

comparison of anthropogenic emissions among AeroCom-II inventories

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and Angelika Heil**

AeroCom emissions

	AeroCom – II ACCMIP	ACCMIP	AeroCom –II HCA0 v1/v2	AeroCom - I
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temporal resolution	1850,1980-2010 yearly monthly	1850-2100 decadal monthly	1980-2006 yearly	1750, 2000 yearly monthly
spatial resolution	0.5°x0.5°	0.5°x0.5°	1°x1°	1°x1°
unit	kg/m2/s	kg/m2/s	kg/grid/yr	kg/grid/yr
species	BC, OC, SO₂, CO, CH₄, NH₃, NO_x	BC, OC, SO₂, CO, CH₄, NH₃, NO_x, VOC	BC, OC, SO₂ updated SO₂	BC, OC, SO₂, DU, SS, SOA
sectors	8 anthr, ship, air 2 bb (GFED-2 and RETRO)	8 anthr, ship, air 2 bb (GFED-2)	8 anthrop 2 bb (GFED-2)	8 anthrop 2 bb (GFED-1)

must know ... about AeroCom-II ACCMIP

- annual AeroCom-II ACCMIP emission (i.e. 1850, 1980 to 2000) were calculated by linear time interpolation of ACCMIP decadal data
- annually varying monthly biomass until 2008
- use of rcp8.5 scenario for 2000-2100 period
- addressed are: anthropogenic and biomass burning emissions of seven selected species
 - **BC, OC, CO, CH4, NH3, SO2, NOx**
- aircraft emissions are stored in separate (annual) files ... because of their 3D nature

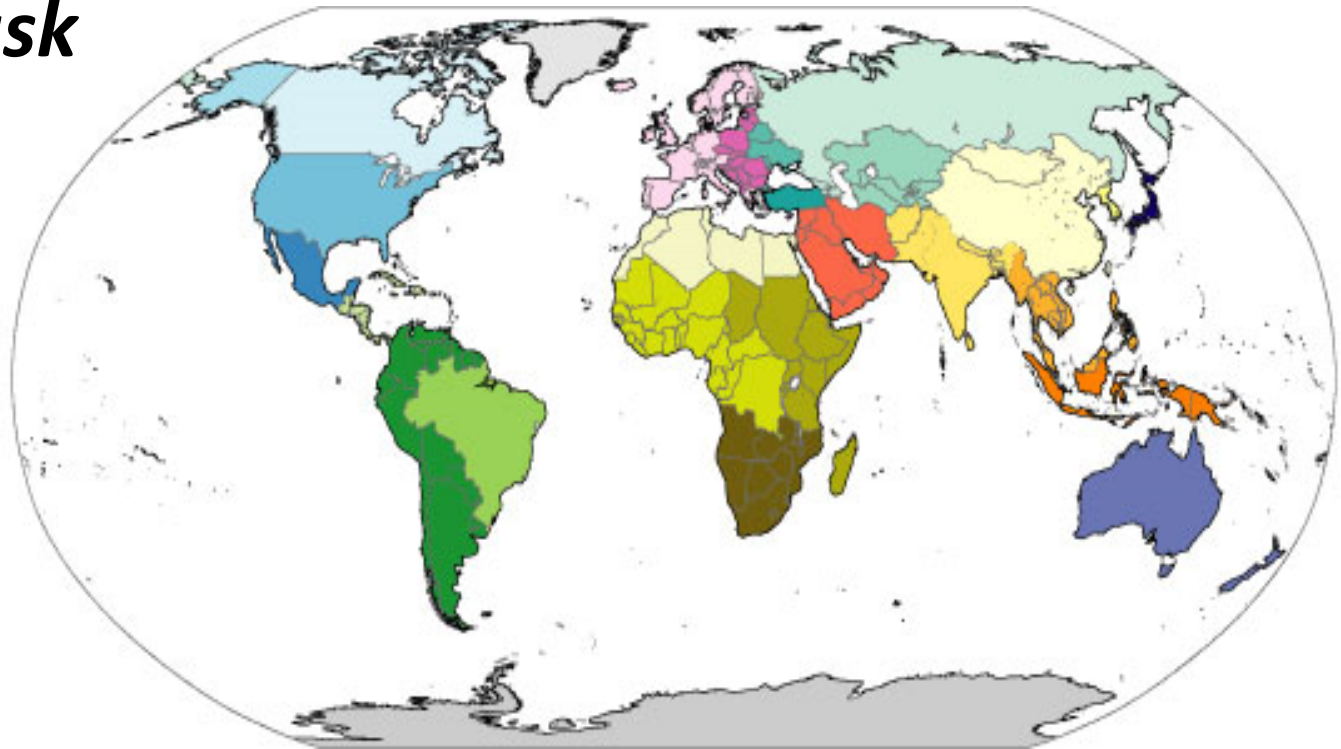
ancillary data ... of AeroCom-II ACCMIP

- ***grid area***

- the grid area for each 0.5deg horizontal grid cell
(in m² assuming an earth radius of 6371000 meters)

- ***region mask***

- based on
IMAGE 24



must know ... AeroCom -II HCA0 v1/v2

yearly emission (1980 to 2006)

- **sub-micron aerosol**

- **fossil fuel**

- time-evolution and regional amounts by D.Streets
- **BC** (SPEW, 1996), **OC** (SPEW, 1996), **SO₂** (EDGAR, 2000)

- **wild-land fires**

- **BC, OC, SO₂** (GFED-2, before 1997: AVHRR-scaling)

- **aircraft** ... by Boeing (25 altitudes)

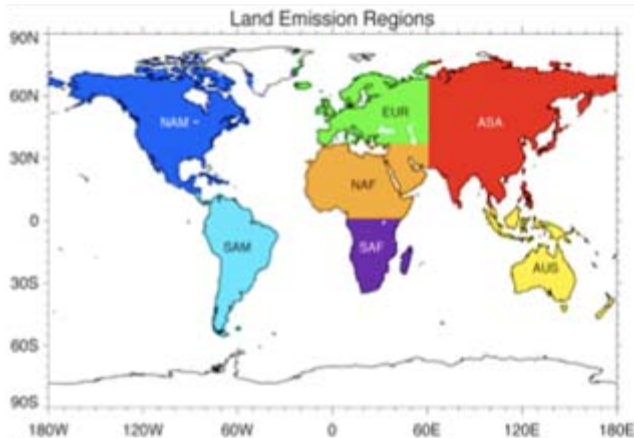
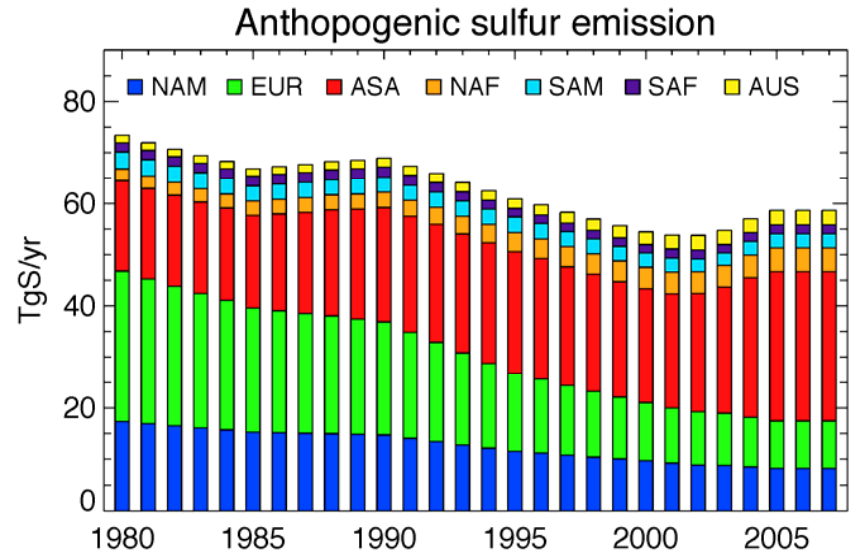
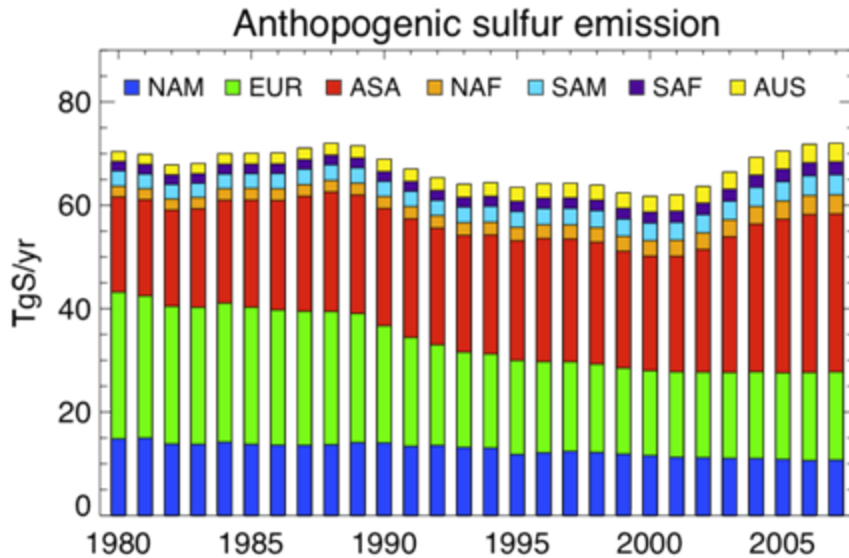
- **ship** ... by Eyring

- **volcanic aerosol**

- **explosive** ... via TOMS satellite data

- **continuous** ... from GEIA inventory

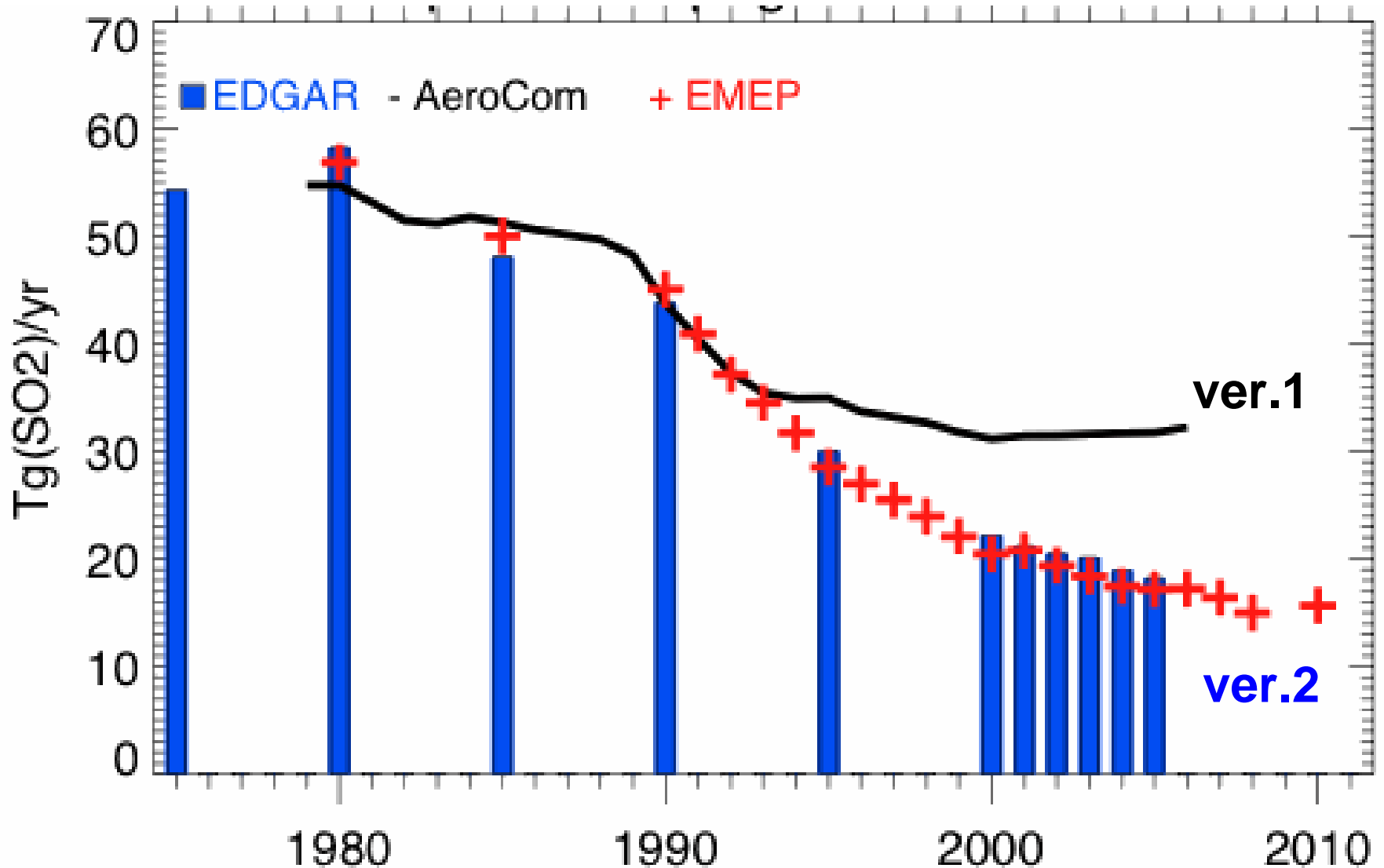
HCA0 v1 vs HCA0 v2



new v2 has diff. SO₂
edgar 2000 → edgar 4.1

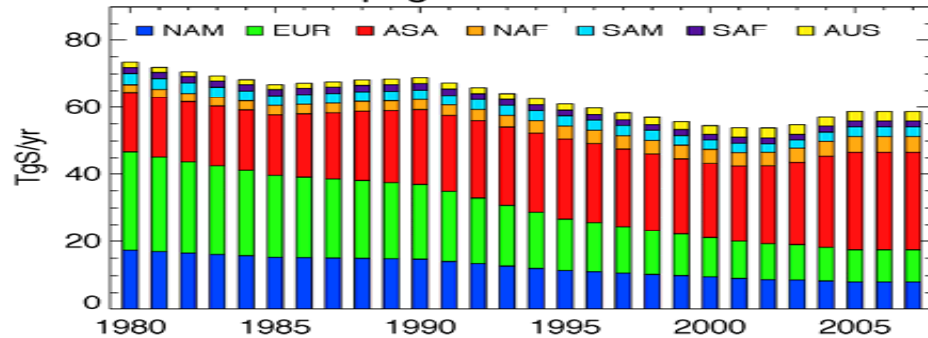
- less SO₂ over Europe
- more SO₂ over N.Africa

anthrop. SO₂ emissions over EU

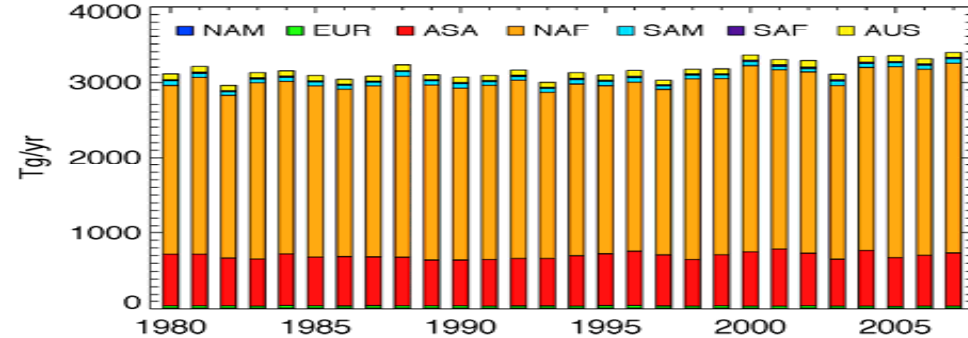


AeroCom - II HCA0 v2

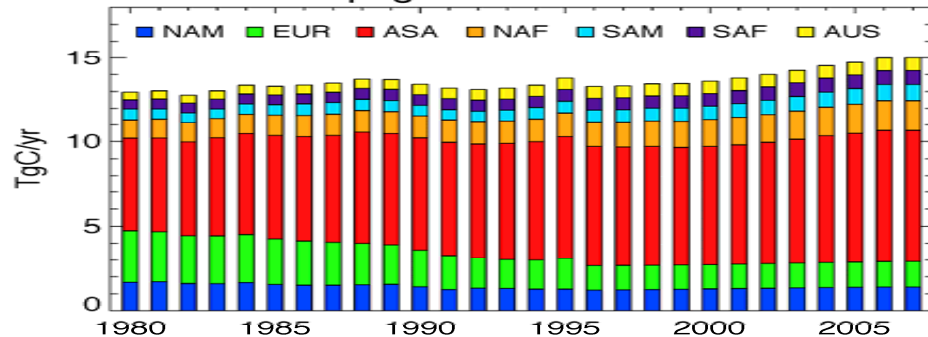
Anthropogenic sulfur emission



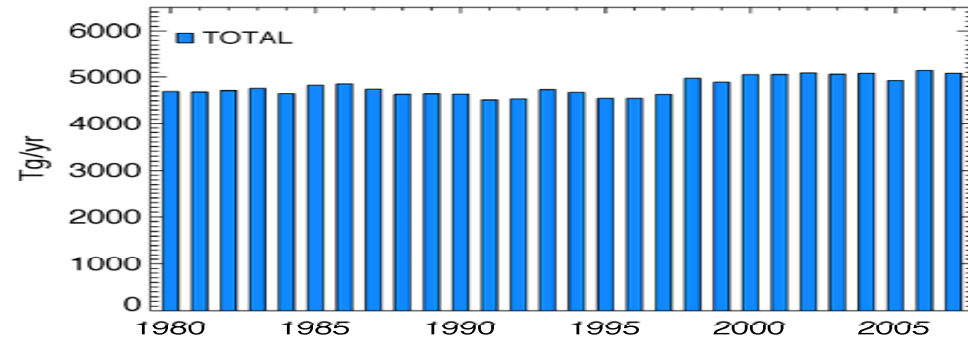
Dust emission



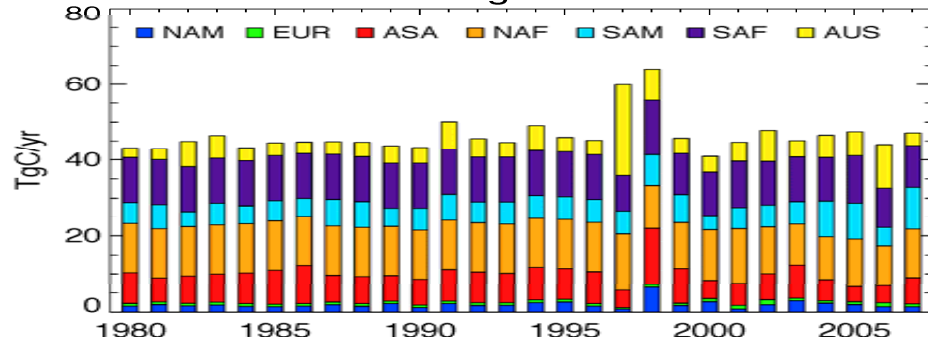
Anthropogenic BC+OC emission



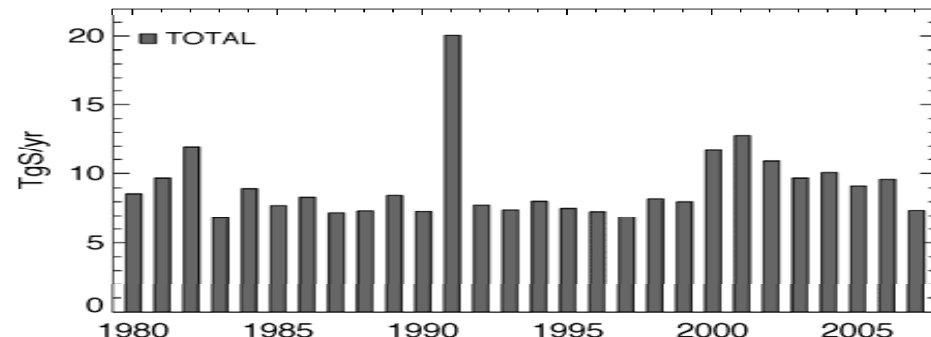
Sea salt emission



Biomass burning BC+OC emission



Volcanic SO2 emission



comparisons

- **ACCMIP**

“IPCC: ACCMIP-hist. / rcp 8.5”

- **AeroCom-II ACCMIP**

“MACCity: ACCMIP MACCity”

- **AeroCom-II HCA0 v1/v2**

“AeroComHC: AeroCom-HC”

anthropogenic emission - SO₂

ACCMIP

IPCC: ACCMIP-hist. / rcp 8.5

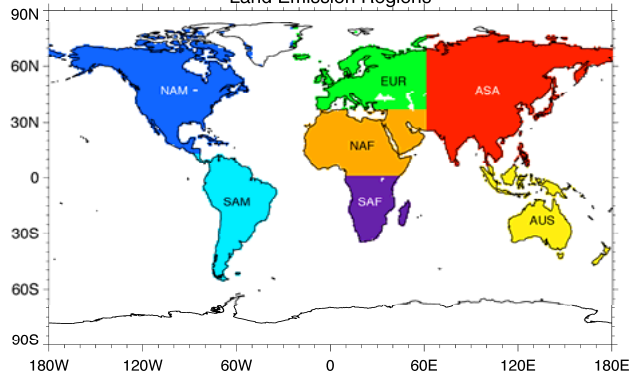
AeroCom-II ACCMIP

MACCity: ACCMIP MACCity

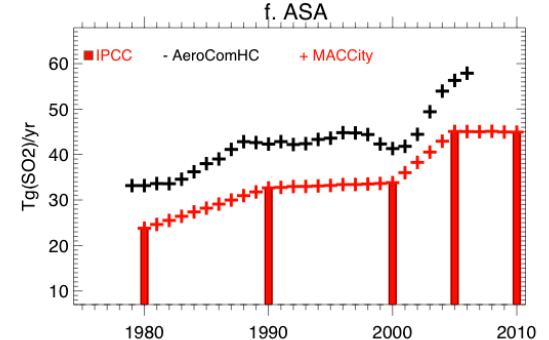
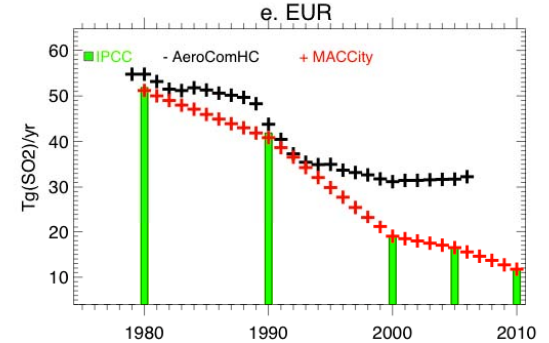
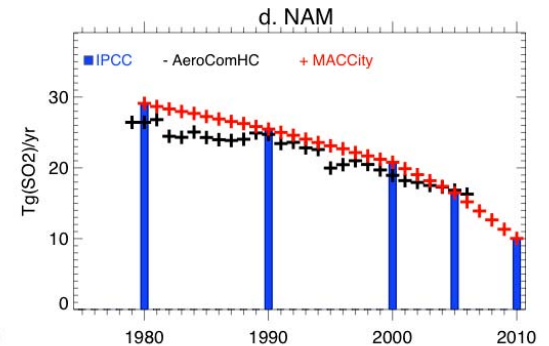
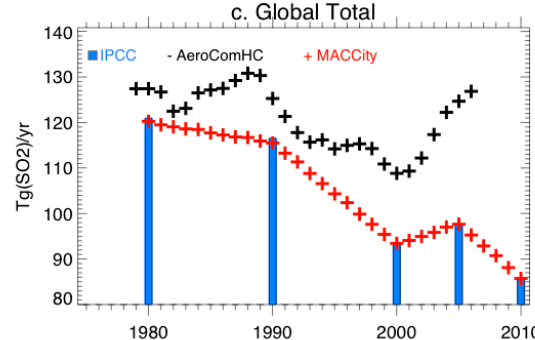
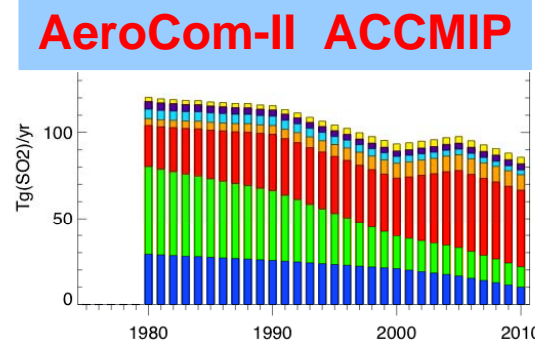
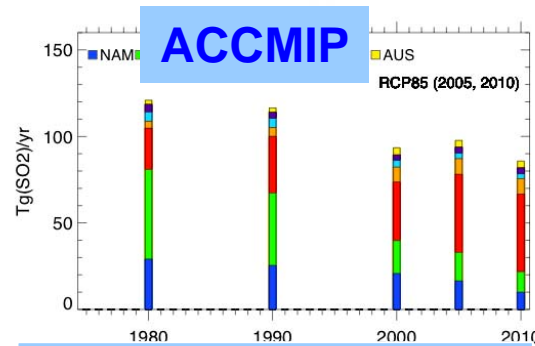
AeroCom-II HCA0 v1/v2

AeroComHC: AeroCom-HC

Land Emission Regions



regional choices
by Mian Chin



sectors_IPCC (before 2000) : ene dom ind tra wst awb
sectors_IPCC (2000 and after): ene dom ind tra wst awb slv agr
sectors_MACCity : ene dom ind tra wst awb slv agr
sectors_AeroComHC : anthro_noship

anthropogenic emission - BC

ACCMIP

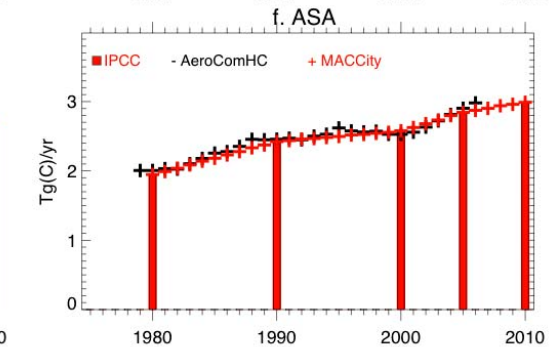
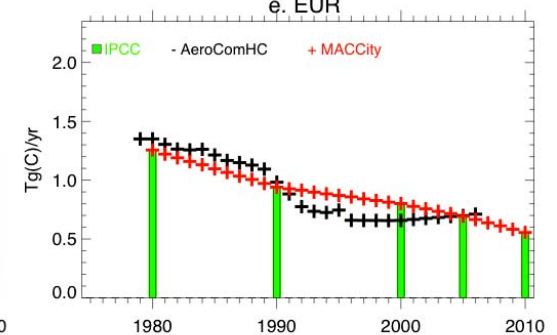
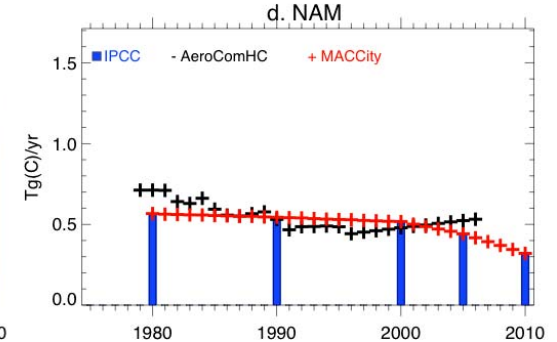
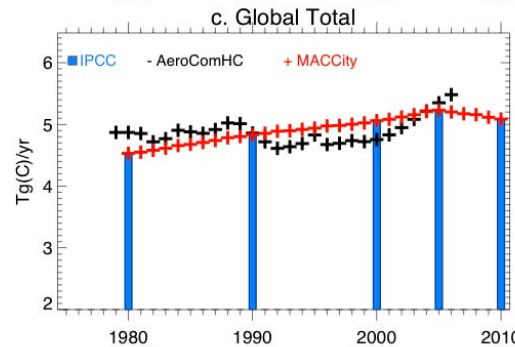
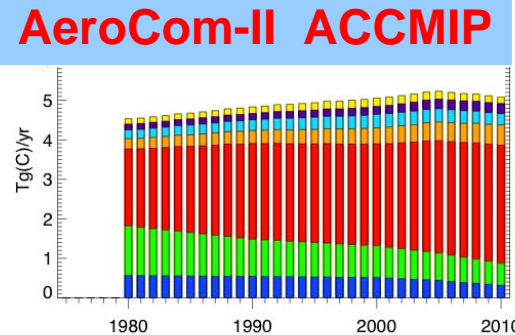
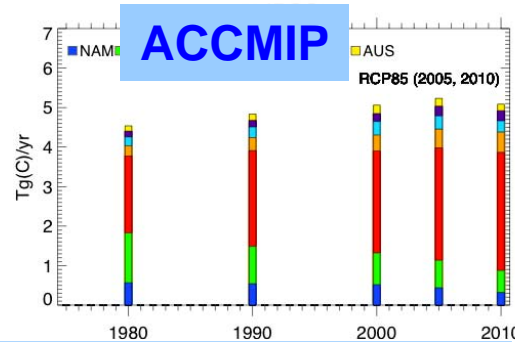
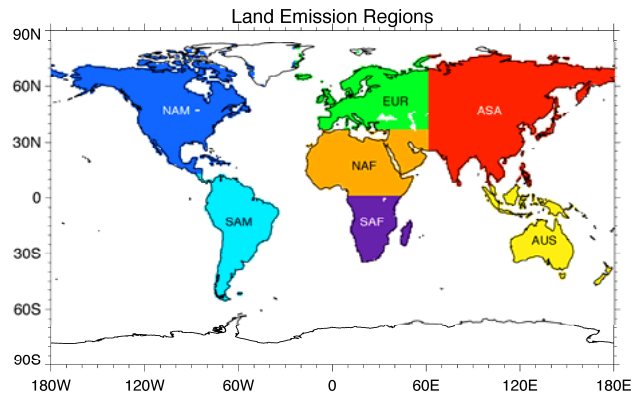
IPCC: ACCMIP-hist. / rcp 8.5

AeroCom-II ACCMIP

MACCcity: ACCMIP MACCcity

AeroCom-II HCA0 v1/v2

AeroComHC: AeroCom-HC



regional choices
by Mian Chin

sectors_IPCC (before 2000) : ene dom ind tra wst awb
sectors_IPCC (2000 and after): ene dom ind tra wst awb slv agr
sectors_MACCcity : ene dom ind tra wst awb slv agr
sectors_AeroComHC : anthro_noship

anthropogenic emission - OC

ACCMIP

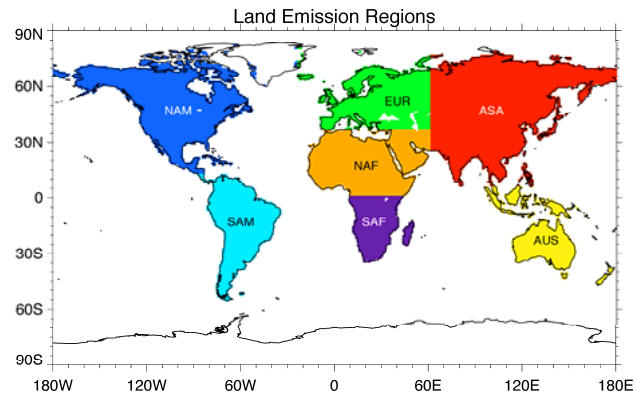
IPCC: ACCMIP-hist. / rcp 8.5

AeroCom-II ACCMIP

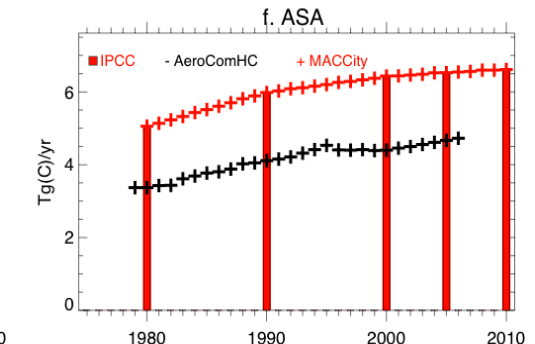
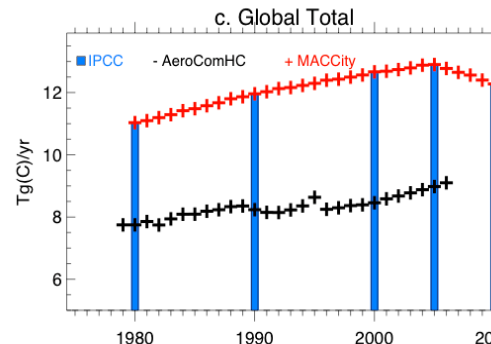
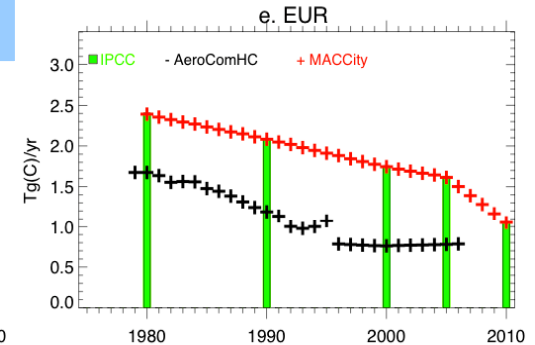
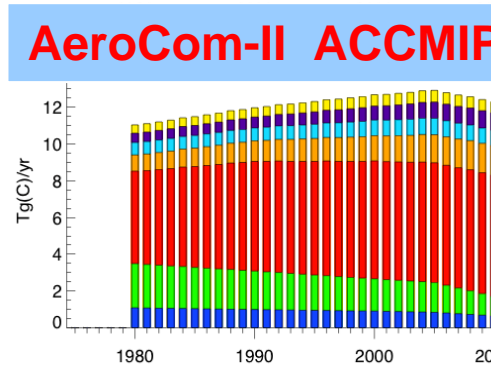
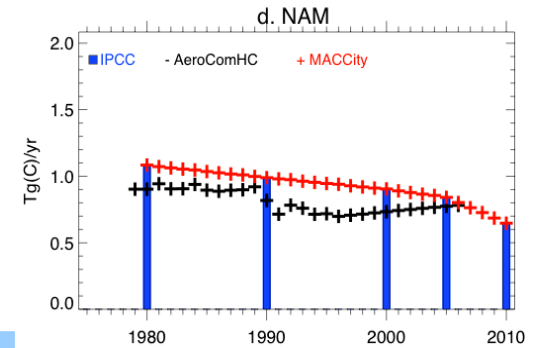
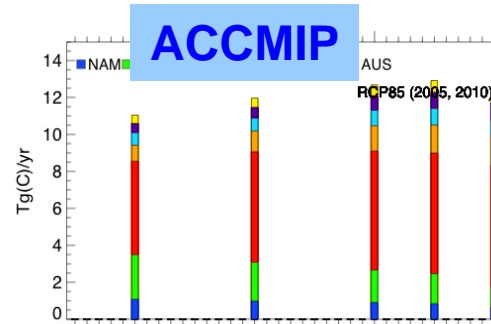
MACCity: ACCMIP MACCity

AeroCom-II HCA0 v1/v2

AeroComHC: AeroCom-HC



regional choices
by Mian Chin



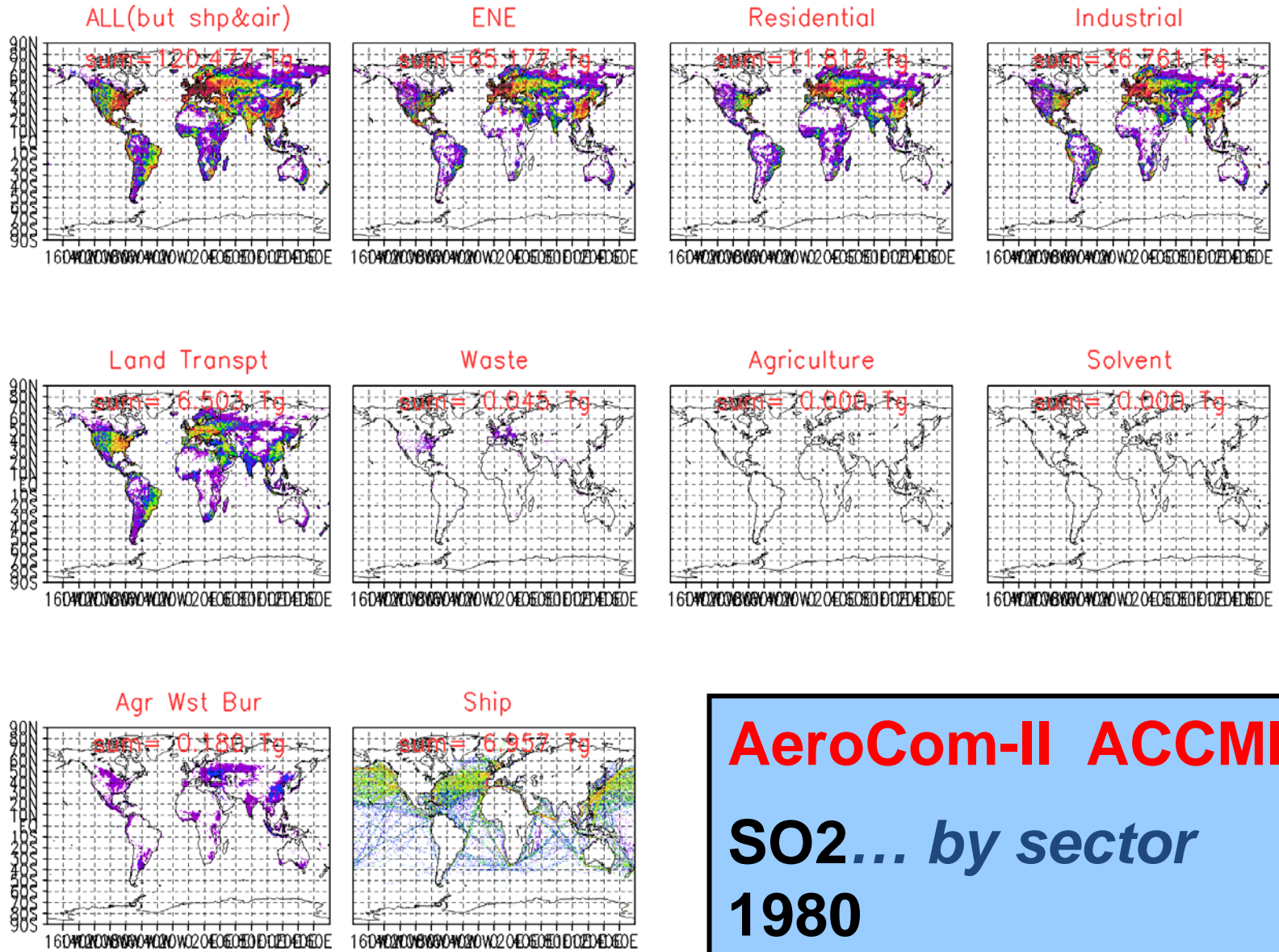
sectors_IPCC (before 2000) : ene dom ind tra wst awb
 sectors_IPCC (2000 and after): ene dom ind tra wst awb slv agr
 sectors_MACCity : ene dom ind tra wst awb slv agr
 sectors_AeroComHC : anthro_noship

anthrop. SO₂, BC and OC ... by sector

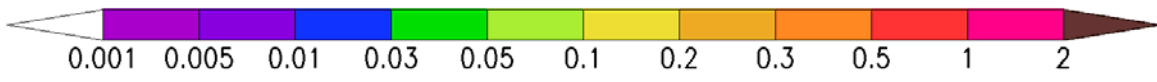
AeroCom-II ACCMIP vs **ACCMIP**

- species
 - SO₂, BC and OC
- years
 - 1980, 1990, 2000 and 2010
- sectors
 - ene, ind, tra, dom, slv, agr, awb, wst
 - shp (ship)

ACCMIP MACCity ANTHROP EMI S02 1980 GLB

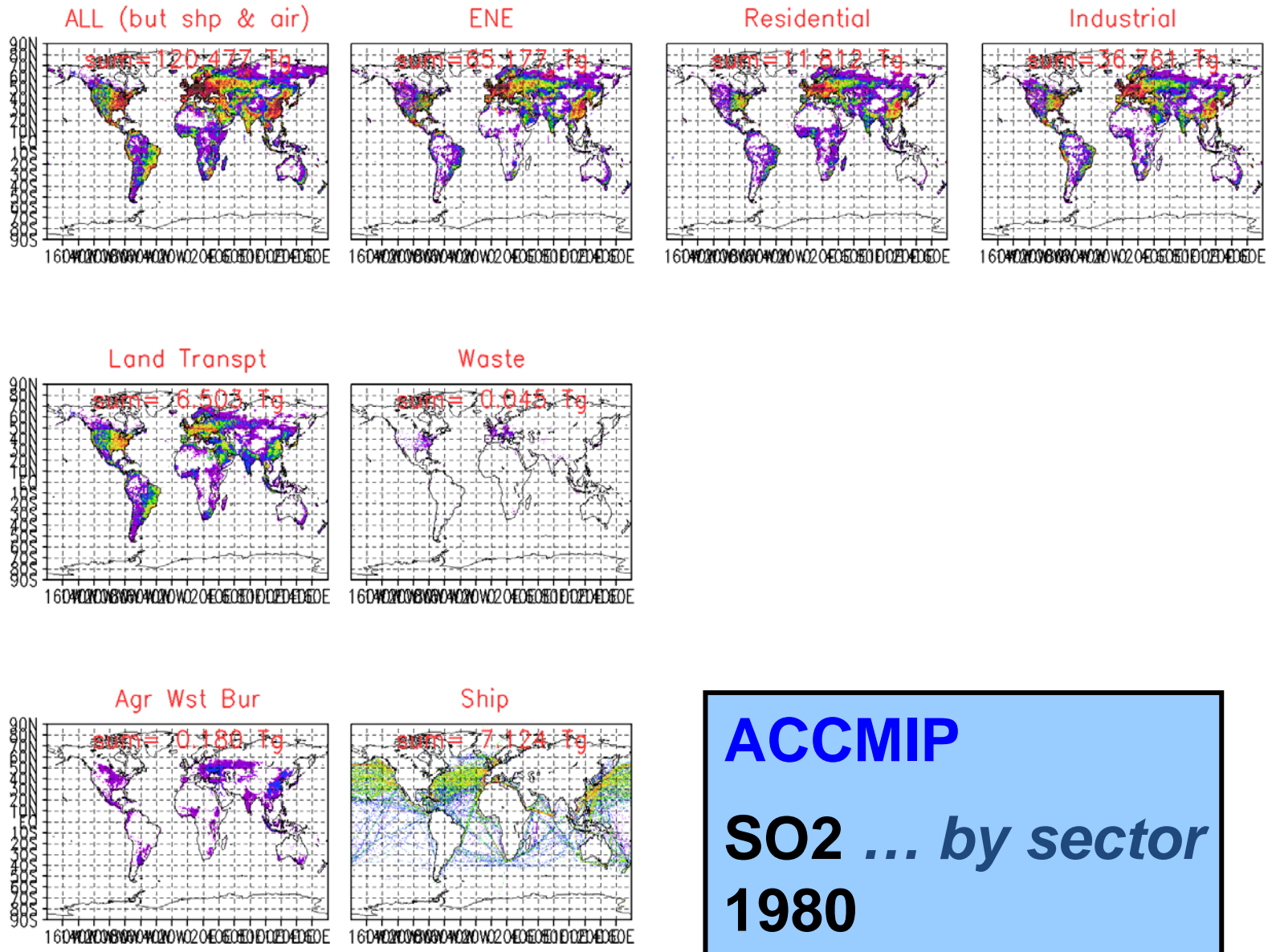


AeroCom-II ACCMIP
SO2... by sector
1980

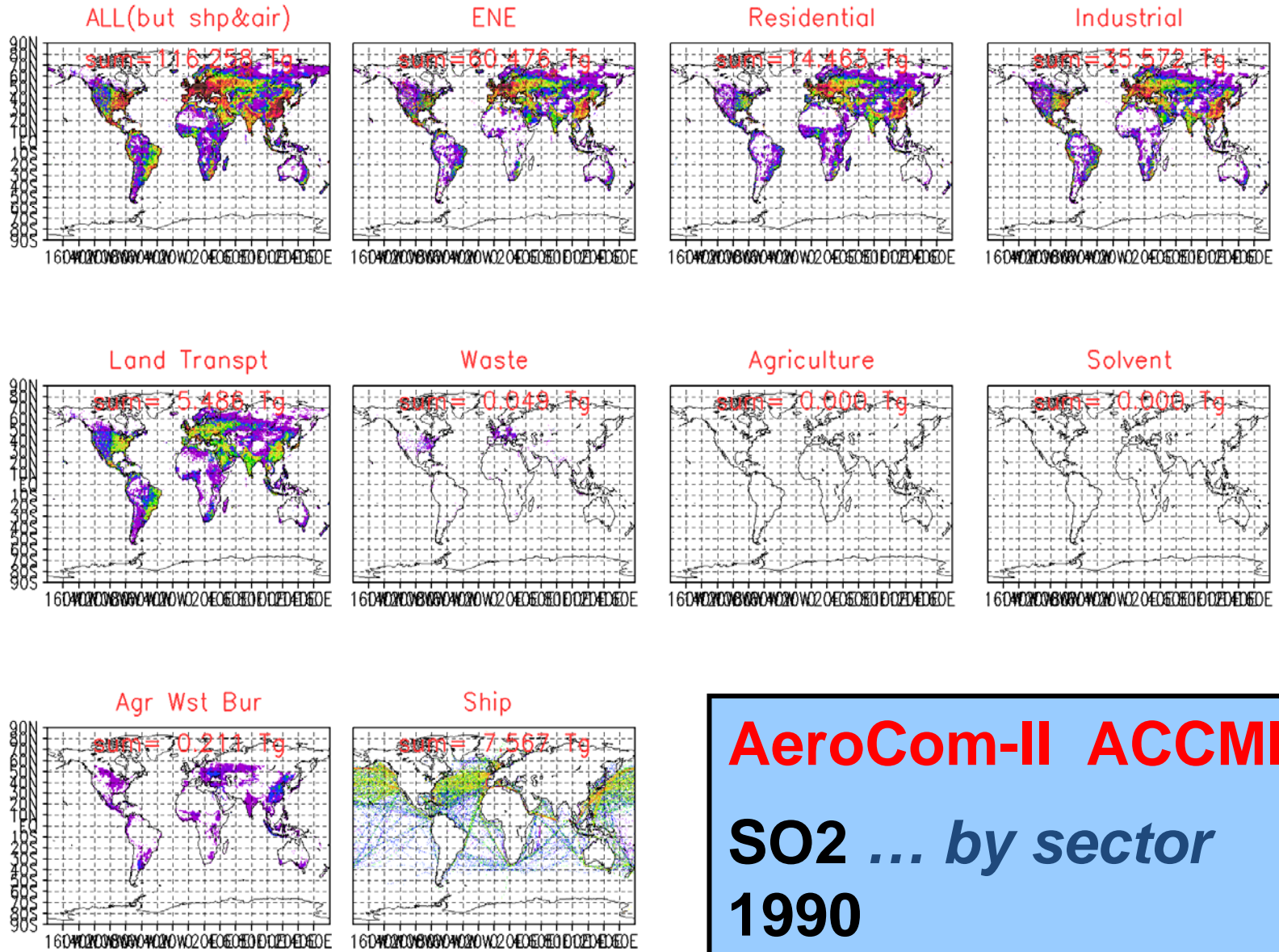


unit: g/m²/year

IPCC_historic ANTHROP EMI SO2 1980 GLB

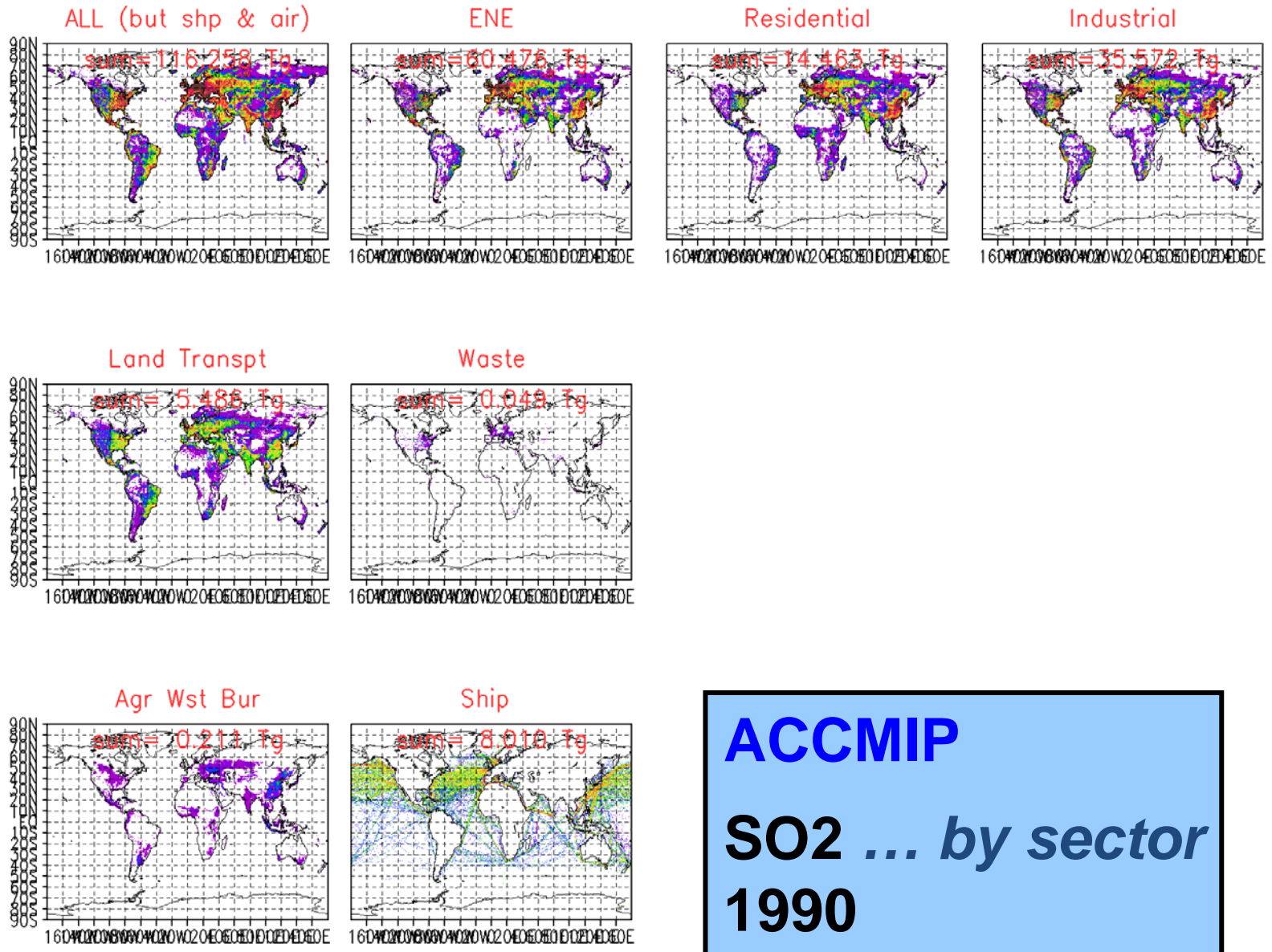


ACCMIP MACCity ANTHROP EMI S02 1990 GLB

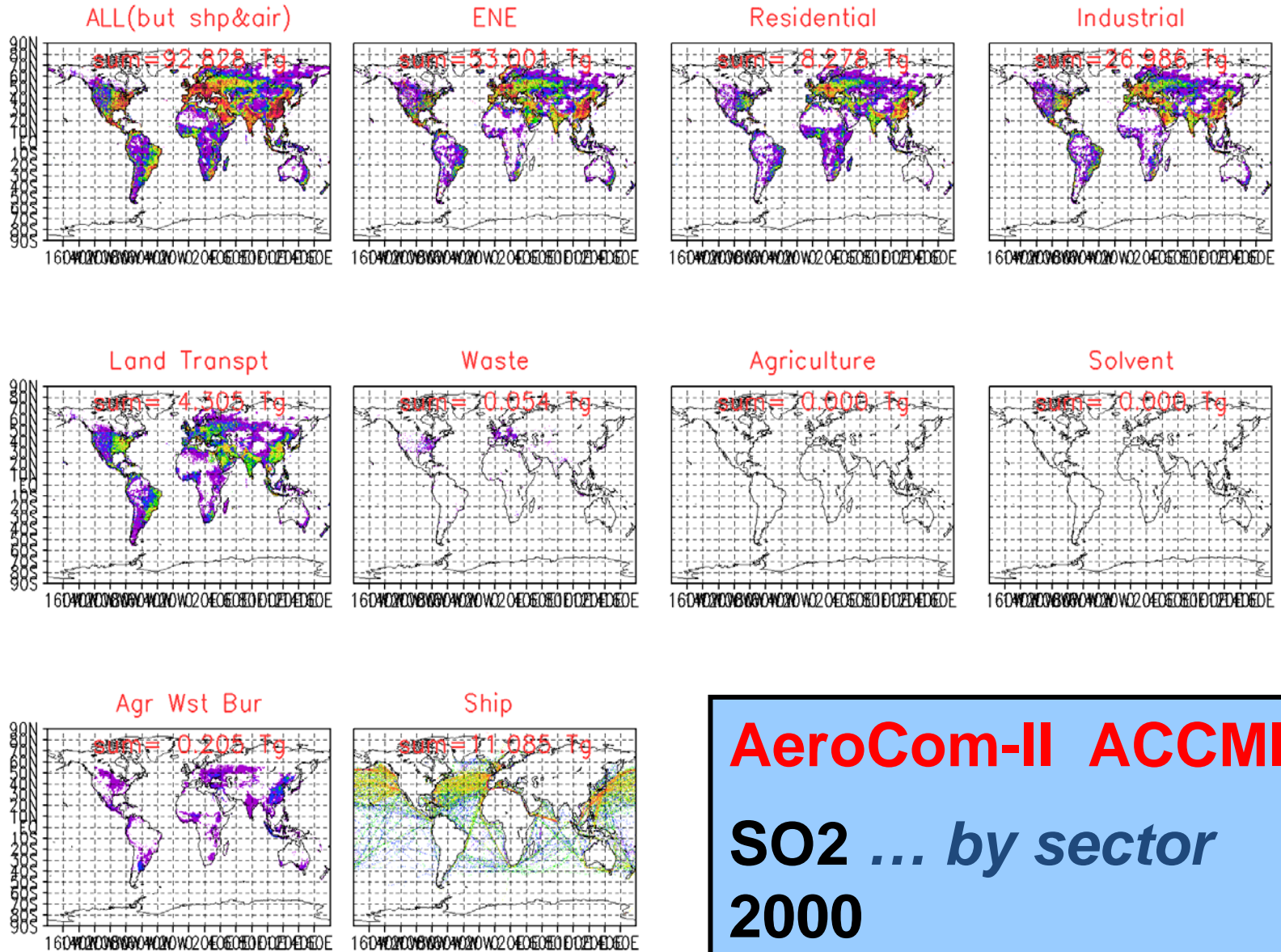


AeroCom-II ACCMIP
SO₂ ... by sector
1990

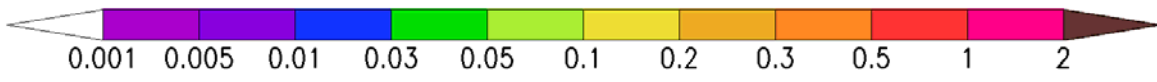
IPCC_historic ANTHROP EMI SO2 1990 GLB



ACCMIP MACCity ANTHROP EMI S02 2000 GLB



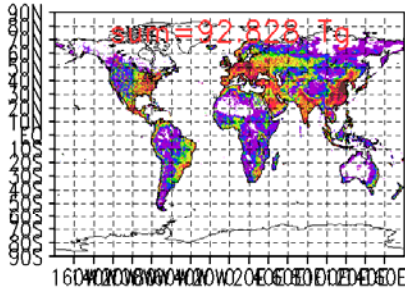
AeroCom-II ACCMIP
SO2 ... by sector
2000



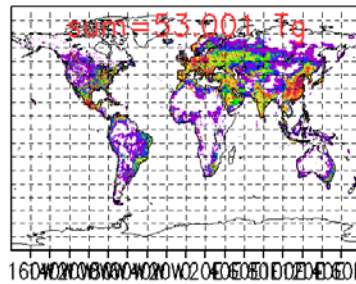
unit: g/m²/year

IPCC_historic ANTHROP EMI SO2 2000 GLB

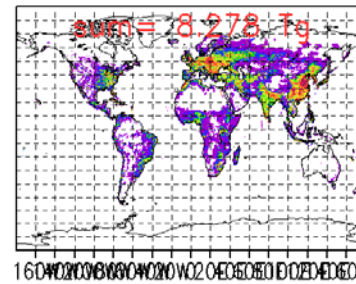
ALL (but shp & air)



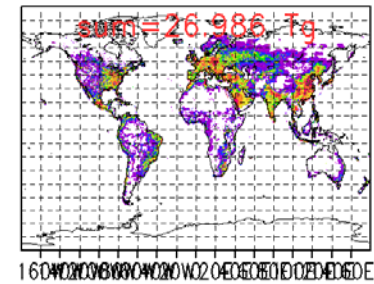
ENE



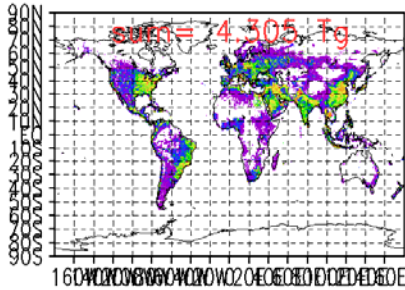
Residential



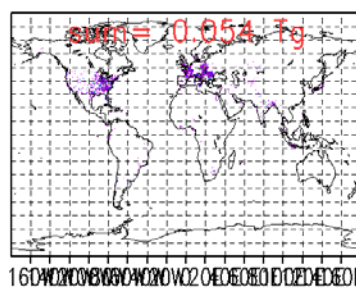
Industrial



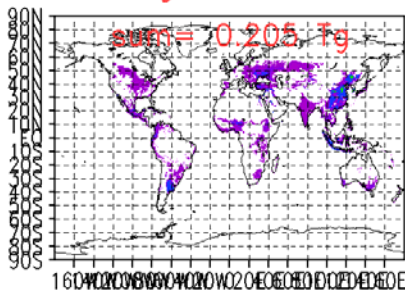
Land Transpt



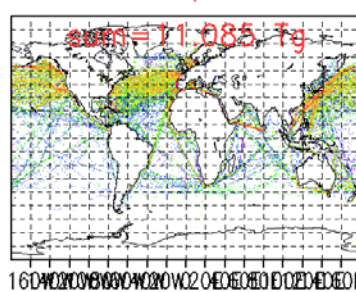
Waste



Agr Wst Bur



Ship

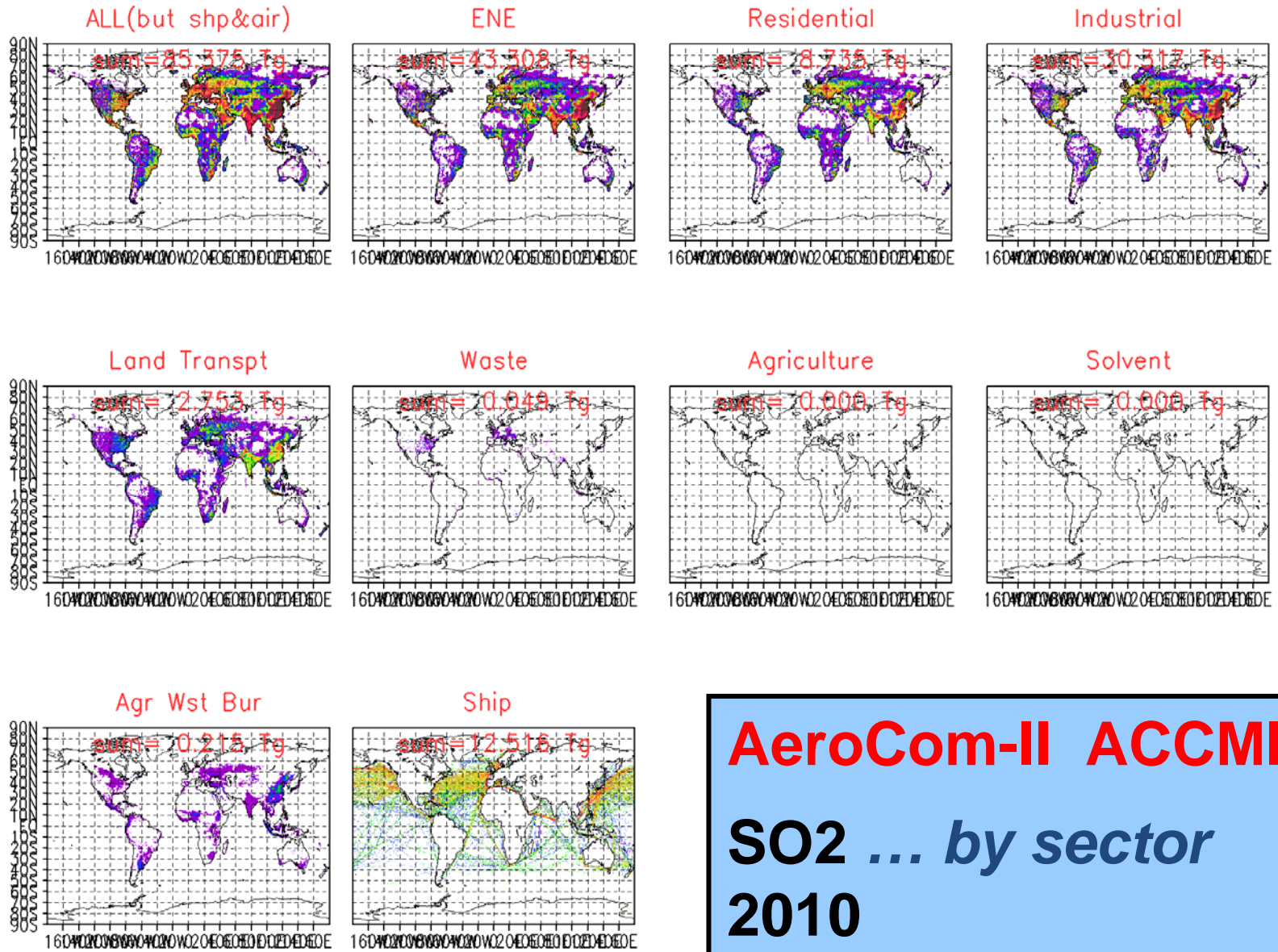


ACCMIP
SO2 ... by sector
2000

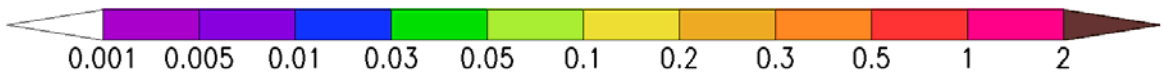


unit: g/m2/year

ACCMIP MACCity ANTHROP EMI S02 2010 GLB

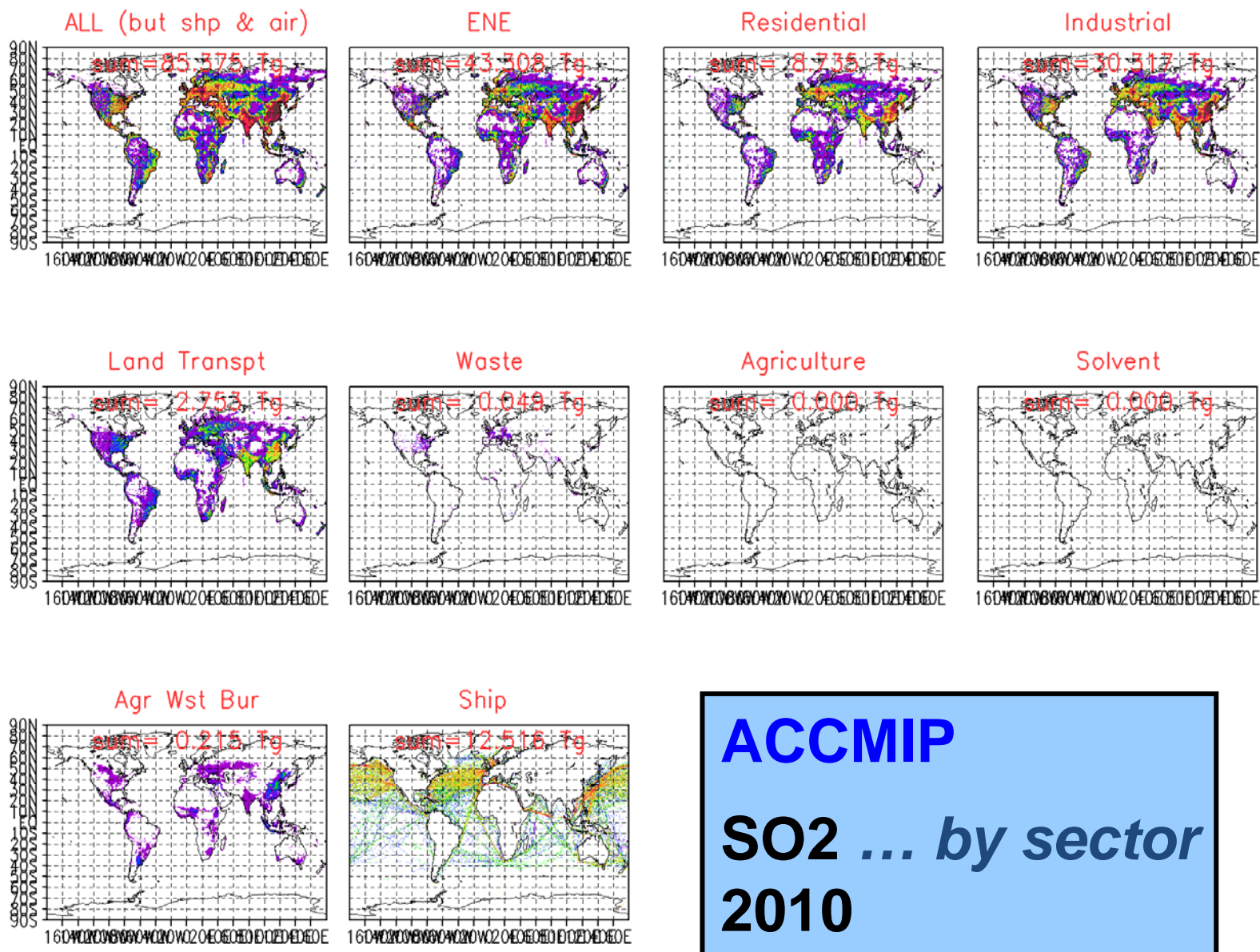


AeroCom-II ACCMIP
SO2 ... by sector
2010

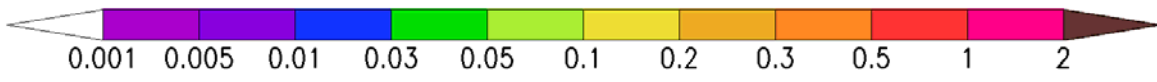


unit: g/m²/year

IPCC_RCP85 ANTHROP EMI SO2 2010 GLB

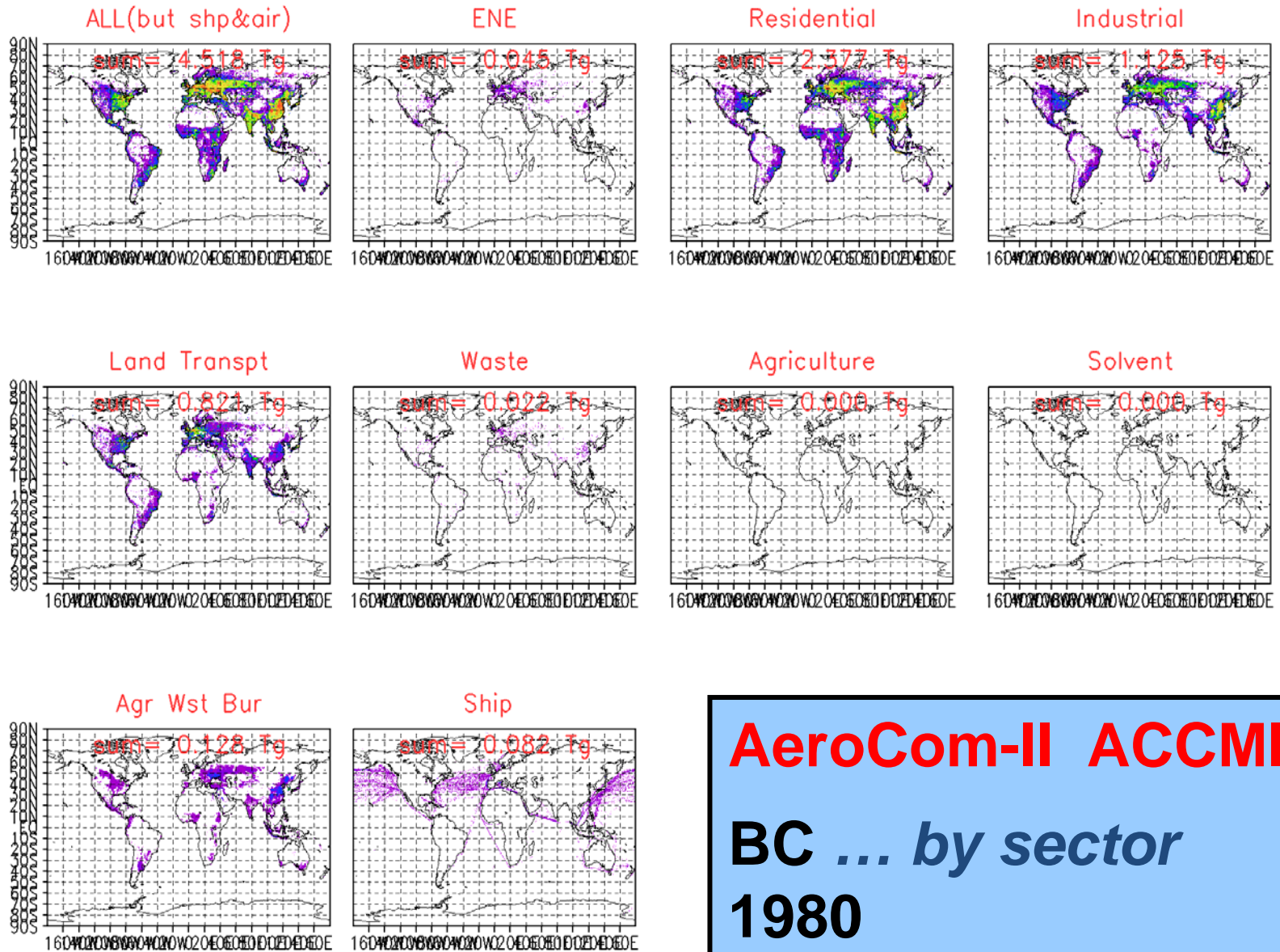


ACCMIP
SO2 ... by sector
2010

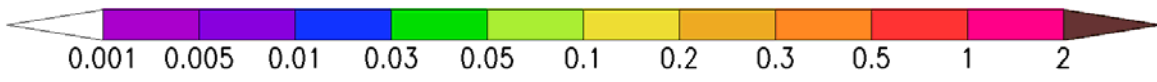


unit: g/m²/year

ACCMIP MACCity ANTHROP EMI BC 1980 GLB

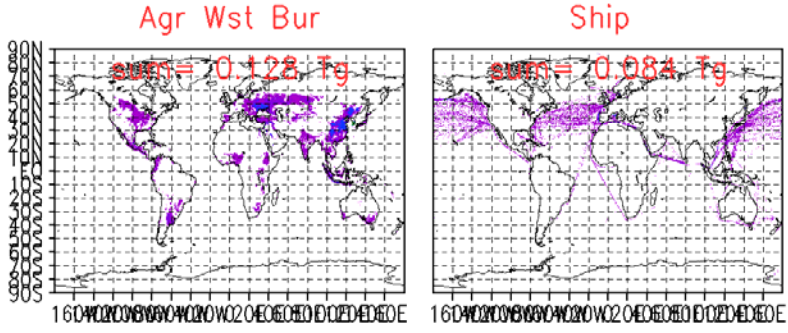
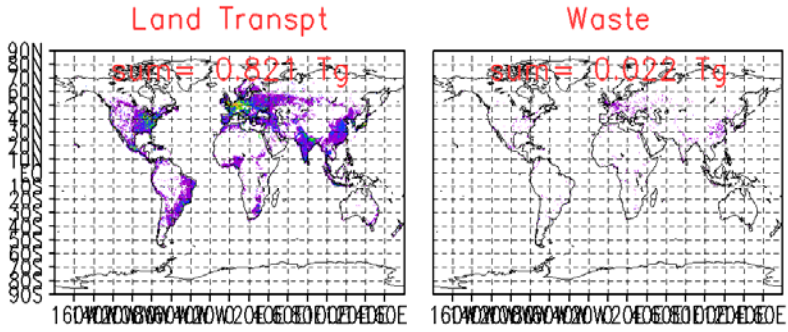
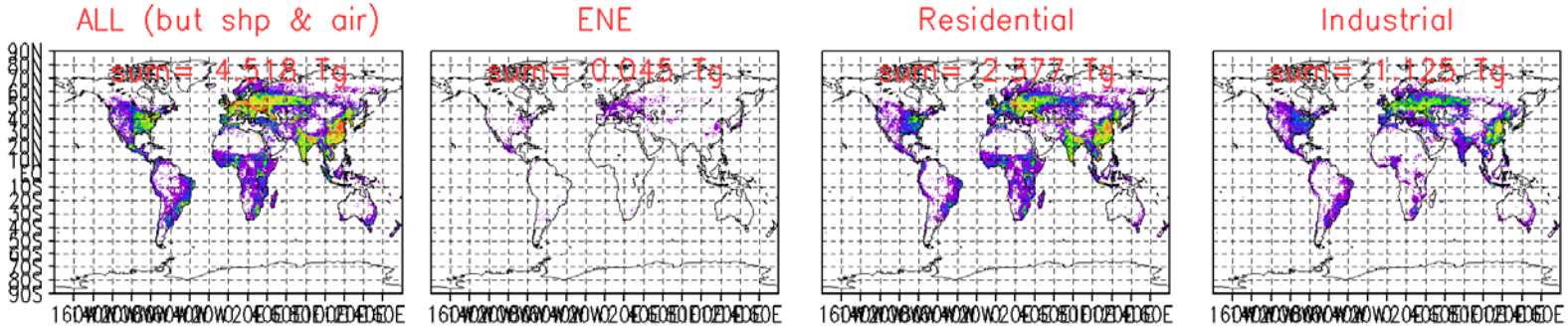


AeroCom-II ACCMIP
BC ... by sector
1980

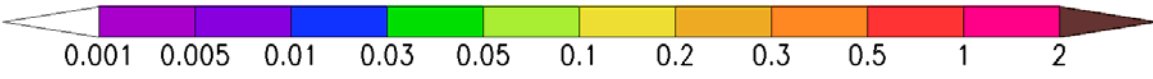


unit: g/m²/year

IPCC_historic ANTHROP EMI BC 1980 GLB

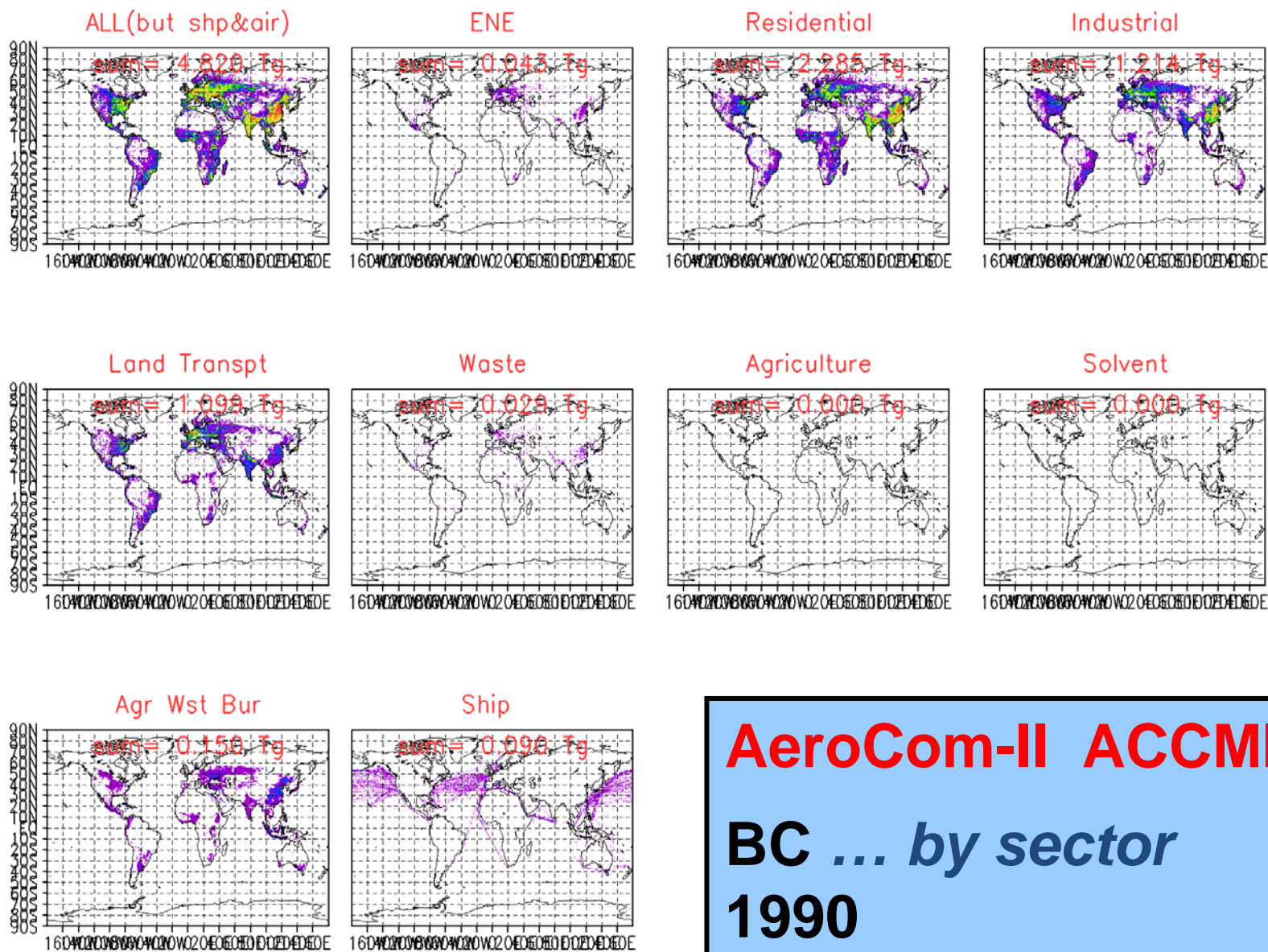


ACCMIP
BC ... by sector
1980

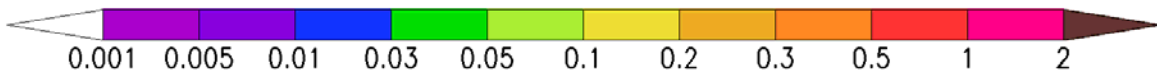


unit: g/m²/year

ACCMIP MACCcity ANTHROP EMI BC 1990 GLB

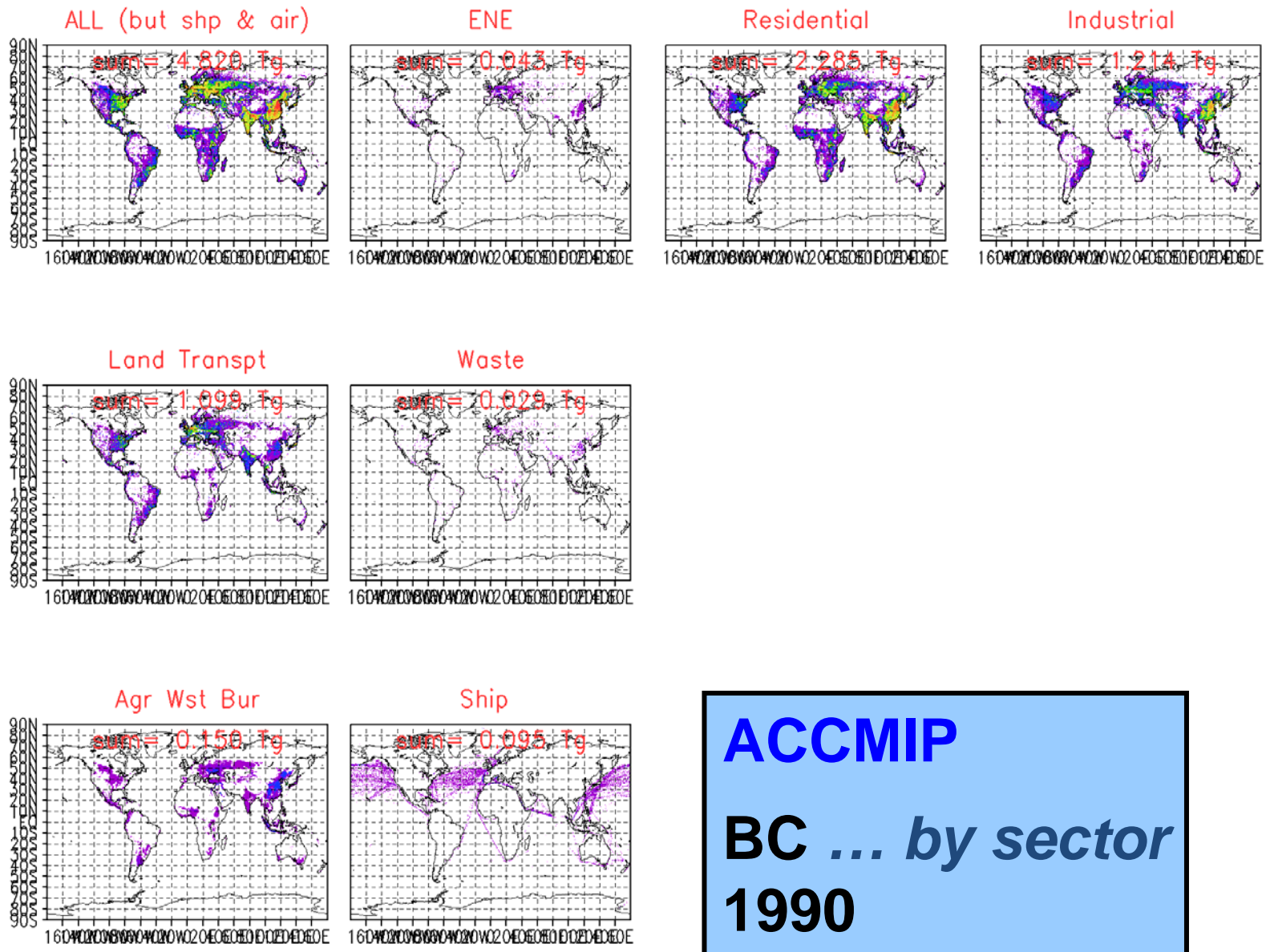


AeroCom-II ACCMIP
BC ... by sector
1990



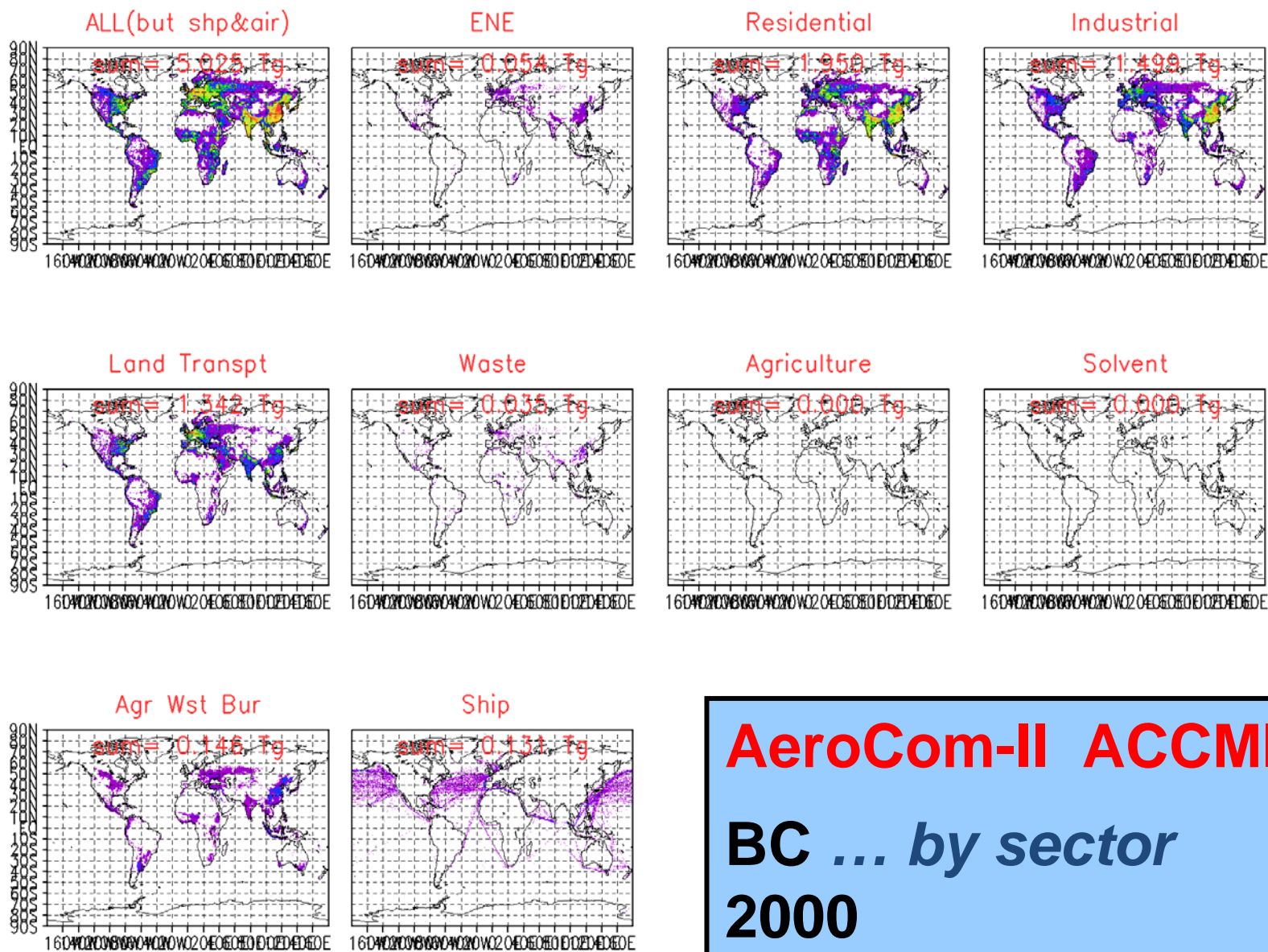
unit: g/m²/year

IPCC_historic ANTHROP EMI BC 1990 GLB

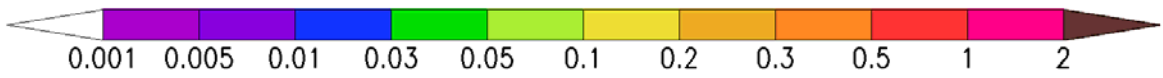


unit: g/m²/year

ACCMIP MACCcity ANTHROP EMI BC 2000 GLB

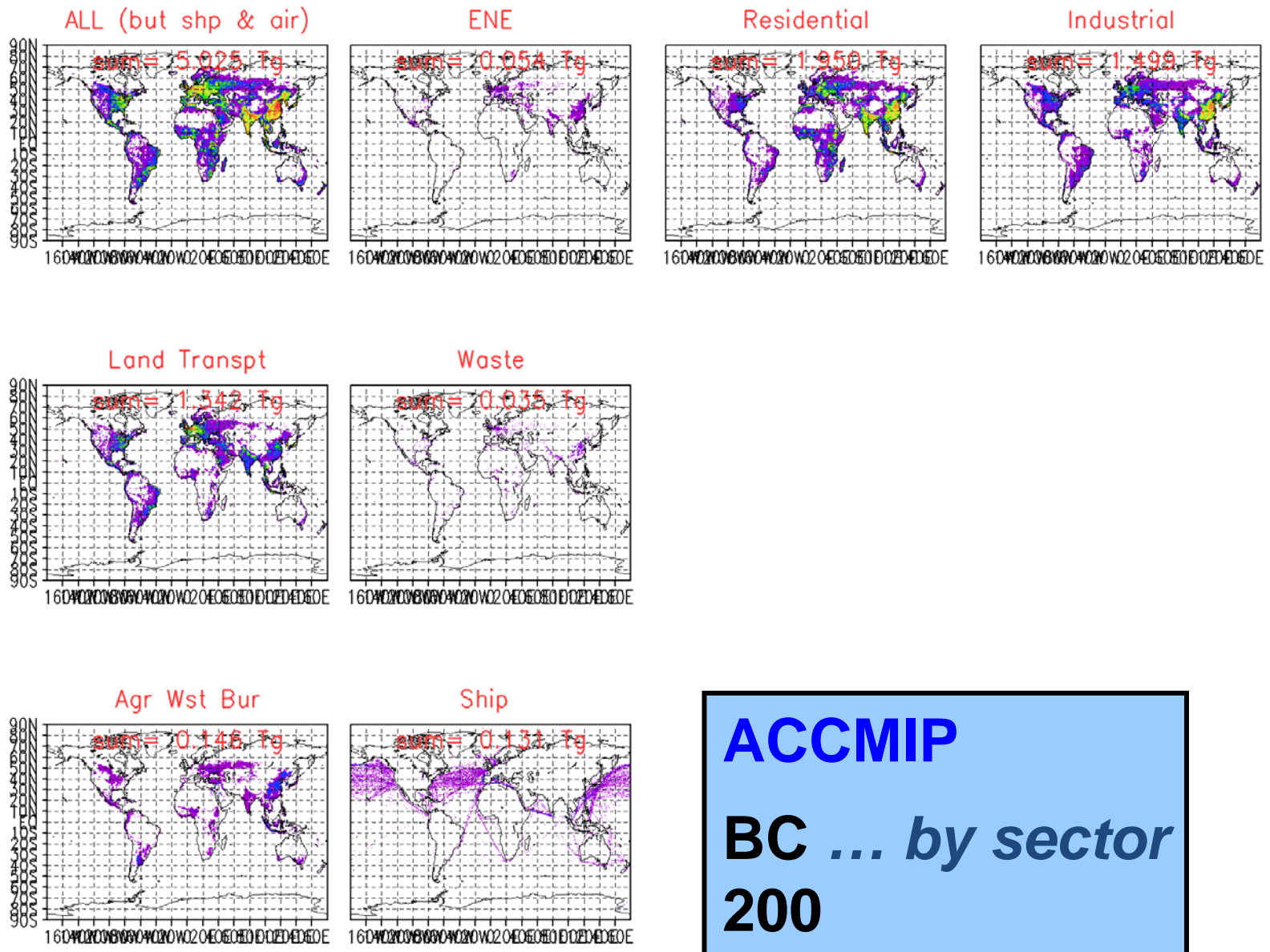


AeroCom-II ACCMIP
BC ... by sector
2000

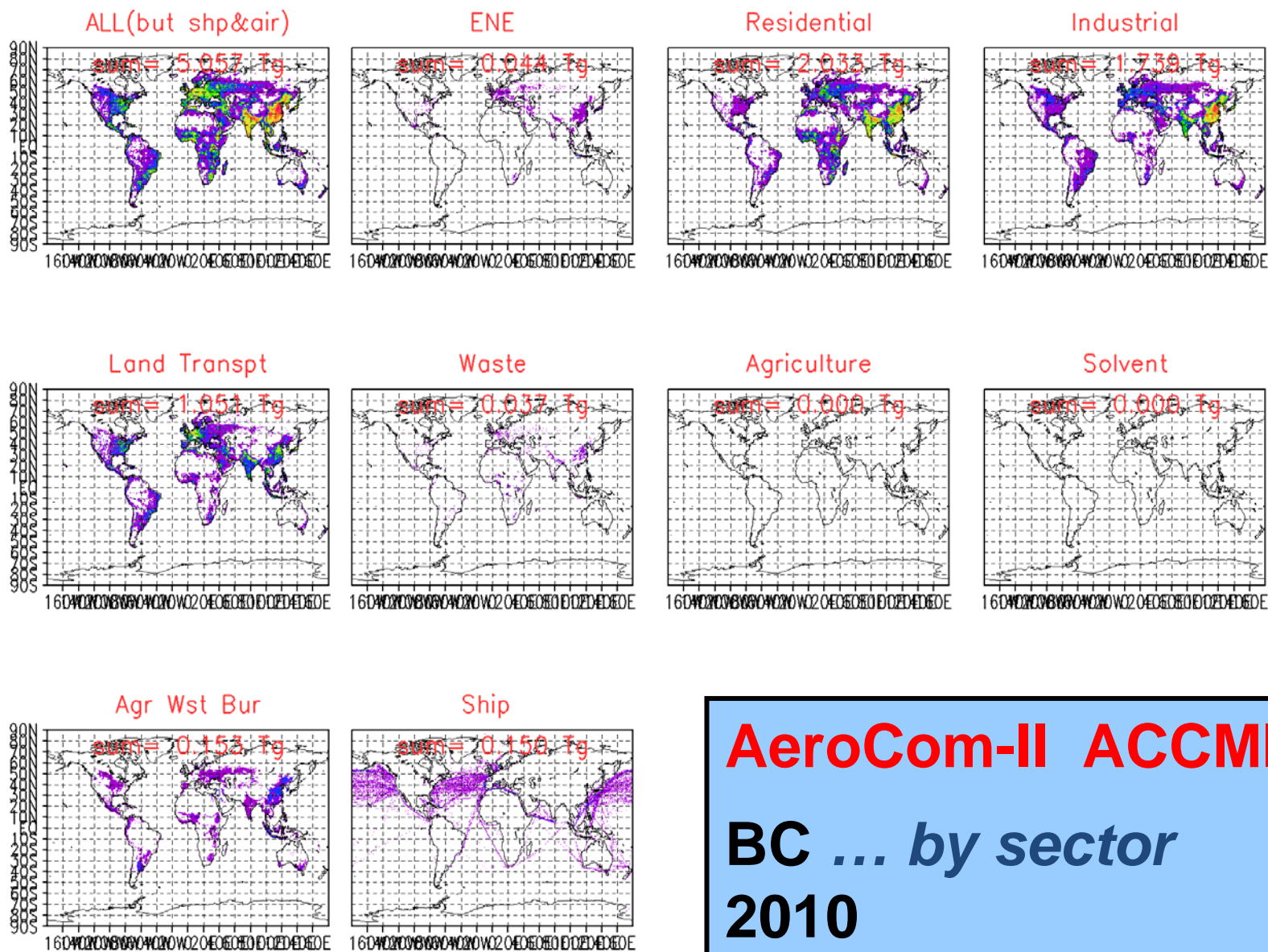


unit: g/m²/year

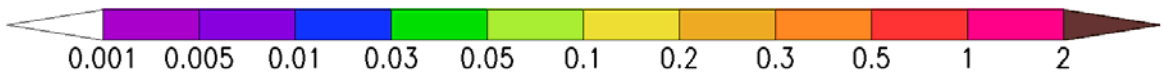
IPCC_historic ANTHROP EMI BC 2000 GLB



ACCMIP MACCcity ANTHROP EMI BC 2010 GLB

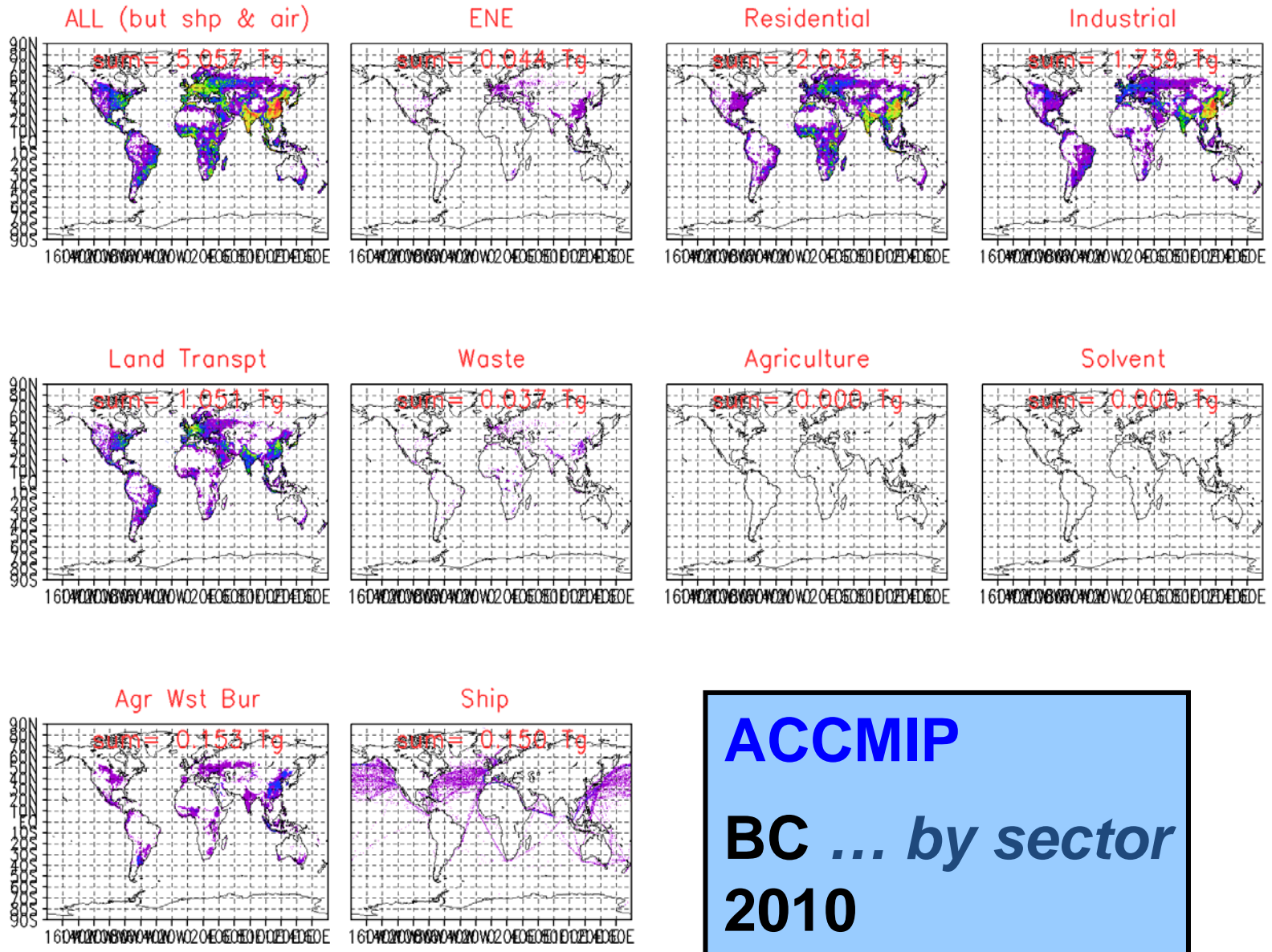


AeroCom-II ACCMIP
BC ... by sector
2010

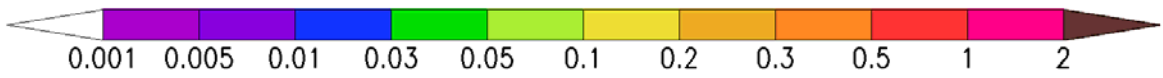


unit: g/m²/year

IPCC_RCP85 ANTHROP EMI BC 2010 GLB

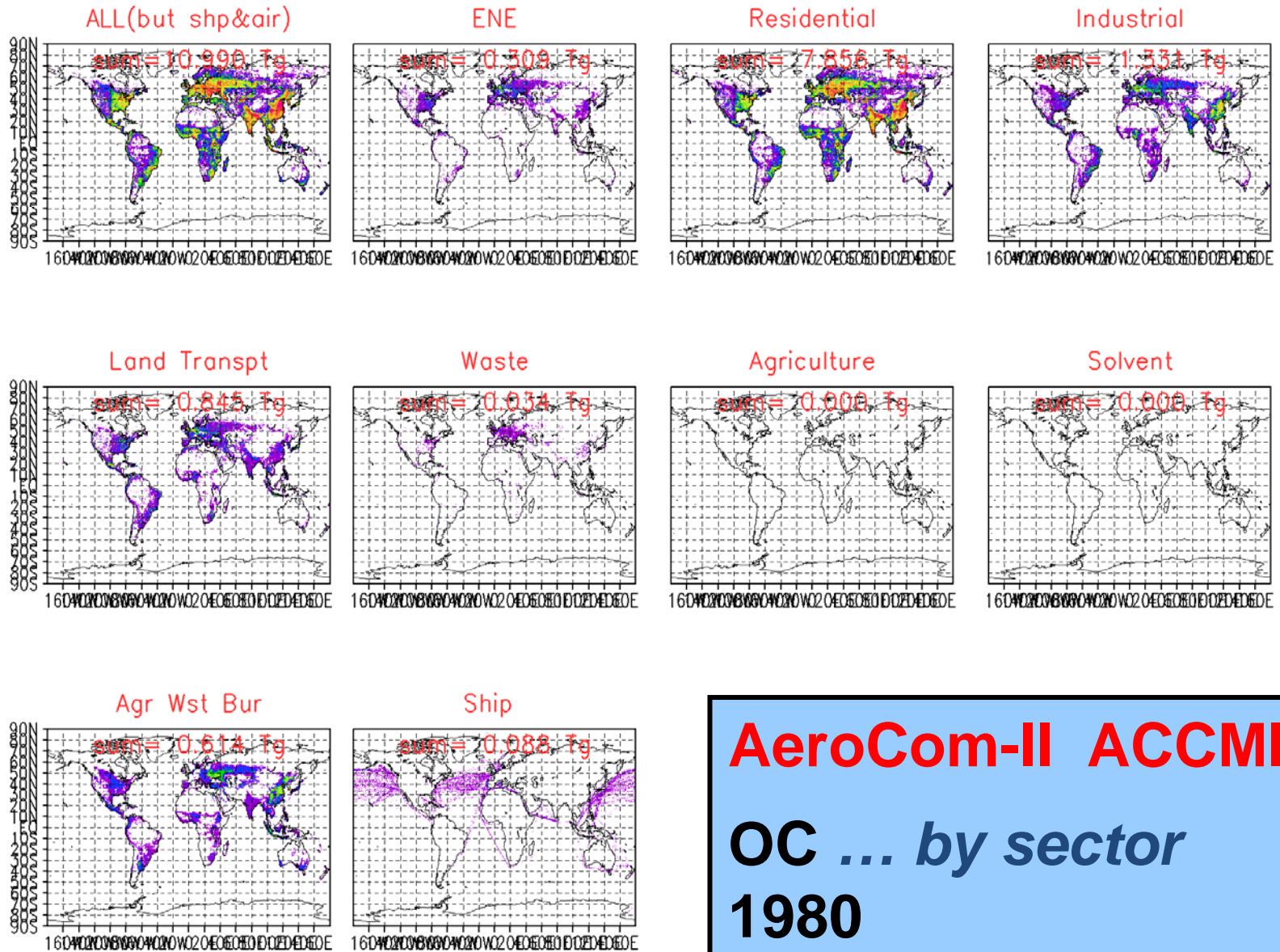


ACCMIP
BC ... by sector
2010

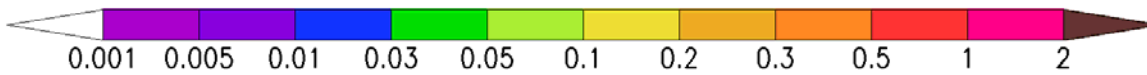


unit: g/m²/year

ACCMIP MACCcity ANTHROP EMI OC 1980 GLB

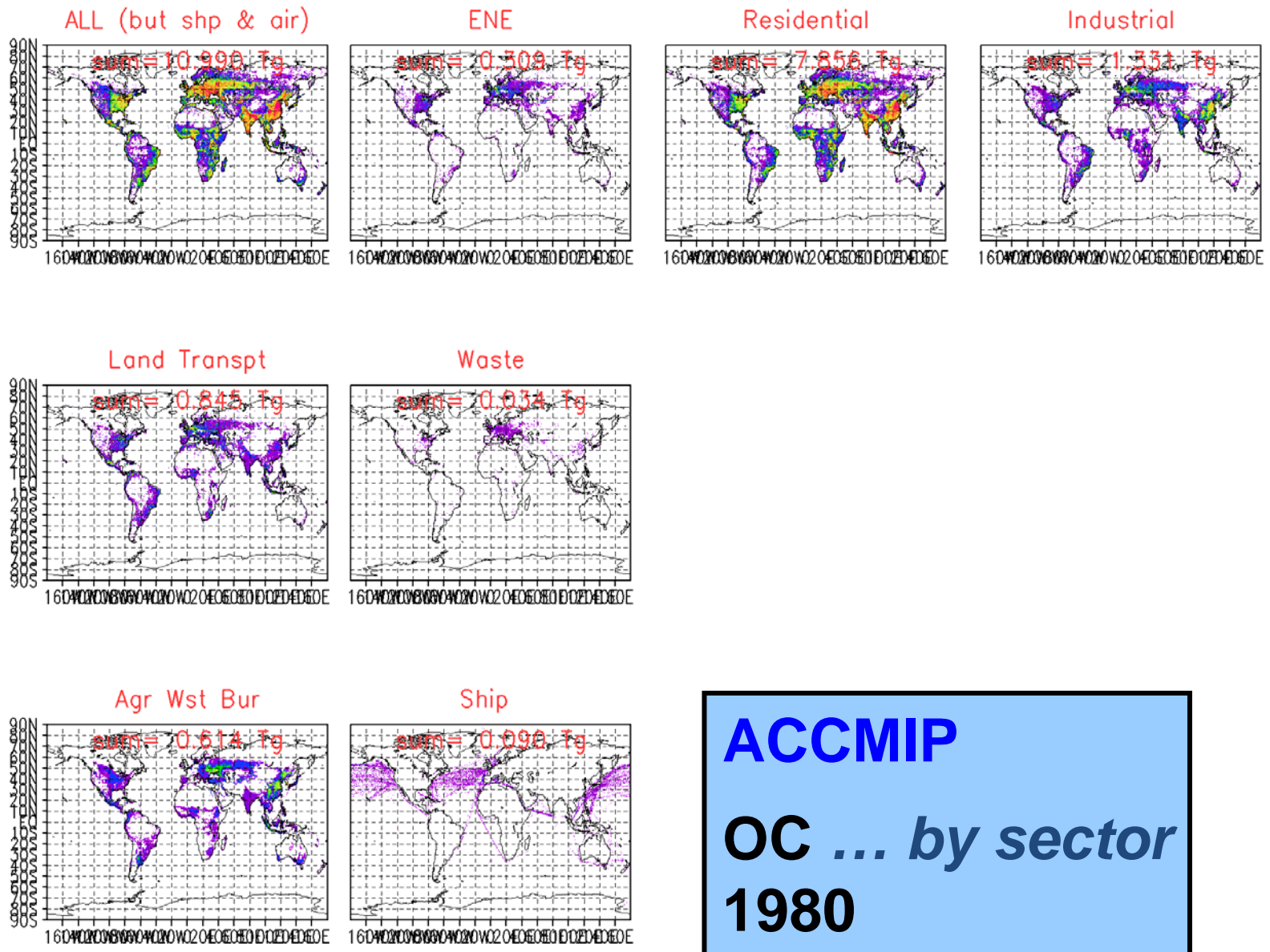


AeroCom-II ACCMIP
OC ... by sector
1980

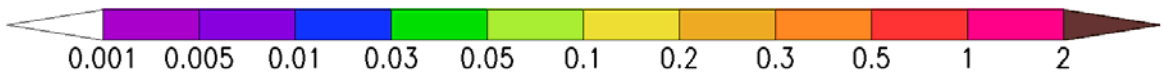


unit: g/m²/year

IPCC_historic ANTHROP EMI OC 1980 GLB

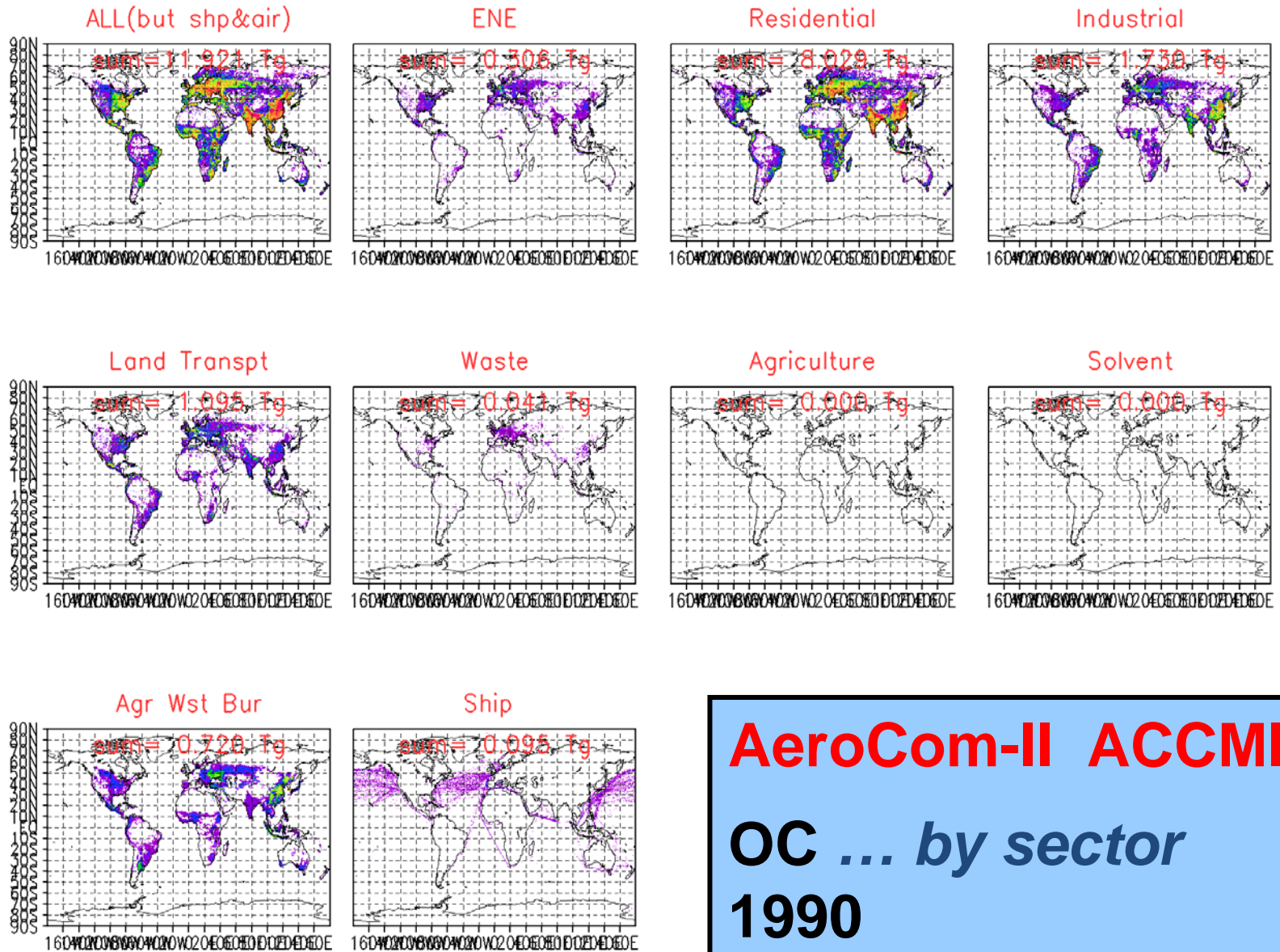


ACCMIP
OC ... by sector
1980

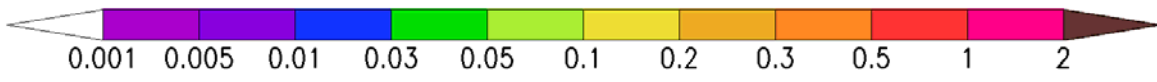


unit: g/m²/year

ACCMIP MACCcity ANTHROP EMI OC 1990 GLB

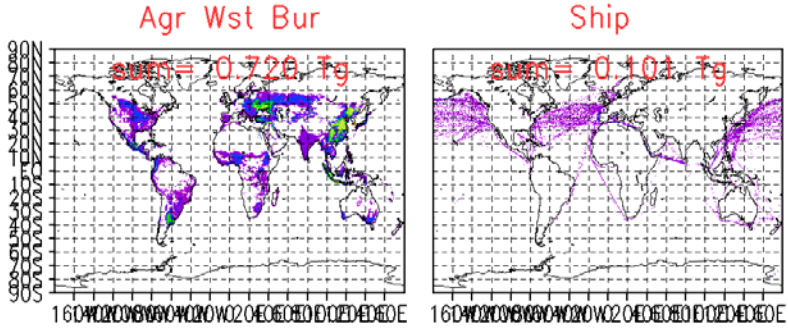
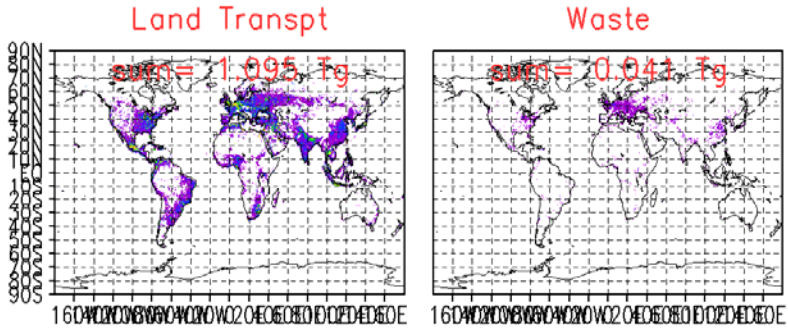
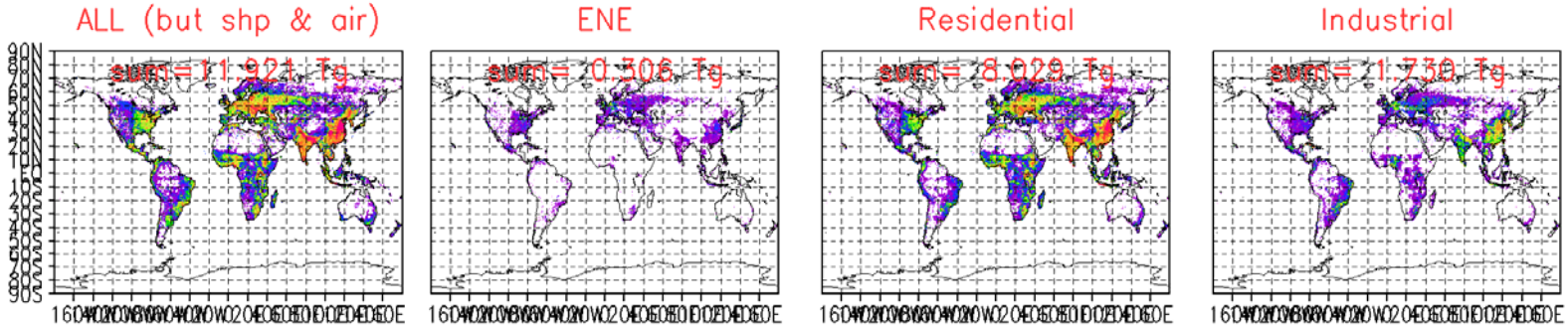


AeroCom-II ACCMIP
OC ... by sector
1990

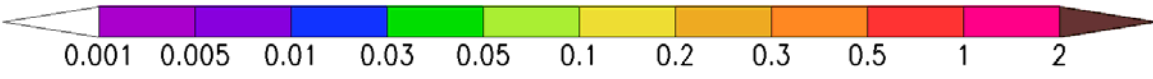


unit: g/m²/year

IPCC_historic ANTHROP EMI OC 1990 GLB

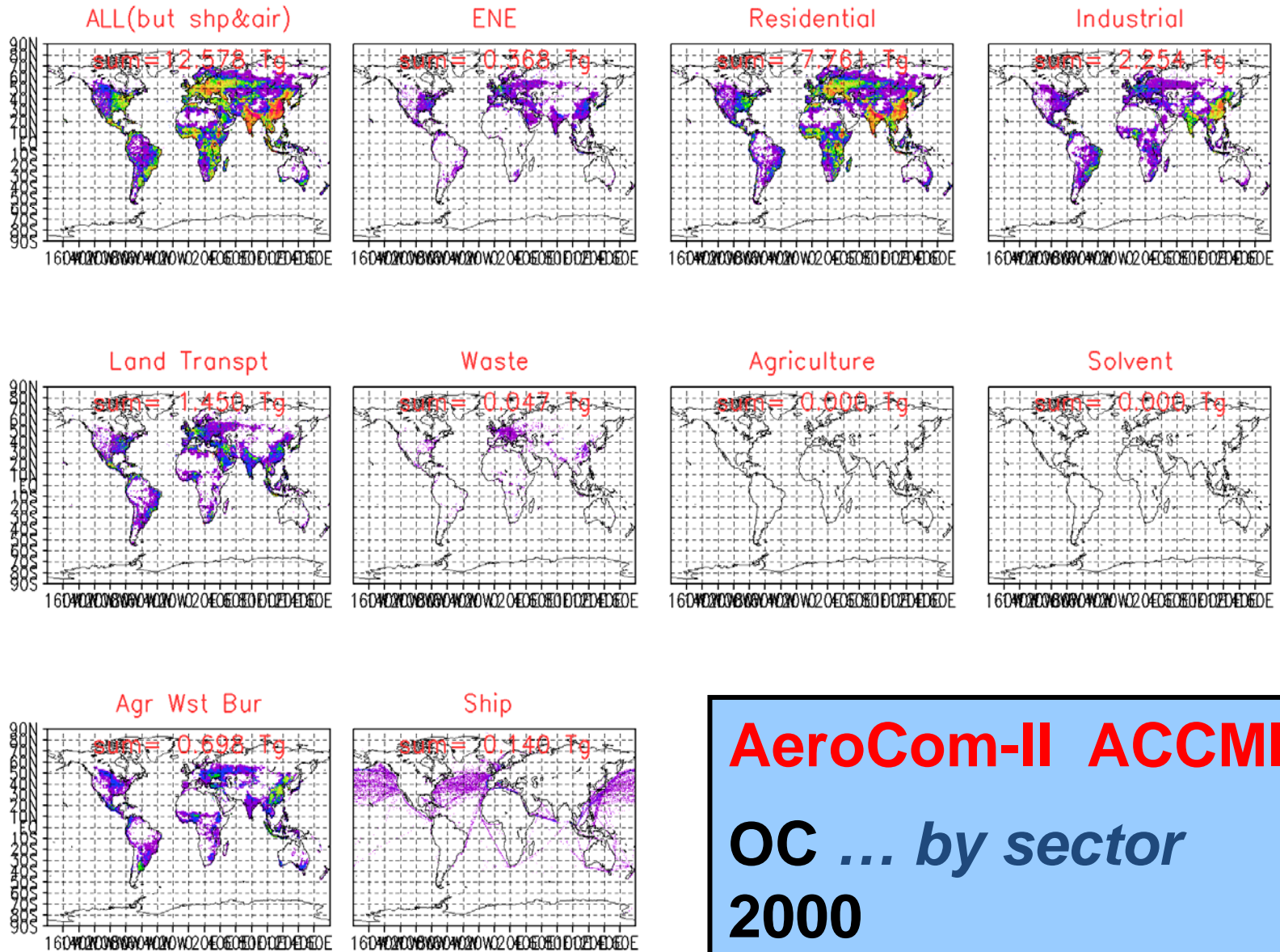


ACCMIP
OC ... by sector
1990

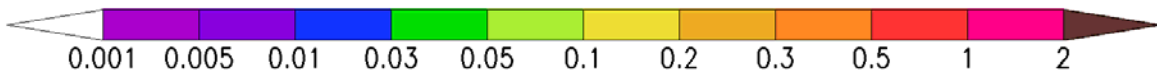


unit: g/m²/year

ACCMIP MACCcity ANTHROP EMI OC 2000 GLB

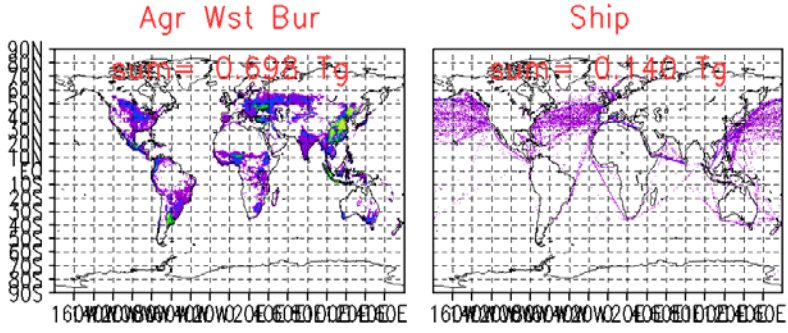
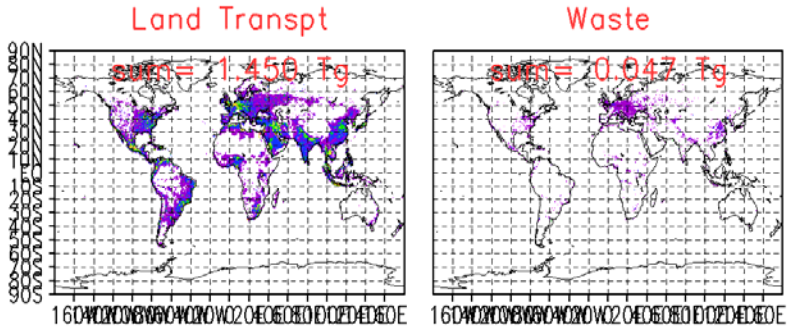
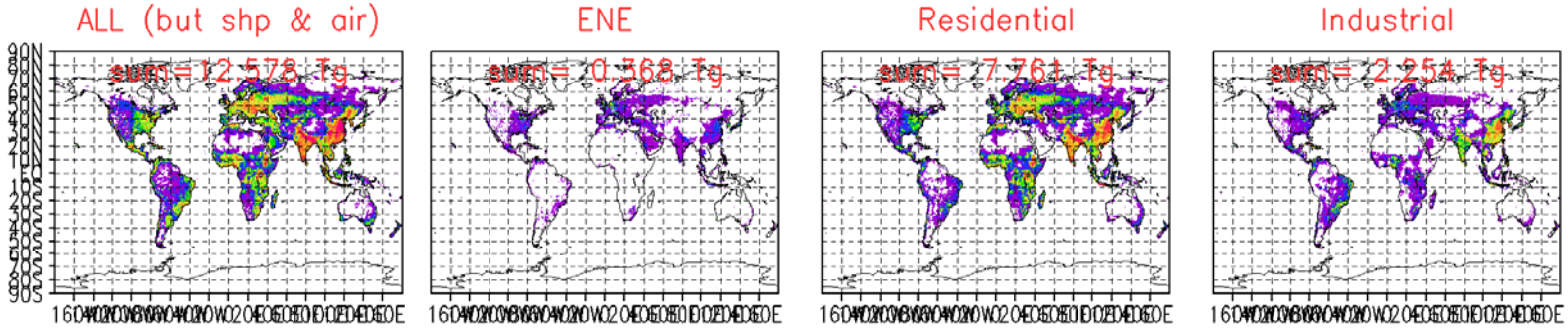


AeroCom-II ACCMIP
OC ... by sector
2000

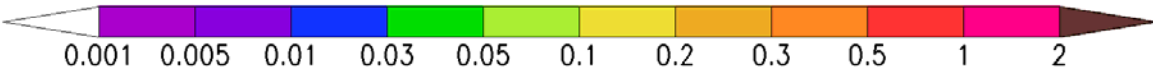


unit: g/m²/year

IPCC_historic ANTHROP EMI OC 2000 GLB

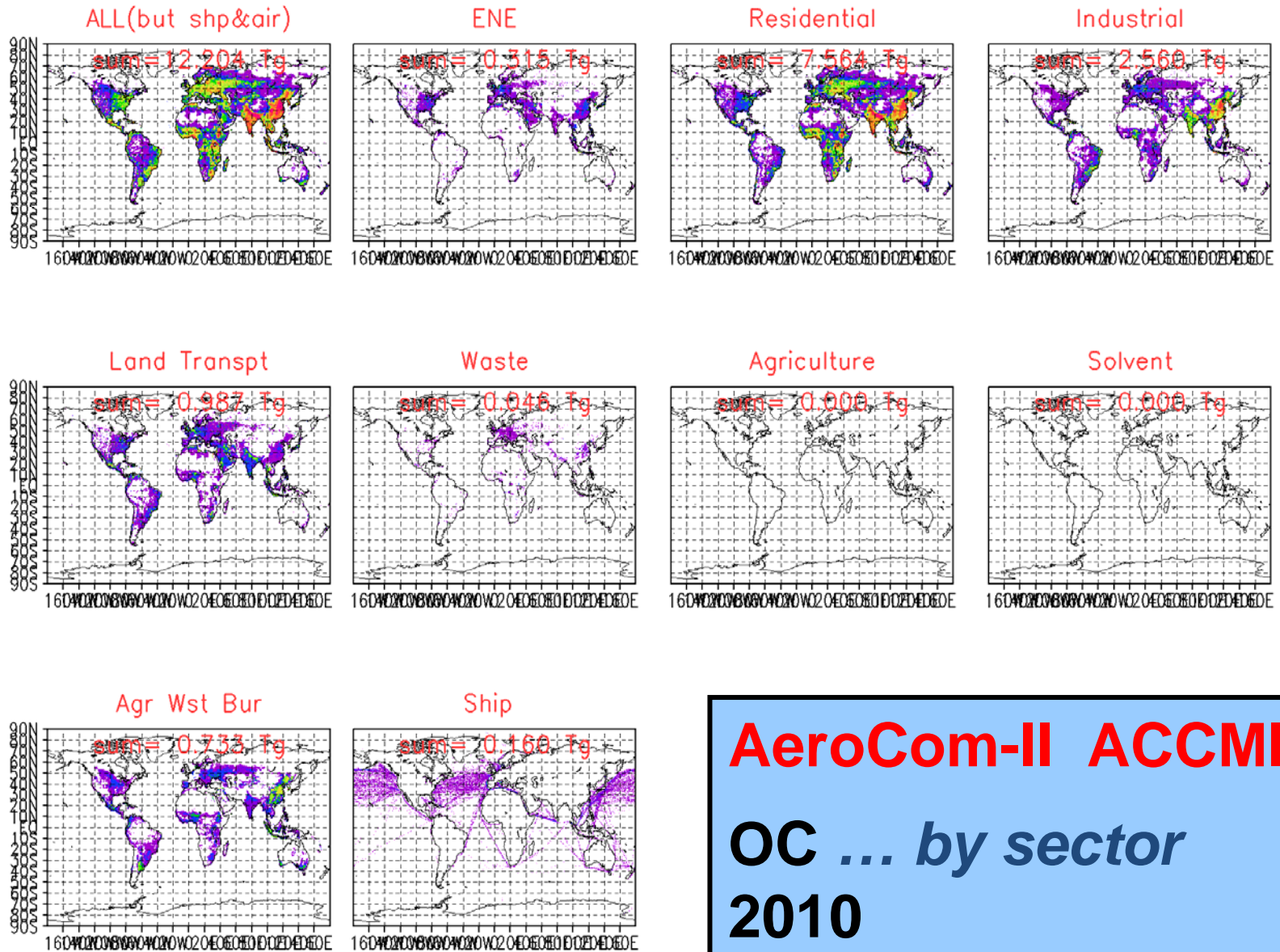


ACCMIP
OC ... by sector
2000

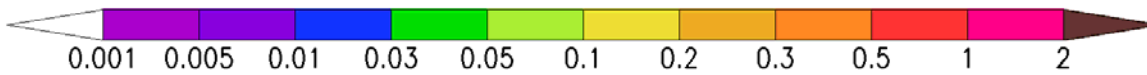


unit: g/m²/year

ACCMIP MACCcity ANTHROP EMI OC 2010 GLB

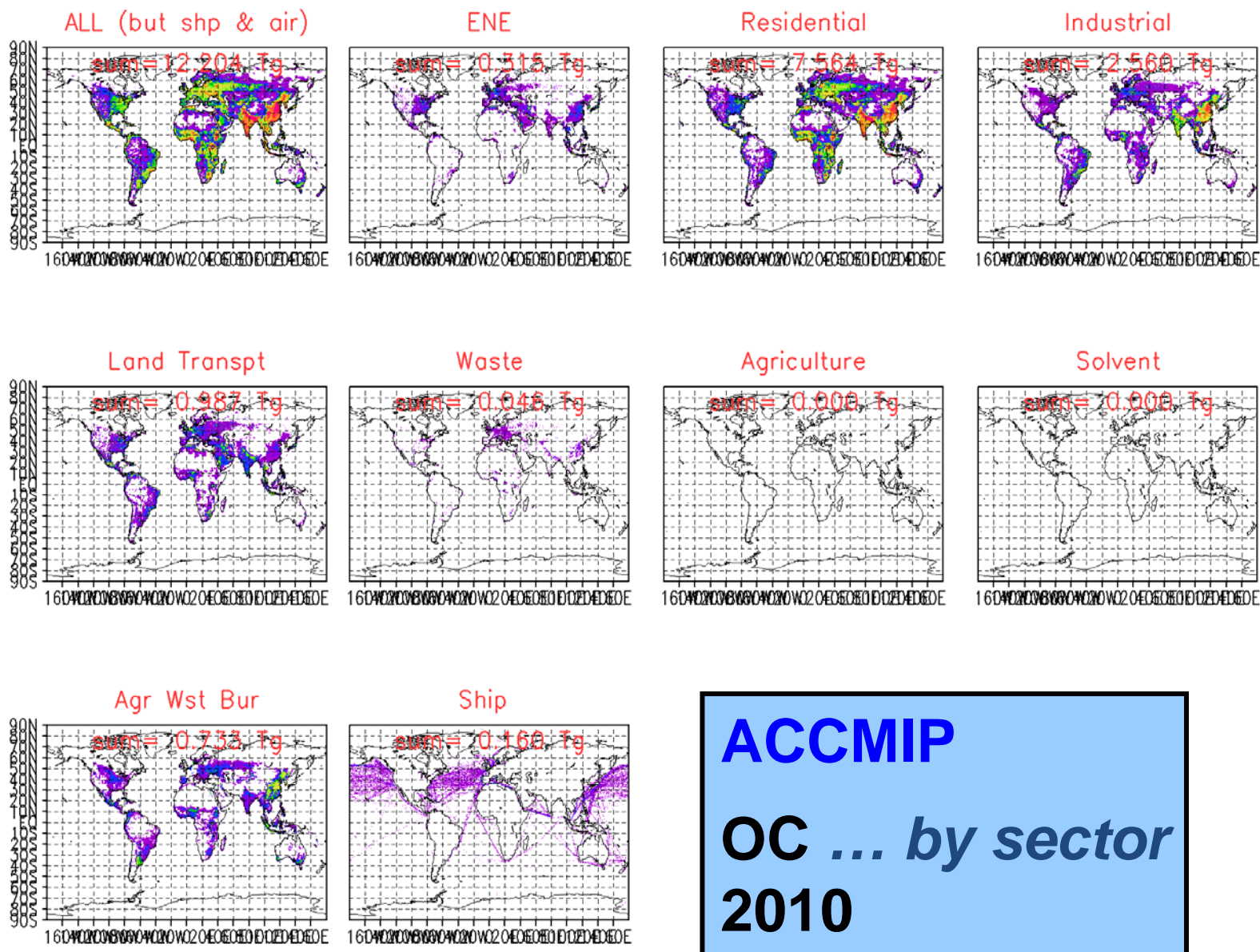


AeroCom-II ACCMIP
OC ... by sector
2010

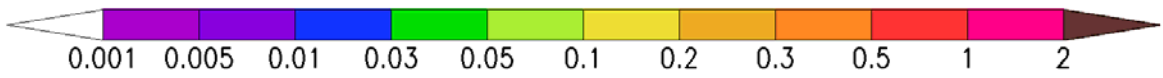


unit: g/m²/year

IPCC_RCP85 ANTHROP EMI OC 2010 GLB



ACCMIP
OC ... by sector
2010



unit: g/m²/year

conclusions (1)

AeroCom-II ACCMIP vs. ACCMIP

- **annual means are identical**
 - **except for ship-emissions** (2-6% smaller for only 1980 and 1990 in AeroCom (-II ACCMIP) due to the linear time interpolation procedure taking into account the ***true*** original timestamps)
 - **except for biomass burning emissions**
- **bio.burn of AeroCom ACCMIP has strong inter-annual variations (1980 to 2008) - ACCMIP not**
- **AeroCom ACCMIP is CF compliant - ACCMIP not**

conclusions (2)

- **AeroCom-II ACCMIP vs AeroCom-II HCA0 v1**
(old SO₂ data)
 - **AeroCom ACCMIP** has lower **anthro. SO₂** emissions
 - Europe after 1990 (~ half less) & Asia (~ 30% less)
 - no big differences between **ACCMIP** and **HCA0 v2**
 - **AeroCom ACCMIP** has higher **anthrop. OC** emissions
 - Europe after 1990 (~ double) & Asia (~ 50% more)
 - **anthrop. BC** emissions are comparable