WCRP/CliC and Asian water cycle, and GEO/GEOSS

Tetsuo Ohata

Institute of Observational Research for Global Change (IORGC), JAMSTEC, Yokosuka, Japan

WCRP/CliC SSG Member

CLIVAR 1995 →

ACSYS/CliC 1994–2003/2000 →

WGNE
WGCM
WGSF

First Science Conference 2005

WOCE 1990-2002

TOGA
1985-1994

WCRP Climate

GEWEX 1988 →

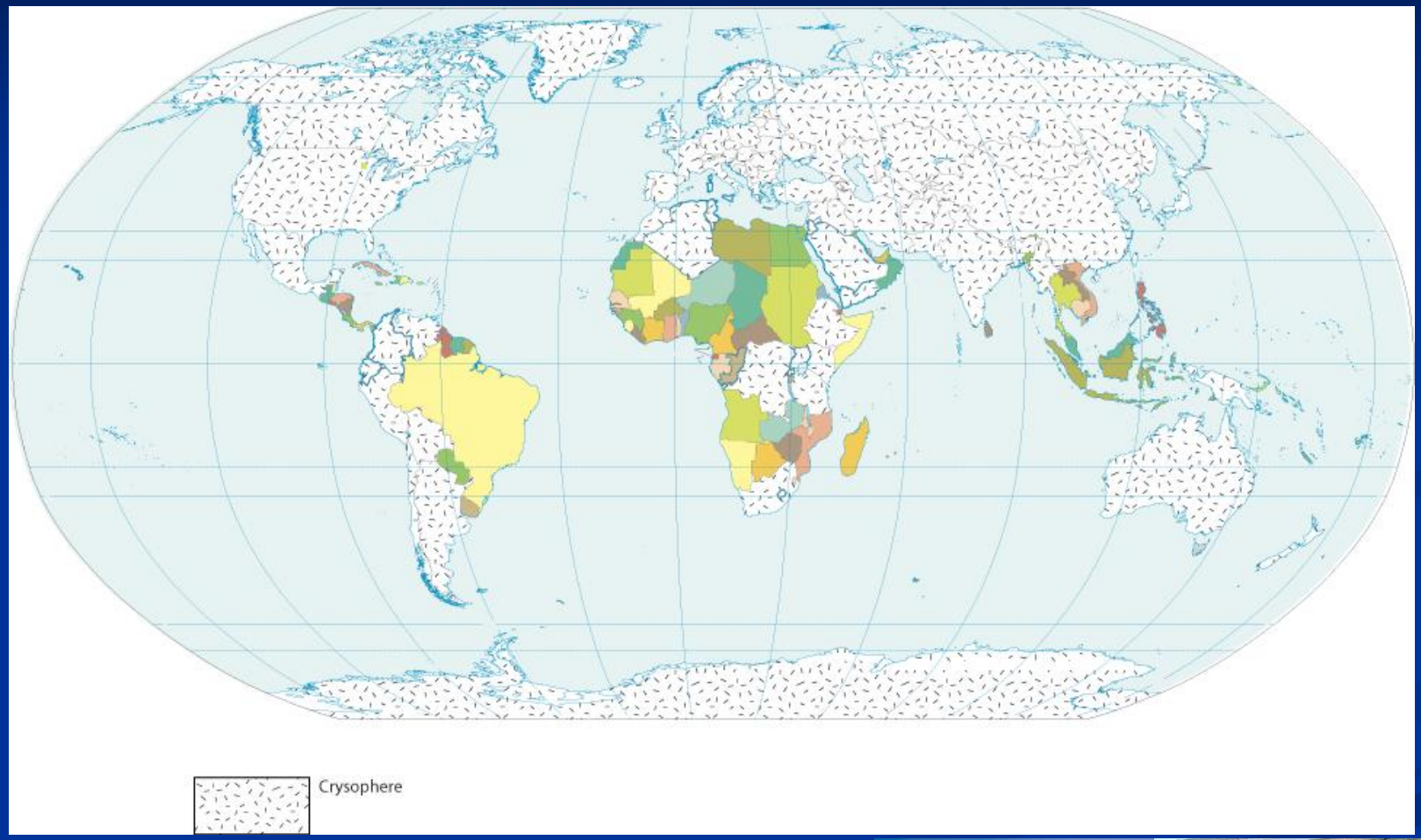
SOLAS 2001 ->

SPARC 1992→

Countries Where Cryosphere Occurs

95 countries identified with cryospheric components

Cryosphere truly is global



<Objectives>

(1) Improve understanding of the physical processes and feedbacks through which the cryosphere interacts within the climate system.

(2) Improve the representation of cryospheric processes in models to reduce uncertainties in simulations of climate and predictions of climate change.

(3) Assess and quantify the impacts of past and future climatic variability and change on components of the cryosphere and their consequences, particularly for global energy and water budgets, frozen ground conditions, sea level change, and maintenance of polar sea-ice covers.

(4) Enhance the observation and monitoring of the cryosphere in support of process studies, model evaluation, change detection.

CliC Project Areas (CPAs)

(1) Terrestrial Cryosphere and Climate

(Snow cover, frozen ground, glacier, lake/river ice)

(2) Glacier/Ice cap/Ice sheet and their relation to Sea-level (Glacier, ice sheet)

(3) High latitude ocean and marine cryosphere

(Sea ice)

(4) Links between Cryosphere and the Global Climate

Especially, (1) and (4) are concerned with water cycle studies in relation to water resources

Cryosphere and water cycle?

- Global warming, strongest warming and precipitation increase expected in cold regions.

  → Amount of solid precipitation would change.

  →surface/sub-surface ice will melt more, decrease of frozen ground?

  →snow cover amount and period will change

  →ground water should be influenced

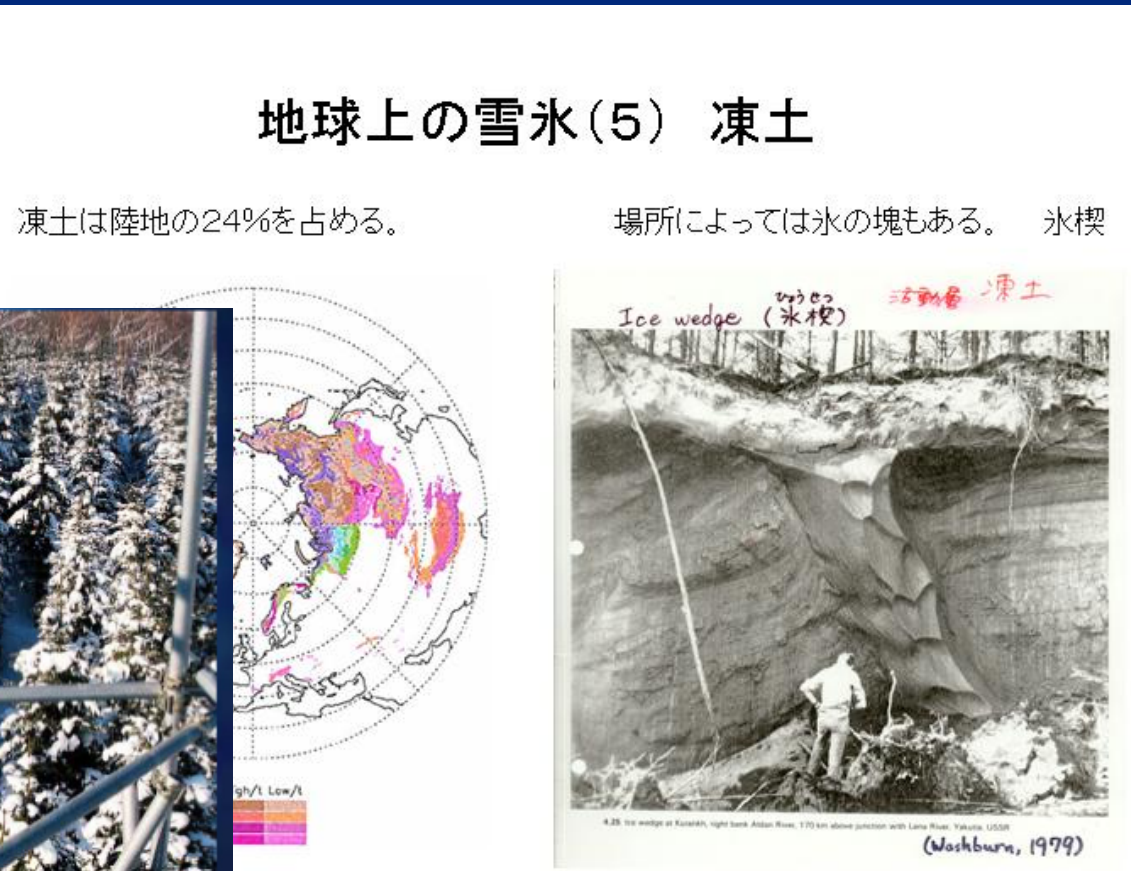
  other land components, vegetation affected by change in water.

- From these change, direct and indirect effect to hydrological cycle will occur. Perhaps intensifying/changing the whole hydrological cycle
- These hydrological changes will Feedback to atmosphere and climate system. What kind of effect to total climate system?.
- Therefore, very important to understand the present condition of cold region especially snow/ice condition, maintenance process of hydrological phenomena and its variability in cold regions.

FACT: Ice underground. How much? Is it changing? Will it melt?

Frozen Ground

PROCESS: Snow on tree canopy, How does it behave? Sublimation



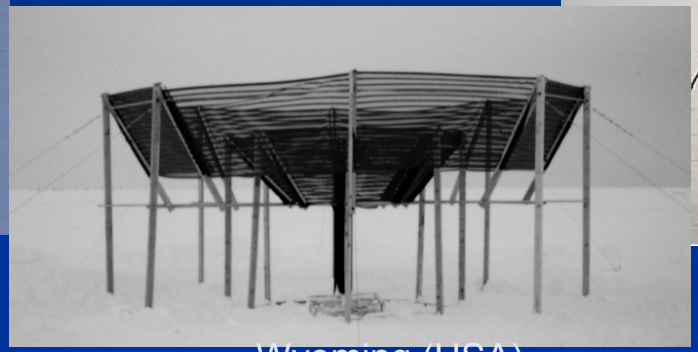
MODELING

UNCERTAINTY in Solid Precipitation:

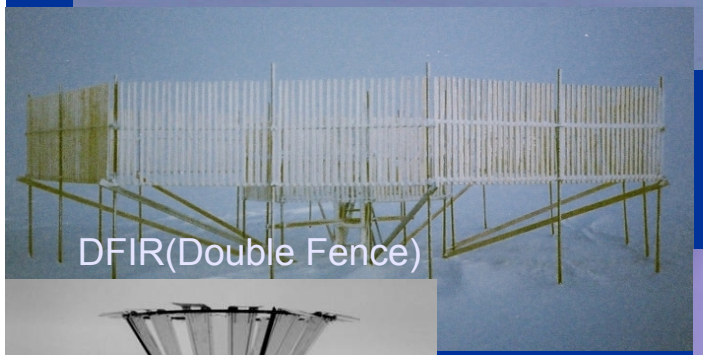
- Correction for past/present used gauges under high wind cases
- Development of better precipitation measurement technique

Observation Layout. Barrow, Alaska

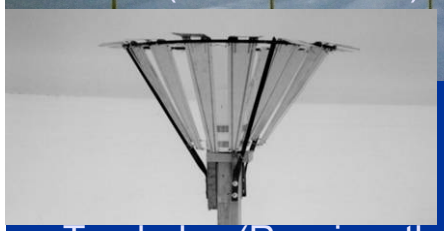
New method!! Snow Particle Counter



Wyoming (USA)



DFIR(Double Fence)



Trechakov(Russia, others)

RT-4 (Japan)

US8inch (USA)

Nipher(Canada)

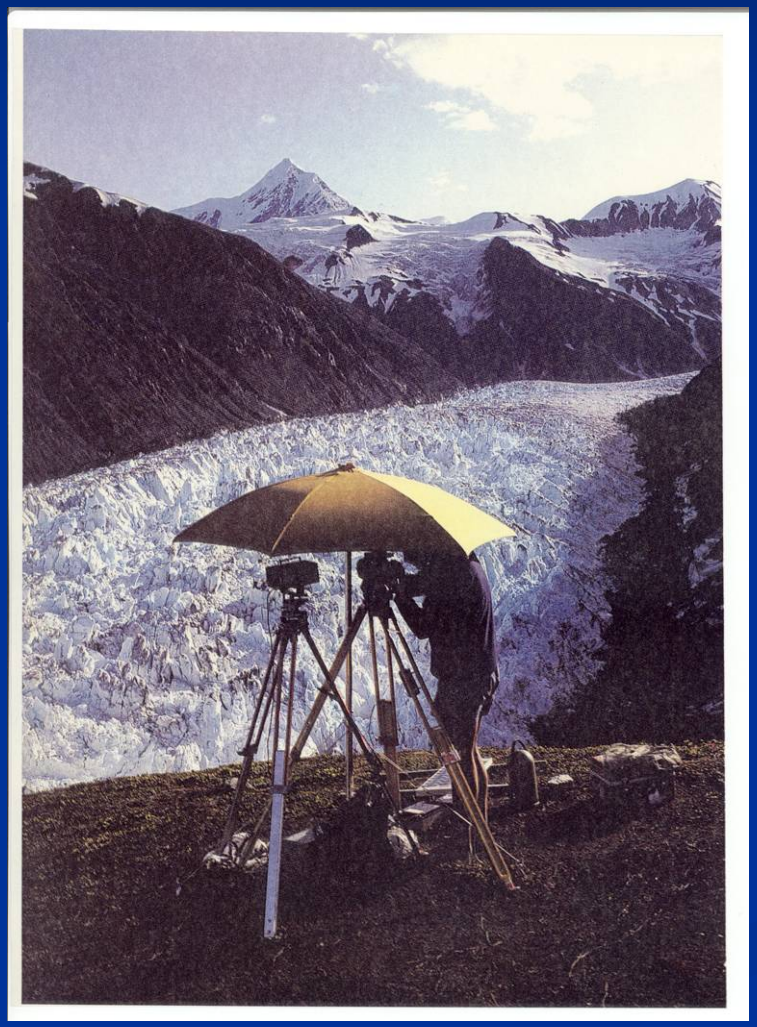
NOAH (USA)

Hellman (Greenland, Denmark, etc.

Glaciers

Due to climate change, size / ice accumulation of glaciers changes. This is an index of climate change and water cycle。

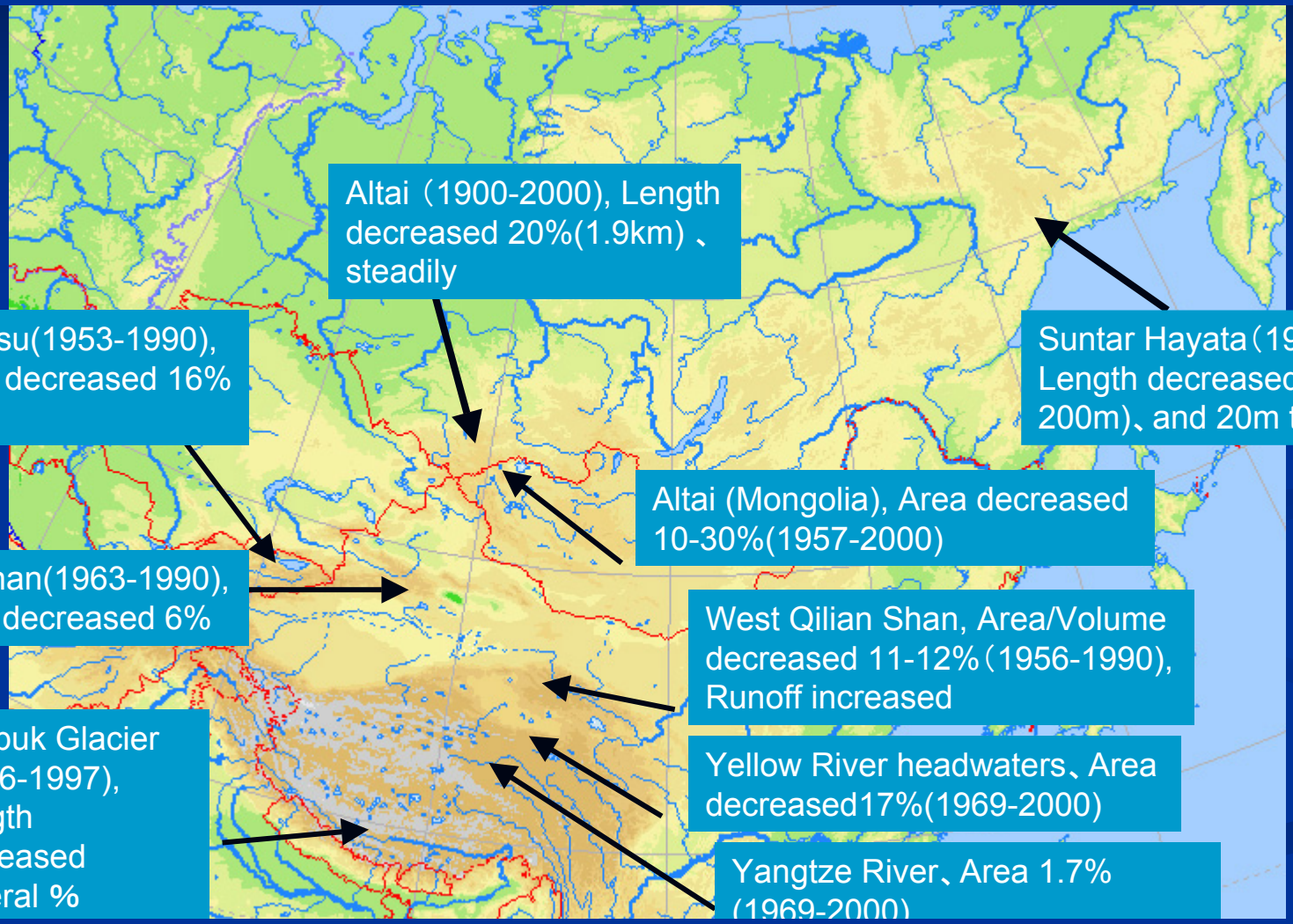
Glacier is dam of frozen water



Glaciers are generally shrinking due to global warming, some are increasing due to change in water cycle.

Glacier change change in length and size

（eastern Eurasia)



These changes are the result from the warming after the little ice age and the on-going global warming.

Main issues of CPA1 in relation to water cycle

1. Identify the present condition and needed observation network for detecting cryosphere change (Snow cover, frozen ground and glaciers) and expand and/or improve observation for related hydrological components, atmospheric (eg. Solid precipitation, moisture), vegetation etc. related to water/energy cycle.
2. Improve understanding of processes and land surface models in cold regions for better climate and hydrological prediction.
   - Sub-grid scale non-uniform snow cover, ・Glacier change
   - Forest snow processes ・Blowing/drifting snow processes
   - Drainage runoff processes (1-1000km^2) uniform climate
3. Climatologically important hydrological phenomena
   - Increase/Variability in the runoff of Arctic draining large rivers.
   - Water (Liquid/Solid) balance of the large basins.
4. Improve the quality and amount of the cryosphere and related hydro-meteorological data-sets of past and present.
5. Inclusion of cryosphere in models appropriately, improve

Relation with GEO

(1) Not discussed so much at international level.

(2) However, there are topics directly related to GEO as

- Since one main issue is "Identify the present condition and needed observation network for detecting cryosphere change (Snow cover, frozen ground and glaciers) and expand and/or improve observation for related hydrological components, atmospheric (eg. Solid precipitation, moisture), vegetation etc. related to water/energy cycle", CliC implementation need to constitute one main part of GEO
- Drainage hydrology studies and modeling.
- Improve the quality and amount of the hydrological and cryosphere data-sets of past and present.
- Interested in utilizing the chance of IPY(2007-2009) for initial implementation, to expand in-situ observation network.

The problem facing now is that issues of cryosphere in GEO, is diversed in various GEO theme such as Climate Change (Global Warming), Hydrological Cycle and Hazard.

Relation to present GEO Asia Water

Can cooperate in the following topics and area.

(1) Mountain hydrology including glaciers and snow cover, and climate at high altitude.

(2) Development of cryosphere measurement techniques.

(3) Archive of past data from experimental and operational observation.

(4) Can supply future data from cryosphere observation network, and development of cold region stations.

Some information for future

(1) Coordination of IPY (International Polar Year) activities, CEOP-CliC joint project are one main issue for CPA1.

(2) CliC-SSG (Nov. 6-9, 2005) will discuss GEO and GEOSS.

(2) Asia CliC Meeting (+IGOS-P Cryosphere Meeting) April 24-27, 2006 at Tokyo, Japan.

will have discussion on how CliC in Asia can contribute to GEO/GEOSS.