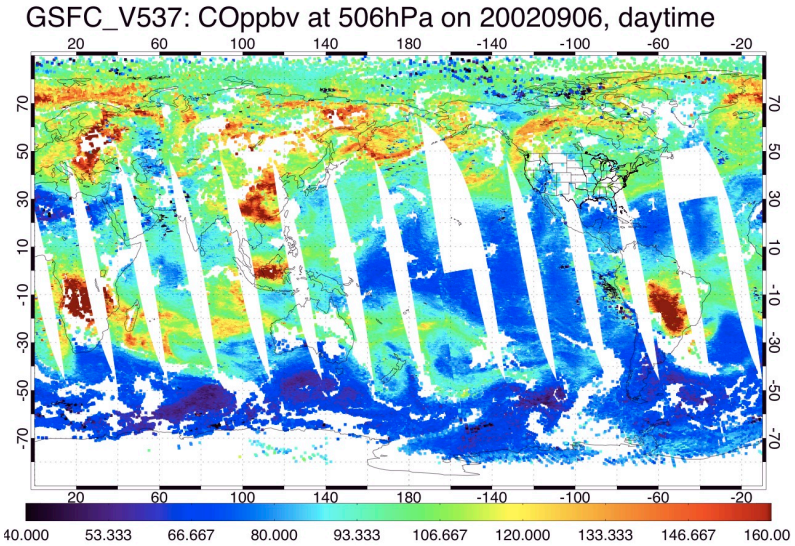
V5 DAAC



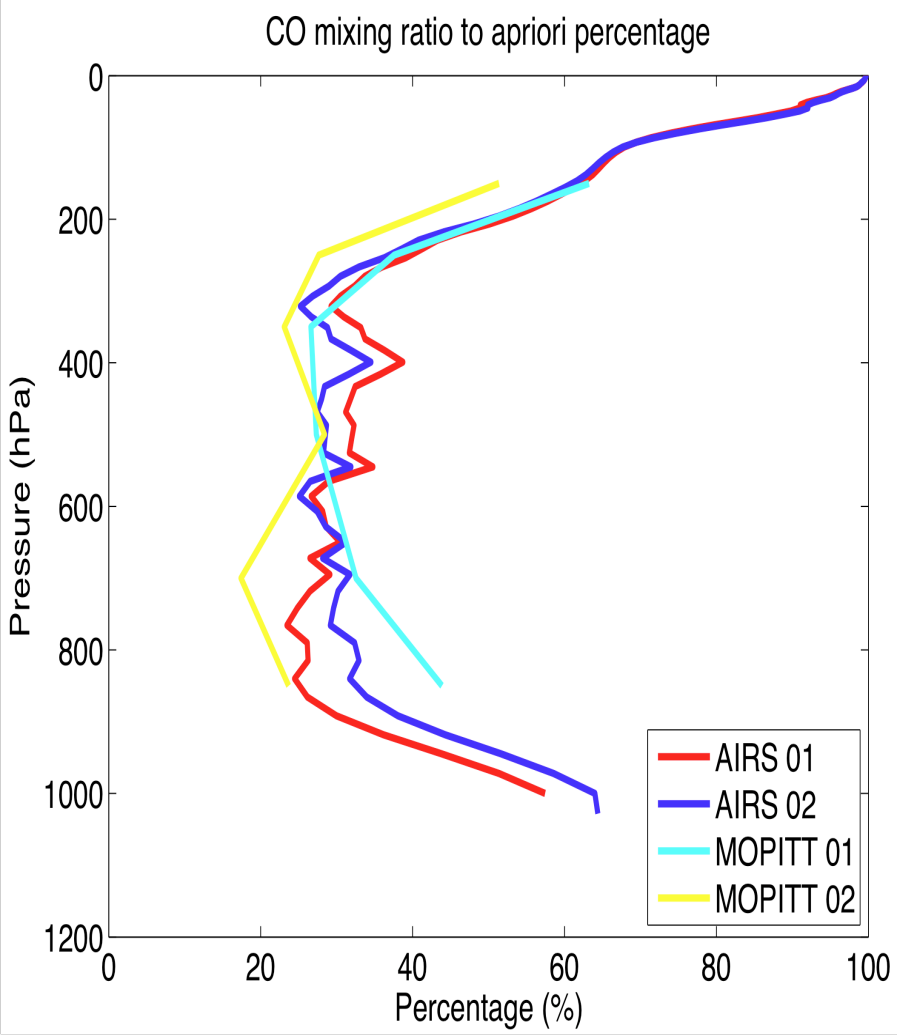
V6- NOAA



V6 GSFC



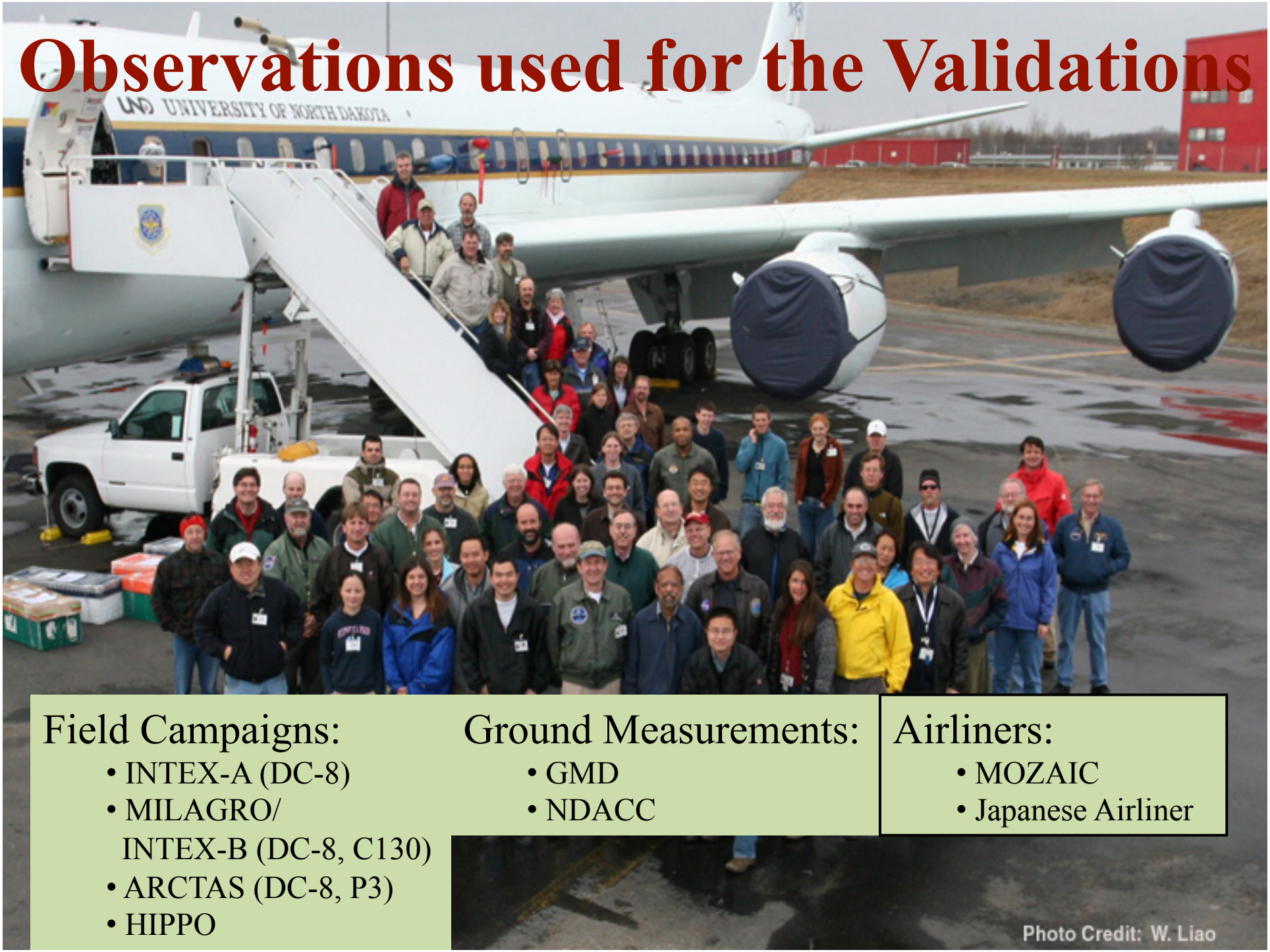
AIRS CO Percent A Priori



- Diagonal of error covariance matrices over a priori

- About 70% of signals are from the measurements in the mid-troposphere.

Observations used for the Validations

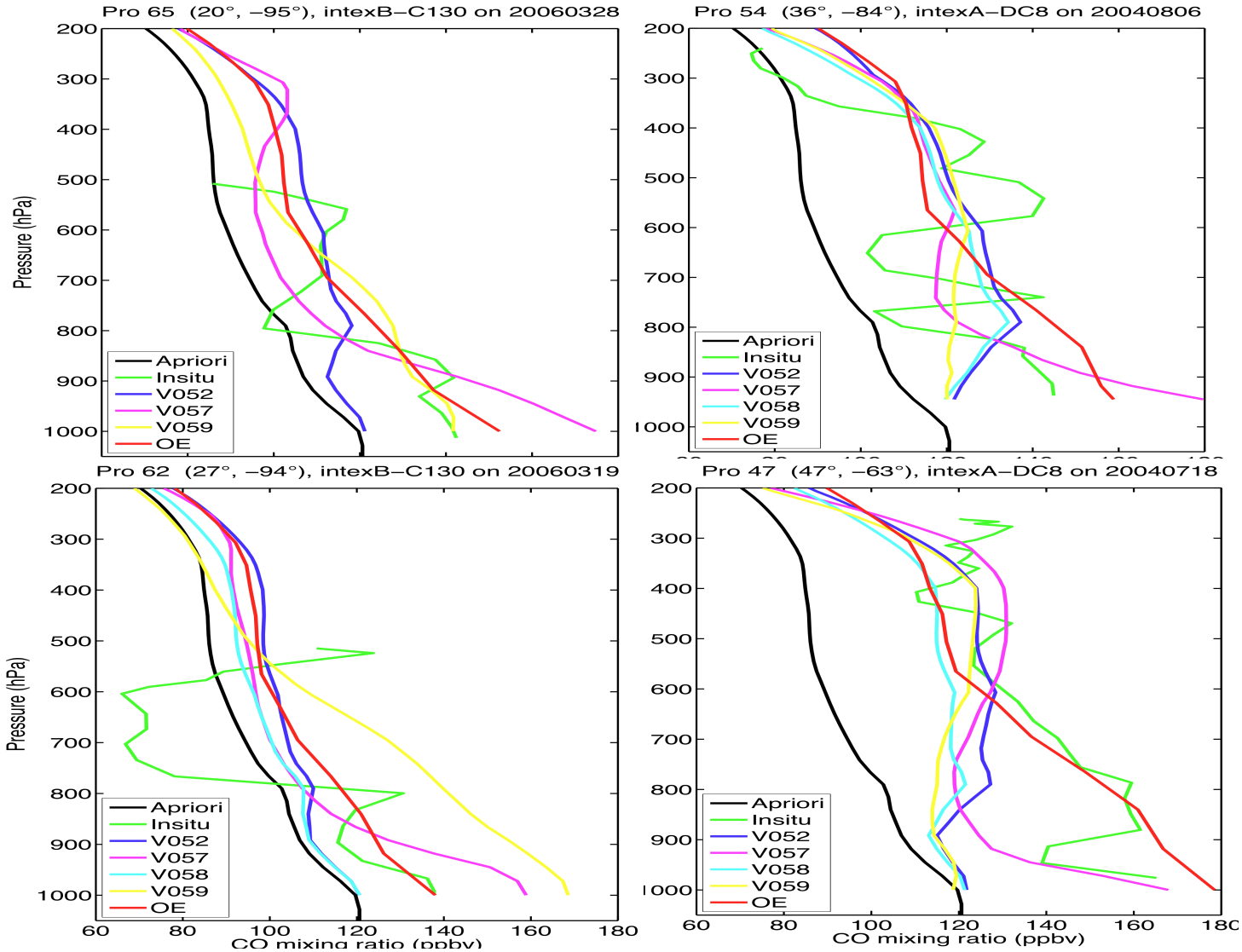


Field Campaigns:
- INTEX-A (DC-8)
- MILAGRO/ INTEX-B (DC-8, C130)
- ARCTAS (DC-8, P3)
- HIPPO

Ground Measurements:
- GMD
- NDACC

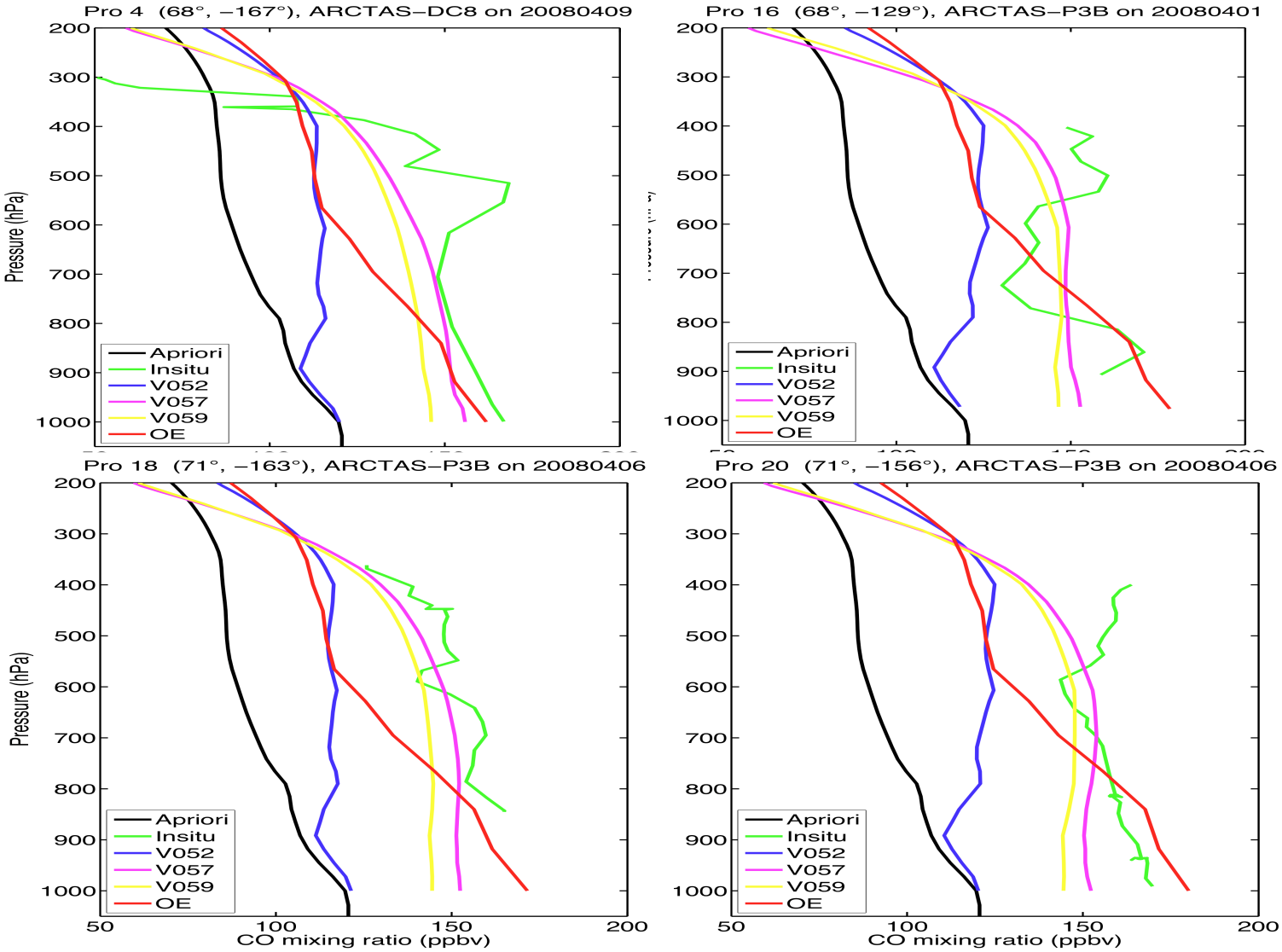
Airliners:
- MOZAIC
- Japanese Airliner

INTEX-A & B – Mid-latitudes



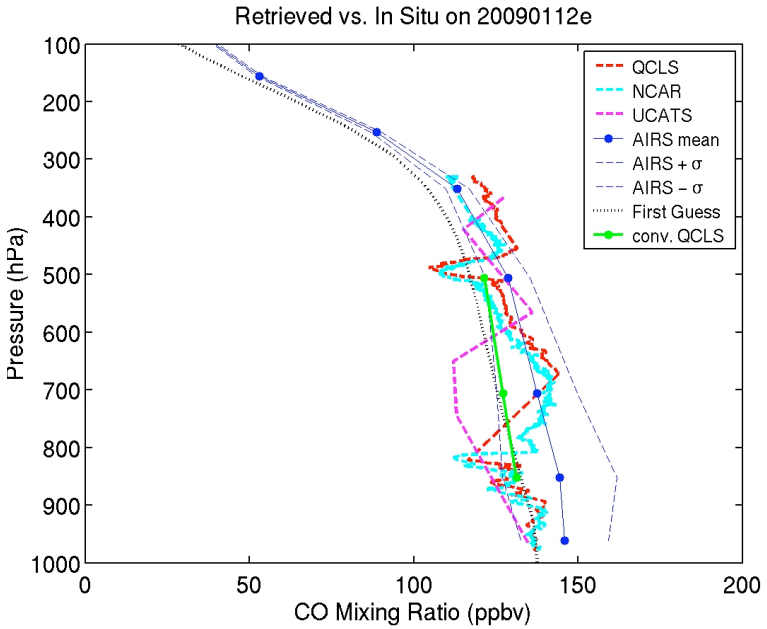
- Using dynamic FG in AIRS v6 improves lower troposphere CO, but
- Signatures of modeled values are evident.

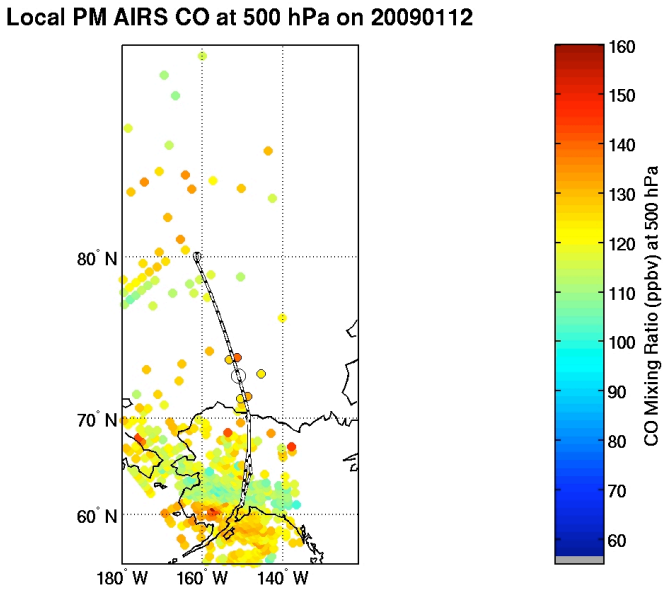
ARCTAS – NH High latitudes



- Using dynamic FG in AIRS v6 improves free troposphere CO at high Latitudes in the spring.

AIRS V6- w/ Zonal Mean MOZART CO Validated Using HIPPO1 in situ data

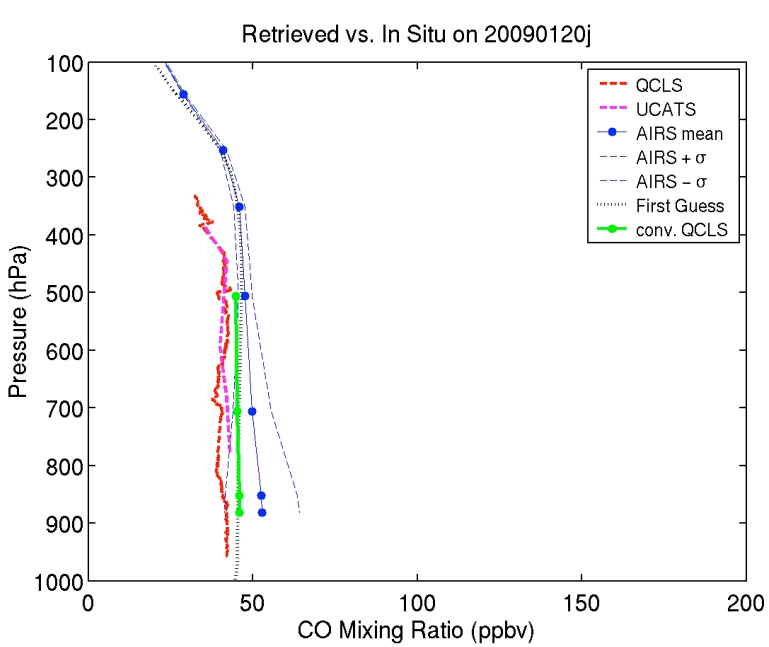


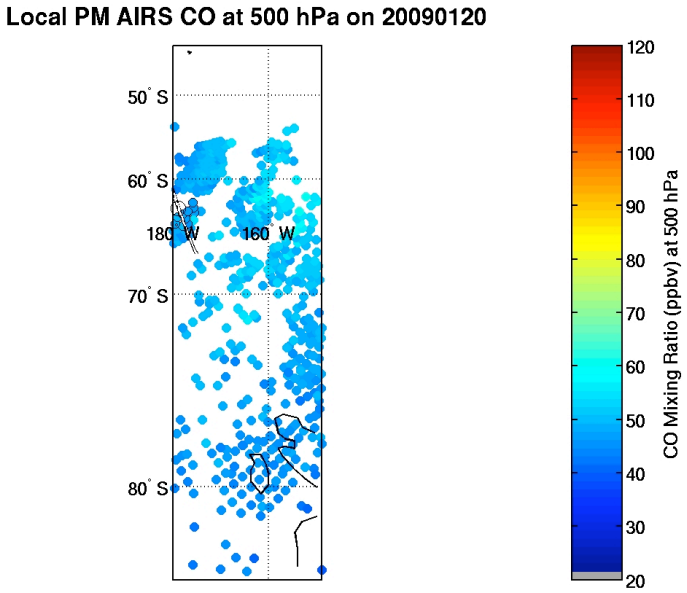


Courtesy of K. Evans and W. McMillan

- Equivalent to V5.9
- Shows very good agreements between AIRS and HIPPO1 CO especially in the mid-troposphere
- This validation will continue with HIPPO 2, 3, etc

AIRS V6- w/ Zonal Mean MOZART CO Validated Using HIPPO1 data in the SH



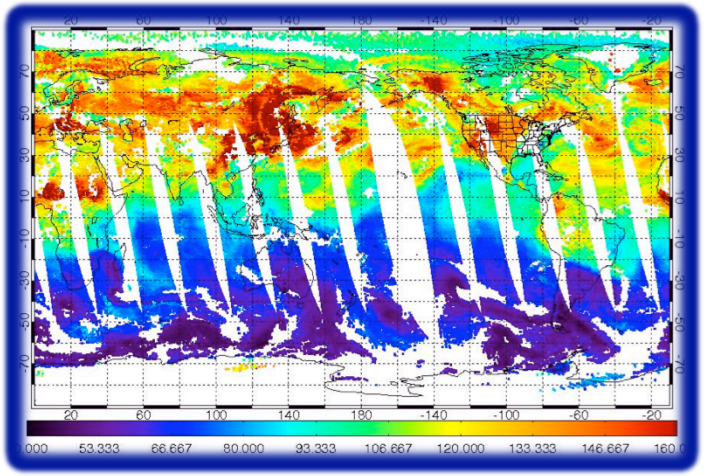


Courtesy of K. Evans and W. McMillan

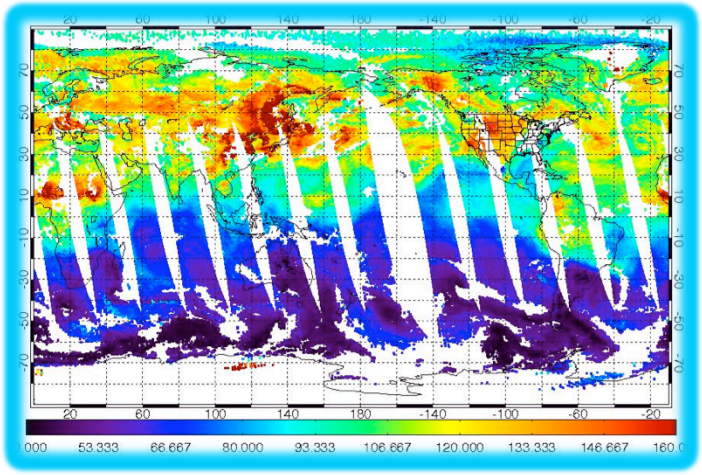
- AIRS V5 CO overestimates over the SH, and V6 w/ model FG are more realistic.
- Shows very good agreements between AIRS and HIPPO1 CO through out the free troposphere.
- This validation will continue with HIPPO 2, 3, etc.

CO VMR (ppbv) 20080404 500 hPa

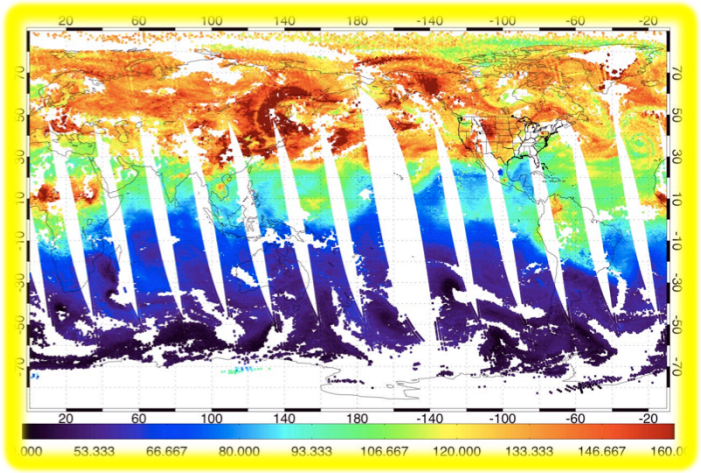
AIRS V5 CO Global FG



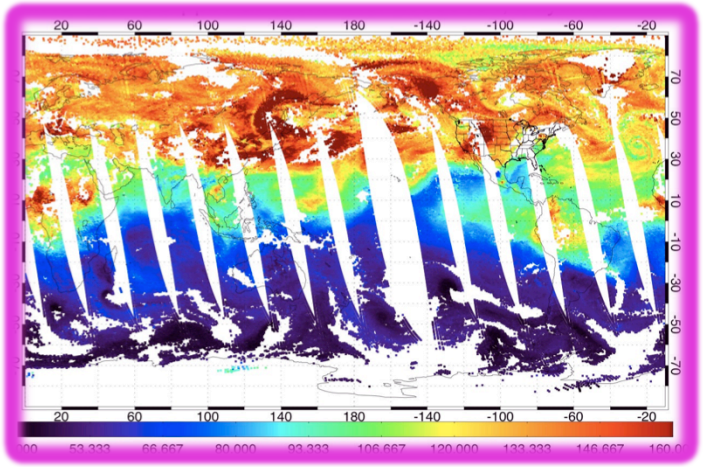
AIRS V6- CO Global FG



AIRS V6- CO Zonal MOZART FG

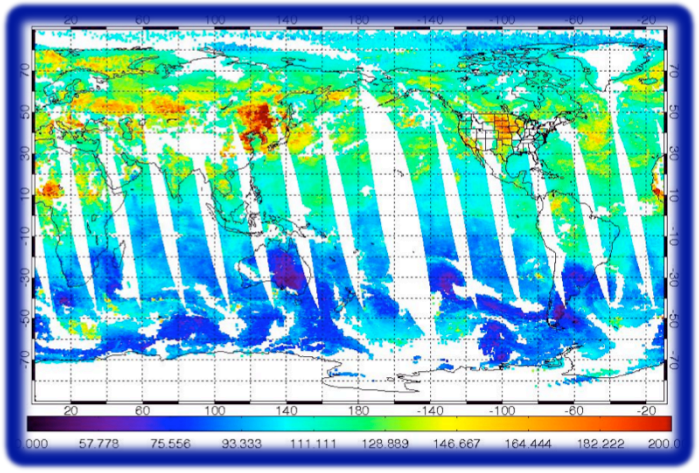


AIRS V6- CO 3-D MOZART FG

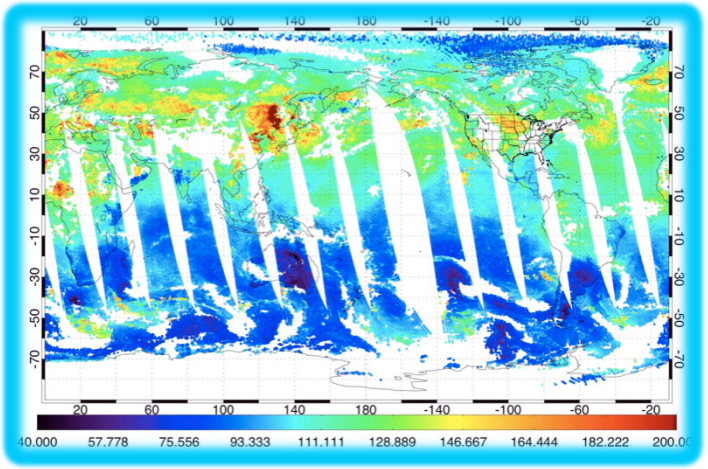


CO VMR (ppbv) 20080404 850 hPa

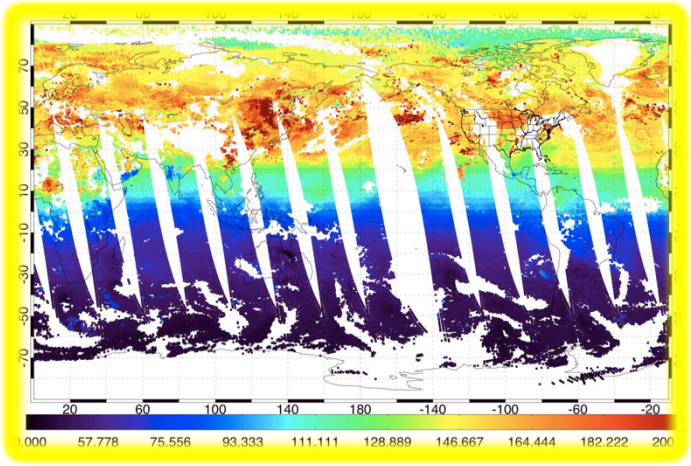
AIRS V5 CO Global FG



AIRS V6- CO Global FG



AIRS V6- CO Zonal MOZART FG



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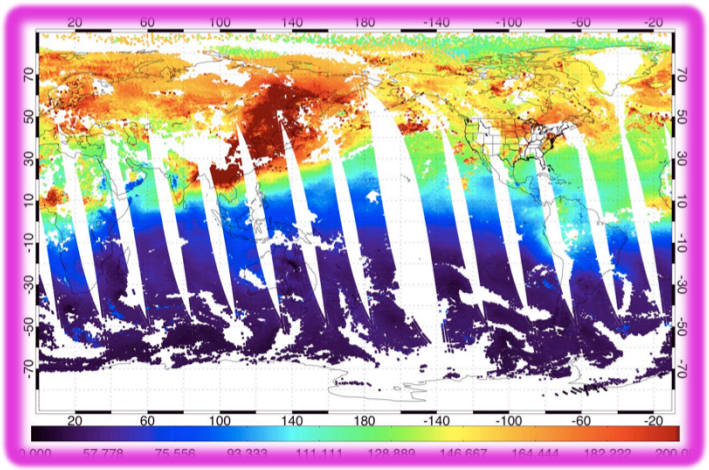

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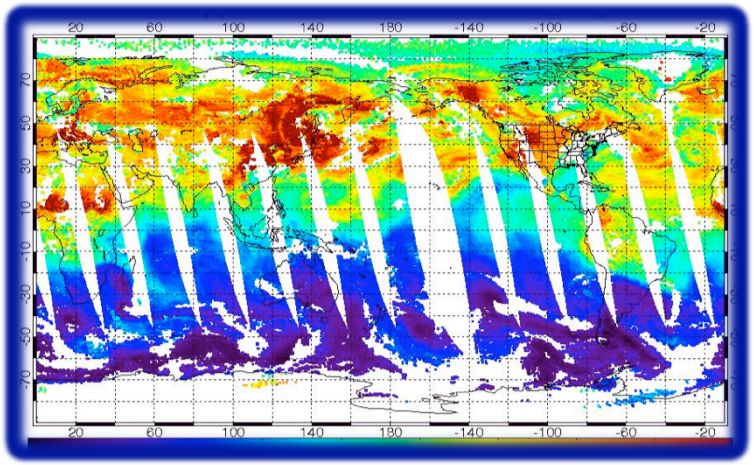

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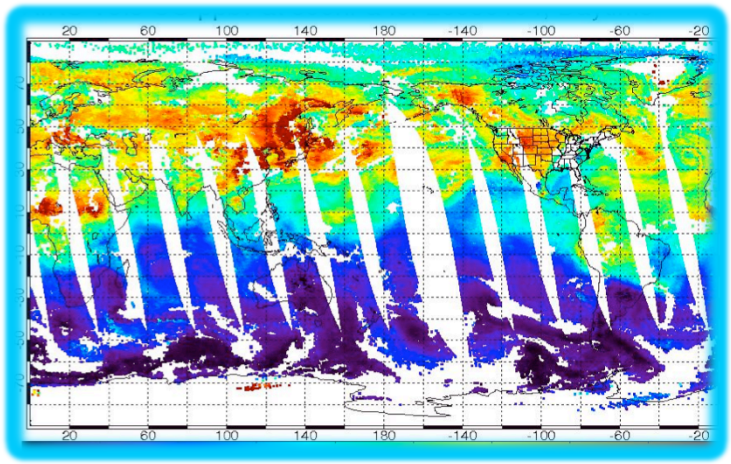
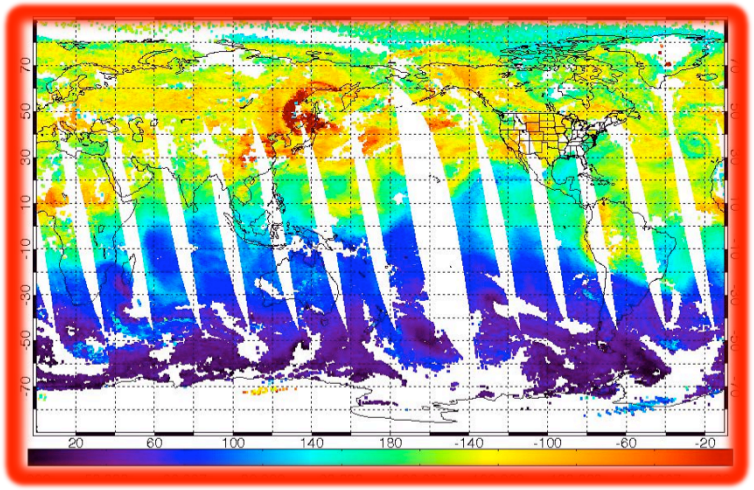


AIRS V6- CO Zonal MOZART FG



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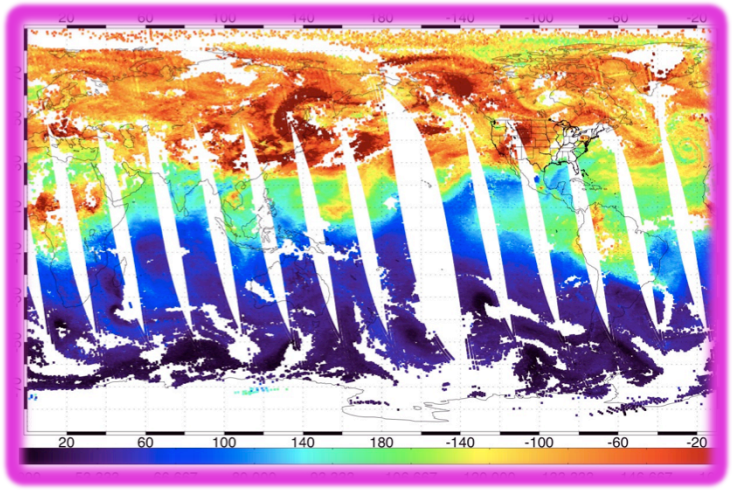

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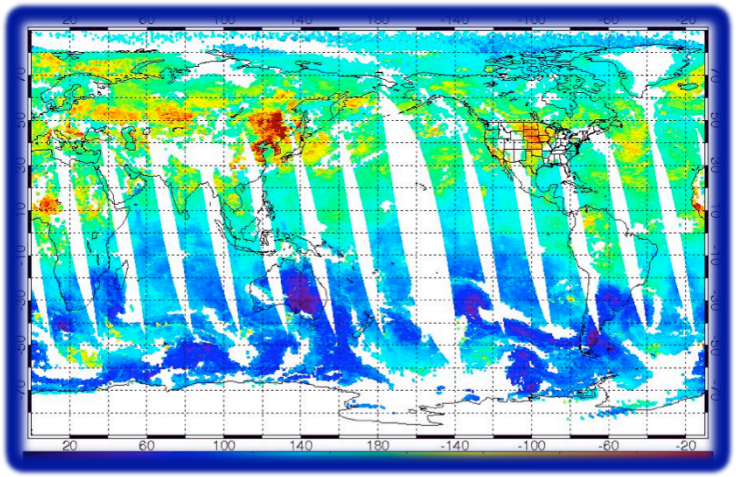

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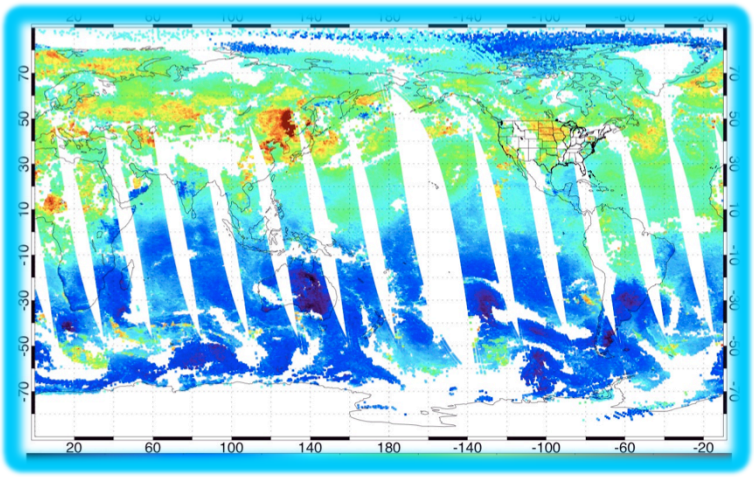
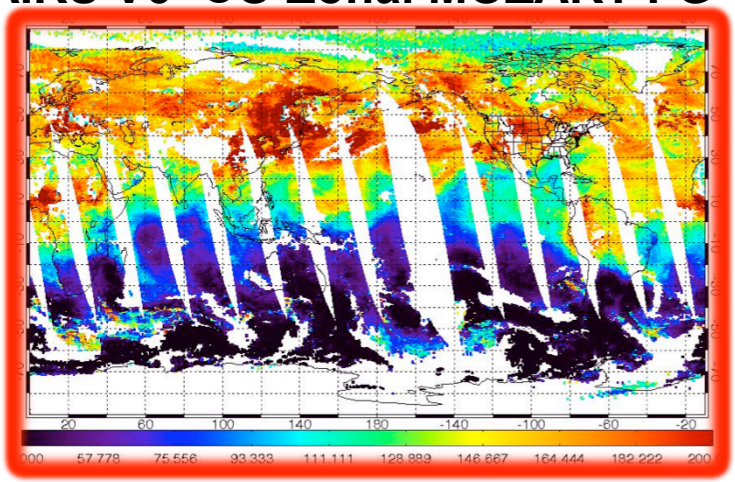
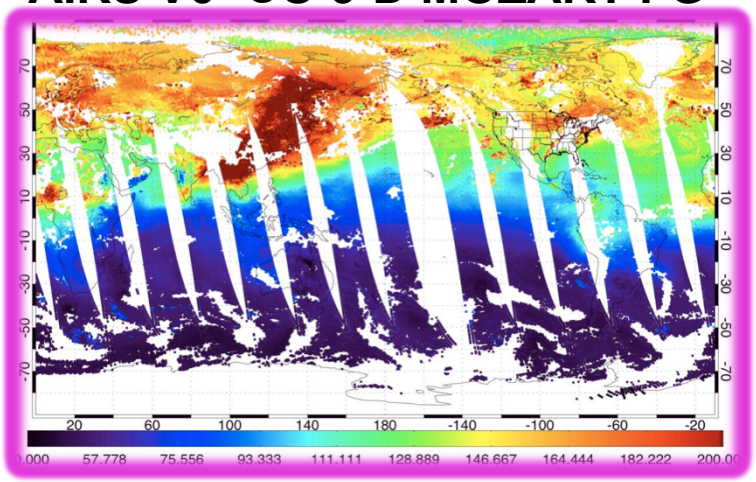


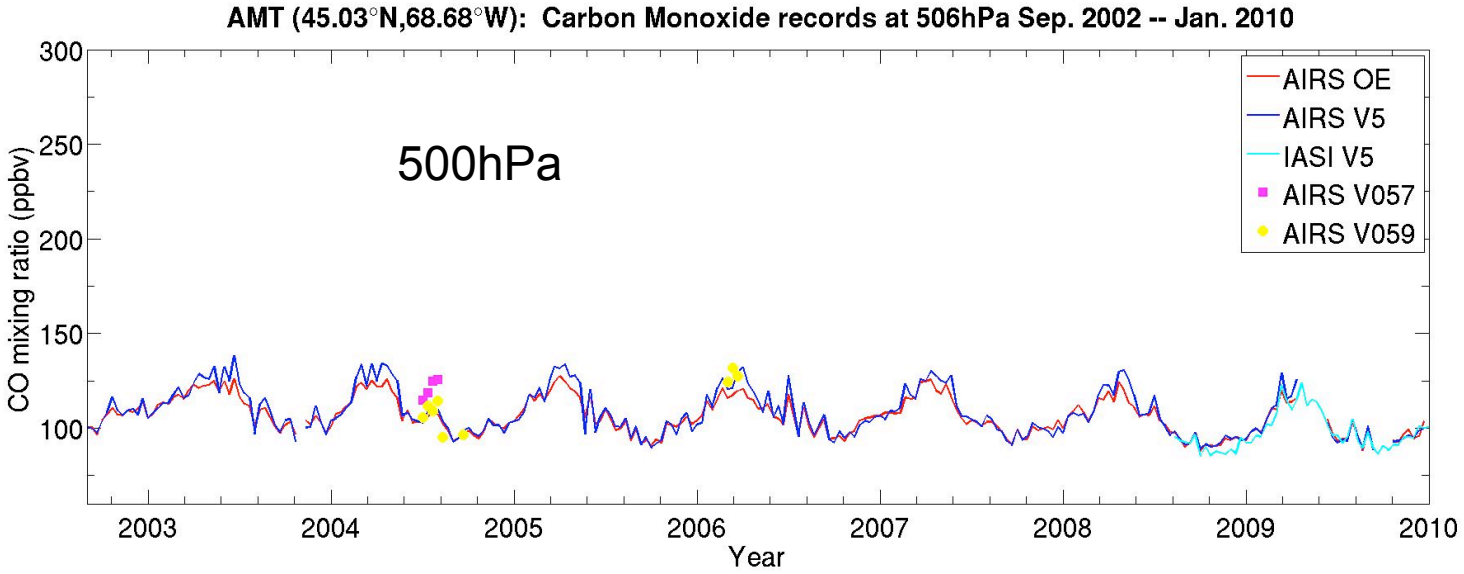
AIRS V6- CO Zonal MOZART FG

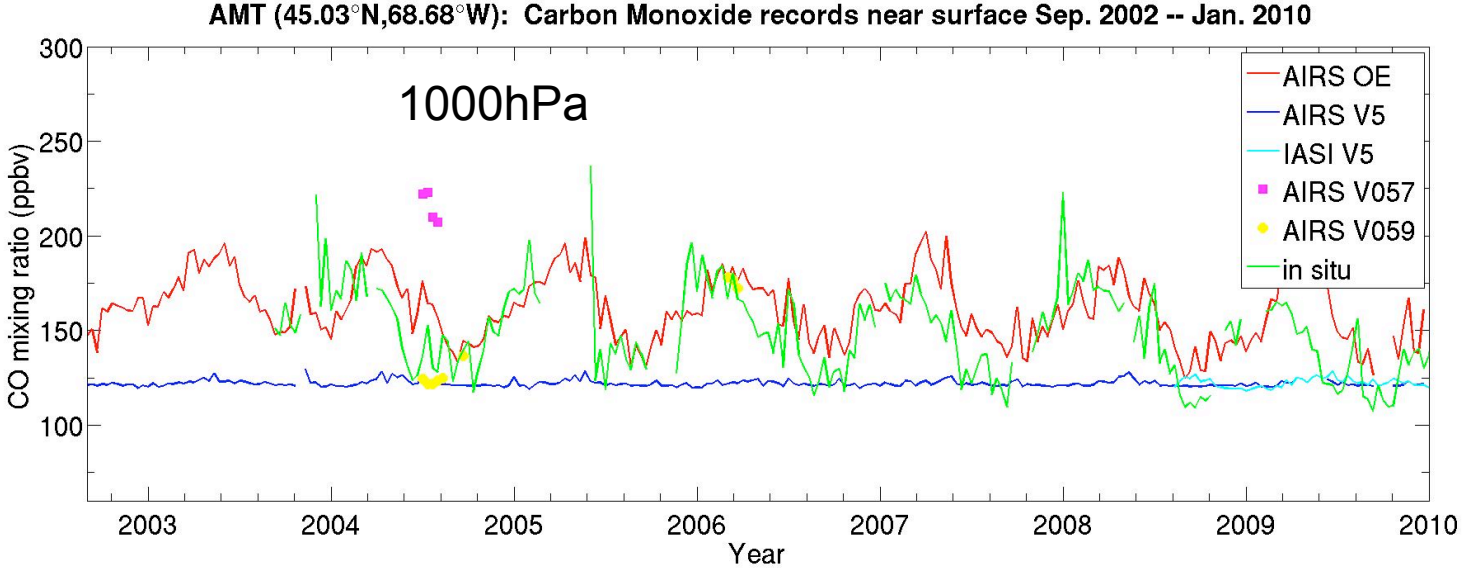


AIRS V6- CO 3-D MOZART FG

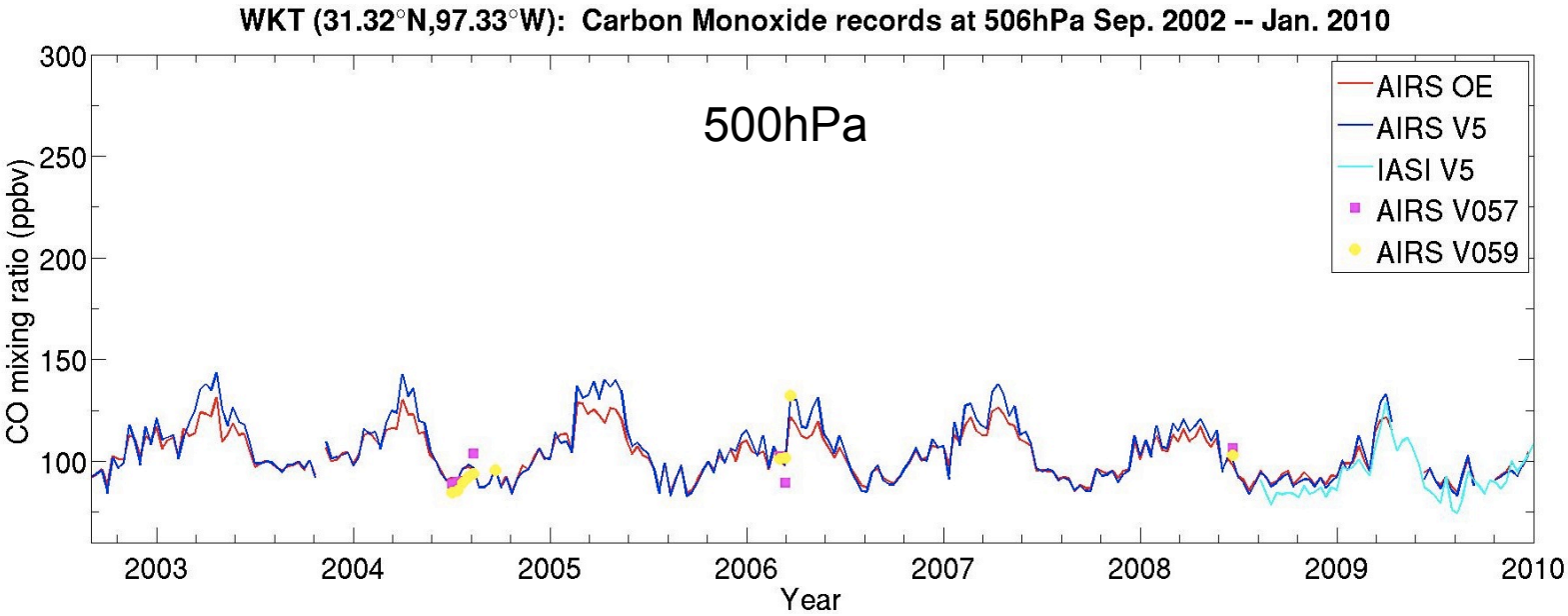


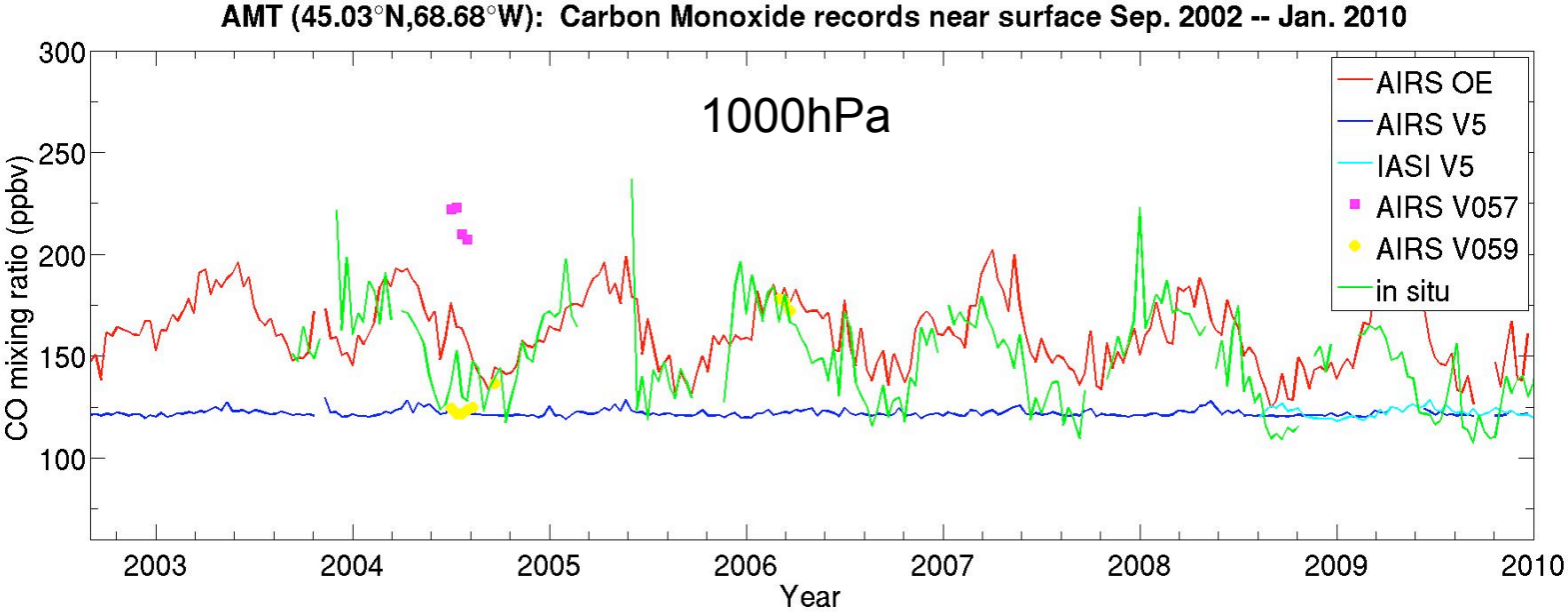
AMT Station in MAINE



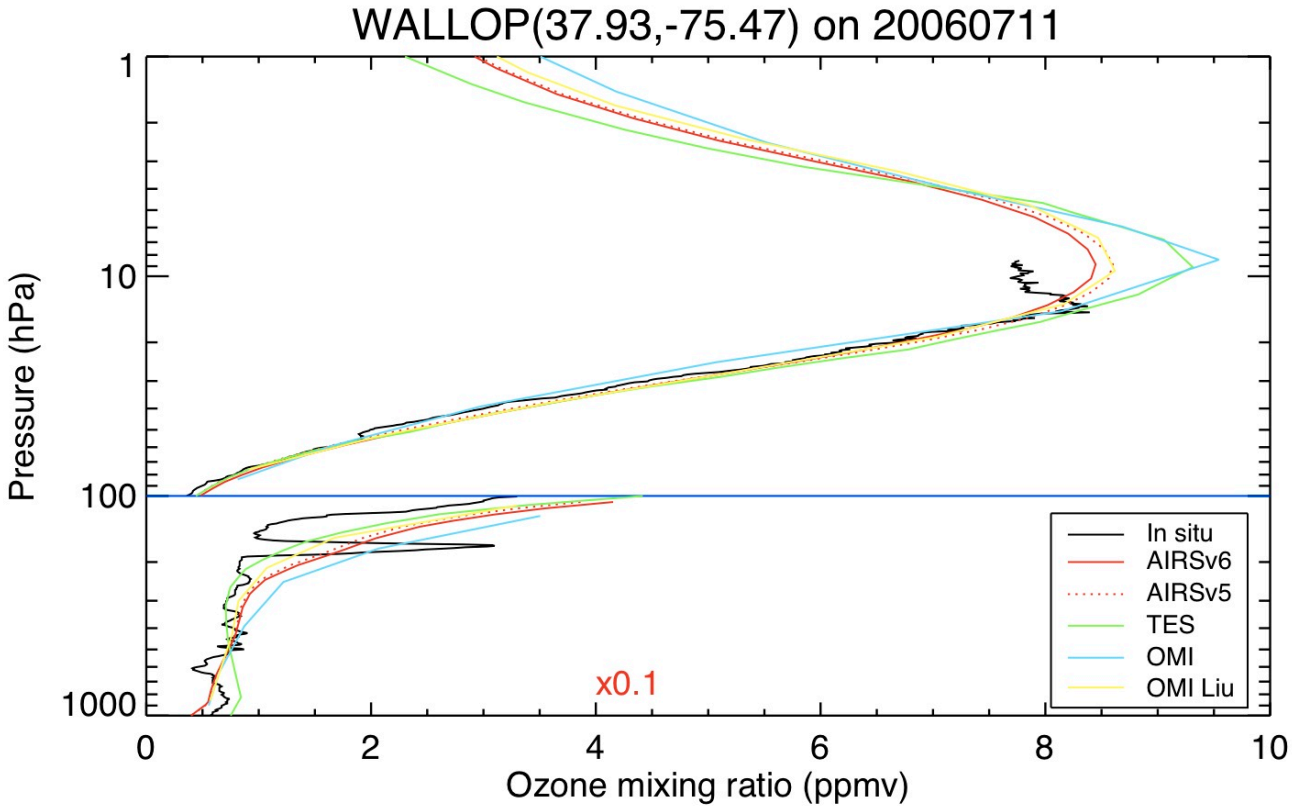


WKT Station in TAXES





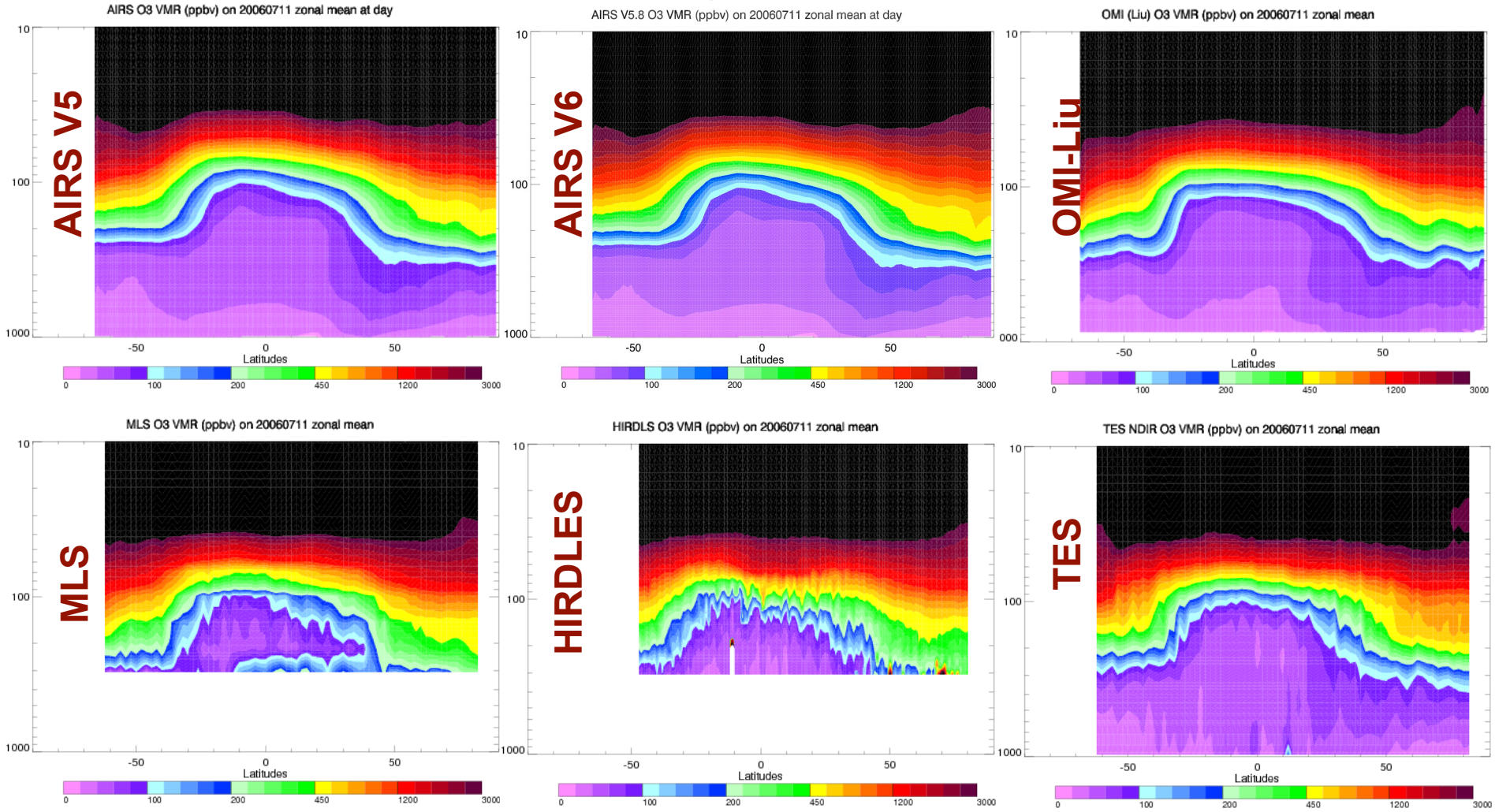
Ozone Sonde Validation for AIRS, TES, OMI, OMI-Liu



• O_3 profile comparisons over Wallops Island, VA on 20060711 between AIRS (red-V6, dash-V5), TES (green), OMI L2 (cyan), OMI Liu (Liu et al., 2010a, 2010b) (yellow), and the in situ measurements (black), where tropospheric O_3 VMRs (ppbv) (approximated as below100hPa) are multiplied by 10.
• O_3 sondes from NASA/GSFC/SHADOZ Archive. PI. Anne Thompson, courtesy of Jackie Witty

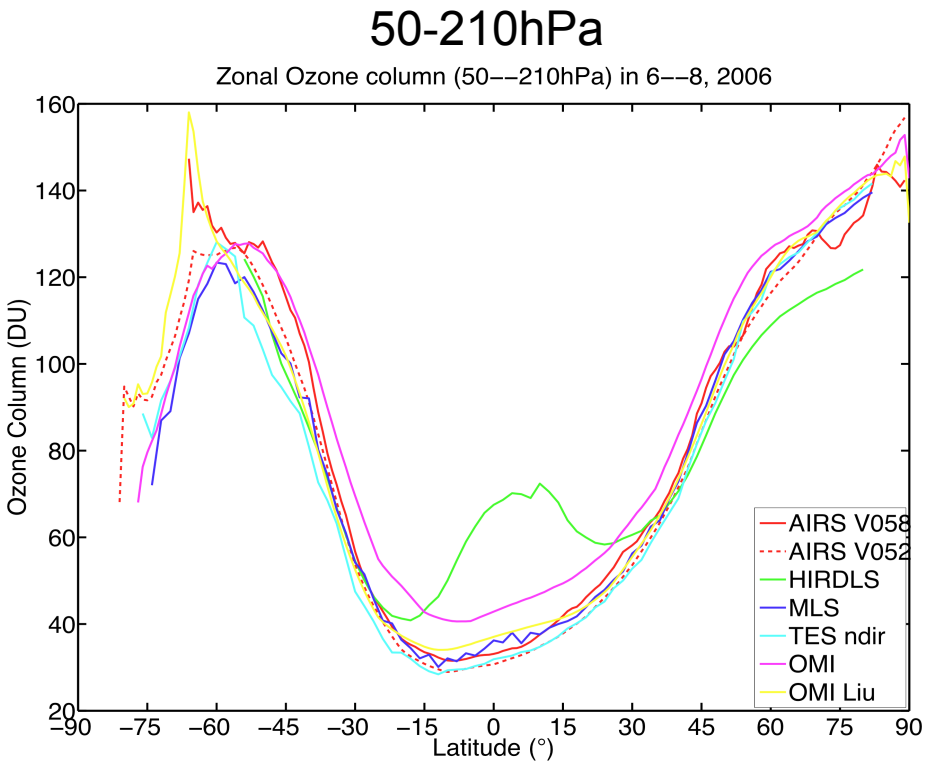
Ozone Zonal Mean Curtains

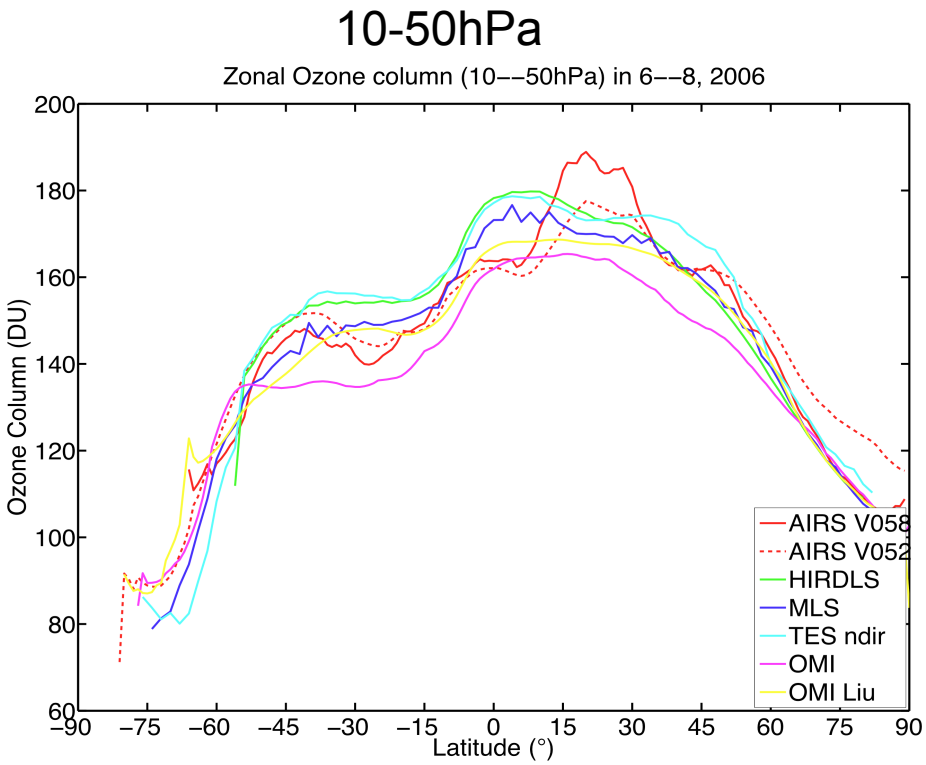
July 11, 2006

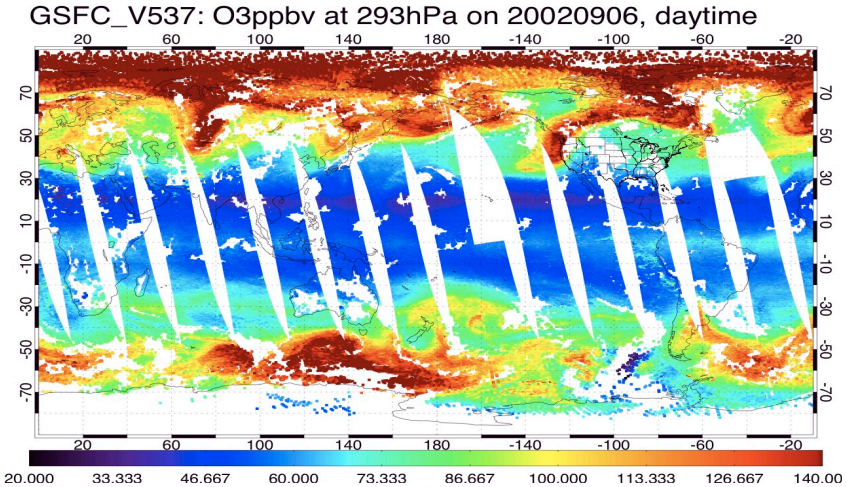


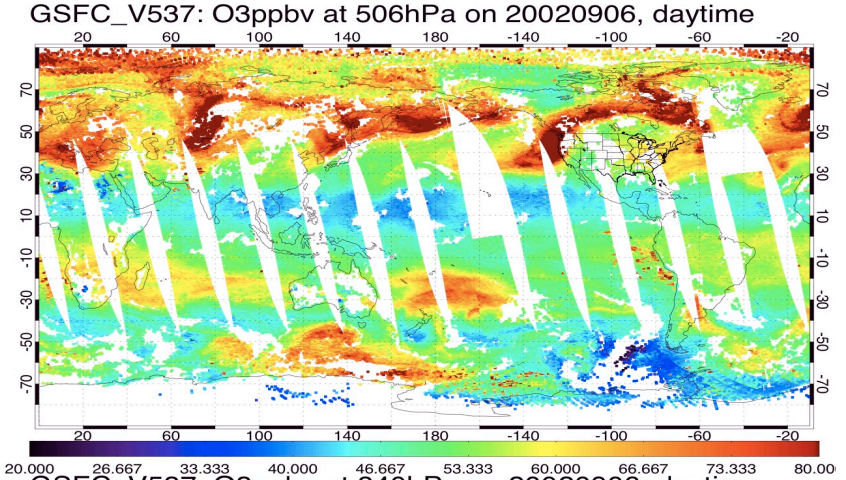
Integrated Zonal Mean O_3 Columns (DU) in the UTLS Region

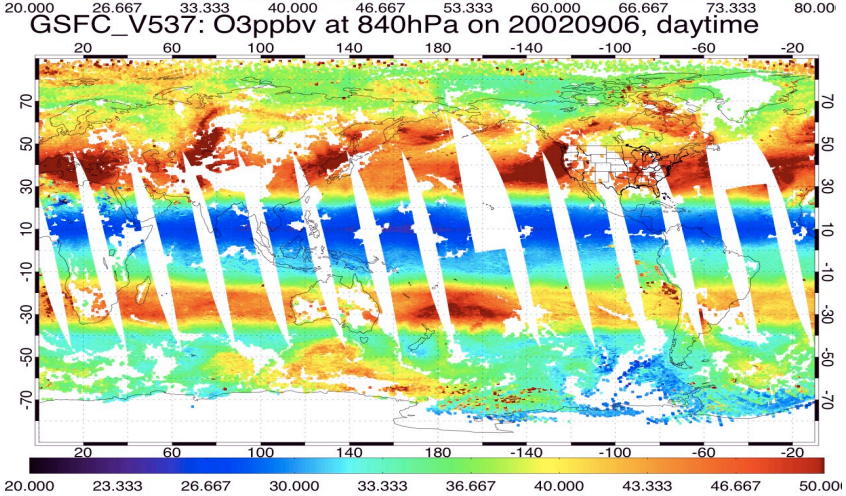
- The zonal mean O_3 integrated into two vertical columns: 10-50hPa (top panel) and 50-210hPa (bottom panel) averaged from June – Aug., 2006 for AIRS (red-V6, dash-V5), TES (cyan), OMI L2 (purple), OMI Liu (yellow), MLS (blue), and HIRDLES (green).
- AIRS O3 mainly differs over top half of the stratosphere.











- Zonal mean climatology is used.
- Not affecting vertical regions where the measurement signals are strong.
- Zonal mean FG does cause striping where measurement signals are weak.

Summary and Future Work

- Using dynamic CO fields, zonal-mean or 3D, shows more realistic values especially in the lower troposphere in the NH, and in the SH.
- Challenges remain (striping with zonal mean and boundary info with 3D).
- Validation and testing for AIRS V6 CO and O3 will continue with more complete collections of in situ measurements
- Pursue AIRS science team consensus on V6 CO