Ozone and CTM studies

Vincent-Henri.Peuch@meteo.fr
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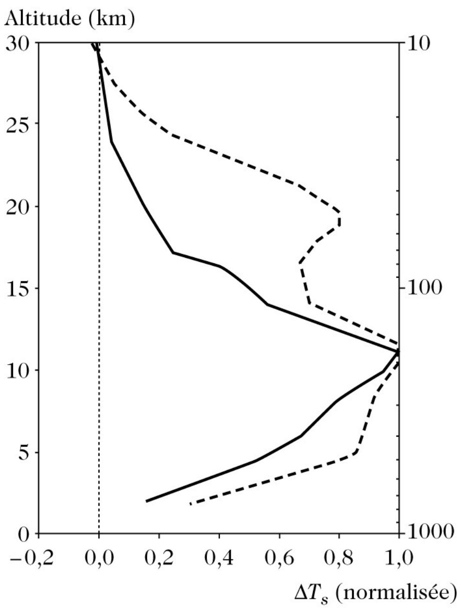
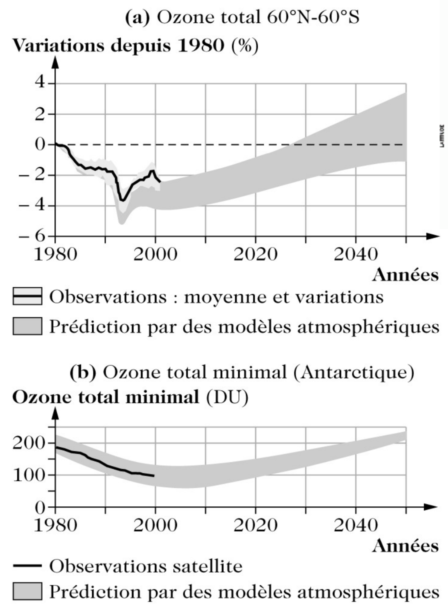
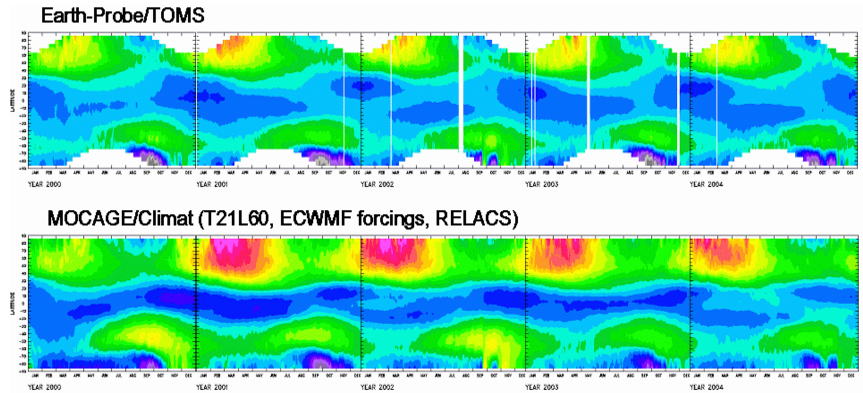
Stratospheric ozone research

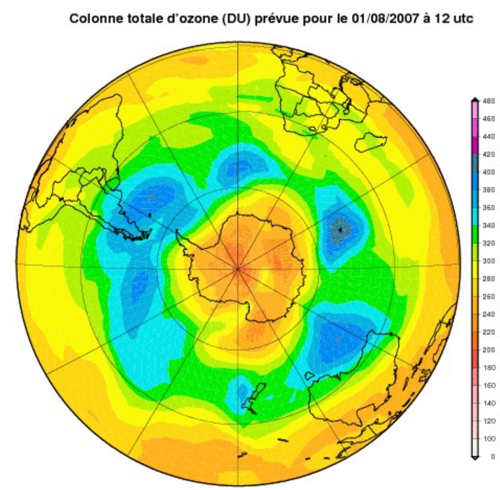


Ozone in the UTLS and ST/TS exchanges

Ozone layer recovery

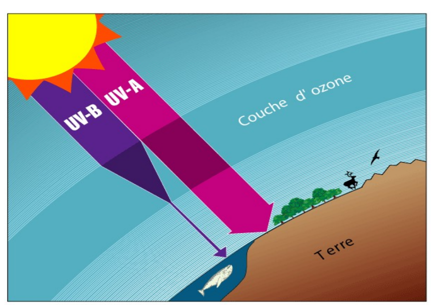




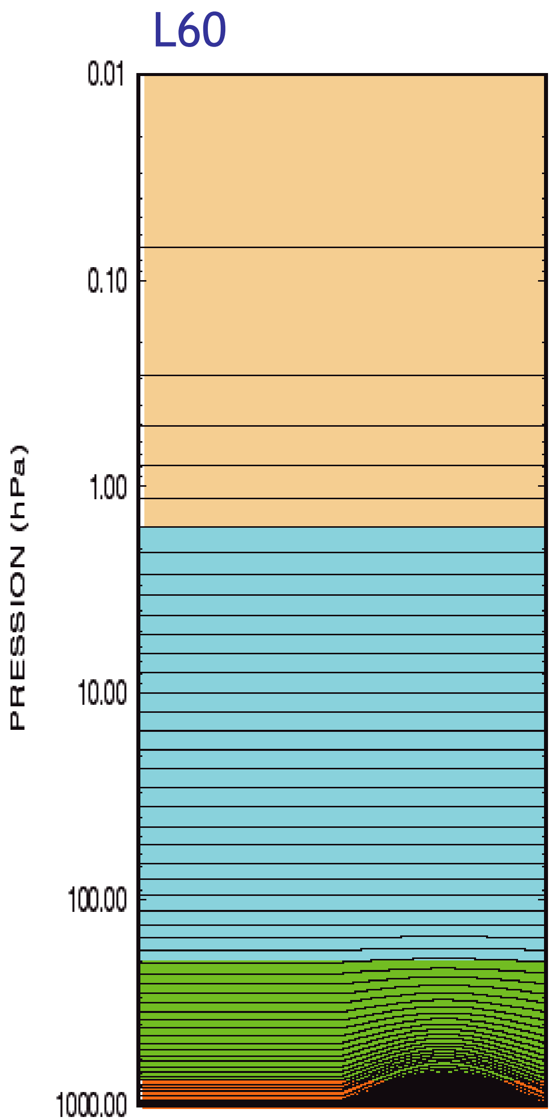


NRT chemical weather forecasts

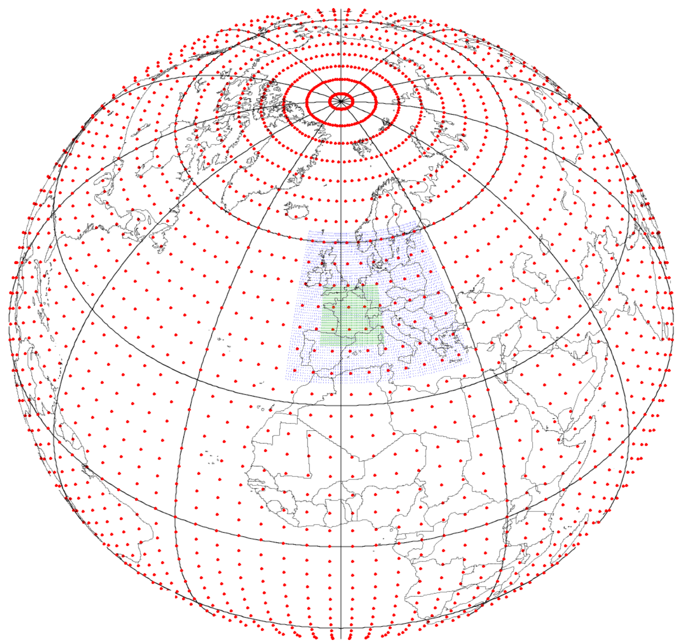
UV radiation



The Mocage Chemistry and Transport Model



Meteorological forcings from ARPEGE, IFS, ALADIN/AROME,… Coupling possible with ARPEGE-climat or IFS



Global grid with limited area zoom option

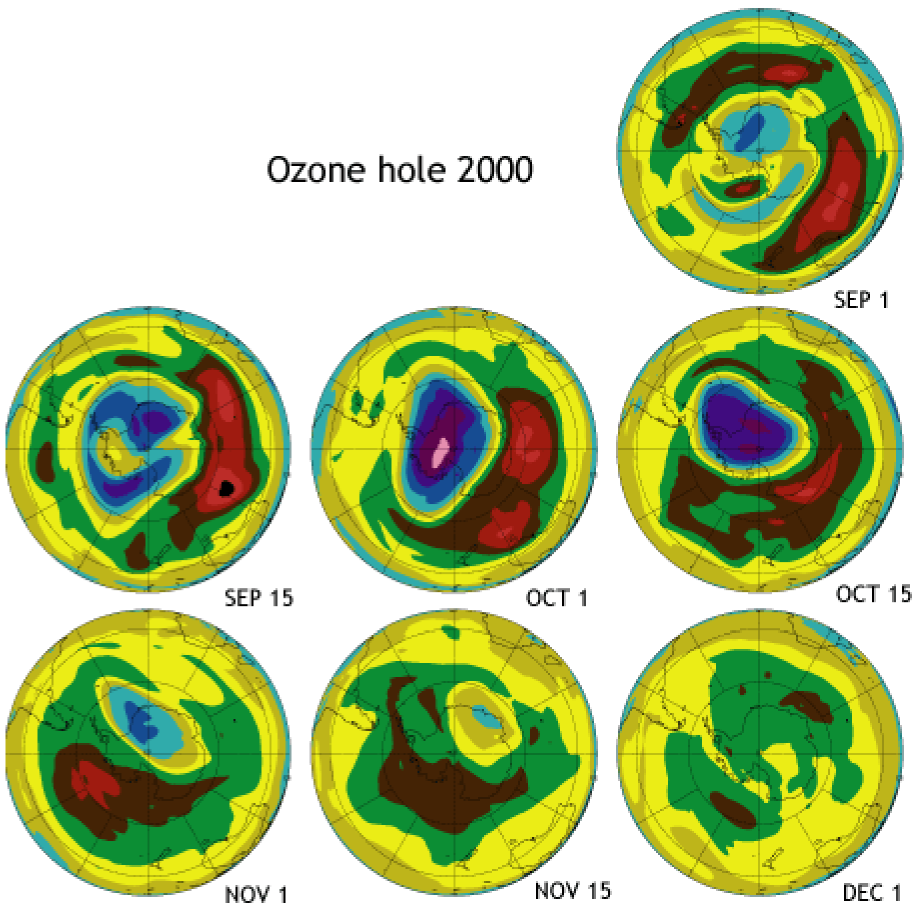
Linear stratospheric ozone chemistry

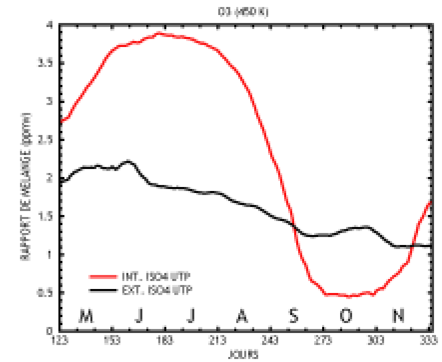
Detailed stratopheric chemistry (Reprobus/Rose)

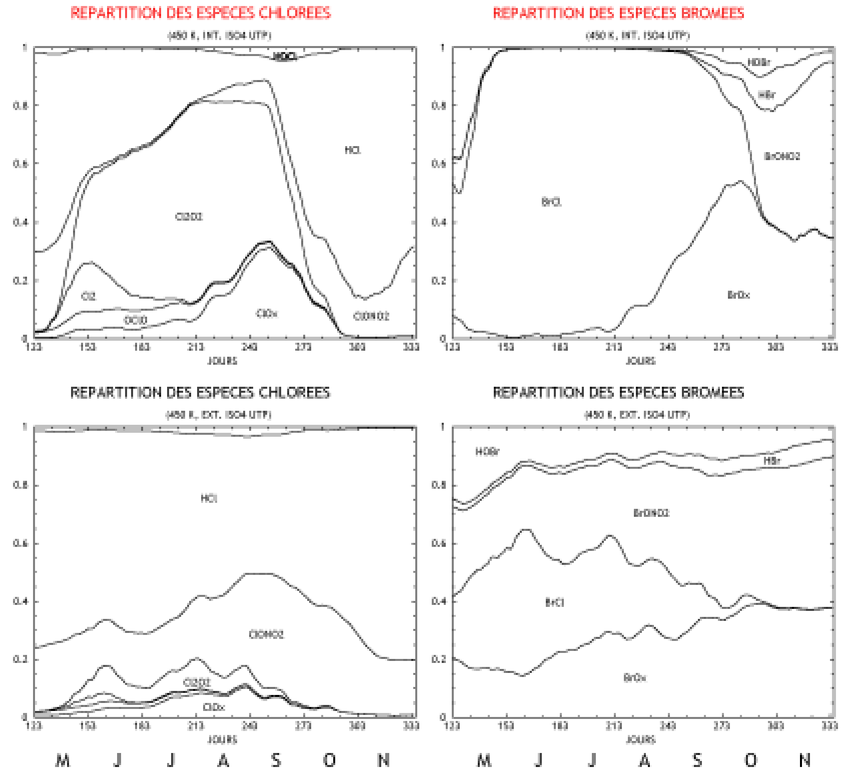
Tropo and stratospheric chemistry (RACM and aerosol components BC, SS, SULF, DUST)

Validation paper : [Teyssèdre et al., ACP, 2007]

Antarctic ozone modelling







Mocage : 2° global resolution, ARPEGE analyses, stratospheric chemistry only.

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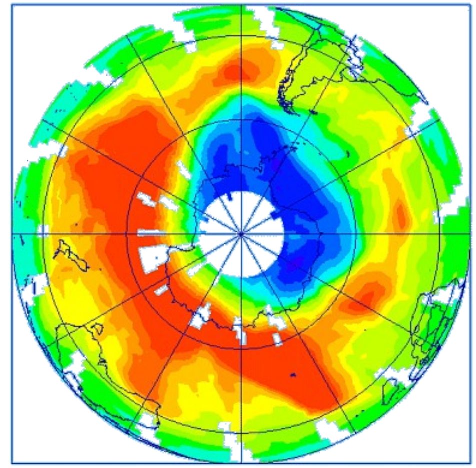
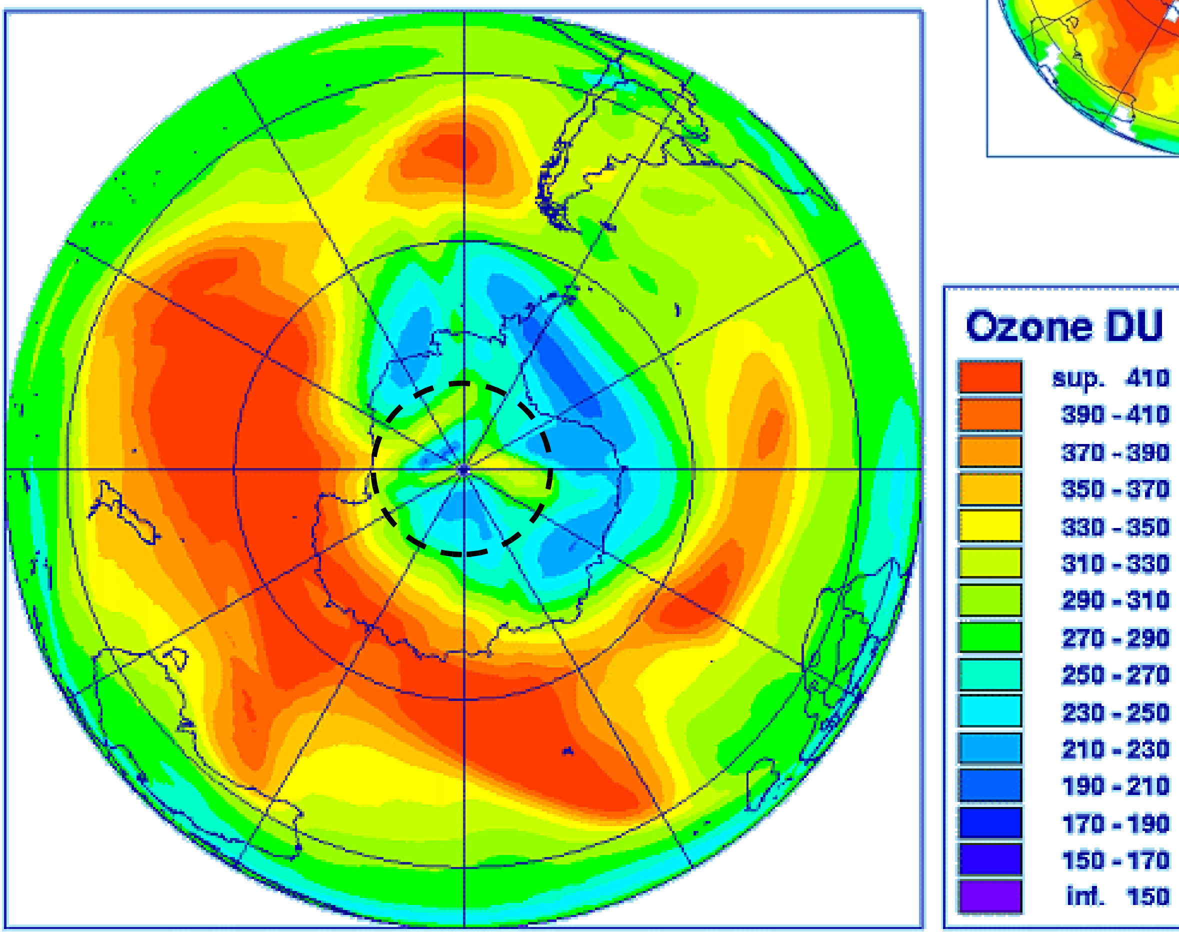
TOMS

pour le 15-09-2002 11 TU



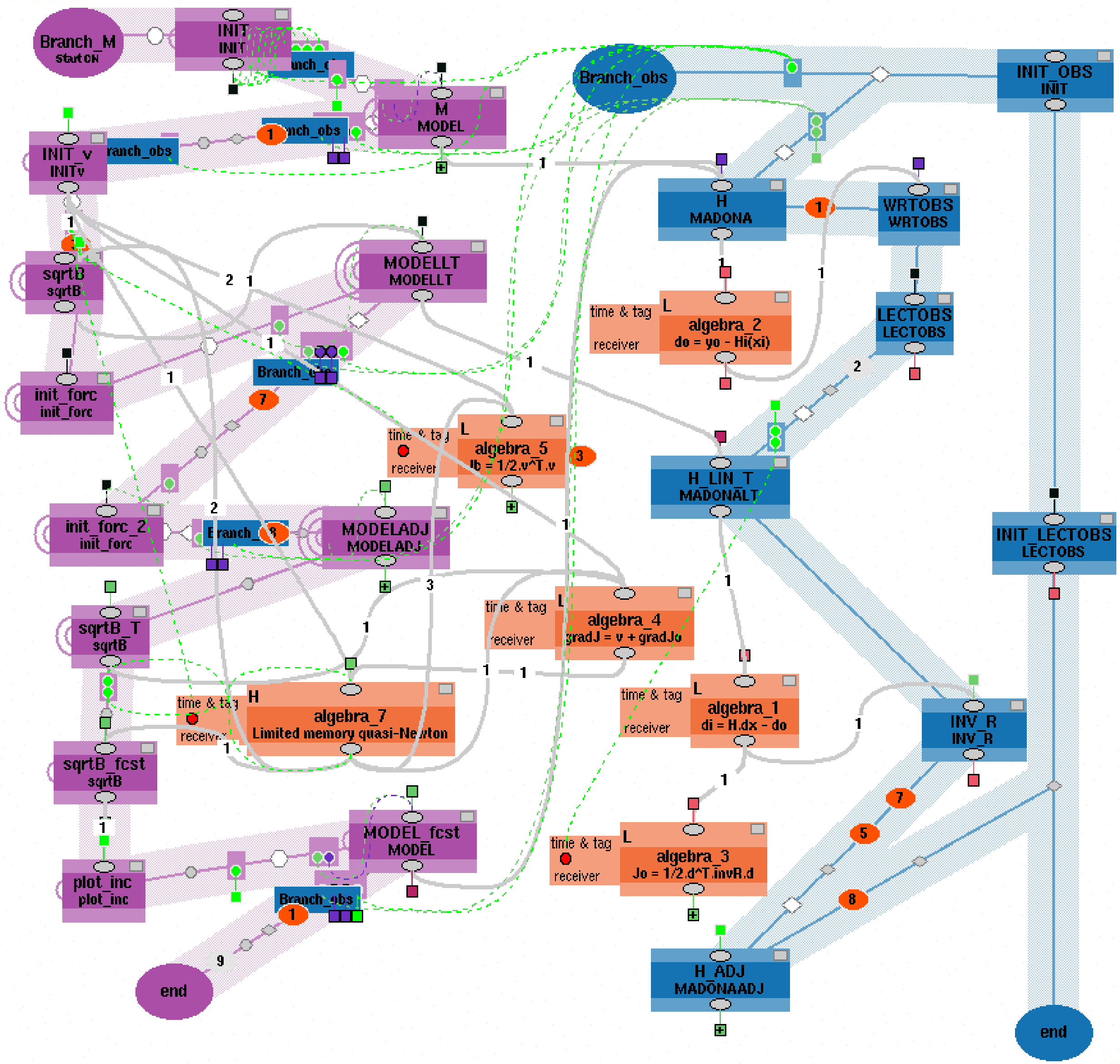
Ozone total (Sud)

pour le 15-09-2002 12 TU

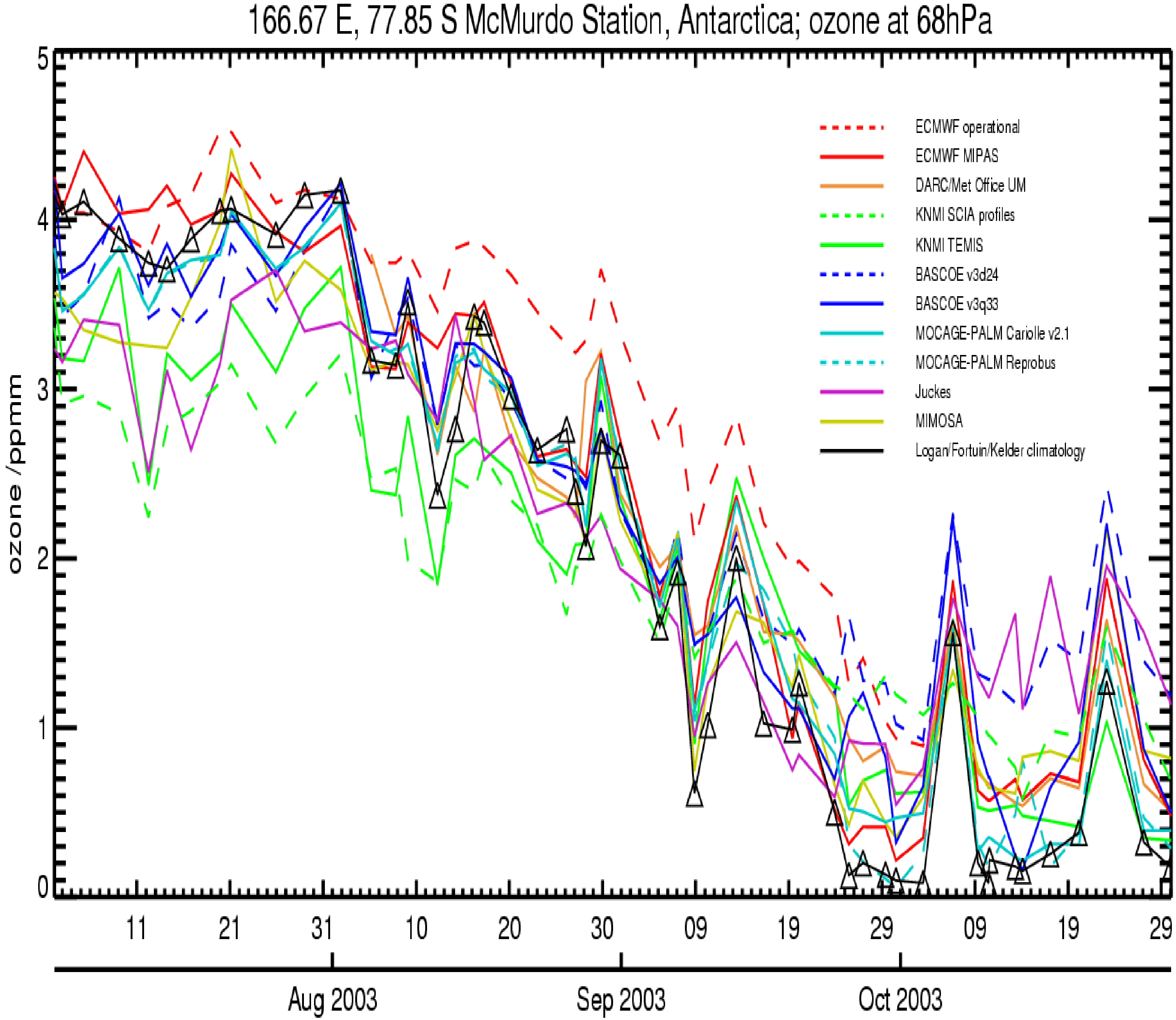


Typical CTM shortcommings are too low ozone columns in the polar low region and two high ozone in the vortex. Dynamics (+numerics) and chemistry involved.

The Mocage-Palm assimilation system



Mocage is interfaced with the PALM software of CERFACS. 3d-var, 3d-fgat and 4d-var can be used. L2 Satellite data (columns or profile, including averaging kernels) already assimilated : O_3, N_2O, CO, (NO_2)…



[Geer et al., ACP, 2006], [Lahoz et al., 2007]

DA : combine informations for better 4D fields

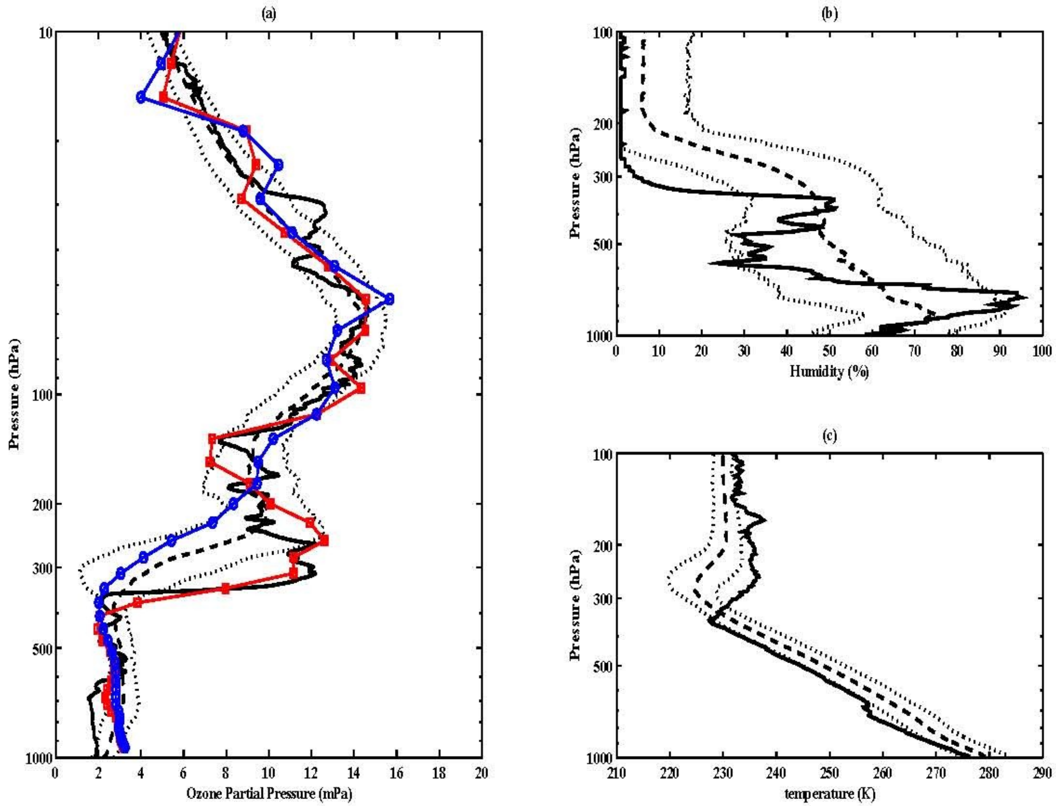


Figure 1. (a) Ozone partial pressure profile as function of pressure as obtained over Eureka (80.05°N, 86.43°W) on August 1, 2003 at 00H00 GMT, solid line (ozonesonde profile), red line with squares (profile from the MIPAS analysis), blue line with circles (profile from the raw model simulation), (b) Same as (a) but for humidity profile, and (c) Same as (a) but for temperature profile. Dashed lines correspond to the summer mean profile and dotted lines indicate 1σ standard deviation shifts of the summer climatology obtained by averaging together all profiles of June, July and August from 1996 to 2004.

Analyses (here example of MIPAS ozone) present features that are hardly captured by the model alone, specially in the UT/LS and areas of strong gradients.

[Semane et al., QJRMS, 133, 171-178, 2007]

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DA : chemistry vs dynamics studies

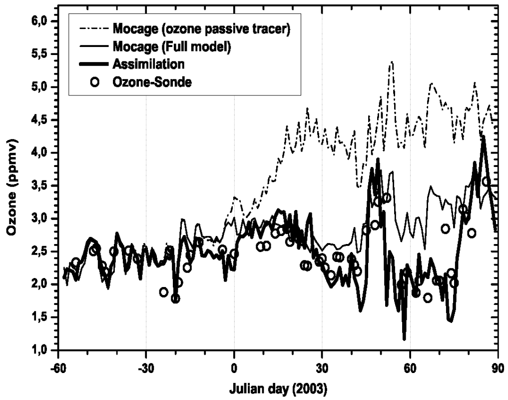


Figure 2. Ozone-sonde observations (open circles) at Ny–Alesund (79°N, 12°E) at the 57.2 hPa level compared to MOCAGE ozone passive tracer (dotted line) and the Odin/SMR ozone assimilated product (solid line).

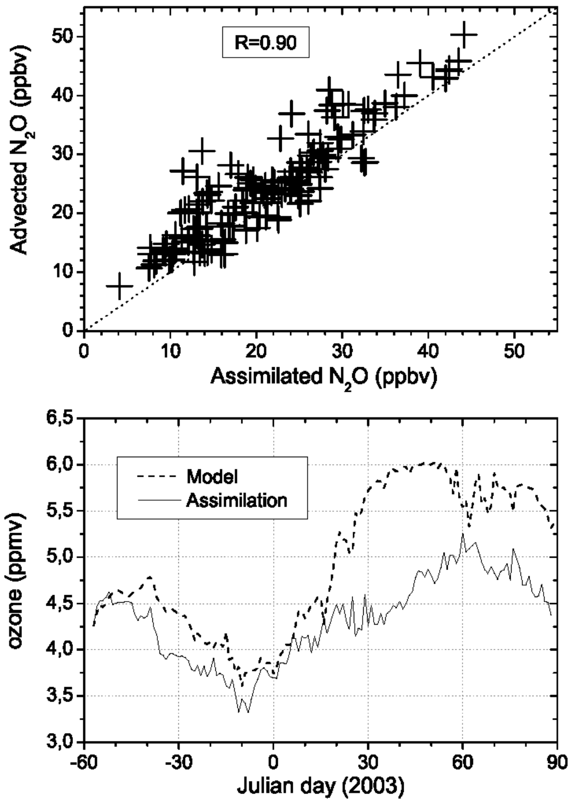


Figure 3. Top panel: correlation plot of the averaged values inside the vortex of modelled N_2O versus assimilated N_2O at 625 K potential temperature level. The linear regression slope is 0.90. Bottom panel: the time evolution of the averaged values inside the vortex of O_3 (modelled and assimilated) at 625 K potential temperature level. Note that, in this study, the model uses the linear ozone parametrization of Cariolle and Teyssèdre (2007) to estimate the O_3 evolution (see text for details).

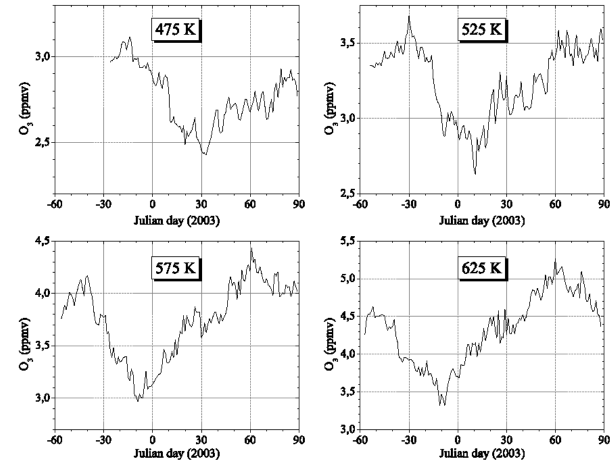
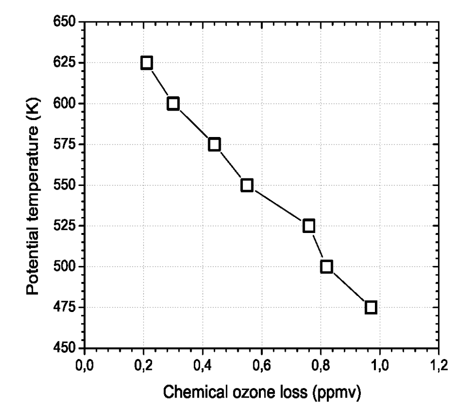


Figure 7. Time evolution of the assimilated ozone averaged inside the vortex for different potential temperature levels (475 K, 525 K, 575 K and 625 K) from November 2002 to March 2003. The vortex edge is determined by the maximum gradient of N_2O assimilated field on each potential temperature level.



Assimilation of SMR N2O and ozone (3d-fgat, 2°, linear ozone chemistry)

[El Amraoui et al., QJRMS, 2007, in press]

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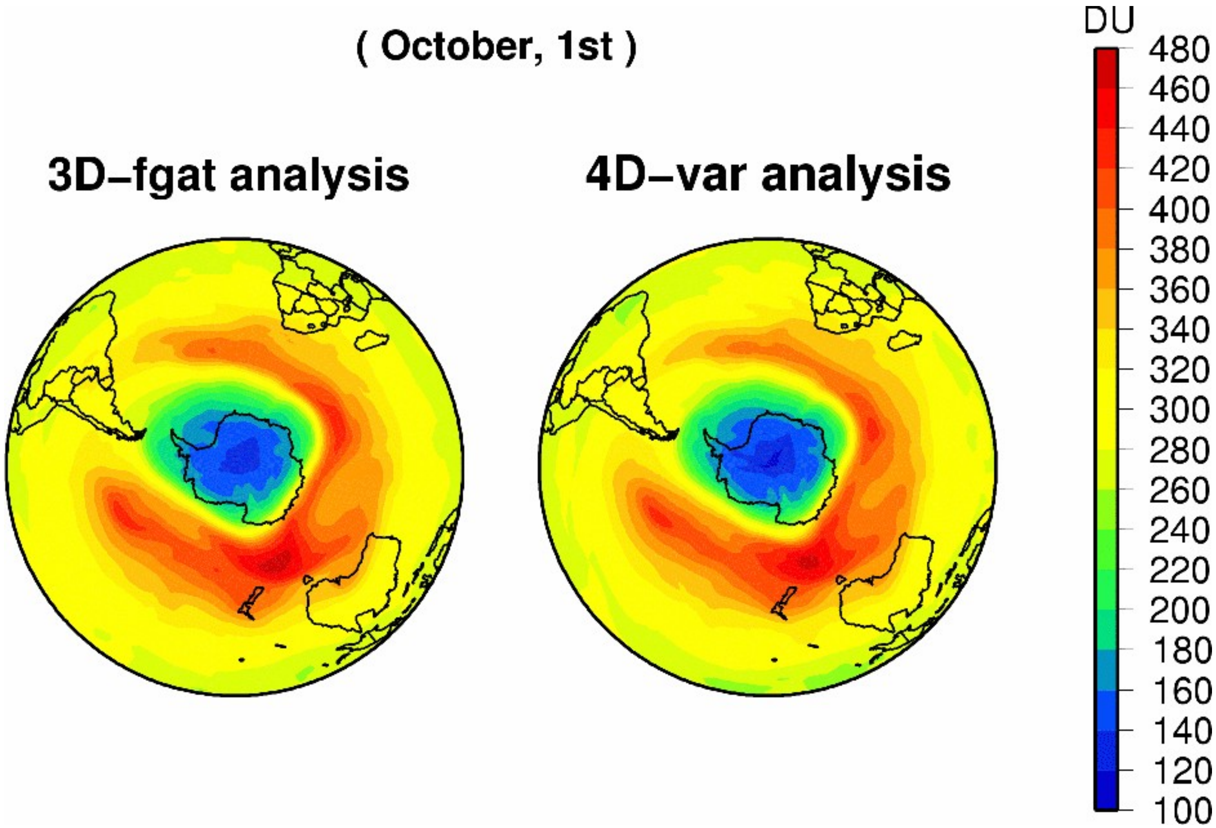
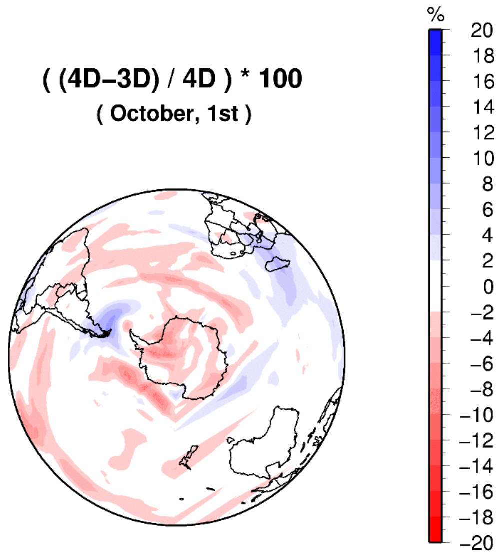
DA : validation issues





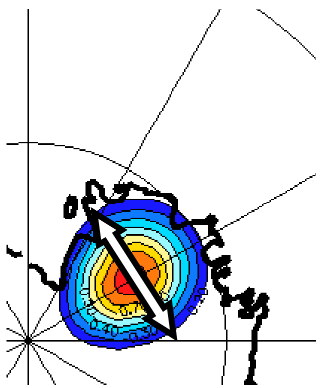
The quality of validated analyses (in the sense of Tallagrand's diagnostics) are generally difficult to assess due to limited independant « high-quality » data.

DA : Modelling of B matrix

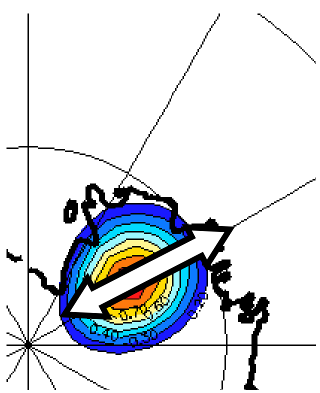
Zonal mean

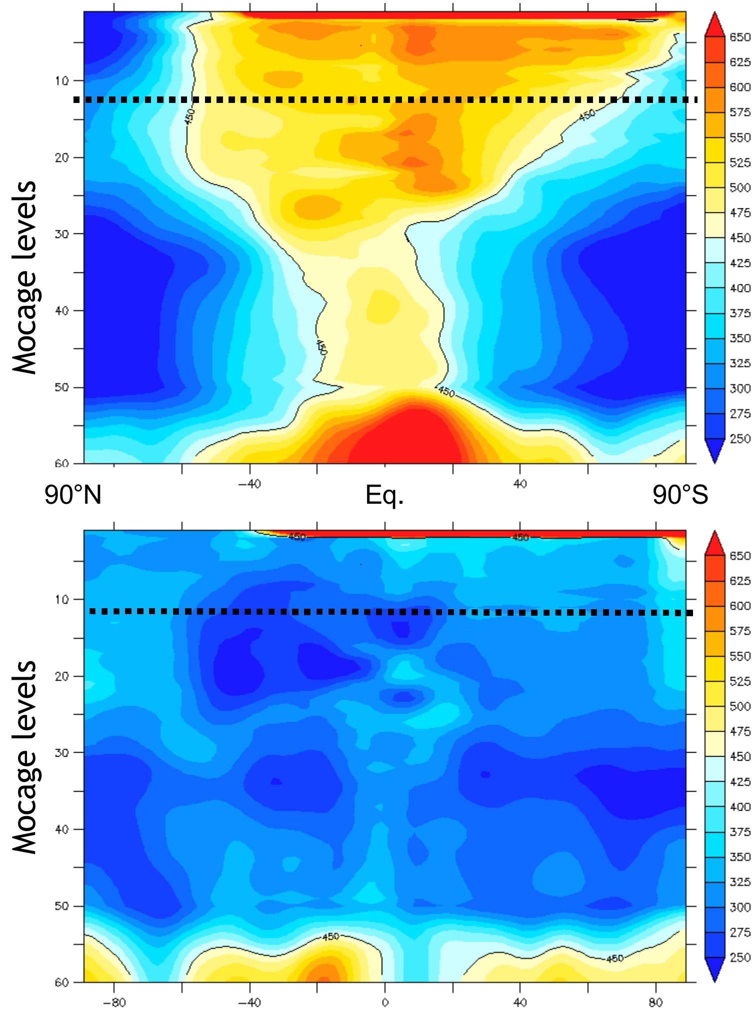
10 hPa

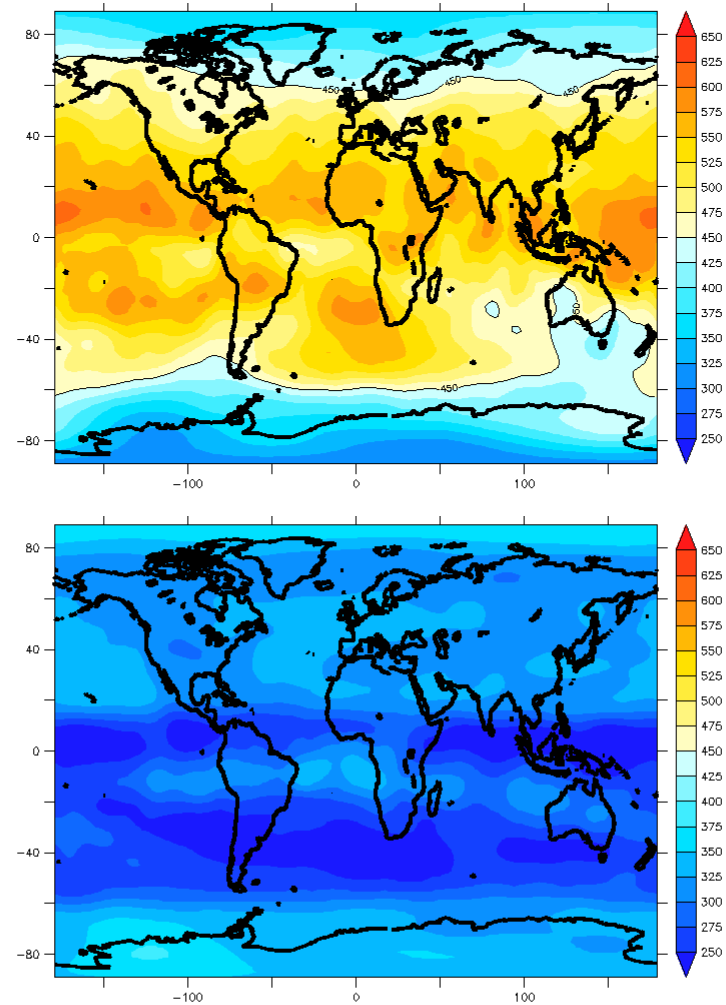
- Lx



- Ly







Massart & Pannekoucke : estimation of anistropic correlation length for July 2003 (800 realisations)

Concordiasi workprogram

- Mocage global 0.5° L60 configuration (+ higher resolution polar zoom, tbd). Linear chemistry to comprehensive S/T chemistry.
- PALM 3d-fgat / 4d-var
- CNRM-CERFACS NRT assimilation and short-term forecast (ARPEGE) : contribute to campaign support (diagnostics tbd).
- Use of campaign in-situ data for independant reference (later re-analysis?).
- Objectives : influence of chemical and dynamical processes on polar ozone chemistry, with modelling at higher horizontal/vertical resolutions ; evaluation of CTM in polar troposphere.
- Sensitivities :
  - Forcings from meteorological analyses (model, resolution,…)
  - Representation of chemistry
  - Assimilation method
  - IASI ozone analyses vs GOME2, MLS, OMI, SCIAMACHY + multi-sensor assimilation

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- N. Semane (PhD 2006-2008)
- PhD 2008-2010 (IASI chemical DA)
- Scientist 04/2008-09 (« IASI chemistry » project)

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