Air Pollution as Climate Forcing: A Second Workshop
April 4-6, 2005 at East-West Center, Honolulu

Panel Discussion – Wed
Michael Prather

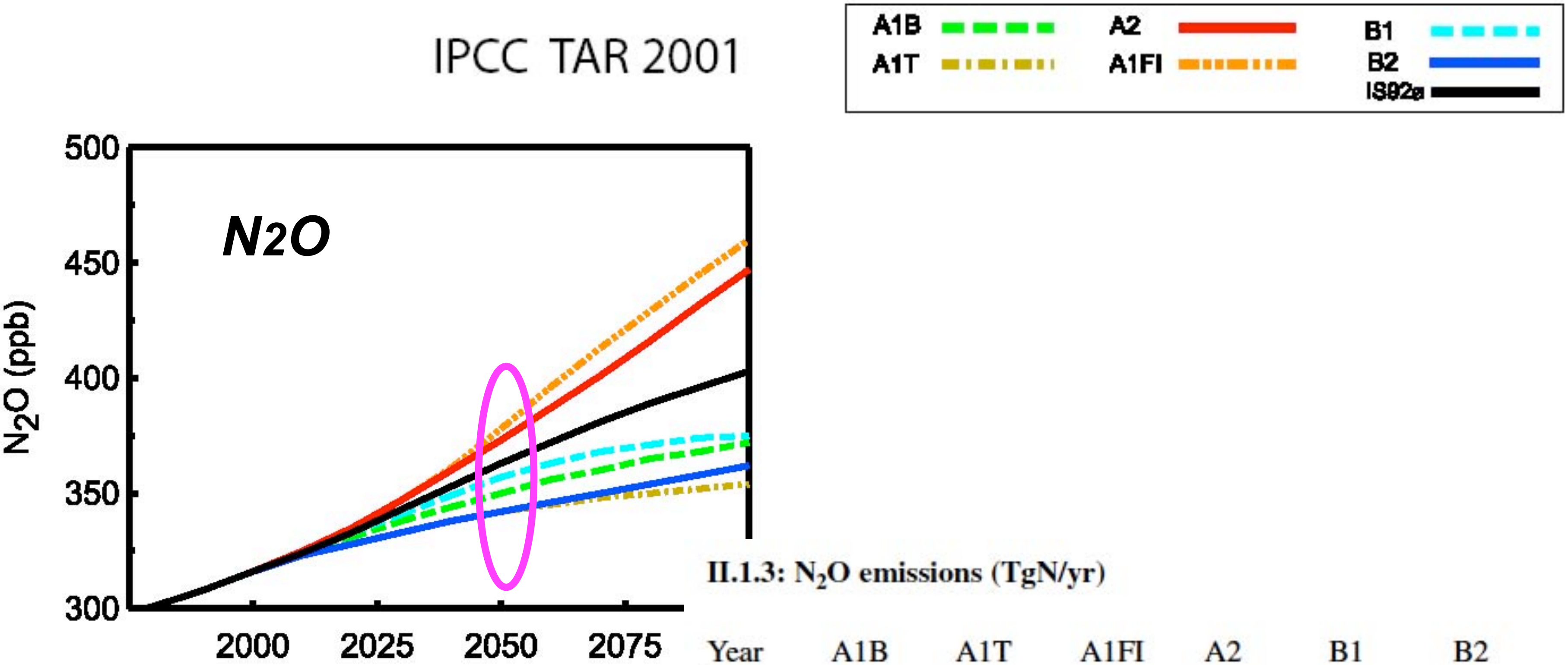
Can increases in N_2O, CH_4, O_3 be reversed ?

N_2O – no

CH_4 – good chance

O_3 – likely

IPCC TAR 2001



II.1.3: N_2O emissions (TgN/yr)

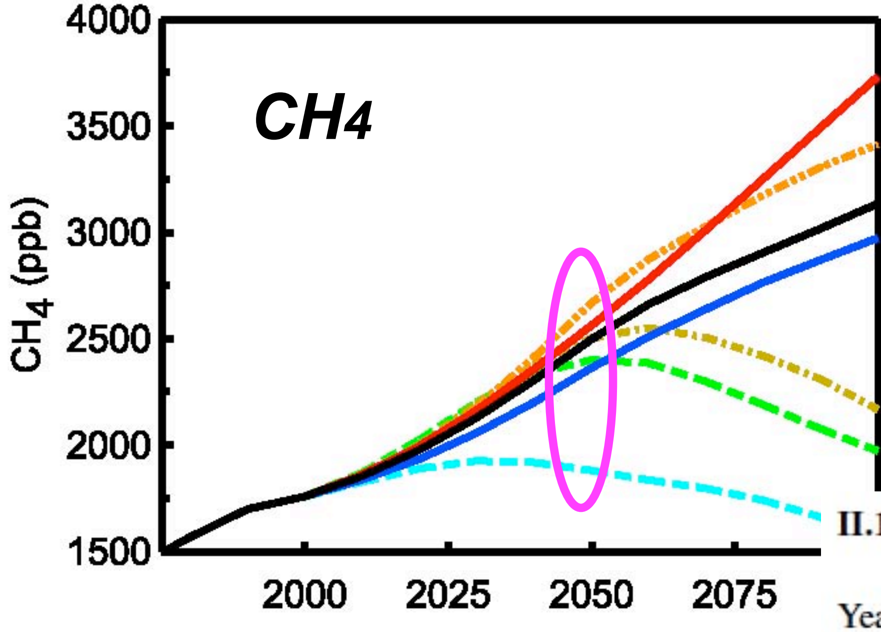
Year	A1B	A1T	A1FI	A2	B1	B2
2000	7.0	7.0	7.0	7.0	7.0	7.0
2010	7.0	6.1	8.0	8.1	7.5	6.2
2020	7.2	6.1	9.3	9.6	8.1	6.1
2030	7.3	6.2	10.9	10.7	8.2	6.1
2040	7.4	6.2	12.8	11.3	8.3	6.2
2050	7.4	6.1	14.5	12.0	8.3	6.3
2060	7.3	6.0	15.0	12.9	7.7	6.4
2070	7.2	5.7	15.4	13.9	7.4	6.6
2080	7.1	5.6	15.7	14.8	7.0	6.7
2090	7.1	5.5	16.1	15.7	6.4	6.8
2100	7.0	5.4	16.6	16.5	5.7	6.9

N_2O BUDGET

Table 4.4: Estimates of the global nitrous oxide budget (in TgN/yr) from different sources compared with the values adopted for this report (TAR).

Reference:	Mosier *et al.* (1998b) Kroeze *et al.* (1999)		Olivier *et al.* (1998)		SAR	TAR
Base year:	1994	range	1990	range	1980s	1990s
Sources						
Ocean	3.0	1 – 5	3.6	2.8 – 5.7	3	
Atmosphere (NH_3 oxidation)	0.6	0.3 – 1.2	0.6	0.3 – 1.2		
Tropical soils						
Wet forest	3.0	2.2 – 3.7			3	
Dry savannas	1.0	0.5 – 2.0			1	
Temperate soils						
Forests	1.0	0.1 – 2.0			1	
Grasslands	1.0	0.5 – 2.0			1	
All soils			6.6	3.3 – 9.9		
Natural sub-total	9.6	4.6 – 15.9	10.8	6.4 – 16.8	9	
Agricultural soils	4.2	0.6 – 14.8	1.9	0.7 – 4.3	3.5	
Biomass burning	0.5	0.2 – 1.0	0.5	0.2 – 0.8	0.5	
Industrial sources	1.3	0.7 – 1.8	0.7	0.2 – 1.1	1.3	
Cattle and feedlots	2.1	0.6 – 3.1	1.0	0.2 – 2.0	0.4	
Anthropogenic Sub-total	8.1	2.1 – 20.7	4.1	1.3 – 7.7	5.7	6.9[a]
Total sources	**17.7**	**6.7 – 36.6**	**14.9**	**7.7 – 24.5**	**14.7**[b]	
Imbalance (trend)	3.9	3.1 – 4.7			3.9	3.8
Total sinks (stratospheric)	**12.3**	**9 – 16**			**12.3**	**12.6**
Implied total source	16.2				16.2	16.4

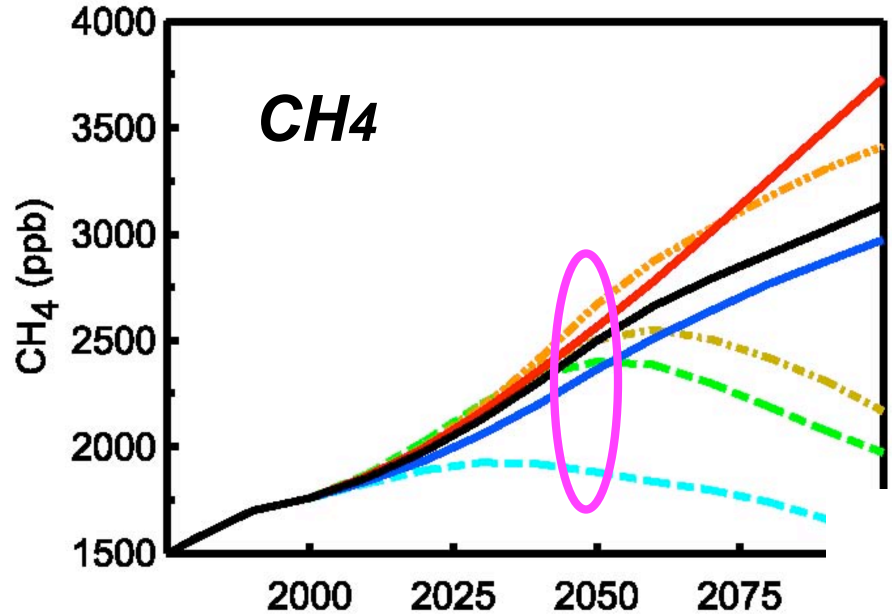
IPCC TAR 2001



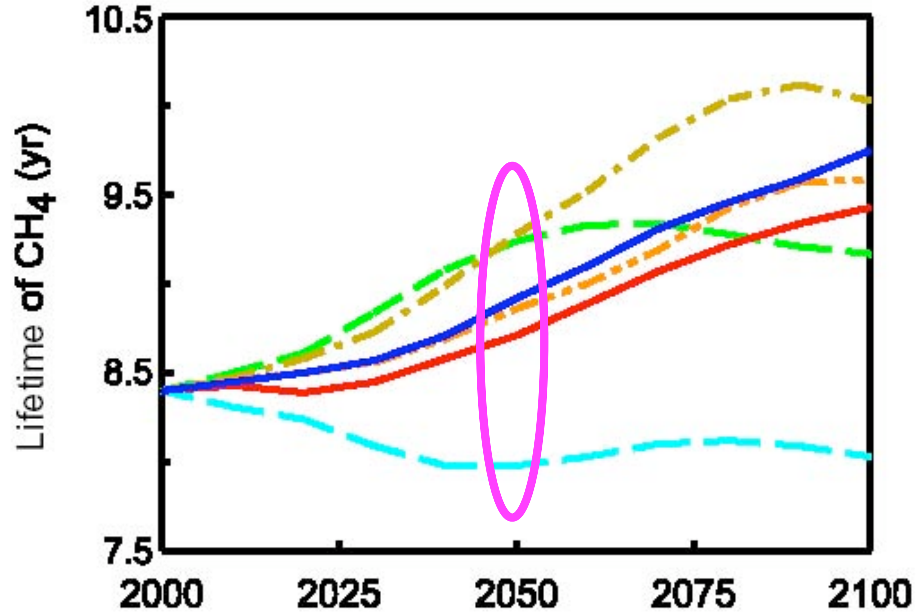
II.1.2: CH_4 emissions ($Tg(CH_4)/yr$)

Year	A1B	A1T	A1FI	A2	B1	B2
2000	323	323	323	323	323	323
2010	373	362	359	370	349	349
2020	421	415	416	424	377	384
2030	466	483	489	486	385	426
2040	458	495	567	542	381	466
2050	452	500	630	598	359	504
2060	410	459	655	654	342	522
2070	373	404	677	711	324	544
2080	341	359	695	770	293	566
2090	314	317	715	829	266	579
2100	289	274	735	889	236	597

IPCC TAR 2001



lifetime of CH_4



IPCC4 Experiment II: 2030 Photcomp:

1. Introduction:

The IPCC AR4 Chapter 7 will focus on Coupling between Changes in the Climate System and Biogeochemistry. In addition to the experiment I (lead by Michael Gauss), we plan to perform and analyze a limited series of dedicated global model simulations of relevance to the AR4 sections:

- 7.3: Global Atmospheric Chemistry and climate change
- 7.4: Air Quality and Climate Change

In the proposed experiment we will focus on the year 2030; 'the inter-mediate' future which is of direct relevance to policy makers, using new emissions scenarios that recently became available from the IIASA group. The 'new' aspects (compared to IPCC TAR) of the simulations are:

- new scenarios that indicate lower emissions of CH_4 and O_3 precursors.
- Emphasis on the synergetic effect of air quality and climate gas emissions (CH_4); with focus on human health and vegetation exposure
- Calculate the corresponding Radiative Forcing.

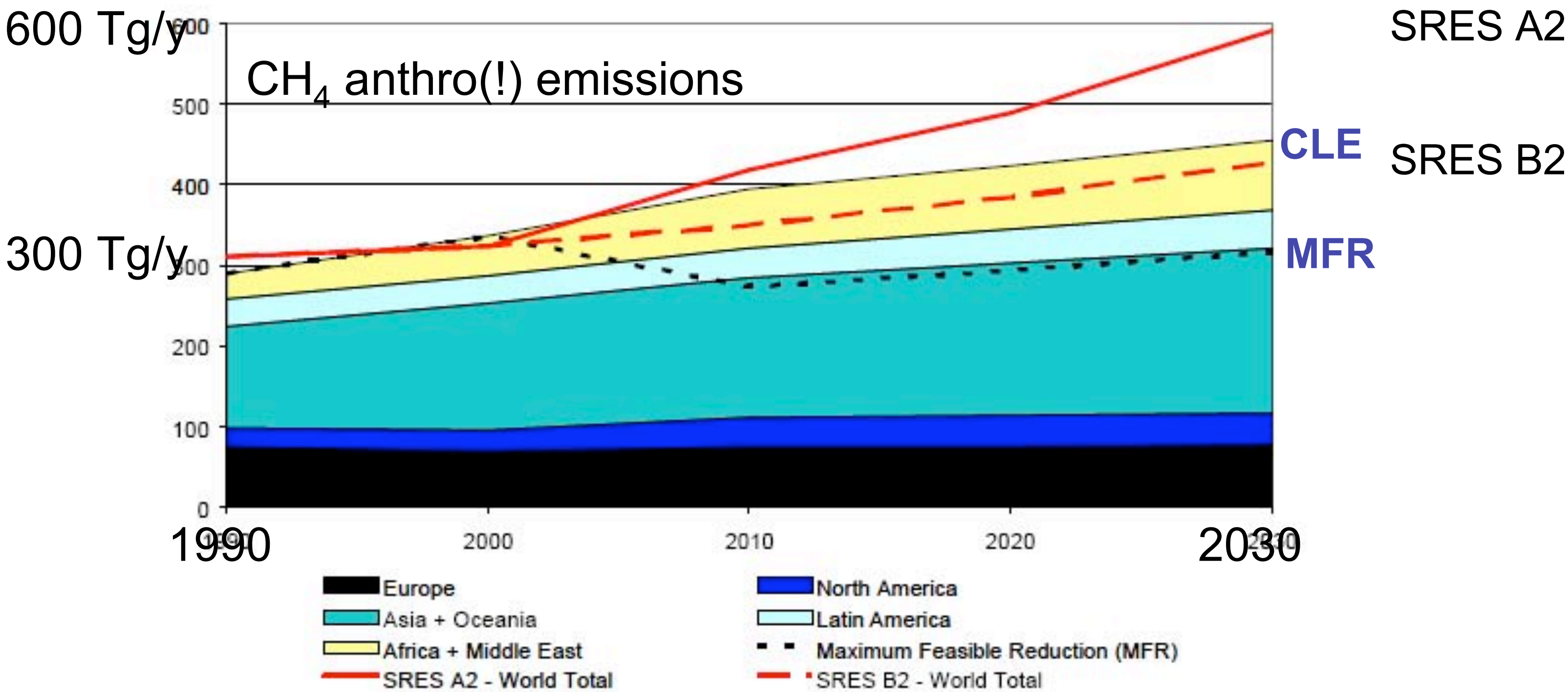
IPCC4 Experiment II: 2030 Photcomp:

2. Simulations:

There are five anticipated simulations. The first 4 scenarios should consider current climate- recommended meteorological year 2000 (or the period 1997-2002). Scenario 5 considers climate change.

Sim.	ID emissions	Met Fields	Description
S1	IIASA-BAU-2000	2000 (1990s)	baseline
S2	IIASA-**CLE**-2030	2000	IIASA Business As Usual (CLE = current legislation)
S3	IIASA-**MFR**-2030	2000	IIASA MFR (Maximum Feasible Reduction optimistic technology scenario)
S4	SRES-**A2**-2030	2000	SRES A2 (the most ‘pessimistic’ IPCC SRES scenario), harmonized with IIASA emissions
S5	IIASA-**CLE**-2030	2020s	Climate Change Simulation. IIASA-CLE emissions using prescribed SST data for the 2020s.

but new IIASA global-RAINS CLE & MFR scenarios project more controlled CH_4 growth



CO emissions

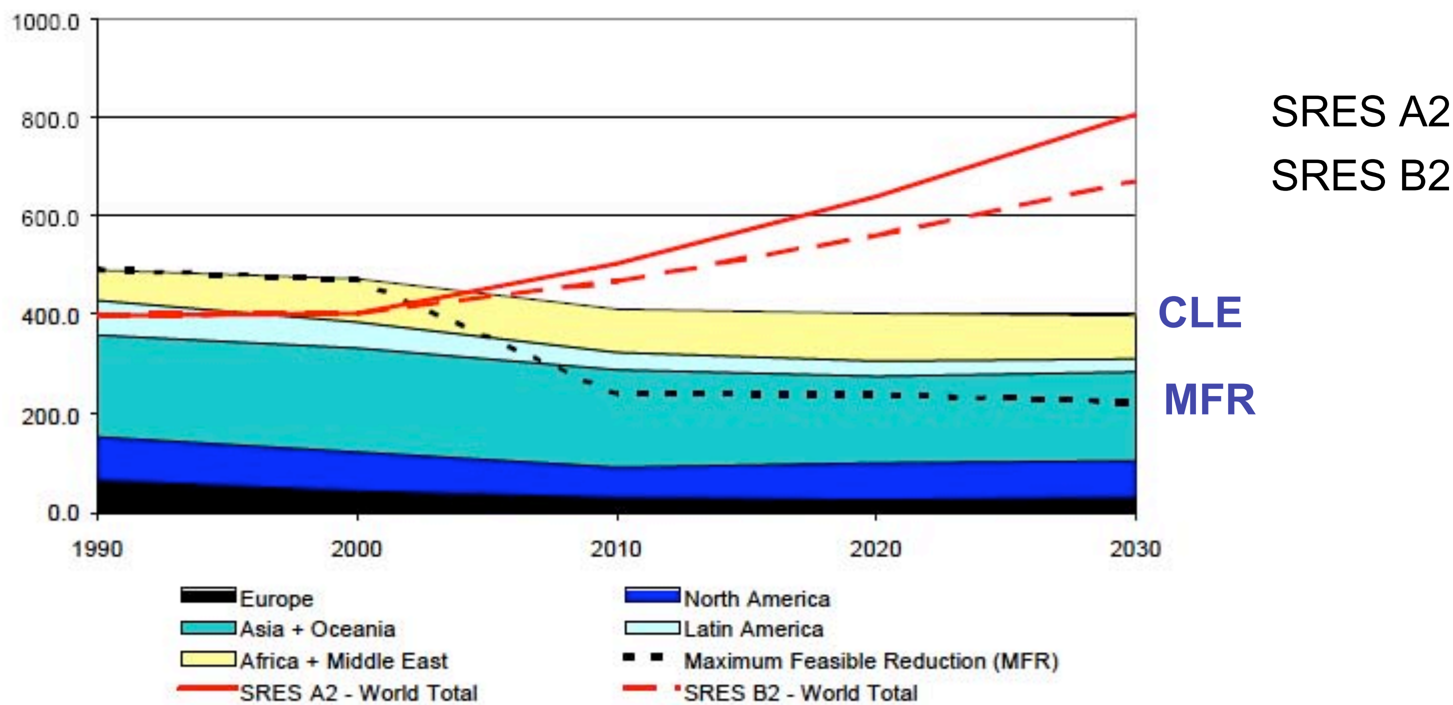


Fig. 2. Projected development of IIASA anthropogenic CO emissions by SRES world region (Tg CO yr^{-1}).

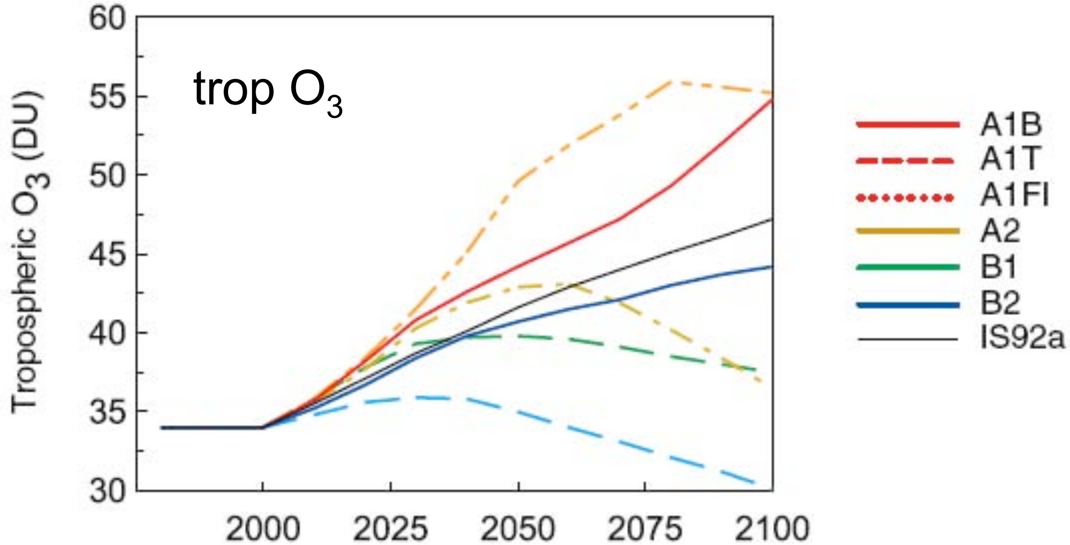
IPCC4 Experiment II: 2030 Photcomp:

2. Simulations:

There are five anticipated simulations. The first 4 scenarios should consider current climate- recommended meteorological year 2000 (or the period 1997-2002). Scenario 5 considers climate change.

3.3 Methane constraints:

Sim.	CH4 [global ppb]
S1 (Y2000)	1760
S2 - CLE	2088
S3 - MFR	1760
S4 - A2	2163
S5 - CLE+cc	2012 (est from STOCHEM)



trop O_3
Tropospheric O_3 (DU)
60
55
50
45
40
35
30
2000
2025
2050
2075
2100
A1B
A1T
A1FI
A2
B1
B2
IS92a

NO_X emissions

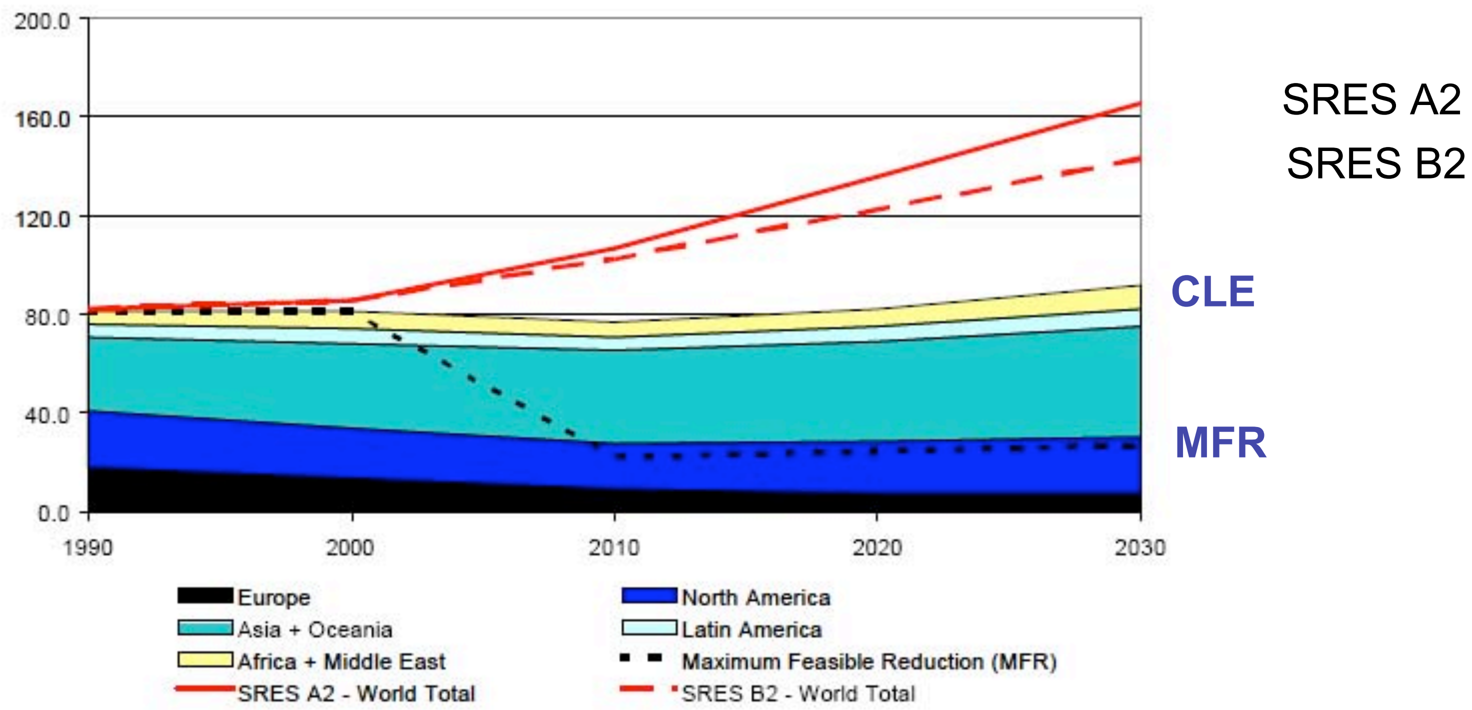
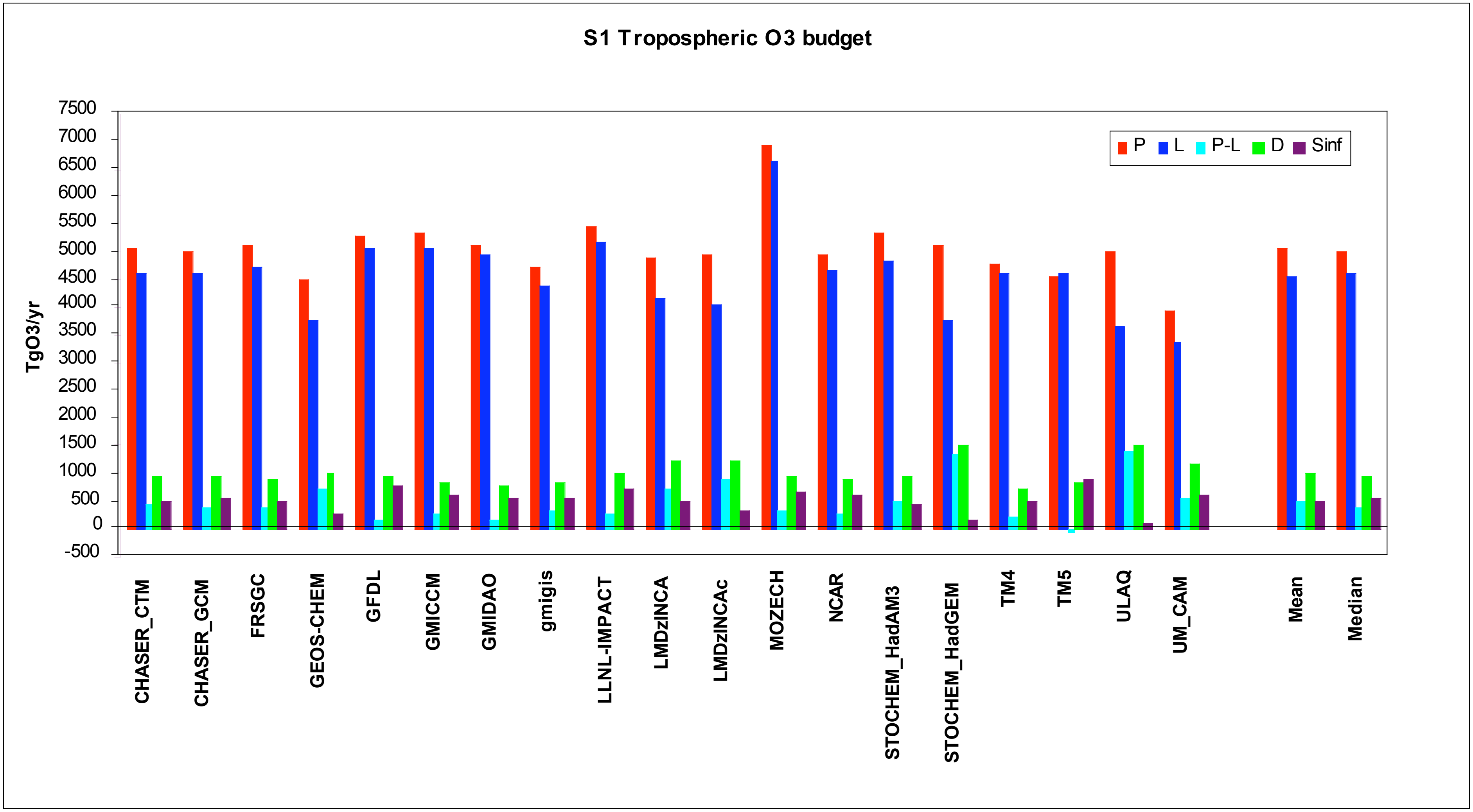


Fig. 1. Projected development of IIASA anthropogenic NO_x emissions by SRES world region ($Tg\ NO_2 yr^{-1}$).

IPCC4 Experiment II: 2030 Photcomp:

2. Simulations:



Atmos. Chem. Phys. Discuss., 4, 1–68, 2004
www.atmos-chem-phys.org/acpd/4/1/
SRef-ID: 1680-7375/acpd/2004-4-1
European Geosciences Union

Atmospheric Chemistry and Physics Discussions

The impact of air pollutant and methane emission controls on tropospheric ozone and radiative forcing: CTM calculations for the period 1990–2030

F. Dentener[1], D. Stevenson[2], J. Cofala[3], R. Mechler[3], M. Amann[3],
P. Bergamaschi[1], F. Raes[1], and R. Derwent[4]

Table 3. Radiative Forcings calculated by TM3 and STOCHEM comparing the 2020s with the 1990s. Other: emissios of NO_x-CO-NMVOC.

	O_3	CH_4
CLE TM3	0.075	0.167
CLE STOCHEM	0.041	0.125
MFR TM3	–0.073	0.004
MFR STOCHEM	–0.072	0.003
MFR-CH4	0.029	–0.039
MFR-pol	–0.030	0.221
IPCC-TAR B1-A1FI 2000–2030	0.08–0.31	0.06–0.16

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but there is a worrisome post-2030 growth in emissions