Direct and indirect forcings in LMDz-INCA

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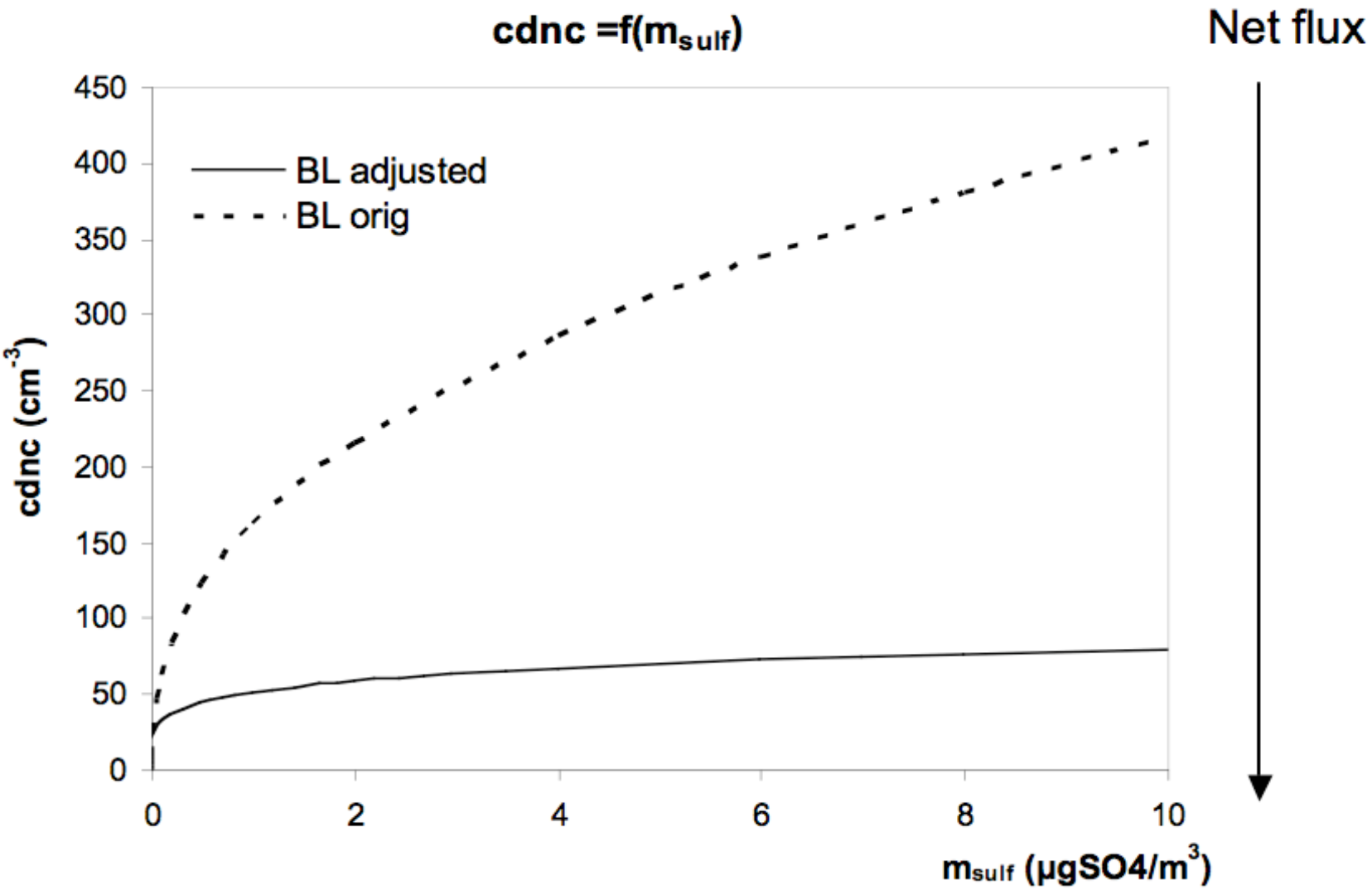
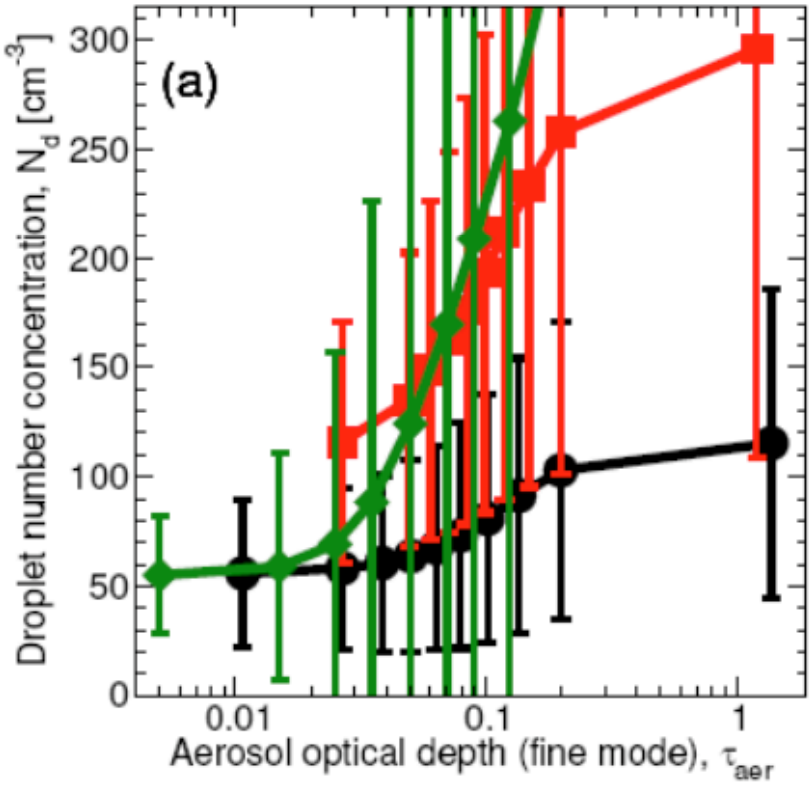
Diagnostic relationship for sulfate

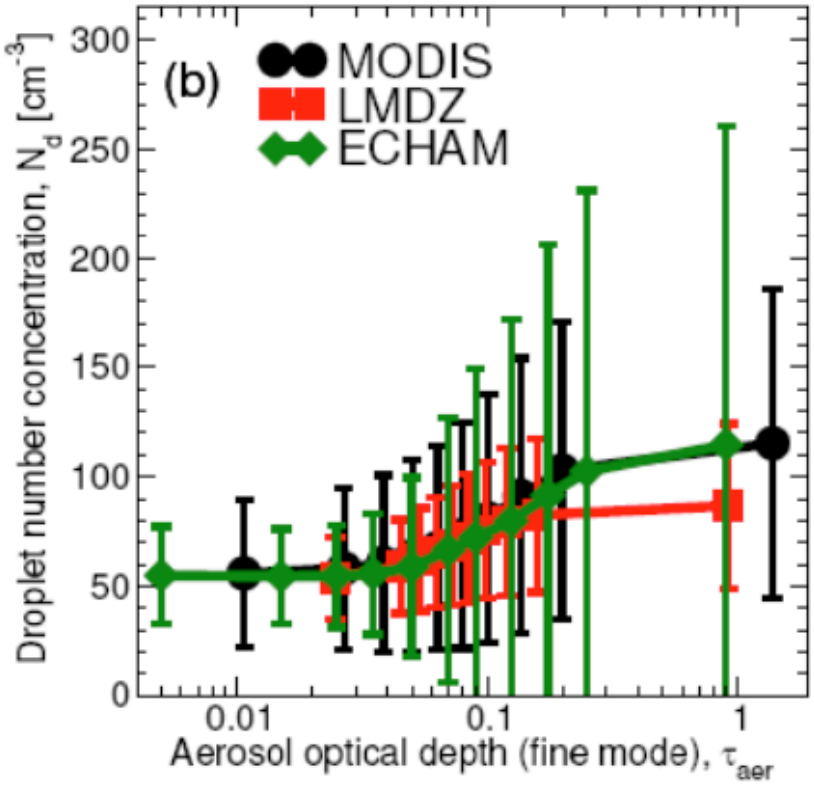


Constraining the indirect effect with observations

ORIGINAL



ADJUSTED



Quaas et al. (2006: ACP)

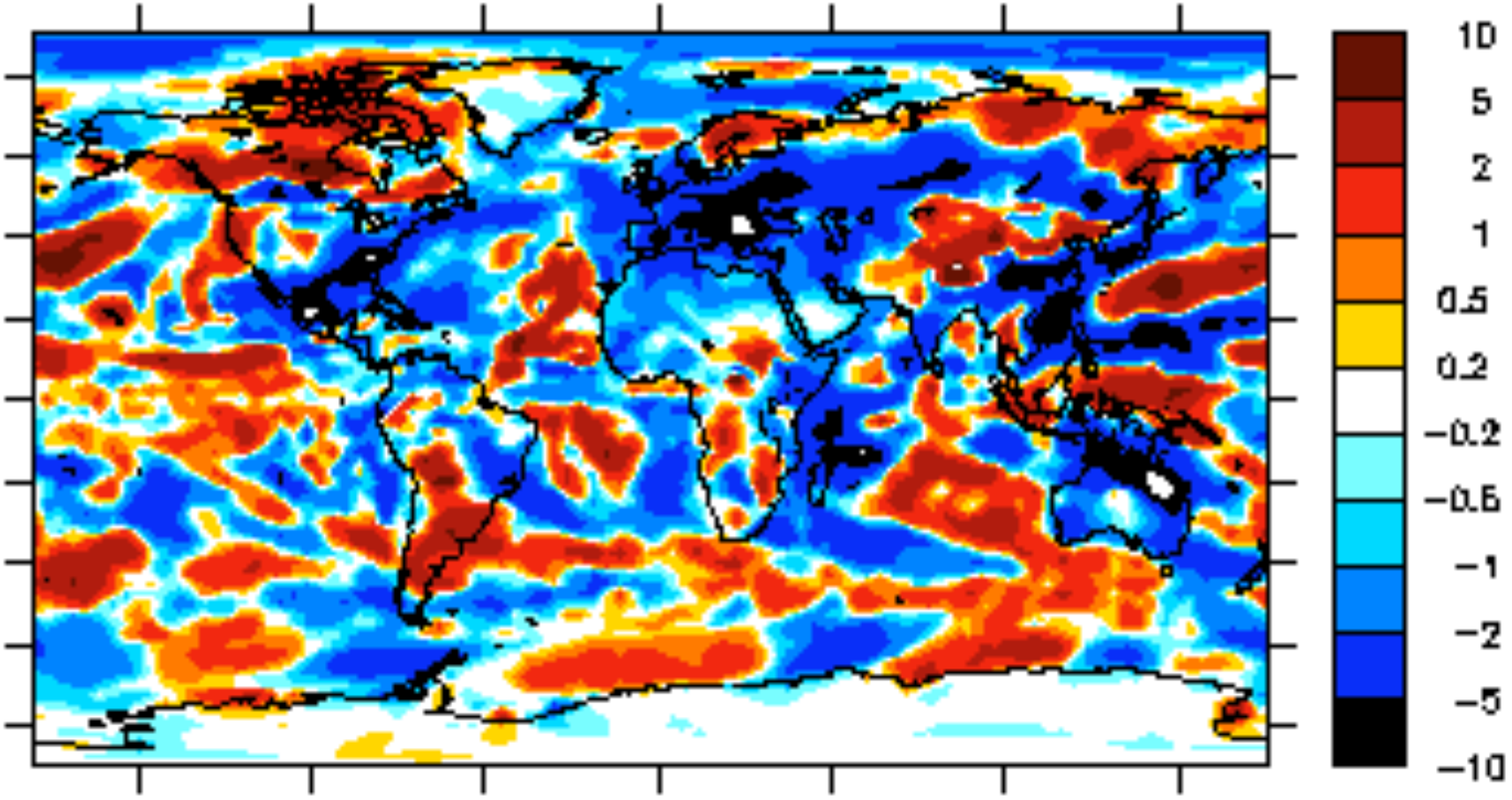
Constraining the indirect effect with observations

Table 1. Global annual mean radiative forcings by the total aerosol indirect effect.

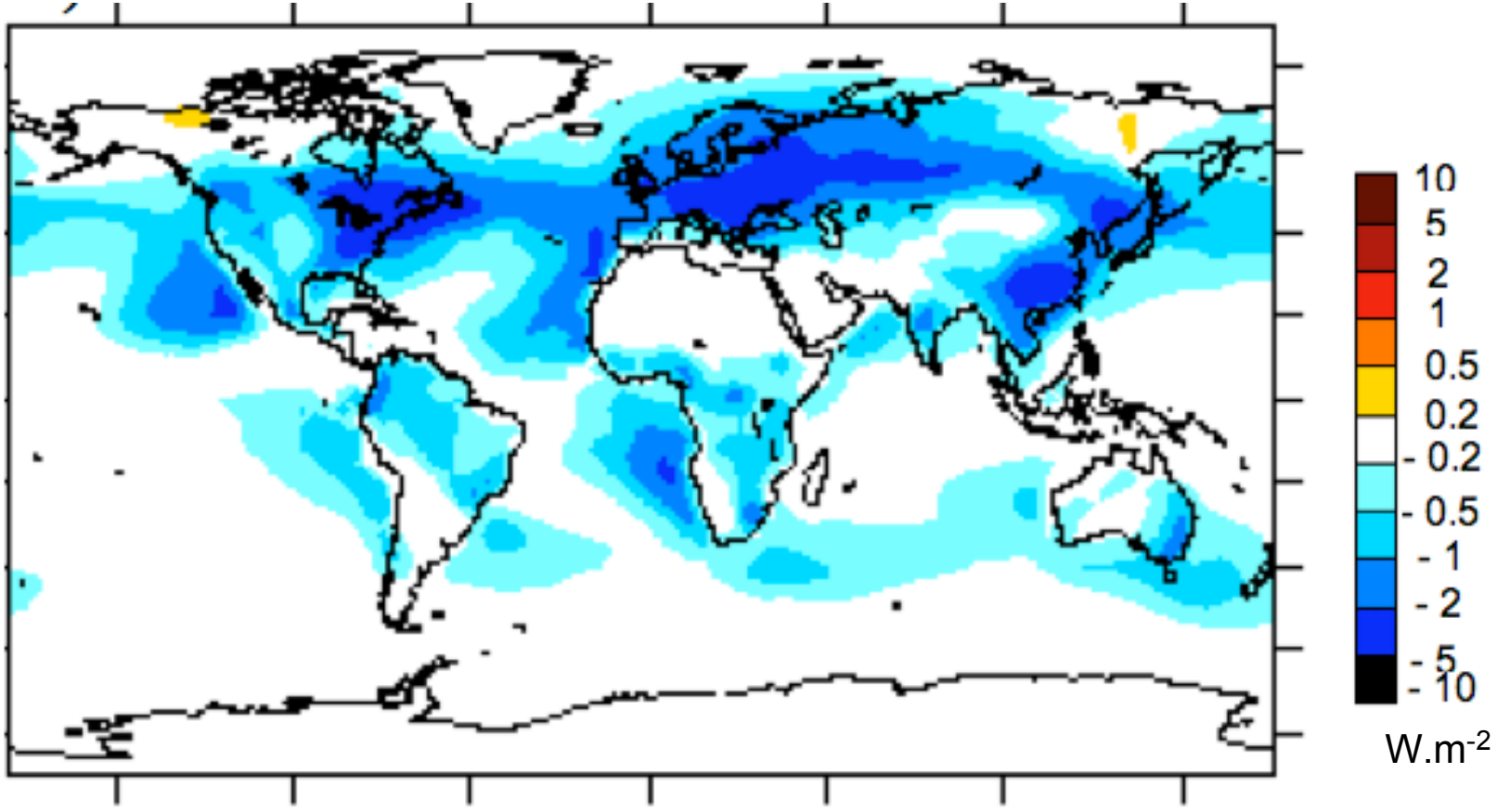
Experiment	Standard (Wm^{-2})	Modified (Wm^{-2})
LMDZ	−0.84	−0.53
ECHAM4	−1.54	−0.29

Quaas et al. (2006: ACP)

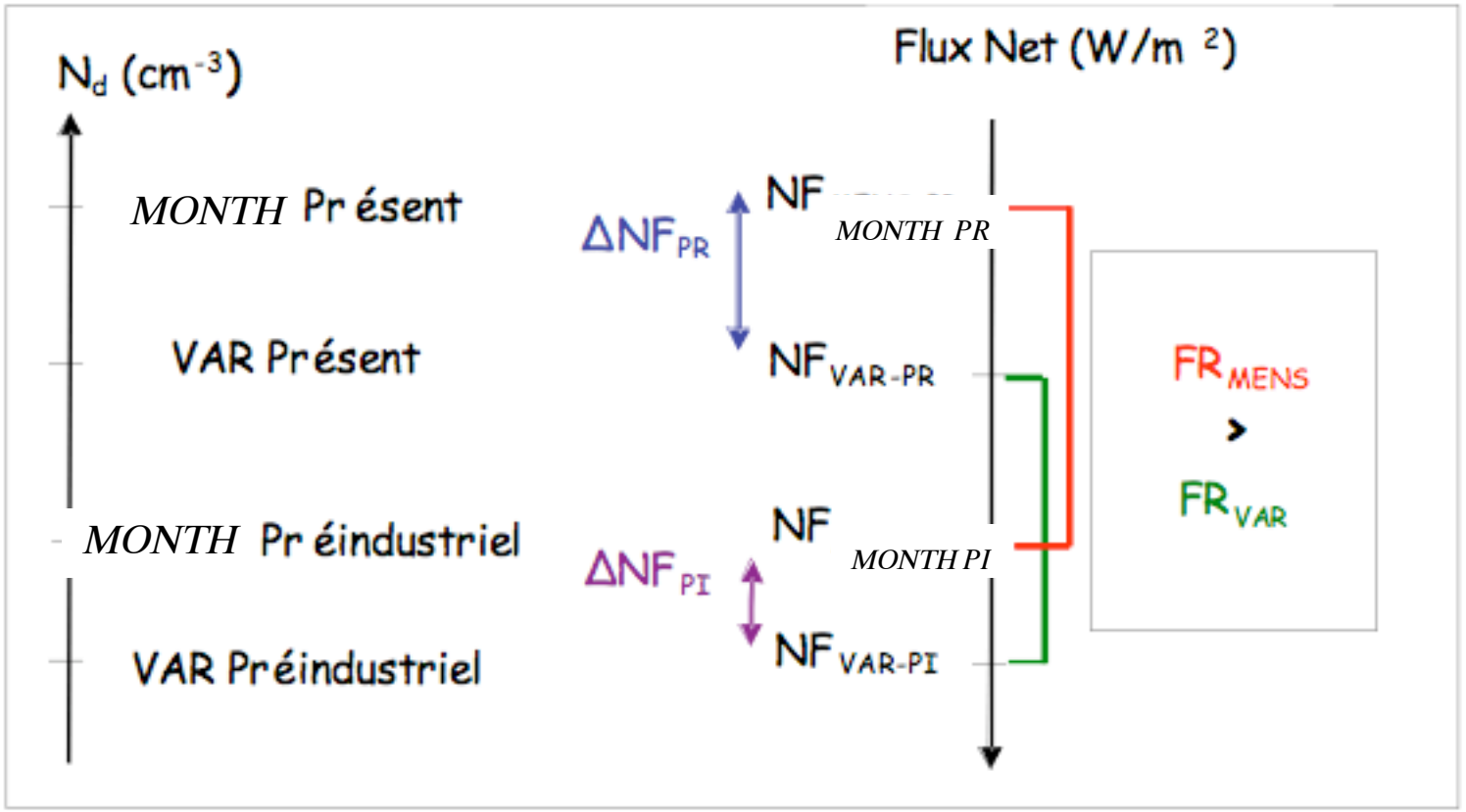
Difference in TOA fluxes (W.m-2) between Present and Preind. in 2 different simulations



Distribution of the 1st indirect effect



Variations in droplet number conc. (Nd) and TOA fluxes



ΔNF_{PR} = + 0.26 W.m $^{-2}$

FR_{MONTH} = -0.39W.m $^{-2}$

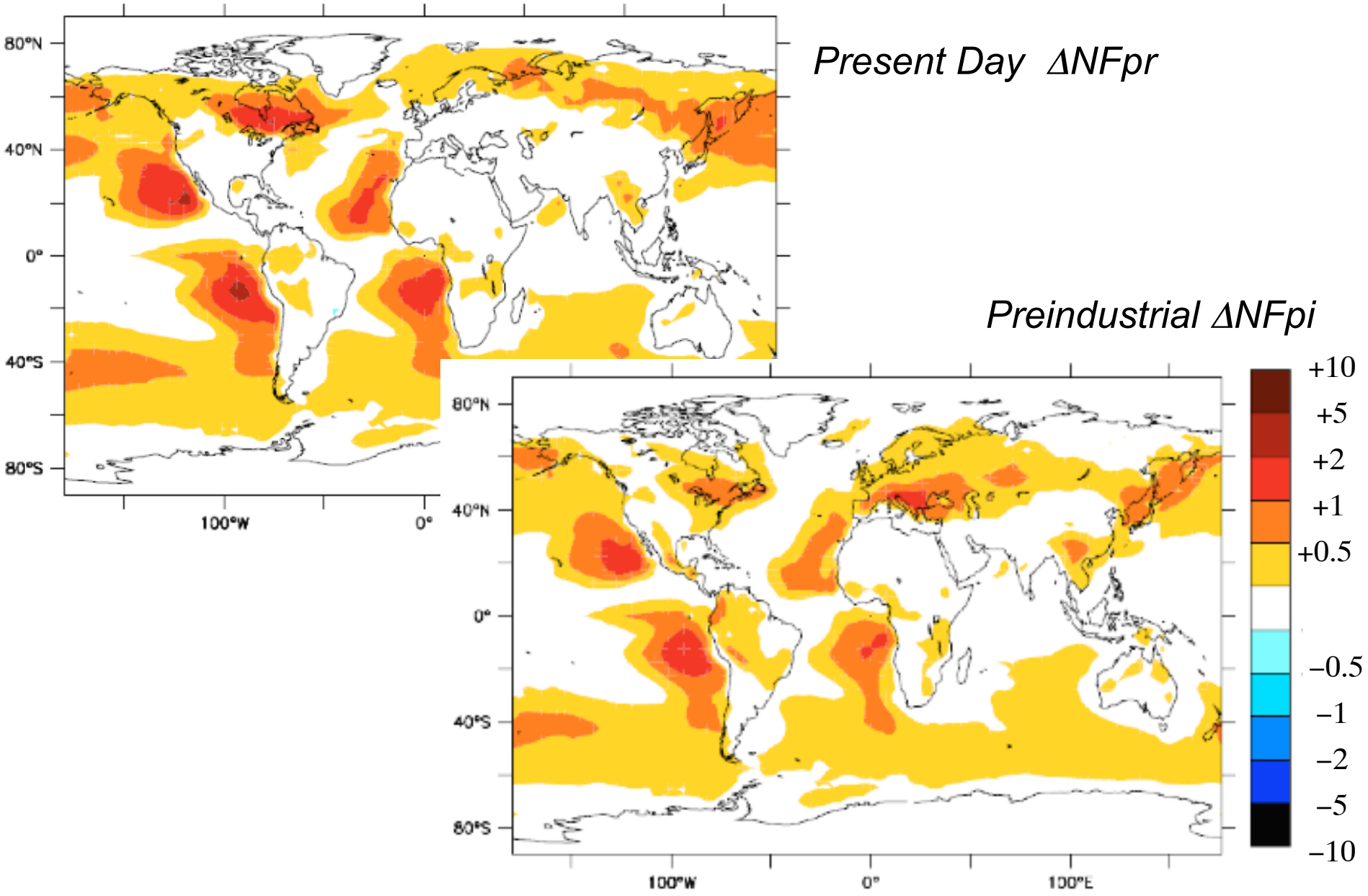
ΔNF_{PI} = + 0.23 W.m $^{-2}$

FR_{VAR} = -0.36W.m $^{-2}$

Top of Atmosphere fluxes

	Present	Preind.	Difference
Exp. VAR	241.12	241.48	-0.36
Exp. AVG	240.86	241.25	-0.39
Fluxes Difference	+0.26	+0.23	+0.03

TOA Flux diff. (W.m-2) between *VAR* and *AVG* aerosol expts



Change in Indirect Effect between varying and monthly mean aerosol concentrations experiments

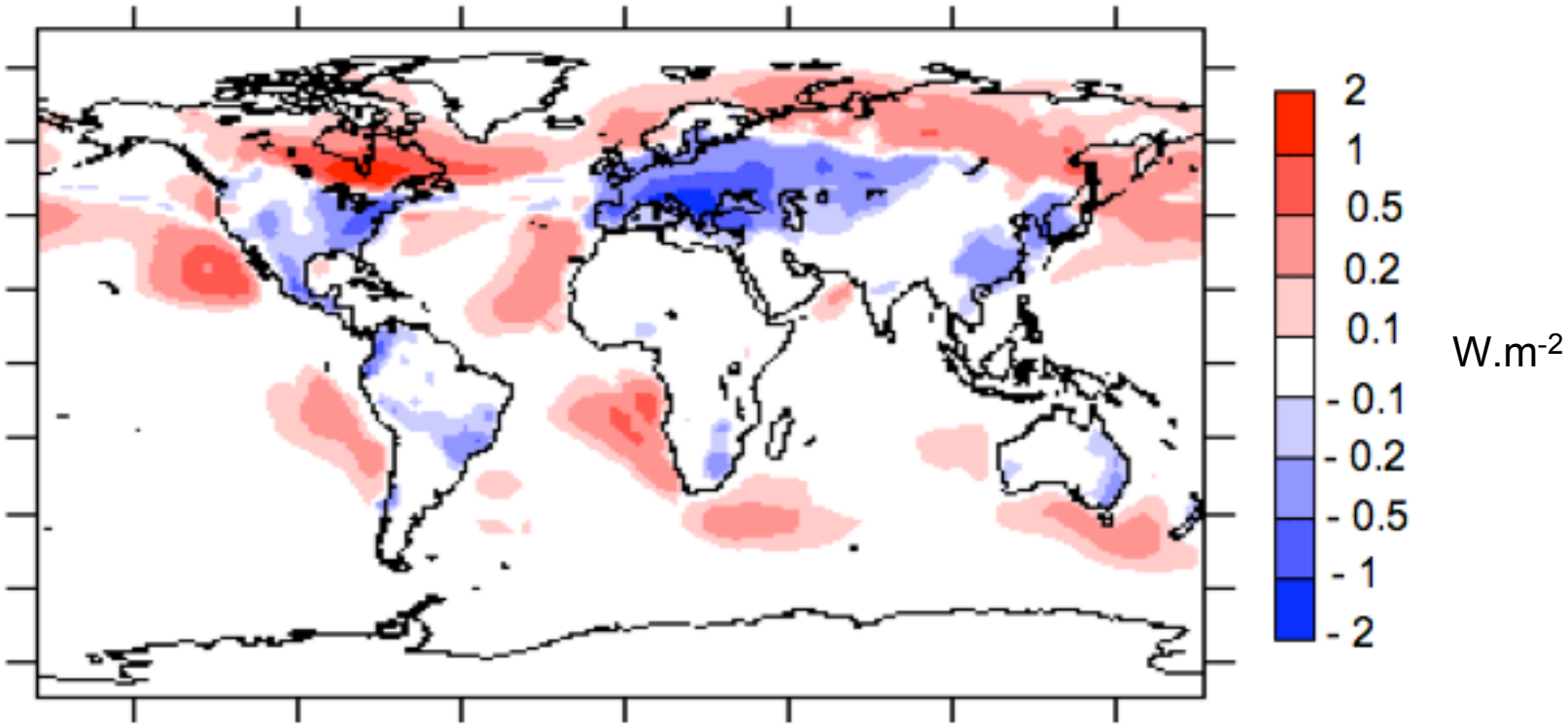
$$\Delta RF = RF_{VAR} - RF_{MONTH} =$$

$$(NF_{VAR\_PR} - NF_{VAR\_PI}) - (NF_{MONTH\_PR} - NF_{MONTH\_PI}) =$$

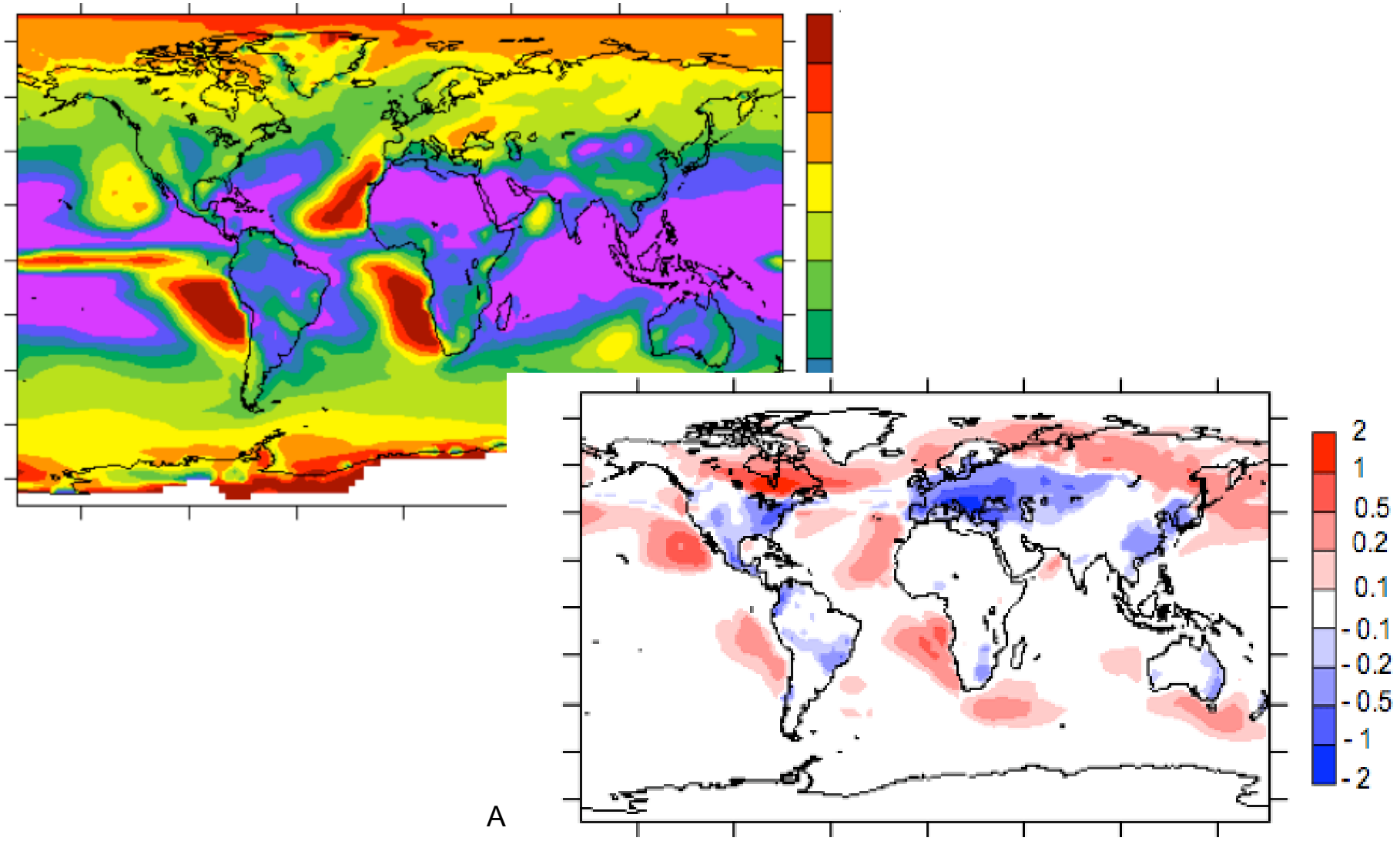
$$(NF_{VAR\_PR} - NF_{MONTH\_PR}) - (NF_{VAR\_PI} - NF_{MONTH\_PI}) =$$

$$\Delta NF_{PR} - \Delta NF_{PI}$$

Difference in Indirect forcing: ΔNF_{pr} - ΔNF_{pi}



Percentage of Low Clouds and difference in fluxes



Effect of the preindustrial concentrations on the Indirect effect

- Several authors have proposed that the aerosol number concentrations during pre-industrial influences our estimate of the indirect effect

- Models often have artificially built in limits on the number of cloud droplets

Lauer et al., ACP 2007

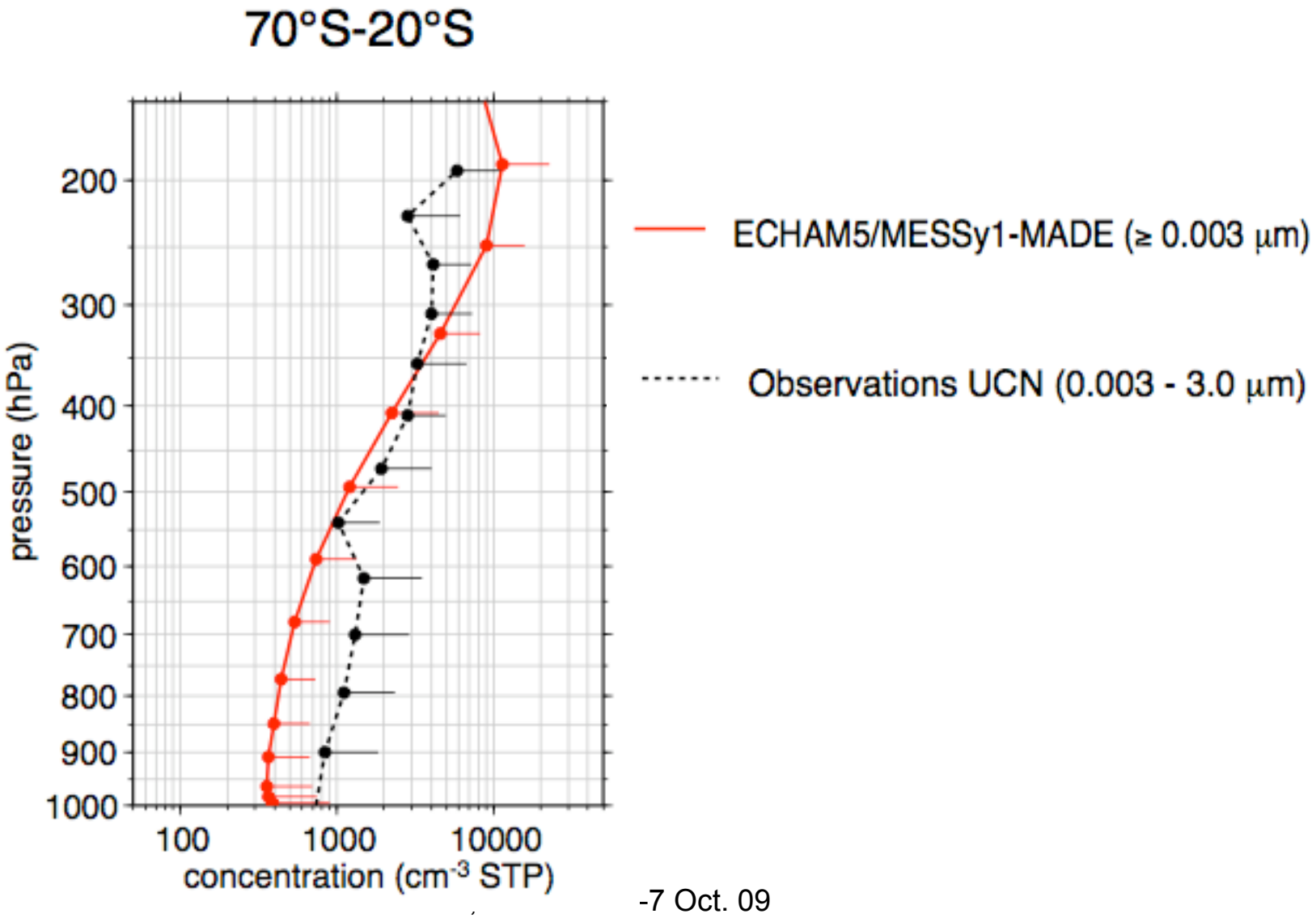
Indirect effect computed for 3 different inventories of aerosols produced form ship emissions

AIE from −0.19 W m^{-2} to −0.60 W m^{-2}

(17 to 39% of the total indirect effect of anthropogenic aerosols)

Vertical profiles of mean aerosol numbers

Lauer et al. ACP, 2007



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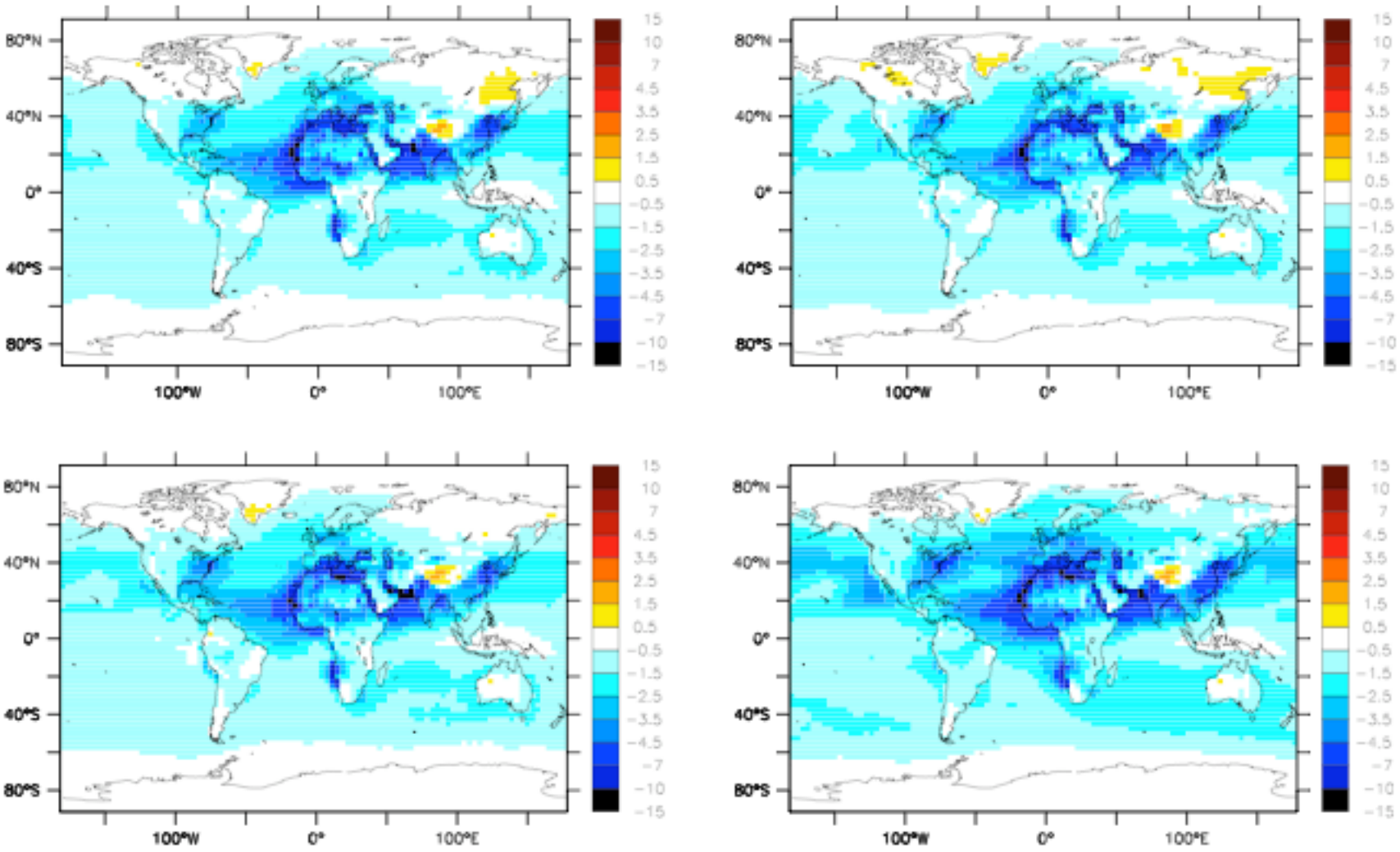
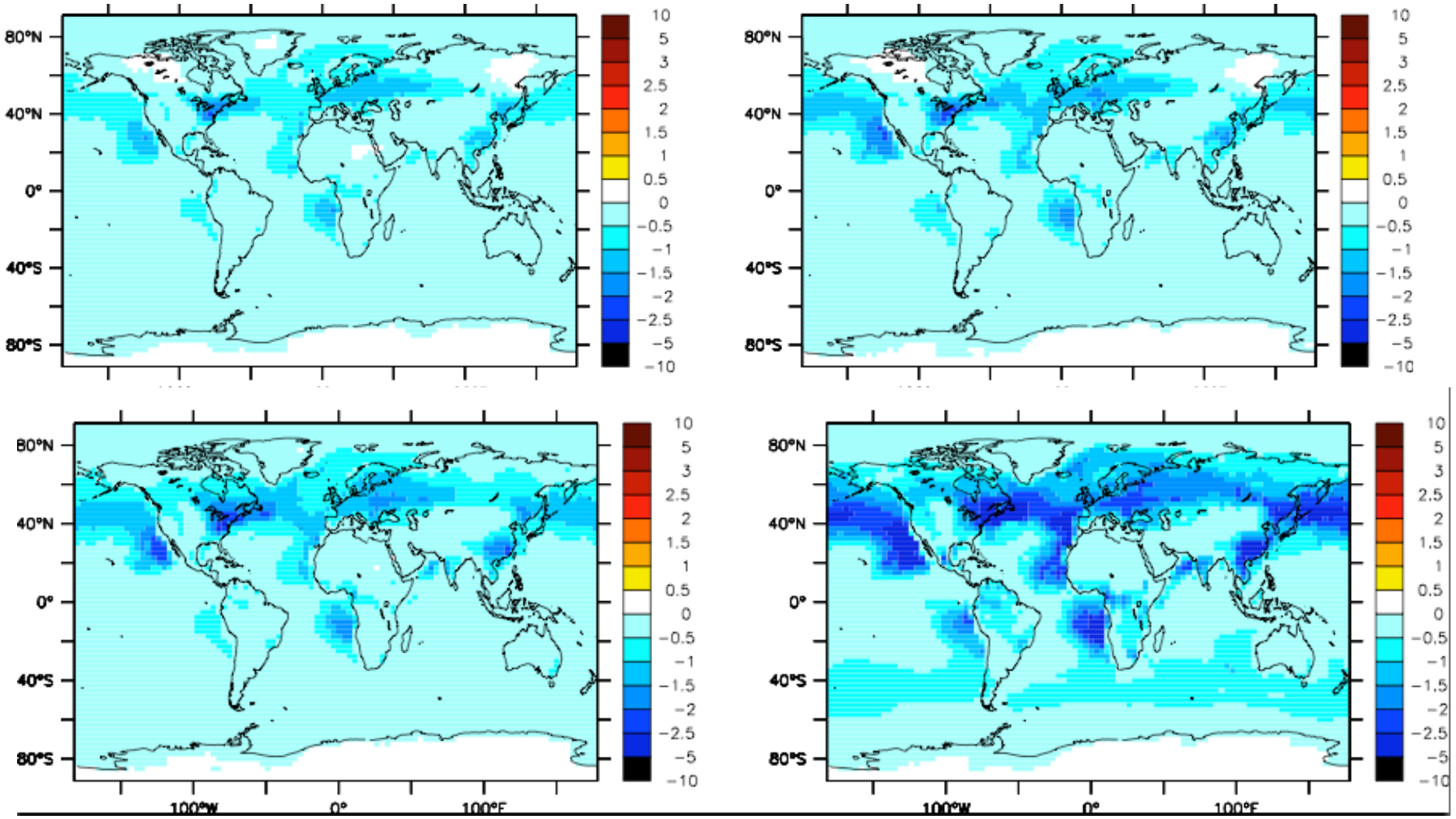
Different simulations to study the effect of the background on the indirect effect

Name	Present	Preindustrial
REF.	SO4+BC+POM+SS acc.	$SO4_{pi}$+BC_{pi}+POM_{pi}+SS acc.
SO4BCPOM	SO4+BC+POM	$SO4_{pi}$+BC_{pi}+POM_{pi}
SO4 only	SO4	$SO4_{pi}$
SO4 1/3rd	SO4/3.	$SO4_{pi}$/3

TOA Net forcings (direct+indirect)



Indirect effect



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Different simulations to study the effect of the background on the indirect effect

Simulation	Indirect (W.m-2)	Direct (W.m-2)
REF.	-0.232	-1.138
SO4BCPOM	-0.305	-1.062
SO4 only	-0.346	-1.073
SO4 1/3rd	-0.650	-1.161

Differences in the direct effect

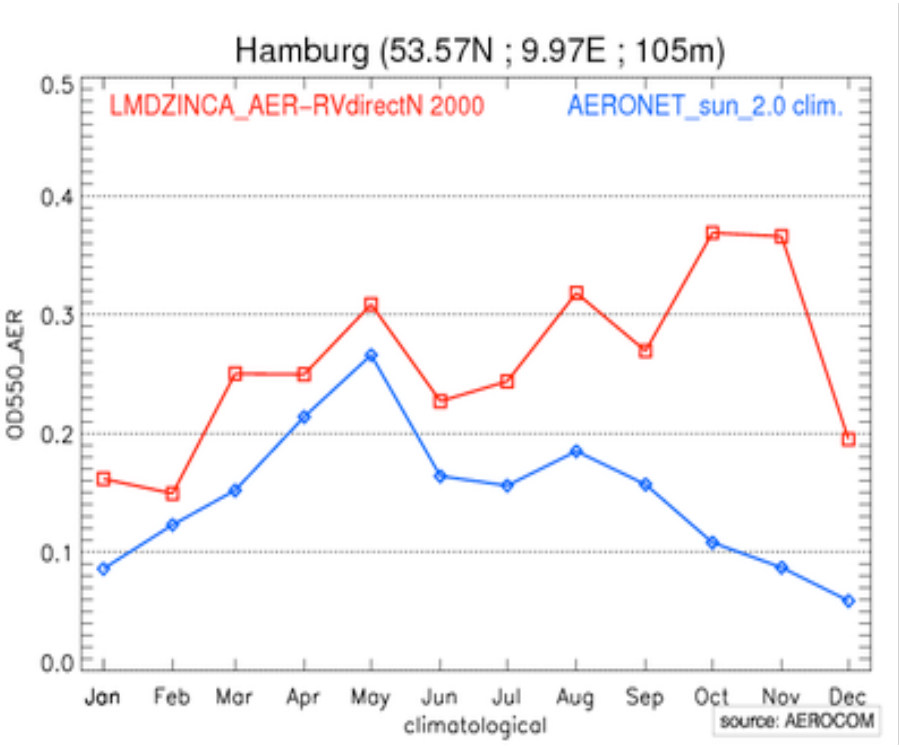
Simulation	ΔDRF (W.m-2)	ΔCRF TOA (W.m-2)	SRF Cld forc. (W.m-2)	ΔCld fract. %
REF.	0 (-1.138)	0 (-52.55)	-57.06	0 (49.2)
SO4BCPOM	0.076	+0.03	-57.04	+0.2
SO4 only	0.065	+0.10	-56.90	+0.4
SO4 1/3rd	-0.026	+1.0!!!	-55.82	-0.1

Differences in the direct effect

Simulation	ΔDRF (W.m-2)	Natural Aer. (W.m-2)	Anthropogenic Aer. (W.m-2)	ΔCld fract. %
REF.	-1.138	-0.911	-0.226	ref: 49.2% 0
SO4BCPOM	-1.062	-0.871	-0.191	+0.2
SO4 only	-1.073	-0.869	-0.204	+0.4
SO4 1/3rd	-1.161	-0.926	-0.235	-0.1

Poster: Raffaella Vuolo et al., Evaluation of the Aerosol radiative forcing in LMDz INCA

OD at 550nm



TOA SW CS Flux