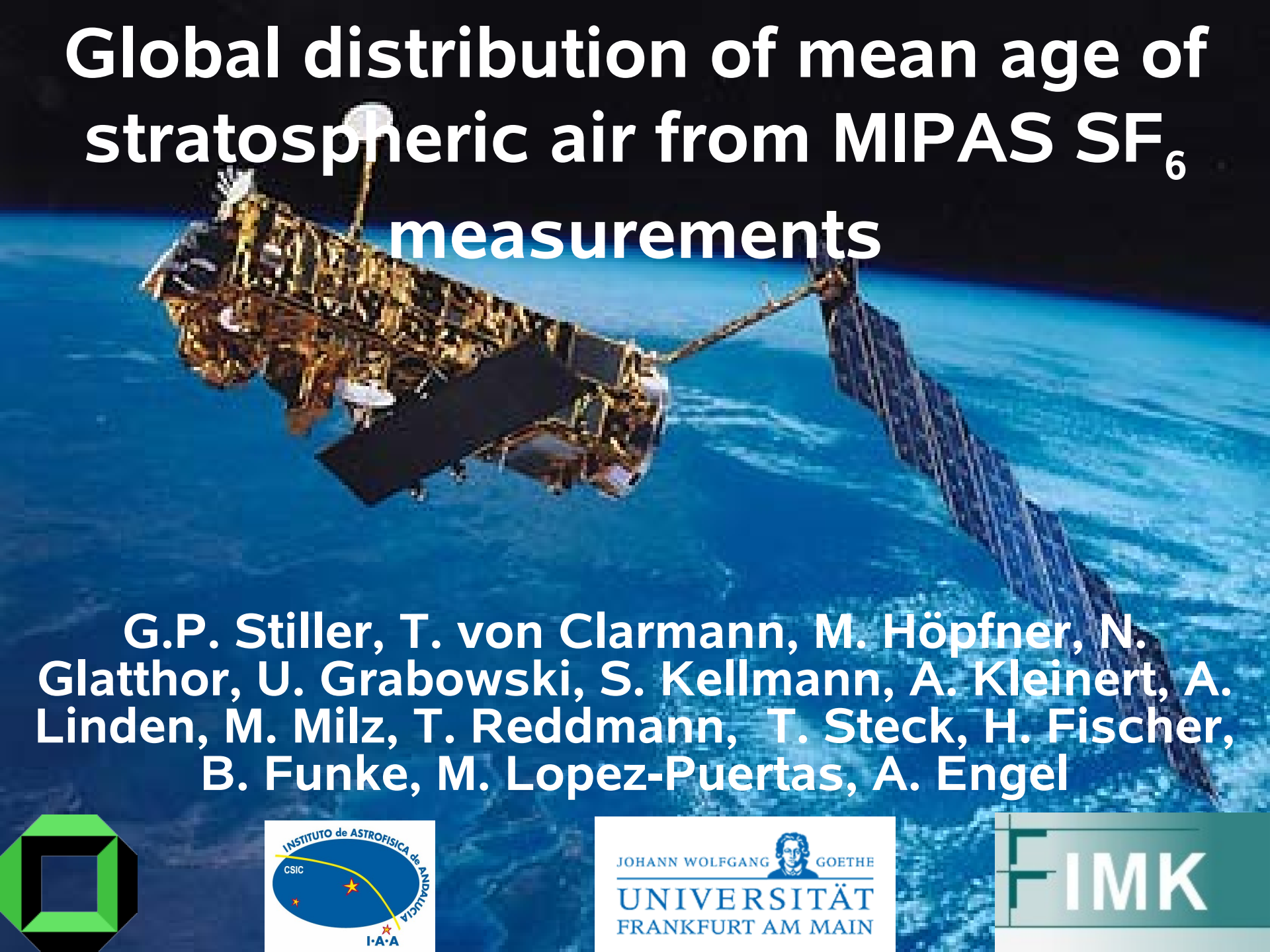
Global distribution of mean age of stratospheric air from MIPAS SF_6 measurements



G.P. Stiller, T. von Clarmann, M. Höpfner, N. Glatthor, U. Grabowski, S. Kellmann, A. Kleinert, A. Linden, M. Milz, T. Reddmann, T. Steck, H. Fischer, B. Funke, M. Lopez-Puertas, A. Engel

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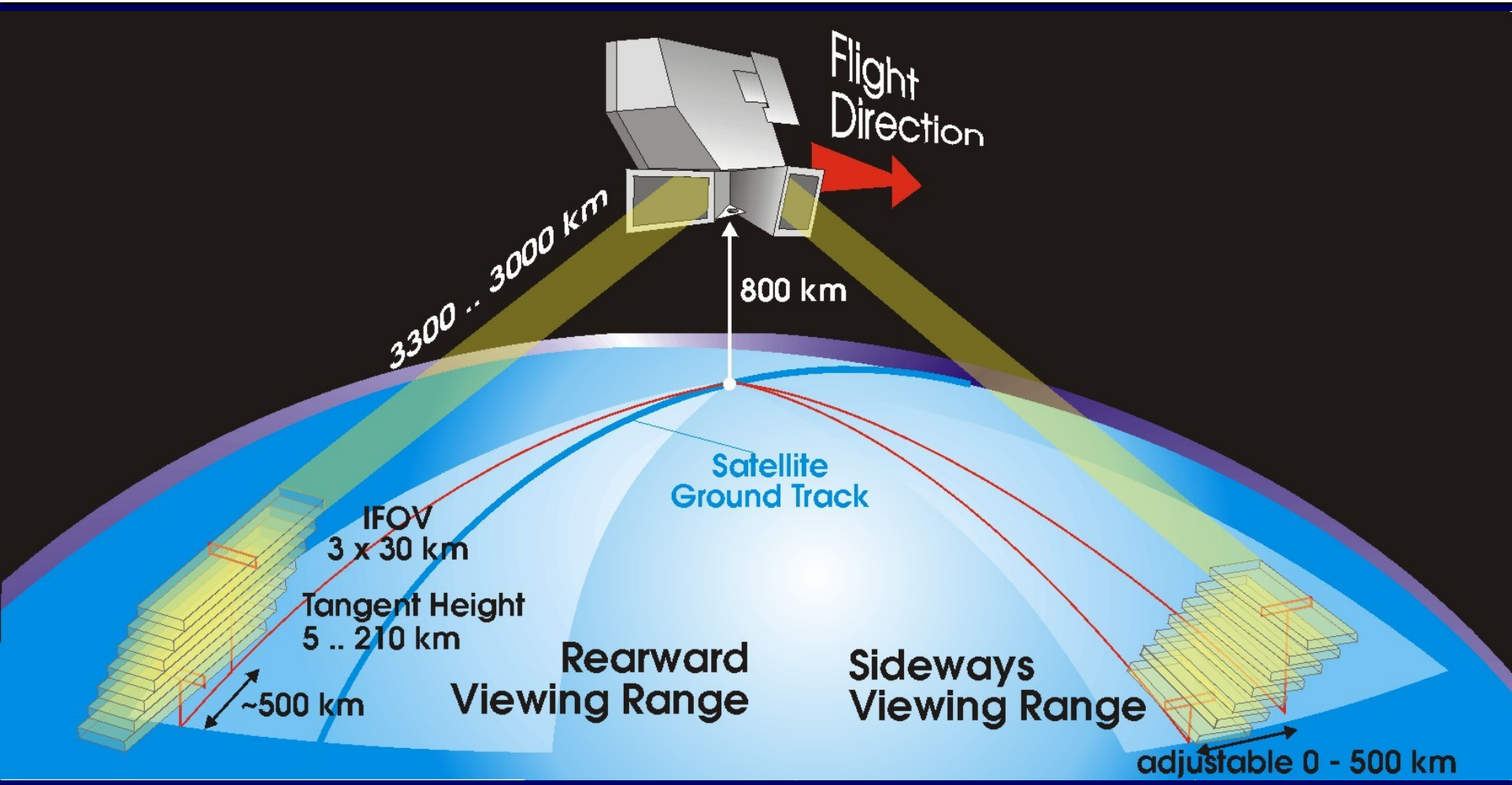
UNIVERSITÄT
FRANKFURT AM MAIN

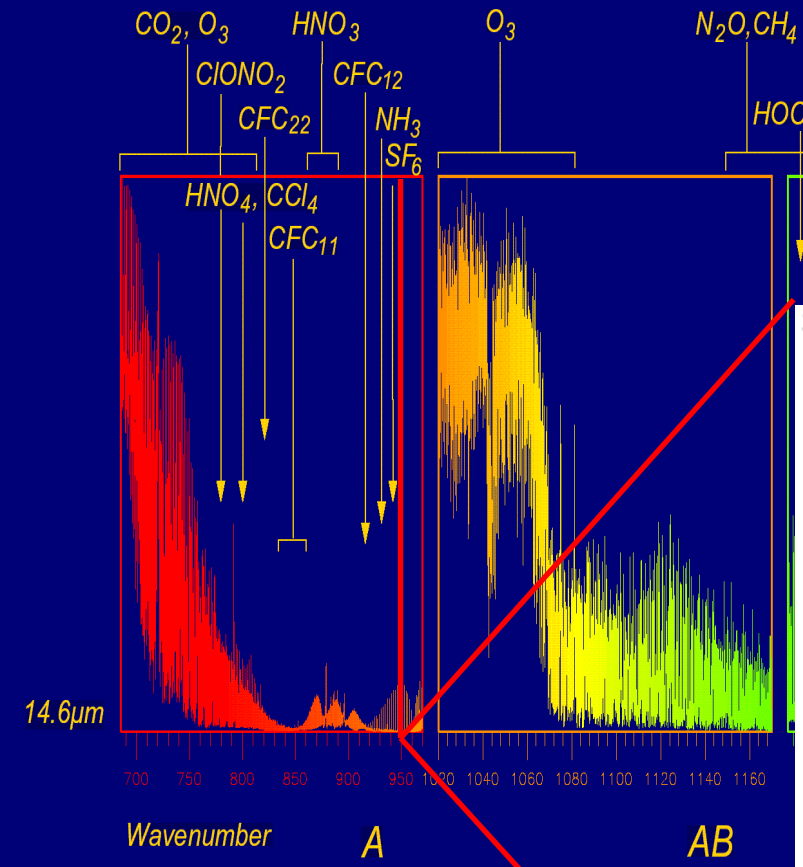
IMK

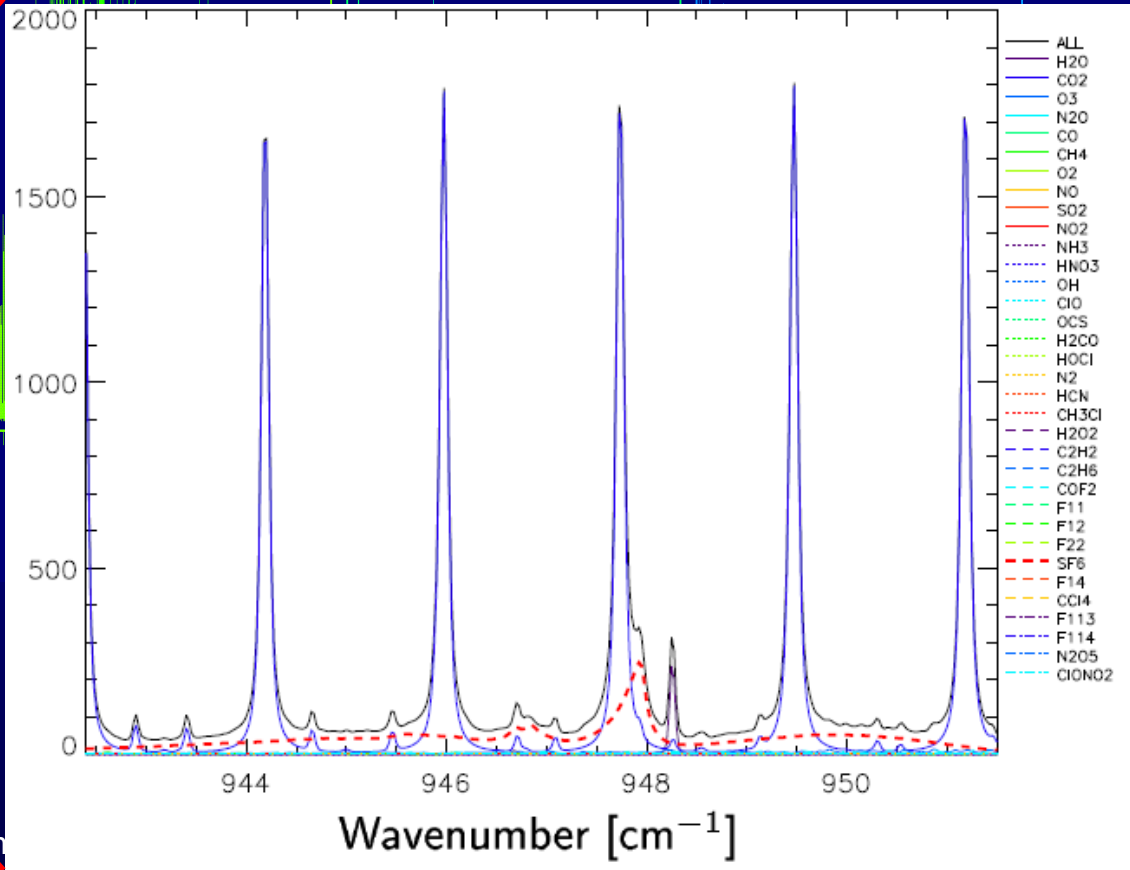
MIPAS



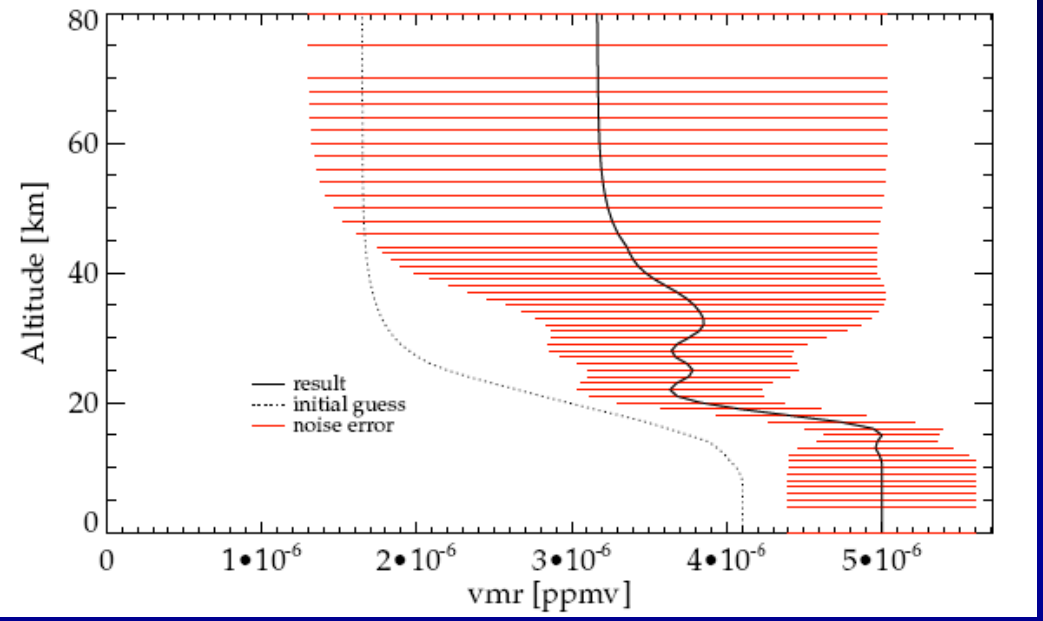
Spectral resolution 0.035 cm^{-1} (Jul 2002 – Mar 2004)
Spectral resolution 0.0625 cm^{-1} (since Aug 2004)
Mission lifetime: financed until end 2010, extension until 2014?

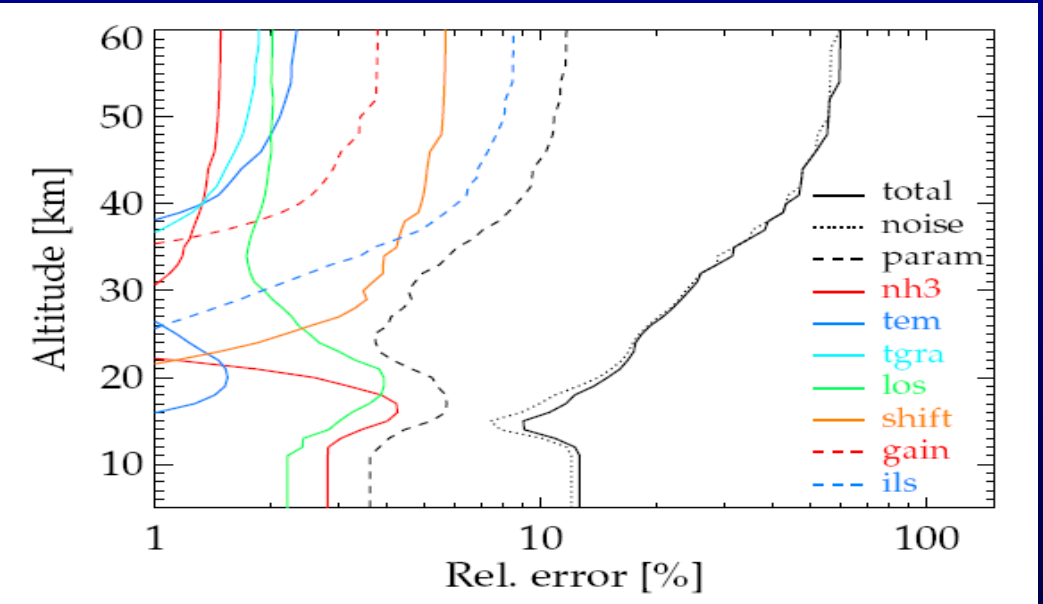
MIPAS spectral measurements at 26 km tangent altitude

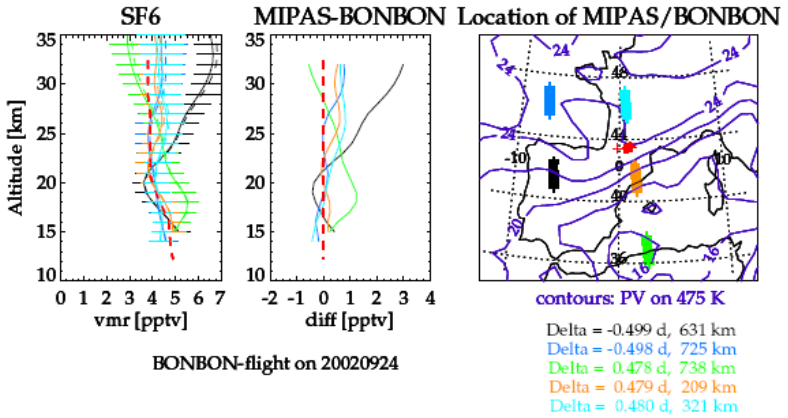


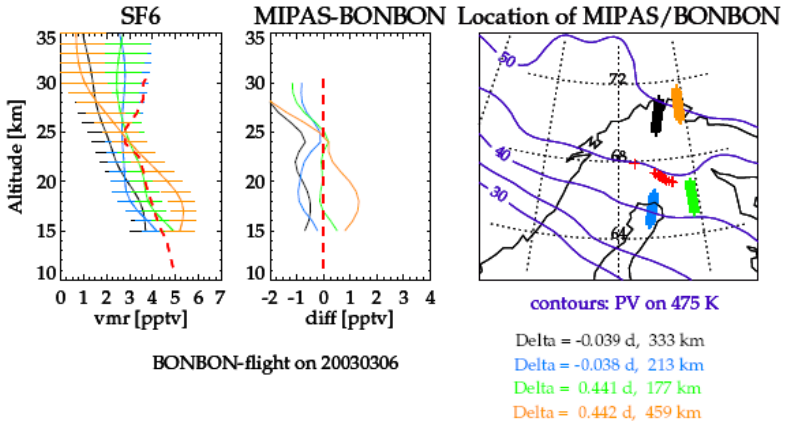


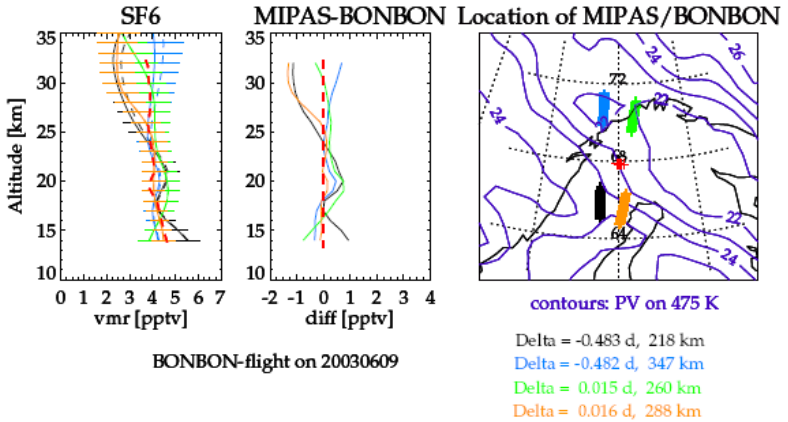
SF_6 retrieval and error budget



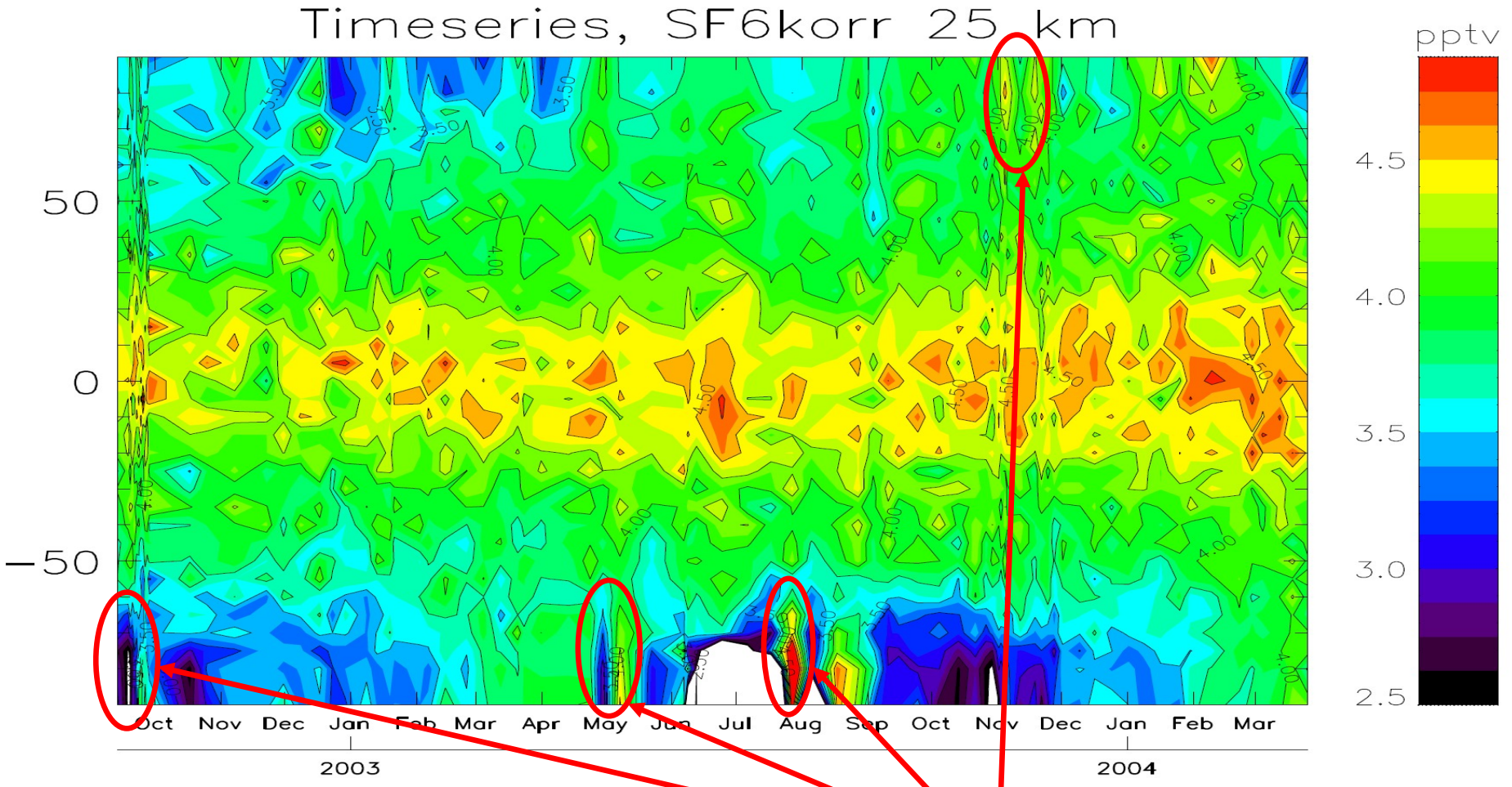




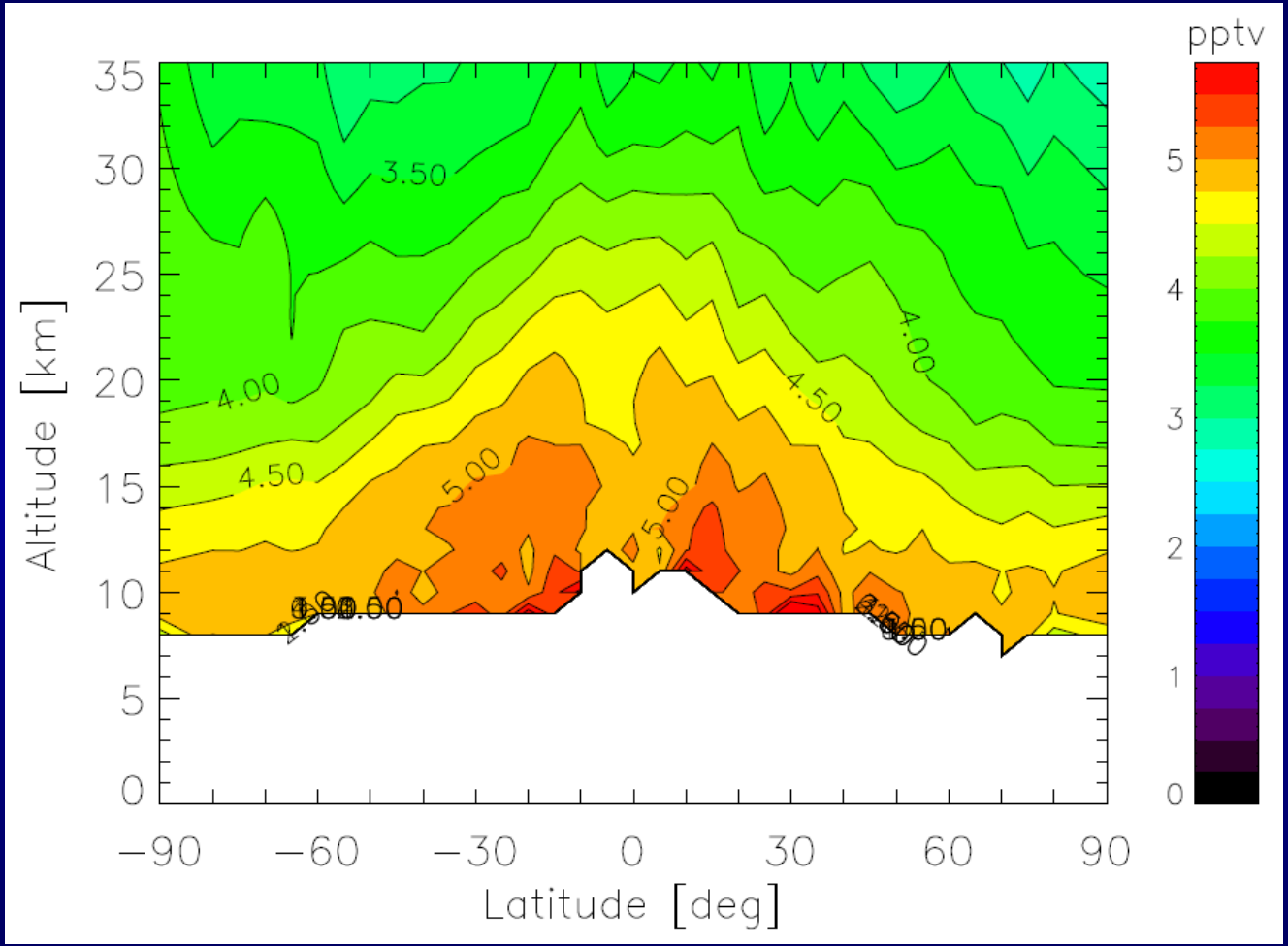




SF_6 timeseries before/after correction

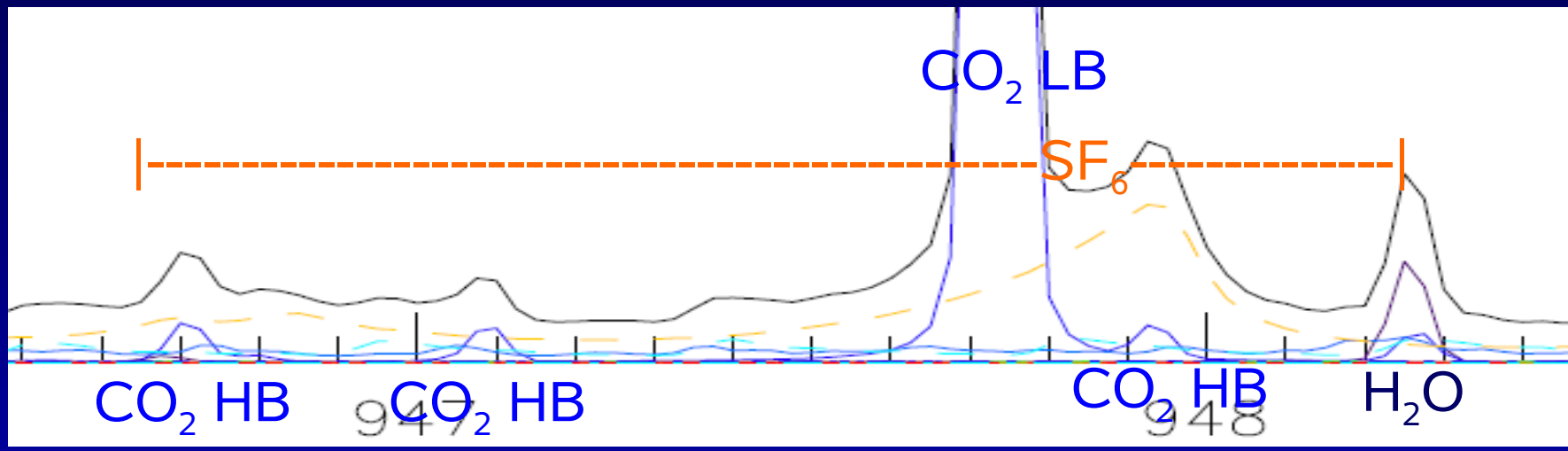


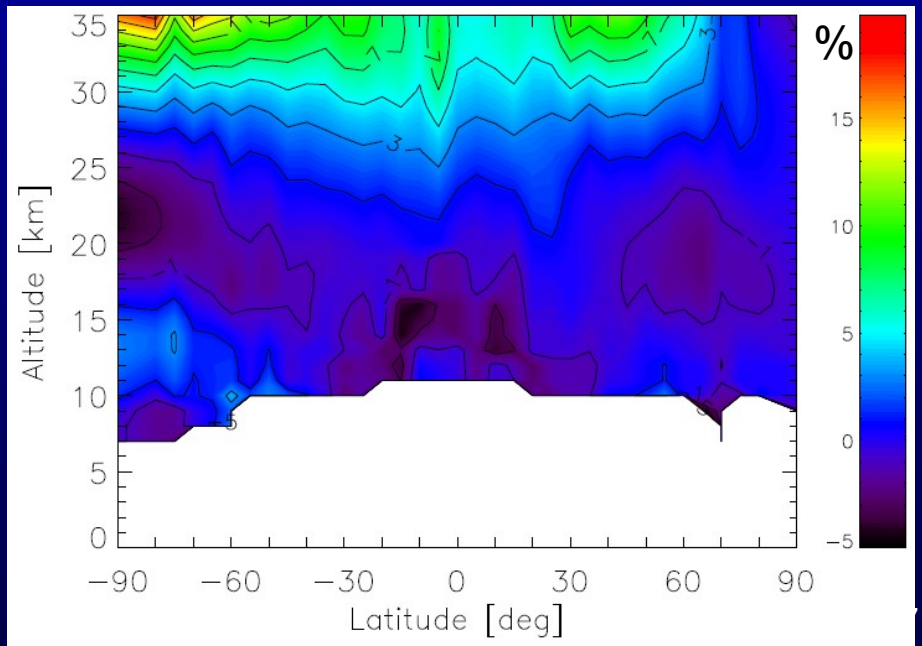
SF_6 daily/monthly zonal means

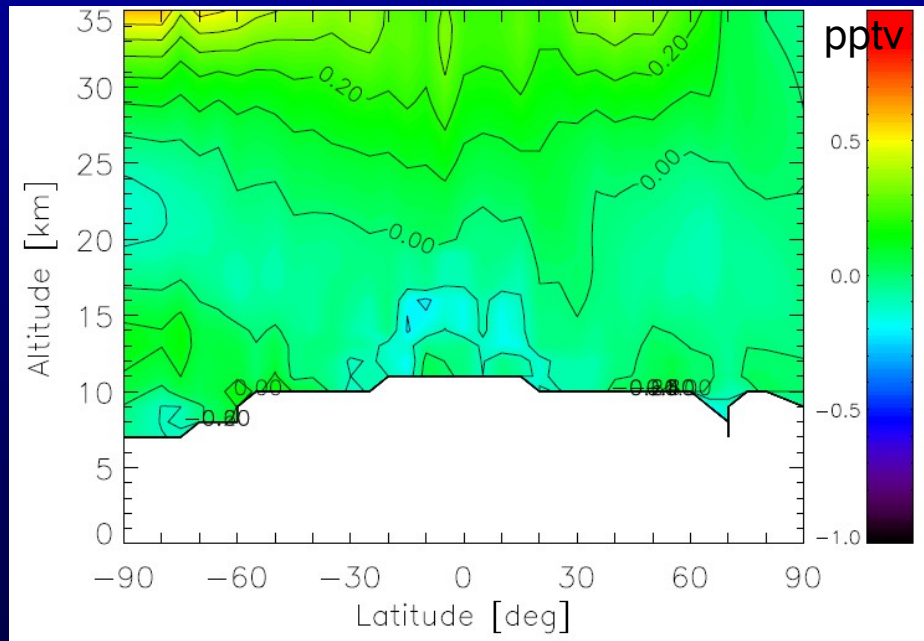


5° zonal mean distribution for March 2003 based on 4 analyzed days (140 profiles per latitude bin); 1σ standard error of the mean is 0.05 pptv or 1%

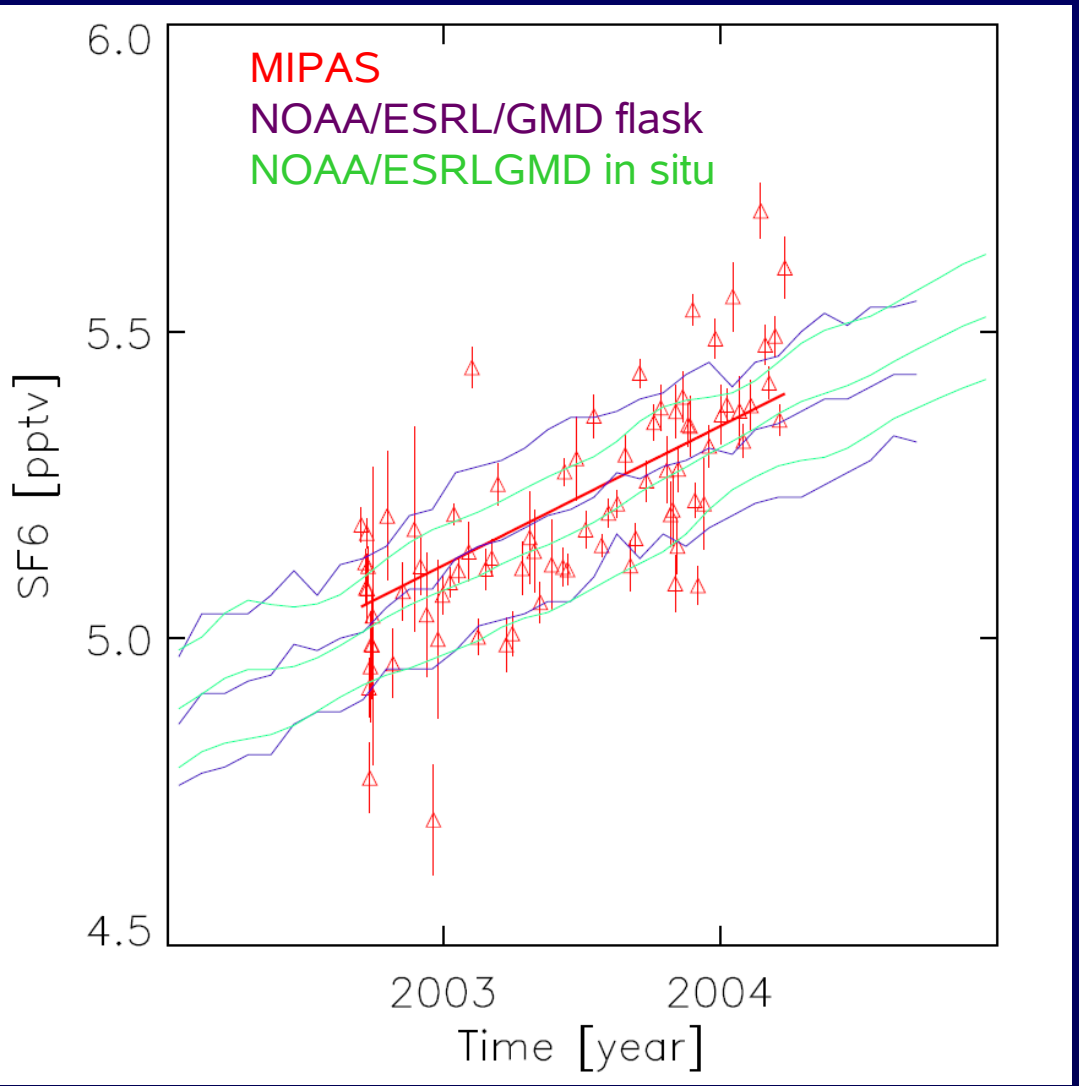
Impact of CO_2 NLTE effects







Tropical tropospheric SF_6 trend



Tropical tropospheric SF_6 trend derived from daily means covering 17.5°S to 17.5°N and 9 to 15 km altitude

Trends:

MIPAS: 0.227 ± 0.008 pptv/yr

In situ: 0.224 ± 0.002 pptv/yr

Flask: 0.217 ± 0.003 pptv/yr

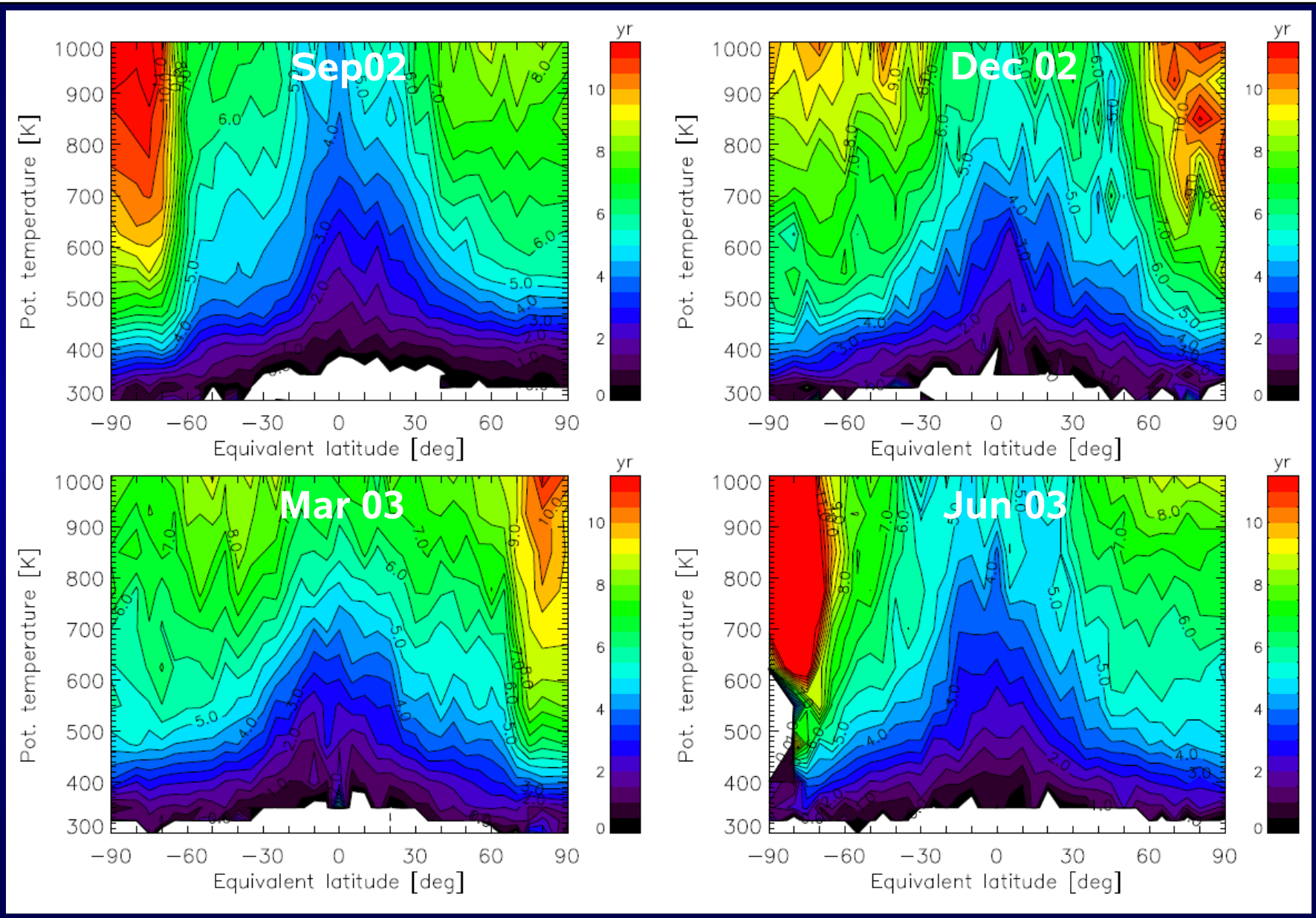
Mean value on 1 Jan 2002:

MIPAS (extrapolated, for tropics): 4.89 pptv

In situ (global): 4.88 ± 0.03 pptv

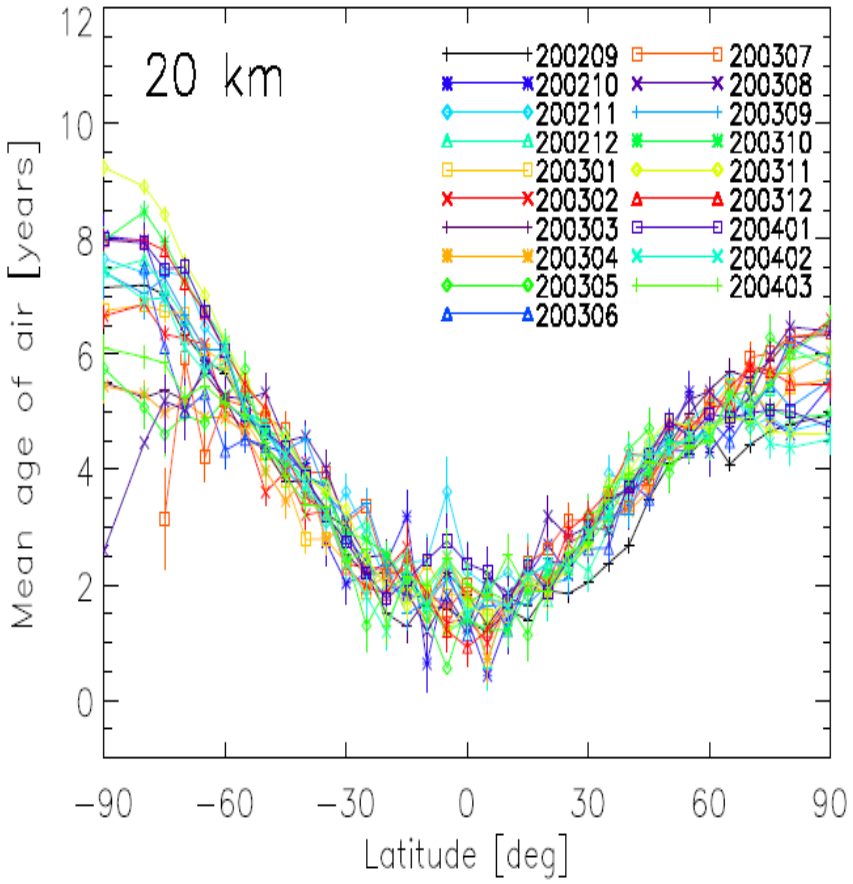
Flask (global): 4.88 ± 0.03 pptv

Monthly global mean distributions of mean age of stratospheric air

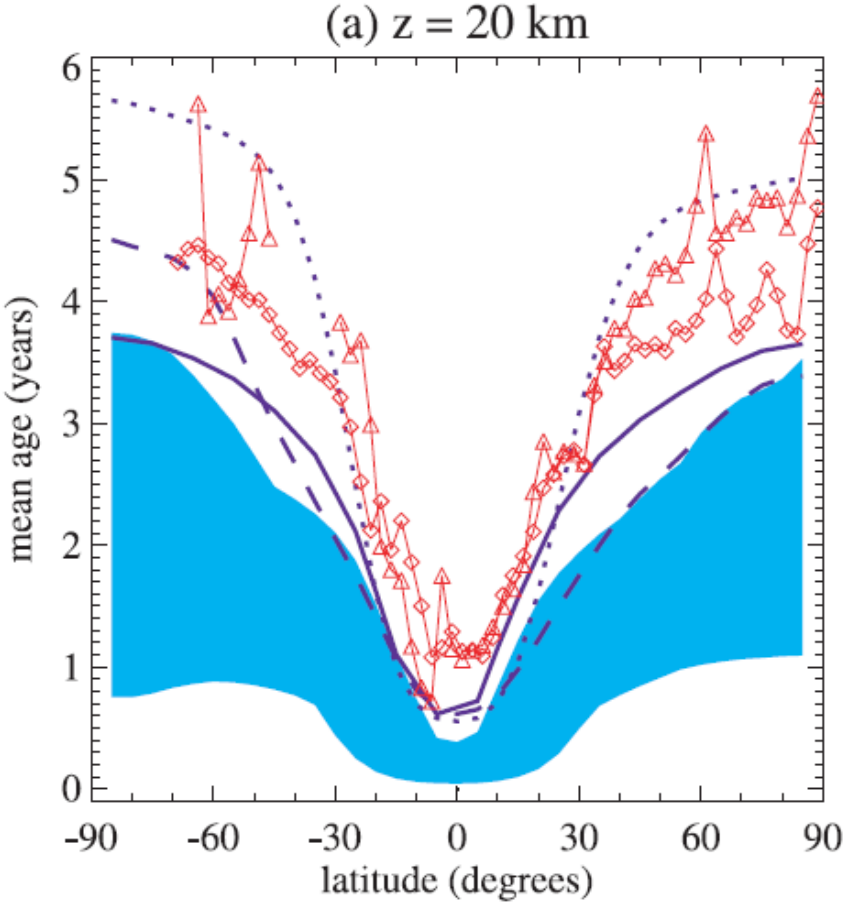


Monthly zonal means at 20 km altitude

MIPAS



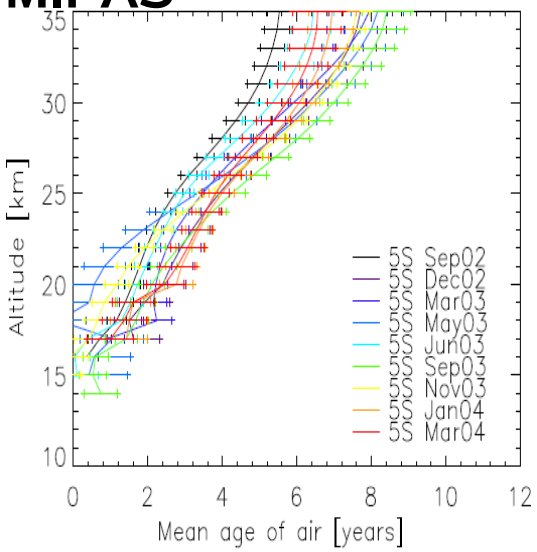
Waugh and Hall, 2002:

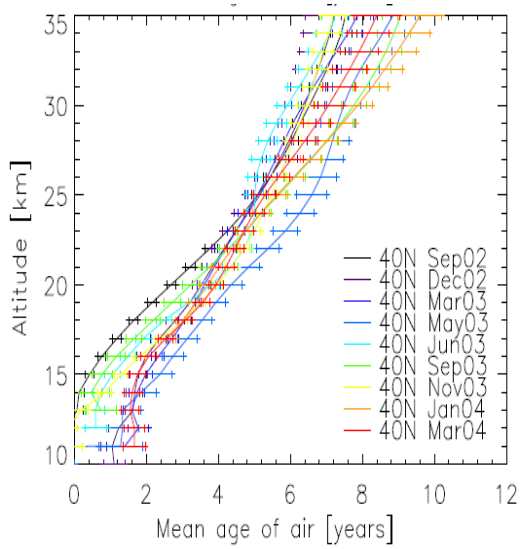


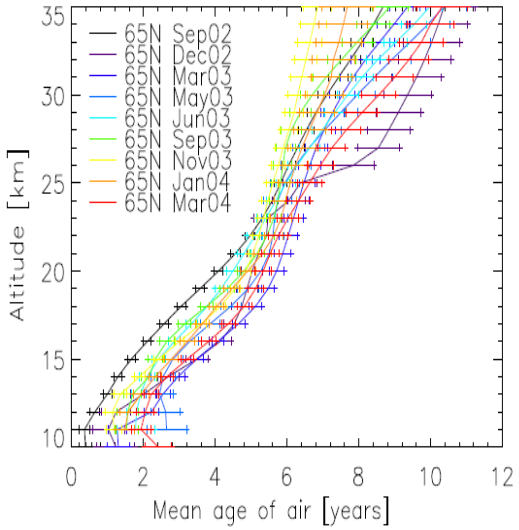
Diamonds: from in situ CO_2 (Boering et al, 1996; Andrews et al., 2001)
Triangles: from in situ SF_6 (Elkins et al., 1996; Ray et al. 1999)

Zonal mean profiles for various seasons

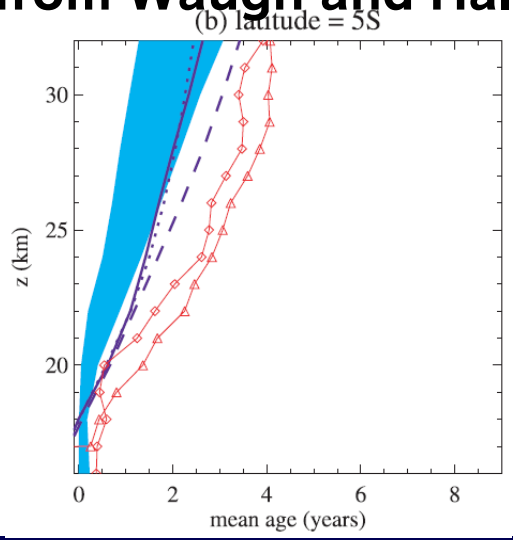
MIPAS

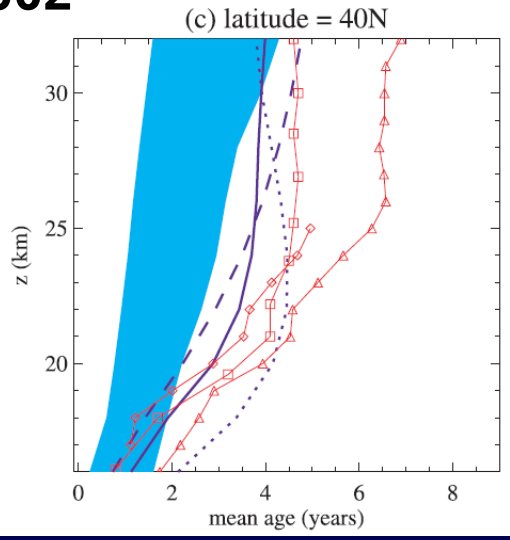


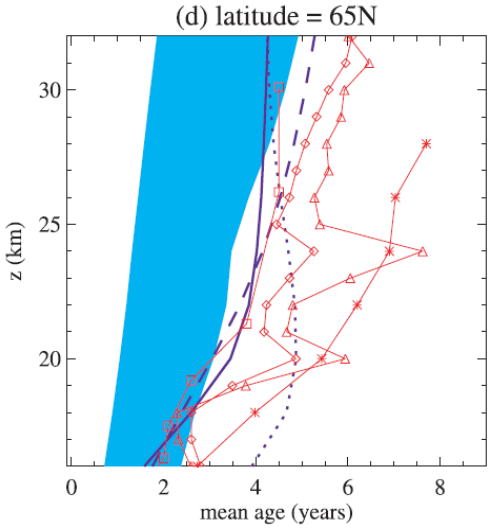




from Waugh and Hall, 2002

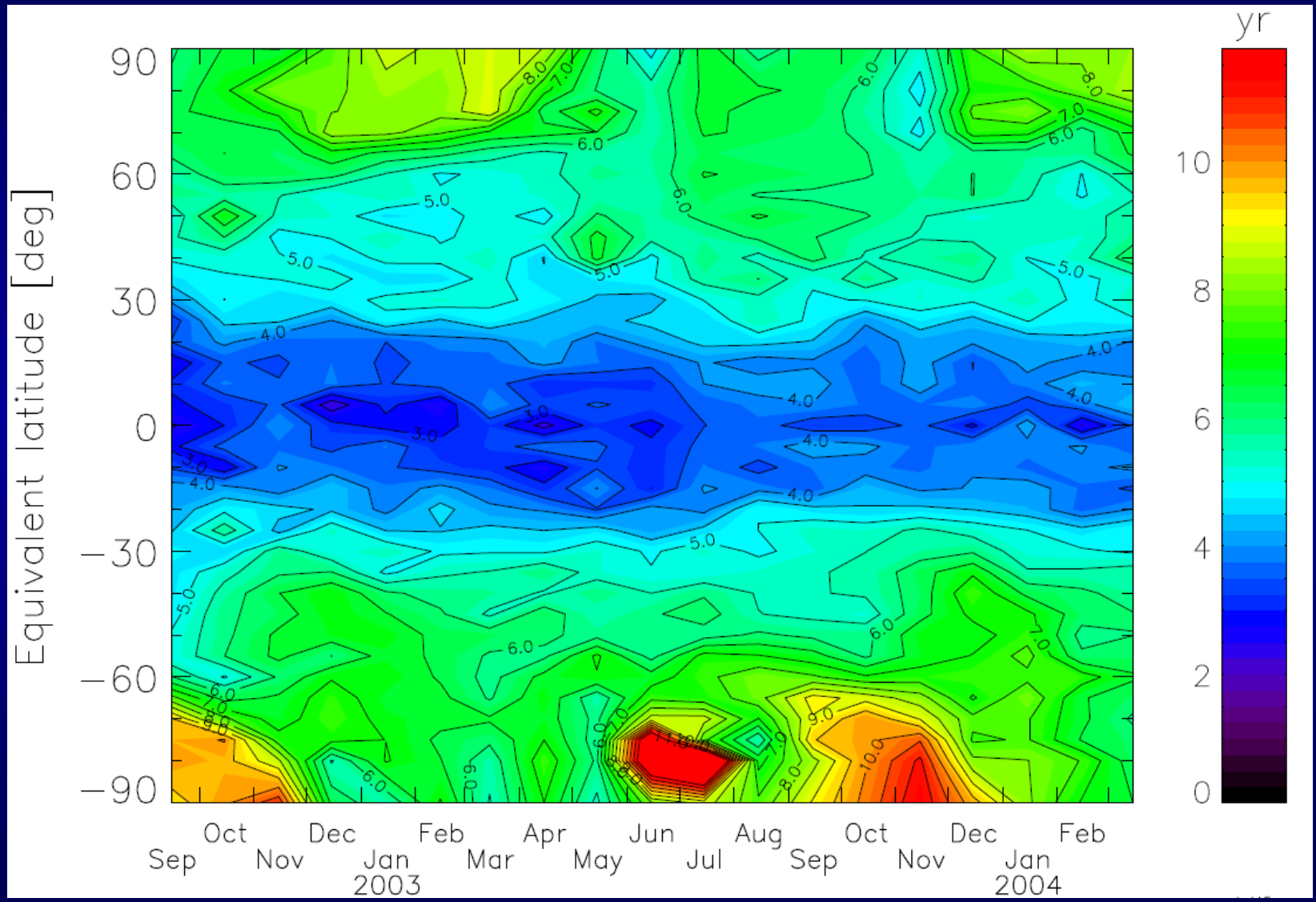




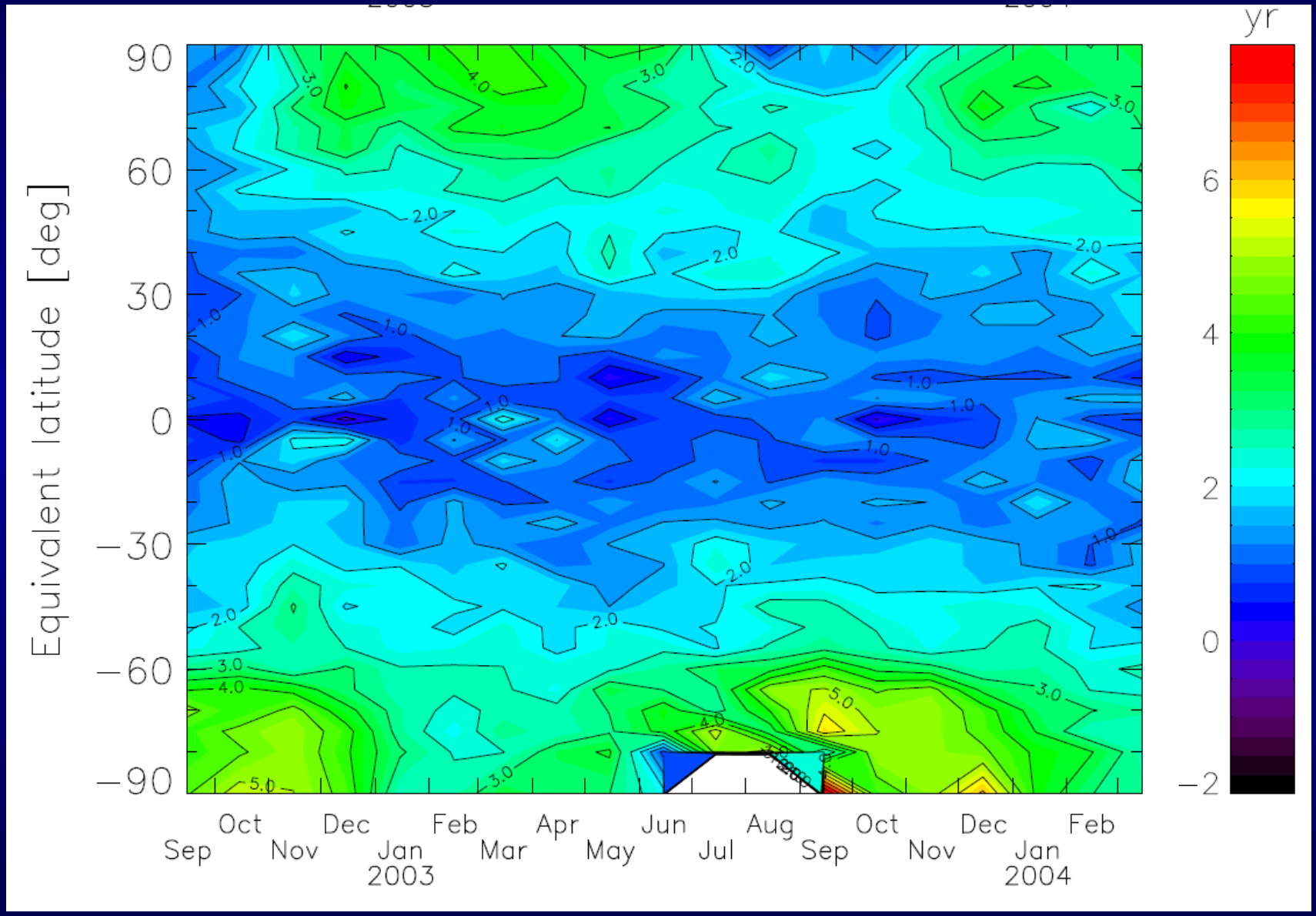


SF_6 whole air samples; Harnisch et al., 1996; squares outside, asterisks inside vortex

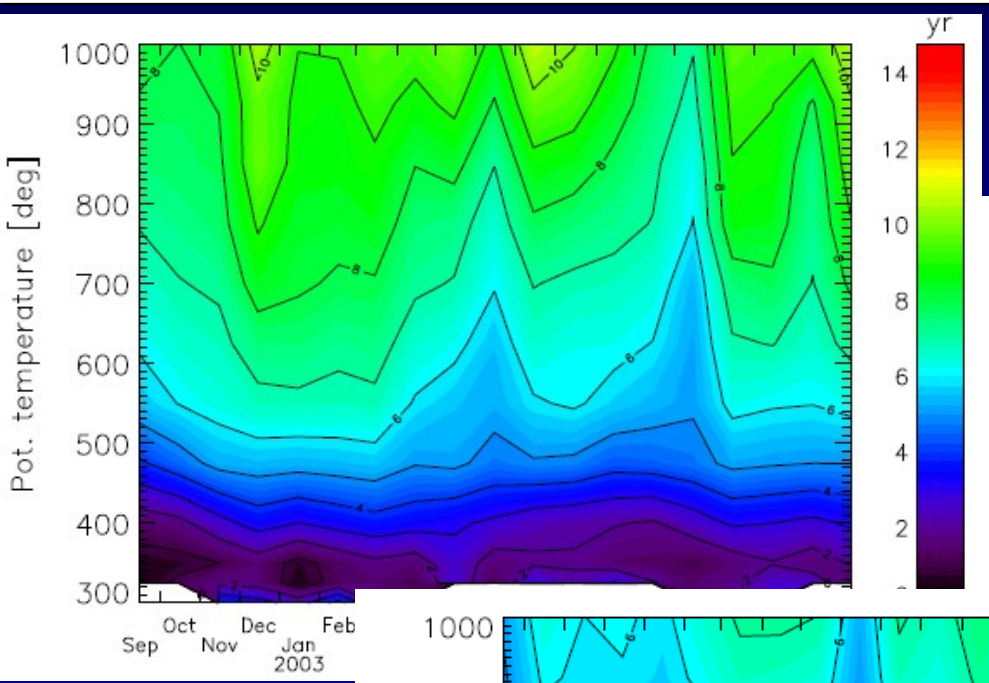
Mean age time series at 625 K



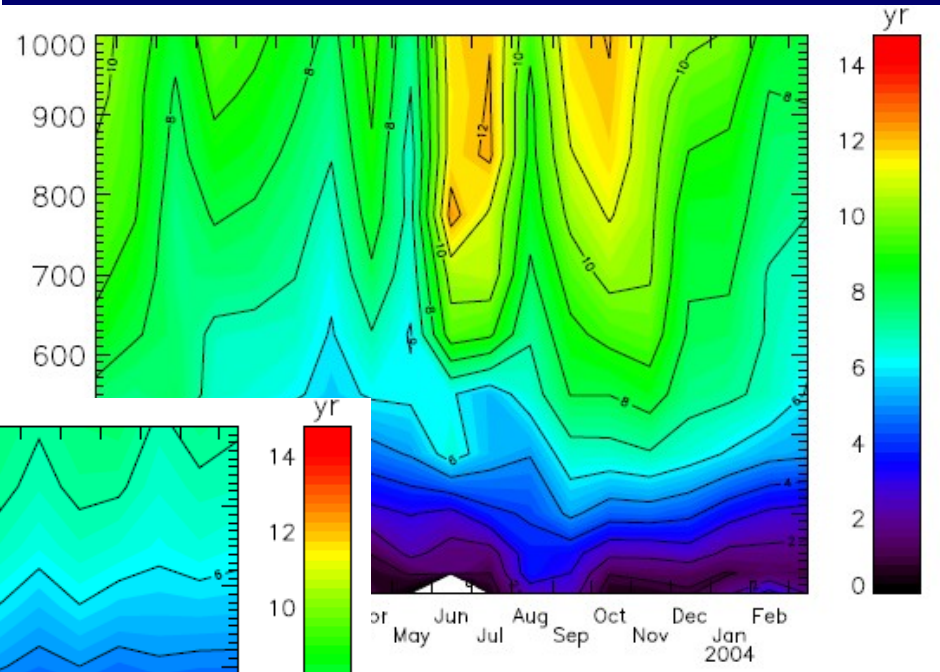
Mean age time series at 400 K

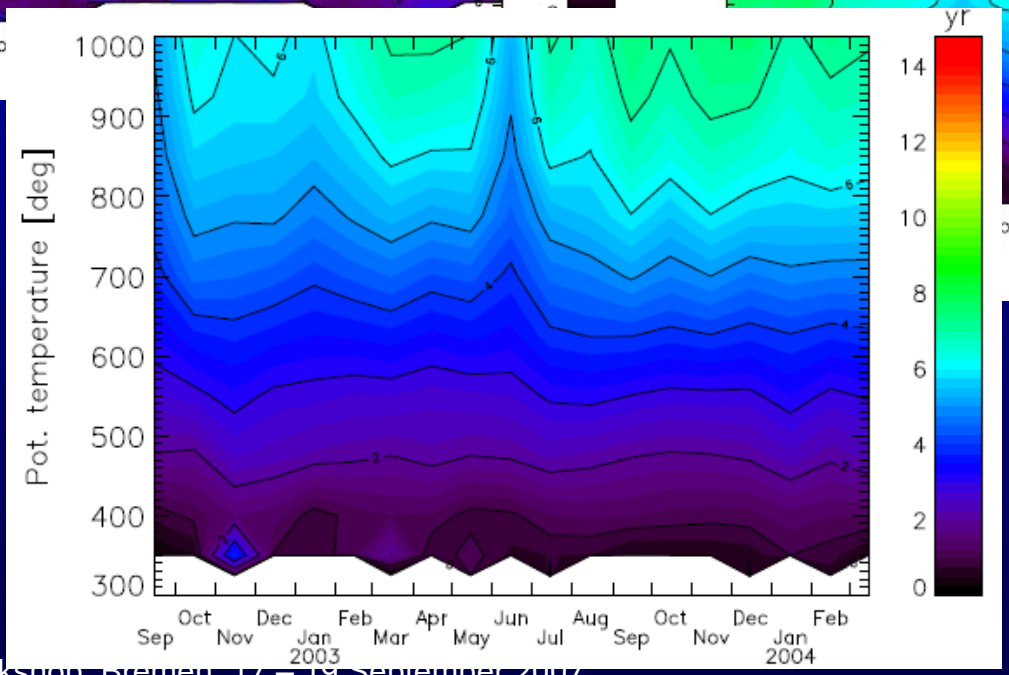


Time series for latitude bands



60N – 90N

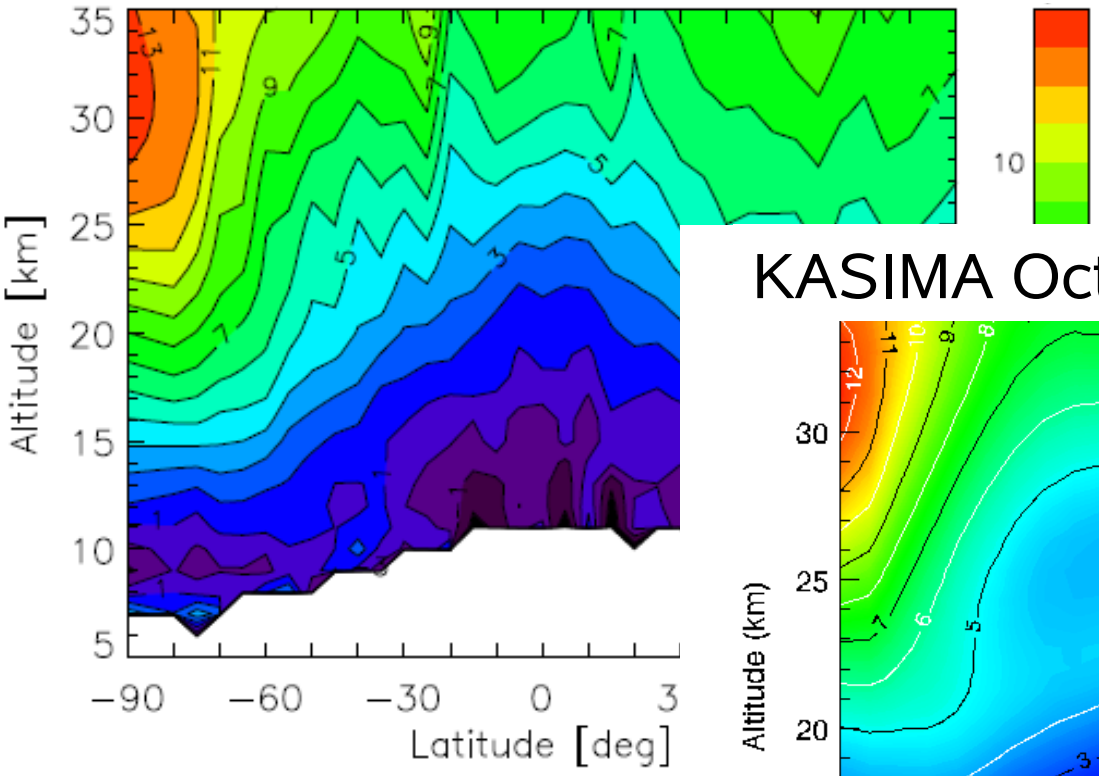




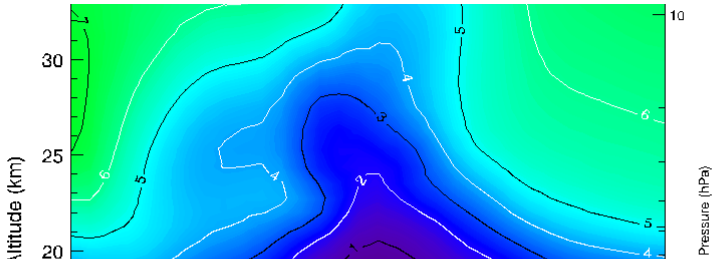
20N – 20S

The mesospheric sink: comparison to model calculations

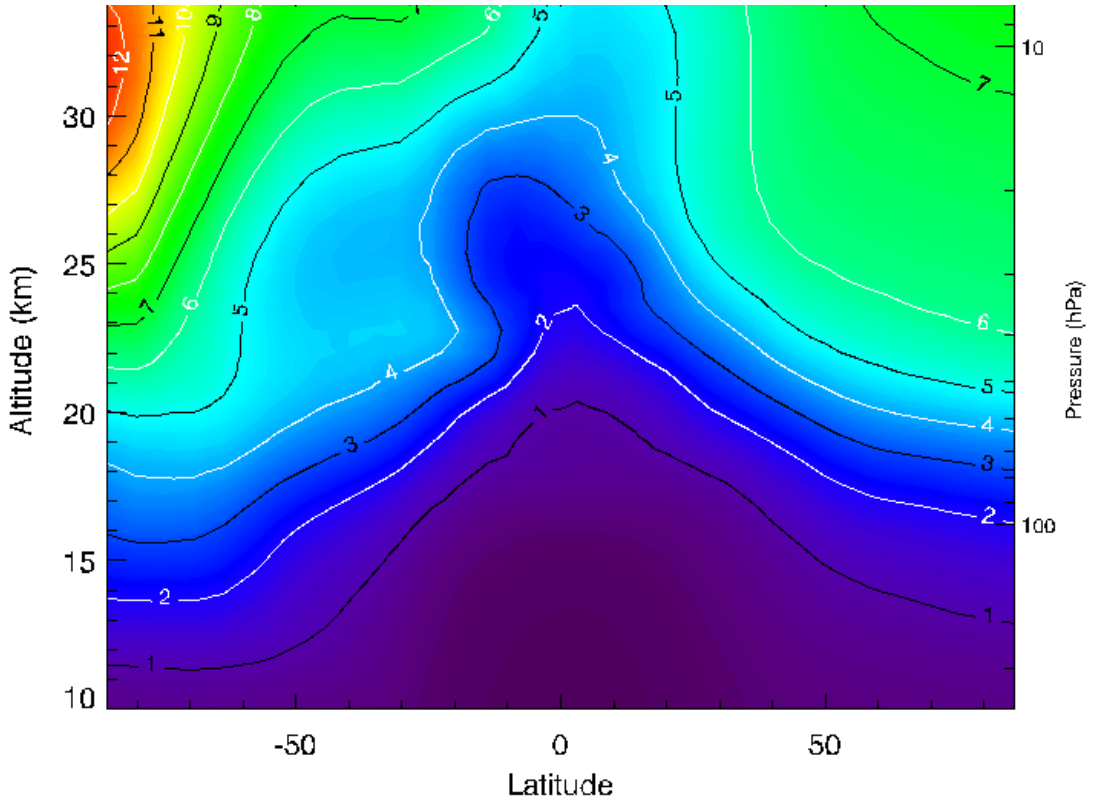
MIPAS Oct 2003



KASIMA Oct 2003 inert tracer



KASIMA Oct 2003 w/ mesospheric sink



00008700 SF6 2003/10/31/ SF6 decay phy Zonal mean 1.0000

Conclusions

- The current data set of MIPAS SF_6/age of air presents daily or monthly global 5° zonal mean data for 5 to 30 km altitude and Sep 2002 to March 2004; precision: 0.05 pptv or 0.25 yr per latitude bin (monthly means) Systematic uncertainties are up to -0.5 yr below 20 km and +1yr above.
- The tropical tropospheric SF_6 trend of 0.227 pptv/yr agrees excellently with NOAA/ESRL/GMD in situ and flask measurements; there is no bias between MIPAS SF_6 and NOAA data.
- The mean age of air distributions reveal a high seasonality, in particular at high latitudes, and also inter-annual differences.
- The inter-hemispheric differences at high latitudes are pronounced, with frequent episodes of much higher ages in the Southern polar vortex.
- Even during polar summer (in particular for the SH), the age of air is rather high. Near the poles, ages typical for mid-latitudes are observed immediately before a new vortex forms.
- Comparison to model calculations with/without consideration of the mesospheric loss reaction of SF_6 confirm that the high ages observed are due to mesospheric intrusions.
- The time series will be extended (2002 to 2010/14) and will be used to observe potential changes in the Brewer-Dobson circulation.