

# **World Climate Research Programme Contributions to Science for Sustainability**



**David Carson  
Director WCRP**

**Energy and Sustainability Science  
Tokyo, 16-19 December 2003**

# **World Climate Research Programme (1980)**

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## **Objectives**

- ◆ **To determine to what extent climate can be predicted**
- ◆ **To determine the extent of human influence on climate**

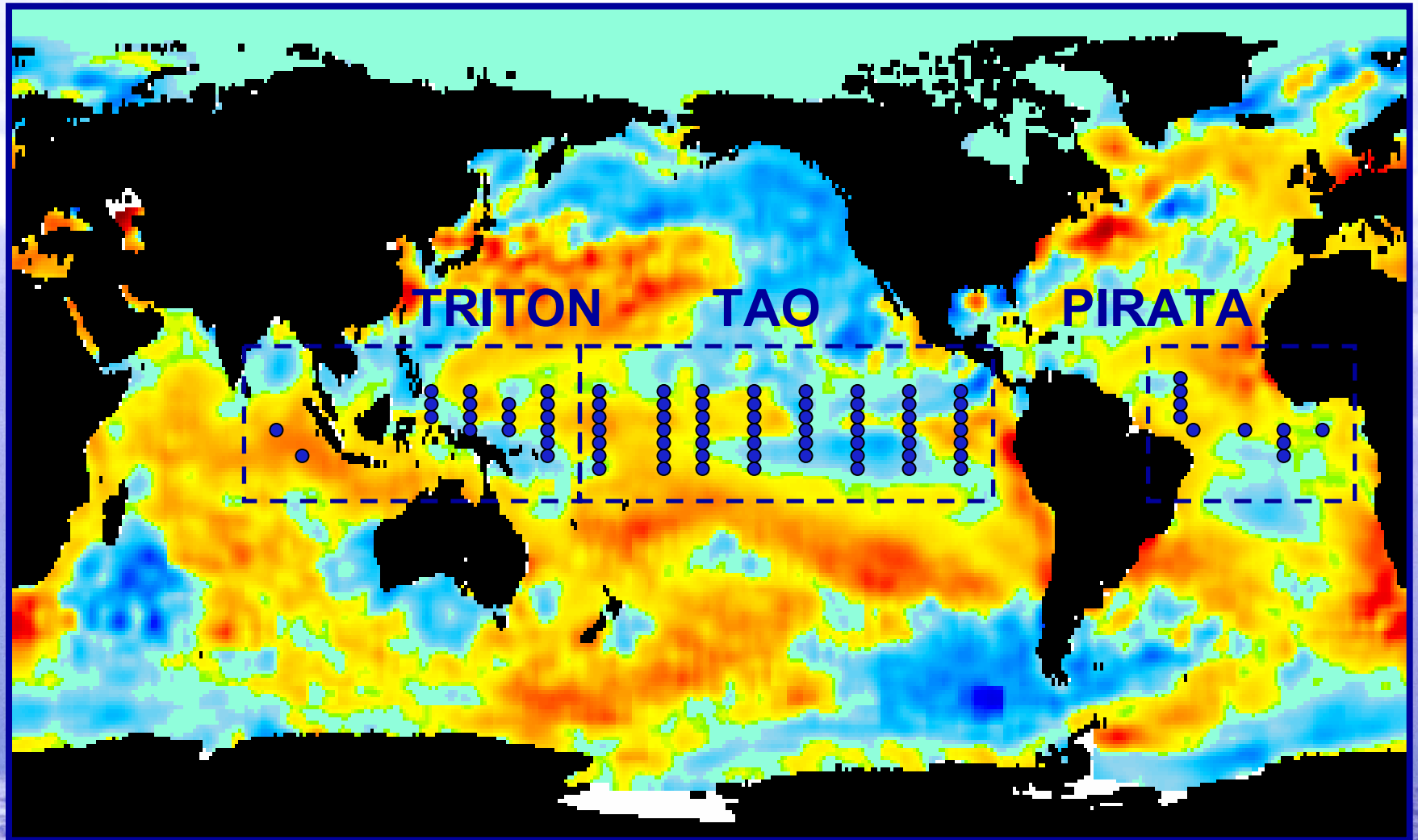
## **Priorities (1997)**

- ◆ **Assessing the nature and predictability of seasonal to inter-decadal climate variations at global and regional scales**
- ◆ **Providing the scientific basis for operational predictions**
- ◆ **Detecting climate change and attributing causes**
- ◆ **Projecting the magnitude and rate of human-induced change (as input for IPCC, UNFCCC, ...)**

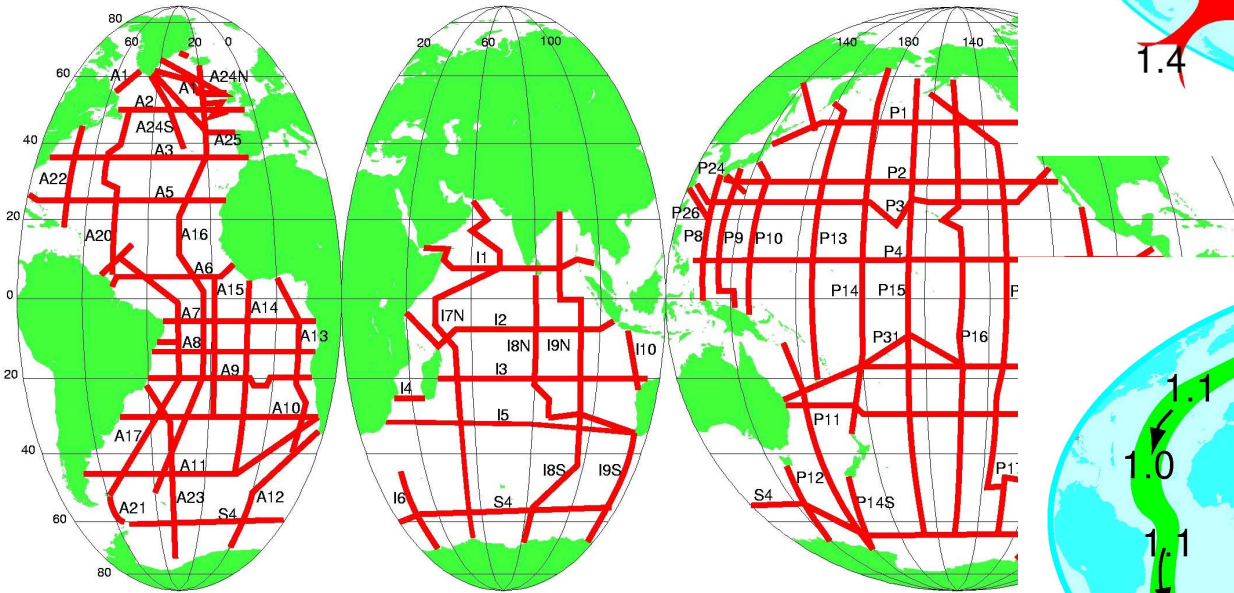
# Observations

- Monitoring
- Detection
- Attribution
- Diagnostic studies
- Development & testing of hypotheses
- Process studies
- Wide range of modelling uses

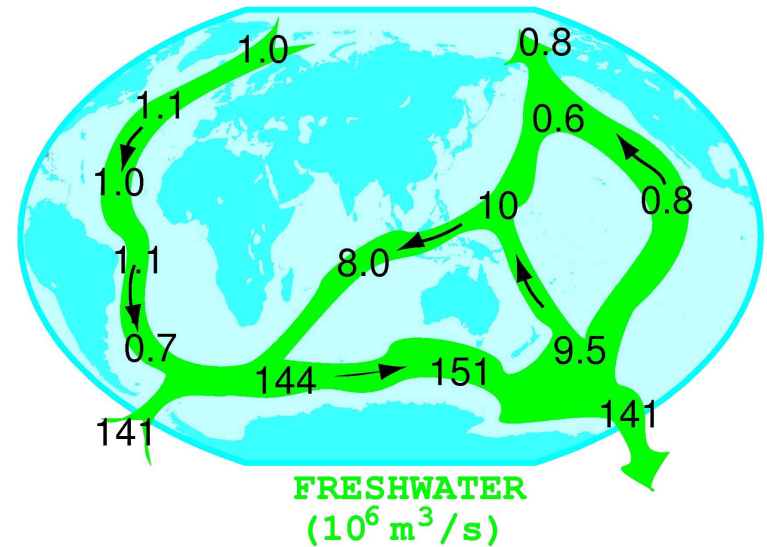
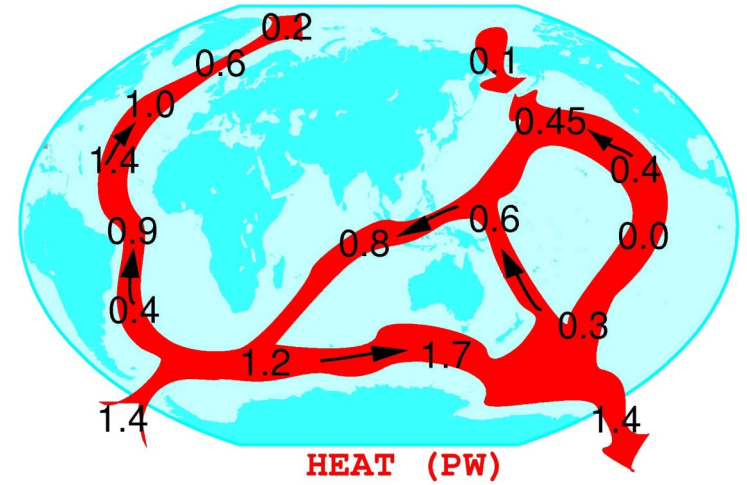
# Status of the Tropical Moored Buoy Network



# The Oceans

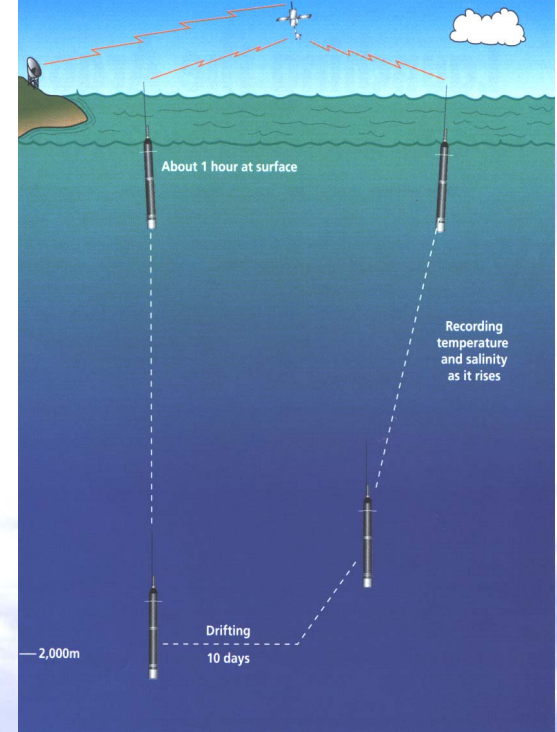
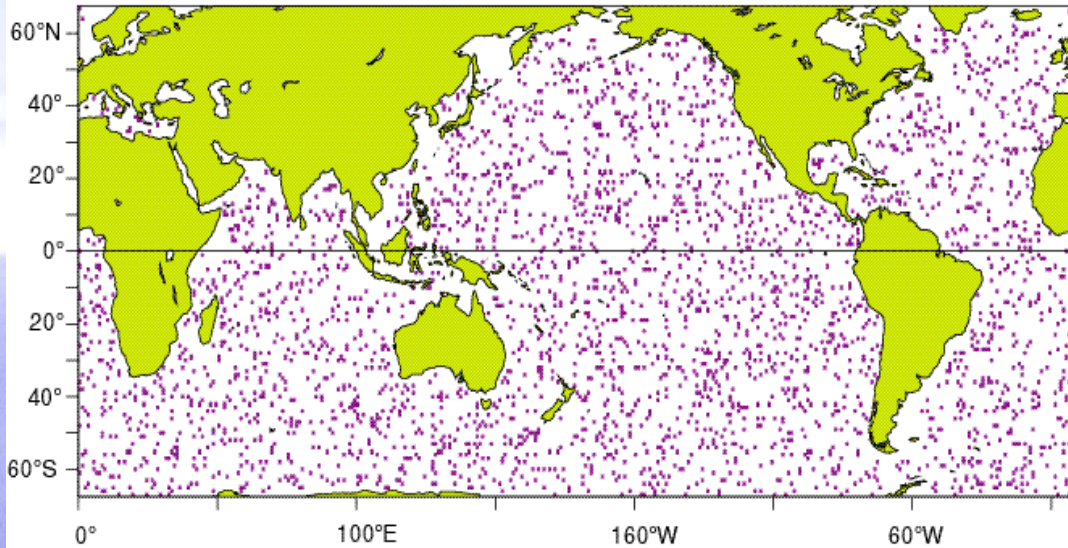


WOCE Hydrographic Programme One-Time Survey  
(Penny Holliday, WOCE IPO)



# Argo implementation status

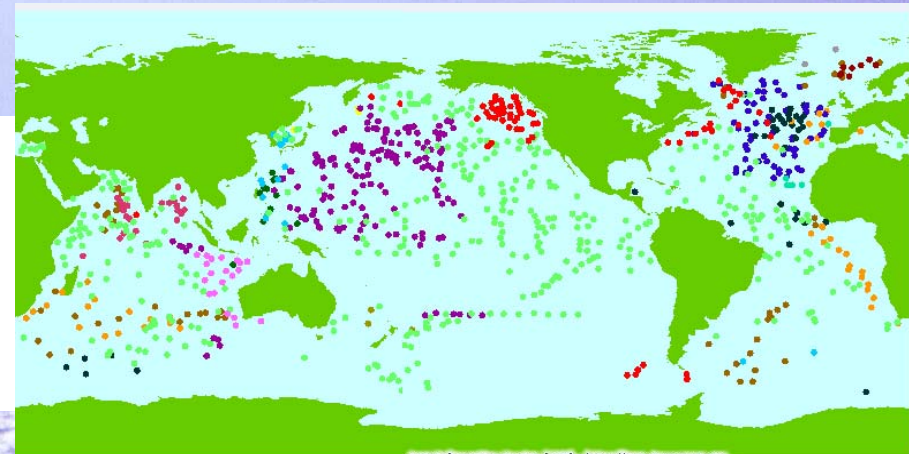
## Planned array of 3000 profiling floats



## Schematic of operation

**Full coverage expected by 2006**  
(750 minimum/year to maintain)

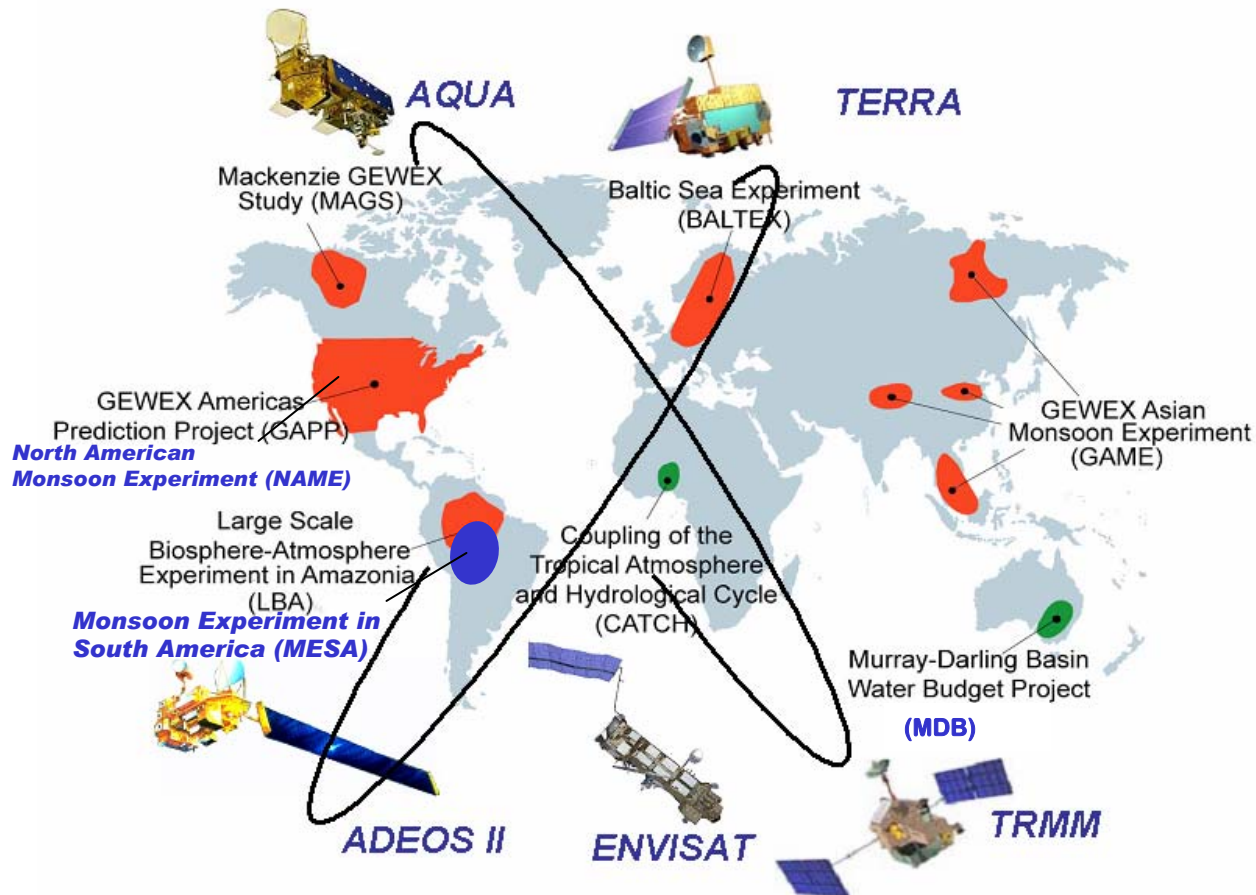
**912 Active floats, 1 October 2003**



**GODAE**  
**Global Ocean Data Assimilation Exp.**

**Ocean Prediction**

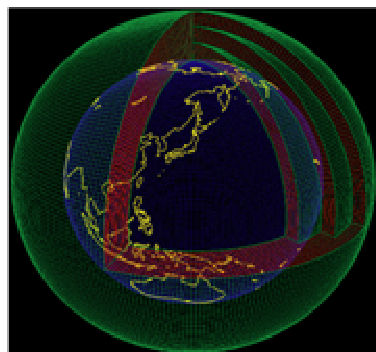
## New satellites and GEWEX/CLIVAR campaigns provide opportunity for significant benefit from a more Coordinated Enhanced Observing Period (CEOP)



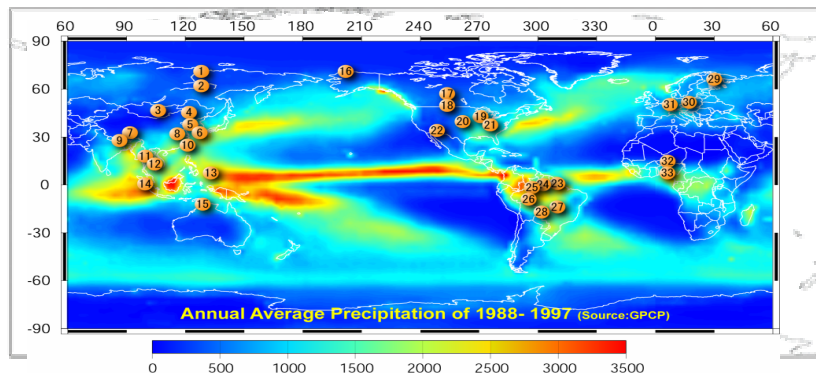
# The First Global Integrated Data Sets of the Water Cycle



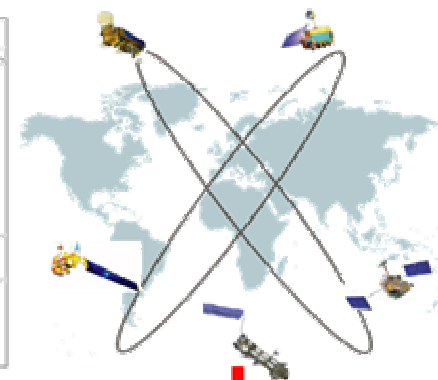
Model Outputs by Numerical Weather Prediction Centers



Surface Observational (*in-situ*) Data from the 33 CEOP Reference Sites



Satellite Remote Sensing Data

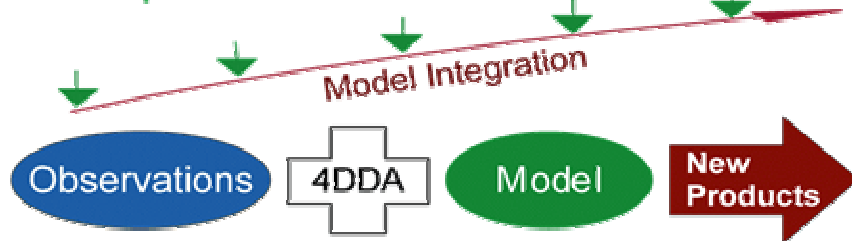


*In-Situ* Data Archiving Center at UCAR  
(Center at University Corporation for Atmospheric Research) of USA  
<http://www.ucar.edu/>

MODEL Output Data Archiving Center at Max-Planck Institute of Germany  
<http://www.mpg.de/>

Data Integrating/Archiving Center at University of Tokyo and NASDA of Japan  
<http://monsoon.t.u-tokyo.ac.jp/ceop/>

Input of Observed Data into Model

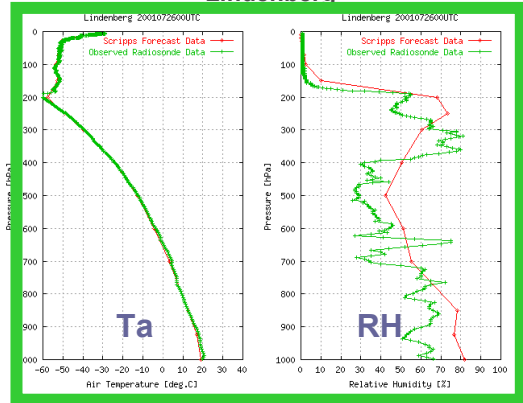


Global Land Data Assimilation System at NASA Goddard Space Flight Center of USA  
<http://ldas.gsfc.nasa.gov/>

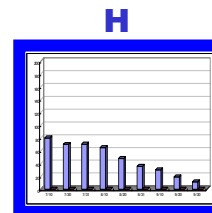
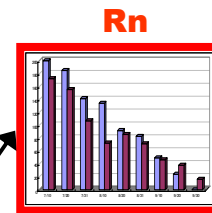
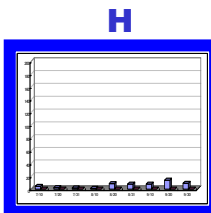
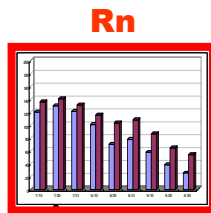


Data Archive Center

### Lindenberg

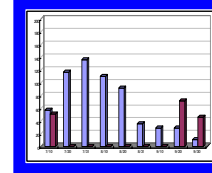
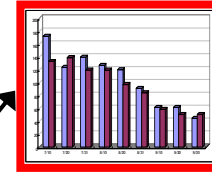
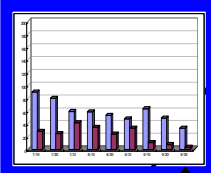
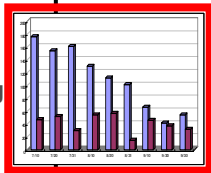


Mongolia



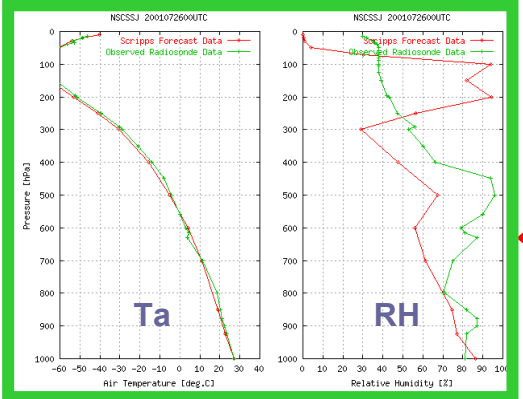
ARM (NPA)

Lindenberg

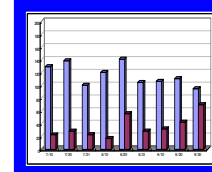
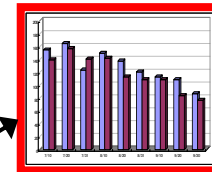
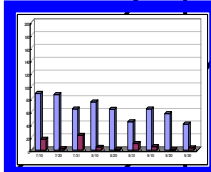
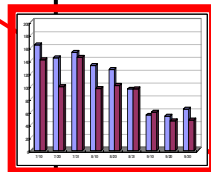


Ft. Peck

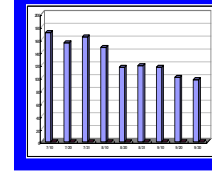
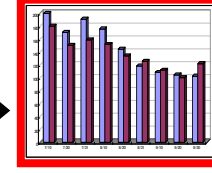
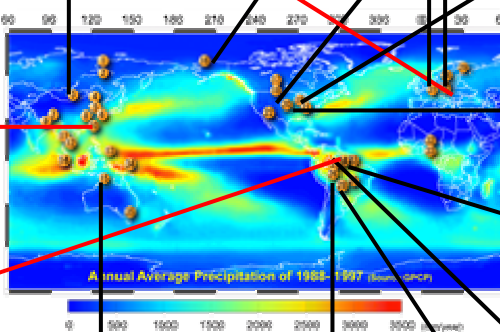
### Northern South China Sea - Southern Japan



Cabauw

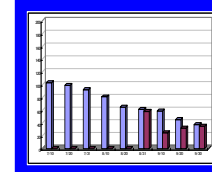
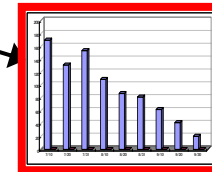
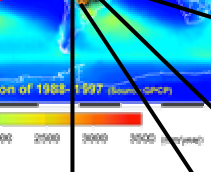
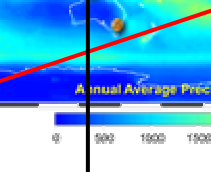


Bondville



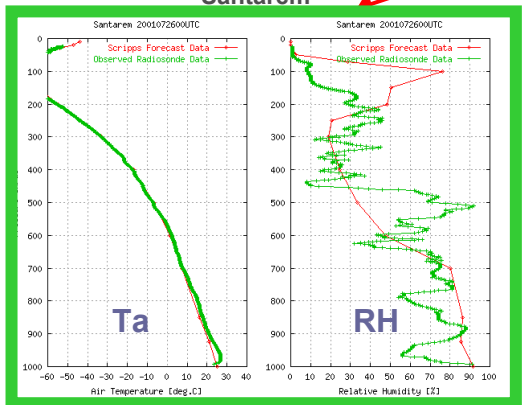
SGP

Lindenberg

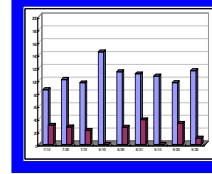
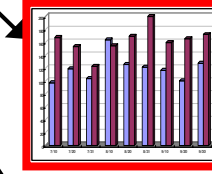
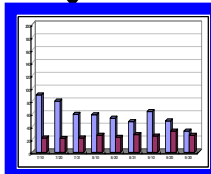
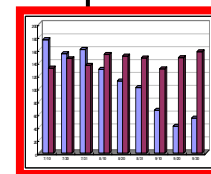


Caxiuana

### Santarem

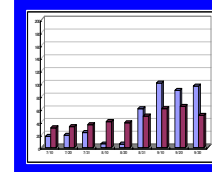
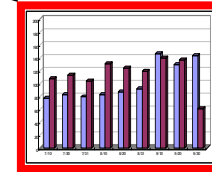
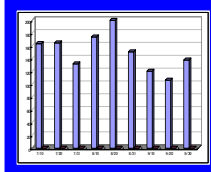
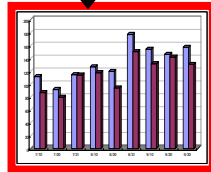


Rondonia



Manaus

ARM (TWP)



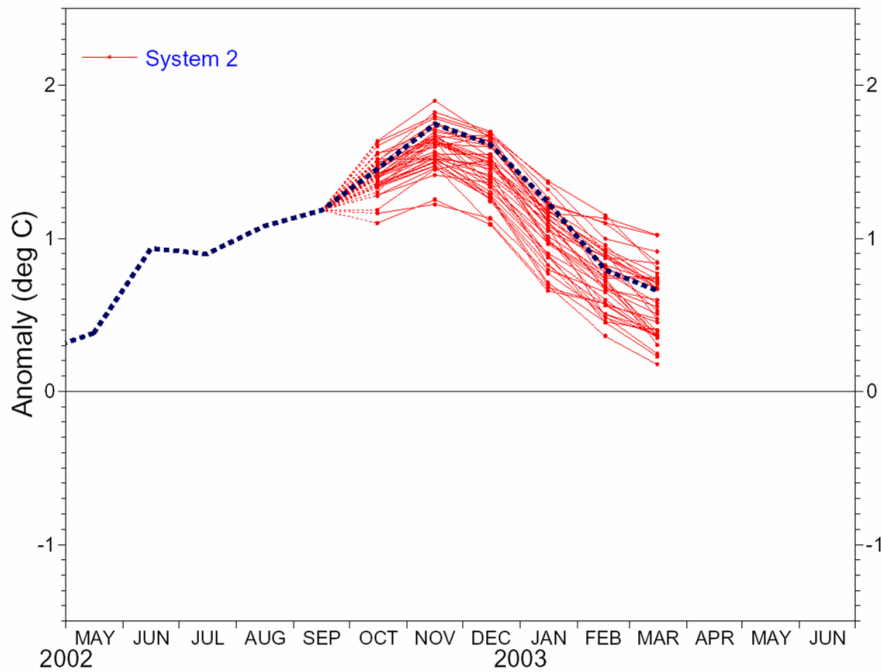
Pantanal

# Models

- Assess predictability
- Make predictions
- Simulation of past/present climates
- Projections of climate change
- Reanalyses of observations
  - produce homogeneous global datasets for climate studies & model validation

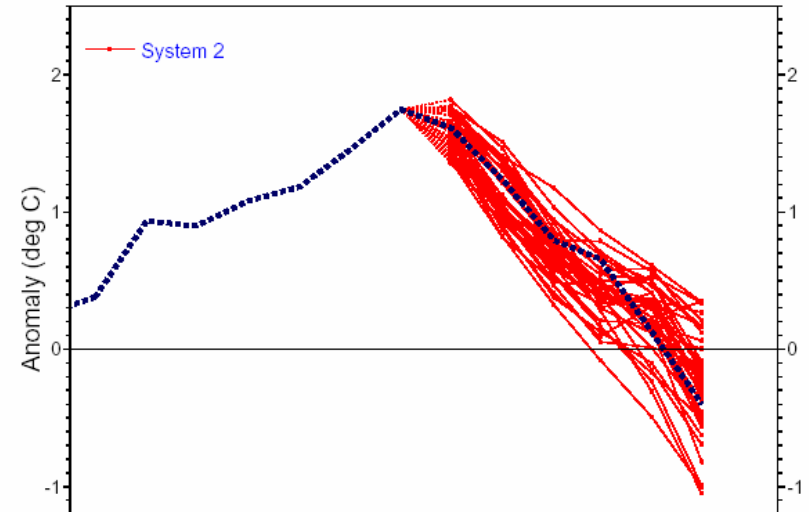
# CLIVAR: WG on Seasonal to Interannual Prediction

NINO3.4 SST anomaly plume  
ECMWF forecast from 1 Oct 2002  
Monthly means plotted using NCEP adjusted Olv2 1971-2000 climatology

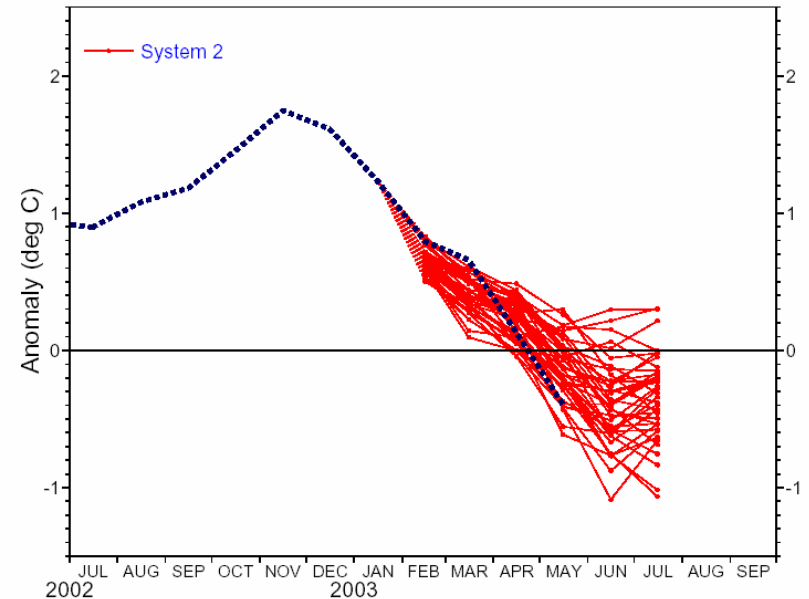


Forecast production date: 14 Oct 2002

NINO3.4 SST anomaly plume  
ECMWF forecast from 1 Dec 2002  
Monthly means plotted using NCEP adjusted Olv2 1971-2000 climatology



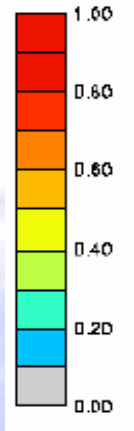
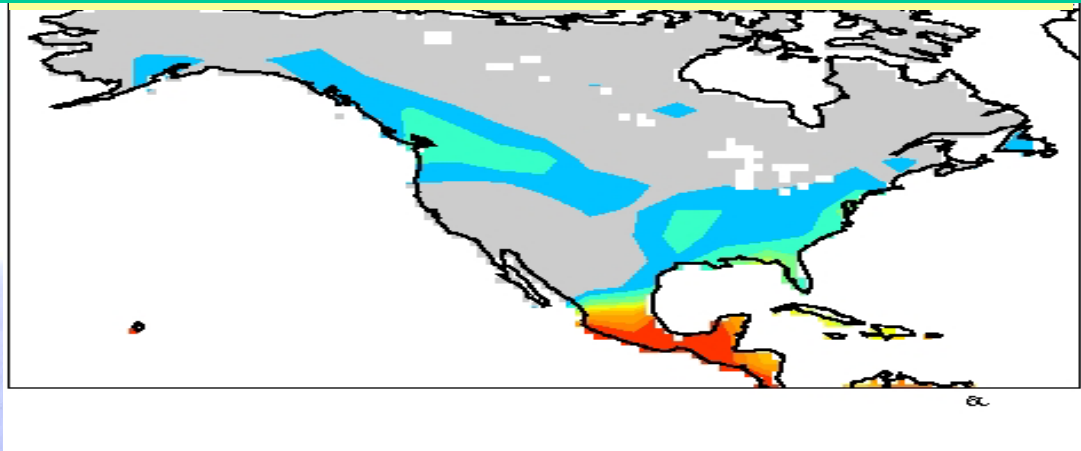
NINO3.4 SST anomaly plume  
ECMWF forecast from 1 Feb 2003  
Monthly means plotted using NCEP adjusted Olv2 1971-2000 climatology



Forecast production date: 14 Feb 2003

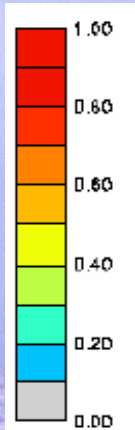
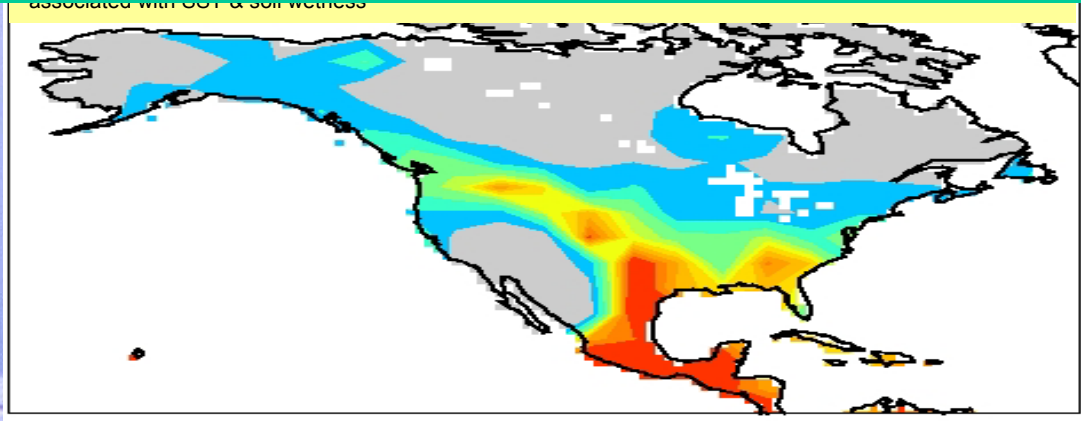


## Predictability of Precipitation Associated with SST



Index of Predictability

## Predictability of Precipitation Associated with SST & Soil Wetness

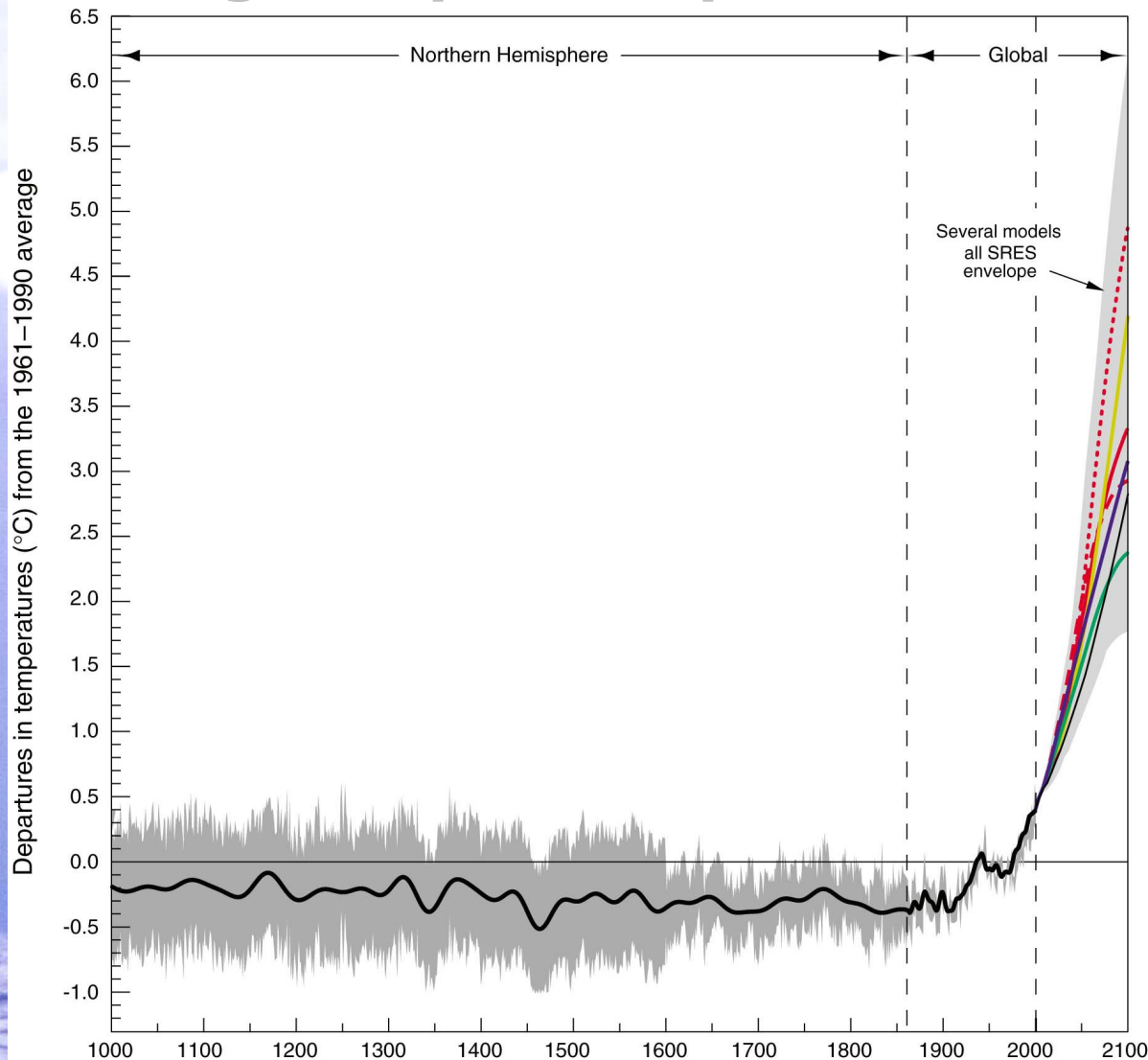


Index of Predictability

Koster GSFC/DAO

# Climate change assessment & projection

Working Group on Coupled Models → IPCC

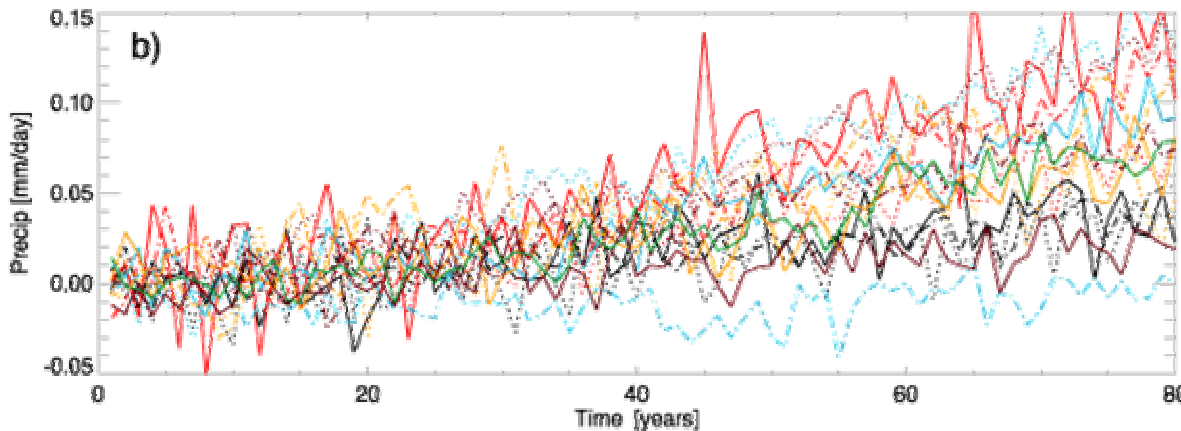
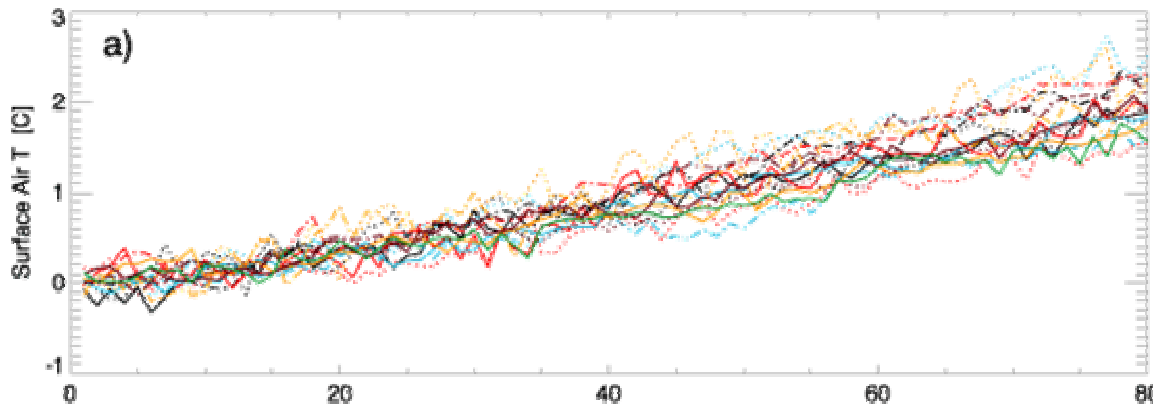


**CLIMATE  
1000 - 2100AD**

Source:  
IPCC 2001

# WORKING GROUP ON COUPLED MODELLING

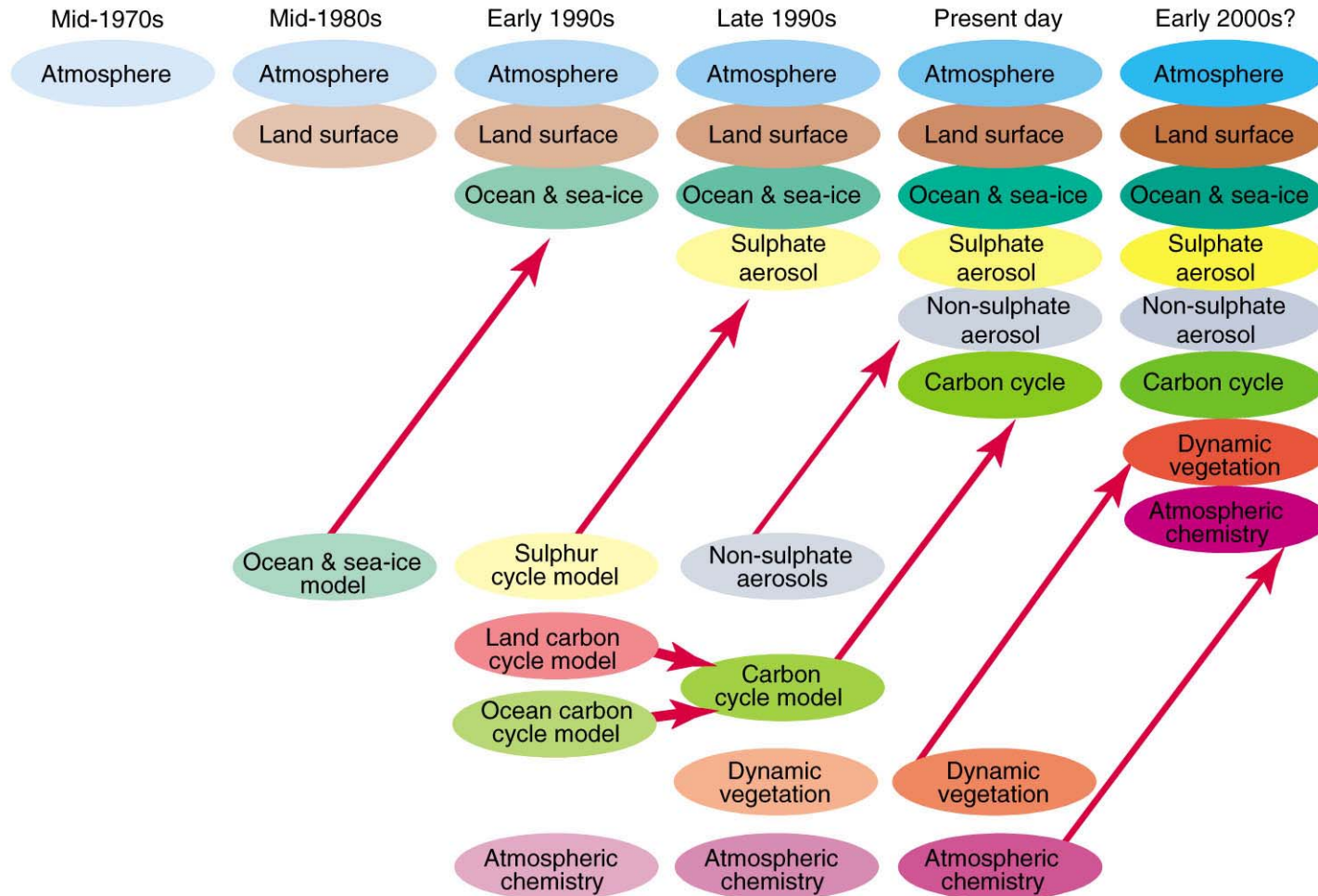
Global+Annual Means (1% / yr CO<sub>2</sub> - control)



**a) Time series of surface air temp. anomalies from various CMIP global coupled climate models for a 1% p.a. compound increase of CO<sub>2</sub>, where CO<sub>2</sub> reaches twice present day concentration around year 70**

**b) same as (a) except for precipitation (mm/day). (after Covey et al., 2003).**

# The Development of Climate models, Past, Present and Future

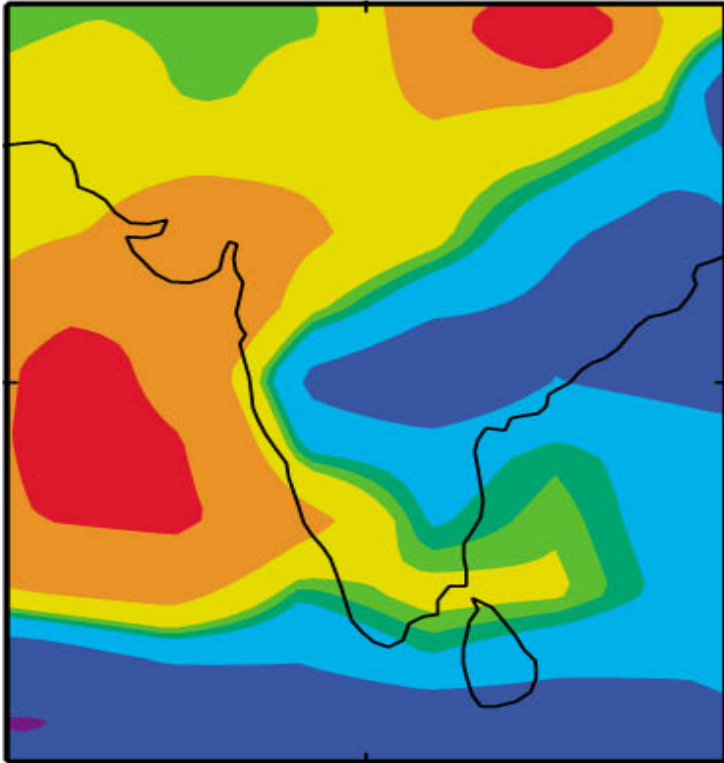


# The Asian - Australian Monsoon System

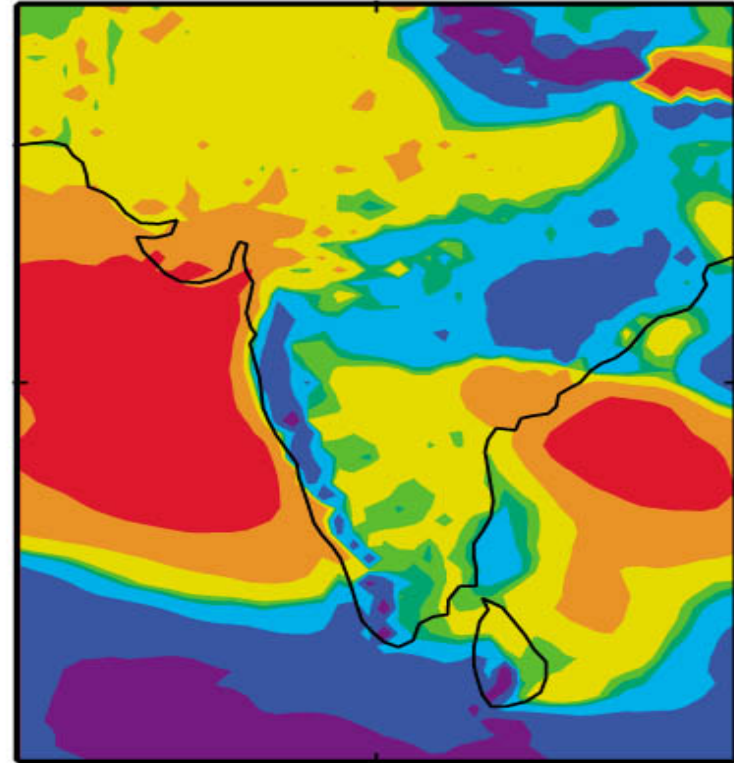


# CHANGES IN MONSOON PRECIPITATION between present day and the middle of the 21st century

Global climate model



Regional climate model



# CLIVAR Questions (1)

- Will there be an El Niño next year?
- Will the monsoon cause droughts or floods?
- What will the next winter be like in northern Europe; 'warm and wet' or 'cold and dry'?

# CLIVAR Questions (2)

- How is the planet warming from human influences?
- How much sea-level rise will there be in the 21st century?
- Will there be more extreme weather events because of global warming?
- Could climate make a sudden switch?

## **GEWEX Phase II Science Questions**

- 1. Are the Earth's Energy Budget and Water Cycle changing?***
- 2. Can we predict these changes on up to seasonal-interannual time scales?***
- 3. How do physical processes contribute to feedback and natural variability?***
- 4. What are the impacts of these changes on Water Resources?***

# Earth System Science Partnership

