Global Earth Observation System of Systems (GEOSS)

International Hydrological Programme (IHP)

• The cycle is changing?
• Increased risks?
• Growing vulnerability?
• More disasters?
• Less water for people?
• Crisis is looming?
• What crisis?
• Global or local?
Humans are changing the global water system in a globally-significant way without adequate knowledge of the system and thus its response to change.
Global change drivers

- Population growth, movement and age structures
- Geo-political changes and realignments
- Trade and subsidies
- Technological changes
- Climate change
Global change impacts

- Global change is more than global climate variability/change
- It has natural PLUS human/social dimensions
- A constellation of changes, many global in domain

For example, we see large changes in:

- Temperature
- Nitrogen Flux to Coastal Zone
- Species Extinctions
- Loss of Tropical Rain Forest and Woodland
- CO₂ concentration (µL/L)

References:
- NOAA
- Vitousek (1994)
- Mackenzie et al. (2002)
- Richards (1991), WRI
- Reid & Miller (1989)
From: Steffen et al. 2004
The Global Water System

- Water **Cycling** Deeply Embedded in Earth System
- Interconnections are Strong
- Change to One Part Reverberates Throughout
The Earth System: Coupling the Physical, Biogeochemical and Human Components

Physical Climate System

Atmospheric Physics/Dynamics

Climate Change

External Forcing

Sun

Volcanoes

Stratospheric Chemistry/Dynamics

Ocean Dynamics

Global Moisture

Soil

Terrestrial Ecosystems

Terrestrial Energy/Moisture

Water

Greenhouse Gases

Land Use

Tropospheric Chemistry

Biogeochemical Systems

Pollutants/Greenhouse Gases

: WCRP

: IHDP

: IGBP
Global Temperature ($^\circ$C)

IPCC Projections

N.H. Temperature ($^\circ$C)

Lower Risk for Instabilities

High Risk for Instabilities

2100 AD
Does the cycle accelerate?
Major floods and droughts worldwide in 2002

There is pressing need to develop advanced risk management on water hazard in order to secure human life and ensure sustainable socio-economic development and poverty alleviation.
Relation between water availability and population
Water Stress Changes to 2025

• 80% of future stress from population & development, not climate change!

• Correct Priorities?
  (E.g. 85% US global change research funding to climate and carbon)

Vörösmarty et al. 2000
Rainfall affects growth...
the case of Zimbabwe
Infrastructure gap: Water storage

Water storage per person (m³):

- Ethiopia: 43
- South Africa: 746
- Thailand: 1,287
- Laos: 1,406
- China: 2,486
- Brazil: 3,255
- Australia: 4,729
- North America: 6,150

North America has the highest water storage per person, followed by Australia and China.
UN Convention on the Law of Non-Navigational Uses of Transboundary Watercourses 1997

- Consistent with state practice
- Comprises earlier efforts of codification
- Adopted equitable utilization as leading principles of international water law, with a list of factors to be used for determination of equitability of share
- Adopted the principle of “no significant harm”
- Ratification process en route

Needed: 35
Obtained: 16

(Not yet in force after 27 years of negotiation)
Aquifer –
Transboundary Issues

Discharge from transboundary flow

INTERNATIONAL BOUNDARY

Recharge contributing to transboundary flow

Local flow systems

Transboundary flow direction
Water hazard as a major challenge

- Intensifying and increasing occurrence of water related hazard in many part of the world
- Serious concern on climate change such as extreme hydrologic events and sea level rising
Fukuoka Flood in 1999

(Source: MLIT)
Human Fingerprint on Land-to-Ocean Linkages

-- Intercepted sediments that “nourish” our coastlines

Vörösmarty et al. 2003
High Technology Earth Systems Tools

- Satellite data
- Simulation models
- Geospatial analysis tools

They show promise but...
The data issue: a major source of risk and vulnerability in river basins

- The case of Africa
- Interconnectedness through data
- Local data networks:
  - The ethical choice vs.
  - The global needs to minimize bias
- GEOSS: space and in situ observations
- Will data secrecy be gone?
- Will it be replaced by sharing?
- What is the way out of trouble?
WATER EDUCATION AND CAPACITY BUILDING
The challenge we all have

How to put water in the minds of people?