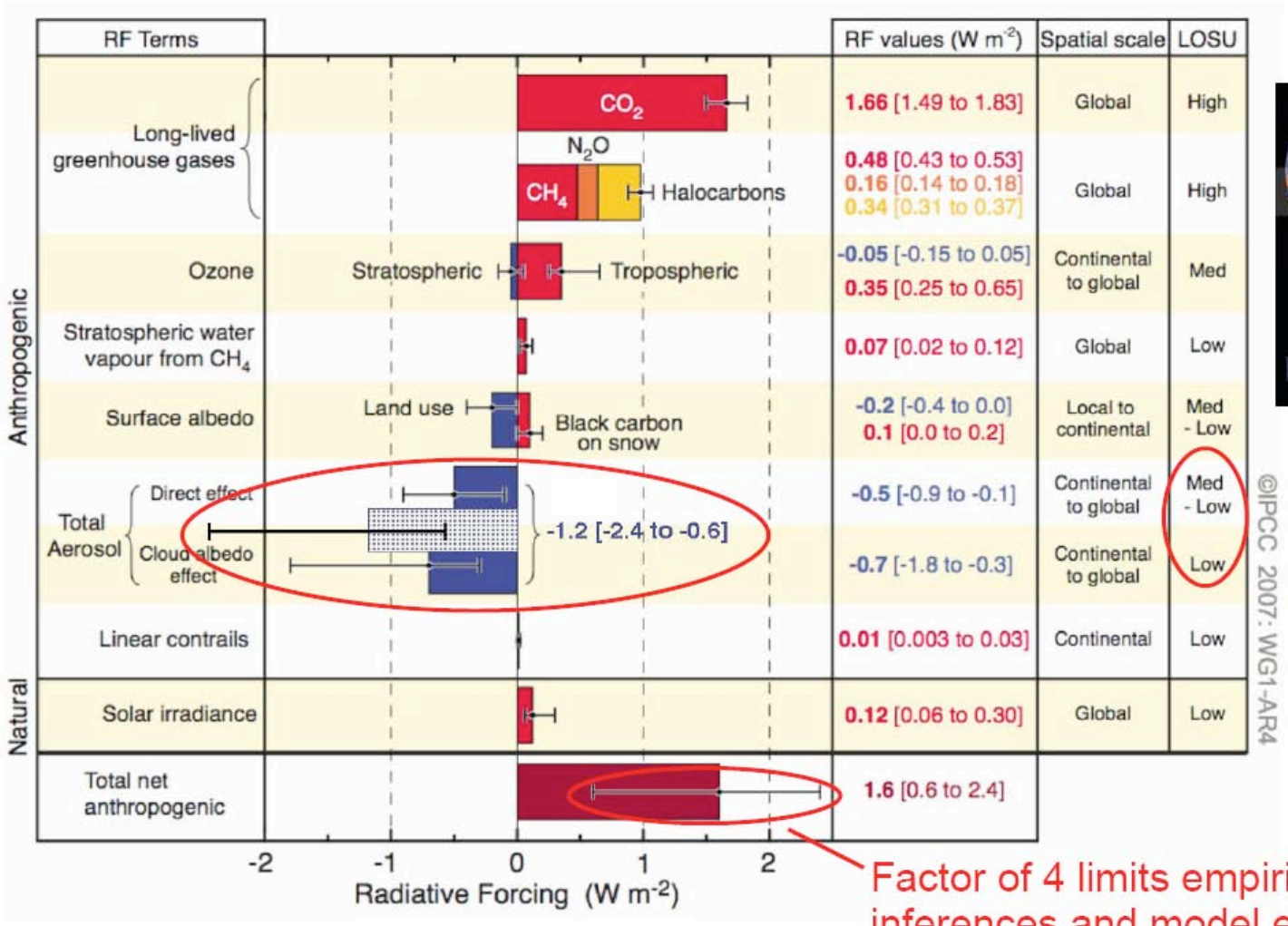
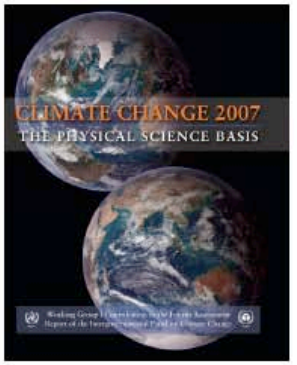
Les aerosols dans le modèle couplé (offline et online)

Anne Cozic, Yves Balkanski, Michael Schulz, Celine Deandreis, Nicolas Yan, Nicolas Huneeus et Jan Griesfeller

GLOBAL-MEAN RADIATIVE FORCINGS (RF)

Pre-industrial to present (Intergovernmental Panel on Climate Change, 2007)



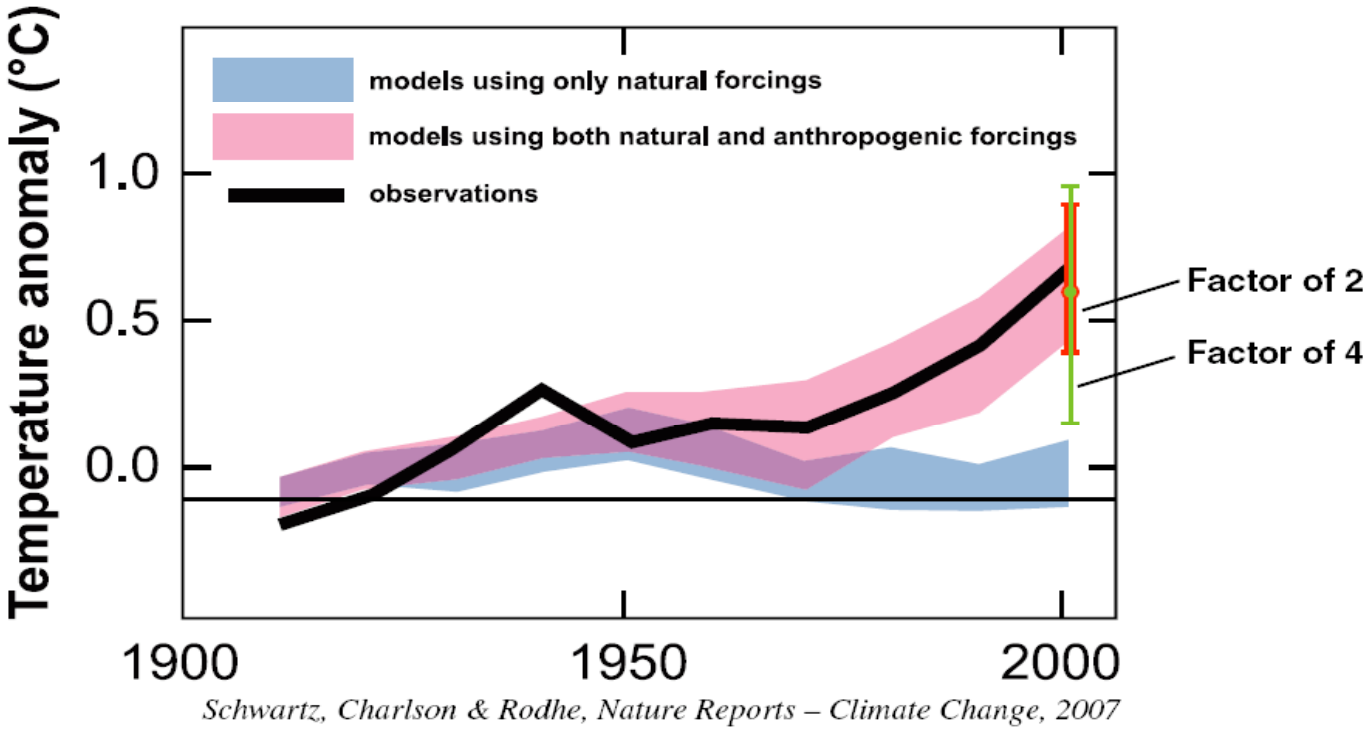


Factor of 4 limits empirical inferences and model evaluation.

LOSU denotes level of scientific understanding.

TOO ROSY A PICTURE?

Ensemble of 58 model runs with 14 global climate models



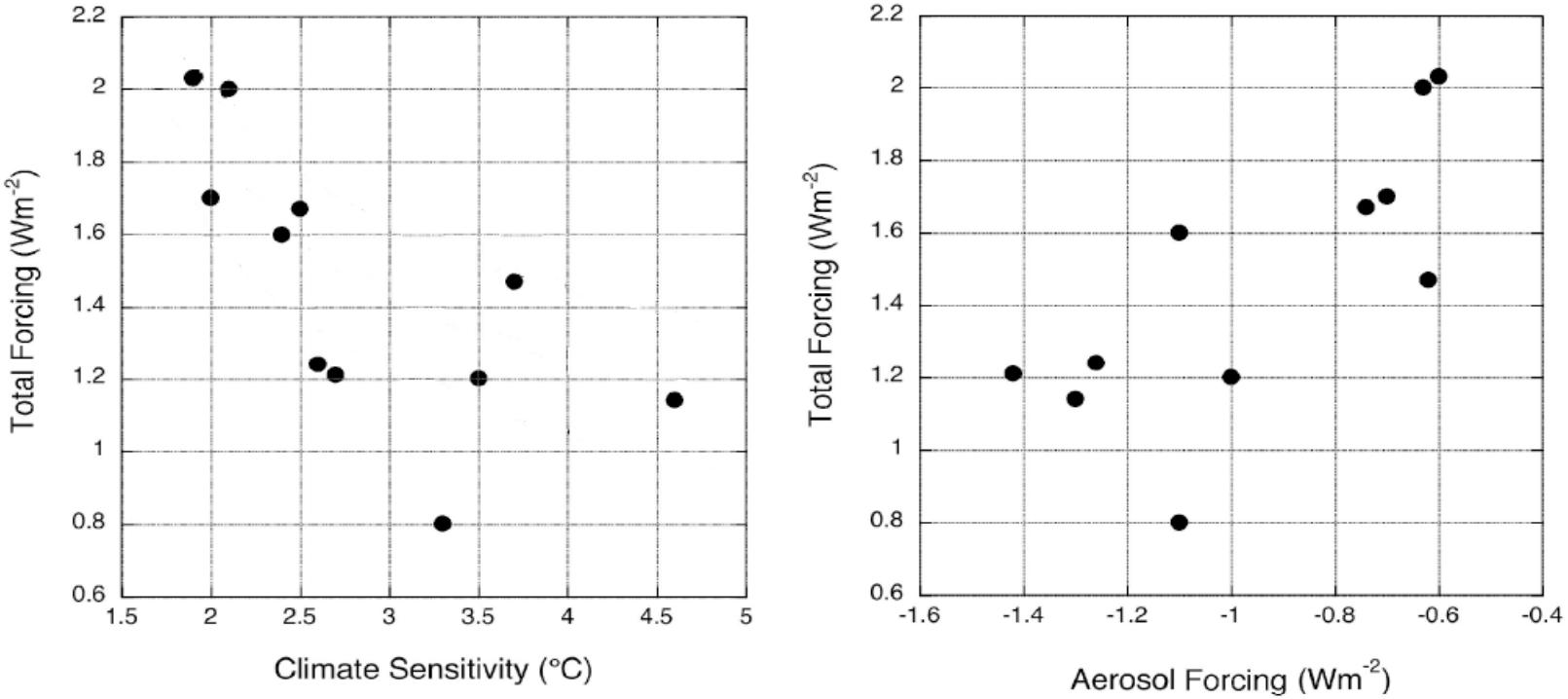
Schwartz, Charlson & Rodhe, Nature Reports – Climate Change, 2007

The models ***did not span the full range of the uncertainty*** and/or . . .

The forcings used in the model runs were ***anticorrelated with the sensitivities of the models***.

CORRELATION OF SENSITIVITY, TOTAL FORCING, AND AEROSOL FORCING IN CLIMATE MODELS

Eleven models used in 2007 IPCC analysis



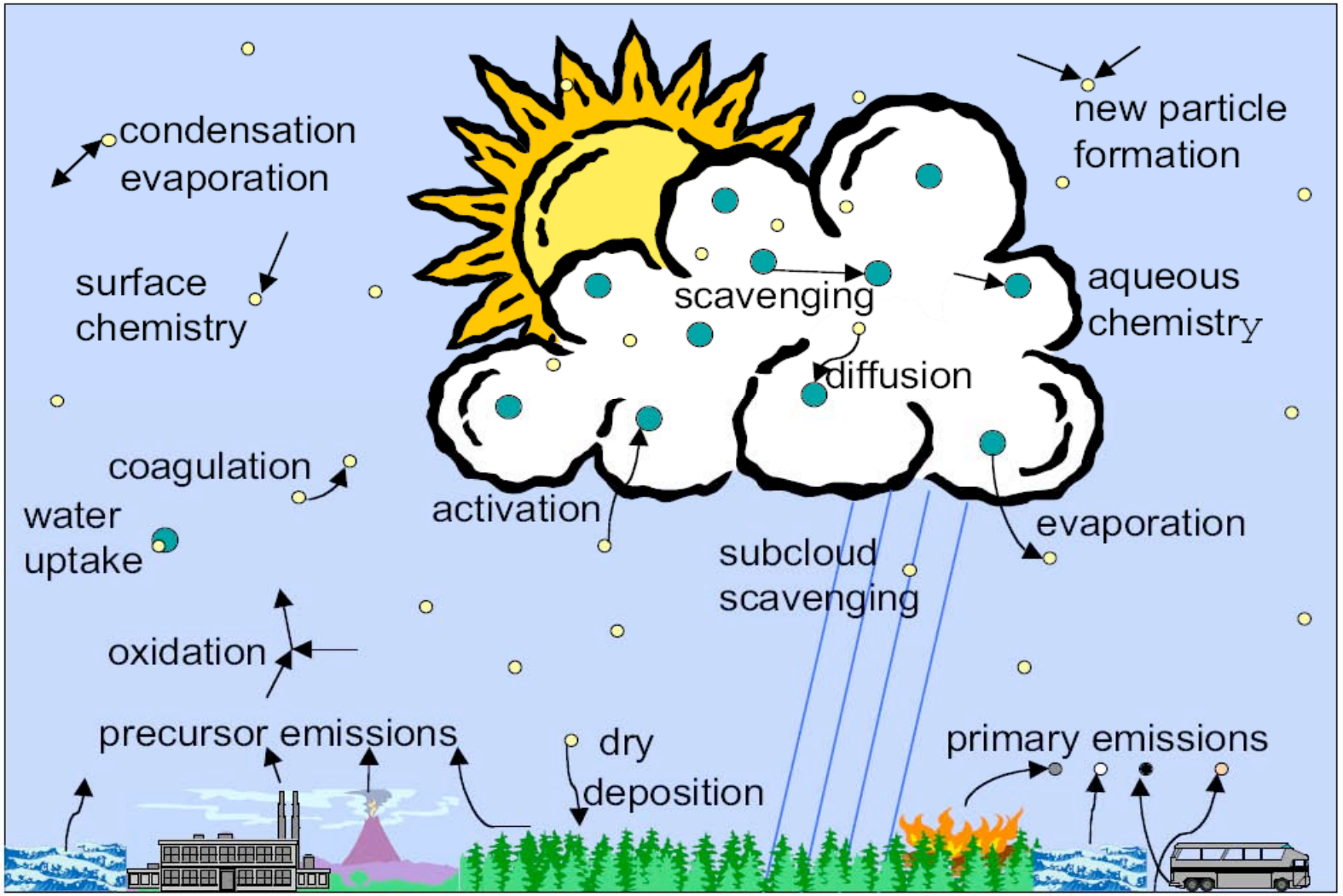
J. Kiehl, GRL, 2007

Climate models with higher sensitivity have lower total forcing.

Total forcing increases with decreasing (negative) aerosol forcing.

These models cannot all be correct.

AEROSOL PROCESSES THAT MUST BE UNDERSTOOD AND REPRESENTED IN MODELS



Ghan and Schwartz, BAMS, 2007

Existant

- **ISPLCM5** → couplage **offline** SO4 / lecture des masses dans un fichier de forçage
  - Rappel : IPSLCM5
    - NEMO (rev 1340)
    - LMDZ (branche LMDZ4-dev rev 1143)
    - ORCHIDEE (orchidee_1_9_2)
- **IPSL_ESM_v1** → couplage **online** BC – SO4 – POM – DUST – SS / calcul des masses avec le modèle INCA

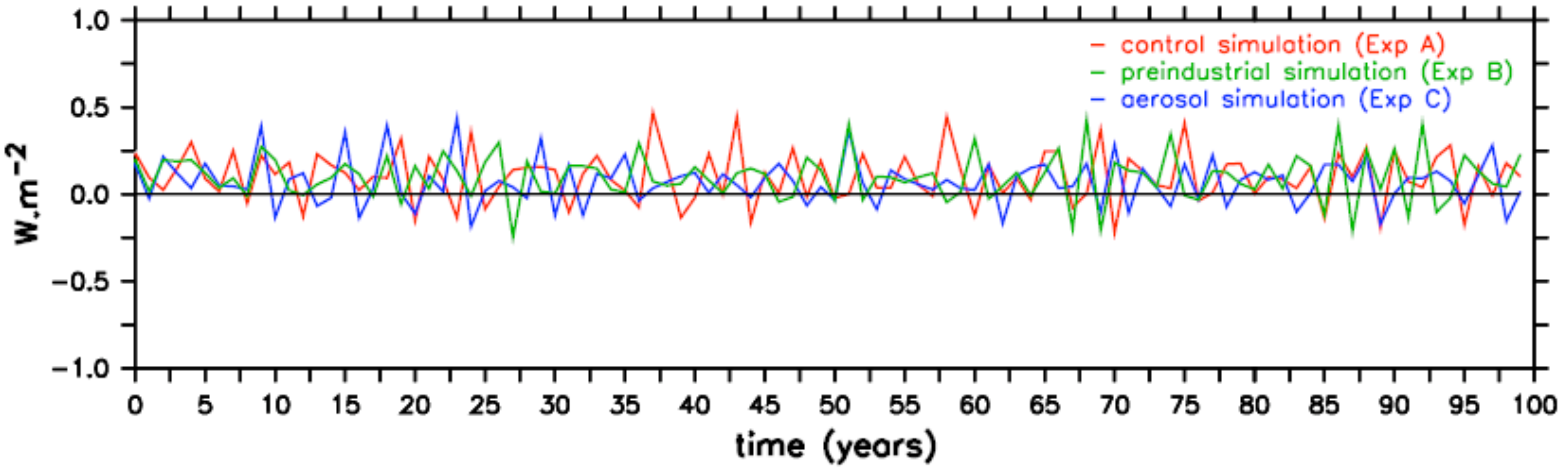
Nouveau modèle IPSL_ESM_v2

- **IPSL_ESM_v2** → couplage **offline/online** BC – SO4 – POM – DUST – SS / lecture des masses dans des fichiers de forçages
  - Options possibles
    - Choix des aérosols
    - Possibilité de passer du **online** au **offline** avec le même exécutable
- Possibilité de retrouver les résultats de IPSLCM5 (dans le cas du SO4)

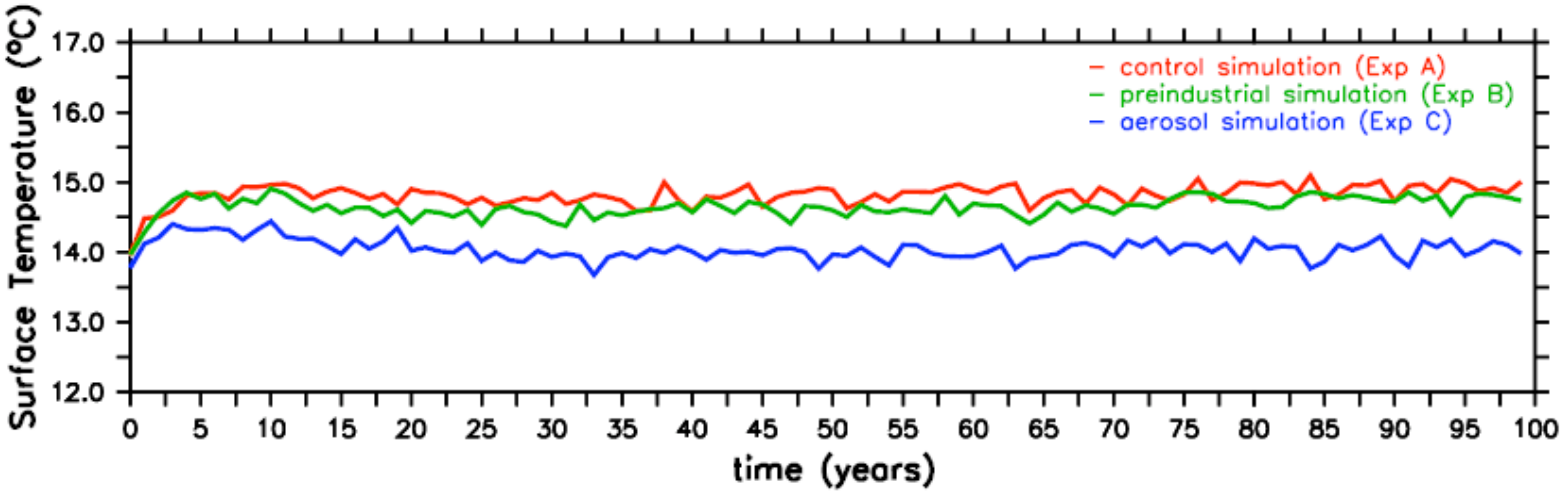
3 simulations

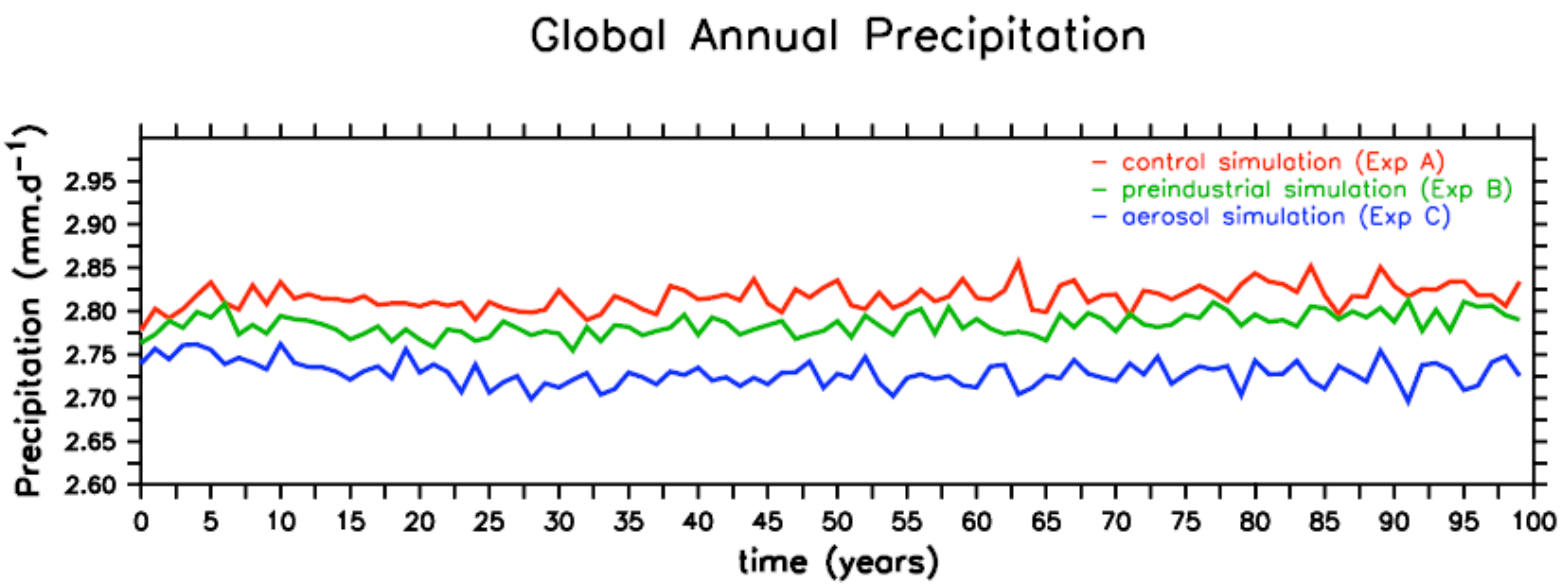
	greenhouse gases	aerosols
Experiment A	**CONTROL** constant CO_2, CH_4 and other GHG (CO_2 = 286ppm, CH_4 = 700ppbv)	no aerosols
Experiment B	same as CONTROL	pre-industrial aerosols
Experiment C	same as CONTROL	present (2000) aerosols

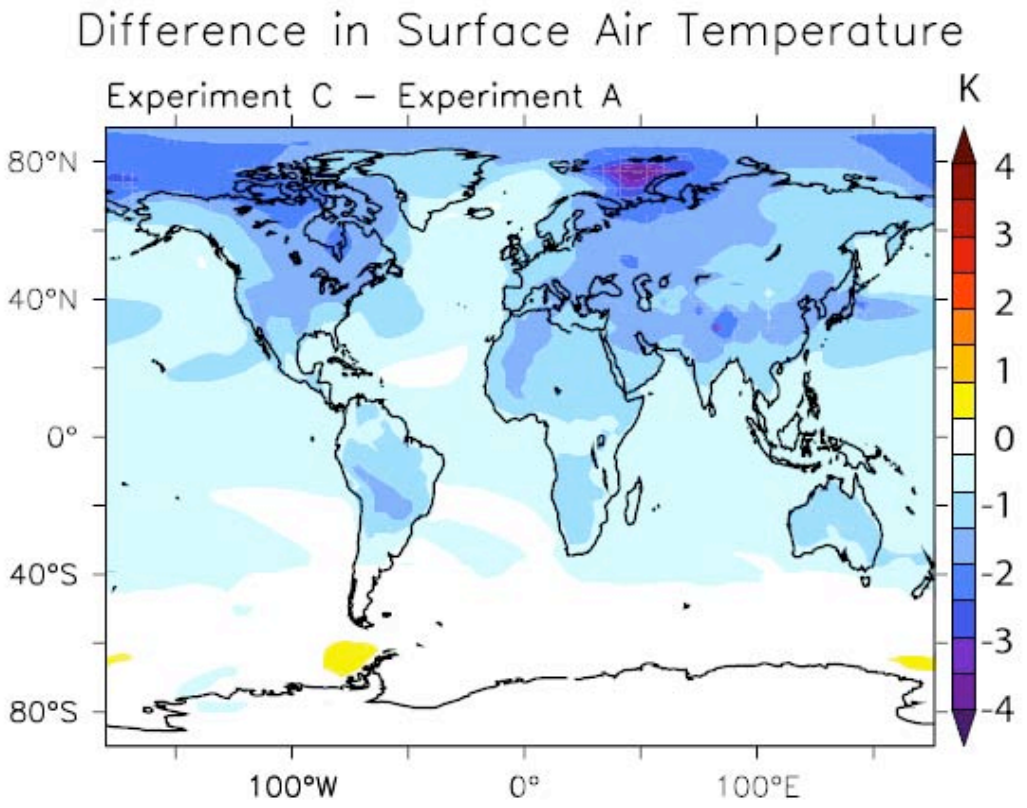
Energy Budget

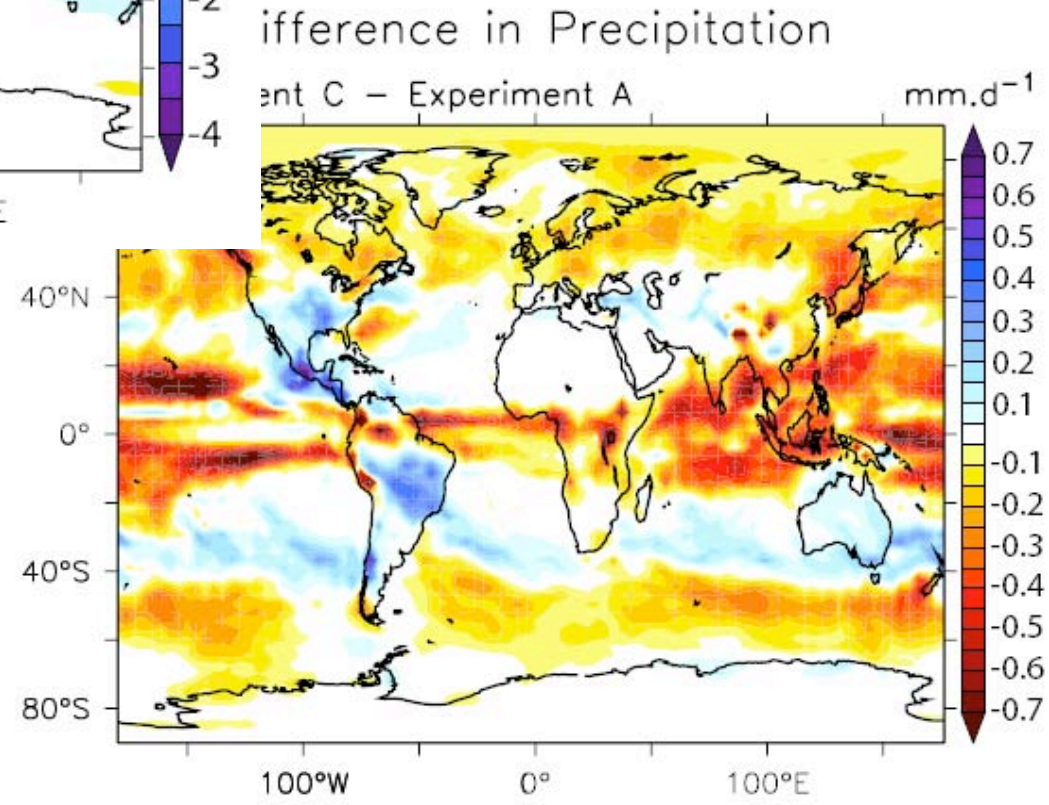


Global Surface Air Temperature




Global Annual Precipitation
Precipitation (mm.d^{-1})
2.95
2.90
2.85
2.80
2.75
2.70
2.65
2.60
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
time (years)
control simulation (Exp A)
preindustrial simulation (Exp B)
aerosol simulation (Exp C)


Difference in Surface Air Temperature
Experiment C – Experiment A
K
4
3
2
1
0
-1
-2
-3
-4
80°N
40°N
0°
40°S
80°S
100°W
0°
100°E


ifference in Precipitation
ent C – Experiment A
mm.d^{-1}
0.7
0.6
0.5
0.4
0.3
0.2
0.1
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
40°N
0°
40°S
80°S
100°W
0°
100°E

MISSTI

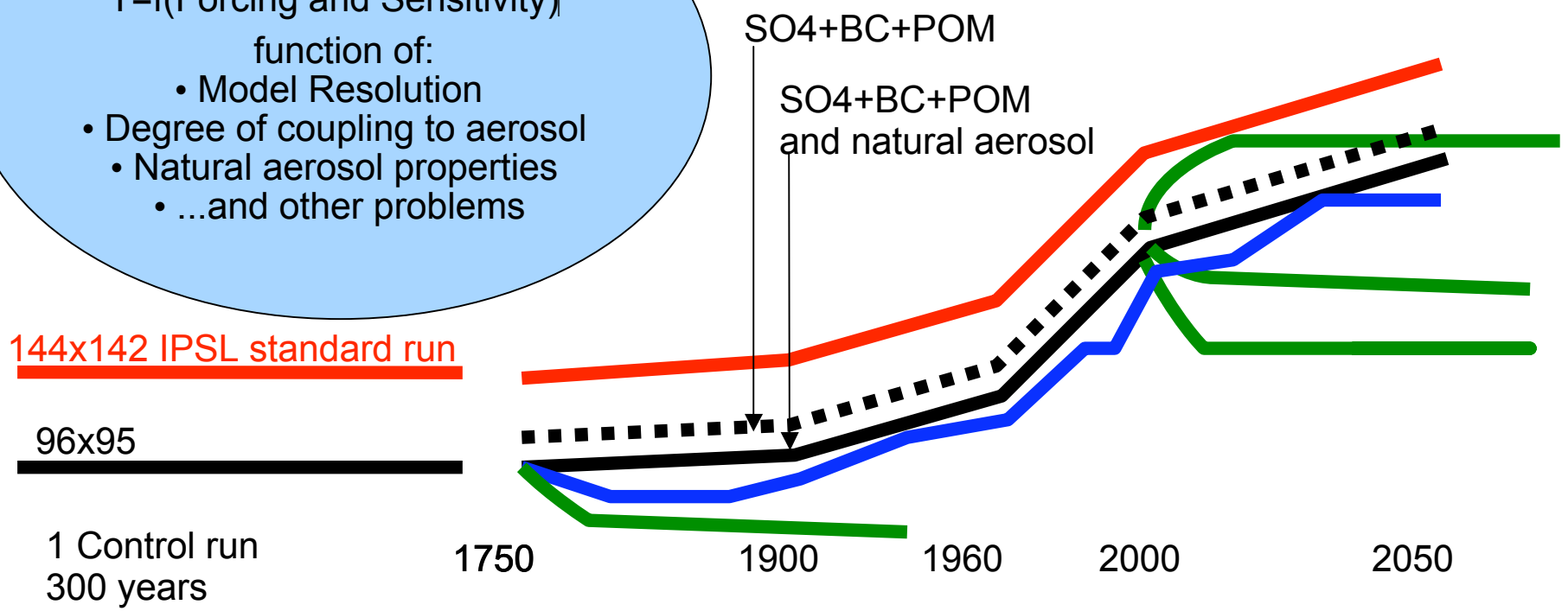
ESM-IPSL-INCA aerosol model configurations for 5th IPCC report

Preindustrial Control Climate state

T=f(Forcing and Sensitivity)

function of:

- Model Resolution
- Degree of coupling to aerosol
- Natural aerosol properties
- ...and other problems



Preindustrial aerosol with precalculated natural aerosol

Decoupled runs

Reading in every 10-20 years precalculated aerosol mass and optical properties, based on IPCC emissions, INCA-NMHC-AER

Interactive coupled aerosol runs

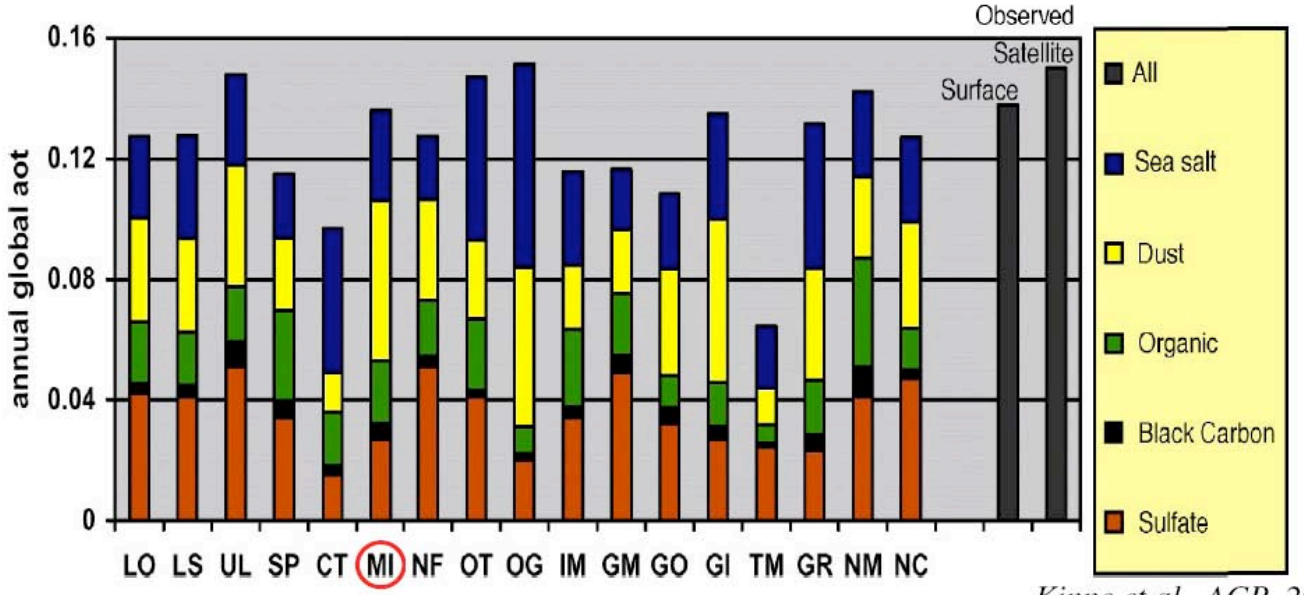
Transient aerosol-climate simulation

Snapshot simulations with different emissions

Hindcast run with SST forcing

AEROSOL OPTICAL DEPTH IN 17 MODELS (AEROCOM)

Comparison also with surface and satellite observations



Kinne et al., ACP, 2006

Surface measurements: AERONET network.

Satellite measurements: composite from multiple instruments/platforms.

Are the models getting the "right" answer for the wrong reason?

Are the models getting the "right" answer because the answer is known?

Are the satellites getting the "right" answer because the answer is known?