Results from aerosol model intercomparisons HTAP and plans of AEROCOM

Michael Schulz

Frank Dentener, Christiane Textor, Kees Cuvelier
Mian Chin, Dorothy Koch, Isabelle Bey, Stefan Kinne
and “HTAP team”

LRTAP Long-range Transboundary Air Pollution

Task Force on Hemispheric Transport of Air Pollution

HTAP Workshop, Juelich, October 17, 2007

HTAP-AeroCom experiment

5 base runs: **4 anthropogenic, 3 dust,** and **4 biomass burning**

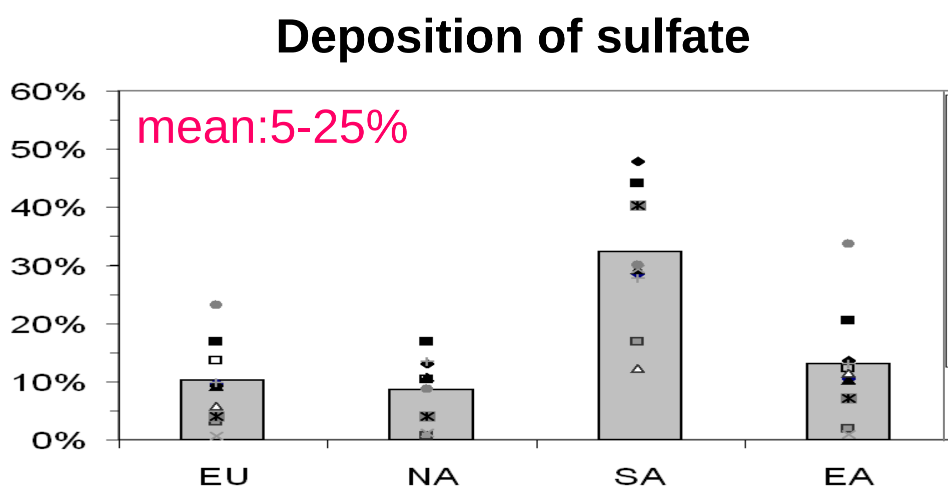
Description	Purpose
Base case simulation for year 2001 with “best estimated” anthropogenic and natural emissions.	Reference/verification
Reducing anthropogenic aerosol emissions by 20% in EA, EU, NA, and SA	Source – receptor relationships
No anthropogenic emissions in 4 HTAP regions	Investigate total effect versus 20%
No dust emissions in 3 dust source regions	Assessing impact of regional dust on air quality & ecosystems
No biomass burning emissions in 4 sectors	Assessing maximum impact of regional and long-range transport of biomass burning aerosol

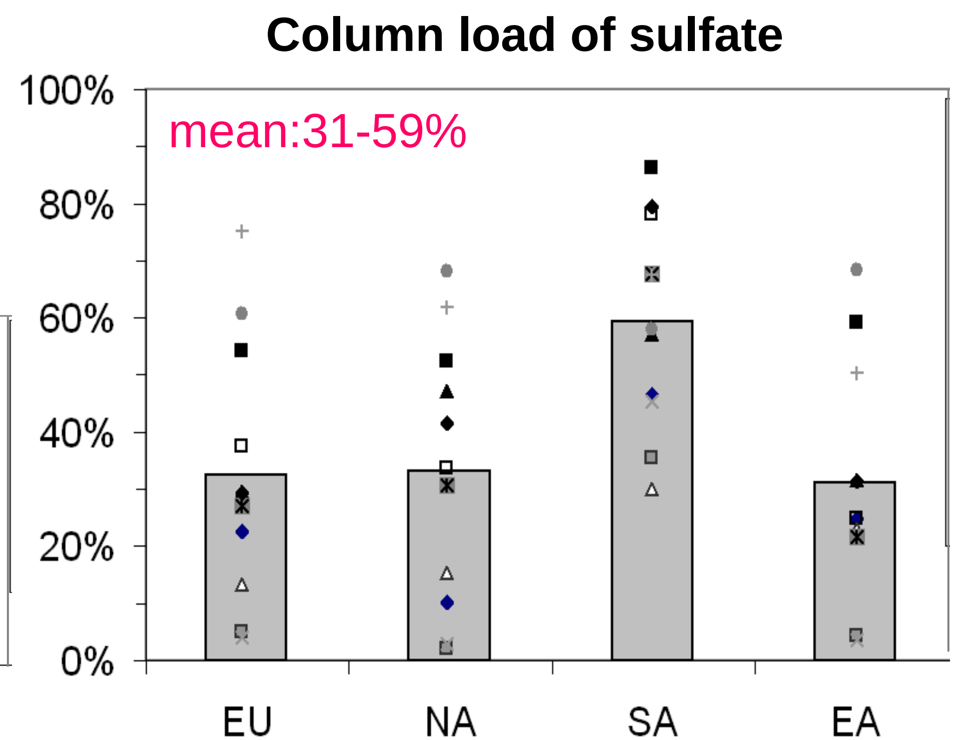
“zero experiments” to assess the maximum impact of long-range transport

Aerosol simulations from 17 models, 8-11 included in analysis

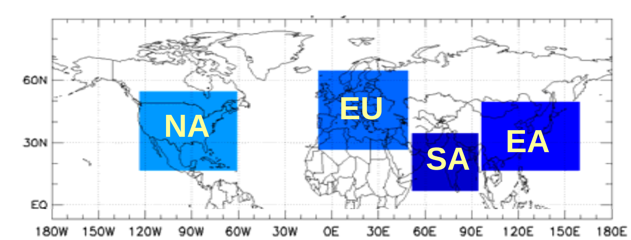
Model/version	**Institute**
CAMCHEM-3311m13	National Center for Atmospheric Research, Boulder, CO, USA.
ECHAM5-HAMMOZ	LMCA, EPFL, Lausanne, Switzerland
EMEP-rv26	Norwegian Meteorological Institute Oslo, Norway.
GEMAQ-EC	Environment Canada, Canada
GEOSChem-v07	Harvard University, Cambridge, USA
GISS-PUCCINI-modelA	NASA GISS Goddard Institute for Space Studies, New York, USA
GISS-PUCCINI-modelE	NASA GISS Goddard Institute for Space Studies, New York, USA.
GMI-v02a	NASA GSFC (Goddard Space Flight Center), Greenbelt, MD, USA.
GOCART	NASA, USA
INCA-v2MS	IPSL, Paris, France
LLNL-IMPACT-T5a	Lawrence Livermore National Laboratory, Livermore, CA, USA.
MOZARTGFDL-v2	Geophysical Fluid Dynamics Laboratory, Princeton, NJ, USA
OsloCTM2	Oslo University, Norway.
SPRINTARS-v356	RIAM, Kyushu University, Japan
STOCHEM-v02	Hadley Centre, Met Office, UK
TM5-JRC-cy2-ipcc-v1	European Commission, Joint Research Center, Italy
ULAQ	University of L’Aquila, Italy

Response import fractions of the four HTAP regions



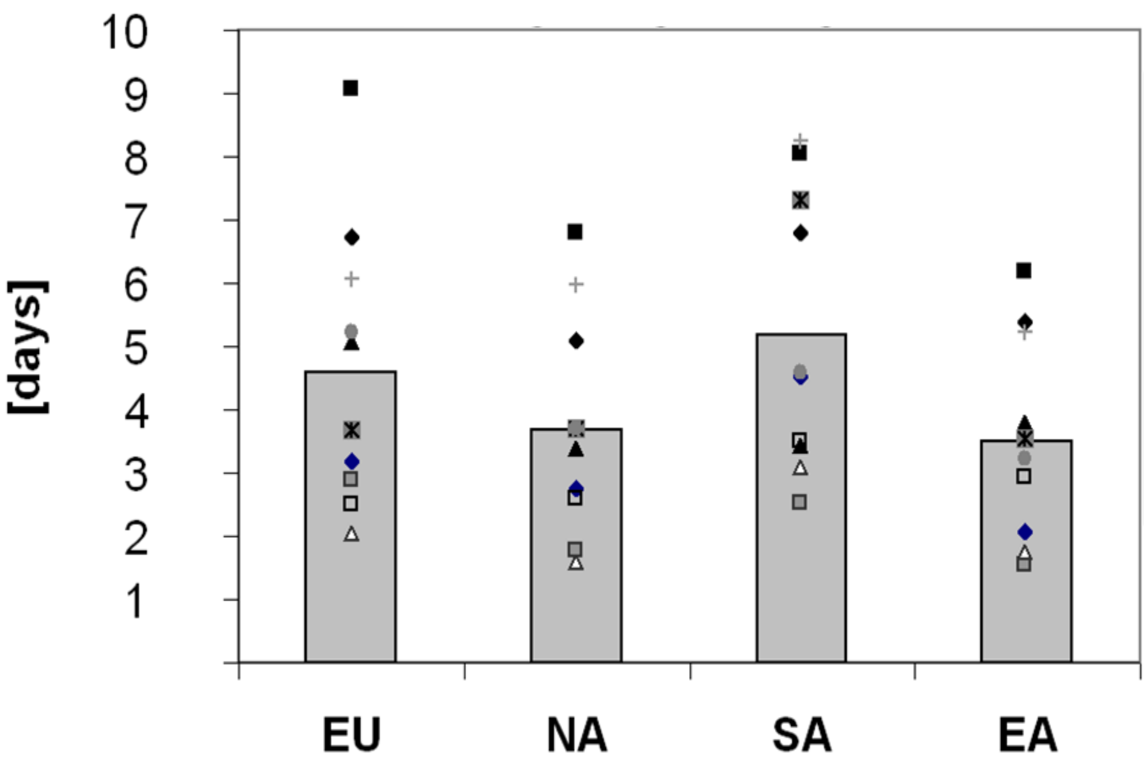


Much higher influence on column load than on surface conc. and deposition



annual means for 2001

Residence time τ of anthropogenic sulfur

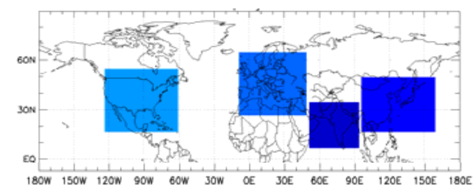


HTAP models

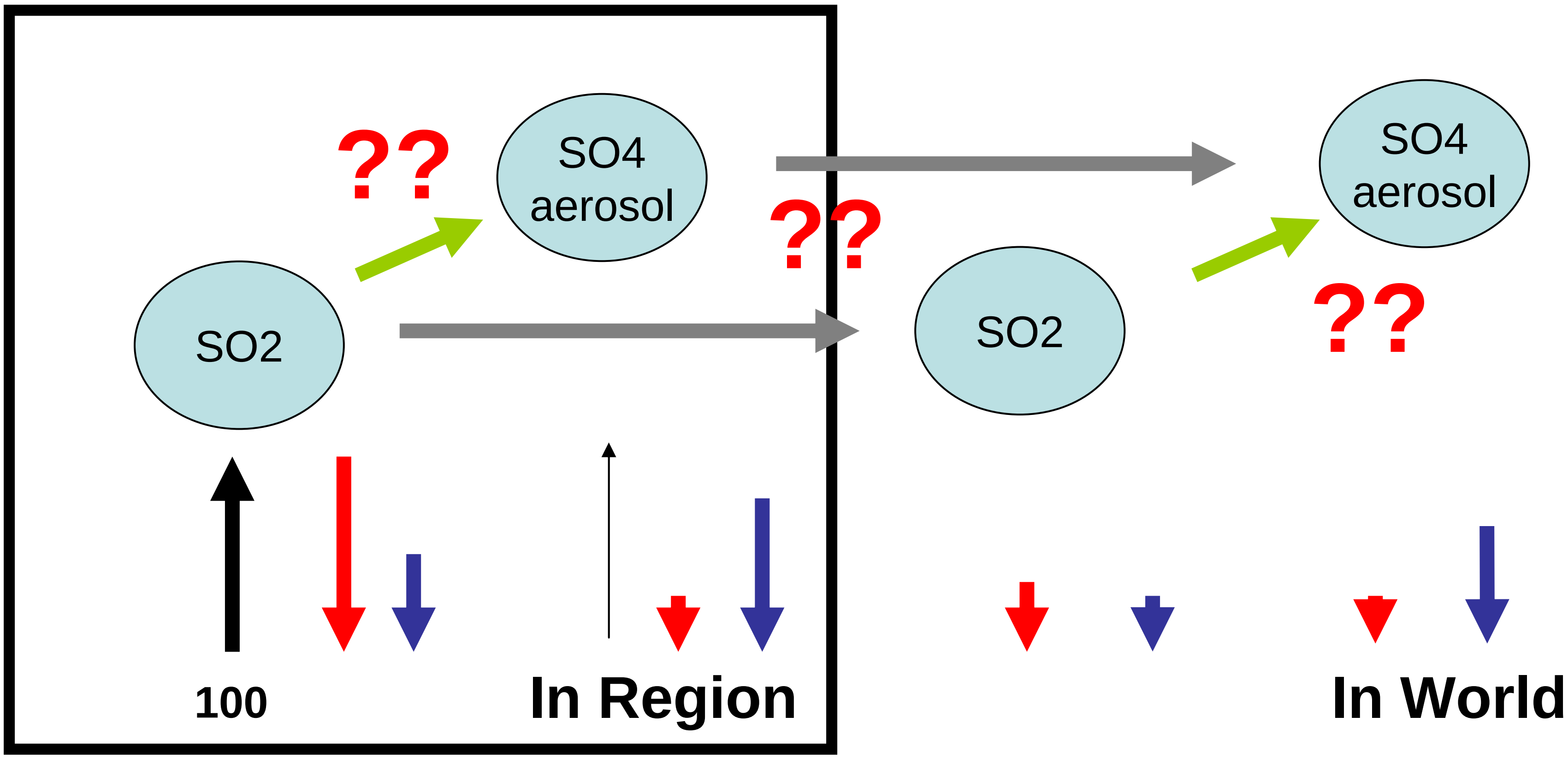
Residence time τ
$= \Delta$ load / Δ deposition flux

Δ : Response to perturbation of domestic emissions

- Large differences in τ (factor 4)
- Models with larger τ show larger export
- Importance of simulated processes



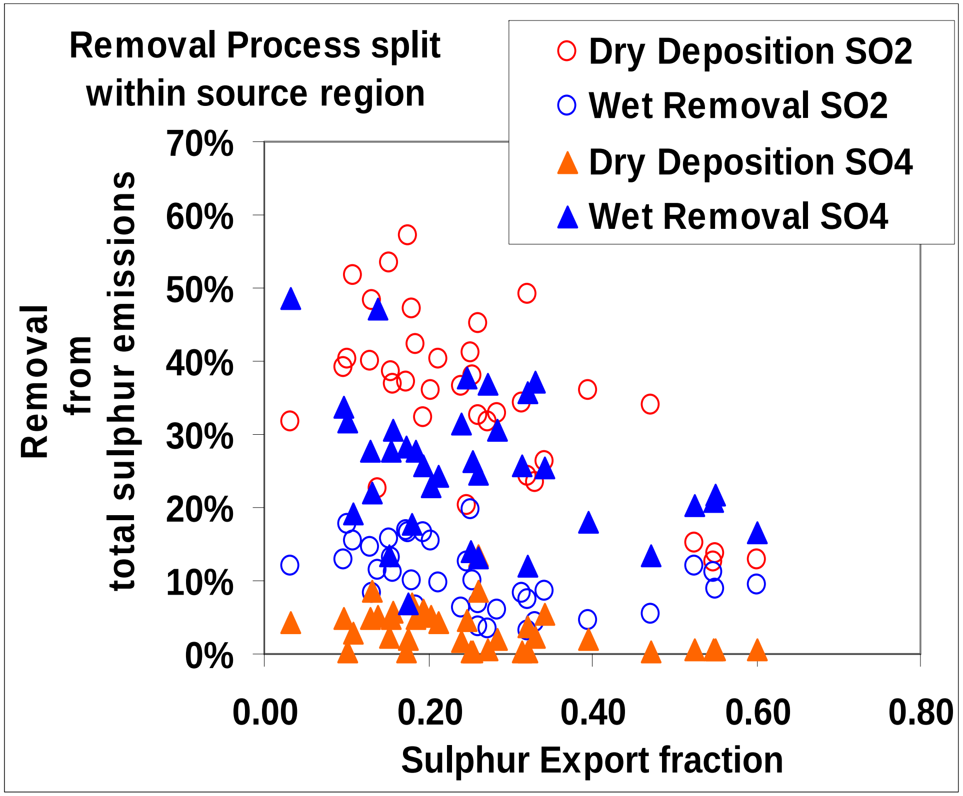
HTAP models sulphur budgeting

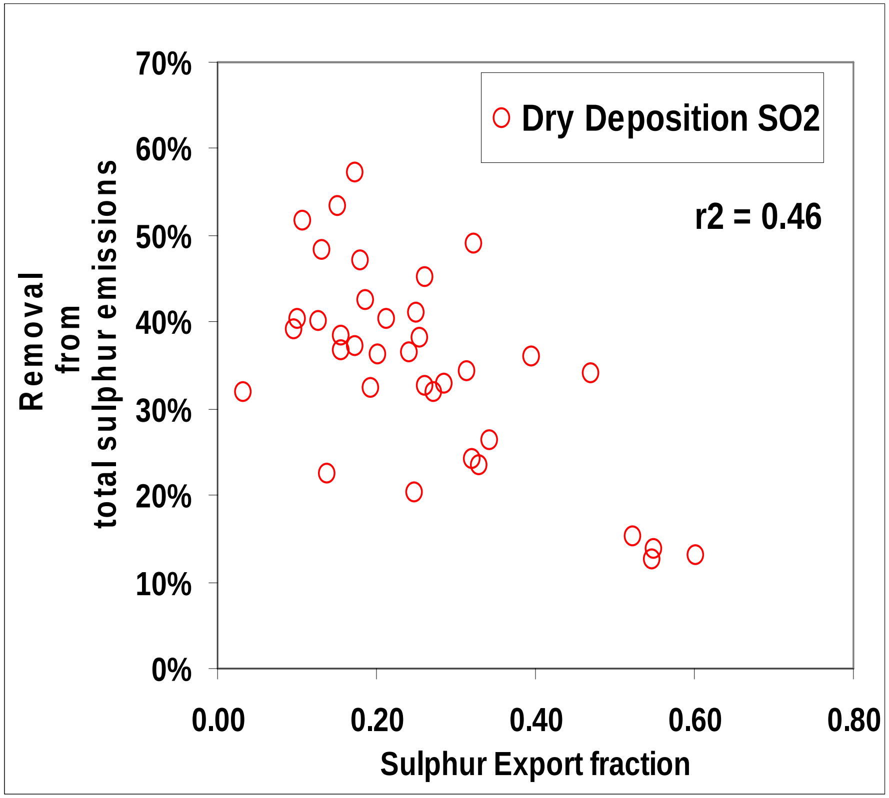


From total [%] : 35 10 3 25 4 2 1 18

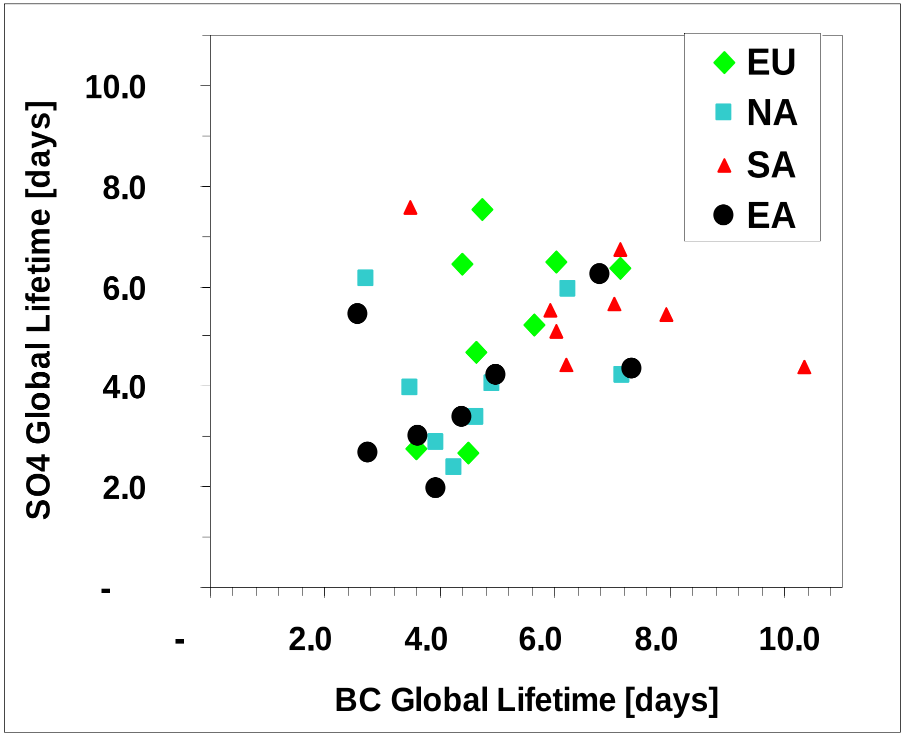
Emission / Chemical production / Dry Deposition / Wet Deposition / Transport

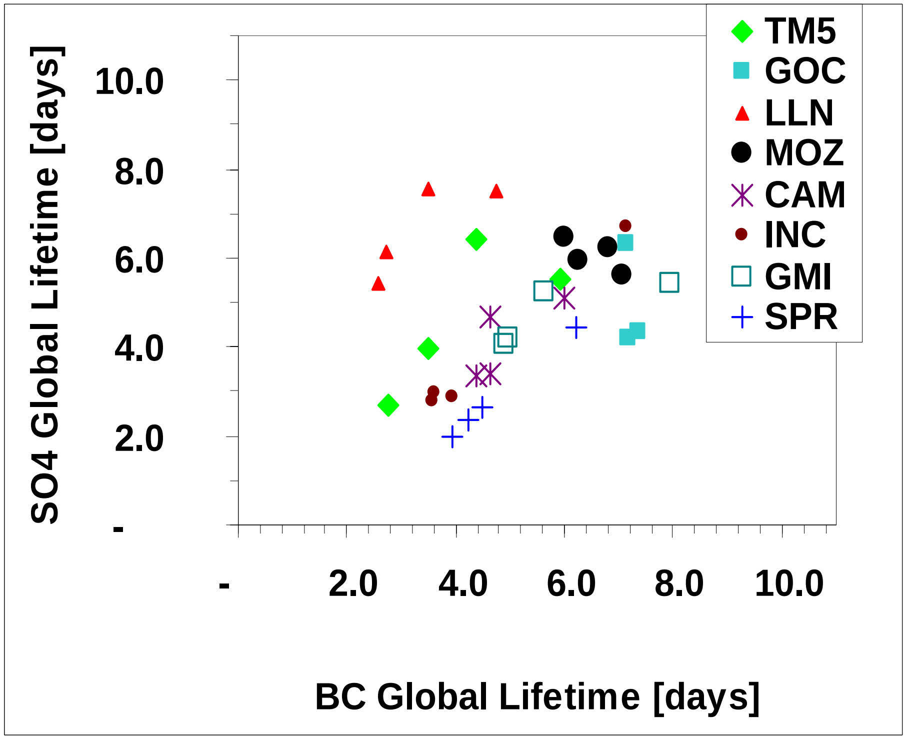
HTAP regional perturbation experiment results





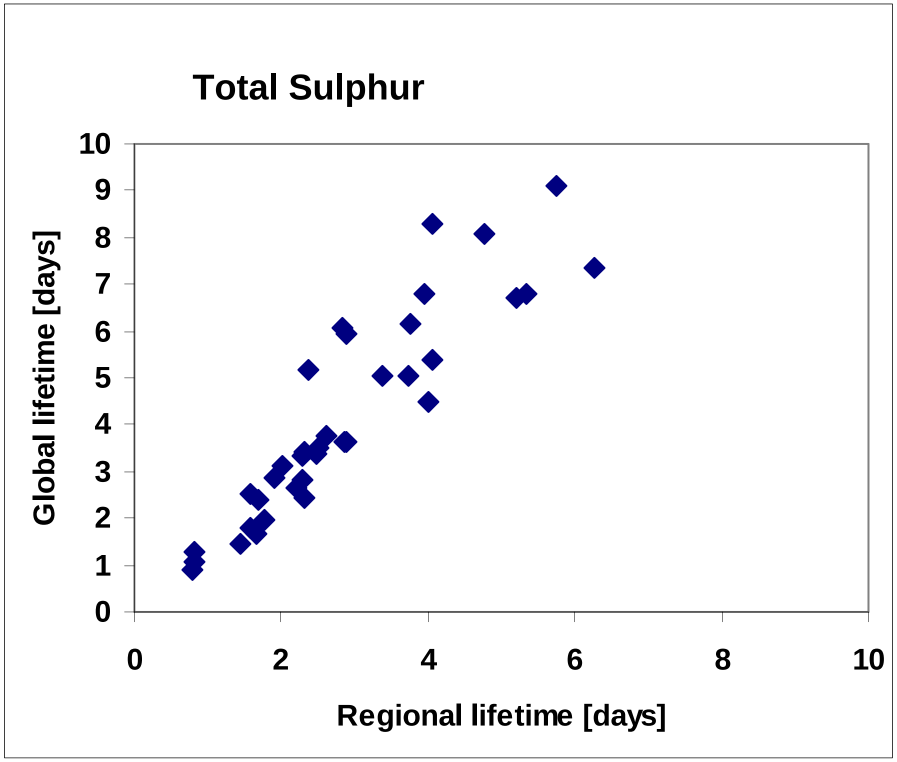
HTAP regional perturbation experiment results

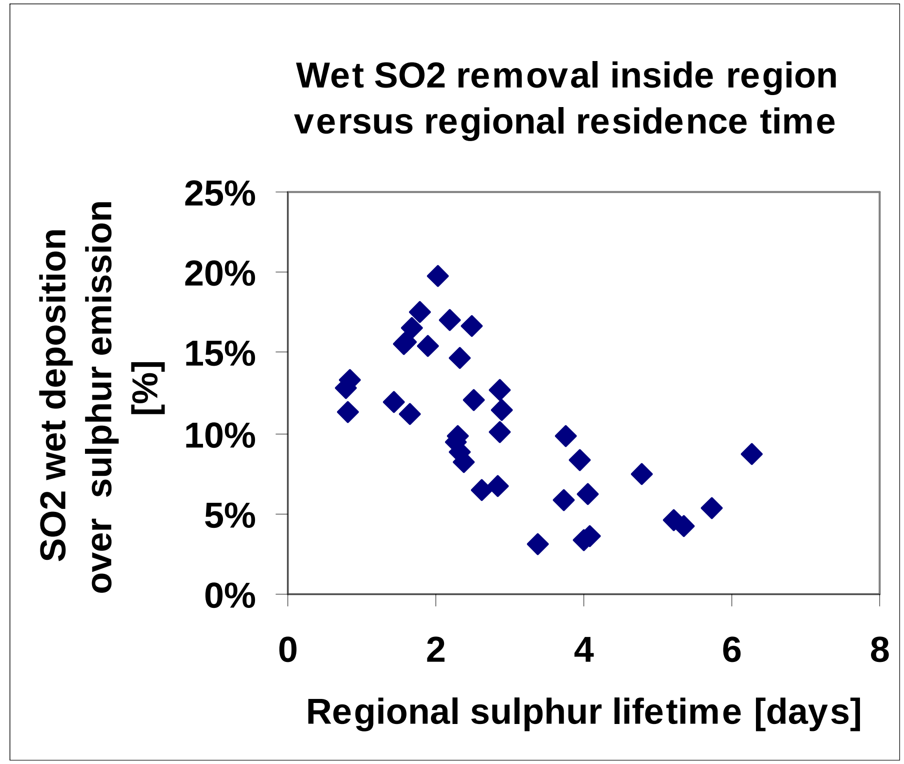




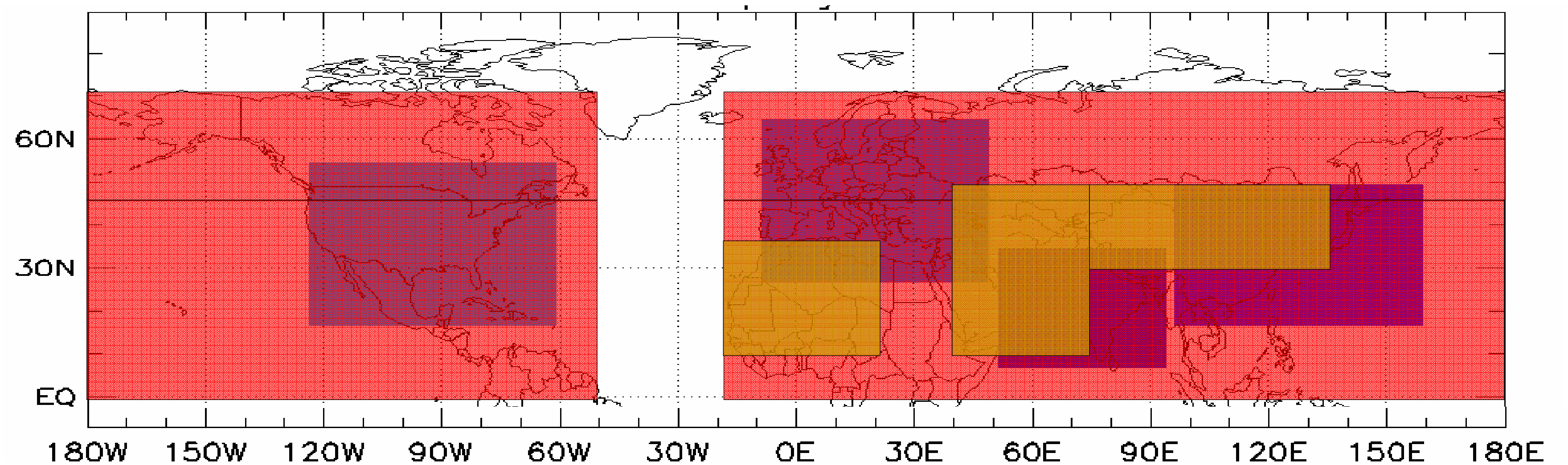
Colored
Per source region ----- Per model

HTAP regional perturbation experiment results





Additional HTAP source-receptor regions



Name	Region	Longitude	Latitude
EA	East Asia	95E – 160E	15N – 50N
SA	South Asia	50E – 95E	5N – 35N
EU	Europe + North Africa	10W – 50E	25N – 65N
NA	North America	125W – 60W	15N – 55N
AS	Dust: Asia	75E – 135E	30N – 50N
ME	Dust: Middle East	40E – 75E	10N – 50N
AF	Dust: Africa	20W – 40E	10N – 36N
NE	Fire: Boreal regions in Asia and Europe	20W – 180E	45N – 70N
NW	Fire: Boreal regions in North America	180W – 50W	45N – 70N
SE	Fire: Tropical and mid-lat regions in Asia, Europe, and northern Africa	20W – 180E	0 – 45N
SW	Fire: Tropical and mid-lat regions in North America and South America	180W – 50W	0 – 45N

TP: Inert Tracer Studies

- Rationale
  - To study differences between models due to dynamical processes without the confounding influences from emissions and chemistry
  - To shadow the full chemistry/aerosol experiments so that they can be used as an aid in interpretation
  - To address additional science goals where possible

- Characteristics
  - Light, low-demand simulations with dynamics only
  - Output specs closely match full HTAP runs (CMOR, etc.)

TP1x: Experiment TP1 extended

- Make inert tracers more CO-like
  - Extend e-fold lifetime of CO from 25 to 50 days
- Look at use of hydrocarbon ratios as clocks of ICT
  - Add three new VOC species with first-order removal
    - C_4H_{10}-like (5.6 days), C_3H_8-like (13 days), C_2H_6-like (64 days)
    - Comparison with observations
    - Soluble CO tracer ???

- Request high temporal resolution output for short period
  - Focus on Mar/Apr 2001 to cover TRACE-P/ACE-Asia period
  - Allows a more critical test of key export/transport processes