Predicted change in global SOA in response to future climate, emissions, and land-use change

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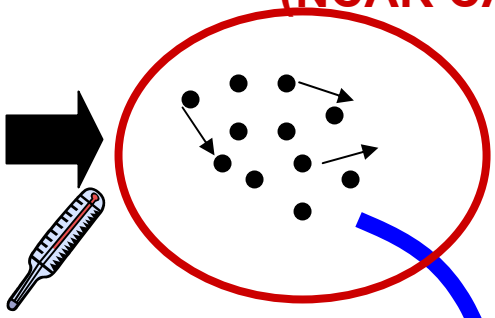
HOW WILL SOA FORMATION RESPOND TO A FUTURE CLIMATE?

Using a coupled land-atmosphere model (NCAR CAM-CLM)

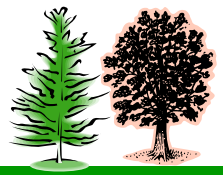


Oxidant levels:
Affected by hydrological cycle and anthropogenic pollution levels

Temperature:
Reduced production

Precipitation:
Changes in removal?

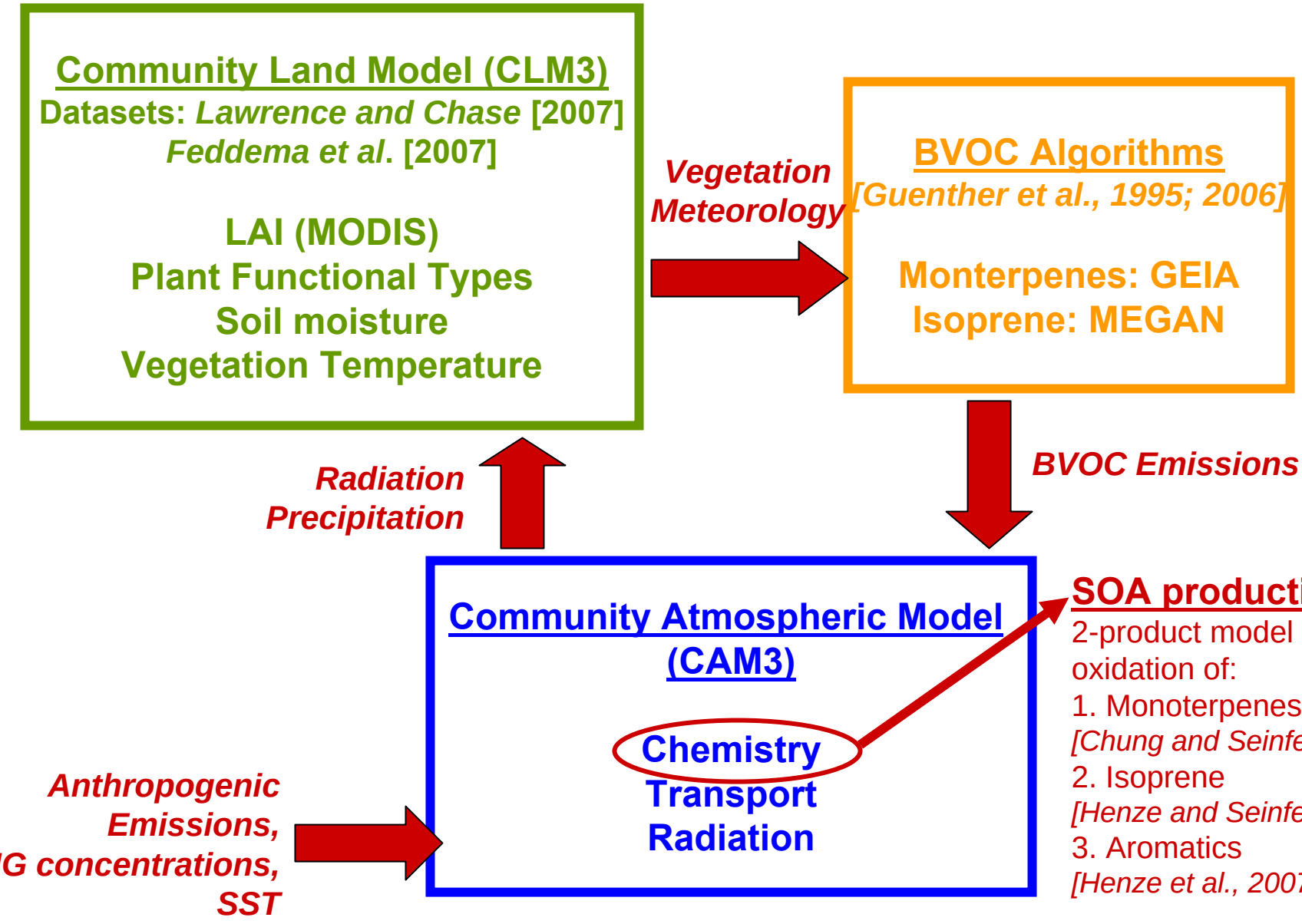
Biogenic Emissions of precursors:
T/light/moisture



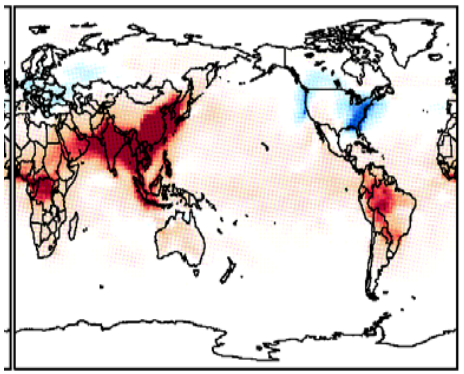
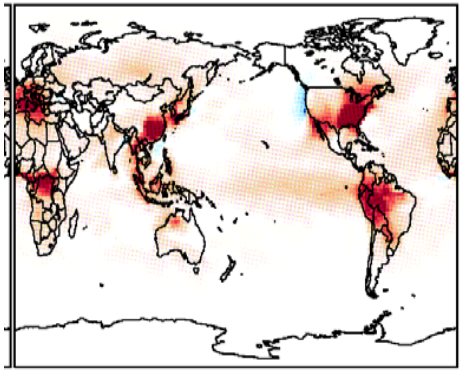
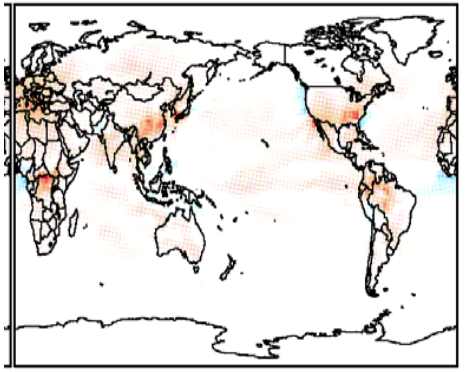
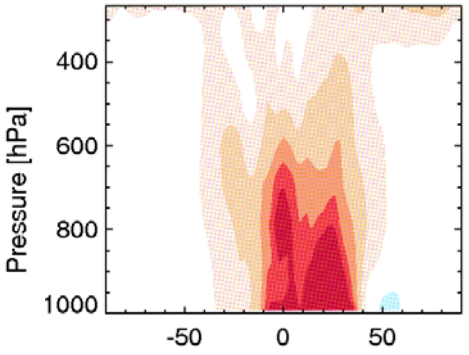
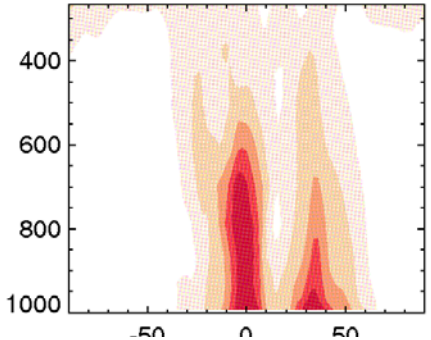
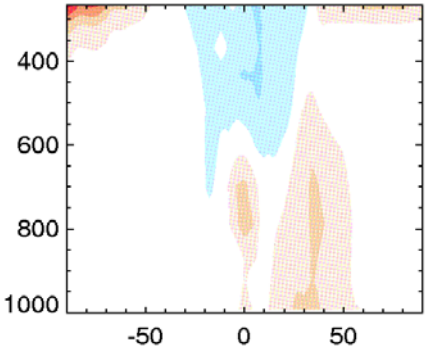
Anthropogenic Emissions:
Increasing aromatic emissions
More surface area for aerosol condensation

Anthropogenic Land-use Change:
Growth of non-emitters (crops)

MODELING FRAMEWORK



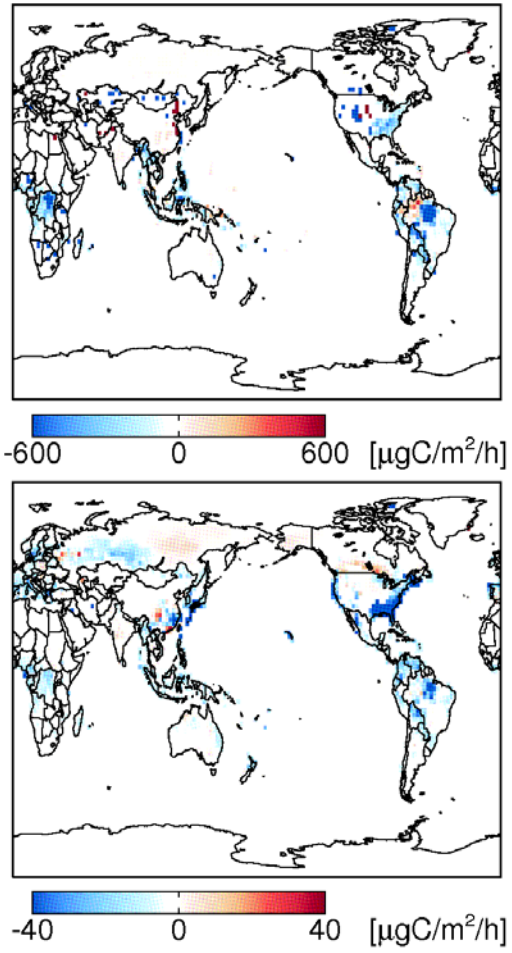
CHANGES IN TOTAL SOA CONCENTRATIONS IN 2100 (A1B) FROM PRESENT-DAY

	Δ Anthropogenic Emissions	Δ Biogenic Emissions	Δ Climate
Surface SOA			
Zonal SOA			
Global Burden	+19%	+17%	~neutral

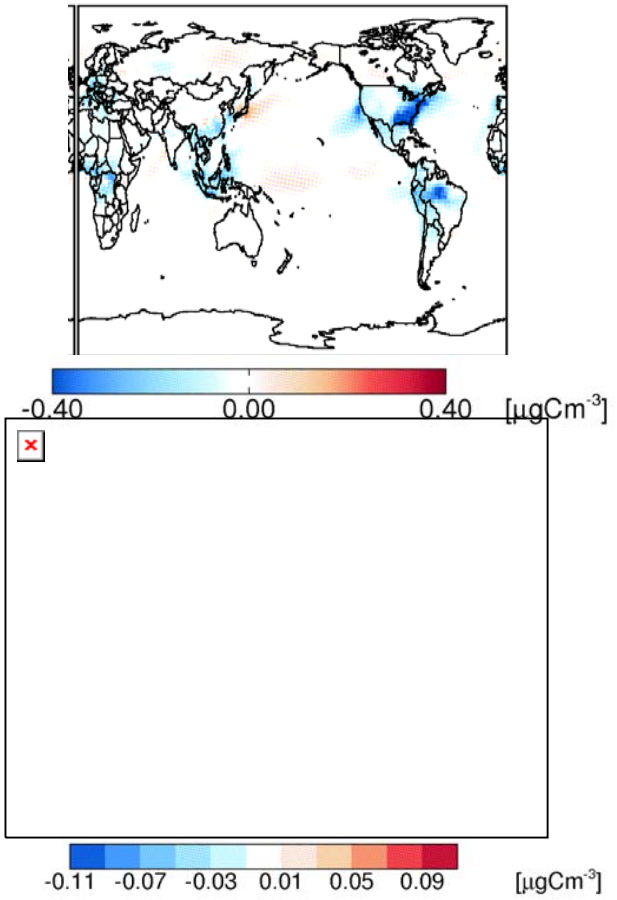
CHANGES IN SOA CONCENTRATIONS IN 2100 FROM PRESENT-DAY DUE TO LAND-USE CHANGE (A2)

***Feddema et al.* [2007] Projections**

BVOC emissions

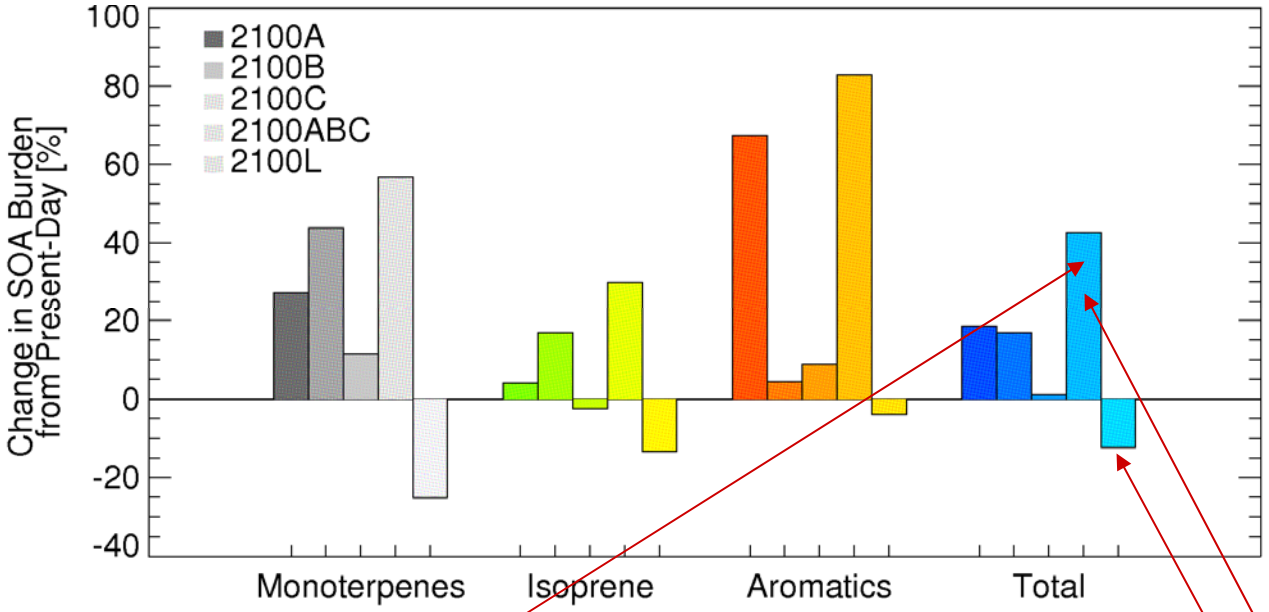


SOA (TOTAL)

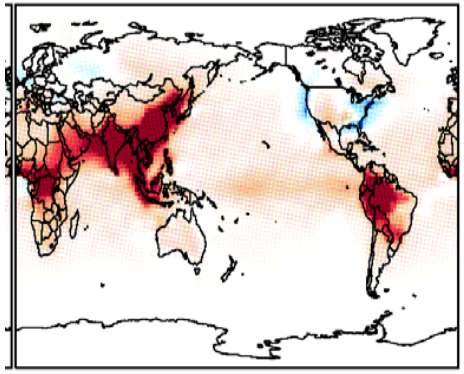


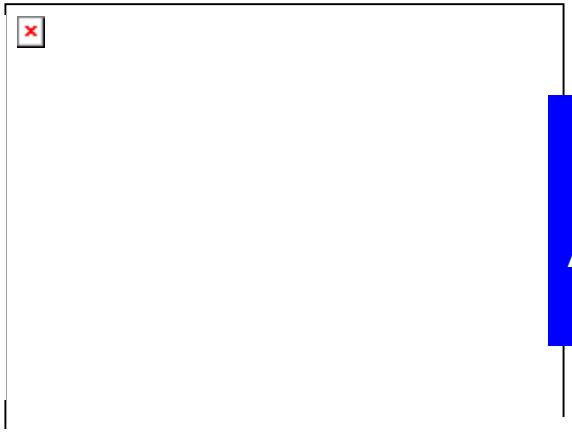
Expansion of croplands (low BVOC emitters) at the expense of broadleaf trees
OVERALL SOA BURDEN: -12%

TOTAL EFFECT OF EMISSIONS & CLIMATE ON SOA



TOTAL SOA





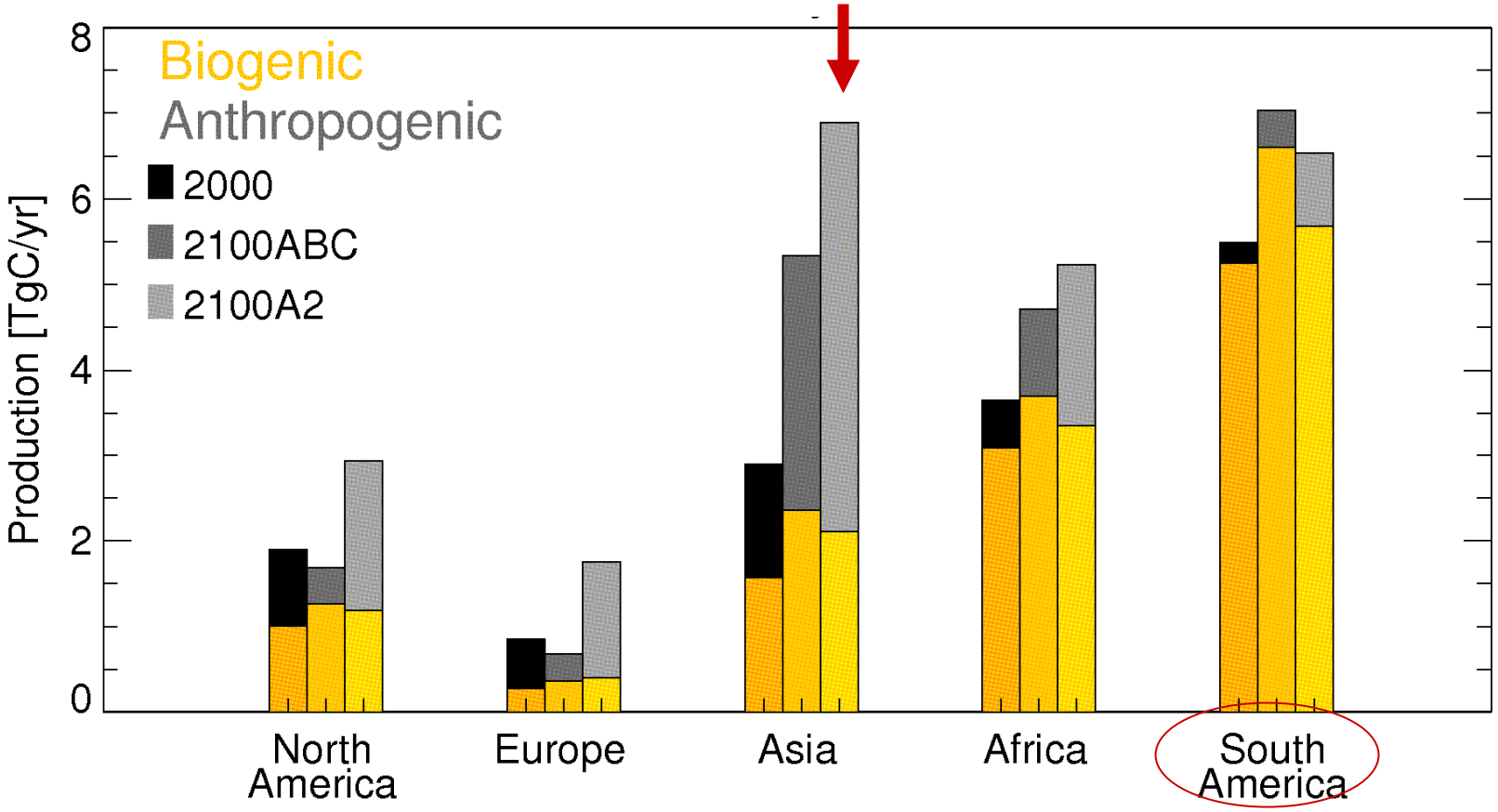
-0.40 0.00 0.40 [μgCm^{-3}]

-0.11 -0.07 -0.03 0.01 0.05 0.09 [μgCm^{-3}]

Climate and Emission: +43%

Anthropogenic Land-use: -12%
Natural Vegetation: ??

REGIONAL SOA SOURCES

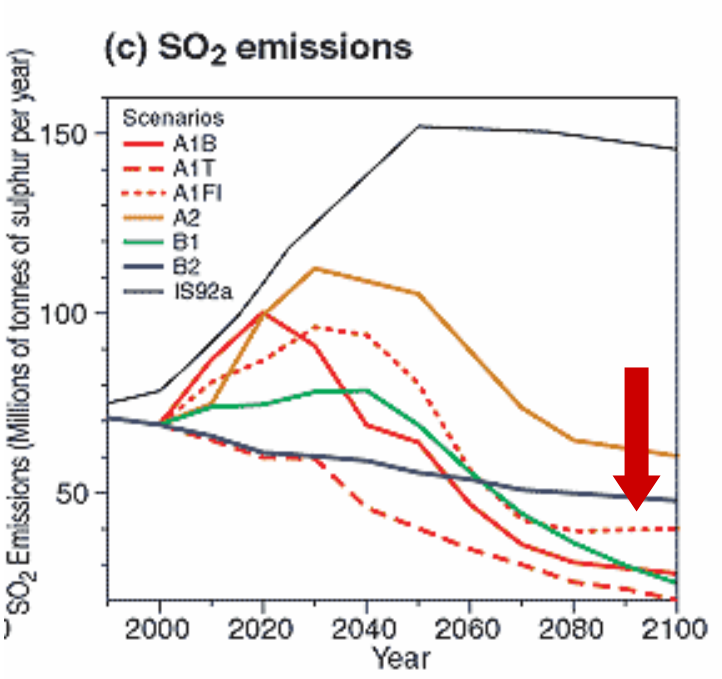


South America is the largest SOA source in present-day but may be overtaken in 2100 by Asia in a business as usual (A2) scenario.

INCREASING SOA: CLIMATE IMPLICATIONS?

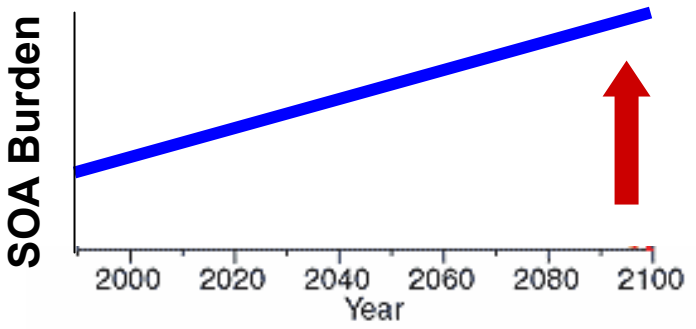
SULFATE

Present-Day Burden: 0.5-0.7 TgS[1]
Projection:↓ by > 50% by 2100?



SOA

Present-Day Burden: 0.51 TgC
Projection: 43%↑



Andreae et al. [2005] suggest ↓ sulfate will accelerate greenhouse gas warming, but SOA may compensate

1 [*Koch et al.*, 1999; *Barth et al.*, 2000; *Takemura et al.*, 2000]