

CAM-Chem (& MOZART-4 & WACCM) in support of ARCTAS and START-08

Louisa Emmons, Simone Tilmes, Ave Arellano,
Gabriele Pfister, Jean-François Lamarque

Atmospheric Composition Remote Sensing and Prediction Program

Atmospheric Chemistry Division

Earth and Sun Systems Laboratory

NCAR



Field Campaigns

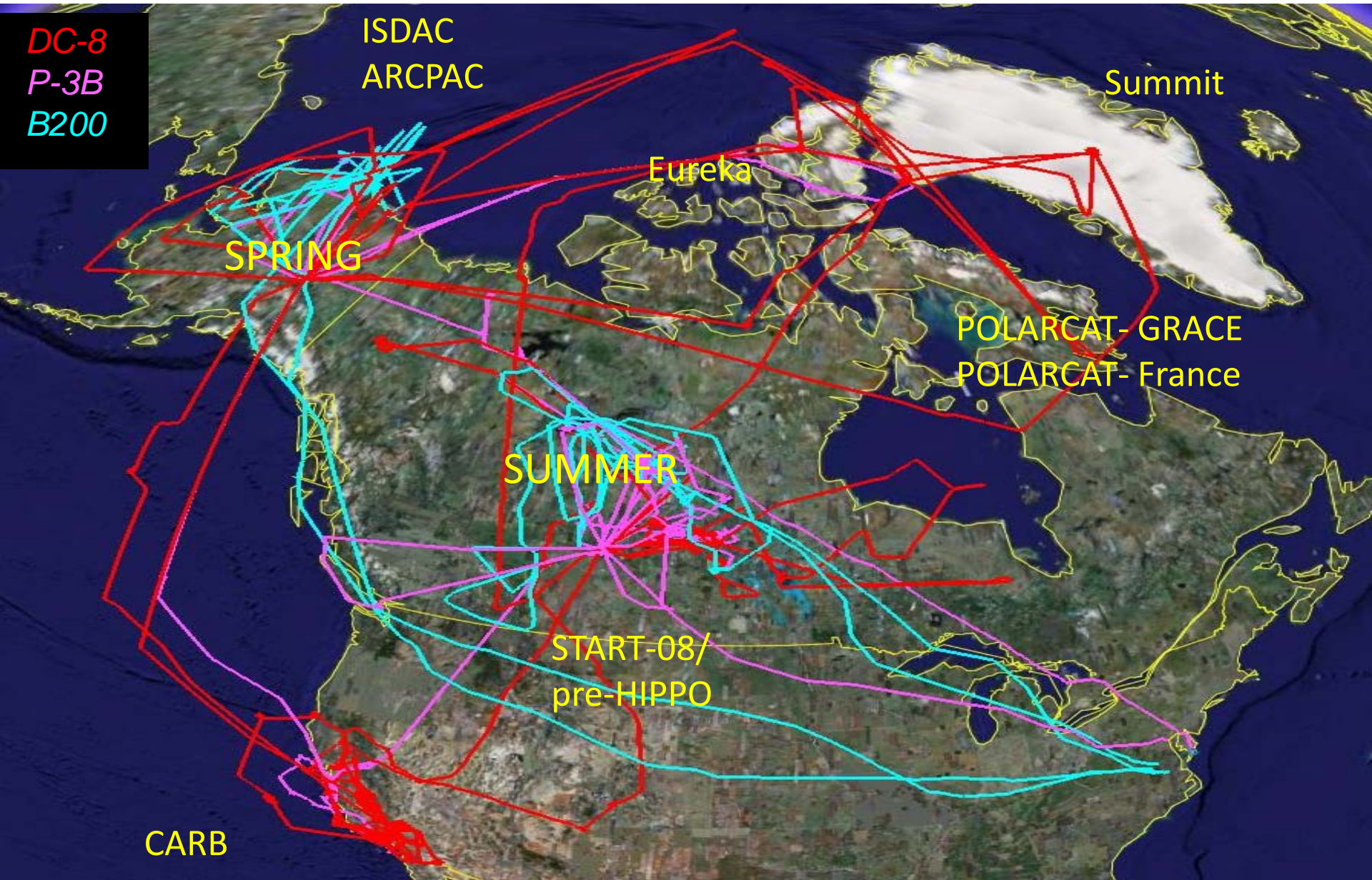
ARCTAS – NASA Arctic Research of the Composition of the Troposphere from Aircraft and Satellites

- Aircraft: DC8, P3, B200
- April 1-19 – Fairbanks
- June 18-24 – Palmdale, CA
- June 26-July 13 – Cold Lake, Alberta
- Coincident campaigns: NOAA ARCPAC, DOE ISDAC, POLARCAT-France & Germany

START-08/pre-HIPPO – NSF HAIPER

- April 18 – June 26
- based in JeffCo, Colorado, covering wide areas of the US and Canada
- START08 Objectives: UTLS exchange processes, Convection, Gravity Waves

ARCTAS flight tracks



Chemical forecasts for ARCTAS

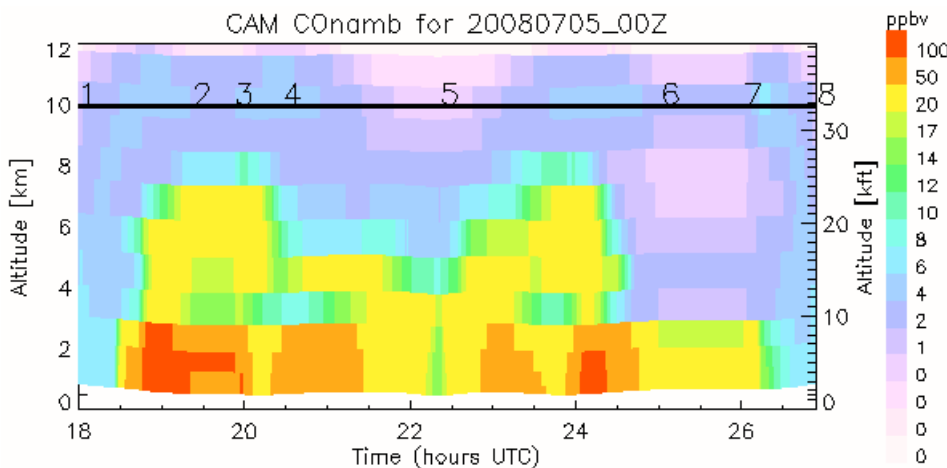
MOZART-4 driven by GFS forecast met fields

CAM-chem/DART – assimilation of met obs,
MOPITT CO, MODIS AOD, free-running for
10-day forecasts

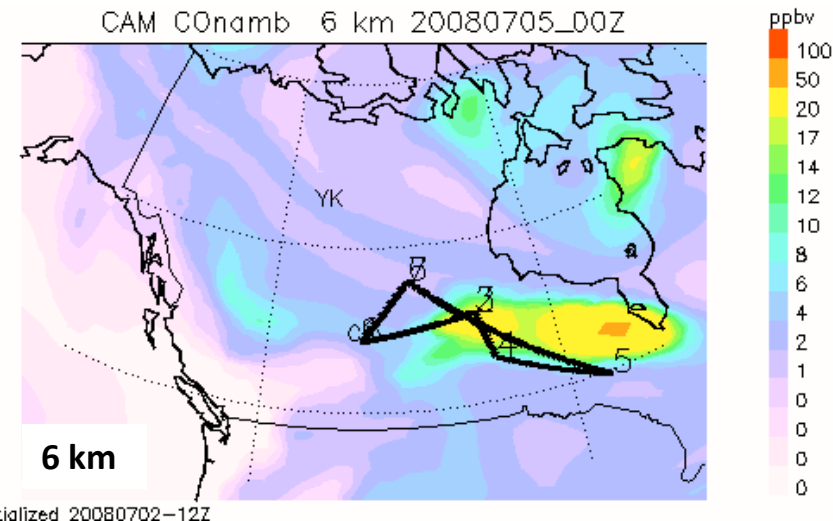
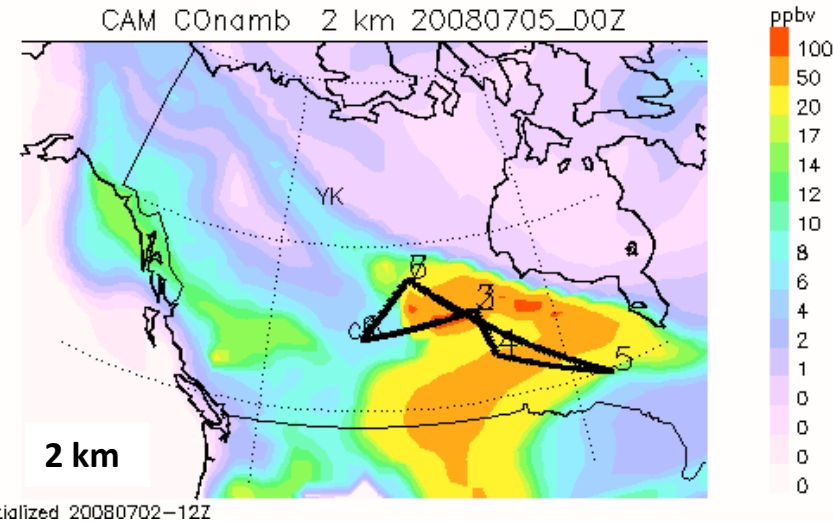
CO tags of anthro and fire emissions (0.5 deg)

Fire emissions based on MODIS fire counts
(C. Wiedinmyer)

***MOZART and CAM-Chem forecasts generally
agreed with other tracer forecasts and
were accurate!***



Flight July 4 – NCAR/CAM-Chem CO from N.America Fires



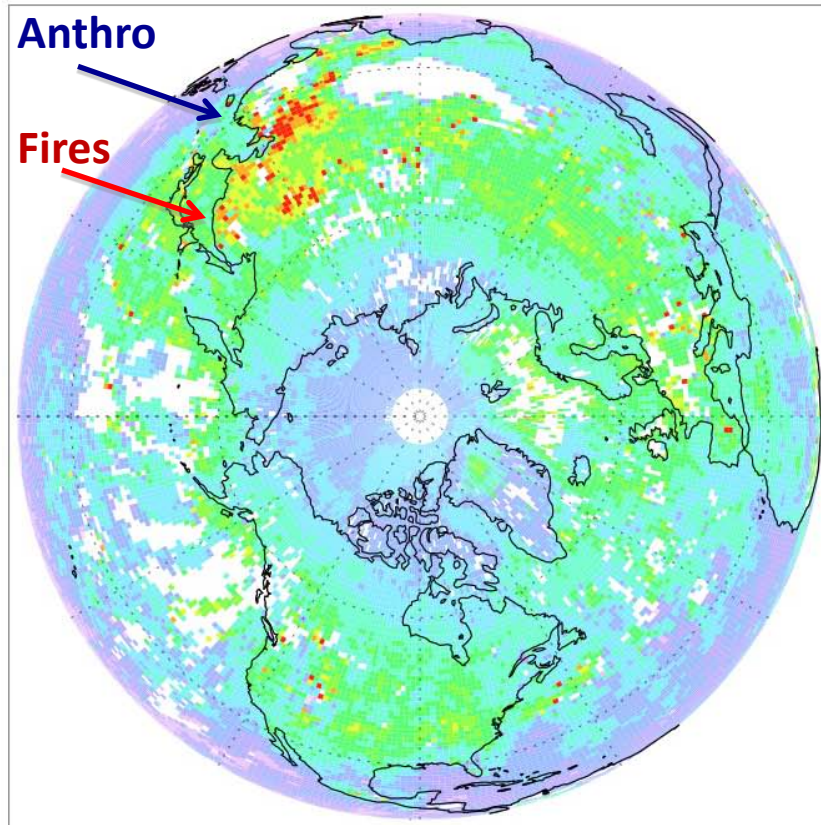
Evaluation of MOZART with MOPITT – April 1-17

MOZART-4 – NCEP/GFS – T85 (1.4° x1.4°)

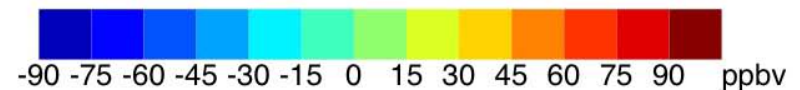
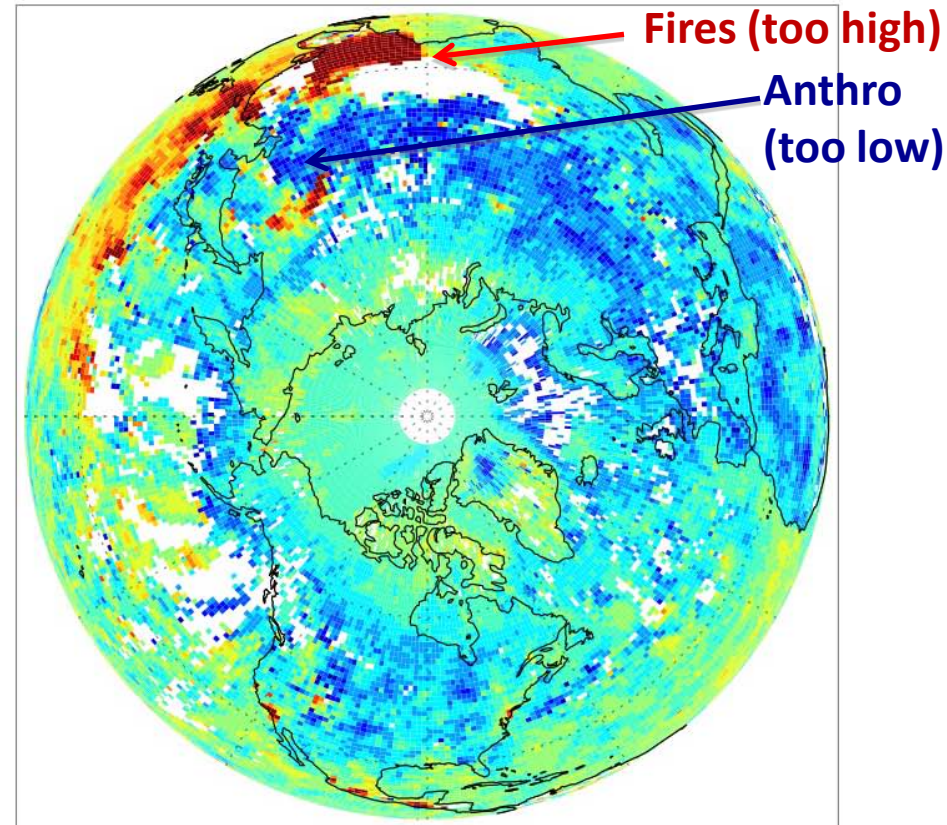
Emissions: Streets pre-ARCTAS emissions + daily fires (C.Wiedinmyer)

MOZART transformed with MOPITT averaging kernel and a priori, for each day

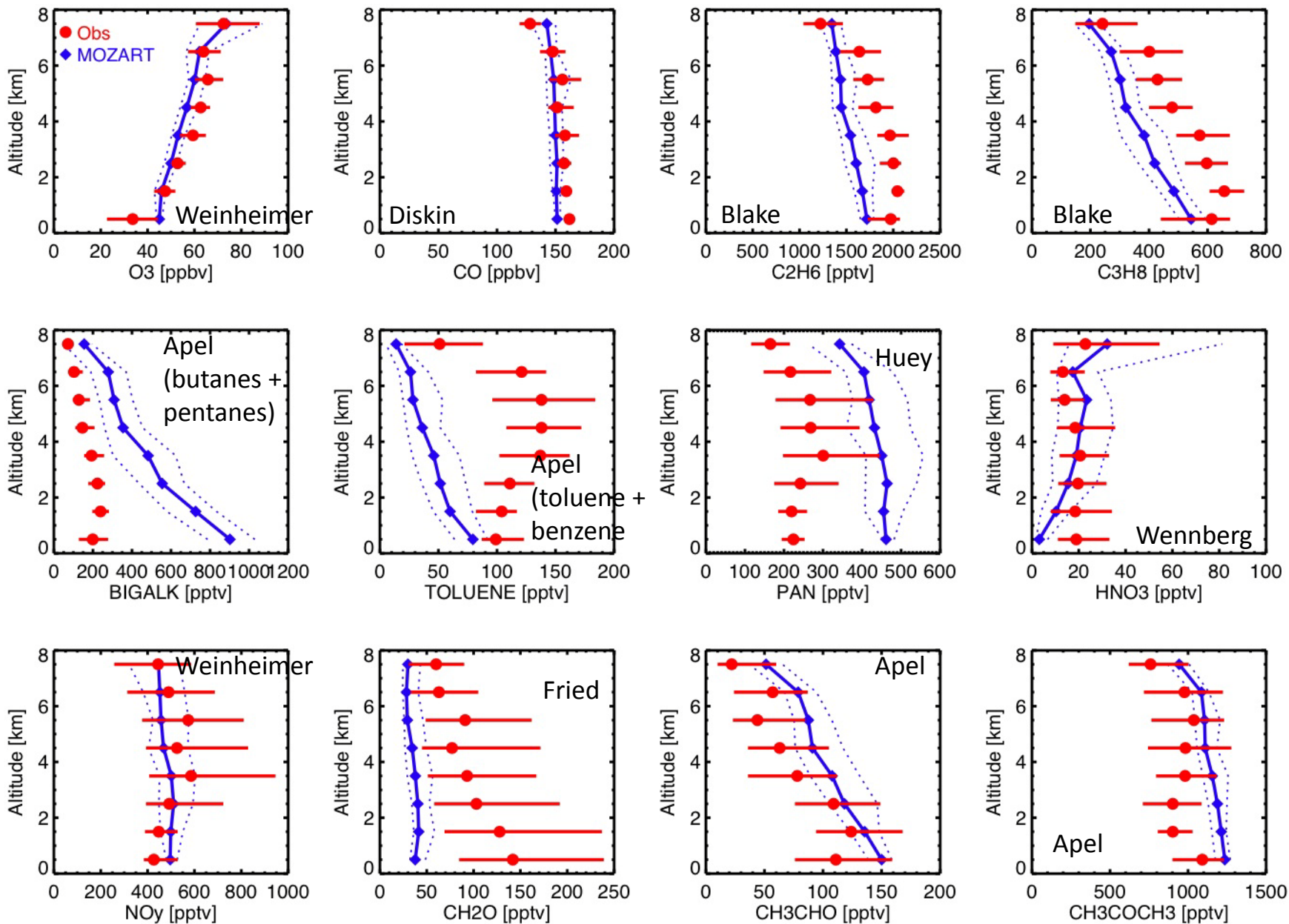
MOPITT 700 hPa



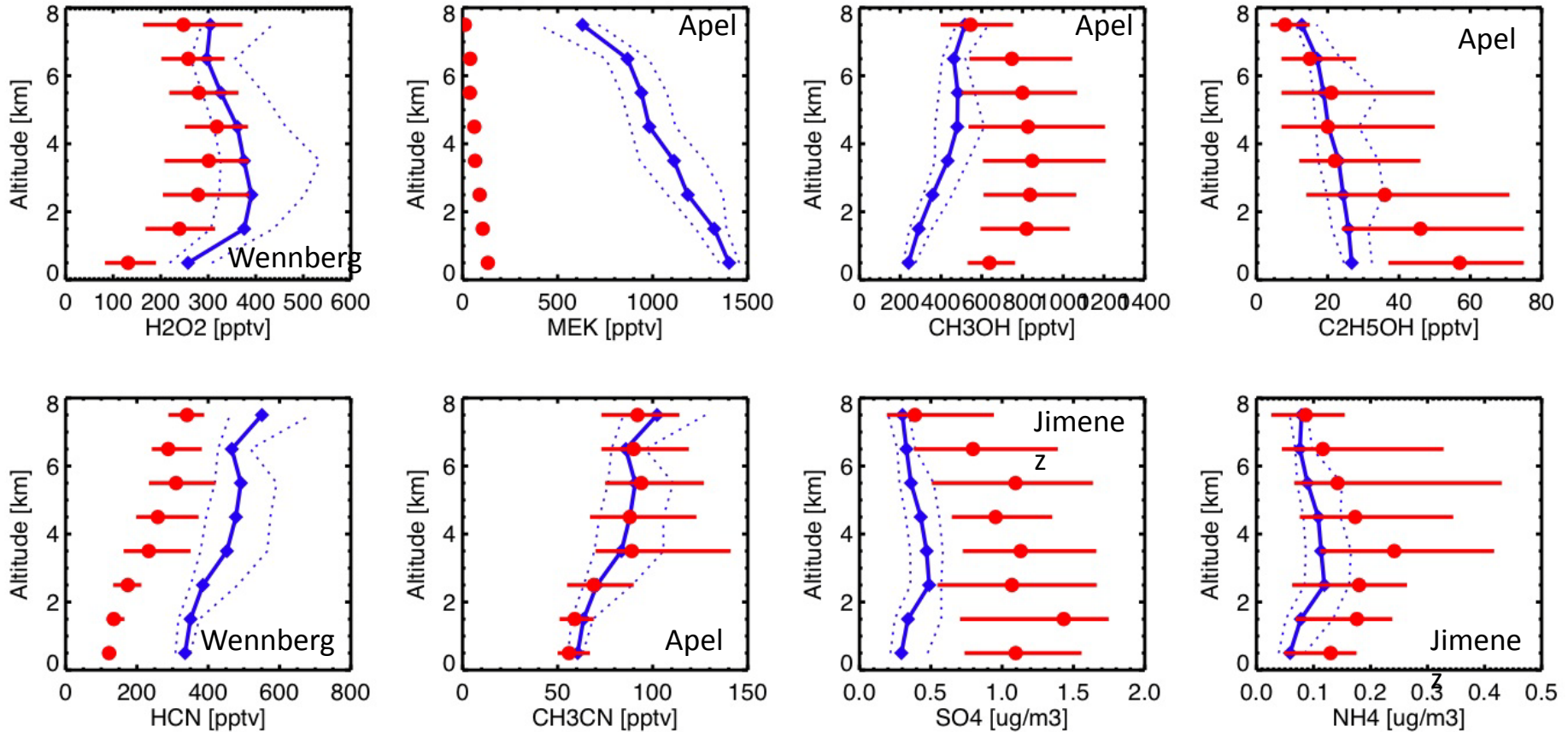
MOZART minus MOPITT



ARCTAS – DC8 – April 1-17 Observations and MOZART-4/GFS-T85



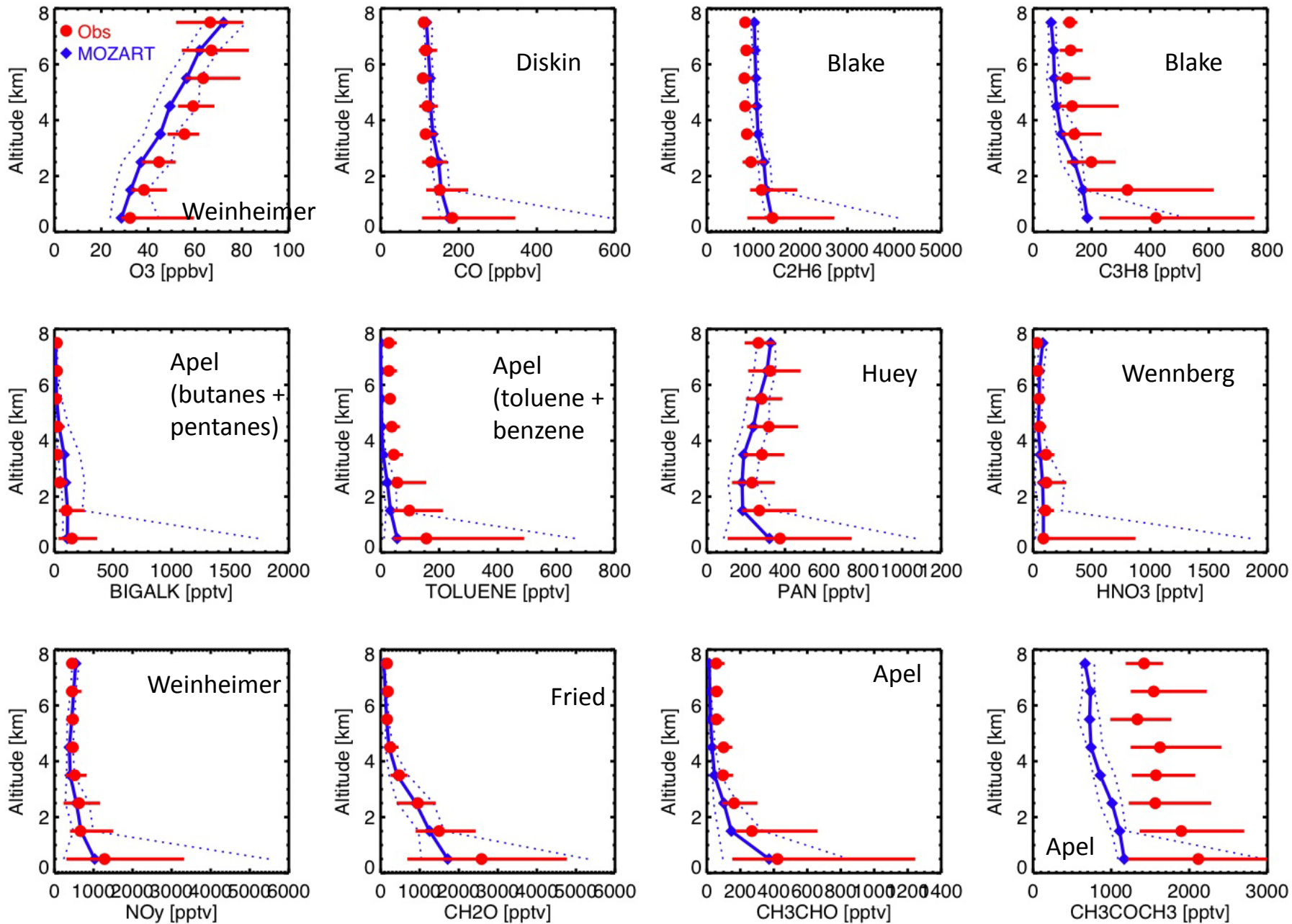
ARCTAS – DC8 – April 1-17 Observations and MOZART-4/GFS-T85



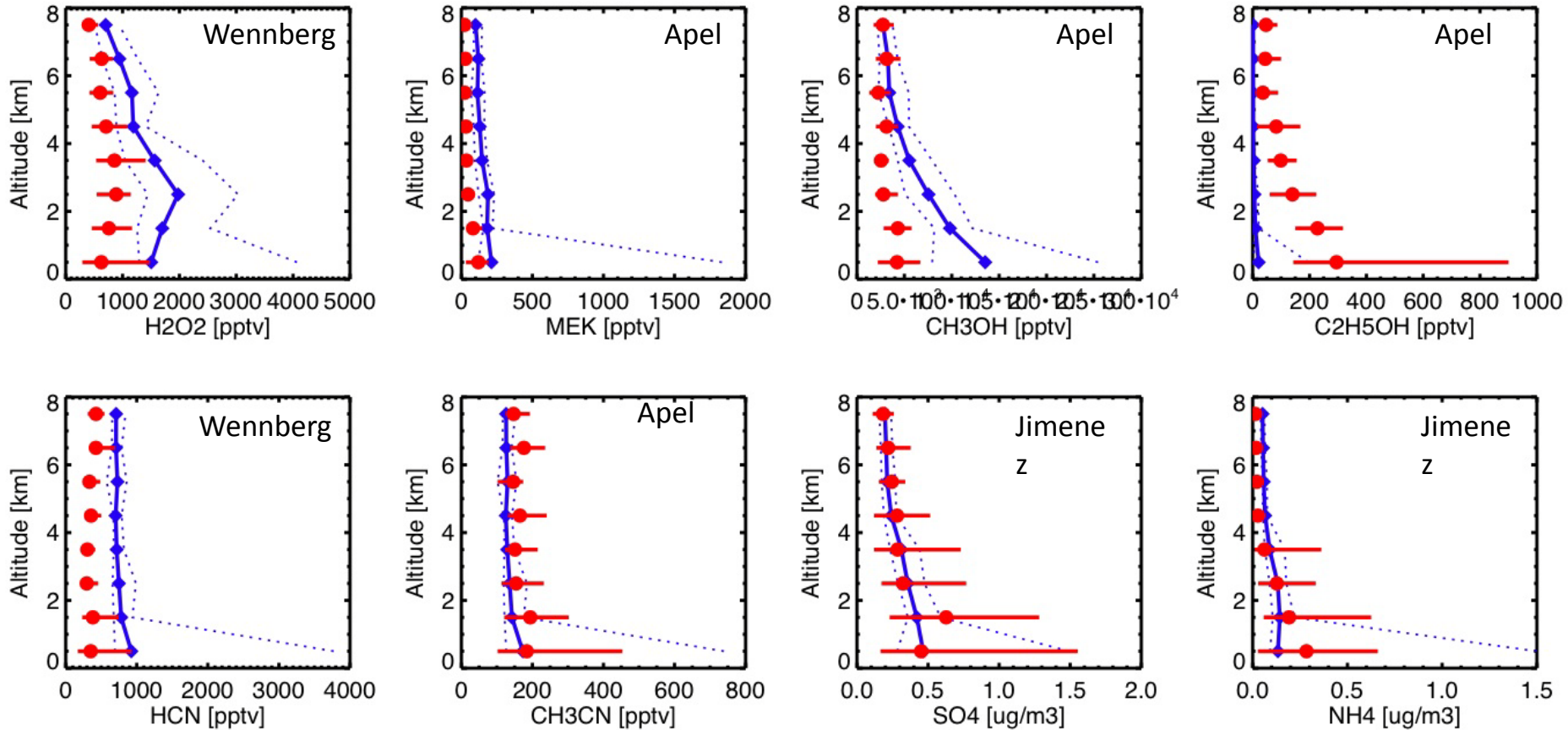
Fire emissions too high (from MOPITT)
 Inconsistency in HCN, CH3CN EFs
 CH3OH anthro emissions too low

Notes:
 MOZART BIGALK represents alkanes C4 and larger
 MOZART TOLUENE represents all aromatics (toluene+benzene+xylenes)
 MOZART MEK is produced from BIGALK, so represents more than purely MEK

ARCTAS – DC8 – June 26-July 13 Observations and MOZART-4/GFS-T85



ARCTAS – DC8 – June 26-July 13 Observations and MOZART-4/GFS-T85



MEK direct emissions may be too high
 CH₃OH biogenic emissions too high
 Same HCN, CH₃CN discrepancy
 SO₄, NH₄ agree well! (as opposed to April)

CAM-Chem simulations for ARCTAS & START-08

Several updates made to CAM-chem after preliminary simulations and evaluation:

- Removed the updates to the offline met fields (U, V and T) in the dynamical core in the offline (Specified Dynamics) version
- Changed the way the tropopause is calculated - lots of points were from the climatology, not the actual tropopause
- Changed the stratosphere climatology (from UARS climatology being used in MZ4 to WACCM output) so that information about the location of topography could be used when interpolating to the CAM grid

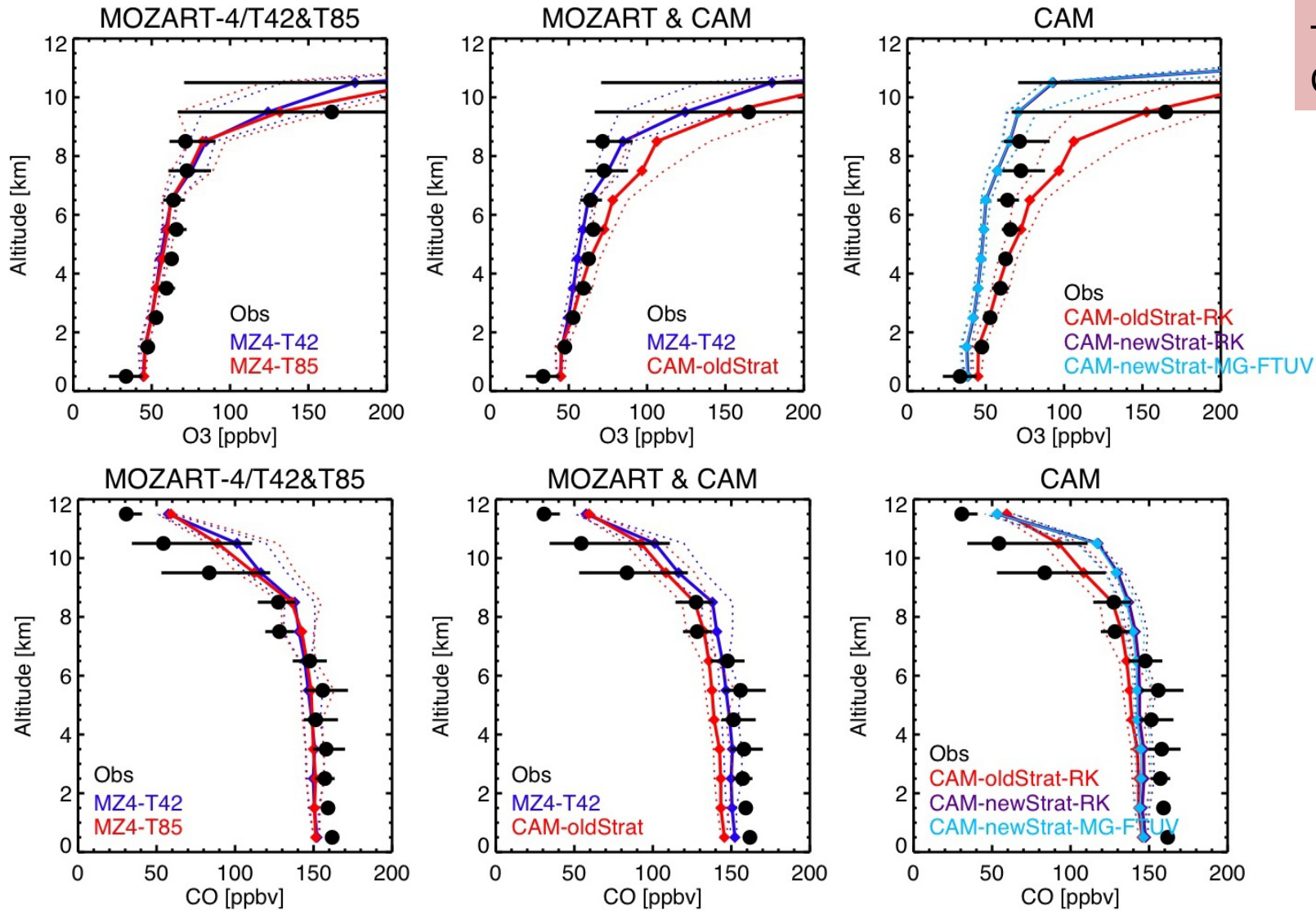
Emissions and met fields (NCEP/GFS) same as MZ4 ARCTAS run

Sensitivity tests with new and old strat, RK and MG microphysics, LUT and FTUV in CAM3.6

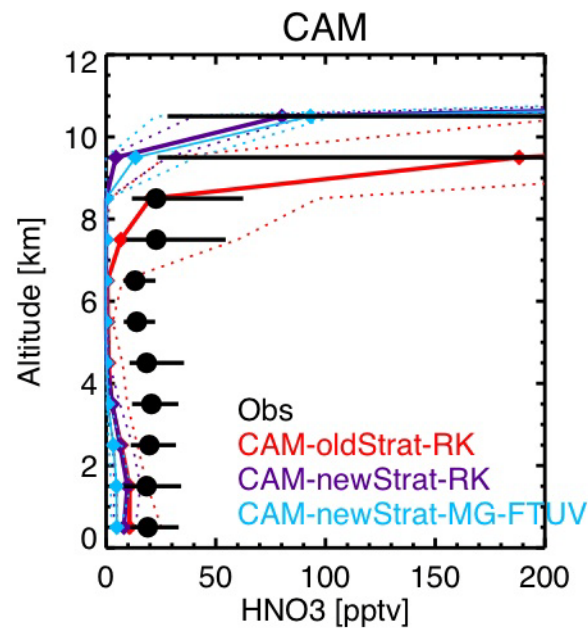
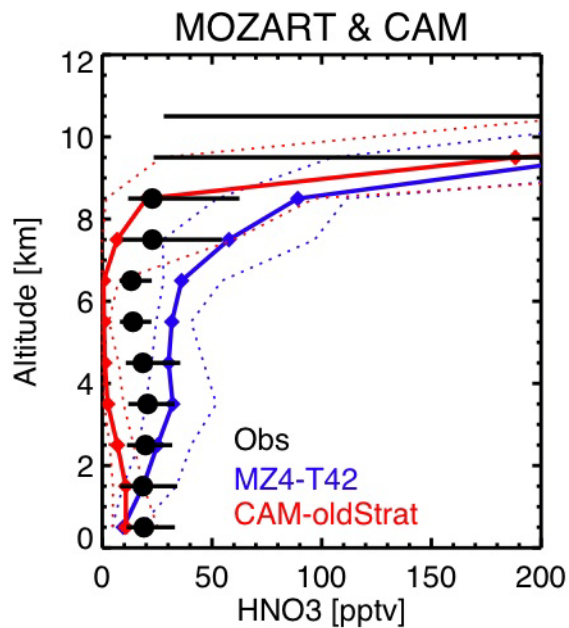
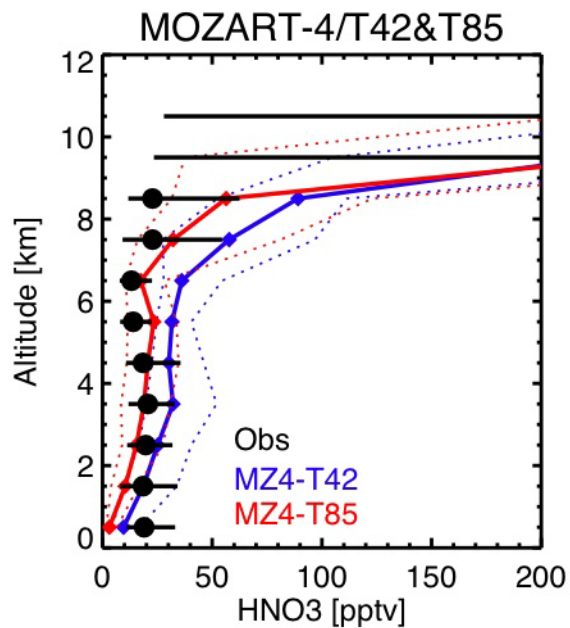
MZ4, CAM for ARCTAS April flights

Model results interpolated to flight tracks, then binned by altitude

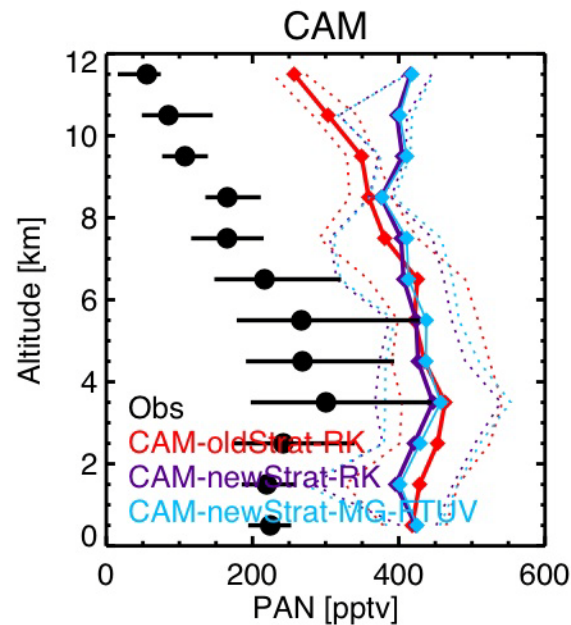
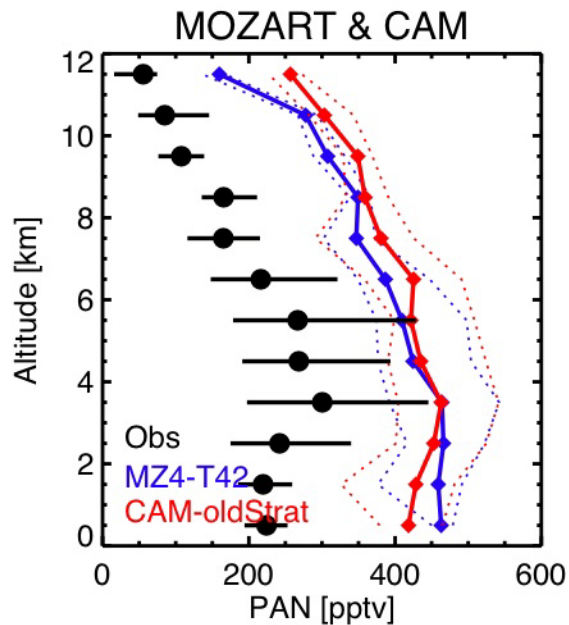
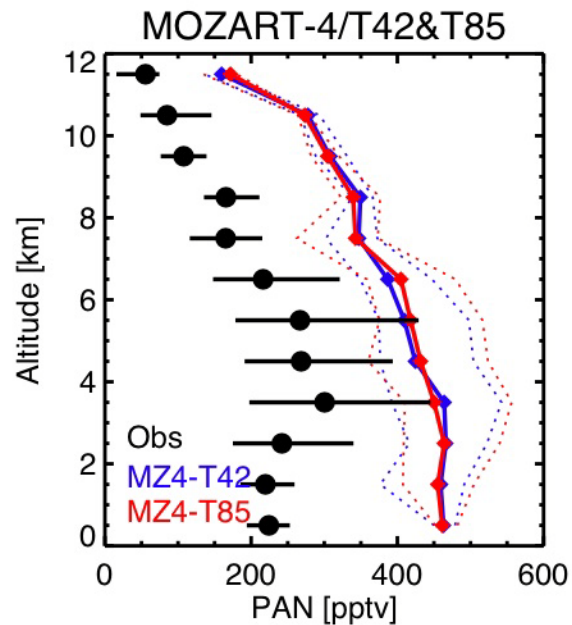
Resolution:
T42: 2.8°
T85: 1.4°
CAM: 1.9x2.5

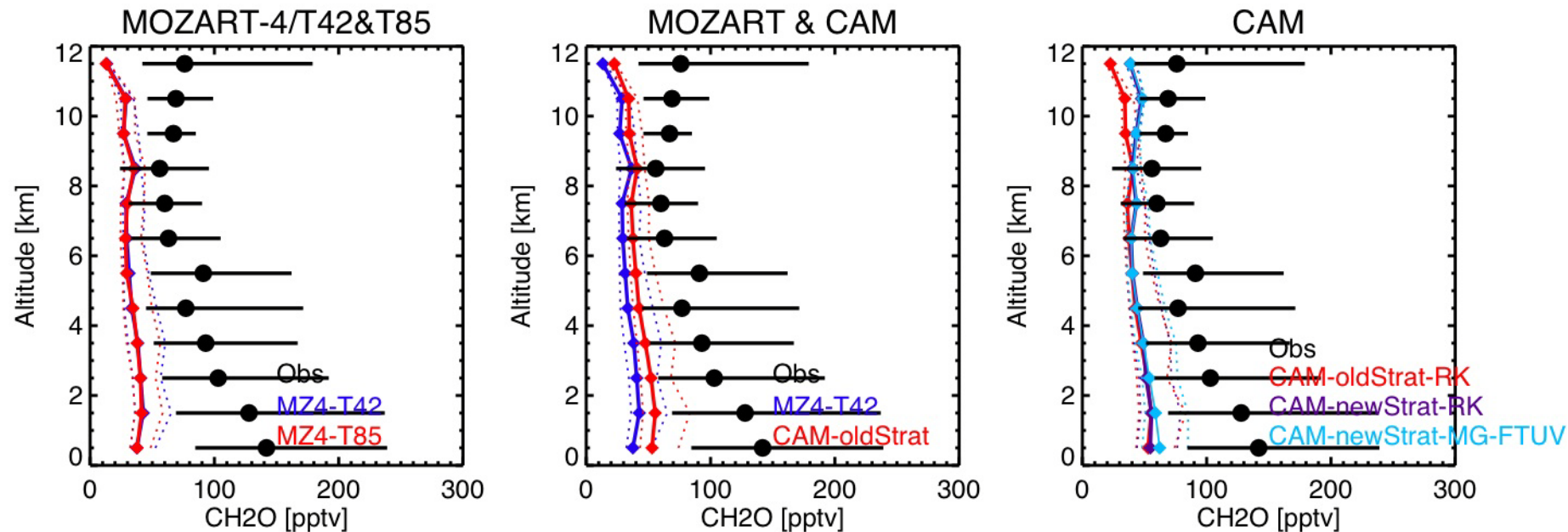


Significant differences between old & new strat. climatology, but not RK-MG, LUT-FTUV

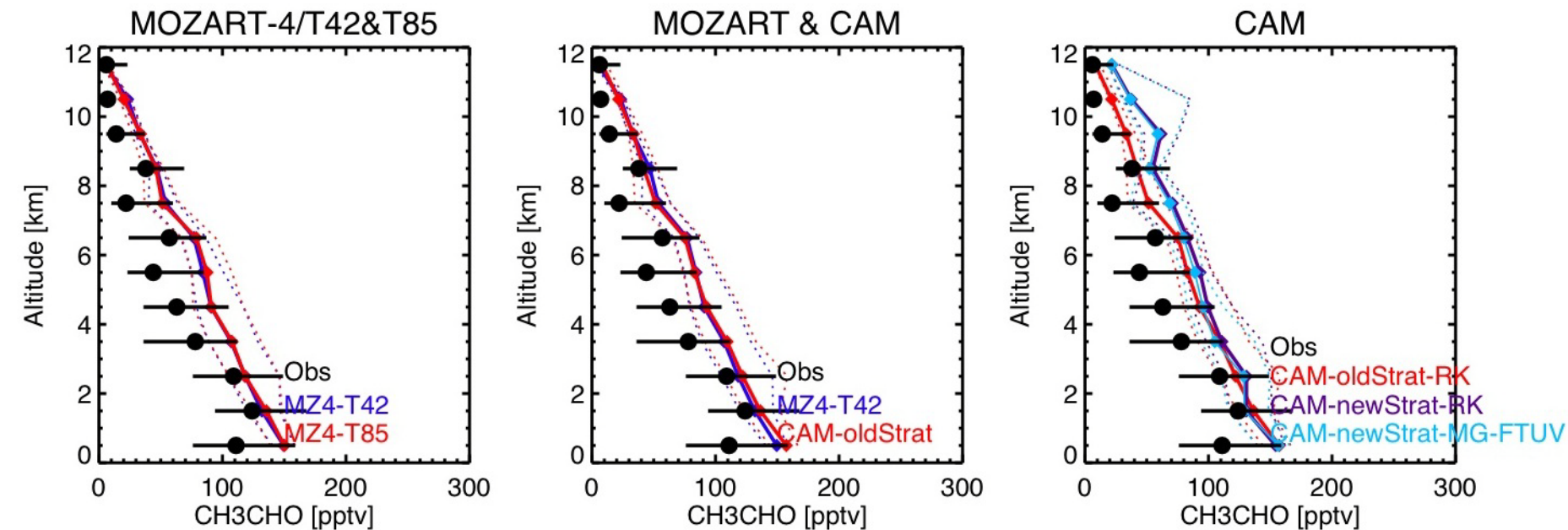


**CAM HNO3 low – washout? microphysics?
PAN influenced by stratosphere constraint (NO_x?)**





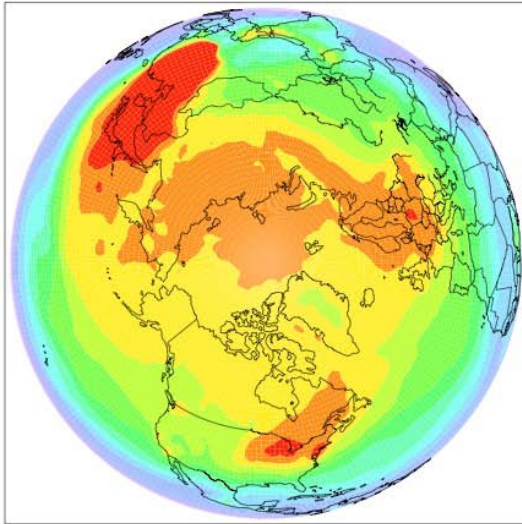
good agreement (MZ4-CAM) for OVOCs



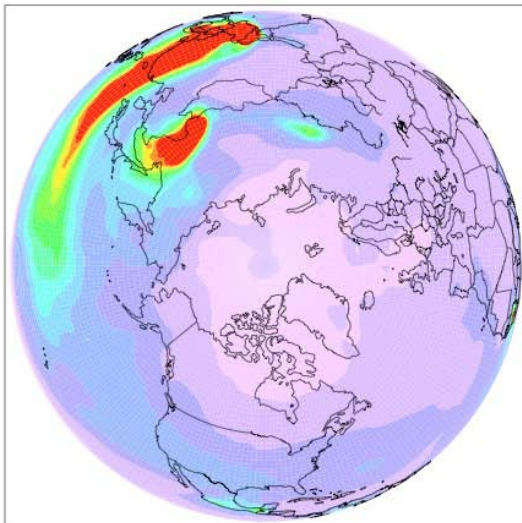
CO Anthro vs Fire

MOZART-4/GFS-T85

NH Anthro



NH Fire



ppbv

70

65

60

55

50

45

40

35

30

25

20

15

10

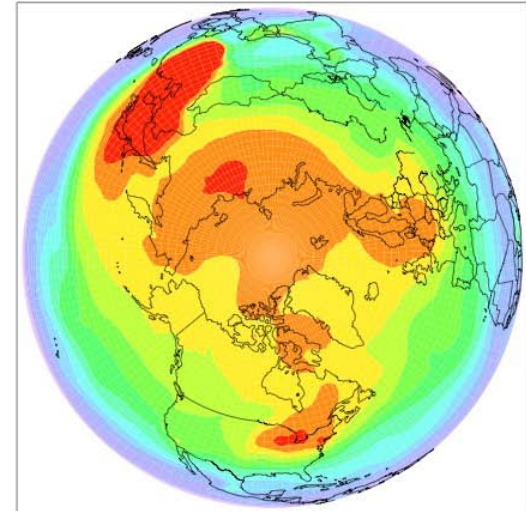
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0

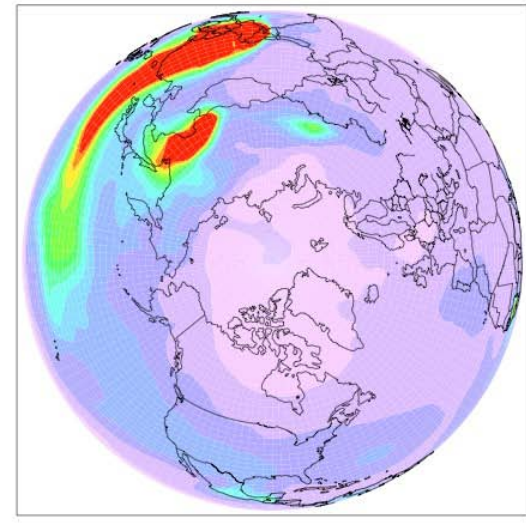
Anthro.
emissions
dominate
trop. column
in Spring and
Summer

CAM-Chem/GFS-1.9x2.5

NH Anthro



NH Fire



ppbv

70

65

60

55

50

45

40

35

30

25

20

15

10

5

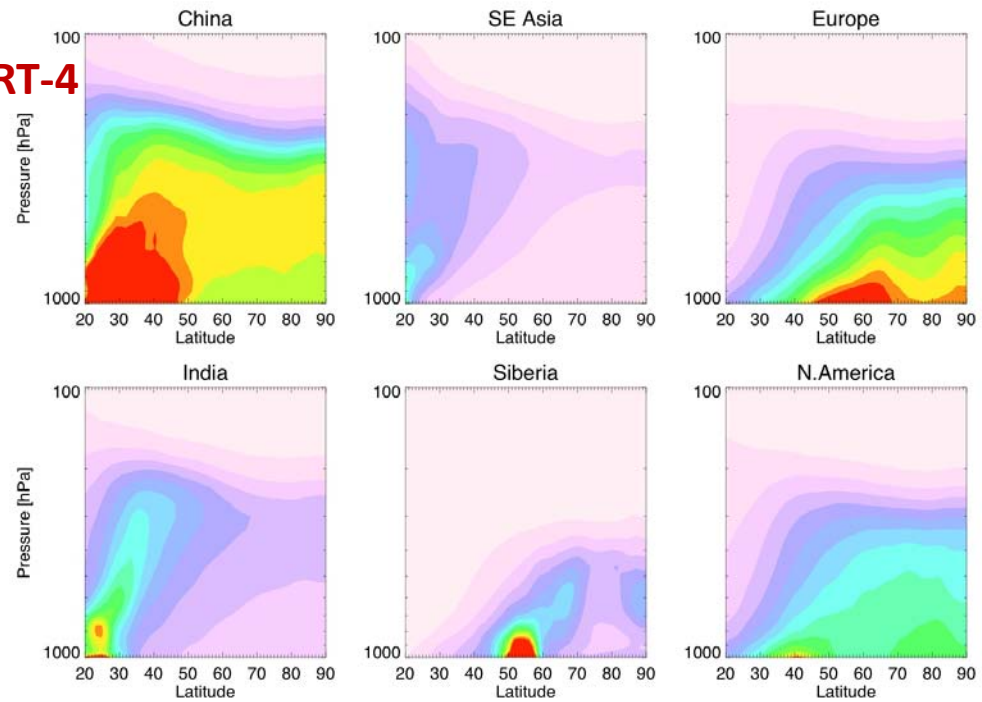
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ZA CO tags

During spring, emissions farther south (China, India) get lofted to mid-trop.

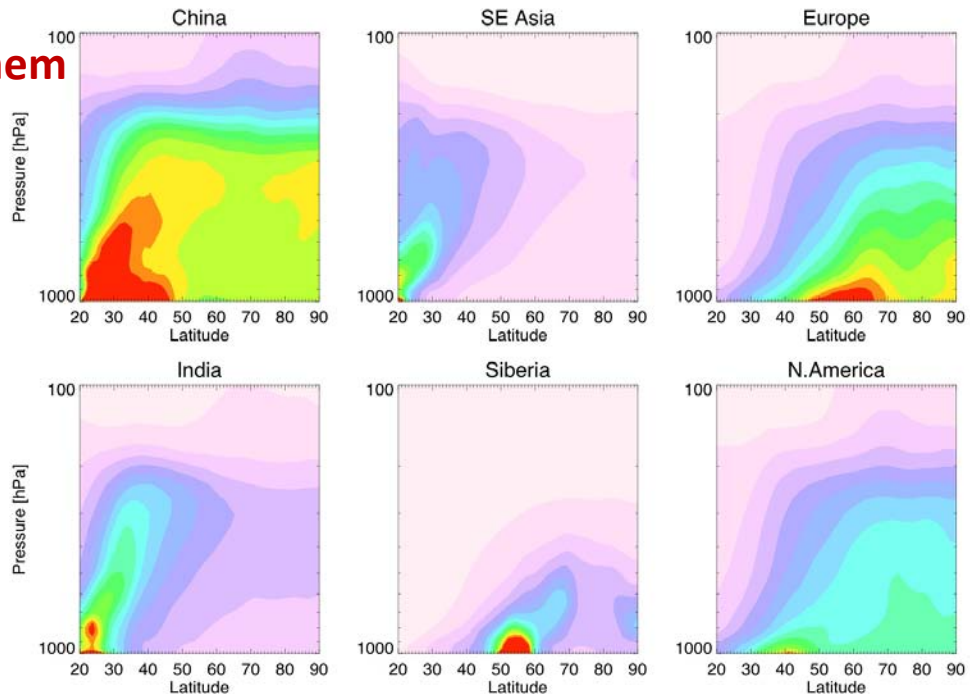
Europe emissions kept to low altitude

MOZART-4

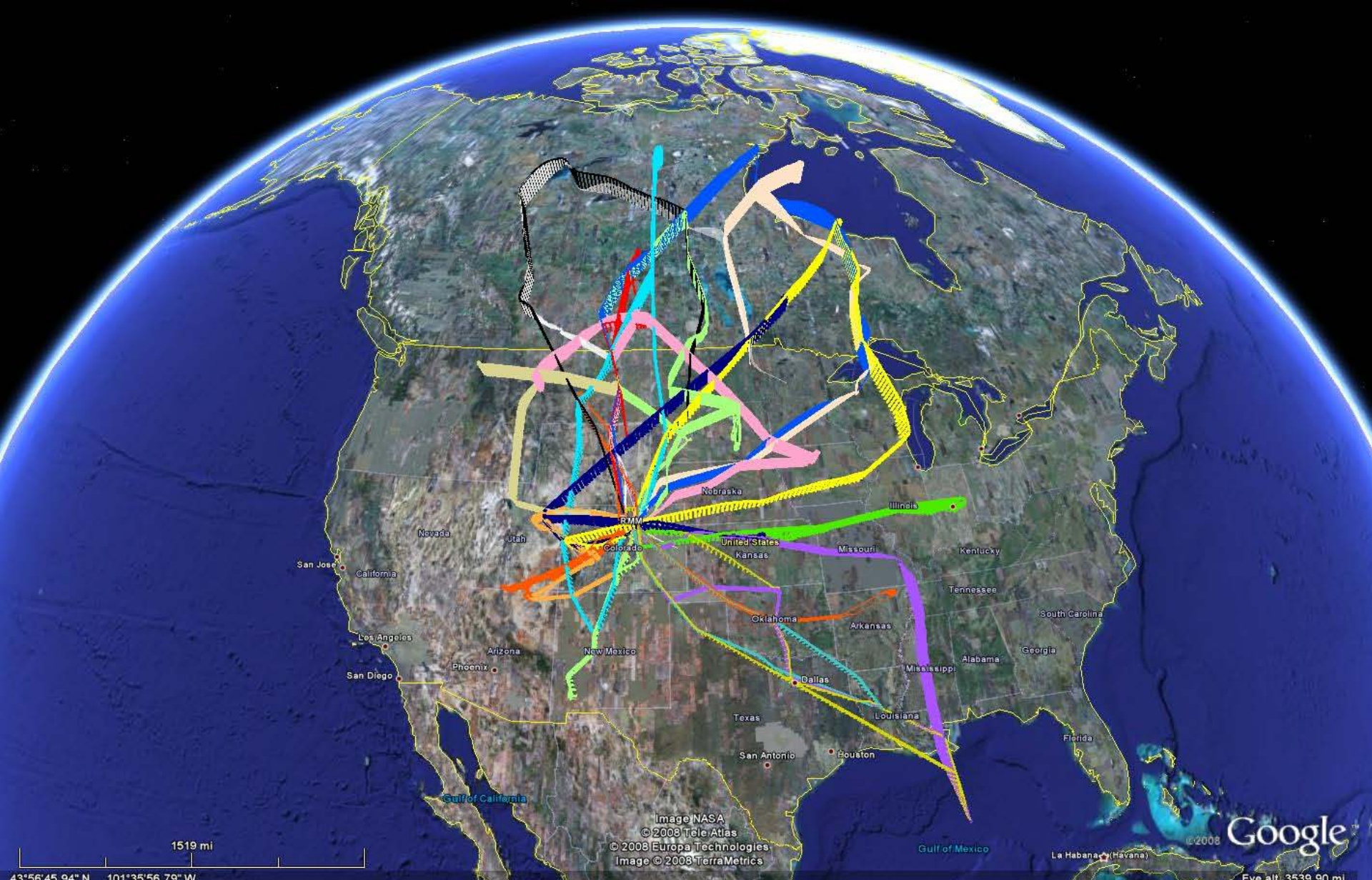


CAM-Chem

CAM-Chem quite similar to MOZART
Differences due to different BL and convection schemes

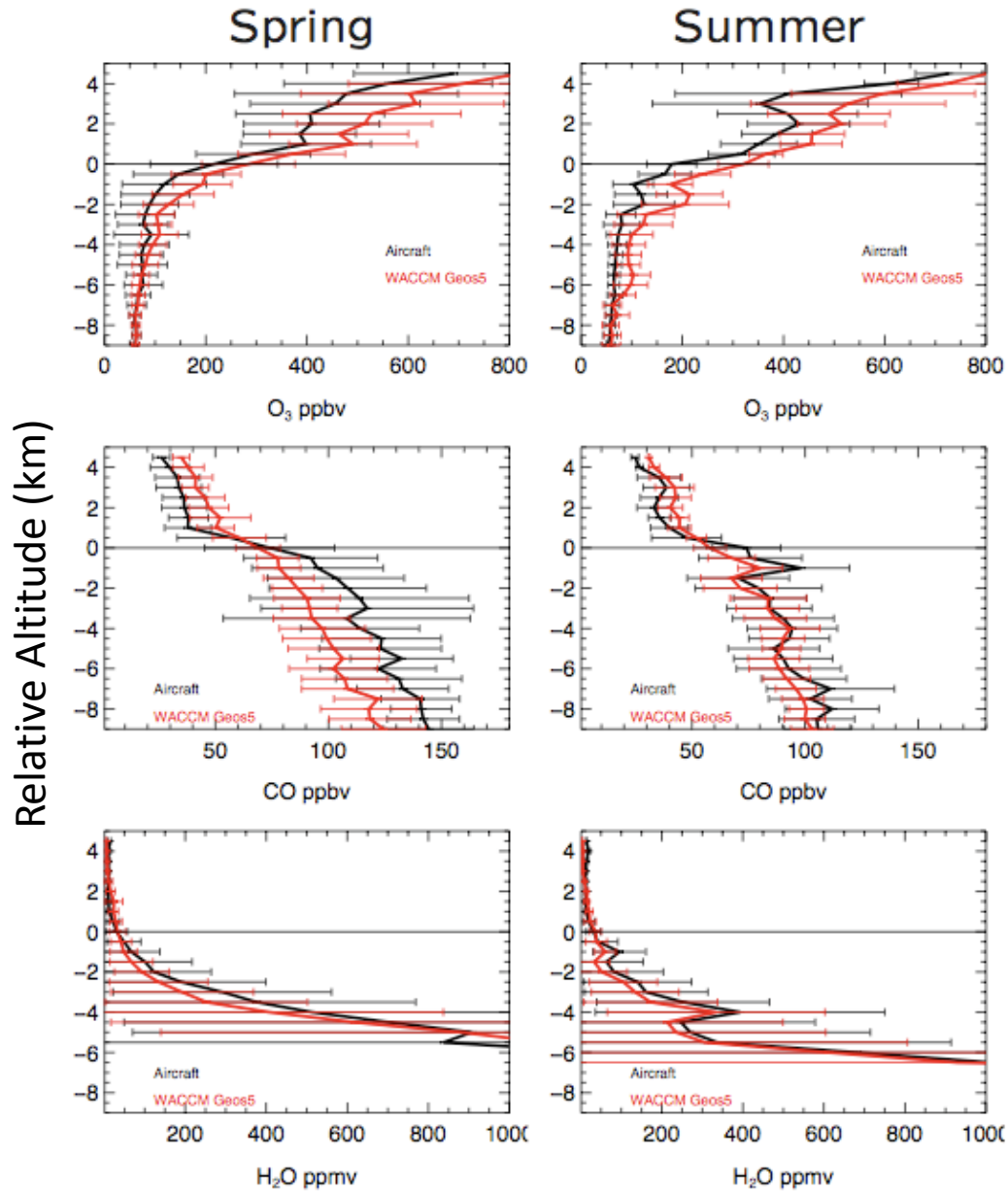


Flight Tracks START08/PreHippo

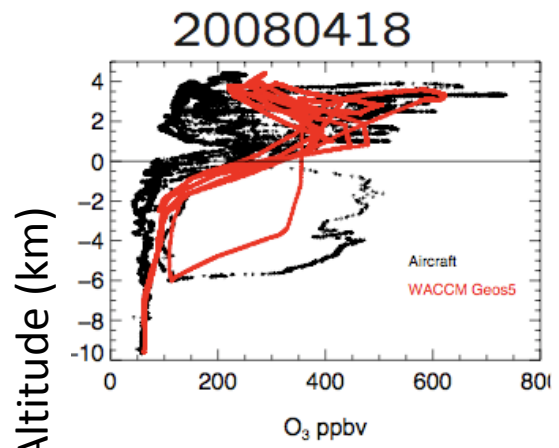
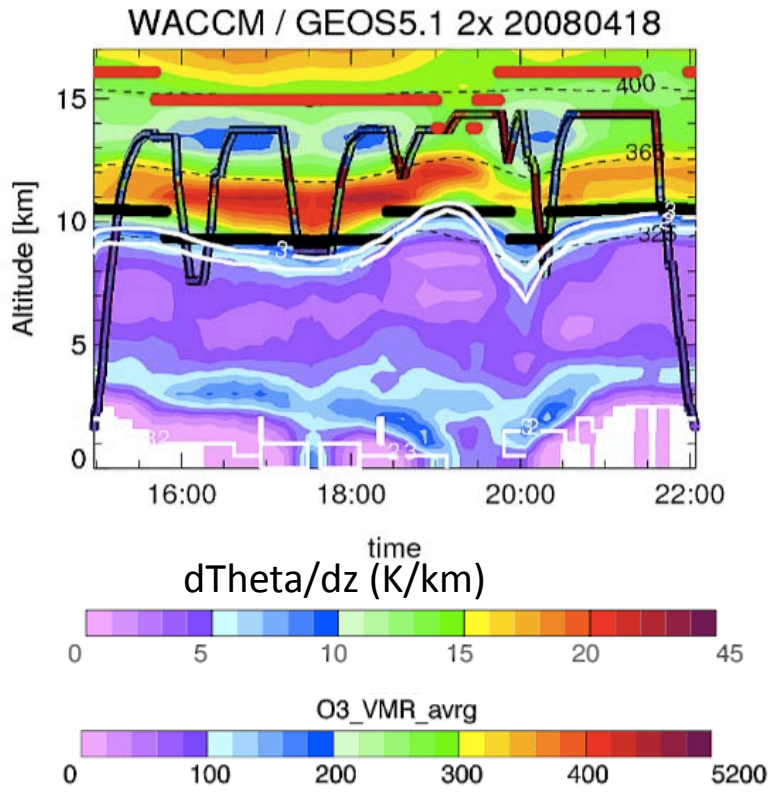


Comparison START08 Aircraft Data vs. WACCM on Flight Tracks

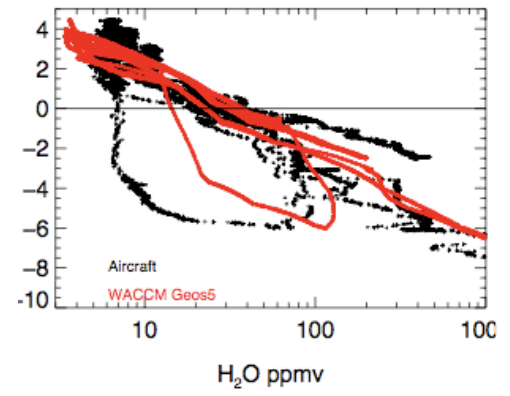
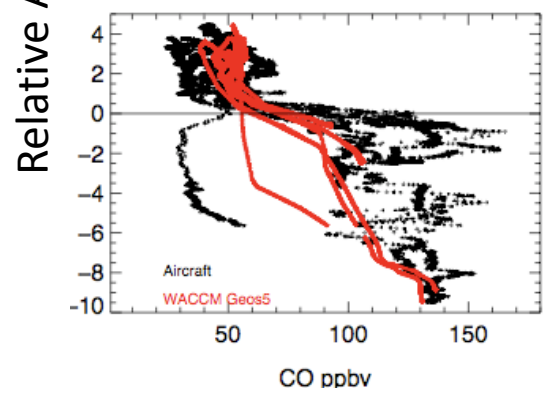
Aircraft
WACCM



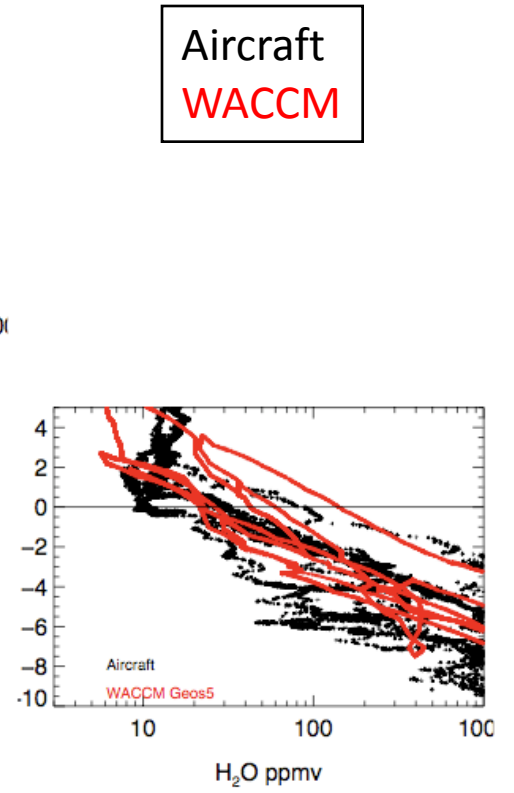
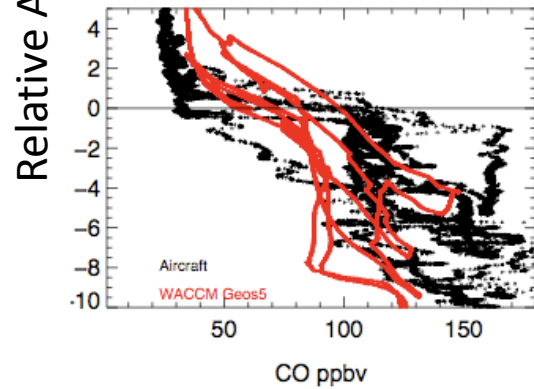
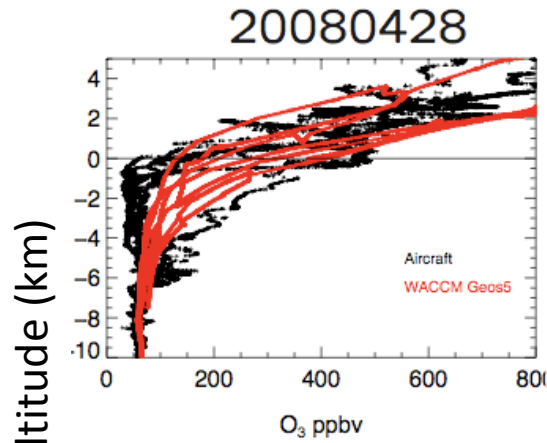
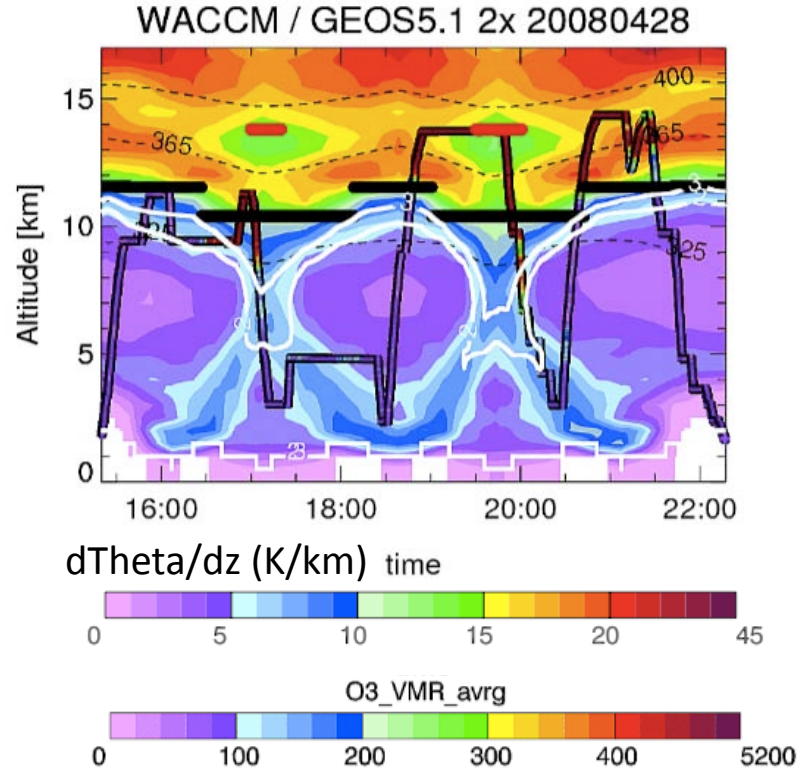
Comparison START08 Aircraft Data vs. WACCM: Tropospheric Intrusion



Aircraft
WACCM



Comparison START08 Aircraft Data vs. WACCM: Stratospheric Intrusion

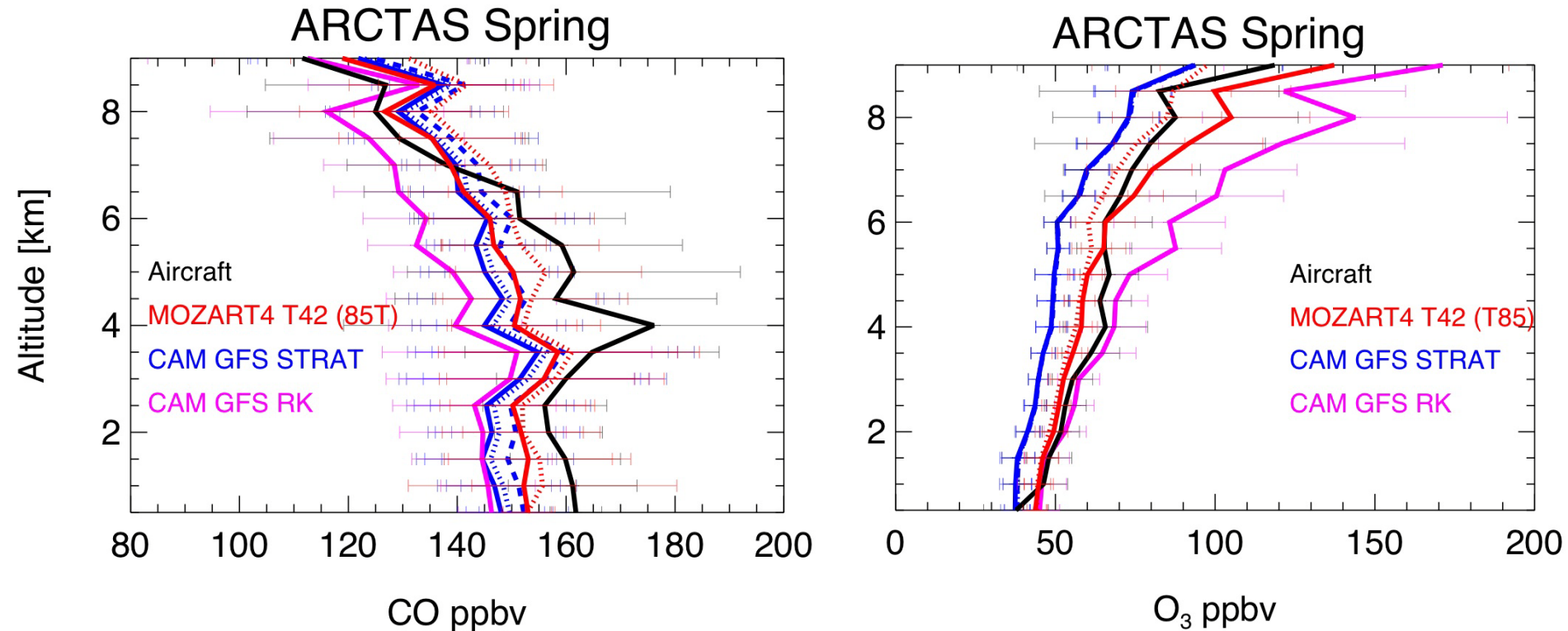


Aircraft
WACCM

Future Plans

- Further evaluation of CAM-Chem (and improvement)
- Comparison of GFS and GEOS-5 met., different resolutions
- Analysis of source contributions to Arctic composition
- Contribution of strat-trop exchange to chemical budgets
- Linking ARCTAS-AK, STRAT-08, ARCTAS-CL (spring to summer)
- Comparison to TOPSE
- Summer campaign: fire plume heights; biogenic emissions (isoprene & products, methanol, acetone)
- Opportunities for linking with climate interactions (soot on snow, radiative forcing...)

CAM-Chem and DC-8 observations



CAM-Chem driven by GFS, same emissions as MOZART-4 simulations

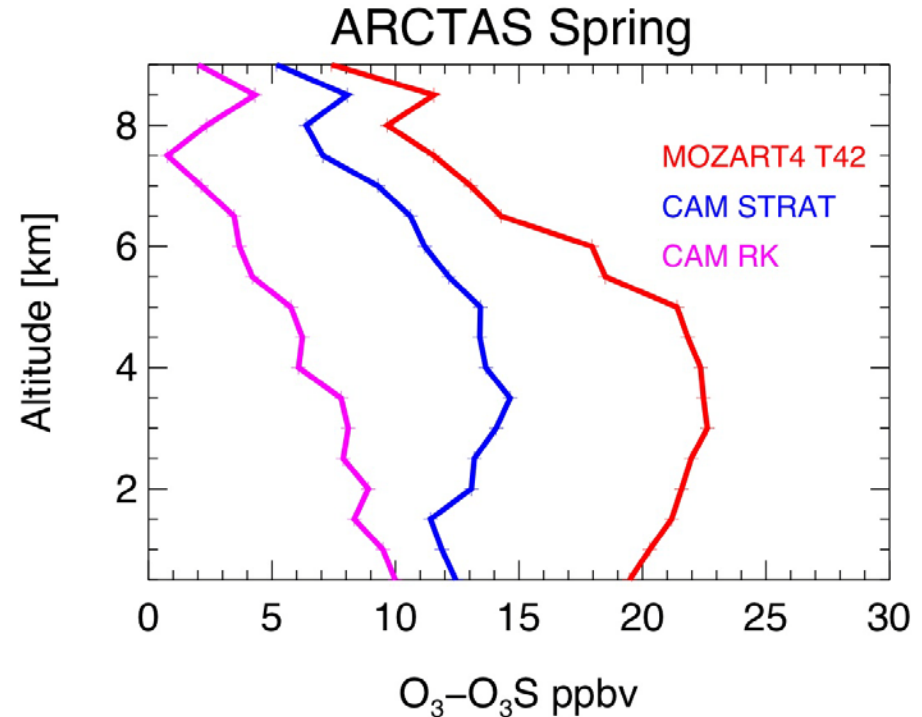
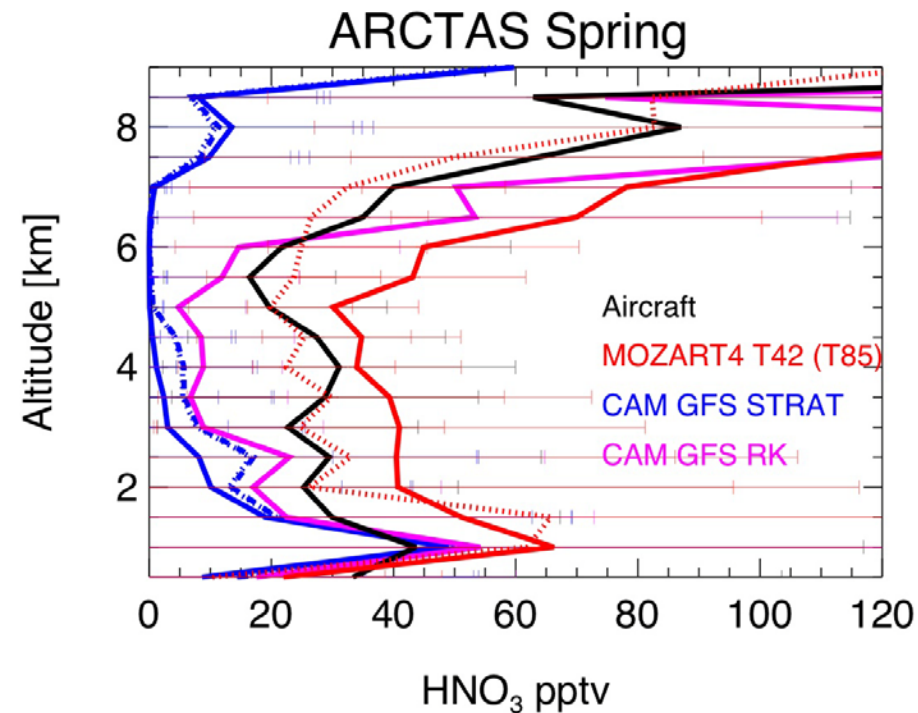
RED: MOZART-4 (solid: T42, dashed: T85)

PINK: old stratosphere climatology, RK (old) microphysics

BLUE: new stratosphere, RK microphysics

dashed: MG microphysics, dotted: FTUV

CAM-Chem and DC-8 observations



CAM-Chem driven by GFS, same emissions as MOZART-4 simulations

RED: MOZART-4 (solid: T42, dashed: T85)

PINK: old stratosphere climatology, RK (old) microphysics

BLUE: new stratosphere, RK microphysics

dashed: MG microphysics