Some papers with a focus on evaluating PMIP models

Chronological by publication date, most recent first:

A cloud feedback emulator (CFE, version 1.0) for an intermediate complexity model

Ullman, D. J. and Schmittner, A. (2017) Geosci. Model Dev., 10, 945-958. open access

from the abstract: `Here, we describe and evaluate a method for applying GCM-derived shortwave and longwave cloud feedbacks from 4xCO2 and Last Glacial Maximum experiments to the University of Victoria Earth System Climate Model. The method generally captures the spread in top-of-the-atmosphere radiative feedbacks between the original GCMs, which impacts the magnitude and spatial distribution of surface temperature changes and climate sensitivity. These results suggest that the method is suitable to incorporate multi-model cloud feedback uncertainties in ensemble simulations with a single intermediate complexity model.`

Terrestrial biosphere changes over the last 120 kyr.

Hoogakker BAA, Smith RS, Singarayer JS, Marchant R, Prentice IC, Allen J, Anderson RS, Bhagwat SA, Behling H, Borisova O, and Bush M, et al. (2015). Clim. Past, 12, 51-73, 2016, doi:10.5194/cp-12-51-2016 http://www.clim-past.net/12/51/2016/cp-12-51-2016.html (open access)

From the conclusions, `We have used a new global synthesis and biomization of long pollen records in conjunction with model simulations to analyse the sensitivity of the global terrestrial biosphere to climate change over the last glacial–interglacial cycle. Model output and biomized pollen data generally agree, lending confidence to our global-scale analysis of the carbon cycle derived from the model simulations. We used the models to estimate changes in global terrestrial net primary production and carbon storage. Carbon storage variations have a strong 23kyr (precessional) cycle in the first half of the glacial cycle in particular.`

Evaluation of CMIP5 palaeo-simulations to improve climate projections.

Harrison, S.P., Bartlein, P.J., Izumi, K., Li, G., Annan, J., Hargreaves, J., Braconnot, P.B., and Kageyama, M., 2015. Nature Climate Change 5: 735-743.
http://www.nature.com/nclimate/journal/v5/n8/full/nclimate2649.html

from abstract: `Past climate changes provide a unique opportunity for out-of-sample evaluation of model performance. Palaeo-evaluation has shown that the` large-scale changes seen in twenty-first-century projections, including enhanced land–sea temperature contrast, latitudinal amplification, changes in temperature seasonality and scaling of precipitation with temperature, are likely to be realistic. Although models generally simulate changes in large-scale circulation sufficiently well to shift regional climates in the right direction, they often do not predict the correct magnitude of these changes. Differences in performance are only weakly related to modern-day biases or climate sensitivity, and more sophisticated models [within the CMIP model ensembles] are not better at simulating climate changes. Although models correctly capture the broad patterns of climate change, improvements are required to produce reliable regional projections.

Glacial Atlantic overturning increased by wind stress in climate models

Juan Muglia and Andreas Schmittner, 2015, Geophys. Res. Lett., 42, doi:10.1002/2015GL064583, http://people.oregonstate.edu/~schmita2/pdf/M/muglia15grl.pdf

excerpts from conclusions: Since LGM wind stress, closure of Bering Strait [Hu et al., 2010], and increased tidal mixing [Schmittner et al., 2015] all tend to increase the strength and depth of the AMOC, a countering effect has to be invoked to reproduce observations of a weaker and shallower overturning during the LGM.” … “It will be an important task for future work to resolve the apparent inconsistency between PMIP models’ LGM circulation and reconstructions.This inconsistency casts doubt on future AMOC projections with these models [e.g., Weaver et al., 2012]. One possible explanation may be that not all PMIP3 models were in equilibrium [Zhang et al., 2013].

Model benchmarking with glacial and mid-Holocene climates.

Harrison, S.P., Bartlein, P.J., Brewer, S., Prentice, I.C., Boyd, M., Hessler, I., Holmgren, K., Izumi, K., and Willis, K., 2013. Climate Dynamics 43: 671-688. DOI 1007/s00382-013-1922-6, http://link.springer.com/article/10.1007%2Fs00382-013-1922-6

We present a comprehensive evaluation of state-of-the-art models against Last Glacial Maximum and mid-Holocene climates, using reconstructions of land and ocean climates and simulations. Newer models do not perform better than earlier versions despite higher resolution and complexity. Differences in climate sensitivity only weakly account for differences in model performance. In the glacial, models consistently underestimate land cooling (especially in winter) and overestimate ocean surface cooling (especially in the tropics). In the mid-Holocene, models generally underestimate the precipitation increase in the northern monsoon regions, and overestimate summer warming in central Eurasia. Models generally capture large-scale gradients of climate change but have more limited ability to reproduce spatial patterns. Despite these common biases, some models perform better than others.

Introduction: Warm climates of the past—a lesson for the future?

D. J. Lunt, H. Elderfield, R. Pancost, A. Ridgwell, G. L. Foster, A. Haywood, J. Kiehl, N. Sagoo, C. Shields, E. J. Stone, and P. Valdes, Phil. Trans. R. Soc. A. 2013 371 20130146; doi:10.1098/rsta.2013.0146 (published 16 September 2013) open access

```
An introduction to a special issue related to the Discussion Meeting ‘Warm
climates of the past—a lesson for the future?’ compiled and edited by Daniel
J. Lunt, Harry Elderfield, Richard Pancost and Andy Ridgwell. It is focussed
towards emphasising the potential usefulness of the warm climates of the
past. Most of the papers seem (I can't read most of them, as only a few are
open access and it seems that even mighty JAMSTEC does not subscribe to Phil
Trans) focussed towards understanding the past, but there is also one on
climate sensitivity by J. Hansen et al, open access
```

Precipitation scaling with temperature in warm and cold climates: an analysis of CMIP5 simulations.

Li, G., Harrison, S. P., Bartlein, P. J., Izumi, K., & Prentice, I. C. Geophysical Research Letters. doi:10.1002/grl.50730, open access, 2013.

keywords: CMIP, PMIP, model ensemble, LGM

```
Abstract, “We investigate the scaling between precipitation and temperature
changes in warm and cold climates using six models that have simulated the
response to both increased CO2 and Last Glacial Maximum (LGM) boundary
conditions. Globally, precipitation increases in warm and decreases in cold
climates by between 1.5 to 3%/ Ċ. Precipitation sensitivity to temperature
changes are lower over land than ocean and lower over tropical land compared
to extratropical land, reflecting the constraint of water availability. The
wet tropics get wetter in warm and drier in cold climates, but the changes in
dry areas differ among models. Seasonal changes of tropical precipitation in
a warmer world also reflect this “rich get richer” syndrome. Precipitation
seasonality is decreased in the cold-climate state. The simulated changes in
precipitation per degree temperature change are comparable to the observed
changes in both the historical period and the LGM.”
```

Statistical framework for evaluation of climate model simulations by use of climate proxy data from the last millennium

Part 1: Theory, Sundberg, R., A. Moberg and A. Hind, Clim. Past, 8, 1339-1353, open access, doi:10.5194/cp-8-1339-2012, 2012.

Part 2: A pseudo-proxy study addressing the amplitude of solar forcing A. Hind, A. Moberg, and R. Sundberg, Clim. Past, 8, 1355–1365, open access

keywords : last millennium, test statistics, evaluation, detection / attribution

```
Pseudo-proxy experiment to distinguish between high and low solar forcings
from model output run over the Last Millennium
```

Evaluation of climate models using palaeoclimatic data

Pascale Braconnot, Sandy P. Harrison, Masa Kageyama, Patrick J. Bartlein, Valerie Masson-Delmotte, Ayako Abe-Ouchi, Bette Otto-Bliesner & Yan Zhao, Nature Climate Change 2, 417–424, paywall, doi:10.1038/nclimate1456, 2012

keywords: review/prospective, PMIP, evaluation

```
Review paper focused on PMIP efforts, displaying relationships between (a)
land temperature change and ocean temperature change and (b) global and
regional changes and elaborating on how carefullyevaluation ofmodelling of
past climates may provide insights / constraints on future climate change.
```

Skill and reliability of climate model ensembles at the Last Glacial Maximum and mid-Holocene

J. C. Hargreaves, J. D. Annan1, R. Ohgaito, A. Paul, and A. Abe-Ouchi, Clim. Past, 9, 811–823, open access doi:10.5194/cp-9-811-20132013. and **Are paleoclimate model ensembles consistent with the MARGO data synthesis?** J. C. Hargreaves, A. Paul, R. Ohgaito, A. Abe-Ouchi, and J. D. Annan Clim. Past, 7, 917–933, open access doi:10.5194/cp-7-917-2011, 2011

keywords: PMIP, LGM, evaluation, temperature (SAT over land, SST for ocean)

```
Show that PMIP2 and available PMIP3 models are reliable and have skill for
air and surface ocean temperatures on broad scales, for the LGM. On the other
hand, the MIROC single model ensemble is under-dispersive (a result common
for single model ensembles - see Yokohata et al 2010). Additionally the
models have no skill and are not reliable for the mid-Holocene interval.
```

Assessment of the use of current climate patterns to evaluate regional enhanced greenhouse response patterns of climate models

Penny Whetton, Ian Macadam, Janice Bathols, and Julian O'Grady GRL, VOL. 34, L14701, paywall, doi:10.1029/2007GL030025, 2007

keywords: evaluation, CMIP3, regional climate

```
One of several papers from around 2007-2009, looking for “metrics”. The idea
was that if a relationship may be found in the multi-model ensemble between a
measurable quantity in the present and a feature of the climate in the future
projections, then this may in principle be use to constrain the ensemble. In
this study the globe was split into the land-based “Giorgi regions”. The
metric is a measure of model similarity. Combining temperature, precipitation
and sea level pressure seems to provide the best correlations for future
performance both regionally and globally.
```

[PMIP3 Wiki Home] - [Help!] - [Wiki syntax]