Report of
全球・地域スケール化学輸送モデルによる大気組成変動とその気候影響の研究

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representing
G5029 (H. Akimoto, leader)
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Plan of the talk

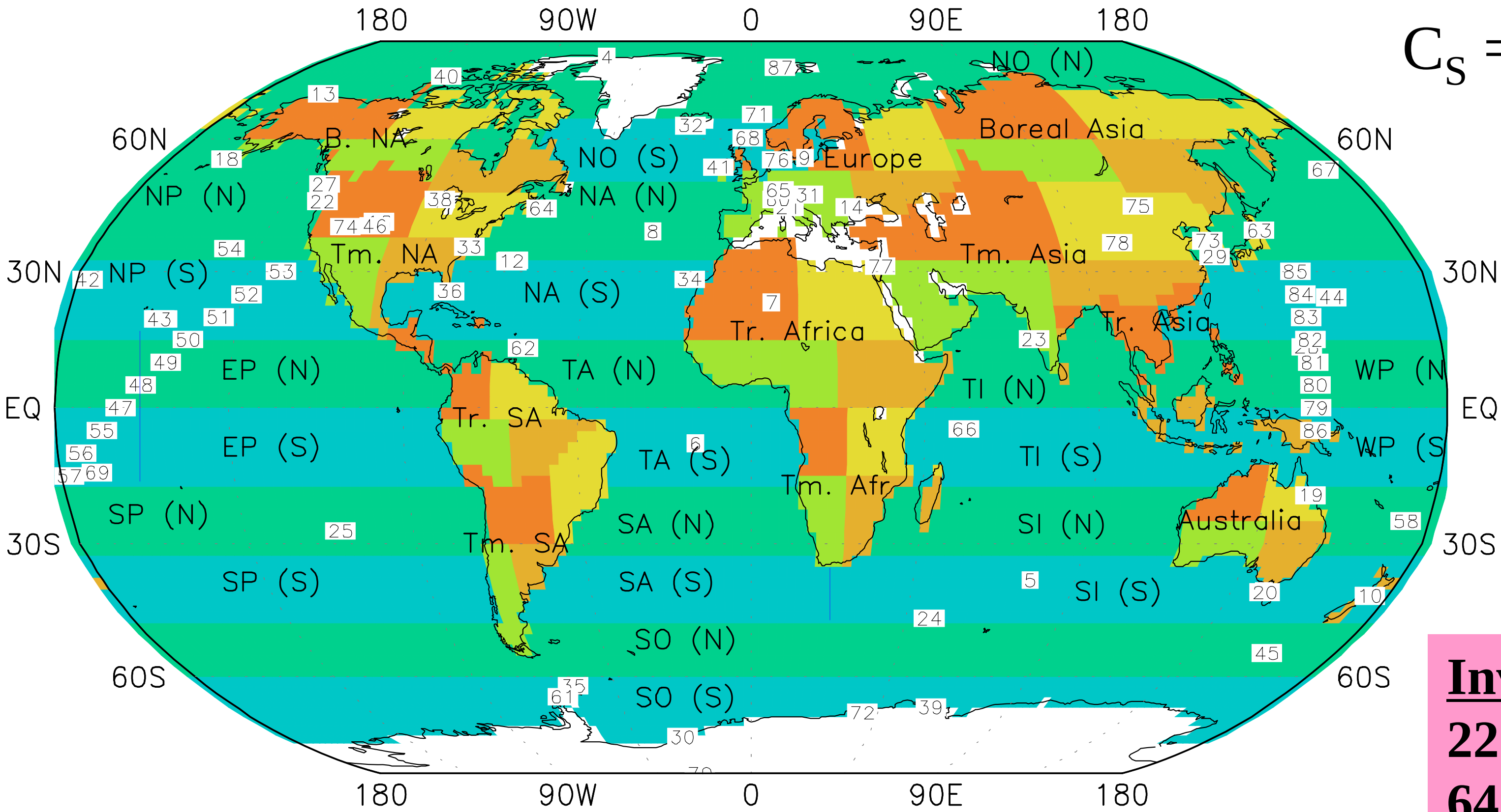
- **Analysis of CO_2-flux by the high resolution inverse modeling**
  - **NIES/FRCGC forward transport model**
  - **JMA transport model**

- **Evaluation of AGCM transport by SF_6 and Radon**
  - **CCSR/NIES/FRCGC transport framework**

- **Analysis of inter-annual variability of N_2O**

64-Regions Inverse Model

(using NIES/FRCGC forward transport model and 15 years of interannually varying NCEP/NCAR winds)



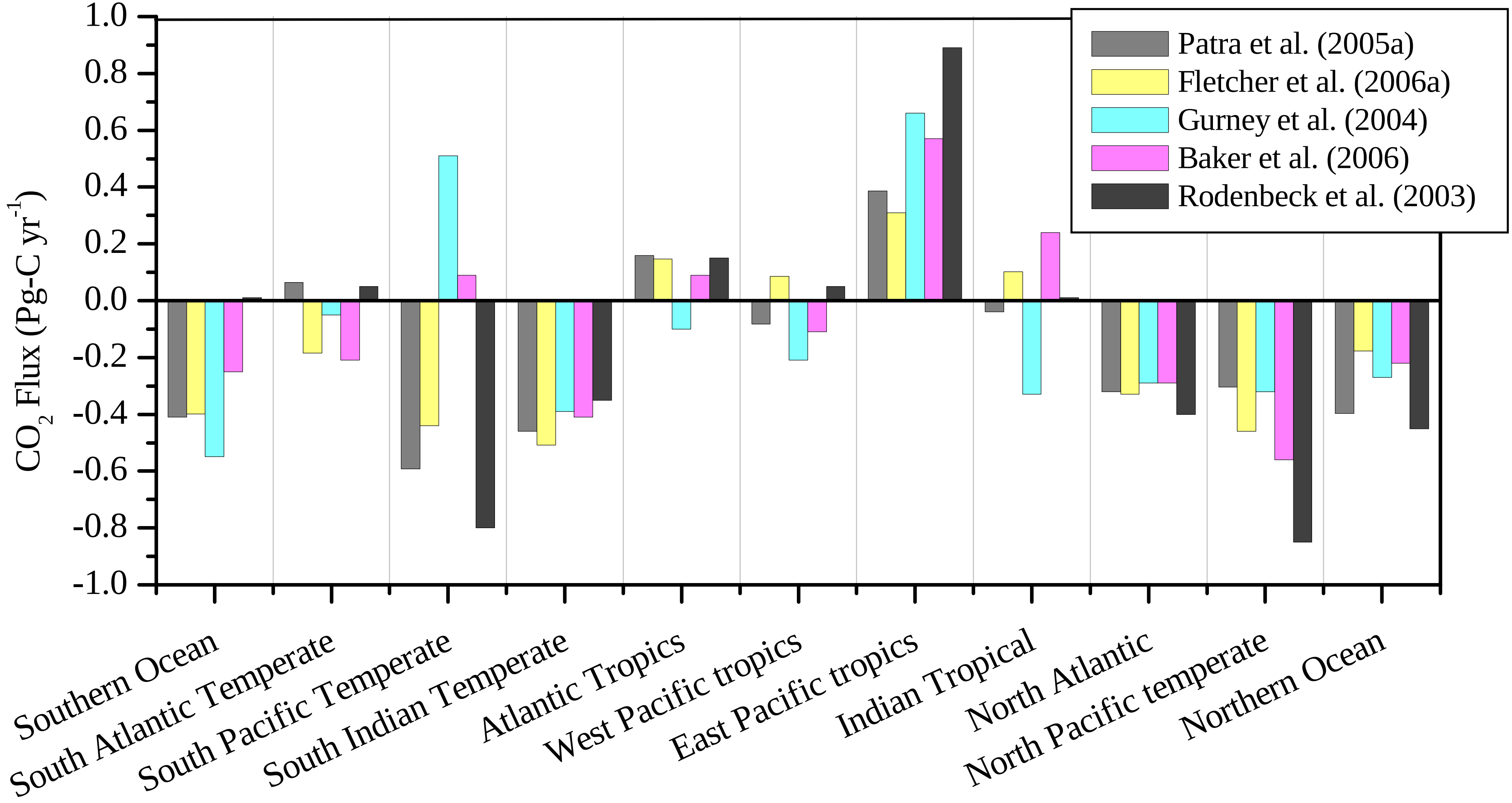
$$C_S = c_{s1} + c_{s2}\ldots$$

Inv. Setup	**Chi2**
22 reg	**2.15**
64 reg	**1.11**
64+IAV	**0.99**

$$\chi^2 = {}^{1}\!/_{T}\left[\frac{1}{N}\sum_{1}^{N}\left[(D - D_{predicted})^2 / C_D + \frac{1}{M}\sum_{1}^{M}(S_0 - S)^2 / C_S\right]\right.$$

Patra et al., Global Biogeochem. Cycles., 2005a,b; Tellus, 2005

Validating Sub-basin scale Ocean Fluxes – Oceanic vs Atmos. Inversions



Patra et al., *Atmos. Chem. Phys. Discuss., 2006*

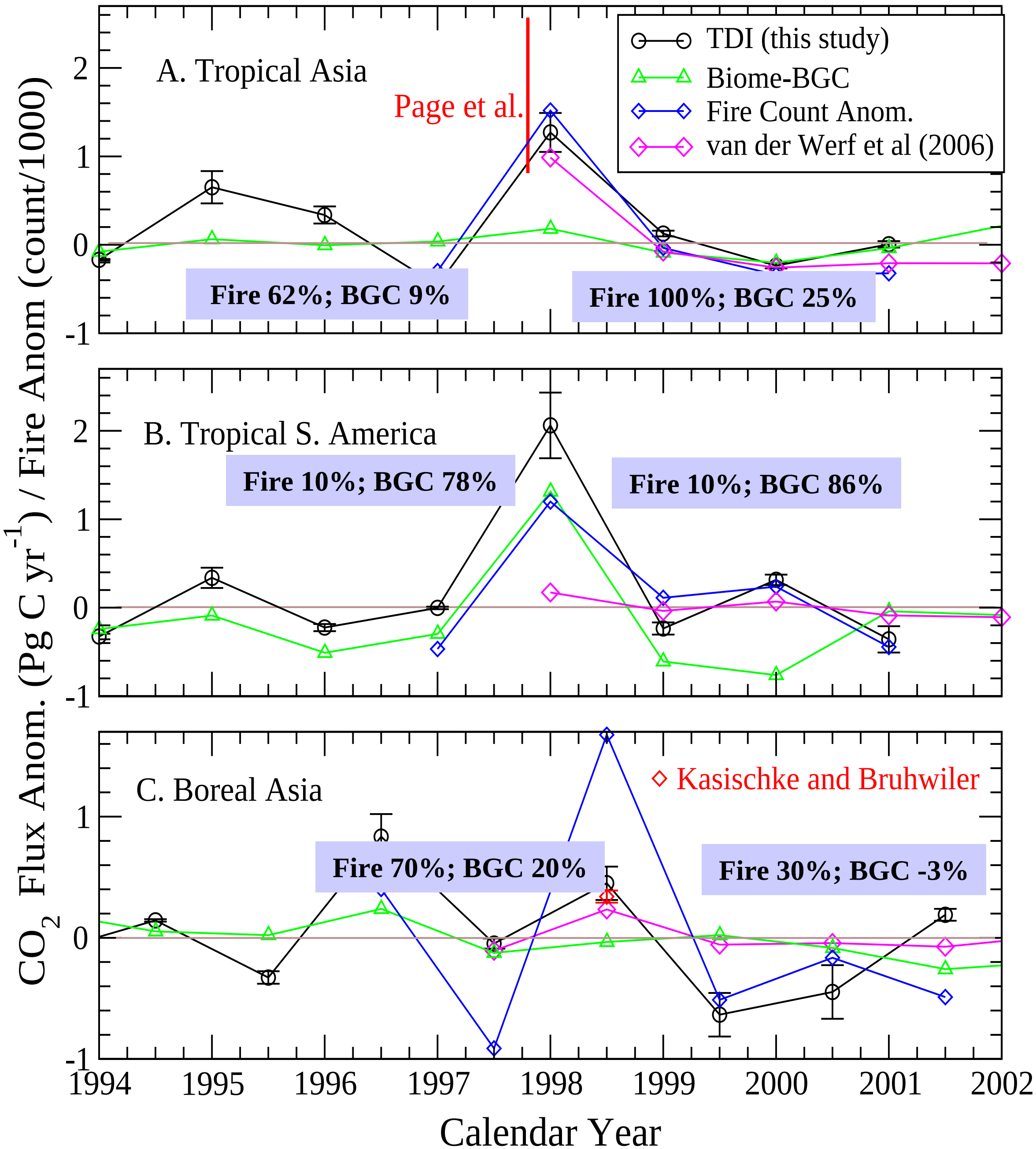
Understanding CO2 flux anomalies for land regions:

TDI,

Biome-BGC /draught,

bottom-up estimates

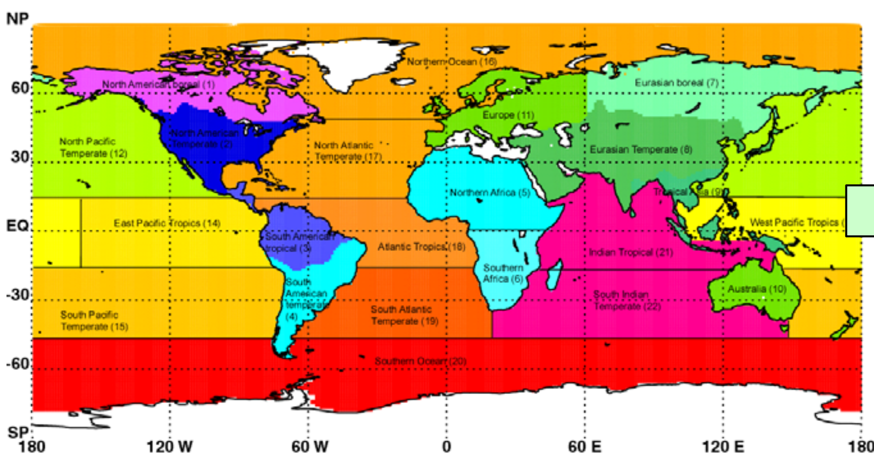
and fire emissions



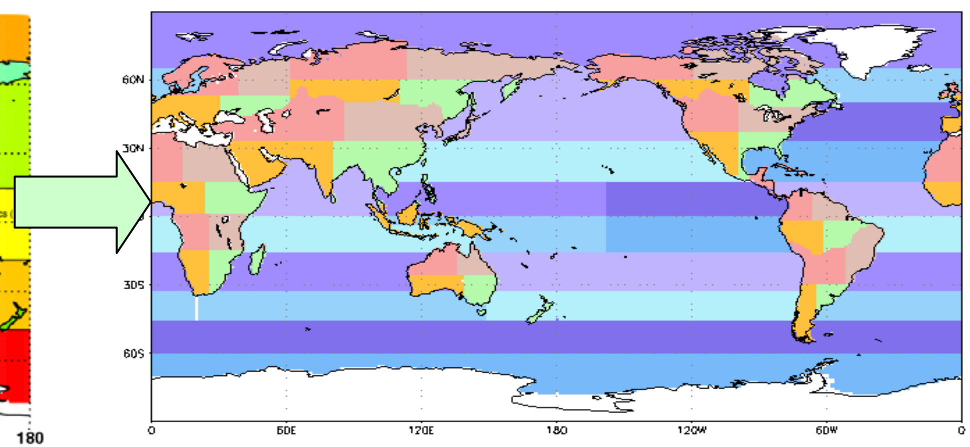
Patra et al., Global Biogeochem. Cycles, 2005b and more

CO2 Flux: Inversion Inter-comparison (Models: NIES/FRCGC, JMA)

Goal	: To estimate analysis and model uncertainty in inversion calculations.
Model	: High resolution (1.0 deg. in horizontal) transport model (FRCGC_NIES, JMA)
Wind	: Interannually varying meteorological field (NCEP、JRA25)



Previous inter-comparison study



This study

The Progress up to this year

2004 Ported transport model code to ES (Vectorization and parallel processing).

Testing high resolution transport model.

2005 Tested 64 regions forward simulation.

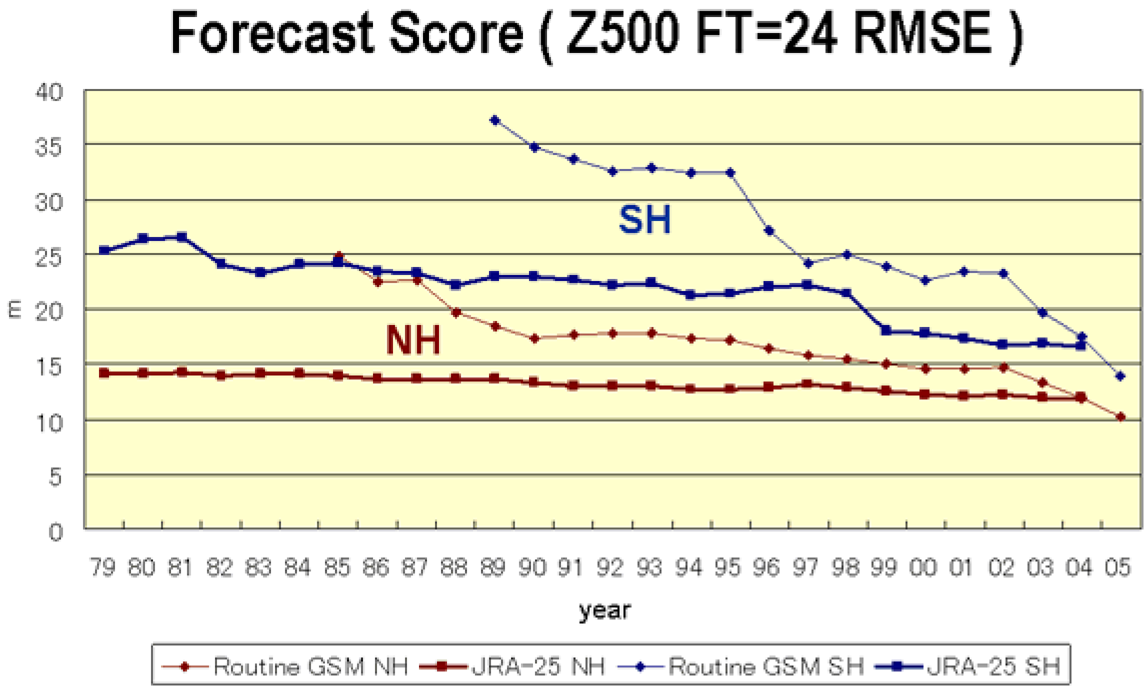
Developing raw observational data screening technique in inversion.

2006 Prepared real meteorological field (1990 - 2004) from re-analysis.

Confirming the advantage of the real (average) meteorological field over the specific year meteorological field in inversion.

Running forward simulation of CO2.

Advantages of using re-analysis meteorological field



JRA-25 re-analysis (http://jra.kishou.go.jp/)

Using re-analysis meteorological field, we can obtain realistic and self-consistent model transport for forward simulation of CO2.

The advantage of real (re-analysis) meteorology in CO2 flux inversion

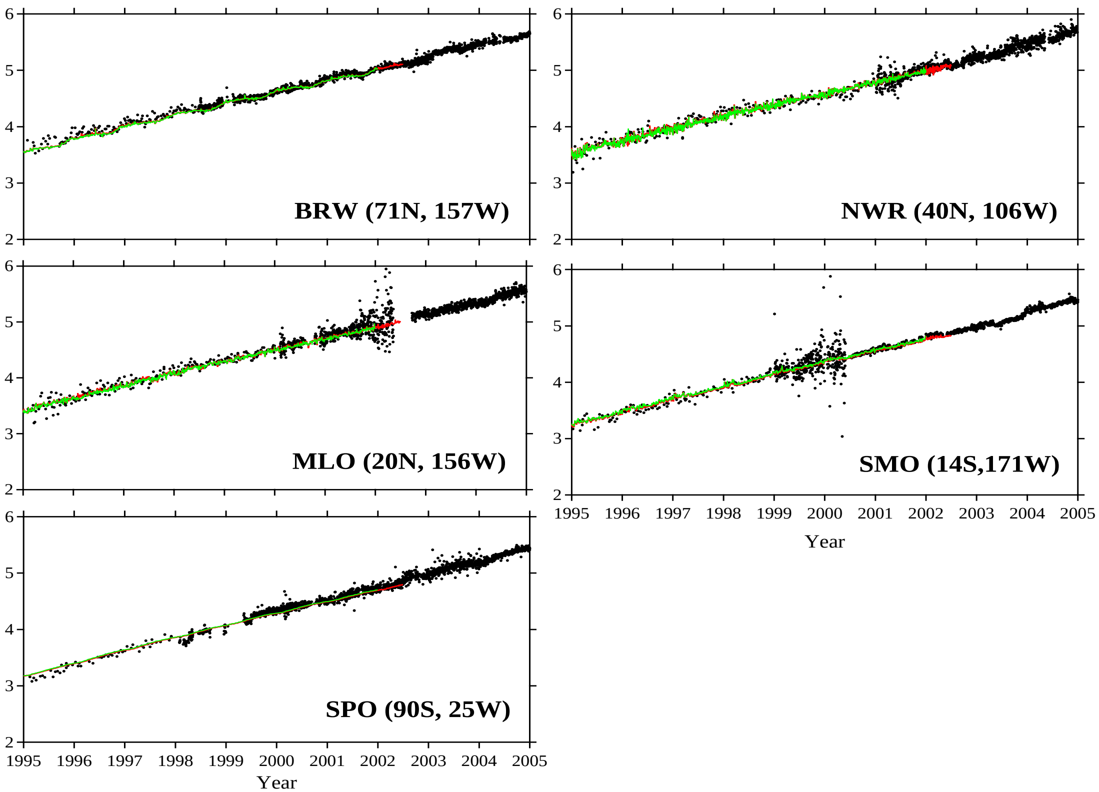
Transport matrix (meteorology)	1999	2000	2001	2002	average (20 yrs)	real
Data selection rate	79.8%	78.3%	78.9%	79.4%	80.8%	79.7%
Analysis error (ppm)	0.716	0.712	0.704	0.713	0.697	0.706

Using real or average transport matrix (meteorological field), the data selection rate and the standard deviation of observation and analysis tend to better than that of specific year.

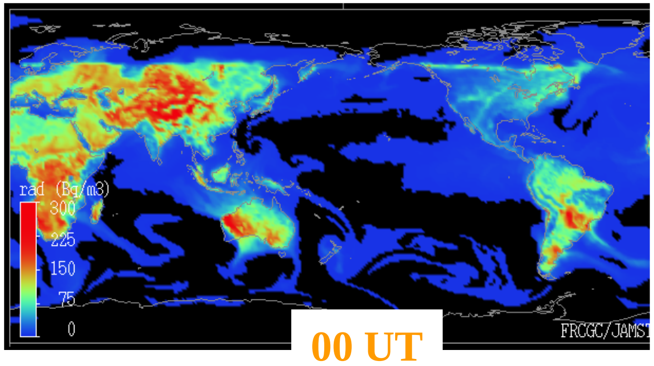
CCSR/NIES/FRCGC AGCM transport

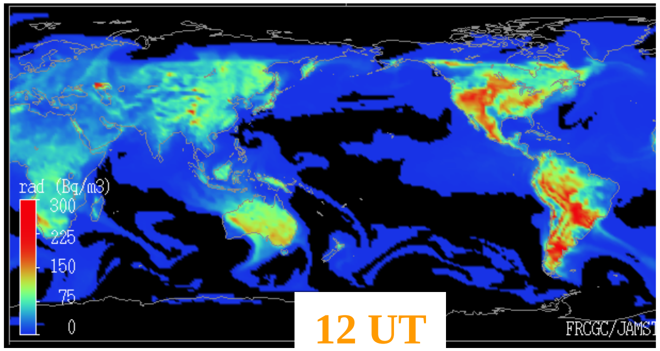
- For more realistic transport mechanisms and stratosphere (compared to CTMs)
- Lesser dependency on (re-)analysed meteorological data
- Computationally expensive, and relatively unexplored

Evaluation of AGCM transport using simulations of SF6 (T42) and Radon (T106)



Diurnal variations in Radon-222 (in mBq) at the surface on 01 July 2002. Radon decays in the atmosphere with a half-life of 3.8 days

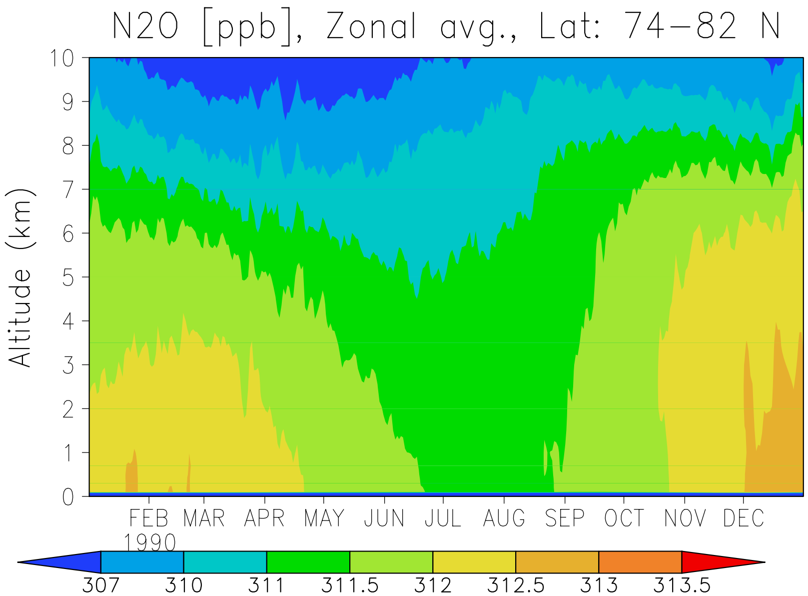




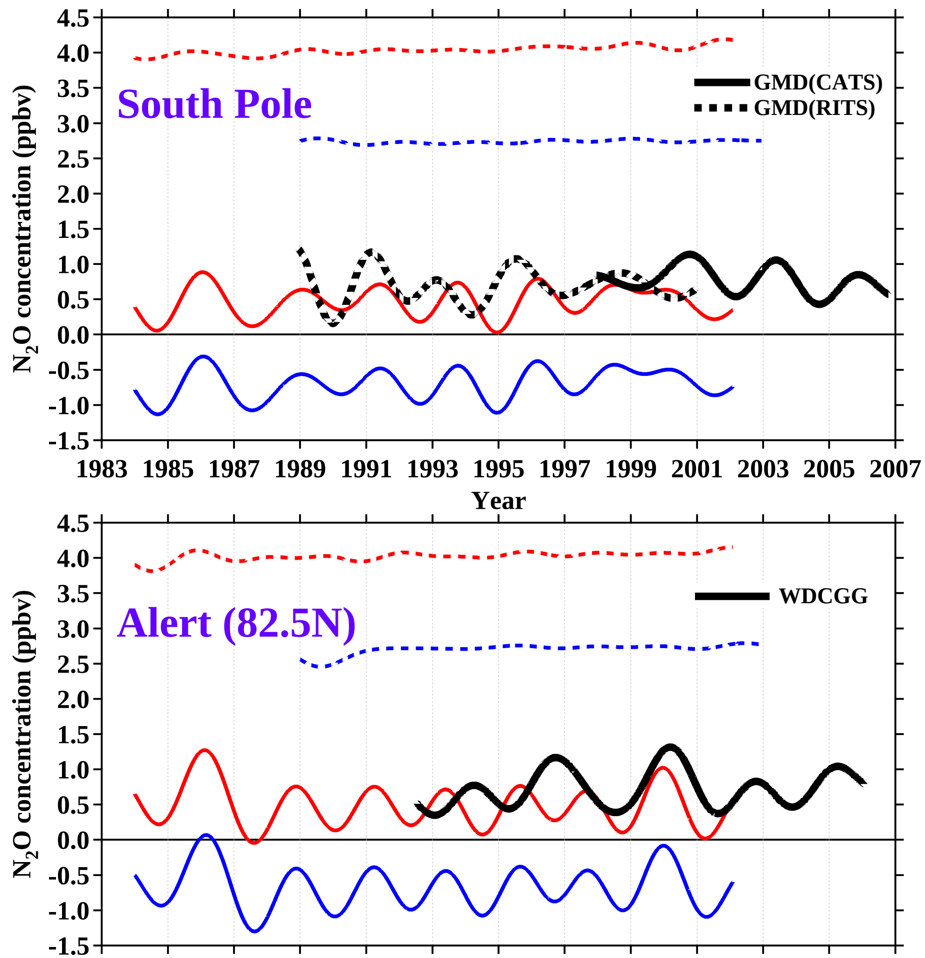
SF6 (in ppt) concentration observed by NOAA/GMD (black dots), and GXE5 (red line) and GXN5 (green line) simulation cases.

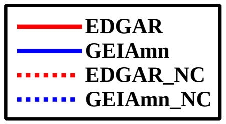
Ishijima et al., IGAC Meeting, 2006

Impact of stratosphere-troposphere transport on tropospheric N_2O concentrations



Seasonality in N2O transport





Interannual variability: importance of chemistry

Future work

1. Time-dependent inversion of atmospheric-CO_2 using AGCM forward transport
   - Expecting smaller bias in flux estimation

2. Development of inverse modelling framework for other gases; e.g., N_2O, CH_4

3. Multi-model flux estimations in collaborations with JMA, NIES, and FRCGC groups