



Evaluation of Global and Regional Gridded Distribution of Emissions

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Studies where accurate emissions are needed at different scales

- Long-term changes in atmospheric composition**
- Quantification of chemistry-climate interactions**
- Forecasting of the chemical composition at global and regional scales**
- Interpretation of observations**
 - at the global scale (satellites),**
 - at the regional scale (aircraft campaigns)**
 - at local scale (surface stations)**

Evaluation of surface emissions

→ 1980 - 2010 period

→ Anthropogenic and biomass burning emissions

1st part of a comprehensive study

→ Total emissions over all sectors

→ Emissions for a few regions

→ Focus on: CO, NO_x, SO₂ and BC

Outline

1. Description of a new inventory for 1900-2100, developed for IPCC simulations
2. Evaluation of anthropogenic emissions
3. Evaluation of biomass burning emissions
4. Conclusions

Why a new inventory?

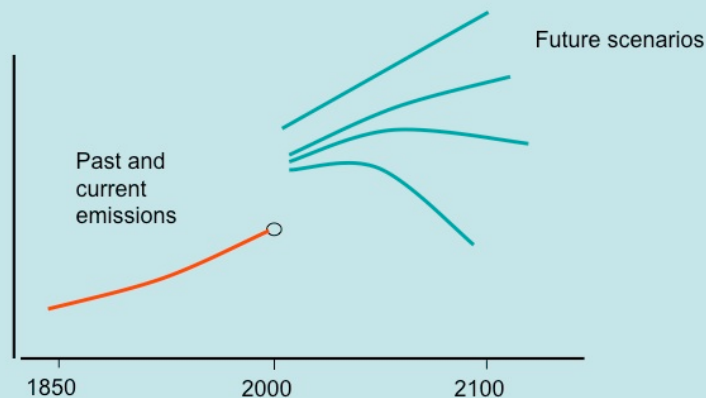
IPCC AR5: simulations started in 2009: start 1850, up to 2100

No emissions dataset existed covering the full period, and discontinuities in 2000 between past/current and future emissions

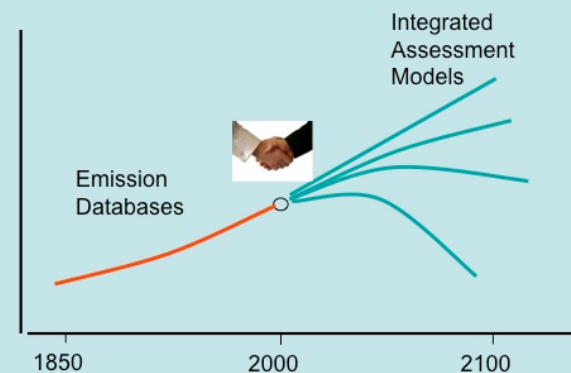
GENERAL APPROACH 2000 is the anchor year. Regional data used if possible. Choose “best” data set for each chemical for each sector for data up to 2000.

Sectors Shipping, aviation, land transport, energy, solvents, waste, residential, industrial processes, agricultural waste burning, animals, savanna waste burning, deforestation, and natural emissions.

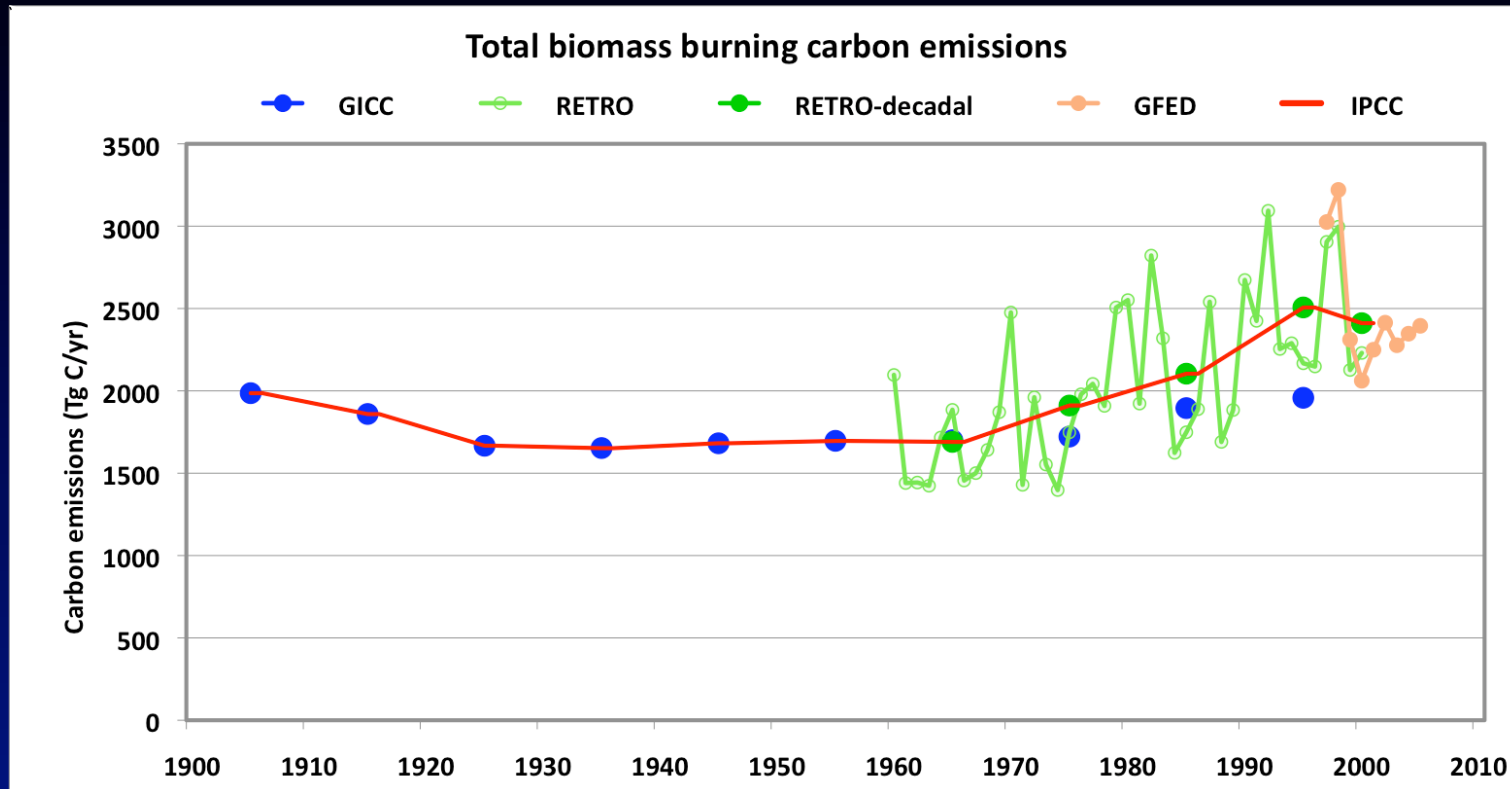
Emissions IPCC AR4



IPCC AR5: The Handshake Process



Example of the methodology: biomass burning emissions



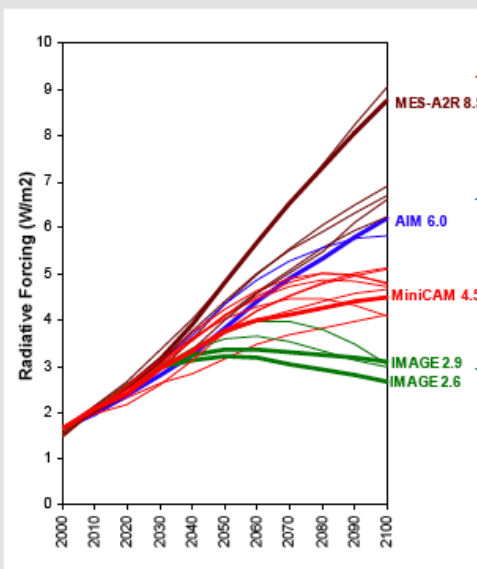
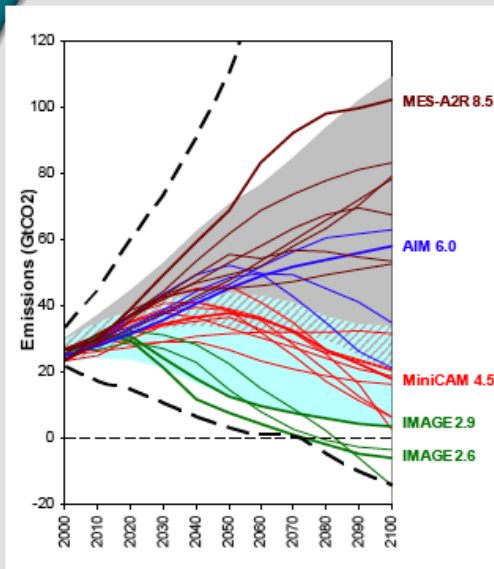
- Methodology and results discussed in Lamarque et al. (ACP, 2010)
- Emissions provided every 10-year

After 2000: IPCC scenarios, now called RCPs
= Representative Concentration Pathways

Definition based on total radiative forcing in 2100, i.e.
mostly constrains CO₂ emissions

RCP 8.5 = 8.5 Wm⁻² forcing in 2100

CO₂ Emissions and Total Radiative Forcing



Graphs: Detlef van Vuuren

IIASA, Austria

NIES, Japan

PNNL, USA

RIVM,
Netherlands

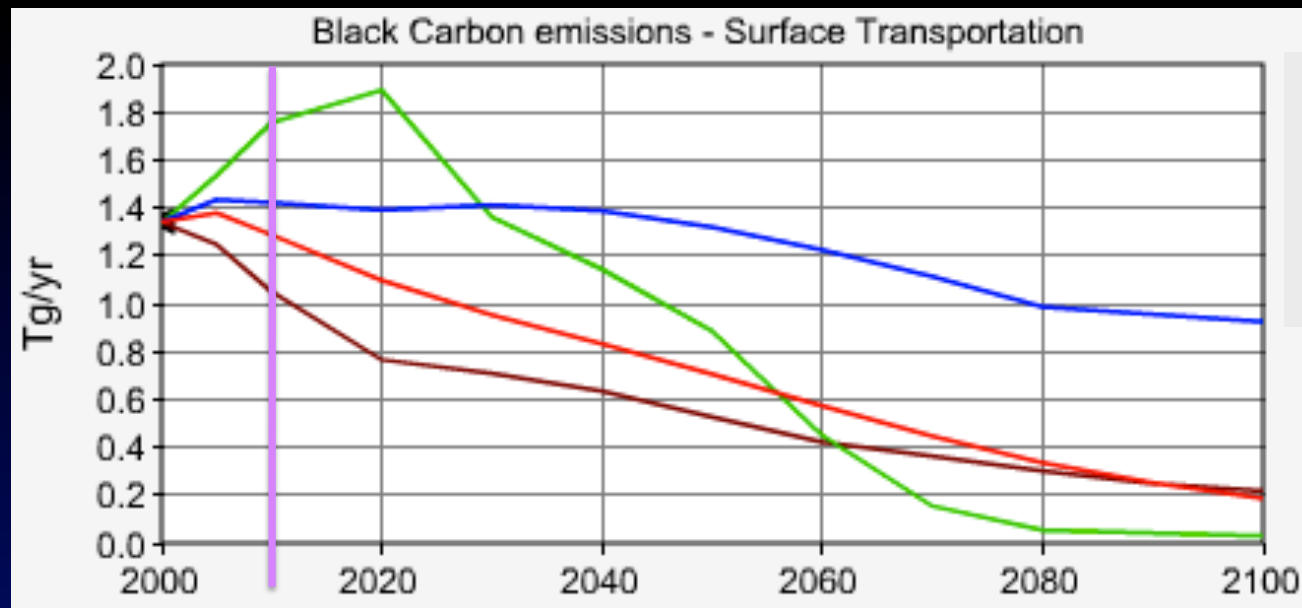
Post-2000 global emissions

→ After 2000, no global emissions dataset was available

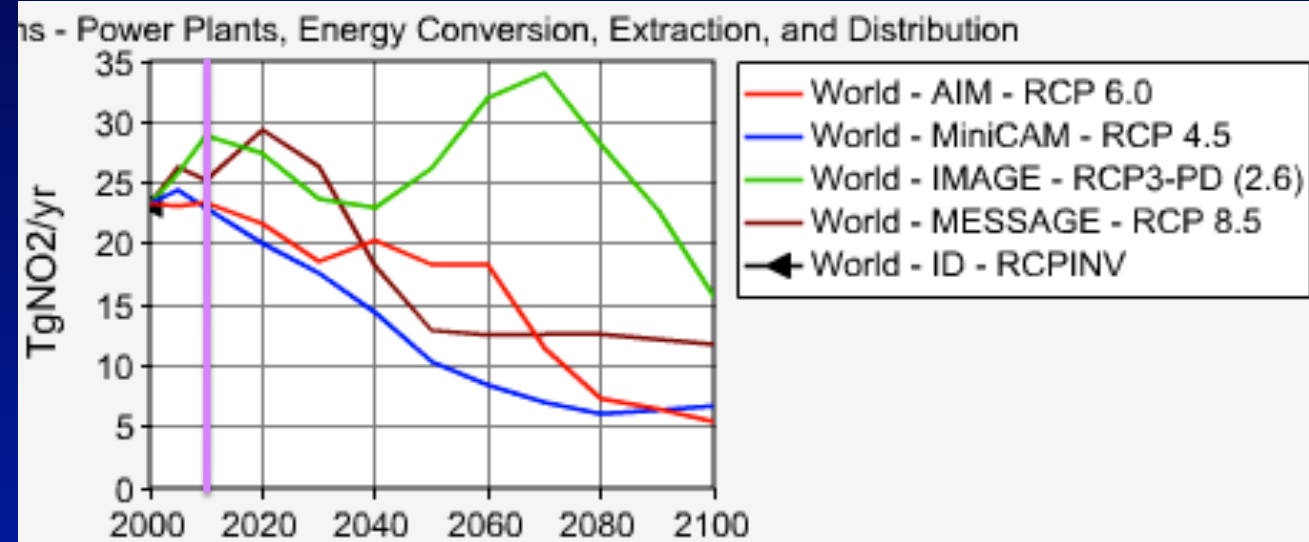
- Since mid-August 2010, EDGAR v4 provides 2005 global emissions, but not evaluated yet, and not considered for now**

→ To obtain 2000-2010 emissions for each year for model simulations:

- Use of emissions provided by RCP 8.5 scenario**
- Interpolation between 2000 and 2005-2010 future emissions**
- Test these emissions: comparisons with inventories and use in global chemistry-transport models**



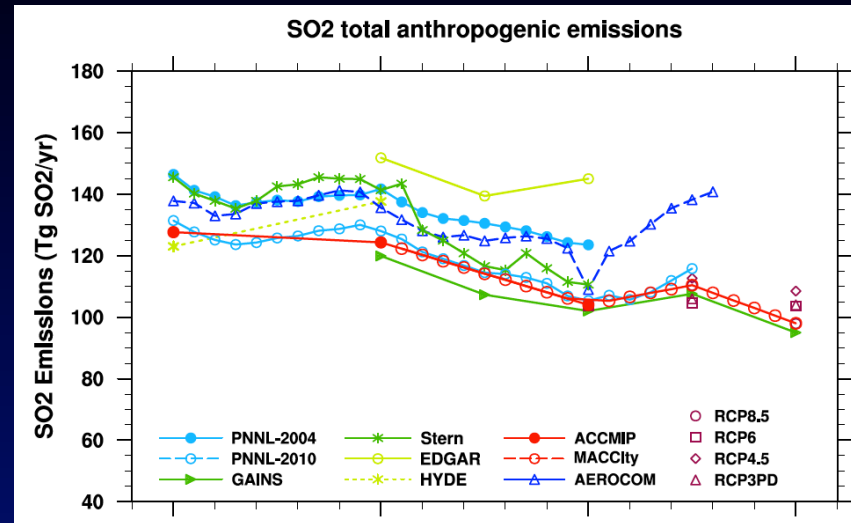
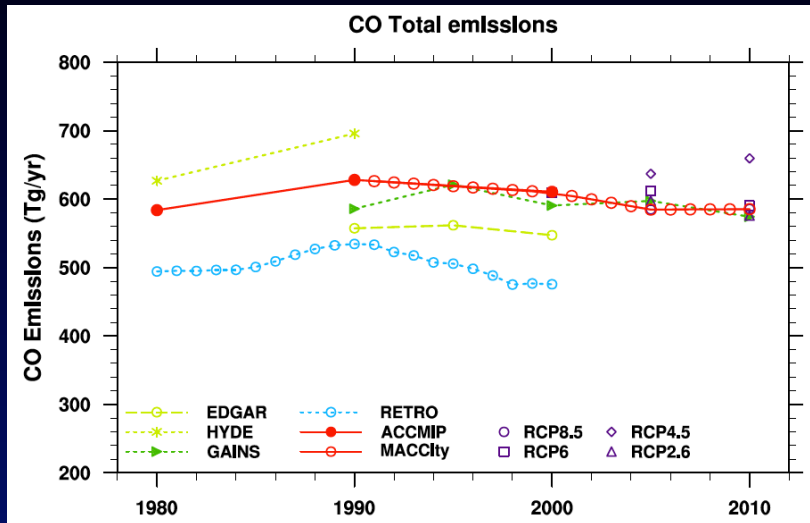
BC



NO₂

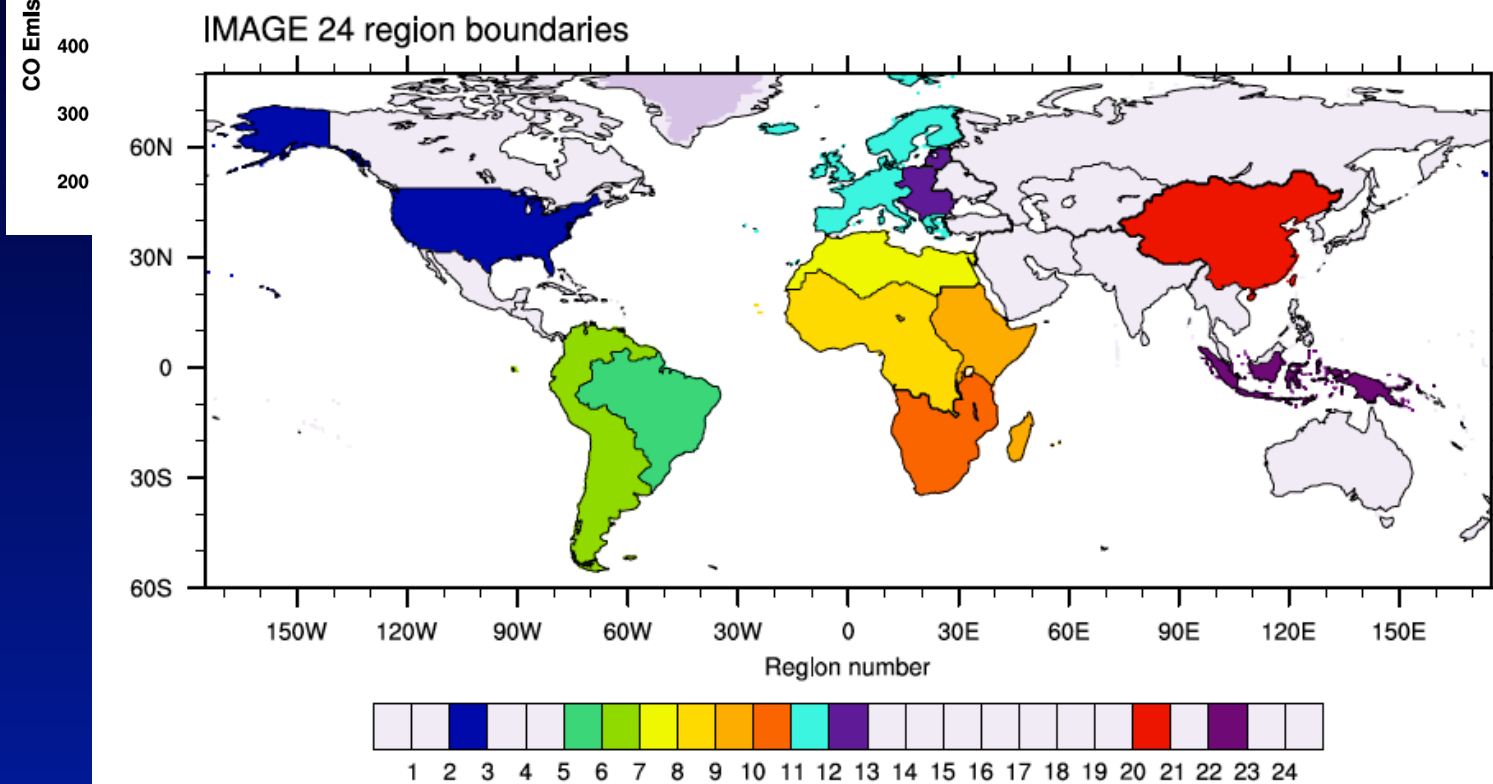
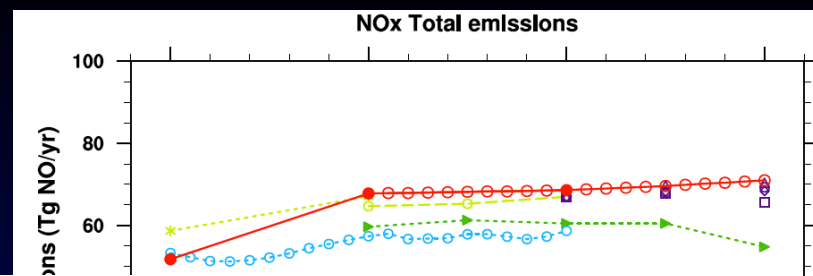
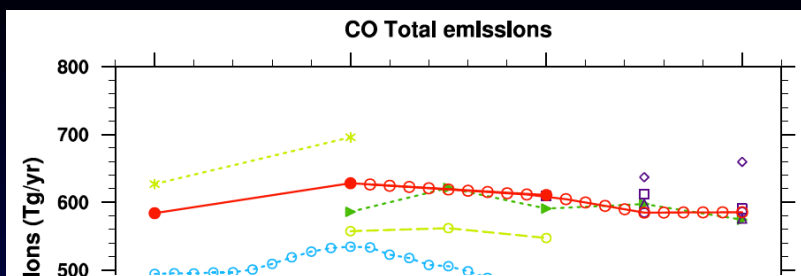
Are these emissions accurate?

- First results of a systematic evaluation of surface emissions:
within GEIA (Global Emissions Inventory Activity)
Funded by the MACC and CITYZEN European projects**
- Open to all people willing to propose new data /
analyze results**
- Start with the 1980-2010 period**
- Only publicly available gridded inventories considered
so far**
- Focus on: CO, NO_x, SO₂ and BC**
- Assess whether the post-2000 scenarios are close to
regional emissions available after 2000**

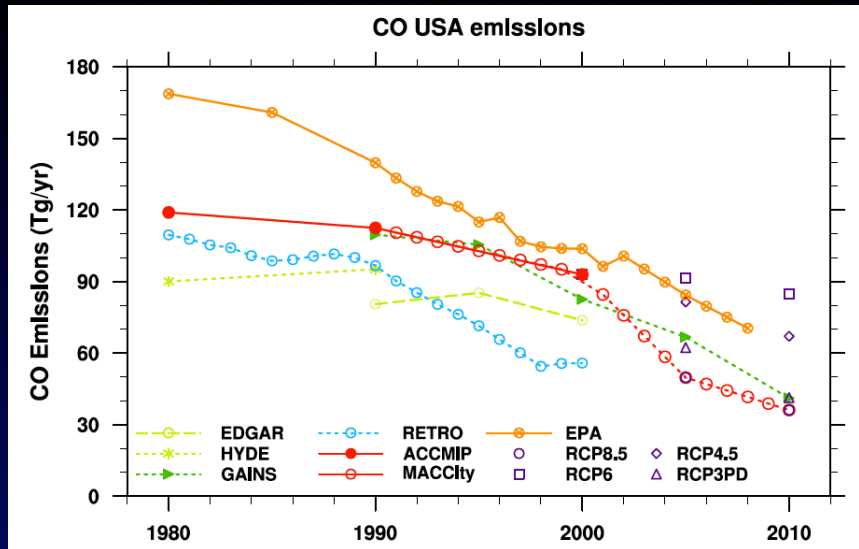


Comparison of CO and SO2 total emissions

Where are the main differences coming from?



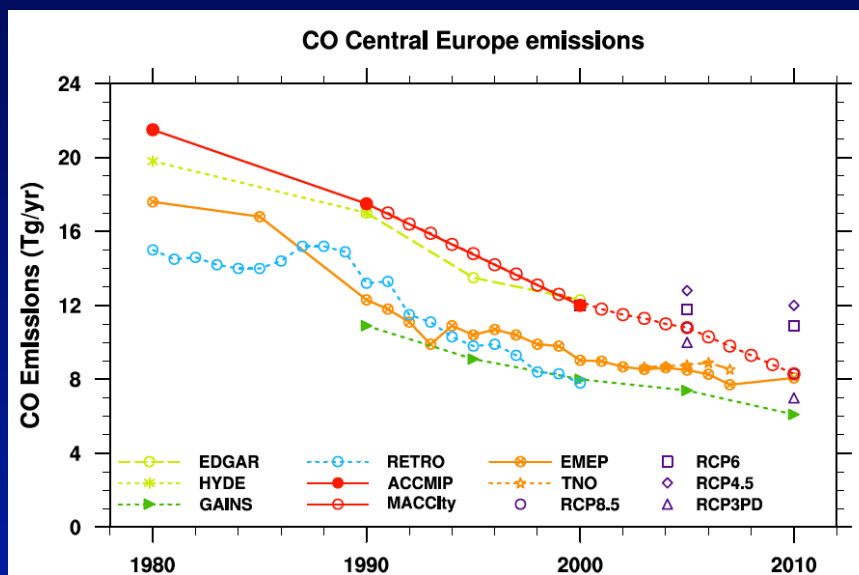
2010



CO USA:

Global inventories

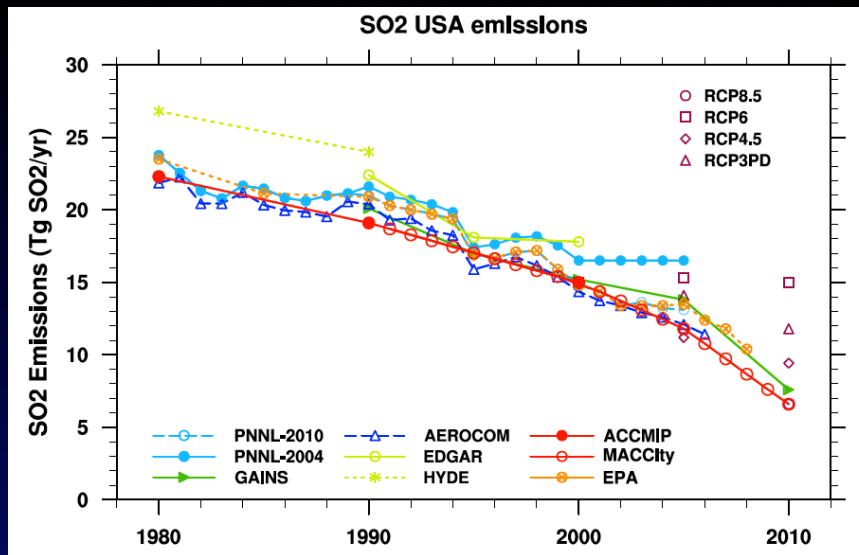
+ EPA US inventory



CO Central Europe:

Global inventories

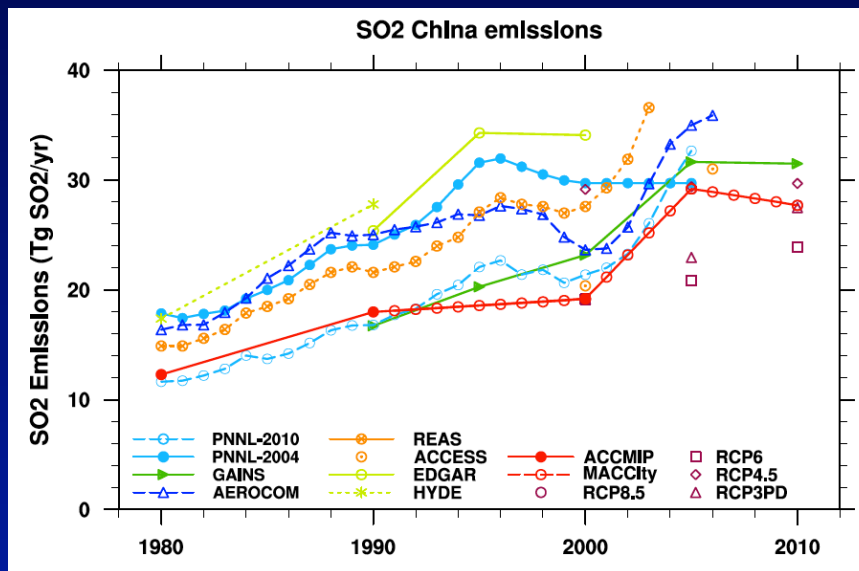
+ EMEP and TNO EU inventories



SO2 USA:

Global inventories

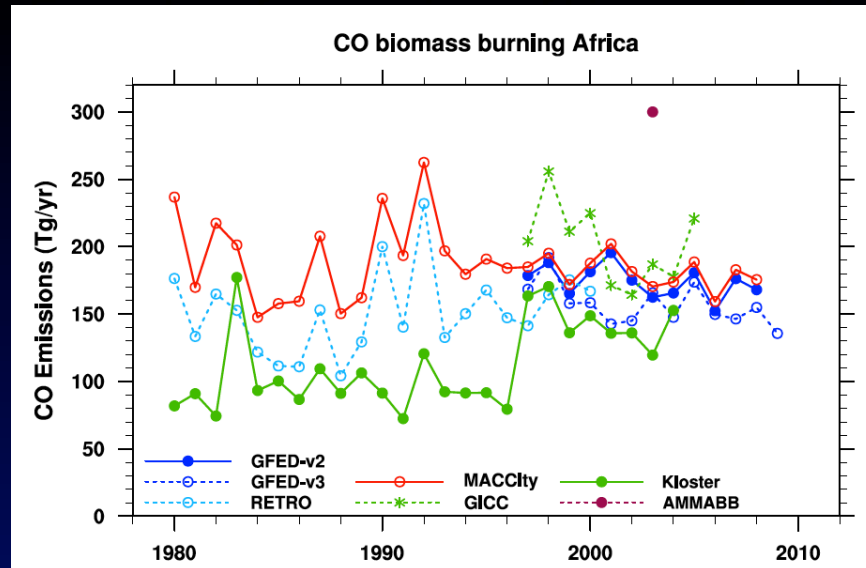
+ EPA US inventory



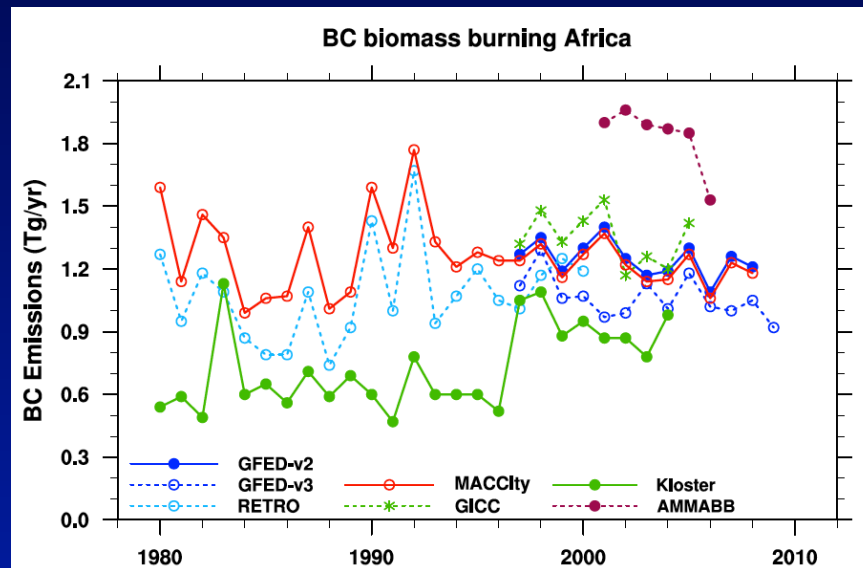
SO2 China:

Global inventories

+ REAS and ACCESS regional inventories



Biomass burning in Africa: CO and BC emissions



AMMABB values:
→ Very different from other
datasets

But the most consistent
with:

- Observations
- Inverse modeling studies

Summary: ratio between highest and lowest emissions

		1980	1990	2000	2005
BC					
	Total	1.53	1.61	1.27	1.27
	Western Europe	2.08	2.04	1.29	1.28
	Central Europe	2.45	2.81	2.21	1.40
	USA	2.38	2.77	1.61	1.59
	China	1.64	1.31	2.12	1.29
CO	Total	1.27	1.33	1.28	1.29
	Western Europe	1.34	1.55	1.77	1.30
	Central Europe	1.43	2.11	1.76	2.10
	USA	1.87	1.73	1.86	1.83
	China	1.34	1.54	1.43	1.17
NO_x	Total	1.10	1.25	1.23	1.19
	Western Europe	1.14	1.18	1.20	1.18
	Central Europe	1.32	1.41	1.24	1.25
	USA	1.27	1.41	1.19	1.43
	China	1.91	1.66	1.31	1.42
SO₂	Total	1.19	1.28	1.54	1.35
	Western Europe	1.25	1.49	2.35	2.35
	Central Europe	2.04	1.37	2.08	2.71
	USA	1.23	1.26	1.20	1.47
	China	1.45	1.66	1.87	1.68

Green:
1 to 1.25

Yellow:
1.25 to 1.5

Orange:
1.5 to 1.75

Grey:
Above 1.75

Conclusions

- Several global/regional inventories compared
- Comparisons of emissions of CO, NO_x, SO₂ and BC
 - large differences in emissions and trends
 - lowest differences for NO_x, largest for BC
 - RCP 8.5 provide reasonable emissions for 2000-2010
 - Most biomass burning emissions (at least in Africa) seem to provide underestimations of emissions
- Paper to be submitted to Climatic Change

Future work

- Understand the origin of differences → comparisons by sector
But sectors considered vary among inventories
→ Only possibility for now: traffic / non-traffic emissions
- Extend to more species:
 - VOCs: under way, but species available depend, and regional inventories do not provide always speciation
 - Add OC to BC: regional inventories provide PMs, so comparisons currently not possible
- Make more comparisons using on-line tools under development within ECCAD and CIERA.