

# Global Change



and the  
**Earth System**

Bill Young

International Geosphere-Biosphere Programme, IGBP

# IGBP Vision and Goal

***The Vision:*** to provide scientific knowledge to improve the sustainability of the living Earth.



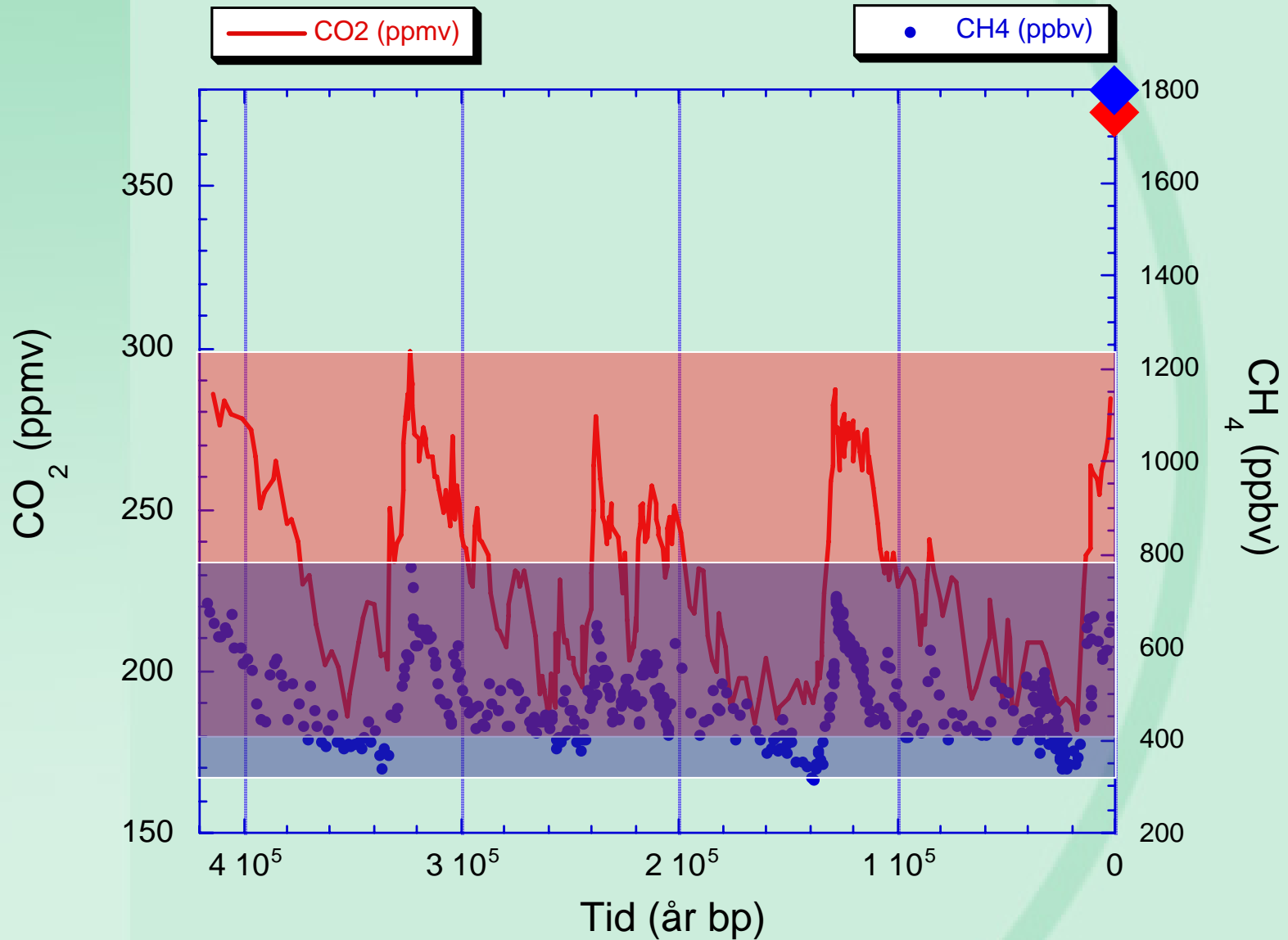
- IGBP studies the interactions between biological, chemical and physical processes and human systems
- IGBP collaborates with other programmes to develop and impart the understanding necessary to respond to global change

# The Foundations

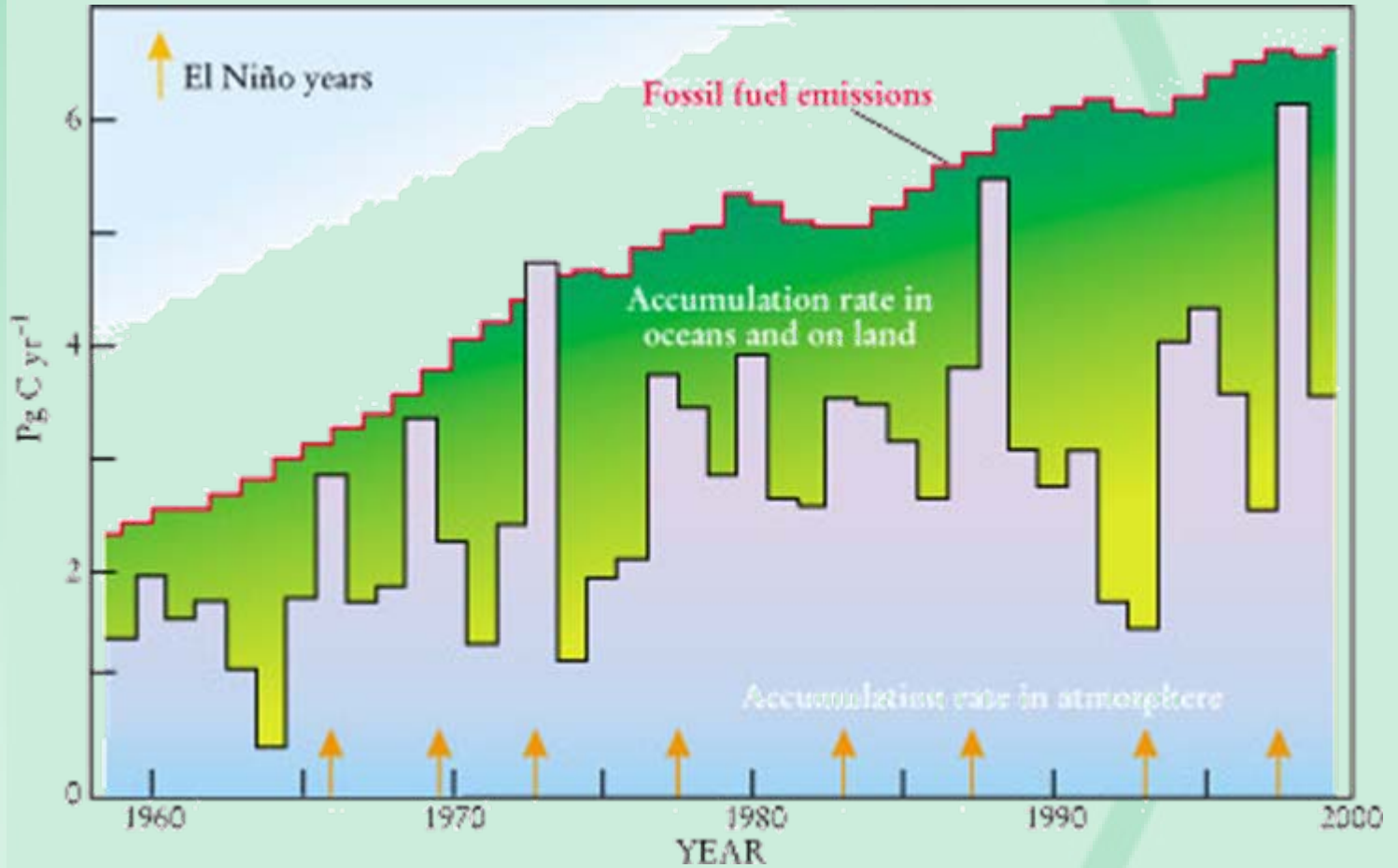


- Biological processes play a much stronger role in Earth System functioning than previously thought.
- Global change is much more than climate change. It's real, it's happening now and it's accelerating.
- The Earth's dynamics are characterised by critical thresholds and abrupt changes.
- Human activities drive multiple, interacting effects that cascade through the Earth System in complex ways with potentially catastrophic consequences.
- The Earth is currently operating in a no-analogue state.

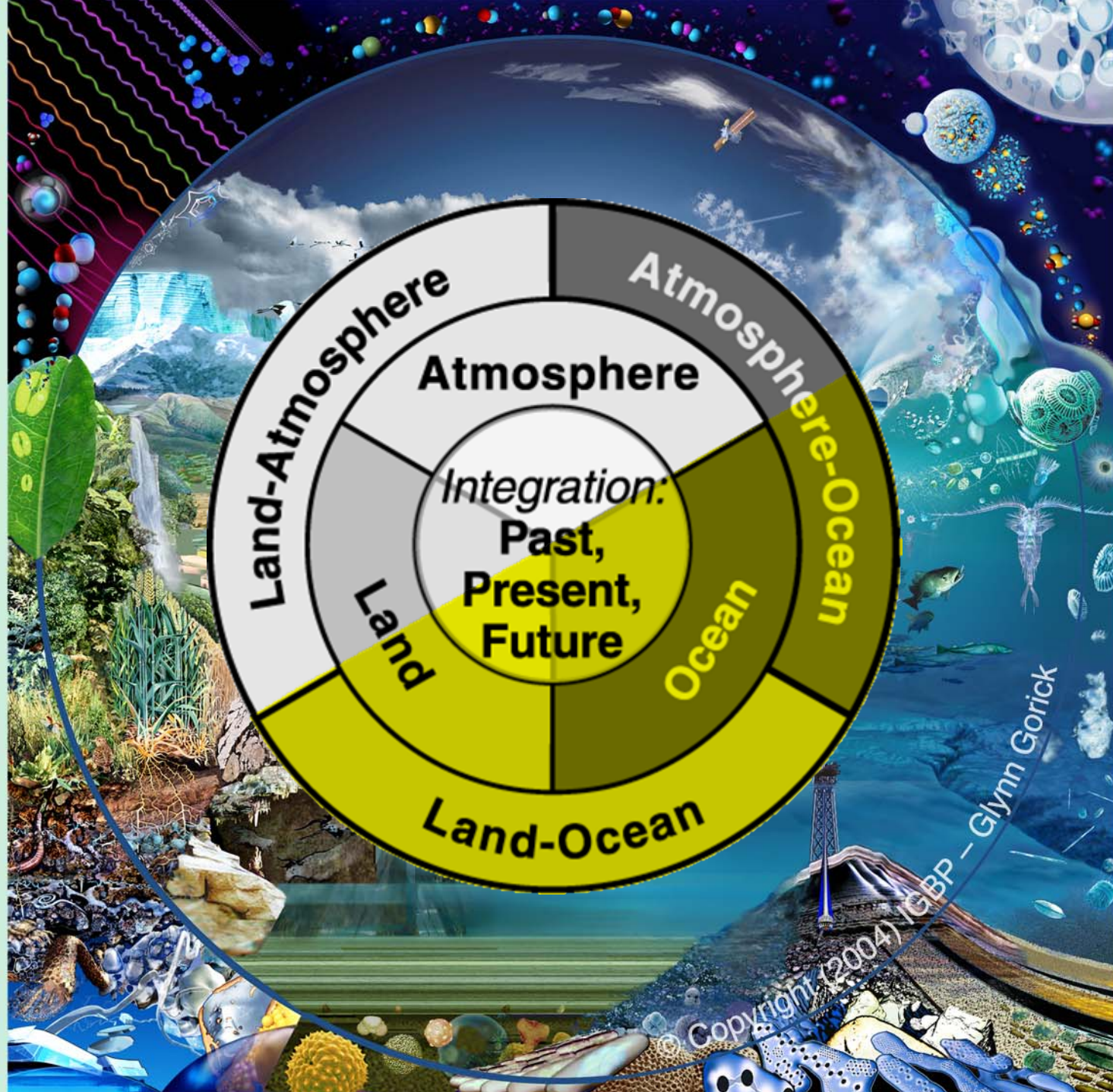
# Vostok Ice Core



# Contemporary Changes





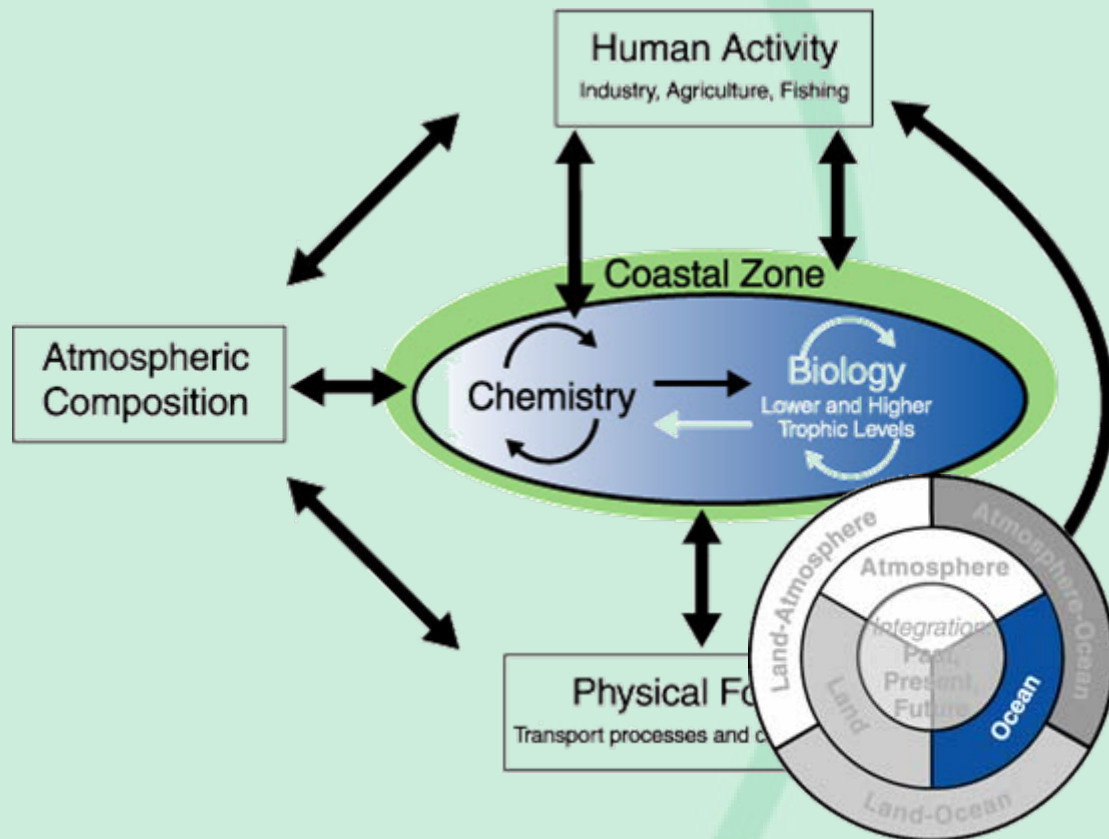


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# Oceans

- Integrated approach linking biogeochemistry and ecosystems
- Links to chemical-physical and human dimensions of global change
- Predicting consequences of global change for the ocean to investigate pathways towards sustainability

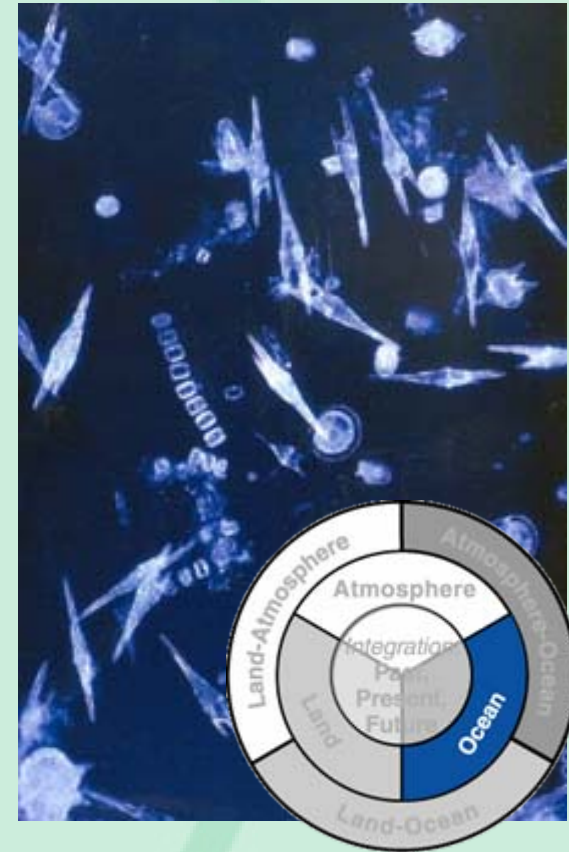






# Ocean Ecosystem Dynamics

- to advance the understanding of the structure and functioning of the global ocean ecosystem, its major subsystems, and its response to physical forcing...
- so that a capability can be developed to forecast the responses of the marine ecosystem to global change

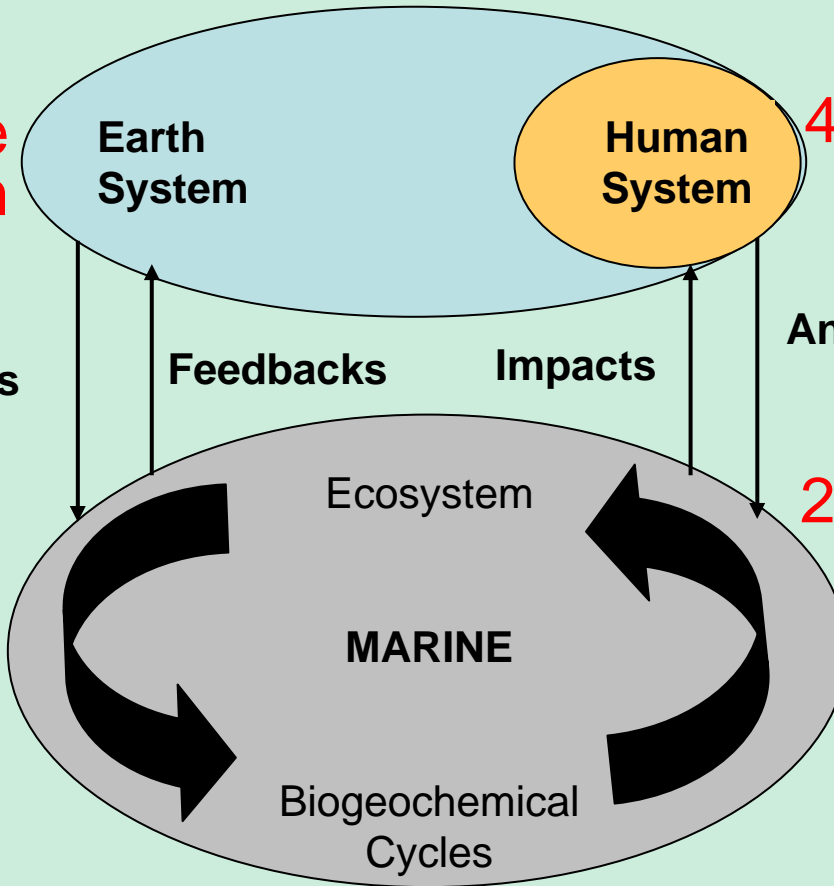




# IMBER Themes

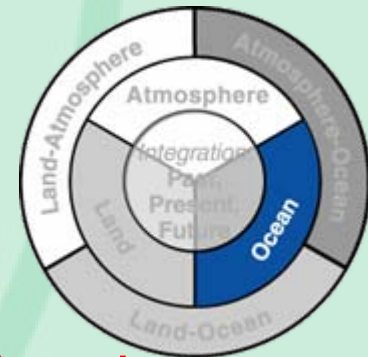
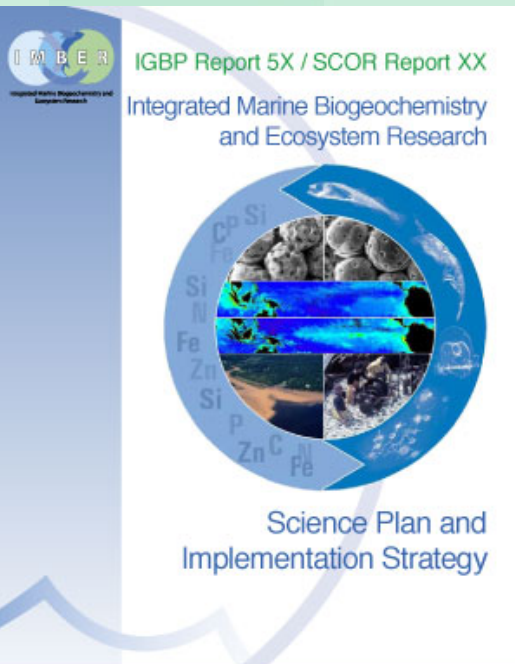
3. Feedbacks to the Earth System

4. Responses of Society



2. Sensitivity to Global Change

1. Interactions between Biogeochemical Cycles and Marine Food Webs





# Ocean-Atmosphere

- Biogeochemical interactions and feedbacks between ocean and atmosphere
- Exchange processes at the air-sea interface and the role of transport and transformations in atmospheric and ocean boundary layers
- Air-sea flux of CO<sub>2</sub> and other long-lived radiatively active gases

[www.solas-int.org](http://www.solas-int.org)



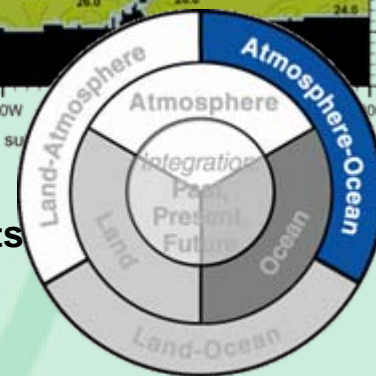
Ocean iron addition experiments

IGBP Report 50

The Surface Ocean – Lower Atmosphere Study

Science Plan and Implementation Strategy

GLOBAL CHANGE CACGP International Council for Science Scientific Committee on Oceanic Research WCRP

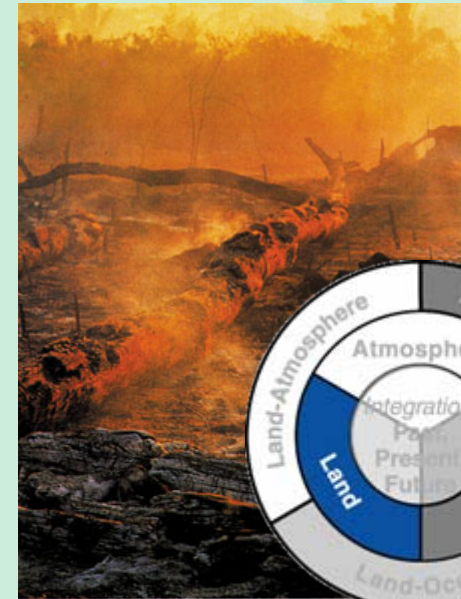




**GLP**

# Land

- The nature and causes of land system change.
- The consequences of land system change for ecosystem services and Earth System functioning.
- Support for sustainable use of land systems using integrated analysis and modelling.

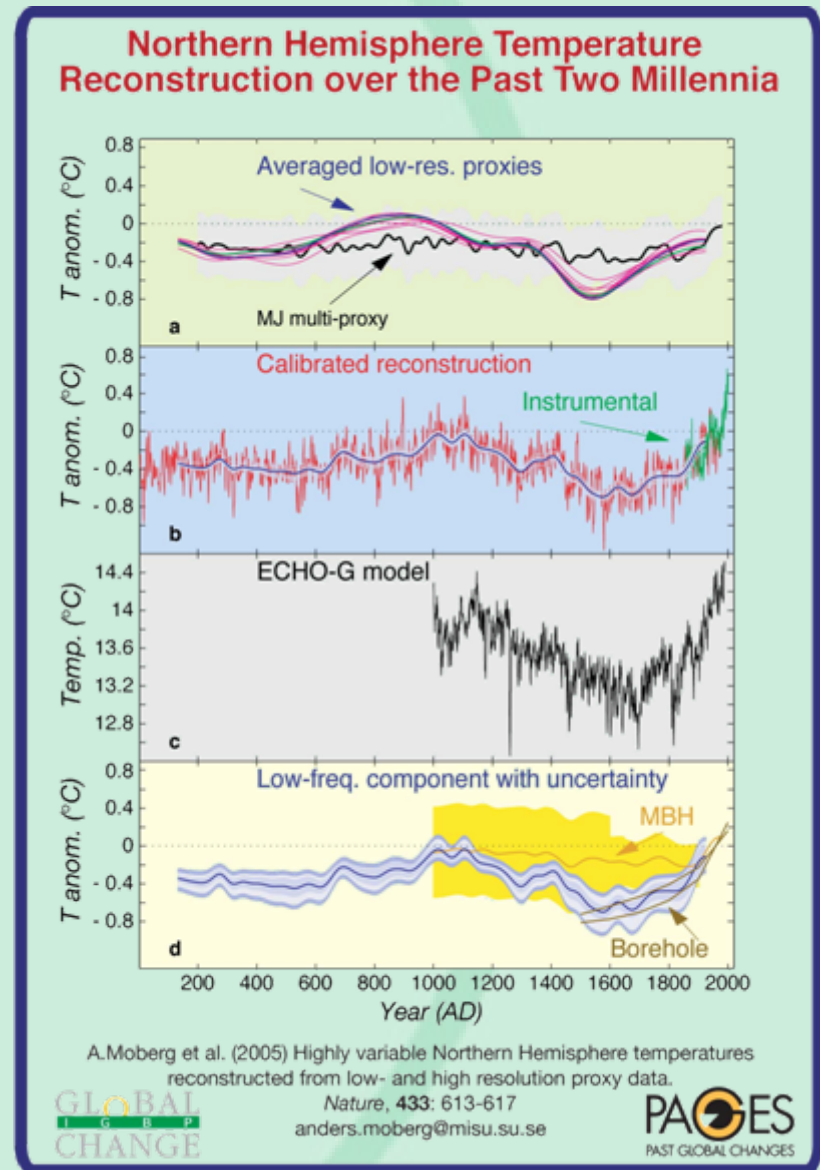


**GLOBAL  
I G B P  
CHANGE**

# Past Global Changes

## Undergoing Restructure (2005)

- Present-past liaison
- Regional variability
- Human dimensions
- Hydrological cycle
- Polar regions
- Greenhouse gases
- Interglacial variability
- Ocean acidification



# PAGES 2nd Open Science Meeting

10-12 August 2005 – Beijing, China

Paleoclimate, Environmental Sustainability and our Future

## Themes

- Future Change: Historical Understanding
- Humans and their Environment: Past Perspectives on Sustainability
- Ocean-Continent-Cryosphere Interactions: Past and Present
- Climate, Humans and the Environment in Asia
- PAGES Research Foci and Initiatives



*Poster contributions are invited from the entire PAGES community.*

*Poster abstract submission deadline:*  
**31 March 2005**

The meeting will focus on understanding past processes and natural variability—within the topics of climate, environmental change and human impact—in order to develop predictive models of the future.

The meeting is being held alongside the 9th IAMAS Scientific Assembly (2-11 August 2005; [www.iamas2005.com](http://www.iamas2005.com)).

[www.pages2005.org](http://www.pages2005.org)

Contact: [osm@pages.unibe.ch](mailto:osm@pages.unibe.ch)



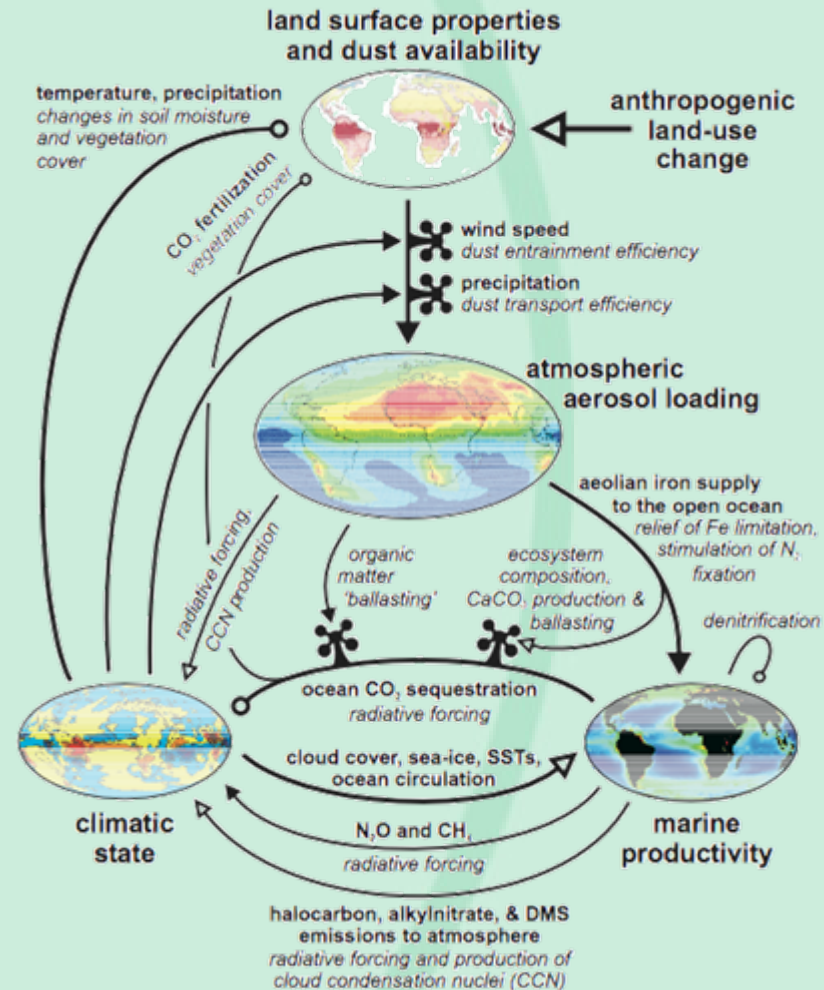
# AIMES: Analysis, Integration and Modelling of the Earth System

- Earth System modelling at various complexities
- Formalisation of human dimensions in the Earth System
- Institutional network
- Postdoc Network
- Earth System Atlas, C<sup>4</sup>MIP, GEIA, IHOPE...



# Fast-Track Initiatives

- Initial FTIs
  - Fire (continuing)
  - Global Iron Cycle (complete)
  - Global Nitrogen Cycle (concluded as FTI)
- New FTIs
  - Ocean Acidification
  - An Earth System Perspective on Sustainability
  - State of the Earth in 2050





# IGBP Science Plans

## *Published*

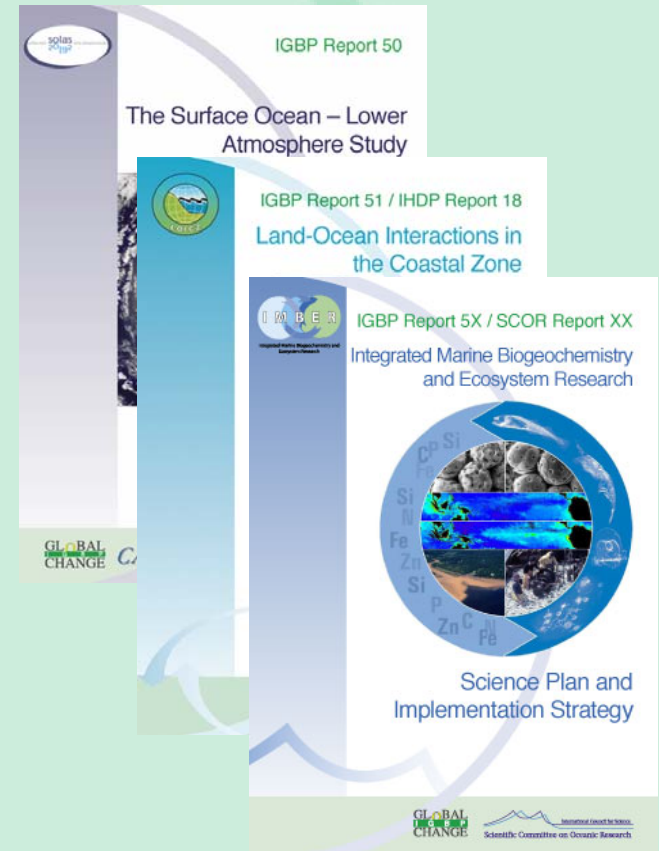
- SOLAS, LOICZ

## *In press*

- IMBER, IGAC, LOICZ,  
iLEAPS & GLP

## *Under revision*

- IGBP Science Plan

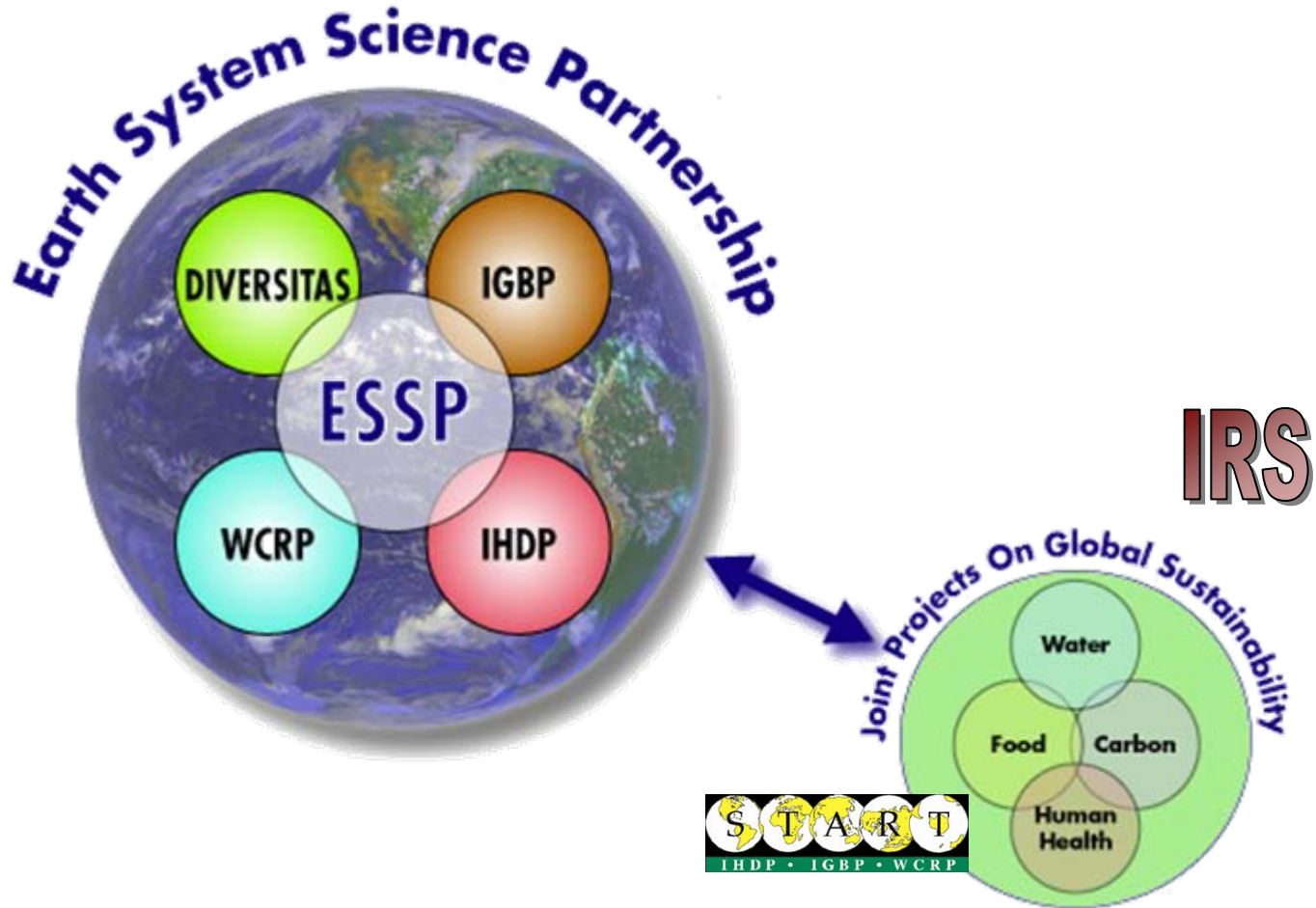


- an integrated study of the Earth System,
- the changes occurring to the System, and
- the implications for global sustainability.

## Open Science Conference Beijing, China, Nov 2006



# Earth System Science Partnership



ESSP is a joint initiative of



[www.globalcarbonproject.org](http://www.globalcarbonproject.org)

- what are the geographical and temporal patterns of carbon sources and sinks?
- what are the controls and feedback mechanisms - natural and anthropogenic - that determine the dynamics of the carbon cycle on scales of years to millennia?
- what are the future dynamics of the carbon-climate system and the opportunities for managing this system?



[www.gwsp.org](http://www.gwsp.org)

- what are the **relative magnitudes of changes** in the GWS due to human activities and environmental factors?
- what are the social and Earth System **feedbacks** of human-driven change to the GWS?
- to what extent is the GWS **resilient** and **adaptable** to global change?



[www.gecafs.org](http://www.gecafs.org)

- how will global env change affect the **vulnerability** of food systems in different regions?
- how can we **adapt** food systems to cope with global env change and improve food security?
- how will adaptation options **feed back** on env and socioeconomic conditions?



# Human Health

(Under Development)

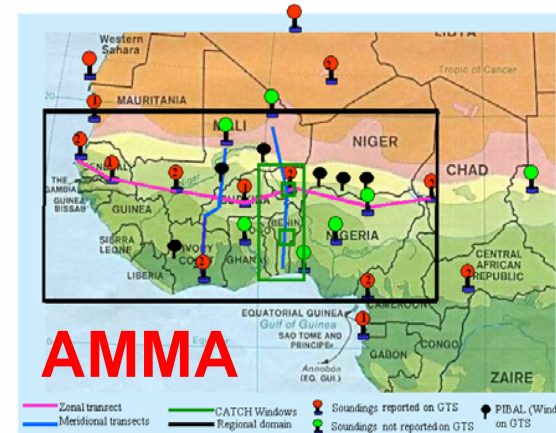
## Goals:

- to determine the past, current and future health impacts of global environmental change
- to enrich the policy discussion about mitigation and adaption from a human health perspective



# Integrated Regional Studies

- assess the influence of regional processes on Earth System function (and vice-versa)
- be integrative: natural & social sciences, all Earth System components, planning to synthesis
- contribute science to support regional sustainable development
- be driven by scientists in the region with global collaboration
- LBA, MAIRS, AMMA...





# Involvement in IGBP

- Contribution to research of projects
- Subscribe and contribute to project newsletters &/or the Global Change NewsLetter
- Attend project OSCs &/or ESSP OSC



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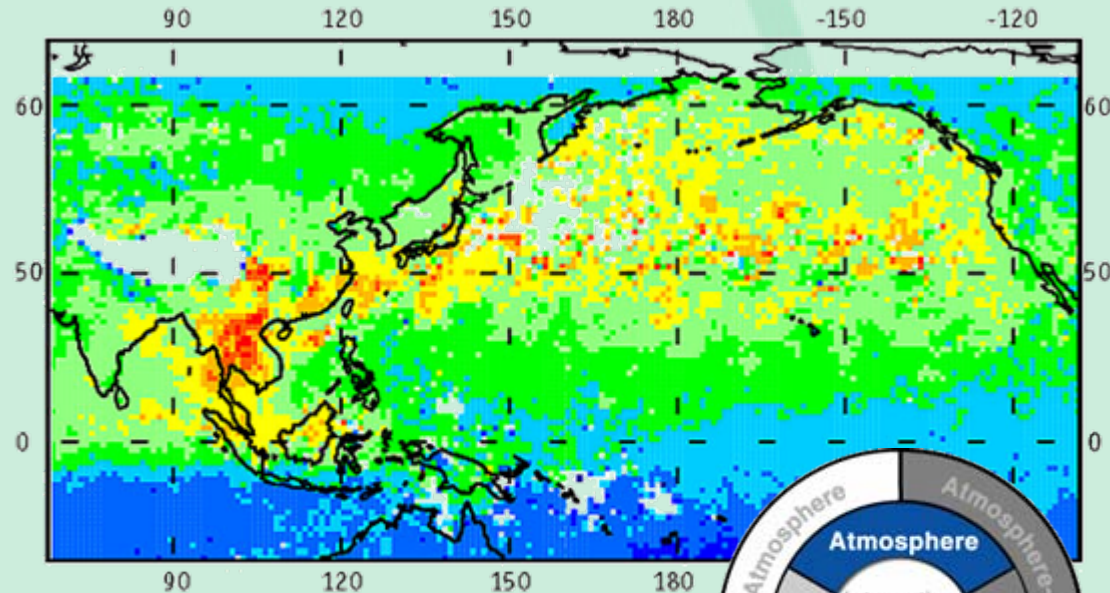
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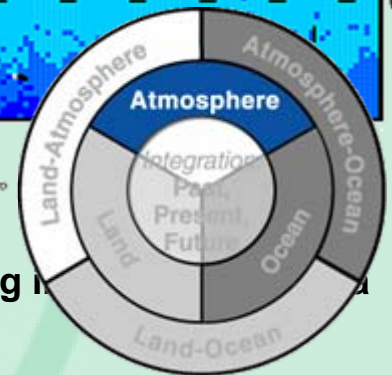
# Atmosphere

- The role of atmospheric chemistry in amplifying or damping climate change.
- The effects of changing regional emissions and depositions, long-range transport, and transformations on tropospheric chemical composition and air quality.



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**Carbon monoxide from biomass burning plume which extends to North America**





# Land-Atmosphere

- Exchange of reactive and conservative compounds.
- Feedbacks between land biota, aerosols, atmospheric composition and climate.
- Dynamics of the land surface-vegetation-water-atmosphere system
- Measuring and modelling material and energy transfers in the soil-canopy-boundary layer system.

