



# Cold region studies in CEOP

based on discussions between core CEOP and CliC group

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## CliC Goal and Objectives

### Principal Goal:

Assess and quantify the impacts that climatic variability and change have on components of the cryosphere and the consequences of these impacts for the climate system, and to determine the stability of the global cryosphere

### Supporting Objectives:

- Enhance the **observation & monitoring** of the cryosphere in support of process studies, model evaluation and change detection
- **Improve understanding** of the physical **processes and feedbacks** through which the cryosphere interacts within the climate system
- **Improve the representation** of cryospheric processes **in models** to reduce uncertainties in simulation of climate and predictions of climate change (*role of the cryosphere on predictability of the climate system*)
- Facilitate assessment of changes in the cryosphere and their impact, and to use this information to aid in the **detection of climate**



# Four overall collaboration topics (in IPY proposal)

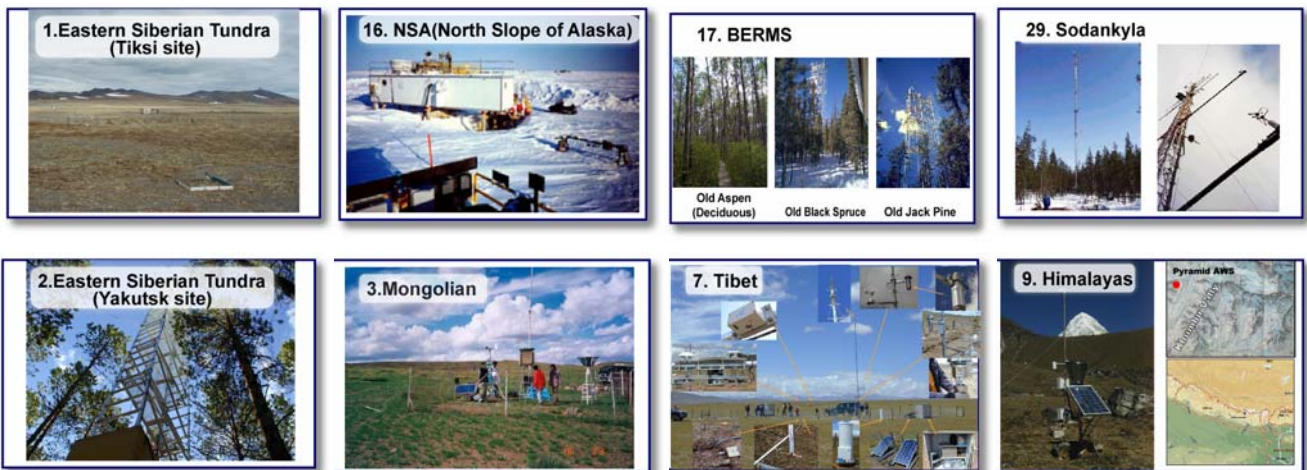
## 1. Convergence of Observation and Data Integration

Targets:

- Reference site/basin network in cryosphere
- Integrated satellite/land products in cold region

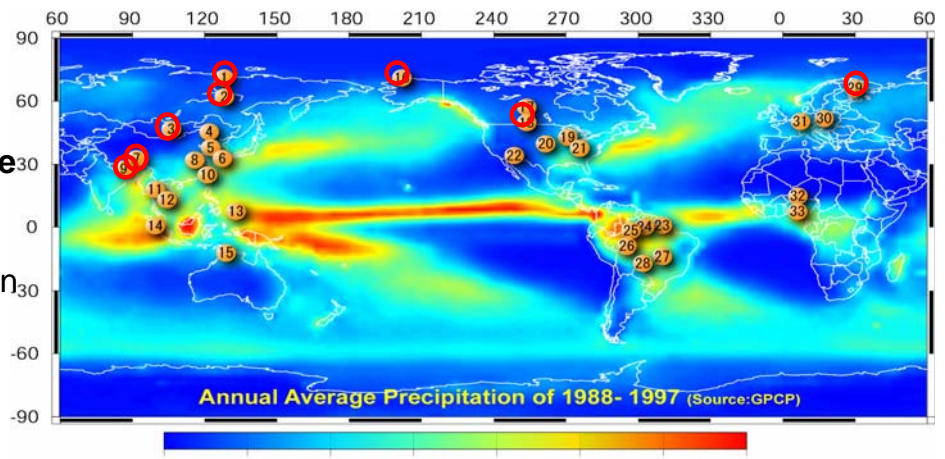
Strategy:

- (1) Sophistically integrated in-situ observation (super site) including isotope: new site involvement through focusing location, number, standard.
- (2) Common metadata and data policy
- (3) Data quality check and archiving system
- (4) Integrated satellite products validated by in-situ data: snow, snowfall, soil moisture, canopy snow, (vegetation)
- (5) Long term, comprehensive, quality observation at different spatial scales: regional-point in Northern Eurasia
- (6) Precipitation data applying various method

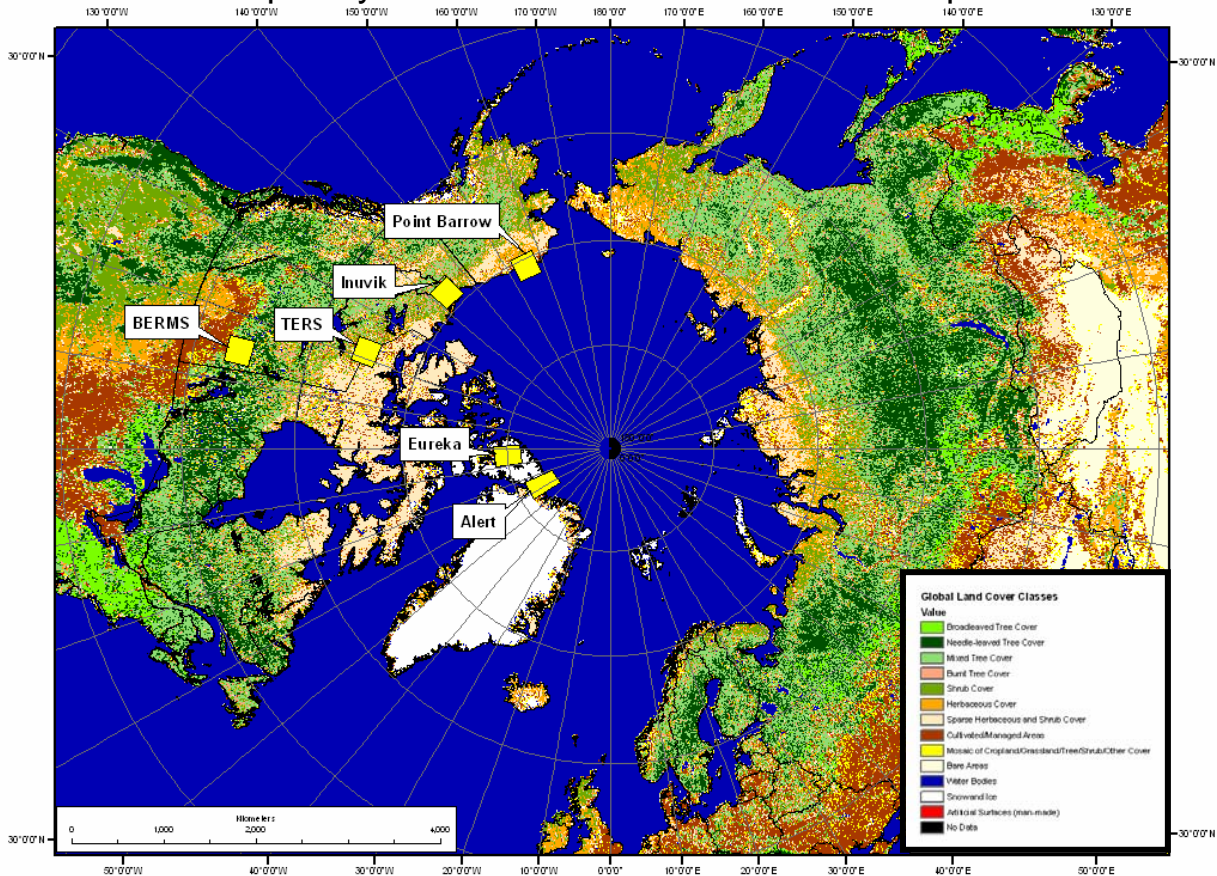


### CEOP Reference Site in the Cold Regions

**water/energy cycle in the cold region:**  
 solid precipitation, snow cover, soil moisture, frozen ground, vegetation....



# Multidisciplinary Environmental Observatories – Supersites



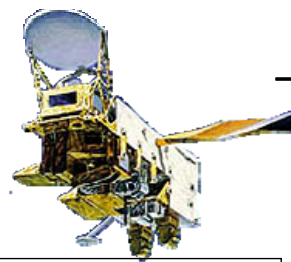
Source: The Global Land Cover Map for the Year 2000, 2003. GLC2000 database, European Commission Joint Research Centre. <http://www-gvm.jrc.it/glc2000/>. (Regrouped 23 original classes into 14 : Peter Toose, MSC)

Environment Canada (B. Goodison)

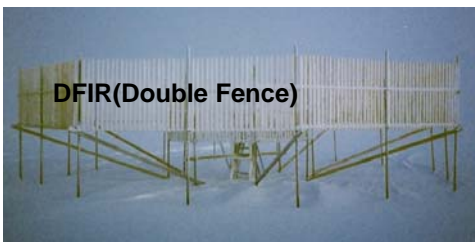
## Decrease the UNCERTAINTY in Solid Precipitation:

- Correction for past/present data and future monitoring.
- Integrated study from space and land.

**(1)**



Precipitating snow



Trechakov (Russia, others)



Snow Particle Counter



Radar



- (1) Verification of remote sensing.
- (2) New precipitation data-set for high altitude.

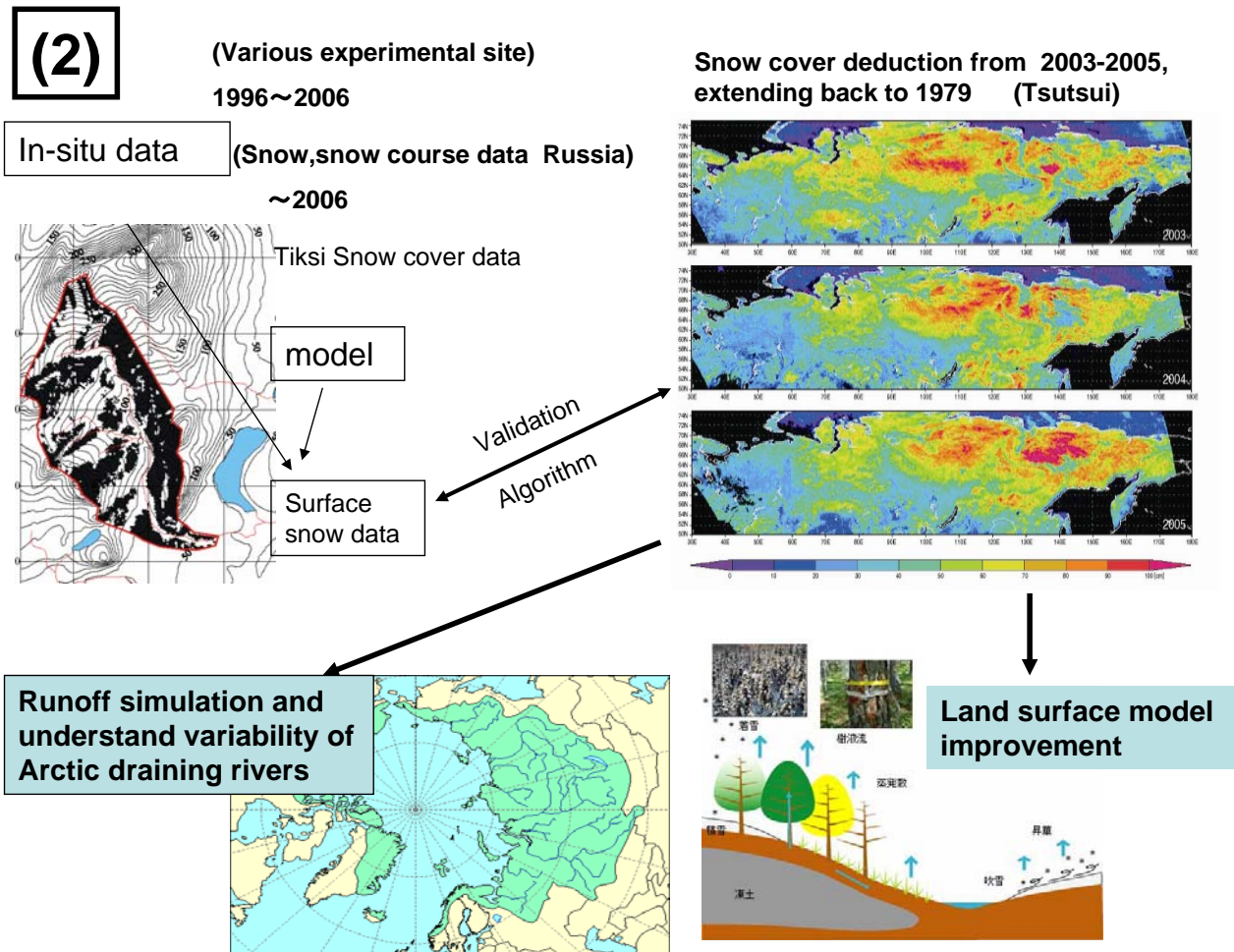
## 2. Long-term Variation of Snow Distribution in the Northern High Latitude Region and Its Impacts on Atmospheric Circulation

*Targets:*

- Seasonal and Inter-annual Variation of Land Hydrological Conditions

*Strategy: (Research based on long-term data)*

- (1) Long-term snow (SWE) and soil moisture by the SSM/I: product, validation, impact analysis concerning atmosphere and hydrology
- (2) Model Analysis Inter-comparison
- (3) Land surface model improvement for regional climate modeling: better inclusion of frozen ground including permafrost

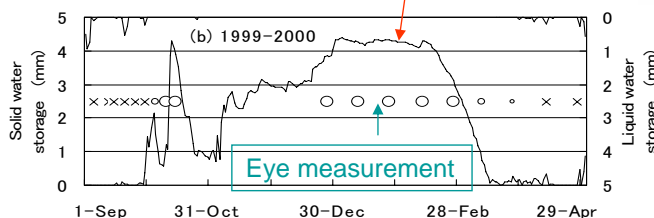


## Land surface process: Canopy snow

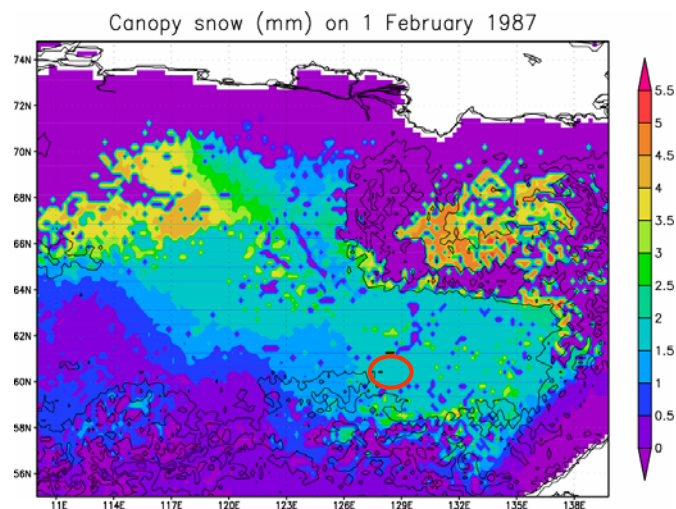


Canopy snow ⇒ Amount and change, sublimation and albedo, not included in GCM land surface scheme

### 1. Application of 2LM (Yamazaki)



### 2. Micromet Model (Base RAMS model) applied to Lena River Basin – Crown snow cover



First time to evaluate areal canopy snow–  
Should improve vapor flux and SWE

## 3. Water and Energy Budgets (WEBs)

(Research for CEOP2 period)

### Targets:

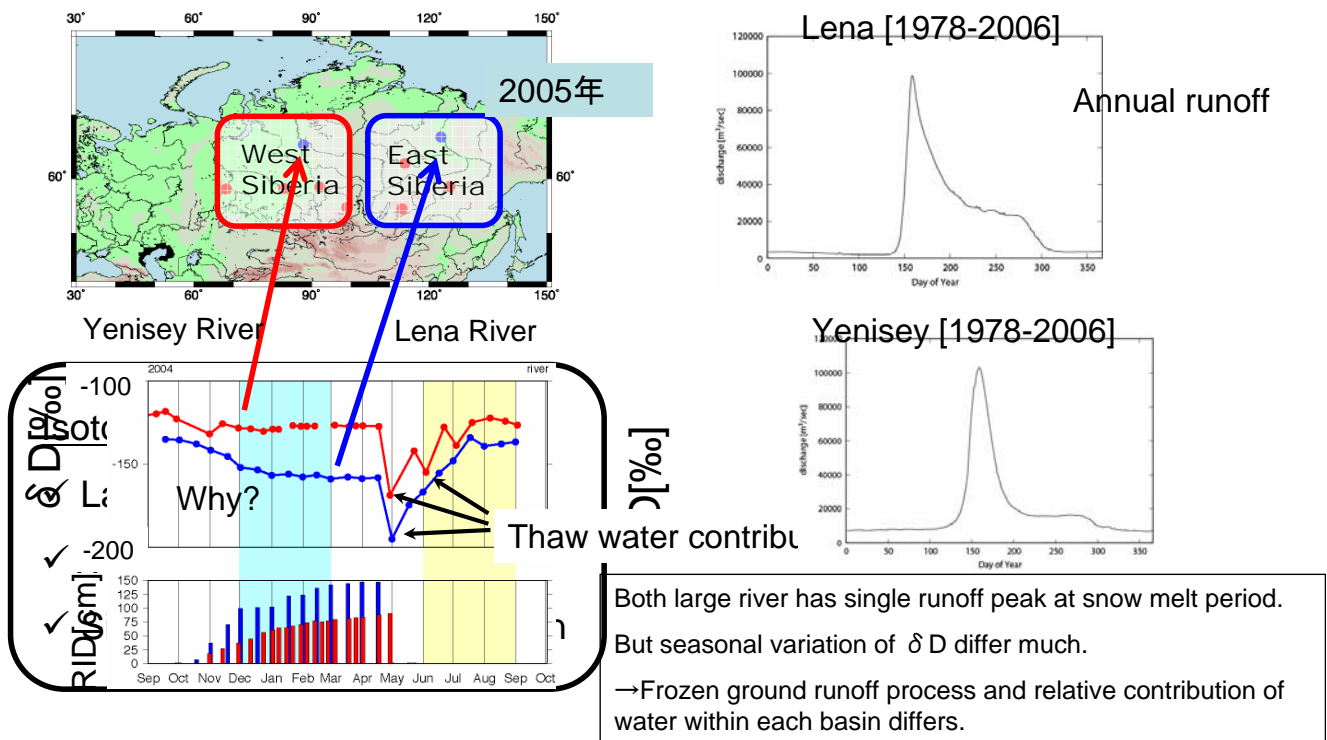
- Intercomparison among the large river basins facing to Arctic Sea, such as *Lena*, *Obi*, *Yenisey*, and *Mackenzie*
- Impacts of the WEB variation on the atmospheric circulation

### Strategy:

- (1) Data integration
- (2) Atmosphere-land interaction  
land processes: snow, permafrost, soil moisture, vegetation, fluxes, land water.
- (3) Predictability Improvement of GCMs coupled with LDAS
- (4) Down-scaling and A-L coupled DAS
- (5) Large Arctic draining River Runoff and its changes  
<Existing project: IPY Arctic-HYDRA>
- (6) Stable isotope budget

# Stable isotope of Cold region rivers - comparison

## Yenisei and Lena — $\delta D$



## 4. High Mountain Hydrology Including Glacier

### Targets:

- From process study to application to water resources management

### Strategy:

- (1) Enhanced collaborative research in reference basins
- (2) Intercomparison of impacts of climate change on water resources
- (3) Cooperation with “Semi-arid region study”

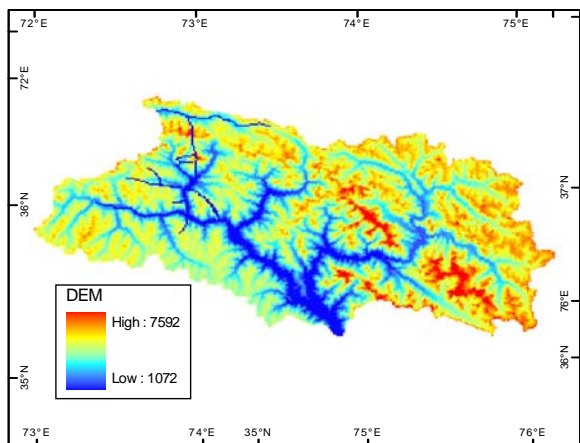
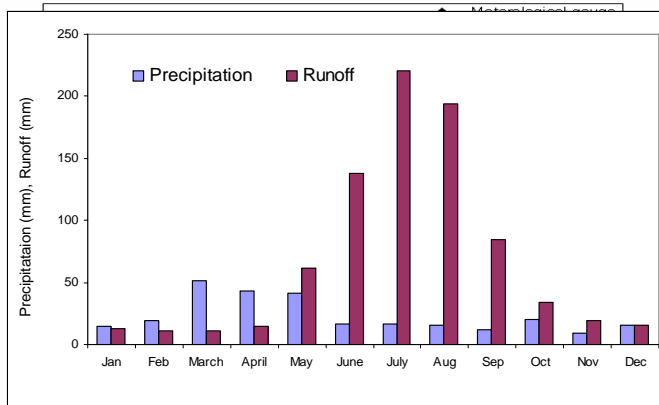
<Planned Project: IHACY, China core>

IHACY: International High Asia Cryosphere Year. CliC related project

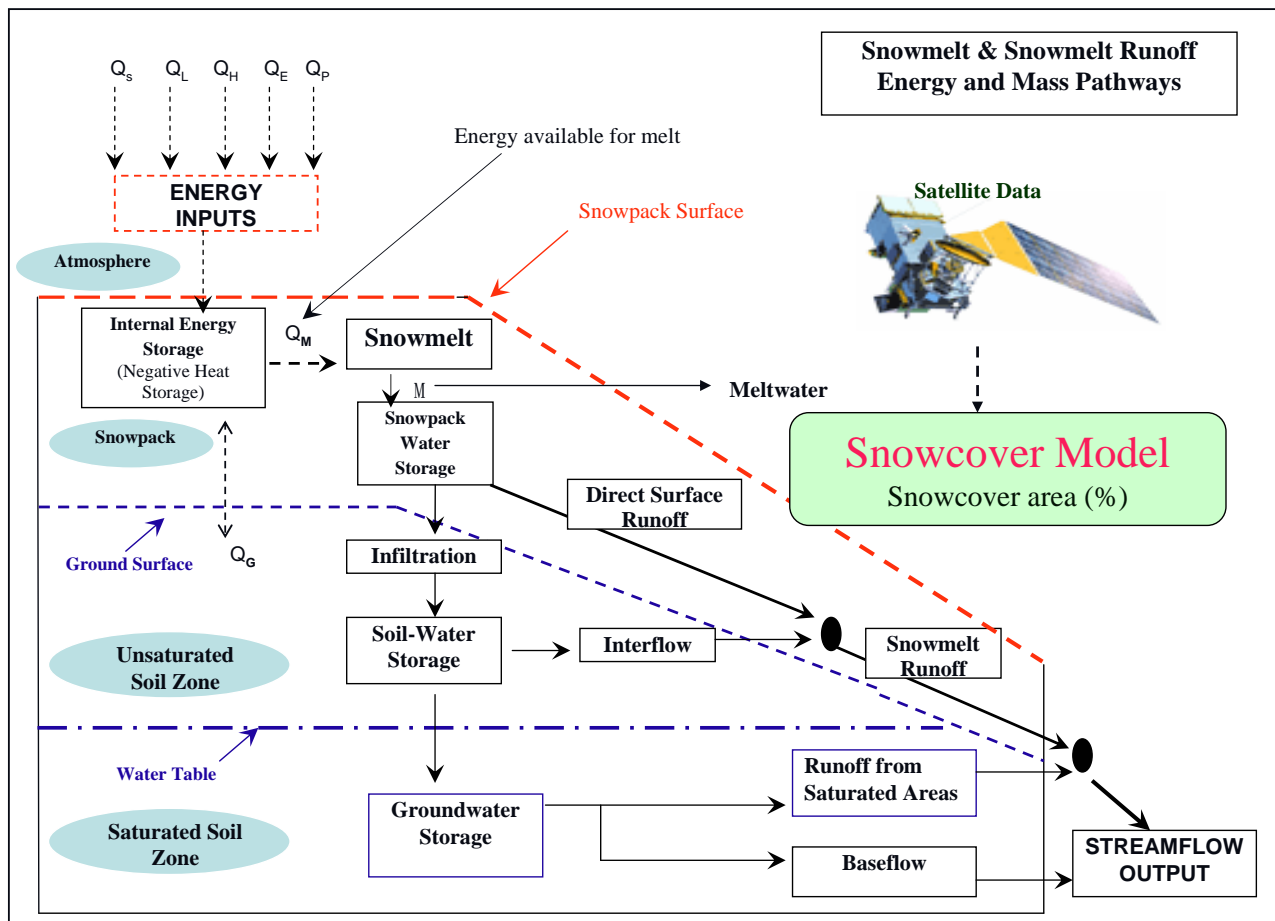
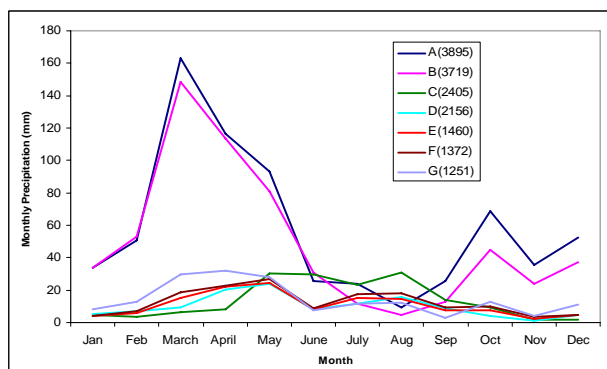
# Gilgit Basin, Indus River



## Monthly runoff and precipitation comparison

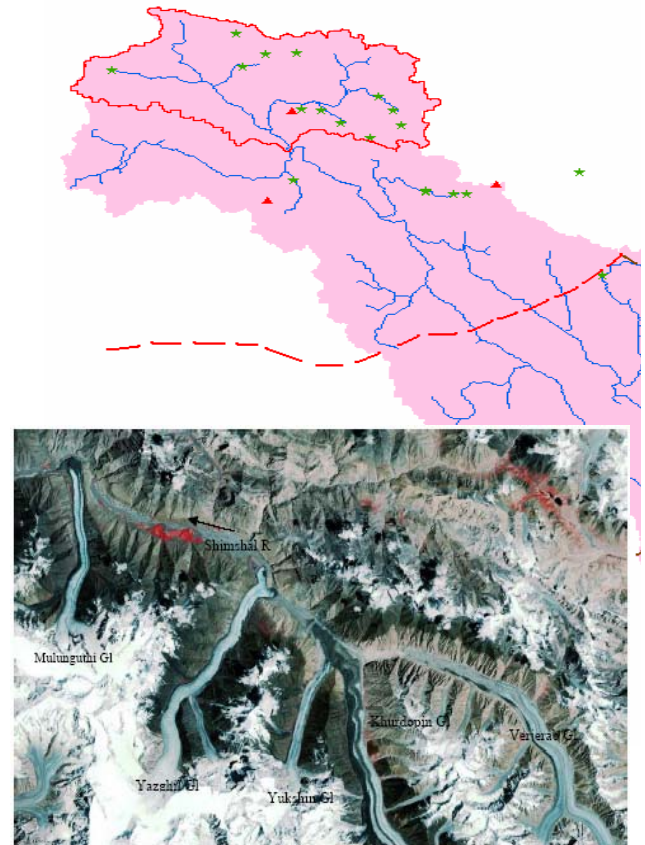
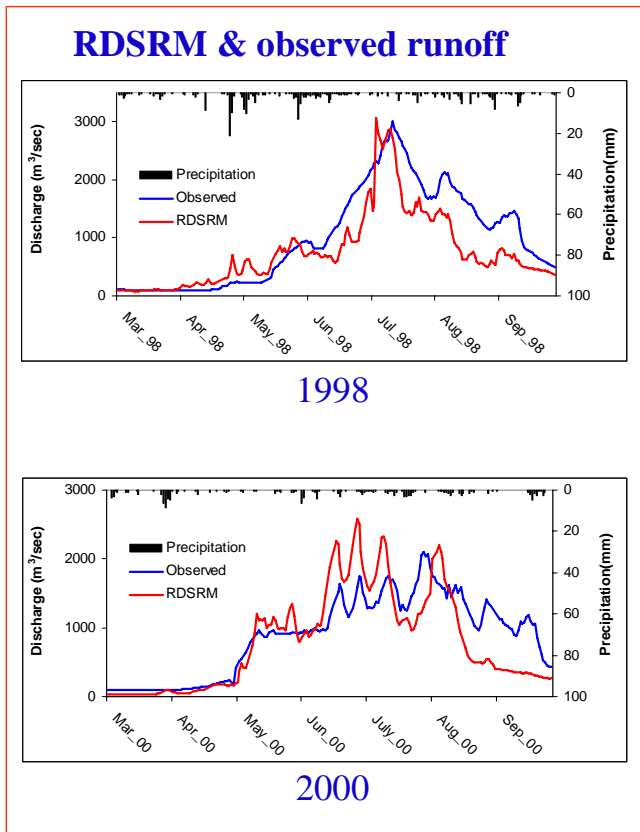


## Inter-station and seasonal precipitation variability



# Discharge Results:

## Rain and snowmelt contribution to runoff



## CABIN (tentative) A Program/project Contributing to CliC CPA1

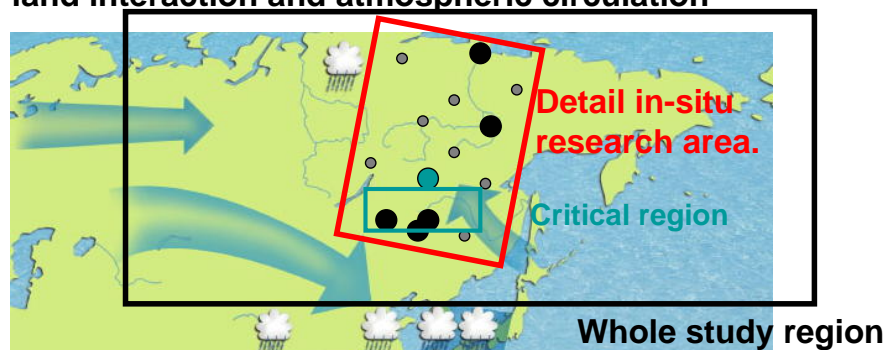
**Character:** post-GAME project in the Northern Part of Eurasia, including other individual project. Shifting stress point of the study from “PROCESS” to “CHANGE”, strengthening the atmospheric regime and regional data archive, focusing on “Hydrometeorological Effect of Shrinking Cyosphere”.

**Target Region :** Asian part of Northern Eurasia north of 40N.

**Central topic:** Cryosphere-Atmosphere-Biosphere Interaction and Changes in Northern Eurasia

- (1) Snow/ice change and processes
- (2) Vegetation change and processes
- (3) Water cycle and hydrological effect.
- (4) Atmosphere-land interaction and atmospheric circulation

*Presently discussed in Japan by core members*





# International High Asia Cryospheric Years (IHACYs)

— a suggested program during IPY and beyond

## Rational

- High Asia, the largest cryospheric parts outside of the polar regions
- Vulnerable to global warming, fast decay and facing the fate of vanishing
- Very important in socioeconomic aspects, as the major water resources of arid regions of central Asia.
- Very important to regional/global scale hydrometeorology

CNC-WCRP/CliC

WCRP/CliC SSG, Dec.5, 2006, Boulder, Colorado, USA

