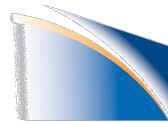


Climatology of WACCM 3.5

Jadwiga (Yaga) H. Richter

R.R. Garcia, A. Gettleman, D. Kinnison, D. Marsh, F. Sassi, A. K. Smith

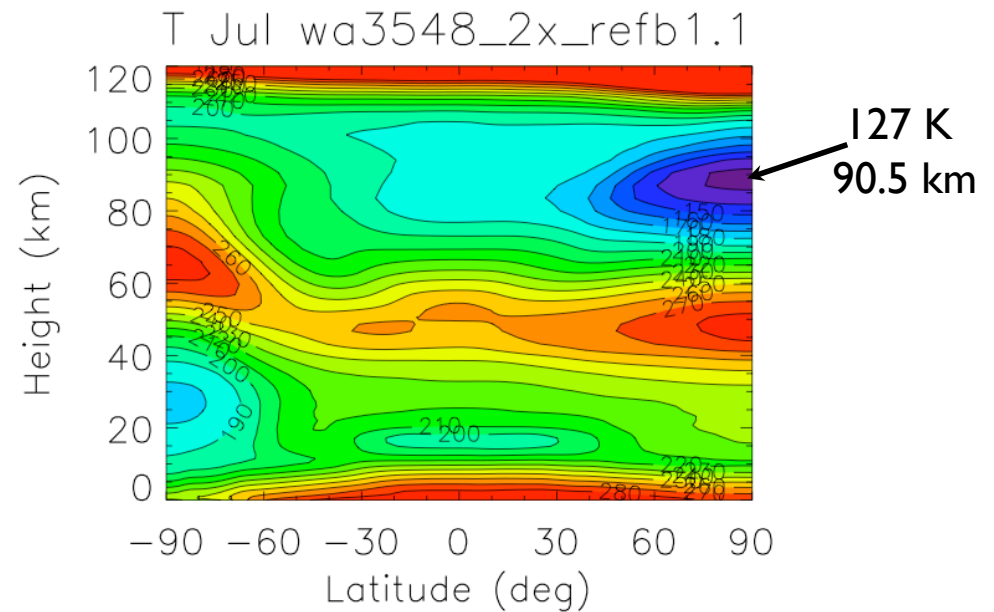
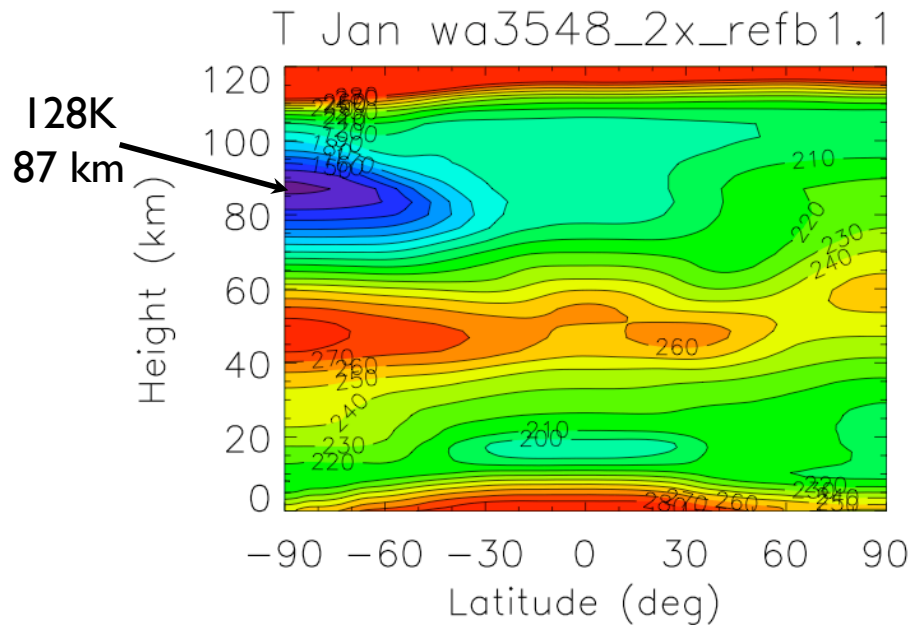


NCAR

Community Climate System Model
CCSM

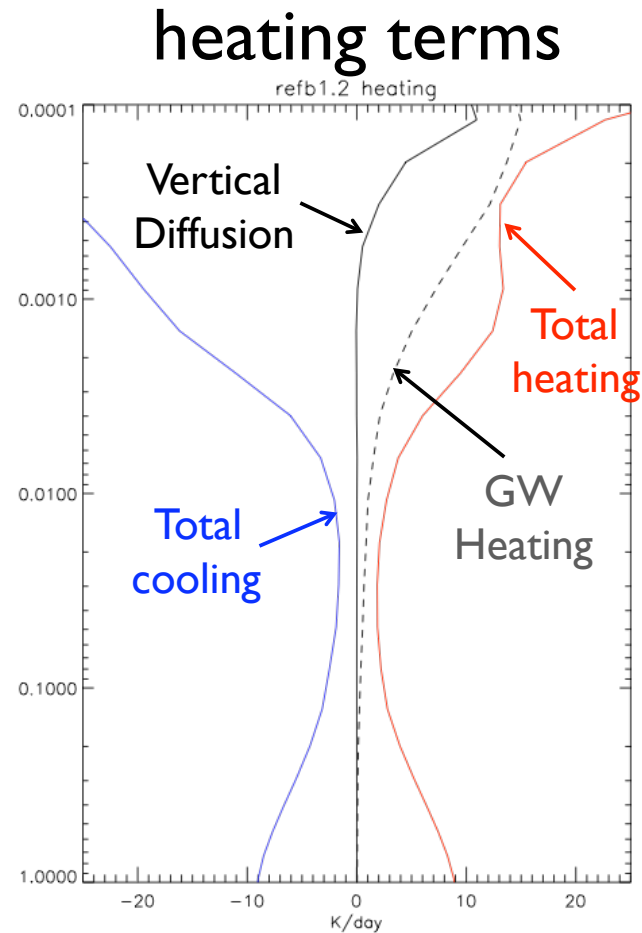
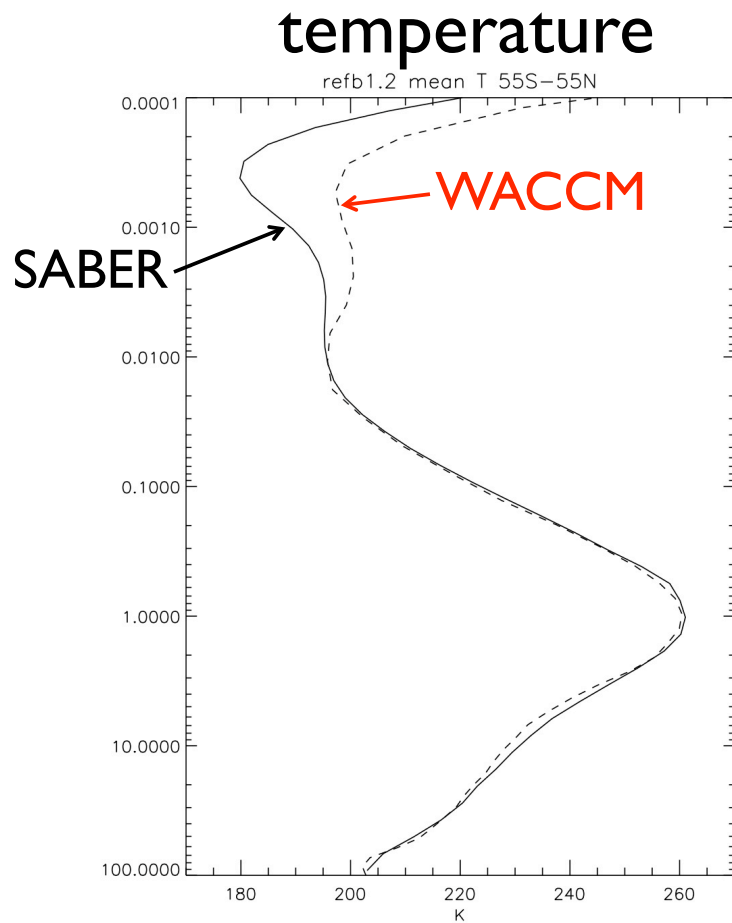
WACCM
Whole Atmosphere Community Climate Model

JAN Zonal-mean Temperature



Summer mesopause is in pretty good agreement with SABER

55N-55S Mean Temperature

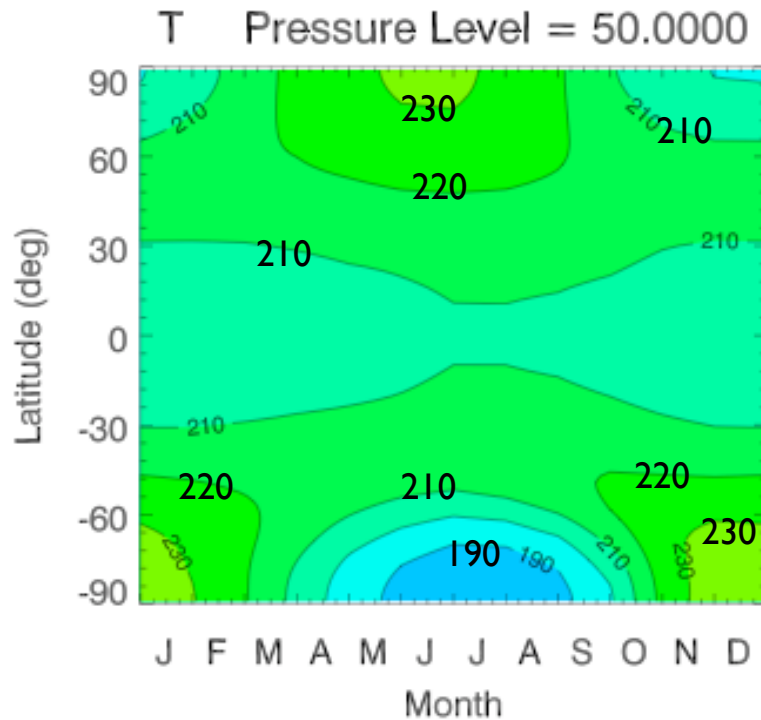


T too warm in the MLT compared to SABER –possible problem with gw heating term?

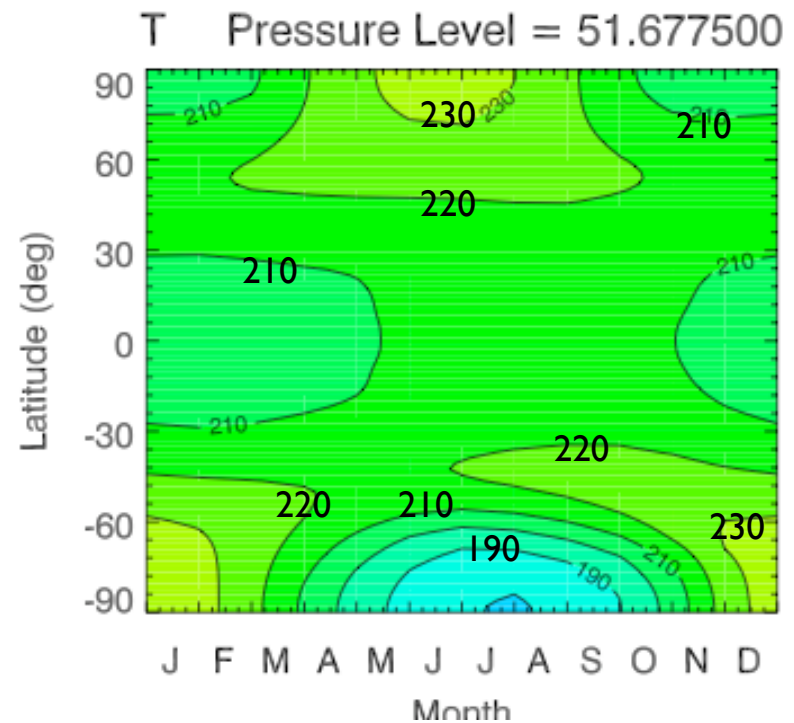
Figures courtesy of A.K. Smith

Seasonal march of T at 50 hPA

ERA 40



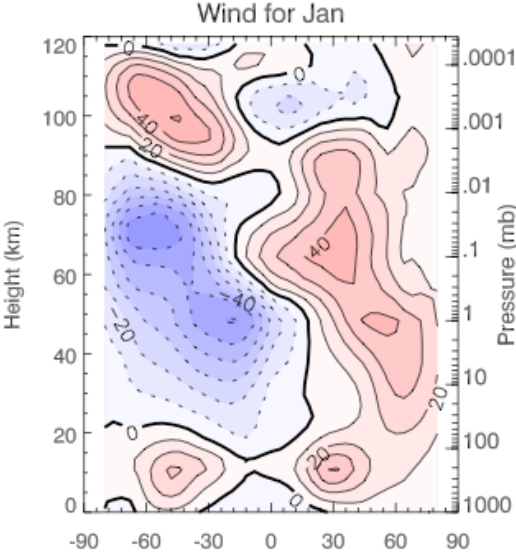
WACCM3.5



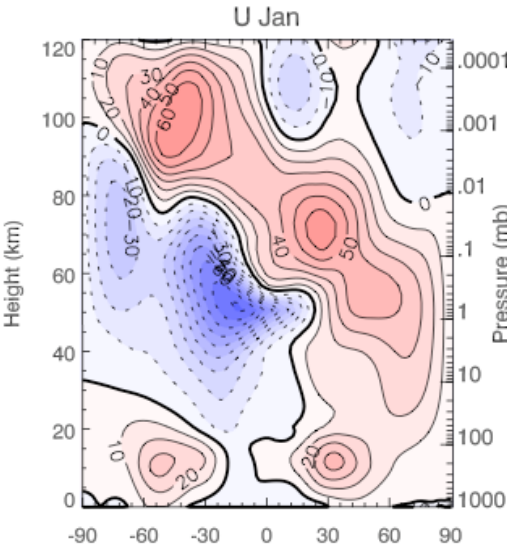
Note slightly different color scales!

JAN Zonal Mean Wind

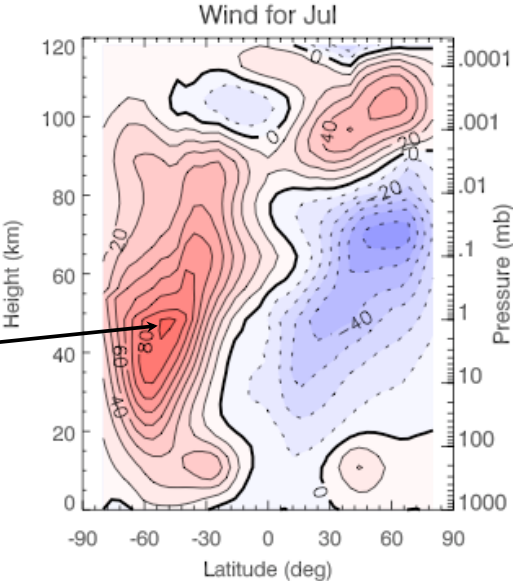
URAP



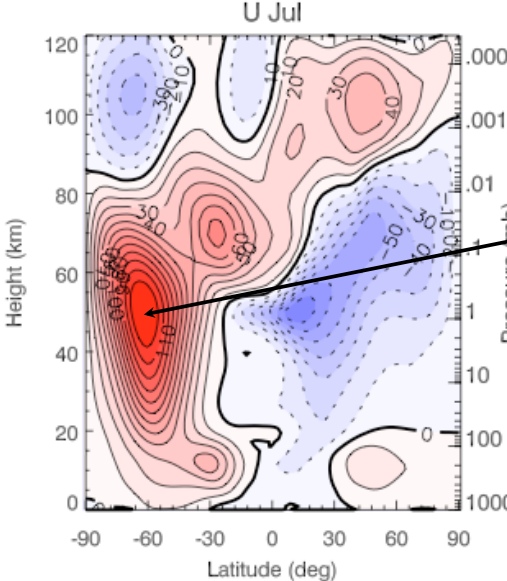
WACCM3.5



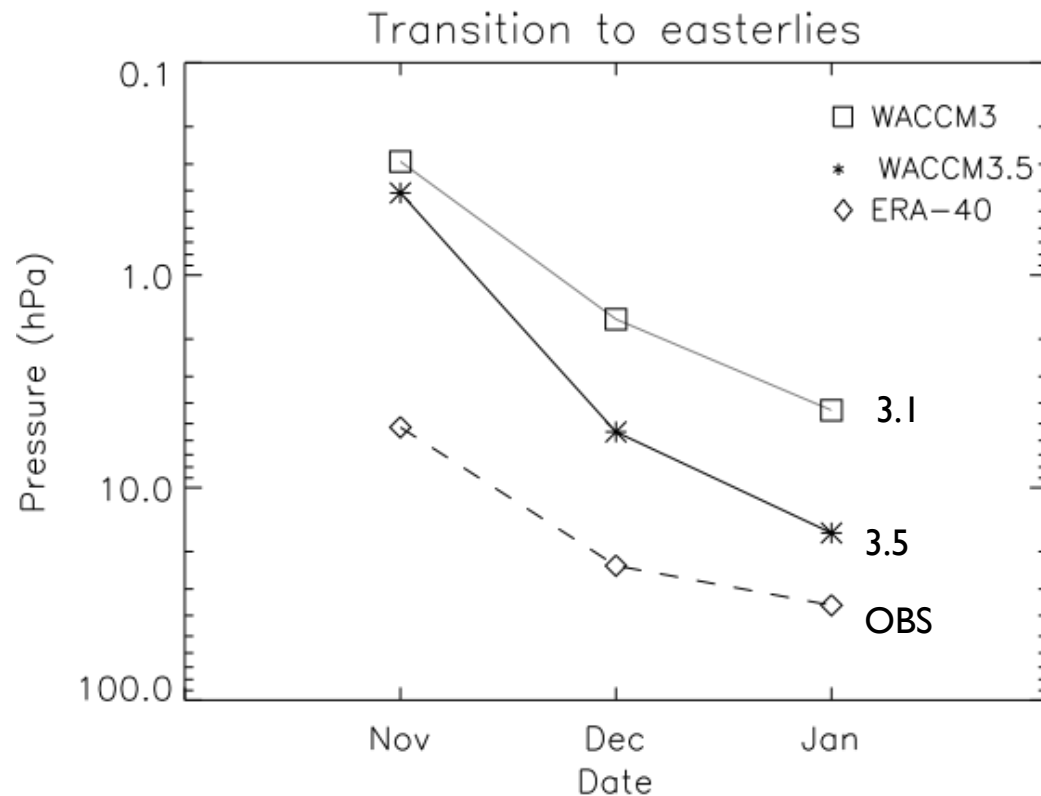
95 m/s



132 m/s

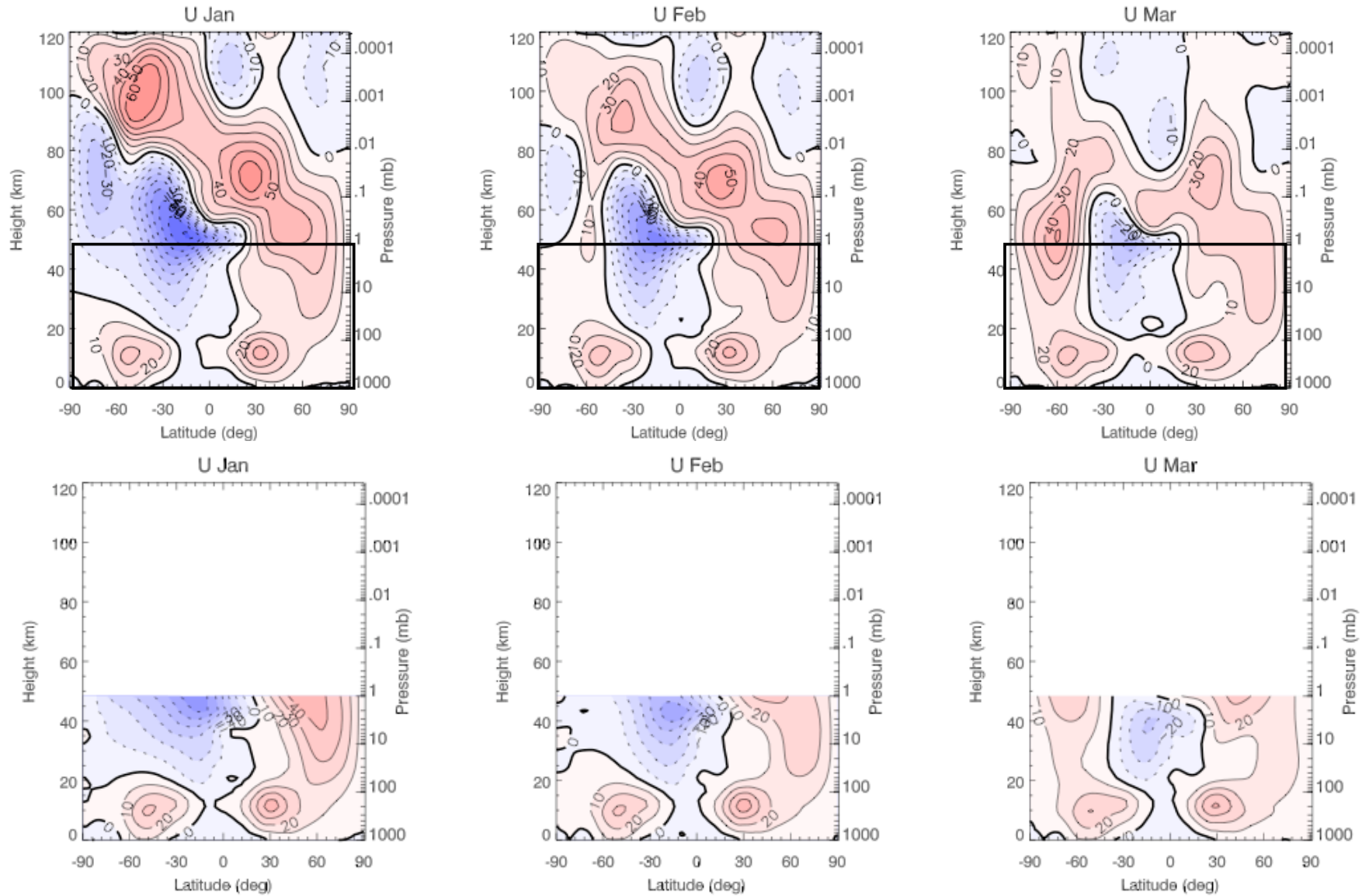


Zonal Mean Wind: winter-summer transition in SH



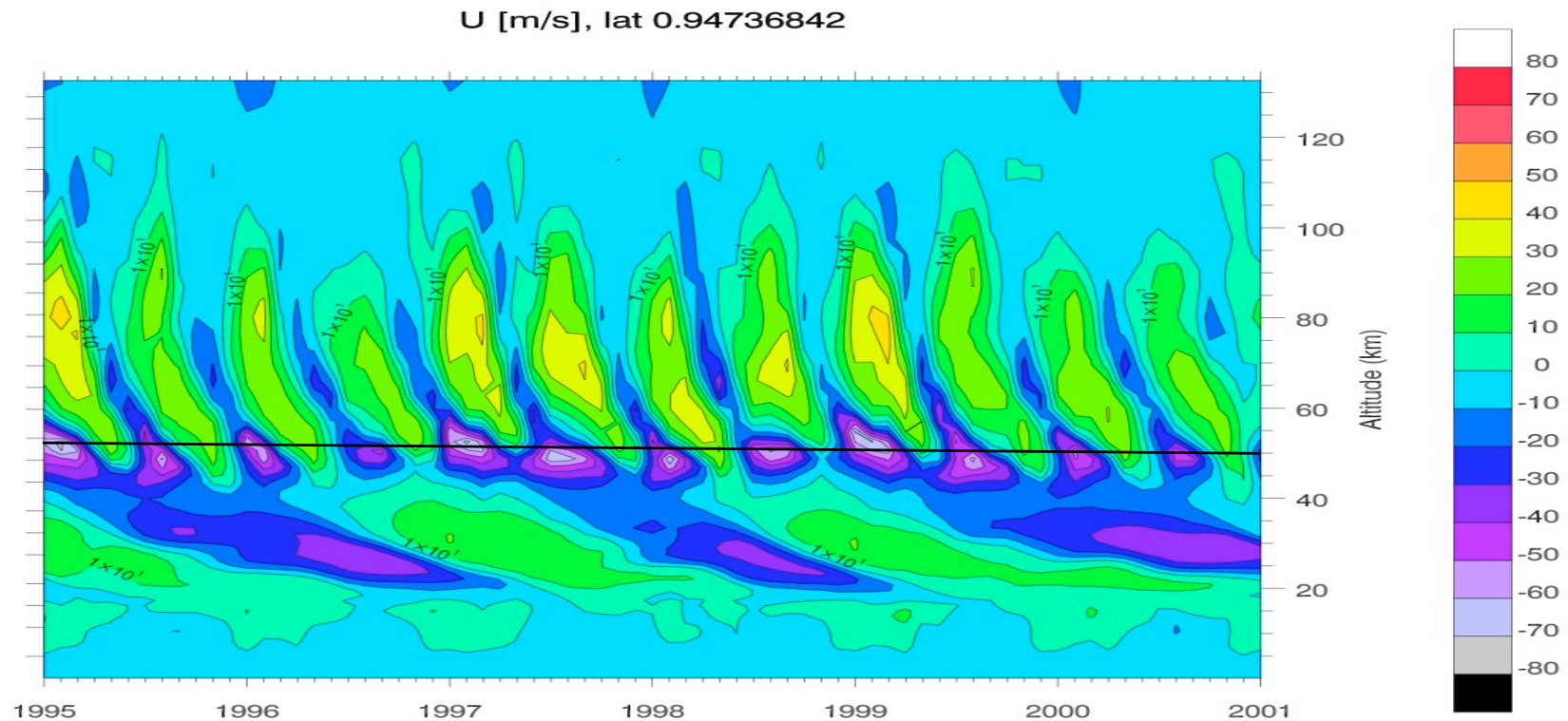
Compared to observations:
zero-wind line still too high in November;
more rapid transition in December;
fairly close to obs. In January

WACCM3.5 vs. ERA40: JAN – MAR



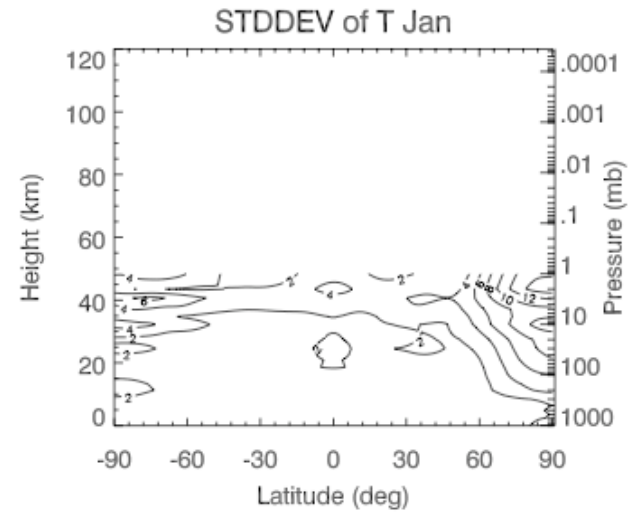
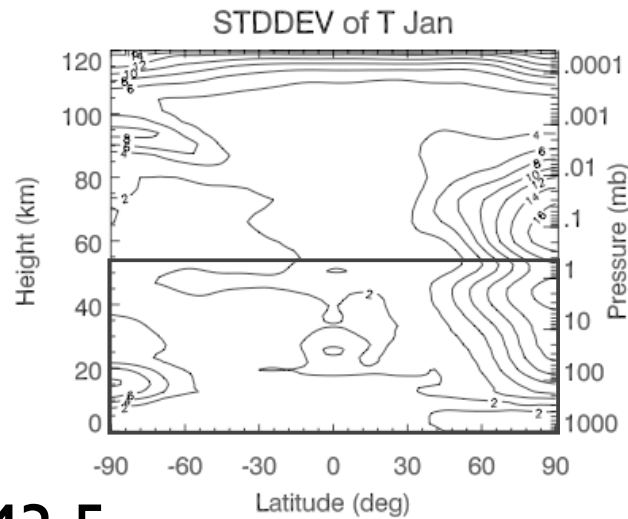
ERA-40

Tropical Winds



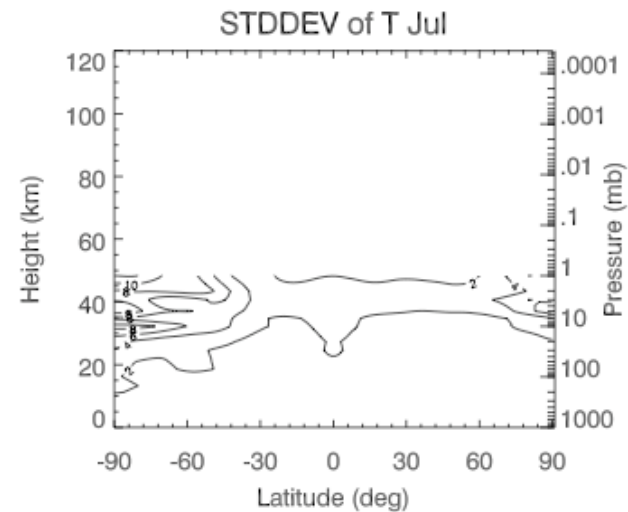
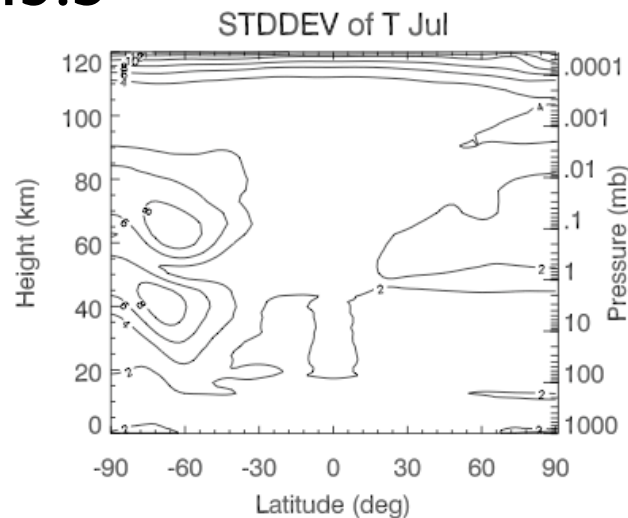
Stratospheric QBO: imposed from observations; impacts the evolution of the SAO
Stratospheric SAO: OK; descending down to ~45-50 km; modulated by the QBO
Mesospheric SAO has generally small amplitude; easterly phase is very weak

Stratospheric Variability



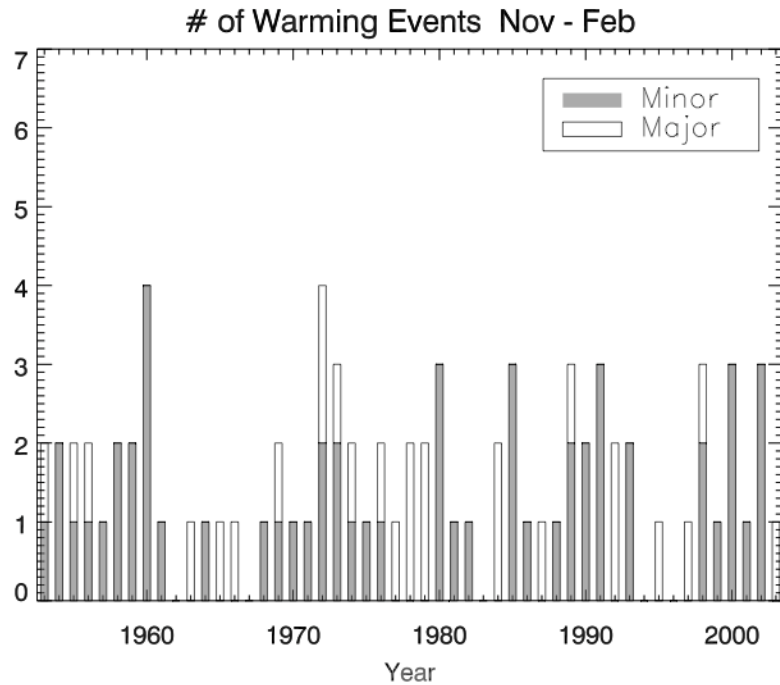
WACCM3.5

ERA40



Stratospheric Sudden Warmings

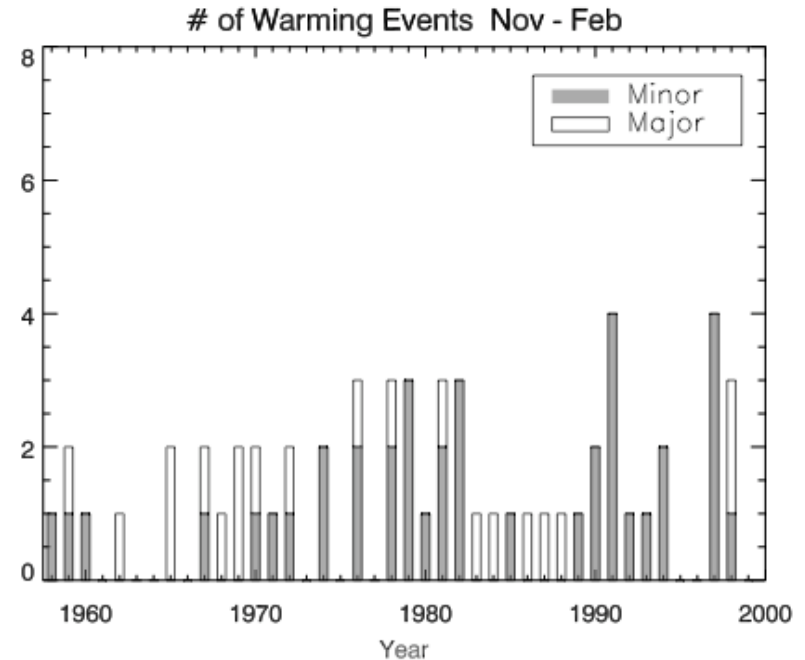
WACCM3.5



Major SSW frequency: 0.53

Minor SSW frequency: 1.1

ERA40

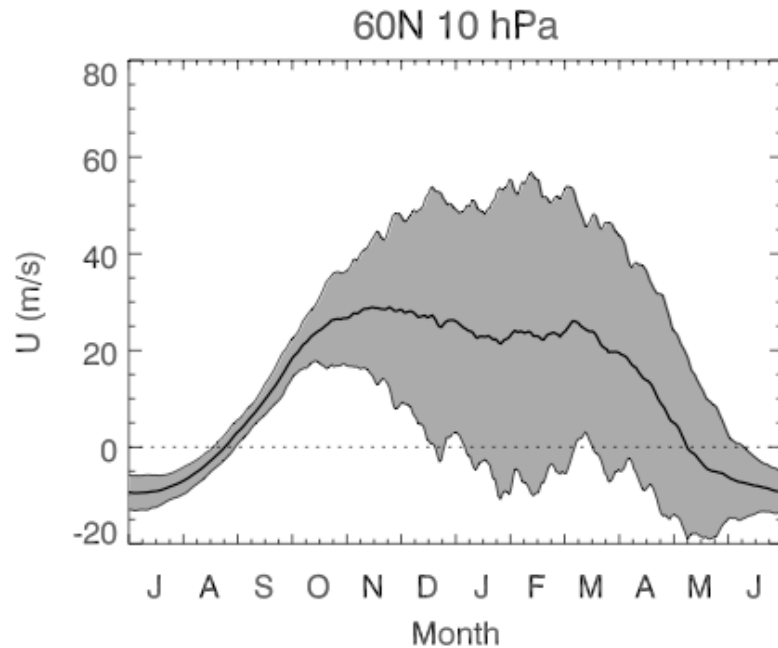


Major SSW frequency: 0.48

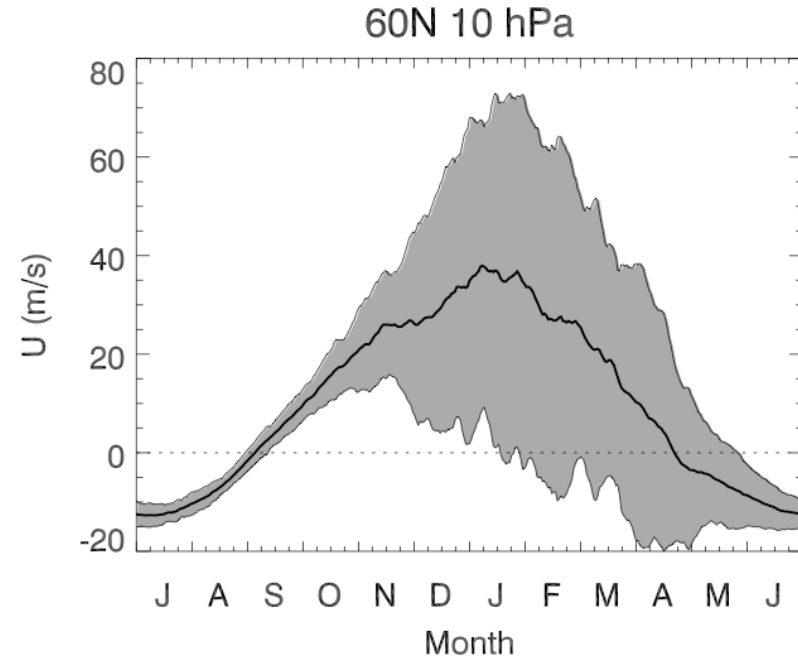
Minor SSW frequency: 0.93

U at 60N 10hPa

WACCM3.5



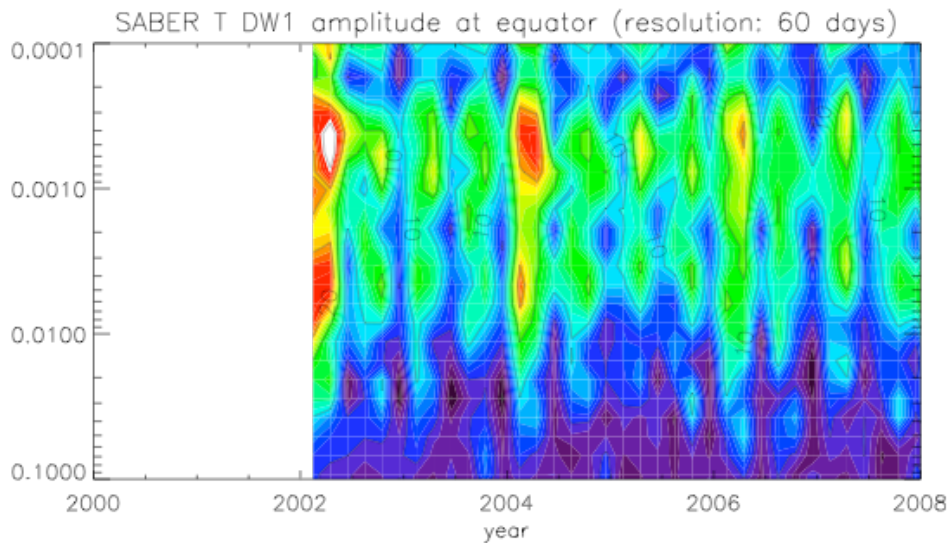
ERA40



Good Variability, but seasonal cycle still needs improvement: wind too weak in midwinter

Diurnal Tide

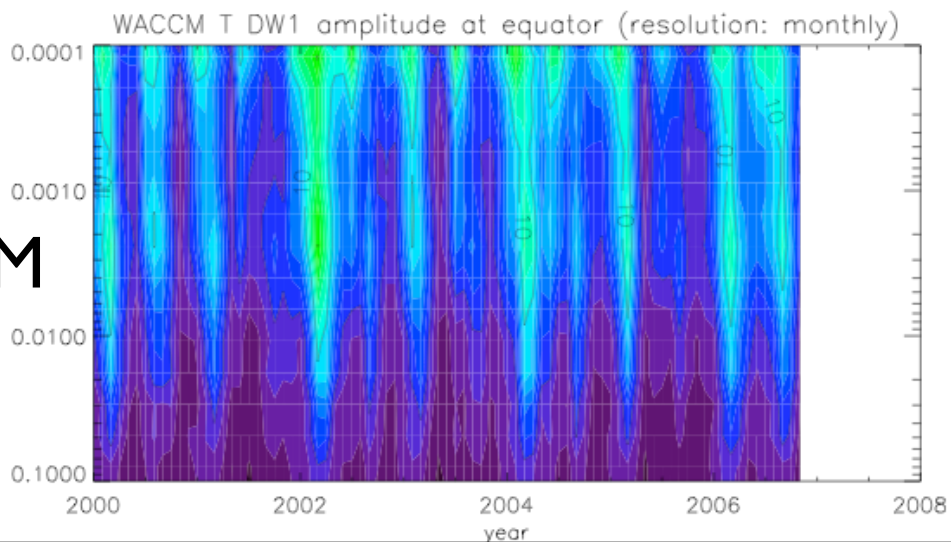
SABER



WACCM amplitude too small

Possibly due to lack of strong diurnal variability in convection

WACCM

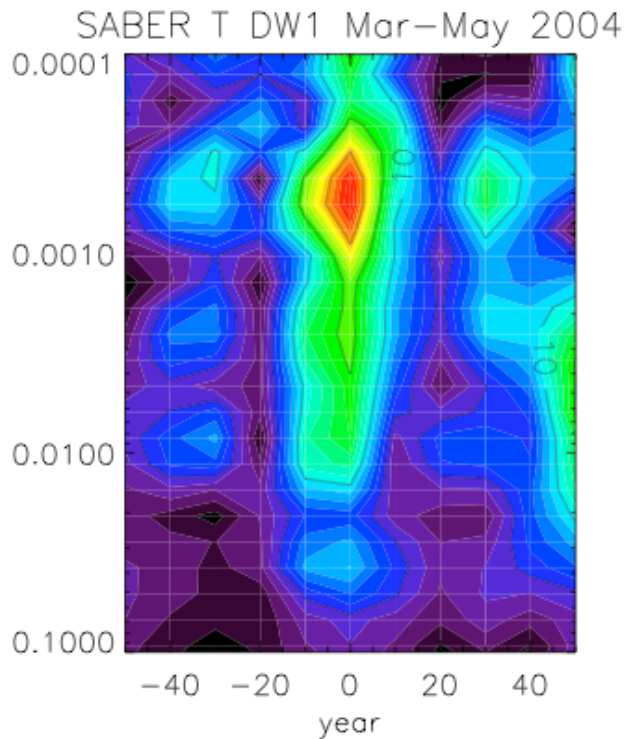


But note the same apparent quasi-biennial variability as in SABER

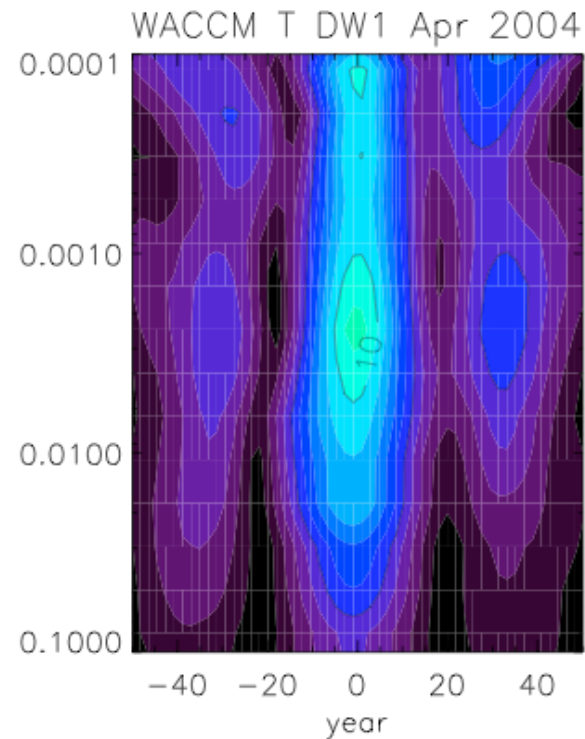
Figure courtesy of A. Smith

Diurnal Tide

SABER



WACCM



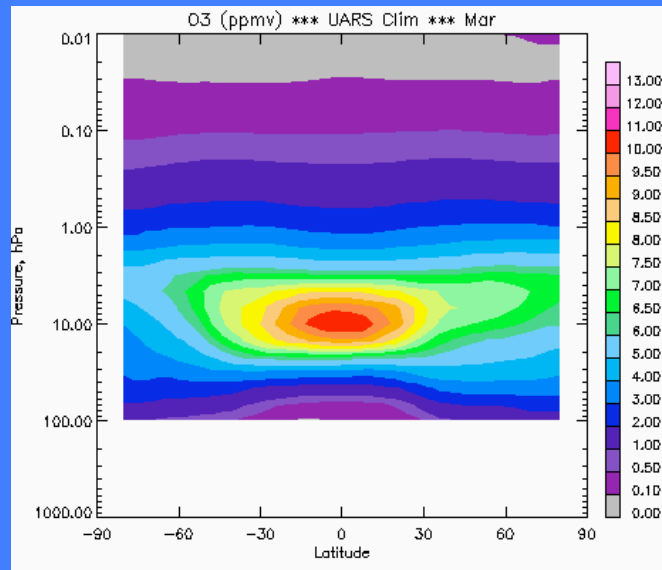
Peak amplitude also too low

Figure courtesy of A. Smith

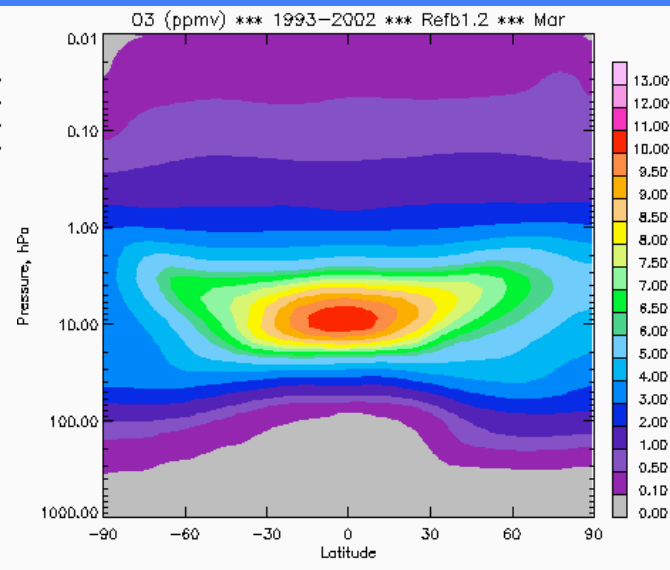
Zonal-mean Ozone Distribution

MARCH

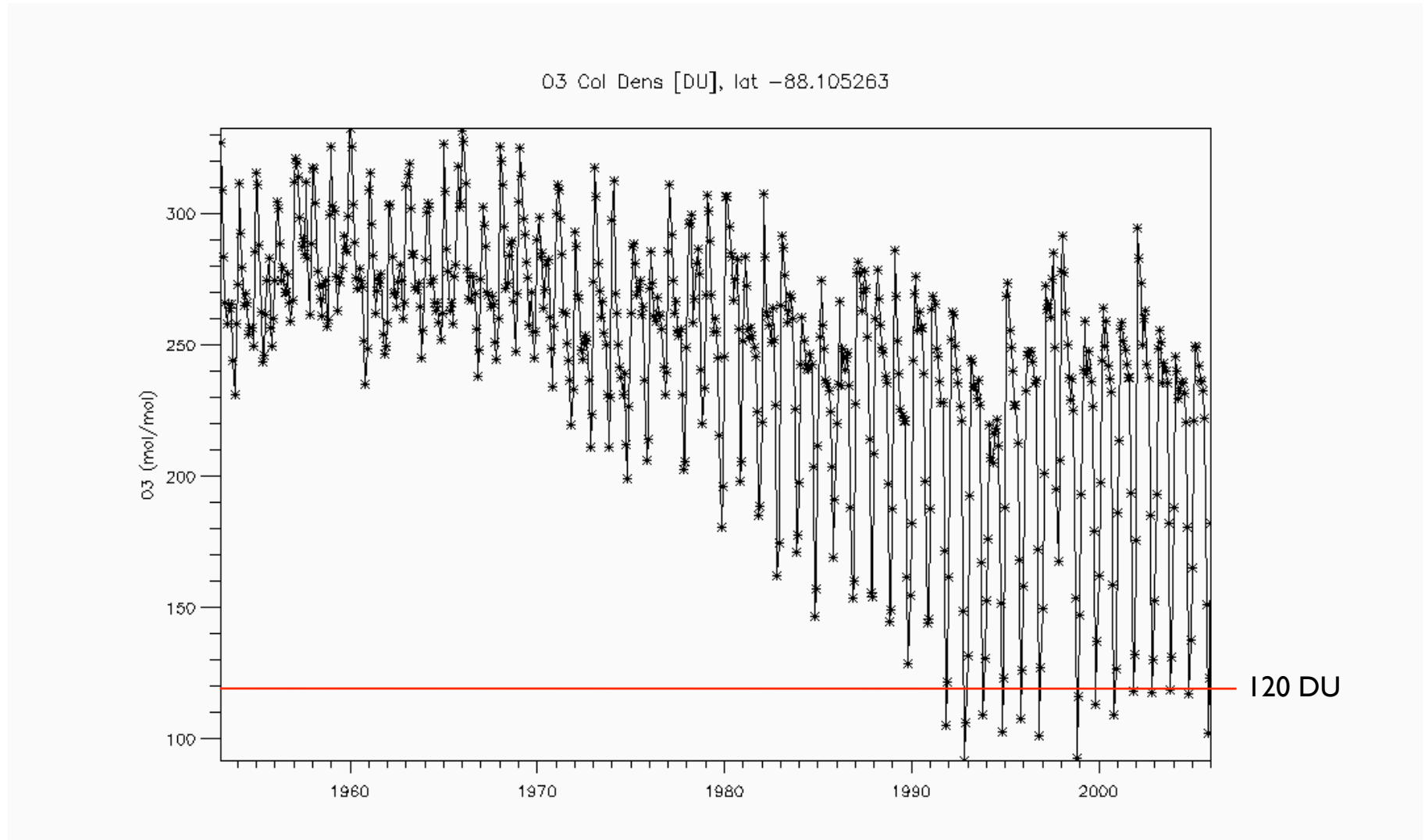
UARS



WACCM3

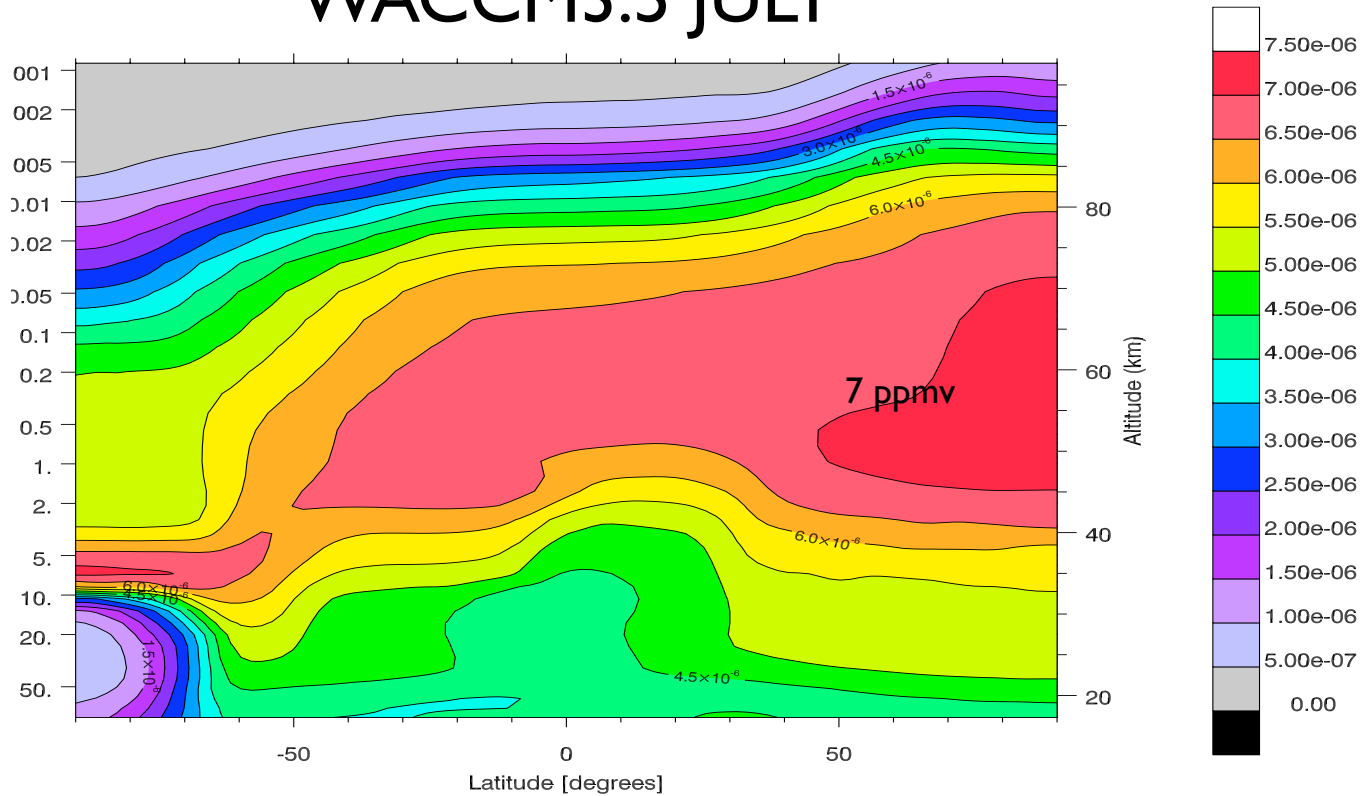


Antarctic Ozone Column 1950 -2006



Water Vapor

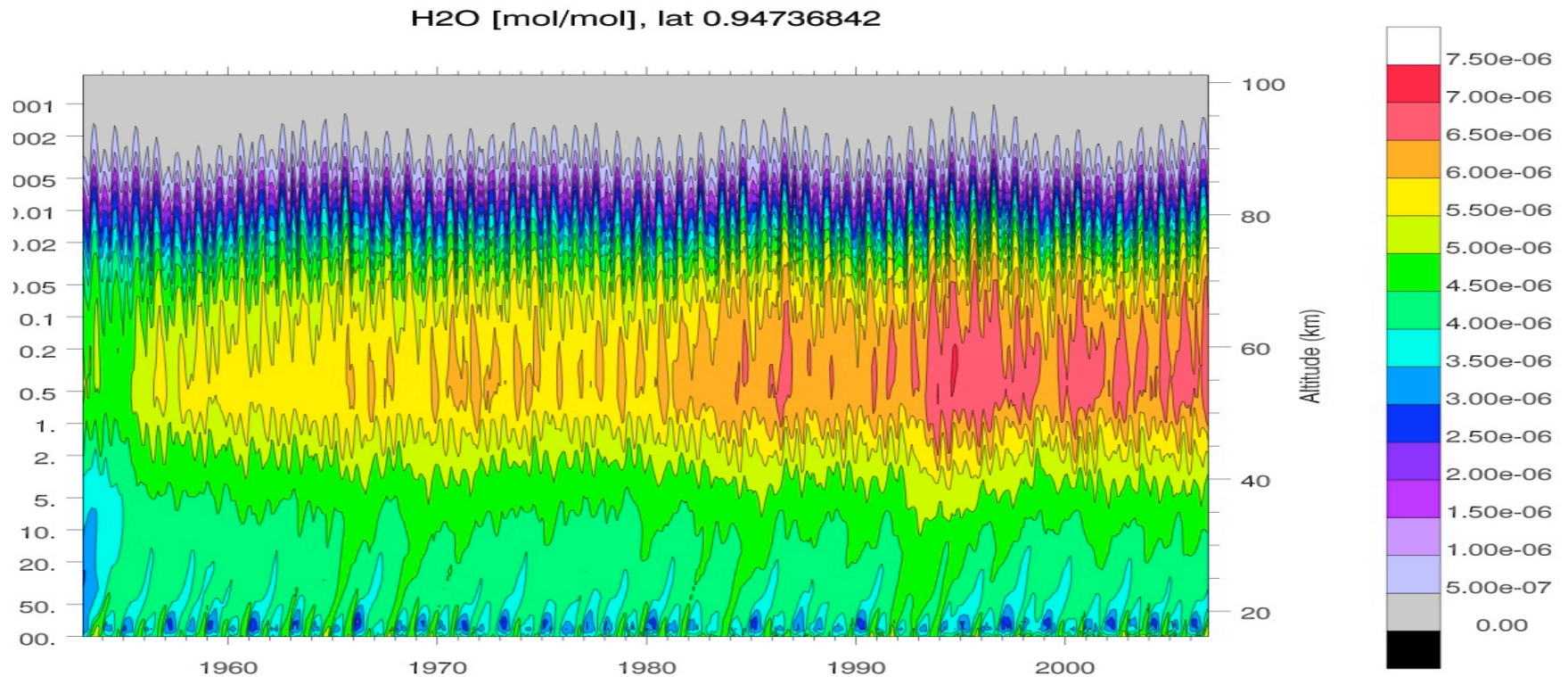
WACCM3.5 JULY



_zm_CH4,H2O,O3,CLOY,NOY,U.nc

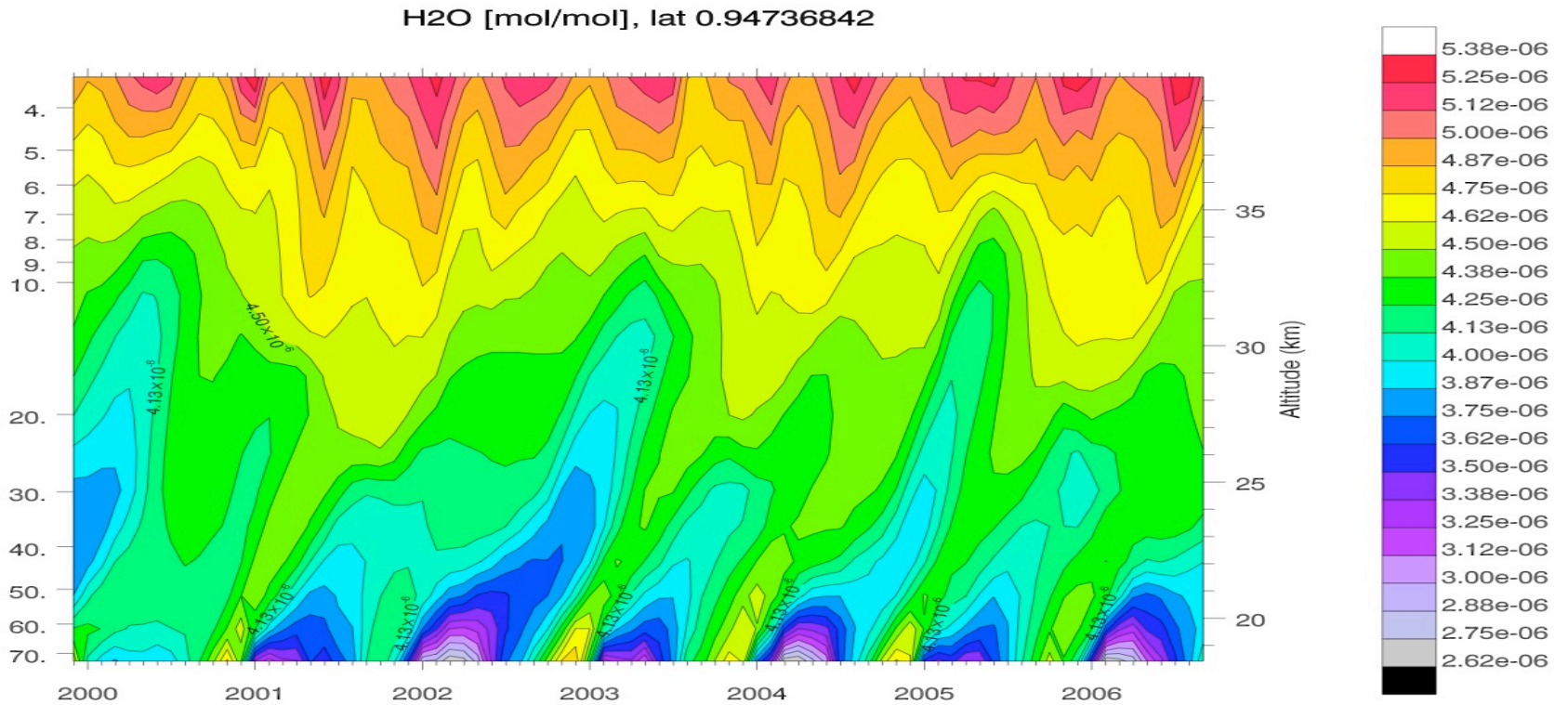
rgarcia 05.03.2009 17:40

Water Vapor Evolution@Equator



Water increases with time due mainly to increasing methane
Stratospheric “tape recorder” is modulated by QBO

Water Vapor Tape Recorder



Summary

- WACCM3.5 climatology, especially in the stratosphere, is the best we have had so far. In particular:
- ‘Cold-pole’ (or westerly winds extending to stratosphere) bias has been improved in DJF; Stratospheric winter jet is also improved.
- Stratospheric variability now closely resembles observations
- Mesopause height and temperatures have improved from WACCM3
- Reasonable ozone hole formation and water vapor distribution
- Mesospheric dynamics: Mean temperature and diurnal tide need improvement