Transient simulation from 1960 to the present with the CCM ECHAM5/MESSy1 with focus on stratospheric water vapor.

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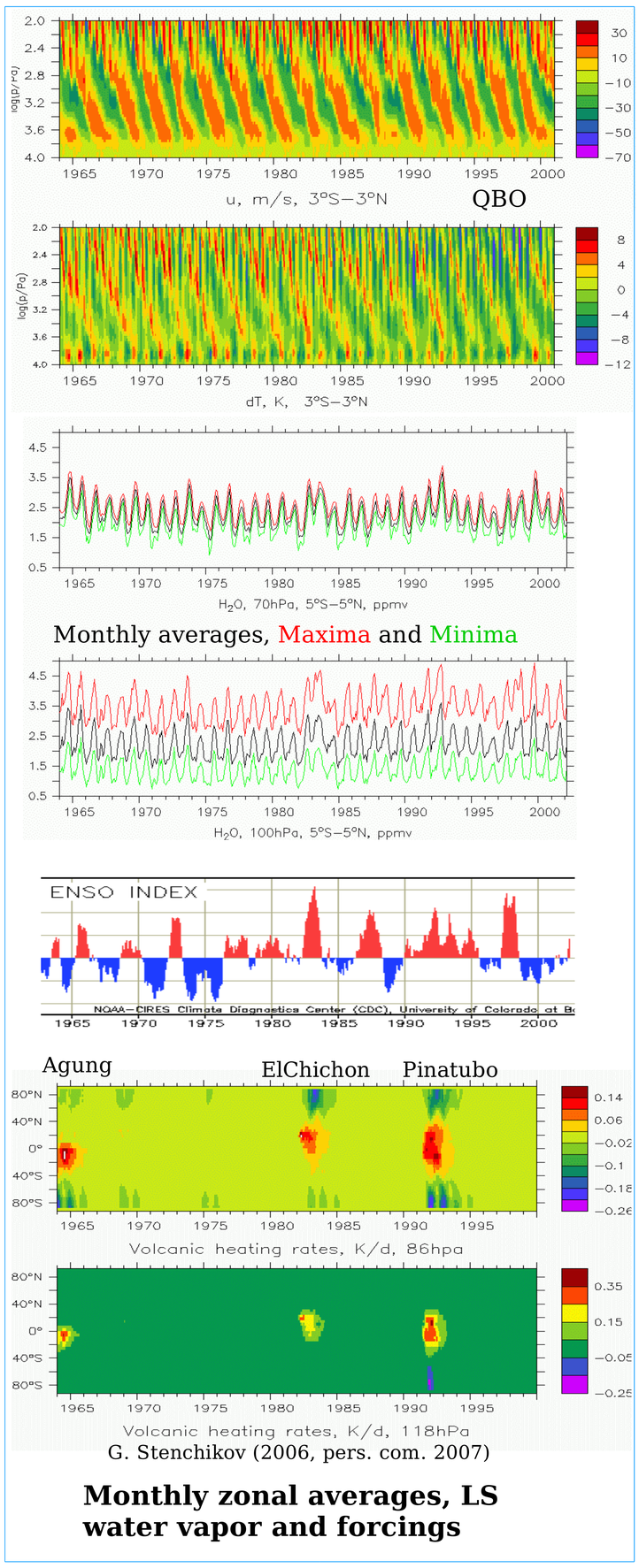
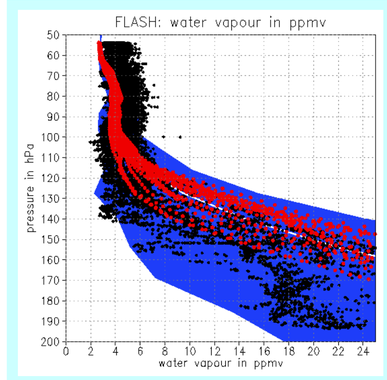
MAX-PLANCK-GESELLSCHAFT

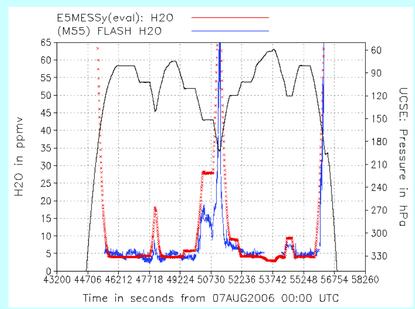


G. Stenchikov (2006, pers. com. 2007)

Monthly zonal averages, LS water vapor and forcings

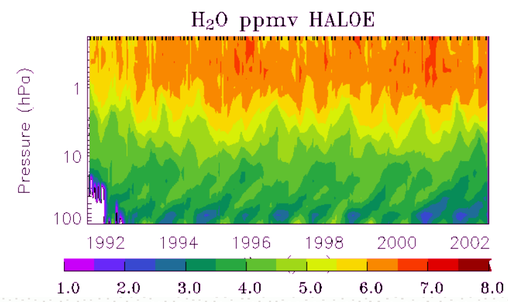
Evaluation

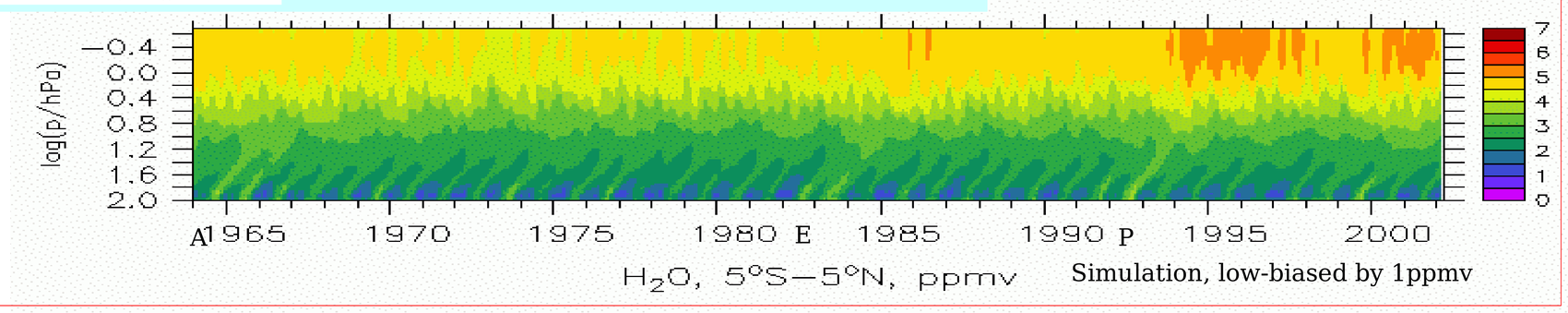




Comparison of a model setup with tropospheric meteorology nudged to observations with aircraft observations during the **AMMA campaign** in West Africa, August 2006. FLASH-data by N.Sitnikov (Central Aerological Observatory, Moscow, Russia). Graphics by M. Kunze, Free University Berlin, Germany as part of SCOUT-O3.

Satellite data (UARS)

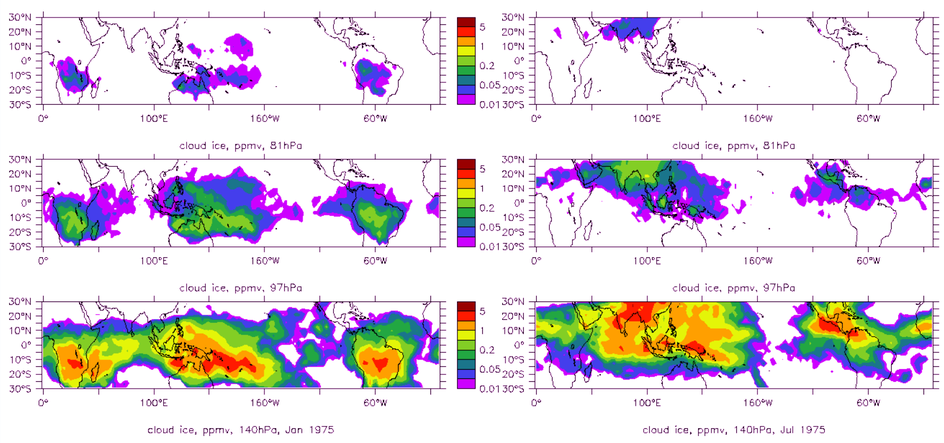


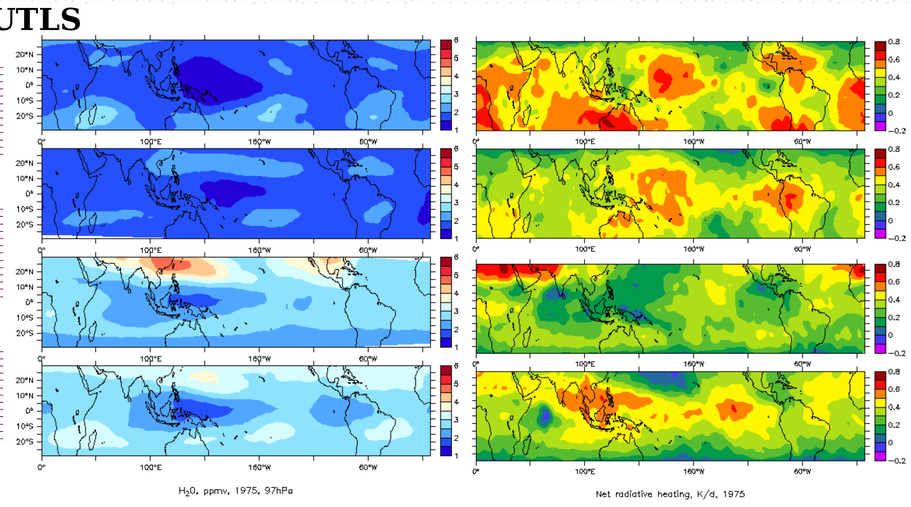


Simulation, low-biased by 1ppmv

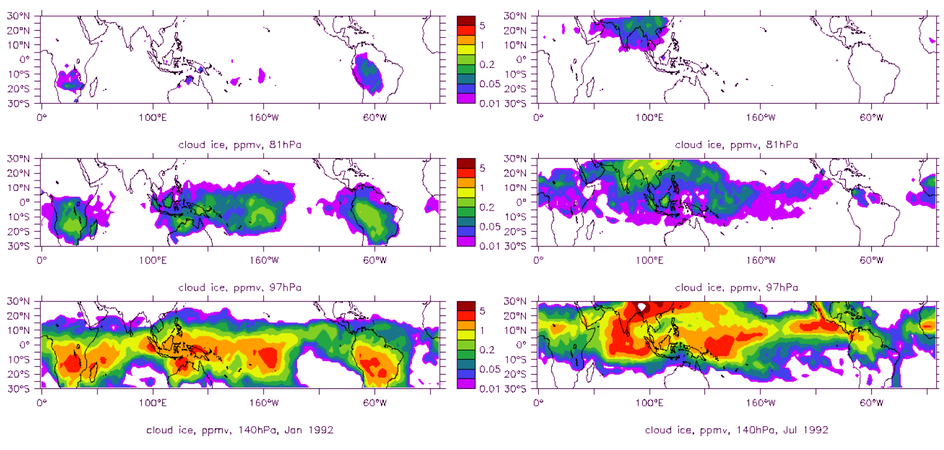
Details for extreme years in the UTLS

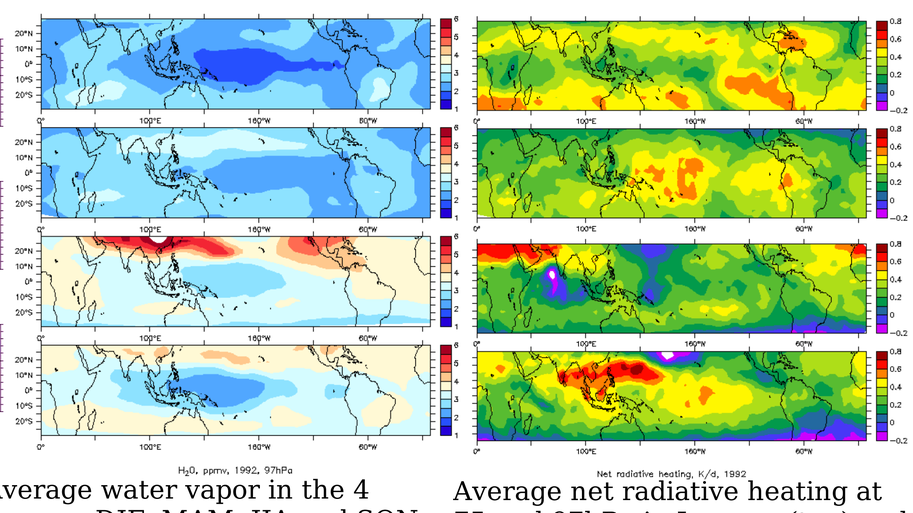
LaNina, dry (1975)





ElNino and volcano, wet (1992)

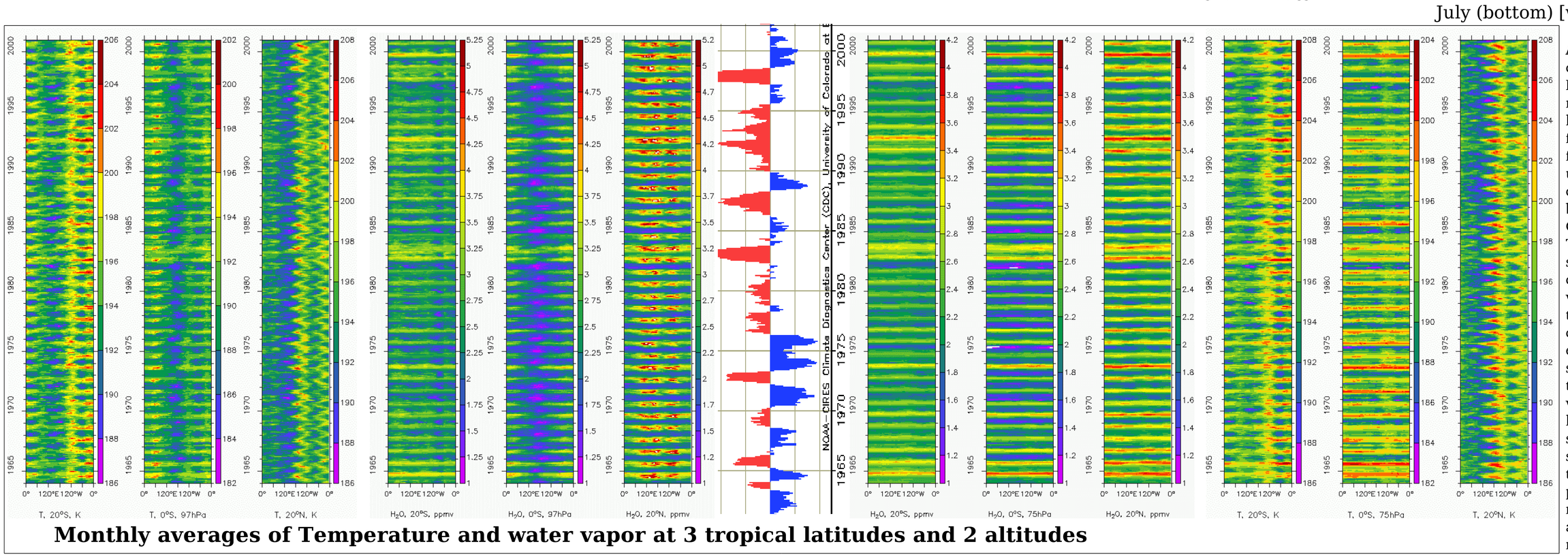




Calculated average cloud water, January and July at different altitudes of the UTLS

Average water vapor in the 4 seasons DJF, MAM, JJA and SON

Average net radiative heating at 75 and 97hPa in January (top) and July (bottom) [w/o volcanic term]

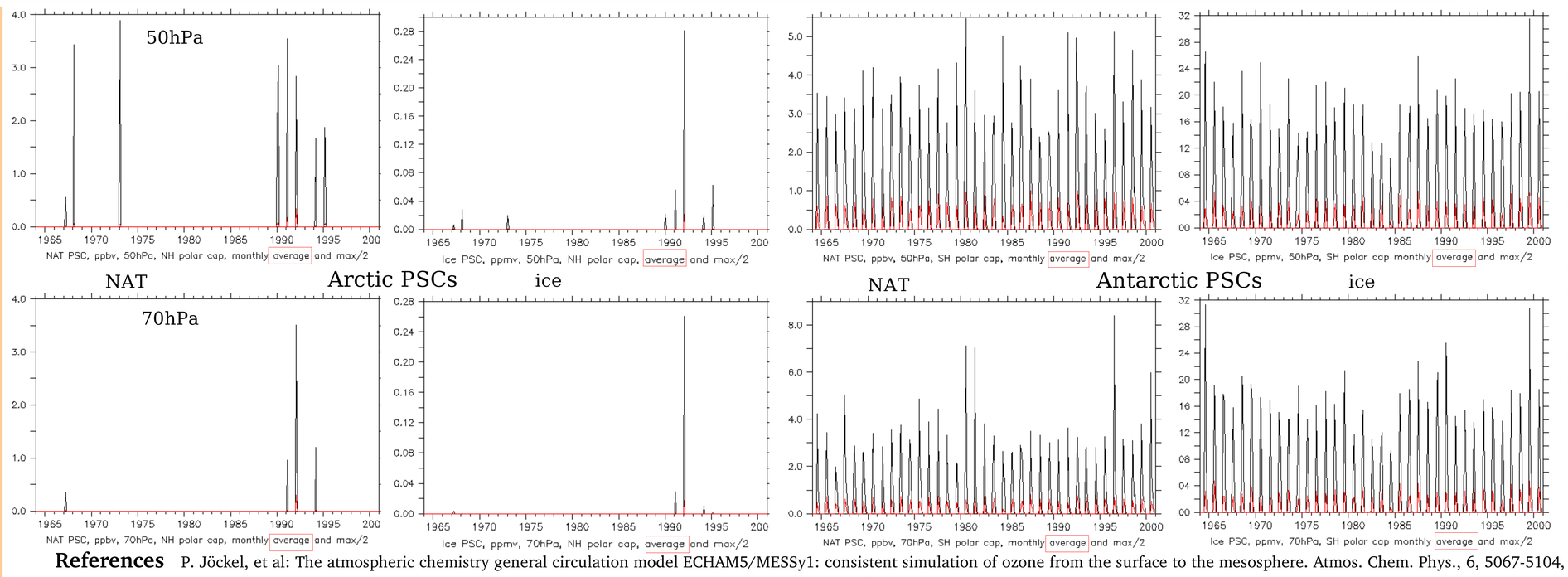


Monthly averages of Temperature and water vapor at 3 tropical latitudes and 2 altitudes

Abstract: The chemistry climate model ECHAM5/MESSy1 with horizontal resolution T42 and 90 layers up to 80km is used for a transient simulation from 1960 (1958 for spin-up) to about 2000 with the chemical and physical boundary conditions of the CCMVal-REF1 scenario. The model includes tropospheric and stratospheric chemistry and has a high vertical resolution near the tropopause. To achieve a quasi biennial oscillation exactly in phase with observations, the model's internally generated QBO is very weakly nudged in the lower stratosphere. We show that we are able to simulate the 'atmospheric tape recorder', the upward propagation of the seasonal signal of water vapor at the tropopause, and its modulation by the QBO, ElNino, volcanic heating, monsoon effects and atmospheric chemistry. The presentation will include also a comparison with observations and some analysis of modification of polar stratospheric clouds by changing water vapor.

Conclusions

- The atmospheric chemistry climate model ECHAM5/MESSy1 (EMAC) reproduces the tropical tape recorder of water vapor observed by HALOE , but with a low bias of about 1ppmv (free running simulation).
- In agreement to observations, heating of the lower stratosphere by volcanoes leads to enhancement of middle stratospheric water vapor (delay ~ 2 years).
- Reduced dehydration over the West Pacific (NH winter) in ElNino years leads to enhanced stratospheric water vapor (strongest signals in 1998, 1992, 1973, 1983, 1988), LaNina vice versa.
- Moistening in NH summer by high South Asian monsoon clouds, and over East Pacific.
- In most years with a moist stratosphere there are more Antarctic PSCs (average, 50hPa), in the Pinatubo year and in 1999 NAT and ice behave different. Enhancement in 1973 in both polar regions.



References P. Jöckel, et al: The atmospheric chemistry general circulation model ECHAM5/MESSy1: consistent simulation of ozone from the surface to the mesosphere. Atmos. Chem. Phys., 6, 5067-5104, 2006.
J. Lelieveld et al.: Stratospheric dryness: model simulations and satellite observations. Atmos. Chem. Phys., 7, 1313 1332, 2007.
M.A. Giorgetta, et al.: Climatology and forcing of the quasi-biennial oscillation in the MAECHAM5 model, J. Climate, 19, 3882-3901, 2006. Stenchikov, G., et al., J.Geophys.Res. 111, D07107, 2006.

www.messy-interface.org ; www.pa.op.dlr.de/CCMVal/Forcings/CCMVal_Forcings.html