Paleoclimate Modeling intercomparison Project

- Supported by WCRP/CLIVAR/WGCM and IGBP/PAGES
  SC: P. Braconnot (France); S. Harrison (UK), S. Joussaume (F), B. Otto-Bliesner (US), A. Abe-Ouchi, (Japan), A. Haywood, P. Valdes, G. Ramstein, K. Taylor, P. Bartlein, M. Kucera, J. Jungclaus

- 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)

<table>
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<tr>
<th>Institute</th>
<th>Country</th>
<th>6k rControl</th>
<th>6k midHolocene</th>
<th>21k n</th>
<th>LM past1000 (1000 years)</th>
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<th>Carbon cycle</th>
<th>Atm</th>
<th>Ocn</th>
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Data distribution

Discussed last year WGCM15

Rqs: would be better to have all LM MH and LGM simulations through CMIP5
PMIP3 imposes PI and 1xCO₂
Database now

Addition fields computed at LSCE
Seasonal cycles and variance
Bioclimatic variables (not yet available)

Difficulties:
○ Support for groups not in CMIP5
○ Link with the national ESG nodes for groups not in CMIP5

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

• 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
  - 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
  - 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
  - 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
- **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**  

- **Historical and idealized climate model experiments: an EMIC intercomparison**  

- **Last interglacial temperature evolution – a model inter-comparison**  
• 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). Pliomip 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
- Pliomip group very active and several papers published
Key focusses for CMIP5 and across PMIP periods

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

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

Braconnot et al. NCC, 2012
Ocean overturning

PMIP2

PMIP3

No progress:
Questions / closure of the fresh water fluxes, mis representation of brine rejection, model resolution

Otto-Bliesner et al. 2007
Land-sea contrasts and polar amplification in past and future climates

Masa Kageyama et al

Last Glacial Maximum main forcings

Ice-sheets

Greenhouse gases

CO2: 185 ppm,
CH4: 350 ppb...

LGM climate reconstructions

Land data
(pollen and plant macrofossils):
Bartlein et al, Clim Dyn 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

Note: all model averages calculated from grid points where LGM data is available
New working group on climate variability

- 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 last millennium proxy database

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

Emile-Geay et al, in prep

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