

## Placing historical marine conditions into the context of the past 2,000 years

A Progress report on the PAGES (Past Global Changes)/Ocean2k Project

### Ocean2k Project Members<sup>1</sup>

Following a suggestion from the CLIVAR Scientific Steering Group (SSG) and a meeting of the PAGES 2k<sup>1</sup> network leadership in Bern, July 2011, the PAGES Scientific Steering Committee (SSC) endorsed the formation of a ninth group focusing on the global oceans during the last 2,000 years (2K): Ocean2K. Motivating this project is an interest in placing observed historical marine conditions into the context of climatic variation over the past 2,000 years (Box 1). A description of project goals was described in PAGES News, 20(1), 2012<sup>1</sup>; this report is a brief progress update since. Two outputs are planned: a metadatabase of Ocean2k-relevant paleodata and paleomodeling simulations; and a preliminary synthesis of the principal common features in the underlying data and model output, both to be developed in time for consideration in the IPCC's Working Group I Fifth Assessment Report, and ultimately contributing to the PAGES2K synthesis planned for 2014/2015.

#### Box 1: Motivating questions

- What are the principal patterns of variation in ocean properties observed in both paleodata and paleomodeling simulations forced with realistic external forcings?
- What are the most likely underlying mechanisms?

### Phase I: Paleodata metadatabase construction.

Our first goal is a metadatabase<sup>1</sup> (Box 2) of Ocean2k-relevant paleoproxy records and model output from publicly-accessible and citable sources. As development of the CMIP5/PMIP3 modeling databases is not yet complete, we decided early on to first develop the paleodata metadatabase, create robust data syntheses therefrom, and then extract suitable comparison diagnostics from available paleoclimate model output. As of January 31, 2012, over 100 volunteers have evaluated or shortly will evaluate 984 candidate proxy records from different marine carbonate archives. Of these records, almost 290 meet criteria for relevance to Ocean2k goals (Box 2). About 300 potential records remain to be screened. This is an impressive volunteer community effort! Secondary screening and analysis of the paleodata (Figure 1) is just beginning, but we hope that we can detect in the data and simulations the ocean imprint of large-scale variations in processes such as the Atlantic Meridional

Overturning Circulation, annular mode activity, monsoon circulations, and El Niño-Southern Oscillation (ENSO).

#### Box 2: Ocean 2K metadatabase components and criteria

- Paleoproxy metadatabase of marine origin: from the public NOAA/WDC-A (<http://www.ncdc.noaa.gov/paleo/>) and PANGAEA (<http://pangaea.de/>) data portals
  - Variable: local interpretation of the measured proxy data
  - Time interval: any portion of the past 2000 years
  - Minimum chronological resolution: 1 date per 200 years, as applicable
  - Uncertainty: internal and/or external reproducibility; interpretation, or bulk uncertainty
  - Reference: a citation in the peer-reviewed literature is available
  - Data link: A URL to the data source in a publicly accessible data repository
- Climate model output metadatabase: from the public CMIP5 ([http://cmip-pcmdi.llnl.gov/cmip5/data\\_portal.html](http://cmip-pcmdi.llnl.gov/cmip5/data_portal.html)) and PMIP3 (<http://pmip3.lsce.ipsl.fr/>) data portals
  - Variable, time interval, uncertainty, reference
  - Metadata to be determined by results of paleodata metadatabase development
  - Data link: A URL to the model output in a publicly-accessible data repository

### Phase II: Preliminary Paleodata/Model Synthesis

The second goal is a synthesis paper, and our initial focus will be to examine whether surface temperature or proxy data compilations are consistent with existing paleoclimate reconstructions primarily derived from terrestrial datasets (the primary focus of the other PAGES 2K working groups). As a simple illustration and practical target, we will study whether the conventional wisdom of a generally warm Medieval Climate Anomaly (MCA; roughly 950-1300 AD) and cold Little Ice Age (LIA; roughly 1450-1850 AD), is valid for the oceans. We will review the principal interpretable features in the data and paleosimulations, discuss likely underlying mechanisms, identify leading uncertainties in the data, model output, and results of our analysis, and highlight areas for future research. Given the short timeline of this phase of the project, our plan is to proceed as follows (Box 3). About 36 project members have volunteered for the synthesis phase of the project.

1 Complete list of participants is at: <http://www.pages.unibe.ch/workinggroups/ocean2k/people>

2 An overview of the PAGES 2K network and regional foci is at: <http://www.pages.unibe.ch/workinggroups/2k-network>

3 Preprint is at: <http://www.pages.unibe.ch/download/docs/Ocean2k-Prepub.pdf>

4 Ocean2k metadatabase is at: <http://www.pages.unibe.ch/workinggroups/ocean2k/metadatabase>

### Box 3: Planned Preliminary synthesis

- Finish reviewing candidate data for inclusion into the Ocean2k paleodata metadatabase.
- Perform secondary screening of the candidate data.
- Organize synthesis group into small teams by expertise.
- Perform simple, reproducible, traceable data analyses on selected subsections of the paleoproxy data, concentrating initially on large-scale surface temperature estimates and widely available proxy measurements, such as oxygen isotopic composition of marine carbonates.
- Evaluate whether the Ocean2k synthesis is consistent with existing and terrestrial-based proxy evidence for climate variability and change over the past 2000 years.
- Identify for future work if variations in processes such as the thermohaline circulation, El Nino-Southern Oscillation (ENSO), and the Atlantic Multidecadal Oscillation (AMO) are detectable in the paleodata and paleomodeling simulations.
- Develop, revise and submit a preliminary Ocean2k synthesis paper by July 2012.

Ocean2k is currently not planning project meetings. Instead, we are working independently, using weekly-to-biweekly internet-based teleconferencing for regular discussions. Further information on project goals is regularly updated at the Ocean2k webpages: <http://www.igbp-pages.org/workinggroups/ocean2k/>

We look forward to your comments on this project. Would you like to participate in the Ocean2k project? Please contact Mike Evans (mnevans@geol.umd.edu).

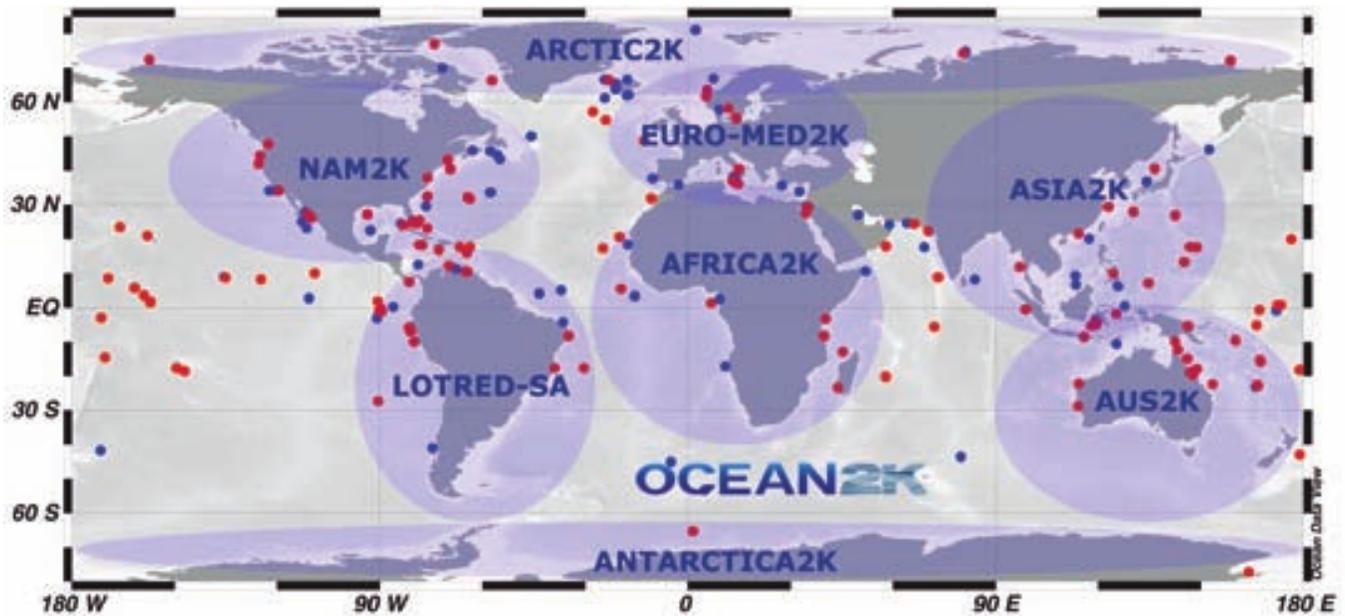


Fig 1: Map of the location of proxy records meeting Ocean2k criteria, first screening (December 2011-January 2012). Red and blue markers indicate "high" (>1 measurement/decade) and "low" (>1 measurement/200 years) resolution paleoproxy data, respectively; map current as of February 1, 2012. Secondary screening of the metadata entries for adherence to Ocean2k inclusion criteria (Box 2), and data synthesis, is underway. Purple shaded areas indicate approximate synthesis regions for the other indicated PAGES 2K projects.