Paleoclimate and climate science – same but different ...
Scientific Partnership
Paleoscience – Climate science
(PAGES – WCRP)

www.pages-igbp.org

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Collaboration across time scales in scientific areas of overlapping interest

Scientific Partnership

between the

World Climate Research Programme (WCRP)

(Geneva, Switzerland, hereafter "WCRP")

and the

Past Global Changes (PAGES) Project

(Bern, Switzerland, hereafter “PAGES”)
PAGES’ new Science structure
Solar forcing
Sea level
Interglacials
Dust
Peat
Sea ice
Varves
Changes since the last ice age
Volcanism and Climate
2000 year climate history
Monsoon
Holocene
Soil and sediment
Land cover
Ecosystem services
Data stewardship
Warm worlds
Thresholds
Extremes
Integrated Activities
Ocean carbon and circulation
Biodiversity
Fire
Aquatic Transitions
Sea level
PALSEA
The Earth model we employ is a spherically symmetric, self-coupled system that includes a 90 km thick lithosphere and is characterised by ocean density (steric) changes is not considered. Not surprisingly, the largest deviations from the eustatic value are found in the near-field of the Laurentide ice sheets, while the former is considered to be within the far-field of the Late Pleistocene ice sheets. In particular, sea levels are predicted to have occurred in broad regions centred on the locations of former and current ice sheets. In this model, Meltwater Pulse IA is sourced entirely from northern hemisphere ice sheets (primarily the North American ice sheets).

The results in Fig. 1A indicate that there are significant departures from the eustatic value that have been corrected for this signal. In addition, the influence of tectonic processes and so the results shown below are only applicable to regions that are tectonically stable or to data sets that account any tectonic processes and so the results shown below are only applicable to regions that are tectonically stable or to data sets that account for any tectonic processes. To emphasise departures from eustasy, the sea level (RSL) for 21 cal. kyr BP (A) and 6 cal. kyr BP (B). That is, these observed sea-level anomalies are shown relative to the eustatic sea level for the same ages (see Fig. 1 in Peltier, 2004).
The Geologic Record provides important data on natural rates of sea-level change.
The Geologic Record provides important constraints on sea-level rise commitments.
2000-year regional climate
PAGES 2k
Temporal Availability

First Millennium

- bivalve
- coral
- historic
- ice core
- lake sediment
- marine sediment
- sclerosponge
- speleothem
- tree

Year (CE)

# proxies

0 200 400 600 800 1000 1200 1400 1600 1800 2000

0 200 400 600 800 1000
Ocean2k - highresolution
Sea surface temperature changes over 2000 years

Figure 4. The best (highest cumulative RE) reconstruction for each of the four target regions, with root-mean-square errors (RMSE) and instrumental HadISST (in black). Portions of the reconstruction where RE < 0 are plotted in gray.

Identifying overlapping interest
Step 1: Mapping PAGES onto WCRP
<table>
<thead>
<tr>
<th>WCRP Grand Challenges</th>
<th>PAGES WGs and Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Regional Sea Level Rise</td>
<td>• Past sea Level WG “PALSEA”</td>
</tr>
<tr>
<td>• Water Availability</td>
<td>• Hydroclimate reconstruction 2k; Global Monsoon WG</td>
</tr>
<tr>
<td>• Cryosphere in a Changing Climate</td>
<td>• Sea ice proxies WG; Ice sheet component in PALSEA; Glaciers and water resources</td>
</tr>
<tr>
<td>• Regional Climate Information</td>
<td>• Regional climate last 2000 years “PAGES2k”</td>
</tr>
<tr>
<td>• Climate Extremes</td>
<td>• Integrated activity “Extreme events”</td>
</tr>
<tr>
<td>• Clouds, Circulation, Climate Sensitivity</td>
<td>• Data-based paleo-sensitivity studies (e.g. Rohling et al.)</td>
</tr>
</tbody>
</table>
Identifying overlapping interest

Step 2: Mapping WCRP onto PAGES
PAGES SSC priorities

• Warmer worlds & ocean heat
• Decadal to multi-decadal variability
• Paleoclimate Modeling Intercomparison Project
• Extreme events
• Sea level
• Young Scientists Meeting with WCRP

WCRP anticipated Interest

• Climate projections and impacts
• Decadal prediction
• Improving modelling capacity and skill validation
• Climate Extremes
• Regional Sea Level Rise
• Young Scientists Meeting with PAGES ?
Step 3: Jumping at opportunities for collaboration

- Southern Ocean Workshop at Scripps, March 2015 (WCRP-PAGES)
- Climate Shifts workshop in Trieste, November 2015 (CLIVAR w. PAGES)
- ...
Step 4: Finding and motivating volunteers

PAGES SSC members and Working Group leaders, but also “next generation”

- Warmer worlds & ocean heat – Alan Mix
- Decadal/multi-decadal – Pascale Braconnot, Hugues Goosse, Michal Kucera
- Paleoclimate Modeling Intercomparison Project – Pascale Braconnot
- Extreme events – Blas Valero
- Sea level – Anders Carlson
- 2000-year regional climate – Darrell Kaufman
- Climate sensitivity – Eelco Rohling
- Monsoon – Pixian Wang, Bin Wang
- Sea ice – Anne de Vernal, Eric Wolff
- Glaciers – Andres Rivera, Mariano Masiokas, Anil Kulkarni, Jörg Schäfer, Olga Solomina
Data and model urgencies

Most urgent model development or improvement
- Transient modeling
- Incorporation of proxies
- Developing data assimilation

Most urgent observational or data deficiency
- Seasonal information records
- Forcing: Solar and volcanic forcing, land cover change
- High-resolution Southern Ocean paleoceanographic records
Next Steps

- Formalize the Scientific Collaboration agreement
  sign agreement document and announce to communities

- Identify priority topics for near-term collaboration (“scoping”)
  low-hanging fruit, opportunities, momentum, ... -> formulate

- Ensure mutual information flow
  online media, newsletters, e-mail lists, committee attendances

- Get on-the-ground collaborations going
  joint workshops, working groups, products, early-career offers
Seasonal for PAGES

Beyond decadal in WCRP

Mediator / connector between WCRP and FE

PAGES-WCRP
Paleoscience – Climate science

Glaciers and water resources
Drought

Antarctic-Australian precipitation history over 750 years

Largest percip period in E Antarctica = largest drought in SW Australia
-to occur once in 5,400 years (or even only once in 38,000 years)
-Hence most likely a feature of the ongoing global change

Van Ommen and Morgan., 2010, *Nature Geoscience*
Estimation of decadal-multidecadal variability

Spectral densities in simulations and reconstructions over the period 850-2005

Frequency (cycles/year)
Highlights

Palaeosens Project Members
Nature, 2012

Perspective

Making sense of palaeoclimate sensitivity

PALAESENS Project Members*
Globally connected monsoon regions – in the past
What is PAGES?

A global network

• 6,000 accomplished paleo-scientists
• over 30 working groups
• open, diverse, community driven, with a focus on involving early career and developing country scientists
Extreme events
Floods

10,000 years of flood history from lake sediments (example from Swiss Alps)

Wirth et al. 2013
Drought / Monsoon failure in India

- DAN-D (Dandak Cave)
  - Sinha et al 2007, Berkelhammer et al 2010
- JHU-1 (Jhumar Cave)

Megadroughts!

Year A.D.

- 700
- 900
- 1100
- 1300
- 1500
- 1700
- 1900
- 2000

- 1792-96
- 1877
- 1918-20
- 1987

δ18OVPDB

Wetter

Drier

-5.5
-5.0
-4.5
-4.0
-3.5
-3.0
-2.5

1756-60
1792-96
1877
1918-20
1987