

Sustained Arctic Observing Networks (SAON) Phase II:

Inventory of Arctic Observing Networks Poland



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1. Overview

Poland is not an Arctic country, however there is a long tradition of the Polish Arctic research. The first Arctic observations by Polish scientists were initiated more than 100 years ago by Polish prisoners in Siberia. After the I World War, the intensive Arctic observing program was conducted by Poland during the II International Polar Year (1932-1933). After the II World War the Polish Polar Station in Hornsund, southern Svalbard, were established in 1957. Traditionally, the Svalbard Archipelago is the Arctic region where most of Polish Arctic activities are focused.

There are two main branches of modern Polish Arctic observational activities. The land based science is led by the **Polish Polar Station**, located at Polar Bear Bay (Isbjørnhamna), Hornsund fjord, West Spitsbergen island, Svalbard archipelago. This is the northernmost Polish research facility operating continuously year-round. The base is operated by the Institute of Geophysics, Department of Polar and Marine Research, Polish Academy of Science (IGF PAN) in Warsaw. The wide range of research in various branches of geophysics and the study of polar environment are carried out. Additionally there are several seasonal field stations in Spitsbergen:

- **The Stanislaw Baranowski Station** near the Werenskild Glacier, operated by the University of Wroclaw;
- **The Nicolaus Copernicus University Polar Station** in the north-western Spitsbergen;
- **Calypsobyen Station** in the Bellsund Fjord operated by the Marie Curie-Sklodowska University in Lublin;
- **Skottehytta Base** in Petunia Bay (central part of the western Spitsbergen coast) operated by the Adam Mickiewicz University in Poznan.

The marine observations are to the large extent carried by the Institute of Oceanology Polish Academy of Sciences (IOPAN) in Sopot. The wide range of oceanographic, marine physics, environmental and ecological studies is carried out from the IOPAN research vessel R/V '**Oceania**'. Additionally, the land-based expeditions (mostly to Hornsund and Kongsfjorden) are organized by IOPAN to study oceanography and ecosystem in the west Spitsbergen fjords. The training vessel '**Horyzont II**' operated by the Marine University in Gdynia is also regularly used for supplying the Hornsund Station and for carrying out the observations.

The large part of the terrestrial and marine observational activities is carried out in collaboration with the international partners, mainly from Norway, Germany, Italy and other countries, active in the Arctic research. The Polish infrastructure (the land stations and research vessels) is utilized by partners from numerous countries and Polish scientists participate in the field programs organized in the frame of international collaboration.

2. Institute of Geophysics Polish Academy of Sciences



2a. Polish Seismological Network

Question 1. a. How can the SAON SG best assist you?

b. What do you see as the role of the SAON SG?

Coordinating data exchange, maintaining reference information related to station siting, data availability, data exchange. Much like ORFEUS which is focused on seismology Europe, only on the Arctic region and not only dealing with seismology but comprehensively approaching the many aspects of Polar research.

Question 2. What are the critical issues facing your observing program or data and information management program?

1. A considerable part of seismic observations at Hornsund is formed by icequakes originating in nearby glacier. Having just one broadband site and three short period sites nearby the broadband site and few km away from the glacier, nothing can be said about those icequakes except that they have taken place. The icequakes take place outside the mini-network which is too small to be treated as an array deployment. Thus a considerable part of the recorded material is unsuitable to further study.
2. High level of local noise at the deployment.
3. Technical support issues at the remote location at Svalbard.

Inventory of Observing Sites, Systems & Networks

Name and acronym: Polish Seismological Network

Contact person (e-mail): Pawel Wiejacz, pwiejacz@igf.edu.pl

Web site: <http://www.igf.edu.pl>;

then go by link to Departments and to the Department of Seismology and Physics of Interior of the Earth

Main objective of the network: Polish Seismological Network is to record and investigate on seismic events recorded by permanent Polish seismic stations. The seismic station at Hornsund is a Polish station despite its location outside Poland's territory.

Member of or connected to a global network: Virtual European Broadband Seismic Network (VEBSN), jointly managed by ORFEUS (Organization of Research Facilities for European Seismology) and EMSC (European-Mediterranean Seismological Centre). The seismic station at Hornsund is also committed to the GLISN (Greenland Ice Sheet Seismological Network).

Type of activity:

- Theme:

Geophysical observations

- Location(s): Polish Polar Station Hornsund,

Latitude 77° 00' N, Longitude 15° 33' E

When operational (year): 1979 – first permanent seismic recording (analogue), 1993 – first digital records (short period in triggered mode), 2002 – continuous digital recording, 2009 – broadband station.

Geographical coverage (countries) : n/a; seismic station at Hornsund can record earthquakes from any part of the world, provided the events are sufficiently big. However, relatively high noise causes that recording distant events is not very common and most of the recorded material pertains to the Svalbard area.

Data archive/centre: Waveform data is being archived at the Institute of Geophysics, Polish Academy of Sciences but there is no web-access to the seismic waveform data. A copy of the waveform data is kept at NORSAR, Norway, on terms of a MoU. Parameter data are available at the Institute of Geophysics, Polish Academy of Sciences but they are not provided in the web.

Data availability:

- Metadata only: since 2006.

- All data: continuous broadband waveform data since mid-2007. Earlier short period data exist only in internal format, no responsibility for format conversion nor on instructions on how to perform it.

- Charge or no charge for data: moderate data volumes that require little effort to produce them are supplied free of charge. Extensive requests requiring laborious selection of the data might be subject to reimbursement of costs thereof. Charge may be imposed in case the data were to be used for commercial purposes. These issues are decided on case-by-case basis.

2b. Hydrological and biochemical monitoring of Revdalen Valley (HREV)

Question 1. a. How can the SAON SG best assist you?

b. What do you see as the role of the SAON SG?

Dissemination of policies and results regarding observation networks, by provision of datasets, analyses, results and literature on a dedicated web site and during (bi-) annual conferences – ‘one stop shop’.

Provision of technical assistance as well as researcher exchange within participating networks. Priority in funding from IASC and WMO.

Provision of expert knowledge in data analysis.

Question 2. What are the critical issues facing your observing program or data and information management program?

- Difficulties in data collection in remote areas.
- Lack of computational facilities, such as server storage or high speed internet bandwidth for data transfer.
- ‘Usefulness’ of data, such as limited dissemination – it stays within closed forum of scientists, rather than being disseminated to i.e. the youth.

Inventory of Observing Sites, Systems & Networks

Name and acronym: Hydrological and biochemical monitoring of Revdalen Valley (HREV)

Contact person (e-mail) graba@igf.edu.pl

Main objective of the network: To collect hydrological and biochemical data in Horsund, Spitsbergen in the area of Rvdalen Valley.

Type of activity:

- **Theme:**

- Atmosphere
- Terrestrial ecosystem, including freshwater
- Coastal
- Cryosphere

- **Location(s):** Revdalen Valley

Main variables:

water temperature, air and soil CO₂, water flows, water stages, catchment runoff, wind speed, precipitation, reservoir bathymetry.

When operational (year): 2012

Geographical coverage (countries) Spitsbergen

Data availability:

- Metadata only

Main gaps, e.g., geographic coverage, variables: Summer season data only, with gaps due to observer and equipment availability.

2c. International Real-time Magnetic Observatory Network (INTERMAGNET)

Inventory of Observing Sites, Systems & Networks

Name and acronym: Polish Polar Station Hornsund as member of **International Real-time Magnetic Observatory Network (INTERMAGNET)**

Contact person (e-mail) Jan Reda (jreda@iqf.edu.pl)

Web site <http://www.intermagnet.org/>

Main objective of the network: INTERMAGNET is global network of observatories, monitoring the Earth's magnetic field

Type of activity:

- **Theme:**

- Geophysical observations
- Space physics
- Terrestrial physics

- **Location(s):** Polish Polar Station Hornsund,
Latitude 77° 00' N, Longitude 15° 33' E
IAGA code: HRN

Main variables: XYZ elements of geomagnetic field

When operational (year): IAGA geomagnetic observatory since 1978,
INTERMAGNET member since 2002

Data archive/centre, including Web site: http://www.intermagnet.org/Data_e.php

Data availability:

- All data: INTERMAGNET web (1 minute time resolution),
1 sec. resolution on request
- Charge or no charge for data: no charge for non-commercial use

2d. International Monitor for Auroral Geomagnetic Effects (IMAGE)

Inventory of Observing Sites, Systems & Networks

Name and acronym: Polish Polar Station Hornsund as member of **International Monitor for Auroral Geomagnetic Effects (IMAGE)**

Contact person (e-mail) Mariusz Neska (nemar@iqf.edu.pl)

Web site <http://www.geo.fmi.fi/image/>

Main objective of the network: The prime objectives of IMAGE are to study auroral electrojets and moving two-dimensional current systems.

Type of activity:

- Theme:

- Geophysical observations
- Magnetospheric-ionospheric physics

- Location: Polish Polar Station Hornsund,
Latitude 77° 00' N, Longitude 15° 33' E
IMAGE code: HOR

Main variables: XYZ elements of geomagnetic field

When operational (year): included to the IMAGE network since October 1993

Data archive/centre, including Web site: <http://www.geo.fmi.fi/image/request.html>

Data availability:

- All data: available on IMAGE web or on request in Institute of Geophysics Polish Academy of Sciences
- Charge or no charge for data: no charge for non-commercial use

2e. Observations of Schumann Resonance

Inventory of Observing Sites, Systems & Networks

Name and acronym: Polish Polar Station Hornsund as **observing site of Schumann Resonance phenomenon**

Contact person (e-mail) Mariusz Neska (nemar@iqf.edu.pl)

Main objective of the network: The network of observations of SR phenomena consists of 3 points:

Hornsund (Svalbard), Belsk (Poland), Nagycenk (Hungary). The data from this network are used for scientific analysis.

Type of activity:

- **Theme:**

- Geophysical observations
- Ionospheric physics
- Global temperature analyses

- **Location(s):** Polish Polar Station Hornsund,
Latitude 77° 00' N, Longitude 15° 33' E

Main variables: XY horizontal geomagnetic elements, Z electric vertical element

When operational (year): since 2004

Data availability:

- All data: on request
- Charge or no charge for data: no charge for non-commercial use

2f. Lidar Arctic Monitoring of the Atmosphere...(LAMA.)



Question 1. a. How can the SAON SG best assist you?

Information about projects, conferences, workshops, meetings

b. What do you see as the role of the SAON SG?

Help in the data exchange, by www or ftp server

Coordinator of similar research activities

Question 2. What are the critical issues facing your observing program or data and information management program?

- Lack of man power and funds

Inventory of Observing Sites, Systems & Networks

Name and acronym: Lidar Arctic Monitoring of the Atmosphere....(LAMA.)

Contact person (e-mail): Grzegorz Karasiński: gkaras@igf.edu.pl

Web site (if any) <http://hornsund.igf.edu.pl/> <http://lidar.igf.edu.pl/hornsund/>

Main objective of the network: Station realizes optical active remote sensing using multiwavelength elastic and Raman scattering lidar. It gives a view to the atmospheric stratification and aerosol concentration. By spatial and time localization of the higher aerosol concentration evidence there is possible determination of source of aerosol origin using HYSPLIT backward trajectory model. Station is also member of AERONET (Aerosol Robotic Network) within NASA and performing observation of solar radiation for determination of atmospheric optical properties.

Member of or connected to a global network: AERONET (Aerosol Robotic Network) within NASA

Type of activity:

- **Theme:**

- Atmosphere: Weather monitoring by meteorological station. Remote sounding of aerosol and water vapour by means of multiwavelength lidar and sunphotometer

- **Location(s):** Svalbard, Hornsund fiord, Polish Polar Station 77.00N 15.55E.....

- **Coordination**, e.g. not directly involved in observations, but coordinating data and information (e.g., AMAP): Institute of Geophysics Polish Academy of Science

Main variables: Profiles of aerosol extinction coefficients for 1064, 532 and 355nm, profiles of aerosol particle size distribution, water vapour profile, optical thickness for 340, 380, 440 500, 670, 870, 937, 1020 nm, Angstrom coefficient, columnar water vapour content.

When operational (year): sunphotometer 2004 - ongoing, lidar 2009 - ongoing.

Geographical coverage (countries): point observation+ 7 days backtrajectories for air masses flow

Data archive/centre, including Web site: <http://lidar.igf.edu.pl/hornsund/>

<http://www.glacio-topoclim.org/>

http://aeronet.gsfc.nasa.gov/cgi-bin/type_one_station_opera_v2_new?site=Hornsund&nachal=1.5

Data availability: - All data:

Example of lidar sounding data – probably Eyafjalla ash observed in Hornsund at 25 of May 2010

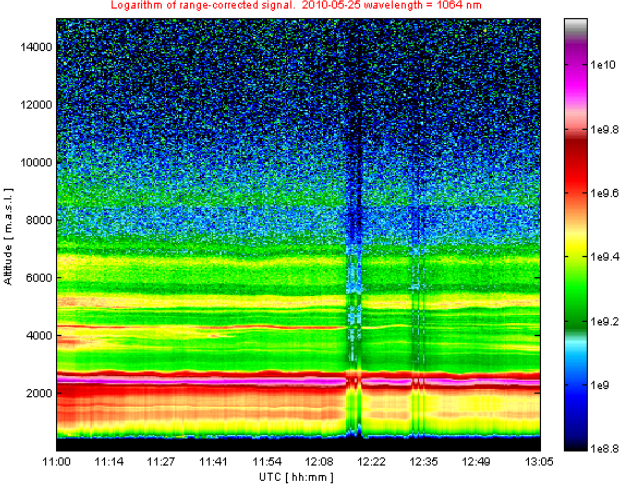


Figure 1. Probably Eyafjalla volcano ash observed over Hornsund 2010-05-25. Higher aerosol concentration at levels 2300, 5200, and 6800 meters above sea level.

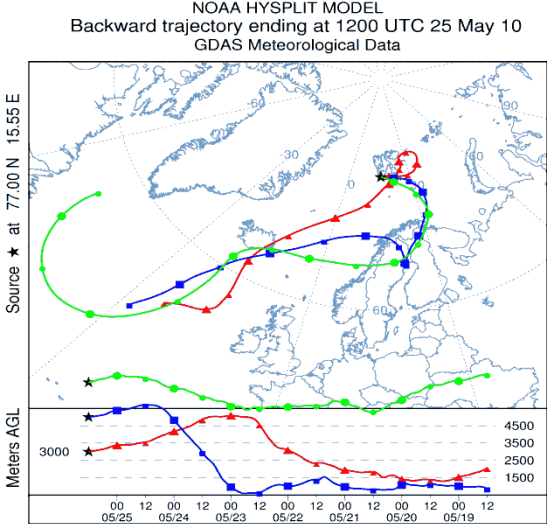


Figure 2. Backward trajectories for air masses for the 25th of May 2010 for levels of higher aerosol concentration levels from figure 1.

2g. Hans Glacier Monitoring (HGM)

Inventory of Observing Sites, Systems & Networks

Name and acronym: Hans Glacier Monitoring (HGM)

Contact person (e-mail) Dariusz Puczko puczko@igf.edu.pl

Web site www.glacio-topoclim.org

Main objective of the network: Main objectives of Hans Monitoring Network are collecting long-term record of mass-balance measurements and surface glacier velocities. Additionally we collect meteorological parameter at 3 AWSs located in ablation and accumulation area and ELA.

Member of or connected to a global network; if yes, which: World Glacier Monitoring Service (WGMS)

Type of activity:

- **Theme:**

- Atmosphere

- Cryosphere

- **Location(s):** Hans Glacier (Hansbreen) **N 77.04° E 15.63°**

- **Coordination:** WGMS (mass-balance measurements)

Main variables: Mass-balance stakes measurements and snow pits, GPS & GPR measurements, AWSs.

When operational (year):

Mass-balance: 1988-now

GPS, GPR and AWS: 2005-now

Geographical coverage (countries) Hornsund, Svalbard

Data archive/centre, including Web site: www.glacio-topoclim.org

Data availability: All data

3. Institute of Oceanology Polish Academy of Sciences



3a. Arctic Oceanographic Observations (AREX) – physical oceanography

Question 1. a. How can the SAON SG best assist you?

- Information about projects, help in the data exchange

b. What do you see as the role of the SAON SG?

-Support in the long time-series collection

Question 2. What are the critical issues facing your observing program or data and information management program?

- The lack of a continuous, sustainable funding scheme for long-term monitoring activities (the vision of a sustainable observing system with the coordinating body, supporting applications for continuation of long-term observations)
- A limited coordination and data exchange between different institutions carrying on a similar kind of activities (repeated hydrographic sections, etc.)

Inventory of Observing Sites, Systems & Networks

Name and acronym: Arctic Oceanographic Observations (AREX)

Contact person: Waldemar Walczowski (walczows@iopan.gda.pl)

Web site <http://www.iopan.gda.pl/index.html>
<http://www.iopan.gda.pl/oceania.html>

Main objective of the network

Since 1988 the regular summer hydrographic observations in the Nordic Seas and Fram Strait have been collected by the Institute of Oceanology Polish Academy of Sciences (IOPAS). Observational activities were carried out under several national programs, in the frames of EU projects VEINS, ASOF-N and DAMOCLES and within Polish-Norwegian cooperation in the AWAKE project.

The main objectives are:

- to study the long-term variability of water mass distribution, their physical and chemical properties and different pathways in the Nordic Seas;
- to investigate the Atlantic water (AW) circulation in the Nordic Seas and its inflow into the Arctic Ocean;
- to recognize the possible feedbacks between the Atlantic water variability and local and global climate changes.

Type of activity:

Theme: Ocean - hydrography, physical oceanography

Location: Nordic Seas with the main a focus on the West Spitsbergen Current and Fram Strait

Main variables: Basic hydrography (temperature, salinity, oxygen, nutrients), sea currents (continuous ADCP measurements and on stations LADCP profiles). All measurements at the fixed oceanographic sections (see map), repeated annually within the period 20 June to 20 July.

When operational: 1988 - ongoing.

Geographical coverage: Nordic Seas, Fram Strait

Data archive/centre: IOPAN data center <http://www.iopan.gda.pl/rbdo.html>

Data availability: Data available from data provider (after the post-cruise processing) without time delay

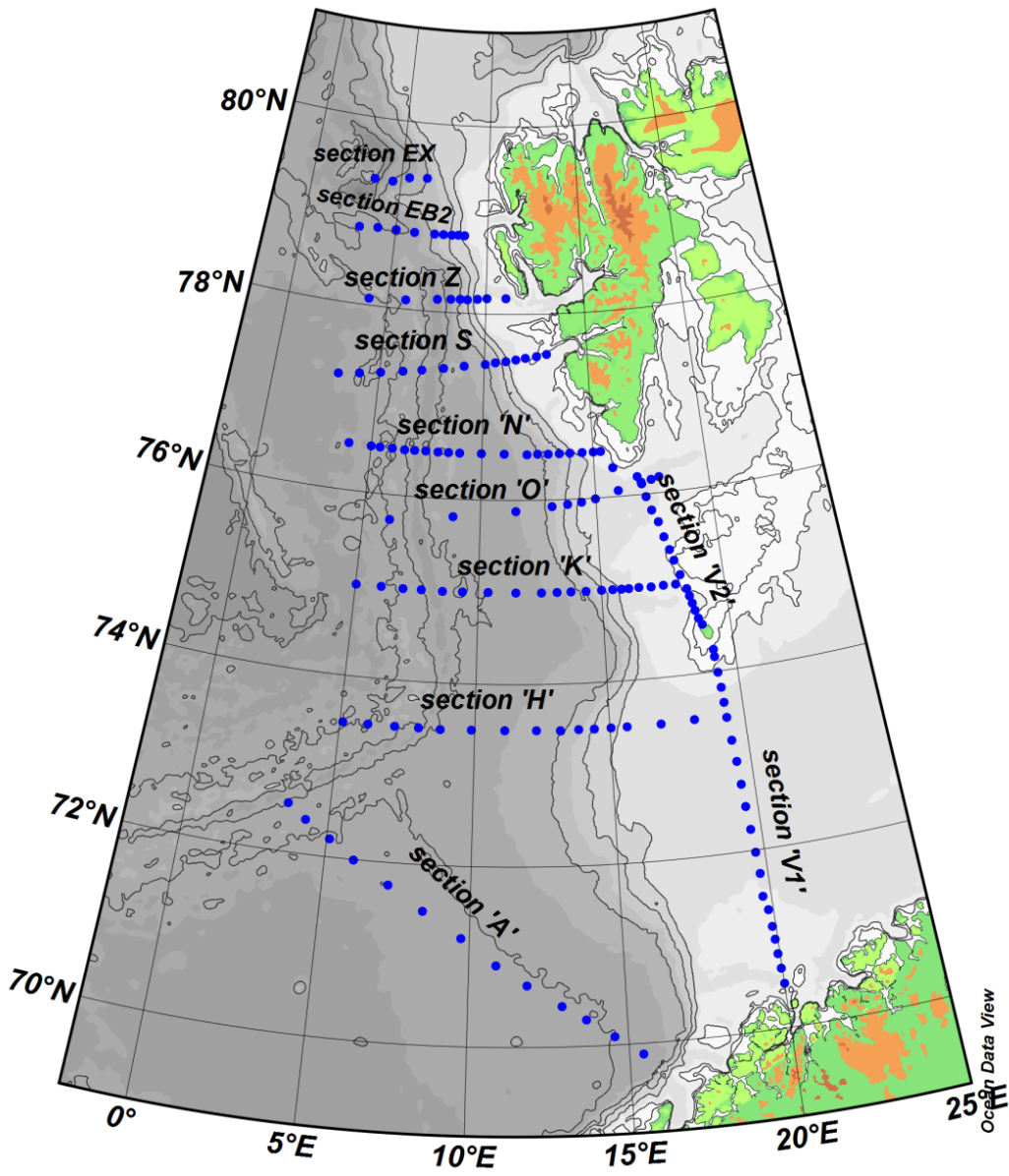


Figure 4. Sections covered every year by S/Y 'Oceania'

3b. West Spitsbergen Fjords Hydrography

Inventory of Observing Sites, Systems & Networks

Name and acronym: West Spitsbergen Fjords Hydrography

Contact person: Agnieszka Promińska (promyk@iopan.gda.pl)

Web site

<http://www.iopan.gda.pl/index.html>

<http://www.iopan.gda.pl/oceania.html>

Main objective of the network

Since 2000 the regular summer hydrographic observations in the Western Spitsbergen Fjords have been collected by the Institute of Oceanology Polish Academy of Sciences (IOPAS). Observational activities were carried out under several national programs, and in the frames Polish-Norwegian research Fund projects ALKEKONGE and AWAKE.

The main objectives are:

- to study the variability of water mass physical and chemical properties in the Western Spitsbergen Fjords;
- to investigate the Atlantic water (AW) inflow into the fjords;
- to recognize the possible feedbacks between the Atlantic water variability, local climate and glaciers discharge.

Type of activity:

Theme: Coastal oceanography - hydrography, physical oceanography

Location: Western Spitsbergen Fjords, mainly Kongsfiorden and Hornsund. Polish Polar Station in Hornsund.

Main variables: Basic hydrography (temperature, salinity, oxygen, nutrients). Sea currents - time series from ADCP moorings, LADCP, VM ADCP. Measurements at the fixed sections (see map), repeated annually within the period 6 July to 5 August.

When operational: 2000 - ongoing.

Geographical coverage: Spitsbergen, Norway

Data archive/centre: IOPAN data center <http://www.iopan.gda.pl/rbdo.html>

Data availability: Data available from data provider (after the post-cruise processing) without time delay

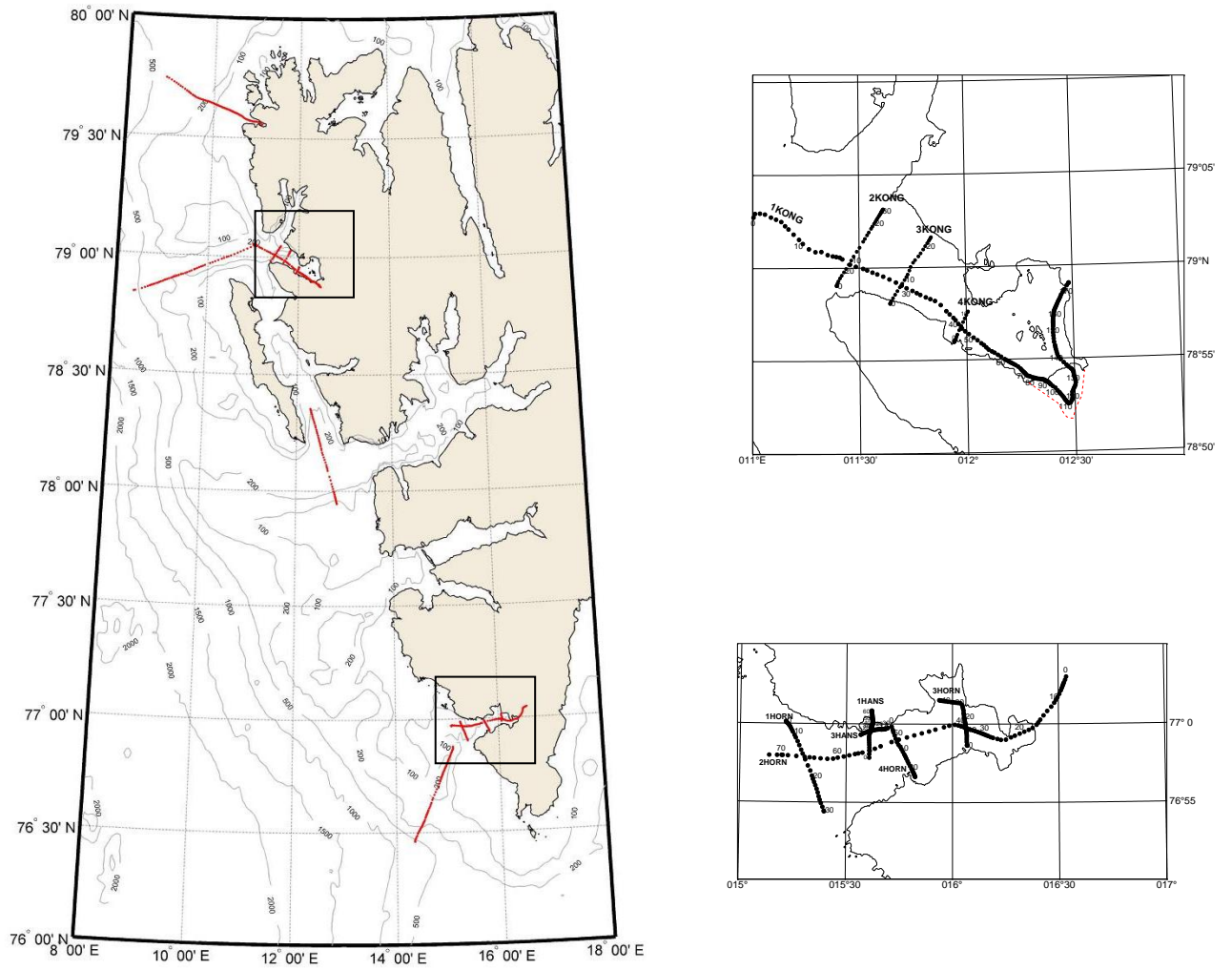


Figure 5. Main sections in Spirsbergen fjords. Maps of Kongsfjorden and Hornsund.

3c. Polar-AOD and AREX (aerosols)

Inventory of Observing Sites, Systems & Networks

Name and acronym: POLAR-AOD and the Arctic Oceanographic Observations (AREX)

Contact persons: Tymon Zielinski (tymon@iopan.gda.pl)

Tomasz Petelski (petelski@iopan.gda.pl)

Web site: <http://www.iopan.gda.pl/index.html>

<http://www.iopan.gda.pl/oceania.html>

Main objective of the network: The Arctic region represents a sensitive ecosystem, which is susceptible to even small changes in the local climate. Special conditions of usually high surface albedo and low solar elevations cause enhanced aerosol/cloud effects due to multiple scattering. It is suspected that this increased interaction between solar radiation and the aerosol particles/clouds magnifies their radiative impact. Thus, for a given aerosol distribution, the specific optical properties are enhanced in the polar regions. For the same reasons, results from field experiments at low latitudes are difficult to transfer to polar regions and as a consequence there is an urgent need to conduct specific measurement programs in high latitude regions. In order to improve the knowledge about the origin, transport pathways, vertical structure of aerosol physical and chemical properties as well as the impact on climate in the polar regions, a combined effort of surface-based, airborne and spaceborne measurements is needed.

Therefore, this proposed project is aiming at a determination of the vertical structure of the chemical, physical and optical properties of Arctic aerosol particles, including solar radiative closure between observed and calculated aerosol properties (direct climate effect)

Type of activity:

Theme: Air-sea interaction, aerosols

Location: Nordic Seas, Svalbard

Main variables: Physical features of aerosols, such as concentration, extinction coefficient, aerosol optical depth and indirectly-radiative forcing. Measurements at fixed oceanographic sections (map as above), every year between 20 June – 20 July and Svalbard region at different times of the year.

When operational: 1988 - now.

Geographical coverage: Nordic Seas, Svalbard

Data archive/centre: IOPAS datacentre <http://www.iopan.gda.pl/rbdo.html>

Data availability: All data

3d.Soft Bottom Fauna time series(BIODAFF)

Question 1. a. How can the SAON SG best assist you?

Providing visibility of sampling and data analyse effort

b. What do you see as the role of the SAON SG?

Calibration, integration of data, exchange of data and joint research initiatives

Question 2. What are the critical issues facing your observing program or data and information management program?

Lack of recognition for the long time series from the side of funding agencies

Inventory of Observing Sites, Systems & Networks

Name and acronym: ...Soft Bottom Fauna time series(BIODAFF)

Contact person (e-mail)Jan Marcin Weslawski (weslaw@iopan.gda.pl)

Web site <http://www.iopan.gda.pl/projects/biodaff/>

Main objective of the network:

EMBOS is a continuation of BIOMARE and aims for integrating marine biological – biodiversity observations Long Term Large Scale in set of selected stations across Europe. Poland (IOPAS) is responsible for the Hornsund site and together with Norway (Norsk Polarinstitutt, UNIS, AKVAPLAN) IOPAS is responsible for the Kongsfjorden site.

Member of or connected to a global network: ARCTOS, ArcticNet, EMBOS /Euromarine..

Type of activity:

- Theme:
 - Marine ecosystem
 - Coastal
 - Location...Svalbard, Hornsund and Kongsfjorden ..

Main variables: soft bottom fauna species lists, abundances per m2

When operational 1996- onwards.....

Geographical coverage (countries) ...Norway- Svalbard

Data archive/centre, including Web site:

...http://www.iopan.gda.pl/ekologia/sampling_stations.htm

Data availability:

- Metadata only:
...http://www.iopan.gda.pl/ekologia/sampling_stations.htm
- All data: ... <http://www.iopan.gda.pl/projects/biodaff/EMBS-14.htm>

- Charge or no charge for data:NO

Main gaps, e.g., geographic coverage, variables: Sediment chemistry

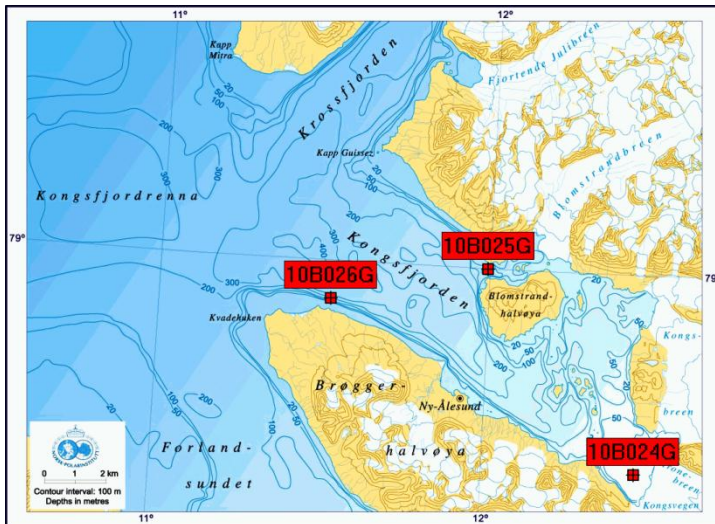
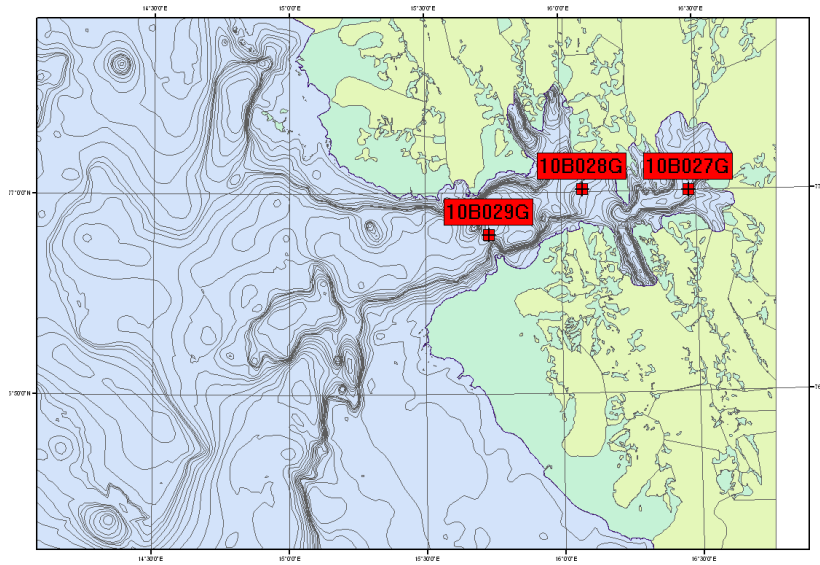


Figure 6. Maps of two Svalbard fjords with long term soft – bottom stations, samples every July, with Van Venn Grab.

3e. Zooplankton Monitoring in the European Arctic Gateway

Inventory of Observing Sites, Systems & Networks

Name and acronym: Zooplankton Monitoring in the European Arctic Gateway (ZooMon-EAG)

Contact person: Slawomir Kwasniewski (kwask@iopan.gda.pl)

Web site: http://www.iopan.gda.pl/ekologia/sampling_stations.htm

Main objective of the network

Zooplankton make essential links between producers and predators in marine ecosystems, so mediating in the CO₂ exchange between atmosphere and ocean. They can be indicators of climate variability, and changes in zooplankton species distribution and abundance may have cascading effects on food webs. West Spitsbergen Current is the main pathway of transport of Atlantic waters and biota into the Arctic Ocean and the Arctic shelf seas. West Spitsbergen Shelf coastal and fjordic waters, therefore, are natural experimental areas to study mechanisms by which the Atlantic and Arctic marine ecosystem interact, and to observe environmental changes caused by variability in climate.

The main objectives of the zooplankton monitoring are:

- to study patterns and variability in composition and abundance in zooplankton of the West Spitsbergen Current and the West Spitsbergen fjords and coastal waters;
- to find out environmental factors responsible for the observed patterns and variability in zooplankton, and to understand possible relations between zooplankton and their environment on different space and time scales;
- to observe and monitor the variability in zooplankton in relation to local and global climate changes.

Type of activity:

Theme: Marine ecosystem

Location: West Spitsbergen Current (WSC), West Spitsbergen Shelf (WSS) – fjords (Kongsfjorden) and coastal waters (Hornsund).

Main variables: Zooplankton composition and abundance, background hydrological data.

When operational: WSC – since 2001, Kongsfjorden – since 1996, Hornsund and shelf waters – since 2001; intended to be continued.

Geographical coverage: Nordic Seas, West Spitsbergen Shelf.

Data archive/centre: IOPAN Department of Ecology

Data availability: Data available after publishing, data base in preparation

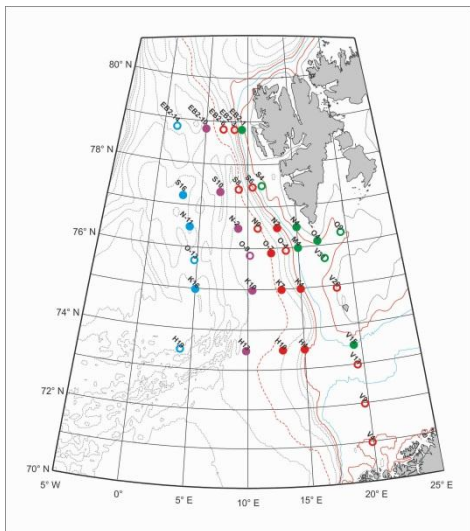


Figure 7. Locations of zooplankton monitoring stations in the West Spitsbergen Current area.

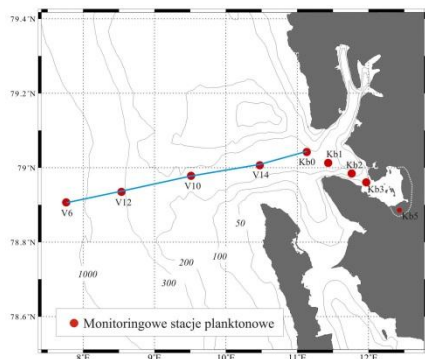


Figure 8. Locations of zooplankton monitoring stations in Kongsfjorden and on its shelf area.

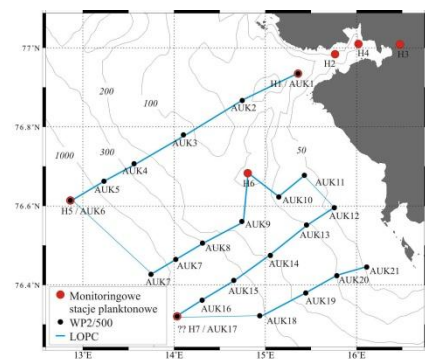


Figure 9. Locations of zooplankton monitoring stations in Hornsund and on its shelf area.

4. University of Wroclaw

Question 2. What are the critical issues facing your observing program or data and information management program?

- please limit your response to a brief description of no more than 3 critical issues.
- No existing professional, covering large arctic geophysical observation data base which could be a field of cooperation with other scientist focused on ice-sea-atmosphere interaction;
- Technical problems to get high quality, continuous data.

4a. Arctic Atmospheric Boundary Layer Observing System (ABLOS)

Inventory of Observing Sites, Systems & Networks

Name and acronym: Arctic Atmospheric Boundary Layer Observing System (ABLOS)

Contact person (e-mail) Krzysztof Migala (krzysztof.migala@uni.wroc.pl)

Web site www.glacio-topoclim.org

Main objective of the network: monitoring of thermal and humidity parameters of arctic atmospheric boundary layer in horizontal and vertical profile covering glaciated area, non-glaciated area and mountain peak

Member of or connected to a global network; if yes, which: cooperation with the Polish Polar Station in Hornsund

Type of activity:

- **Theme:** Interaction between atmosphere, ice and sea
- **Location:** SW Svalbard (Hornsund fjord surroundings)
- **Coordination:** IGP PAS

Main variables: selected meteorological parameters (mostly air temperature and humidity; also wind speed and direction, solar irradiation)

When operational (year): since 2005

Geographical coverage (countries): Svalbard, Norway

Data archive/centre, including Web site: Warsaw, IGP PAS; www.glacio-topoclim.org

Data availability:

Data available for registered users.

5. Marie Curie- Skłodowska University, Lublin

5a. Geographical environment conditions and its changes in the polar and subpolar regions (POLARUMCS)

Inventory of Observing Sites, Systems & Networks

Name and acronym: Geographical environment conditions and its changes in the polar and subpolar regions (POLARUMCS)

Contact person:

Sławomir Terpiłowski (terpis@poczta.umcs.lublin.pl) - scientific coordinator

Piotr Zagórski (piotr.zagorski@poczta.umcs.lublin.pl)

Waldemar Kociuba (waldemar.kociuba@umcs.pl)

Andrzej Gluza (andrzej.gluza@umcs.lublin.pl)

Web site:

<http://geografia.umcs.lublin.pl/>

<http://geografia.umcs.lublin.pl/wyprawy/>

Main objective of the network:

The study includes comprehensive study of the geographical environment in the area of Polar Station of Maria Curie-Skłodowska University in Calypsobyen (NW part of Wedel Jarlsberg Land, Svalbard). Currently, studies have been carried out within research projects:

- Dynamics of matter circulation in the polar catchment are a subject to deglaciation processes (Scottelva, Spitsbergen) (DYNACAT)
- Morphogenetic and morphodynamics conditions of development of the coast of the NW part of Wedel Jarlsberg Land (Spitsbergen) in the late Vistulian and Holocene (MORCOAST)
- Mechanisms of fluvial transport and sediment supply to Arctic river channels with various hydrological regimes (SW Spitsbergen) (ARCTFLUX)

Type of activity:

Theme:

- geomorphology and paleostratigraphy,
- hydrology, hydrochemistry,
- coastal zone, shore line dynamics, bottom of the fjord (offshore)
- glaciology, permafrost
- environmental study
- hydrometeorology
- soil sciences

Location: Svalbard, NW part of Wedel Jarlsberg Land, Bellsund, Recherchefjorden, Calypsobyen

Main variables:

topoclimatic and microclimatic conditions, water stage and flow, analysis of the genetic structure of fluvial outflow, fluvial material discharge, coastal dynamics, change of glaciers geometry, glacial and paraglacial processes transformation.

When operational: 1986 - now.

Geographical coverage: Svalbard

Data archive/centre: Faculty of Earth Sciences and Spatial Management, Maria Curie-Skłodowska University

Data availability: all data, publication (<http://geografia.umcs.lublin.pl/wyprawy>)

5b. Dynamics of matter circulation in the polar catchment subject to the deglaciation processes (Scottelva, Spitsbergen) (DYNACAT)

Inventory of Observing Sites, Systems & Networks

Name and acronym: Dynamics of matter circulation in the polar catchment subject to the deglaciation processes (Scottelva, Spitsbergen) (DYNACAT)

Contact person: Andrzej Gluza (andrzej.gluza@poczta.umcs.lublin.pl)

Web site:

<http://geografia.umcs.lublin.pl/>

<http://geografia.umcs.lublin.pl/wyprawy/>

Main objective of the network:

The project aims at analysing dynamics of matter circulation in the polar catchment under the deglaciation processes and its effect on topoclimatic and microclimatic diversification of the area in question. Equally important are: 1) the dynamics of periglacial and 2) hydrological processes and changes in the local environment as an indicator of global climatic changes. The proposed project shall take into account the following: - general weather and climatic conditions and topoclimatic and microclimatic differentiation of selected sites; - albedo and solar radiation and their influence on the course of the processes; - changes in the circulation of water in space and time (precipitation-evaporation-outflow) as an effect of local and global processes; - analysis of processes that determine the amount of water entering the hydrological cycle including global climatic changes and characteristics of summer ablation in terms of meteorological conditions; - analysis of the factors which determine the occurrence and circulation of waters in the permafrost active layer and assessment of static and dynamic water resources in the active layer in meteorological and hydrogeological aspects; determination and quantitative analysis of the genetic structure of fluvial outflow; - water balance of selected catchments (glacial and periglacial ones) with diverse outflow alimentation sources.

Type of activity:

Theme:

- atmosphere, meteorological conditions,
- hydrological conditions, structure of fluvial outflow (glacier and non-glacier components), determination of the amount of material discharged
- permafrost active layer dynamics,

Location: Svalbard, NW part of Wedel Jarlsberg Land, Bellsund, Scott Glacier Catchment, Scottelva, Calypsobyen.

Main variables: topoclimatic and microclimatic diversification, changes in the circulation of water in space and in time, meteorological and hydrogeological aspects of analysis of the genetic structure of fluvial outflow, quantitative and qualitative structure of the material discharged from the catchment.

When operational: 2010 - now.

Geographical coverage: Svalbard

Data archive/centre: Faculty of Earth Sciences and Spatial Management, Maria Curie-Skłodowska University

Data availability: all data (now in preparation)

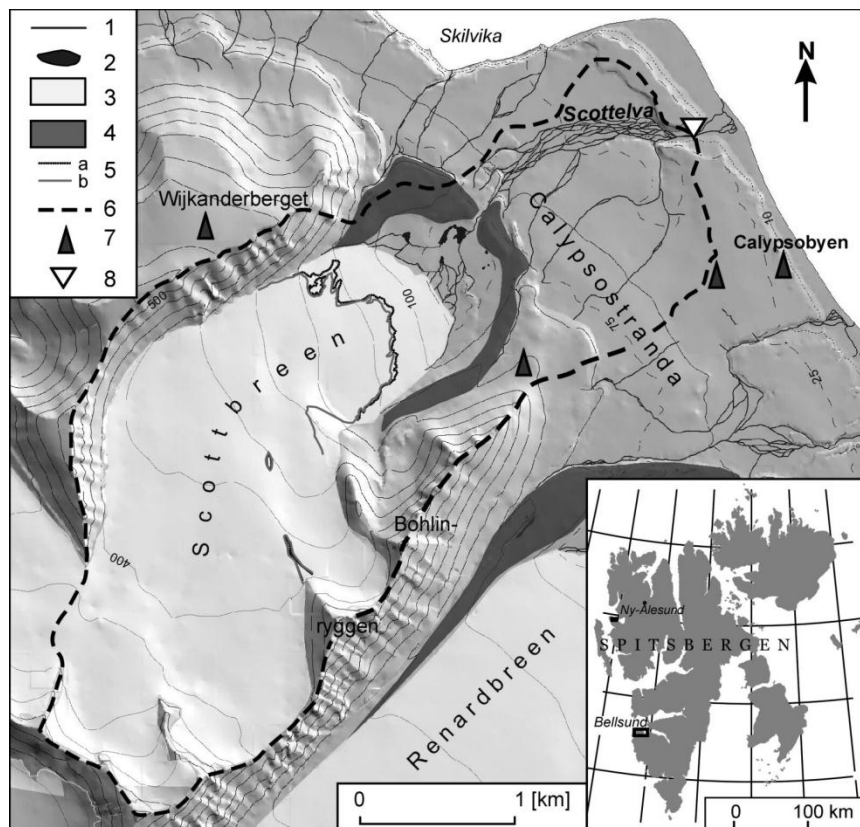


Figure 10. Scottelva chatchment area (NW Wedel Jarlsberg Land). Location of the study area. Existing and planned locations of meteorological and hydrological stations: 1 - the river, 2 - lakes, 3 - the area of the glacier in 1990, 4 - moraine ridge, 5 - the glacier front in a - 2006 and b - 2007, 6 - catchment boundary, 7 - location of meteorological stations, 8 - location of hydrological station.

5c. Morphogenetic and morphodynamics conditions of development of the coast of the NW part of Wedel Jarlsberg Land (Spitsbergen) in the late Vistulian and Holocene (MORCOAST)

Inventory of Observing Sites, Systems & Networks

Name and acronym: Morphogenetic and morphodynamics conditions of development of the coast of the NW part of Wedel Jarlsberg Land (Spitsbergen) in the late Vistulian and Holocene (MORCOAST)

Contact person: Piotr Zagórski (piotr.zagorski@poczta.umcs.lublin.pl)

Web site:

<http://geografia.umcs.lublin.pl/>

<http://geografia.umcs.lublin.pl/wyprawy/>

Main objective of the network:

Arctic coast is extremely sensitive and important area of interaction between land and sea. The diagnosis of the mechanisms governing the polar zone is of fundamental importance for tracing the evolution of the coast caused by climate change. Diagnosis of morphogenesis and morphodynamics of the polar coast becomes important in recent years, a research priority, not only from the scientific point of view, but also practical. Therefore, the key aims of the project include: - determining the dynamics of morphogenetic processes with particular emphasis on marine processes within the coastal zone in the context of climate change after the Little Ice Age (LIA) and the development of model of the coast functioning during this period. - to try to reference this model to the development of the coast at the turn of Vistulian and Holocene (14-8 ka) by defining the stages of shaping the shoreline including glaciostatic and eustatic and elements of tectonical and lithological features of the coastal zone.

Type of activity:

Theme:

- marine processes, tidal flat evolution,
- degree of transformation of raised marine terraces, paraglacial landscape,
- coastal zone, shore line dynamics, bottom of the fjord (offshore)
- the role of glaciers in shaping the coastal zone

Location: Svalbard, NW part of Wedel Jarlsberg Land, Bellsund, Recherchefjorden,
Calypsobyen

Main variables: shore line changes (GPS measurement), coastal dynamics, impact of glacial and paraglacial processes on transformation of the raised marine terrace, degree on transformation of the raised marine terraces, sources of supply of material to the coastal zone and the conditions of its distribution, fjord bathymetry and bottom sediment characteristics

When operational: 2011 - now.

Geographical coverage: Svalbard

Data archive/centre: Department of Geomorphology, Faculty of Earth Sciences and Spatial Management, Maria Curie-Skłodowska University

Data availability: all data (now in preparation)

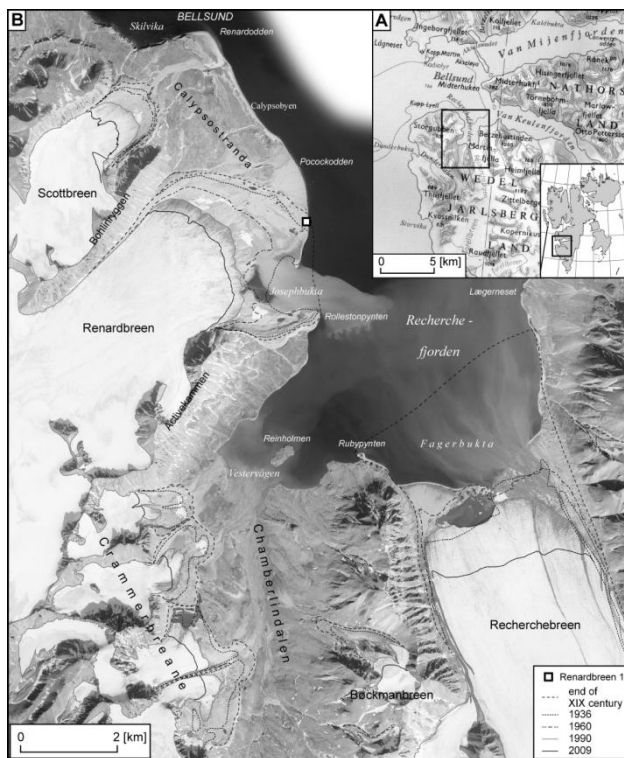


Figure 11. A - Location of the study area (fragment of topographical map of Svalbard, scale 1:1000000, Norwegian Polar Institute); B- Changes of front of the glaciers in Recherchefjorden area in the last century (Orthophotomap, scale 1:25000, vertical aerial photographs from 1990, ZAGÓRSKI 2005). Location of archaeological site Renardbreen 1.

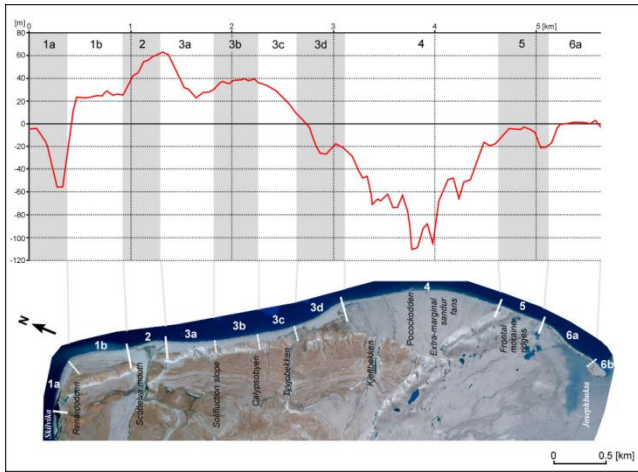


Figure. 12. Calypsostranda shoreline displacements during the period 1936-2007.



Figure.13. Sedimentological studies of the coastal zone (Calypsostranda).

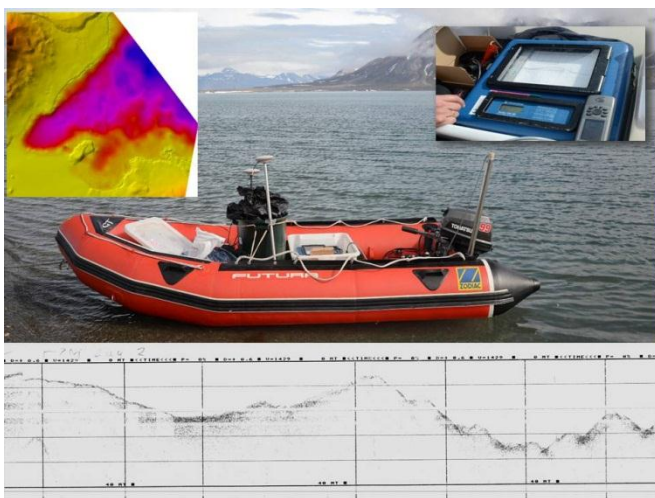


Figure.14. Batymetric studies of the bottom fjord (Recherchefjorden).

5d. Mechanisms of fluvial transport and sediment supply to Arctic river channels with various hydrological regimes (SW Spitsbergen) (ARCTFLUX)

Inventory of Observing Sites, Systems & Networks

Name and acronym: Mechanisms of fluvial transport and sediment supply to Arctic river channels with various hydrological regimes (SW Spitsbergen) (ARCTFLUX)

Contact person: Waldemar Kociuba (waldemar.kociuba@poczta.umcs.lublin.pl)

Web site:

<http://geografia.umcs.lublin.pl/>

<http://geografia.umcs.lublin.pl/wyprawy/>

Main objective of the network:

Fluvial transport, its dynamics and structure, constitute a good indicator of the condition of the natural environment in various climatic zones. Analysis of fluvial transport components allows for precise determination of the rate and directions of transformations of geosystems of any importance. In the polar zone, very sensitive to global changes, it seems expedient to identify the mechanisms and structure of fluvial transport, particularly in the conditions of the observed glacier retreat, the main alimentation source of proglacial rivers. Studies carried out in the zone revealed difficulties in determination of fluvial transport structure, particularly the actual bedload of gravel-bed rivers based on direct measurements, resulting from: short measurement series, lack of standardization of research methods and measurement equipment, and strategy of selection of study objects and sampling. The research project presented concerns determination of mechanisms of fluvial transport and sediment supply to Arctic gravel-bed river channels. The mechanisms reflect the processes of adaptation of proglacial rivers of the Arctic zone to changing environmental conditions, and indicate the dominant directions of transformations of paraglacial geosystems of various importance. For studies on Arctic geosystems, the region of the south Bellsund (SW Spitsbergen) was selected due to extensive knowledge on its hydro-meteorological and glacial-geomorphological conditions, and long-term measurement series carried out by the research station of the MCSU, among others within the framework of the international monitoring network: SEDIBUD (IAG) and Small-CATCHMENT program. For detailed studies, rivers with various hydrological regimes were selected, functioning at the forefield of the Scott and Renard Glaciers. The Scott River glacial catchment and glacier-free catchments of the Reindeer Stream and the Wydrzyca Stream (with a snow-permafrost hydrological regime) meet the selection criteria for representative test catchments analyzed for the following programs: SEDIFLUX, SEDIBUD, and POP.

Type of activity:

Theme:

- atmosphere, meteorological conditions,
- hydrological conditions, structure of fluvial outflow,

- fluvial transport, tendencies of changes in the morphology of river beds and valley bottom,

Location: Svalbard, NW part of Wedel Jarlsberg Land, Bellsund, Recherchefjorden, Calypsobyen

Main variables:

The studies will be carried out based on an integrated monitoring program of sediment transport. The study will focus on identification of patterns of channel development of rivers analyzed, tendencies of changes in the morphology of river beds and valley bottoms, as well as identification of their transportation regime, and determination of modern sedimentation (sub)environments. Water discharge intensity and fluvial transport volume will be analyzed in selected hydrometric cross-sections closing subcatchments. Individual components of sediment transported, their spatial differentiation, and variability at various time scales (diurnal, seasonal, long-term) will be identified. Discharge rate will be determined with the application of an current meter, and water levels in the river bed – by means of pressure limnigraphs. Measurements of dissolved and suspended material will be carried out with the application of the conductometric and gravimetric method. Bedload material will be measured based on an innovative methodology with the application of River Bedload Traps – RBT, constructed by W. Kociuba. Material sampled will be subject to field granulometric analyses for the purpose of determination of statistical parameters of granulation distribution. The analyses planned will be supplemented by meteorological measurements carried out in the ‘Calypsobyen’ and glaciological measurements (based on a network of ablation stakes and GPS measurements) of the Scott Glacier, allowing for determination of the effect of meteorological conditions and glacier ablation rate on the dynamics of fluvial processes.

When operational: starting in summer 2012

Geographical coverage: Svalbard

Data archive/centre: Faculty of Earth Sciences and Spatial Management, Maria Curie-Skłodowska University

Data availability: all data (now in preparation)

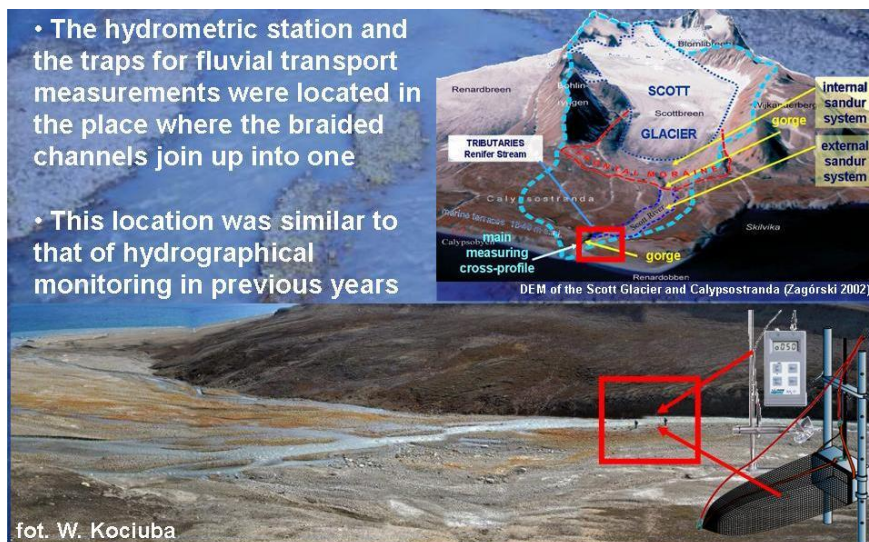


Figure 15. Environmental conditions of the analysed catchment.

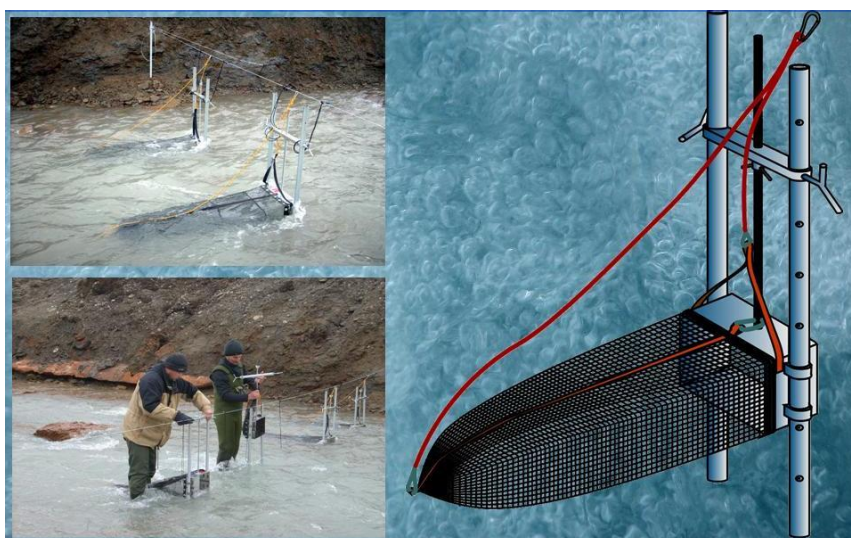


Figure 16. Methodology – River Bed Load Trap (RBT). (W. Kociuba)

6. Nicolaus Copernicus University, Torun

6a. Nicolaus Copernicus University Polar Station, Spitsbergen (NCU PS) Inventory of Observing Sites, Systems & Networks



Name and acronym: Nicolaus Copernicus University Polar Station, Spitsbergen (NCU PS)

Contact person (e-mail): Ireneusz Sobota (irso@umk.pl)

Web site: www.stacja.arktyka.com

Main objective of the network: Polar Station (base)

The Polar Station of the University of Nicolaus Copernicus is located in the western part of the Oscar II Land, in the northern part of the coastal Kaffiøyra Lowland which is closed by the Forlandsundet from the west. The undertaken research included almost all components of the geographical environment. Scientific programs put pressure on research in glaciology, glacial geomorphology, permafrost and periglacial processes, as well as climatologic and botanical studies. Since 1995 glaciological research and the studies of permafrost of various ground types and their seasonal thawing, as well as meteorological observations have been the major issues on the research agenda.

Glaciers pose the dominating feature of the Kaffiøyra region. Since the 19th century their area has decreased by about 30%. Thus, one of the main scientific issues studied there is the course and the reasons for the change in the glaciers' range. This can be achieved by studying mass balance of the glaciers. Presently, mass balance of four glaciers is studied: the Waldemarbreen, the Irenebreen, the Elisebreen and the Aavatsmarkbreen.

The research includes both the summer balance (ablation and outflow from the glaciers) and the winter snow accumulation. The detailed research plans also refer to two large glaciers which end up in the sea. Those are the Aavatsmarkbreen in the north and the Dahlbreen in the south of the Kaffiøyra. Currently, subaquatic glacial relief of the bays in the Forlandsundet region is under scrupulous investigation. The results of the research can be obtained from the station's website (www.stacja.arktyka.com), from the publications by the World Glaciological Monitoring Service (WGMS- IAHS), as well as the website of the Circumpolar Active Layer Monitoring (CALM- IPA).

The research carried out in the N.Copernicus University Polar Station has enabled numerous scientists of most specialties of the Earth sciences (glaciology, climatology, hydrology, geomorphology, pedology and botany) to collect material for numerous papers, including master and doctoral theses. Scientific attractiveness of the Kaffiøyra's geoecosystem has been appreciated by scientists from various scientific centres in Poland and elsewhere, who take part in interdisciplinary expeditions organized every year. The most Polish polar research in the north-west Spitsbergen is based on the N.Copernicus University Polar Station

Once the station has had an extension addend, it can host 10-15 people at any one time. The new section of the station is 32 sq. m downstairs and 24 sq. m upstairs. This includes a study, a workshop, a bedroom as well as two bedroom entresols. The extension is connected with the old section of the station, which includes a living room and a bedroom, but there is also a separate entrance to the new part of the station. Additionally, the station gained extra storage floor, a laboratory, a bathroom, as well as a garage to keep boats, snowmobiles and engines. All together the station now has about 100 sq. m. The station is used 3 to 4 months annually, but it is possible to stay there for as long as a whole year. It is equipped with necessary technical facilities, motor-generators, solar panels, motorboats and snowmobiles. More important measurement equipment includes: a weather station with the basic measuring instruments (the measurements conducted since 1975); automatic weather stations (with the measurements taken at any intervals); limnigraphs and loggers installed in the selected watercourses (measurements of water levels, flow rates and the selected physicochemical features of water since 1975); a system of ablation poles installed on the glaciers; ice drills; loggers for measuring ground temperatures and ice temperatures, and others.

The extension of the station in 2007 enabled larger groups of scientists to work and conduct research. The fact that both the living and laboratory space has been enlarged is especially important, as the station is often visited by scientists from all over the world. As a result, the extension will make it possible to intensify current international contacts, as well as start new co-operation projects in the Kaffiøyra region.

Type of activity:

Theme:

- Cryosphere
- Glaciology
- Hydrology
- Permafrost
- Climatology
- Geomorphology
- Coastal ecosystem
- Atmosphere
- Environmental study
- Soil sciences

Location:

Svalbard, NW Spitsbergen, Oscar II Land, Kaffiøyra

When operational (year): since 1975
Geographical coverage (countries): Svalbard

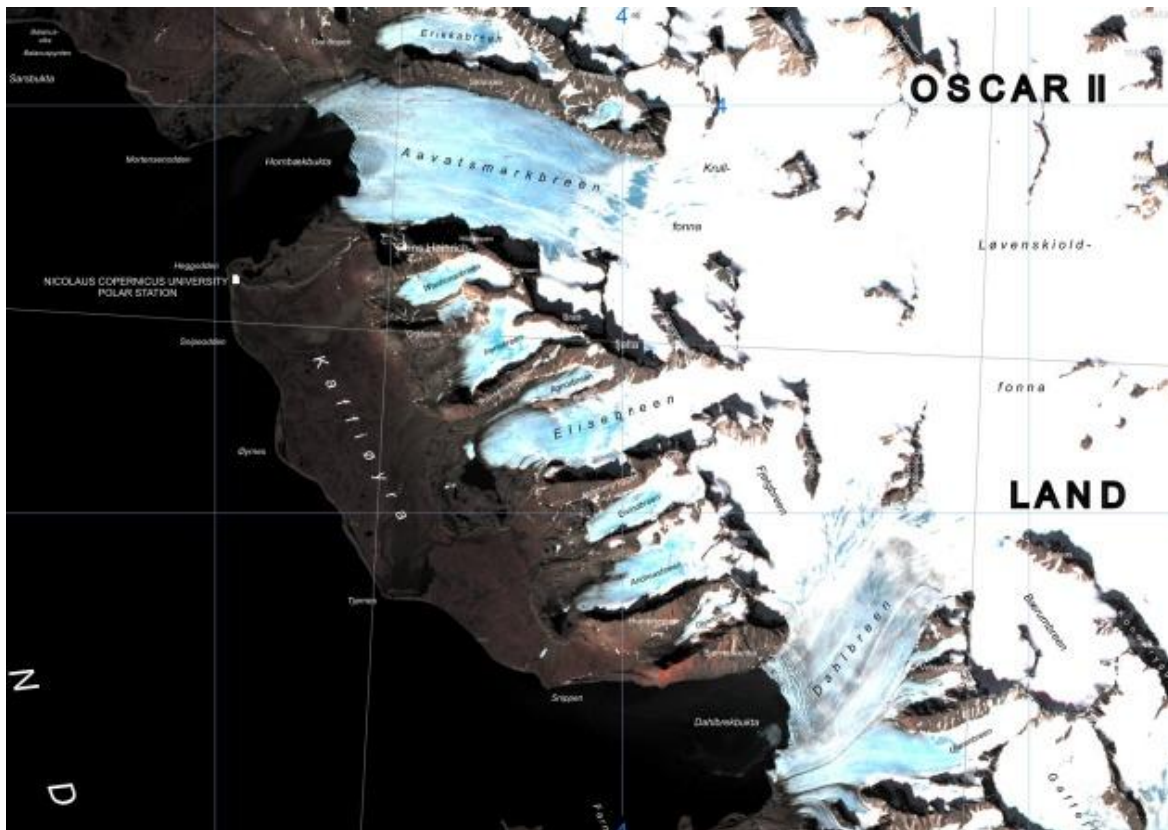


Figure 17. Part of region satellite orthophotomap with marked Station site (Król and Ćmielewski, 2010)

**6b. Changes of North-Western Spitsbergen Cryosphere (CryoChange)
Inventory of Observing Sites, Systems & Networks**

Name and acronym: Changes of North-Western Spitsbergen Cryosphere (CryoChange)

Contact person: Ireneusz Sobota (irso@umk.pl)

Web site: www.stacja.arktyka.com

Main objective of the network:

Project aims indicate of changes of main terrestrial cryosphere components – glaciers and permafrost. Research on glaciers assumes both to inspect recent changes (mass balance, geometry, thermal structure and widely understood dynamics) and to reconstruct past events (especially in base on subaquial records in the marine-part forefields of the tide-water glaciers). Selected research results are part of the World Glacier Monitoring Service (WGMS). The most widely studied are Waldemar Glacier, Irene Glacier and Elise Glacier. Several research aspects, such as geometry of glaciers are investigated for more than 30 years, since first NCU Polar Expedition in 1975.

Permafrost investigations are focused on the depth of the summer active layer thawing and thermal properties of it. Selected results constitutes a part of Circumpolar Active Layer Monitoring (CALM) programme.



CHANGES OF CRYOSPHERE IN NORTH-WESTERN SPITSBERGEN
Kaffiøyra Region

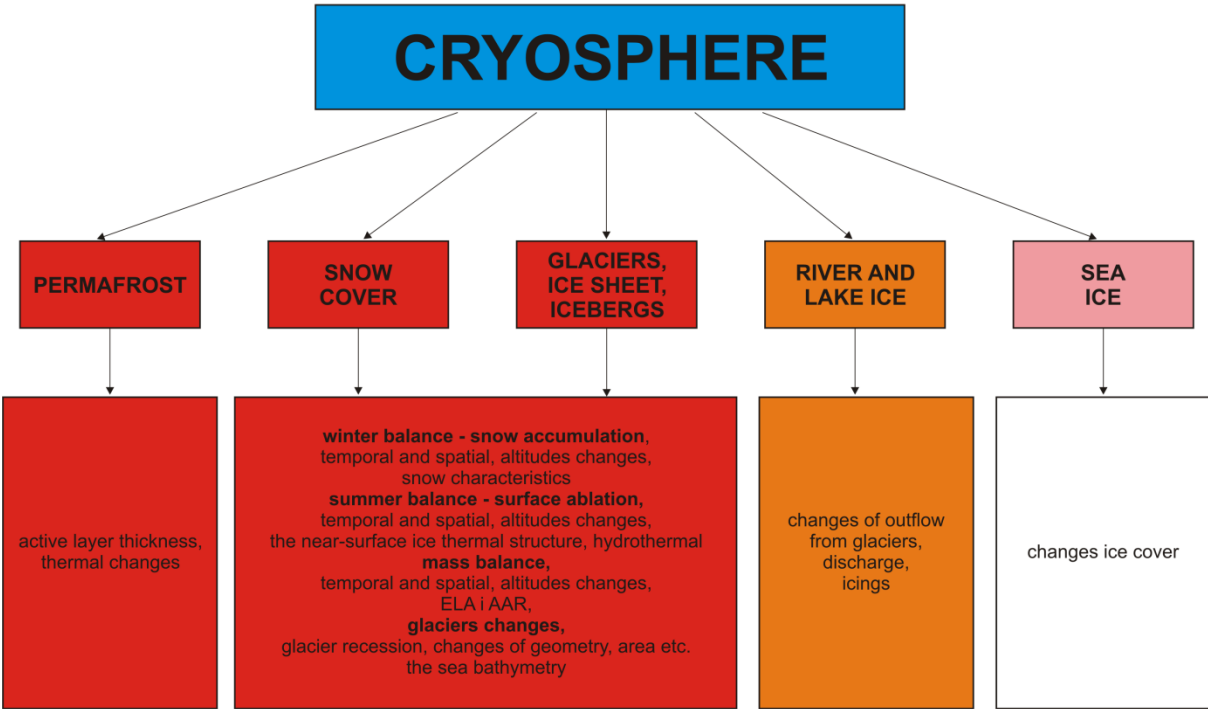


Figure 18. Scheme of Kaffiøyra region cryosphere components change research (I. Sobota)

Type of activity:

Theme:

- Mass balance of glaciers
- Glaciers geometry change processes
- Glacier dynamics
- Glacier-climate interactions
- Polar hydrology
- Thermal structure of the near-surface glaciers layer
- Subaqual extent change records in the forefields of marine-type glaciers
- Permafrost

Location: Svalbard, NW Spitsbergen, Oscar II Land, Kaffiøyra

Main variables: winter and summer mass balance, changes in glaciers geometry (both, geodetic *in-situ* and remote sensing methods), thermal structure of glaciers (direct measurements and indirect features, e.g. icings formation monitoring), bathymetry of glaciers bays, active layer key features

When operational: some selected aspects: 1975 – now; other: 1995 – now.

Geographical coverage: Svalbard

Data archive/centre: Department of Cryology and Polar Research, Institute of Geography, Nicolaus Copernicus University in Torun

Data availability: publications; CALM website, www.stacja.arktyka.com

6c. Hydrological issues of the glacierized Waldemar River catchment

Inventory of Observing Sites, Systems & Networks

Name and acronym: Hydrological issues of the glacierized Waldemar River catchment (HIWRC)

Contact person: Ireneusz Sobota (irso@umk.pl)
Marcin Nowak (m.nowak@doktorant.umk.pl)

Web site: www.stacja.arktyka.com

Main objective of the network:

Recently observed changes in glacierized areas significantly influences on water circulation features in those regions. Project assumes hydrological research in Waldemar River catchment as the example of the High-Arctic glacierized basin. Those investigations began in late 1970's. From that date substantial changes in catchment characteristic are observed (e.g. decrease degree of glaciation). Glacier-fed river characteristics are well recognized all over the globe. But still there is a need to define how contemporary deglaciation processes affects the water circulation cycle. Basics hydrological features in Waldemar River Catchment are continuously investigated since 1995. In the close future, a HIWRC programme will be expanded to include research of major glaciohydrological processes in catchment (e.g. internal glacial drainage and its contribution to total outflow). Study assume measurements in a few river points – both in close vicinity of glacier (with no other than glacial water source tributaries) and in lowest part of catchment (with periglacial tributaries).

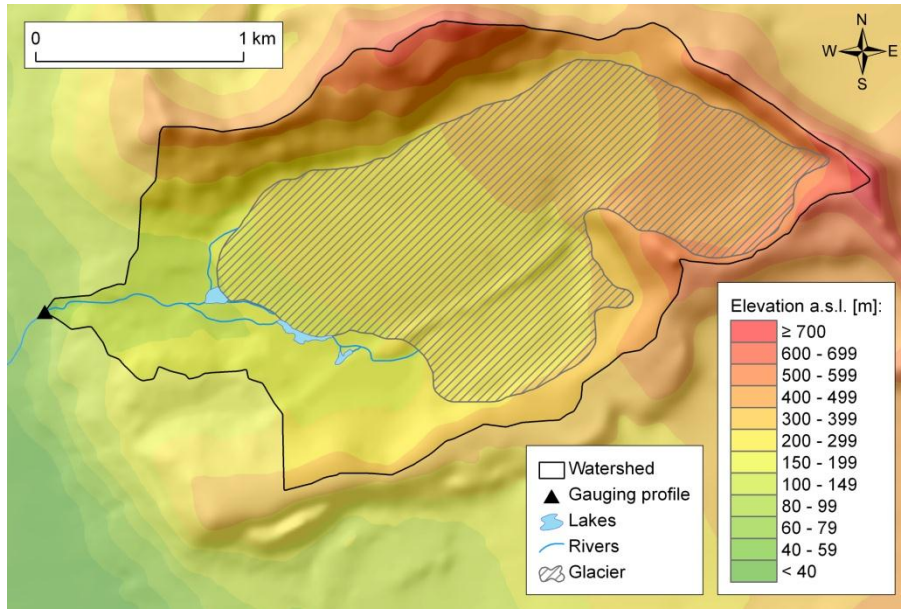


Figure 19. Map of the part of Waldemar River catchment

Type of activity:

Theme:

- Outflow regime
- Sediment transport
- Physicochemical issues

- Water movement through glacier
- Short-term and long-term mass balance and glacier geometry variations

Location:

Svalbard, NW Spitsbergen, Oscar II Land, Kaffiøyra

Main variables:

When operational: some selected aspects: 1995 – now; other: close future

Geographical coverage: Svalbard

Data archive/centre: Department of Cryology and Polar Research, Institute of Geography, Nicolaus Copernicus University in Torun

Data availability: publications. www.stacja.arktyka.com



Figure 20. Measurements in major gauging profile

7. University of Silesia

Monitoring of tidewater glaciers dynamics in Southern Svalbard

Question 1. a. How can the SAON SG best assist you?

Providing frames for unification / standardization of methods and techniques on monitoring of tidewater glaciers in the Arctic, conducted by different research groups. Facilitating extension of the network to other areas of the Arctic and providing a platform for exchange of data.

b. What do you see as the role of the SAON SG?

The SAON SG has to stimulate development of monitoring of tidewater glaciers in all regions of the Arctic. Moreover, the SG has to pay attention for support of methodological and training workshops on monitoring of glaciers, including field and remote sensing methods.

Question 2. What are the critical issues facing your observing program or data and information management program?

Critical issue of glaciological monitoring program is related to longer term continuation of field observations on glaciers. Logistics is complicated and costly and instruments are often affected or damaged by severe weather conditions and also by polar bears. Maintenance of observing program during long polar night requests special technologies (e.g. energy supply) and risk of field observers. Costs of high resolution satellite images.

7a. Dynamic Response of Arctic Tidewater Glaciers to Climate Change (GLACIODYN-T)

Inventory of Observing Sites, Systems & Networks

Name and acronym: Dynamic Response of Arctic Tidewater Glaciers to Climate Change (GLACIODYN-T)

Contact persons (e-mail): Tomasz Budzik (Tomasz.budzik@us.edu.pl) – meteorology

Małgorzata Błaszczuk (malgorzata.blaszczuk@us.edu.pl) – remote sensing

Web site: <http://www.glacio-topoclim.org/>

Main objective of the network:

University of Silesia in close cooperation with the Institute of Geophysics, Polish Academy of Sciences (PAS) has developed and maintain monitoring of glaciers in SW Spitsbergen, Svalbard.

Monitoring network of land ice masses in Southern Spitsbergen is aimed to study the response of tidewater glaciers to climate warming, with focus on mass loss due to calving. Seasonal and interannual changes in glacier flow velocity, fluctuation of terminus position and calving rate are studied for better understanding of ice berg calving. The target glacier Hansbreen has a comprehensive ground observing system (Figure 21). It consists of mass balance stakes, automatic weather stations (AWS), time lapse GPS survey of velocity at stake T4, two time lapse cameras, automatic laser ranger and panoramic radar for measurements of ice cliff fluctuations. Moreover, mass balance, including snow cover studies are conducted every year since 1989. In some years high frequency ground penetrating radar is used for snow thickness measurements along the same profiles on the glacier. Satellite remote sensing is used for extraction of data on glacier flow velocity and fluctuation of termini and calculation of mass loss by calving. Up-to-dated inventory of glaciers in Southern Spitsbergen has been done by remote sensing methods (Figure 23).

Studies are conducted in cooperation with Spanish, Norwegian and Italian partners.

Cooperation with Institute of Oceanology, PAS (since 2010) is developed to monitor sea water parameters for studies of sea water - ice cliff interaction.

Member of or connected to a global network; if yes, which: World Glacier Monitoring Service (WGMS)

Type of activity:

- Theme:

- Atmosphere: local climate of glacier – Automatic Weather Stations
- Cryosphere: dynamics and mass balance of glacier

- Location(s): Southern Spitsbergen, Svalbard

- Community-based: Observations maintained by crews of the Polish Polar Station, Hornsund

- Coordination, e.g. not directly involved in observations, but coordinating data and information (e.g., AMAP): any

Main variables: Air Temperature, Relative Humidity, Wind Speed, Wind Direction, Solar Radiation, Net Radiation, Snow Depth/ice ablation

Accumulation & ablation on stakes – manual readings; snow thickness and density, glacier movement velocity by time lapse precise GPS every 3 h at stake T4, glacier terminus position fluctuations and calving event by time lapse photos every 3 h – year round, high time resolution (10 min) and high accuracy (± 0.5 m) survey of ice cliff position changes in one point by laser distance ranger, entire ice cliff position changes every day by panoramic radar (low precision ± 12.5 m). Sea water temperature and salinity.

Snow cover monitoring by high frequency ground penetration radar in 2006, 2008, 2011, t.b.c.

Fluctuations of Hornsund tidewater glaciers termini (by satellite remote sensing). Database of optical satellite images for Southern Spitsbergen since 2004; few archive optical satellite images 1975 - 1993, radar satellite images 2000-2009.

When operational (year): beginning in 1982, progress in 2003, recent development in 2009.

Geographical coverage (countries): Svalbard, Norway

Data archive/centre, including Web site: data archive under development,

<http://www.glacio-topoclim.org/>

Data availability:

- Metadata only: from the web page
- All data: on request; for collaboration in national & international projects
- Charge or no charge for data: NO

Main gaps, e.g., geographic coverage, variables:

Gaps in series of observations due to failures of equipment, lack of power supply or damage by polar bears. Long term tide and wave record required. More tidewater glaciers advisable with monitoring of flow velocity by GPS as ground truth data for calibration of remote sensing survey.

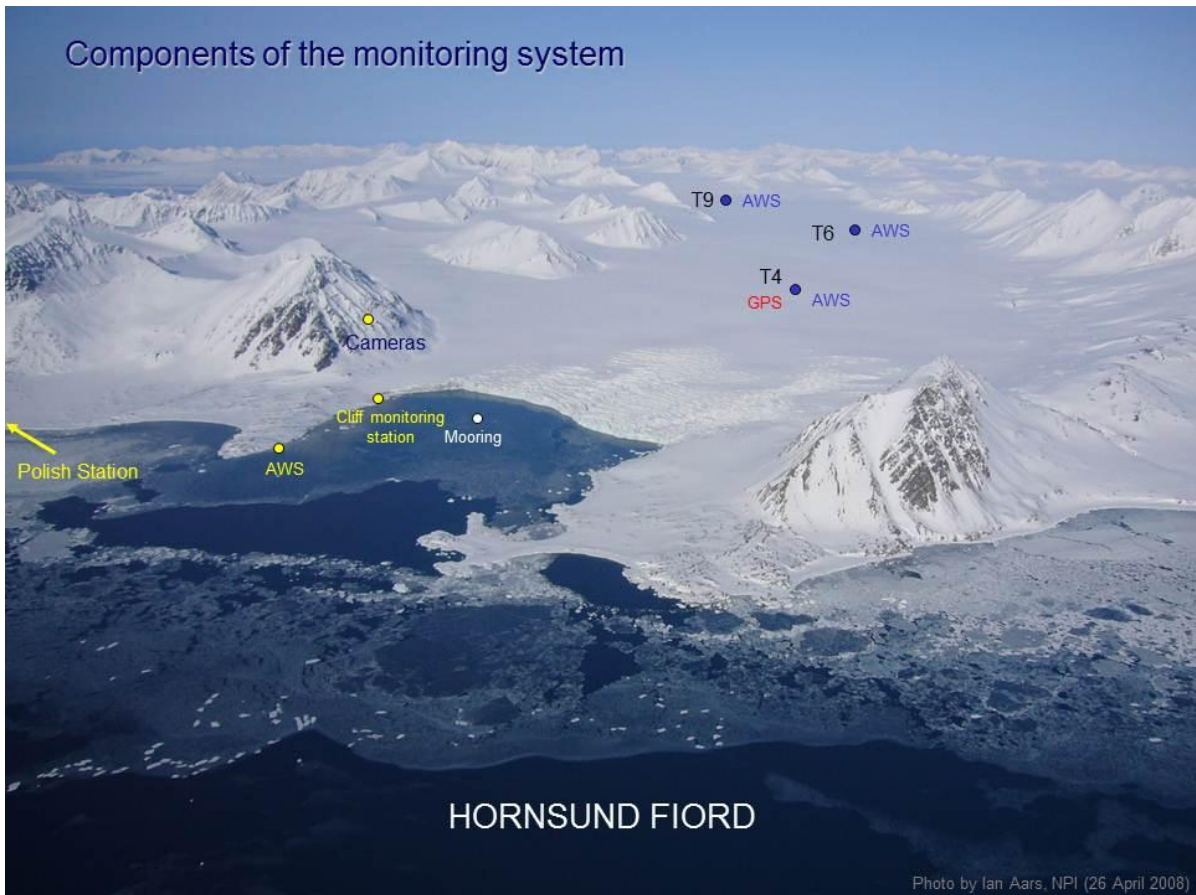


Figure. 21. Aerial view on Hansbreen with marked elements of glacier monitoring system. Photo by courtesy I. Aars (NPI)



Figure. 22. Ice Cliff of Hansbreen and front position monitoring station with laser distance ranger and panoramic radar. Riegl laser distance meter is giving high time resolution (every 10 min) and high accuracy (± 0.5 m) point data (weather depended record). Garmin panoramic radar provides data on entire cliff position every day during day and night and bad weather, with low accuracy (± 12.5 m). Photo by M. Laska

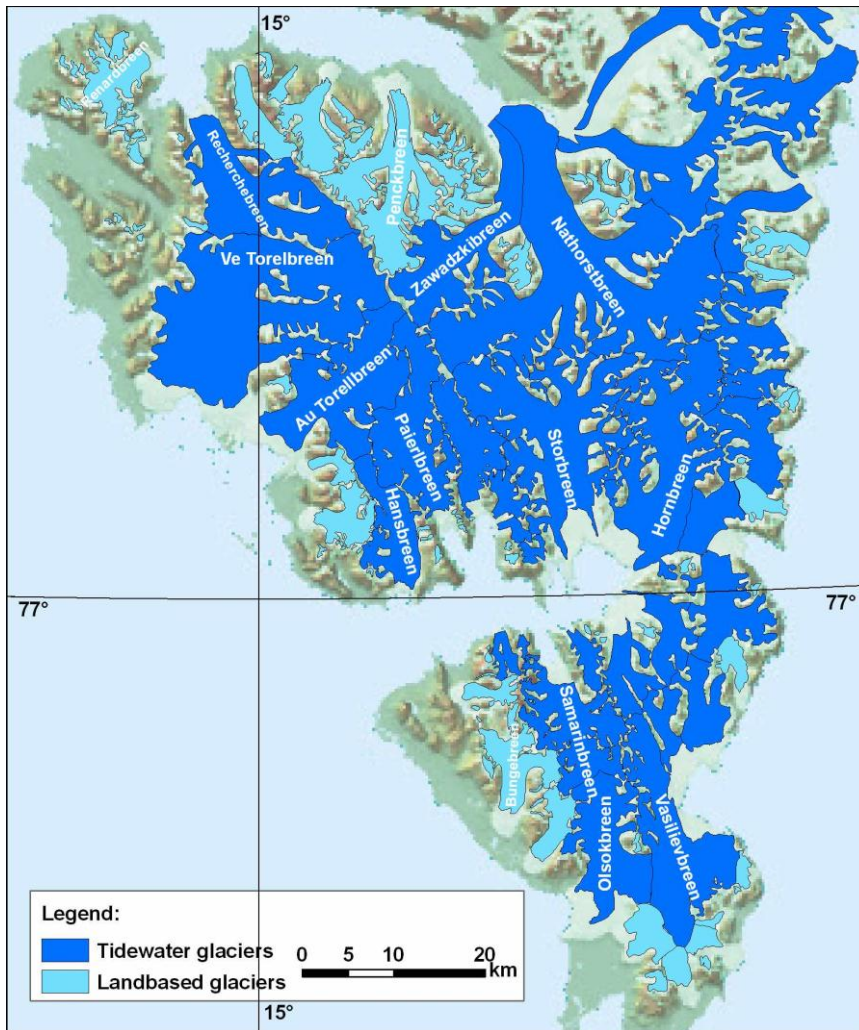


Figure. 23. South Spitsbergen, Svalbard. Glacier inventory general map with distinction of tidewater glaciers (based upon satellite remote sensing). Note location of Hansbreen. Prepared by M. Blaszczyk