's perspectives on CMIP6

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PMIP3 in brief

➢ Currently: 21 modelling groups, 26 models

➢ PMIP3-CMIP5 simulations (# in CMIP db/# final number in CMIP/PMIP db):

last millenium (8/15), mid-Holocene (13/21), Last Glacial Maximum (8/15)

➢ PMIP3 non CMIP5 simulations:

last interglacial, Mid Pliocene, …

➢ Scientific discussions organised with 11 working groups:

- **5 on specific periods:** past 2 millenia, Quaternary Interglacials, Mid-Pliocene, Pre-Pliocene climates, Last Glacial Maximum (ice-sheet uncertainties)

- **3 on model-data comparison or proxy-modelling**: isotopic modelling, paleo-data assimilation, ocean model-data comparison, benchmarking

- **2 cross-cutting across periods**: past2future, variability

PMIP3 in CMIP: motivations

Period	Main forcing(s)	Scientific interest
Last Millenium	• Solar variability • Volcanic activity	• Natural climatic variability • Sensitivity to volcanic and solar forcings
Mid-Holocene (6000 years ago)	• Insolation (amplification of seasonal cycle in northern hemisphere)	• Changes in hydrological cycle (e.g. monsoons) • Changes in variability (e.g. ENSO)
Last Glacial Maximum (21000 years ago)	• Lower CO_2 (and other GHG) • Northern hemisphere ice-sheets	• Climate changes comparable to predicted future climate changes in amplitude • Potential constraints on climate sensitivity

All three periods are well documented, with strong chronological contraints

Contribution to AR5

- ➢ 6 figures in paleoclimate chapter, 4 in evaluation chapter
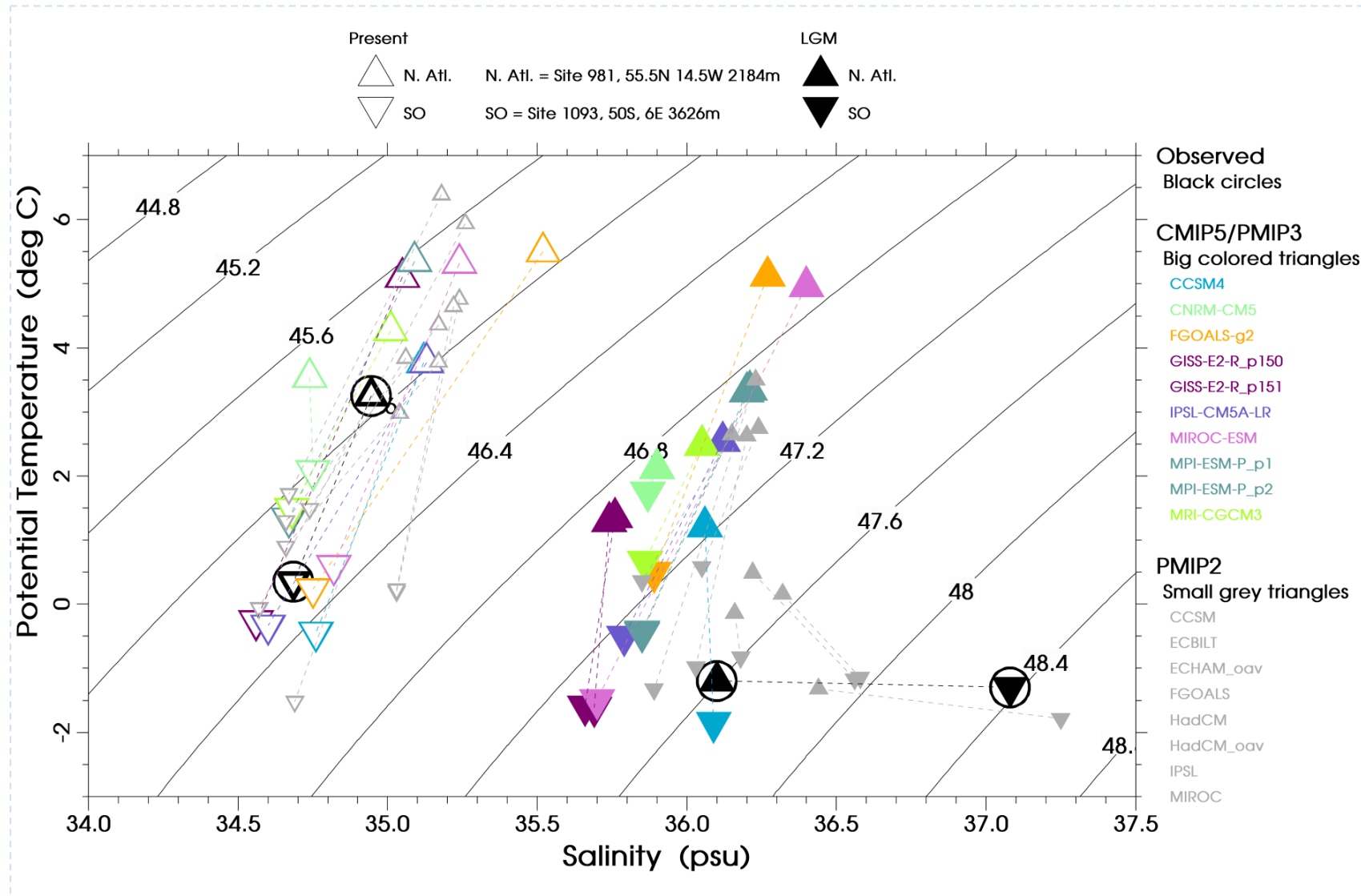- ➢ PMIP-CMIP and PMIP-non-CMIP simulations
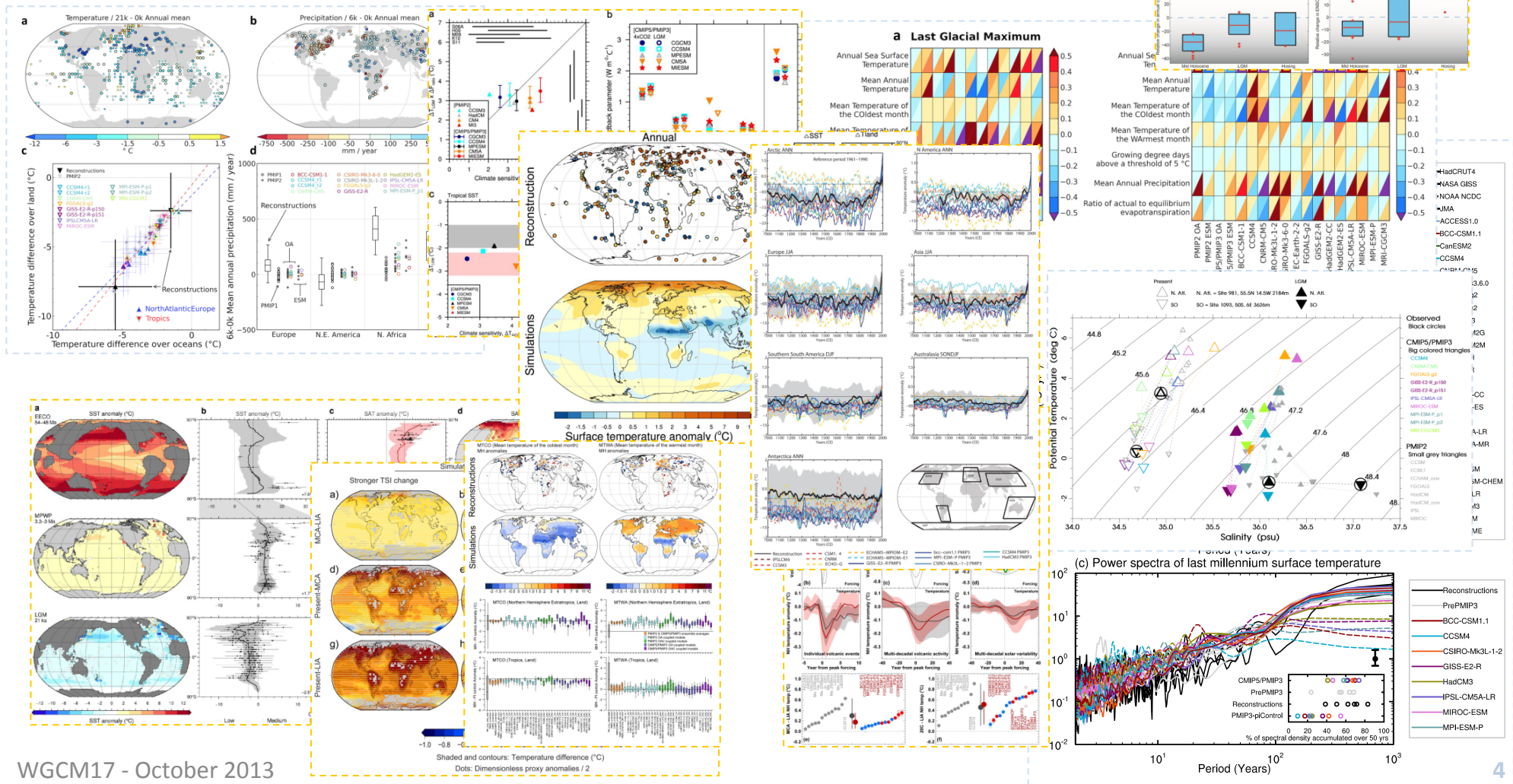
PMIP-CMIP papers

- ➢ Officially in CMIP5 publication database:
  - 14 under « Paleoclimate » keyword
  - 12 for « lgm » experiment, 9 for midHolocene, 5 for past1000
- ➢ But there are more papers
  - Climate of the Past Special Issue on « Progress in Paleoclimate Modelling »
  - Wider search (ISI web of science, citeulike) gives ~32 papers + a number in discussions in EGU journals + some « regional » reports
  - Generally, « climate/paleoclimate papers » but 6 papers on impact on regional vegetation (Brazil)
  - A few papers from authors outside PMIP community
- ➢ Grand Challlenges will be a good opportunity to share paleodata/paleoclimate simulation analyses with people from outside the paleo community

Example 1: deep ocean LGM

Fig 9.18 from IPCC AR5

Example 2: Δprecip vs Δtemperature

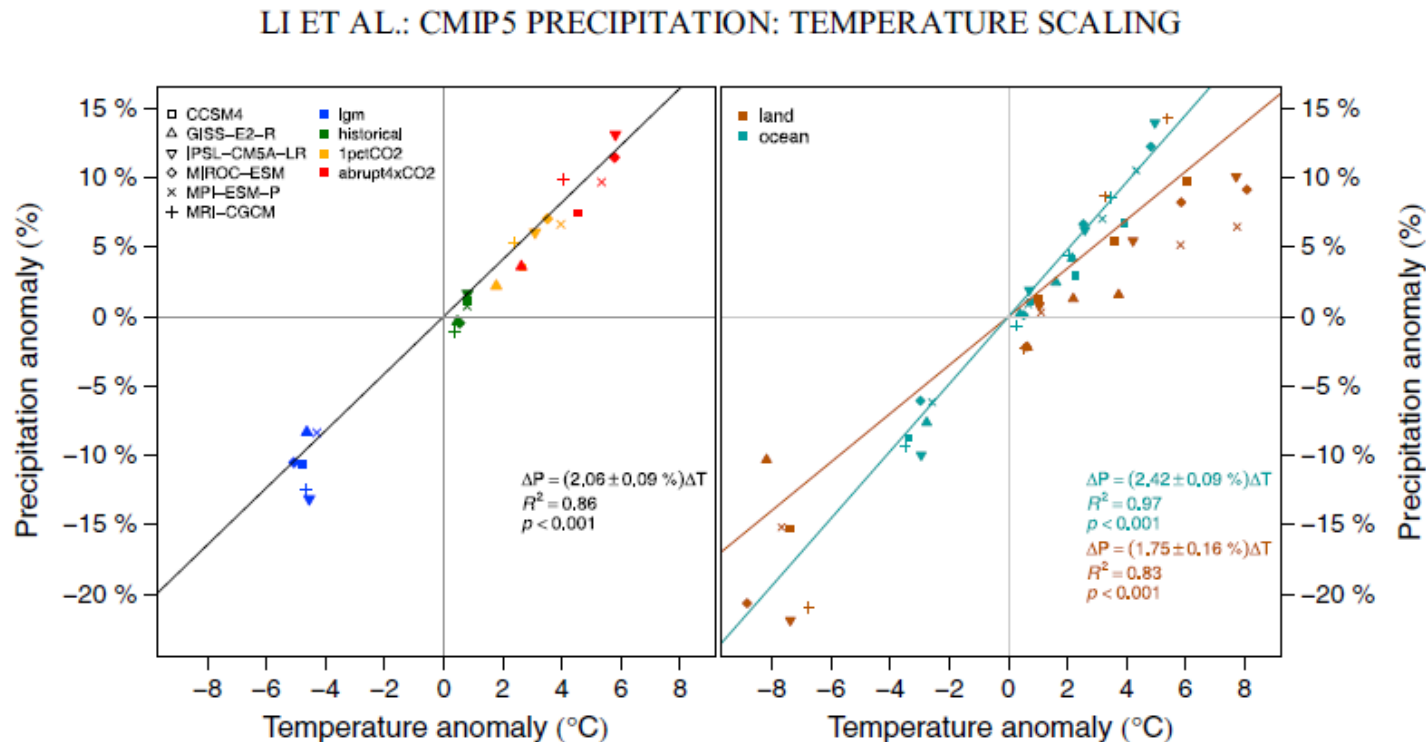LI ET AL.: CMIP5 PRECIPITATION: TEMPERATURE SCALING

Figure 2. The change in precipitation (%) as a function of the change in global temperature (°C) as simulated by each of the six CMIP5 models (IPSL-CM5A-LR, MPI-ESM-P, MIROC-ESM, CCSM4, MRI-CGCM3, and GISS-E2-R) at the Last Glacial Maximum (LGM), from the historical run (average for period 1979–2005 CE), the 1% CO_2 run (*1pctCO2*, average for model years 86–115), and the *4xCO2* run. The left-hand plot shows the global relationship, while the right-hand plots shows the change in global precipitation (%) over (red) land and (blue) ocean as a function of the change in global land and ocean temperature (°C).

Li et al, GRL, 2013

Summary of CMIP5 survey

- ➢ Real added value of having the same model versions used for past, present and future simulations

- ➢ Real added value of having all data on same « archive » system, including « PMIP3 but not CMIP5 » runs (although this was a little hard to achieve + some groups couldn't have access to some nodes « because they were not CMIP5 »)

- ➢ Next time, need to be more careful about transition between past1000 and historical (in terms of forcing)

- ➢ Simulations with carbon cycle included interesting for comparing to data (e.g. ocean biogeochemistry)

- → A wealth of results which have just started to be analysed

- ➢ Need more time for analyses
  - - In particular, need to get more « non paleo » groups involved in the analyses

Thoughts for CMIP6 -1

- ➢ Great benefit of running same models for all time periods, past, present & future → we should keep this approach

- ➢ For better comparison of past vs future climates, we would need one stabilized scenario (e.g. $4xCO_2$, for several hundred years). This would also be useful for studying changes in variability.

- ➢ Need to improve quantification of the forcings and their impact for each period and compare to forcings for other periods/future climate

  Sensitivity experiments to be designed in coordination with other MIPS: e.g. AMIP runs → $AMIP4xCO_2$,

  but also AMIP_lgmCO2, AMIP_midHolocene insolation

Thoughts for CMIP6 -2

- ➤ New/interactive components?

    Vegetation (fully dynamical), aerosols, ice-sheets, « proxy modelling »

    → Discussion at next PMIP meeting

- ➤ Regional modelling:

    Interesting for model-data comparisons, already used to compute impact of climate change on paleo-environnements and early humans

    → to be coordinated with CORDEX activities?

- ➤ New periods:

    Mid-Pliocene? Last Interglacial ?

    → to be discussed next May in PMIP3 general meeting

Thoughts for CMIP6 – contributions from paleo-modelling

➢ Evaluation: Climate sensitivity, benchmarking (including by modelling paleoclimate proxies) → link with future climate prediction

➢ Evaluation/understanding: hydrological cycle changes w.r.t temperature/circulation changes

➢ Evalution/understanding: carbon cycle (proxies + feedbacks)

➢ Better quantification of the forcings/feedbacks via sensitivity experiments.

  - « new » feedbacks from components added in ESMs
  - Sensitivity experiments, to be coordinated with those run for other MIPs

→ Questions addressed in nearly all other MIPs are valid for paleoclimate simulations too.

Upcoming events

➢ Main PMIP plans to be discussed at next PMIP meeting in Namur (Belgium) in May 2014

➢ Workshops until then:

- Last millenium: Madrid, November 2013

- COMPARE (ocean model-data comparisons): Corvallis, December 2013

- PaleoVar, February 2014

- Grand Challenge on clouds, circulation, climate sensitivity, March 2014