

CCM Modelling : LMDz-Reprobus

Marchand Marion, Slimane Bekki, Franck Lefèvre,
François Lott, David Cugnet, Line Jourdain, Perrine
Lemmenais, Virginie Poulain, Julien Jumelet, Slimane
Bekki, marie-Pierre Lefebvre



GCM: Dynamics and physics

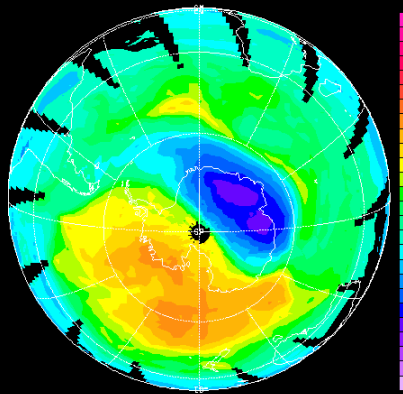
- Extended version of the LMDz-4 general circulation model (Lott et al., 1999; 2005)
 - Grid point model (2.5° lat - 3.75° lon)
 - hybrid sigma-pressure vertical coordinate
 - 50 levels from surface to 0.07 hPa (65 km)
- LMDz-4: atmospheric component of the IPSL Earth System model (Dufresne et al., 2002; IPCC, 2007)
 - used by a wide community in France
 - Also includes carbon cycle, tropospheric chemistry, etc..
 - Involved in IPCC simulations
- Physical parameterisations
 - Radiation scheme: ECMWF scheme (Morcrette, 1989)
 - Convection scheme: Emanuel scheme (Emanuel, 1993)
 - Subgrid scale orography: Lott and Miller (1997), Lott (1999).
 - Doppler-spread non orographic gravity waves scheme: Hines (1997) and adapted from Manzini (1997)
 - Rayleigh drag sponge layer between 55 km to 65 km (Shepherd et al., 1996)
 - Transport of tracers: Van Leer I scheme (Van Leer, 1977)

REPROBUS: stratospheric chemistry module

- **Reprobus:**
 - initially designed as a chemical-transport model (Lefèvre et al., 1998; Ricaud et al., 2005; Tripathi et al., 2007)
 - Coupled interactively to LMDz since 2004
- **Gas-phase chemistry:**
 - detailed description of Ox, NOx, HOx, ClOx, BrOx et CHOx chemistries.
 - 55 species, 160 gas-phase reactions
 - Includes CH₂Br₂* as a proxy for bromine VSLS ($\text{CH}_2\text{Br}_2^* = \text{CH}_2\text{Br}_2 + \text{CHBr}_3 + \text{CH}_2\text{BrCl} + \text{C}_2\text{H}_4\text{Br}_2 + \dots = \sim 5 \text{ pptv}$)
- **Heterogeneous chemistry:**
 - flexible microphysical scheme: can handle liquid binary (H₂O/H₂SO₄), liquid ternary (H₂O/H₂SO₄/HNO₃) aerosols, solid NAT, solid ice particles. Different microphysical scenarios can be assumed: mixture of solid/liquid particles, varying radius, bimodal distribution, varying particle number density, etc...
 - Liquid aerosol composition: Carslaw et al., (1995)
 - 6 heterogeneous reactions (Shi et al. for reactions on liquid aerosols)
- **Photolysis rates:**
 - J values calculated at high spectral resolution from the TUV model (Madronich and Flocke, 1998). Stored in a 4-dimensional lookup table

2002

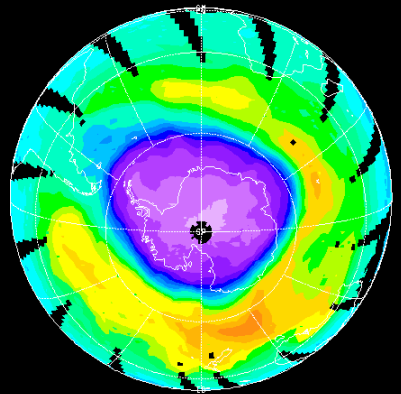
TOTAL OZONE (DU) 1 October 2002



Earth Probe/TOMS

2003

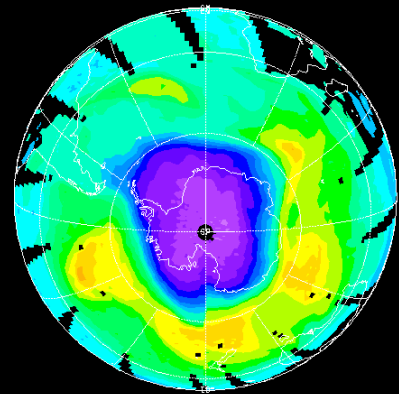
TOTAL OZONE (DU) 1 October 2003



Earth Probe/TOMS

2004

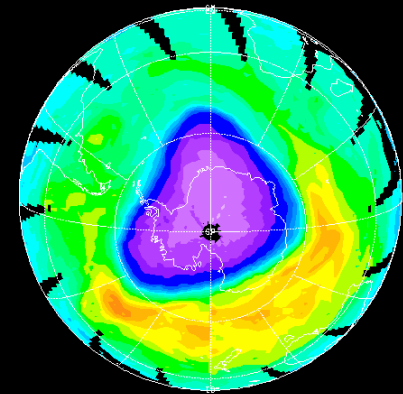
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Earth Probe/TOMS

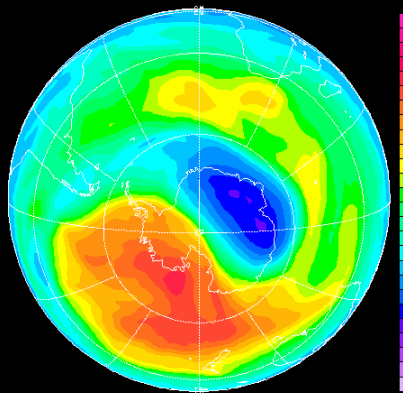
2005

TOTAL OZONE (DU) 1 October 2005



Earth Probe/TOMS

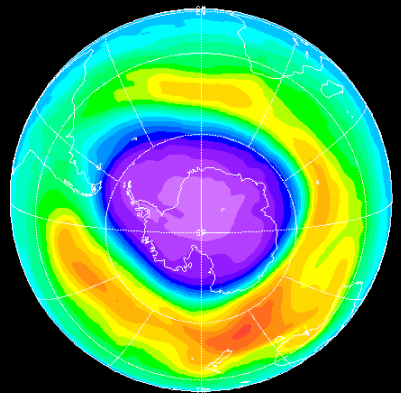
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Reprubus

Exp 001401

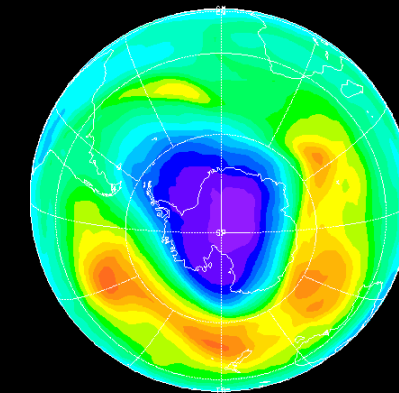
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Reprubus

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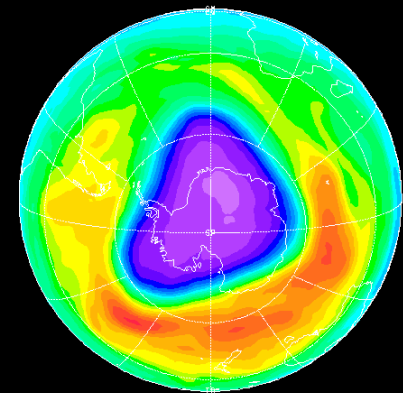
TOTAL OZONE (DU) 1 October 2004



Reprubus

Exp 001401

TOTAL OZONE (DU) 1 October 2005



Reprubus

Exp 001401

Near real time (D+1) Reprobus results available at: <http://ether.ipsl.jussieu.fr>

Ether: Accueil - Mozilla Firefox

http://ether.ipsl.jussieu.fr/etherTypo/index.php?id=60&L=0

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Accueil

Cartes de Champs atmosphériques issus du modèle Reprobus

Date : 14/05/2008, Cartes Hémisphère Sud

435K	O3	N2O	HCl	ClONO2	NOx	ClOx	NO2	HNO3	O3loss	BrOx	PSC
475K	O3	N2O	HCl	ClONO2	NOx	ClOx	NO2	HNO3	O3loss	BrOx	PSC
550K	O3	N2O	HCl	ClONO2	NOx	ClOx	NO2	HNO3	O3loss	BrOx	PSC

http://ether.ipsl.jussieu.fr - HNO3_2008051412_550K.png (Image PNG, 64K)

Fichier | Édition | Affichage | Historique | Marque-pages | Outils | Aide

Reprobus : HNO3 gas (ppbv) 14 May 2008 12UT

550 K

001407

Ether/Production

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14:56

Chemistry-Climate Model Validation Activity for SPARC (CCMVal)



goal = improve understanding of ChemistryClimate Models (CCMs) and their underlying GCMs (General Circulation Models) through process-oriented evaluation, along with discussion and coordinated analysis of science results.

MODEL	GROUP	PI
AMTRAC, CCSRNIES, CMAMMSC, E39C, GEOSCCM, LMDZrepro, MAECHAM4 CHEM, MRI, SOCOL, ULAQ, UMETRACUK, UMSLIMCAT, WACCM (v.3,)	GFDL USA NIES, Tokyo, Japan Univ. of Toronto + York Univ., Canada, DLR Oberpfaffen- hofen, Germany, NASA/GSFC, USA, IPSL, France, MPI Mainz, MPI Hamburg, Germany, MRI, Tsukuba, Japan, PMOD/WRC and ETHZ, Switzerland, University of L'Aquila, Italy, Met Office, UK, University of Leeds, UK, NCAR, USA,	J. Austin Akiyoshi, T.Nagashima Plummer, T. Shepherd M. Dameris, V. Eyring S. Pawson, R. Stolarski S. Bekki C. Brühl, M. GiorgettaE. Manzini .Shibata, M. Deushi E. Rozanov E. Mancini, G. Pitari N. Butchart M. Chipperfield, W. Tian R. Garcia, D. Kinnison

CCMVAL simulations

REF-B0 = time-slice experiment for 2000 conditions (over 20 annual cycles)

Goal: facilitate the comparison of model output against constituent datasets

(done, in validation phase)

REF-B1 (1960-2006) = transient run from 1960 to the present.

Goal: reproduce the well-observed period of the last 35 years during which ozone depletion is well recorded All forcings in this simulation are taken from observations (changes in trace gases, solar variability, volcanic eruptions, quasi-biennial oscillation, and SSTs/SICs).

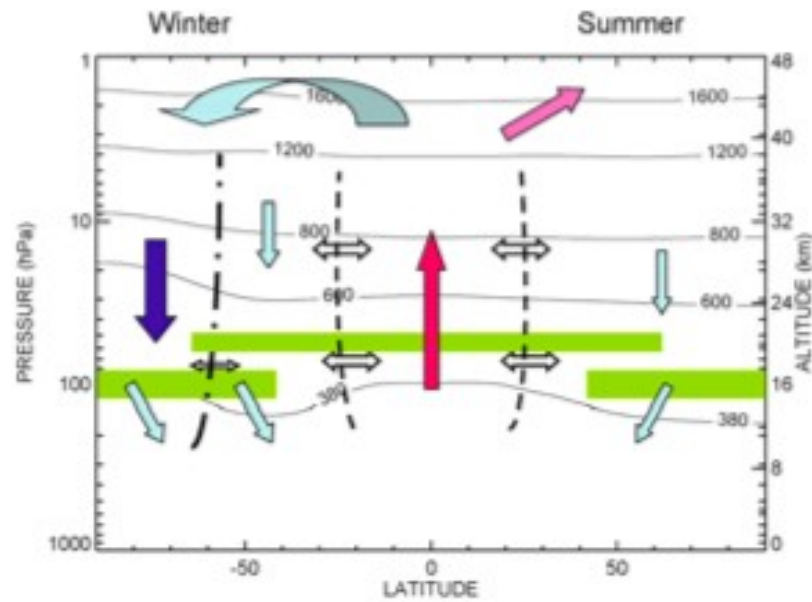
(done, in validation phase)

REF-B2 (1960-2100) = internally consistent simulation from the past into the future.

Goal: produce best estimates of the future ozone-climate change up to 2100 under specific assumptions about GHG increases (Scenario SRES A1B) and decreases in halogen emissions (adjusted Scenario A1) in this period.

(in progress)

Schematic of stratospheric transport

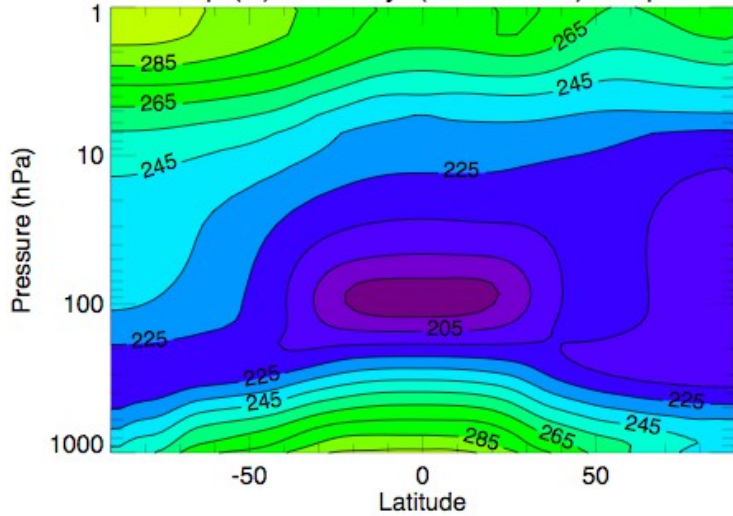


Zonal mean temperature

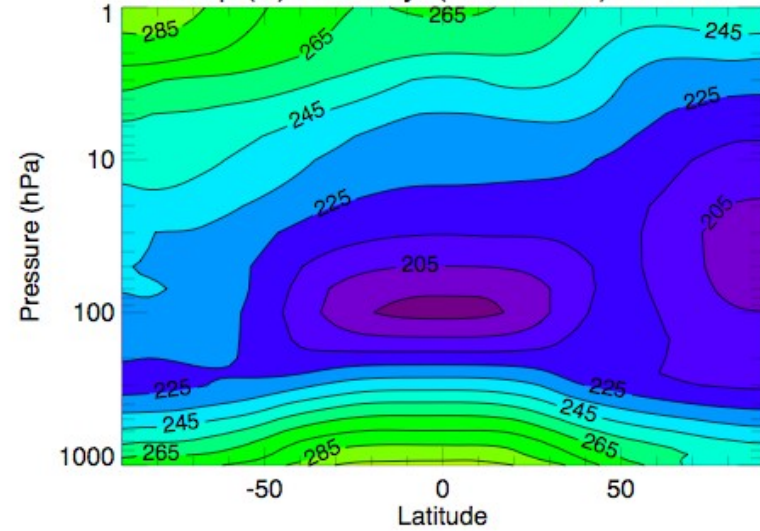
LMDZ-Repro

ERA40

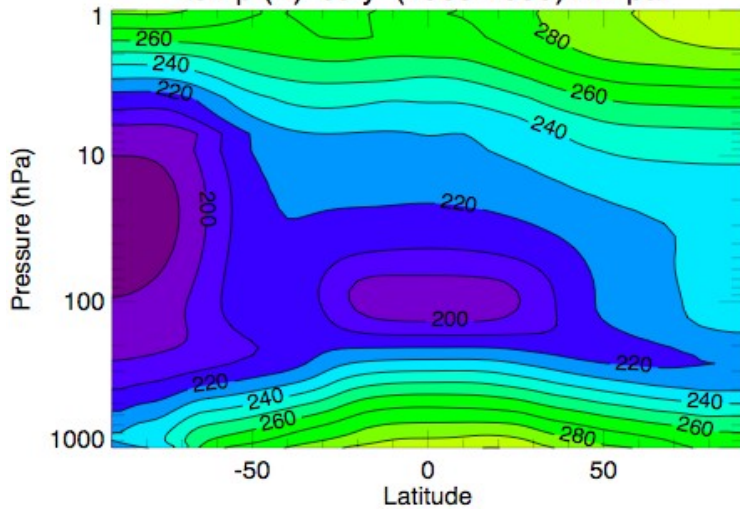
temp (K) January (1980-1999) KE-par



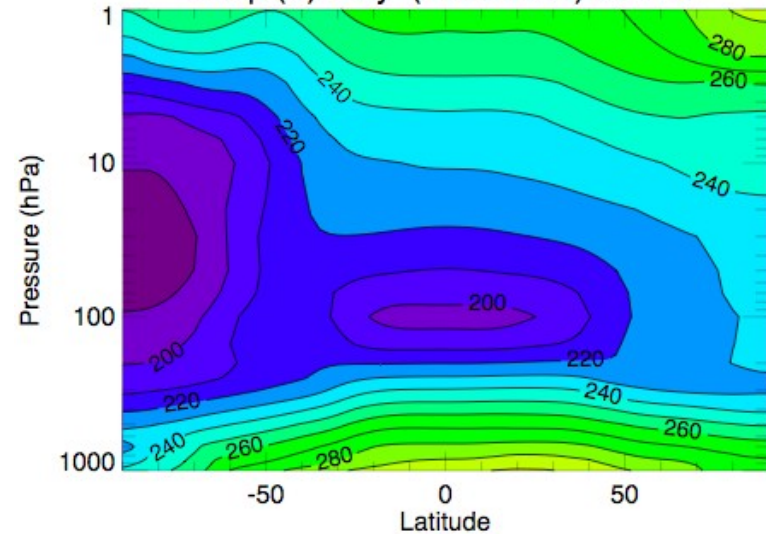
temp (K) January (1980-1999) ERA40



temp (K) July (1980-1999) KE-par

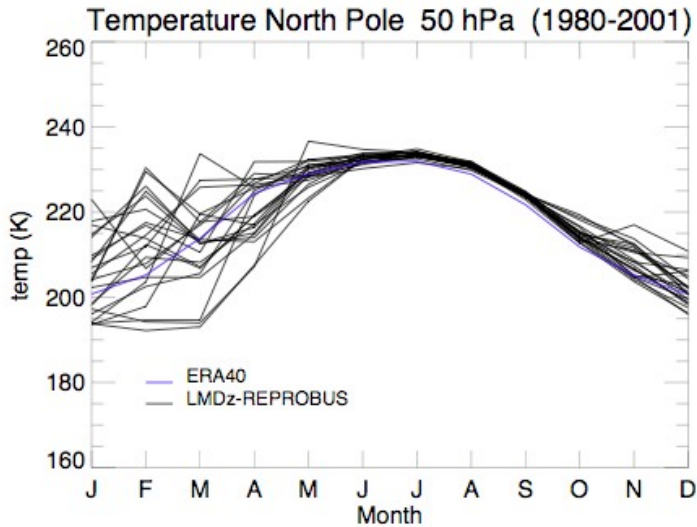


temp (K) July (1980-1999) ERA40

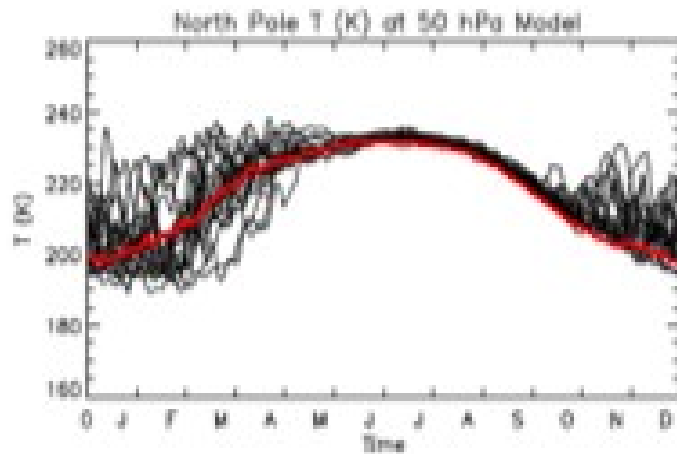
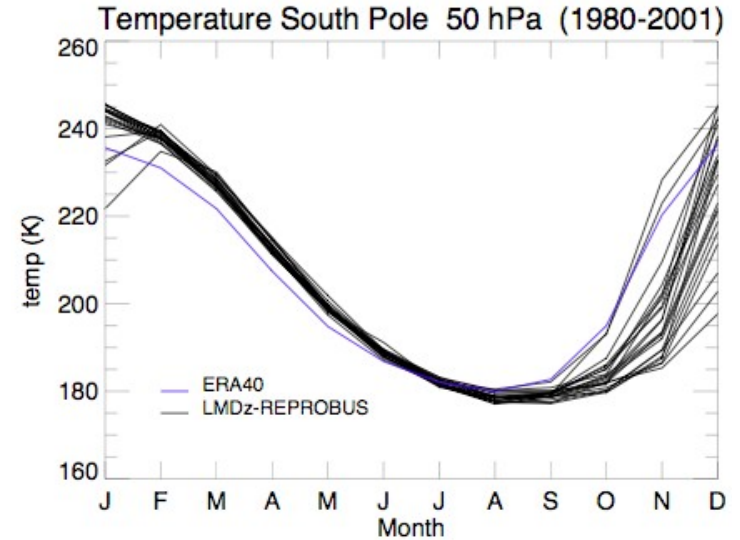


Seasonal cycle of polar temperatures at 50hPa

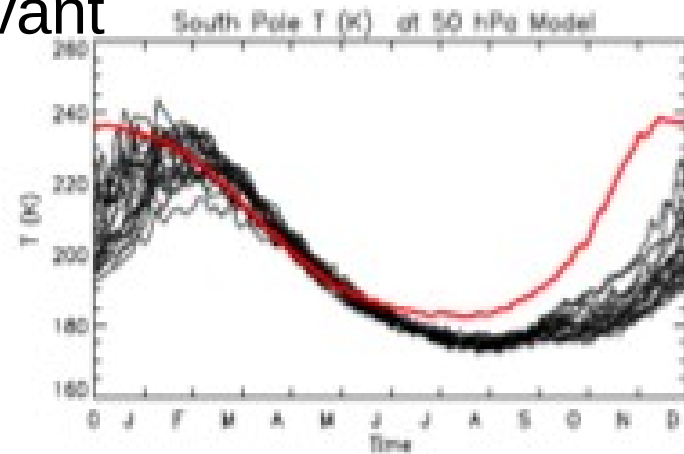
LMDz-Repro



----- ERA40



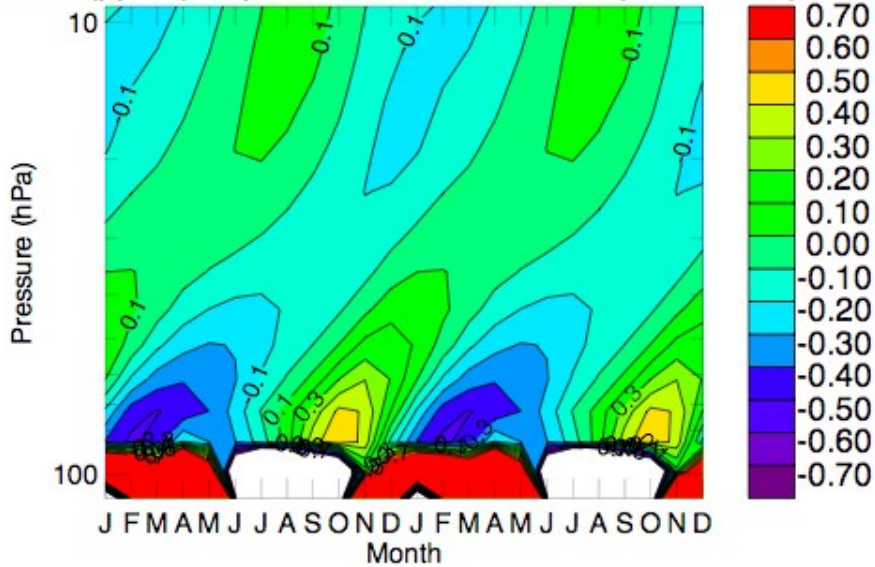
avant



H2O Tape recorder

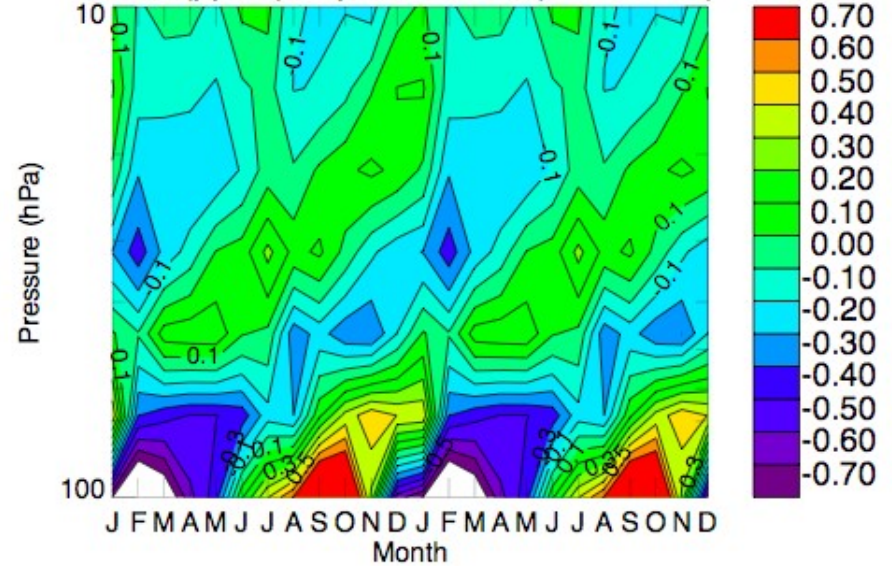
LMDz-Reprobus

H2O (ppmv) tropics LMDz-REPROBUS (1991-2002)



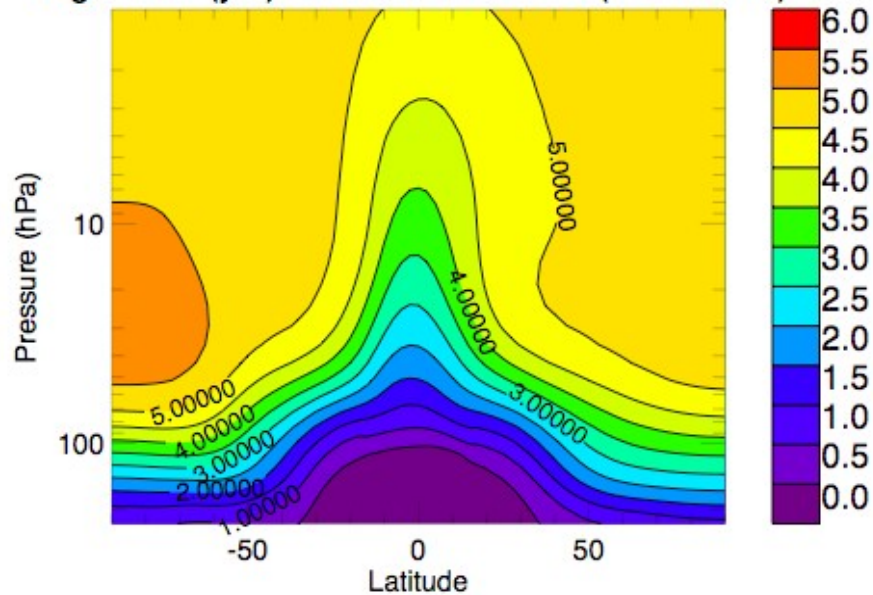
HALOE

H2O (ppmv) tropics HALOE (1991-2002)

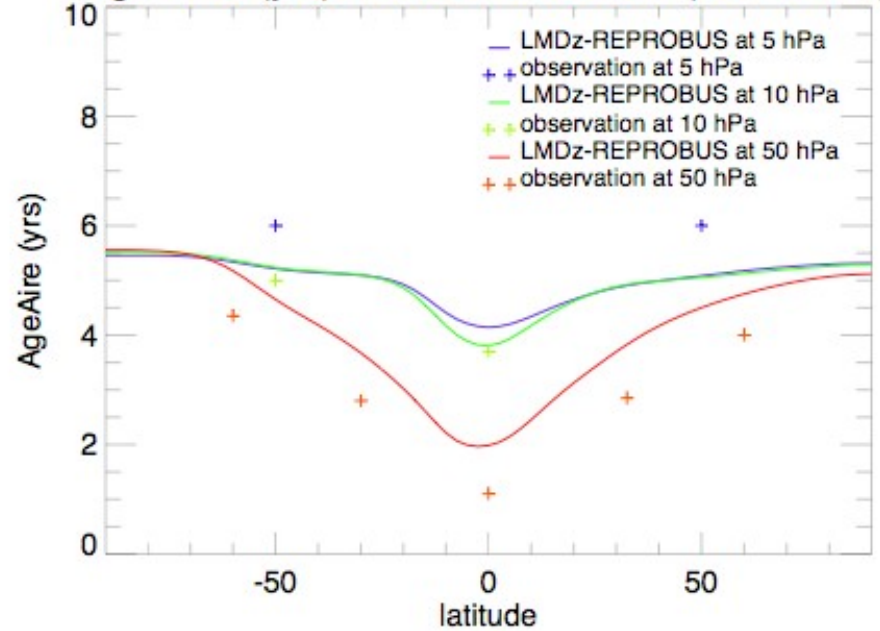


Latitudinal variation of the annual mean age of air

Age of air (yrs) LMDz-REPROBUS (1980-2001)

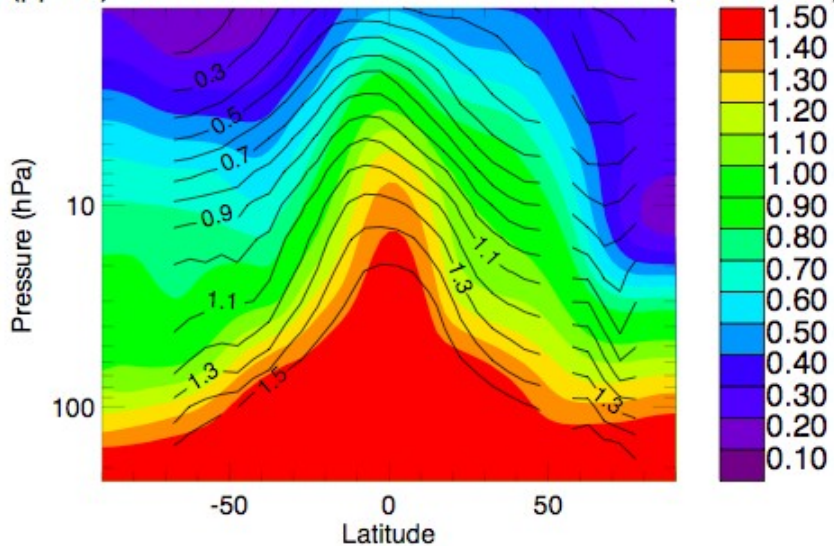


Age of air (yrs) LMDZ-REPROBUS (1980-2001)

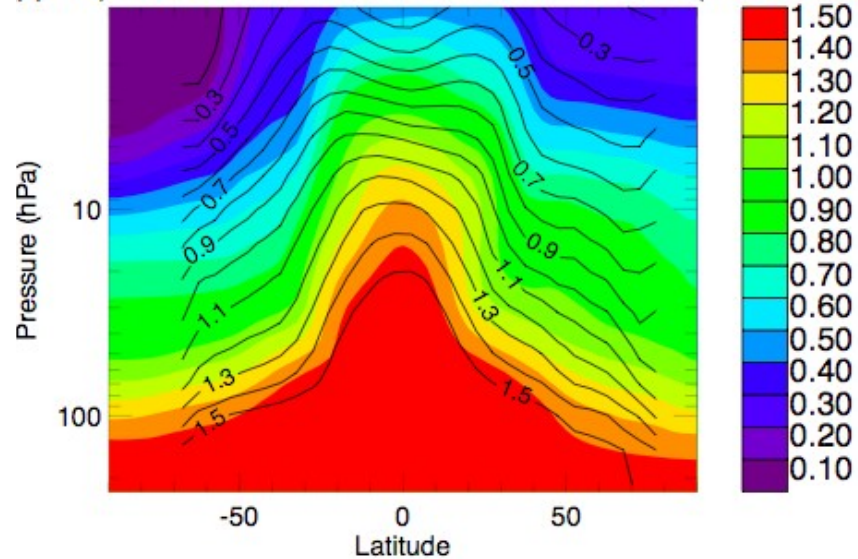


Climatological zonal mean CH₄ mixing ratios

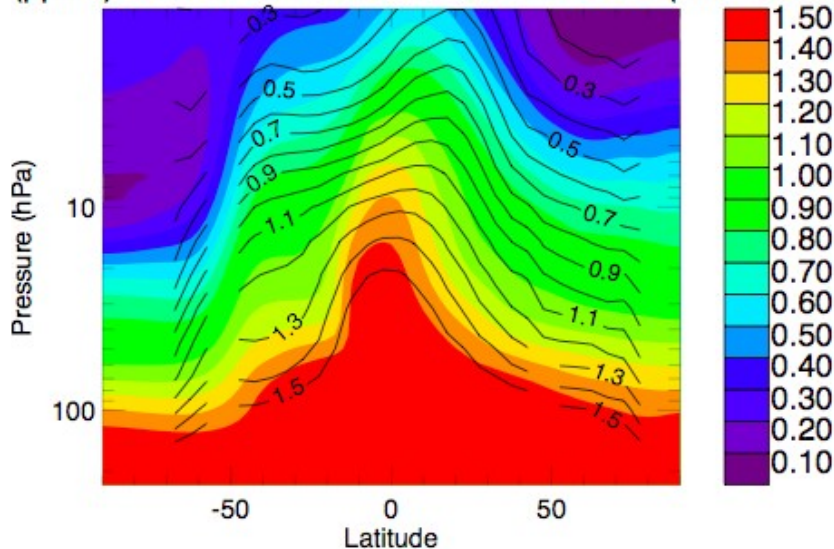
4 (ppmv) DJF LMDz-REPROBUS and HALOE (1991-2002)



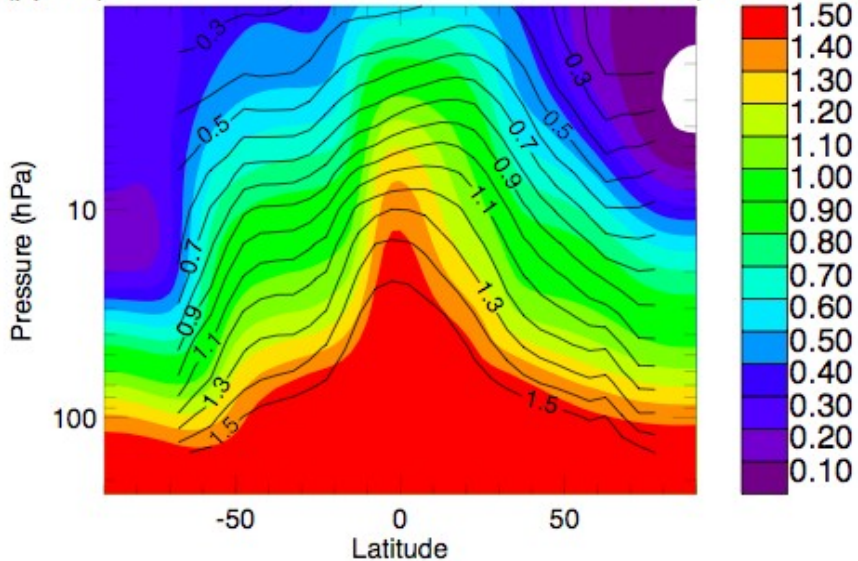
ppmv) MAM LMDz-REPROBUS and HALOE (1991-2002)



(ppmv) JJA LMDz-REPROBUS and HALOE (1991-2002)

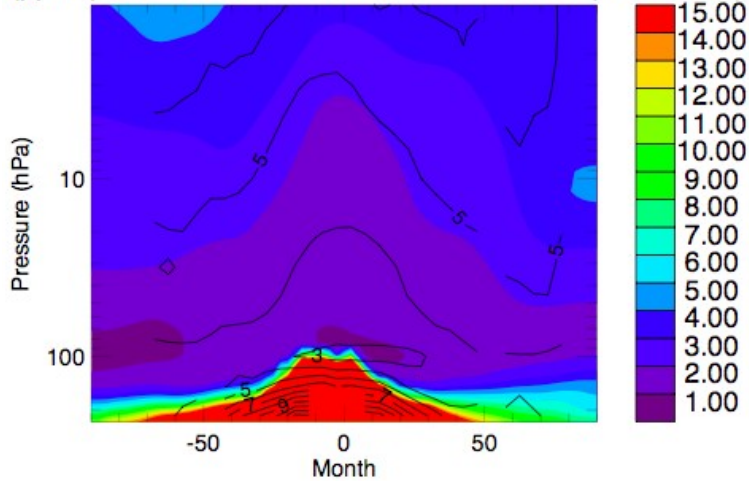


(ppmv) SON LMDz-REPROBUS and HALOE (1991-2002)

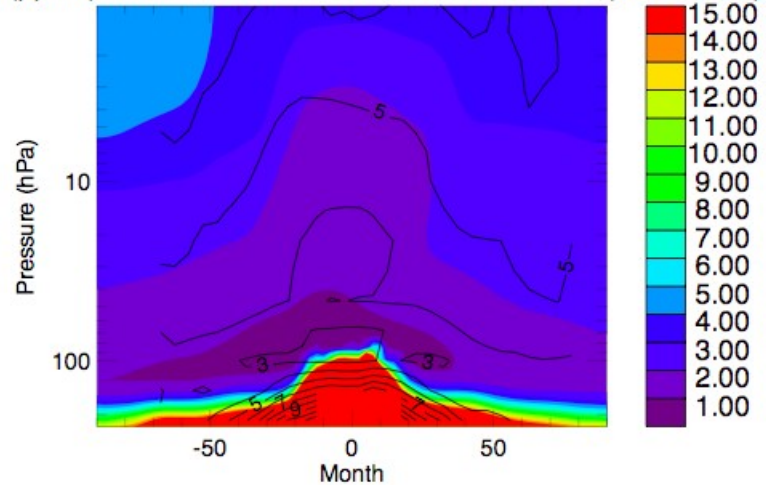


Climatological zonal mean H₂O mixing ratios

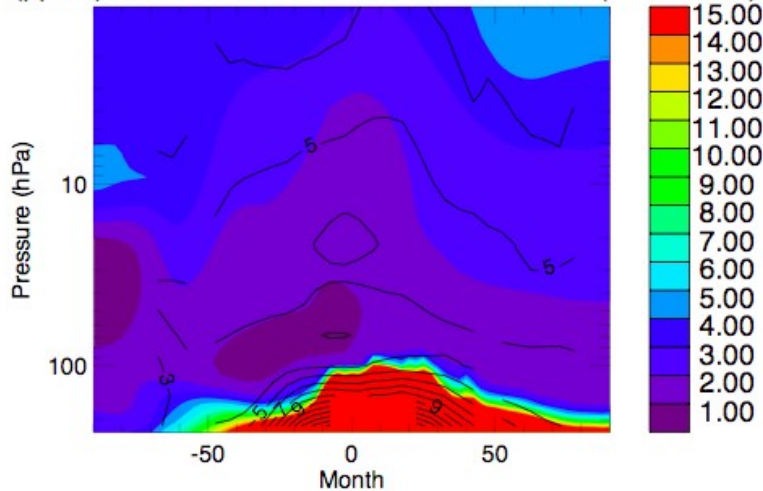
(ppmv) DJF LMDz-REPROBUS and HALOE (1991-2002)



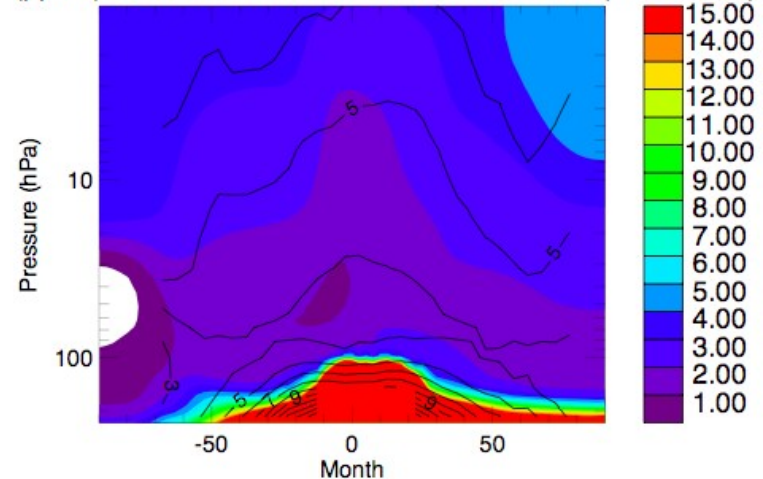
(ppmv) MAM LMDz-REPROBUS and HALOE (1991-2002)



(ppmv) JAJ LMDz-REPROBUS and HALOE (1991-2002)



(ppmv) SON LMDz-REPROBUS and HALOE (1991-2002)



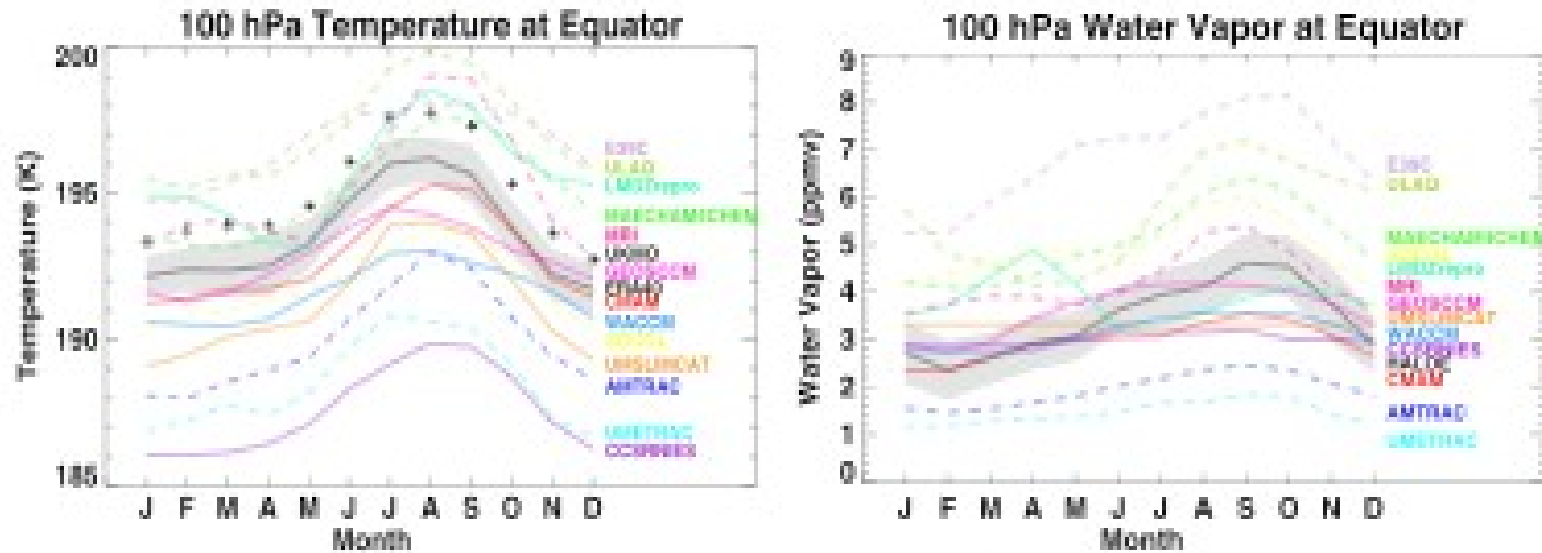


Figure 7. Seasonal variation of climatological means at 100 hPa at the equator for (left) temperature and (right) water vapor. Modeled fields for the 1990s are compared to the 1991–2002 HALOE water vapor climatology and the 1992–2001 temperature climatology from UKMO and ERA-40.

Seasonal variation of O₃ column (DU) zonal mean 1991-1999

