成層圏化学過程の進捗状況

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関連プロジェクトとの連携

- CCM validation activity for SPARC
  （永島、秋吉@環境研）
- TransCom continuous data Experiment
  （Patra, 石島@大気組成）

CCMVal

http://www.pa.op.dlr.de/CCMVal/index.html

CCM Validation Activity for SPARC (CCMVal)

Scope:

GRIPS has been the focus of SPARC's climate model assessment, having performed formal assessments of the dynamical-radiative state of the models. Annual workshops have served as the focus for presenting progress in the formal projects, as well as for presenting new results as models have been developed. An important component of the workshops has been to discuss progress in coupled chemistry-climate models, even though no formal assessment has been conducted. As more climate models have evolved to include mature chemical components, the time has arrived for formal comparisons of these coupled chemistry-climate models (CCMs). The approach to be taken will allow the strong working relationships that have developed within GRIPS to continue, but to expand and reformulate the model assessment activities to include chemistry. A final GRIPS workshop will be held in March 2005. A new SPARC model validation activity will be established, based on experiences within GRIPS (Pawson et al., 2000) and on the concept that was developed in a SPARC workshop on process-oriented CCM validation, held in Grainau, Germany in November 2003. Within SPARC, this new activity will be one of the supporting "pillars" of the integrated themes, just as GRIPS has been.

The goal of the new activity is to improve understanding of CCMs including their underlying GCMs (General Circulation Models) through process-oriented validation, which will lead to improvements in the representation of processes. This will involve confronting the CCMs with (robust) relationships between variables found in observations. At the Grainau workshop, a table of key diagnostics was defined in the four areas of radiation, dynamics, transport, and chemistry and microphysics. The plan is that with the table defined, modelers will decide (based on their own priorities and resources) which diagnostics to examine in any particular application. In order to kick-start the comparison, papers in all four thematic areas are planned within the coming year, in order to be available for citation by the upcoming UNEP/WMO and IPCC assessments. The radiation comparison was already underway within GRIPS, and for dynamics the comparison can include an update of some of the diagnostics in Pawson et al. (2000) and Austin

TABLE 1. Main features of current CCMs. CCMs are listed alphabetically. The horizontal resolution is given in either degrees latitude x degrees longitude (grid point models), or as T21, T30, etc., which are the resolutions in spectral models corresponding to triangular truncation of the spectral domain with 21, 30, etc., wavenumbers, respectively. All CCMs have a comprehensive range of chemical reactions except that in the UMUCAM model the chemistry is parameterized. The coupling between chemistry and dynamics is represented in all models, but to a different degree. All models include O-GWD schemes, most models additionally include NonO-GWD.

Model	Horizontal resolution	No. vertical levels/upper boundary	Coupling chemistry/dynamics	GWD	Group and location	Reference
AMTRAC	2° x 2.5°	48/0.0017 hPa	O_3, H_2O	O-GWD + NonO-GWD	GFDL, USA	Anderson et al. (2004), Austin (2002)
CCSR/NIES	T21	30/0.06 hPa	O_3, H_2O, CH_4, N_2O, CFCs	O-GWD + NonO-GWD	NIES, Tsukuba, Japan	Nagashima et al. (2002), Takigawa et al. (1999)
CMAM	T32 or T47	65/0.0006 hPa	O_3, H_2O	O-GWD + NonO-GWD	MSC, University of Toronto, and York University, Canada	Beagley et al. (1997), de Grandpré et al. (2000)
E39/C	T30	39/10 hPa	O_3, H_2O, CH_4, N_2O, CFCs	O-GWD	DLR Oberpfaffenhofen, Germany	Dameris et al. (2005)
ECHAM5/MESSy	T42	90/0.01 hPa	O_3, H_2O, CH_4, N_2O, CFCs, NO_2, aerosols	O-GWD + NonO-GWD	MPI Mainz, MPI Hamburg, DLR Oberpfaffen-hofen, Germany	Jöckel et al. (2004), Roeckner et al. (2003), Sander et al. (2004)
FUB-CMAM-CHEM	T21	34/0.0068 hPa	O_3, H_2O, CH_4, N_2O, CFCs	O-GWD + NonO-GWD	FU Berlin, MPI Mainz, Germany	Langematz et al. (2005)
GCCM	T42	18/2.5 hPa	O_3	O-GWD	University of Oslo, Norway; SUNY Albany, USA	Wong et al. (2004)
GEOS CCM	2° x 2.5°	55/80 km	O_3, H_2O, CFCs, CH_4, N_2O	O-GWD + NonO-GWD	NASA GSFC, USA	S. Pawson, and P. A. Newman 2005, personal communication
GISS	4° x 5°	23/0.002 hPa	O_3, H_2O, N_2O, CH_4, CFCs	O-GWD + NonO-GWD	NASA GISS, USA	Schmidt et al. (2005a, manuscript submitted to *J. Climate*)
HAMMONIA	T31	67/2.10^{-7} hPa	O, O_2, O_3, H_2O, N_2O, CO_2, CH_4	O-GWD + NonO-GWD	MPI Hamburg	Schmidt et al. (2005b, manuscript submitted to *J. Climate*)
LMDREPRO	2.5° x 3.75°	50/0.07 hPa	O_3, H_2O, N_2O, CH_4, CFCs	O-GWD + NonO-GWD	IPSL, France	S. Bekki and D. Hauglustaine 2005, personal communication
MRI	T42	68/0.01 hPa	O_3	O-GWD+ NonO-GWD	MRI, Japan	Shibata and Deushi (2005); Shibata et al. (2005)
MAECHAM4/CHEM	T30	39/0.01 hPa	O_3, H_2O, CH_4, N_2O, CFCs	O-GWD + NonO-GWD	MPI Mainz, MPI Hamburg, Germany	Manzini et al. (2003), Steil et al. (2003)
SOCOL	T30	39/0.01 hPa	O_3, H_2O	O-GWD + NonO-GWD	PMOD/WRC and ETHZ, Switzerland	Egorova et al. (2005)
ULAQ	10° x 20°	26/0.04 hPa	O_3, H_2O, CH_4, N_2O, CFCs, NO_2, aerosols	Rayleigh frict. + vert. diffusion	University of L'Aquila, Italy	Pitari et al. (2002)
UMETRAC	2.5° x 3.75°	64/0.01 hPa	O_3	O-GWD + NonO-GWD	Met Office, UK	Austin (2002), Austin and Butchart (2003)
UMSLIMCAT	2.5° x 3.75°	64/0.01 hPa	O_3, N_2O, CH_4, H_2O	O-GWD + NonO-GWD	University of Leeds, UK	Tian and Chipperfield (2005)
UMUCAM	2.5° x 3.75°	58/0.01 hPa	O_3	O-GWD, Rayleigh friction	University of Cambridge, UK	Braesicke and Pyle (2003 and 2004)
WACCM3	2° x 2.5° 4° x 5°	66/140 km	O_3, H_2O, N_2O, CH_4, CFCs	O-GWD + NonO-GWD	NCAR, USA	Sassi et al. (2005)

←ベースモデルは agcm5.4g
解像度は t21/t42

CCMValに参加しているモデル

Eyring et al.,2005

CCMValシナリオ

CCMVal Forcings

http://www.pa.op.dlr.de/CCMVal/Forcings/CCMVal_Forcings.html

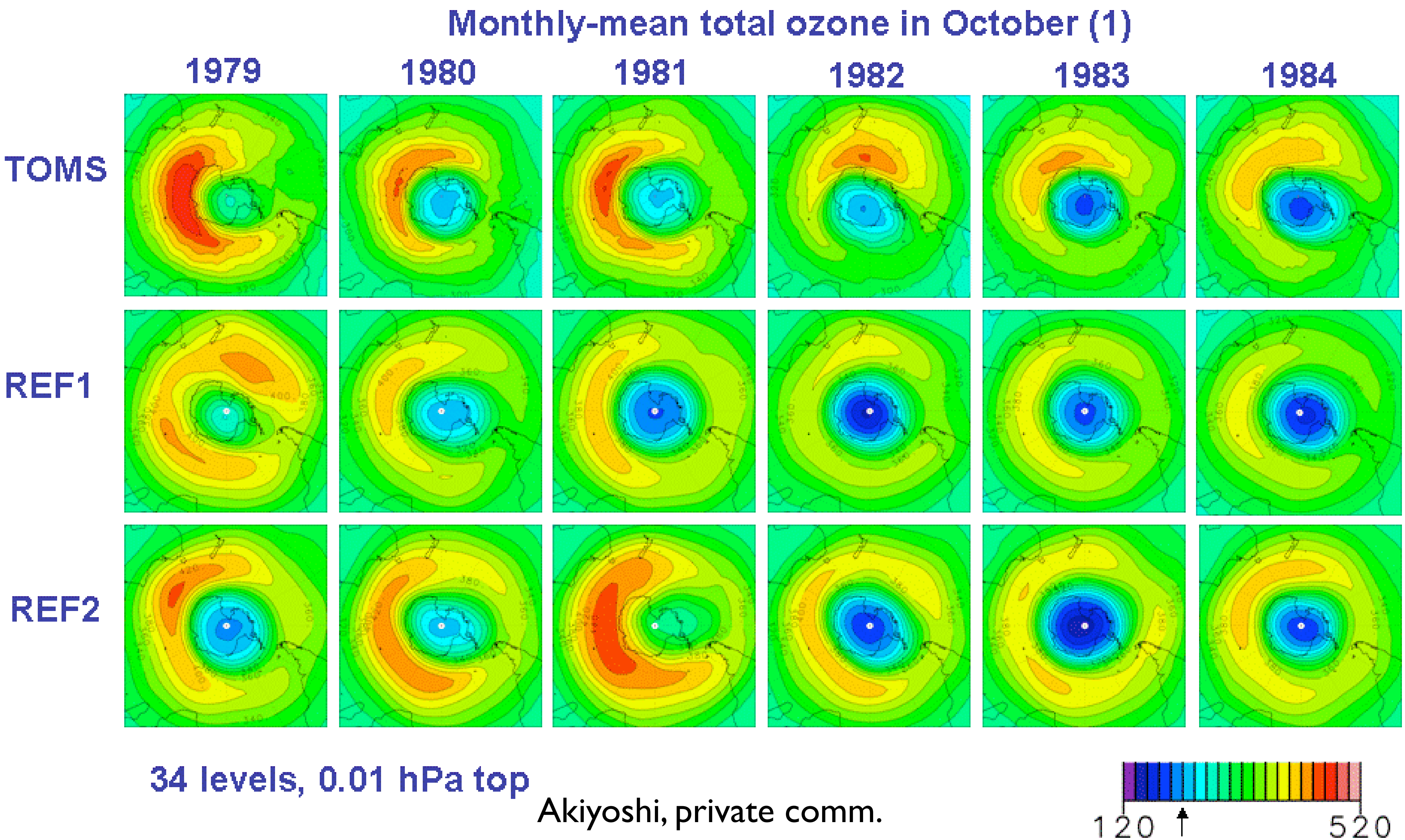
IBM XL Fortran Compiler　Google　アップル　.Mac　ニュース (1181)　研究関連　趣味関連　アップル (42)

Table 1: Summary of proposed CCMVal scenarios.

Scenario	Period	Trace Gases	Halogens	SSTs	Background & Volcanic Aerosol	Solar Variability	QBO	Enhanced Br_y	
REF1	**1980-2004** If possible 1960 to 2004	**OBS** GHG used for WMO/UNEP 2002 runs. Extended until 2004	**OBS** used for WMO/UNEP 2002 runs.	**OBS** HadISST1	**OBS** Surface Area Density data (SAD)	**OBS** MAVER data set, observed flux	**OBS or internally generated**	-	
REF2	**1980-2025** If possible until 2050	**OBS + A1B(medium)**	**OBS + Ab** scenario from WMO/UNEP 2002	**Modeled SSTs**	**Constant SADs** (1999 background aerosol for entire period)	**Not included** Please use average solar flux for the entire REF2 period		**Only internally generated**	-
SCN1	**1980-2004**	**OBS**	**OBS** used for WMO/UNEP 2002 runs	**OBS**	**OBS**	**OBS**	**OBS or internally generated**	**Included** Based on Salawitch *et al.* (2005)	
SCN2	**1980-2025**	**OBS + A1B(medium)**	**OBS + Ab** scenario from WMO/UNEP 2002	**Modeled SSTs** (same as in REF2)	**Constant SADs** (1999 background aerosol for entire period)	**OBS** in past and repeating in future	**OBS / repeating in future or internally generated**	-	

REF1は過去再現実験、REF2は将来予測実験に対応。
SCN1, SCN2 は感度実験

Calculation of ozone variation using a CCSR/NIES CCM with T42 horizontal resolution and bromine chemistry

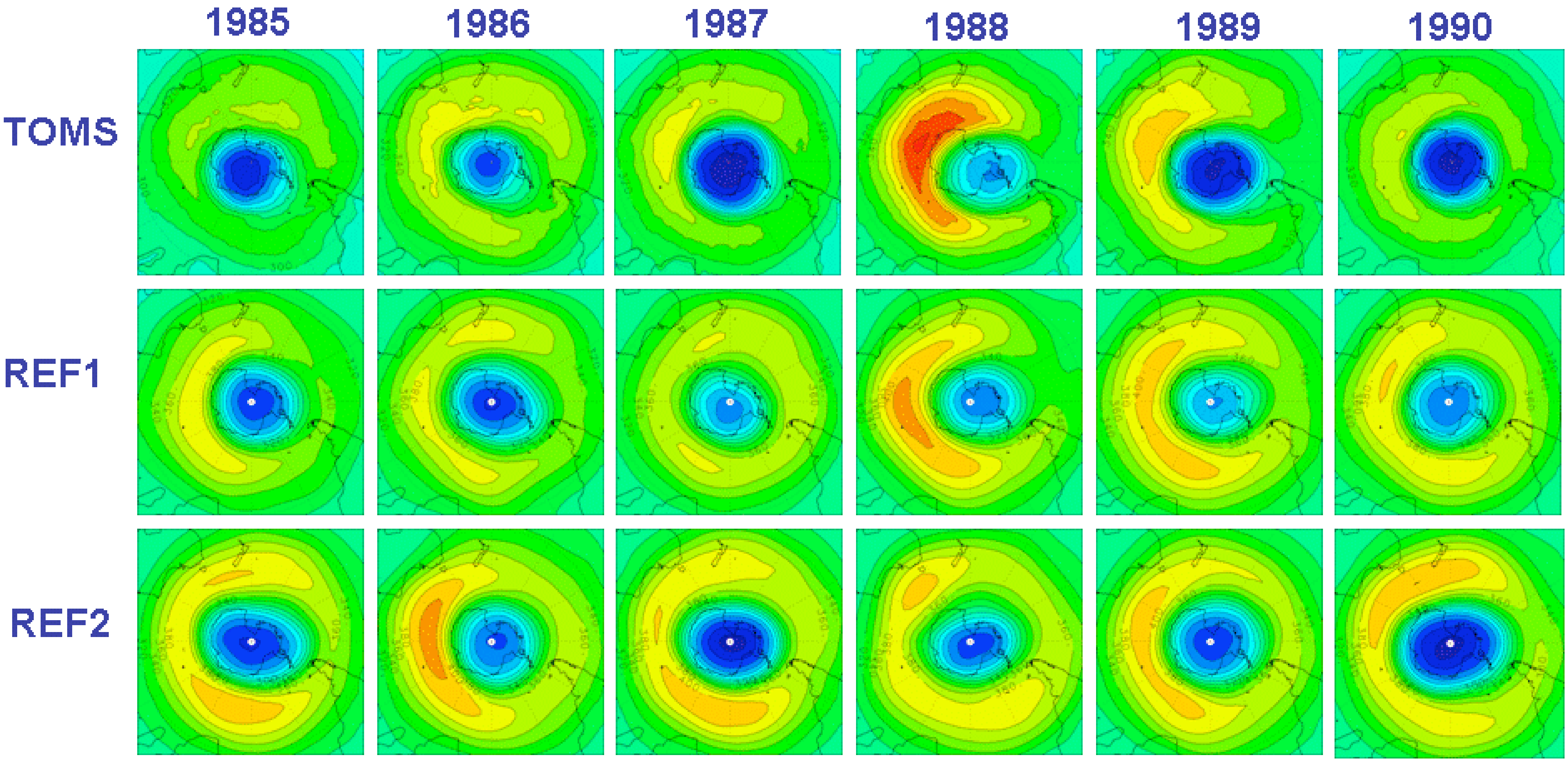


34 levels, 0.01 hPa top

Akiyoshi, private comm.

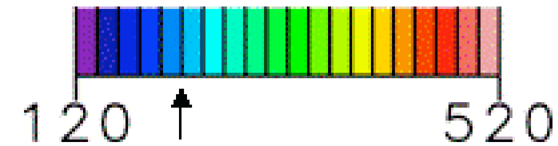
Calculation of ozone variation using a CCSR/NIES CCM with T42 horizontal resolution and bromine chemistry

Monthly-mean total ozone in October (2)



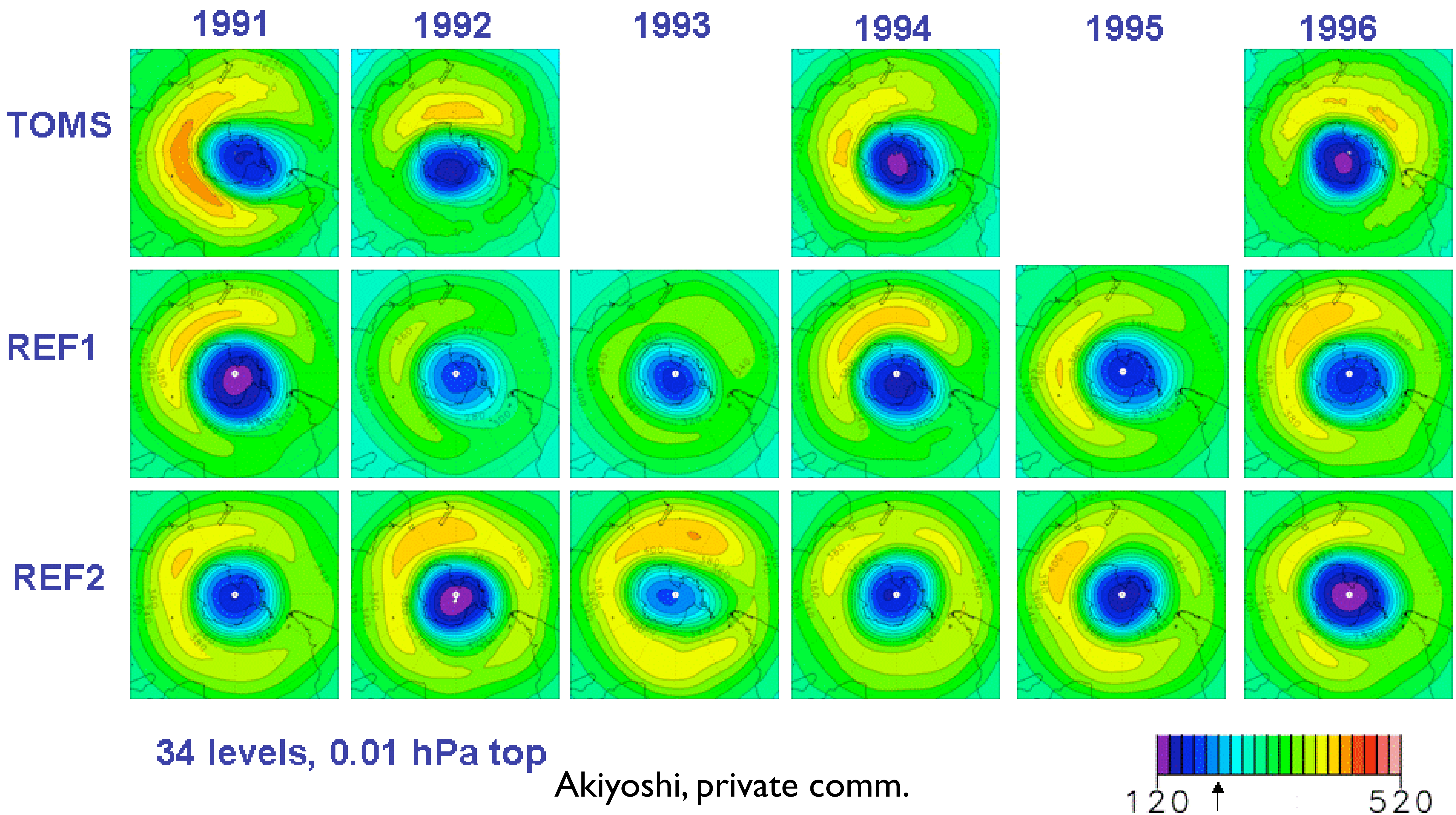
34 levels, 0.01 hPa top

Akiyoshi, private comm.



Calculation of ozone variation using a CCSR/NIES CCM with T42 horizontal resolution and bromine chemistry

Monthly-mean total ozone in October (3)



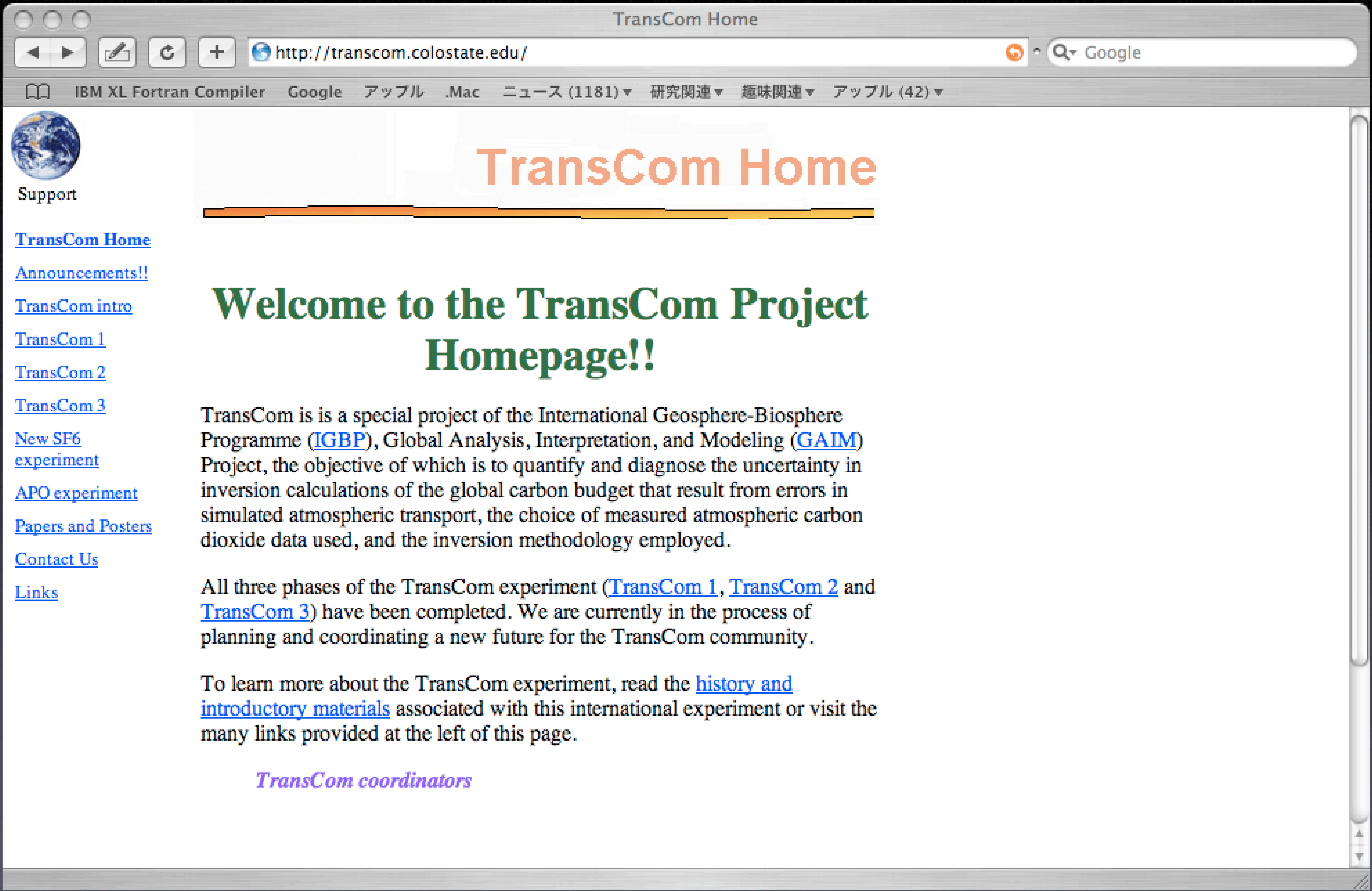
34 levels, 0.01 hPa top

Akiyoshi, private comm.

CCMVal実験の今後の見通し

- アンサンブル数を増やす (REF1,REF2)
- 温室効果気体を増加させないREF2実験

TransCom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TransCom Home

Welcome to the TransCom Project Homepage!!

TransCom is is a special project of the International Geosphere-Biosphere Programme (IGBP), Global Analysis, Interpretation, and Modeling (GAIM) Project, the objective of which is to quantify and diagnose the uncertainty in inversion calculations of the global carbon budget that result from errors in simulated atmospheric transport, the choice of measured atmospheric carbon dioxide data used, and the inversion methodology employed.

All three phases of the TransCom experiment (TransCom 1, TransCom 2 and TransCom 3) have been completed. We are currently in the process of planning and coordinating a new future for the TransCom community.

To learn more about the TransCom experiment, read the history and introductory materials associated with this international experiment or visit the many links provided at the left of this page.

TransCom coordinators

Continuous experimentシナリオ

Tracer name	Description	Flux time resolution
SiB	SiB biosphere model fluxes	hourly
SiB_day	SiB model daily average fluxes	daily
SiB_mon	SiB model monthly average fluxes	monthly
CASA	CASA biosphere fluxes with diurnal cycle	3 hourly
CASA_mon	CASA monthly fluxes	monthly
SF6	SF6 emissions	constant
radon	Radon emissions	constant
fossil98	Fossil emissions for 1998	constant
Taka02	Takahashi ocean fluxes, 2002 compilation	monthly

Table 1: List of tracers

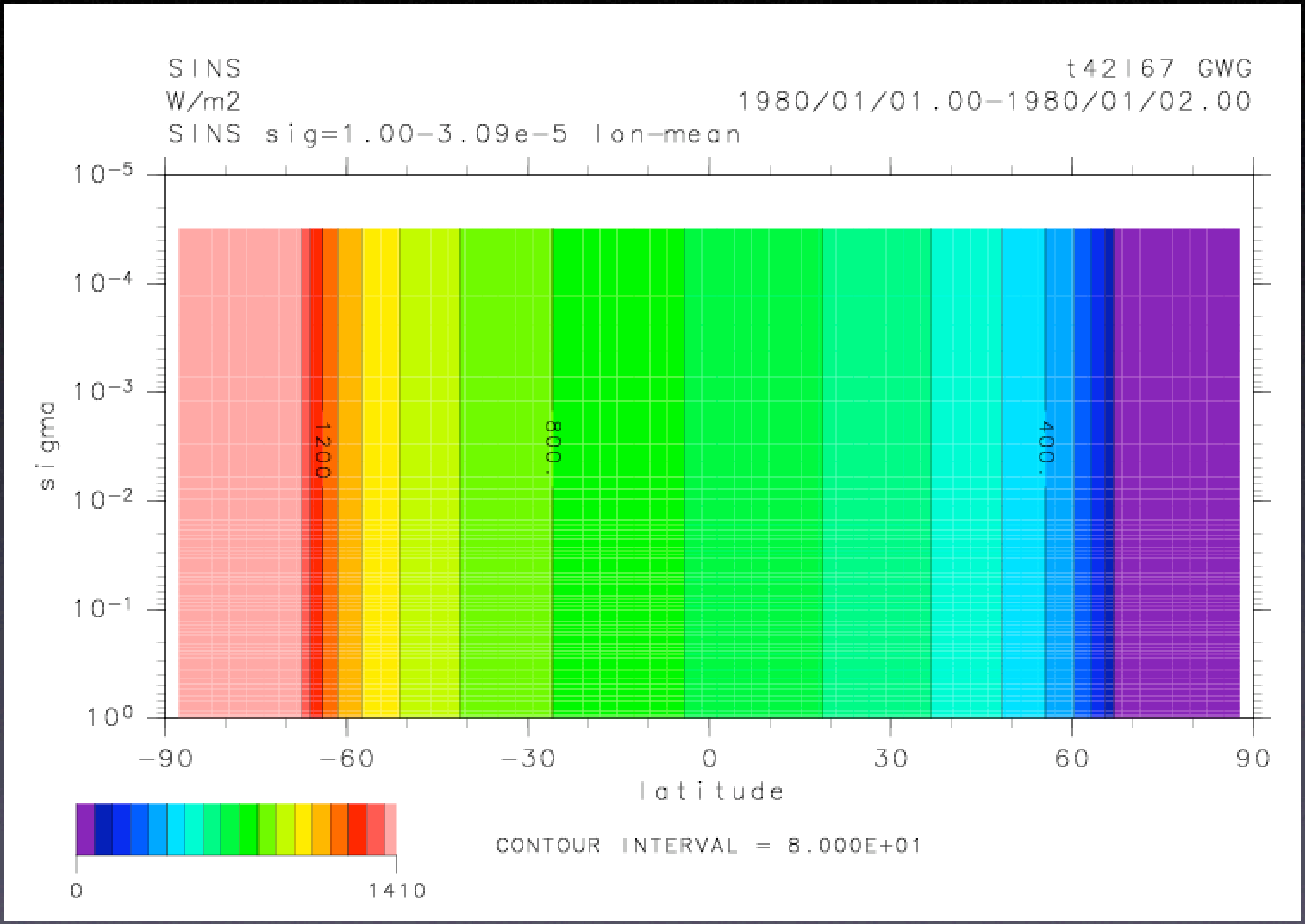
積分期間は2000-2003

TransCom Contiunous Experimentの今後の見通し

- submit 済み (t106l32tc)

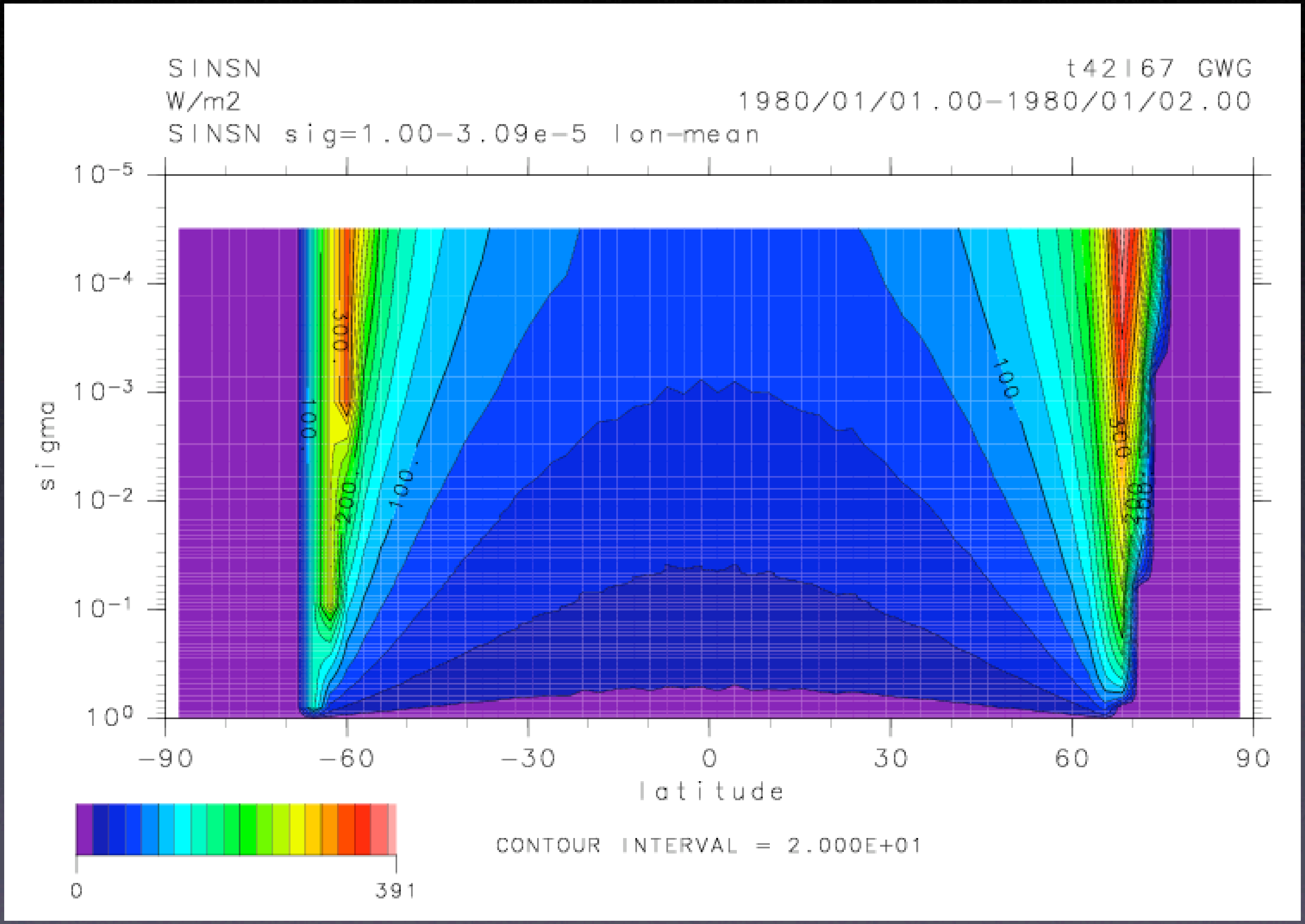
球面効果の影響

（球面効果がない場合の太陽放射フラックス）



球面効果の影響

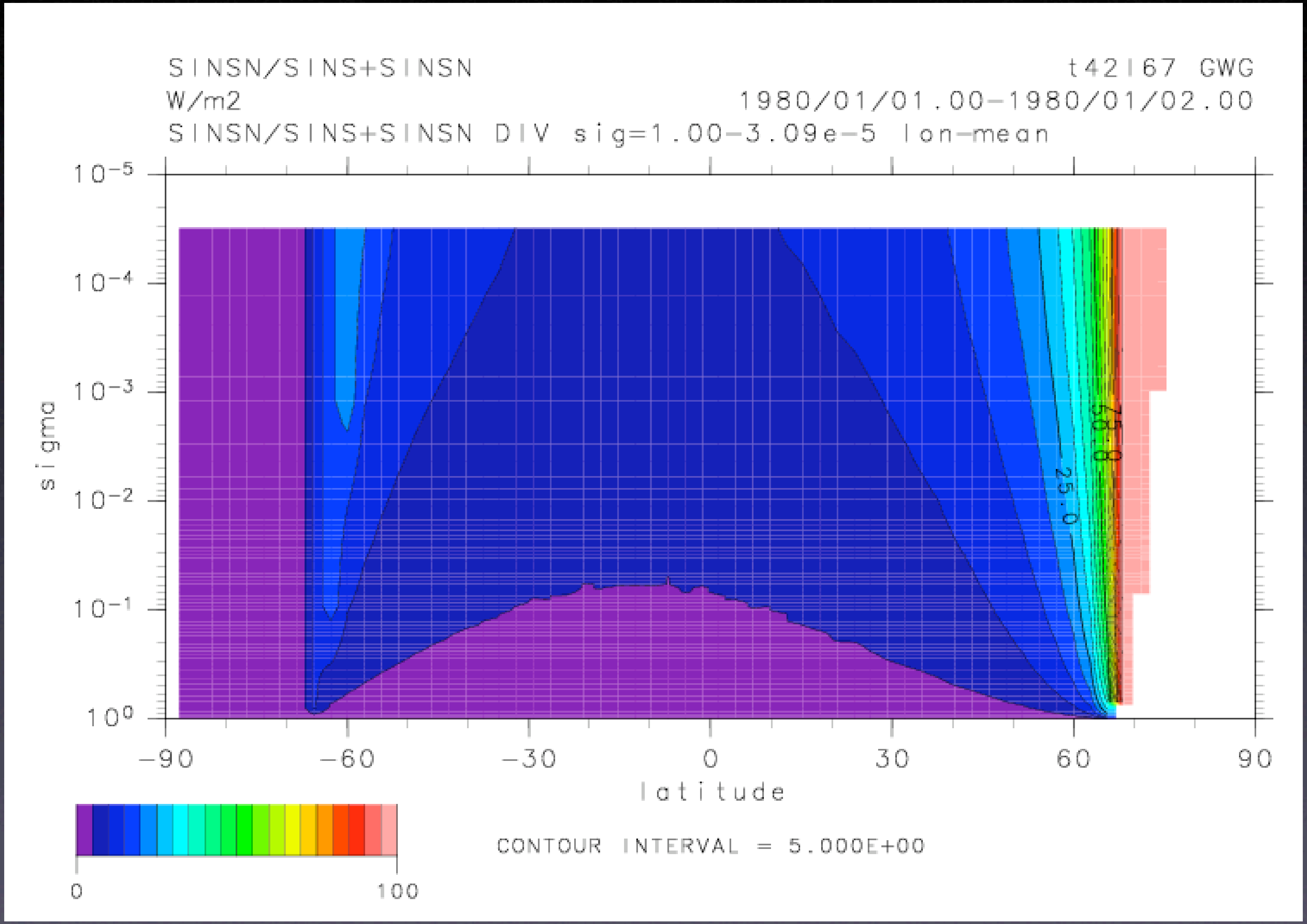
（球面効果による太陽放射フラックス）



成層圏・中間圏において、高緯度域での影響が大きい

球面効果の影響

（球面効果の全太陽放射フラックスに占める割合）



極渦の中や、極渦の周辺で影響が大きい。

それ以外の領域ではおおむね10%程度。

成層圏化学過程のCHASERへの導入状況

	species		photo.	gas-phase reaction	liquid-phase	hetero. reactions
	long	short				
CHASER	52		26	102	4	7
	37	15				
+Br	+26		+19	+37	0	(+13)
	+20	+6				

前回報告時(2004/03)との相違点：

box model → 3D model (CHASER本体)へ導入

BrOx, ClOxなどをファミリー化（トレーサーを削減）

光解離定数、エミッション等を成層圏モデルから適当に流用（塩素系のみ）

ハロゲン系化合物導入による計算時間の変化

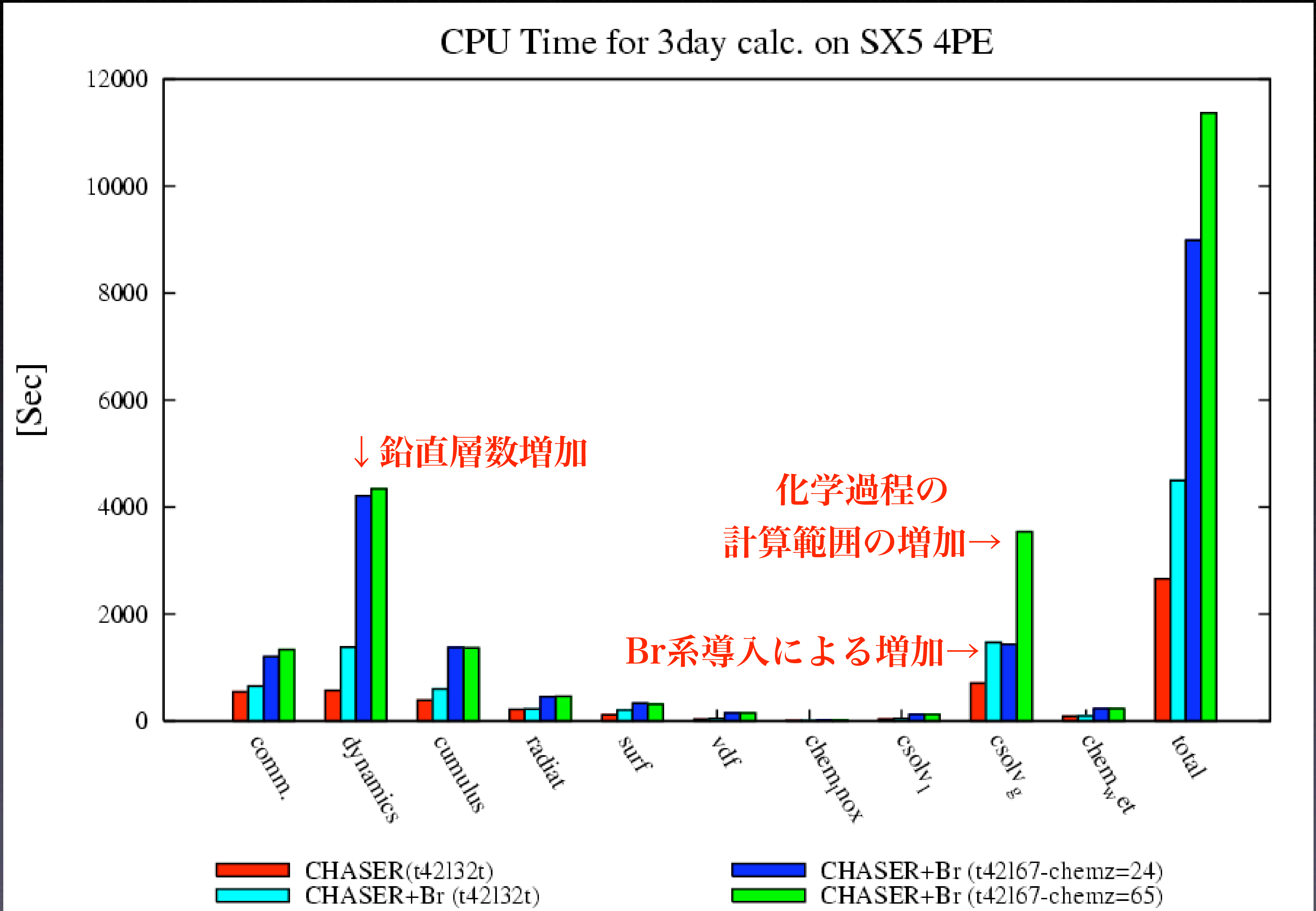
	resolution	range of chemistry calc.	chemisty
EXP1	t42l32t	z=1,24	original CHASER
EXP2	t42l32t	z=1,24	+Br
EXP3	t42l67	z=1,24	+Br
EXP4	t42l67	z=1,65	+Br

EXP2: 解像度を変えず、化学過程のみを変える

EXP3: 化学過程を変えず、鉛直層数のみを変える

EXP4: 化学過程を計算する範囲を変える

ハロゲン系化合物導入による計算時間の変化



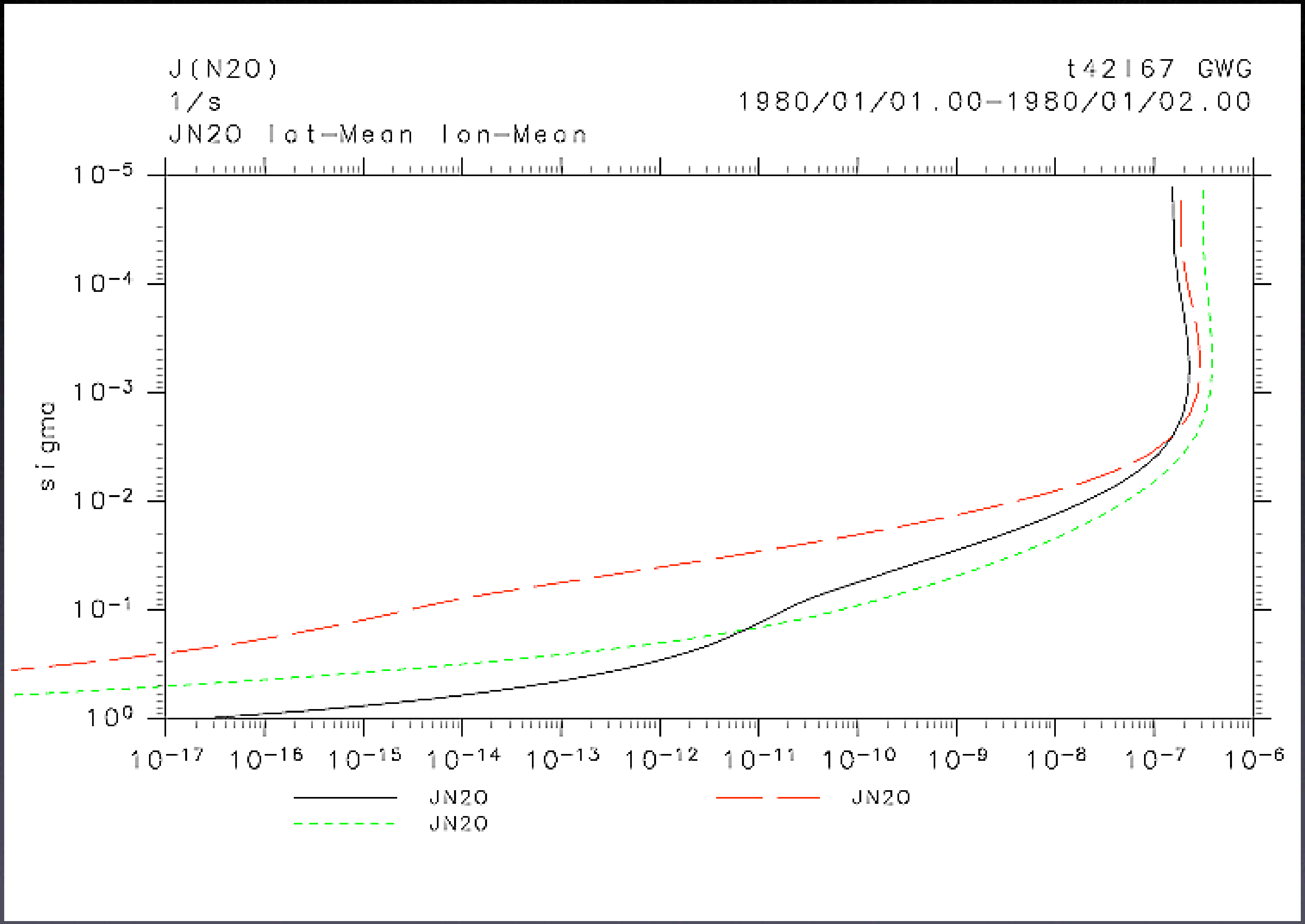
光解離定数を二倍程度増やしているが、放射への影響はさほど無い。

ハロゲン系化合物導入による計算時間の変化

	ratio of calc. time	vector operation ratio	vector length
EXP1	1	98.1%	203
EXP2	1.69	98.3%	196
EXP3	3.38	98.2%	174
EXP4	4.21	98.6%	190

ベクトル化率はほぼ変わらないが、ベクトル長がかなり変化する。

N2O光解離速度の、放射スキームによる違い
rad9(58ch), radX(70km),radX(90km)



radX(90km)で増加しているのは 200nm 以下の波長域を考慮しているため。radX(70km)は過小評価？

まとめとこれから

- とりあえず CHASERにハロゲン系化合物を導入した。
- 球面効果を入れた。上部対流圏程度までの高度域で、極渦の縁で影響がありそう。
- パッシブトレーサーモデルを用いた輸送過程検証実験もやっていない訳ではない。
- PSC表面上での不均一反応を導入する。
- 化学過程のパフォーマンスチェック（再現実験等）