CryoNET and Japanese contribution

Tetsuo Ohata
Japan Agency for Marine-Earth Science and Technology (JAMSTEC),
Yokosuka, Japan
Chairman, Japan Consortium for Arctic Environmental Research

And

Teruo Aoki
Meteorological Research Institute, JMA, Tsukuba, Japan.

2011, November, 1st GCW Implementation Meeting

Possible contribution to GCW from Japan

– A country with small cryosphere, but with large global interest-.

Tetsuo Ohata
Japan Agency for Marine-Earth Science and Technology,
Yokosuka, Japan
Chairman, Japan Consortium for Arctic Environmental Research

GCW Implementation Plan Meeting, Geneve, November 21-24, 2011.

Japanese CryoNET sites: Information forwarded this time.

(**): Part of Intl. Network.

(1)Ice sheet: 4 sites in Antarctica and Greenland.

(2)Glaciers: 1 site in Mongolia

(3)Snow cover: 5 sites in Japan

(4)Terrestrial(Permafrost, snow cover): 9 sites and network in Siberia and Alaska

GTN-P, Asia Flux, CEOP(DIAS), INTERACT)

(5) Others: , Svalvard station

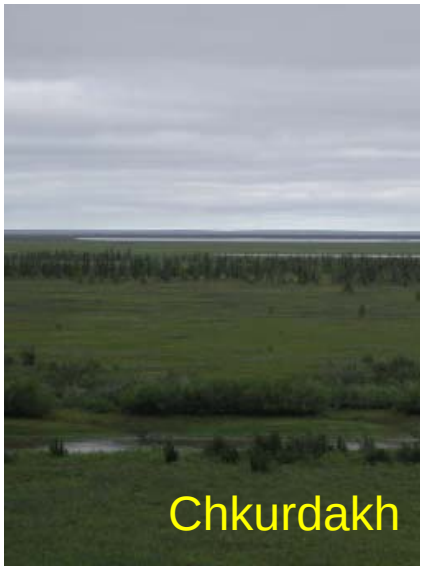
Observation network in north-eastern Eurasia and Alaska in collaboration with Japanese institutions

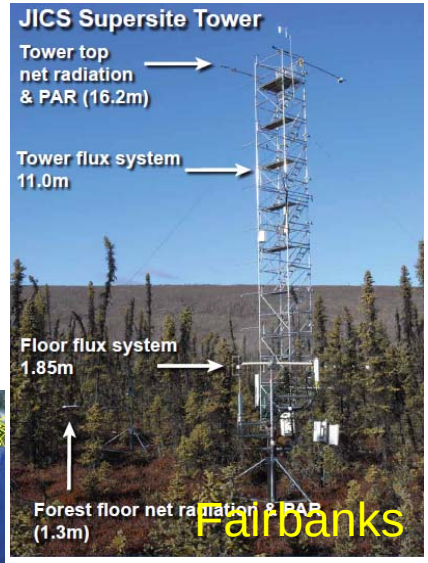
Super site

Permafrost observation network

(Prepared by Iijima)

Super site





Tower (mast)

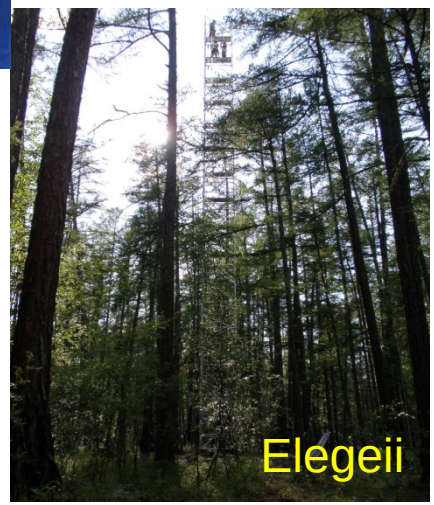
Meteorology

H_20, CO_2 CH_4 fluxes

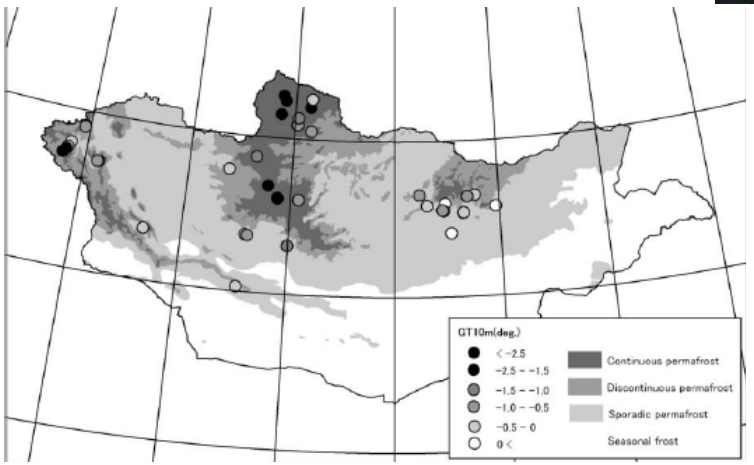
Ecology

Hydrology

Permafrost



Permafrost Observation Network



Borehole (5-10 m)

soil temperature

soil moisture (AL)

Active layer thickness

National Research Institute for Earth Science and Disaster Prevention

積雪・気象観測ネットワーク（SW-Net）

Mainly in the mountain regions

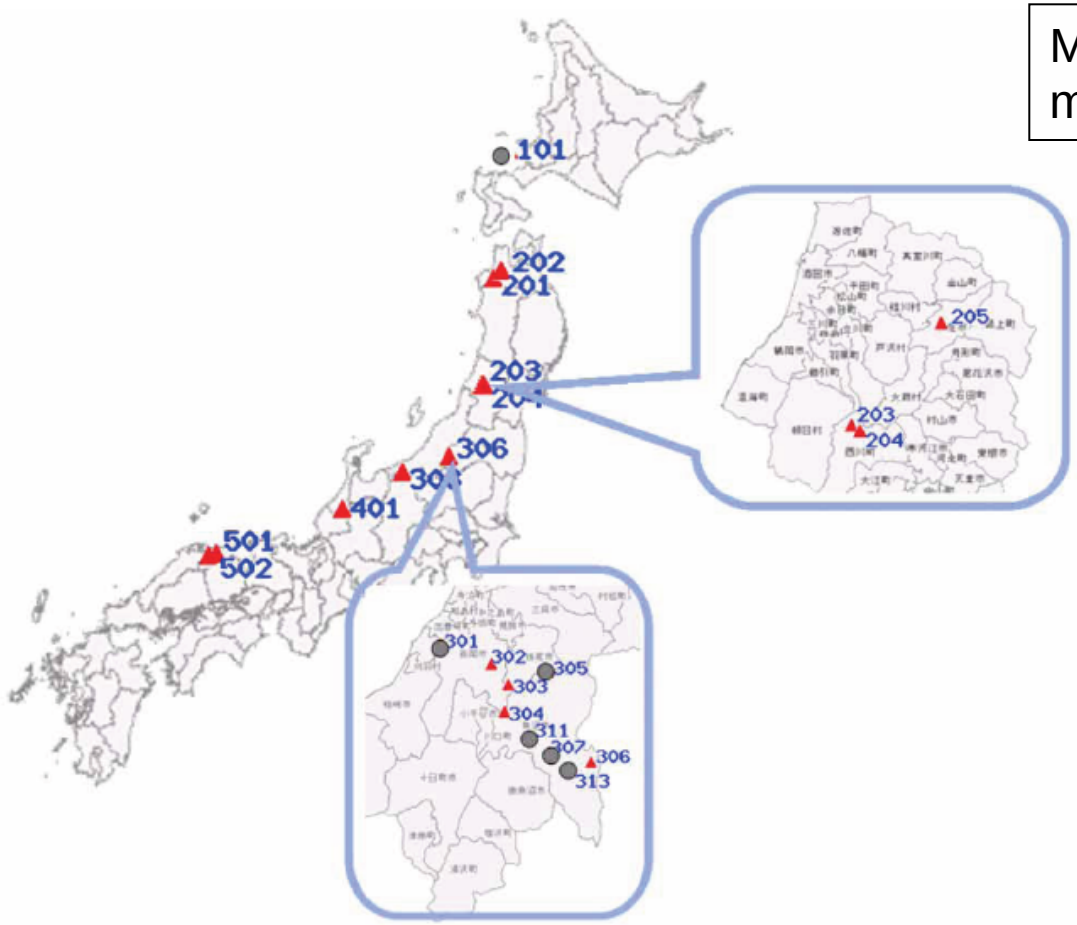


図１ 防災科研が各地に展開している積雪・気象観測ネットワーク
赤△が、積雪重量の測定を行っている地点
灰色○が、積雪深のみを測定している地点

http://www.bosai.go.jp/seppyo/

Other potential sites for CryoNET

Did not have enough time to ask people to submit CryoNET infomations. Totally, it would double.

(1)Ice sheet:

- Inland station in Antarctica

(2) Glaciers:

- Several in mid-latitude, Himalaya and Patagonia

(3) Snow cover, others:

- JMA observation sites
  (WMO station and AMeDAS network)
- Network of hydrological division, MLIT, Japan

(4) Frozen ground, snow, others: Stations of MAFF, Japan.

(5) Forest/ecological directed sites.

Japanese data archive activities: (Recent Several Years)

(1)CrDAP (Cryopshere Data Archive Project)at JAMSTEC

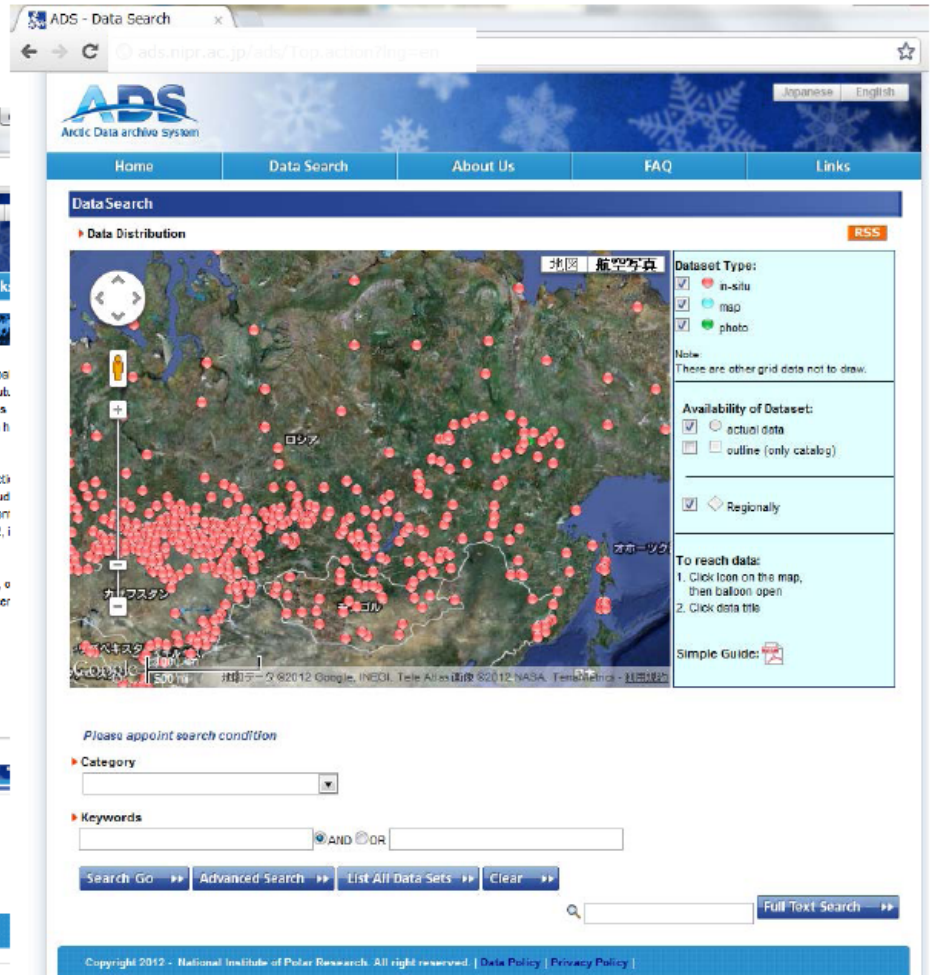
(2)ADS (Arctic Data System) at NIPR being developed.
Presently, there is a old system, which is very weak.

Mainly developed with the effort of H. Yabuki and H. Kawamoto

Arctic Data archive System

http://ads.nipr.ac.jp/

New version launched in November 2012



Questions related to implementation in general and in Japan.

(1) What is the criteria for being an CryoNET site.

- Continuous, important?
- Quality.

(2) Authorized listing or registration of the sites in CryoNET.

- How will the crynoNET list prepared by peoples be treated in the present work? GCW direct contact (document to be presented to) to all contributors, or through brokers in each country.
- Credit of listing at CRyoNET for contributors.

(3)Past data:

- What do we do with past taken data, terminated ones.

If clear direction is built up, people may re-start observation.

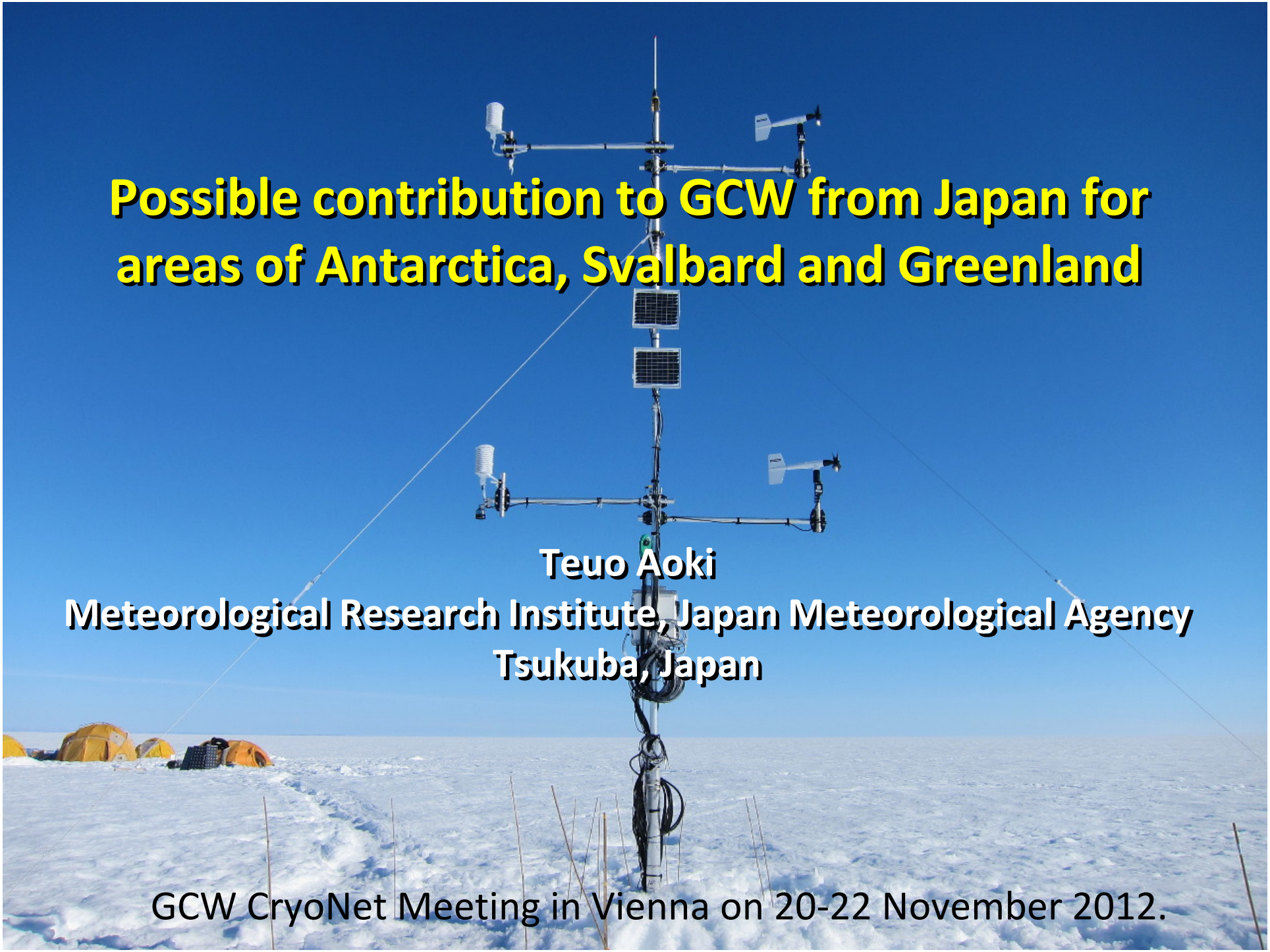
(4) How can we maintain the sustaining observation, which is needed for high quality data-sets for GCW. Quite many are made under research activity with limited short-term fund.

(5) National functions: Is there any national function (discussion) in each country.

this may be the barometer of interest to GCW.

(6) Duplication may be arising at the listing for some large observation and ones done by international cooperation, listed up by several countries.

(7) Necessity of “Guideline”, showing the optimum network of cryopshere.



Possible contribution to GCW from Japan for areas of Antarctica, Svalbard and Greenland

Teuo Aoki
Meteorological Research Institute, Japan Meteorological Agency
Tsukuba, Japan

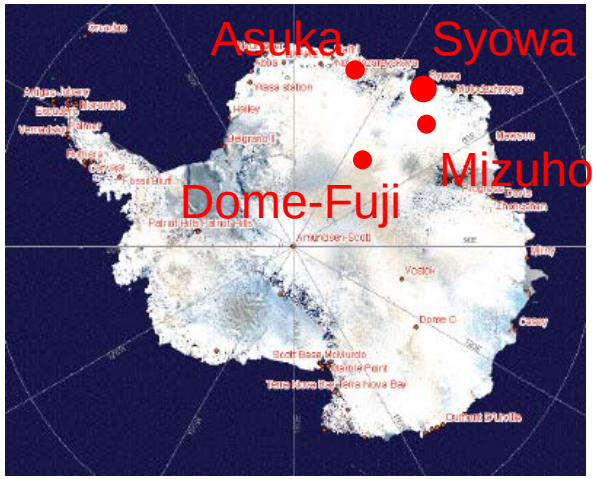
GCW CryoNet Meeting in Vienna on 20-22 November 2012.

Polar regions and mountain cryosphere, and cold region in winter

Antarctic.1957..	ice sheet
Himalaya.1970s~.	Nepal, Bhutan: glaciers
Patagonia.1980s~.	Chile and Argentine: glaciers
..... (1980s -> 1990s)	glacier, afterwards China
Siberian Region (1996~.	Russia: permafrost, snow cover, glacier
Mongolia (2003~.	Mongolia: glacier, permafrost
Alaska (2000~)	USA (Univ. Alaska), permafrost, snow cover
Greenland (1950s~ -> 1990s)	ice sheet, ice caps, glaciers
Svalbard (1991~)	glacier, ice cap

other regions in Arctic .1990s, and strengthened after 2011 including .)

Syowa Station in Antarctica



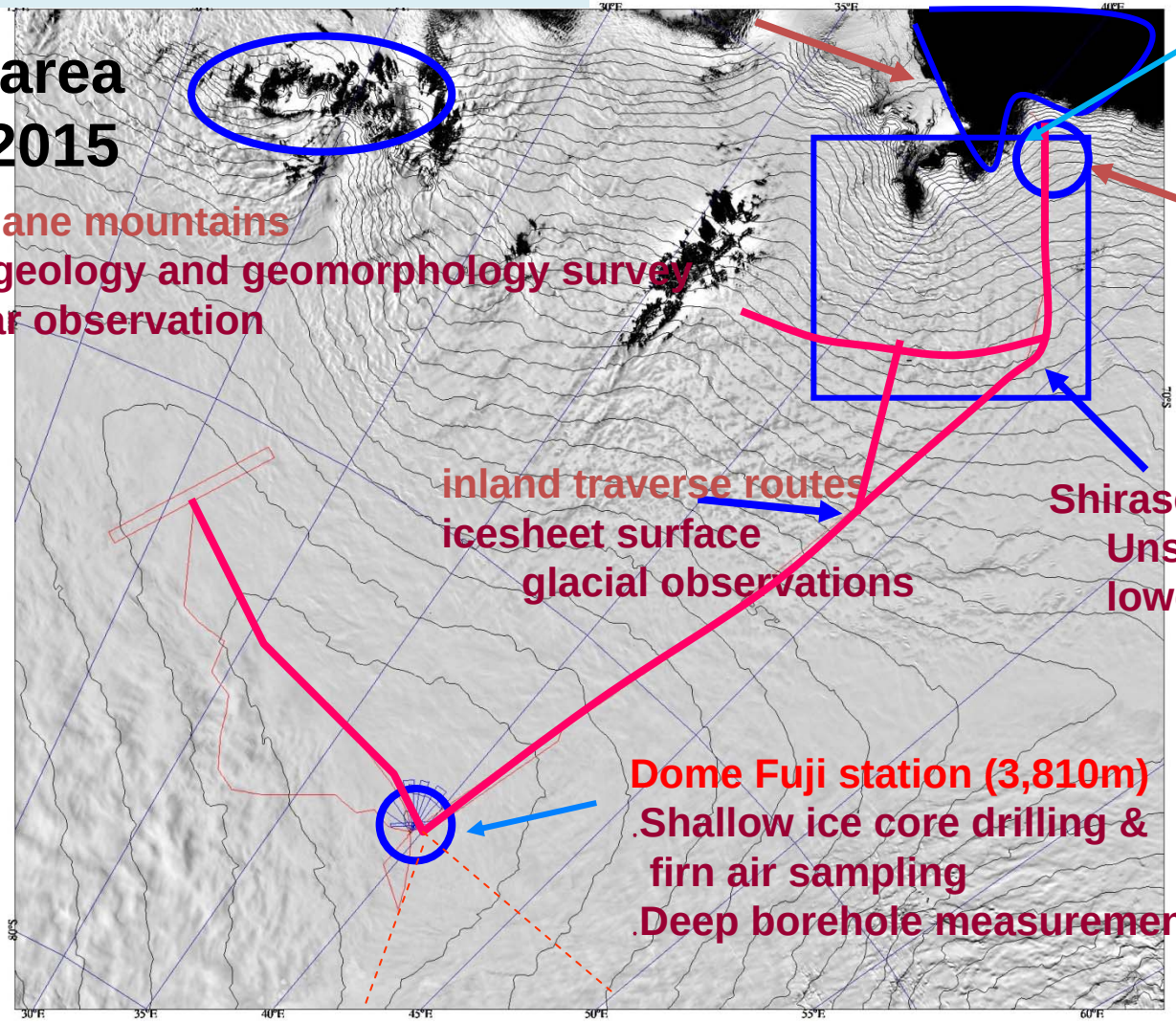
Location: 69° 0.3' S, 39° 34.8' E, 21.8m
Landscape type: Antarctic coastal
Onsite technical staff: Yes (~30 in winter, ~100 in summer)
All-year round observations: Yes
Year established: 1957
Solid precipitation: No
Snowfall: Snow depth
Trace gases: CO_2, CO, CH_4, O_2, ozone and aerosols (GAW station)
Aerosols: Sunphotometer, and skyradiometer
UV, stratospheric ozone: UVB spectral, broadband), UVA (broadband), ozonesonde, total column ozone, umkehr
Radiation: Downward and upward radiant flux densities for SW and LW, and direct solar radiation (BSRN site)
Meteorology: Air temperature, relative humidity, wind speed and direction, air pressure, and aerological observation with radiosonde

Research area in east Dronning Maud Land, Antarctica

Lützow Holm Bay and southern Ocean Obs.
bottom of the sea
geology and geomorphology survey
sampling of marine sediments

Study area 2010-2015

Sør Rondane mountains
.glacial geology and geomorphology survey
.ice radar observation



Syowa station

Middle depth
ice core drilling

inland traverse routes
icesheet surface
glacial observations

Shirase glacier area
Unstable glacier flow
lowering 10-50cm/year

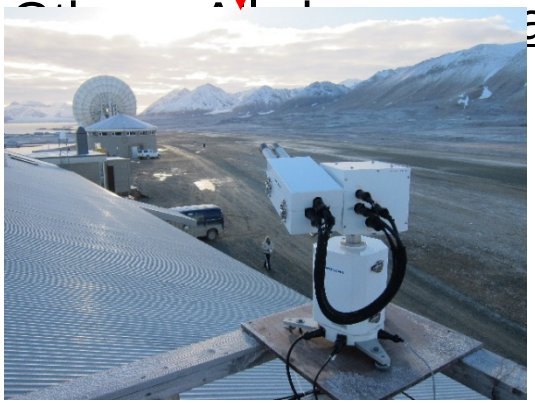
Dome Fuji station (3,810m)
.Shallow ice core drilling &
firn air sampling
.Deep borehole measurement

0 100 200 300 400 500 Km

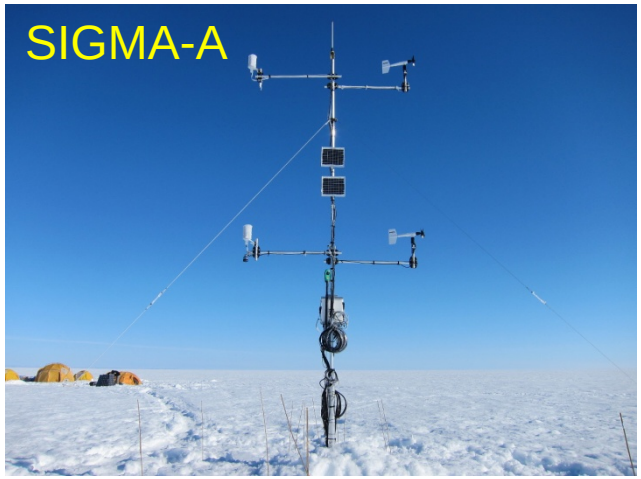
Map Scale 1:7,500,000

Rabben Station in Ny-Alesund, Svalbard

Location: 78˚55’ N, 11˚56’ E, 8 m
Landscape type: arctic coastal
Onsite technical staff: No
All-year round observations y/n: Yes
Year established: 1991
Solid precipitation: No
Snowfall: Snow depth
Trace gases: CO_2, CH_4, N_2O, SF_6 and O_2
Aerosols: Sky radiometer
Radiation: Ground-based Spectral Albedo and Flux radiometer (GSAF) to measure downward and upward spectral flux at selected wavelengths

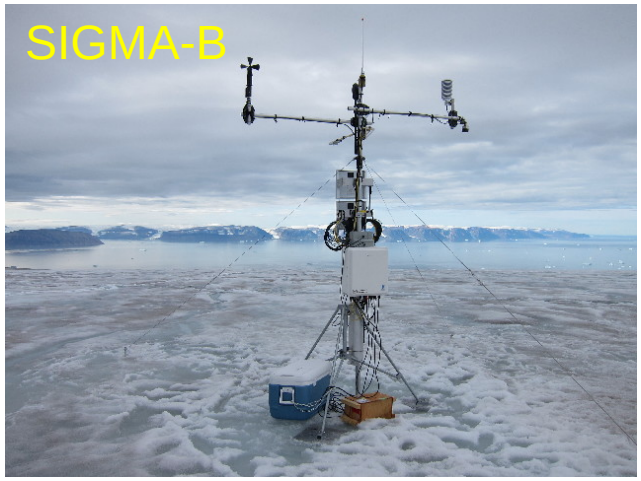


Site SIGMA-A in Greenland



Location: 78°03’ 06" N, 67°37’ 42" W, 1,490 m
Landscape type: Ice sheet (accumulation area)
Onsite technical staff: No
All-year round observations y/n: Yes
Year established: 28 June 2012 (new!)
Snowfall: Snow depth
Radiation: Downward and upward SW, NIR and LW
Mass balance: Relative snow level with ultrasonic snow gauge
Meteorology: Air temperature, relative humidity, wind speed and direction, and air pressure at two heights (Argos data transmission)

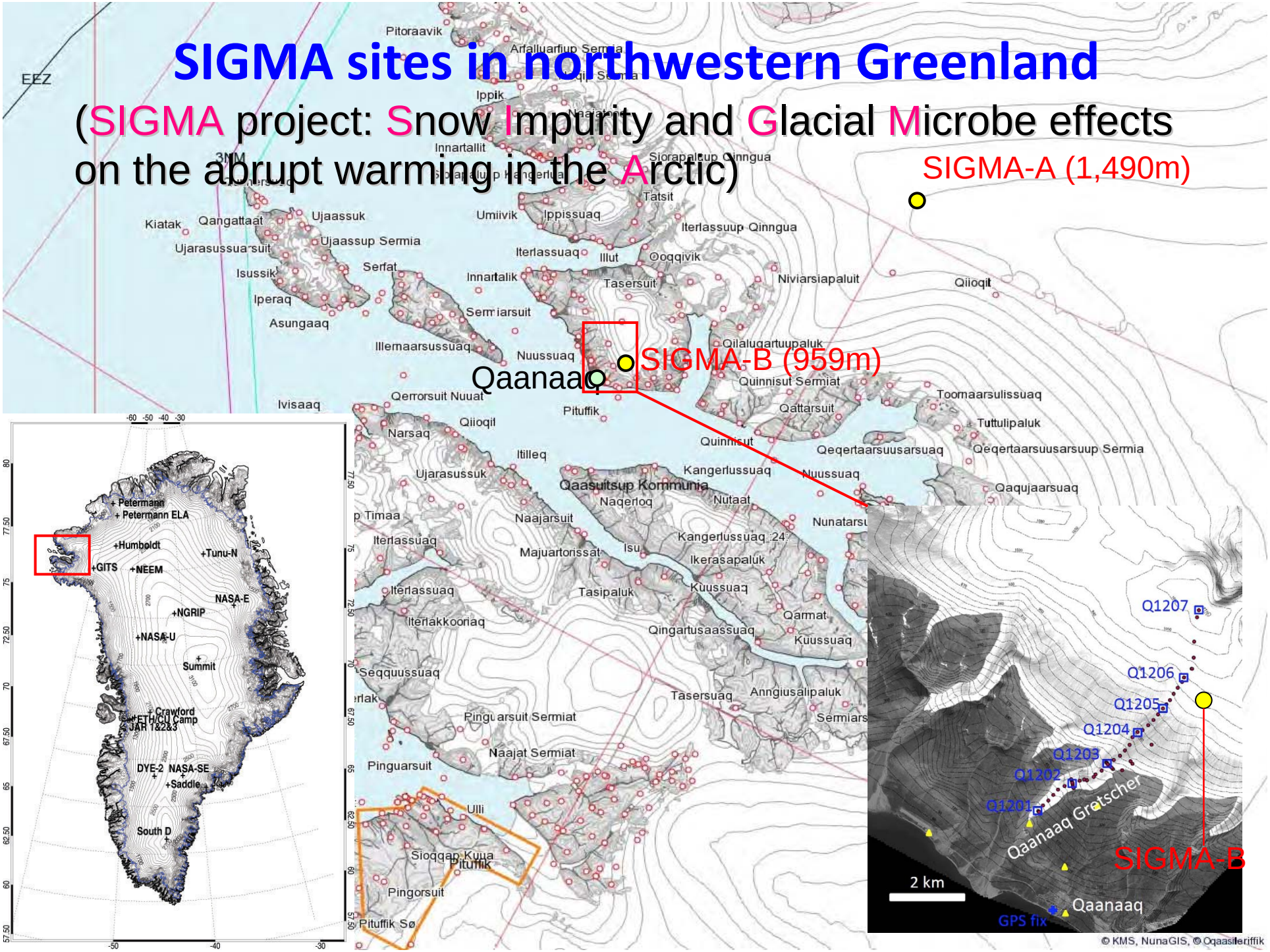
Site SIGMA-B in Greenland



Location: 77°31’ 06" N, 69°03’ 43" W, 959 m
Landscape type: Ice cap (ablation area)
Onsite technical staff: No
All-year round observations y/n: Yes
Year established: 19 July 2012 (new!)
Snowfall: Snow depth
Radiation: Downward and upward SW and LW
Mass balance and meteorology : Same as SIGMA-A at one height (Argos data

SIGMA sites in northwestern Greenland

(SIGMA project: Snow Impurity and Glacial Microbe effects on the abrupt warming in the Arctic)



Extreme melt across the Greenland ice sheet in 2012

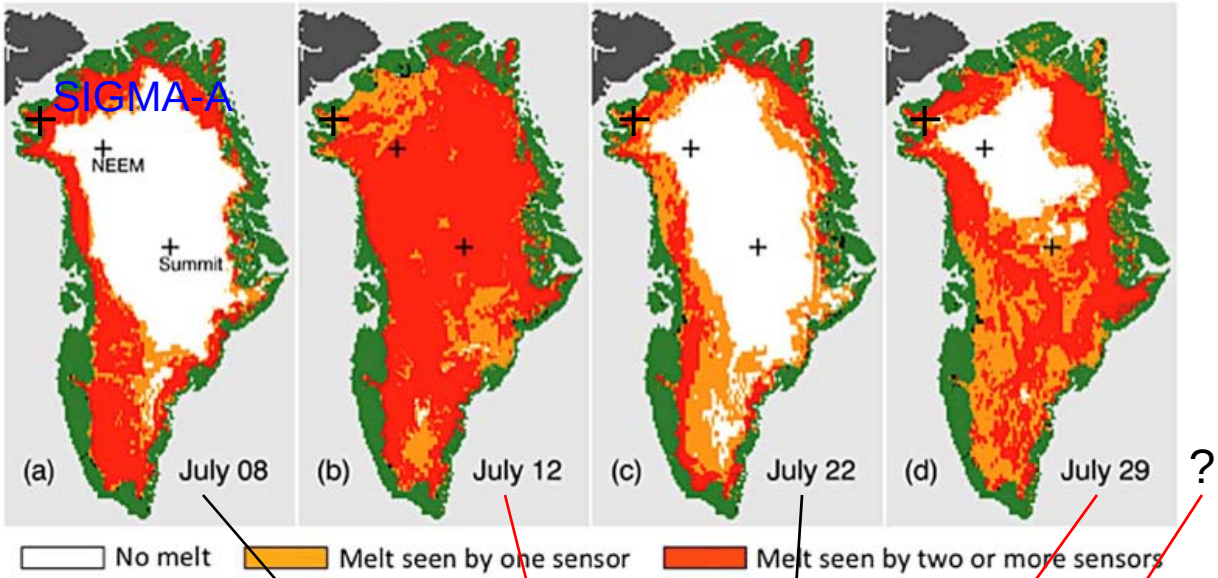


Figure 1. Composite maps of melt extent from OS2, SSMIS, and MODIS satellite data for: (a) 8 July, (b) 12 July, (c) 22 July, and (d) 29 July 2012. In the red areas, two or more of the satellites detected melt while in the orange areas only one satellite detected melt. No melt was detected in the white areas, black indicates insufficient data, green and dark grey show land, and light grey represents ocean.

Nghiem et al. (2012), GRL

とけるグリーンランド JAXA衛星画像

宇宙航空研究開発機構（JAXA）の水循環変動観測衛星「しずく」が、グリーンランドの氷がとけている様子をとらえた。その画像から、南部は内陸までとけているなど、融解は広範囲に及んでいることがわかった。氷床上にも研究者が入り、宇宙からの目と連携して氷の状態を調べる。

上空から見たグリーンランド北西部のカナック付近。夏の日差しに氷がとけて、氷河の末端から水が流れ出していた＝16日、中山由美撮影

温暖化で氷の融解が進むグリーンランド。その氷床を3～9日に観測、JAXA地球観測研究センターが解析した。とけている日数を色の違いで表している。青色が濃いほどとけている日数が多い。

解析した直木和弘研究員は「南部は標高の高い内陸まで広くとけている」と説明。同じ期間を調査した2002年以降では、とけていた領域が大きかった02年と07年に迫る広さだという。「しずく」は5月にH2Aロケットで打ち上げられ、7月に観測を始めた。

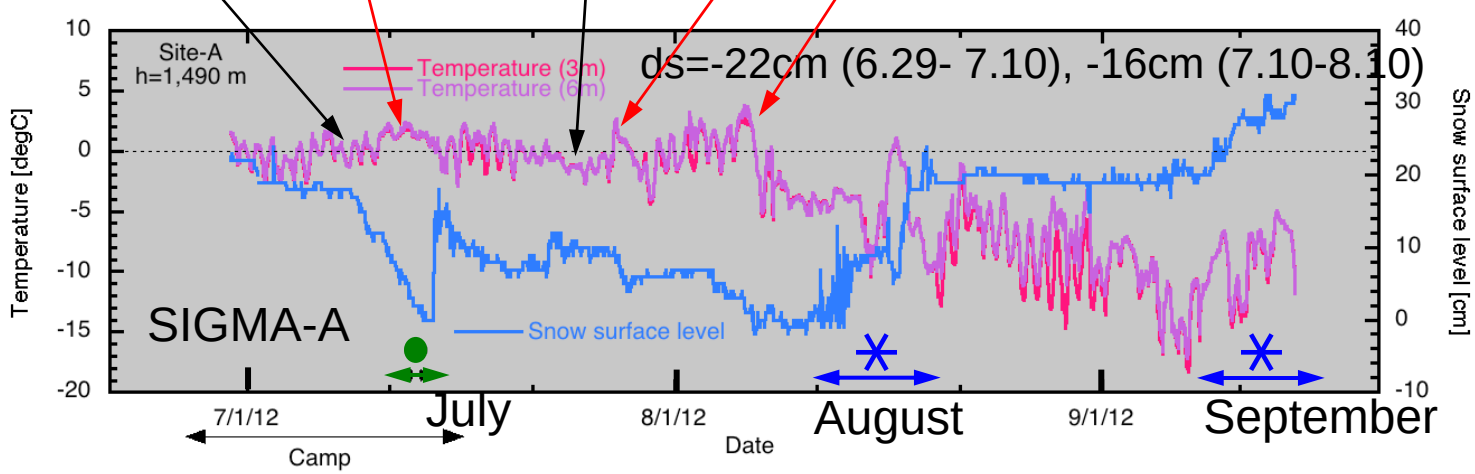
グリーンランド北西部の氷床（北緯78度、標高1500㍍）は16日午前、気温2度。表面はとけてシャーベット状だった。

3日間で約100㍉の降雨もあり、現地で3週間観測していた気象研究所の青木輝夫・物理気象研究部第3研究室長は「雨が降るとは思わなかった。氷の融解は予想以上だ」と驚いていた。

（グリーンランド・カナック＝中山由美）

水循環変動観測衛星「しずく」がとらえたデータを解析した画像＝JAXA提供

Newspaper July 17, 2012

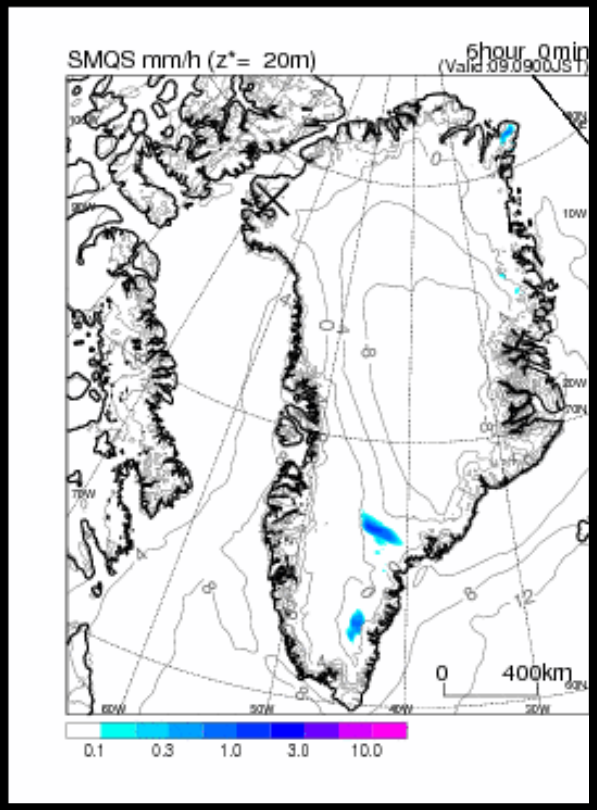


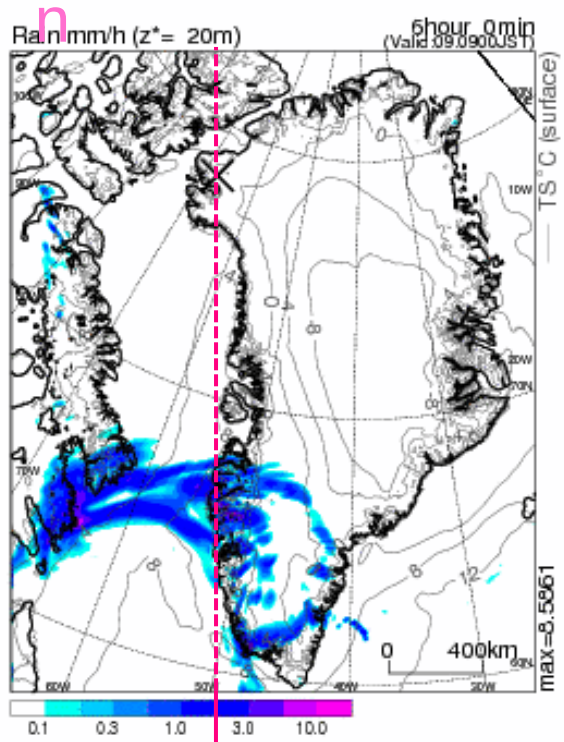
Regional model simulation for IOP: July 8 – 13, 2012

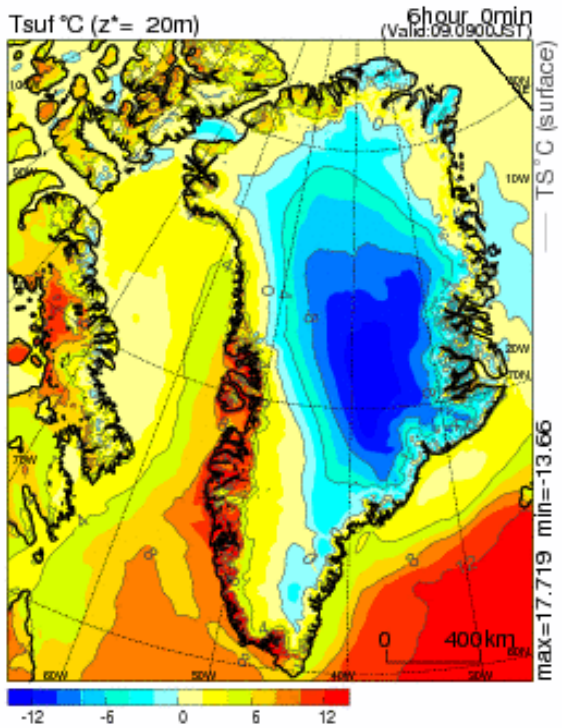
Snow

Rain

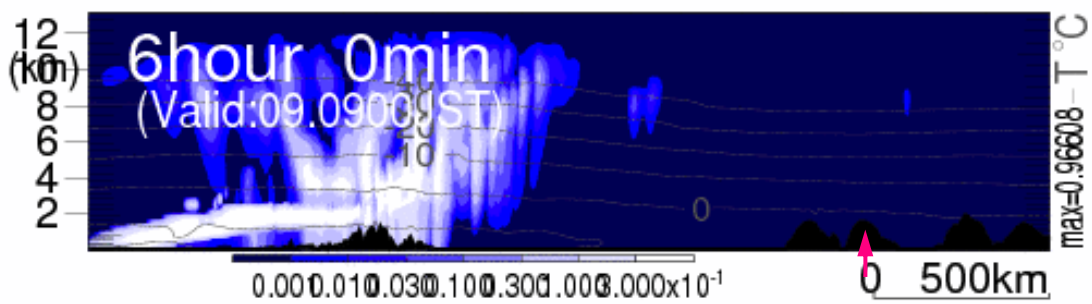
Temperature







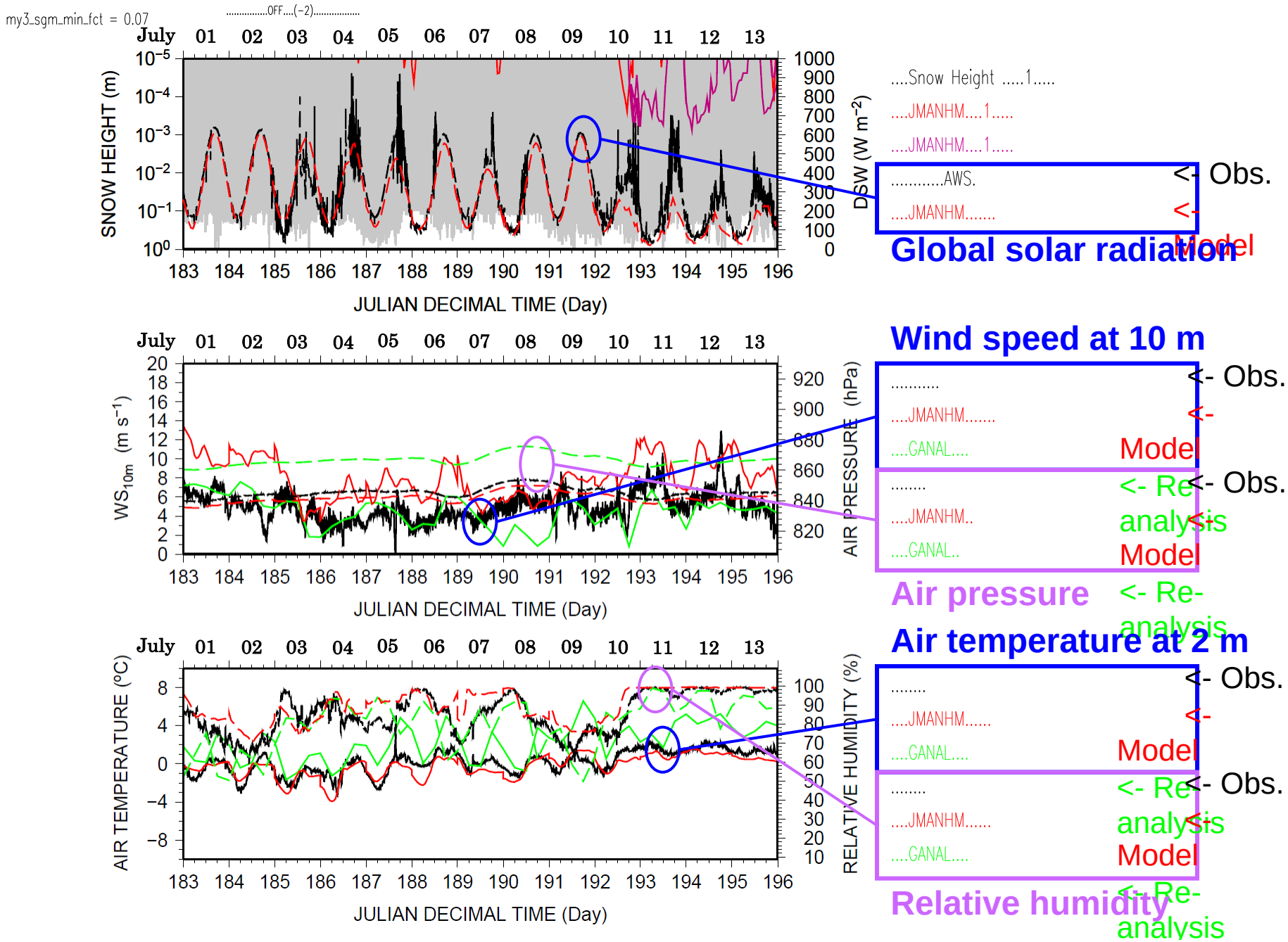
Mixing ratio (water and ice)



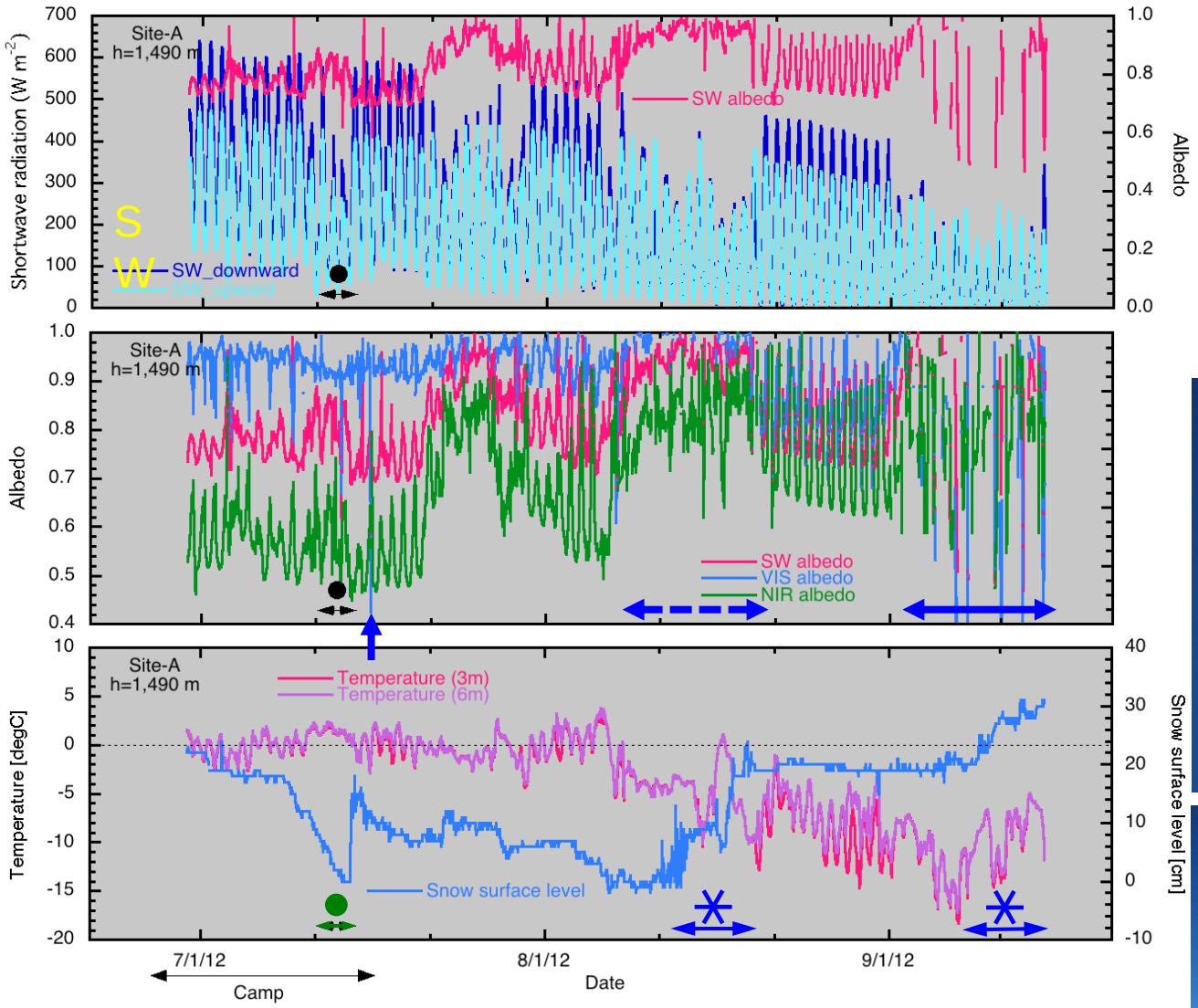
Hashimoto et al. (to be submitted)

08 July 2200LT

IOP2012 Validation for SIGMA-A (1,560 m a.s.l.)



Effects of frost and icing on broadband



- ✓ Frost and icing are serious problem for radiation measurements.
- ✓ Web camera will be used for quality check.
- ✓ Effective defrost method without AC power is needed.

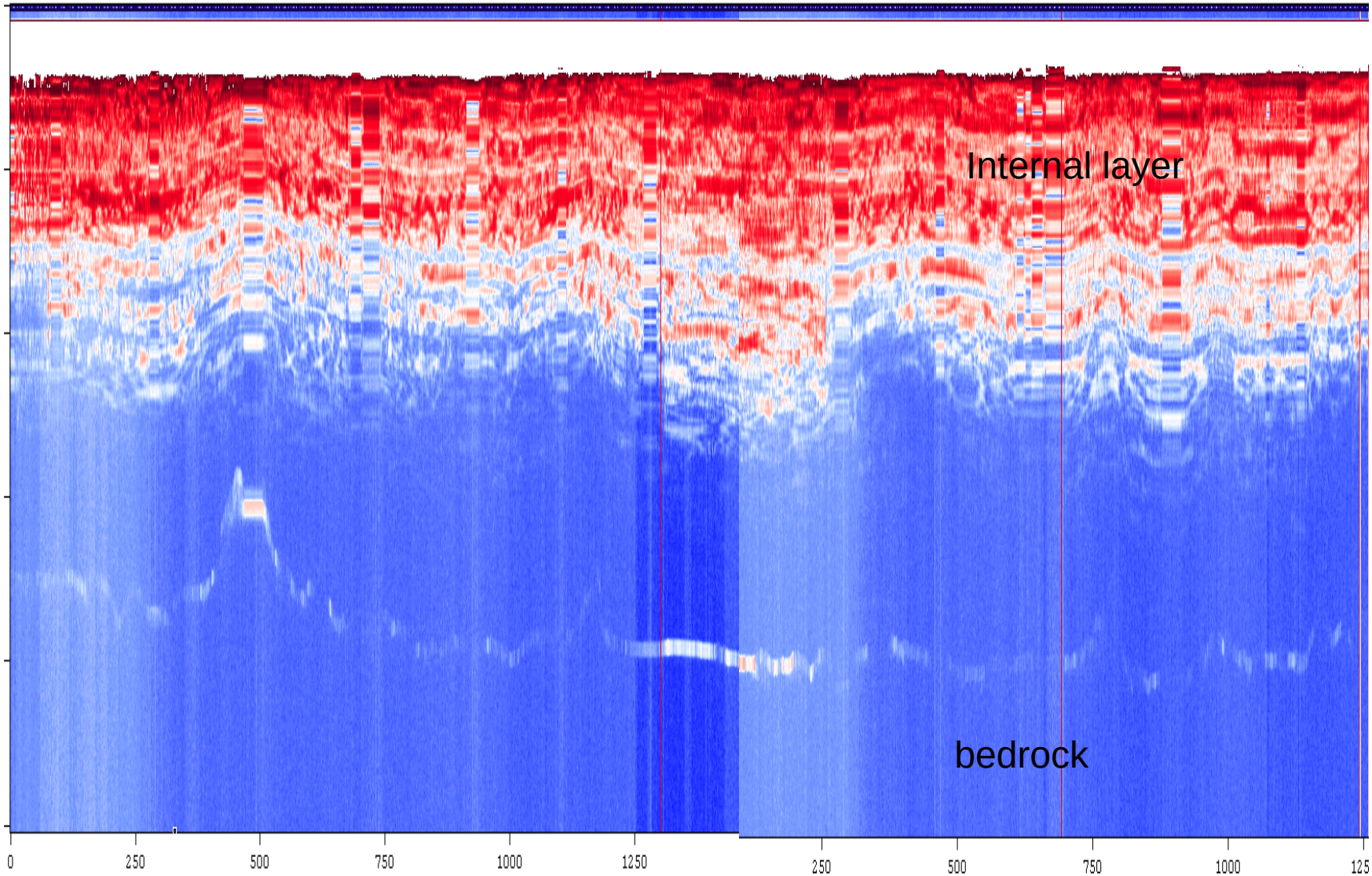
Summary

✓Syowa Stations in Antarctica and Rabben Station in Svalbard, where comprehensive observations are being made for atmosphere, snow/ice and ocean, are potentially super sites of CryoNet.

✓Sites SIGMA-A and -B are AWS site without on site technical staff and electric power except for solar panel.

✓Unmanned instruments sometimes encounter the serious troubles such as frost, icing and malfunction in cryosphere. The knowledge and technical know-how for protecting and reducing those problems are important. -> *Standards, guidelines and training for observations in CryoNet activities.*

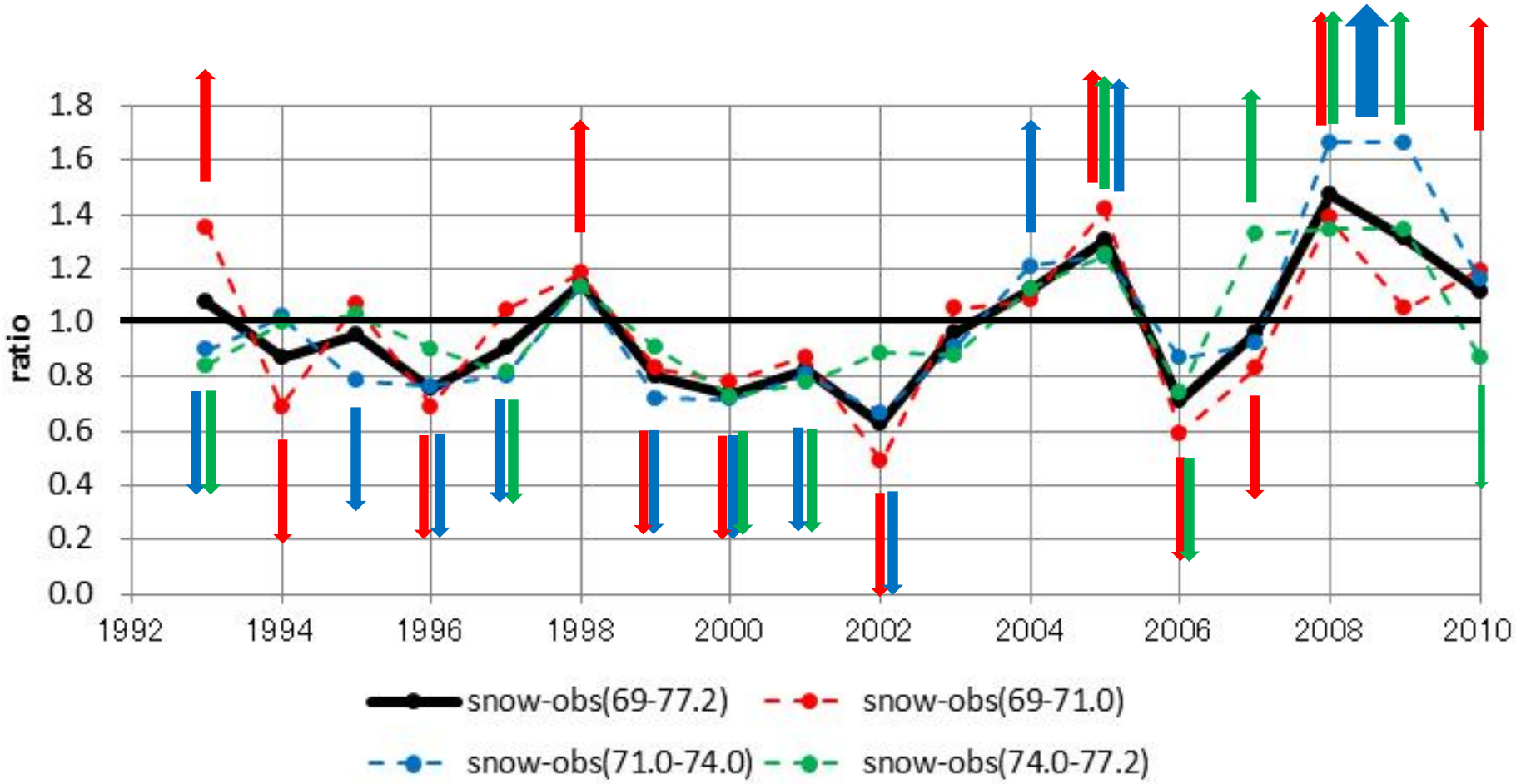
topic . environmental condition under the ice sheet



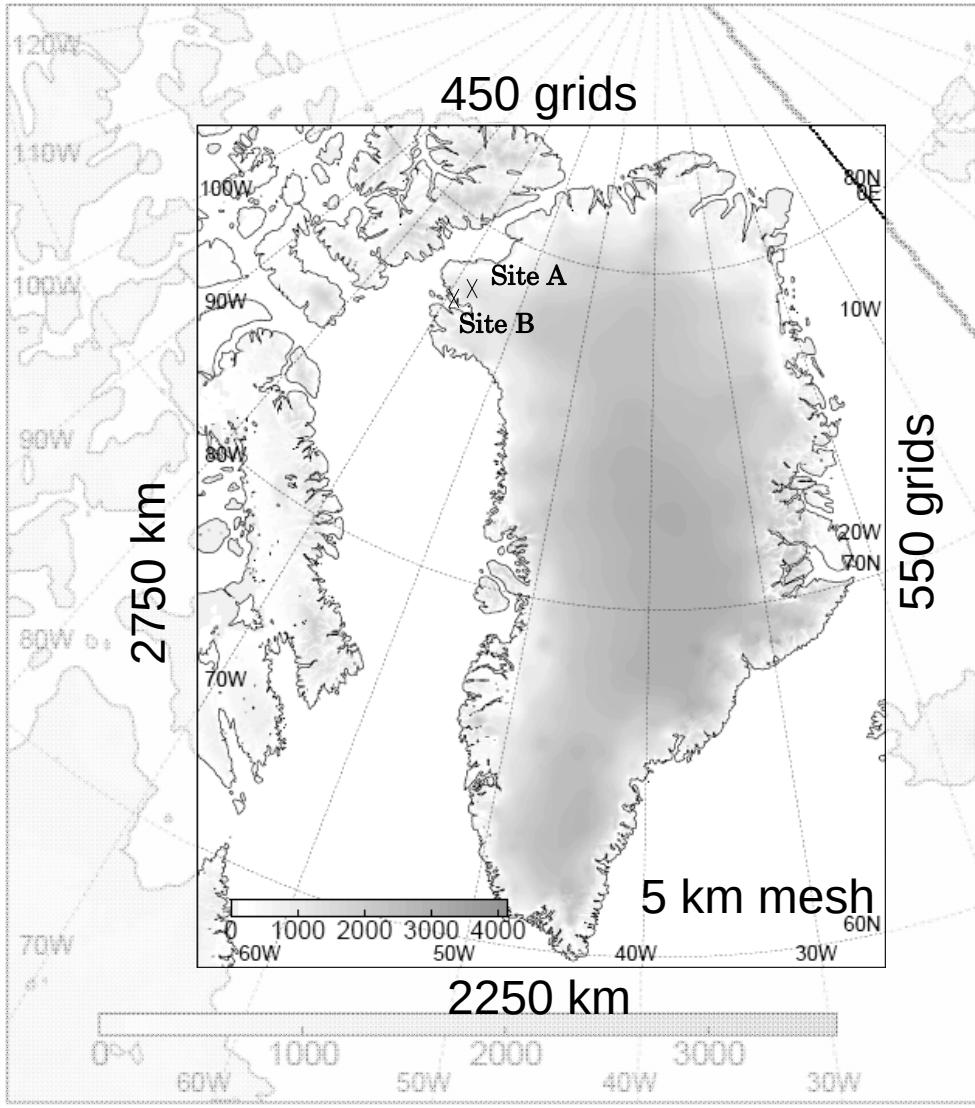
High reflection: Subglacial water

Annual accumulation from 1993 to 2010

(69 to 77.2 deg south)



Regional model simulation for IOP: July 8 - 13, 2012



Model: JMA Non-Hydrostatic Model (NHM)

Grids and layer: 450 x 550 x 50L

Integration time: 390 hours (1 run = 30 h x 13), FT = 6-30 (24hours)/1 run (30 hours) is used.

Resolution: Horizontal: 5 km, Vertical: 40 - 886 m, Time interval: 20 sec

Initial and boundary: Global Objective Analysis Data of JMA (GANAL), June 30, 2012, 18 UTC – July 13, 2012, 24 UTC (6 hourly)

Validation sites for regional simulation
July 8 - 13, 2012