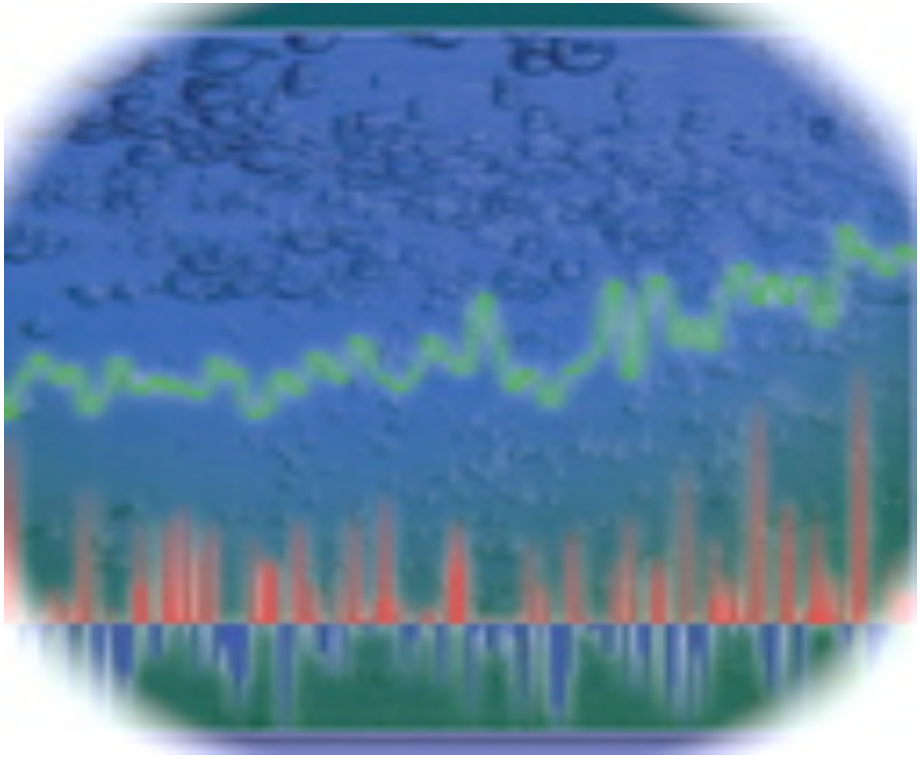
Climate Dynamics: Why Does Climate Vary?



Class I: Introduction and Overview

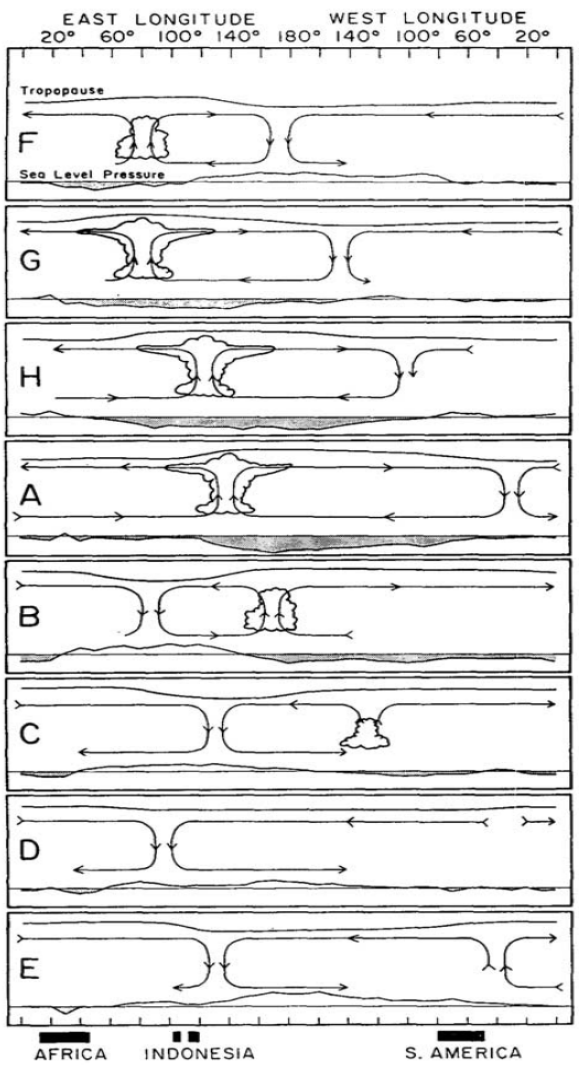
Goals

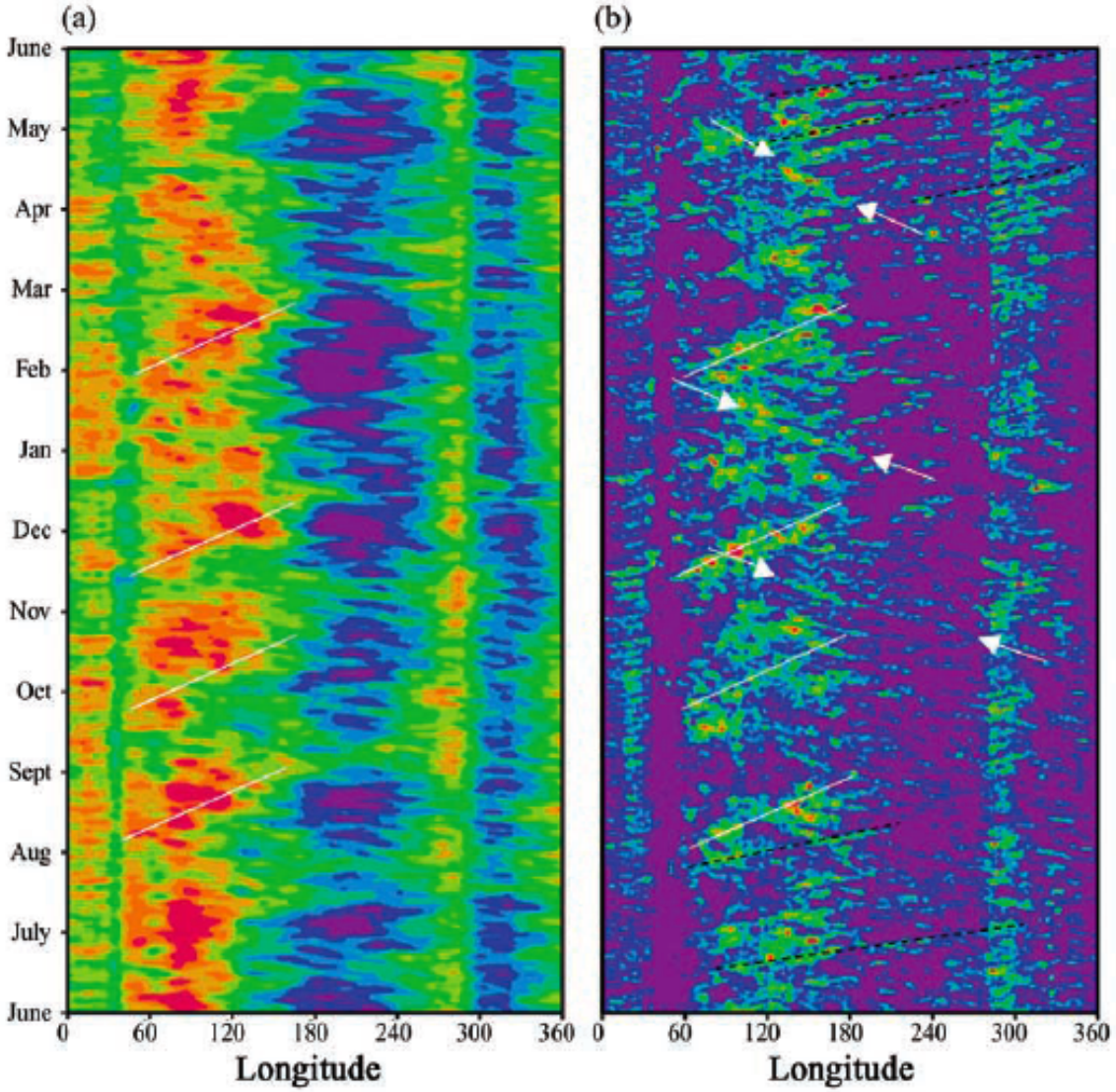
- To help you to get acquainted with some major climate phenomena in the climate system.
- To help you to obtain an updated understanding of mechanisms behind climate variability.
- To prepare you for pursuing a deeper understanding of why the state of the system has varied in the way we have observed and how it may change in the future.

Approaches

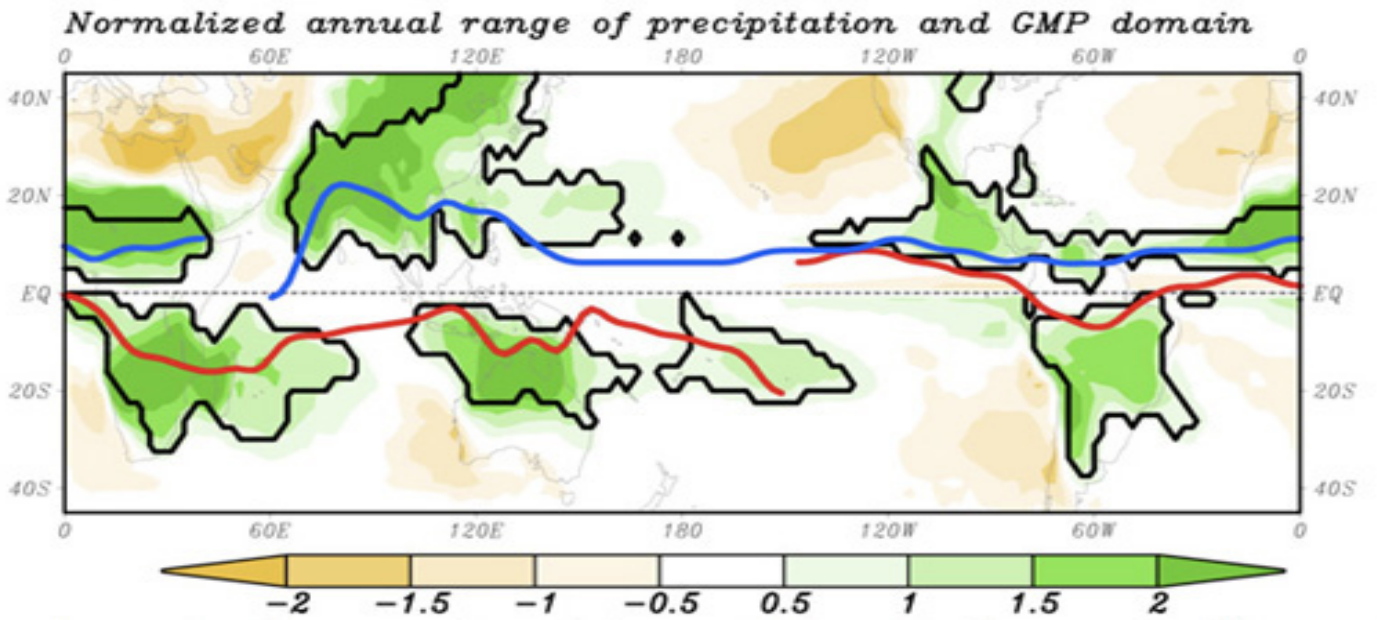
- A climate phenomenon is introduced upfront from an observationist's perspective. Key physical concepts and necessary mathematical tools are then introduced in the process of dissecting the phenomenon and illuminating the dynamics and mechanisms involved.
- The climate phenomena chosen are those underscoring the importance of dynamics and are introduced in the order defined by their time-scales.
- The class is viewed as a joint journey with the students. Constant feedback from the students about both the path and pace is strongly encouraged.

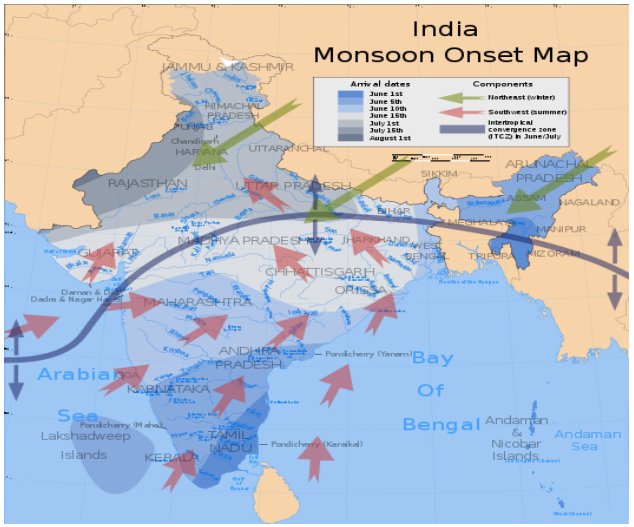
Madden-Julian Oscillation





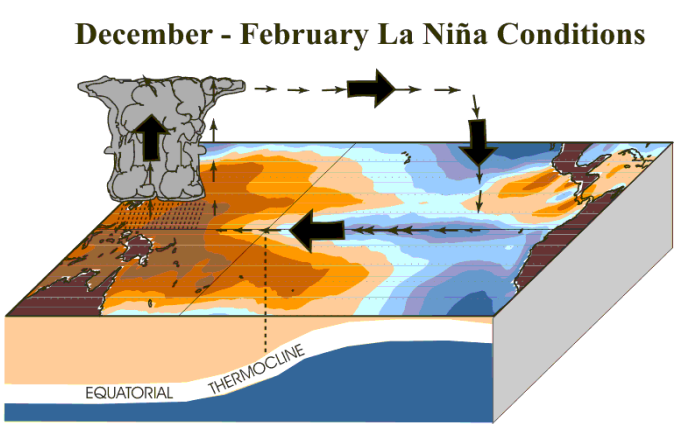
The Monsoons



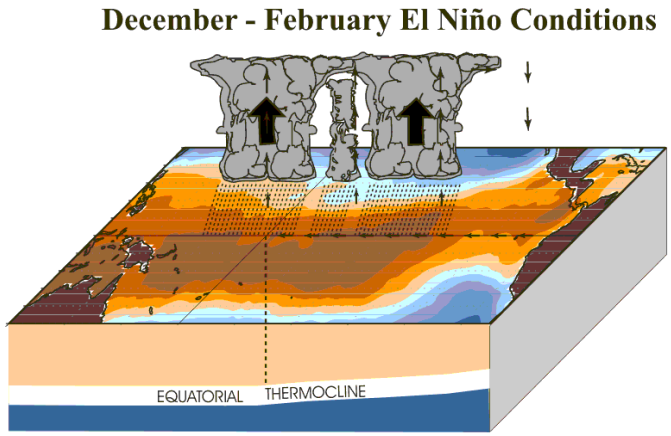


The El Nino-Southern Oscillation

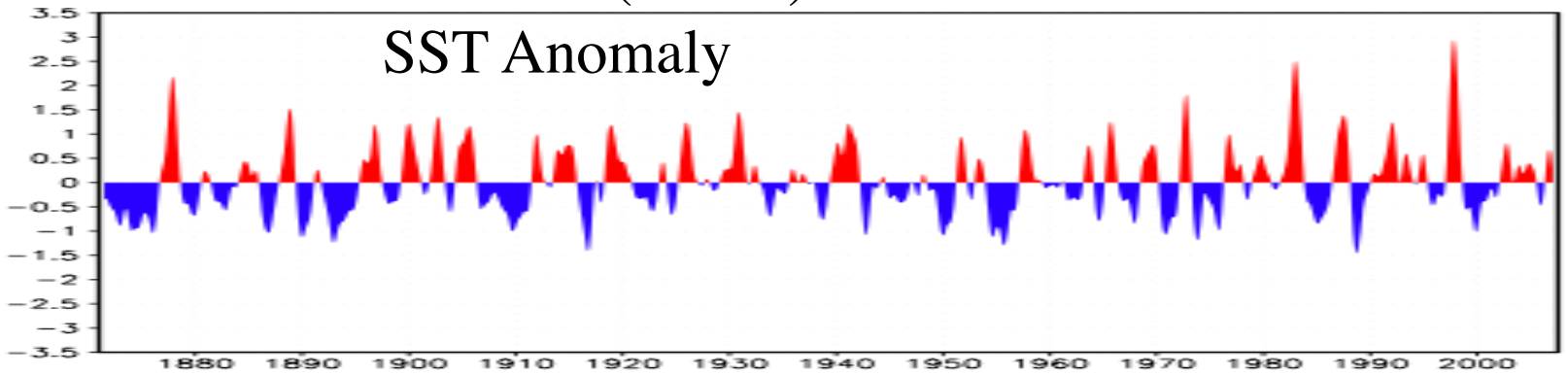
La Niña



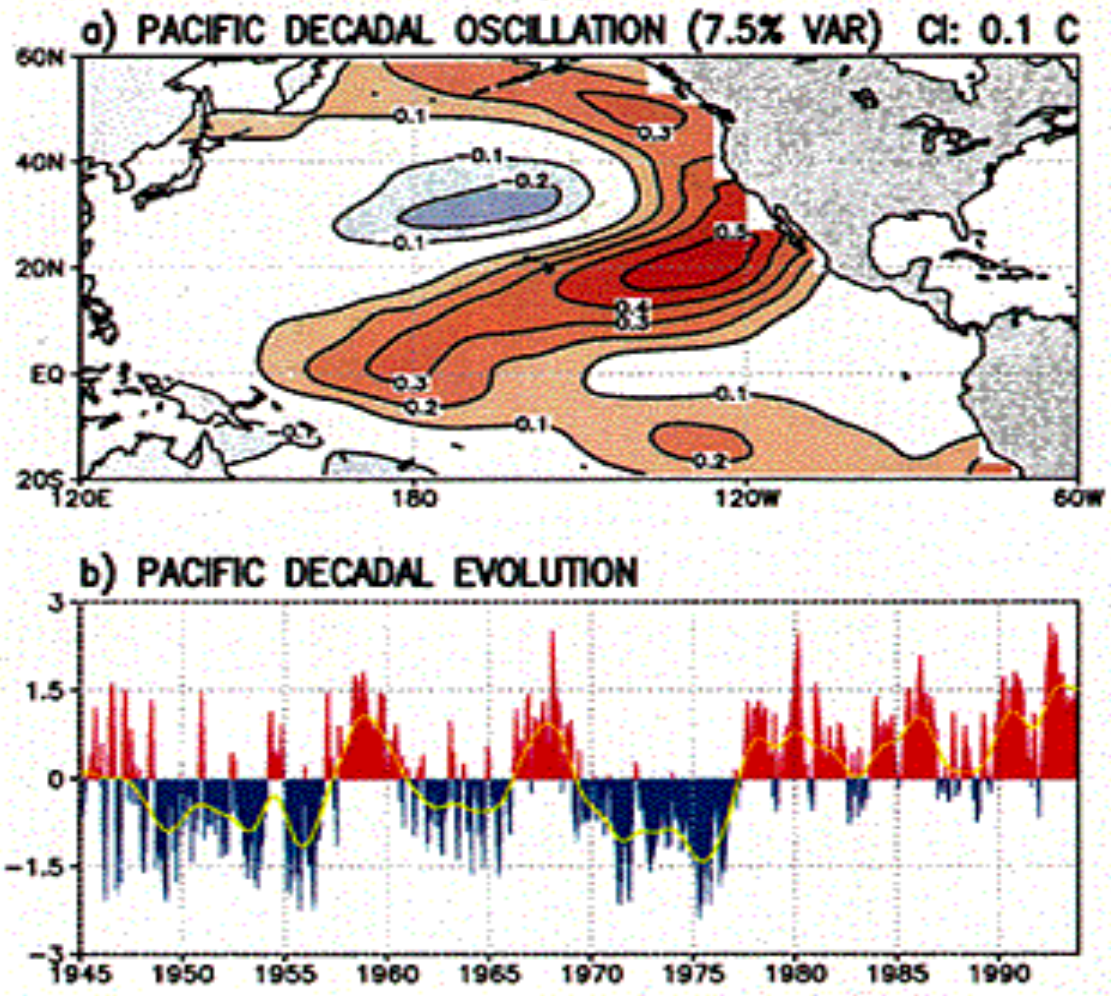
El Niño



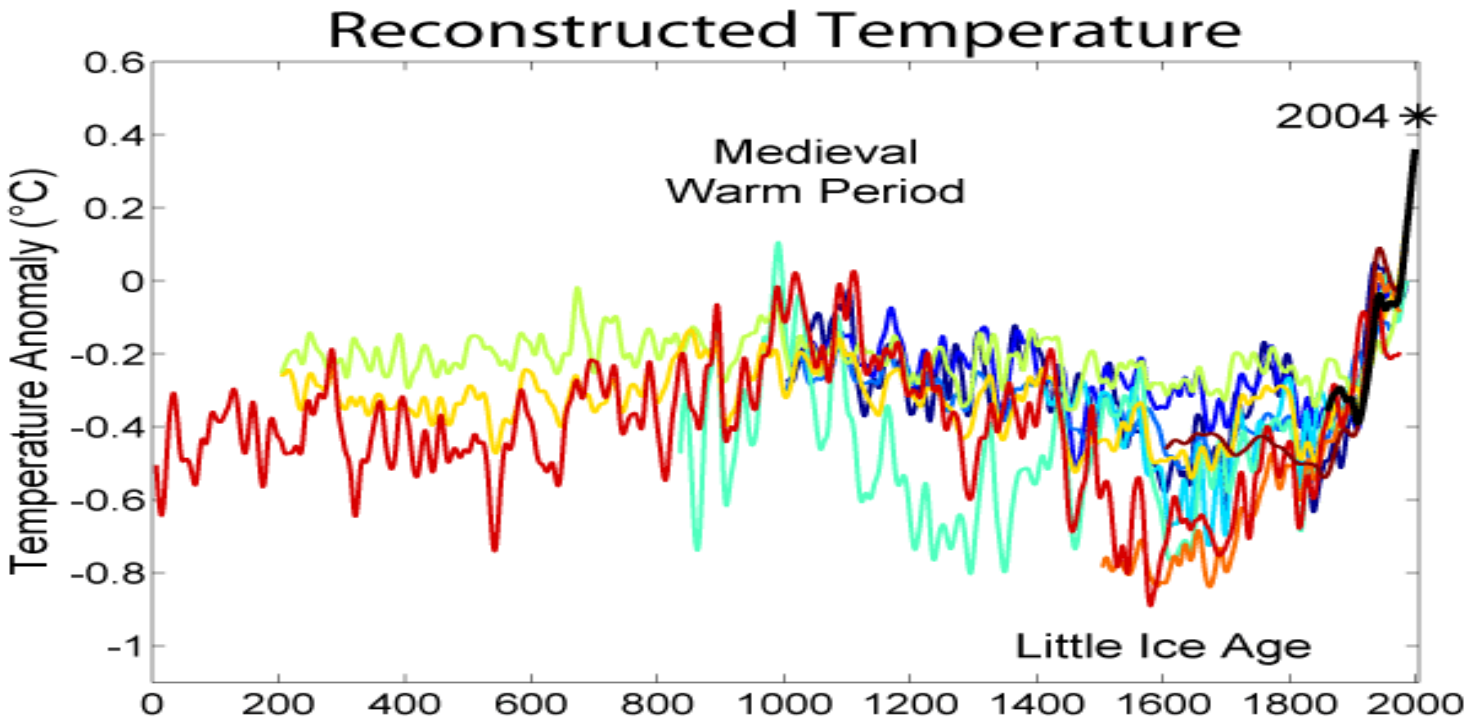
East Pacific (Nino3) SST Anomalies



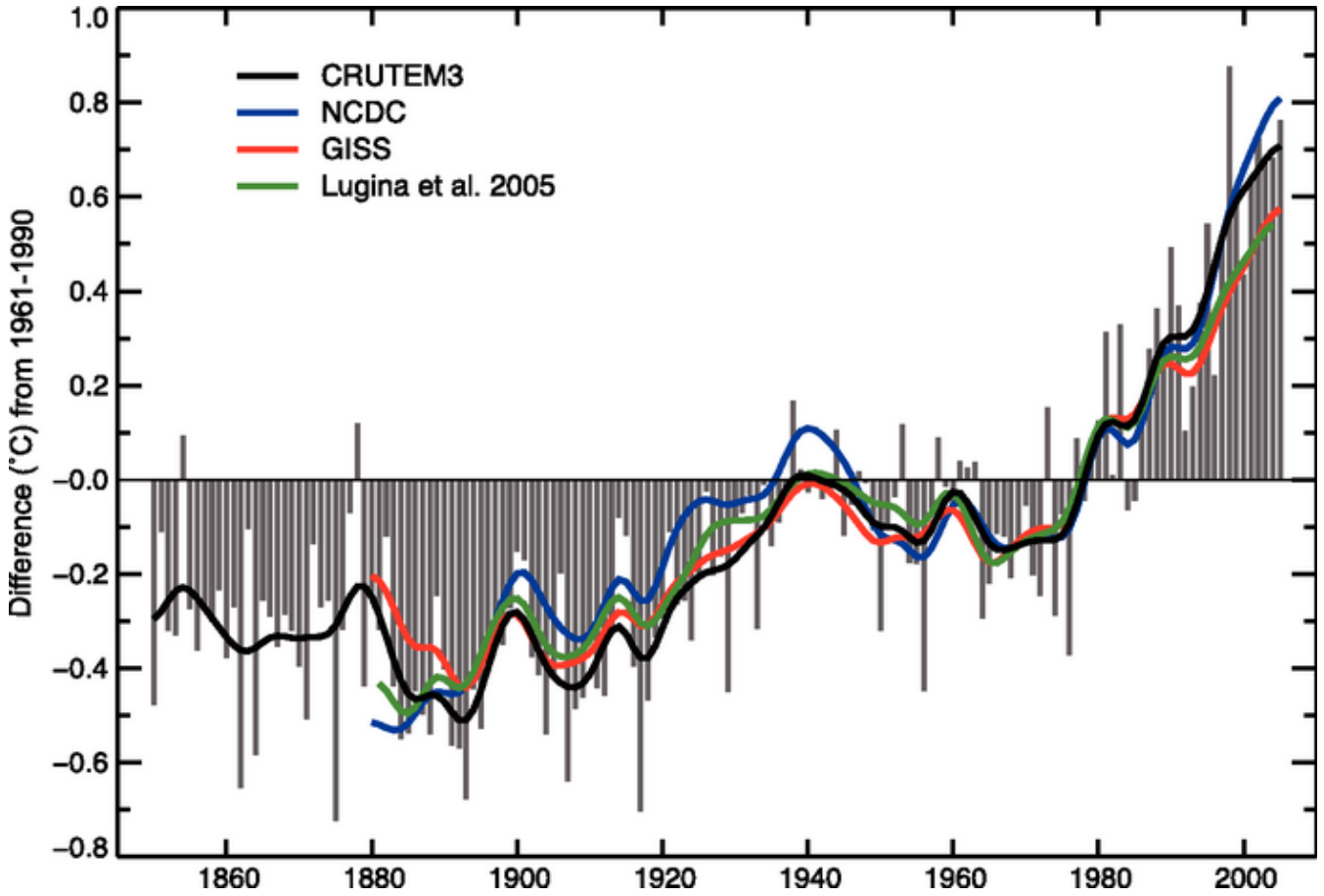
PDO


a) PACIFIC DECADAL OSCILLATION (7.5% VAR) CI: 0.1 C
60N
40N
20N
EQ
20S
120E
180
120W
60W
b) PACIFIC DECADAL EVOLUTION
3
1.5
0
-1.5
-3
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990

The Medieval Warm Period and The Little Ice Age



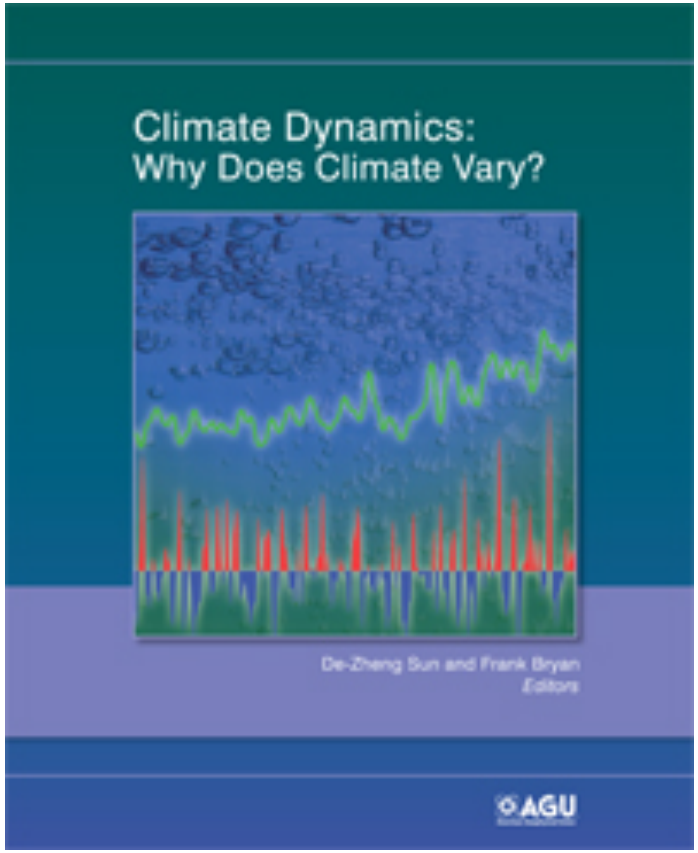
The Recent Global Warming



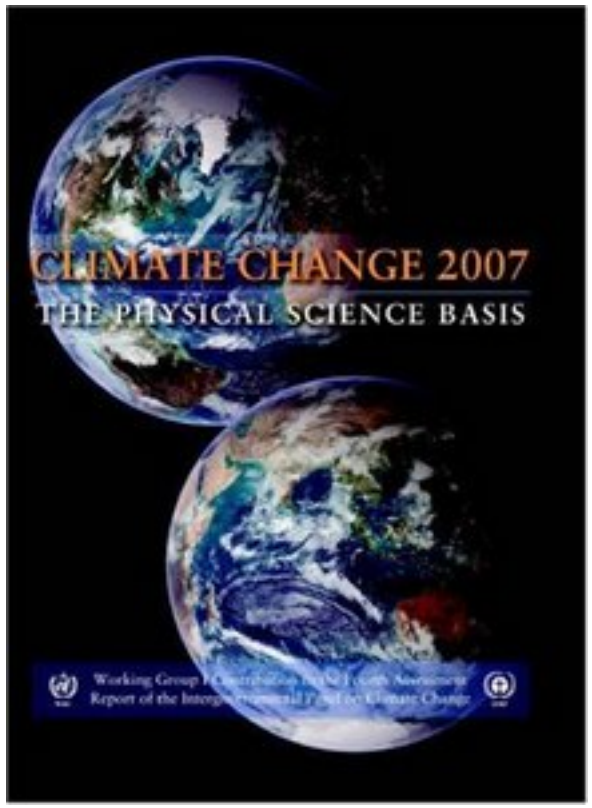
Syllabus

08/29	Introduction and Overview: Goals, Approaches, Road Maps, and a Few Other Things
09/05	The Climate System: Components, Interactions, Forces, Circulations, and Instabilities
09/12	The Madden-Julian Oscillation: Organization of Weather Events Over the Warm Oceans
09/19	The Madden-Julian Oscillation: Organization of Weather Events Over the Warm Oceans
09/26	The Monsoons: A Seasonal Dialogue Between the Land and the Adjacent Oceans
10/03	The Monsoons: A Seasonal Dialogue Between the Land and the Adjacent Oceans
10/10	The El Nino-Southern Oscillation: Coupling between the Atmosphere and the Ocean In the Presence of Nonlinearity
10/17	The El Nino-Southern Oscillation: Coupling Between the Atmosphere and the Ocean In the Presence of Nonlinearity
10/24	Midterm Exam
10/31	The Pacific Decadal Oscillation: Noise Integration, Nonlinear Rectification, and Scale Interaction
11/07	The Pacific Decadal Oscillation: Noise Integration, Nonlinear rectification and Scale interaction
11/14	The Medieval Climate Anomaly and the Little Ice Age: Thermolhaline Circulation and the Tropical-Extratropical Interaction
11/21	Fall Break
11/28	The Recent Global Warming: Observations, Theories, and the Science and Art of Modeling
12/05	AGU
12/12	The Recent Global Warming: Observations, Theories, and the Science and Art of Modeling
12/19	Final Exam

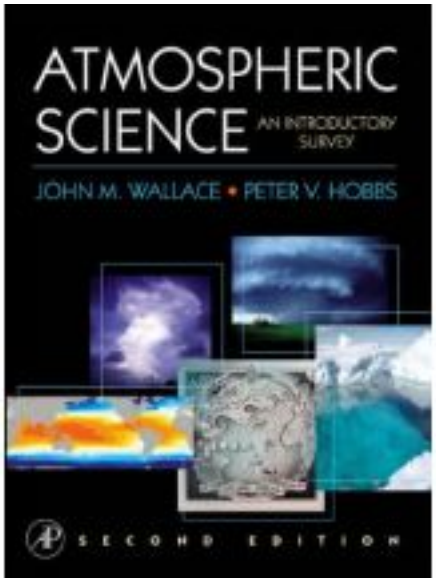
Main Text Book

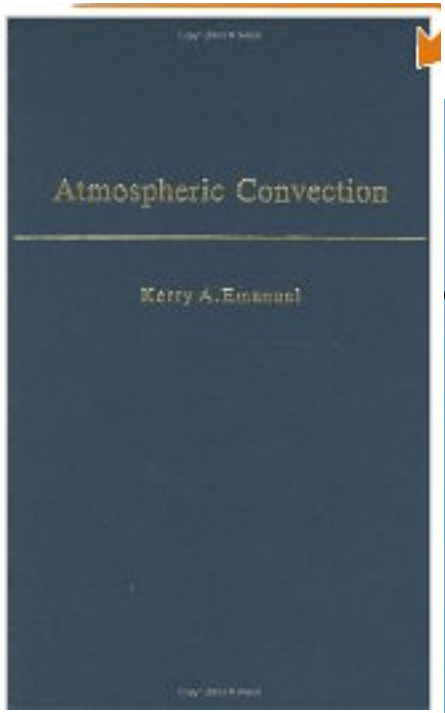


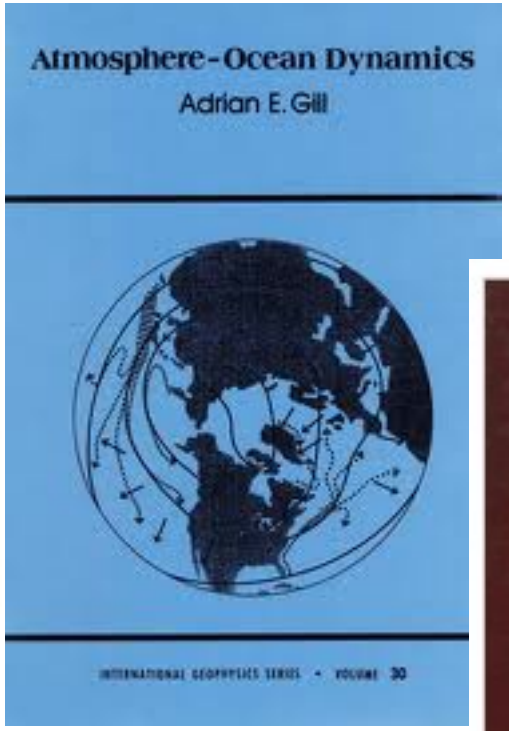
Supplement Text Book

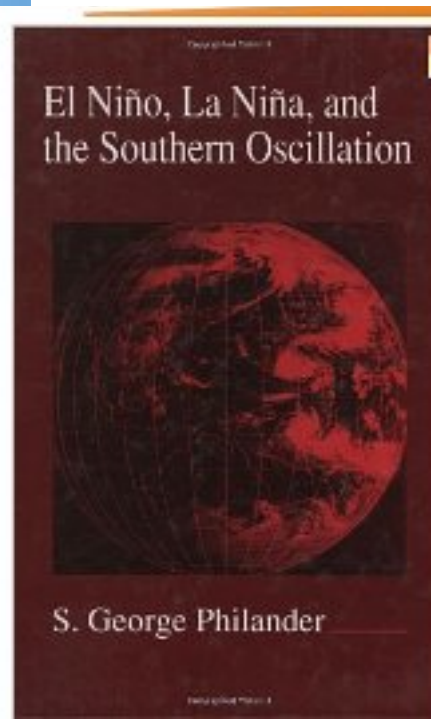


Other Books for Reference









Pre-requisites

ATOC 5050:
Atmospheric Physics and Dynamics

Grading Policy

1. Homework (30%)
2. Midterm Exam (30%)
3. Final Exam (40%)

Office hours

1. Try emailing me first with your questions or requests for an appointment. My email is dezheng.sun@noaa.gov

2. Calling me is permitted. My phone is 303 497 6272.

3. Individual meetings are preferred to be in my NOAA office (1D108, David Skaggs Research Building), but can be arranged on campus as well in one of the conference rooms of ATOC.

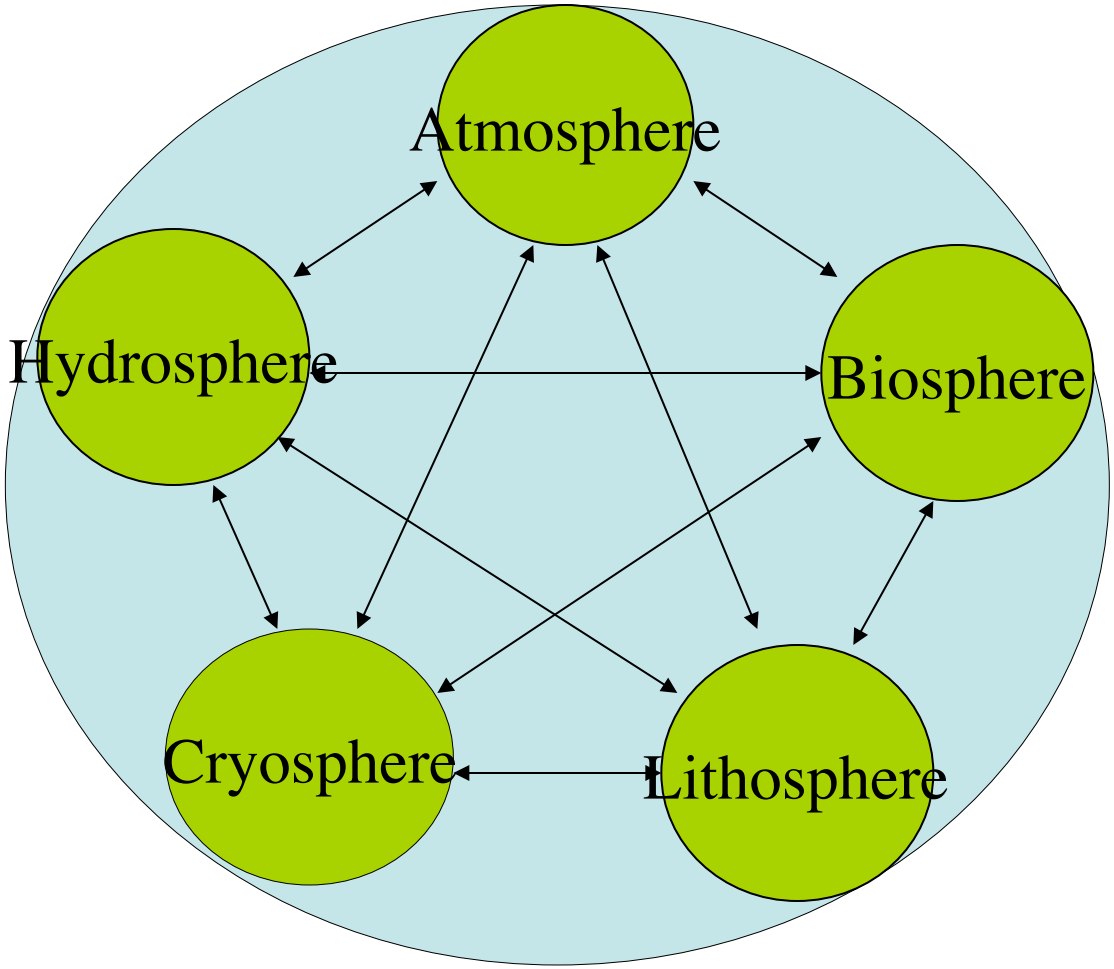
Homework

A short essay on “What I would like to learn from this class and why?” (500---1500 words)

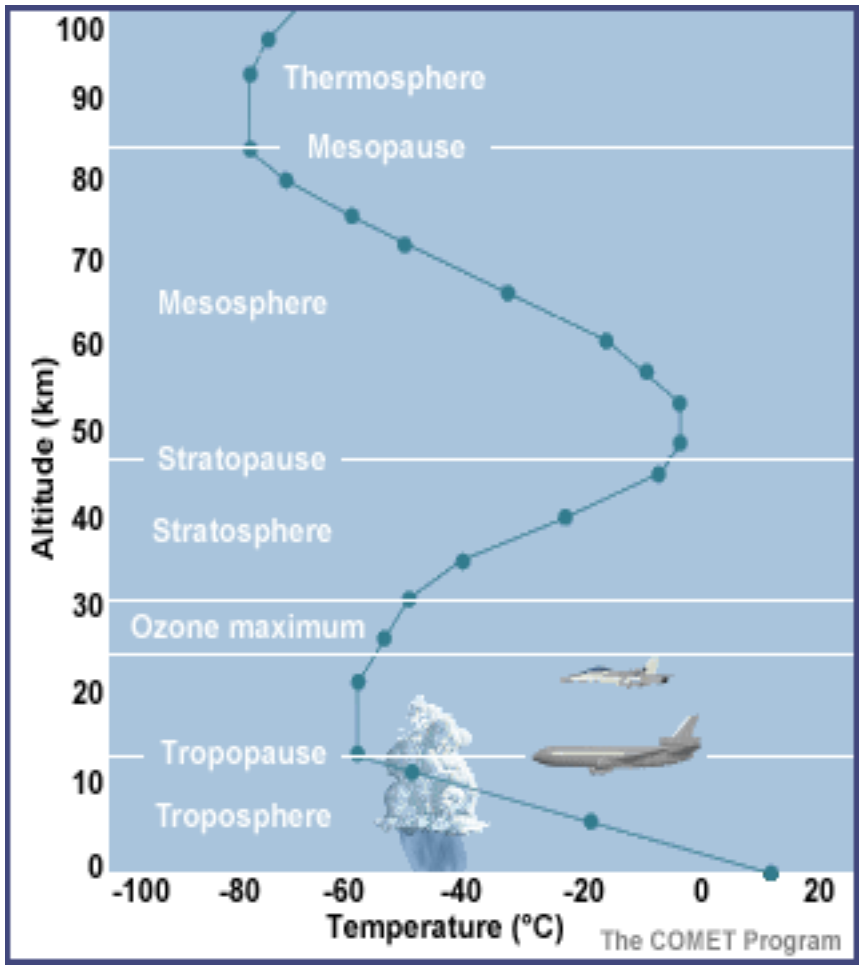
Recommended readings for the next lecture

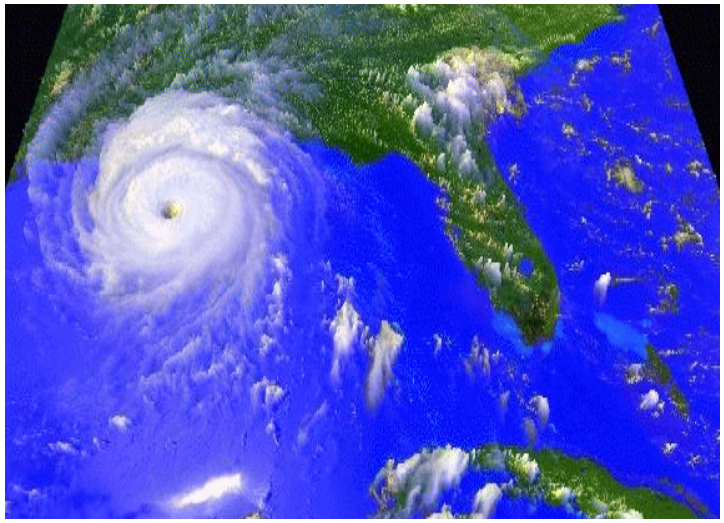
Chapter 2 of Wallace and Hobbs; Chapter 1 of Emanuel, Chapter 1 of Gill;

The Climate System



The Atmosphere





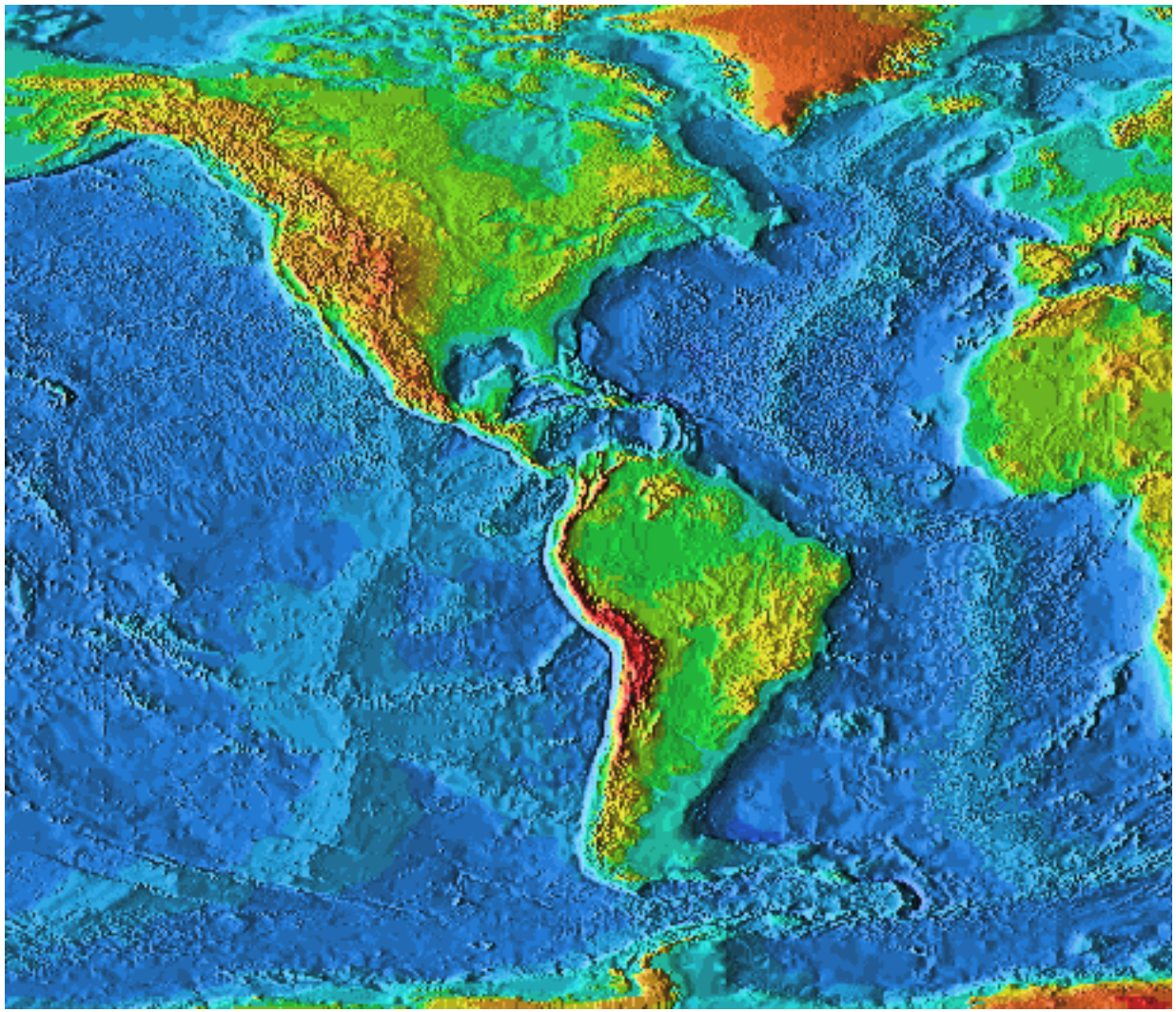
The Hydrosphere

The Cryosphere

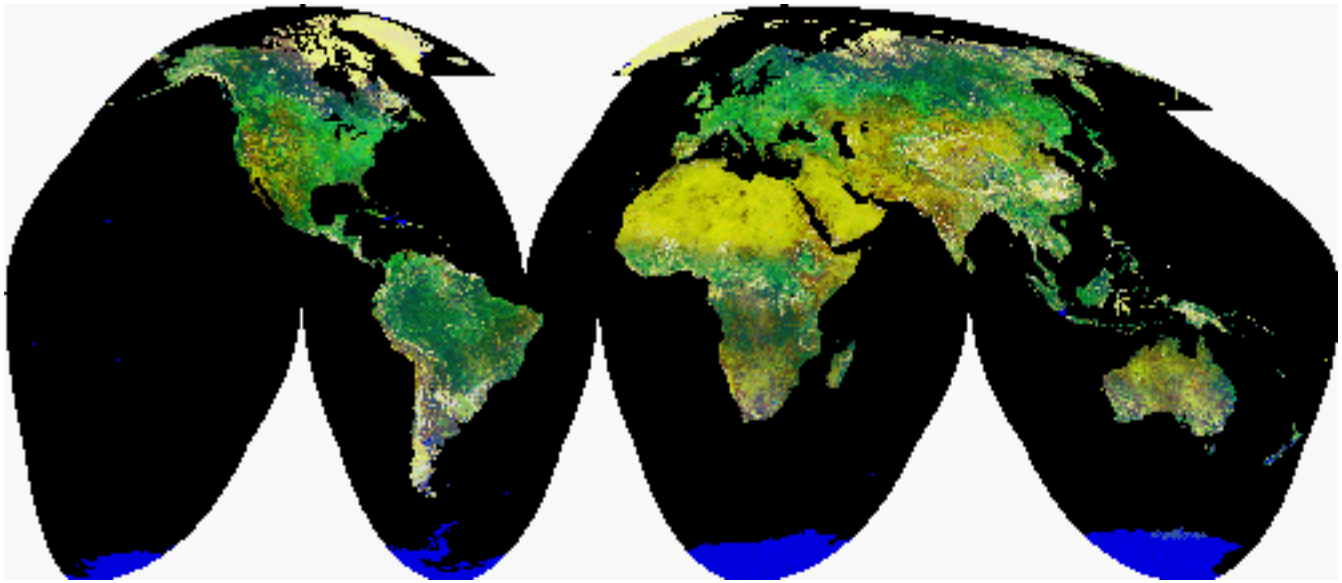
Land Ice

Sea Ice

The Lithosphere



The Biosphere



The Interactions