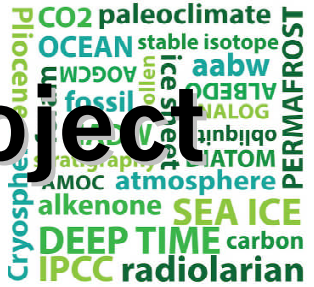
US Geological Survey PRISM Project

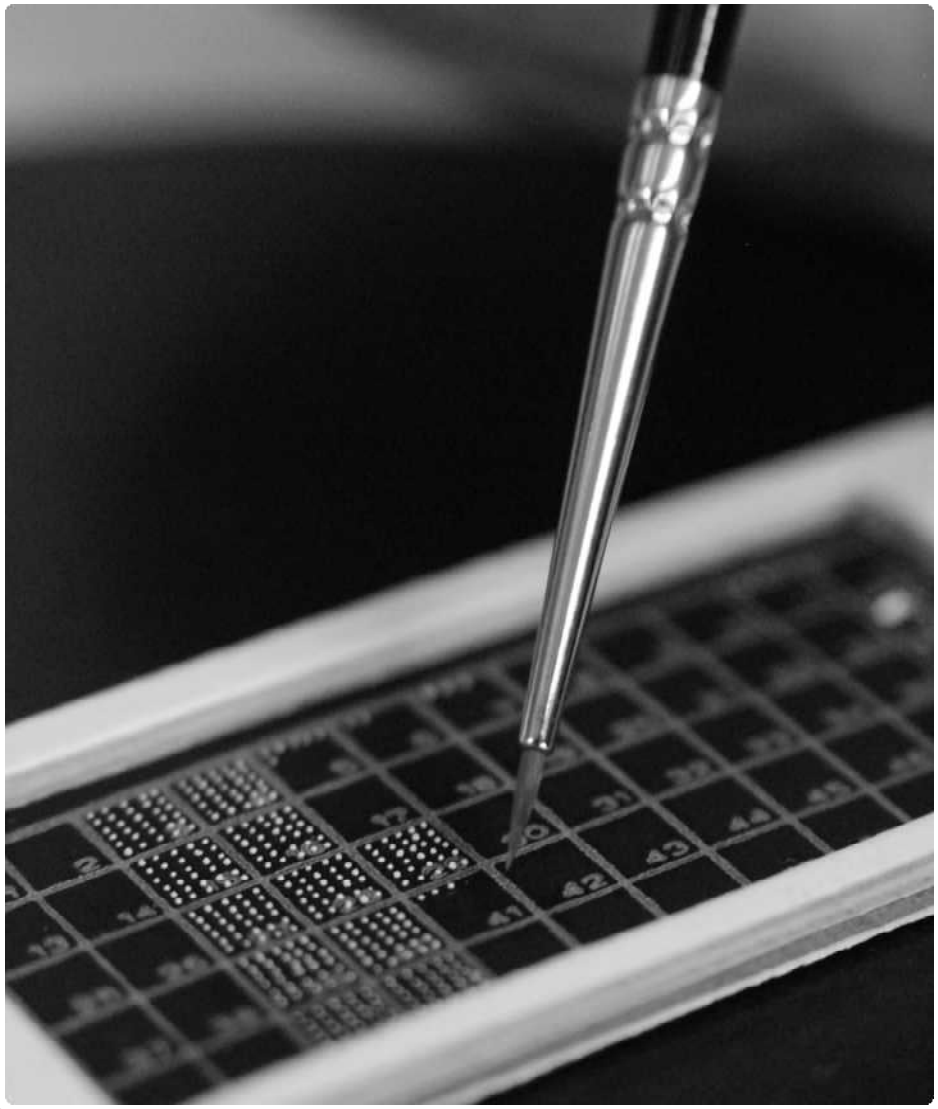


Pliocene Paleoclimate Research

Harry J. Dowsett

USGS science for a changing world

U.S. Geological Survey | Reston, VA
Eastern Geology & Paleoclimate Science Center



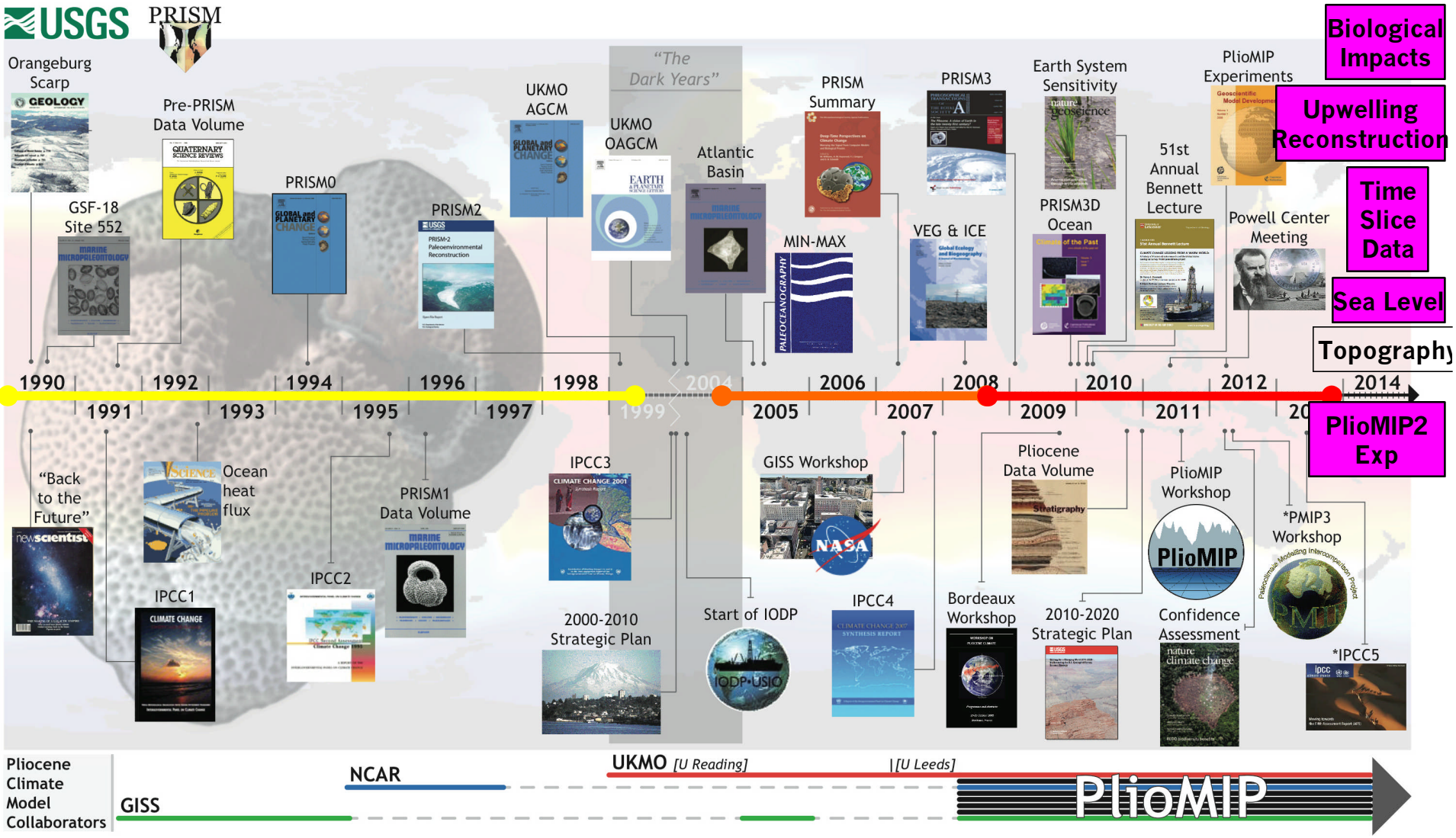
Northumbria/GMU

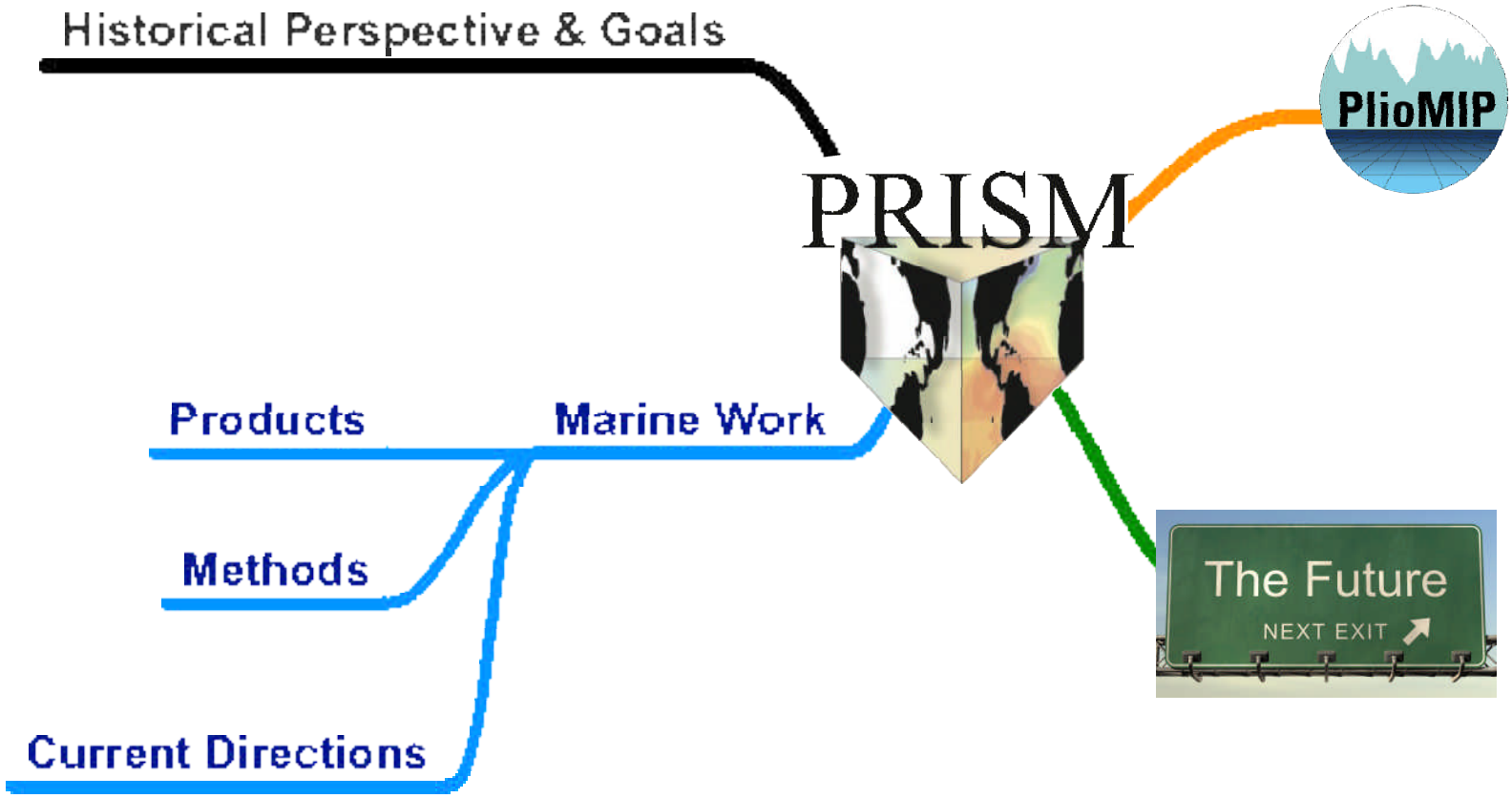
PRISM/PlioMIP Collaboration

Pliocene Research, Interpretation and Synoptic Mapping Project
Pliocene Model Intercomparison Project

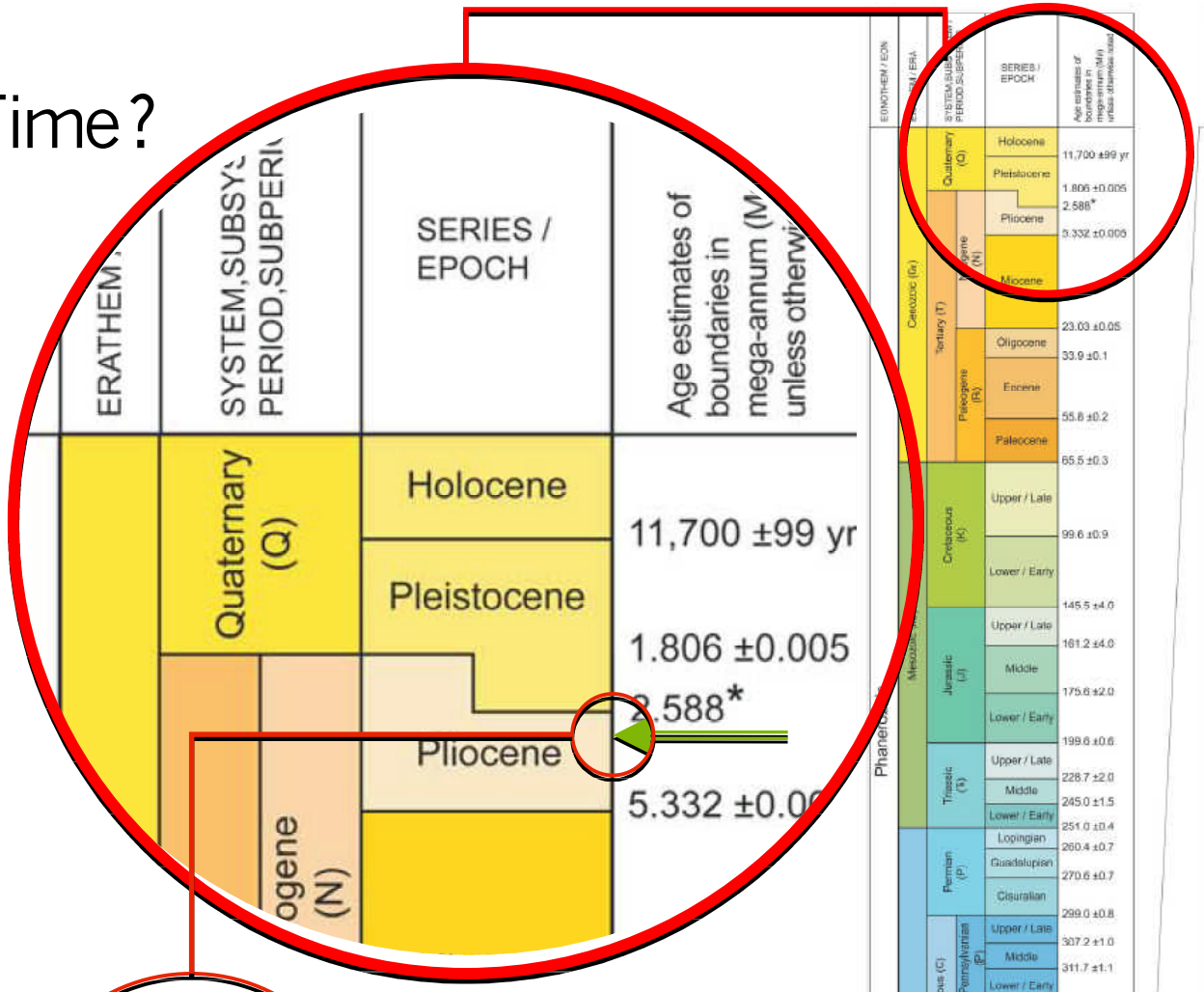
Pliocene Research, Interpretation & Synoptic Mapping

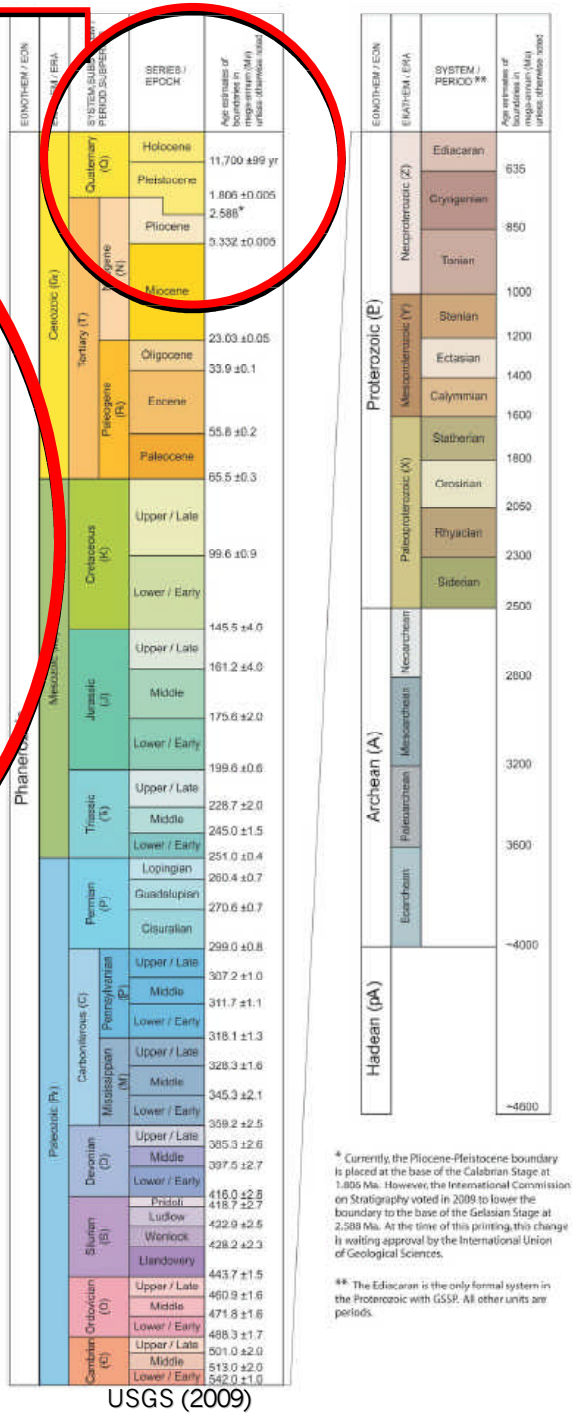
PRISM History




Historical Perspective & Goals
PRISM
PlioMIP
Products
Marine Work
Methods
Current Directions
The Future
NEXT EXIT

Deep Time?





* Currently, the Pliocene-Pleistocene boundary is placed at the base of the Calabrian Stage at 1.806 Ma. However, the International Commission on Stratigraphy voted in 2009 to lower the boundary to the base of the Gelasian Stage at 2.588 Ma. At the time of this printing, this change is waiting approval by the International Union of Geological Sciences.

** The Ediacaran is the only formal system in the Proterozoic with GSSP. All other units are periods.

USGS (2009)

General theme of Soviet Era authors. . .

the Arctic ice is a great disadvantage, as are the permanently frozen soil (permafrost), dust storms, dry winds, water shortages in the deserts, etc. if we want to improve our planet and make it more suitable for life, we must alter its climate.

Geoengineering?

(Rusin & Flit, 1960)

Dam the Bering Straights, pump Arctic water to Pacific

Divert major rivers away from Arctic to central Asia

Accelerate the Greenhouse Effect

The US Advanced Research Projects Agency (ARPA) had a classified program Nile Blue investigating National Security implications of deliberate or inadvertant climate modification by the Soviets.

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Events leading to the National Climate Program in 1987

- **1970s** Budyko suggested reconstructions of Late Cen… (Eemian, Pliocene, Miocene, Eocene) climatic optima as palaeoanalogues for 21st century climate

  ↑CO_2 **in the past meant warmer conditions**

- **Early 1980s** State of climate predictions was *less* than encouraging to U.S. policy makers

- **1982** NAS suggested new deep time synoptic reconstructions were necessary

- **1988** USGS began its **Warm Pliocene Project** to produce a better synoptic view of the Pliocene; NASA agreed to model Pliocene climate using
  USGS boundary conditions

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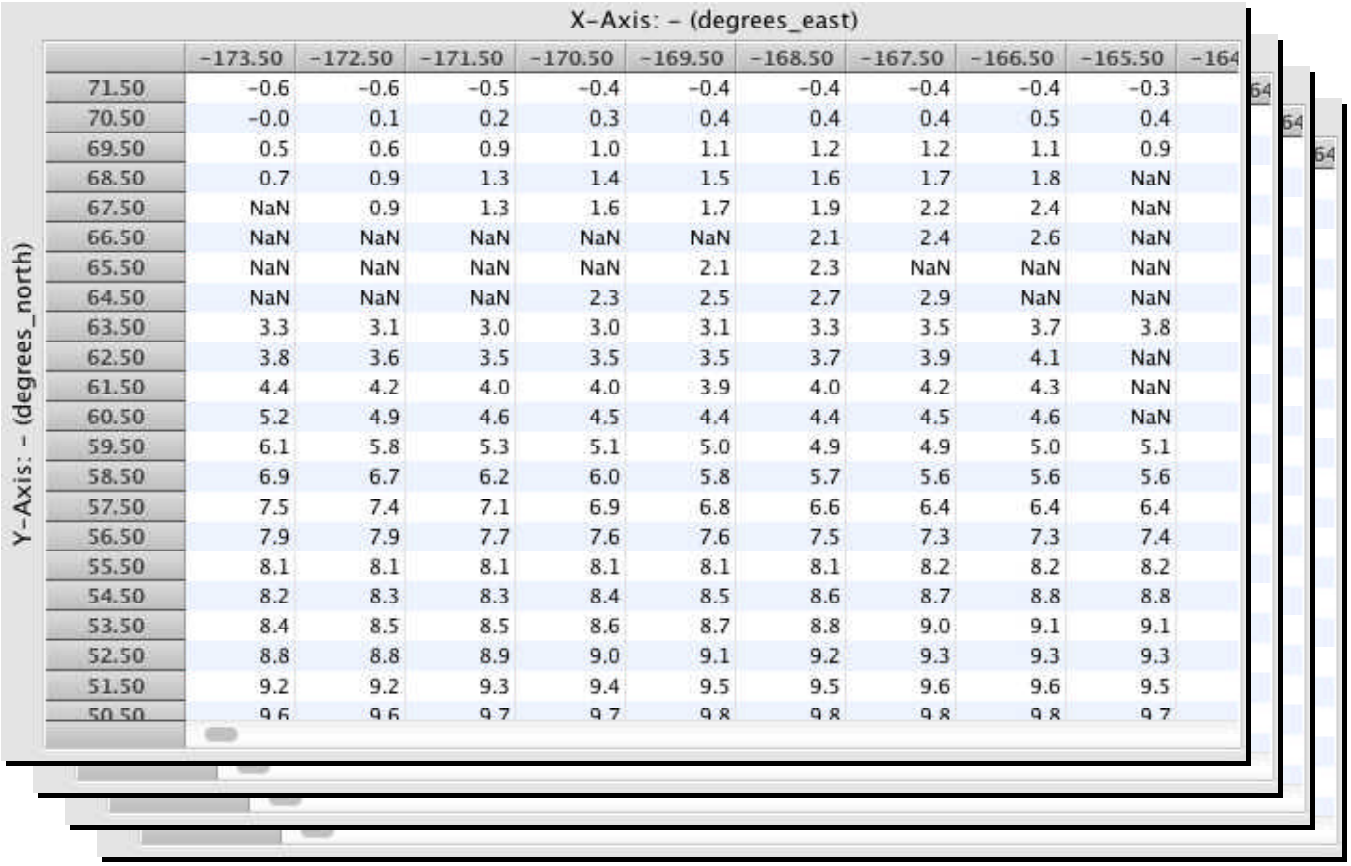
PRISM Goals

1. Reconstruct the Pliocene paleoenvironment to better understand the most recent interval of *Global Warmth* similar to that projected for the end of the 21st Century.

PRISM Goals

2. Provide digital data sets of boundary conditions that can be used to *initialize* and *verify* [Pliocene] paleoclimate simulations.



X-Axis: – (degrees_east)

Y-Axis: – (degrees_north)	–173.50	–172.50	–171.50	–170.50	–169.50	–168.50	–167.50	–166.50	–165.50	–164
71.50	–0.6	–0.6	–0.5	–0.4	–0.4	–0.4	–0.4	–0.4	–0.3	
70.50	–0.0	0.1	0.2	0.3	0.4	0.4	0.4	0.5	0.4	
69.50	0.5	0.6	0.9	1.0	1.1	1.2	1.2	1.1	0.9	
68.50	0.7	0.9	1.3	1.4	1.5	1.6	1.7	1.8	NaN	
67.50	NaN	0.9	1.3	1.6	1.7	1.9	2.2	2.4	NaN	
66.50	NaN	NaN	NaN	NaN	NaN	2.1	2.4	2.6	NaN	
65.50	NaN	NaN	NaN	NaN	2.1	2.3	NaN	NaN	NaN	
64.50	NaN	NaN	NaN	2.3	2.5	2.7	2.9	NaN	NaN	
63.50	3.3	3.1	3.0	3.0	3.1	3.3	3.5	3.7	3.8	
62.50	3.8	3.6	3.5	3.5	3.5	3.7	3.9	4.1	NaN	
61.50	4.4	4.2	4.0	4.0	3.9	4.0	4.2	4.3	NaN	
60.50	5.2	4.9	4.6	4.5	4.4	4.4	4.5	4.6	NaN	
59.50	6.1	5.8	5.3	5.1	5.0	4.9	4.9	5.0	5.1	
58.50	6.9	6.7	6.2	6.0	5.8	5.7	5.6	5.6	5.6	
57.50	7.5	7.4	7.1	6.9	6.8	6.6	6.4	6.4	6.4	
56.50	7.9	7.9	7.7	7.6	7.6	7.5	7.3	7.3	7.4	
55.50	8.1	8.1	8.1	8.1	8.1	8.1	8.2	8.2	8.2	
54.50	8.2	8.3	8.3	8.4	8.5	8.6	8.7	8.8	8.8	
53.50	8.4	8.5	8.5	8.6	8.7	8.8	9.0	9.1	9.1	
52.50	8.8	8.8	8.9	9.0	9.1	9.2	9.3	9.3	9.3	
51.50	9.2	9.2	9.3	9.4	9.5	9.5	9.6	9.6	9.5	
50.50	9.6	9.6	9.7	9.7	9.8	9.8	9.8	9.8	9.7	

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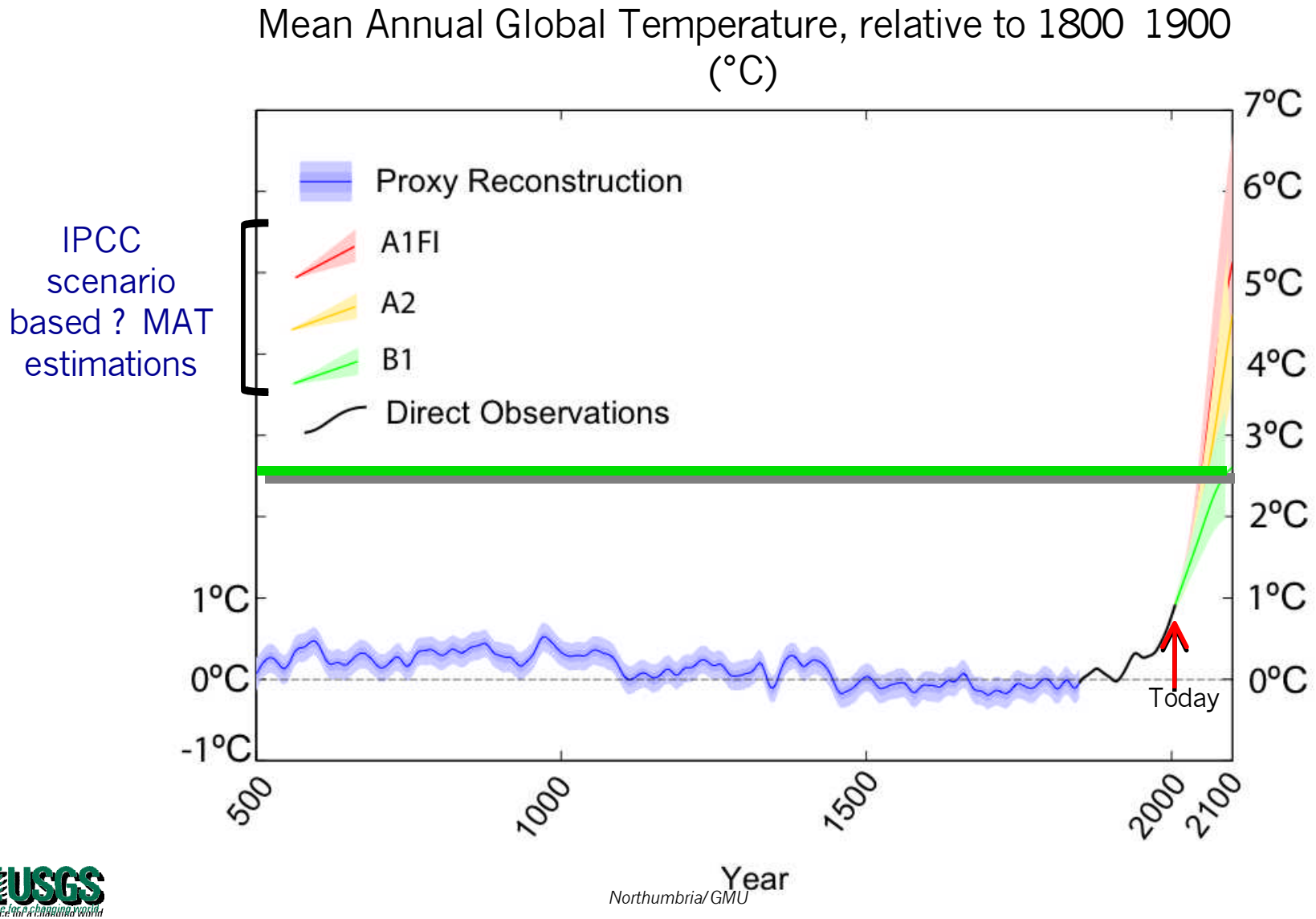
Why the Pliocene?
A future beyond our experience



800,000 year composite record of CO_2 variability from Antarctic ice cores

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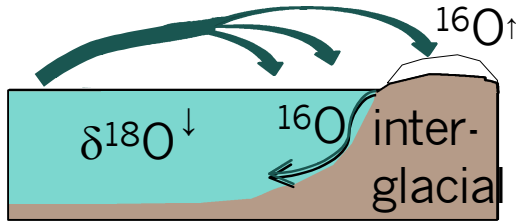
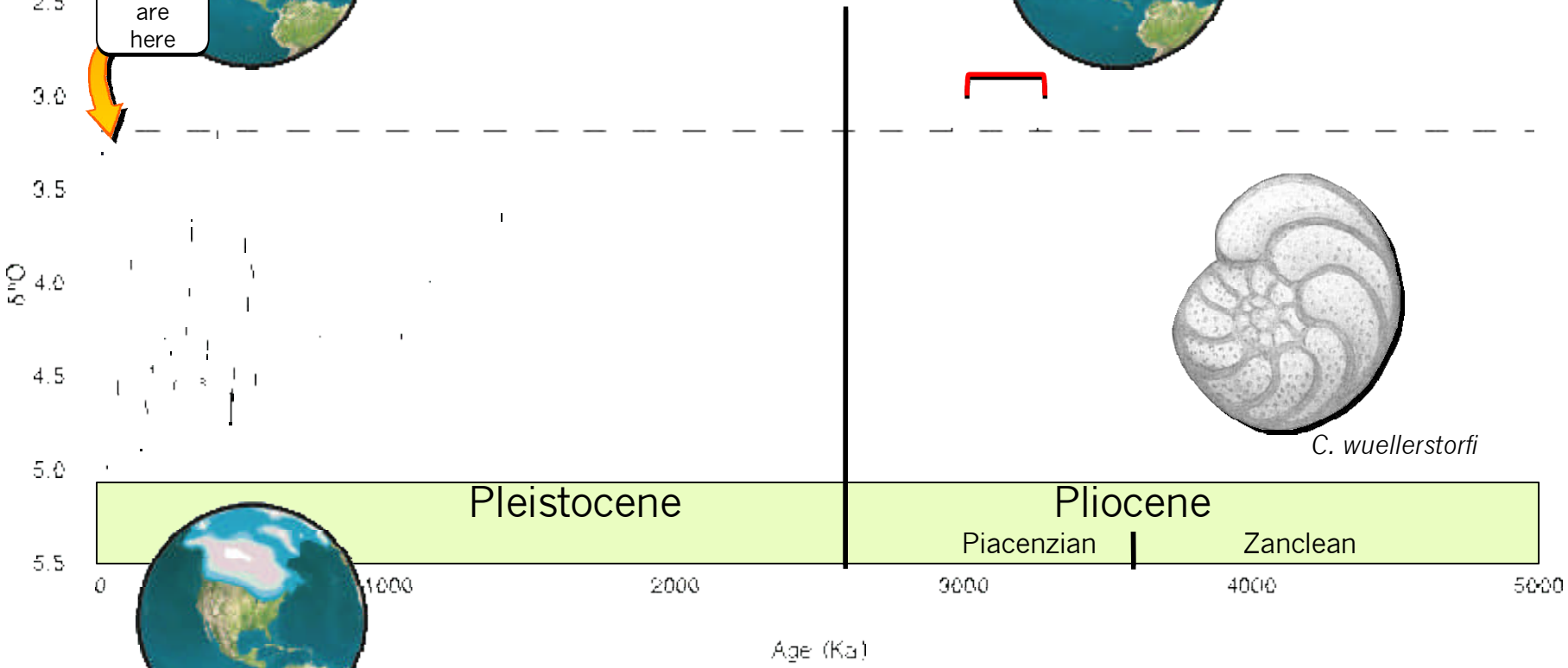
Benthic oxygen isotopes



Interglacial
(warm, less ice volume)

No NH ice



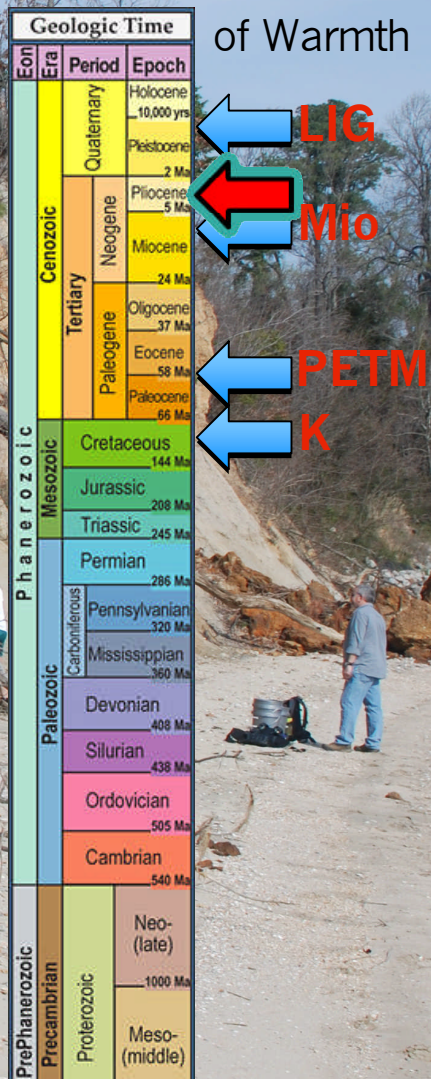
C. wuellerstorfi

Glacial
(cool, more ice volume)

Why the Pliocene?

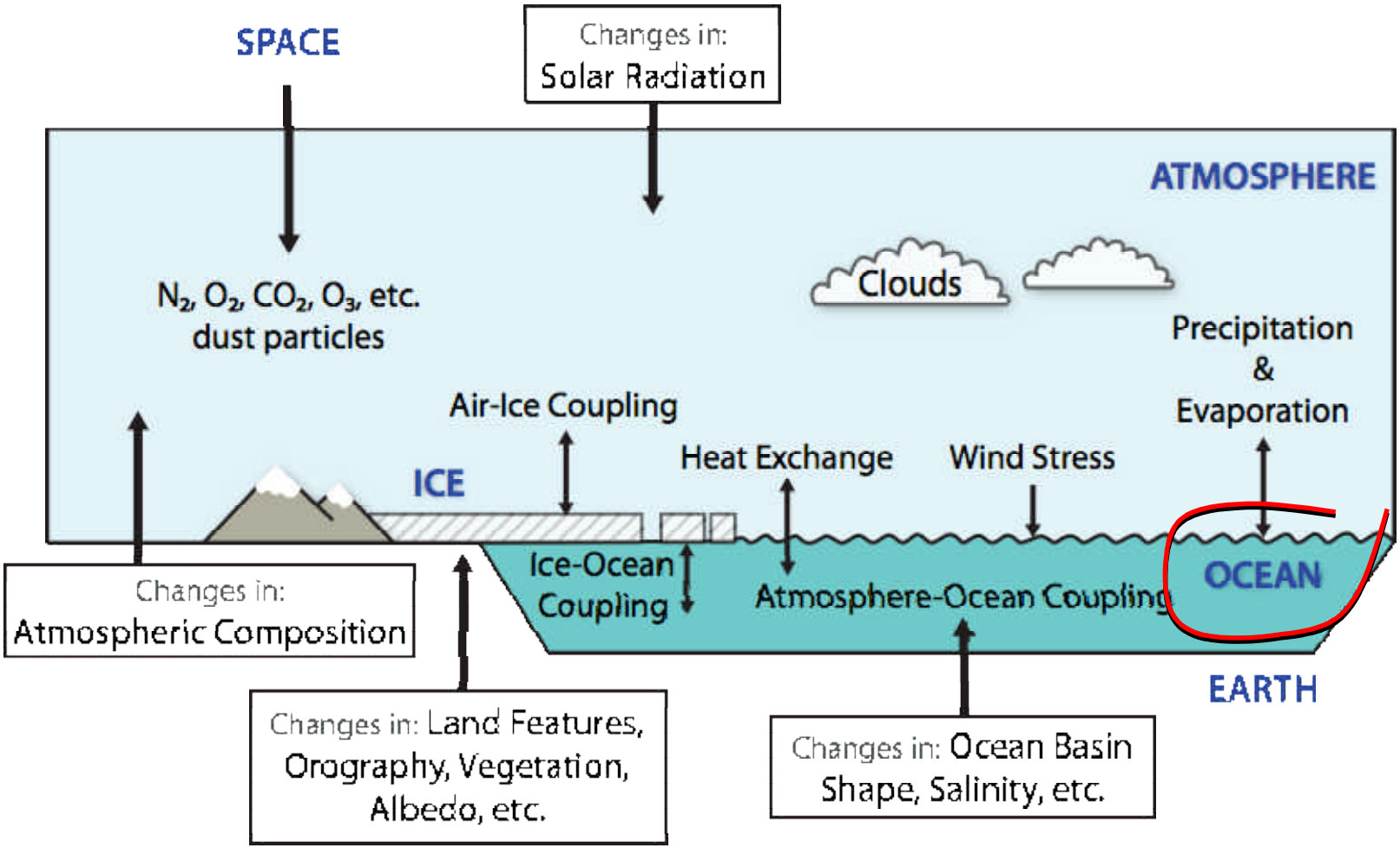
- The **PETM** was certainly warmer with more CO_2
  ~~Boundary conditions, methods~~
- The **LIG** is certainly more accessible
  ~~Not much different from today~~
- The **Pliocene** is a *compromise*: warming on the order of 2-3°C, boundary conditions mostly identical to present day, within reach of many of the proxy methods used for more recent climate reconstructions, biota extant

Intervals of Warmth

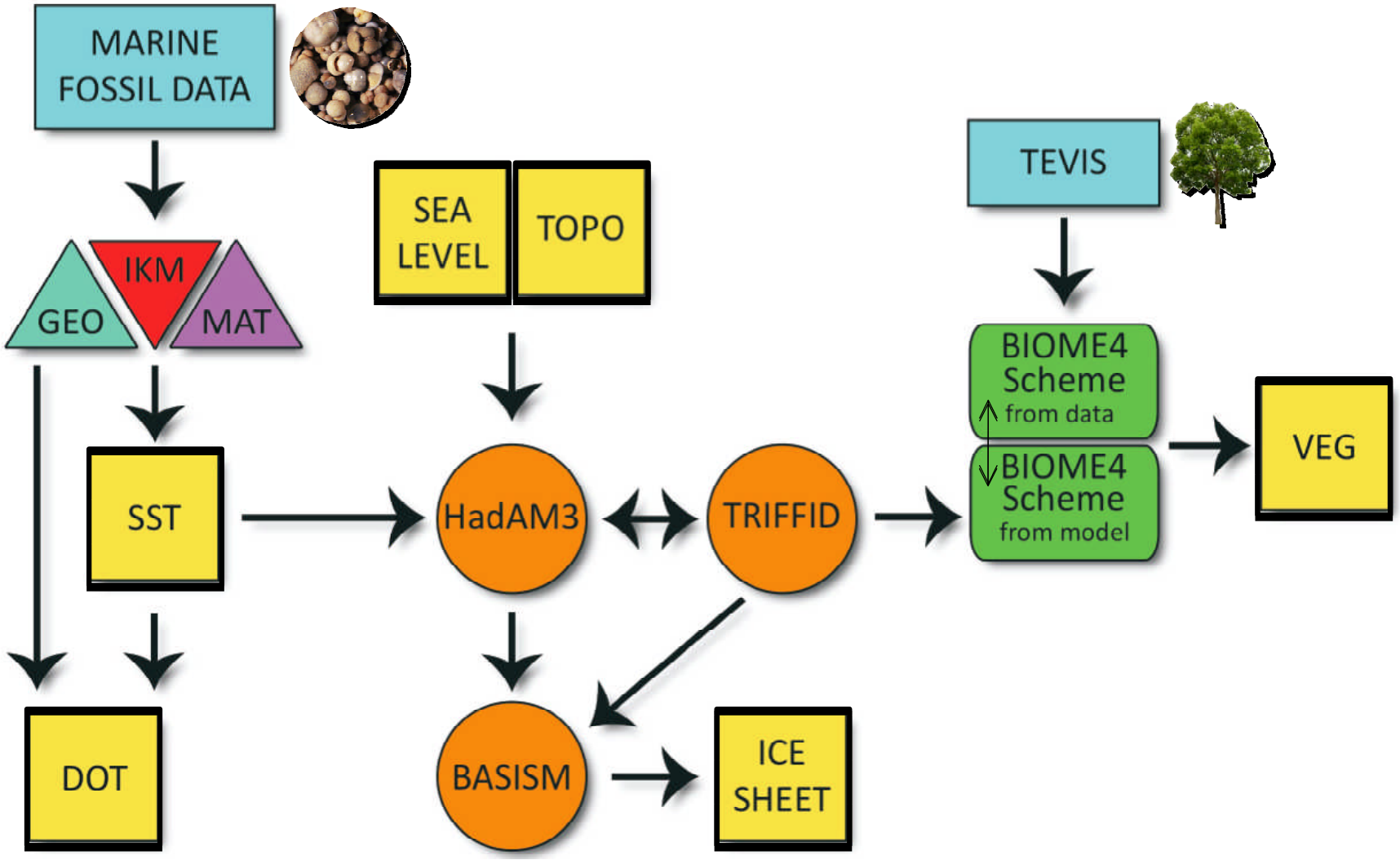


Pliocene Yorktown Formation, SE Virginia

Climate System boundary conditions



PRISM3 Data Model Scheme



(*Stratigraphy Dowsett et al., 2010*)