ARC for Paleoclimatology

So where do we go from here? Large-scale surface temperature reconstructions have the potential to further improve our knowledge of temperature variations over the last 2,000 years, particularly if additional proxy evidence can be identified and obtained from areas where the coverage is relatively sparse and for time periods before A.D. 1600 and especially before A.D. 900. (J. North, Statement to U. S. House of Representatives, July 19, 2006)

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National Climatic Data Center
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Outline

- Brief Project Overview
- Approach (1-2 slides)
- Results/Accomplishments (1-3 slides)
- Validation Strategy/Results (1-2 slides)
- Algorithm/Product Maturity
- Issues/Risks & Work-Off Plans
- Schedule
- Research-to-Operations or Delivery Plan
- Resources

Overview

- Goal-
  - Provide paleoclimate data needed to understand and predict climate change, extend instrumental record
- Source- Data published in journals
- Deliverables
  - Abrupt climate change data archive, transient simulations
  - Paleo Climate Network v1.0, Temperature of the last 2,000yr
- ECVs
  - Raw data incl. oxygen isotope ratios, tree ring width
  - EVC's include temperature, precipitation, pressure
- User communities
  - Paleoclimate scientists
  - Non-paleo climate scientists, environmental scientists
  - Decision-makers, staffers, NGO
  - Educators and curious citizens

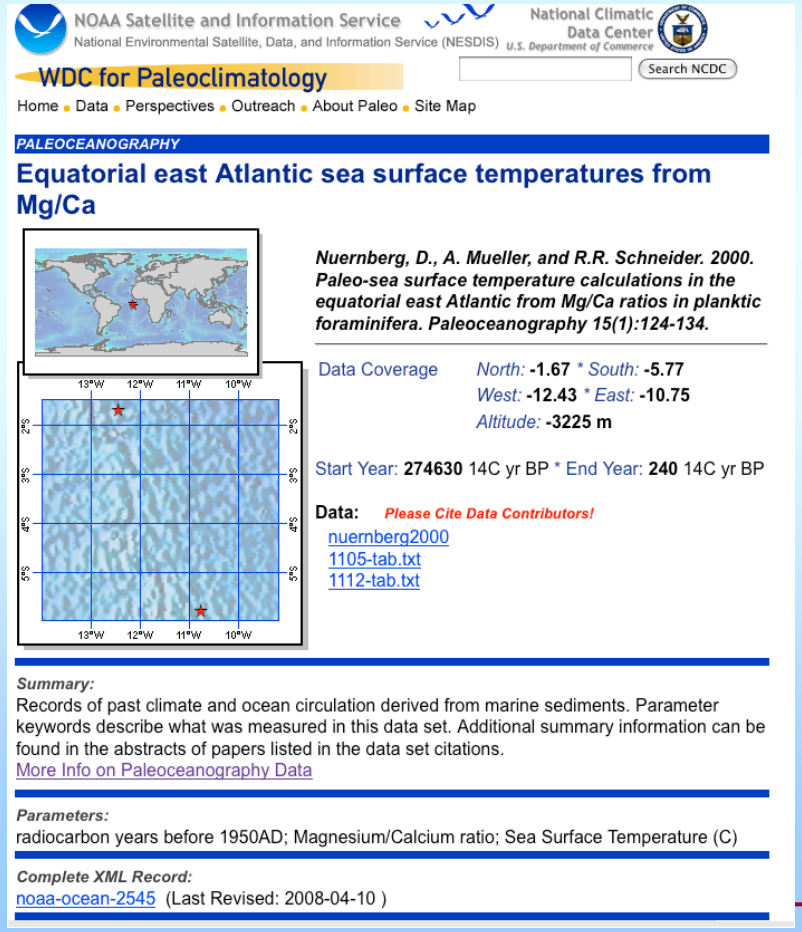
Approach: What do we actually do?

Step 1: Work with partners to identify data sets, request data (Carrie, Gene)

Step 2: Receive data, add sufficient metadata to catalog and discover, format data

Step 3: Create products requested by community

Step 4: Put data on Internet, provide catalog, map, discovery tools (secondary audience!)



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WDC for Paleoclimatology

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PALEOCEANOGRAPHY

Equatorial east Atlantic sea surface temperatures from Mg/Ca

Nuernberg, D., A. Mueller, and R.R. Schneider. 2000. Paleo-sea surface temperature calculations in the equatorial east Atlantic from Mg/Ca ratios in planktic foraminifera. Paleoceanography 15(1):124-134.

Data Coverage
North: **-1.67** * *South:* **-5.77**
West: **-12.43** * *East:* **-10.75**
Altitude: **-3225 m**

Start Year: **274630** 14C yr BP * End Year: **240** 14C yr BP

Data: *Please Cite Data Contributors!*
nuernberg2000
1105-tab.txt
1112-tab.txt

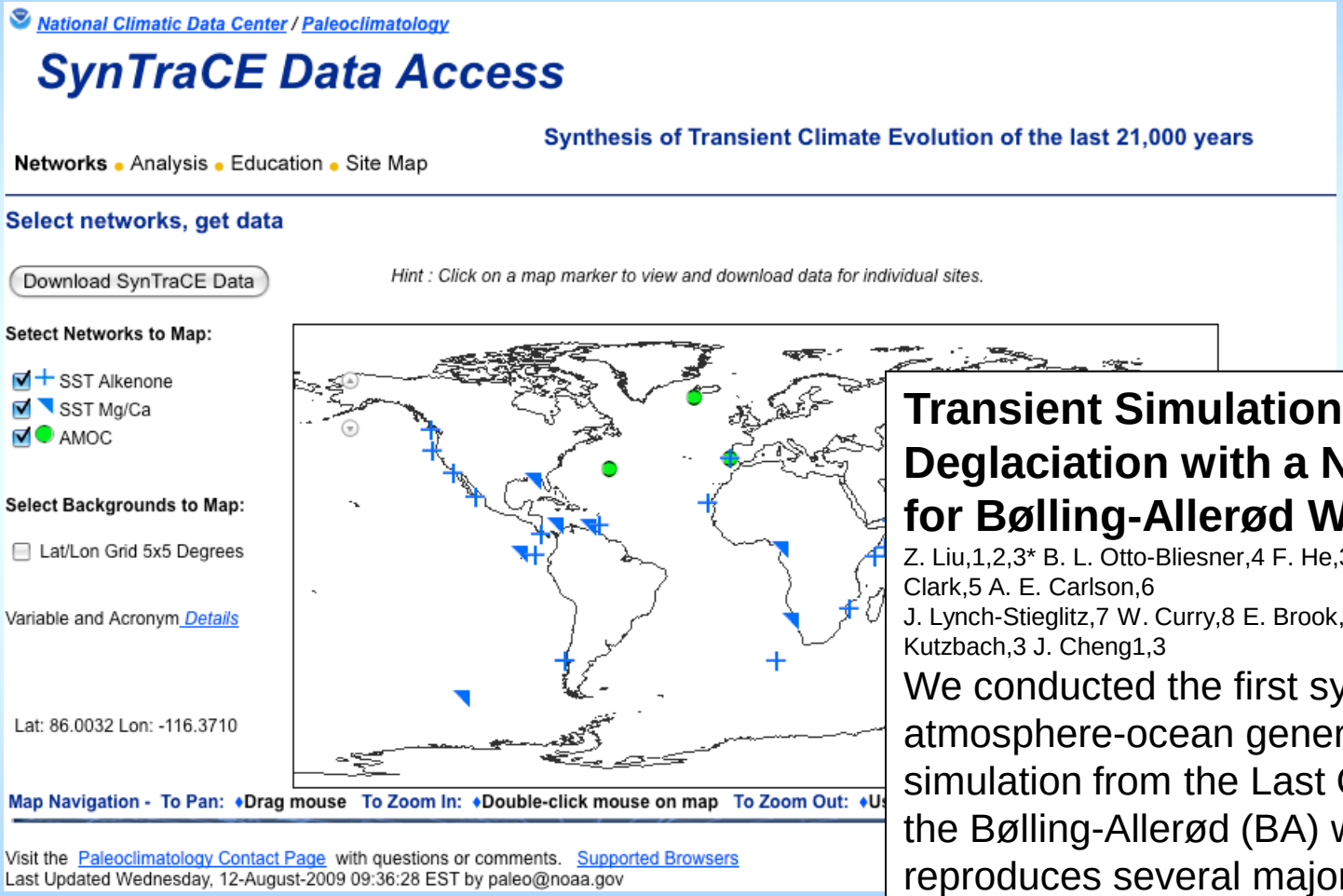
Summary:
Records of past climate and ocean circulation derived from marine sediments. Parameter keywords describe what was measured in this data set. Additional summary information can be found in the abstracts of papers listed in the data set citations.
More Info on Paleoceanography Data

Parameters:
radiocarbon years before 1950AD; Magnesium/Calcium ratio; Sea Surface Temperature (C)

Complete XML Record:
noaa-ocean-2545 (Last Revised: 2008-04-10)

```
# NOAA Paleoclimatology Program - Paleocean Site Data
# 1105-fwc.txt
# File Created: 18-Jan-2005
#**************************************************************
# Please cite the contributor and the original publications whe
#**************************************************************
# PI:             Dirk Nuernberg
# Core/Site:      1105
# Latitude:       1.39.54S          ( -1.665)
# Longitude:      12.25.42W         ( -12.42833)
# Water Depth(m): 3225
# Publications:
#   Nuernberg, D., A. Mueller, and R.R. Schneider. 2000. Paleo-
#     calculations in the equatorial east Atlantic from Mg/Ca r
#     Paleoceanography 15(1):124-134.
#-----------------
# Description & Notes:
#   Equatorial east Atlantic sea surface temperatures from Mg/C
#   Relative standard deviation is < 1% for Mg and Ca, the rela
# Variables:
#             depth         Depth (cm)
#             yrBP          radiocarbon years B.P. (Libby half-
#             Mg/Ca         Magnesium/Calcium ratio
#             sst           Sea Surface Temperature (C)
# CORE: 1105
depth         yrBP          Mg/Ca         sst
 1             240           3.214         24.73867
 4             960           2.969         23.69479
 13            3120          3.063         24.10514
 38            8790          3.282         25.01431
```

Results: Abrupt Climate Change



Science
August 17, 2009

Transient Simulation of Last Deglaciation with a New Mechanism for Bølling-Allerød Warming

Z. Liu,1,2,3* B. L. Otto-Bliesner,4 F. He,3 E. C. Brady,4 R. Tomas,4 P. U. Clark,5 A. E. Carlson,6
J. Lynch-Stieglitz,7 W. Curry,8 E. Brook,5 D. Erickson,9 R. Jacob,10 J. Kutzbach,3 J. Cheng1,3

We conducted the first synchronously coupled atmosphere-ocean general circulation model simulation from the Last Glacial Maximum to the Bølling-Allerød (BA) warming. Our model reproduces several major features of the deglacial climate evolution, suggesting a good agreement in climate sensitivity between the model and observations…

Results: Paleo Climate Network v1.0

data available.. pap

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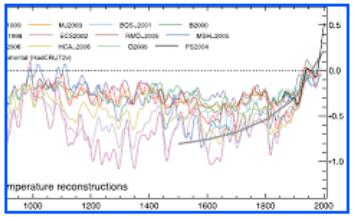
NOAA Paleoclimatology Reconstructions Network



IPCC Figure 6-10b, comparing published annual temperature reconstructions. Click image for full figure.

NOAA Paleoclimatology has released the first product of its Paleoclimate Network (PCN), including 92 high-resolution temperature records over the past 2+ millennia in its archive. These records include global, hemispheric, regional, and local reconstructions, generally with annual time-step resolution. The records come with many categories of metadata, including complete citations to original publications, seasonal period reconstructed (when applicable), anomaly period (if reconstructions are anomalies), latitude/longitude coverage, and URLs to the original NOAA Paleoclimate web pages from which the data were drawn. Each record is available as a separate ASCII file with fixed header and data formats, allowing machine reading of the data and time-step information. All the records together are also available in netCDF, ASCII, and Excel formats, including the complete metadata within the files themselves. The netCDF format version is provided in two files, the first with each record represented as a separate variable and the second as a time-by-study array in which each record is represented as a component of the study dimension. Sample scripts to open the netCDF versions in the R programming environment are also provided.

Download data from the NOAA/WDC Paleo archive:

Data Description and Format, Paleoclimate Network of 92 temperature reconstructions in Text, Excel, netCDF and netCDF as time-by-study array formats. Sample scripts to open the netCDF versions in the R programming environment are also provided.

92 Individual temperature reconstruction time series files from the 46 published papers listed below are also available in text format. File names consist of lead author's name and year of publication. Another way to view the individual files is via the PCN Study Index. This page lists all the studies with bounding latitude/longitude, timespan and investigators.

The Holocene 19,1 (2009) pp. 3–49

High-resolution palaeoclimatology of the last millennium: a review of current status and future prospects

P.D. Jones,[1]* K.R. Briffa,[1] T.J. Osborn,[1] J.M. Lough,[2] T.D. van Ommen,[3] B.M. Vinther,[4] J. Luterbacher,[5] E.R. Wahl,[6] F.W. Zwiers,[7] M.E. Mann,[8] G.A. Schmidt,[9] C.M. Ammann,[10] B.M. Buckley,[11] K.M. Cobb,[12] J. Esper,[13] H. Goosse,[14] N. Graham,[15] E. Jansen,[16] T. Kiefer,[17] C. Kull,[18] M. Küttel,[5] E. Mosley-Thompson,[19] J.T. Overpeck,[20] N. Riedwyl,[5] M. Schulz,[21] A.W. Tudhope,[22] R. Villalba,[23] H. Wanner,[5] E. Wolff[24] and E. Xoplaki[5]

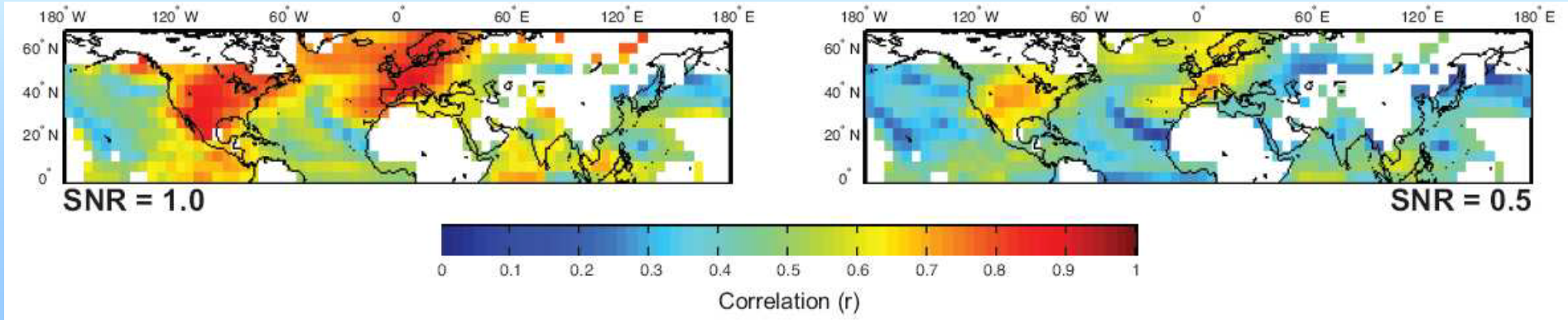
([1]Climatic Research Unit, School of Environmental Sciences, University of East Anglia, Norwich NR4 7TJ, UK; [2]Australian Institute of Marine Science, Townsville MC, QLD 4810, Australia; [3]Australian Antarctic Division & ACE CRC, Private Bag 80, Hobart Tasmania 7001, Australia; [4]Centre for Ice and Climate, Niels Bohr Institute, University of Copenhagen, Juliane Maries Vej 30, DK-2100 Copenhagen Ø, Denmark; [5]Oeschger Centre for Climate Change Research (OCCR) and NCCR Climate and Institute of Geography, Climatology and Meteorology, University of Bern, Hallerstrasse 12, CH-3012 Bern, Switzerland; [6]Division of Environmental Studies and Geology, Alfred University, NOAA-Paleoclimatology, Boulder CO 80305, USA; [7]Climate Research Division, Environment Canada, 4905 Dufferin Street, Toronto Ont. M3H 5T4, Canada; [8]Earth System Science Center, Department of Meteorology, Pennsylvania State University, 523 Walker Building, University Park PA 16802, USA; [9]NASA Goddard Institute for Space Studies, 2880 Broadway, New York NY 10025, USA; [10]Climate & Global Dynamics Division, NCAR, Boulder CO 80307-3000, USA; [11]Tree-Ring Laboratory, Lamont-Doherty Earth Observatory, Palisades, New York NY 10964, USA; [12]School of Earth and Atmospheric Sciences, Georgia Institute of Technology, 311 Ferst Drive, Atlanta GA 30332-0340, USA; [13]Swiss Federal Research Institute WSL, Zürcherstrasse 111, CH-8903 Birmensdorf, Switzerland; [14]Institut dAstronomie et de Géophysique G. Lemaître, Université Catholique de Louvain, Chemin du cyclotron 2, 1348 Louvain-la-Neuve, Belgium; [15]Hydrologic Research Center, 12780 High Bluff Drive, ú, La Jolla CA 92130-3017, USA; [16]Department of Geology, University of Bergen, Bjerknes Centre for Climate Research, Allegaten 55, NO-5007 Bergen, Norway; [17]PAGES International Project Office, Sulgeneckstrasse 38, 3007 Bern, Switzerland; [18]Advisory Body on Climate Change (OcCC), Schwarztorstrasse 9, CH-3007 Bern, Switzerland; [19]Department of Geography and Byrd Polar Research Center, Ohio State University, 108 Scott Hall, 1090 Carmack Road, Columbus OH 43210, USA; [20]Institute for the Study of Planet Earth, University of Arizona, 715 N. Park Avenue, 2nd Floor, Tucson AZ 85721, USA; [21]MARUM – Center for Marine Environmental Sciences and Faculty of

10.1177/0959683608098952

Validation in Paleoclimatology

- Multiple proxies, replicate data
- Comparison with model simulation

Comparisons between temperature reconstructions and the known model temperature (850-1855) AD. Correlations like this show the effect of paleo data network density (best over North America and Europe) as well as the effect of noise on our ability to reconstruct the past millennium.



Product Maturity

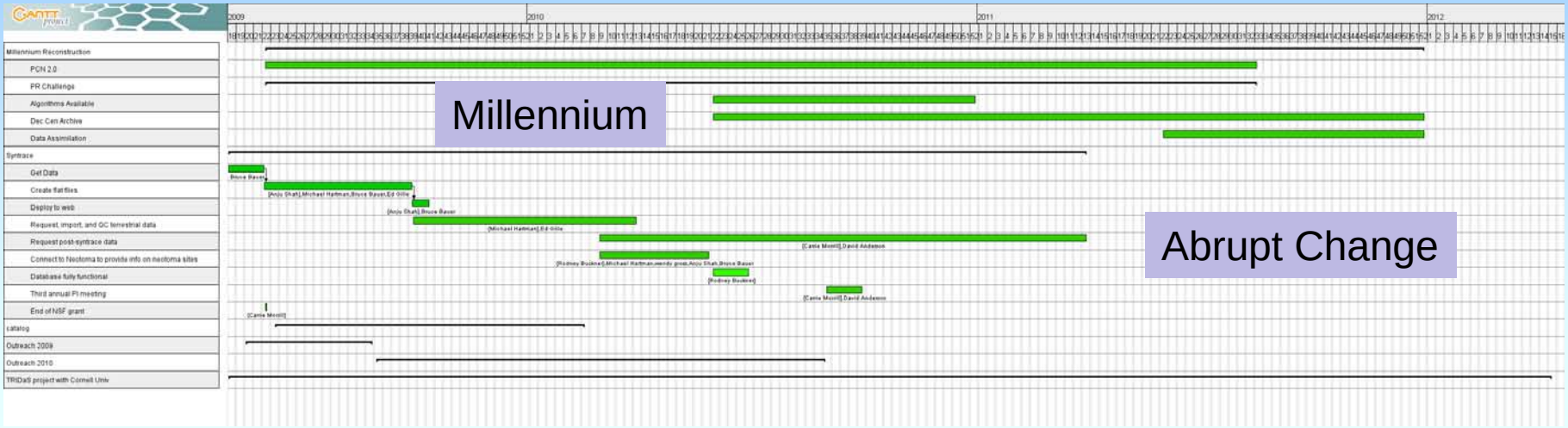
<Please fill in cells as appropriate; Best guess/estimates acceptable; See Example>

Maturity	Sensor Use	Algorithm stability	Metadata & QA	Documentation	Validation	Public Release	Science & Applications
1	Research Mission	Significant changes likely	Incomplete	Draft ATBD	Minimal	Limited data availability to develop familiarity	Little or none
2	Research Mission	Some changes expected	Research grade (extensive)	ATBD Version 1+	**Uncertainty estimated for select locations/times**	**Data available but of unknown accuracy; caveats required for use.**	Limited or ongoing
3	Research Missions	Minimal changes expected	Research grade (extensive); Meets international standards	Public ATBD; Peer-reviewed algorithm and product descriptions	Uncertainty estimated over widely distribute times/location by multiple investigators; Differences understood.	Data available but of unknown accuracy; caveats required for use.	Provisionally used in applications and assessments demonstrating positive value.
4	**Operational Mission**	**Minimal changes expected**	Stable, Allows provenance tracking and reproducibility; Meets international standards	Public ATBD; Draft Operational Algorithm Description (OAD); Peer-reviewed algorithm and product descriptions	Uncertainty estimated over widely distribute times/location by multiple investigators; Differences understood.	Data available but of unknown accuracy; caveats required for use.	Provisionally used in applications and assessments demonstrating positive value.
5	All relevant research and operational missions; unified and coherent record demonstrated across different sensors	Stable and reproducible	Stable, Allows provenance tracking and reproducibility; Meeting international standards	Public ATBD, Operational Algorithm Description (OAD) and Validation Plan; Peer-reviewed algorithm, product and validation articles	Consistent uncertainties estimated over most environmental conditions by multiple investigators	Multi-mission record is publicly available with associated uncertainty estimate	Used in various published applications and assessments by different investigators
6	All relevant research and operational missions; unified and coherent record over complete series; record is considered scientifically irrefutable following extensive scrutiny	Stable and reproducible; homogeneous and published error budget	**Stable, Allows provenance tracking and reproducibility; Meeting international standards**	**Product, algorithm, validation, processing and metadata described in peer-reviewed literature**	Observation strategy designed to reveal systematic errors through independent cross-checks, open inspection, and continuous interrogation	Multi-mission record is publicly available from Long-Term archive	**Used in various published applications and assessments by different investigators**

Issues/Risks

- 'Need more data' (NRC, 2006)
  - The evidence (trees, sediments, coral) is out there
  - Field is grossly under-funded ($12M per year from NSF) compared to other efforts ($120M).
  - *Decadal challenge is worth it..*
- Partners want exclusive use
  - As we get closer to evolving/ cutting edge, partners want a data moratorium to provide exclusive use
  - Mostly model issue, but data too

Schedule



Millennium reconstructions
- PCN 1.0 (2009)
- PCN 2.0, includes field reconstructions (2010)
- PR Challenge (2011)
- Data Assimilation (2012)

Abrupt Climate Change
- Syntrace, transient runs, last 21,000 years (2011)
- New Paleo archive (2012)
- Additional transient runs archived (2012)

Resources

- Personnel=4
- Leveraging NCDC computers, technology
- Collaborators:
  - NSF "Syntrace" Project (n=25)
  - NSF "Paleoclimate Reconstruction Challenge (n=50), International Past Global Changes Project (n=500)
- NOAA point-of-contact
  - David Anderson, NCDC
- Target NOAA Data Center NCDC
  - *Metadata available for geospatial one stop, others*