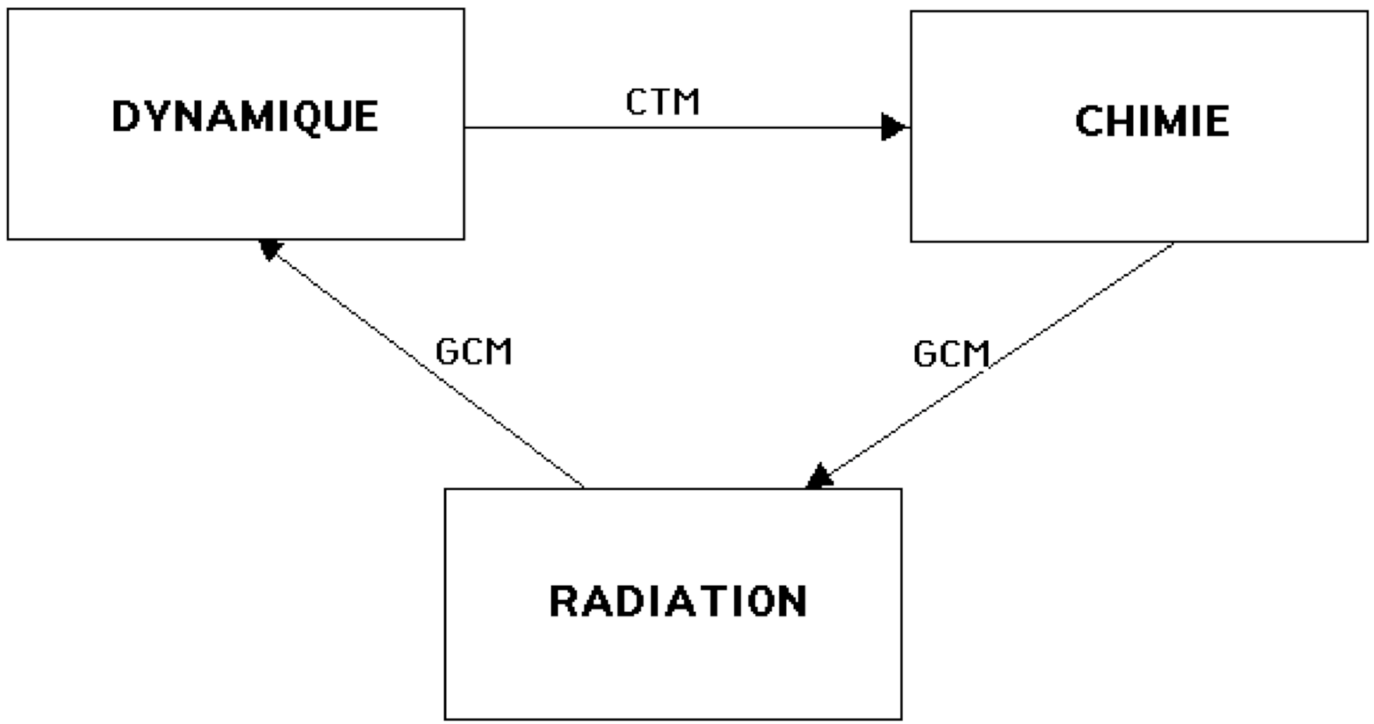
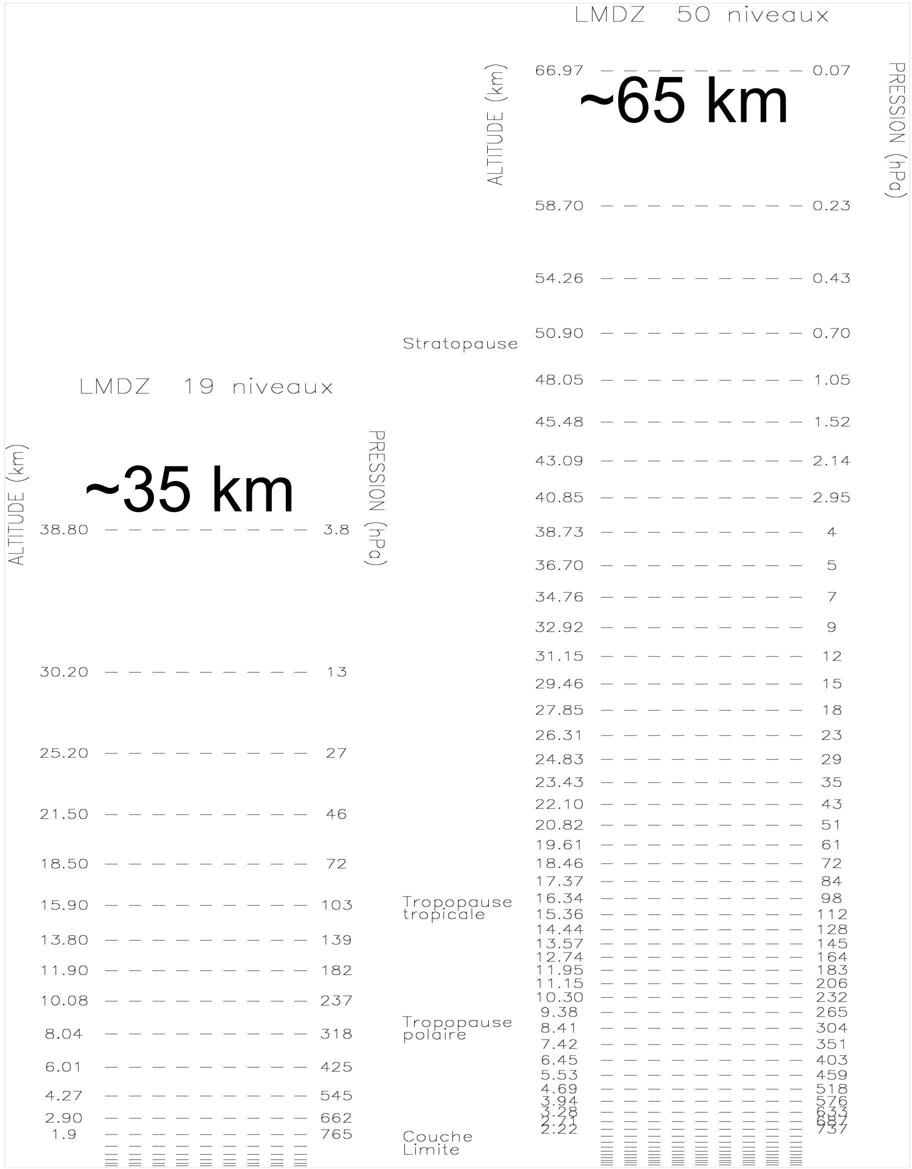
Couplage climat-chimie stratosphérique



CTM + GCM = CCM (modèles de chimie climat)

- -> IPSL: module de chimie dans GCM
- -> CNRM: couplage CTM-GCM

CCM IPSL: modèle étendu LMDz (F. Lott)
+ chimie REPROBUS (F. Lefevre)



Ajout :
Onde de gravite non orographiques (Hines et al., 1997) et (Manzini et al., 1997)
Couche d'amortissement des ondes dans les 4 derniers niveaux

Chemistry-Climate Model Validation Activity for SPARC (CCMVal – AC & C4)

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,
AMTRAC,	**GFDL, USA**
CCSRNIES,	**NIES, Tokyo, Japan**
CMAMMSC,	**Univ. of Toronto + York Univ., Canada**
E39C,	**DLR Oberpfaffen- hofen, Germany**
GEOSCCM,	**NASA/GSFC, USA**
LMDZrepro,	**IPSL, France**
MAECHAM4 CHEM,	**MPI Mainz, MPI Hamburg, Germany**
MRI,	**MRI, Tsukuba, Japan**
SOCOL,	**PMOD/WRC and ETHZ, Switzerland**
ULAQ,	**University of L'Aquila, Italy**
UMETRACUK,	**Met Office, UK**
UMSLIMCAT,	**University of Leeds, UK**
WACCM (v.3,)	**NCAR, USA**
ARPEGE-MOCAGE	**CNRM, France**

CCMVAL simulations:

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

Goal: **facilitate the comparison of model output against constituent datasets**

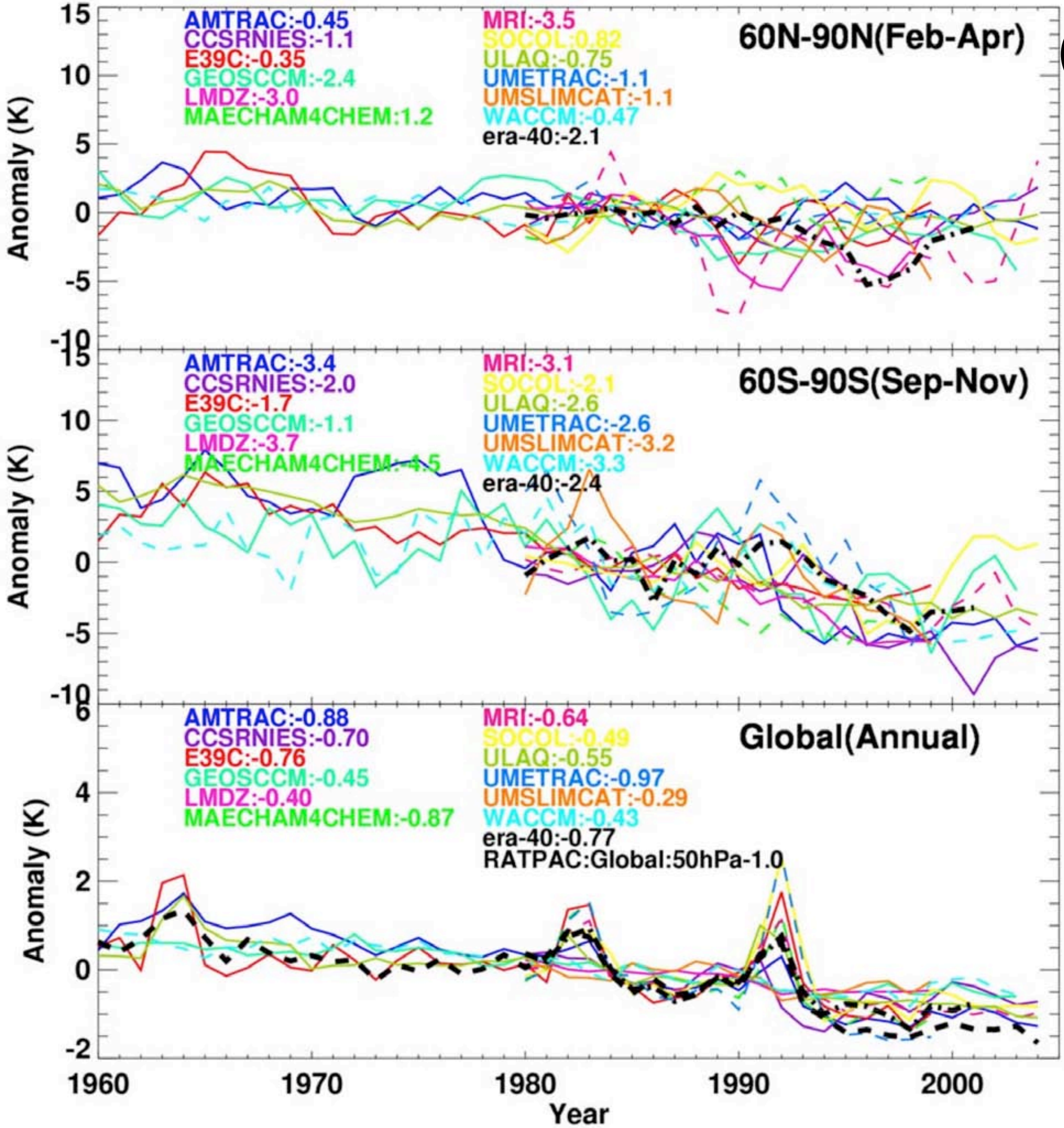
REF-B1 (1960-2006) = transient run from 1960 to the present.

Goal: **reproduce the well-observed period of the last 35 years during which ozone depletion is well recorded** (detailed investigation of the role of natural variability and other atmospheric changes important for ozone balance and trends). All forcings in this simulation are taken from observations. This transient simulation includes all anthropogenic and natural forcings based on changes in trace gases, solar variability, volcanic eruptions, quasi-biennial oscillation (QBO), and SSTs/SICs.

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. REF-B2 only includes anthropogenic forcings. External natural forcings such as solar variability and volcanic eruptions are not considered,

T anomaly at 50 mb (CCMVal1)



<u>Validation</u>:
Dynamique,
Radiation,
Chimie

Impact of ozone hole on SH high latitude surface climate

Depends on alt. of the model top

- **Model forced by ozone depletion**

Observed (1979-2000) December-May trends

Trends in 500hPa Geopotential Height

Observations and model reveal falling geopotential heights poleward of 60°S and rising geopotential heights in the middle latitudes

Trends in Surface Temperature

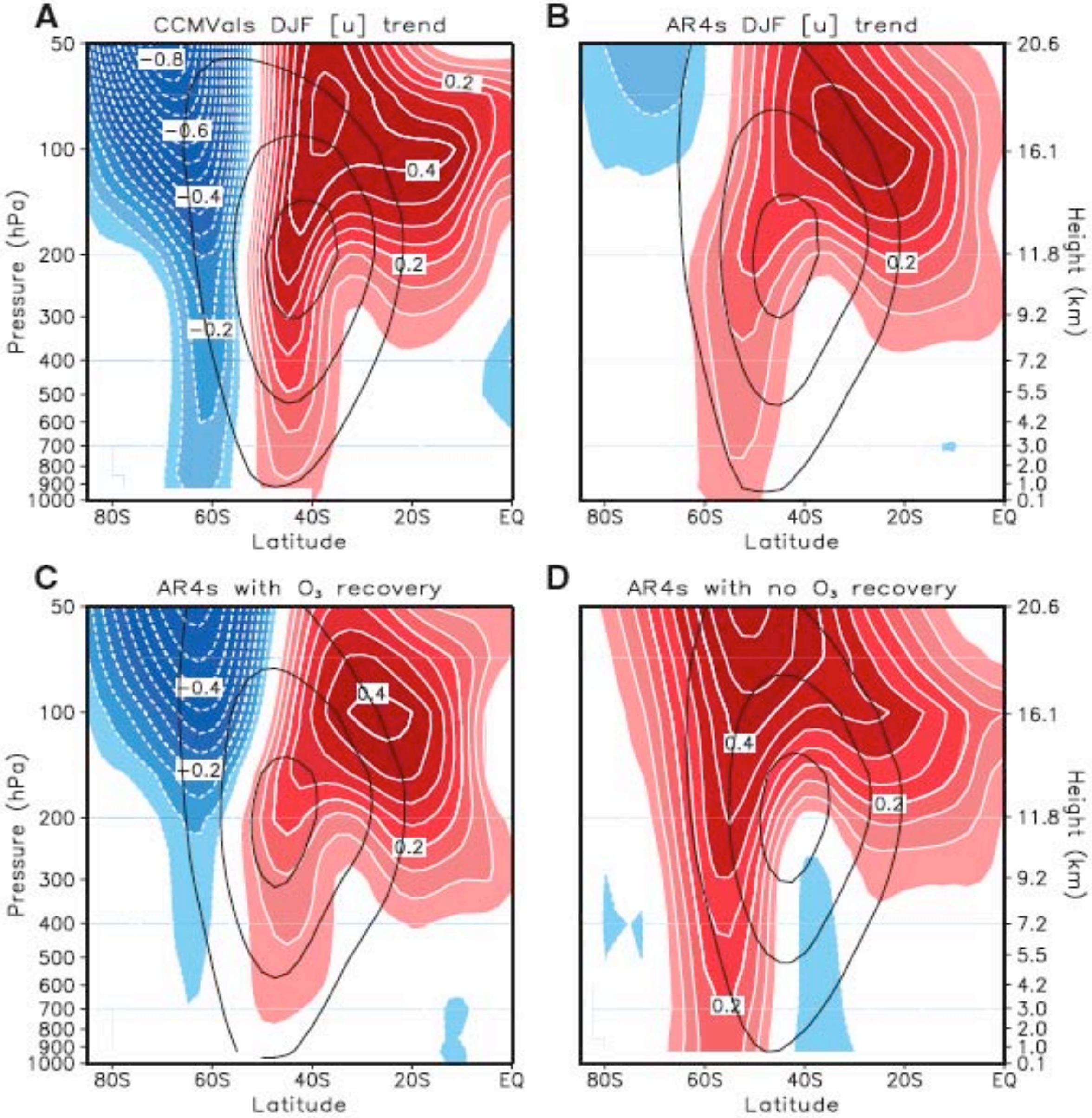
This trend during summer months is accompanied by a significant surface cooling over most of Antarctica; warming over Antarctic Peninsula & Patagonia

Gillett & Thompson, Science, 2003 (Eyring's tak)

=> Acceleration of the tropospheric westerly wind in SH poleward of the surface wind maximum.

Comparison CCMs with AR4 models: tropospheric jets

2000-2050 trend in Zonal Wind



Owing to the disappearance of the ozone hole in the first half of the 21st century:

- Deceleration poleward side of jet found in multi-CCM mean.
- Opposite response in mean of IPCC AR4 simulations.
- Importance of ozone can be seen by comparing AR4 models with & without ozone recovery.
- Weaker response in AR4 models with O_3 recovery.

Son et al., Science, 2008
see also Perlwitz et al., GRL, 2008
from Eyring's talk

Questions en suspens

Pour AR5, configuration du modèle est figé mais

° Ozone = f(modèle, scénario?) -> capacité oxydante (CH_4,..)

° Dans le future, nombre de niveaux? sommet du modèle?

° Océan? Schéma radiatif?