JAMSTEC
Japan Agency for Marine-Earth Science and Technology

Hydrological Cycle studies in Institute of Observational Research for Global Change of Japan Agency for Marine-Earth Science and Technology

Tetsuo Ohata

Water Cycle studies in JAMSTEC

●FRCGC (Frontier Research Center for Global Change) Water Cycle: T. Yasunari and 25

Objective：To clarify how the hydrological cycle, including precipitation, evaporation and land-surface hydrological processes change and vary due to anthropogenic and other external forcings (e.g., ENSO, NAO etc). How regional and river basin scale hydro-climate and water resources vary associated with these large-scale forcings is also an important issue.

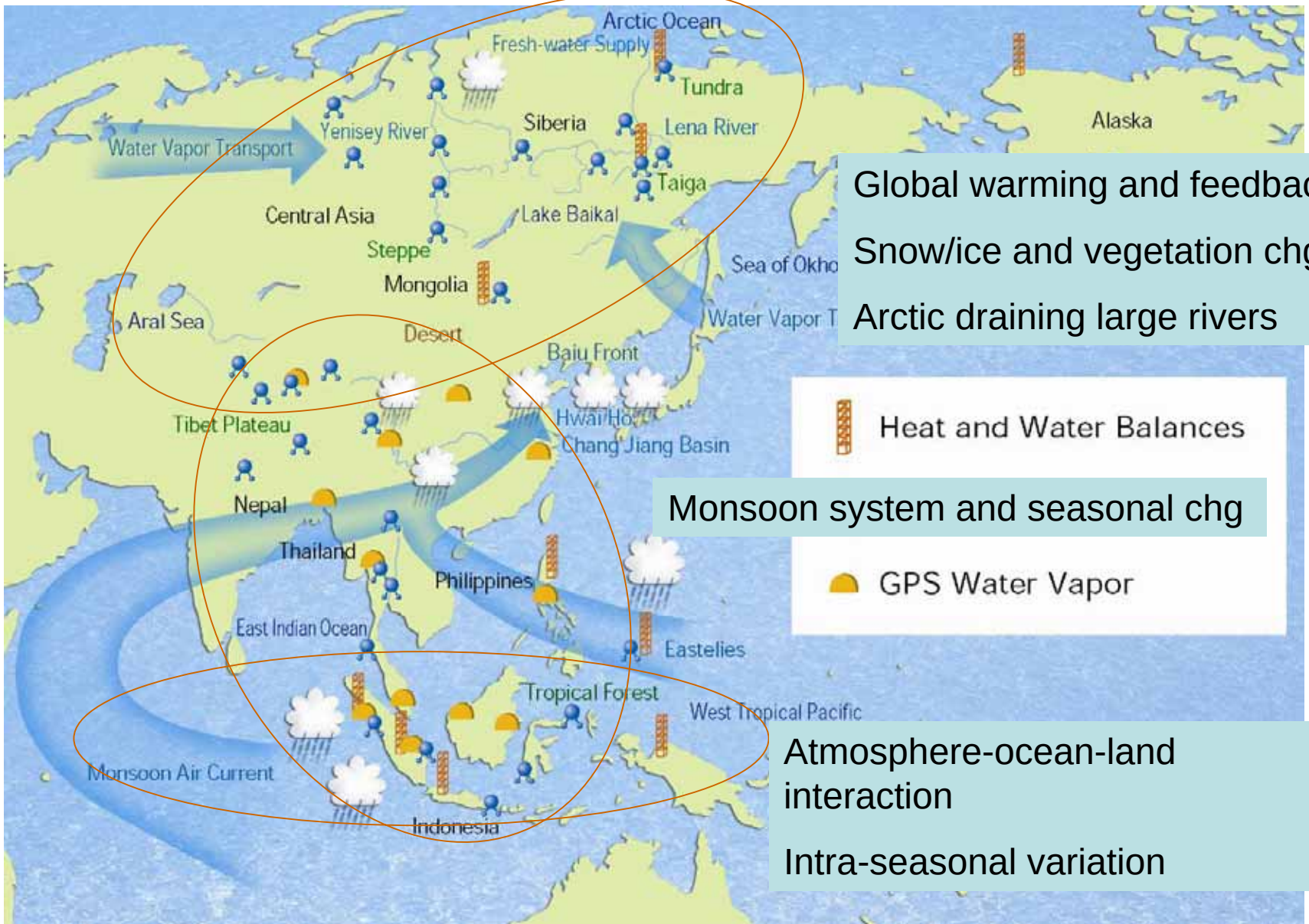
Method: Usage of comprehensive hydro-meteorological data and modeling

●IORGC (Institute of Observational Research for Global Change) Water Cycle: T. Ohata and 25

Objective: To reveal and understand hydro-meteorological processes in the eastern part of Eurasian and west pacific region (including the western Pacific warm pool, the maritime continent, and the cold region of Eurasia), which regulate climate formation and changes including the Asian monsoon system. Contribute to modeling.

Method: Large-scale intensive process studies and long-term monitoring.

Observation network of HCP



Global warming and feedback.

Snow/ice and vegetation chg.

Arctic draining large rivers

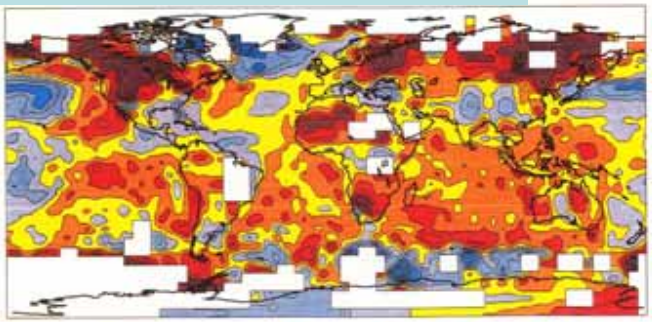
Monsoon system and seasonal chg

Atmosphere-ocean-land interaction

Intra-seasonal variation

Water Cycle of Northern Eurasia - Important component -

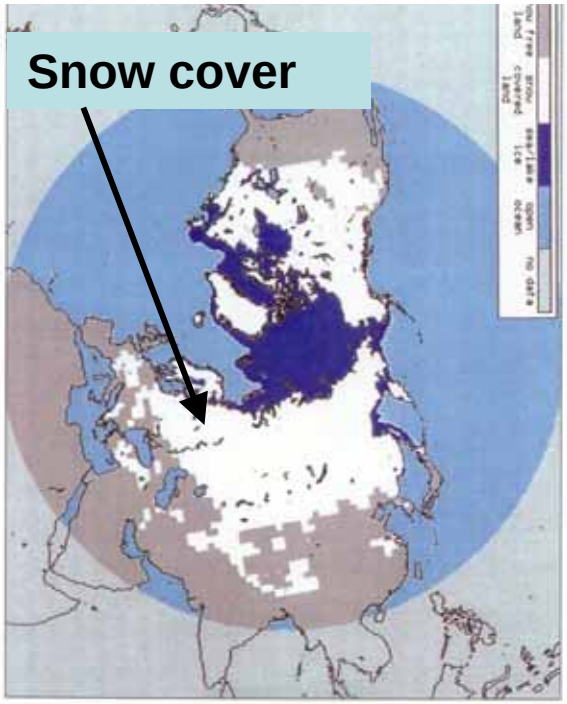
Strong warming



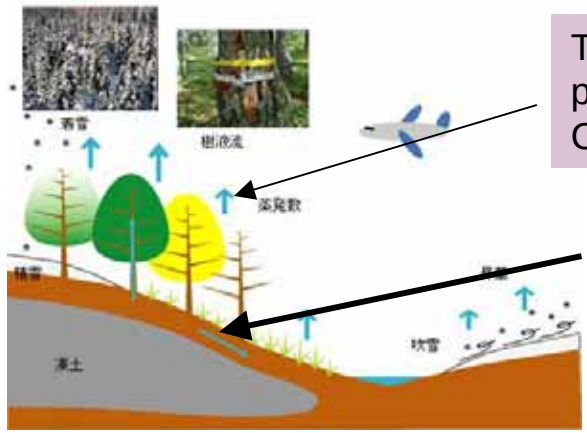
Immense boreal forest

Frozen ground and borehole

Snow cover



Complex surface processes



Tree physiological Characteristics

Frozen layer maintains surface moist

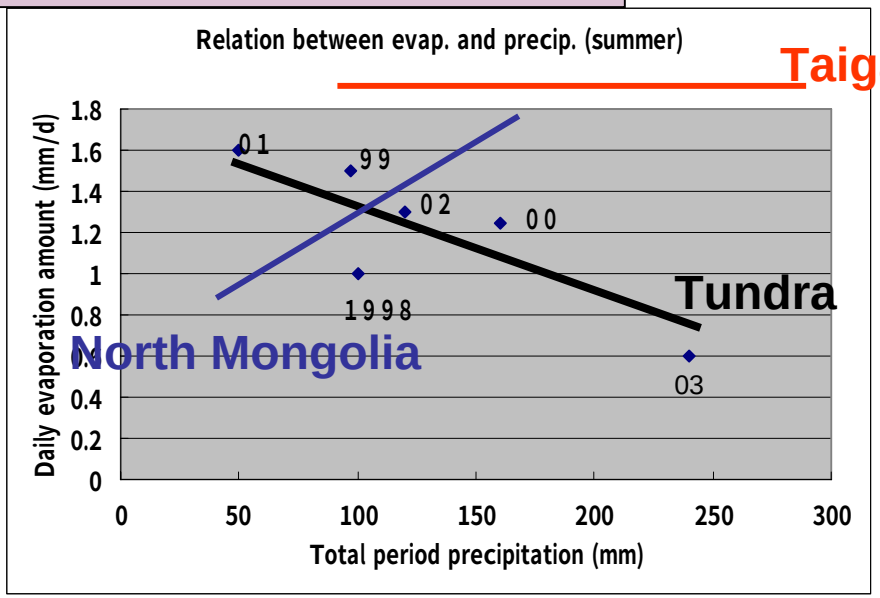
Long-term observation of surface process

Measurement

ACOS(Automatic Climate Observation System)
Observed element: Vertical profile of AT, H, W; Radiation 4 component, WD, Ground temp., Soil moisture, Precip., Ground heat flux, Snow depth, Drainage meas.; runoff, snow distri., CALM grid, depth of thaw layer

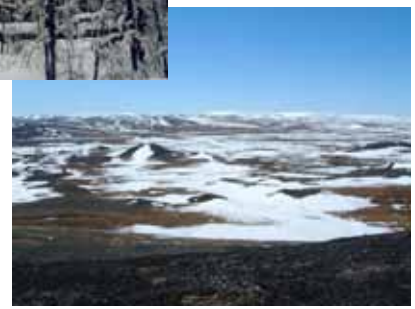
Year to year analysis

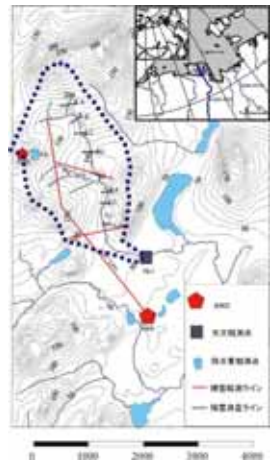
Relation between precip. Evap.

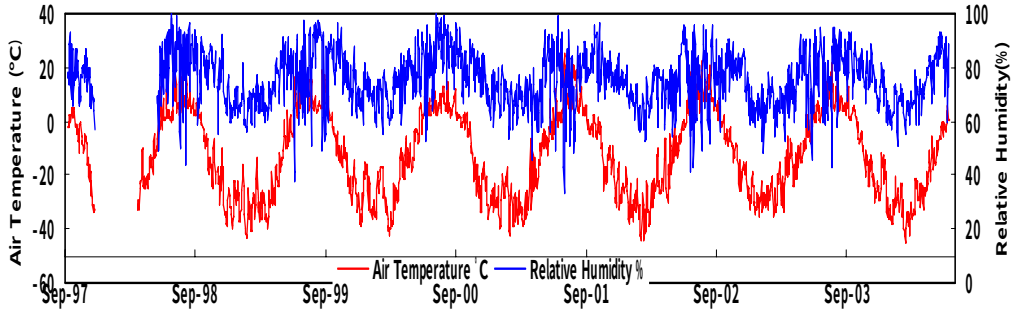


Taiga

First obs. of flux without stop for such long period (1997-2006) on tundra surface.







10 year data of AT and H

・Calibration and renewal of land surface schemes (ef. MATSIRO)

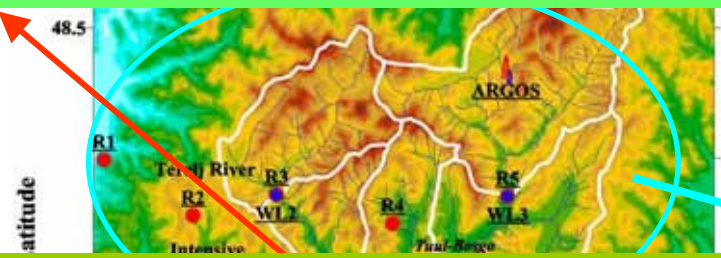
・Large scale simulation

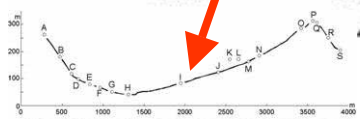
More accurate future prediction

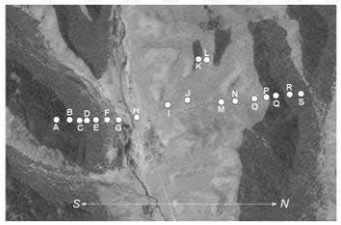
Hydrometeorological obs. Network of Tuul River.(2002-)

South facing slope

North facing slope







Rain gauge network

charge meas.

Mast obs. met and sub-surface

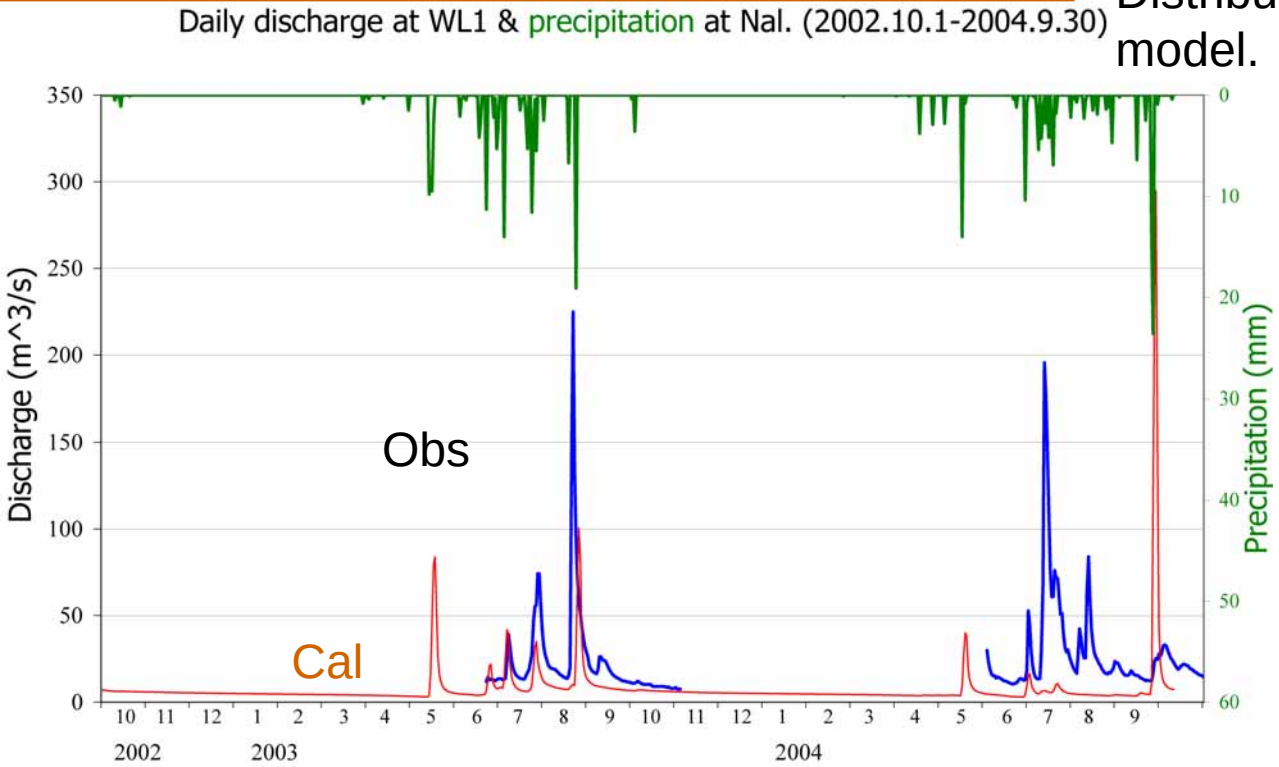
Objectives: Understand the characteristics of drainage hydrological conditions, where special land, such as frozen ground, selective forest distribution, snow cover exists.

Forest/grass land traverse hydromet obs.

Application of hydrological model, using Nalaikh surface data as input. 1st step

Model: Ma et al.(2000)

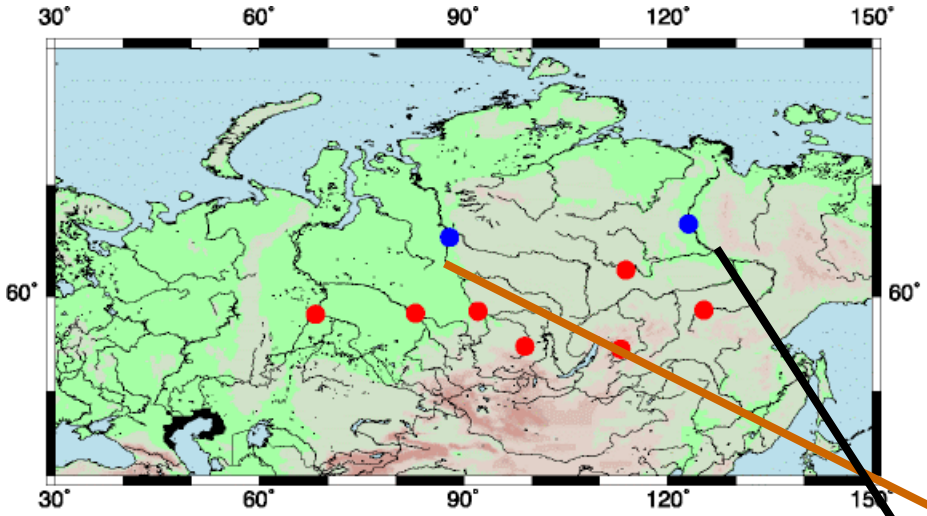
Distributed hydrological model.



(1) The seasonal variation in 2003 is rather well simulated. But limit exist since meteorological data was not ditributed within basin.

(2) The relation (obs. and cal.) is different in the two years (2003, 2004)。 ??

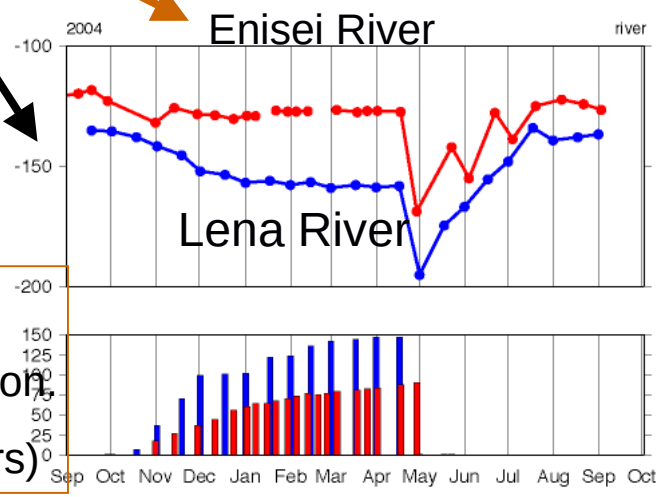
Application of Stable Isotope for understanding the hydrological cycle of Large Arctic draining Rivers.



δ D[‰]

Ice [cm]

The sampling site of various water components from 2004 (left), and Deutrium and ice depth information (September, 2004 – September, 2005) 。

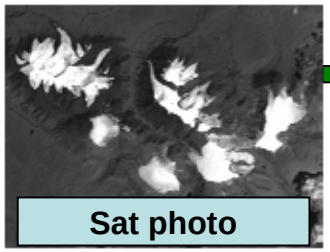


CAUSE

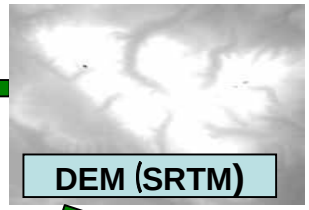
- Difference in snow cover distribution and contribution.
- Difference in sub-surface flow. (frozen ground differs)

Glacier identification

Water storage and changes in mountains in form of snow/ice - Glacier -



Sat photo

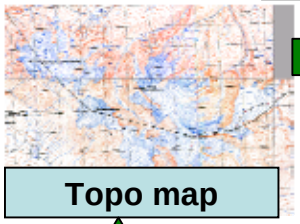


DEM (SRTM)

Calib

In-situ glacier data

Calib

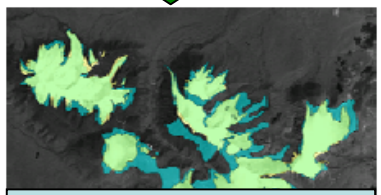


Topo map

Validation

Air photo

GIS format



Dedeuction of glacier distribution and area

GLACIER INVENTORY

面積変化量の抽出

Distribution of Changes

Integration of data

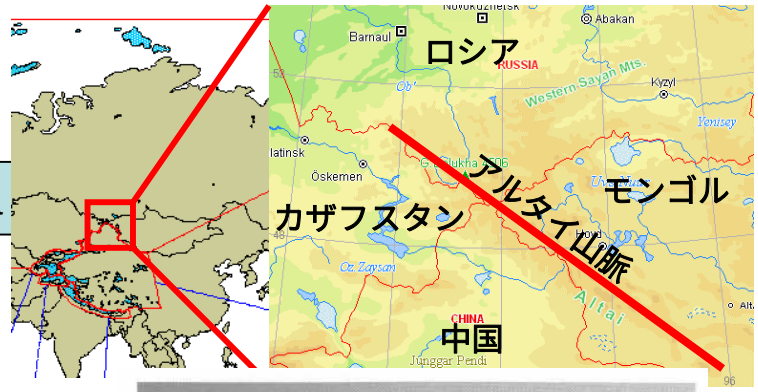


Fig. 2. The No. 31 Glacier photgraphed from north. Bulky moraine complex surrounding the present terminus is considered to be the Little Ice Age moraine. The Base Camp is located just below the left-lower corner of the photograph.

Comparison with various climate data

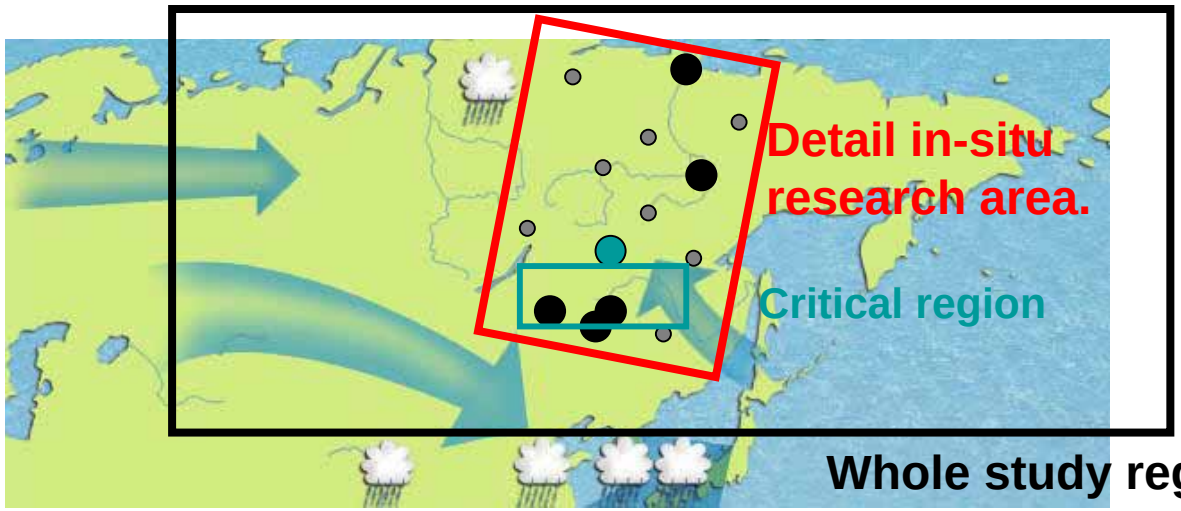
CABIN (tentative) A Program/project Contributing to CliC CPA1

Character: post-GAME project in the Northern Part of Eurasia, including other individual project. Shifting focus point of the study from "process" to "change", strengthening the atmospheric part and regional data archive.
Target Region :Asian part of Northern Eurasia north of 40N.
Central topic: Cryosphere-Atmosphere-Biosphere Interaction and Changes in Northern Eurasia

(1) Climate change and water cycle
(2) Atmosphere-land interaction and atmospheric circulation
(3) Vegetation
(4) Snow and ice

Presently discussed in Japan by core members

This will have tight relation with CEOP



Relation with international Program/projects for cold region studies in IORGC/JAMSTEC

(1) WCRP-CliC (Climate and Cryosphere)

Asia CliC: Taking responsibilities in organizing regional studies.

CABIN: Taking essential role in establishing the project.

(1) IPY Arctic HYDRA

State and Fate of Global Cryosphere

Permafrost

(3) Coooperation with CEOP through CliC-CEOP Collaboration.

(4) Glacier Inventory – GLIMS.

(5) GEO – Contribution by holding planning WS using the framework of WCRP Programs.

How JAMSTEC can contribute to AWCI

(1) Data opening: You can get various observation at the HP. Generally within 2 years of measurement.

Meteorological, Hydrological, Glaciological, Isotope.

(2) Can work on cooperative work if interest fits each other.

(3) Coordination function (domestic and international level) of water cycle observation in the context of GEO (such as JACCO) is being discussed.

Surface Processes

Study on un-solved processes → Modeling

Eastern Siberia and Hokkaido

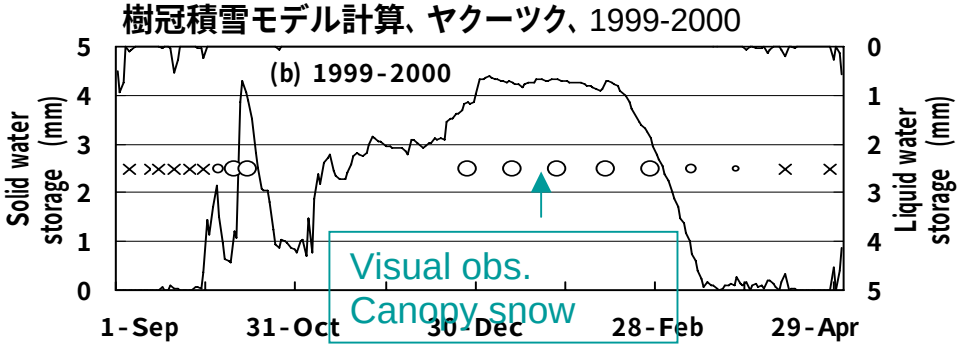
Sap flow meas.

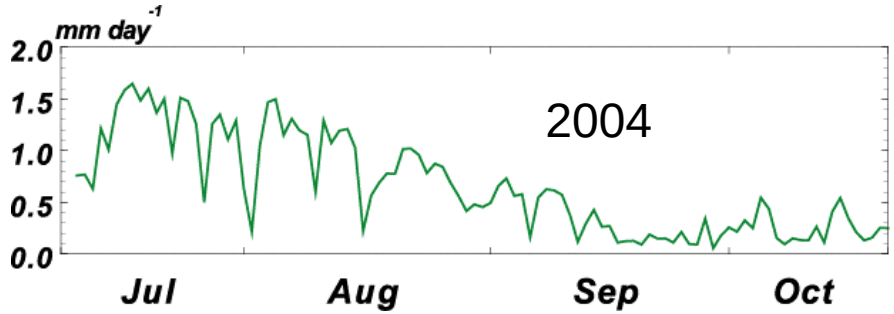
Northern Mongolia

Canopy snow cover⇒ How much, sublimation and influence to radiation budget. Not included in GCMs

How much do trees uptake water. How is it regulated.

Comparison of model(2LM) output and obs.(Yakutsk)





Seasonal variation of sap flow

Application of stable isotope of water <Precipitation, Snow cover, River water> to water cycle study

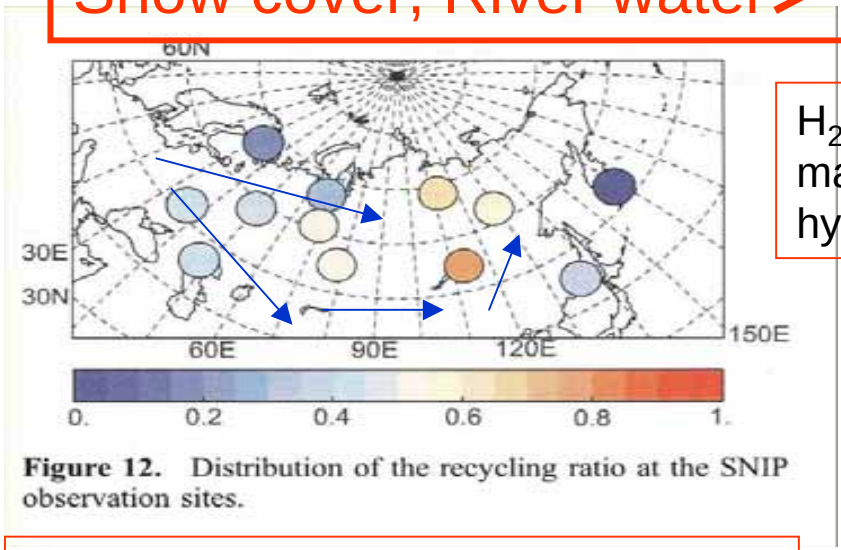


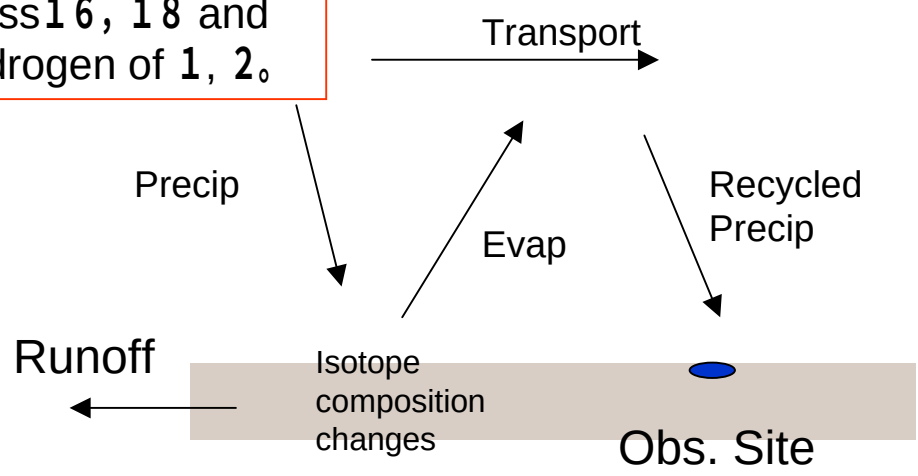
Figure 12. Distribution of the recycling ratio at the SNIP observation sites.

The recycling ratio differs place to place. High in the east !

The data is used for validation of models

$H_2 0$。 Oxygen of mass16, 18 and hydrogen of 1, 2。

(Kurita et al., 2004, 2003)



Mass spectrometer (1993、1995)

Present precip (High value)

Ice inside ground (Low value)

runoff

Isotope composition changes as ground ice melts

Progress of melting of ground ice can be detected