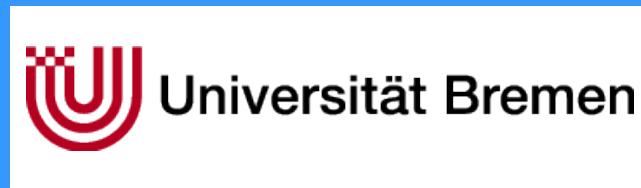


Helmholtz Research School Earth System Science

Paleoclimate Dynamics:

**Qualify the next generation of excellent
scientists for the challenging questions in
Earth System Science**



Helmholtz Research School Earth System Science

Paleoclimate Dynamics:

**Qualify the next generation of excellent
scientists for the challenging questions in
Earth System Science**



Paleoclimate Dynamics

Gerrit Lohmann

6. October 2008

- **Broaden the view of the climate system**
- **Interpretation of past environmental changes**
- **Data and Modelling**
- **Climate variability: North Atlantic Oscillation, El Niño – Southern Oscillation**

Paleoclimate Dynamics

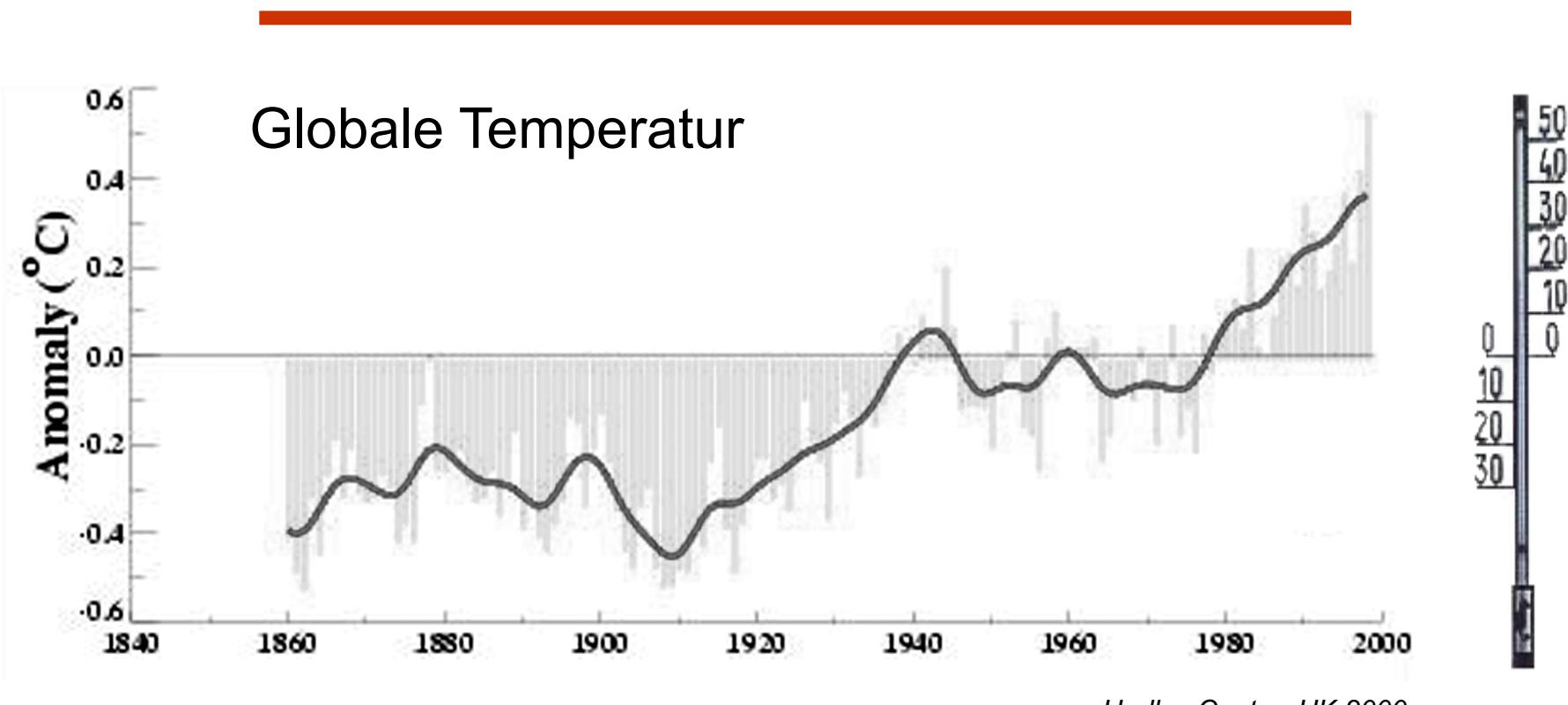
Gerrit Lohmann

6. October 2008

- **Broaden the view of the climate system**
- **Interpretation of past environmental changes**
- **Data and Modelling**
- **Climate variability: North Atlantic Oscillation, El Niño – Southern Oscillation**
- 2008: Overview
- 2009: Statistical Interpretation with practical units

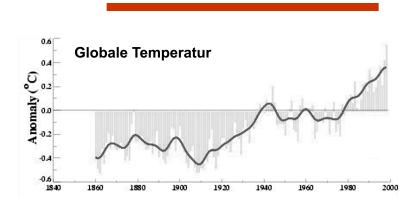
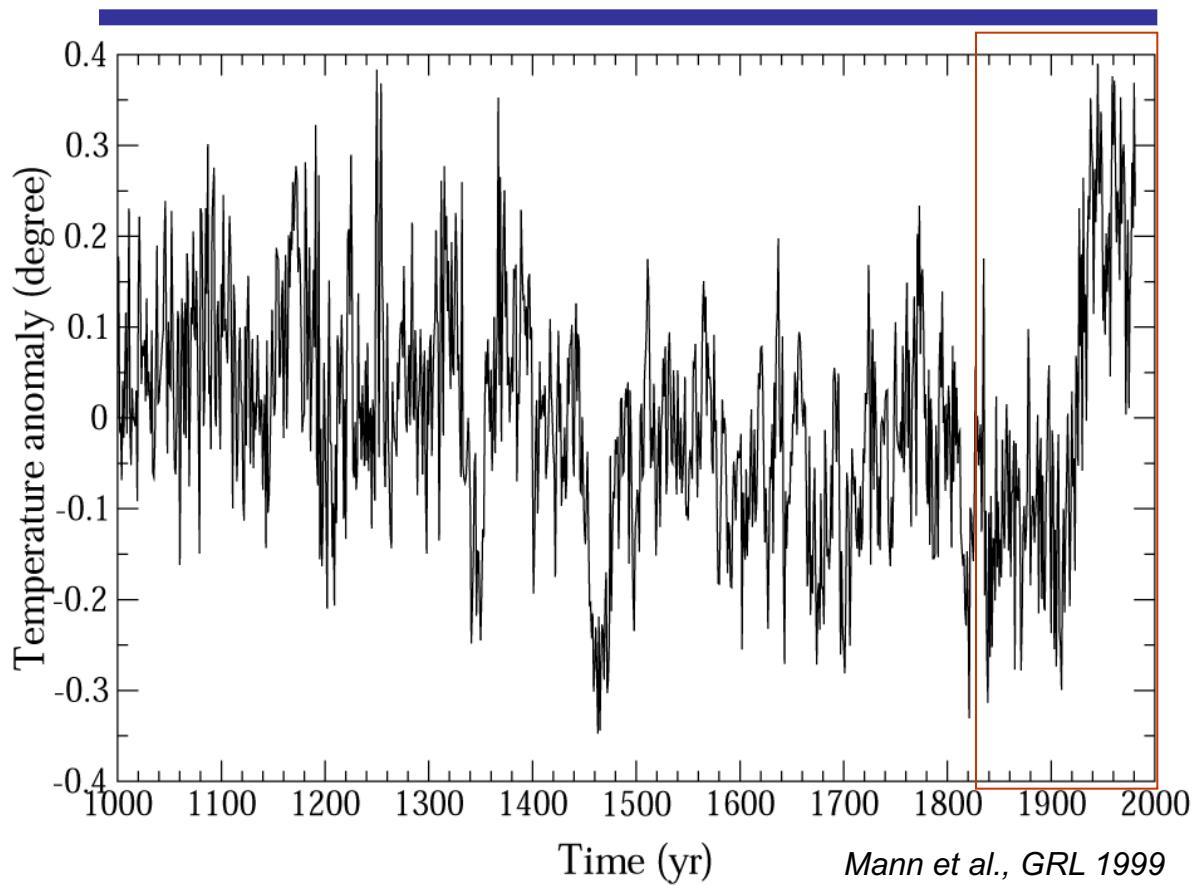
Klimatrends auf verschiedenen Zeitskalen

Temperatur der letzten **150 Jahre** (instrumentelle Periode)



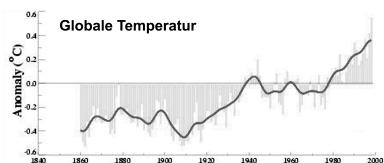
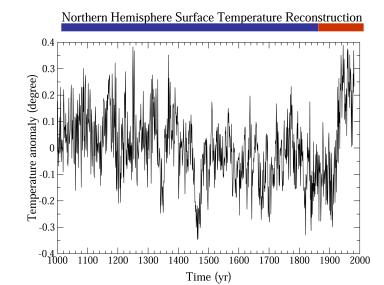
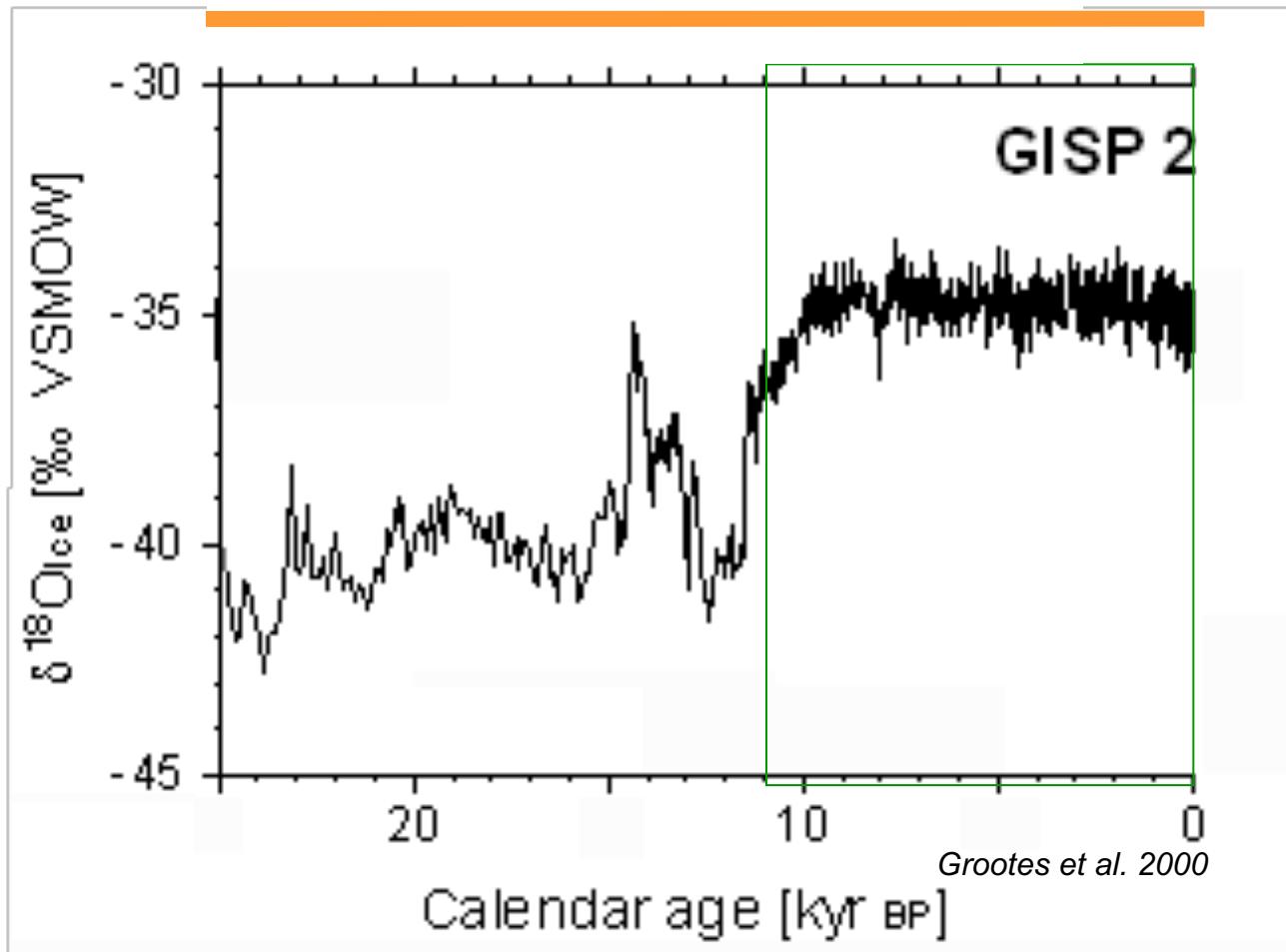
Klimatrends auf verschiedenen Zeitskalen

Temperatur der letzten **1000 Jahre**



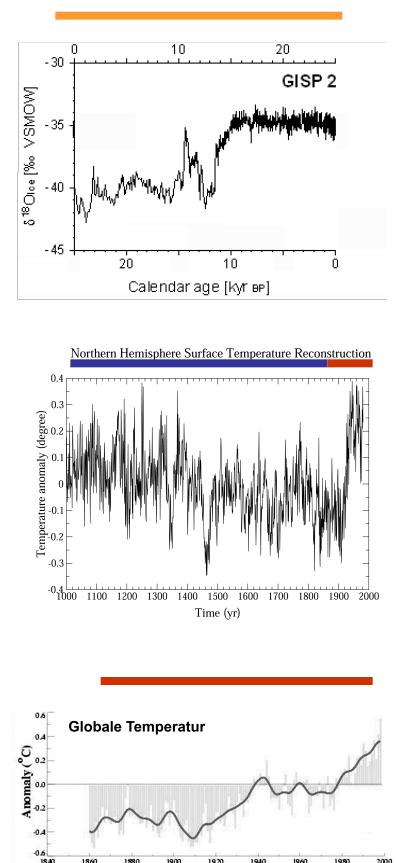
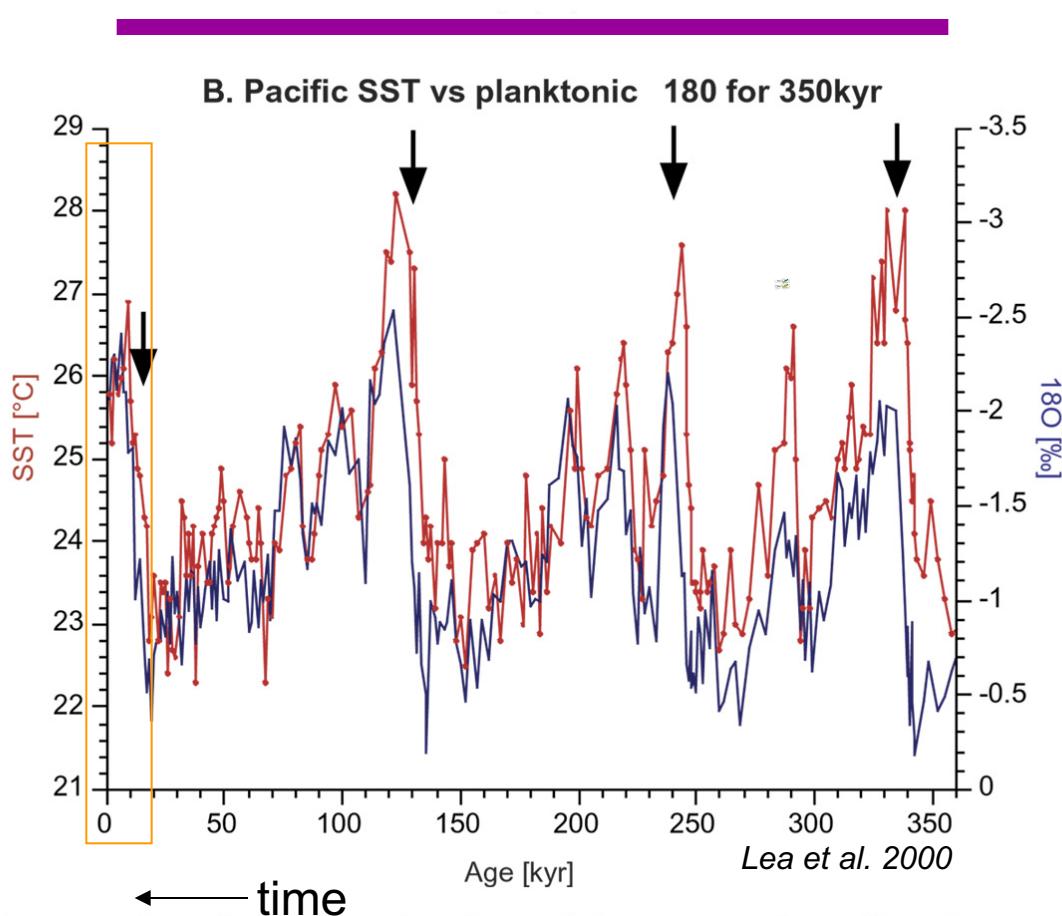
Klimatrends auf verschiedenen Zeitskalen

Grönländischer Eiskern

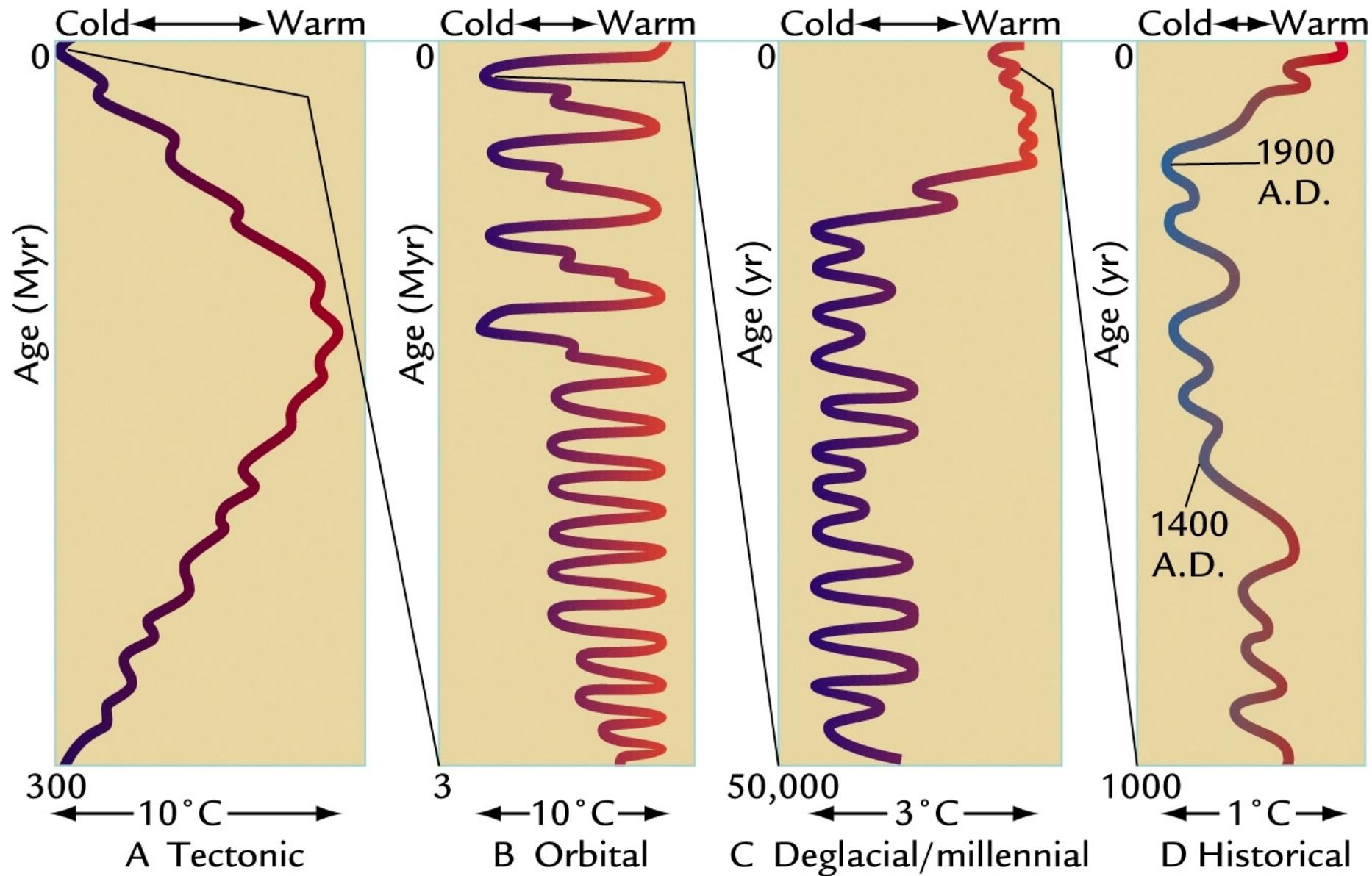


Klimatrends auf verschiedenen Zeitskalen

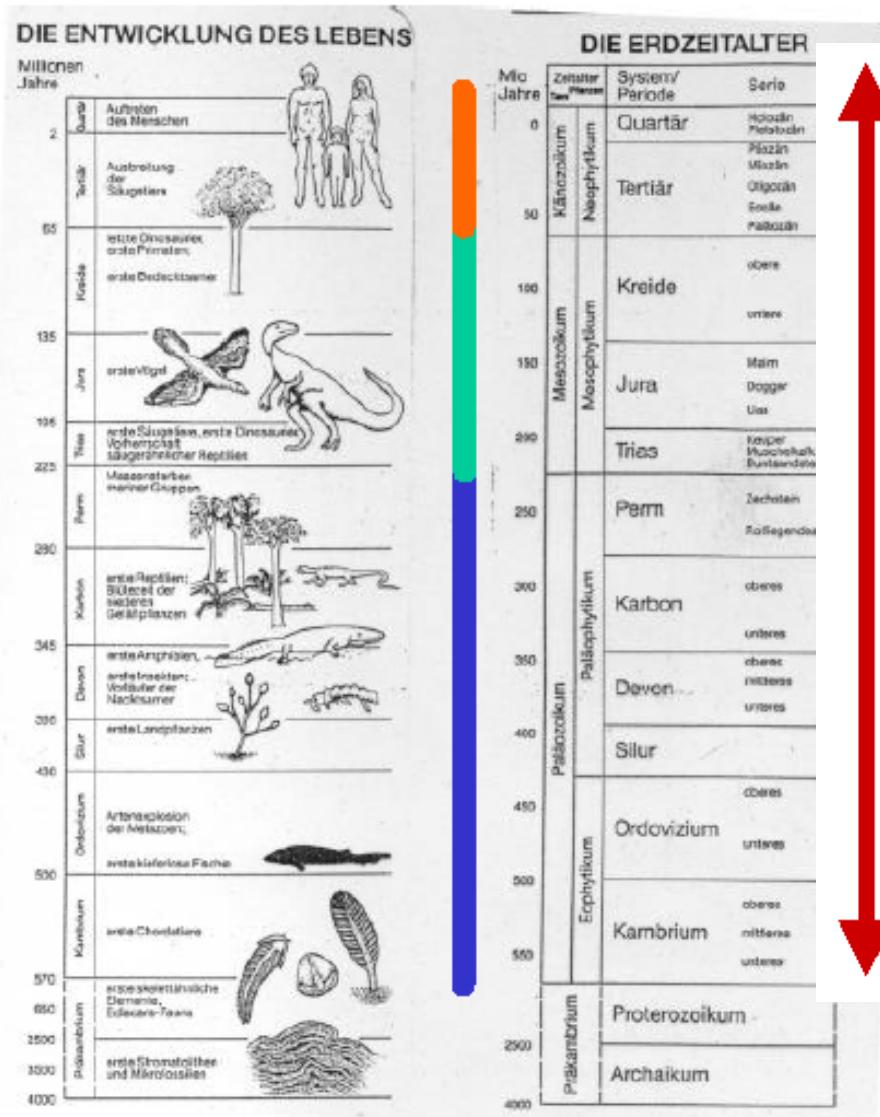
Eiszeitzyklen



Global temperature



Globale Klimaschwankungen



◆ 450 000 Jahre

Menschen seit
2 Millionen Jahren

4 Milliarden Jahre

Datenerfassung

- Anfänge physikalischer Messtechnik
 - ca. 1650 erste Luftdruckmessungen (Italien, Frankreich, Schweden)
 - 1654-1670 erste aufgezeichneten Lufttemperaturmessungen (Pisa)
 - 1677-1704 erste Niederschlagsmessreihen (England)
 - ca. 1700 erste Windmessungen in Deutschland (Leibniz)
- Vieljährige (lückenlose) Messreihen
 - Längste lückenlose und homogene Lufttemperaturmessreihe der Erde: „Zentral-England“-Reihe seit 1659
 - Längste Niederschlagsreihe: Kew (bei London) seit 1697
 - Längste Luftdruckreihe: De Built (Holland) seit 1740
 - Längste Windreihe: Hohenpeißenberg seit 1781

Collaborating Institutes



Paleoclimate Dynamics (G. Lohmann, K. Grosfeld)
Ocean Dynamics (D. Olbers, S. Danilov)
Glaciology (H. Fischer)
Geophysics (K. Gohl, G. Uenzelmann-Neben)
Marine Geology (R. Tiedemann, R. Schlitzer)
Sea Ice Physics (Chr. Haas, P. Lemke)
Geo-Biology (D. Wolf-Gladrow, J. Bijma)
Marine Animal Ecology (T. Brey)

Directorate:
H. Wolke



Remote Sensing (J. Notholt, G. Heygster)
Physics and Chemistry of the Atmosphere (J. P. Burrows,
A. Ladstätter-Weißenmayer)



JACOBS
UNIVERSITY

Earth and Space Sciences (A. Schaefer, V. Unnithan)
Computational Science (P. Baumann, L. Linsen)



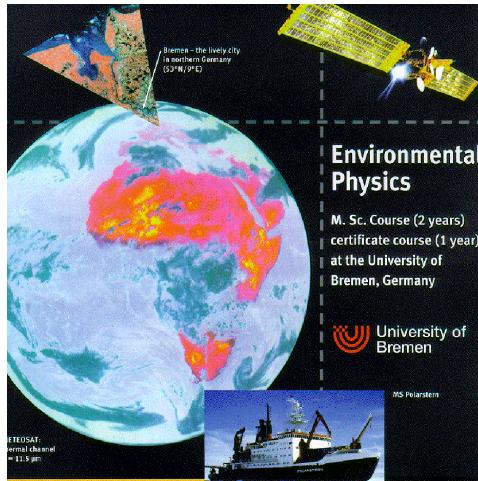
Polar and Marine Research: Global Environment & the Earth System Observations - Models - Applications

Universities Bremen, Potsdam, Kiel, Jacobs, Oldenburg,
Hamburg, FH Bremerhaven

Guest Scientists & Lecturers at AWI and
Hanse Wissenschaftskolleg Delmenhorst (HWK)

Block Courses at 'Biologische Anstalt
Helgoland' (Helgoland & Sylt)





International Postgraduate Programme Environmental Physics (PEP):

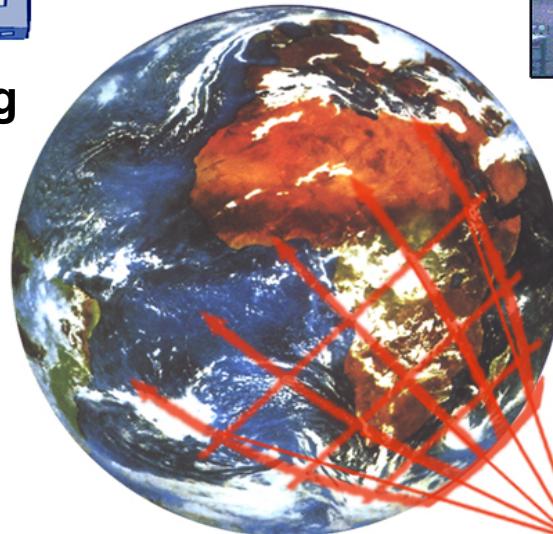
- Started in 2000, one of the first international Master Courses
- 25 students from 11 countries



Climate Modelling



**Physics & Chemistry
of the Atmosphere**

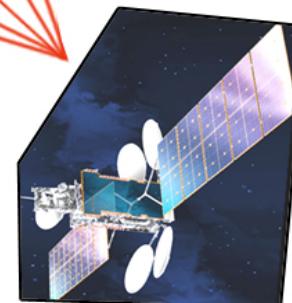


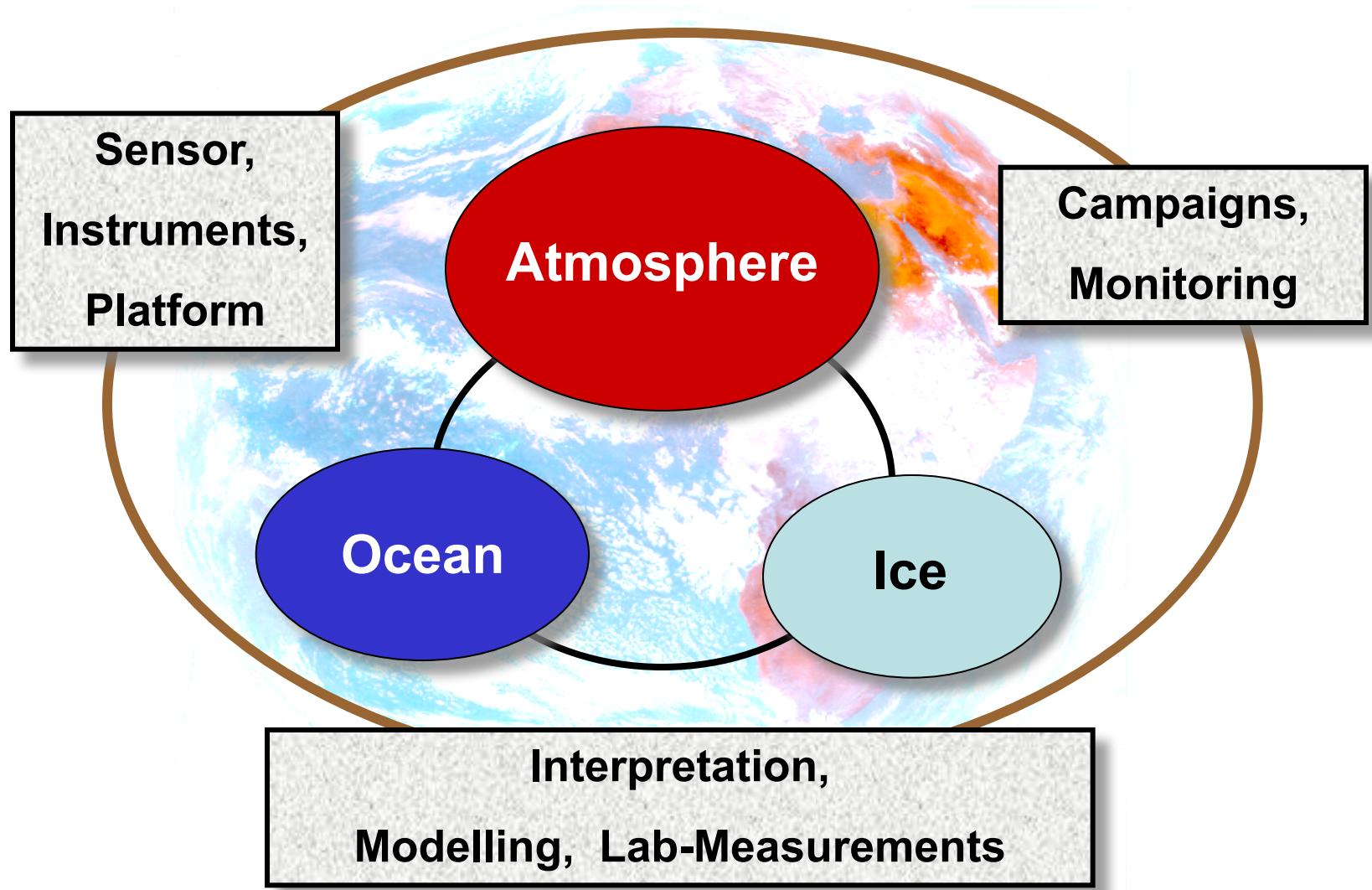
Oceanography



**Measurement
Techniques**

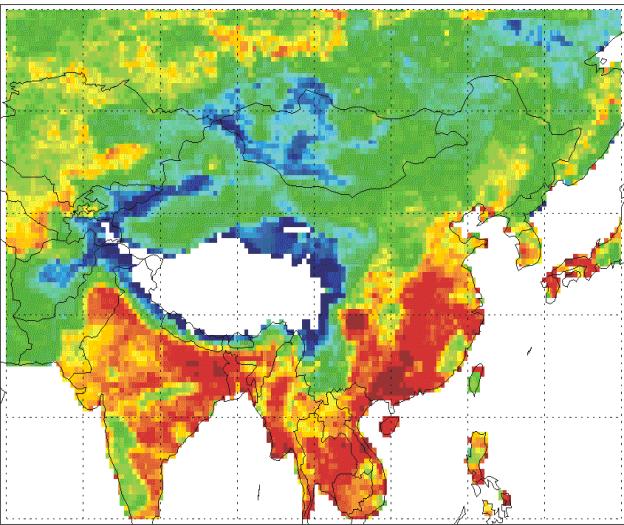
Remote Sensing





Sensor,
Instruments,
Platform

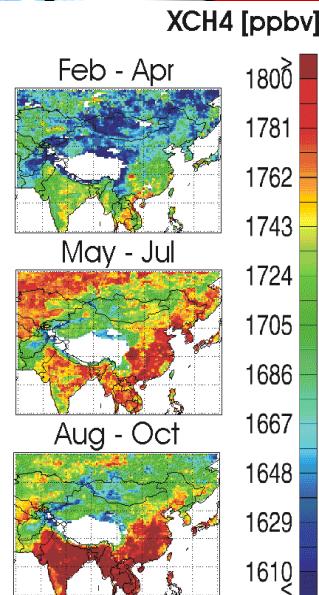
Methane SCIAMACHY 2003



Atmosphere

Campaigns,
Monitoring

Ice



Vegetation,
Measurements



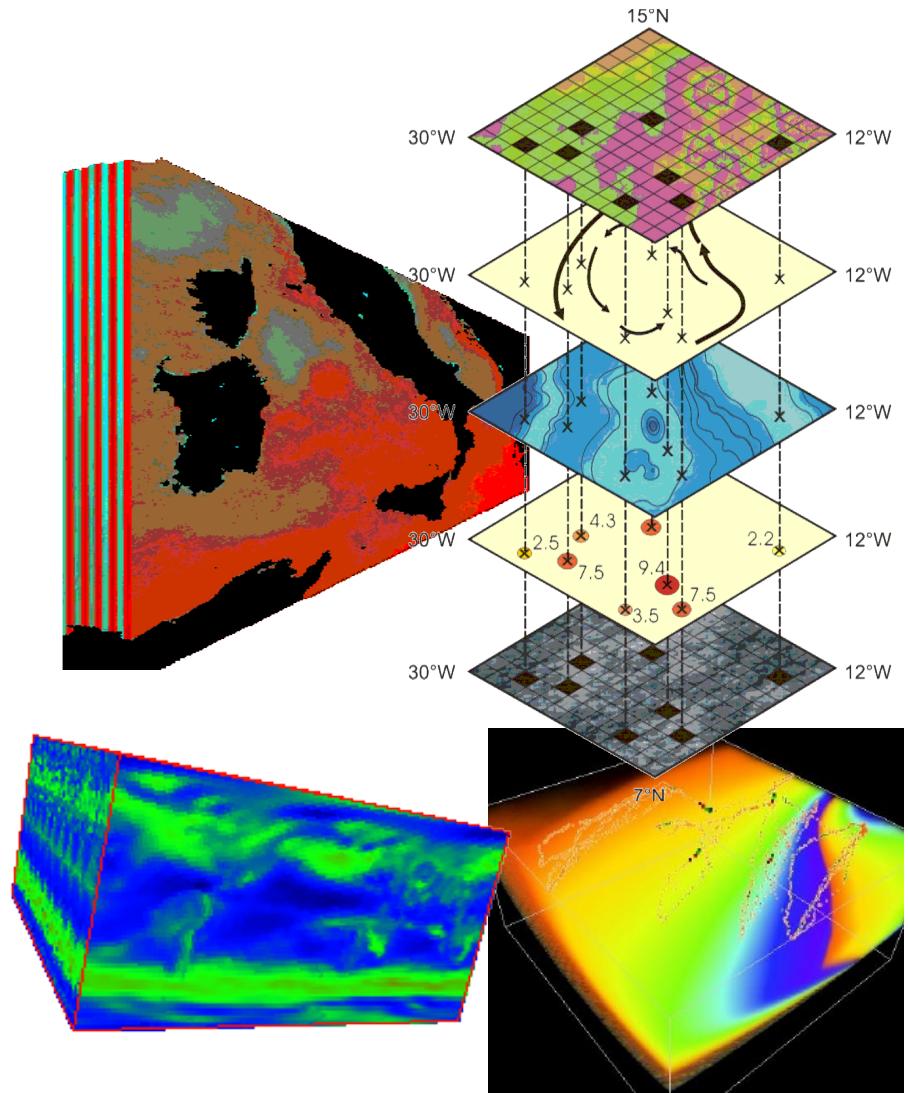
Education

- **International / intercultural campus**
 - 86 nations, English official language
 - Soft skills & language courses
 - Industry contacts & internship programmes
- **Graduate Programmes:**
 - Geo-Ocean Dynamics
 - Smart Systems
 - Gender balance:
25% female staff,
40% female PhD students
- **Existing AWI-Jacobs links**
 - AWI faculty teaching
 - Theses, Seminars

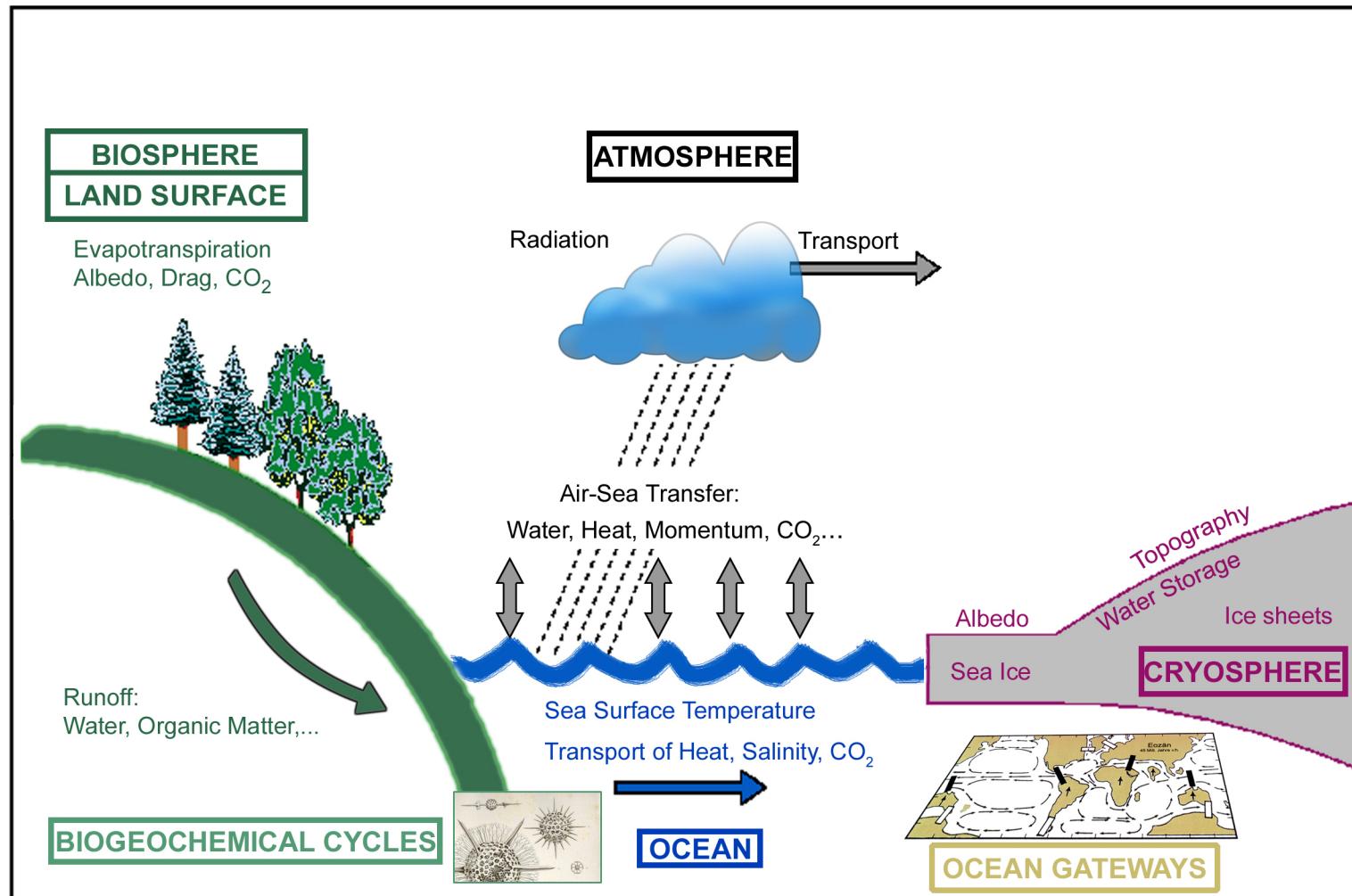


Research

- **Earth & Marine Sciences**
 - Geoinformatics
 - GIS & spatial data modelling
- **Computational Science**
 - Large-scale raster services, databases, Web technologies
 - Modelling & visualization
 - Supercomputing & multi-dimensional grid processing



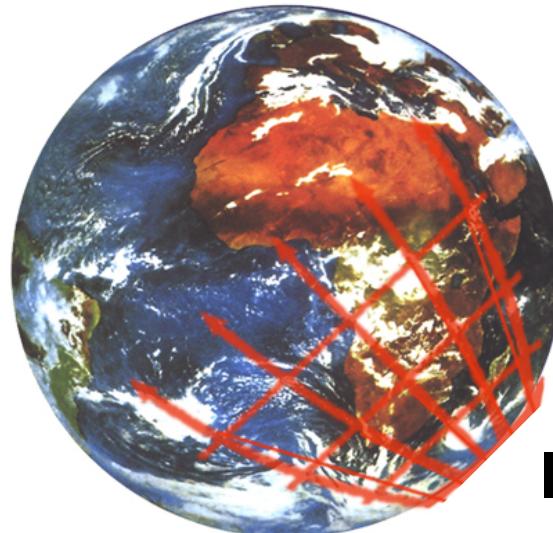
High complexity → multi-disciplinary approach



Modified after Hasselmann

Bridging the gap between disciplines

**Data exploration
& analysis**



**Processes
Lab experiments**

**Interpretation
Models**

Bridging the gap between disciplines

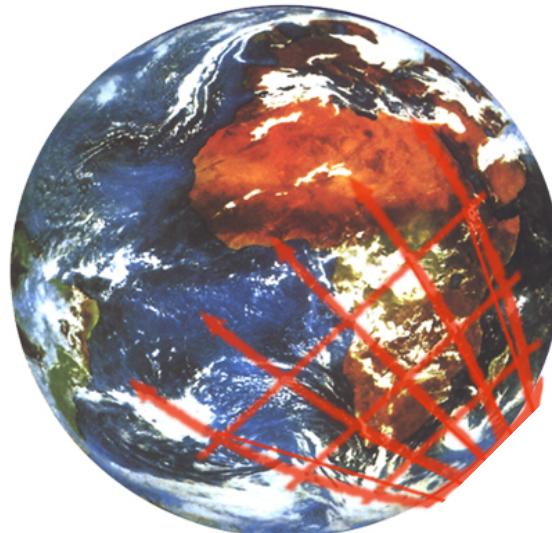
Examples:

Carbon cycle
Proxies (O-18, C-13)
Modelling

Processes

Lab experiments

**Data exploration
& analysis**



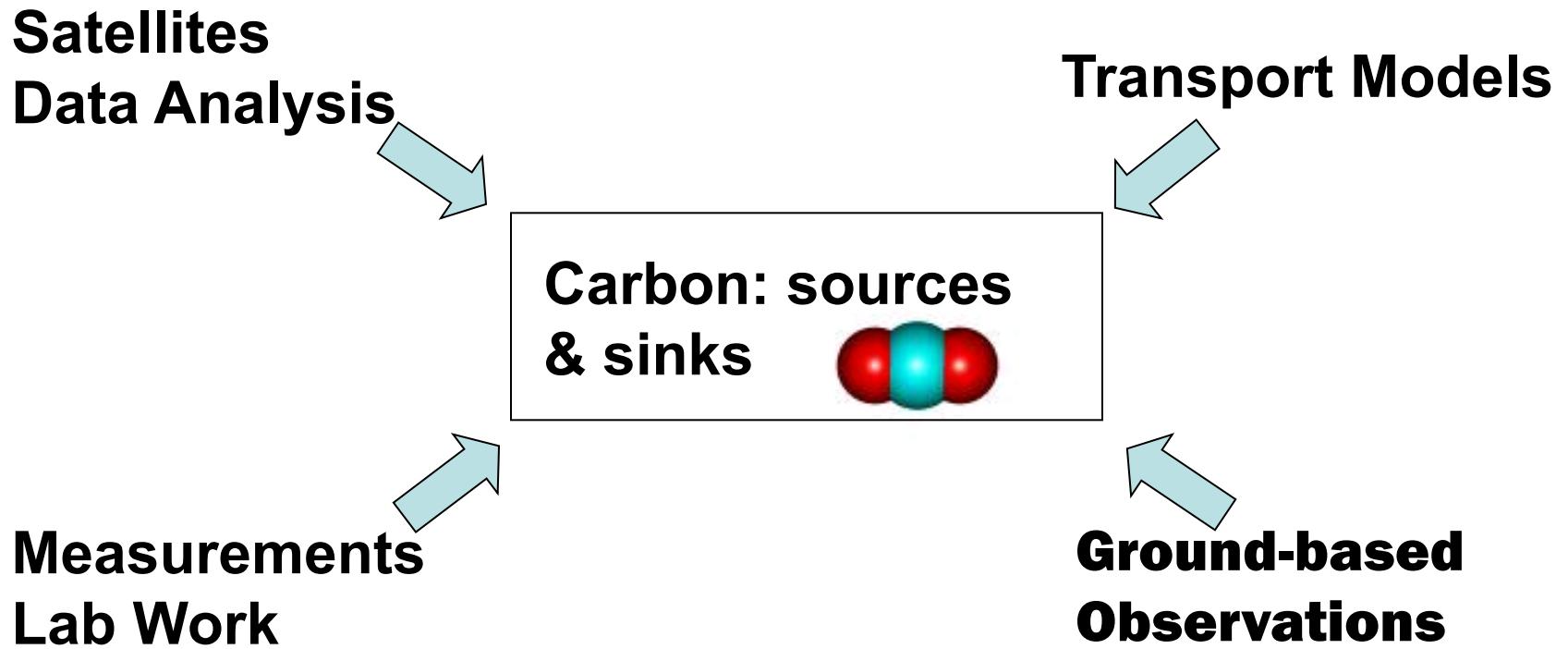
Examples:

Marine ecosystem
Earth history: Gateways
Geoinformatics

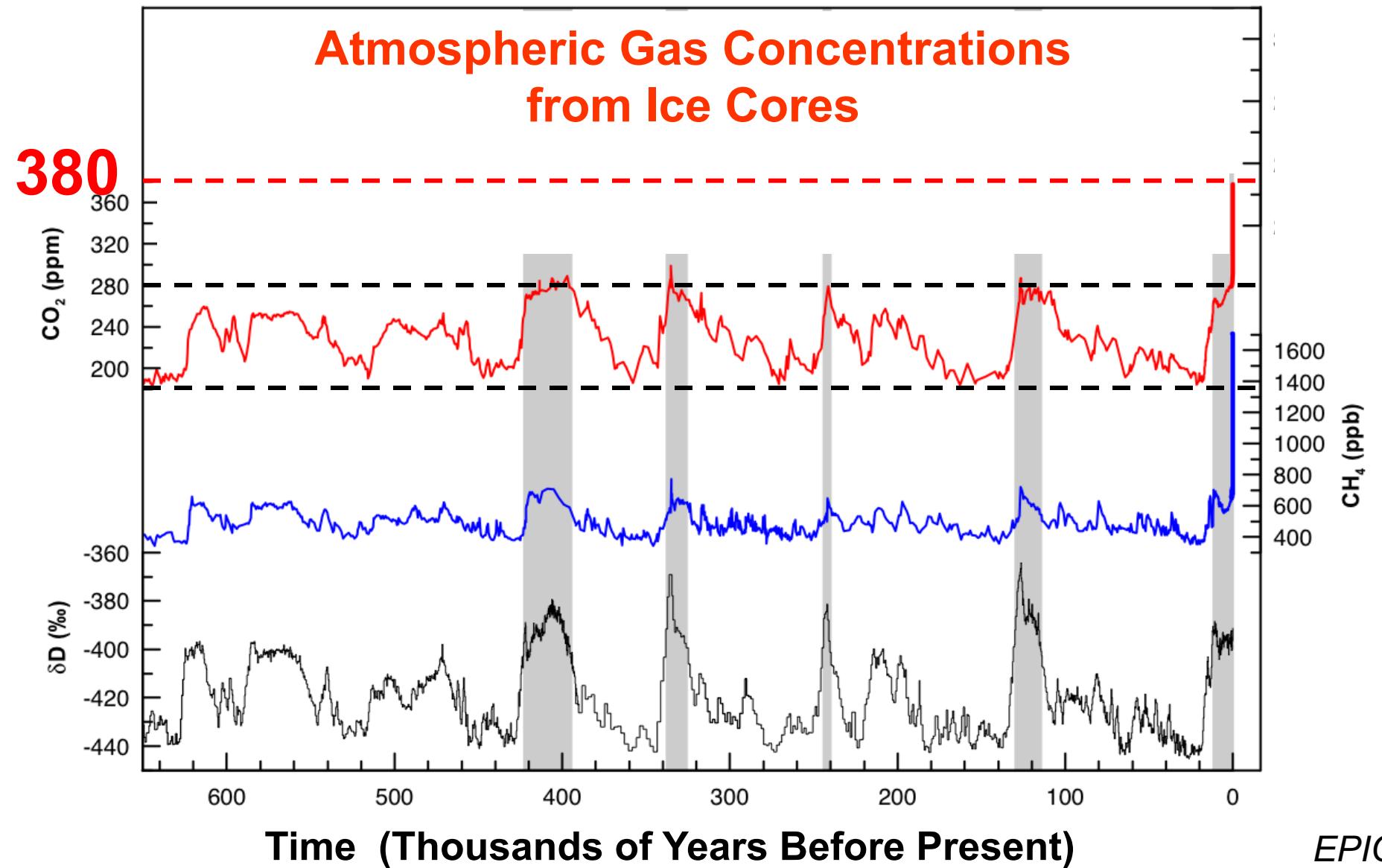
Interpretation

Models

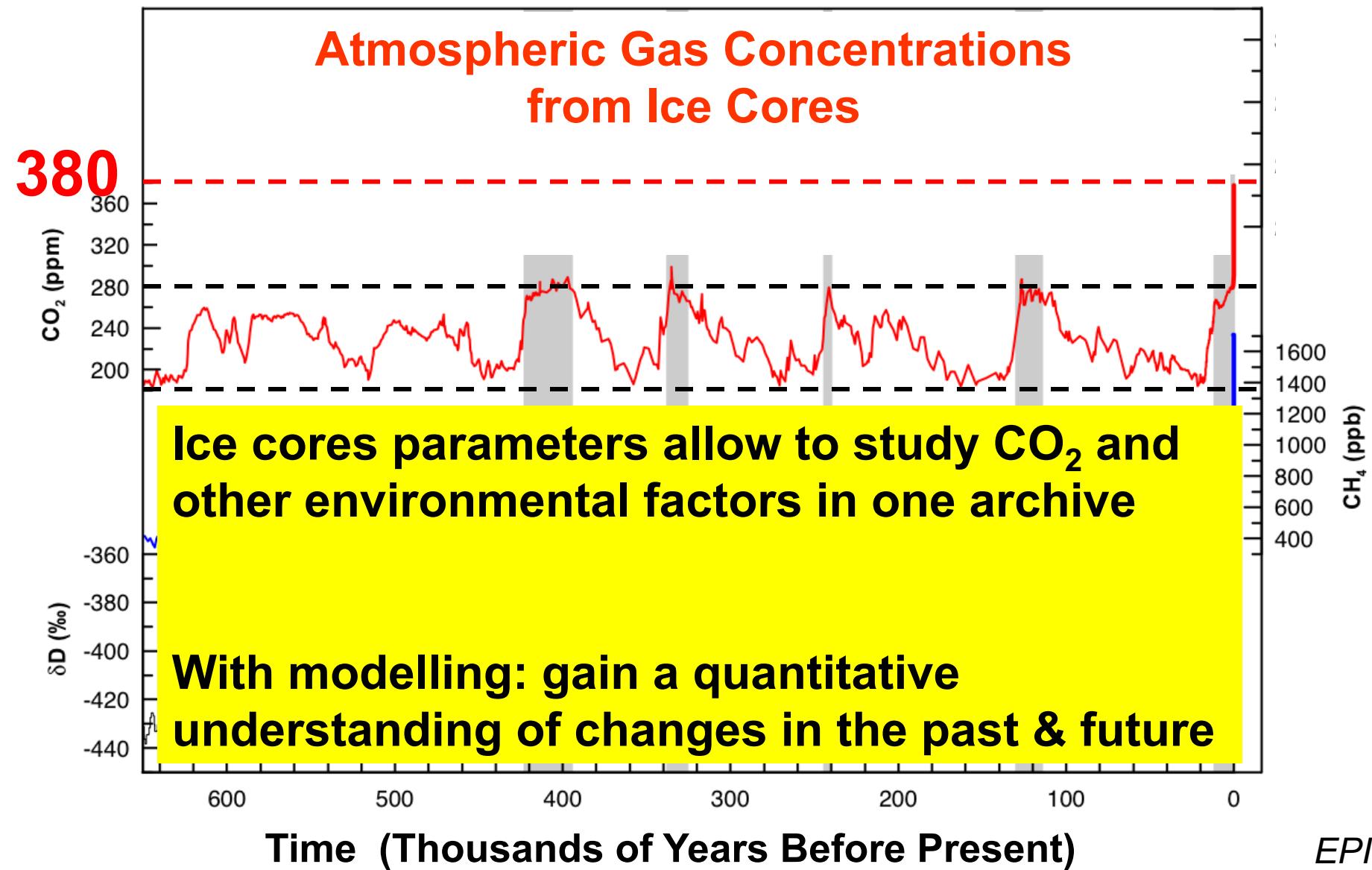
Example: Carbon Cycle



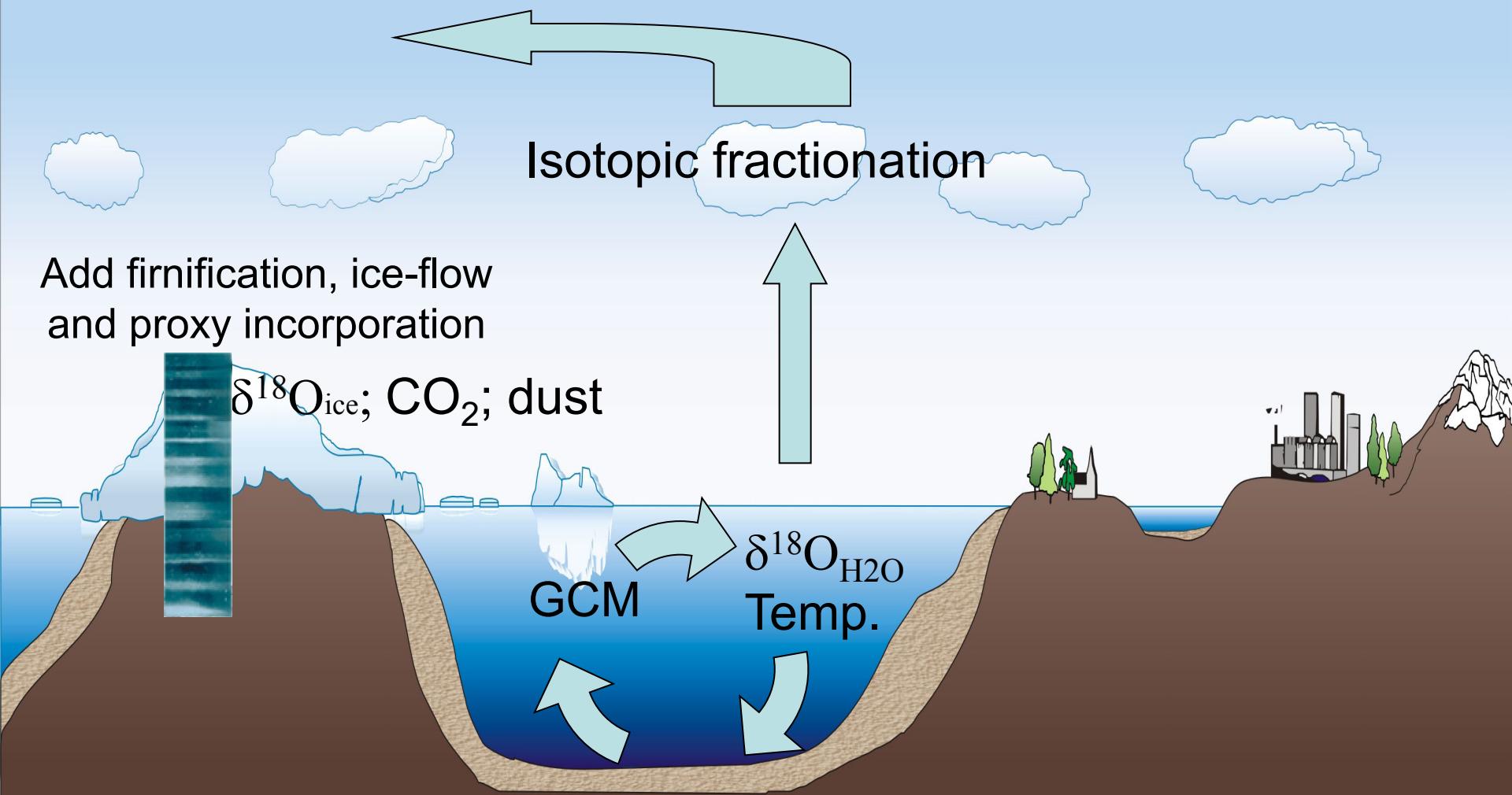
Carbon cycle: long time scales



Carbon cycle: long time scales

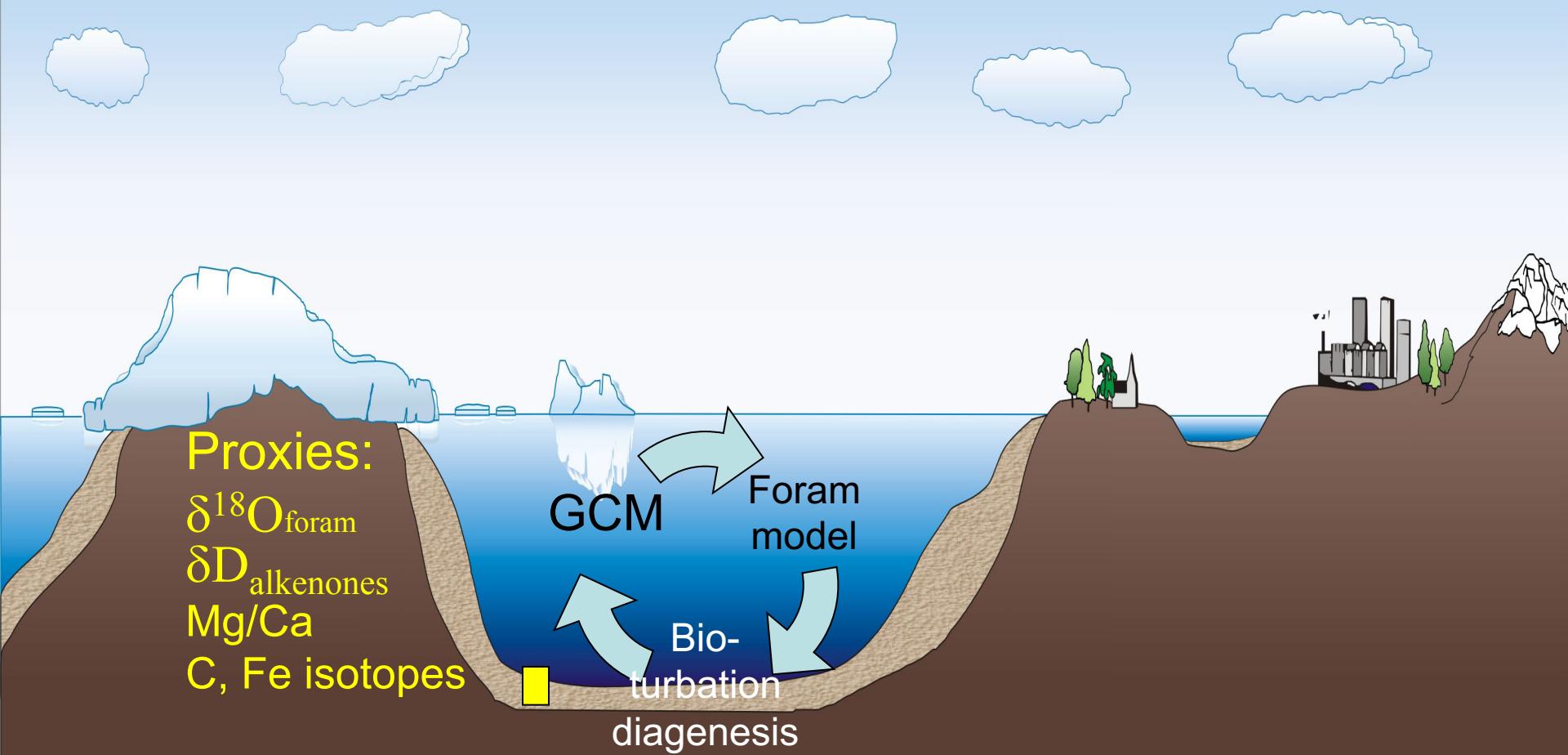


Climate Archives & Modelling: Ice Cores



Marine Cores

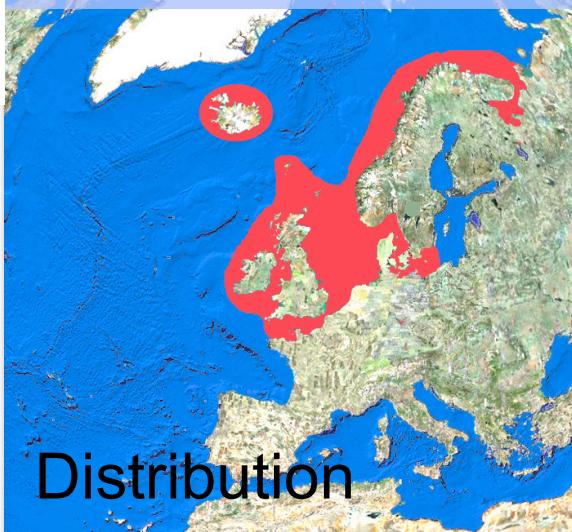
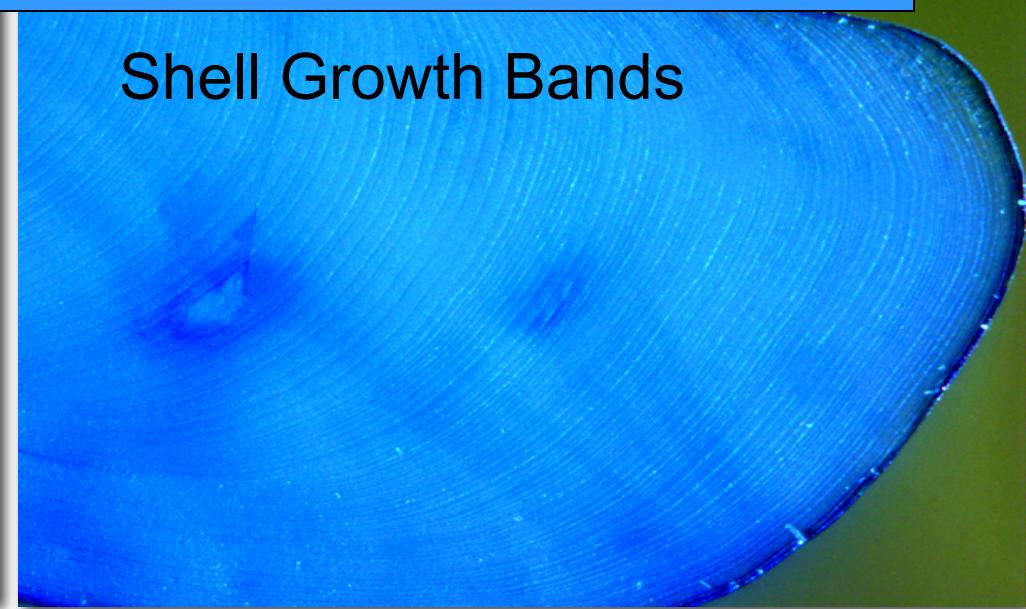
Compare simulations with real cores



Climate change over the last 100 years



Bivalve Bioarchive
Arctica islandica

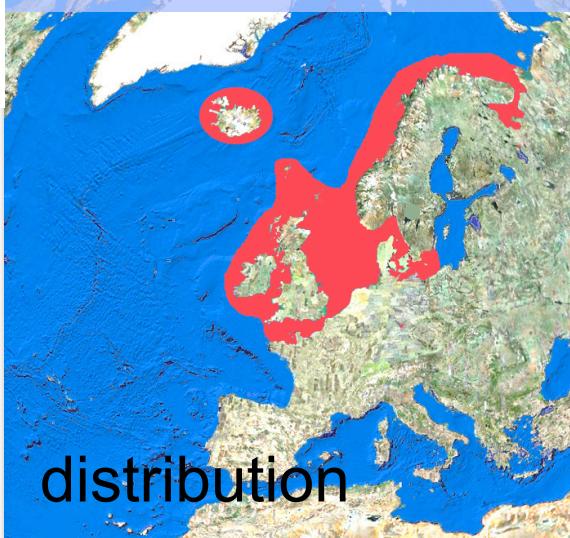


Distribution

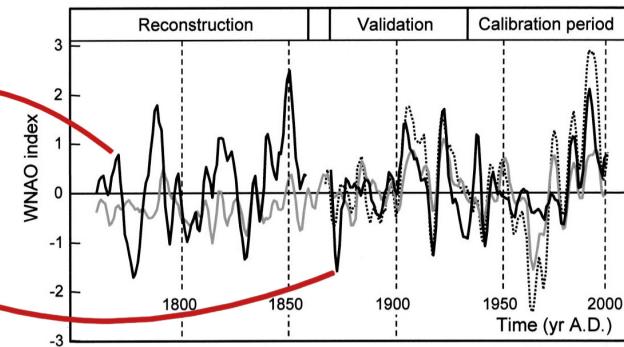
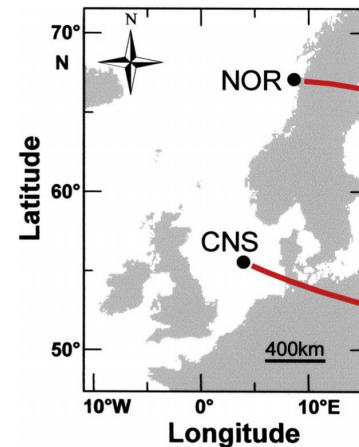
Climate change over the last 100 years



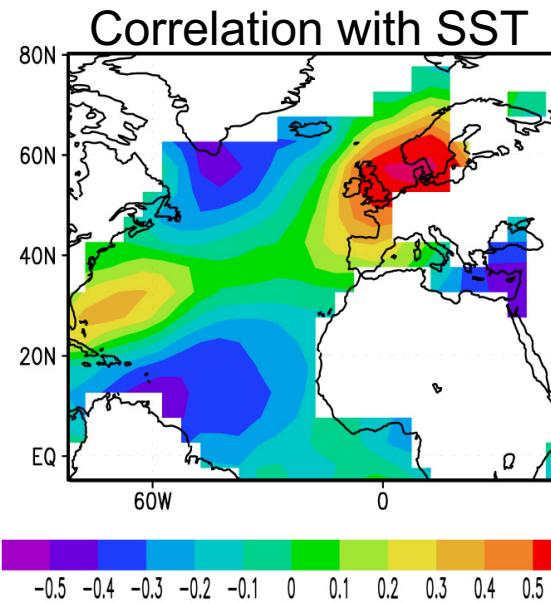
Bivalve Bioarchive
Arctica islandica



distribution



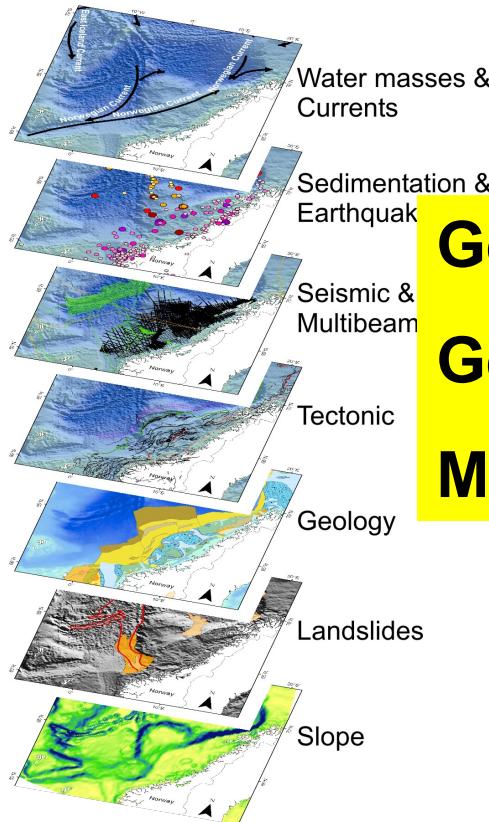
Schoene et al., 2003



NAO-Signature

Lohmann et al., 2006

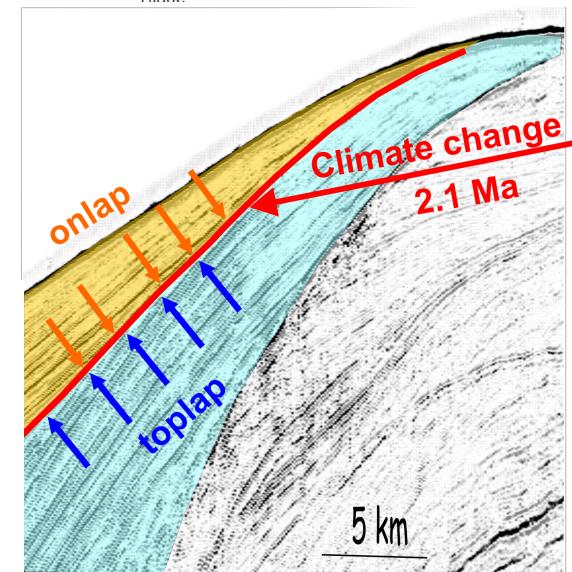
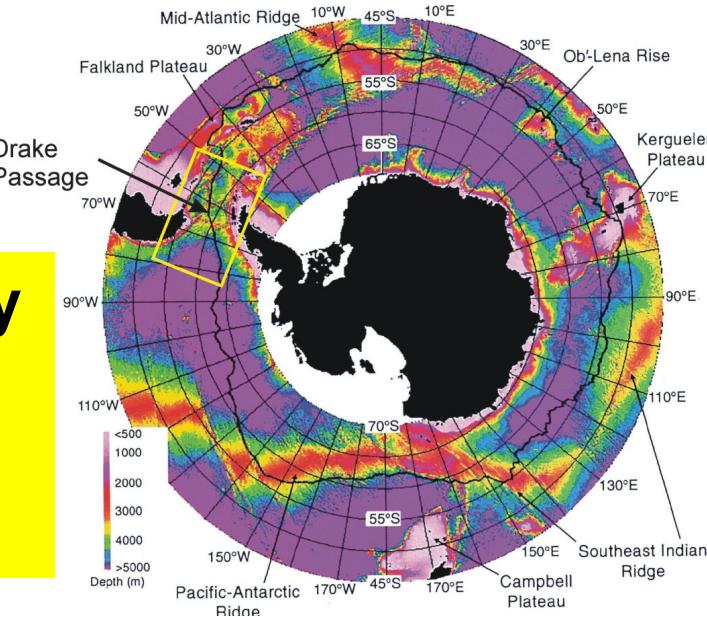
Example: A tectonic-sedimentary puzzle



**Geophysics/Geology
Geoinformatics
Modelling**

Grid processing & GIS

**Seismic reflector:
Climate Shifts**



Study Programme

year

1.



2.



3.



Thesis & Defence

- B**asic courses
- S**oft skill courses
- E**xpert courses
- P**resentations
- I**nt. conferences

Self-organised units:

- literature seminars
- students teach students

Study Programme

year

1.

PhD candidate selection



Basic courses: Earth System Sciences - Introductory Course

1st week: Geophysics, Glaciology, Oceanography, Physics & Chemistry of the Atmosphere
2nd week: Remote sensing, Climate Dynamics, Marine Biology and Ecology, Geoinformatics

Soft skill courses: communication, scientific presentations, language

1 week: Helmholtz Association, Jacobs: intercultural campus infrastructure,
complementary Seminars at Uni HB

Expert courses: Advanced, e.g. Guest Scientists

Presentations: Seminar attendance, 6 monthly seminar presentation

Study Programme

year

2.



Expert courses: Guest Professors, Special topics, Lab days

1st week: Climate System

2nd week: Biogeosciences

Soft skill courses: communication, scientific writing, project management

1 week: Helmholtz Association, complementary Seminars possible

Presentations: Seminar attendance and presentations

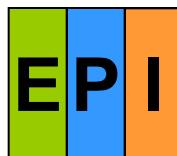
International conferences, summer schools

Foreign lab stay in another research institute
(preferably in a foreign country)

Study Programme

year

3.



Research

Thesis & Defence



Expert courses: Guest Professors, Special topics

1st week: Geo-informatics & Computational Modelling,

2nd week: Special guests



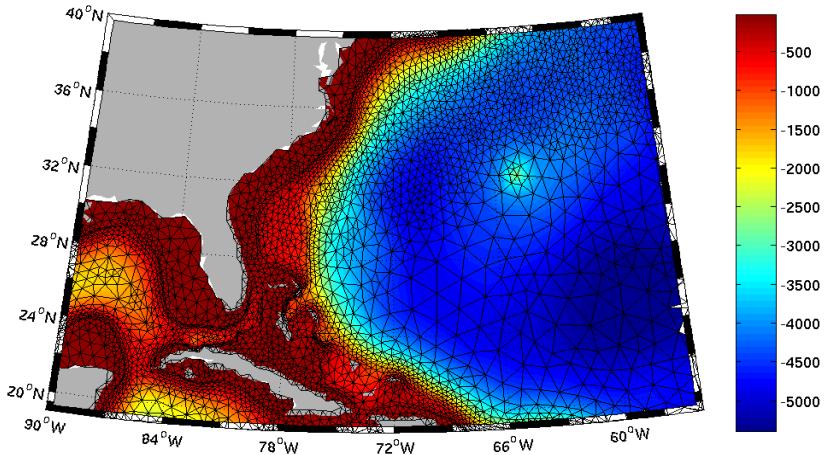
Presentations: Seminar attendance and presentations



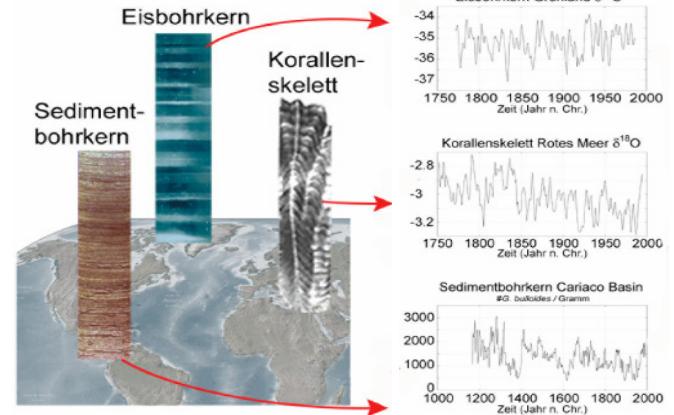
International conferences, summer schools

What shall the students learn?

Complex Models



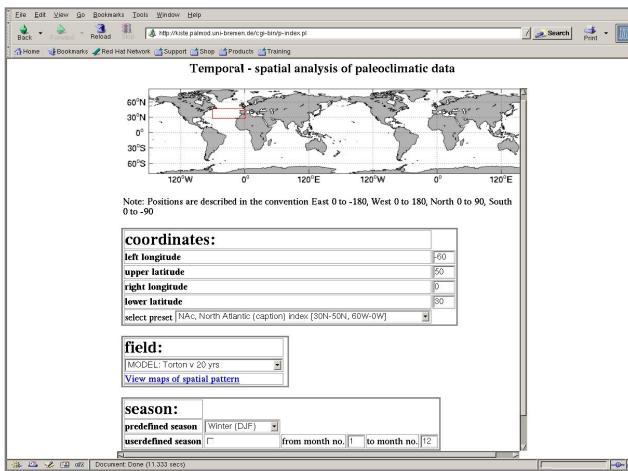
Observations & Interpretation



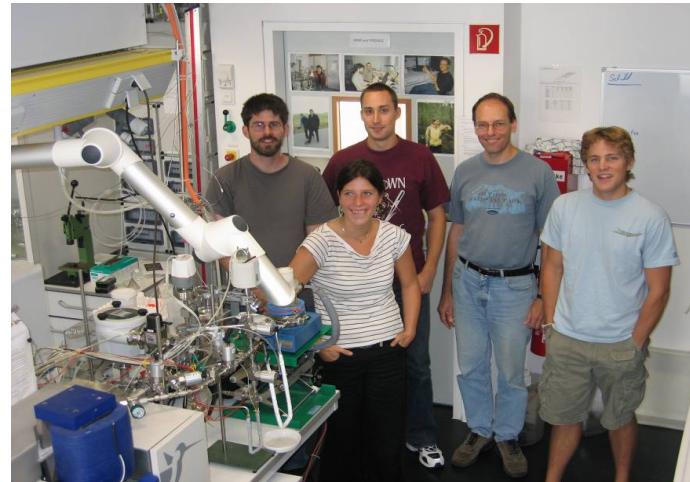
a) Proxydaten aus früheren Klimata

b) Zeitserien

Data Analyses Tools



Measurement Techniques

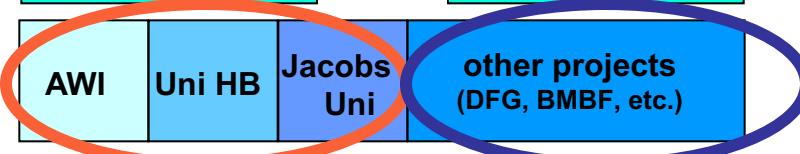
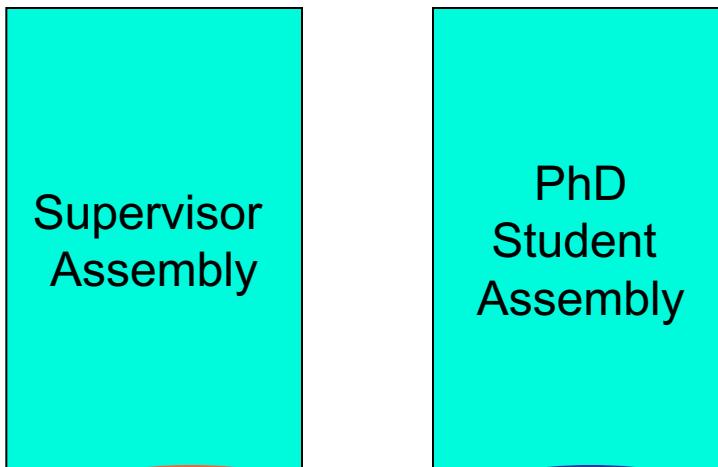


Helmholtz Research School

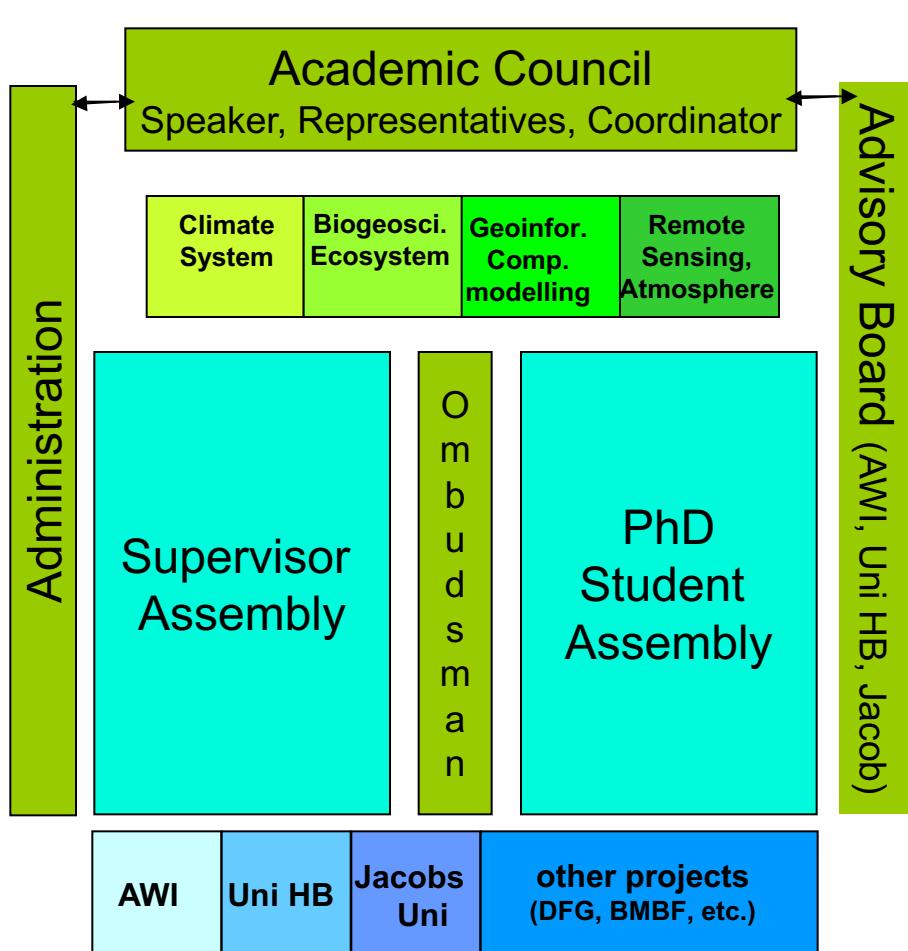
Size of class

12 PhD grants + 12 external PhD stud.

| | | | |
|----------------|-------------------------|---------------------------------|----------------------------------|
| Climate System | Biogeosci. Ecosystem | Geoinfor. Comp. modelling | Remote Sensing, Atmosphere |
|----------------|-------------------------|---------------------------------|----------------------------------|

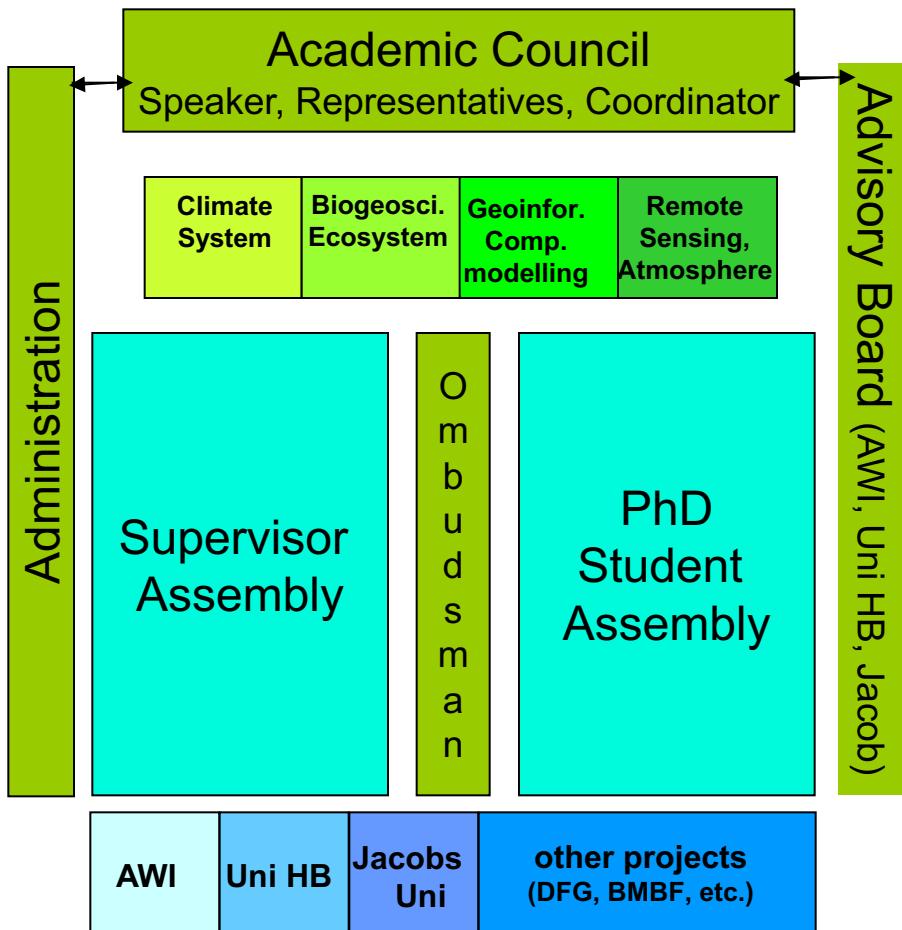


Helmholtz Research School



Size of class
12 PhD grants + 12 external PhD stud.

Helmholtz Research School



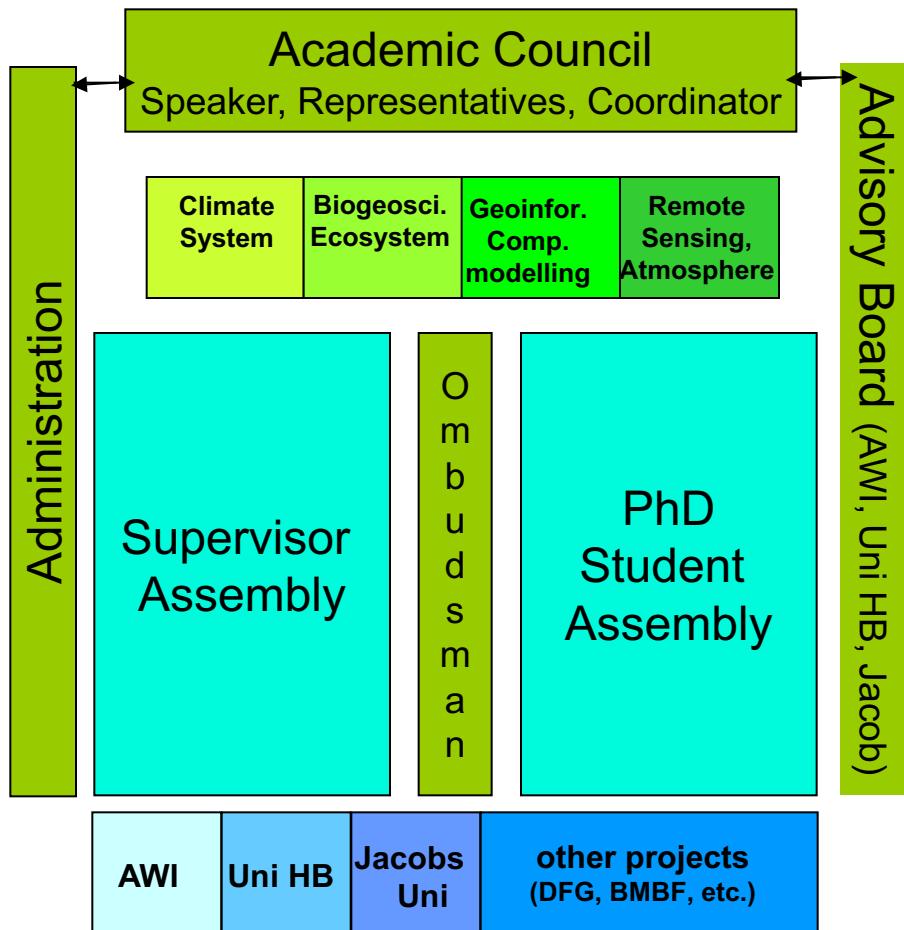
Size of class
12 PhD grants + 12 external PhD stud.

Finances

| | |
|-------------------------------|-------------|
| Coordinator (PostDoc) | € 73.000,- |
| 12 PhD student grants | € 173.000,- |
| Soft skill training | € 20.000,- |
| Conferences | € 12.000,- |
| Course lecturer | € 4.000,- |
| Consumables | € 3.000,- |
| Additional funding | |
| Unforeseen, Child care, HiWis | € 15.000,- |

per year € 300.000,-

Helmholtz Research School



Size of class
12 PhD grants + 12 external PhD stud.

Finances

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|-------------------------------|-------------|
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| Additional funding | |
| Unforeseen, Child care, HiWis | € 15.000,- |

per year € 300.000,-

Internal student proposals

Strengths of the Research School Earth System Science

Collaboration of data and modelling groups

Geosciences and biology: detailed knowledge about proxy data, expertise to obtain new data

Expertise in numerical modelling, algorithms, understanding of processes, data analysis

Helmholtz Research School Earth System Science

**Qualify the next generation of excellent
scientists for the challenging questions in
Earth System Science**

