

Hydrological Cycle Program at  
Institute of Observational Research for  
Global Change (IORGC)

of

Japan Agency for Marine-Earth Science and Technology  
(JAMSTEC)

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IORGC/JAMSTEC

# Hydrological Cycle Observational Research Program

- **Objectives:**

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 strongly affects variation, including the Asian monsoon system, through large-scale intensive process studies and long-term monitoring.

To contribute to the climate modeling and prediction, by improving the physical model and model parameterization of hydro-meteorological processes.

# Observation network HCP of IORGC



# Main study topics of HCP

## <Cold region studies>

- (1) Investigate the characteristics and variation of surface components such as snow cover/ frozen ground, vegetations and **hydrometeorological and atmospheric processes in cold continental regions**, and clarify the interaction with the climate systems, characteristics of runoff of large Arctic draining rivers, and influence of cold regions to atmospheric circulations such as monsoon system. (Cold region hydrological cycle Group; Ohata; 11 members)

## <Tropic to mid-latitude studies>

- (2) Investigate the intra-seasonal variation to inter-annual variations of eastern **Asia Baiu front**, tropical **cumulus convection**, and contribute to the development of high-resolution cloud model through observations. (Cloud/precipitation Processes Group; Uyeda; 6 members)
- (3) Investigate the **variation of hydrological cycle** such as water vapor and precipitation in the area from **Indo-China Peninsula to Indonesia**, and clarify the influence of these regions to the El-Nino and Asian Monsoon. (Large scale hydrological cycle group; Yamanaka; 6 members)

# Need for strong cooperation/collaboration with international programs/activities (e.g., WCRP, IGBP, CEOP)

- Global/continental/ocean-basin scale observational studies can be promoted only through these c/c.
- Exchange of data are crucial for promoting observational studies of the earth system and global change.
- **Hydrological cycle processes** need intensive observation by highly-advanced systems and instruments.

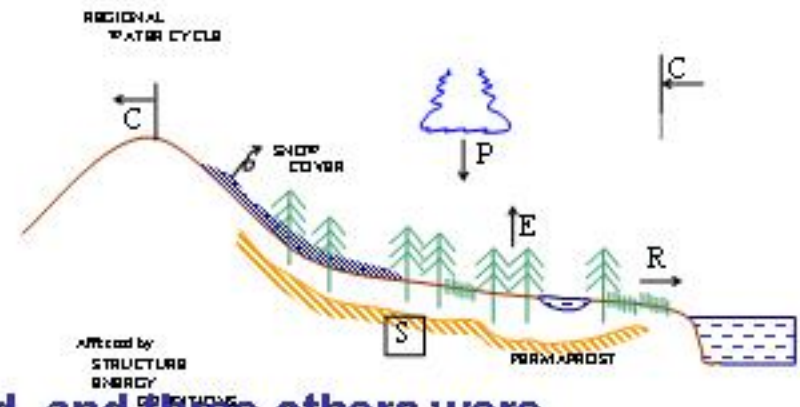


# Land surface process group

## Five objectives and strategy

- (1) Surface hydrological processes and detection of changes at special observation area
- (2) Atmosphere-land surface interaction in cold regions
- (3) Glacier and permafrost variation study
- (4) Development of better hydrological data-sets for cold regions
- (5) Validation and development of one-dimensional, regional hydrological and meteorological models

\_\_\_\_\_ will be presented here.



### Strategy

- (1) **Four sites were newly established, and three others were succeeded from other projects so that longer hydrological variability study can be made.**
- (2) **The main region of study was eastern Siberia in the Lena River Basin which has influence to the global circulation and Arctic hydrological budget.**

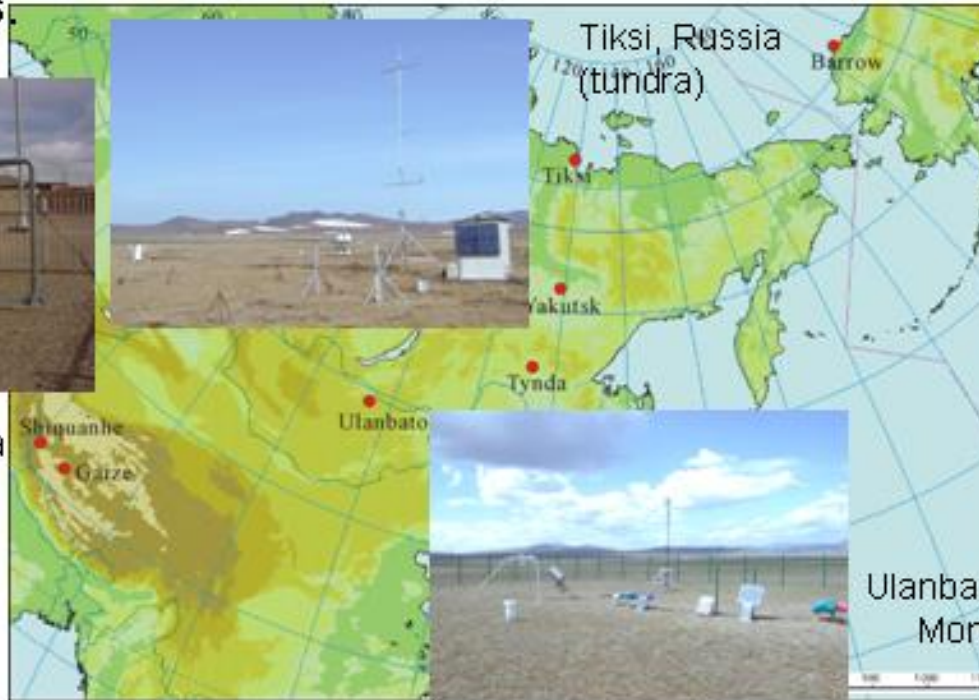


**Follow-up of GAME-Siberia and CliC-Eurasia**

**1. Surface hydrological processes and detection of changes at special observation area.:** Surface process considering the snow cover and frozen ground is still not known well yet. The target of the this study is to clarify the role of snow cover, frozen ground and related surface conditions to the heat/water exchange at patch-scale and drainage scale, and supply data for model studies.



Gerze, Tibet, China  
Plateau



Yakutsk, Russia,  
taiga

Ulanbaataar,  
Mongolia



Schematic figure of the cross section from Tiksi to Ulanbaataar, the main study area.



# Hydrometeorological Measurements(Tiksi, Russia)



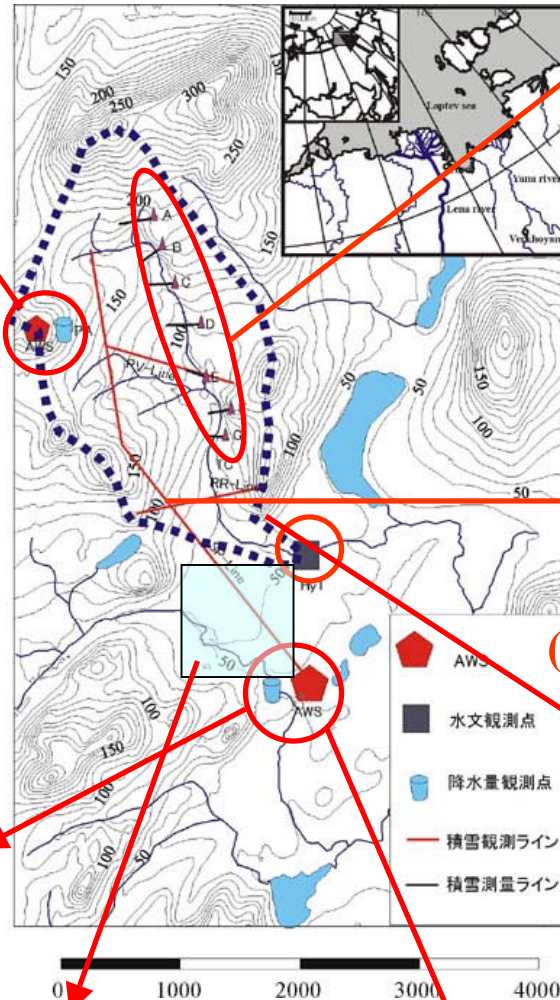
**Mountain  
AWS**

1998 June ~

**ACOS (Mast met and  
sub-surface obs.)**



1997 Sep. ~



**CALM (Thaw depth)**  
Jul., Aug., Sep. 1997 ~  
Precipitation sampling for Stable Isotope  
1997 ~

**Snow Drift survey**  
May, June



1998 ~



**Snow Survey**  
(snow depth, Snow density, SWE)  
May, June

1997 ~



**Discharge**

1997 ~





Landscape of Tiksi  
(tundra)

### The observing meteorological elements by ACOS at Tiksi



Tiksi ACOS mast

Element	Data logging
Short wave radiation (upwards and downwards)	logging: 1min, Record:10 min average Value
Long wave radiation(upwards and downwards)	logging: 1min, Record:10 min average Value
Net all wave radiation	logging: 1min, Record:10 min average Value
Air temperature and Relative Himidity 4 levels (1, 2, 4, 10m)	Logging and record:10 min
Wind speed 3level (2, 4, 10m)	Record: 10min average value
Wind direction (10m)	Logging and record: 10 min
Ground heat flow two point 2 depths (5, 8 cm)	logging: 1min, Record: 10 min Average Value
Ground temperature 2 point 6 depths (0, 5, 10, 20, 30 and 47cm)	Logging and record: 10 min
Soil Moisture content 2 point 3 depth (0, 15, 30cm)	Logging and record: 60 min
Precipitation	Record: 60min sum value
Snow depth	Logging and record: 60 min

# Forest Tower Observation

## Hydrometeorological Measurements (Yakutsk, Russia)



Larch Forest



Larch Forest Floor



Pine Forest

Soil Moisture and Soil Temp. Network  
(1-2 times a month)

1997~



▲ : タワー観測地点 (S: スパースカヤ ; T: ティングルー)  
▲ : 地温土壌水分観測地点, 同位体用水サンプリング地点



River water sampling for stable isotope



Soil Moisture measurement

Soil Moisture and Soil Temp. Network  
(1-2 times a month)  
2002~



## Larch forest tower

Element	Data logging
Short wave radiation(32,1m) (upwards and downwards)	logging: 1min, Record:10 min average Value
Long wave radiation(32,1m) (upwards and downwards)	logging: 1min, Record:10 min average Value
Net all wave radiation(32,1m)	logging: 1min, Record:10 min average Value
Air temperature and Relative Humidity 4 levels (32,24,6,2 m)	Logging and record:10 min
Wind speed 3level (32, 24, 6,2 m)	Record: 10min average value
Wind direction (32 m)	Logging and record: 10 min
Ground heat flow two point 2 depths (5, 8 cm)	logging: 1min, Record: 10 min Average Value
Soil temperature 7 depths (0, 10, 20, 40, 60, 80 and 120cm)	Logging and record: 10 min
Soil Moisture content 5 depth (10, 20, 40, 60, 80cm)	Logging and record: 60 min



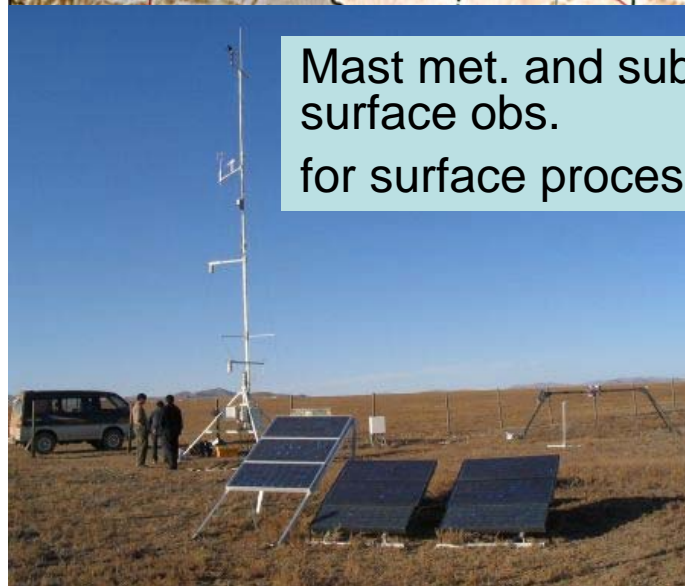
## Pine forest tower

Element	Data logging
Short wave radiation(22m) (upwards and downwards)	logging: 1min, Record:10 min average Value
Long wave radiation(22m) (upwards and downwards)	logging: 1min, Record:10 min average Value
Net all wave radiation(22m)	logging: 1min, Record:10 min average Value
Air temperature and Relative Humidity 4 levels (22,18 m)	Logging and record:10 min
Wind speed 2 level (22, 18 m)	Record: 10min average value
Wind direction (22 m)	Logging and record: 10 min





# Hydrometeorological Measurement Sites in Mongolia



Mast met. and sub-surface obs.  
for surface process



Radiation budget meas.



South facing slope

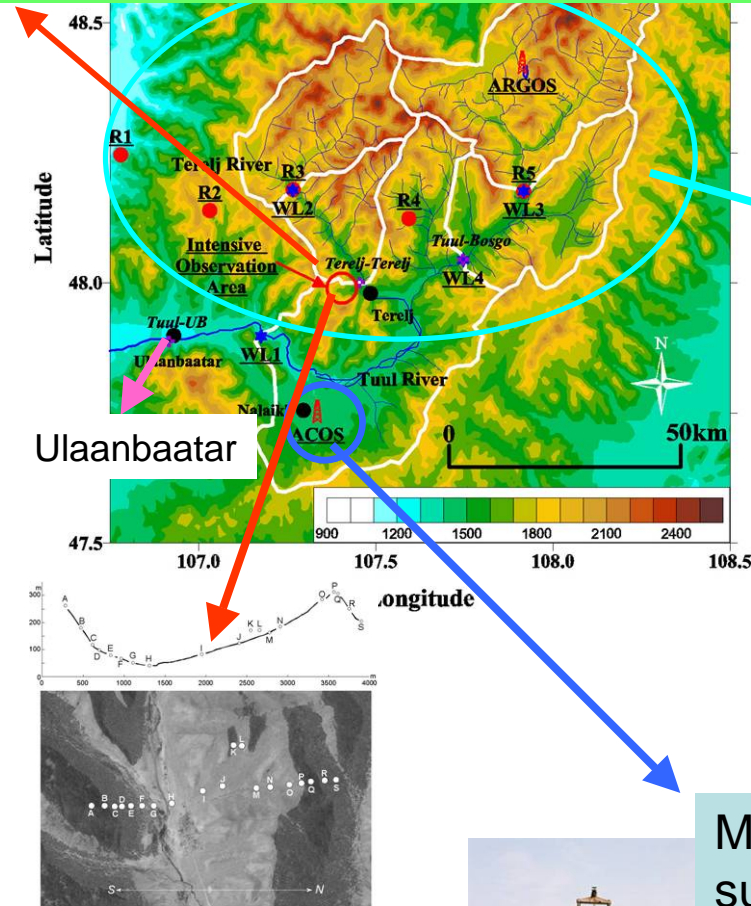


North facing slope



Forest/grass land traverse hydromet obs.

# Hydrometeorological obs. Network of Tuul River



Rain gauge network



Discharge meas.

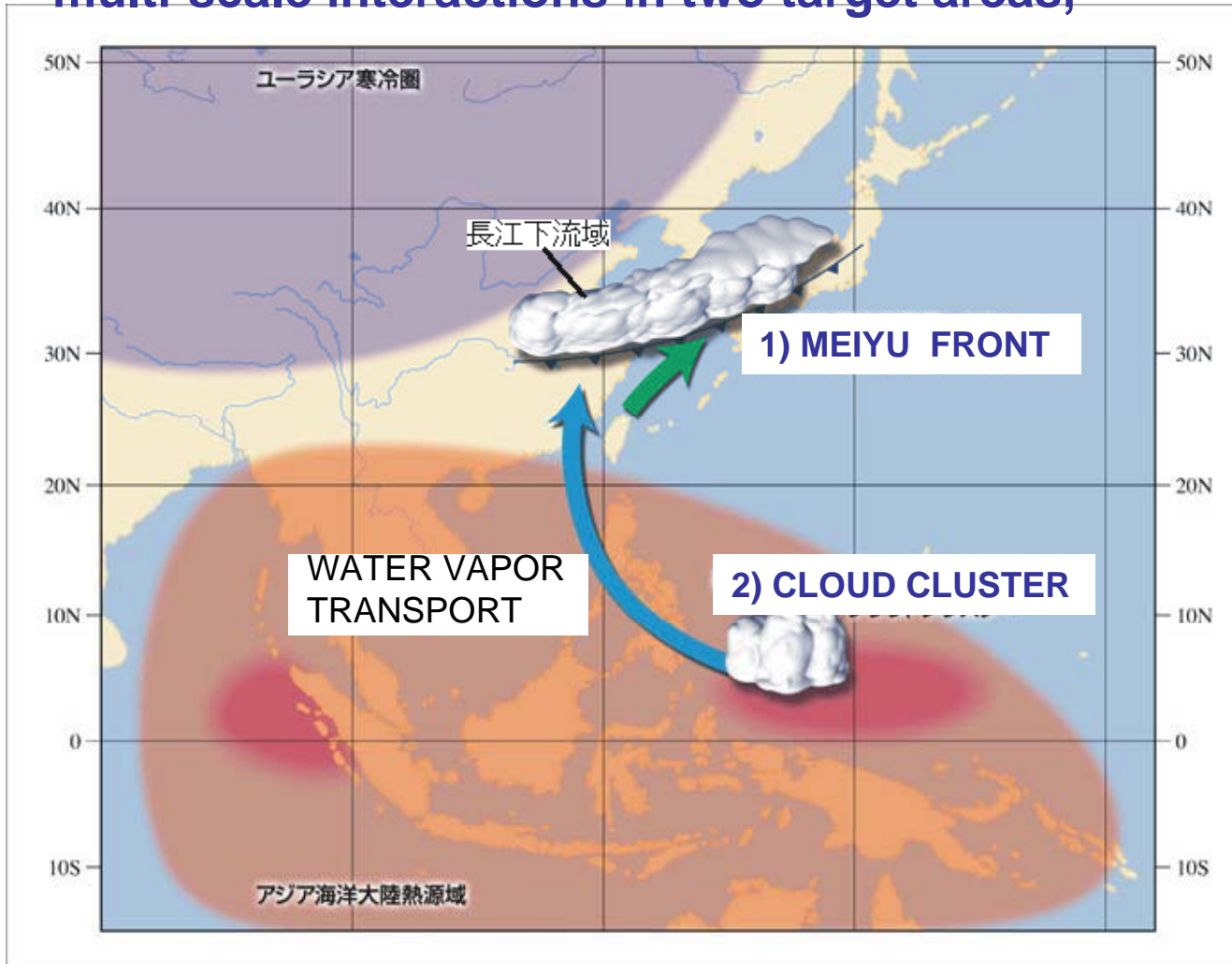


Mast obs. met and sub-surface



**Cloud and Precipitation Processes Group,**  
*Hydrological Cycle Observational Research Program, IORGC*

**aims to elucidate cloud and precipitation processes and their multi-scale interactions in two target areas,**



**1) the eastern Asia  
(Meiyu or Baiu frontal zone)**

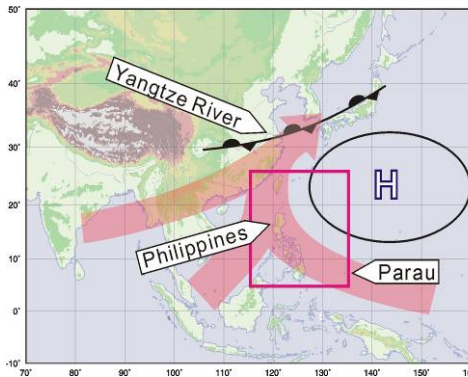
**2) the western tropical  
Pacific (the warm  
water pool region),**

**with high-resolution  
and three-  
dimensional data set  
based on synthetic  
observation,**

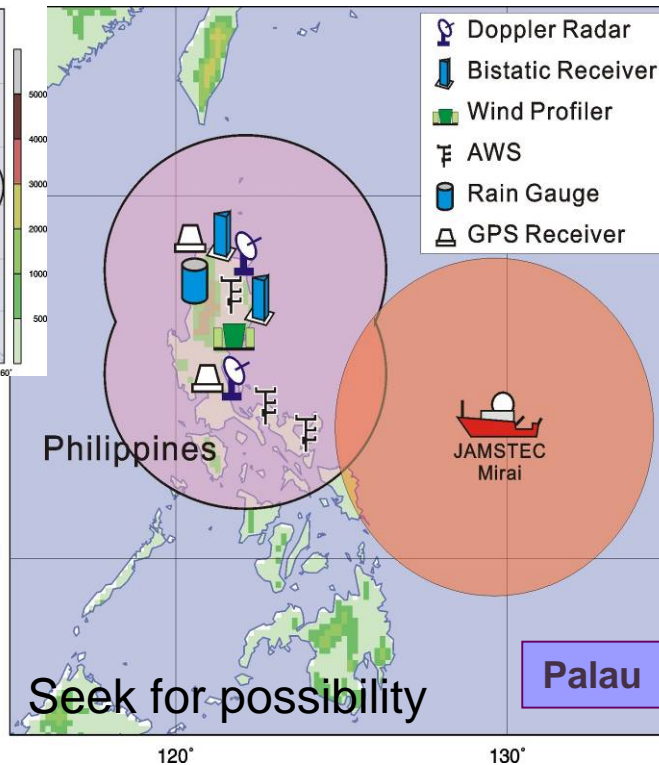
**for better  
understanding of cloud  
systems and  
improvement of the  
numerical models.**



## For Future



Synthesized understanding of cloud and precipitation processes, and water vapor transportation



Cooperation with Climate Variations Observational Research Program

Intensify observation network in Palau !

- Wind Profiler
- Doppler Radar
- and others

- Intensive observations will reveal the water cycles from the tropical West Pacific to east Asia.
- High resolution observation will be useful for the development and validation of cloud system resolving model (GCM).

# Large-Scale Hydrological Cycle Group

GL: *M.D.Yamanaka*

SL: *P.M.Wu, (A.Numaguti)*

PD: *S.Mori, J.Hamada, K.Ichiyanagi*

RA: *T.Sasaki,*

## Targets:

Regional processes & global climatic impacts of

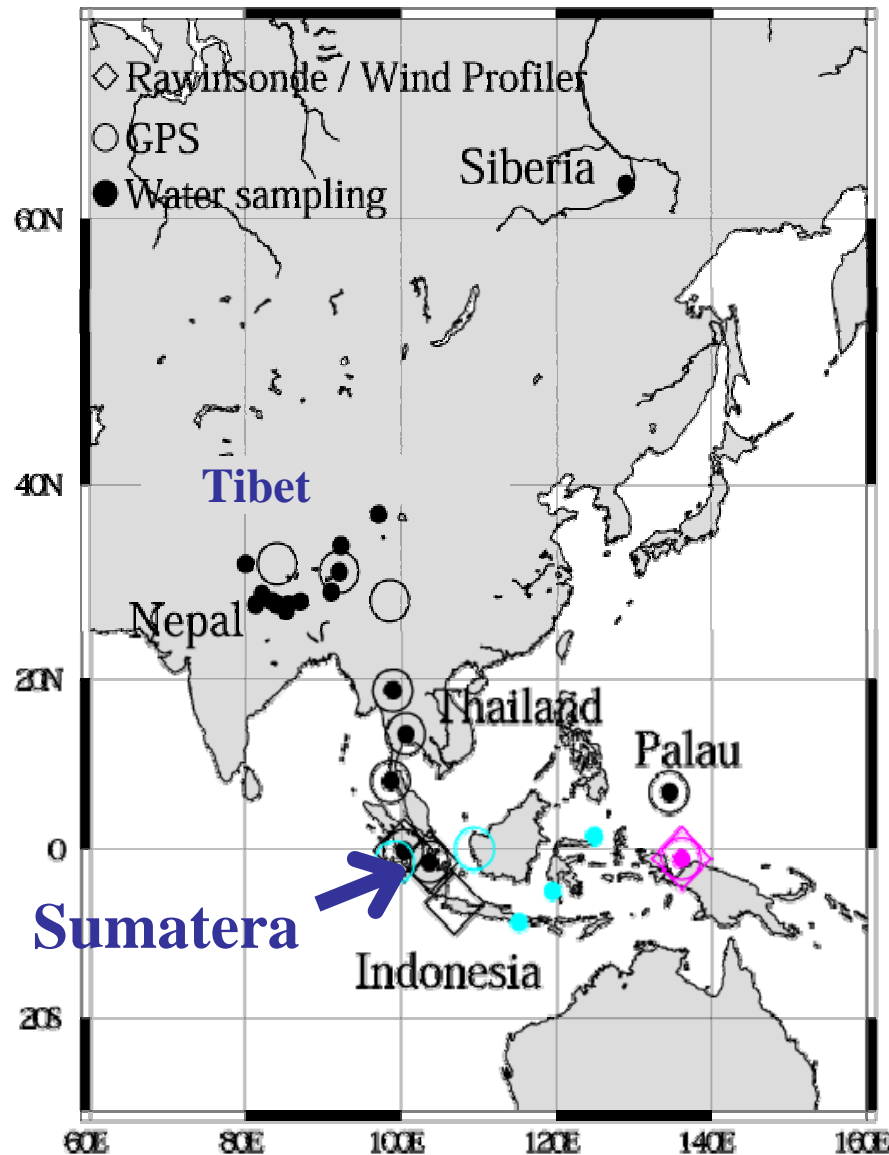
- (1) Heat source region over/around the Indonesian **Maritime Continent**
- (2) Cold source region over **Tibetan Plateau**

## Observational methods:

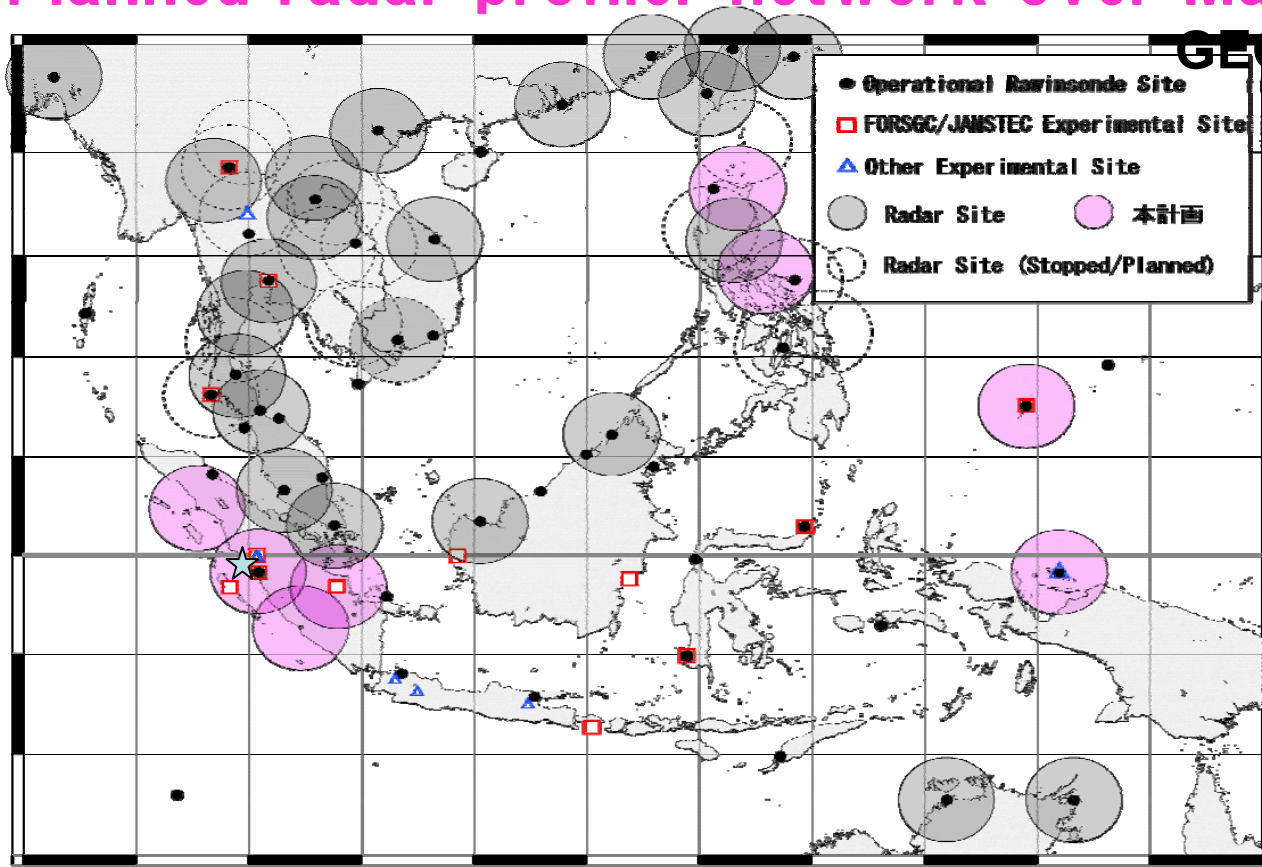
- (i) ◇ Intense **rawinsonde** launch
- (ii) ○ **GPS** soundings of precipitable water
- (iii) ● **Isotope** analysis of sampled water

## Construction of observational network:

- ◇ ○ ● : stations constructed until FY2000  
○ ● : stations constructed in FY2001-2  
◇ ○ ● : stations planned in/after FY2003



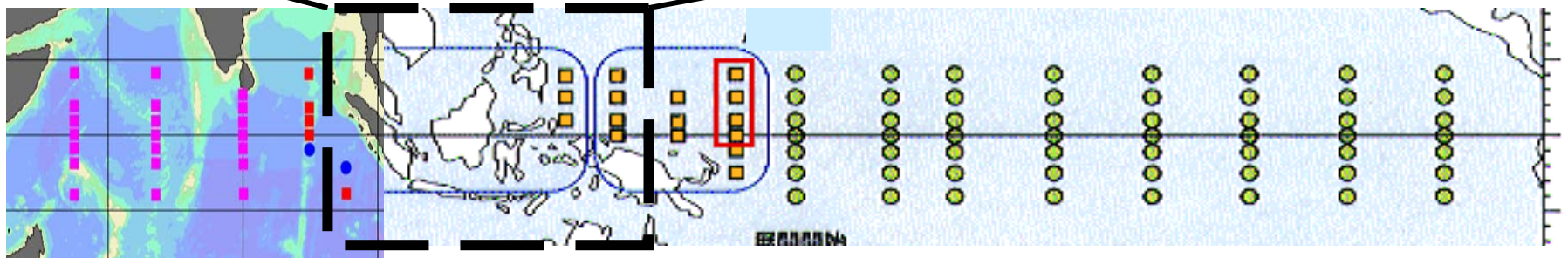
# Planned radar-profiler network over Maritime Continent



## GEO/GEOS Contribution.

Major Targets:

- Cloud cluster organizations and modifications
- Diurnal-intraseasonal scale interaction
- Interannual scale monitoring
- “Radar-AMeDAS”-like system planning

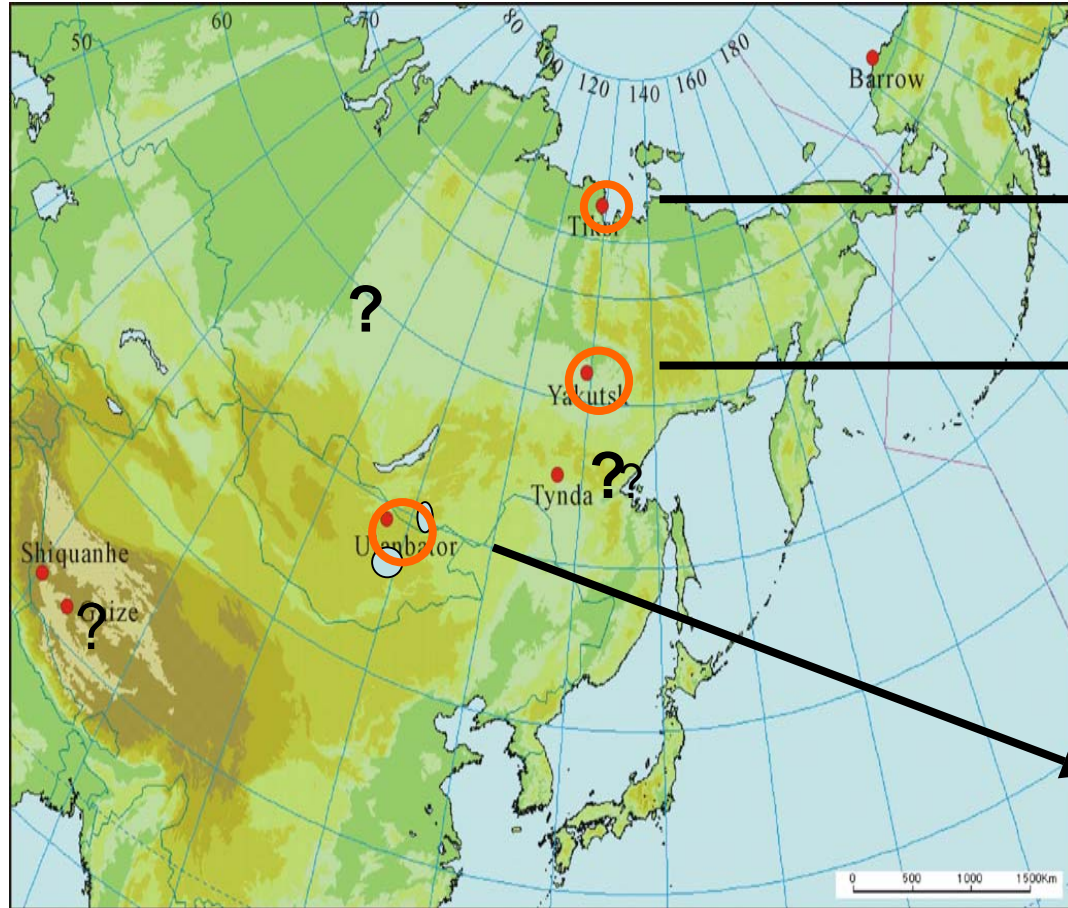


Planned buoy network over Indian Ocean

Existing buoy network over Pacific Ocean



# Plan of Development of Super-stations in the Cold Regions. (GEO/GEOSS Contribution)



Basin meas.

+ intensif., vegetation, fg monitor atmosphere sounding.

(coop.: NIPR, Hokkaido Univ., PI-RAS,)

Tower meas.+ sub-surface network

+ Intensif., vegetation, radar, fg monitor, atmosphere sounding

(coop.: Nagoya Univ., IBPC-RAS, PI-RAS)

Basin meas., satellite val. Site, Tower meas.

+ intensif., fg monitor atmosphere sounding

(coop.: Hiroshima Univ., Tsukuba Univ., IMH, IG)

→ CEOP2 Cold region processes study

