WACCM Applications for the Polar Stratosphere and Mesosphere

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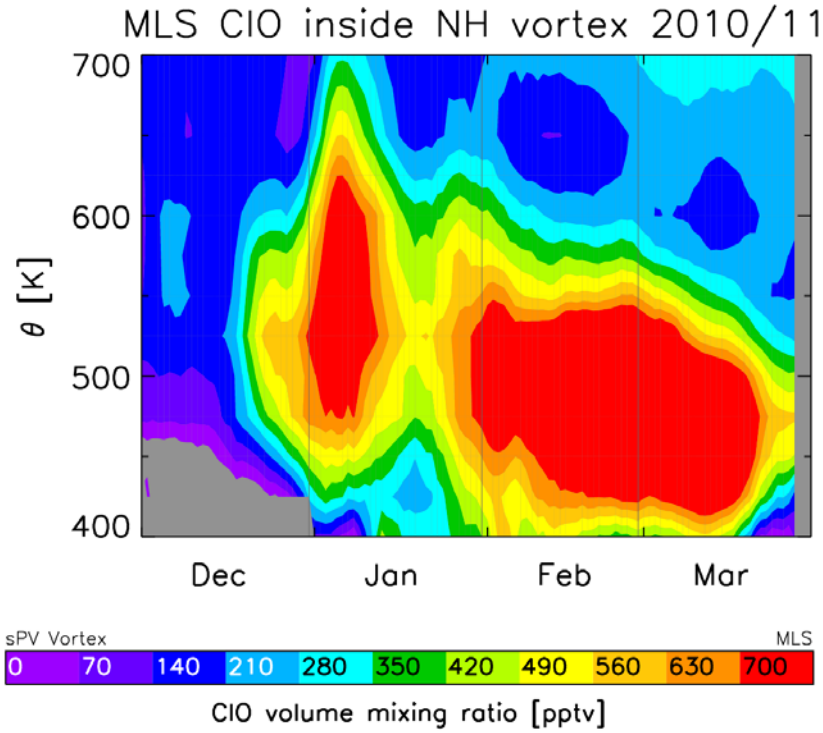
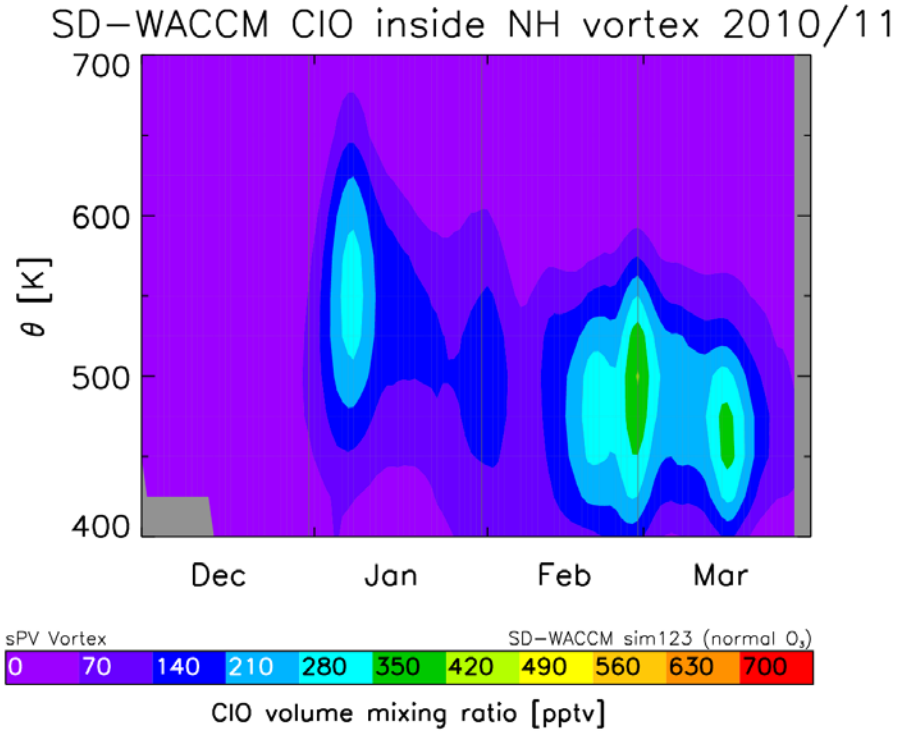
Outline

- Polar Stratospheric Ozone Loss
- Polar Mesospheric Temperatures and Clouds
  - Verification of summer polar temperatures
  - Inter-hemispheric teleconnections
- Energetic Particle Precipitation
  - Auroral electron precipitation effects
  - MLT Transport
- WACCM CO_2 evaluation

WACCM Output at Satellite Times/Locations
(Matthias Brakebusch)

Specific Motivation: To evaluate diurnally varying species in WACCM by comparison with satellite data, for diagnosing ozone loss processes





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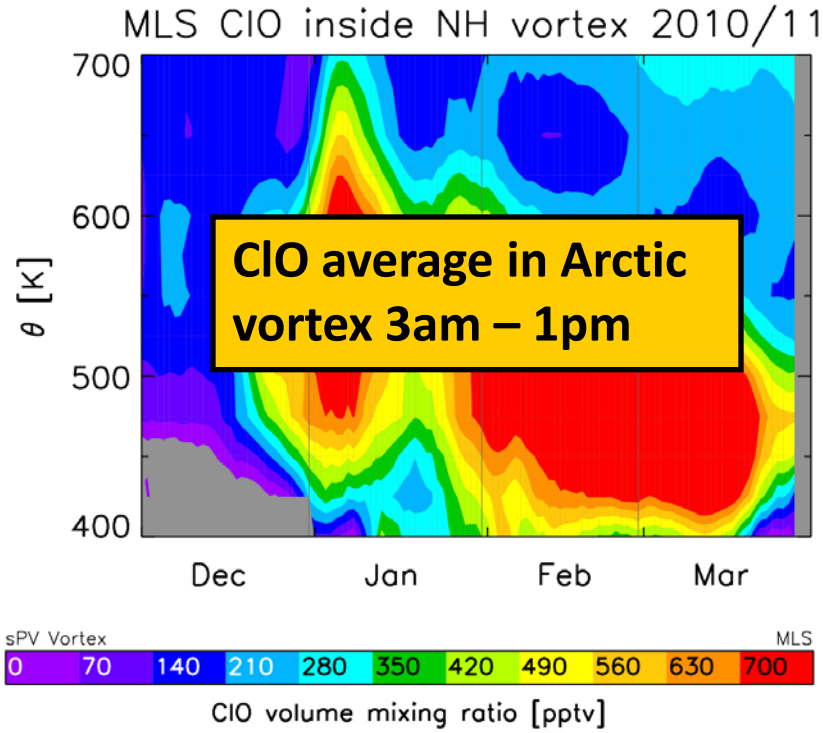
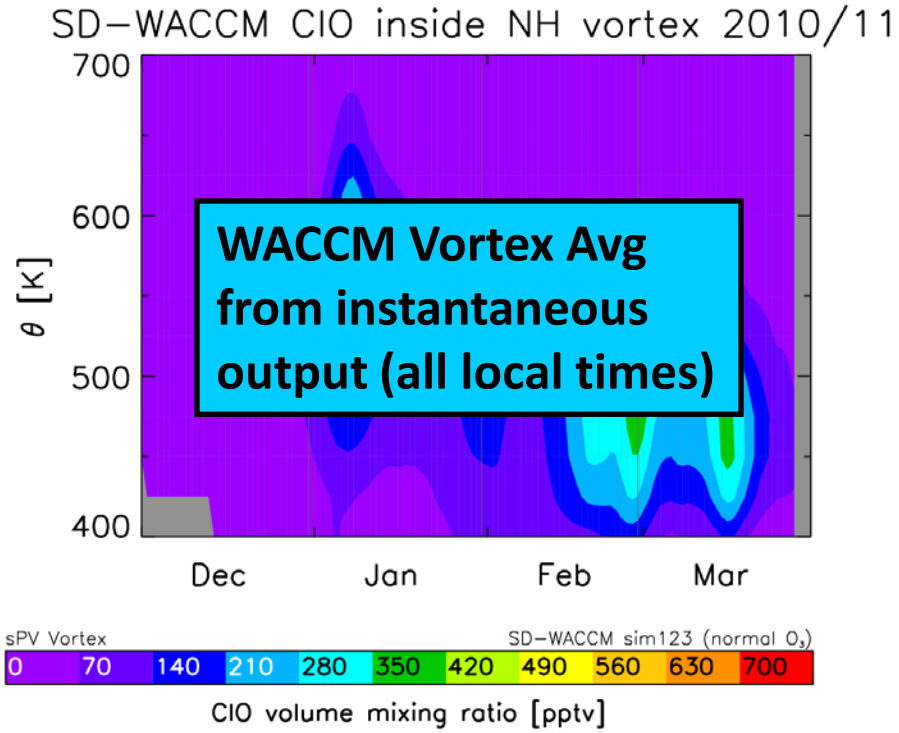




WACCM Output at Satellite Times/Locations

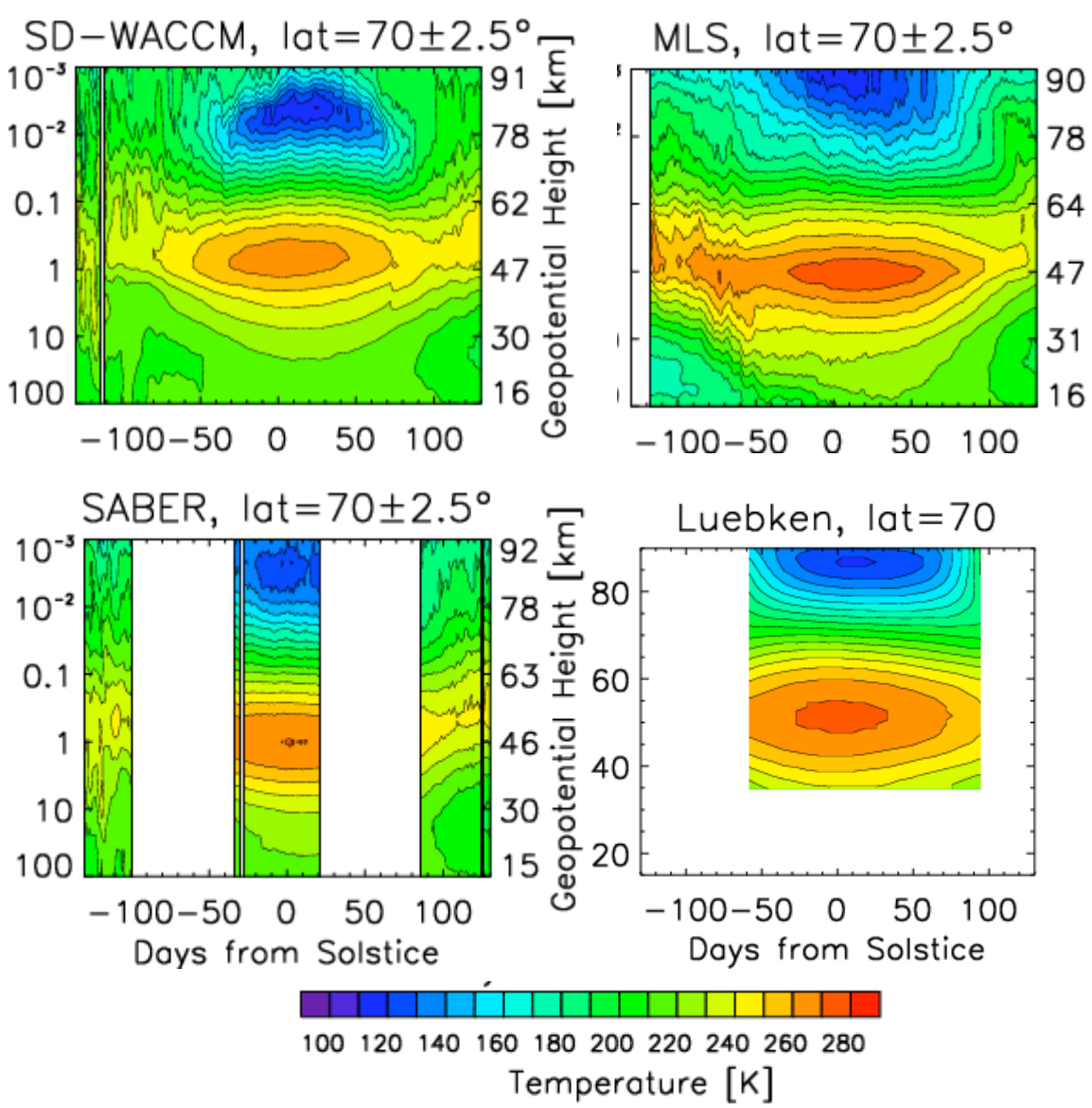
Example:
satellite_profilelist_20020125_20110331.nc

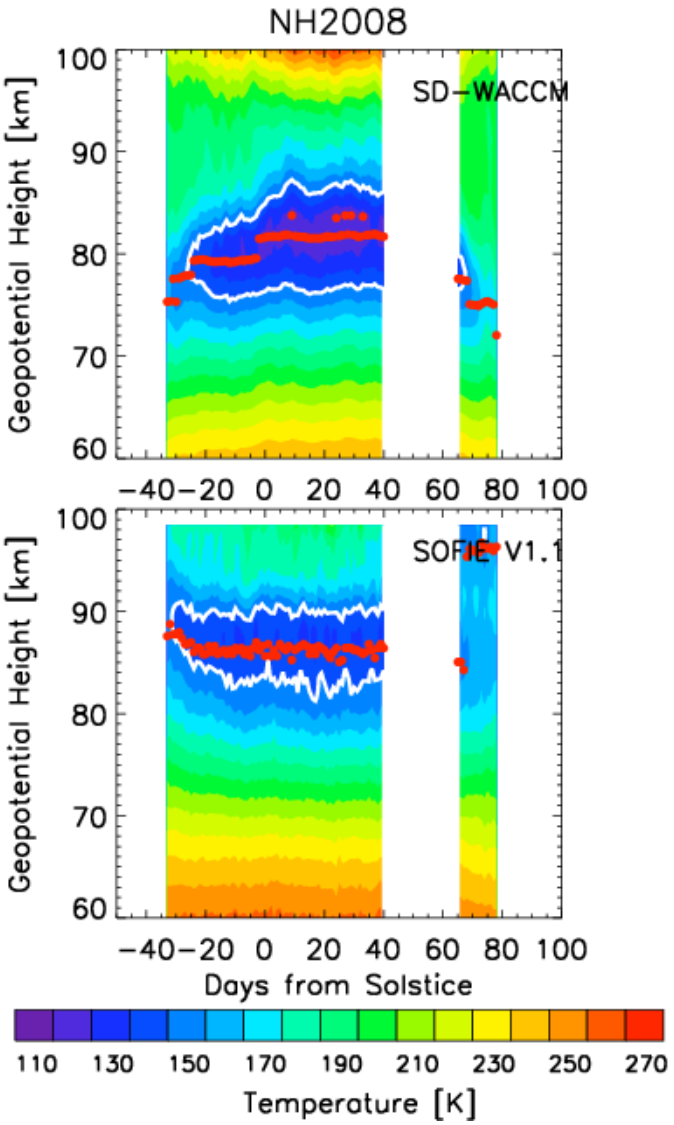
- 25-Jan-2002 – 31-Mar-2011
- MLS, ACE-FTS, HIRDLS, SABER, and SOFIE
- Mandatory Variables: Date, Time, Lat, Lon, Orbit #, Profile #, Instrument
- Optional Variables: DOY, Local Time, Occultation Type, SZA, Julian Day

PMCs: WACCM Summer Polar Mesosphere T (Susanne Benze)

- SD-WACCM run: "SD-WACCM wa4_sdna4_beta0" provided by Dan Marsh.
- Years 2007-2009
- Compare to MLS V3.3, SABER V1.07, and SOFIE V1.1, and Luebken.

PMCs: WACCM Summer Polar Mesosphere T



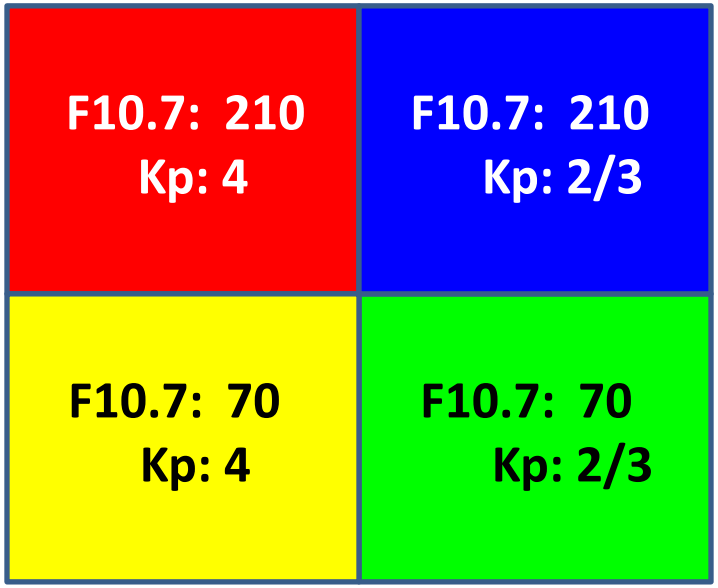


PMCs: WACCM Summer Polar Mesosphere

- Mesopause shape: model still “frowning”.
- Low mesopause compared to MLS, SABER, SOFIE, and Luebken.
  - 3 km too low near solstice,
  - Up to 10 km too low at beginning and end of PMC season.
- NH: model T ~agrees with MLS and Luebken, colder than SABER and SOFIE.
- SH: model T colder than MLS, SABER, Luebken, and SOFIE.
- T variability compared to SOFIE: only fair correlation (R ~ 0.3) in most seasons, better (~0.5) in SH2008.

Energetic Particle Precipitation (EPP)

Free-Running WACCM



Constant Year Repeating (1950 vs. 2000 SST/GHG/Halogens)

Transient Simulations (1992-Present)

- Auroral Electrons
- Higher Energy Electrons
- Solar Proton Events (C. Jackman)

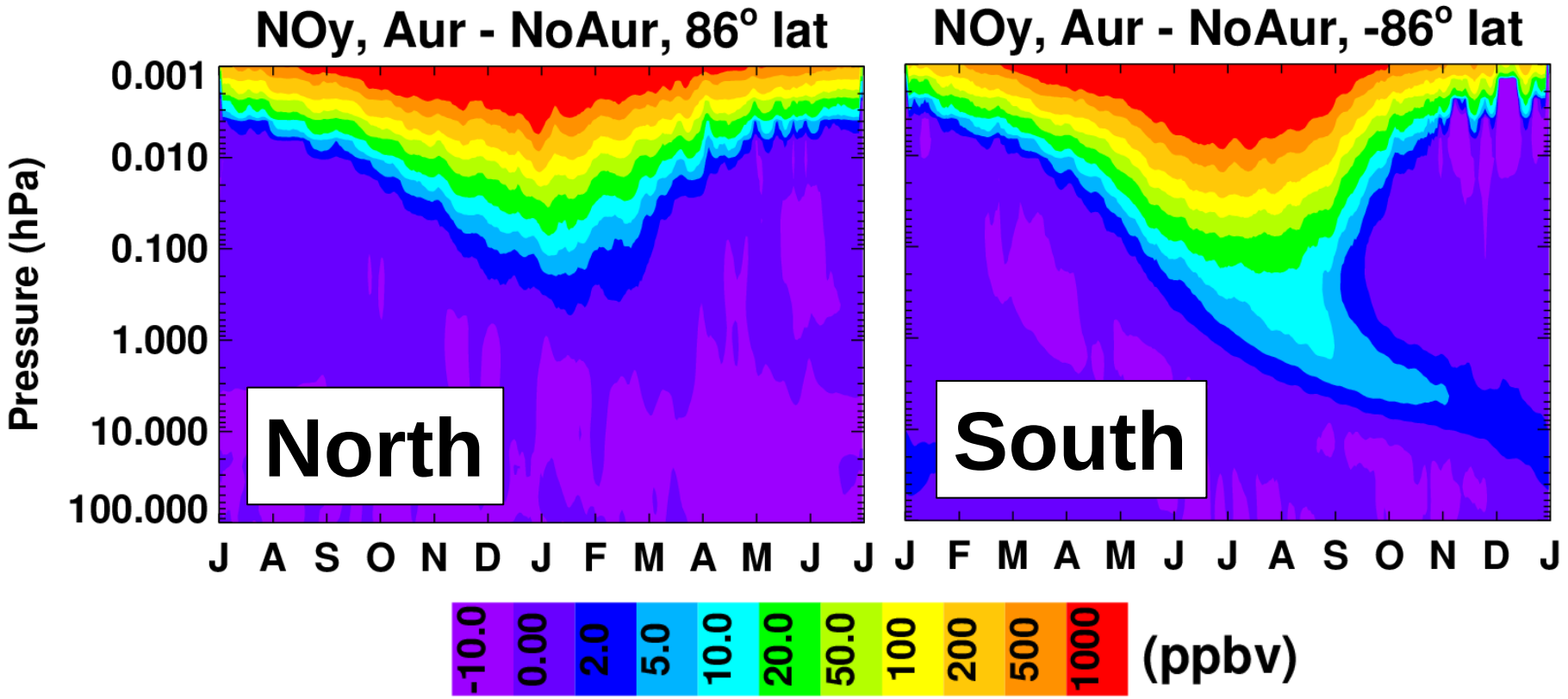
Specified Dynamics WACCM

1992-Present (No EPP, Aurora, Aurora+MEE, Aurora+MEE+SPE)

2004 (2003 Halloween storms imposed in ~1 January)

WACCM4 with/without Aurora (20-yrs): NOy

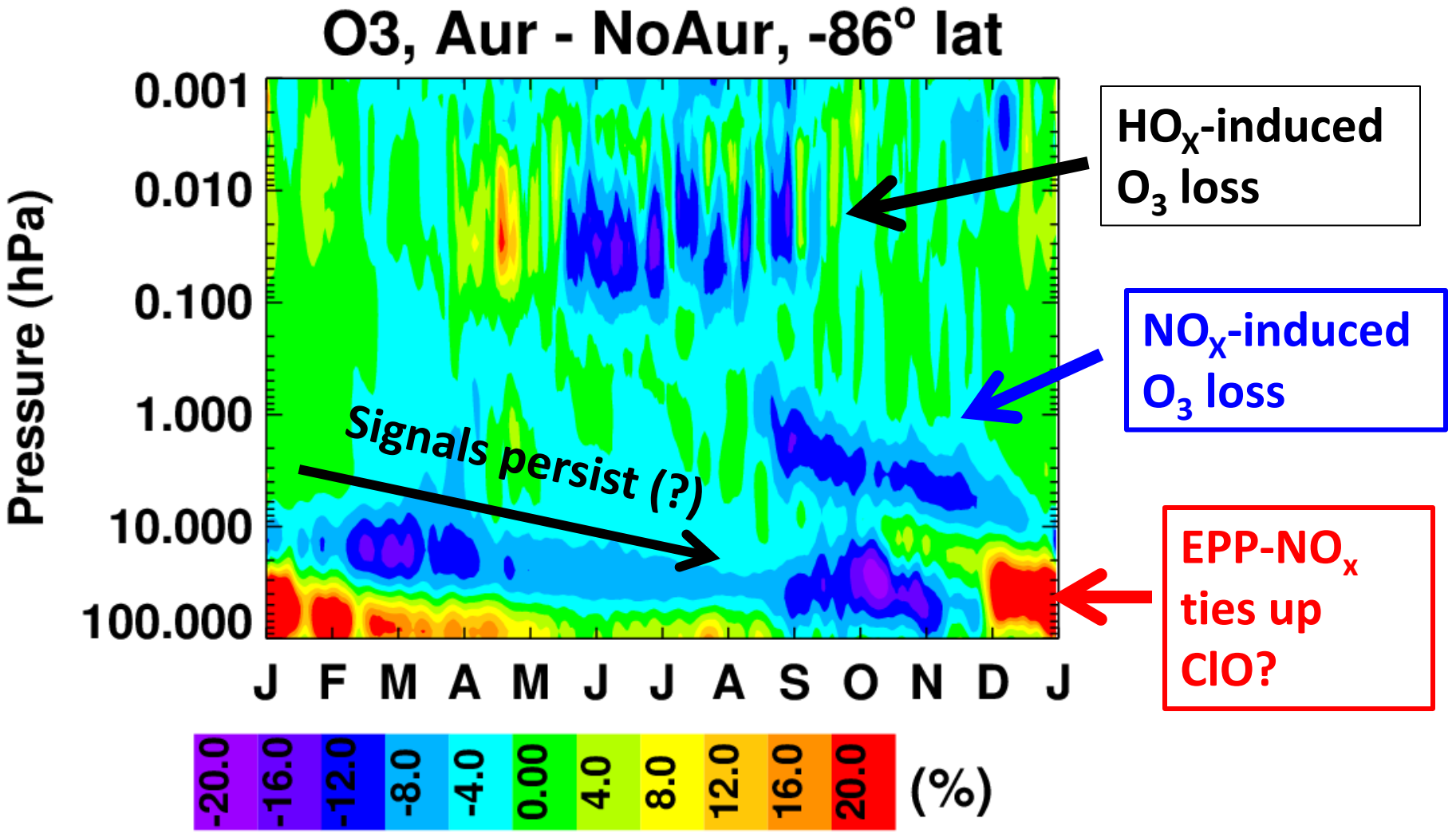
(Ethan Peck)



Significant EPP-NOy descent in both hemispheres, but stronger in South

Cora Randall, CU-LAMA Group

Energetic Particle Precipitation (EPP): SH Ozone



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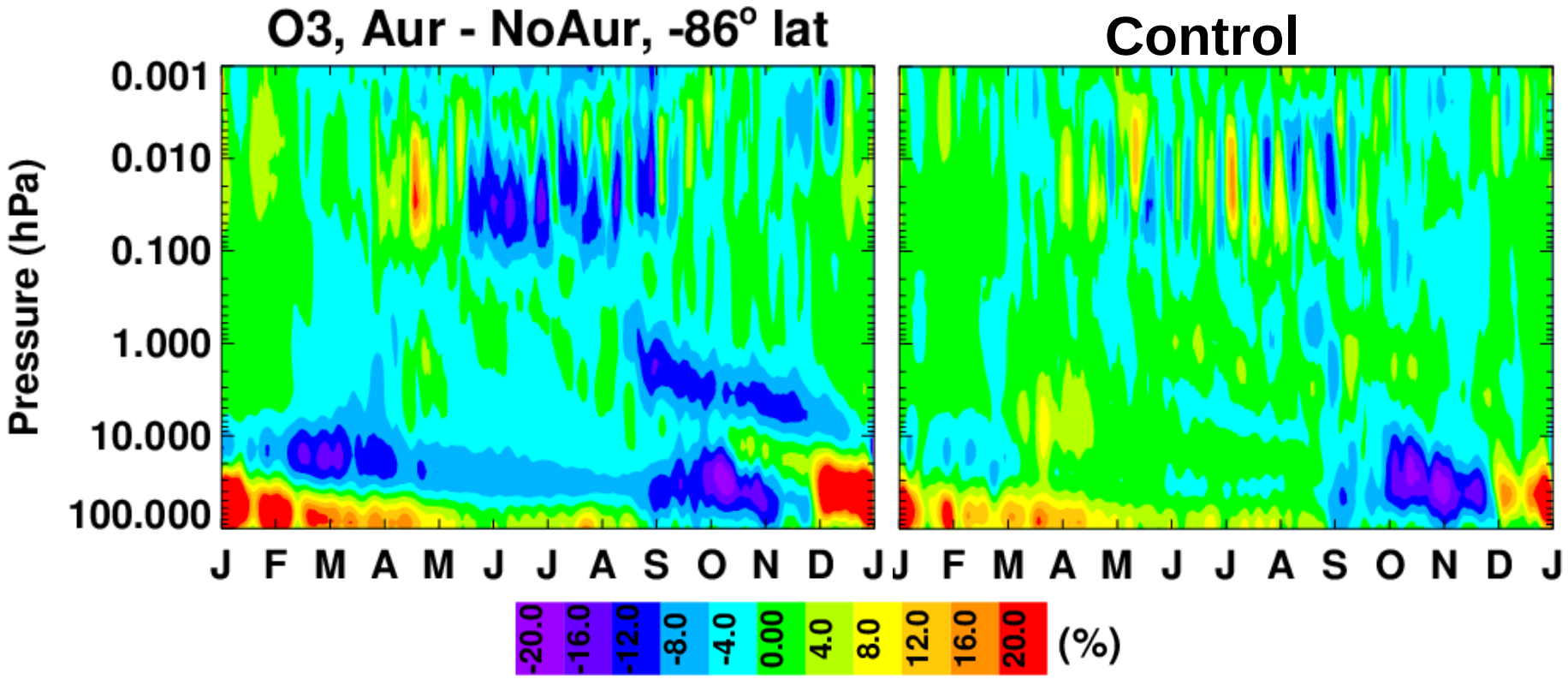
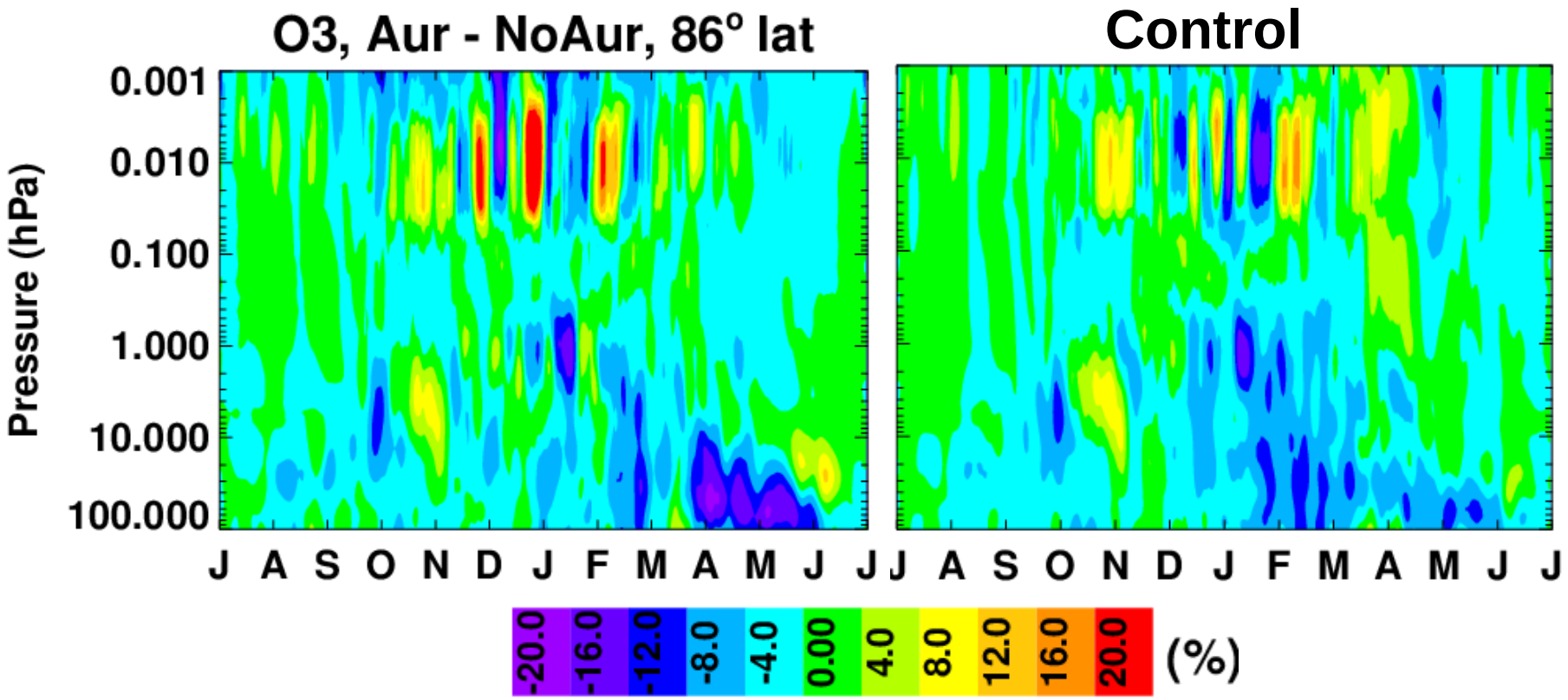


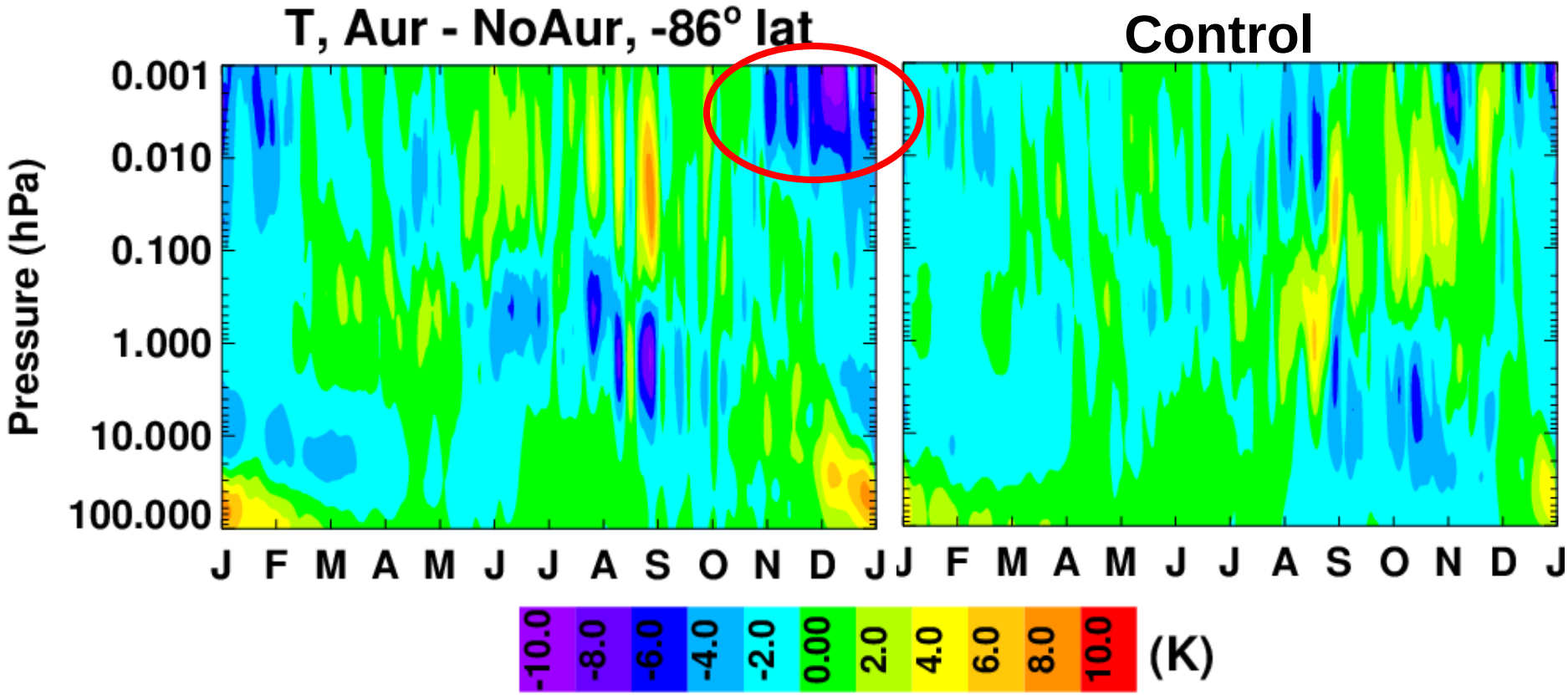
- Rigorous significance tests will be done.
- HOx- and NOx-induced ozone depletion, including persistence through August, possibly "real".
- UTLS signals are spurious

Energetic Particle Precipitation (EPP): NH Ozone



Few, if any, significant effects on ozone in the North.

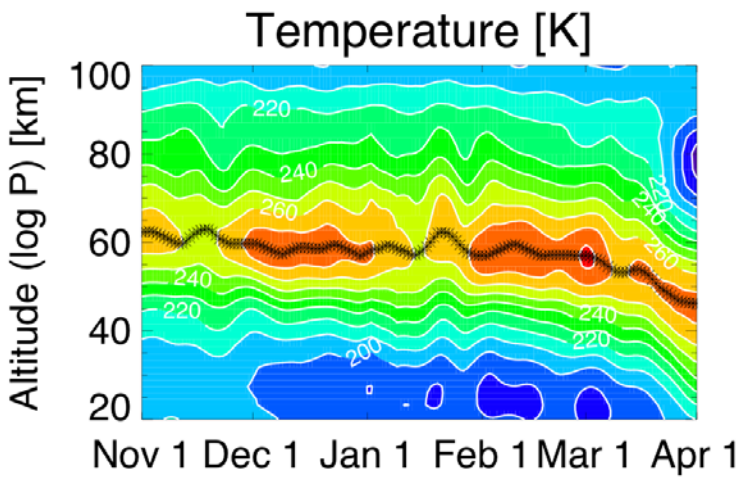
Energetic Particle Precipitation (EPP): SH Temp

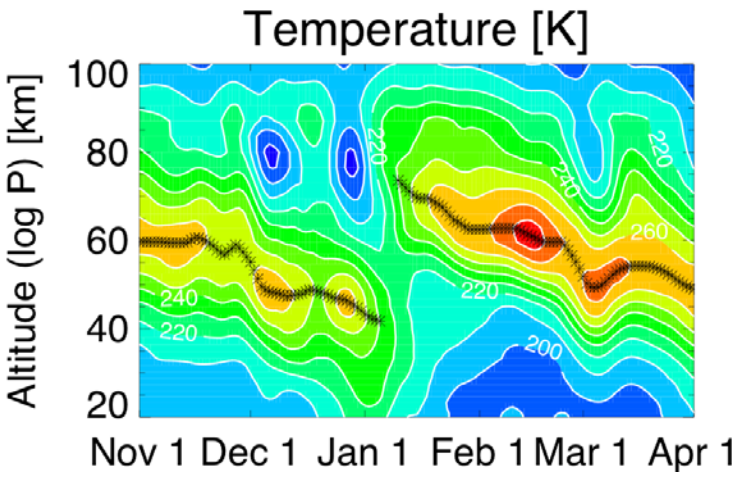


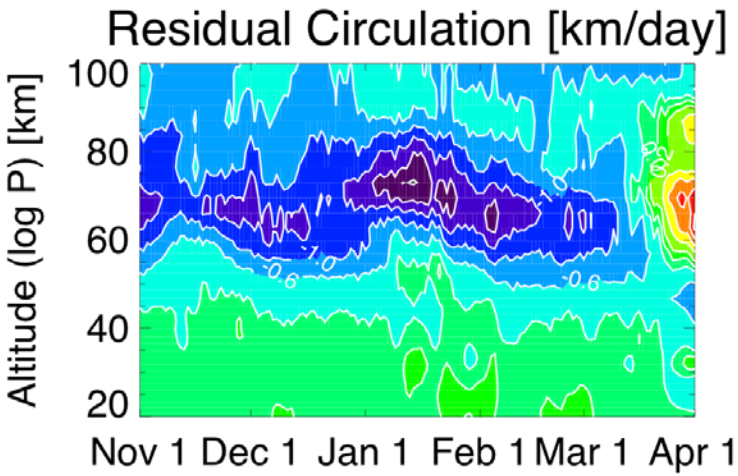
- Tantalizing results for temperature, but need more statistics
- Possible effect on PMCs?

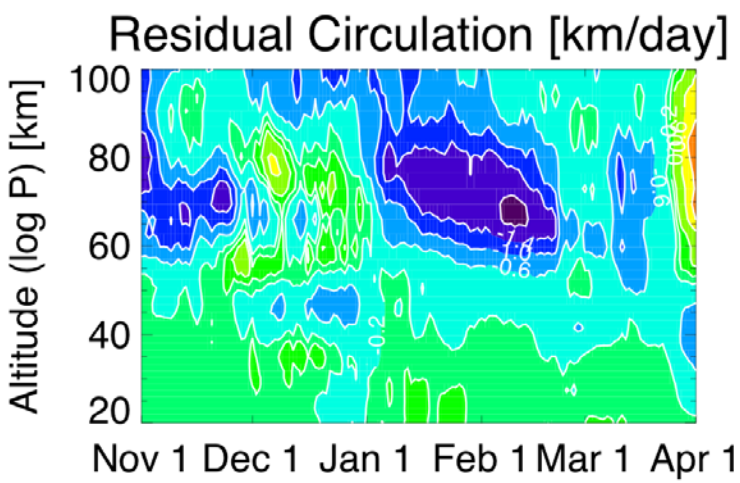
EPP: Is the WACCM meteorology correct?

(Laura Holt)









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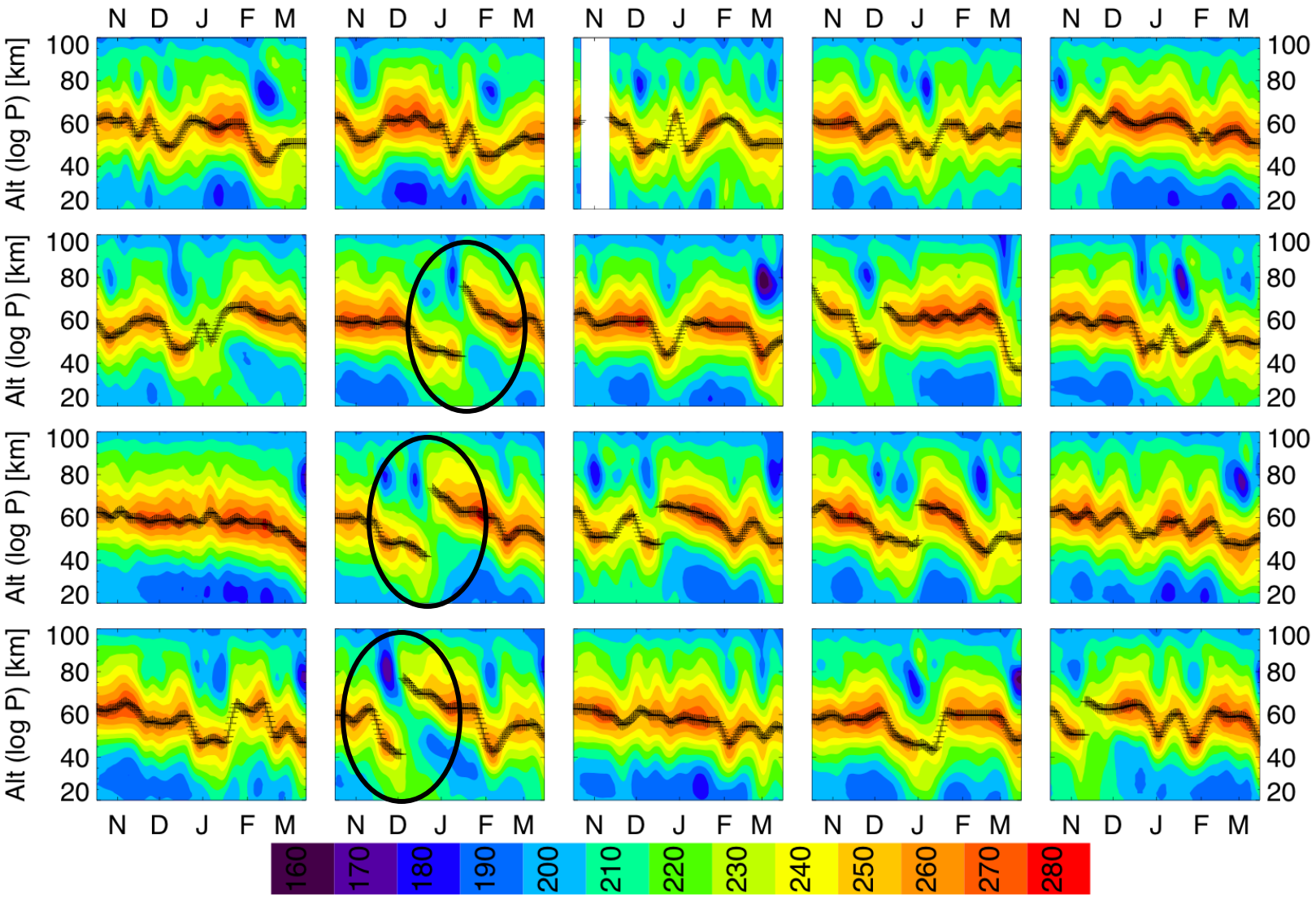

WACCM T from 20-yr NoAur run

Lat>80N

Cora Randall, CU-LAMA Group

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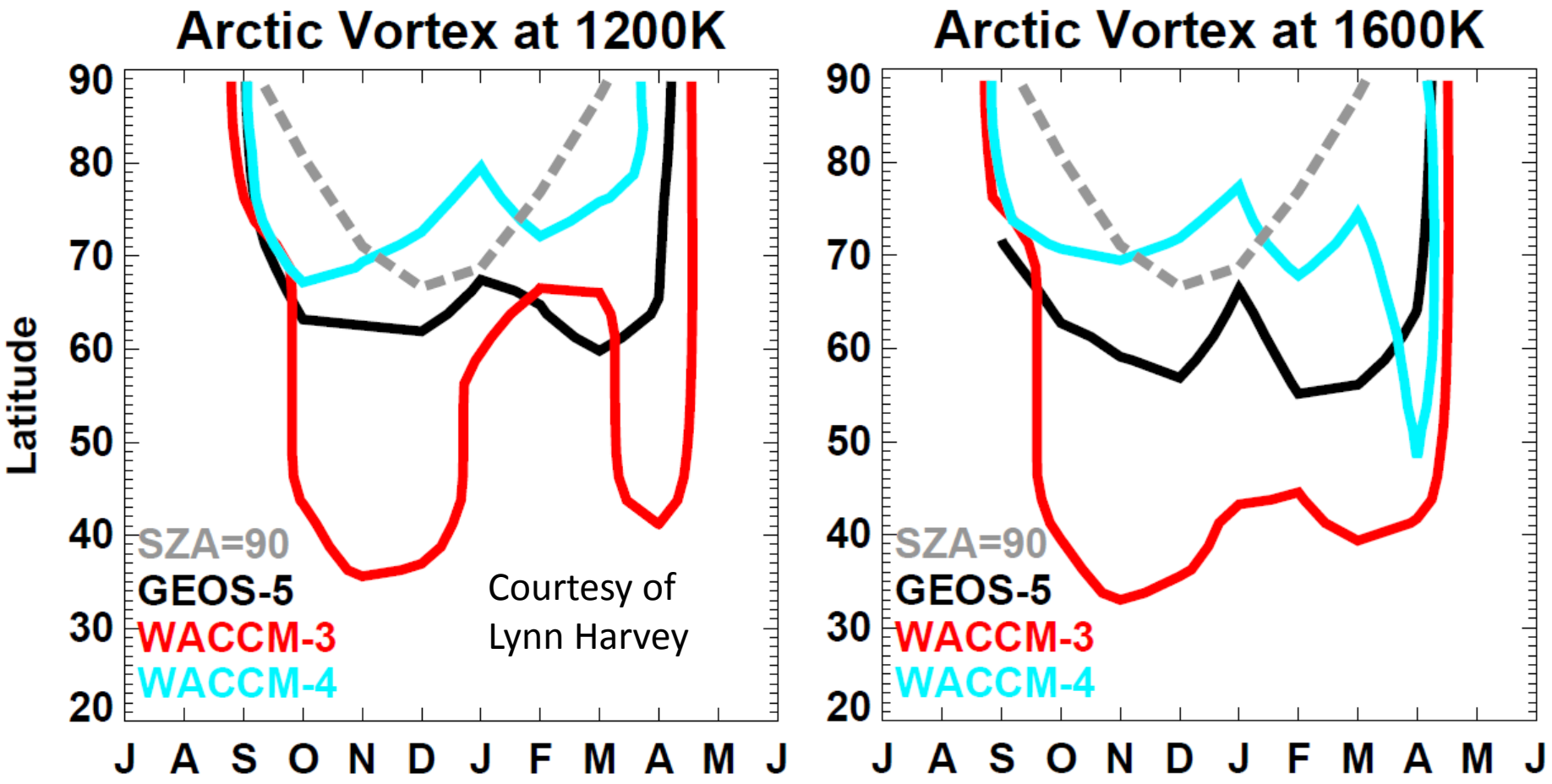


WACCM4 much better than WACCM3: But is the average vortex too small now?

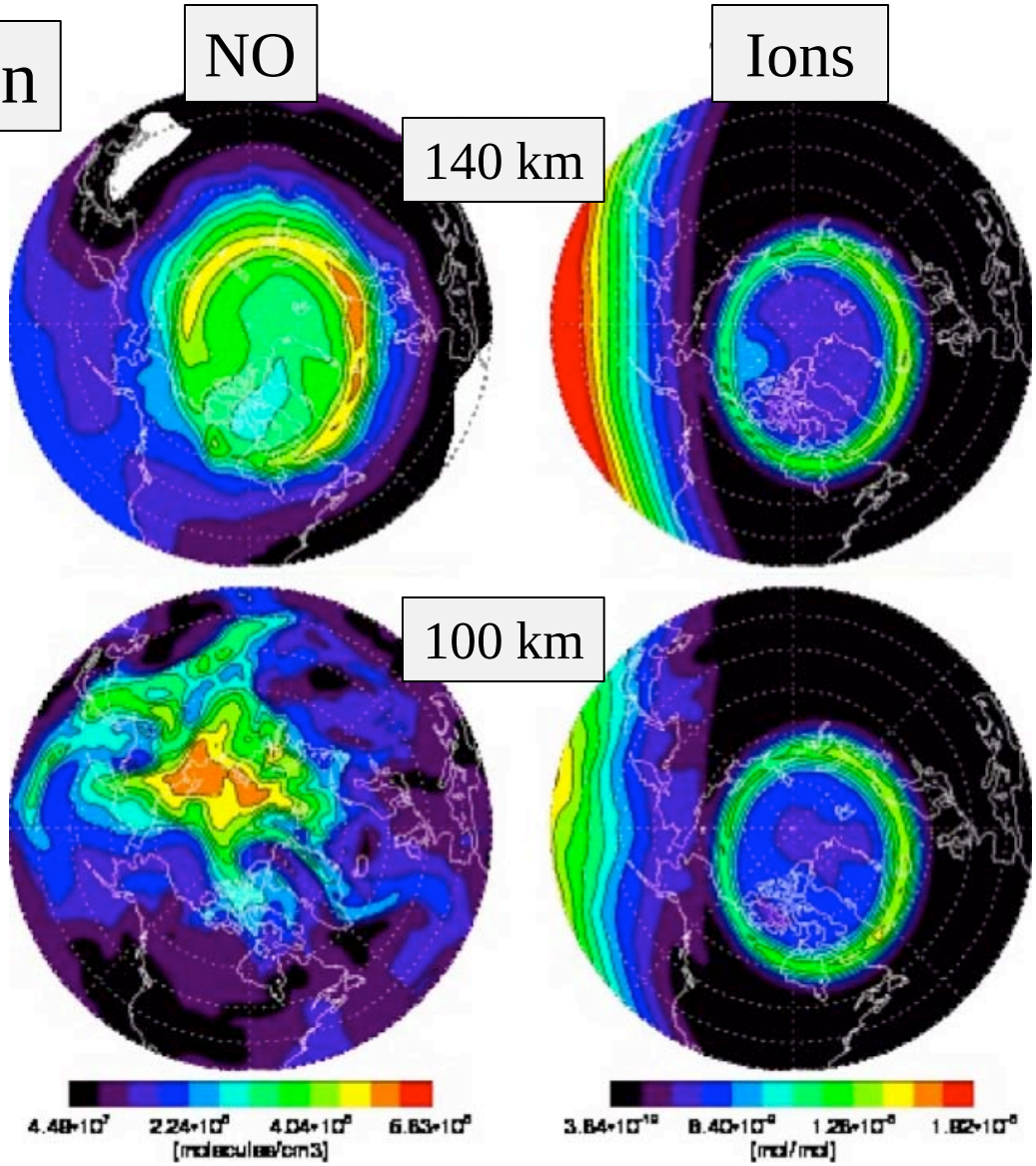
EPP: How is EPP-NO redistributed?

(Lynn Harvey)

WACCM4 for 1 Jan

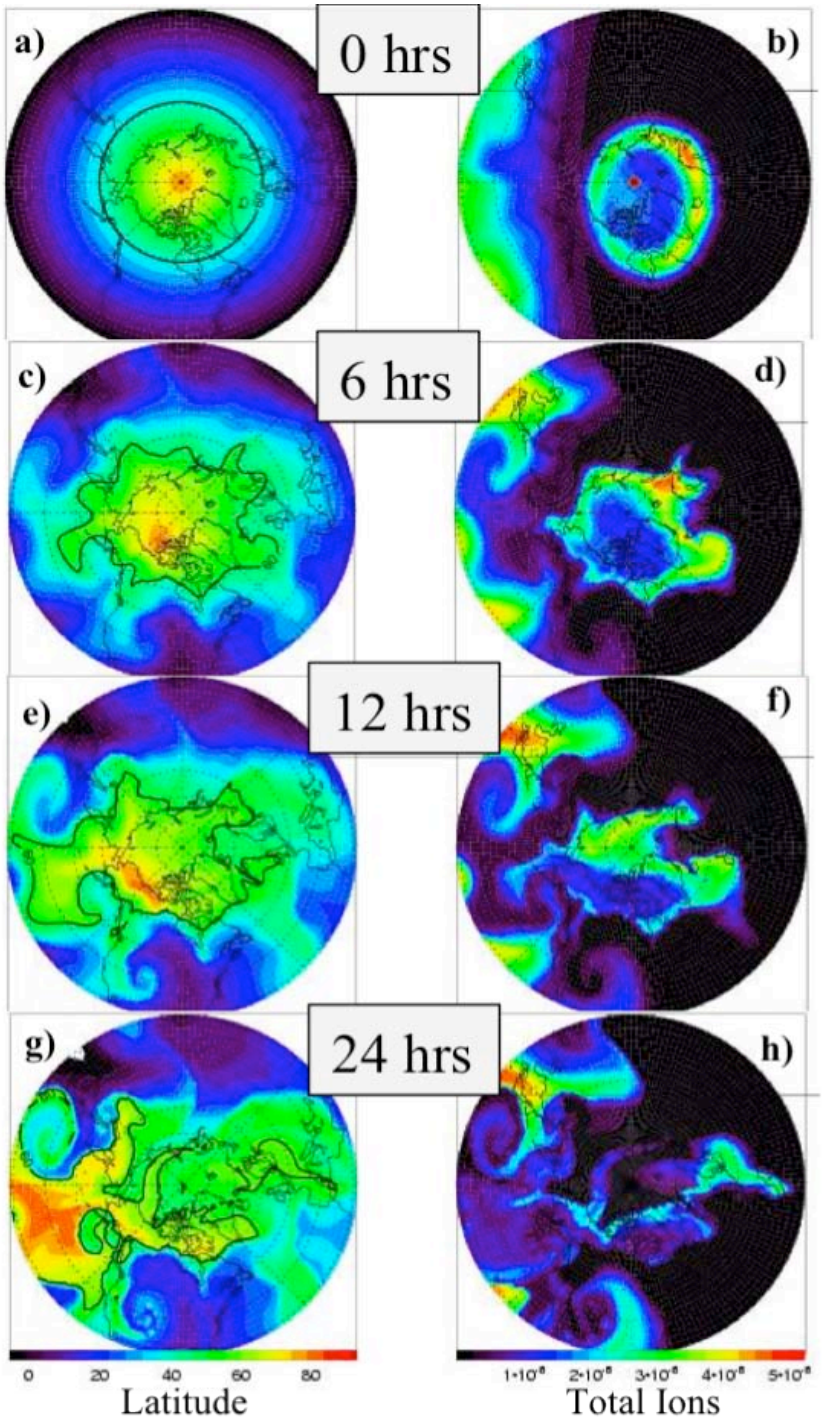
Maintained chemically

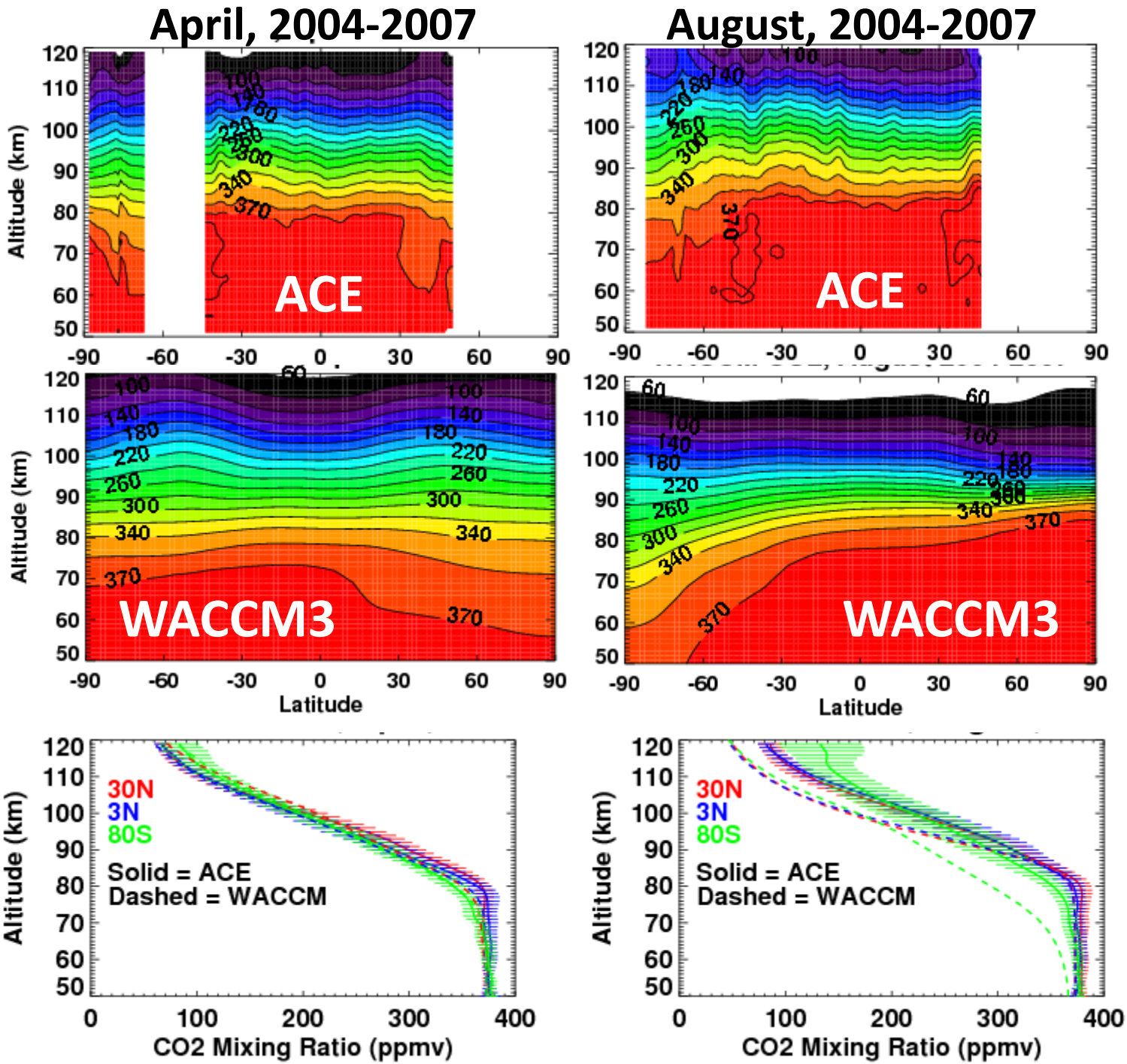
Maintained dynamically



EPP: MLT Trajectories
(Lynn Harvey)

- Initialize trajectories with latitude & ions
- Advect over 24 hours on 1 Jan with WACCM U, V, and diabatic heating rates
- Results imply very rapid transport of NO out of auroral oval and to lower latitudes





WACCM CO_2 compares very well with ACE overall

Disagreement at high SH latitudes by end of winter: Too much descent in WACCM

Thanks very much!!