

Paleoclimate Modeling intercomparison Project

- Supported by WCRP/CLIVAR/WGCM and IGBP/PAGES

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- Objectives:

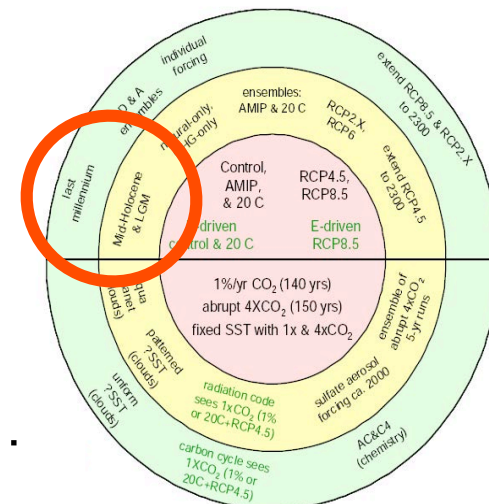
- Understand mechanisms of past climate change
- Evaluate roles of feedbacks from the different climate subsystems (atmosphere, ocean, land-surface, sea-ice ...)
- Evaluate the ability of climate models to simulate a climate different from that of today

- PMIP3 in CMIP5

CMIP5 : long term simulations
Taylor et al. 2009

- Other periods

- Warm climates, abrupt events, transients...





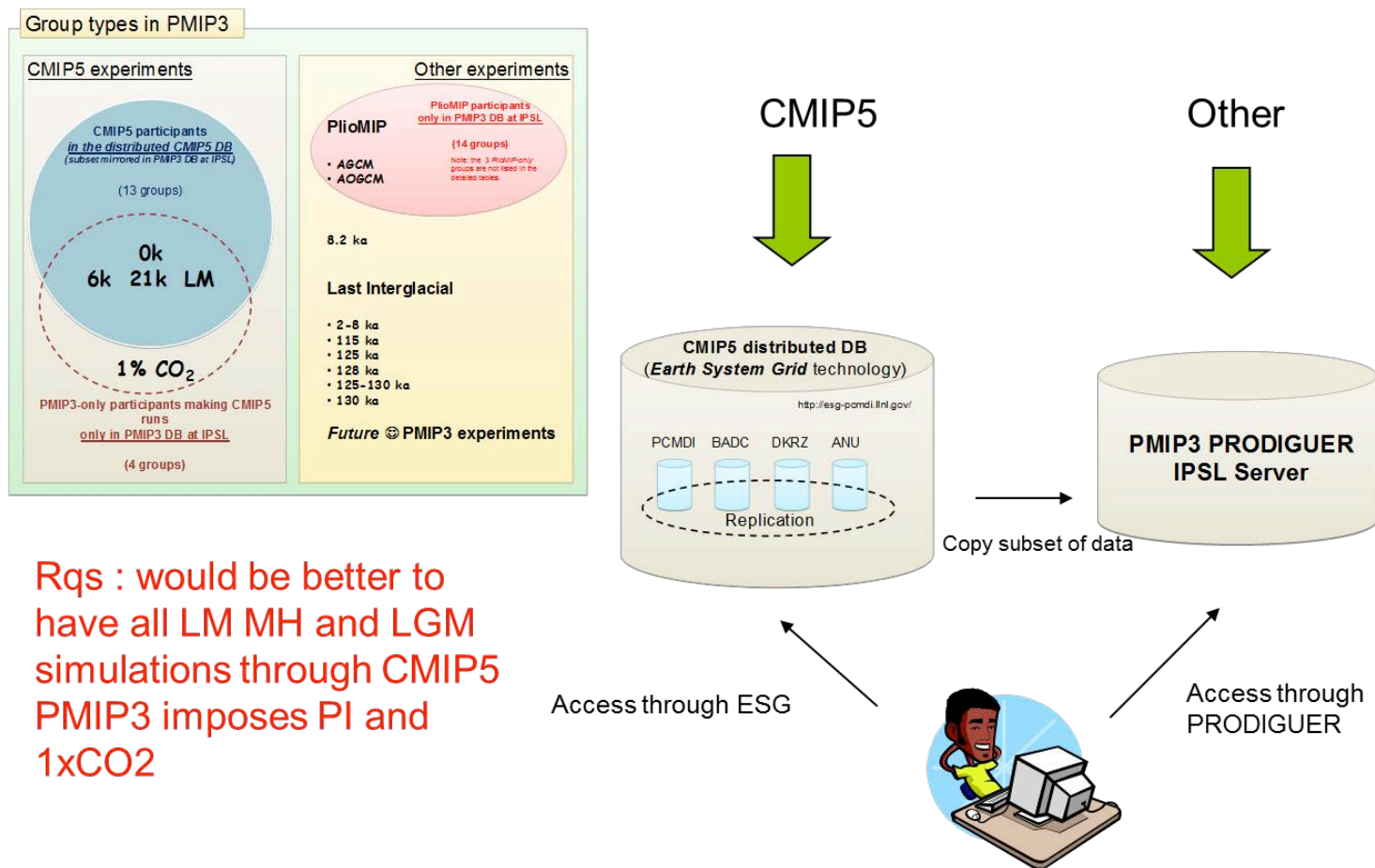
Status of simulations

10 models (5 Carbon cycle); LGM 8 models (2 CC), LM 8 (2 CC)

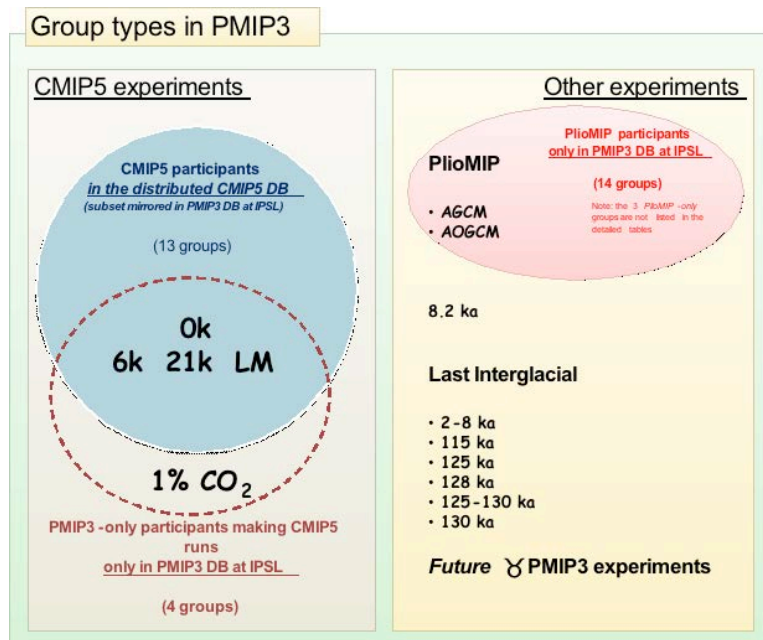
	Institute	Country	0k <i>piControl</i>	6k <i>midHolocene</i>	21k <i>lgm</i>	LM <i>past1000</i> (1000 years)	1 % CO ₂ <i>1pctCO2</i> (140 years)	Carbon cycle	Atm	Ocn	Model id
1	AWI	Germany	Completed	Completed	Completed			Yes	96x48 x L19	120x101 x L40	COSMOS-aso ?
2	BCC	China	CMIP5 (500)	CMIP5 (100)		CMIP5	CMIP5	Yes	128x64 x L26	360x232 x L40	bcc-csm1-1
3	BCCR	Norway	Running Summer 2012	Running Summer 2012	Running Summer 2012	Running Summer 2012	Start April 2012 May 2012	Yes	96x48 x L26	100x116 x L32	NorESM1-L
4	CAU-GEOMAR	Germany	Completed	Completed			Running	No	96x48 x L19	182x149 x L31	KCM1-2-2
5	CNRM-CERFACS	France	CMIP5 (850)	CMIP5 (200)	CMIP5 (200)		CMIP5	No	256x128 x L31	362x292 x L42	CNRM-CM5
6	FUB	Germany	PMIP3 (400)		PMIP3 (600)			Yes	96x48 x L19	120x101 x L40	COSMOS-ASO
7	NOAA-GFDL	USA	CMIP5 (470)		Start Spring 2012 End 2012		CMIP5	Yes/No	144x90 x L24	360x200 x L50	GFDL-CM3
8	NASA-GISS	USA	CMIP5 (1163)	Completed	CMIP5 (100)	CMIP5	CMIP5 (151)	No	144x90 x L40	288x180 x L32	GISS-E2-R
9	IPSL	France	CMIP5 (1000)	CMIP5 (500)	CMIP5 (200)	CMIP5	CMIP5	Yes	96x95 x L39	182x149 x L31	IPSL-CM5A-LR
10	KNMI or ICHEC ?	Netherlands	Completed	Completed			?	No	320x160 x L62	362x292 x L42	EC-Earth-2-2
11a	LASG-IAP LASG-CESS	China	CMIP5 (900)	Completed	Completed		CMIP5	No	128x60 x L26	360x180 x L30	FGOALS-g2
11b			CMIP5 (501)	Completed ?	Started ? End ?				x L26		FGOALS-s2
11c			Completed			CMIP5			72x45 x L26		FGOALS-g1
12	LOVECLIM	Belgium France Netherlands	Completed	Completed	Completed	Completed		No	32x64 x L3	122x65 x L20	LOVECLIM1-2
13	MIROC	Japan	CMIP5 (531)	CMIP5 (100)	CMIP5 (100)	CMIP5	CMIP5	Yes	128x64 x L80	256x192 x L44	MIROC-ESM
14	MPI-M	Germany	CMIP5 (1156)	CMIP5 (100)	CMIP5 (100)	CMIP5	CMIP5	No	196x98 x L47	256x220 x L40	MPI-ESM-P
15	MRI	Japan	CMIP5 (500)	CMIP5 (100)	CMIP5 (100)	Not started July 2012?	CMIP5	No	320x160 x L48	364x368 x L51	MRI-CGCM3
16	NCAR	USA	CMIP5 (501)	CMIP5 (301)	CMIP5 (101)	CMIP5	CMIP5	No	288x192 x L26	320x384 x L60	CCSM4
17	OSUVic	USA	Completed	Running May 2012	Running May 2012		Not started April 2012	No	128x64 x L10	100 x 100 x L19	OSUVic-0-3
18	CSIRO-QCCCE	Australia	CMIP5 (500)	CMIP5			CMIP5	No	192x96 x L18	192x192 x L31	CSIRO-Mk3-6-0
19	UK Groups (UBRIS/LEEDS/EDINB URGH - Hadley)	UK	CMIP5 (497)	CMIP5 (-ES: 102 -CC: 35)	Not started Spring 2012	Running Summer 2012	CMIP5	Yes	192x145 x L38	360x216 x L40	HadGEM2-ES HadGEM2-CC
20	UNSW	Australia	PMIP3 (1000)	PMIP3 (500)	Running June 2012	PMIP3	PMIP3	No	64x56 x L18	128x112 x L21	CSIRO-Mk3L-1-2
21	UofT	Canada	Running June 2012		Running June 2012			No	256x128 x L26	320x386 x L40	UofT-CCSM3

Data distribution

Discussed last year WGCM15



Database now



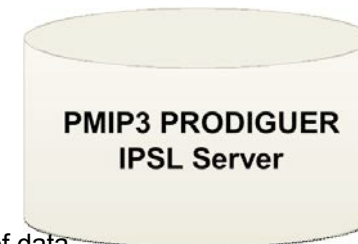
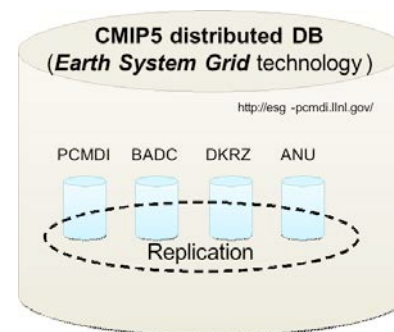
CMIP5

PMIP3

Addition fields

computed at LSCE

Seasonal cycles and variance
 Bioclimatic variables (not yet available)



Copy subset of data

Difficulties:

- Support for groups not in CMIP5
- Link with the national ESG nodes for groups not in CMIP5

Access through ESG



Access through PRODIGUER

Database : Jean-Yves Peterschmitt, LSCE/IPSL
 + thanks to the IPSL groupe (Sébastien Denvil) for the infrastructure

Workshop and conferences

- Connection with sessions in different conferences
 - WCRP-OSP (October 2012)., EGU (2012), WCRP-OSP (October 2012), CMIP5 (March 2012).
- Workshops (support from WCRP, PAGES, PALCOM)
 - PCMIP (carbon): November 2011, Blue Montaine, Australia
 - Benchmarking, February 2011, Australia
 - PAGES/CLIVAR past/future, March 2012, Hawaii, USA
 - COMPARE « ocean model-data »(PMIP/MARGO), Bremen, March 2012
- PMIP meeting : 6-11 May 2012, Crewe, UK
 - EOS paper (Crucifix et al.)
 - Newsletter PAGES (Hill et al. In preparation)
 - Special issue of climate of the past (not only CMIP5 but PMIP3 activity in general)

Climate of the Past- Special Issue

- Progress in paleoclimate modelling
 - Editor(s): M. Kageyama, C. Brierley, M. Crucifix, J. C. Hargreaves, A. Paul, and G. Ramstein
- Manuscript submitted and in discussion in CPD
 - Large-scale features of Pliocene climate: results from the Pliocene Model Intercomparison Project
 A. M. Haywood, D. J. Hill, A. M. Dolan, B. Otto-Bliesner, F. Bragg, W.-L. Chan, M. A. Chandler, C. Contoux, A. Jost, Y. Kamae, G. Lohmann, D. J. Lunt, A. Abe-Ouchi, S. J. Pickering, G. Ramstein, N. A. Rosenbloom, L. Sohl, C. Stepanek, Q. Yan, H. Ueda, and Z. Zhang
 - The East Asian summer monsoon at mid-Holocene: results from PMIP3 simulations
 W. Zheng, B. Wu, J. He, and Y. Yu
 - Climate and African precipitation changes in the mid-Holocene simulated using an Earth System Model MIROC-ESM
 R. Ohgaito, T. Sueyoshi, A. Abe-Ouchi, T. Hajima, S. Watanabe, H.-J. Kim, A. Yamamoto, and M. Kawamiya
 - Arctic sea ice in the mid-Holocene Paleoclimate Modelling Intercomparison Project 2 simulations
 M. Berger, J. Brandefelt, and J. Nilsson
 - Skill and reliability of climate model ensembles at the Last Glacial Maximum and mid Holocene
 J. C. Hargreaves, J. D. Annan, R. Ohgaito, A. Paul, and A. Abe-Ouchi
 - A multi-model assessment of last interglacial temperatures
 D. J. Lunt, A. Abe-Ouchi, P. Bakker, A. Berger, P. Braconnot, S. Charbit, N. Fischer, N. Herold, J. H. Jungclaus, V. C. Khon, U. Krebs-Kanzow, G. Lohmann, B. Otto-Bliesner, W. Park, M. Pfeiffer, M. Prange, R. Rachmayani, H. Renssen, N. Rosenbloom, B. Schneider, E. J. Stone, K. Takahashi, W. Wei, and Q. Yin
 - Southern westerlies in LGM and future (RCP4.5) climates
 Y. Chavaillaz, F. Codron, and M. Kageyama
 - Proxy benchmarks for intercomparison of 8.2 ka simulations
 C. Morrill, D. M. Anderson, B. A. Bauer, R. Buckner, E. P. Gille, W. S. Gross, M. Hartman, and A. Shah

- **Climatic impacts of fresh water hosing under Last Glacial Maximum conditions: a multi-model study**
M. Kageyama, U. Merkel, B. Otto-Bliesner, M. Prange, A. Abe-Ouchi, G. Lohmann, D. M. Roche, J. Singarayer, D. Swingedouw, and X. Zhang
- **Model sensitivity to North Atlantic freshwater forcing at 8.2 ka**
C. Morrill, A. N. LeGrande, H. Renssen, P. Bakker, and B. L. Otto-Bliesner
Clim. Past Discuss., 8, 3949-3976, 2012
- **Temperature response to external forcing in simulations and reconstructions of the last millennium**
L. Fernández-Donado, J. F. González-Rouco, C. C. Raible, C. M. Ammann, D. Barriopedro, E. García-Bustamante, J. H. Jungclauss, S. J. Lorenz, J. Luterbacher, S. J. Phipps, J. Servonnat, D. Swingedouw, S. F. B. Tett, S. Wagner, P. Yiou, and E. Zorita
- **Historical and idealized climate model experiments: an EMIC intercomparison**
M. Eby, A. J. Weaver, K. Alexander, K. Zickfeld, A. Abe-Ouchi, A. A. Cimatoribus, E. Cressin, S. S. Drijfhout, N. R. Edwards, A. V. Eliseev, G. Feulner, T. Fichefet, C. E. Forest, H. Goosse, P. B. Holden, F. Joos, M. Kawamiya, D. Kicklighter, H. Kienert, K. Matsumoto, I. I. Mokhov, E. Monier, S. M. Olsen, J. O. P. Pedersen, M. Perrette, G. Philippon-Berthier, A. Ridgwell, A. Schlosser, T. Schneider von Deimling, G. Shaffer, R. S. Smith, R. Spahni, A. P. Sokolov, M. Steinacher, K. Tachiiri, K. Tokos, M. Yoshimori, N. Zeng, and F. Zhao
- **Last interglacial temperature evolution – a model inter-comparison**
P. Bakker, E. J. Stone, S. Charbit, M. Gröger, U. Krebs-Kanzow, S. P. Ritz, V. Varma, S. Khon, D. J. Lunt, U. Mikolajewicz, M. Prange, H. Renssen, B. Schneider, and M. Schulz

- Coordination of a suite of papers and newsletters
 - Meeting outputs :
 - EOS , PAGES
 - PMIP boundary conditions
 - Schmidt et al. , GMD 2011, 2012: Last Millennium
 - Abe-Ouchi et al., GMD, still in progress : LGM ice sheet
 - PMIP2 synthesis and perspectives :
 - Braconnot et al., NCC 2012 : Evaluation of climate models using palaeoclimatic data,
also a reference for LGM and MH PMIP3 boundary conditions
 - Several coordinated papers on the different periods of PMIP (submitted). Plomip group very active, Eemian, sensitivity to fresh water fluxes in the Atlantic.

Also

- First intercomparison of LM simulations (Gonzales-Roucou et al. Clivar newsletter + paper submitted)
- Analyse of the carbon cycle in LM simulations (PCMIP group)
- Benchmarking paper for LGM and MH (Harrison et al. Submitted)
- Working group to reassess LGM tropical SST and better use the information from the different proxy records for model evaluation (use of biogeochemical and foram models) and estimates of climate sensitivity.
- Comparison of Emien simulations (125-130ka) for mid-High latitude warming and link with ice-sheet and sea-level
- Plomip group very active and several papers published

Key focusses for CMIP5 and across PMIP periods

- Benchmarking (mainly MH and LGM and / future)
- Climate sensitivity and polar amplification
- Uncertainties in boundary conditions
- Ocean circulation (THC and fresh water fluxes)
- Climate variability

« Benchmarking »

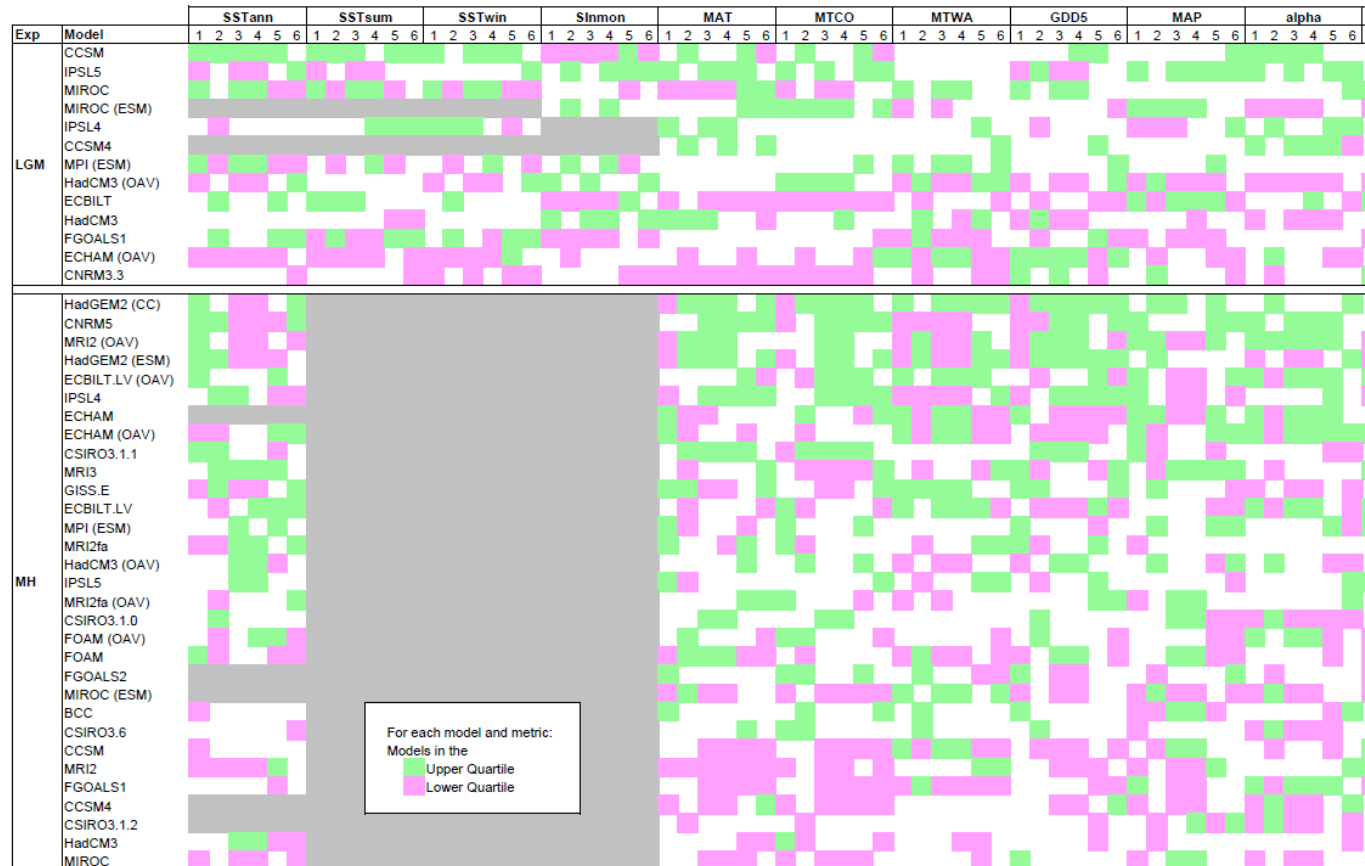


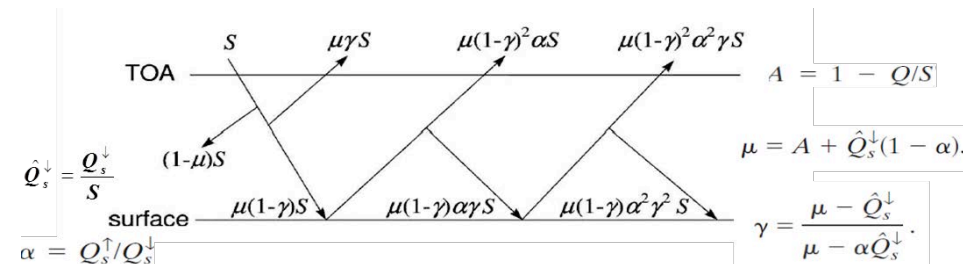
Figure from Harrison et al, submitted

Question about reliability of ensemble (ex Hargreaves and Annan, submitted), the best way to connect it to model feedbacks what the model do for PI or future climates, regional features.....)

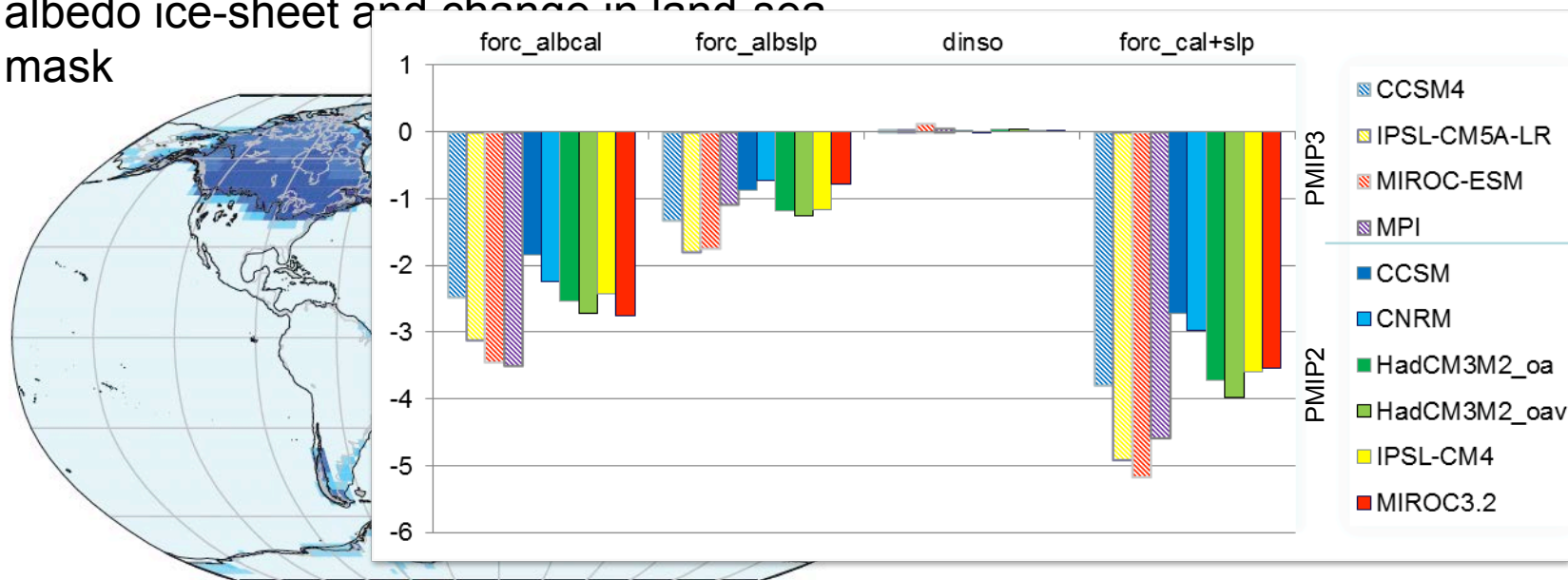
Climate forcing : boundary condition

Estimation of albedo effect on SW radiation

Taylor et al. 2007



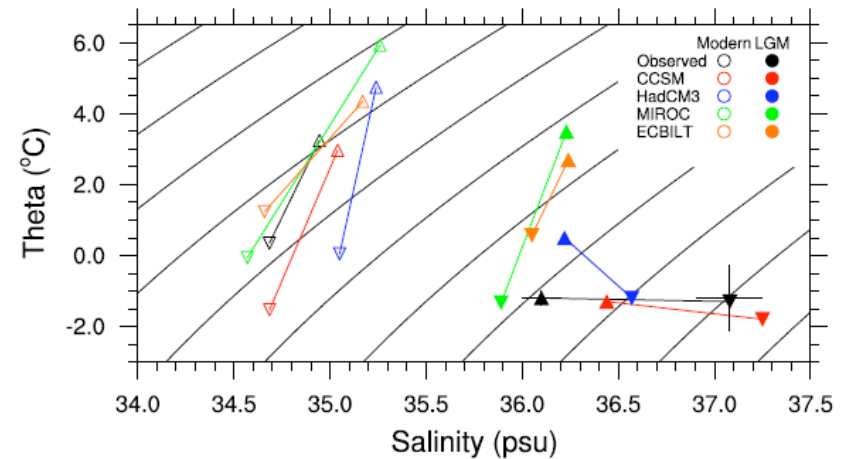
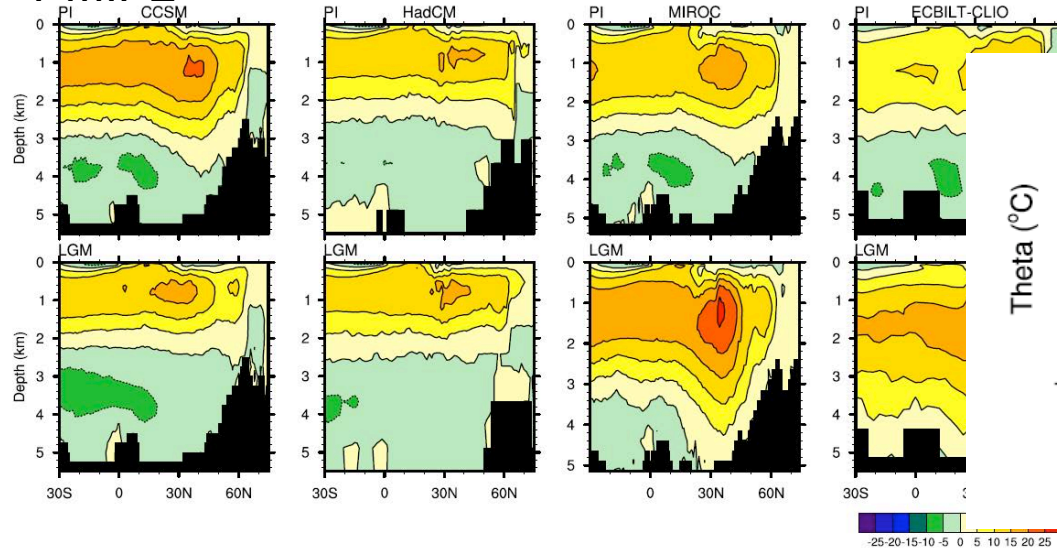
Ensemble mean of PMIP2 estimates :
 albedo ice-sheet and change in land sea
 mask



Braconnot et al. NCC, 2012

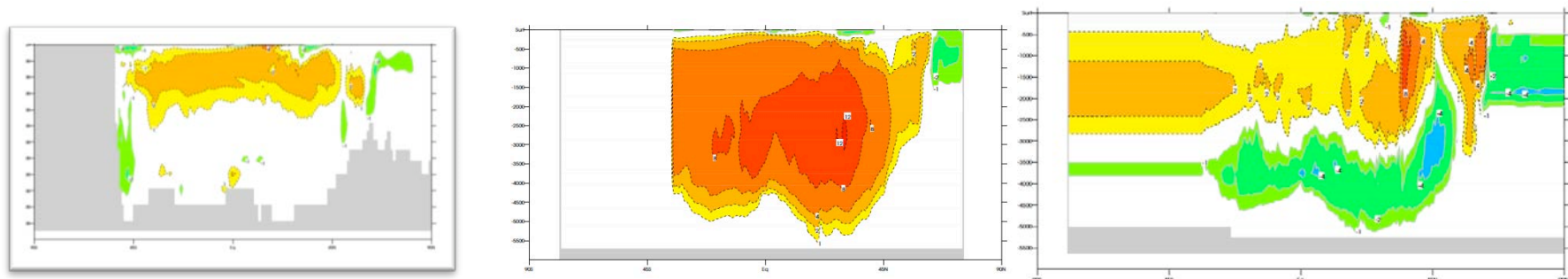
Ocean overturning

PMIP2



Otto-Bliesner et al. 2007

PMIP3



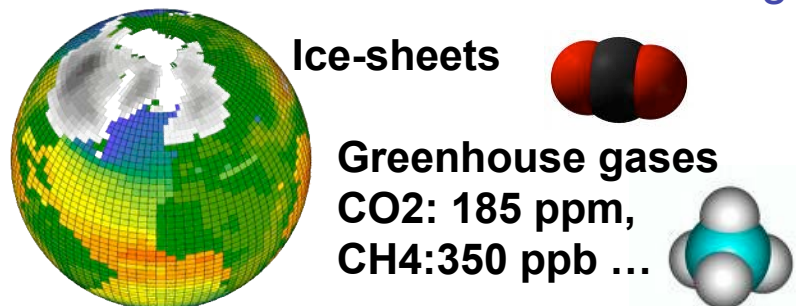
No progress :

Questions / closure of the fresh water fluxes, mis representation of brine rejection, model resolution

Land-sea contrasts and polar amplification in past and future climates

Masa Kageyama et al

Last Glacial Maximum main forcings



LGM climate reconstructions

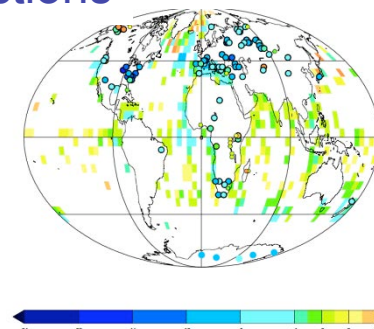
Land data

(pollen and plant macrofossils):
Bartlein et al, Clim Dynam 2011

Ocean data (multi proxy):
MARGO, NGS 2009

Ice-core data:

Masson-Delmotte et al pers. comm

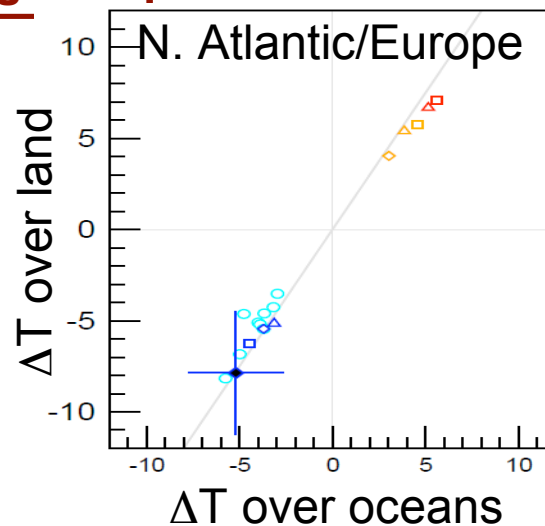
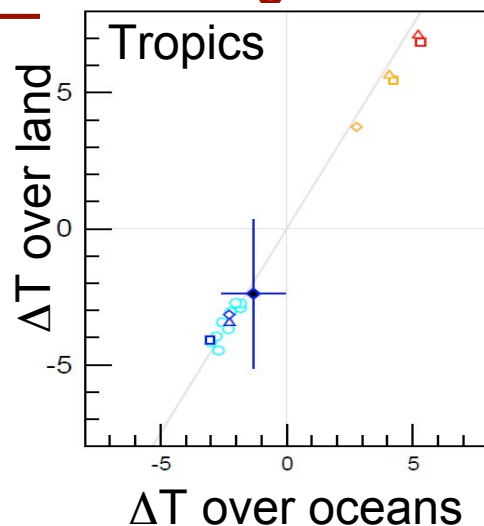


Relationships between LGM vs higher CO₂ climates?

Are the large scale relationships stable? Can we evaluate them from paleodata ?

Can we relate LGM global cooling to Equilibrium climate sensitivity (CO₂) ?

**Example:
Land sea
contrasts**

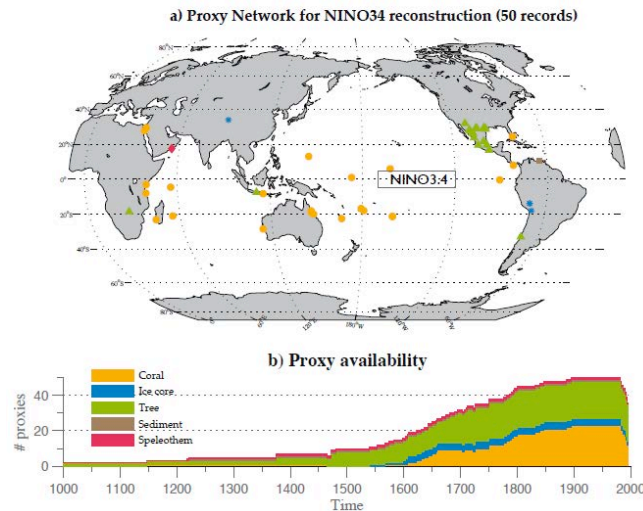
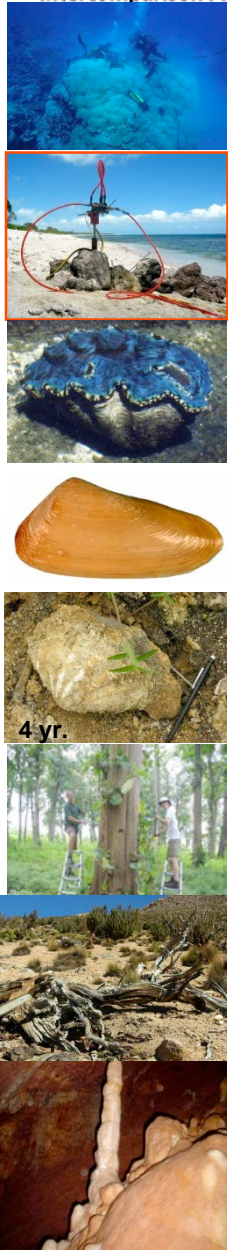


- 21k PMIP2
- IPSLCM5A-LR 21k
- △ MPI-ESM-P 21k
- ◇ NCAR-CCSM4 21k
- IPSLCM5A-LR 1petCO₂
- △ MPI-ESM-P 1petCO₂
- ◇ NCAR-CCSM4 1petCO₂
- IPSLCM5A-LR abrupt4xCO₂
- △ MPI-ESM-P abrupt4xCO₂
- ◆ reconstructions

Note: all model averages
calculated from grid
points where LGM data
is available

New working group on climate variability

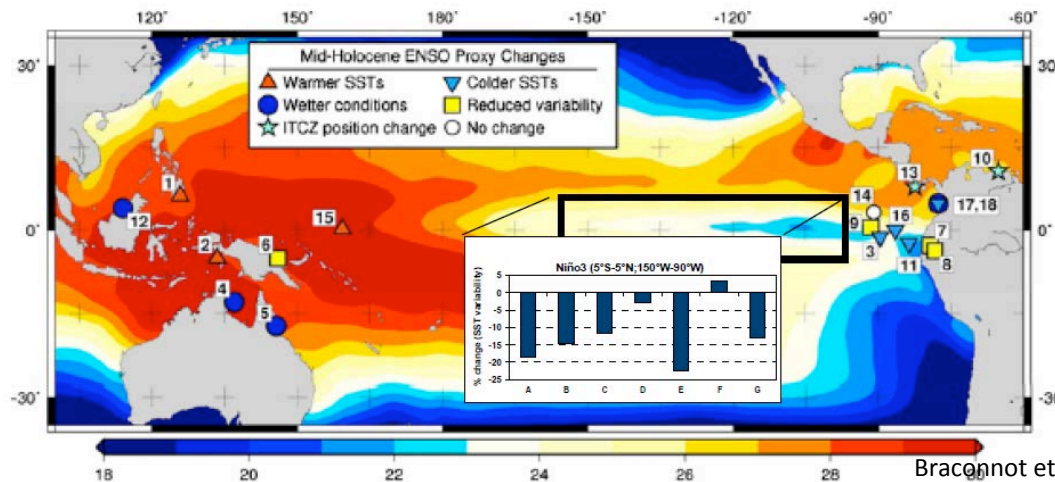
EX last millennium proxy database



Emile-Geay et al, in prep

- Improve existing syntheses by merging several sources (published and unpublished data)
- Connect variations over the ocean and tropical lands
- Develop appropriate methodologies to compare model results with these syntheses
- Connection with US Clivar group on ENSO diversity
- Newsletter ENSO past/present/future planned for the end of 2012 (PAGES, eds: P. Braconnot, S. Harrison and C. Brierley)

EX Mid-Holocene synthesis from bibliography and ENSO reduction (%) as simulated by 7 models (PMIP2)



Braconnot et al. (2012), Zheng et al. (2008)