

# ATOC 1060-001

## OUR CHANGING ENVIRONMENT

### Class 2: Global Change (Chapter 1)

Objectives of today's class:

- 1: The changing Earth: an overview;
- 2: Three major themes of the changing Earth.

Class website: <http://atoc.colorado.edu/~whan/ATOC1060>

# Announcements

- Link to download acrobat reader: visit course website at <http://atoc.colorado.edu/~whan/ATOC1060> under “Class\_News”;
- Register your iClicker;
- Lecture updates: each Monday;
- Travels: Sep 21, 23; Oct 19,21; Lectures have already arranged;
- Student athletes: University letter;
- Disability: Disability letter.

# Exams

3 Exams:

Two in-class exams and the final exam;

One make-up exam will be offered, if you need to miss one of the in-class exams.

If you miss both in-class exams you will get a grade of zero for 1 of them.

Inform me before you miss the exam

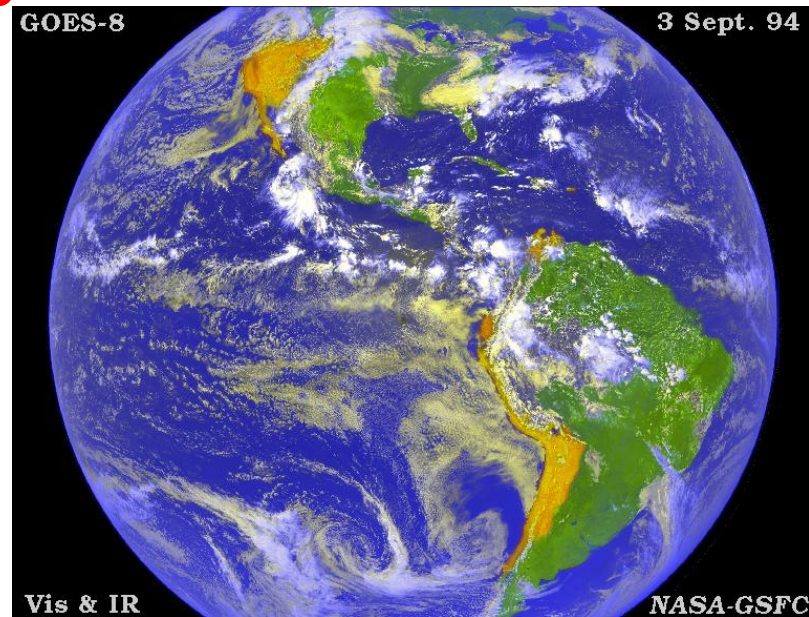
No make-up exam for the final.

# 1. The changing Earth: an overview

Earth has always been changing:  
significantly **faster rate now than the past**  
throughout most of its 4.6 billion-year history.

**Causes for the faster change  
in recent decades: human  
activities (anthropogenic  
forcing).**

**Increased population &  
high technology=> big  
impact.**



# The Earth System:



How do human impact each component of the Earth System?

*Atmosphere;*

*Hydrosphere: (e.g., land water, ocean);*

*Solid Earth (e.g. land use)  
(core, mantle and crust);*

*Biota (e.g., deforestation);*

*=> global climate.*



# Human impacts: greenhouse gases

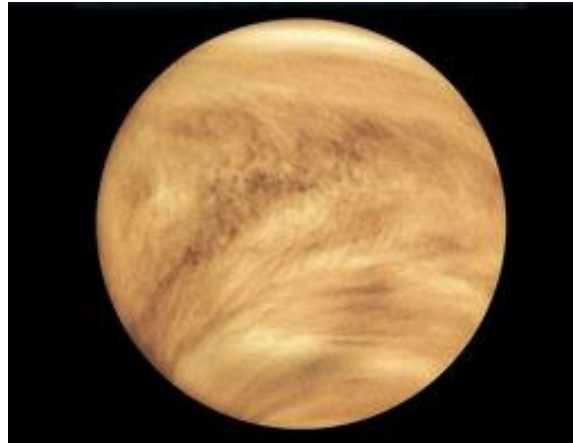
*Global climate*, the prevailing weather patterns of a planet or region over time, *is being altered by the addition of green house gases to the atmosphere.*

*Greenhouse gases* are gases that warm a planet's surface by absorbing outgoing *infrared radiation* - radiant heat - and reradiating some of it back toward the surface. This process is called the

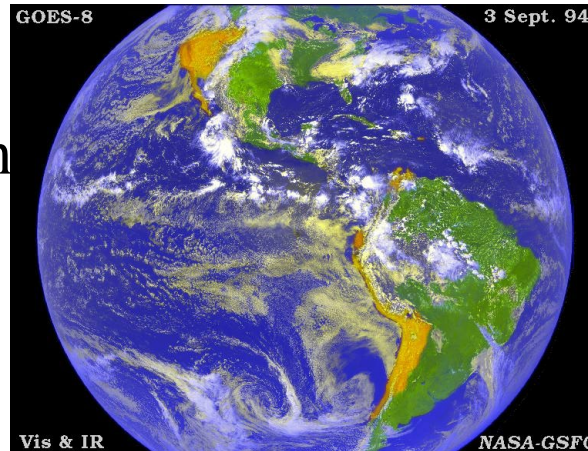
*Greenhouse effect.*

A natural physical process in all planetary atmosphere

Venus



The Earth



Venus -  $460^{\circ}C$  ( $CO_2$  carbon dioxide: major composition)  
Earth -  $15^{\circ}C$   $CO_2$  much less



On Earth, most abundant  
**anthropogenic greenhouse gases are  $CO_2$**

**Burning fossil fuels**

(coal, oil, natural gas - contains fossilized remains of organisms)

**Deforestation**

(trees cut down, decay, release  $CO_2$  )

→ **Global warming**, *a warming of Earth's due to an anthropogenic enhancement*

**Natural processes:** produce/consume  $CO_2$

**Volcanic emissions**  
(10%  $CO_2$ )

**Cycled back & forth**  
by **living plants & animals**



→  $CO_2$  abundance is controlled by a combination of natural and human-induced processes

# Human impact: Ozone depletion

**Ozone layer:** a chemically distinct region within the stratosphere (part of the earth's atmosphere)

Protect Earth's surface from the Sun's harmful ultraviolet (UV) radiation.

**Antarctic ozone hole** in recent decades, a patch of extremely low ozone concentration, is thought to be human origin (freon can destroy ozone)

# Human impact: deforestation

**Deforestation** (mainly in the tropics) at a fast rate; kill off many species of plants and animals; **decrease biodiversity** (the number of species present in a given area).

Meanwhile, **deforestation**  atmospheric  $CO_2$ .

# Are these anthropogenic effects urgent problems?

Earth is altered by human  
activities currently at an  
unprecedented rate:

- a) Increased greenhouse gases  
=>global warming – entire earth;
- b) Chlorine-containing compounds (freon)  
=>ozone depletion, ozone hole – mainly southern  
hemisphere;
- c) Tropical deforestation  
=>decrease biodiversity release.  $CO_2$

## 2. Three major themes of the changing Earth

### a) Global environmental issues: what should we do about them?

(global warming, ozone depletion, deforestation):

IPCC AR4 (Intergovernmental Panel on Climate Change, the 4<sup>th</sup> Assessment Report) – “Warming of the climate system is unequivocal,…” – how much due to human? Controversial.

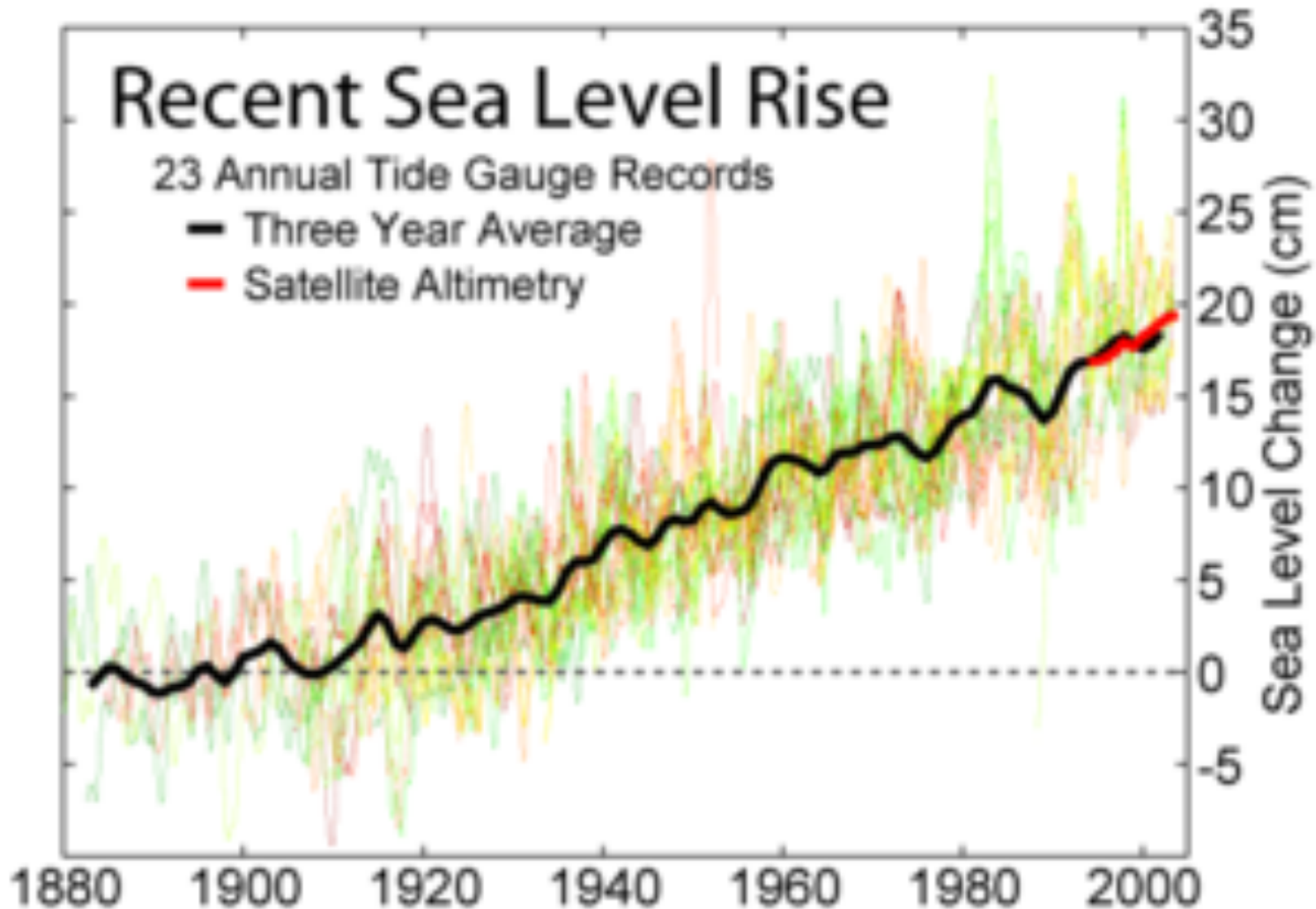
Intelligent decision requires scientific knowledge;  
politics: science incomplete, costly;

=> need to understand the problems.



# Possible consequences?

## Sea level Rise:



# Regional: Non-uniform regional change

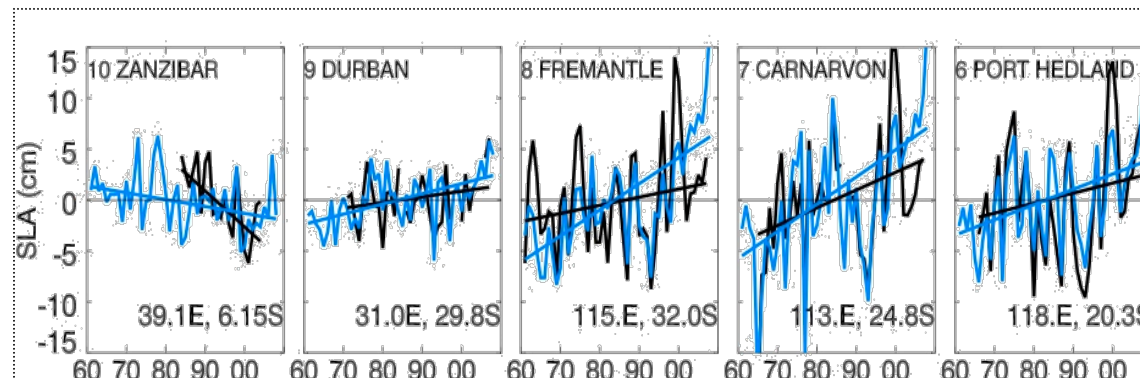
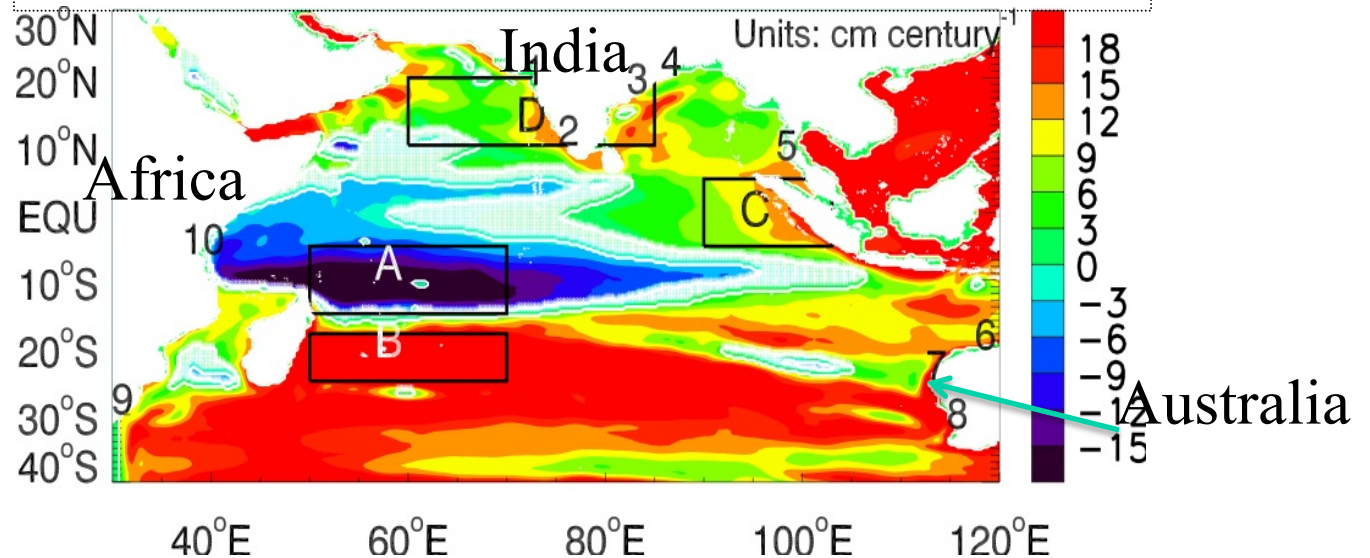
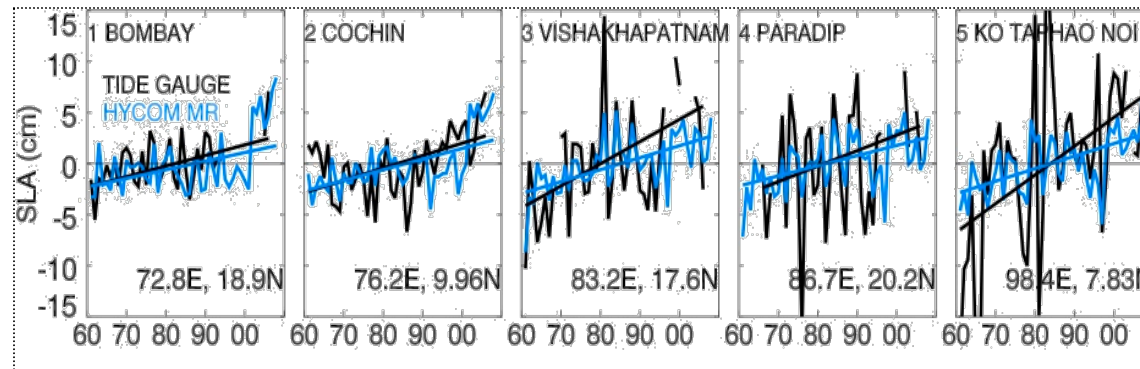
Han et al. 2010

Nature

Geoscience;

“Partly due to  
Anthropogenic and  
Partly due to natural  
Variability”

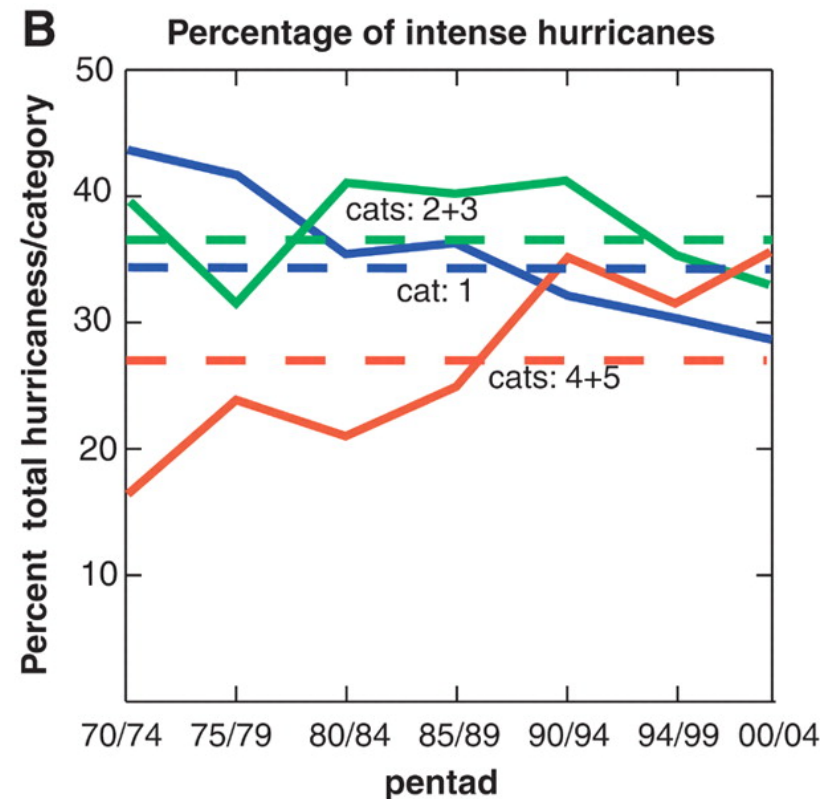
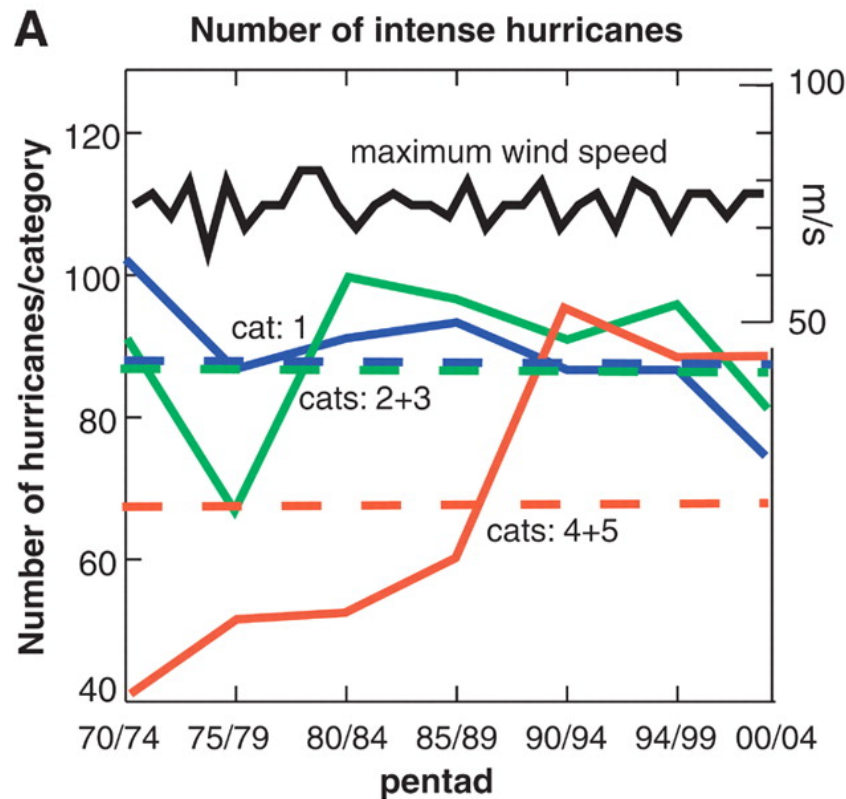
Regional: Important  
for risk assessments.



# Extreme climate events: Are hurricanes intensified?

Webster et al. 2005: Science:

Possible effects: Global warming & Hurricane intensity;



Increased heat waves?

b) How to estimate and understand human impact? → Global change in the past.

Understand the past before humans came on the scene: long + short time scale changes. Cores Drilling Program => today we are in *interglacial* period in between *glacial* periods.

Understand the present climate with human influence.

### c) The Earth system.

A system is a group of components that interact.

The Earth  
system:

Atmosphere

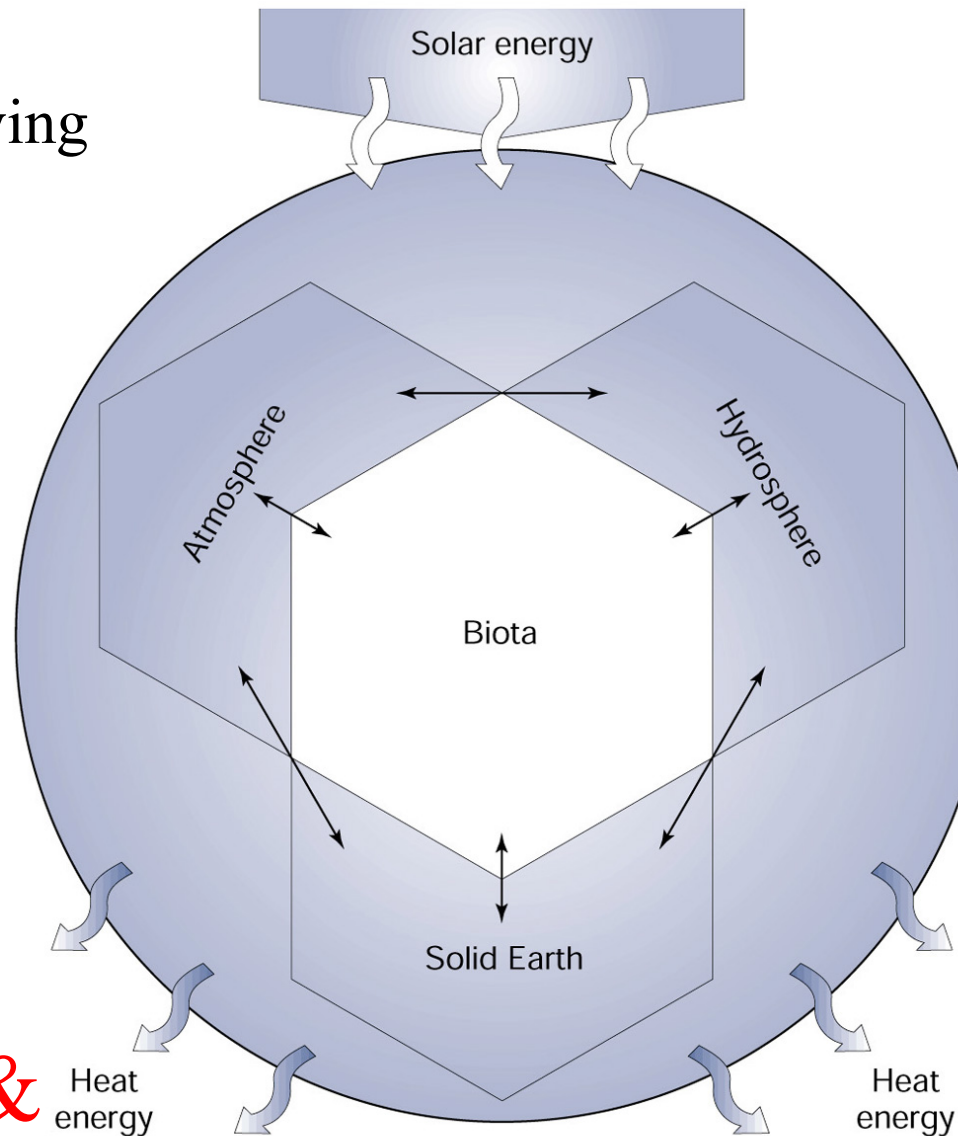
Hydrosphere: water

Biota: all living organisms

Solid Earth

Fig 1-1 of text book.  
Schematic diagram of  
the Earth system, showing  
interaction among its  
four components.

One goal:  
understand  
how these  
components  
interact in  
response to  
various internal &  
external influences.



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# Summary

## 1. The changing Earth: an overview

**Emphasis - human-induced changes:**

- a) Global warming: Increased greenhouse gases
- b) Ozone depletion: freon
- c) Tropical deforestation

## 2. Three major themes

- a) Global environmental issues
- b) Climate in the past
- c) The Earth system