# Earth System Science and The Carbon Cycle

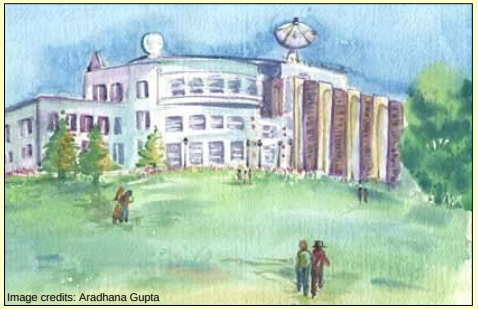

**Anupma Prakash**

Day : Monday
Date : September 26, 2008
Audience : AMIDST Participants

Geophysical Institute, University of Alaska Fairbanks

## My contact details







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## Contents





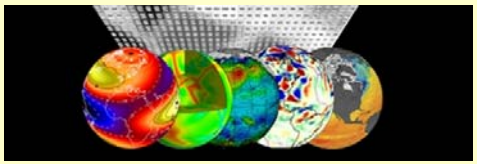

Image credits: ESSE Design Guide



## Traditional Earth Science



Photo Credits: NSF EDGE Program

## Earth System Science

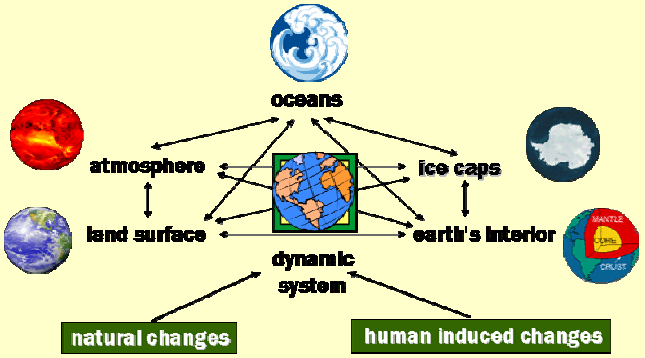


Figure credit: A. Prakash



## The Difference

- ESS deals with the relationships between physical and biological systems instead of the systems themselves.
- Earth System Science uses holistic rather than reductionist approaches.
- Earth System Science is interdisciplinary, including many academic disciplines No single discipline can fully address the scope of ESS.



## Questions in ESS

How is the global Earth system *changing*?

Image credits: NASA



## Questions in ESS

What are the primary *forcings* of the Earth system?

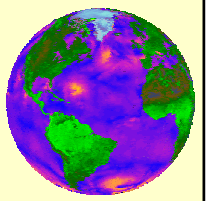

Image credits: NASA

## Questions in ESS

How does the Earth system *respond* to natural and human-induced changes?

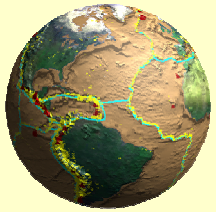

Image credits: NASA

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9

## Questions in ESS

What are the *consequences* of changes in the Earth system for human civilization?

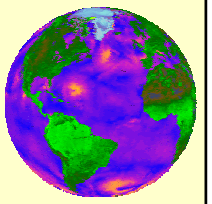

Image credits: NASA

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10

## Questions in ESS

How well can we *predict* future changes to the Earth system?

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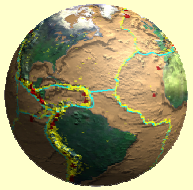
11

## The only constant is change

- Earth is changing
- Technology is changing
- Career paths are changing



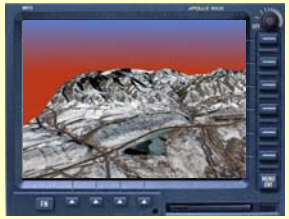


Image credits: NASA

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12

## Earth System Science

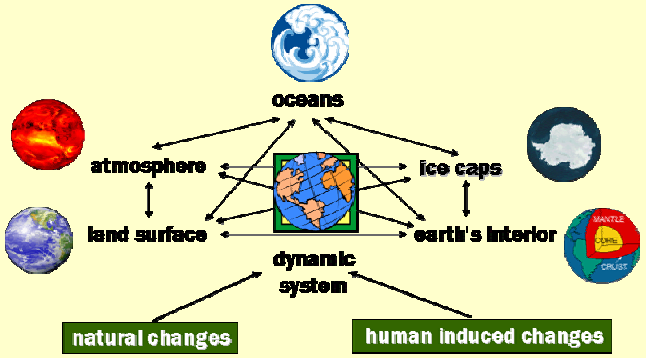



Figure credit: A. Prakash



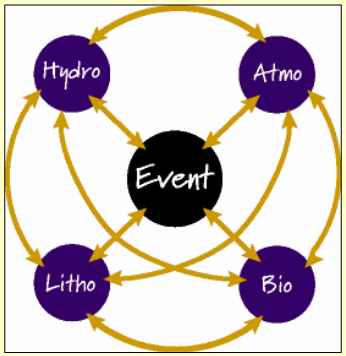
## Literature on ESS Concept

You will find several variations of the same basic thought:

- Terms change
- Complexity of diagram changes



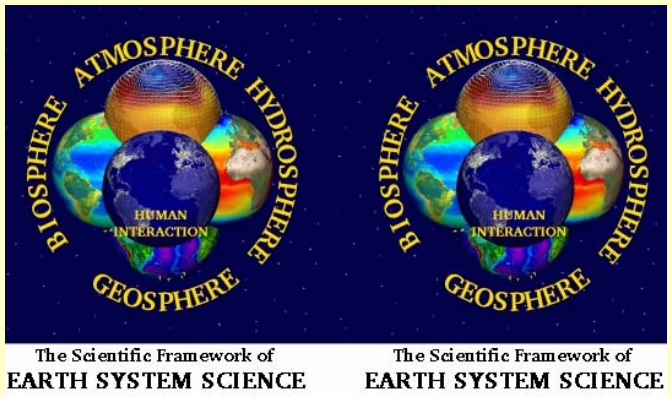
## ESS: Spheres




Source: http://www.cotf.edu/ete/ESS/ESSmain.html

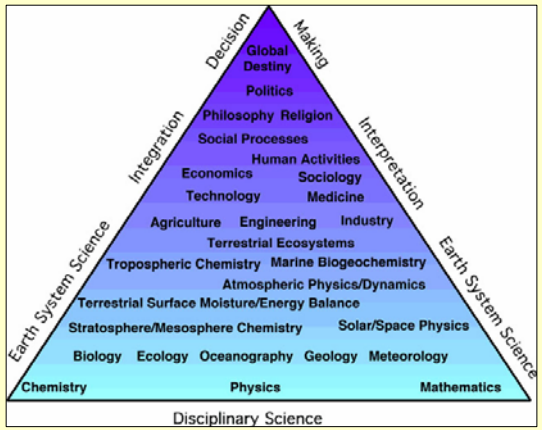


## ESS: Spheres




Source: http://essedesignguide.org

## Earth System Science

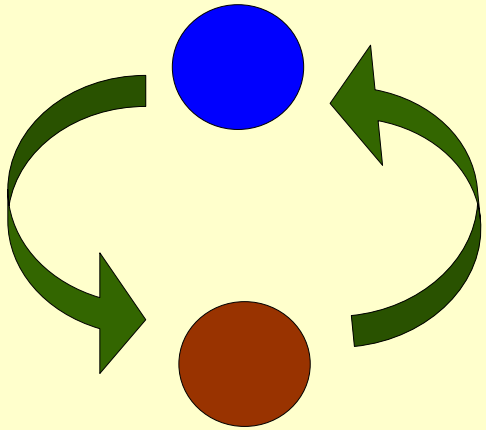



Source: "Earth System Science: A Model for Teaching Science as State, Process and Understanding" (Johnson, 2006, Journal of Geoscience Education)





## Simple Cycle (System)







## Making it Complex

- Keep adding the spheres
- Keep adding the connecting arrows
- Extend beyond the Earth
  - eg. Sun-Earth Connection/System
  - The Planetary System

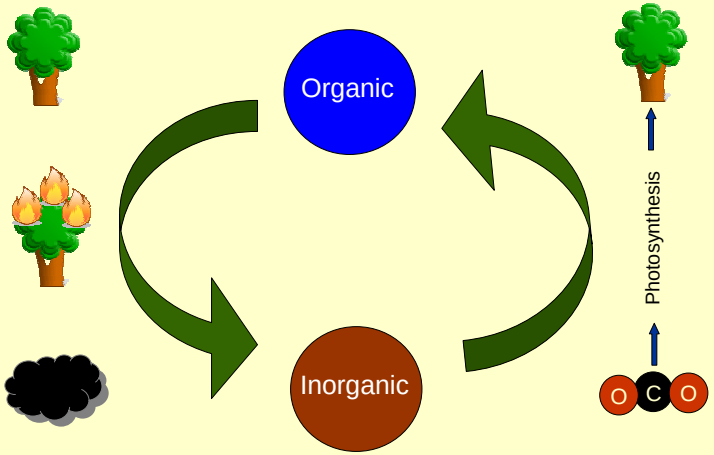




## Let's pause and think…

- About Our Complex Earth System
- Let's use the example of one element (Carbon) and see how it cycles
  - Simple to Complex Scenario Building

## Inorganic/Organic Cycle

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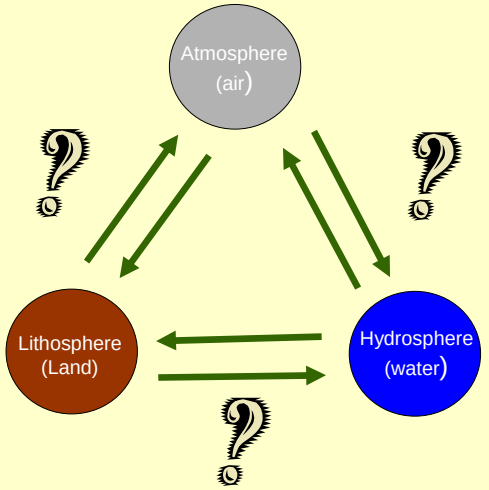
21

## Inorganic/Organic Cycle

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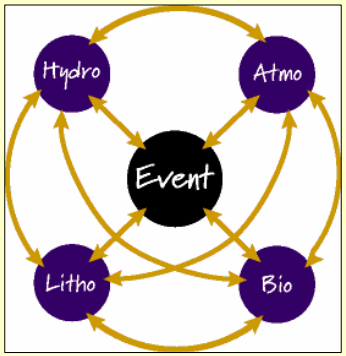
22

## Carbon Cycling in the Spheres




Source: http://www.cotf.edu/ete/ESS/ESSmain.html

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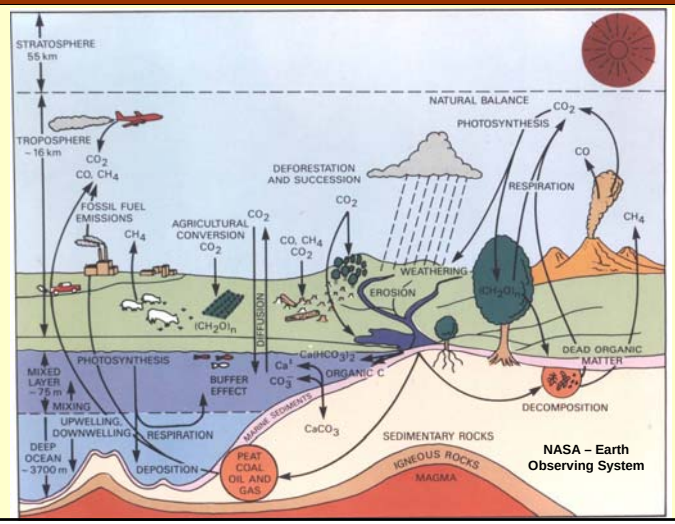
23

## Carbon Cycle: One Schematic

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24

## Looking Beyond Carbon

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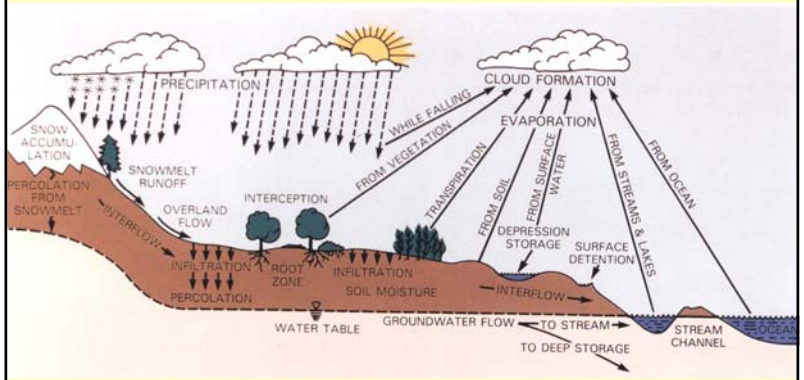
You can start seeing the connectivity and cycles in practically everything once you start taking a "systems approach" to thinking

25

## The Hydrologic Cycle




NASA – Earth Observing System

26

## Some Resources:

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- Earth System Science Education Design Guide: http://essedesignguide.org
- Symphony of Sphere: Special Issue of the Journal of Geoscience Education www.nagt.org/nagt/jge/abstracts/may06.html
- The Carbon Cycle: Module by D. Anastasio www.ei.lehigh.edu/esse/carbon/

27

## Questions?

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28