EEA Grants
Norway Grants

AWAKE-2, Institute of Geophysics Polish Academy of Sciences, Warsaw, Poland

17-18.10.2016

AWAKE-2

WP5 – fresh water from land report

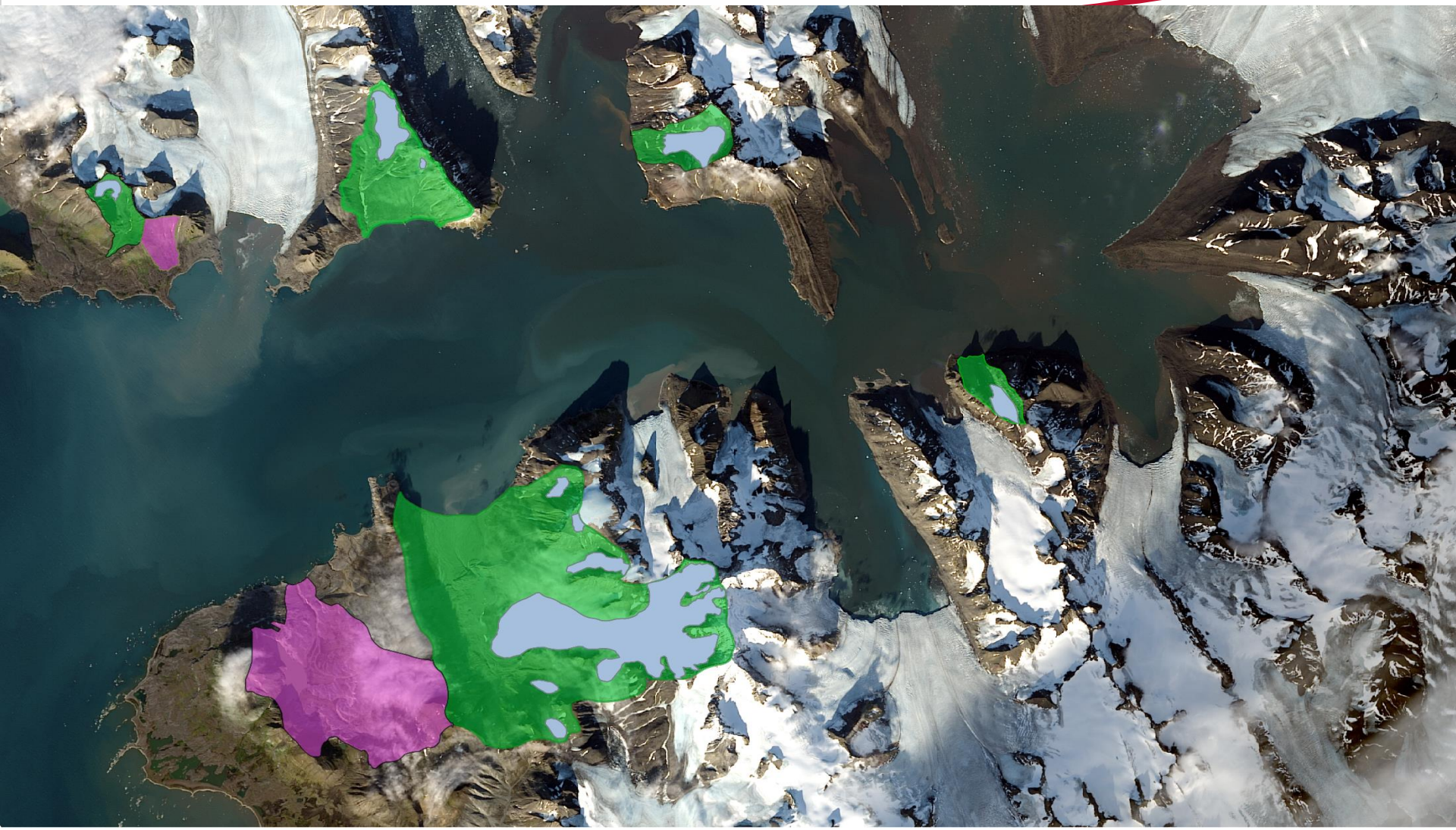
- Adam Nawrot, Tomasz Wawrzyniak, Marzena Osuch

Final meeting 2016

KNOW | Krajowy Naukowy Ośrodek Wiodący

Main objectives

- to identify main features of the Hornsund hydroglaciological basin and functioning of its drainage systems.
- a pattern of hydro-thermal structure of glaciers and its evolution will be defined with interpretation of the GPR data.
- the key factors of tidewater glaciers dynamics and calving intensity are aimed to be defined basing on broad range of terrestrial and remote sensing methods of front activity investigations and analysis of sea water properties.
- the freshwater quantification with respect to detailed glaciers' mass balance study and outflow measurements from different sources.
- study of unglaciated and partly glaciated catchments including outflow measurements, mass balance, and precipitation.
- Both Institutions will contribute in analysis of hydroglaciological system functioning and estimation of total terrestrial freshwater supply to the fjord.



Landsat-8, NASA

Task

T1. Detailed mapping and evaluation of features of the current state and main features of glaciated and unglaciated catchments within the Hornsund hydro-glaciological basin (UŚ/IGF)

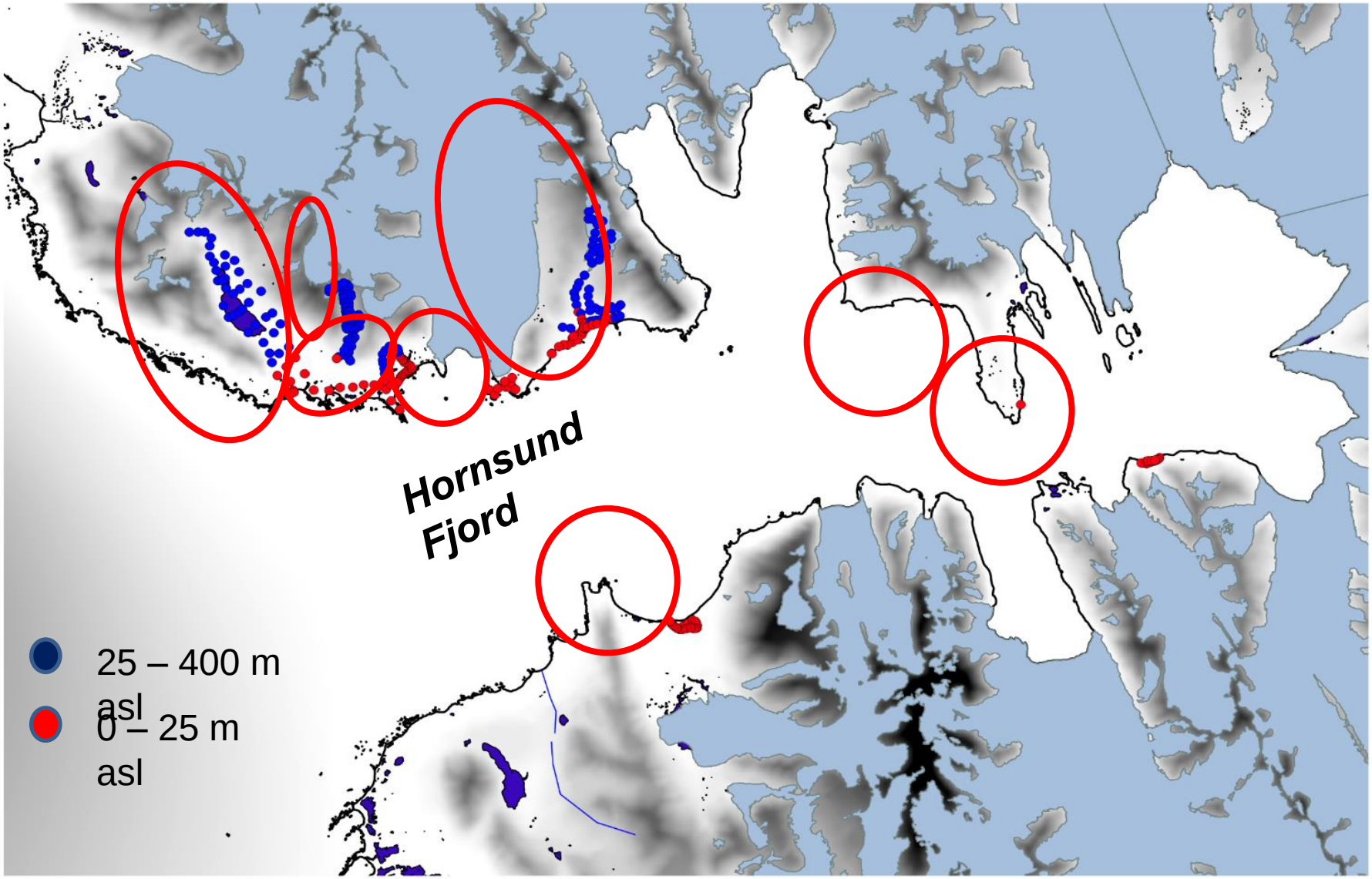
T2. Studies of factors and regimes of outflow from specific terrestrial sources i.e. partly glaciated and unglaciated catchments (IGF)

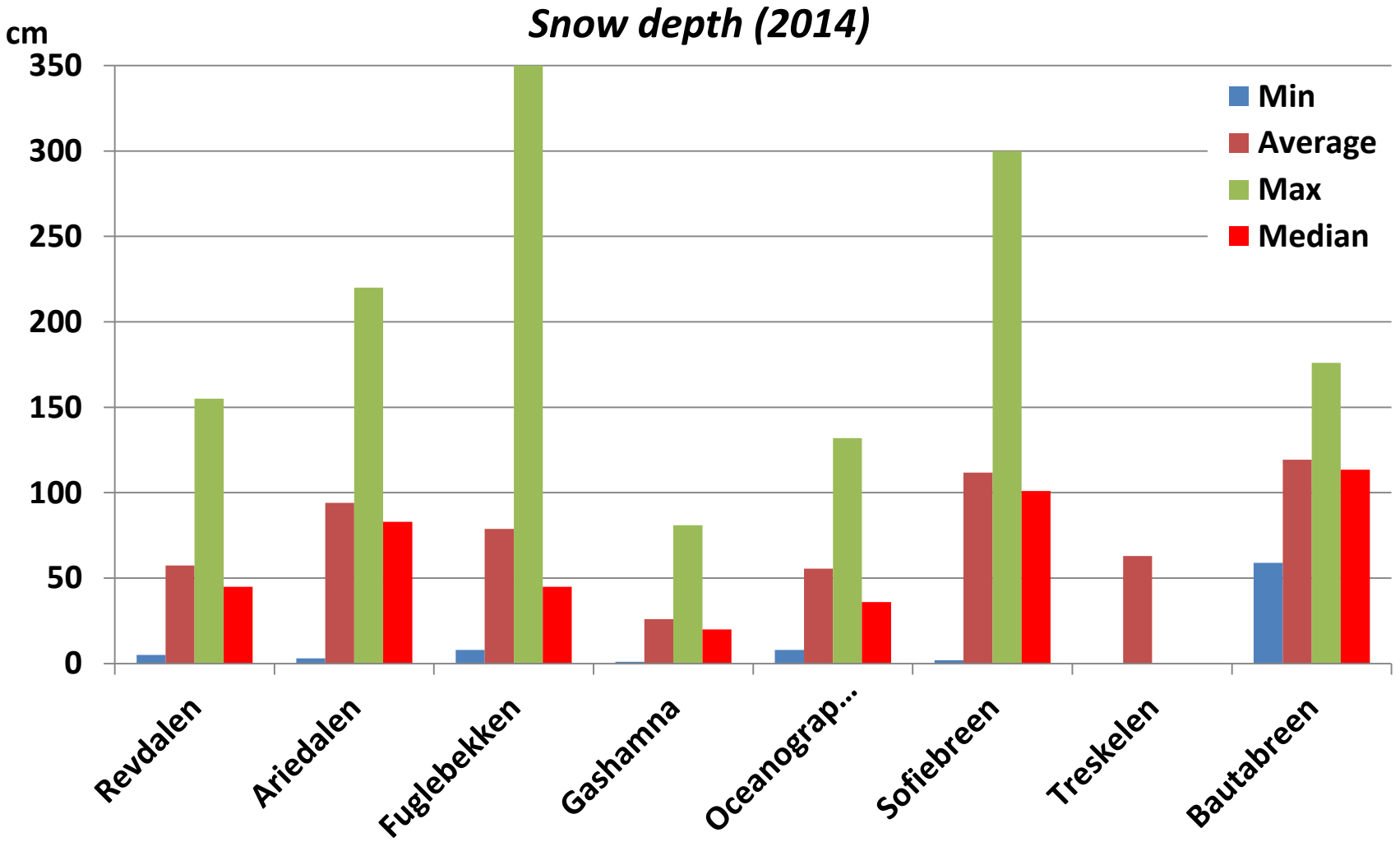
T3. Building of conceptual and semi-quantitative model of water drainage system and discharge from tidewater glaciers emptying into Hornsund fiord (US/IGF)

T4. Identification of key factors of the tidewater glacier's dynamics and calving intensity to the fiord (US)

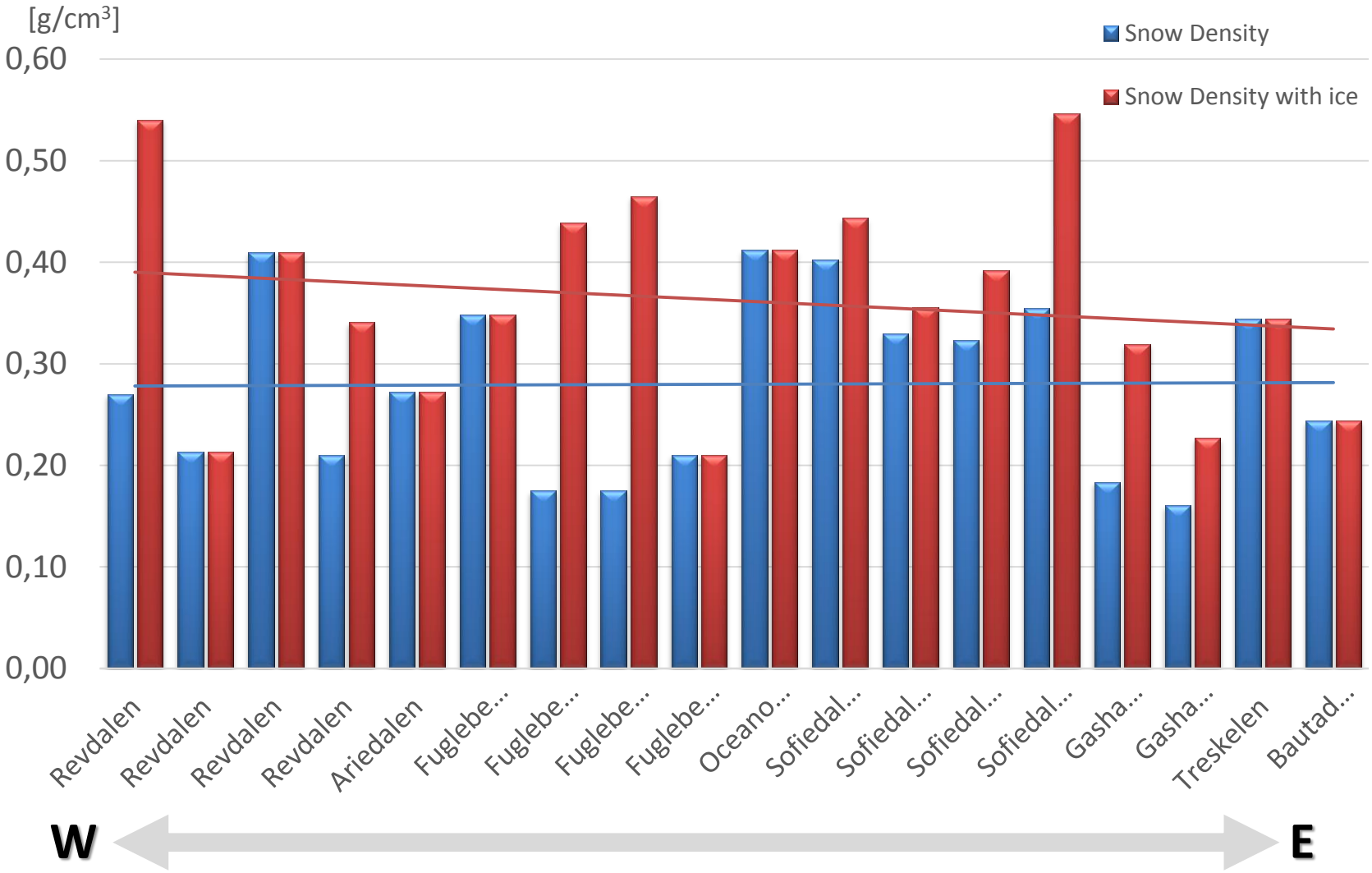
T5. Elaboration of the total water budget of the Hornsund hydroglaciological basin including surface mass balance and icebergs production by tidewater glaciers (US/IGF)

Snow cover in Hornsund (2014-2016)



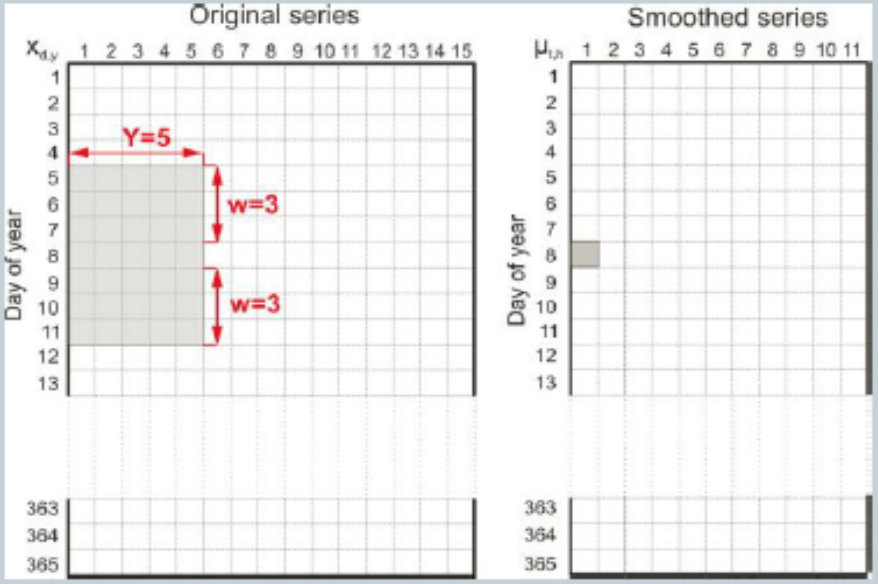

Snow depth (2014)
cm
350
300
250
200
150
100
50
0
Min
Average
Max
Median
Revdalen
Ariedalen
Fuglebekken
Gashamna
Oceanograp...
Sofiebreen
Treskelen
Bautabreen

Mean snow density up to 25 m asl



MASH

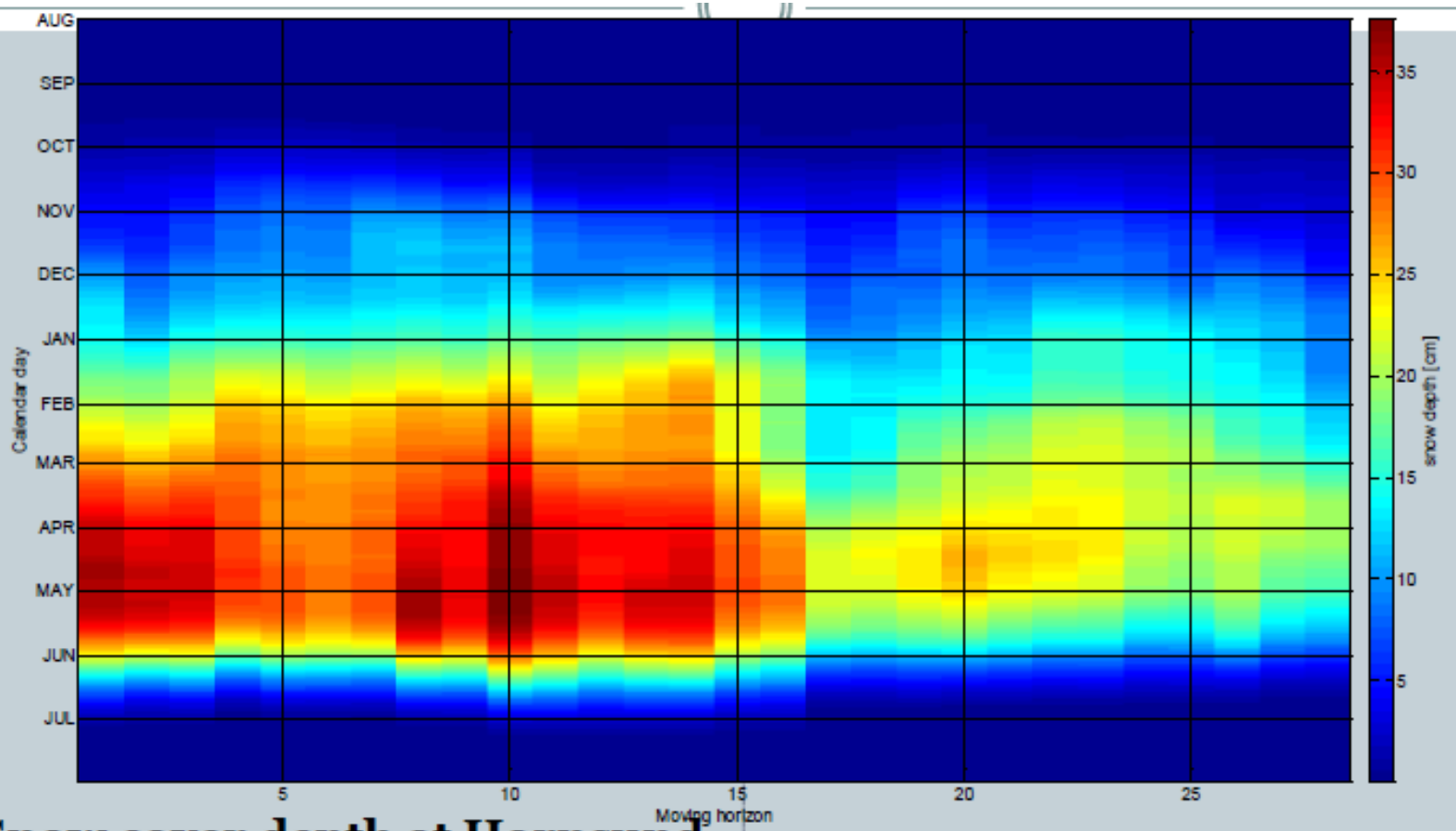
- Moving Average over Shifting Horizon (MASH) introduced by Anghileri *et al.* (2014)
- the data are arranged into array and than averaged in two dimensions: over the same days in the consecutive years and over consecutive days in the same year.
- This averaging is performed over shifting horizon which is parametrized by w and Y.
  - w describes number of consecutive days taken during averaging. The average over 2w+1 days.
  - Y is related to the averaging over years.
- In this study w=15 days and Y=7 years
- Trend analysis of the filtered data – Mann Kendall method



$$\mathrm{MASH} = \begin{bmatrix} \mu_{1,1} & \mu_{1,2} & \cdots & \mu_{1,N_h} \\ \mu_{2,1} & \mu_{2,2} & \cdots & \mu_{2,N_h} \\ \cdots & \cdots & \cdots & \cdots \\ \mu_{365,1} & \mu_{365,2} & \cdots & \mu_{365,N_h} \end{bmatrix}$$

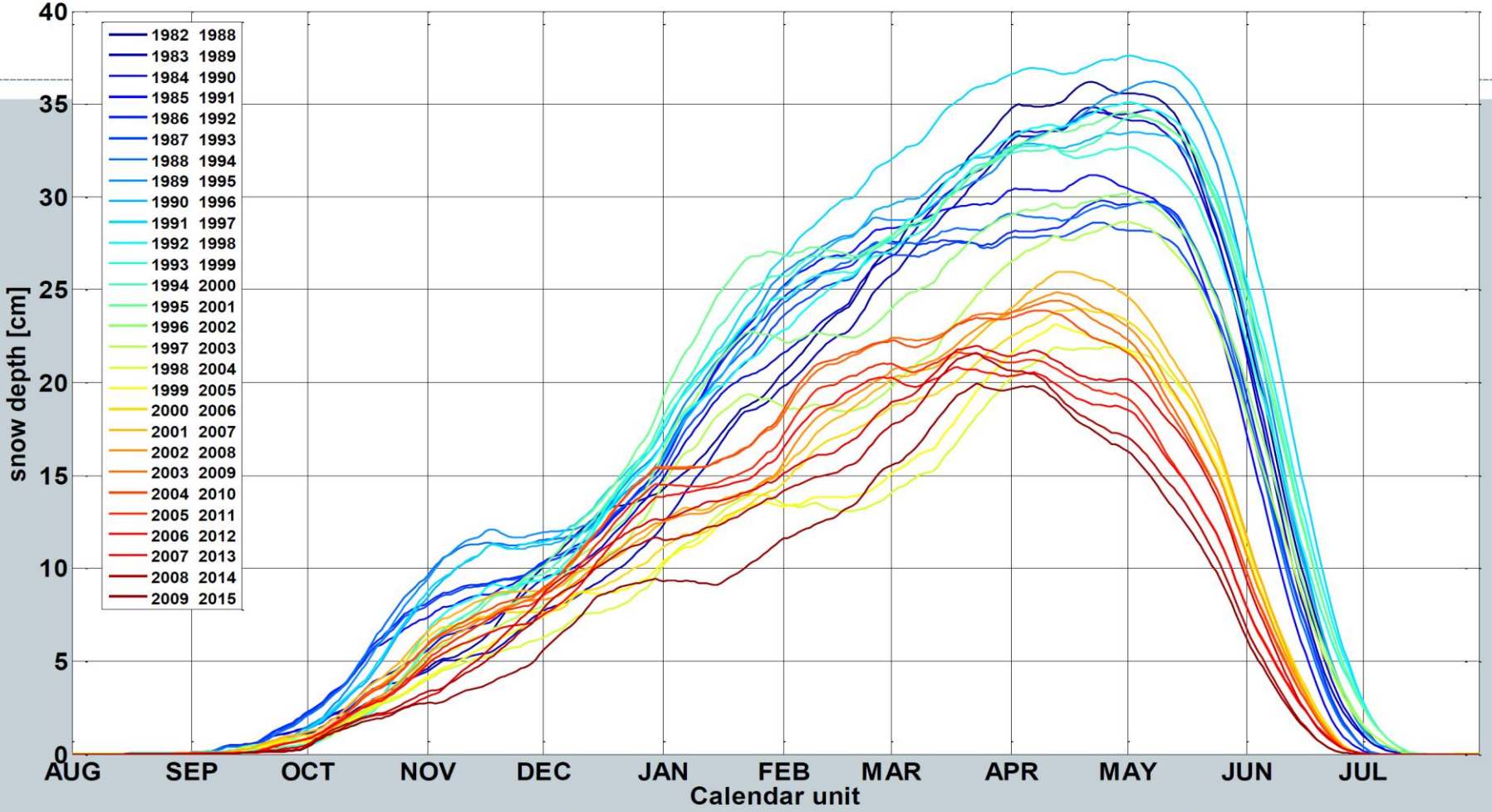
$$\mu_{t,h} = \underset{y\in[h,h+Y-1]}{\mathrm{mean}} \left[\underset{d\in[t-w,t+w]}{\mathrm{mean}} x_{d,y} \right]$$

MASH visualisation



- **Snow cover depth at Hornsund**
- Original time series covers period $Ny = 35$ years, from 1982 to 2016, so MASH is composed of $Nh = 28$ patterns.

Hornsund snow cover

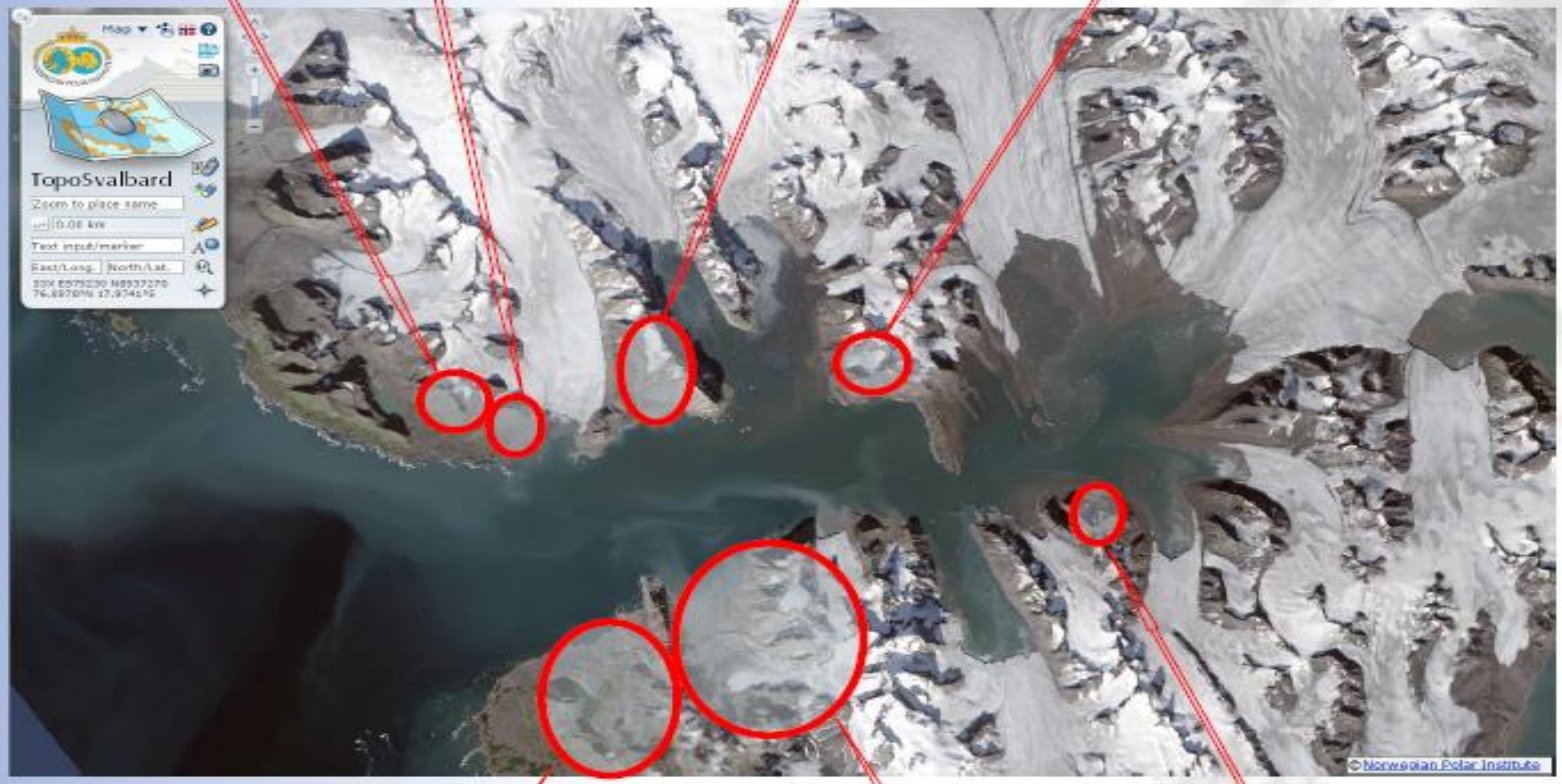


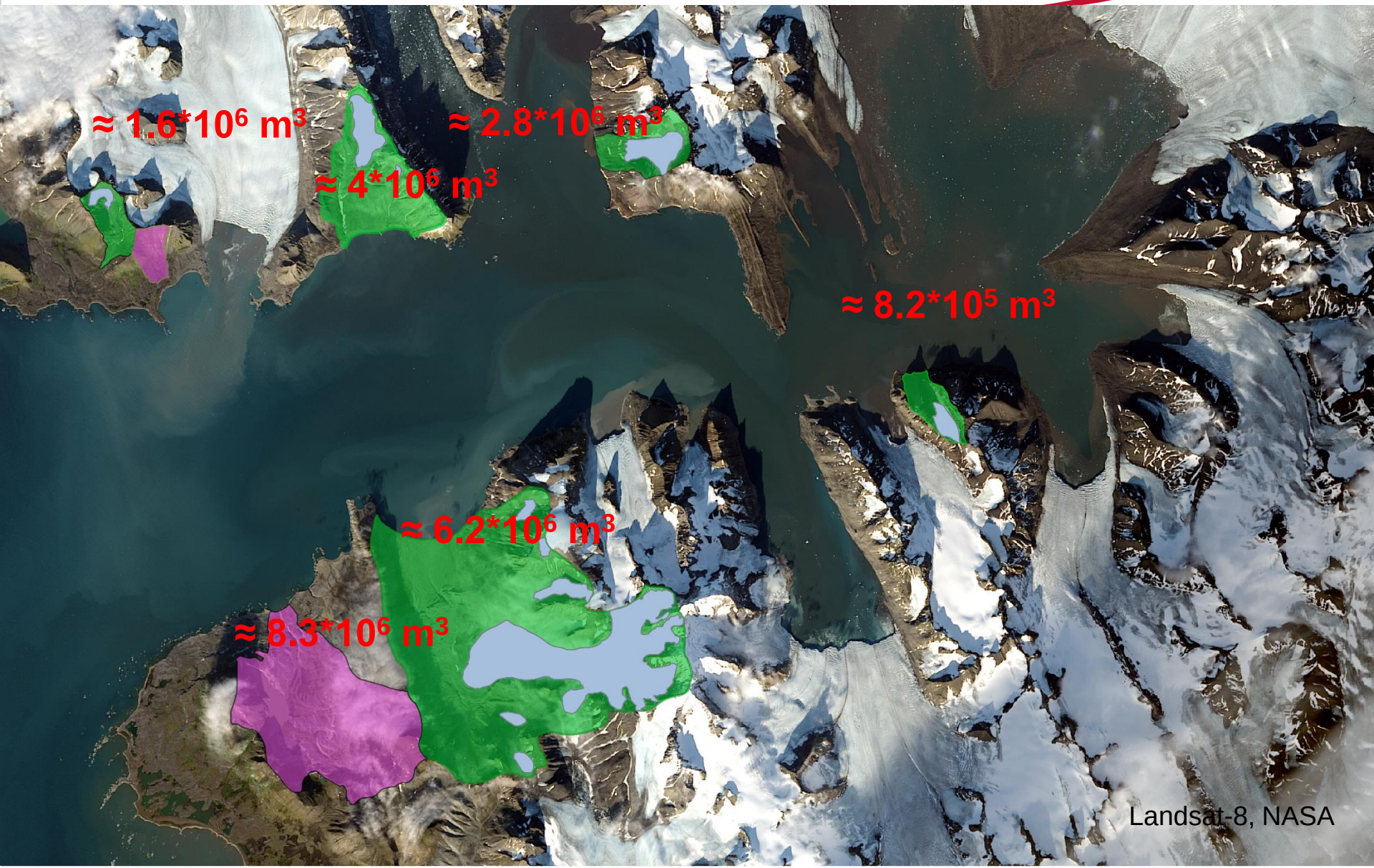
Another way of visualizing results using MASH, in which moving 7 years average over older horizons are plotted with blue lines and more recent horizons with red line.

Monthly sum of precipitation measured in:

- Sofiedalen
- Bautabreen
- Lorchbreen
- Lisbetdalen
- Arieskaret (400 m asl)

Catchments – outflow measurements (2014 – 2016)




≈ 1.6*10⁶ m³
≈ 2.8*10⁶ m³
≈ 4*10⁶ m³
≈ 8.2*10⁵ m³
≈ 6.2*10⁶ m³
≈ 8.3*10⁶ m³
Landsat-8, NASA

Task

T1. Detailed mapping and evaluation of features of the current state and main features of glaciated and unglaciated catchments within the Hornsund hydro-glaciological basin (UŚ/IGF)

T2. Studies of factors and regimes of outflow from specific terrestrial sources i.e. partly glaciated and unglaciated catchments (IGF)

T3. Building of conceptual and semi-quantitative model of water drainage system and discharge from tidewater glaciers emptying into Hornsund fiord (US/IGF)

T4. Identification of key factors of the tidewater glacier's dynamics and calving intensity to the fiord (US)

T5. Elaboration of the total water budget of the Hornsund hydroglaciological basin including surface mass balance and icebergs production by tidewater glaciers (US/IGF)

2016

- June/July and August/October fieldwork in Hornsund:
  - Water level and discharge measurements;
  - Precipitation gradient measurements;
  - Devices deinstallation and cleaning.

Workshops and conferences

No.	Title of presented work	Authors	Date and place	Title of the event	Type (international/national)	Presentation/ poster/other (specify)
1.	Deciphering origins of acidic pollutants in Svalbard - Hansbreen case study	Pakszys P. , Nawrot A.P., Migała K., Luks B.	4-9 September 2016, Tours, France	22nd European Aerosol Conference	International	poster
2.	Water from land – the fresh water outflow from glaciated and non-glaciated catchments into the Hornsund fjord, Svalbard	Nawrot A., Wawrzyniak T., Walczowski W., Osuch M.	17-22 April 2016, Vienna, Austria	EGU 2016	international	poster
3.	Polish Polar Station Hornsund (SW Spitsbergen) Inter-and intra-annual changes of snow cover	Wawrzyniak T., Osuch M., Nawrot A., Luks B., Kępski D.	3-7 October 2016, Kjeller, Norway	Ny-Ålesund Atmosphere Flagship open work group meetings	International	presentation
4.	Snow measurements around the Hornsund Fjord (Svalbard)	Nawrot A., Luks B., Wawrzyniak T.	06th October 2016, Warsaw, Poland	*ES1404-CORE GROUP MEETING*	International	presentation
5.	Distribution and chemical properties of snow cover in selected catchments around the Hornsund Fjord	Nawrot A., Wawrzyniak T., Luks B., Kępski D., Walczowski W., Araźny A. and Kozioł K.	9-11 November 2016, Gothenburg, Sweden	Taking the next step in Svalbard snow research Phase II	international	presentation

Polar Science 10 (2016) 249–261

Contents lists available at ScienceDirect

Polar Science

journal homepage: https://www.evise.com/profile/#/JRNL_POLAR/login

Chemistry of snow cover and acidic snowfall during a season with a high level of air pollution on the Hans Glacier, Spitsbergen

Adam P. Nawrot [a, b, *], Krzysztof Migała [c], Bartłomiej Luks [a], Paulina Pakszys [d], Piotr Głowacki [a]

[a] Institute of Geophysics, Polish Academy of Sciences, ul. Księcia Janusza 64, 01-452 Warszawa, Poland
[b] forScience Foundation, ul. Leśna 11, 62-081 Przeźmierowo, Poland
[c] University of Wrocław, Institute of Geography and Regional Development, pl. Uniwersytecki 1, 50-137 Wrocław, Poland
[d] Institute of Oceanology, Polish Academy of Sciences, ul. Powstańców Warszawy 55, 81-712 Sopot, Poland

ARTICLE INFO

Article history:
Received 26 November 2015
Received in revised form
10 May 2016
Accepted 7 June 2016
Available online 9 June 2016

ABSTRACT

The central Arctic is within the range of air pollution transported from industrial areas of Eurasia and North America. A poor network of weather stations means that there is limited information available about air quality and contaminant deposition in the Arctic environment. For this reason seasonal snow cover is an important source of information. Chemical properties of precipitation, snow cover and fresh snow were monitored at the Hornsund Polish Polar Station (Spitsbergen) and in the altitude profile of the Hans Glacier. Meteorological data from the coast and the glacier helped to examine in detail the impact

Submitted

Araźny A., Przybylak R., Wyszyński P., Wawrzyniak T., Nawrot A., Budzik T. **Spatial differentiation of air temperature and humidity in the Hornsund Fjord area, Spitsbergen**. *Geografiska Annaler*

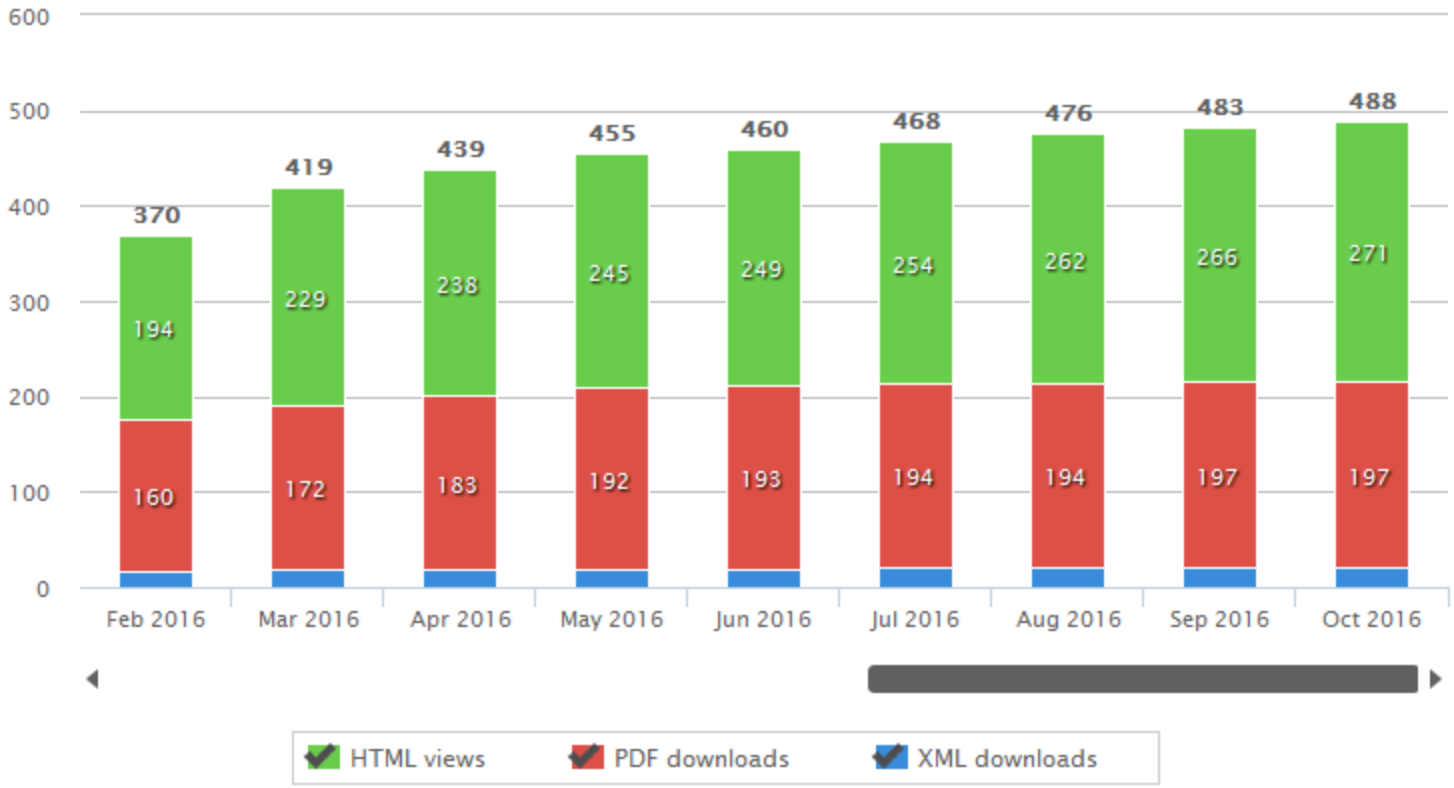
In preparation

Nawrot A., Wawrzyniak T., Kępski D., Walczowski W., Kozioł K., Araźny A., Luks B. **Distribution and chemical properties of snow cover in selected catchments around the Hornsund Fjord**.

Nawrot A., Wawrzyniak T., Osuch M. **Comparison of partly glaciated and non-glacieted catchment hydrology in the Hornsund region.**

doi:10.5194/t

Cumulative views and downloads (calculated since 26 Mar 2015)



Research ar

Overview
waters

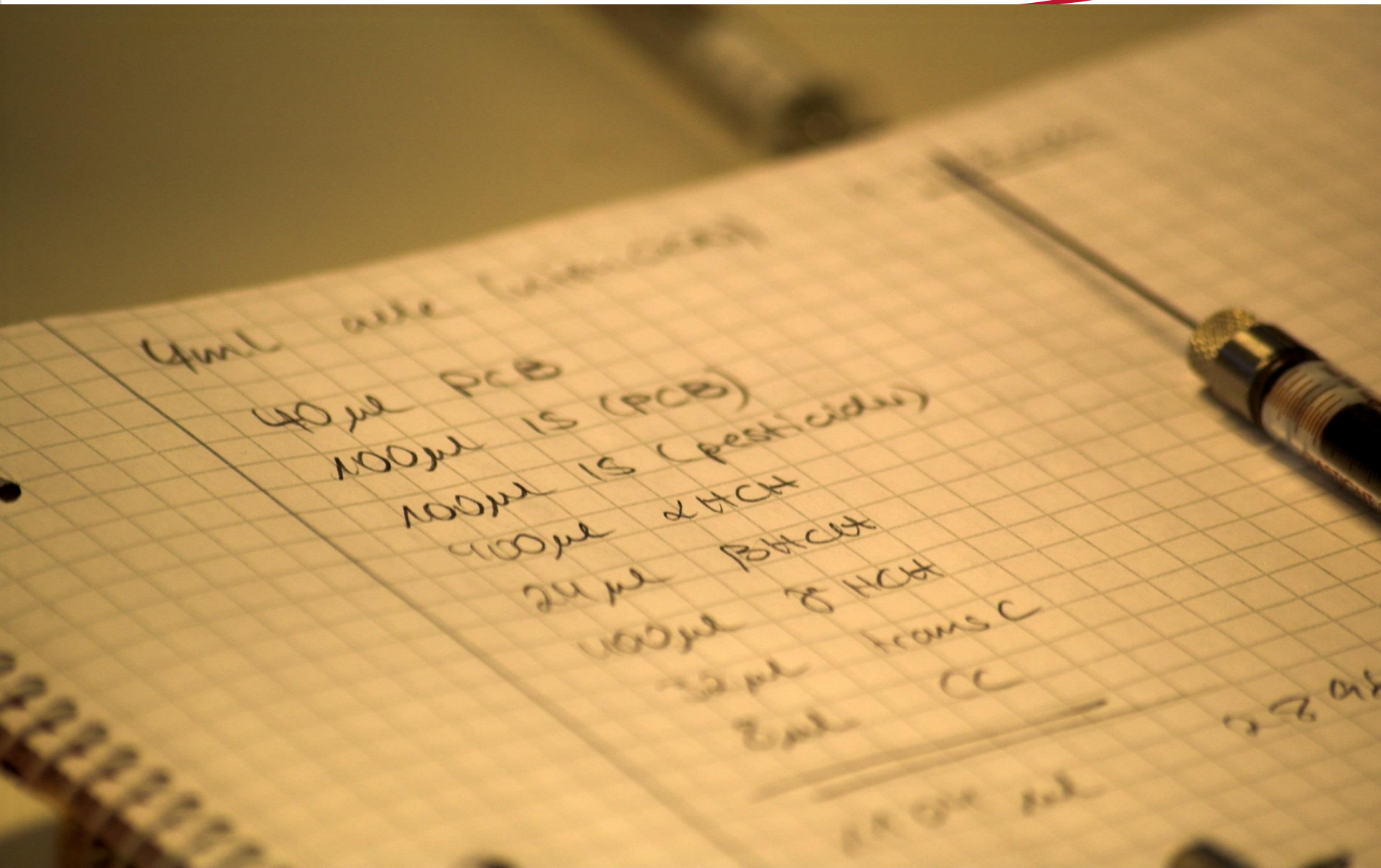
A. Kies[1], O.
[1]Laboratoire P
[2]Institute of G
(KNOW), Wars
[3]Faculty of Ea

Abstract. We
glacierized b
temperature
radon isotop
measuremer
values up to
mixing of wa
water recent
radon measu

ublications
ess Publisher

dy of the
nent in
natural
n....

What data do we have?



The Hornsund Polish Polar Station

Description:

- **The meteorological station 01003 in Hornsund has been working as a part of World Meteorological Organisation since 1978.**

- **The meteorological automatic weather station was installed at the Polish Polar Station Hornsund in 2001 (new Vaisalain 2016).**

- **The meteorological data is automatically sent to Oslo, Norway, every 1 hour.**

- **In every3 hours observers working year-roundat the station send meteorological observations as SYNOP-codes to Oslo.**

Tomasz Wawrzyniak

Measured meteorological parameters:

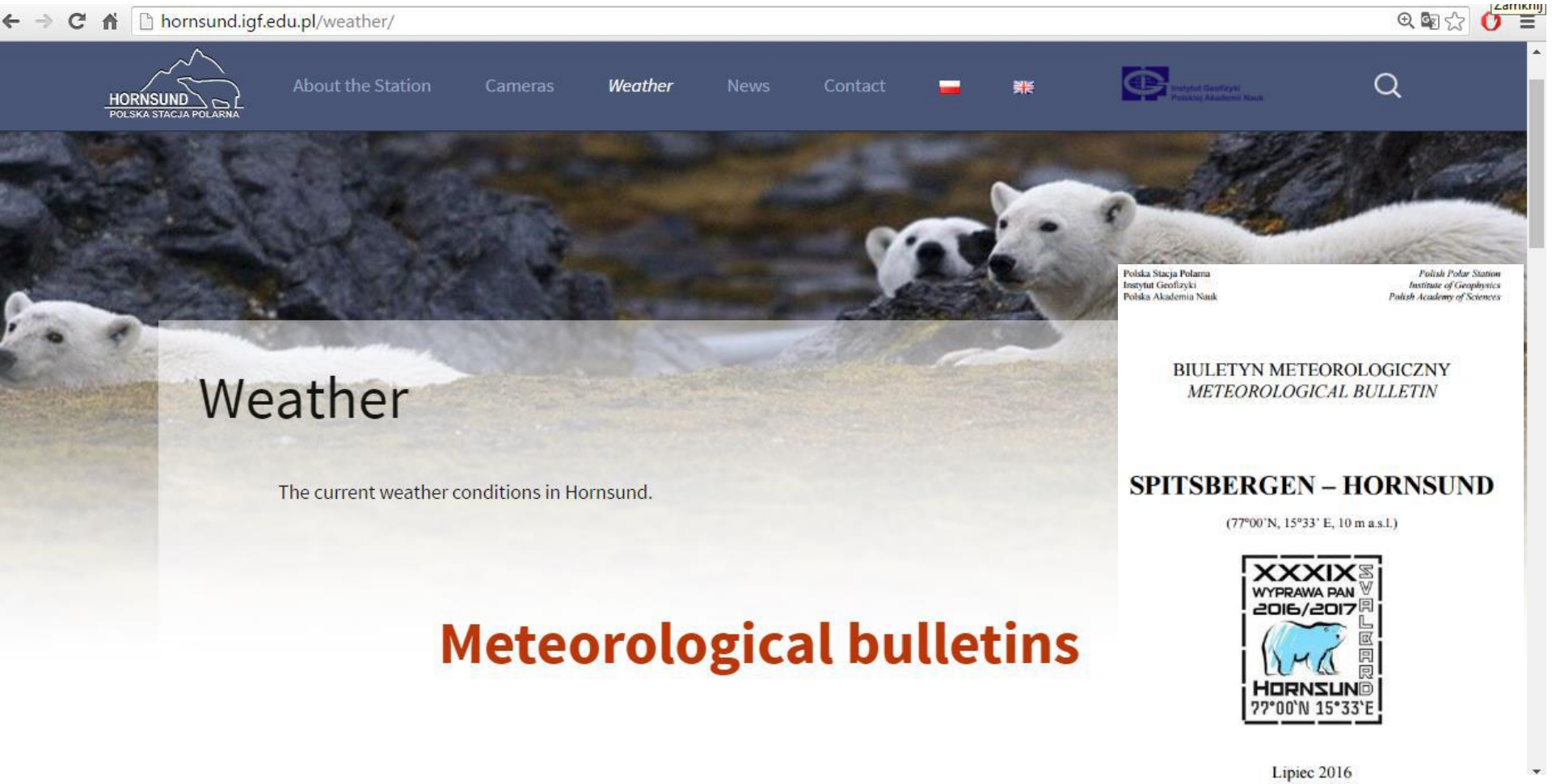
1. manual measurements and observations (3 or6 hours)–since 1978:

- Air temperature, **air humidity, wind speed and direction, air pressure, minimum temperature near the ground, ground temperature (5, 10, 20, 50 cm), precipitation (Hellman), visibility, cloud cover, total sunshine, snow cover and snow water equivalent (SWE).**

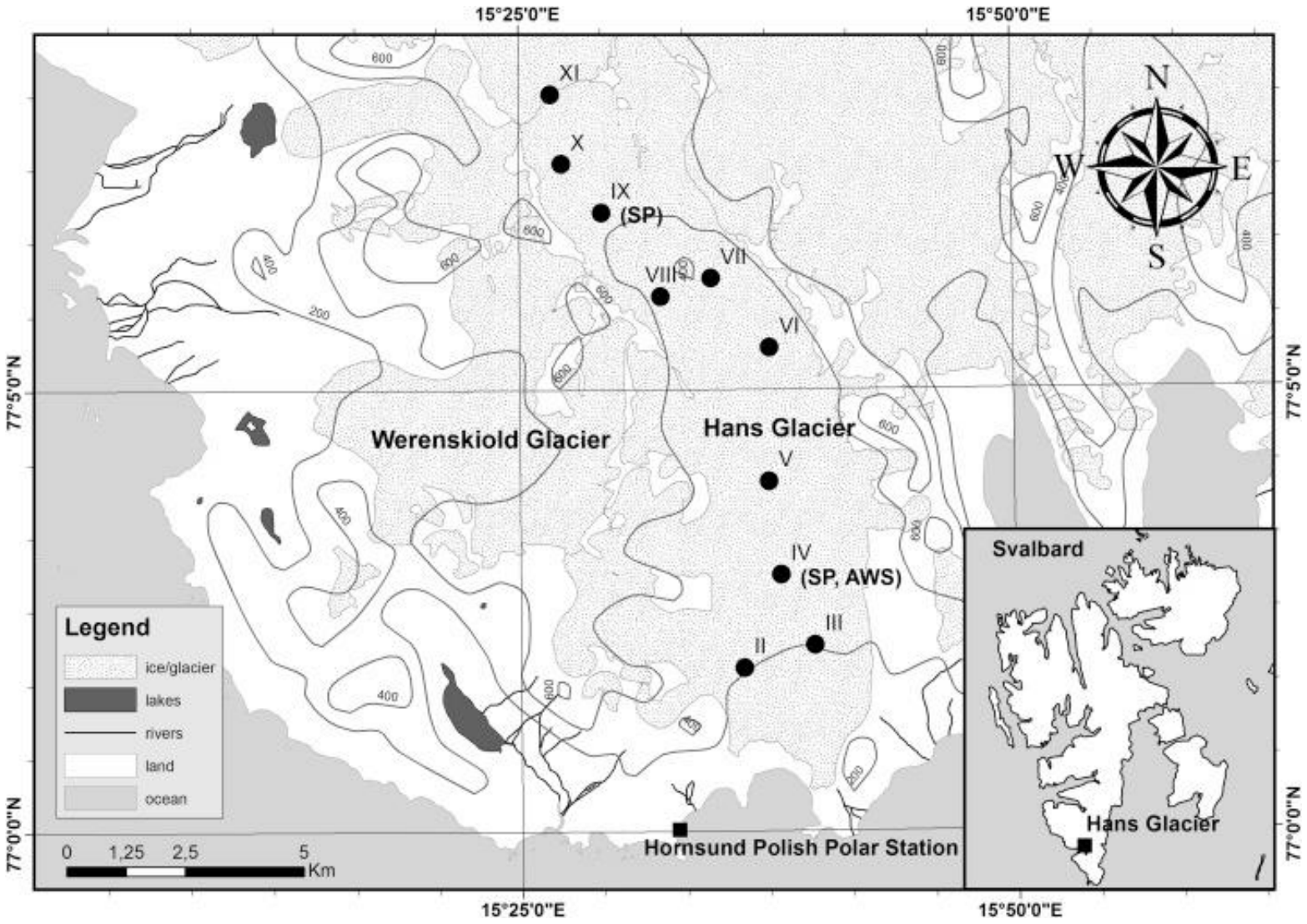
2. **automatic weather station (1 minute interval since 2006):**

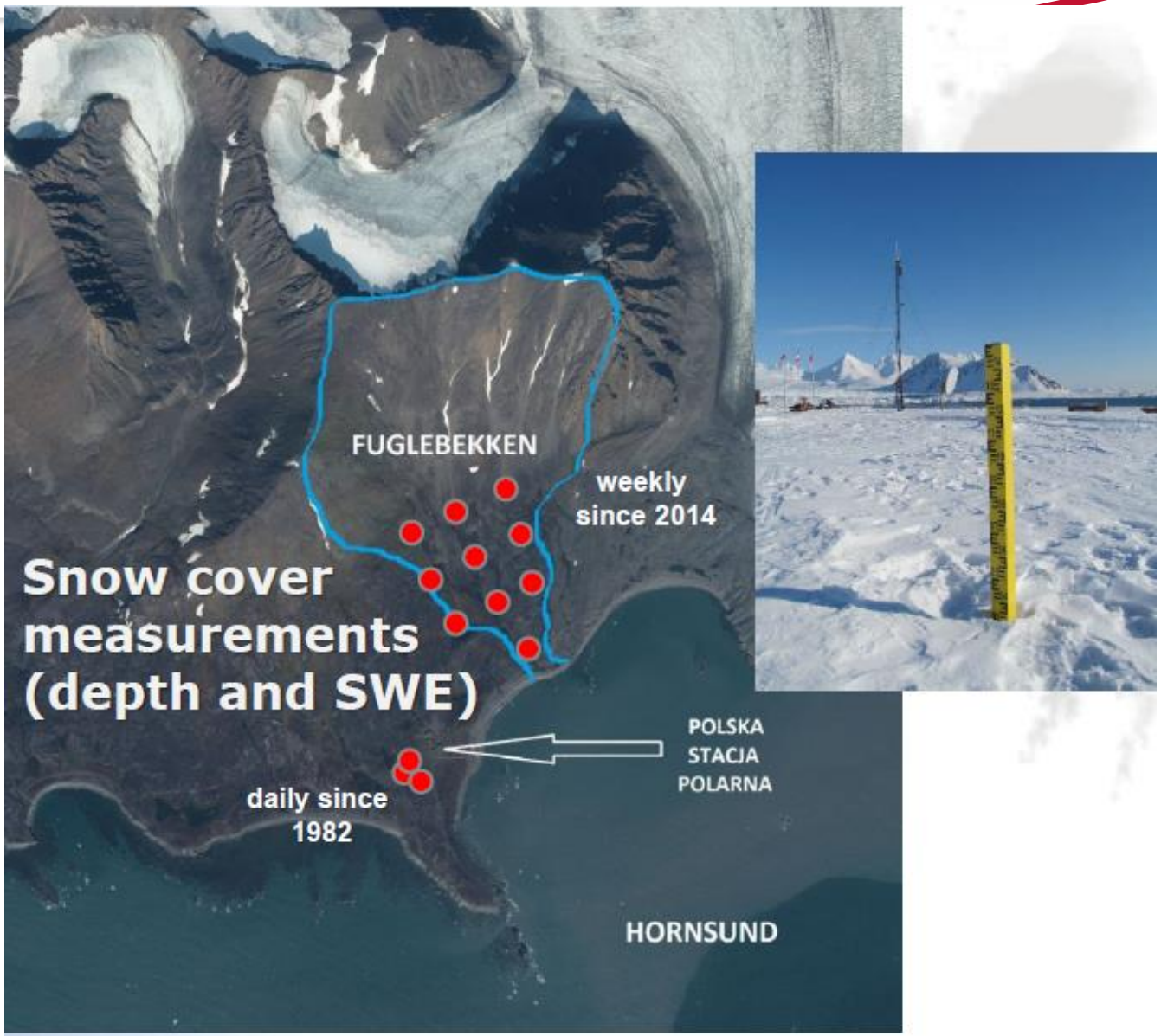
- **air temperature, air humidity, wind speed and direction, air pressure, modern laser-based optical system for continuous measurement of all kinds of precipitation (GEONOR and OTT Parsivel)**
- **Since September 2016 – New Vaisala station,e.g. Present Weather Detector PWD 52 (visibility, precipitation)**

www.hornsund.igf.edu.pl/weather



Fresh snow monitoring (since 2006)




FUGLEBEKKEN
weekly
since 2014
Snow cover
measurements
(depth and SWE)
POLSKA
STACJA
POLARNA
daily since
1982
HORNSUND

INTERNATIONAL JOURNAL OF CLIMATOLOGY
Int. J. Climatol. **0**: 000–000 (2016)
Published online in Wiley Online Library
(wileyonlinelibrary.com) DOI: 10.1002/joc.4901

RMetS
Royal Meteorological Society

Inter- and intra-annual changes in air temperature and precipitation in western Spitsbergen

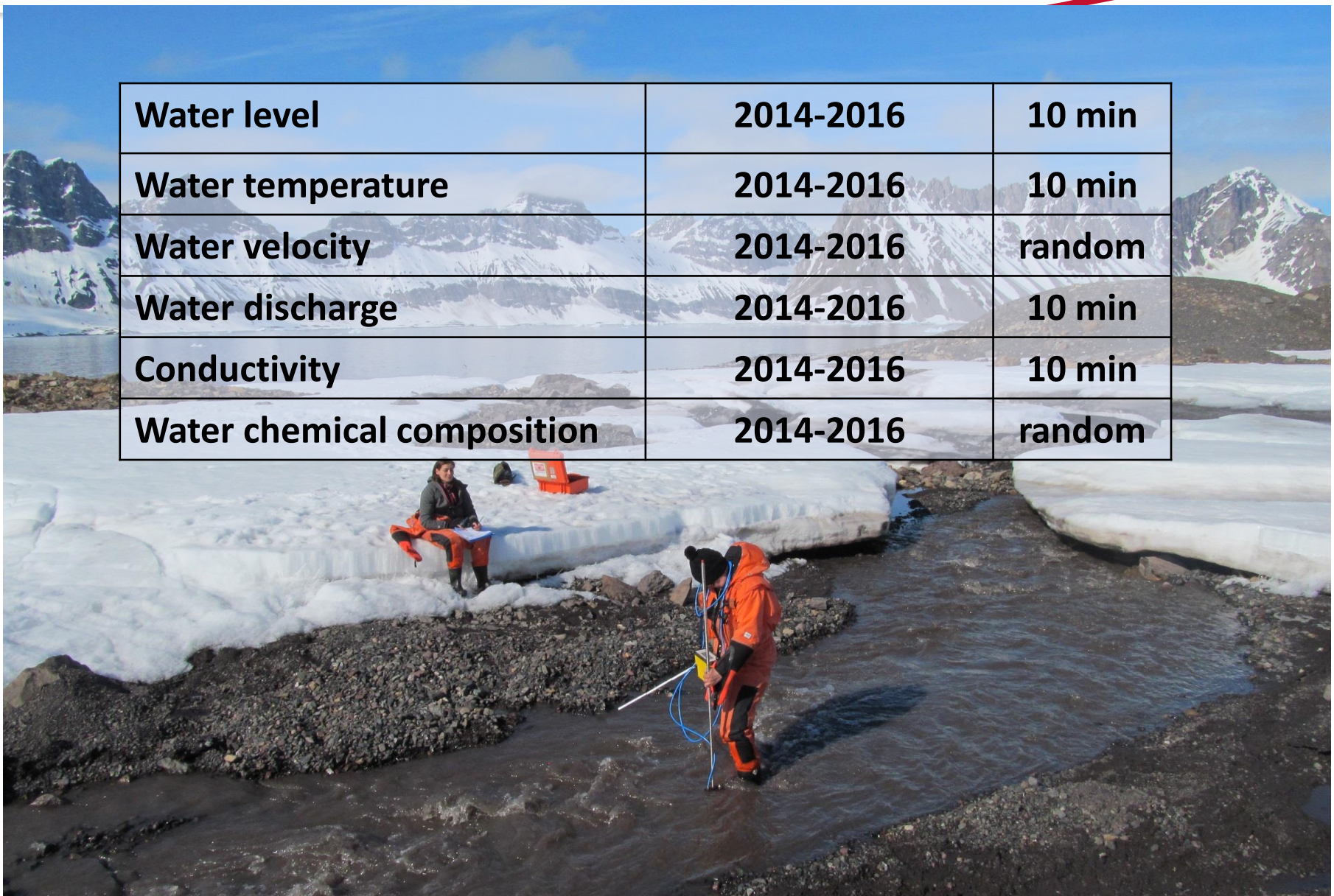
Osuch Marzena •* and Wawrzyniak Tomasz
Institute of Geophysics, Polish Academy of Sciences, Warsaw, Poland

Aims:

- analysis of variability of snowcoverin the 1983–2014 period at Hornsund,
- identification of changes with statistical change detection test,
- analysis of potential sources of changes in snow cover.

Freshwater data:

Water level	2014-2016	10 min
Water temperature	2014-2016	10 min
Water velocity	2014-2016	random
Water discharge	2014-2016	10 min
Conductivity	2014-2016	10 min
Water chemical composition	2014-2016	random



"*Arctic climate system study of ocean, sea ice and glaciers interactions in Svalbard area*" - AWAKE2 (Pol-Nor/198675/17/2013) supported by the National Centre for Research and Development within the Polish-Norwegian Research Cooperation Programme.

The National Centre for Research and Development

KNOW | Krajowy Naukowy Ośrodek Wiodący