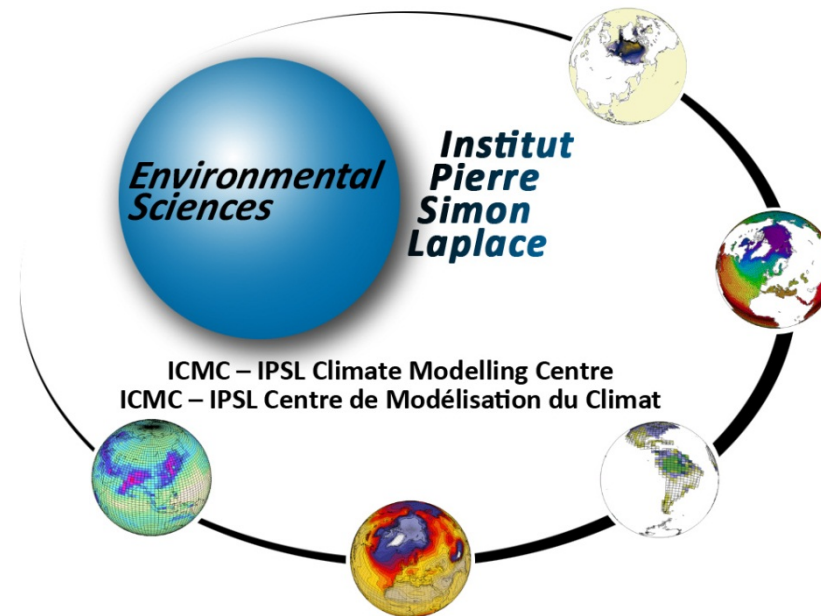
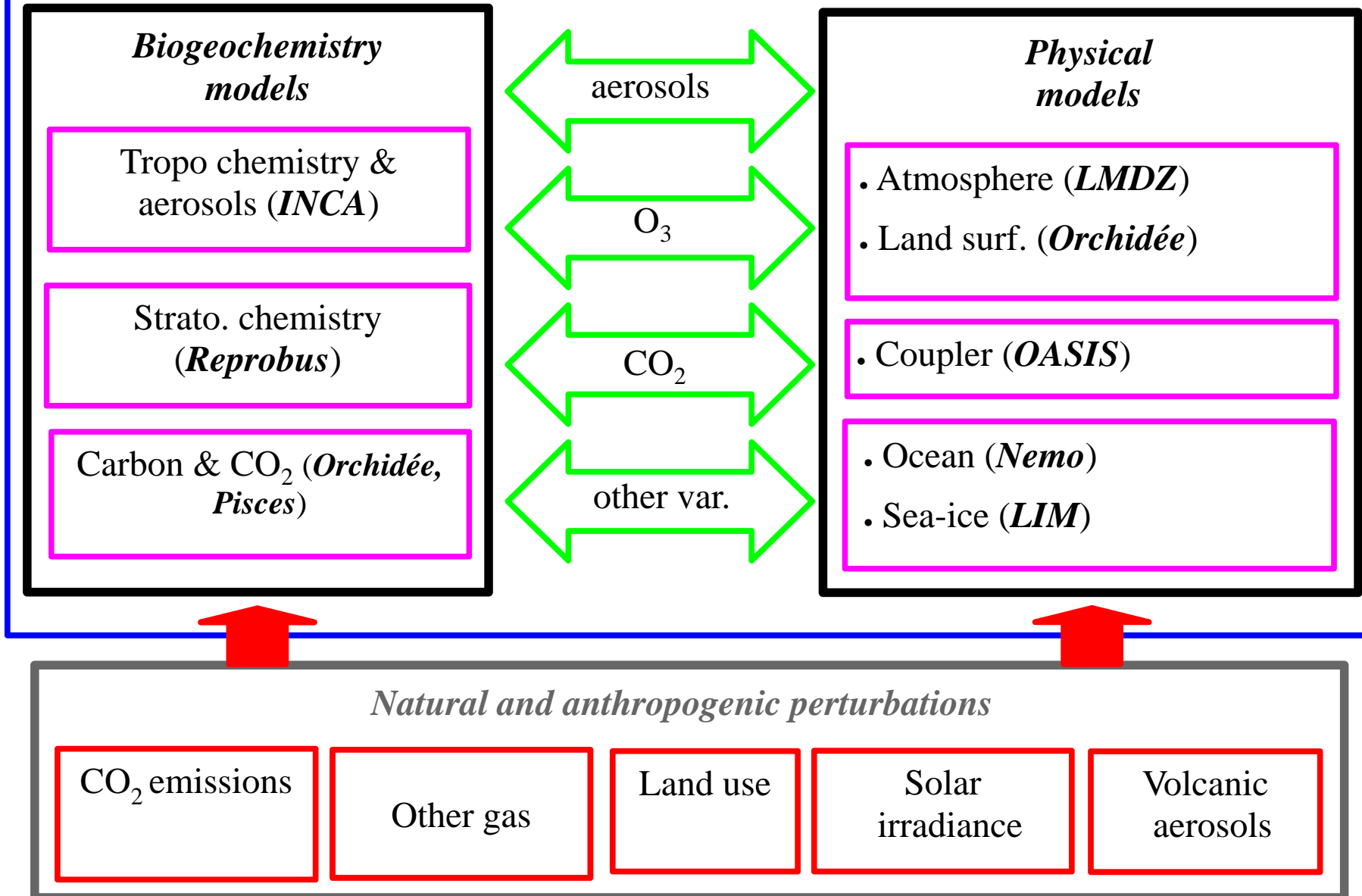


Simulation CMIP5 avec IPSL-CM5



Journée MissTerre, 19-23 novembre 2012

IPSL-CM5 Earth System Model platform



Modèles de l'IPSL pour CMIP5

LMDZ-ORCHIDEE-ORCA-LIM-PISCES-INCA-REPROBUS-OASIS

IPSL-CM5A

Modèle intégré du système
Terre (ESM)

IPSL-CM5B

Idem IPSL-CM5A, avec modèle
atmosphérique LMDZ5B

IPSL-CM5A-LR

Basse résolution
atm: 3.75° x2° L39
oce: 2° L31

IPSL-CM5A-MR

Moyenne résolution
atm: 2.5° x1.25° L39
oce: 2° L31

IPSL-CM5B-LR

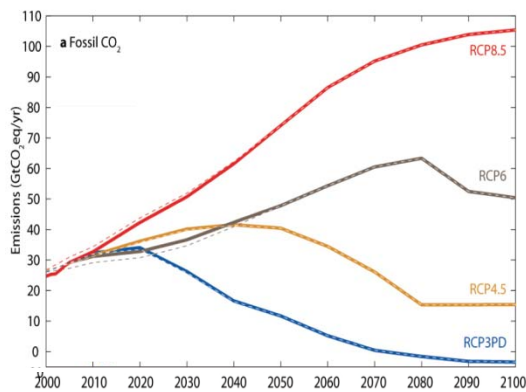
Basse résolution
atm: 3.75° x2° L39
oce: 2° L31

Simulations réalisées avec IPSL-CM5

Simulations	CM5A-LR		CM5A-MR		CM5B-LR	
	# Yr	#Expe	# Yr	#Expe	# Yr	#Expe
piControl+historical+AMIP	2900	16	1260	8	490	4
Paleo	3000	3	-	-	500	1
Future climate projections	2200	16	800	4	200	2
Carbon emission	800	8	140	1	-	-
Diagnostic & understanding	1750	22	280	2	510	9
Detection and attribution	4800	30	960	6	-	-
Others	4400	35	-	-	-	-
Total	19850	130	3440	21	1700	16

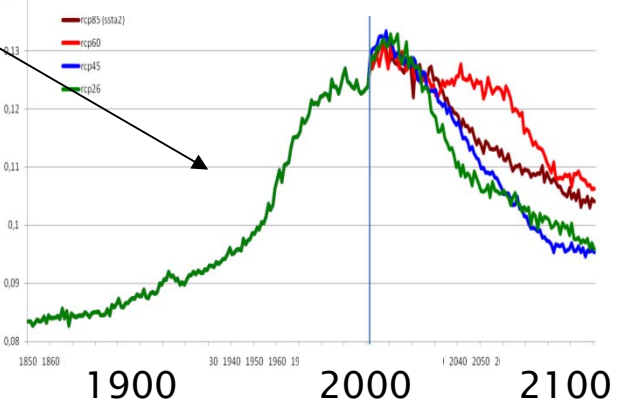
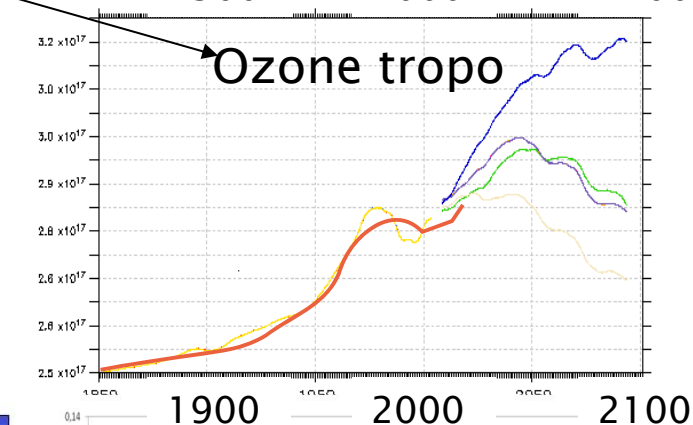
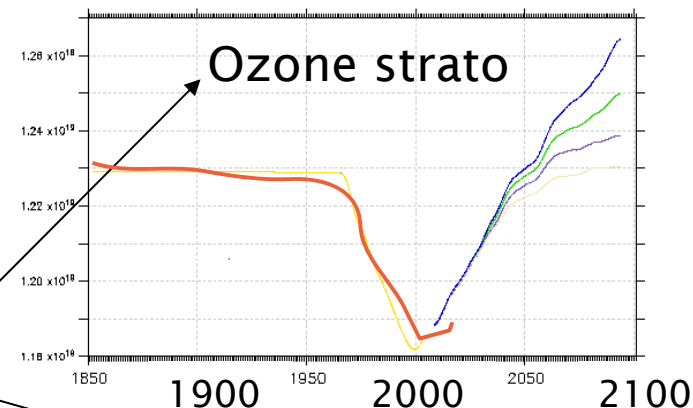
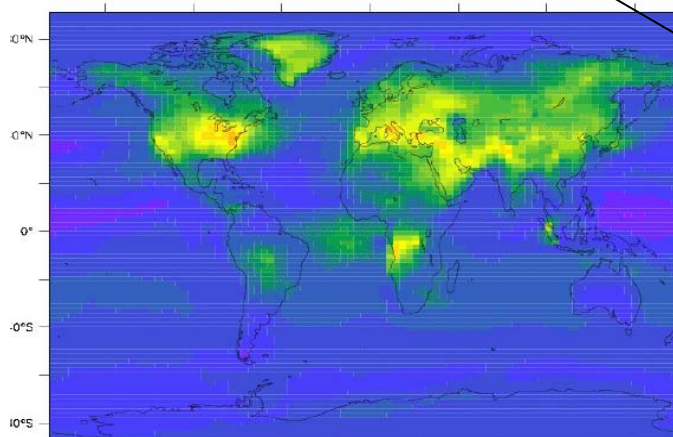
Calcul des champs d'ozone et d'aérosols

- émissions et concentration de gaz
- première estimation de l'évolution des SST et de la banquise



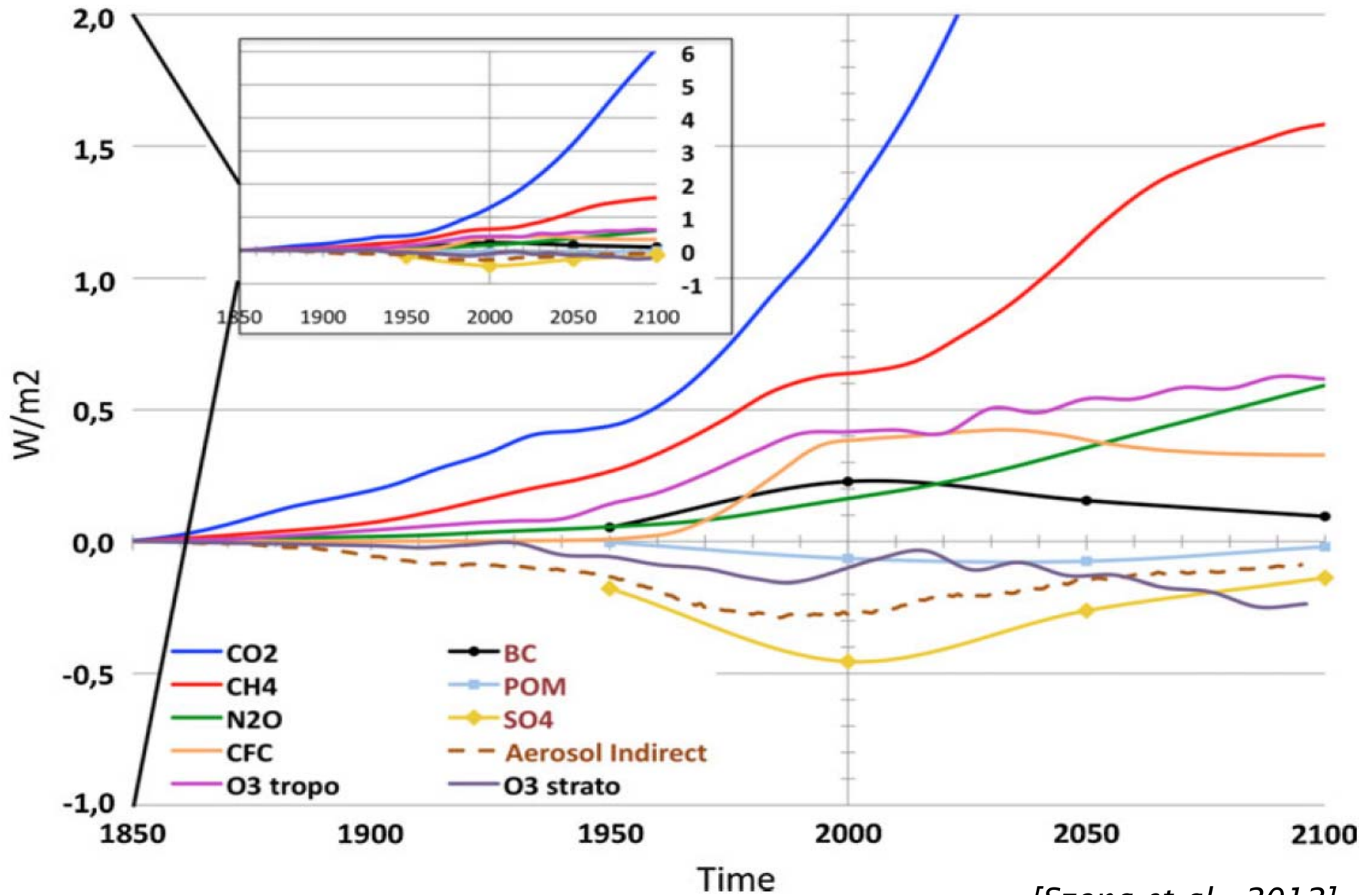
LMDZ -
Reprobus
LMDZ - INCA

Aérosols (sulfaté,
BC, POM...)



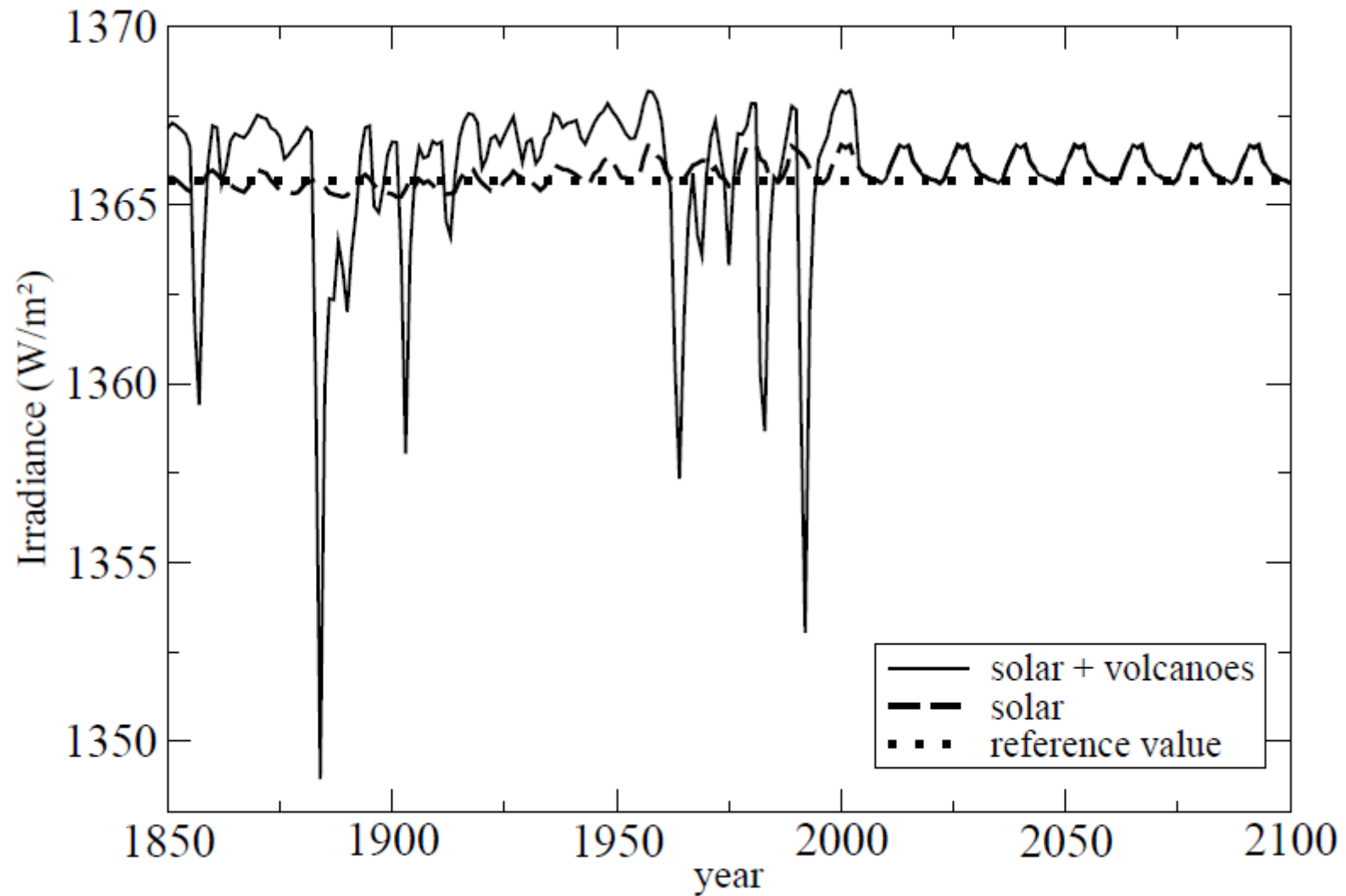
[Szopa et al., 2012]

Time evolution of the anthropogenic radiative forcings in the IPSL-CM5A-LR historical and RCP8.5 simulations



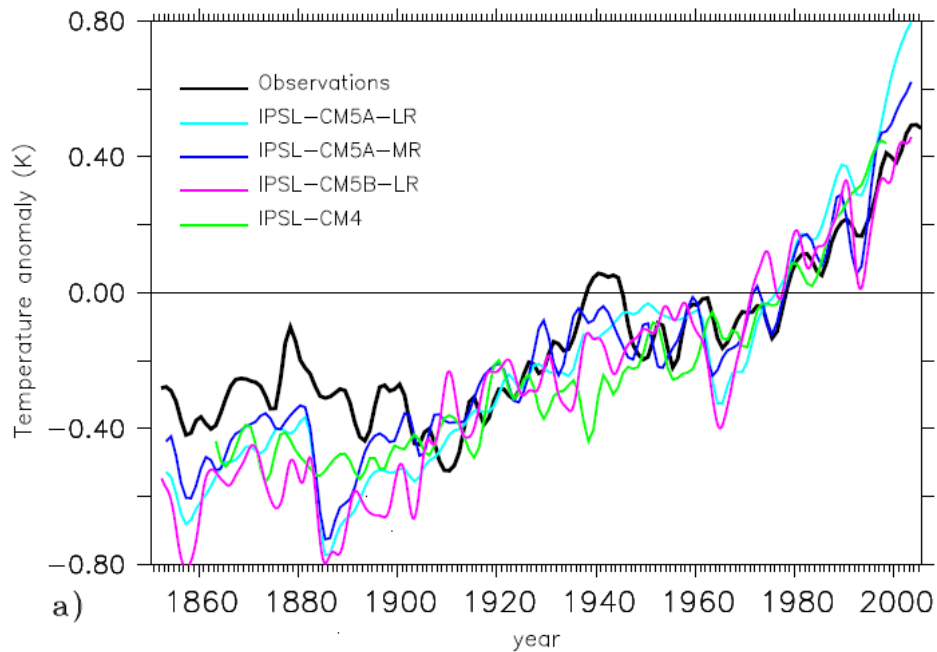
[Szopa et al., 2012]

Time evolution of the natural radiative forcings in the IPSL-CM5 historical and RCPs simulations

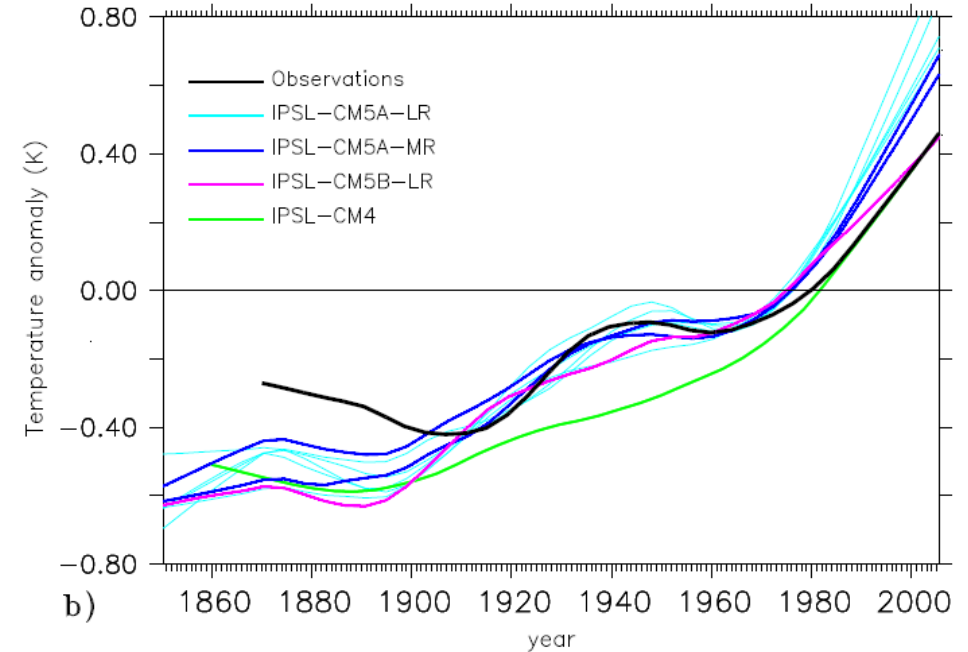


Time evolution of the global mean air surface in the IPSL-CM historical simulations

5 years running mean

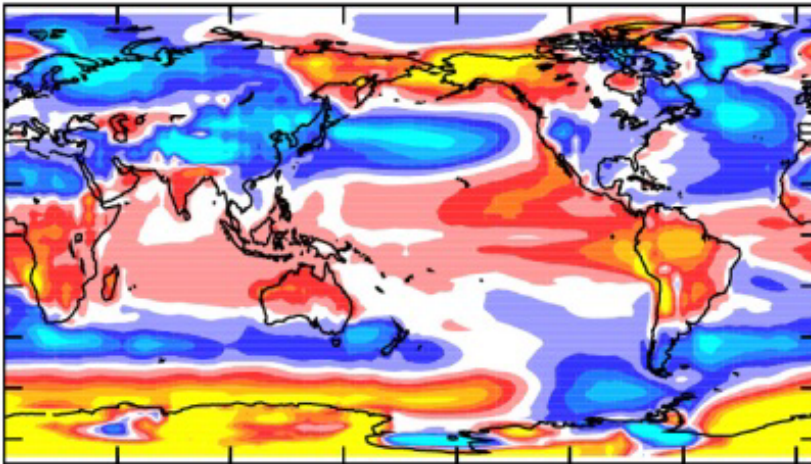


Trends (STL decomposition)

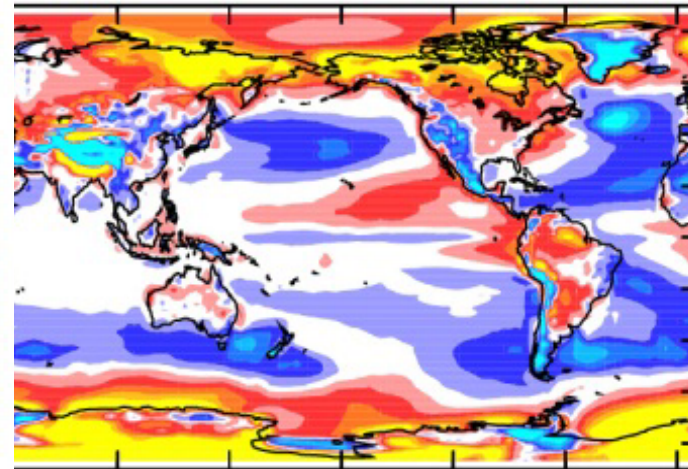


Bias in air surface temperature (1961-1990)

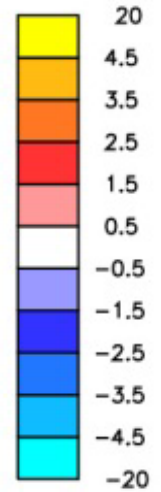
IPSL-CM4



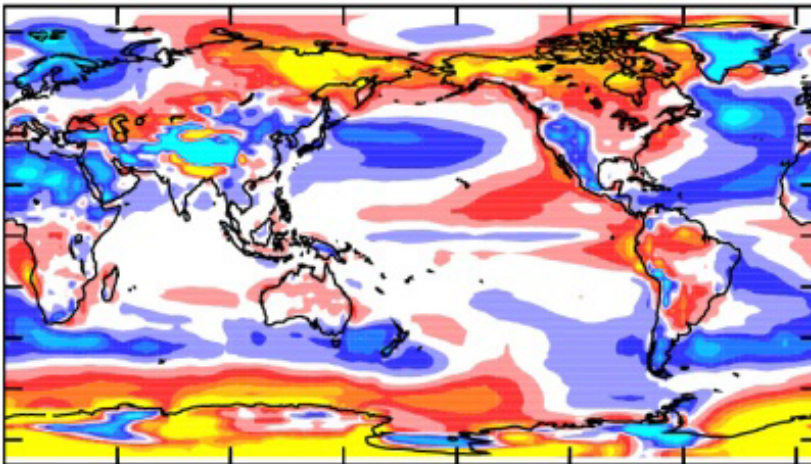
IPSL-CM5A-MR



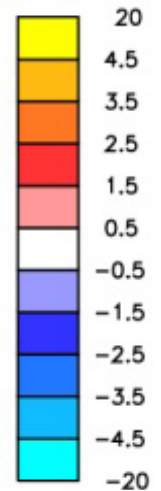
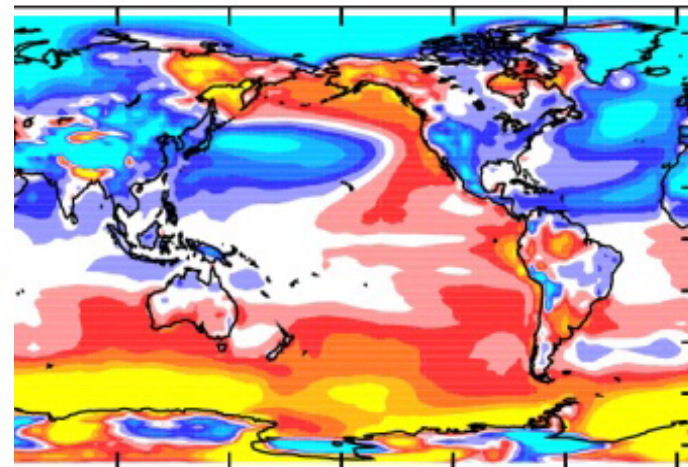
°C



IPSL-CM5A-LR



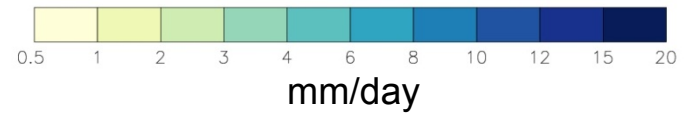
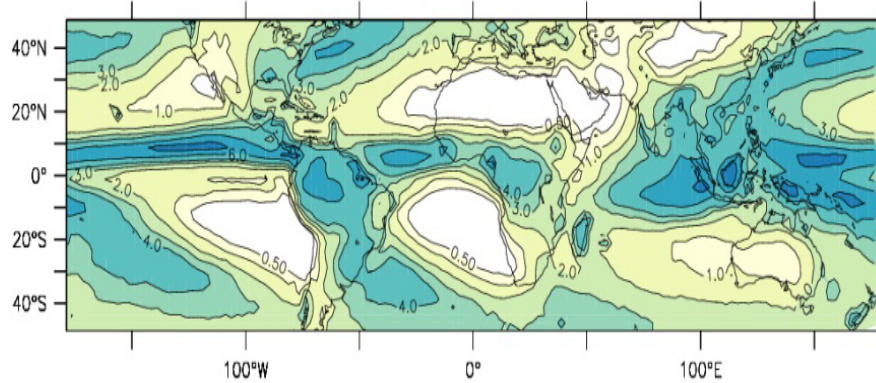
IPSL-CM5B-LR



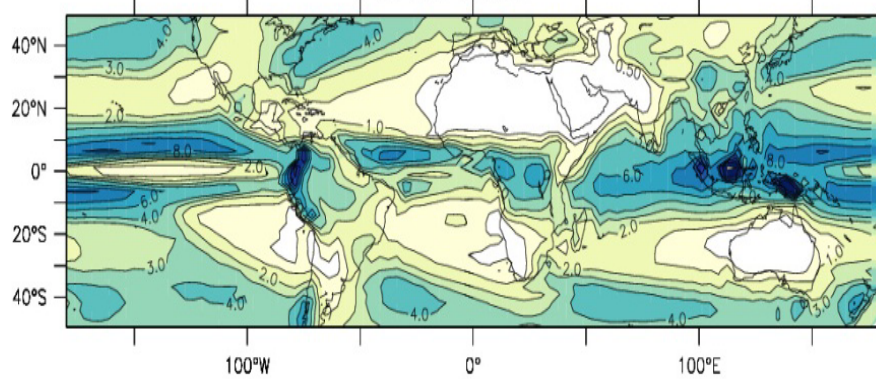
Precipitation

(1961-1990)

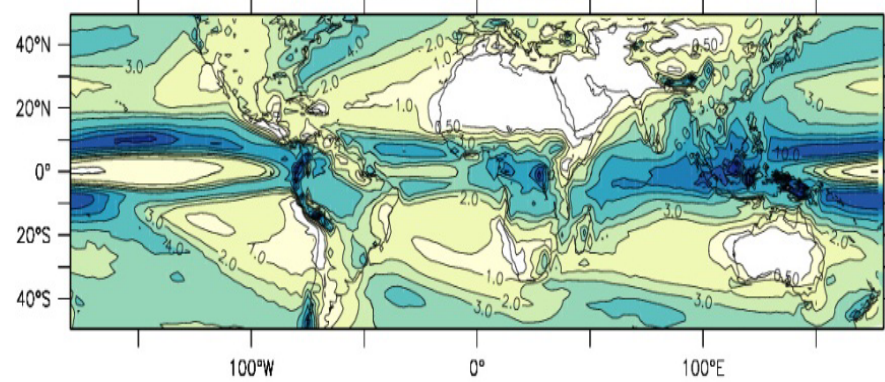
GPCP



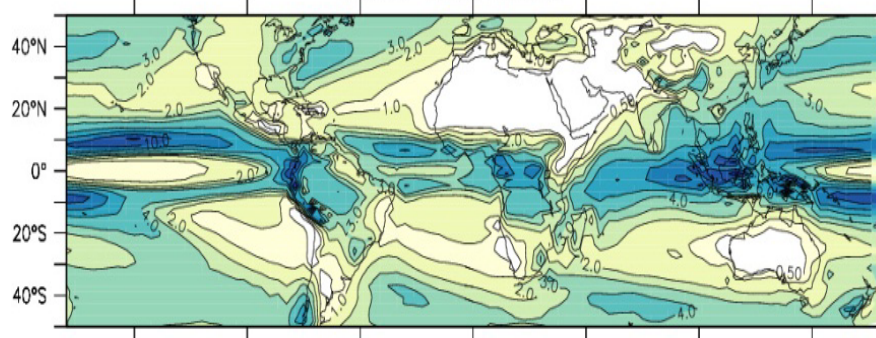
IPSL-CM4



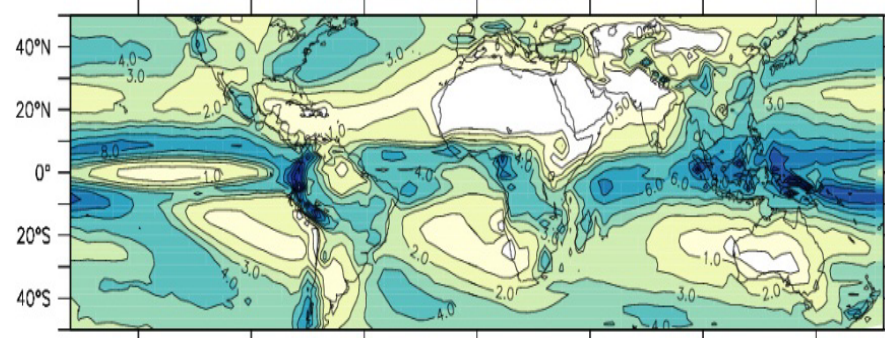
IPSL-CM5A-MR



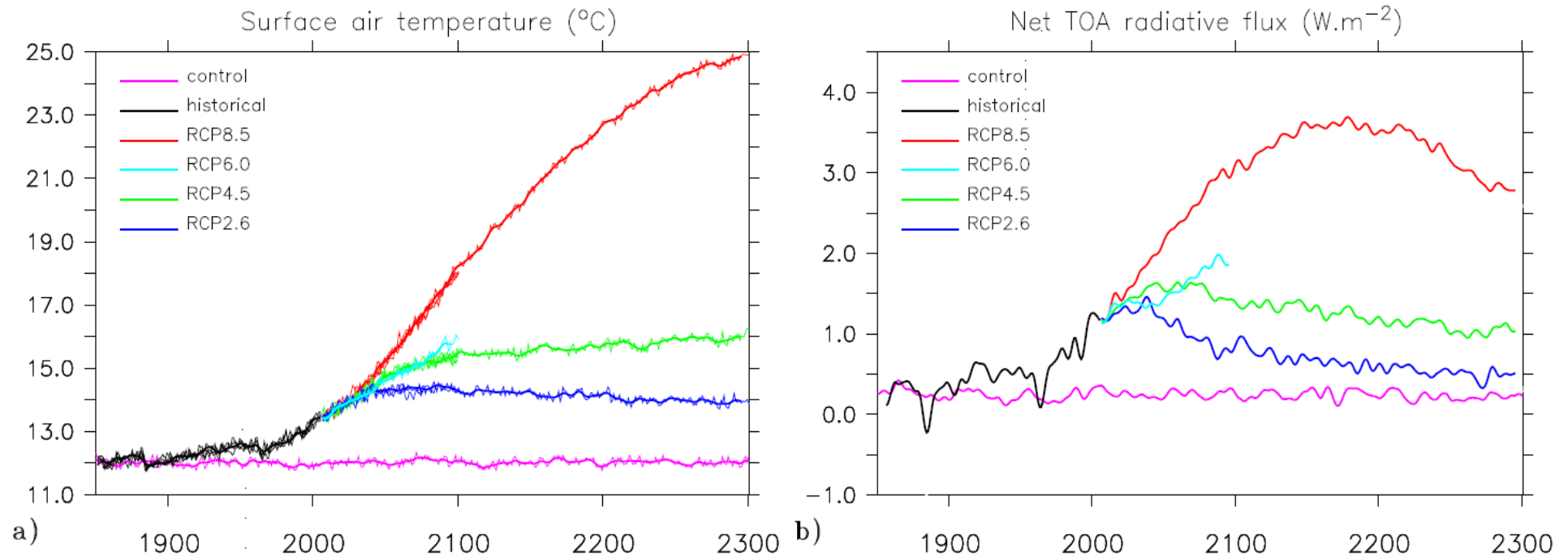
IPSL-CM5A-LR



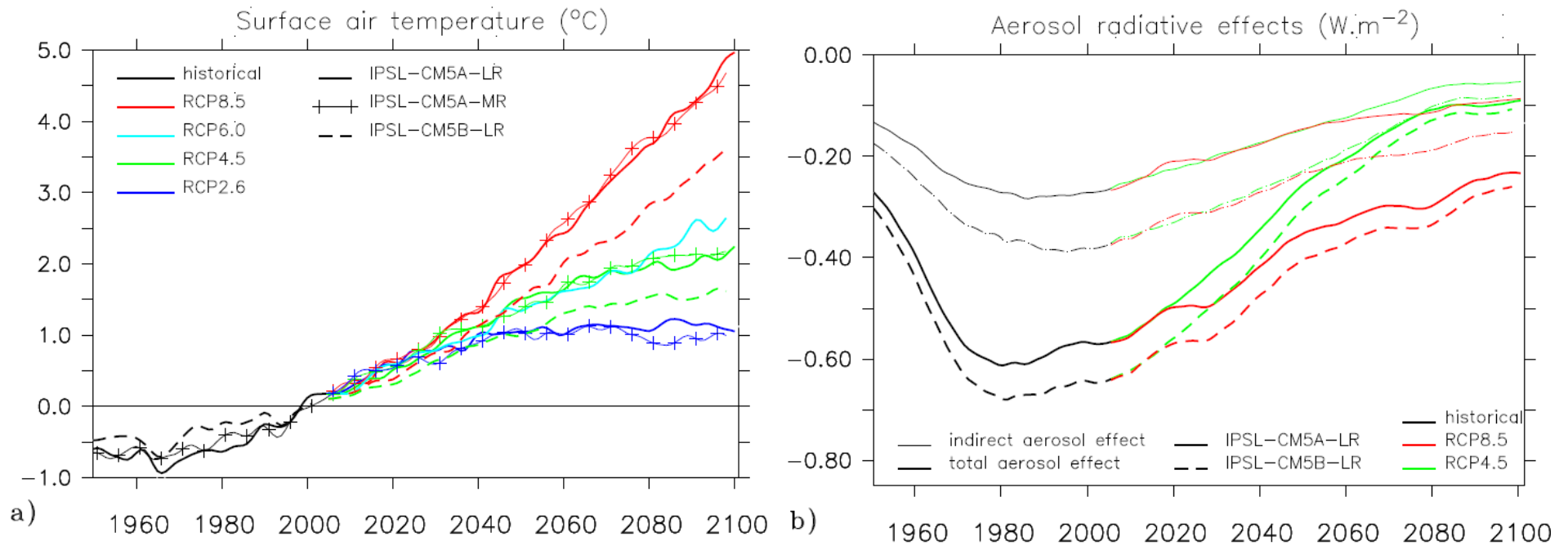
IPSL-CM5B-LR



Time evolution of the global mean air surface and heat budget in the IPSL-CM5A-LR historical and RCPs simulations

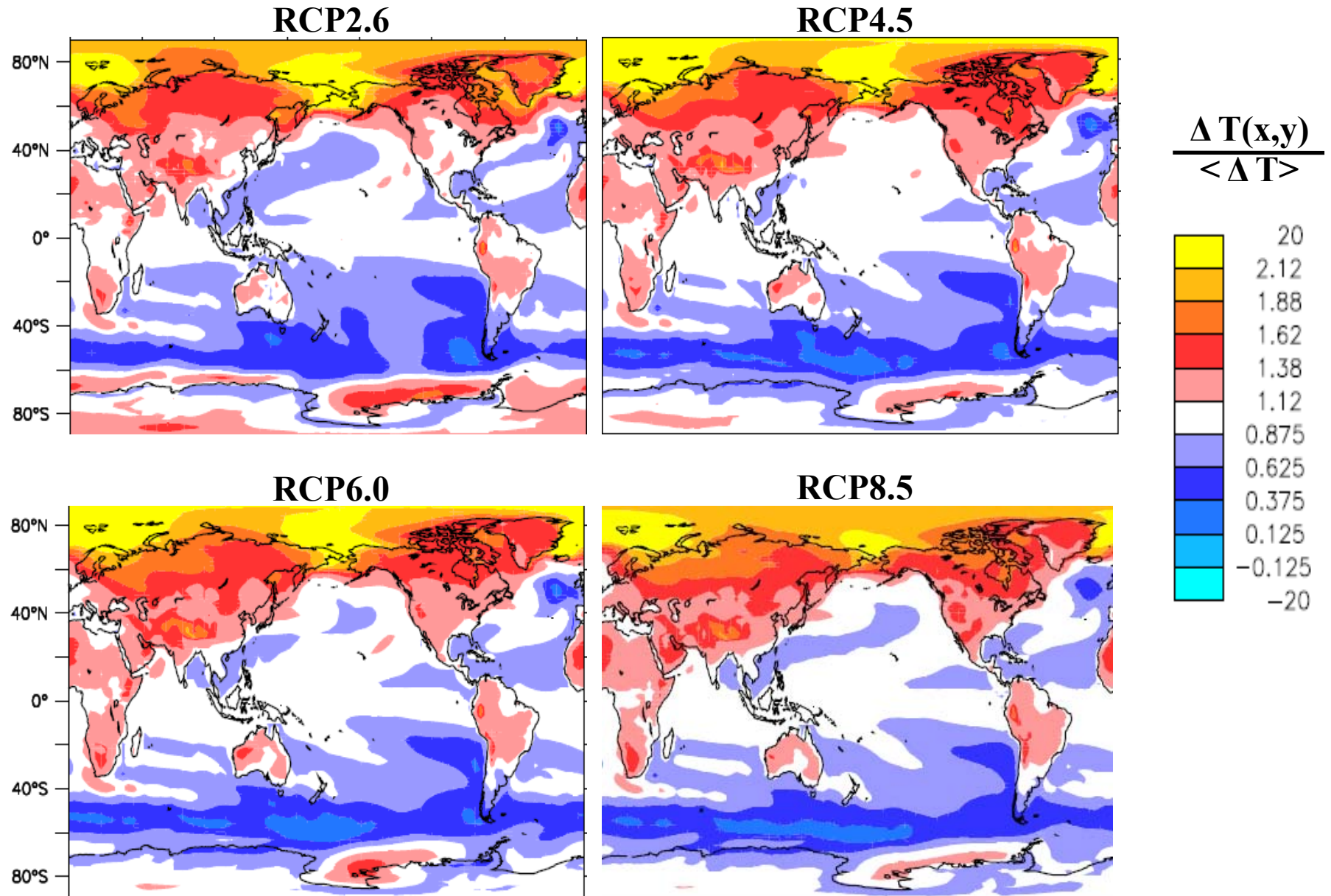


Time evolution of the global mean air surface and aerosols forcings in the historical and RCPs simulations for IPSL-CM5A-LR, CM5A-MR and CM5B-LR



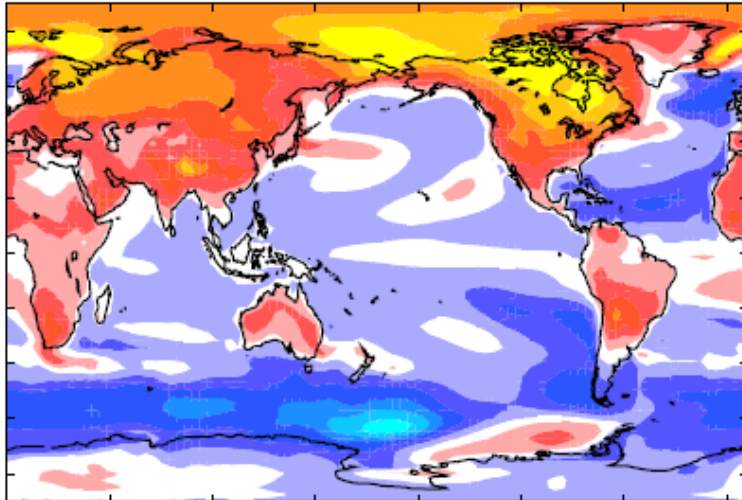
Pattern of normalized air surface temperature in 2100

IPSM-CM5A-LR, different scenarios

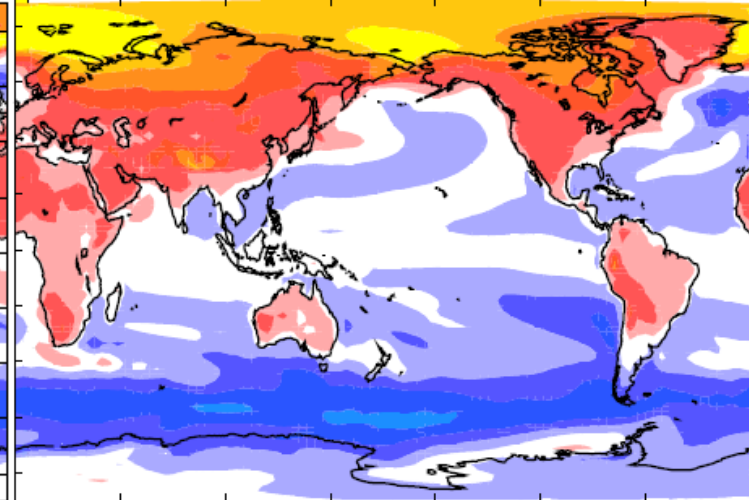


Pattern of normalized air surface temperature in 2100 different IPSL-CM models

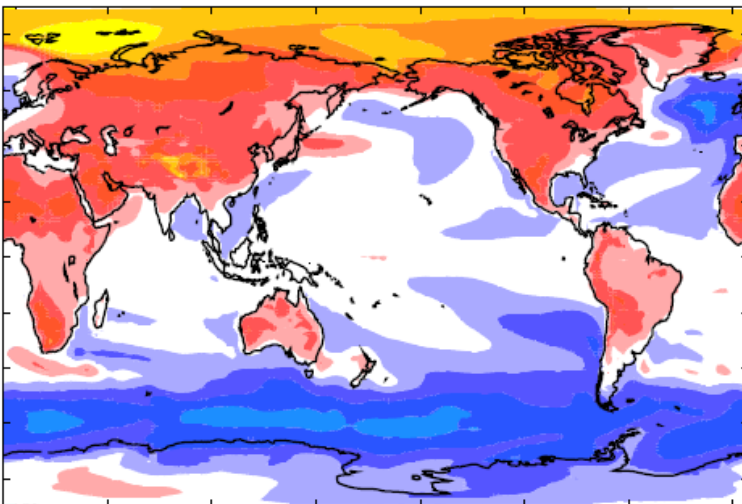
a) Temp, IPSL-CM4



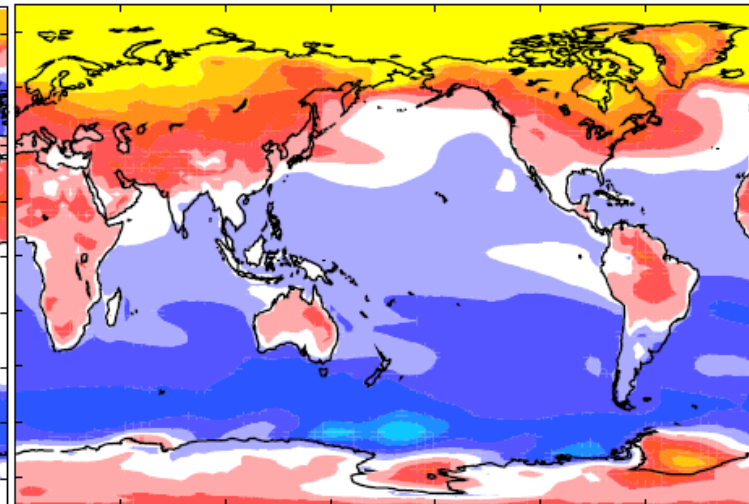
b) IPSL-CM5A-LR, RCP85, 2100



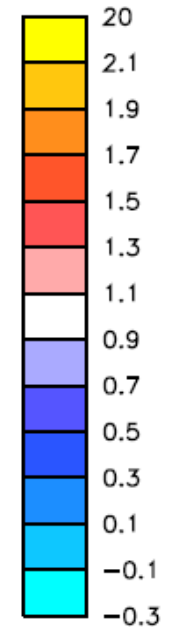
d) IPSL-CM5A-MR, RCP85, 2100



f) IPSL-CM5B-LR, RCP85, 2100

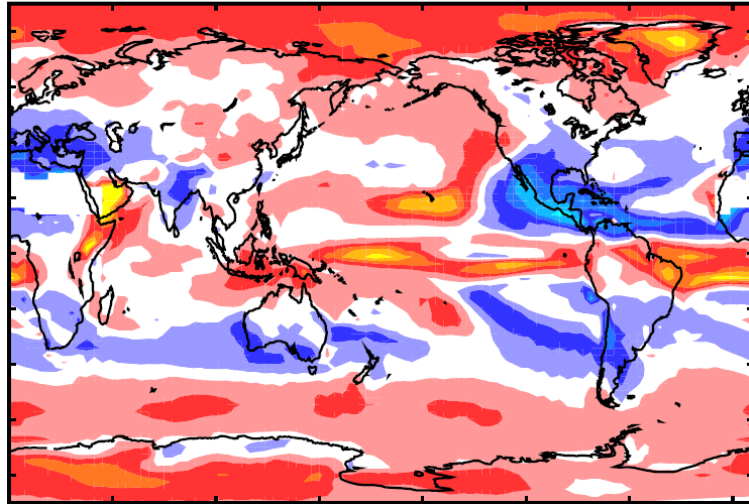


$$\frac{\Delta T(x,y)}{\langle \Delta T \rangle}$$

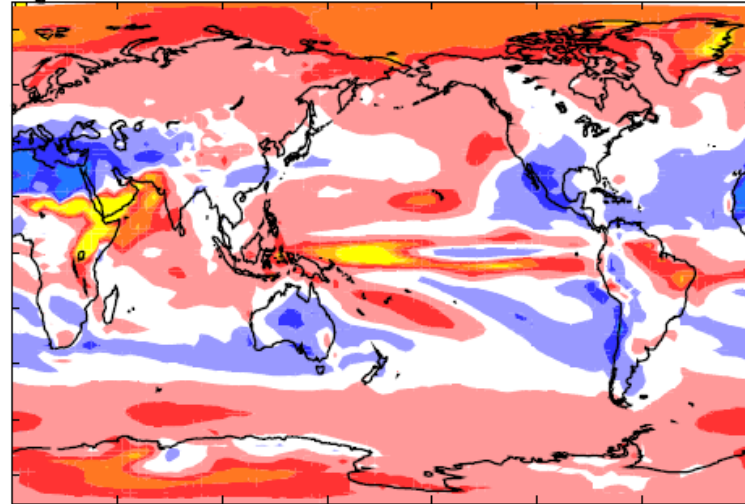


Pattern of normalized relative precipitation changes in 2100 different IPSL-CM models

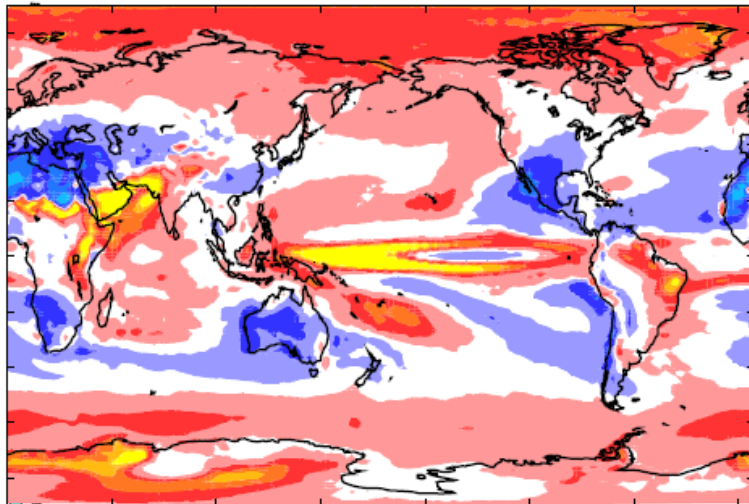
c) Precip, IPSL-CM4



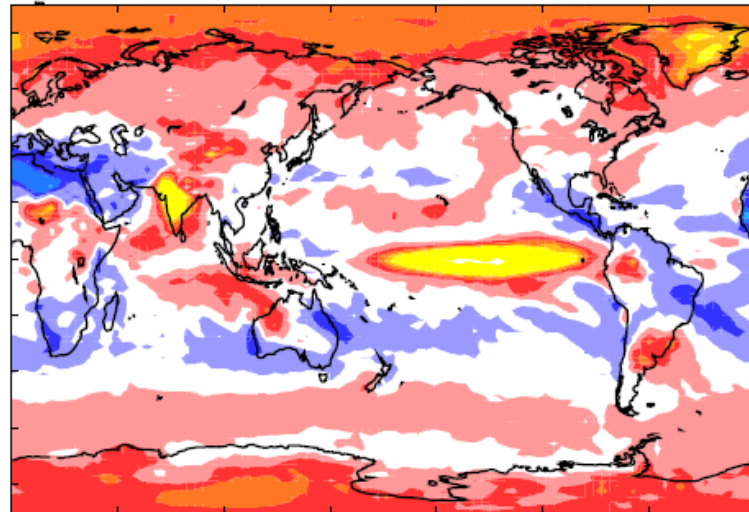
b) IPSL-CM5A-LR, RCP85, 2100



d) IPSL-CM5A-MR, RCP85, 2100

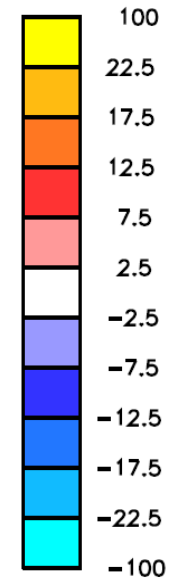


f) IPSL-CM5B-LR, RCP85, 2100



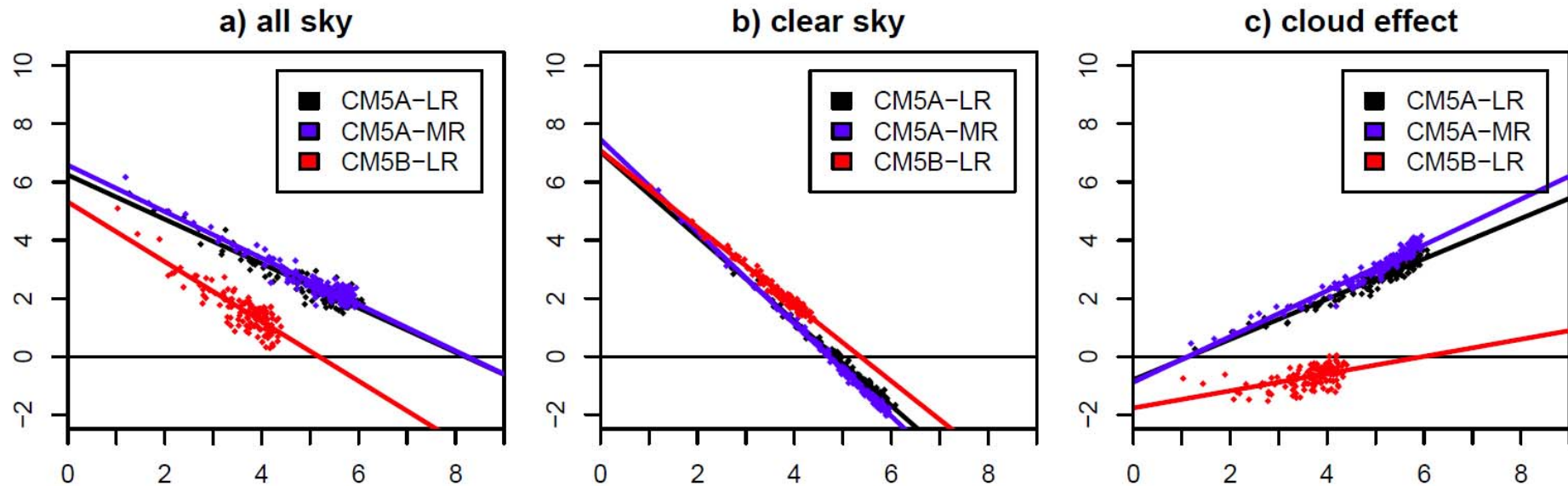
$$\frac{\Delta P(x,y)}{P(x,y)} \\ \frac{\quad}{\langle \Delta T \rangle}$$

*100

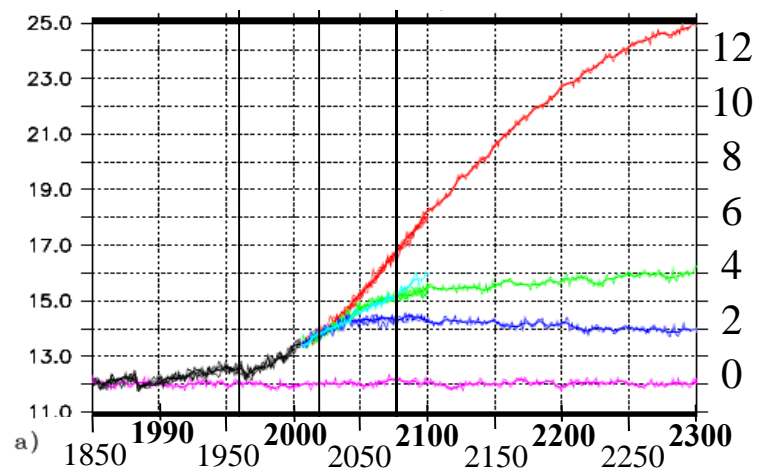
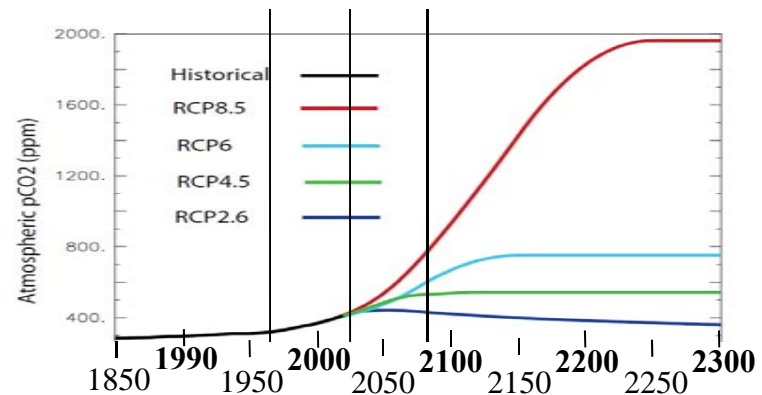
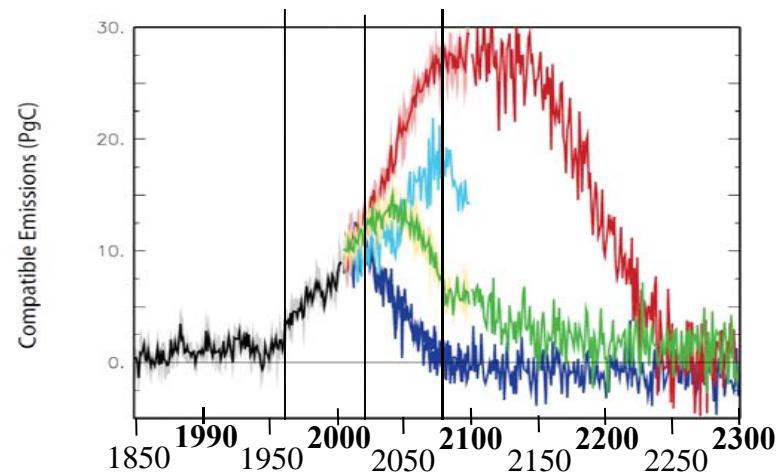
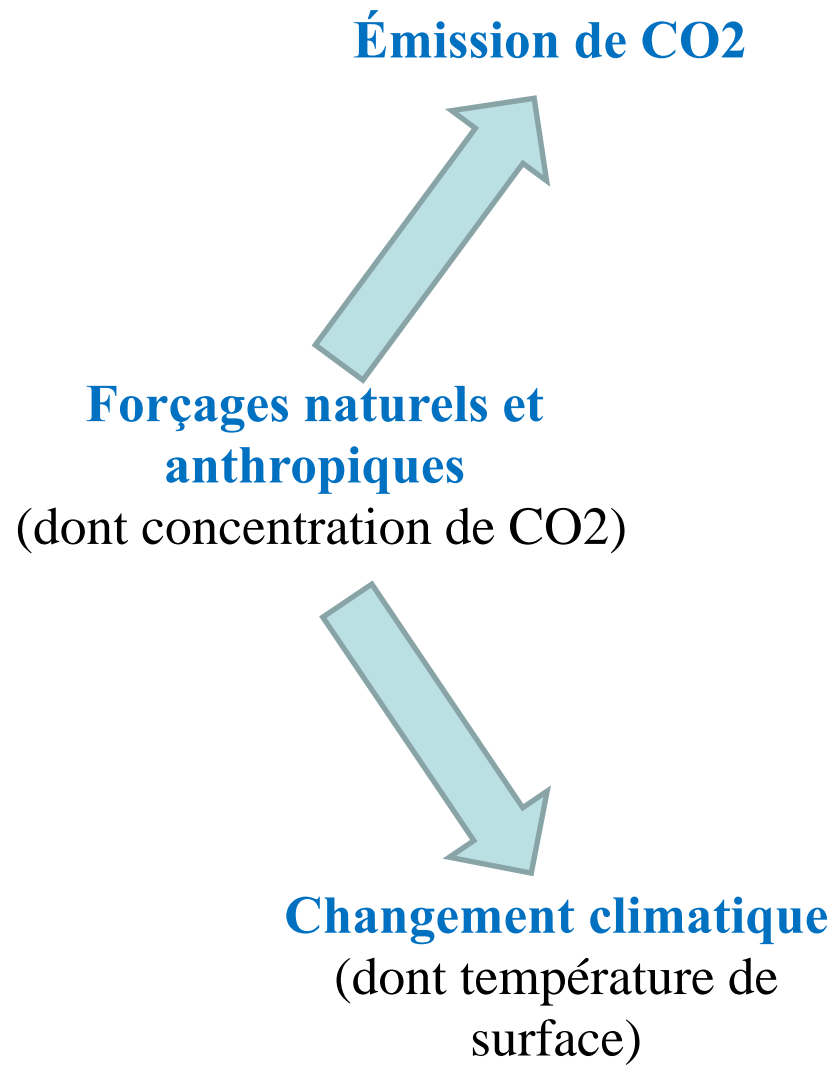


Climate sensitivity for different IPSL-CM models

Flux TOA vs surface temperature for the abrupt 4xCO₂ simulations

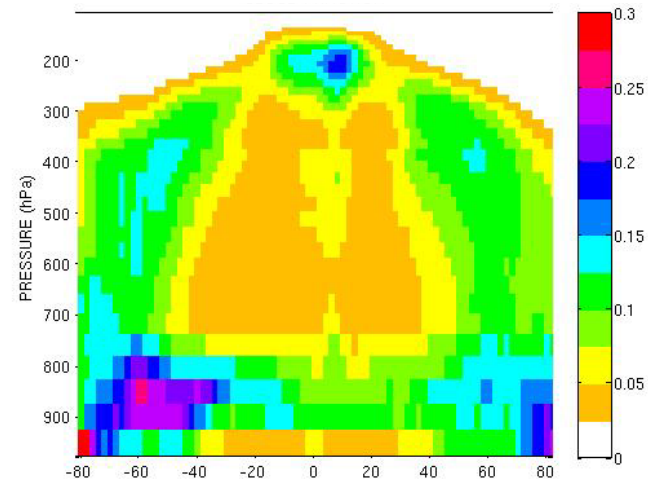


model	1%/year CO ₂ increase				abrupt 4xCO ₂		
	$\Delta Q_t(2CO_2)$	λ	TCR(2CO ₂)	$\Delta T_s^e(2CO_2)$	$\Delta Q_t(2CO_2)$	λ	$\Delta T_s^e(2CO_2)$
	(Wm ⁻²)	(Wm ⁻² K ⁻¹)	(K)	(K)	(Wm ⁻²)	(Wm ⁻² K ⁻¹)	(K)
IPSL-CM4	3.5	-0.92	2.13	3.79			
IPSL-CM5A-LR	3.5	-0.98	2.09	3.59	3.12	-0.76	4.10
IPSL-CM5A-MR	3.5	-1.01	2.05	3.47	3.29	-0.80	4.12
IPSL-CM5B-LR	3.5	-1.68	1.52	2.09	2.66	-1.03	2.59

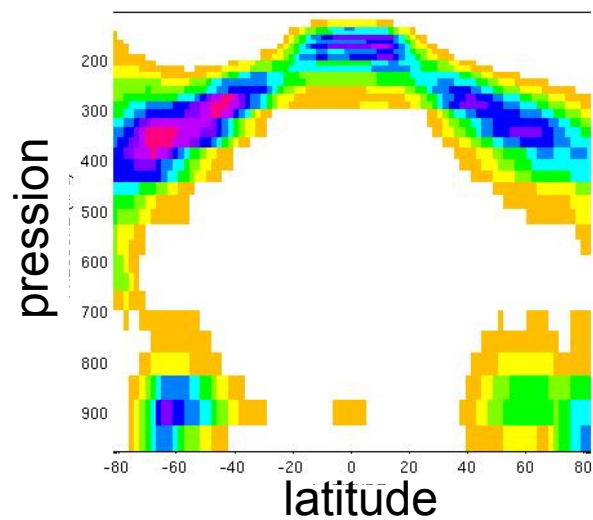


Évaluation de la structure verticale des nuages CALIPSO – simulateur COSP

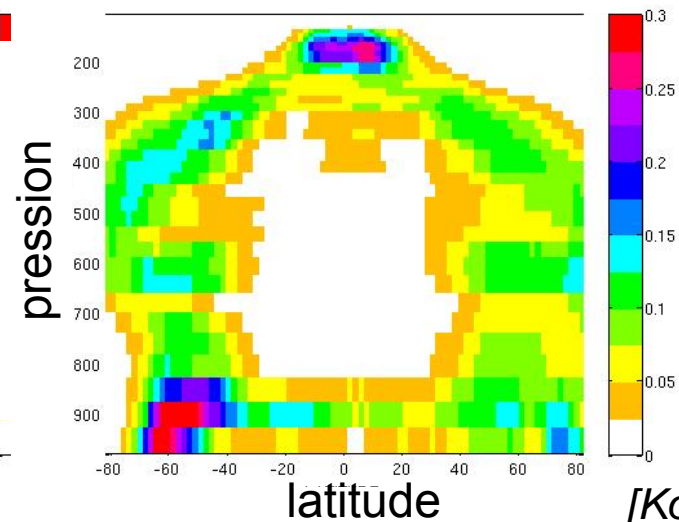
Fraction nuageuse observée (Calipso/GOCCP)



IPSL-CM5A + COSP

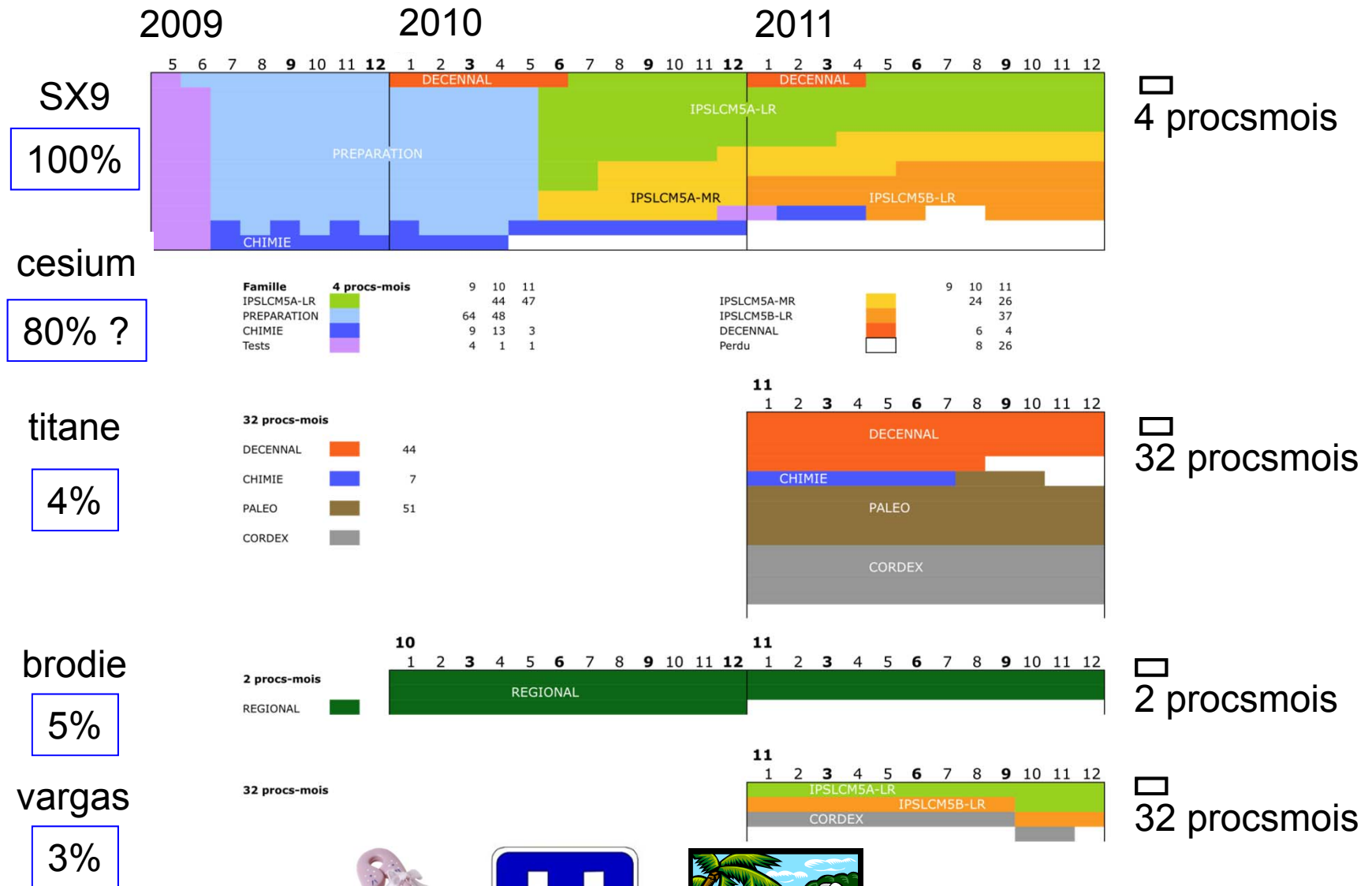


IPSL-CM5B + COSP



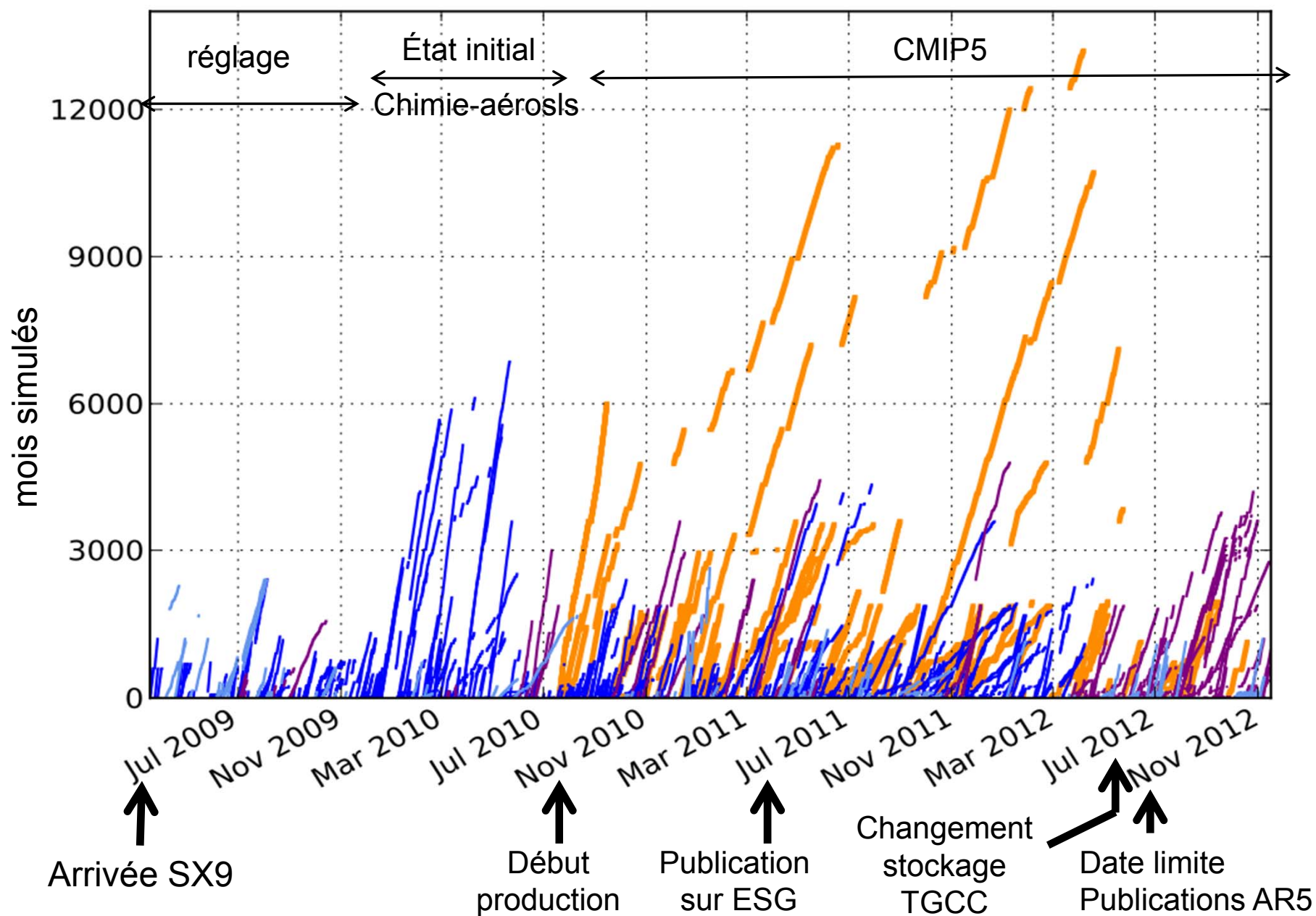
[Konsta et al., 2012]

Production SX9 et autres machines 2009-2011



54 logins
(dont 20 SX9)

Déroulement des simulations CMIP5 (2009-2012)



CMIP5 variables counts

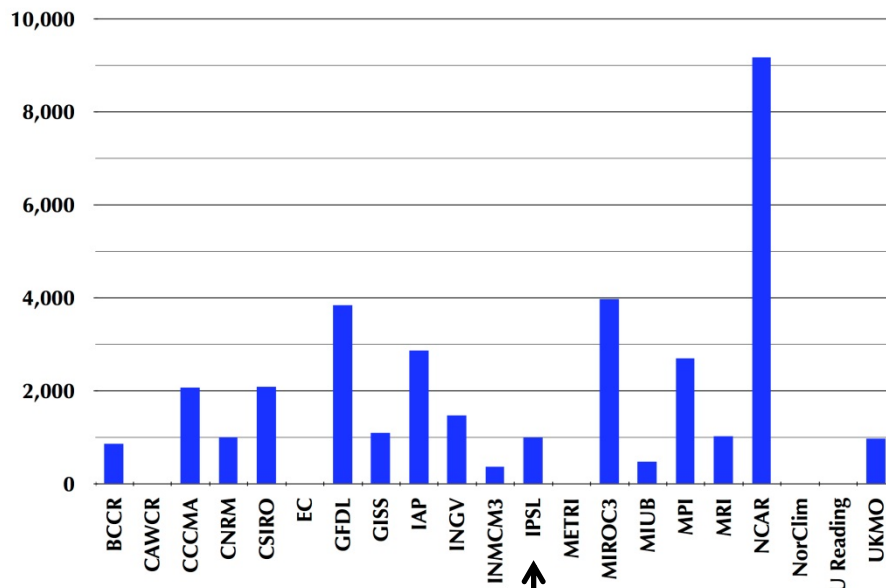
	1 hour	3 hour	6 hour	daily	month	annual	totals
aerosol	0	0	0	0	81	0	81
atmosphere	75	101	9	86	184	0	455
land	0	3	0	2	59	0	64
land ice	0	0	0	2	13	0	15
ocean	0	1	0	3	116	0	120
biogeochemistry	0	0	0	0	88	71	159
sea ice	0	0	0	4	47	0	51
totals	75	105	9	97	588	71	945

Analyse et distribution des données

- Plus de variables, fréquence plus élevée
- Plus de type d'expériences
- Simulations d'ensemble
- IPSL- Trois versions de modèle

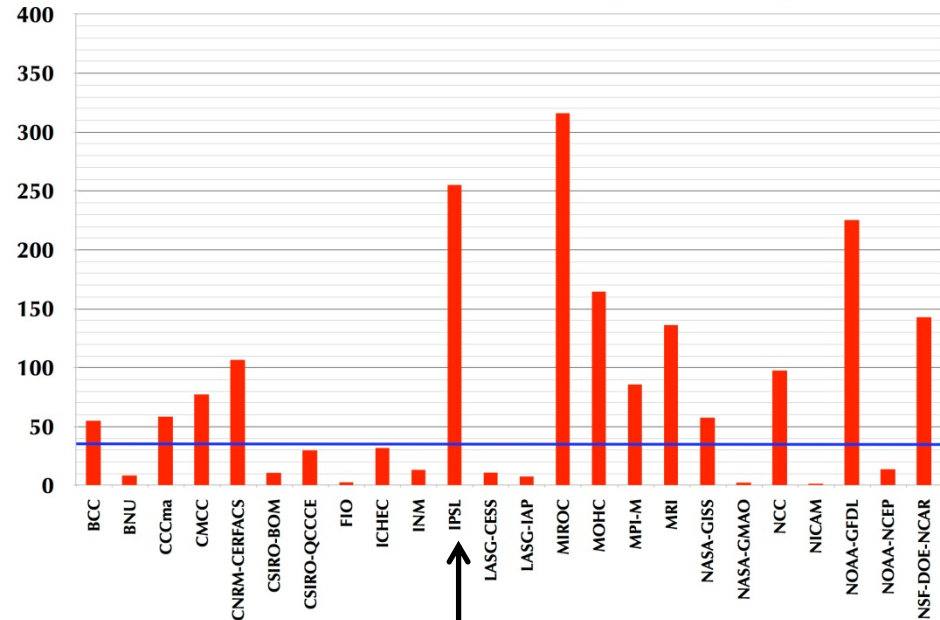
en moyenne: x30 de CMIP3 à CMIP5

CMIP3 data volumes by group (GB)



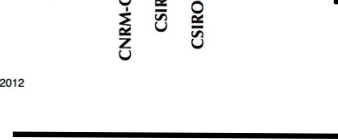
Friday, October 26, 2012

CMIP5 data volumes by group (TB)



Friday, October 26, 2012

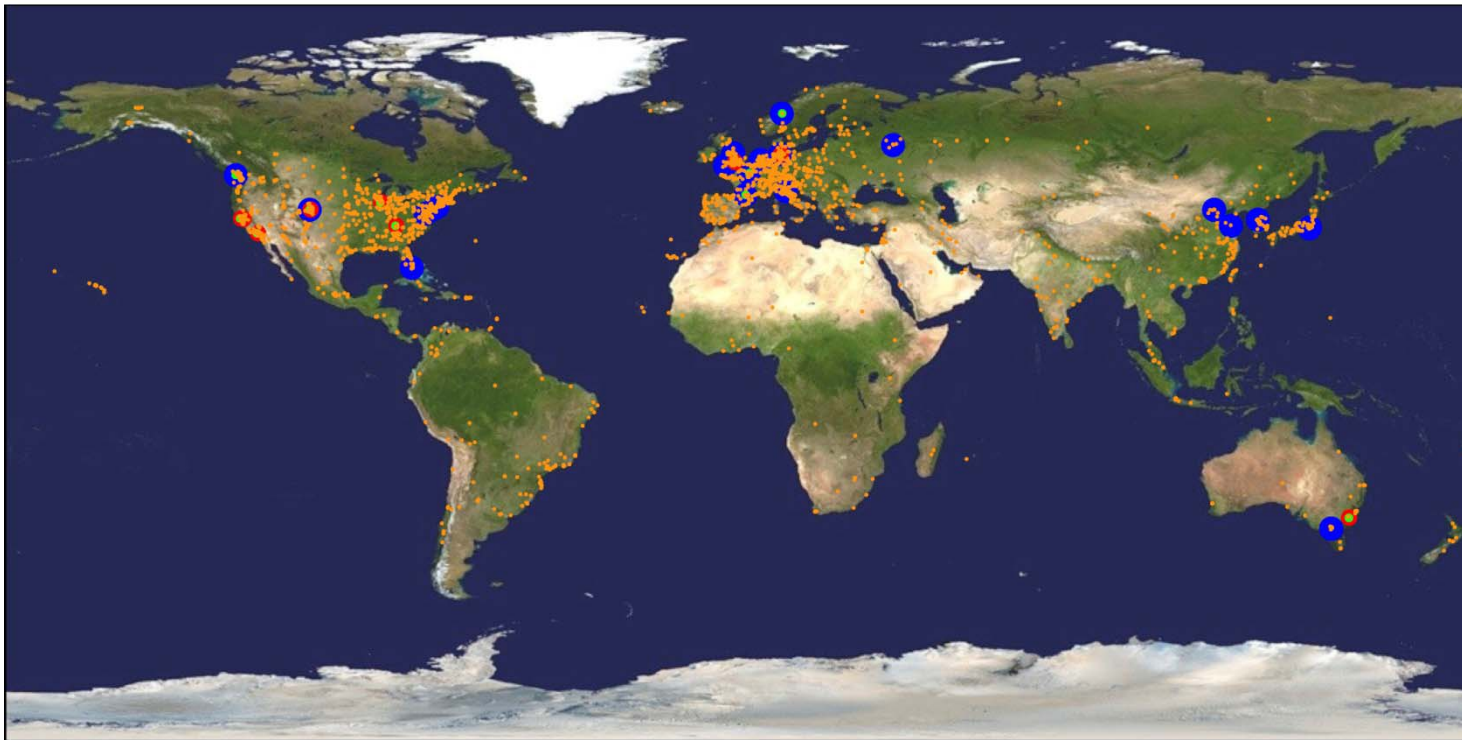
IPSL
x250



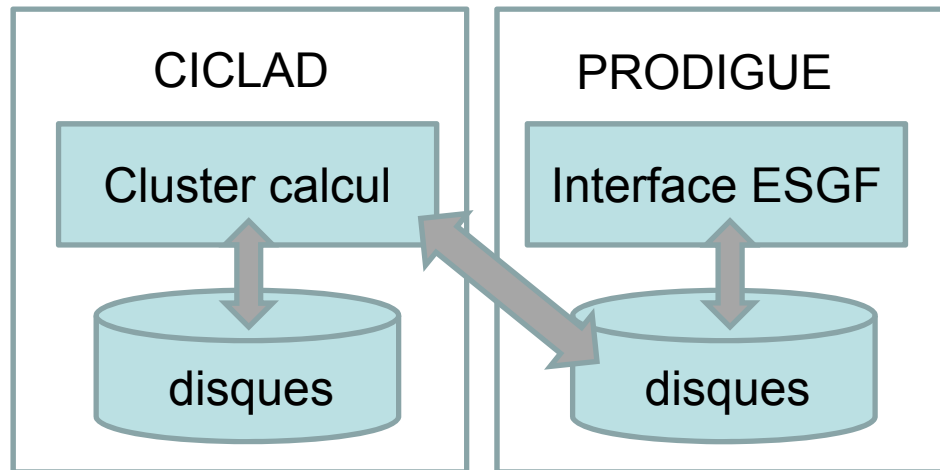
CMIP5 distribution: Earth System Grid (ESG)

CMIP3: distribution des données via 1 serveur (PCMDI)

CMIP5: distribution répartie des données



Analyse et distribution des données



Sébastien Denvil, Franck Corsini, Philippe Weill

Projet initial

- Distribution sous ensemble donnée modèle IPSL
- Analyse multi modèle CMIP5

Réalisation actuelle

- Distribution de l'ensemble des donnée modèles IPSL-CM5
- Data node ESGF + publisher
- Analyse multi modèle CMIP5
- Hébergement autres projets

Accès (moyenne sur 1 an)

- 30 To/mois
- 30 000 fichiers/mois
- ≈ centaines utilisateurs

394T CMIP5 (250 To IPSL-CM5)
8.4T OCMIP5/
3.0T CMIP3
2.8T PMIP3/
248G GeoMIP
97G TAMIP
? IsiMIP
? Cordex

CMIP5 à l'IPSL

- **IPSL-CM5A: ESM avec cycle du carbone, chimie et aérosols.** Décliné en deux résolutions horizontales (atm.). A des caractéristiques proches de IPSL-CM4
- **IPSL-CM5B: OAGCM,** avec nouvelle physique atmosphérique
- **IPSL-CM5A et CM5B ont des sensibilités climatiques très différentes**
- **Intérêt de normaliser** les changements climatiques **par le réchauffement climatique moyen.** Surprenante linéarité des résultats et faible sensibilité au scénario.
- **Avec IPSL-CM5A-LR:** simulations longues (> 1000 ans) + ensembles de simulations
- Un nombre de simulations, de variables, de fichiers, et un volume de données **sans précédent pour nous.**
- Mise en place de ressources (disques + CPU) pour l'analyse multi-modèle CMIP5

