

Book of Abstracts



35th Polar Symposium
Diversity and state of polar ecosystems
4th –7th June 2014, Wrocław



Book of Abstracts
35th Polar Symposium
Diversity and state of polar ecosystems
4th –7th June 2014, Wrocław

Editors

Krzysztof Migąła, Mateusz C. Strzelecki, Piotr Owczarek, Tymoteusz Sawiński, Magdalena Korzystka-Muskała, Piotr Muskała, Marek Kasprzak

Cover image:

Ice cliff of the Hansbreen, the Hornsund fjord (photo M. Kasprzak, 2011)



©Copyright 2014 by Institute of Geography and Regional Development, University of Wrocław

ISBN 978–83–62673–39–1 electronic publication

Institute of Geography and Regional Development,
University of Wrocław.
Plac Uniwersytecki 1, 50–137 Wrocław, Poland



Uniwersytet
Wrocławski

Book of Abstracts

35th Polar Symposium

Diversity and state of polar ecosystems

4th – 7th June 2014, Wrocław

Editors

Krzysztof Migala, Mateusz C. Strzelecki, Piotr Owczarek,
Tymoteusz Sawiński, Magdalena Korzystka-Muskala,
Piotr Muskala, Marek Kasprzak

Wrocław, 2014

Contents

P. ANDROSIUK, K. SZANDAR, I. GIEŁWANOWSKA: Adaptive genetic variation of the <i>Colobanthus quitensis</i>	9
I.V. BERCHENKO, E.I. DRUZHKOVA, A.A. OLEYNIK, M.P. VENGER, T.G. ISHKULOVA: Planktonic community of Frans-Josef Land	10
M. BŁASZCZYK, J. A. JANIA, T. SMAGACZ, M. GRABIEC, M. MOSKALIK: Location of subglacial water outflows from tidewater glaciers on Spitsbergen by means of satellite remote sensing	11
M. BŁAŻEWICZ-PASZKOWYCZ, R. M.JENNINGS, K. JESKULKE, S. BRIX-ELSIG: When a male meets a female: mystery of 'swimming' males of Paratanaoidea (Crustacea: Tanaidacea)	12
M. BŁAŻEWICZ-PASZKOWYCZ, P. JÓŹWIAK, K. PABIS, A. STĘPIEŃ, A. DYLIK, E. KOBYLECKA: Tanaidacean diversity of the shelf break, slope and abyssal depths in the Ross Sea (Antarctic)	13
A. BUCHWAŁ: Arctic Dendrochronology: Examples of challenges and opportunities of tree-ring growth studies in the Arctic	14
A. BUCHWAŁ, M. STAWSKA, P. FONTI: Radial growth of Arctic woody plants in Petuniabukta (central Spitsbergen)	15
M. CHERNAYA: From Pomor'e to Siberia: Models of Eco-Cultural Adaptation in the Context of Colonization of Spaces	16
M. CHMIELEWSKA, E. MAJCHROWSKA: The Overview of Human Settlements on Spitsbergen in Time and Space	17
K. J. CHWEDORZEWSKA, M. KORCZAK-ABSHIRE, M. OLECH: Conservation issue in "Arctowski" oasis – alien plant introduction risk	18
K.J. CHWEDORZEWSKA, I. GIEŁWANOWSKA, M. WÓDKIEWICZ, H. GALERA, M. OLECH., M.A. MOLINA-MONTENEGRO: <i>P. annua</i> in the maritime Antarctic-case study	19
W. CIĘŻKOWSKI, T. GŁOWACKI, K. GRUDZIŃSKA, D. KASZA, P. ZAGOŹDŻON: Analysis of changes in position of the Werenskiöld Glacier forehead in years 2012-2013	20
W. CIĘŻKOWSKI, T. GŁOWACKI, K. GRUDZIŃSKA, D. KASZA, P. ZAGOŹDŻON: Application of thermovision technic in non-invasive environmental research of south Spitsbergen	21
W. CIĘŻKOWSKI, T. GŁOWACKI, K. GRUDZIŃSKA, D. KASZA, P. ZAGOŹDŻON: Geotouristic and cognitive importance of mining relics in Longyearbyen	22
A. CWANEK, M. A. OLECH, J. W. MIETELSKI: Determining of activity level of radioisotopes in lichens from lands along the Northwest Passage (Arctic)	23
B. CZERNECKI, M. KRYZA, L. KOLENDOWICZ, K. MIGAŁA: Application of the WRF model for Svalbard area: sensitivity to domain and physics configuration	24
J. CWIĄKAŁA, M. MOSKALIK, P. ZAGÓRSKI: The glacial history of the Svalbard archipelago from late Vistulian to the present time in late Holocene	25
W. DOBIŃSKI: Cryology and the rule of uniformitarianism	26
W. DOBIŃSKI: IPA – IGS consultations in order to determine potential possibilities of cooperation. Polish proposition	27
W. DOBIŃSKI, M. GLAZER: Discrepancy in permafrost extent on Earth	28
K. DOBROWOLSKA: Comparison of types of weather in Verkhojansk and New Siberian Islands	29
M. DREWNIAK, W. SZCZUCIŃSKI, M. C. STRZELECKI: Record of extreme waves generated by iceberg roll events and landslide in Arctic beach sedimentology – examples from Western Greenland	30
A. DRZENIECKA-OSIADACZ, P. MUSKAŁA, K. MIGAŁA, M. KORZYSTKA-MUSKAŁA, T. SAWIŃSKI: A case study on meteorological conditions in PPS Hornsund and surrounding area during Solar eclipse, 1 st August 2008	31
M. HASSAN EL-MEHLAWY, J. ROKICKI: Morphological and ecological analysis of the parasitic copepoda <i>Eubrachiella antarctica</i> (Quidor, 1906) [Copepoda: Lernaepodidae] from Antarctic fish	32
W. ERDMANN, J. SMYKLA, M. ROSZKOWSKA, K. ZWIERUCHA, Ł. KACZMAREK: Intra- and interpopulation variability in Antarctic tardigrade <i>Acutunctus antarcticus</i> (Richters 1904)	33
Ł. FRANCAZAK, W. KOCIUBA, G. GAJEK: Effect of climate drivers on extreme Arctic river flows during floods (melt season 2013)	34
G. GRZEGORZ, K. WALDEMAR, F. ŁUKASZ: Changes in Scottbreen geometry in the light of archival cartographic materials and the latest TLS measurements	35
O. GŁOWACKI, G.B. DEANE, M. MOSKALIK, P. BLONDEL, J. TĘGOWSKI: Acoustic signatures of different calving modes: results from spectral analysis	36
D. GÓRNIĄK, H. MARSZAŁEK, J. DUNAŁSKA, B. JAWORSKA, J. TUNOWSKI: Biological diversity of microbiocenoses in aquatic ecosystems formed as a result of deglaciation	37

M. GRABIEC, J. A. JANIA, D. IGNATIUK, T. BUDZIK, P. GŁOWACKI, D. PUCZKO: Hydrothermal evolution of Svalbard glaciers	38
J. GRZELA: The Role of Greenland in the Arctic	39
J. GRZESIAK, M. K. ZDANOWSKI, D. GÓRNIAK, A. ŚWIĄTECKI, M. ŻMUDA-BARANOWSKA, P. BORSUK: Arctic and Antarctic psychrophilic isolate collection	40
J. GRZESIAK, M. K. ZDANOWSKI, D. GÓRNIAK, A. ŚWIĄTECKI, T. ALEKSANDRZAK-PIEKARCYK, K. SZATRAJ: Microbial community changes along Hans and Werenskiöld glaciers' ablation zone	41
L. GRZONKA, M. MAŃKO, A. PANASIUK-CHODNICKA: Population structure, and morphometric differentiation of some Siphonophora (Cnidaria) in the Antarctic waters (Admiralty Bay; South Shetland Islands)	42
D. HAMRYSZCZAK, W. DRZEWICKI, M. MALKIEWICZ: Paleoclimatic conditions reconstruction basing on isotopic analyses of $\delta^{13}\text{C}$ and palynological analyses of the bog from the southwestern part of Spitsbergen (preliminary results)	43
A. IGLIKOWSKA, P. KUKLIŃSKI, J. PRZYTARSKA, J. PIWOWARCZYK, M. WŁODARSKA KOWALCZUK, P. RENAUD, M. CARROLL, R. BELLERBY, J. STOLARSKI: POLNOR – The Changing Ocean of the Polar North	44
D. IGNATIUK, J. A. JANIA, M. CIEPŁY, M. BŁASZCZYK, D. PUCZKO: Short term fluctuations of the Hansbreen ice-cliff position	45
A. JAKIEL, T. BORSZCZ: Unravelling variability of Antarctic echinoid dominant <i>Sterechinus neumayeri</i> from Admiralty Bay (Admiralty Bay, King George Island, Antarctica)	46
J. A. JANIA, M. CIEPŁY, D. IGNATIUK, M. BŁASZCZYK, E. WELTY: Calving modes of tidewater glaciers (with special reference to Spitsbergen ones)	47
M. JANOUC, L. SIEGER, M. STANEK, H. OCHOA: The Detection of the State of the Earth's Ozone Layer and UV-radiation in Antarctica	48
M. JASKÓLSKI, Ł. PAWŁOWSKI, M. C. STRZELECKI: Assessment of impact of coastal hazards on scientific and community infrastructure in polar regions using remote sensing, geoinformation and new geomorphological mapping methods - project aims and potential impacts	49
B. JERZAK: Feeding activity of Antarctic herbivorous copepods in response to change in phytoplankton community composition (Admiralty Bay, South Shetland Islands) – a preliminary results	50
B. JERZAK: Taxonomic and population diversity of Chaetognaths of the Admiralty Bay (South Shetland Islands, Antarctica)	51
M. JÓZEFczyk: The Tradition of Polar Ecosystems Research in Wrocław	52
C. KABAŁA, B. KORABIEWSKI: Cryoturbated soils development on uplifted marine terraces in SW Spitsbergen	53
P. KACPRZAK, J. WAWRZYNEK, A. PANASIUK-CHODNICKA, M. IWONA ŻMIJEWSKA: Horizontal variability and population structure of Pteropoda in the Subarctic waters (Barents Sea)	54
M. KALARUS, M. I. ŻMIJEWSKA: Taxonomic differentiation of larvacea on African – Antarctic transect during Antarctic summer 2010	55
M. KASPRZAK: DEMs based analysis of moraines degradation, the Werenskiöldbreen case study (SW Spitsbergen)	56
G. KARASIŃSKI, T. WAWRZYŃIAK, B. LUKS, M. BLOCH, D. PUCZKO: Validation, homogenization and evaluation of meteorological data from Polish Polar Station at Hornsund	57
W. KELLMANN-SOPYŁA, J. SZEWCZYK, M. NOWICKI, I. GIEŁWANOWSKA: Germination ability of diaspores of polar Caryophyllaceae and Poaceae species under different temperature conditions	58
N. KOCHMAN, T. NOGA, J. STANEK-TARKOWSKA, A. PAJĄCZEK, Ł. PESZEK, M. OLECH: Soil diatom communities development on the Sphinx Glacier foreland (King George Island, Antarctica)	59
W. KOCIUBA: Bedload transport in a High Arctic gravel-bed river (Scott River, Svalbard SW)	60
W. KOCIUBA, G. GAJEK, Ł. FRAN CZAK, S. LEHMANN, Ż. POLKOWSKA: The distribution and changeability of sediment yield and its delivery at the small glacial catchment (Scott River, Svalbard SW)	61
P. KÖHLER: Polish expedition to Torell Land, Spitsbergen, in 1934 in the light of archival materials	62
M. KOLICKA, K. ZAWIERUCHA: Gastrotricha from the Spitsbergen – one new genus and four new species of freshwater Chaetonotida (Gastrotricha)	63
K. KOLON, B. WOJTUŃ, A. SAMECKA-CYMERMAN: Multivariate exploratory technique (PCCA) as a tool in the classification of the metals composition in various types of tundra vegetation, SW Spitsbergen, Norway	64
M. KOMOROWICZ, A. FOJUTOWSKI, H. WRÓBLEWSKA, A. KROPACZ, A. NOSKOWIAK, G. GAJEK, Ł. FRAN CZAK, L. ŁĘCZYŃSKI: Properties of driftwood from Bellsund coast (Svalbard) – Preliminary results	65

M. KORZYSTKA-MUSKAŁA, T. SAWIŃSKI, J. ZELINKA, P. MUSKAŁA, J. PIASECKI: "Arctic" conditions in non-arctic regions – an example from entrance area of Dobšinská Ice Cave (Slovak Paradise, Slovakia).....	66
K. KOZAK, M. SZOPIŃSKA, Ł. STACHNIK, M. RUMAN, S. LEHMANN, S. CHMIEL, Ż. POLKOWSKA: Chemoetric studies on the metals concentration levels in the surface water samples collected in the Revelva River catchment.....	67
K. KOZAK, M. SZOPIŃSKA, Ł. STACHNIK, M. RUMAN, S. LEHMANN, S. CHMIEL, Ż. POLKOWSKA: Recognition of the atmospheric precipitation role in the proces of POPs migration on the example of PAHs and PCBs in relation to the arctic catchment (Hornsund, Svalbard).....	68
K. KUBIAK: Russian Icebreakers. Present day and future	69
G. KUSZA, L. ŁĘCZYŃSKI, P. ZAGÓRSKI, Ł. FRAN CZAK, G. GAJEK, T. OPARA: Magnetic susceptibility of soils and sediments in the fjord region of Bellsund (Spitsbergen)	70
S. LEHMANN, Ł. FRAN CZAK, G. GAJEK, L. ŁĘCZYŃSKI, K. KOZAK, Ż. POLKOWSKA: Arctic lakes as a sink of anthropogenic pollutants (Bellsund, SW Spitsbergen).....	71
S. LEHMANN, W. KOCIUBA, G. GAJEK, Ł. FRAN CZAK, K. KOZAK, J. NAMIEŚNIK, Ż. POLKOWSKA: Organic compounds of anthropogenic origin present in a small glaciated catchment of Scott Glacier	72
S. LEHMANN, G. GAJEK, Ł. FRAN CZAK, W. KOCIUBA, L. ŁĘCZYŃSKI, S. CHMIEL, K. KOZAK, Ż. POLKOWSKA: Spatial distribution of metals present on the surface of Scott and Blomli glaciers (Bellsund, SW Spitsbergen).....	73
M. ŁUSZCZUK: Development of hydrocarbons resource in the Arctic. Much ado about nothing?	74
J. MACZUKIN, W. KELLMANN-SOPYŁA, M. DOMACIUK, E. SZCZUKA, J. PERKOWSKA, J. SZEWCZYK, I. GIEŁWANOWSKA: Modification ways of development of the female generative structures Antarctic grasses, native <i>Deschampsia antarctica</i> Desv. and alien <i>Poa annua</i> L.	75
M. MADEJ: Arctic Council and the ecosystem-based management approach.....	76
E. MAJCHROWSKA: Freshwater of Werenskioldbreen drainage basin compared to other studied glaciers on Svalbard.....	77
J. MAŁECKI: Why is Svenbreen more resistant to climate warming than other small glaciers in Svalbard?	78
M. MAŃKO, A. SŁOMSKA, A. PANASIUK-CHODNICKA: Influence of climate fluctuations on gelatinous zooplankton population structure, distribution, and diversity in polar regions	79
H. MARSZAŁEK, M. RYSIUKIEWICZ, L. POPRAWSKI, D. GÓRNI AK: Warm springs of Disko Island (Western Greenland)	80
K. MICHALSKI, K. NEJBERT, J. DOMAŃSKA-SIUDA, G. MANBY: Integration of palaeomagnetic, structural and geochemical studies to understand Svalbard Caledonian Terranes assemblage (PALMAG project 2012-2015) – preliminary results	81
M. MOSKALIK, O. GŁOWACKI, A. PROMIŃSKA, J. ĆWIAKAŁA: The effect of Hansbreen tidewater glaciers on the hydrology of Isbjørnhamna (Hornsund, Svalbard).....	82
A. MOZER, K. P. KRAJEWSKI, Z. PÉCSKAY: Eocene age of the Baranowski Glacier Group on King George Island, South Shetland Islands: New data from the Red Hill section.....	83
A. MOZER, K. P. KRAJEWSKI, Z. PÉCSKAY: Geology and preliminary dating of Red Hill exposure of King George Island (SSI), West Antarctica	84
A. MOZER: Paleoecology of preglacial sequencess of King George Island, West Antarctica	85
B. MYSŁEK-LAURIKAINEN, H. TRZASKOWSKA, M. KUBICKI, A. ODZIEMCZYK: The role of natural like ⁷ Be and anthropogenic radionuclides in Global Electrical Circuit(GEC) of the Earth based on the selected measurements in polar regions and medium geographic zone	86
K. NAJDA, A. KIJEWSKA, J. DZIDO, K. PLAUSKA, J. ROKICKI: Differences between <i>Ascaridoidea</i> in Arctic Atlantic and Pacific	87
T. NIEDŹWIEDŹ, E. ŁUPIKASZA, Ł. MAŁARZEWSKI: The dynamic of atmospheric circulation over the Greenland Sea and its impact on air temperature	88
M. NOWAK, I. SOBOTA: An application of the artificial neural networks in proglacial runoff simulation; a case study of Waldemar River (Svalbard).....	89
M. NOWICKI, J. MACZUKIN, J. PERKOWSKA, I. GIEŁWANOWSKA: Germination performance and cultivation of polar flowering plants belonging to family Caryophyllaceae.....	90
M. OPAŁA, K. MIGAŁA, P. OW CZAREK: Tree rings of <i>Betula pubescens</i> from Troms Region (Norway) as proxies for past temperature changes in the Low Arctic	91
P. OW CZAREK, M. OPAŁA, K. MIGAŁA: Climatic factors influencing the tree-ring growth of <i>Salix polaris</i> in Hornsund area (SW Spitsbergen, Svalbard)	92

M. OŹMIŃSKI, K. ZAWIERUCHA, M. OSTROWSKA: First observation of quill mites (<i>Acari: Syringophilidae</i>) from Arctic birds <i>Rissa tridactyla</i> (L.) and <i>Branta leucopsis</i> (Bechstein, 1803).....	93
J. PAWŁOWSKA, F. LEJZEROWICZ, P. ESLING, W. SZCZUCIŃSKI, M. ZAJĄCZKOWSKI, J. PAWŁOWSKI: Ancient DNA provides new insight into the Svalbard fossil foraminiferal record	94
J. PAWŁOWSKA, M. ZAJĄCZKOWSKI: In a changing climate: paleoceanographic record of environmental changes after the Little Ice Age in the Hornsund fjord.....	95
M. PĘTLICKI, C. KINNARD, S. ZAMBRA, J. ABERMANN: Area-volume scaling of calving based on terrestrial laser scanning and video data	96
R. PRZYBYŁAK, A. ARAŻNY, P. ULANDOWSKA-MONARCHA: Spatial diversity of relative air humidity in the Kaffiøyra region (NW Spitsbergen) from August 2010 to August 2013	97
G. RACHLEWICZ, A. STACH, K. RYMER, I. SOBOTA, P. WECKWERTH, M. NOWAK: Short-term changes in temperature and thickness of active layer of permafrost in Petuniabukta Region, central Spitsbergen, Svalbard	98
G. RACHLEWICZ, W. RYGIELSKI, M. SPRUTTA, A. DOMINICZAK, K. PLESKOT: Sulphate karst and ground water circulation in Billefjorden region (Central Spitsbergen, Svalbard)	99
D. RICHTER, M. PIETRYKA, J. MATUŁA: The relationships between cyanobacteria and green algae communities and different type of tundras from the West Spitsbergen (Archipelago Svalbard)	100
M. ROSZKOWSKA, M. OSTROWSKA, J. SMYKLA, K. ZWIERUCHA, Ł. KACZMAREK: Preliminary studies on water bears (Tardigrada) from Continental Antarctica (Ross Sea region)	101
K. RYMER: Characteristics of aeolian and niveo-aeolian deposits in central Spitsbergen (Ebba valley)	102
T. SAWIŃSKI: Arctic pilot Jan Nagórski – the hundredth anniversary of the flight in 1914	103
J. SICIŃSKI, P. JÓŹWIAK, K. PABIS, A. JAŹDŻEWSKA: Polychaete and amphipod diversity along depth and sediment gradients in an Antarctic fjord (Admiralty Bay, South Shetlands)	104
E. SIERDZIŃSKI: Possibilities of non-biting midges (Chironomidae) detecting in Antarctica	105
E. SIEREDZIŃSKI: Wingless flies from sub-Antarctic archipelagos – phylogeographical view?	106
I. SOBOTA, P. WECKWERTH, M. NOWAK, G. RACHLEWICZ, A. STACH, K. RYMER: Short-term changes in temperature and thickness of the active layer in the Kaffiøyra Region, NW Spitsbergen, Svalbard.....	107
P. SOBOLEWSKI, J. KRZYŚCIN: The long-term variability of biologically weighted UV radiation from the ground-based measurements at Polish Polar Station, Hornsund, (77°00' N, 15°33' E) for the period 1996–2013.....	108
L. STACHNIK, D. IGNATIUK, M. KONDRACKA, J.C YDE: Evolution of icings and their relationship to the subglacial drainage system based on water chemistry and GPR surveys (Werenskioldbreen, SW Svalbard)	109
L. STACHNIK, A.P. NAWROT, D. IGNATIUK : Hydrological and chemical coupling in proglacial and subglacial conditions of glaciated basin (Werenskioldbreen, SW Svalbard)	110
J. STANEK-TARKOWSKA, N. KOCHMAN, T. NOGA, A. PAJĄCZEK, Ł. PESZEK, M. OLECH: Preliminary description of soil diatoms communities growing near penguin colonies on Windy Glacier forefield (South Shetlands Islands, Antarctica)	111
V. STARKOV: Russian naval moves in the sea of the Arctic Ocean	112
K. STEPANOWSKA: Effects of starving the antarctic fish <i>Notothernia rossii</i> (richardson, 1844) on selected biochemical components of blood and boby chemical composition	113
A. STĘPIEŃ, P. KUKLIŃSKI, M. WŁODARSKA-KOWALCZUK: Bryozoan size structure across a gradient of thermal regimes in the Northern Hemisphere (DWARF) – an overview of the project	114
M.C. STRZELECKI, W. SZCZUCIŃSKI, A.J. LONG, N. ROSSER, T. LAWRENCE, A. BUCHWAL, M. DREWNIĄK, S. DUNNING, E. NORMAN, P. ĆWIK: Catastrophic events shaping polar coasts - impact of recent tsunamis in Greenland	115
M. SZUMNY, D. IGNATIUK: Spatial distribution and changes of snow cover in the Hornsund area in winter 2012/2013	116
Z.M. ŚWIRAD, P.MIGOŃ, M.C. STRZELCKI: Coastal embayments between Werenskioldbreen and Hansbreen (Hornsund, Svalbard): morphology, development and controls	117
Z.M. ŚWIRAD, A. SÉJOURNÉ: Ice-related landforms on Mars.....	118
M. TOMALA: The Role of Greenland in the Arctic	119
A. M. TOMCZYK: Frost waves in north-western Spitsbergen.....	120
W. WALCZOWSKI, A. PROMIŃSKA: Project AWAKE-2 – origin, aims and realisation.....	121

A. WASIŁOWSKA, M. RZEPECKI, A. TATUR: Changes of biotic and abiotic features in Antarctic fjord (Admiralty Bay KGI)	122
P. WECKWERTH, I. SOBOTA, K. GREŃ: Basal decoupling and soft-sediments deformations: contributors to Aavatsmarkbreen movement (Kaffiøyra, Svalbard)	123
S. WESTERMANN, B. LUKS, T. WAWRZYŃIAK, A. NAWROT: Snow Monitoring using Automatic Camera Systems at Svalbard key sites (SMACS) - preliminary results.....	124
M. WĘGRZYN, P. WIETRZYK: Snowbed tundra communities of Spitsbergen in the classical phytosociological approach	125
J.M. WĘSŁAWSKI, C. LYDERSEN, H. STEEN, M. WŁODARSKA-KOWALCZUK, J. BERGE, L. STEMPNIEWICZ: Tidal glaciers a refugium for Arctic marine ecosystem?	126
A. Z. WOJTAL, A. POCIECHA, J. PIĄTEK, A. JÓZEFOWSKA, T. JANECKI, I. SATOSHI: Together and/or apart: microorganisms (algae and invertebrates) in soil and its plant cover of King George Island (Southern Shetlands, Antarctica)	127
B. WOJTUŃ, G. SKRZYPEK, D. RICHTER, A. SAMECKA-CYMERMAN: Nitrogen availability constraints for tundra vegetation diversification in the Arctic	128
P. ZAGÓRSKI, M. C. STRZELECKI, J. RODZIK: Mechanisms controlling the development of polar coasts in post-glacial periods (post-LGM and post-LIA) – southern Bellsund, Svalbard – similarities and differences.....	129
P. ZAGÓRSKI, J. JANIA, M. BŁASZCZYK, P. GŁOWACKI, M. MOSKALIŁ, J. TĘGOWSKI: Surge behavior of the Recherche Glacier (W Spitsbergen) and its submarine record	130
K. ZAWIERUCHA: Current state of knowledge of the glacier invertebrates.....	131
K. ZAWIERUCHA, M. OSTROWSKA, M. KOLICKA, Ł. MICHALCZYK, Ł. KACZMAREK: Tardigrada of the Svalbard archipelago – testing the theory of island biogeography – preliminary results	132
M. K. ZDANOWSKI, J. GRZESIAK, R. GROMADKA, J. GAWOR, A. ŚWIĄTECKI, D. GÓRNIĄK: Bacterial diversity of Ecology Glacier (King George Island, Antarctica) in the age of global warming, revealed by classical and metagenomic analyses.....	133
W. ZIAJA: Main changes of the western Sørkapp Land (south Spitsbergen) landscape and ecosystem since the 1980s	134
A. ZMARZ, M. KORCZAK-ABSHIRE, S. R. KARLSEN, M. RODZEWICZ, R. STORVOLD, Z. GORAJ, K.J. CHWEDORZEWSKA: Remote sensing techniques for monitoring the King George Island	135

Piotr Androsiuk*, Kamil Szandar, Irena Giełwanowska

* University of Warmia and Mazury in Olsztyn
piotr.androsiuk@uwm.edu.pl

Adaptive genetic variation of the *Colobanthus quitensis*

Plants of the polar regions has developed a number of mechanisms which enable them to grow and develop in extremely harsh climatic and habitat conditions. Morphological and physiological adaptation of these organisms were analyzed on the example of many species including Antarctic pearlwort (*Colobanthus quitensis*), one of the two vascular plant species found in the Antarctic region. However, we have still limited knowledge on the genetic variability of the species.

Vascular plants have various mechanisms which enable them to response to biotic stress or changes in environmental conditions. Some of them may lead to genetically determined phenotypic variation. One of the mechanisms responsible for the formation of genetic variation is associated with the presence of the transposable elements (TE).

These mobile genetic elements have a significant impact on the organization, plasticity and evolution of genomes. TE are also one of the major factors responsible for the genome adaptation to changing environmental conditions and in response to stress. Due to the specific character of the TE, a number of marker systems were developed on the basis of their sequences (IRAP, REMAP, SSAP), which allowed to track genetic variability. Unfortunately, their application is limited to the species for which transposon sequences are known.

However, a new and versatile method of genotyping organism based on the use of transposon sequences was recently developed. The method, inter-PBS amplification, is based on the virtually universal presence of a tRNA complement as a reverse transcriptase primer binding site (PBS) in LTR retrotransposons. The iPBS technique has proved to be a powerful DNA fingerprinting technology without the need for prior sequence knowledge. iPBS is therefore a useful tool for tracking genetic variation in non-model plant species such as *Colobanthus quitensis*, for which data resources on the structure of the genome are limited.

The aim of the study was to determine the genetic variation *Colobanthus quitensis* and test the iPBS markers for their suitability for the genetic studies of intraspecific variation. The material consisted of eight *Colobanthus quitensis* populations from King George Island (South Shetland Islands), the location site of H. Arctowski Station. The plant material represented Antarctic habitats diverse in terms of abundance of nutrients in the soil, exposure to sunlight, exposure to strong winds or the degree of exposure to salty sea water (direct effect of water and through the air spray of sea water). Obtained data allowed an analysis of adaptive variation shaped in response to diverse environmental conditions. Applied class of molecular markers revealed the presence of genetic polymorphism between individuals within populations and affirmed low level of genetic variation of the species.

I.V. Berchenko*, E.I. Druzhkova, A. A. Oleynik,
M.P. Venger, T.G. Ishkulova

* Russian Academy of Sciences
berchenko.igor@gmail.com

Planktonic community of Frans-Josef Land

Significant changes of the Arctic climate have a strong impact on environment, especially on the extended melting and retreat of tidewater glaciers. Increasing melting of glaciers and discharge of subglacial freshwater into the sea have a great influence on the thermohaline circulation in Arctic fjords and on the whole ecosystem. Location of subglacial water outflows at the glacier front is also important for identification of areas of intensive submarine fluvioglacial sedimentation. Such deposits influence bathymetry at the glacier front and in turn glacier dynamics. Subglacial water discharge leads to development of an embayment at the ice cliff, and in consequence, to more intensive calving in this part of glacier front.

Location of subglacial water outflows from tidewater glaciers on Southern Spitsbergen was based upon multispectral satellite images (Landsat, Aster, Alos Avnir) from summer seasons 2005-2013. Analysis of visible, infrared and thermal bands made possible detection and location of outflows from both, tidewater glaciers as well as from partly glaciated and unglaciated catchments. High load of suspended matter in the sea surface layer coming from glaciers is clearly visible on optical satellite images. Radiometric temperatures acquired from thermal bands indicate colder freshwater occurrence in the sea. Hans Glacier in Southern Spitsbergen located close to the Polish Polar Station was used as a reference glacier for field calibration of satellite data. Monitoring system of the frontal part of Hansbreen in 2013 (Canon EOS 1000D, time lapse cameras) and measurements of oceanic factors performed in front of Hansbreen (temperature and salinity) were used for calibration of satellite data. Results show usefulness of satellite data for location of subsea outflows from tidewater glaciers and determination of distribution of the superficial layer of freshwater in the sea.

M. Błaszczyk¹, J. A. Jania¹, T. Smagacz¹, M. Grabiec¹, M. Moskalik²

¹Faculty of Earth Sciences University of Silesia, Sosnowiec

malgorzata.blaszczyk@us.edu.pl

²Institute of Geophysics Polish Academy of Sciences, Warszawa

Location of subglacial water outflows from tidewater glaciers on Spitsbergen by means of satellite remote sensing

Significant changes of the Arctic climate have a strong impact on environment, especially on the extended melting and retreat of tidewater glaciers. Increasing melting of glaciers and discharge of subglacial freshwater into the sea have a great influence on the thermohaline circulation in Arctic fjords and on the whole ecosystem. Location of subglacial water outflows at the glacier front is also important for identification of areas of intensive submarine fluvioglacial sedimentation. Such deposits influence bathymetry at the glacier front and in turn glacier dynamics. Subglacier water discharge leads to development of an embayment at the ice cliff, and in consequence, to more intensive calving in this part of glacier front.

Location of subglacial water outflows from tidewater glaciers on Southern Spitsbergen was based upon multispectral satellite images (Landsat, Aster, Alos Avnir) from summer seasons 2005-2013. Analysis of visible, infrared and thermal bands made possible detection and location of outflows from both, tidewater glaciers as well as from partly glaciated and unglaciated catchments. High load of suspended matter in the sea surface layer coming from glaciers is clearly visible on optical satellite images. Radiometric temperatures acquired from thermal bands indicate colder freshwater occurrence in the sea. Hans Glacier in Southern Spitsbergen located close to the Polish Polar Station was used as a reference glacier for field calibration of satellite data. Monitoring system of the frontal part of Hansbreen in 2013 (Canon EOS 1000D, time lapse cameras) and measurements of oceanic factors performed in front of Hansbreen (temperature and salinity) were used for calibration of satellite data. Results show usefulness of satellite data for location of subsea outflows from tidewater glaciers and determination of distribution of the superficial layer of freshwater in the sea.

Magdalena Błażewicz-Paszkowycz*, Robert M. Jennings,
Karen Jeskulke, Saskia Brix-Elsig

* University of Lodz
magdab@biol.uni.lodz.pl

When a male meets a female: mystery of ‘swimming’ males of Paratanaoidea (Crustacea: Tanaidacea)

Males of Apseudomorpha and Neotanaidomorpha (Tanaidacea, Crustacea) are relatively well known and usually identified without hesitation to species level. In the case of Tanaidomorpha the problem of distinguishing the sexes is more problematic. Truly troublesome is identification of the males of paratanaid families, which are morphologically different from females and have not been discovered for most genera so far. Not finding males has led to the assumption that tanaidaceans might have parthenogenetic reproduction or simply have totally undeveloped secondary sex traits. During the IceAGE project (Icelandic marine Animals: Genetics and Ecology), with the support of molecular methods, first evidence for the existence of highly dimorphic males (‘swimming’) in four families of the superfamily Paratanaoidea (Agathotanaidae, Cryptocopidae, Akanthophoreidae, and Typhlotanaidae) is presented. This study demonstrates that the ‘swimming’ males, which might be the next instars after ‘juvenile’ males, which are morphologically similar to females. It is assumed that ‘juvenile’ males with restricted ability for swimming (e.g. undeveloped pleopods) have matured testes and capable of reproduction, so they can mate with females nearby, while swimming males can pair off with distant females. The rationale of dimorphism in Tanaidomorpha must lie in the fact that some males (Nototanais) have retained the same lifestyle or niche as the females, so secondary traits improve their ability to guard females and successfully mate. The other males of other species that have moved into a niche different to that of the female have demanded complex anatomical changes (Typhlotanais).

M. Błażewicz-Paszkowycz*, P. Józwiak, K. Pabis,
A. Stępień, A. Dylik, E. Kobyłecka

* University of Lodz
magdab@biol.uni.lodz.pl

Tanaidacean diversity of the shelf break, slope and abyssal depths in the Ross Sea (Antarctic)

The New Zealand IPY-CAML project (NIWA) aimed to describe the diversity of benthic macrofaunal communities and their distribution along a depth gradient off the Ross Sea. Material was collected from a board of RV Tangaroa in the summer season of 2008. During the expedition seven areas located on continental shelf, slope, abyssal plain and seamounts off the Ross Sea were sampled. Samples were collected using the epibenthic sledge (EBS) at the depth range from 474 to 3380 m. Here we analyze the tanaidacean fauna collected during that sampling campaign and this study represents the first analysis of the slope and abyssal tanaidaceans in the Ross Sea. Tanaidacea is a group of small, peracarid crustaceans, with very low mobility and limited dispersal potential. They are amongst the most underestimated groups of benthic macrofauna in the Antarctic. Sixty three species were found in the studied collection. Most of them (94%) represent phylogenetically young suborder Tanaidomorpha. The taxonomical studies of these material are still in progress, however at least 51 of them represent species new for science. This result increases the number of Southern Ocean tanaidaceans by about 25%. Our analysis demonstrated also that diversity of this crustaceans is higher in deep-water (>1000 m). Twenty eight species were found at the depth not exceeding 1000 m, while 43 species were recorded below that border.

Agata Buchwał

Adam Mickiewicz University in Poznań
kamzik@amu.edu.pl

Arctic Dendrochronology: Examples of challenges and opportunities of tree-ring growth studies in the Arctic

Recent changes in the thermal regime of the Arctic and related tundra expansion in higher latitudes resulted in an intense development of dendrochronological and dendroecological research in the polar regions. In last decade we observed a significant increase in the use of tree-ring growth analysis in high latitudes where radial growth of woody plants, from shrubs to perennial herbs, is studied. Thermal limitations of cambial growth in the Arctic enable mainly dendroclimatological studies, which application requires a construction of reliable tree-ring chronologies.

The study presents an anatomical structure of radial growth of common shrubs species and arctic herbs, in particular the species from central Spitsbergen (i.e., 78°N: *Salix polaris*, *Dryas octopetala*) and Greenland (69°N: *Betula nana*, *Salix glauca*, *Juniperus nana*). The collection includes more than a century-old polar willow (Ebbadalen, central Spitsbergen), dwarf birch (Disko Island, Western Greenland) and more than a two-hundred-year-old junipers (Kobbefjord, Western Greenland). The study discussed the methodological problems and limitations of dendrochronological applications in the Arctic. The challenges of dwarf shrubs growth studies is discussed in the light of their common irregular growth, expressed in a missing and wedging rings occurrences.

The examples of shrubs dendrochronological studies emphasized the need of serial sectioning which needs to be performed within both above- and below-ground plant parts. This procedure allows for a complete cross-dating and a detection of irregular radial growth, including missing rings associated with negative pointer years.

Agata Buchwał*, Monika Stawska, Patrick Fonti

* Adam Mickiewicz University in Poznan
kamzik@amu.edu.pl

Radial growth of Arctic woody plants in Petuniabukta (central Spitsbergen)

The aim of this study is to present the anatomical structure of radial growth of selected dwarf shrubs and herbaceous plant communities in the High Arctic. The material presented was collected in central Spitsbergen (Ebbadalen), in the vicinity of Adam Mickiewicz University Polar Station (AMUPS). The presentation includes a comparison of tree-ring growth of selected dwarf shrubs, i.e. *Salix polaris*, *Salix reticulata*, *Dryas octopetala*, *Cassiope tetragona* and some commonly distributed arctic herbs, i.e. *Silene furcata*, *Silene uralensis*, *Cerastium arcticum*, *Draba alpina*, *Draba cymbosa*, *Pedicularis hirsuta*, *Erigeron humilis*, *Arenaria pseudofrigida*. Herbaceous plants represent a diverse anatomical structure with a majority of semi-ring porous species. Limited size and a fragile wood structure limits micro-sections preparation of some herbs. Ring shake features challenge the use of some commonly growing species (*Saxifraga oppositifolia*, *Saxifraga aizoides*) in dendrochronological studies. Outside of a scientific value of the study an illustrative part of this work shows a hidden beauty and complexity of Arctic wood anatomy.

Maria Chernaya

National Research Tomsk State University, Russia
mariakreml@mail.ru

From Pomor'e to Siberia: Models of Eco-Cultural Adaptation in the Context of Colonization of Spaces

Annexation of spaces by Russia from Kievan Rus to Early Modern period is the spreading out of ethno-cultural and state territory. The annexation of Siberia in late XVI - XVII centuries had become the culmination of colonization process, which converted Russia into a Eurasian country. Colossal spaces (from the White Sea region to Siberia) embraced diverse natural and climatic zones, that stipulated forming of various eco-cultural adaptation models.

Ecological features of Russian North (Eurasia's north extremity and arctic islands, including Spitsbergen) determined Pomors' economic orientation on fur and marine hunting and fishery. Nevertheless the economic specifics and some cultural originality did not mean formation of some independent culture in the north region. On the contrary, fur trade assisted to develop production, provide quick settling, accumulate capitals for subsequent colonization, and strengthen international economic and political connections of Russia. Economy of subarctic cities combined fur hunting with crafts, trade, and stock-raising.

When migration streams displaced to the south, other adaptation models, based on agriculture together with various economic fields according to ecological potential of new areas, were realized.

The process of eco-cultural adaptation is presented in archaeological materials. Hunting and fishery and agriculture influenced over ecological state and landscape by new lands ploughing under and up, bog drainage, weir building, population reduction of fur and marine beasts. Nevertheless, natural resources exploitation was not uncontrolled and disastrous. There was the state and communal regulation of hunting and plough-lands to keep the "protected" forests, meadows, rivers, to devastate those was unprofitable to the government, Russian migrants and aborigines. Different adaptation models in Russian North and Siberia were used and local cultural variants were formed, however, they had the all-Russian basis. Agricultural and hunting colonization took Russian North and Siberia into the world-wide context and opened new prospects in development for these regions.

Marta Chmielewska, Elżbieta Majchrowska

Faculty of Earth Sciences, University of Silesia, Sosnowiec, Poland
machmielewska@us.edu.pl , emajchrowska@us.edu.pl

The Overview of Human Settlements on Spitsbergen in Time and Space

Harsh climatic conditions and location in high latitudes makes the polar regions extremely difficult to live. Winter temperatures reaching deep into the negatives and the winter night lasting for months are among unfavorable factors for the development of human settlements in such areas. Despite this, in the course of history people have tried to settle there, more or less successfully. No different is on Spitsbergen which was colonized over the years several times by people of different cultures and nationalities induced to settle in the archipelago by diverse motives (they were: hunters, whalers, miners, trappers, explorers and researchers). The settlers had come and gone leaving behind remains of their activities, many of which are still noticeable in the landscape of Spitsbergen. Nowadays the archipelago is dotted with human settlements of different kind: towns, miners settlements, research stations and huts, some of which are inhabited and some abandoned.

The poster is about the diversity and the spatial arrangement of human settlements on Spitsbergen. On the basis of the history of the colonization of the archipelago, there are separated and characterized types of these settlements. The main factor of this division is the genesis of a settlement, which may be determined after answering three questions: when it was built, by whom and what for. Another factors are: types of building, layout and the conservation status of a settlement. Finally it is taken into account whether the settlement is inhabited or abandoned. The poster contains also the analysis of the spatial arrangement of settlements classified to particular types.

Katarzyna J. Chwedorzewska¹,
Małgorzata Korczak-Abshire¹, Maria Olech^{1,2}

¹Institute of Biochemistry and Biophysics Polish Academy of Sciences, , Warszawa
kchwedorzewska@go2.pl

²Institute of Botany, Jagiellonian University, Kraków

Conservation issue in "Arctowski" oasis – alien plant introduction risk

Conducted study clearly demonstrates that many diaspores can be quite easily unintentionally transported in good condition to the Antarctic via human vector. After crossing the dispersal barrier, the next question is whether these species would be able to cross the next physiological barrier and survive in harsh conditions of the polar regions.

The region of the Western Antarctic Peninsula and Scotia Arc archipelagos are predicted to have the highest risk of alien plant establishment, due to such factors like: annual cumulative degree days for plant (measure of environmental suitability), risk index (based on propagule pressure and origin, and climate suitability of the ice-free area). Results obtained for "Arctowski" oasis are in agreement with whole WAP region estimations. Thus, spatial location (at the Antarctic Peninsula region) and intensive human pressure: both tourist and expeditioner, favourable microclimate condition, large ice-free area, newly exposed big glacial forelands, put "Arctowski" oasis in the highest risk group. Thus, is a matter of time when flexible species, characterized by a wide ecological amplitude, high adaptation capabilities and diverse ways of reproduction may thrive under harsh environmental conditions and colonize recipient ecosystems. Substantiation of this assessment is provided by rapid grow and spread of population of *P. annua*.

K.J. Chwedorzewska¹, I. Giełwanowska², M. Wódkiewicz³,
H. Galera³, M. Olech⁴, M.A. Molina-Montenegro⁵

¹Institute of Biochemistry and Biophysics Polish Academy of Sciences, Warszawa
kchwedorzewska@go2.pl

²Department of Plant Physiology and Biotechnology, University of Warmia and Mazury, Olsztyn

³Department of Plant Ecology and Environmental Conservation,
Faculty of Biology, University of Warsaw

⁴Instytut of Botany, Jagiellonia University Kraków

⁵Centro de Estudios Avanzados en Zonas Áridas (CEAZA), Facultad de Ciencias del Mar,
Universidad Católica del Norte, Coquimbo, Chile

***P. annua* in the maritime Antarctic-case study**

The whole Antarctic is protected according to many international agreements. Nevertheless, these agreements did not protect parts of Antarctic from the expansion of an alien species like *Poa annua* (Poaceae), the only species of flowering plants that successfully established breeding population in this continent. Therefore, will be of significant importance for protecting the Antarctic terrestrial ecosystem monitoring the spreading and functioning of *P. annua*, and potentially of other alien species which so far have appears as ephemerophyt in Antarctic terrestrial communities. An alien species like *Poa annua* already occurring in the Antarctica may present a value for further research and for modeling changes of plant communities associated with the arrival of other alien species.

In this study We analyzed the historical and contemporary rang of *P. annua* in the Antarctic and analyzed characteristic make the species highly adaptable to stress and unstable polar habitats.

Wojciech Ciężkowski, Tadeusz Głowacki, Katarzyna Grudzińska,
Damian Kasza, Paweł Zagożdżon

Wrocław University of Technology
wojciech.ciezkowski@pwr.edu.pl

Analysis of changes in position of the Werenskiold Glacier forehead in years 2012-2013

Werenskiold Glacier in Spitsbergen is one of the research polygons in which is carried out assessment of the rate of ablation. Location of its forehead is precisely presented in the literature since early 60s of the XX century.

The study analyzes the selected historical data about this issue and shown results of research in the years 2012-13. The material showing the starting position of the glacier's forehead is a topographic map at 1:5000 scale designed in 1961 (data from 1957 to 1959) by the Polish Military Topographical Service. Furthermore, as a comparison data showing the location of a glacier in subsequent periods, there were used the results of captured photogrammetric image from 1973 and orthophotomap from 1990. Entire collected informations including results of own measurements – Total Station and GNSS - has been converted to a uniform coordinate system that allow to further analysis.

Thus prepared data allowed to estimate the speed of the retreat of the glacier Werenskiøldbreen during 1957–2013. It was found that over the 56 years it has shifted by about 1200 meters, which gives the average value of the regression at a level of about 25 meters per year. It is also shown a variation rate of the process. In the years 1957-1973 the average speed was 29 meters per year, in 1973-1990 18 meters per year and in the years 1990-2013 about 21 meters per year.

Wojciech Ciężkowski, Tadeusz Głowacki, Katarzyna Grudzińska,
Damian Kasza, Paweł Zagożdżon

Wrocław University of Technology
wojciech.ciezkowski@pwr.edu.pl

Application of thermovision technic in non-invasive environmental research of south Spitsbergen

Innovative research using thermovision increase possibilities and range of field research. These techniques allow to the non-invasive research of Arctic regions – on the strict environmental protection areas particularly. Using a thermal imaging camera makes possible the infrared measurements of selected natural and anthropogenic environment elements. Thermography allows to get pictures of infrared radiation (invisible to the human eye) so extends available measurement methods for observed objects and phenomena.

Thermovision camera gathers infrared radiation measurements that reaches camera's detector. Input signal is amplified and analysed. Results are shown as thermal image. Each pixel of this image has its own temperature value, so the temperature scale is created. Object's temperature value is counted on the basis of emissivity parameter of its surface, current environment temperature, temperature and humidity of atmosphere and distance from camera. All conditions necessary to take proper results are fulfilled if we talk about Spitsbergen region. This area has constant light conditions (or total lack of it), different emissivity of each particular objects taken under analysis, good visibility (low water-vapour concentration in atmosphere), large and homogeneous surface areas, lack of intensive vegetation.

Study shows results of observations made on August, 2008 as well as July, 2012 and 2013 on the southern part of Spitsbergen (Hornsund area). Those infrared measurements concerned: estimated thickness of deposits covering theofmoraine, mixing of waters (flow of supraglacial waters into lake placed in front of Werenskiöldbreen), thermal waters outflow (Orvin and Gnall Spring), determining of number of little auks (*Alle Alle*) colonies (south hillside of Arieekammen, Hornsund near Polish Polar Station, determining of permafrost thickness.

Such studies will be applicable for natural environment monitoring of Svalbard Archipelago and other arctic environment.

Wojciech Ciężkowski, Tadeusz Głowacki, Katarzyna Grudzińska,
Damian Kasza, Paweł Zagożdżon

Wrocław University of Technology
wojciech.ciezkowski@pwr.edu.pl

Geotouristic and cognitive importance of mining relics in Longyearbyen

Basic geographical, geological and historical information on Svalbard (with particular emphasis on geology and the history of exploitation on of coal) were presented. The study of literature and the results of field investigations carried out in the Longyear dalen valley (West Spitsbergen, Longyearbyen) were showed. The fieldworks are located inside the main mine units (shown on many maps) or beyond – even at a distance of over 500m. Almost all adits were tunnelled at the same stratigraphic level, corresponding to the seam Longyear. Only one of the peripheral adits in Gruve 2b is located above – in Svarteper seam. Particular attention was paid to two small underground works located on the N slope of Longyear dalen. They are probably the oldest preserved tunnels in the area, which have not been changed by later mining activity. Examining all tunnels were not available. Their inlets collapsed, have been covering up with the stone material as a result of extensive surface mass movements, or their initial parts are filled to the roof with compact, banded ice. At inlets of several tunnels can watch specific wooden constructions, which probably allowed use of the excavations in the winter, when snow covered the area.

There are no big dumps in the vicinity of main mine units – except of Gruve 1b, while such heaps occur by the peripheral adits. Two of banks, despite the ruling of permafrost, generate periodic flows in a form of mine effluents. A complete, well-preserved complex of mine buildings and a number of items of mining equipment can be observed only in the case of Gruve 2b. The buildings of Gruve 1 are maintained in a rudimentary state, other mine's buildings are completely destroyed.

Anna Cwanek¹, Maria A. Olech^{2,3}, Jerzy W. Mietelski¹

¹The Henryk Niewodniczański Institute of Nuclear Physics, Polish Academy of Sciences, Kraków
anna.cwanek@ifj.edu.pl

²Zdzisław Czeppe Department of Polar Research and Documentation,
Institute of Botany, Jagiellonian University, Kraków

³Institute of Biochemistry and Biophysics, Polish Academy of Sciences, Warszawa

Determining of activity level of radioisotopes in lichens from lands along the Northwest Passage (Arctic)

Arctic environments are commonly perceived as a wilderness, however they are unfortunately especially vulnerable to radioactivity and other contamination as well. The need for protection of these pristine regions against contamination is great, thus present research are made. There were few main sources of radioactive in the Arctic area; atmospheric nuclear weapon tests, releases from nuclear reprocessing plants in Western Europe and Chernobyl fall-out. There are also exist several other sources which have given small or only localized contamination, inter alia nuclear bomber crash near Thule (1968) in Greenland or Kosmos 954 crash in northern Canada (1978). Releases radioactive contamination during these all occurrences spread over large areas also reaching the Arctic region. The radioactive contamination of the Northwest Passage in the Arctic is not well recognized because of for many years lands (islands and peninsulas) along it were not accessible from the sea for sampling due to the ice covering it even in summer or due to serious danger of collision with massive icepack. In summer 2012 it become available for travel even using small yacht „Marguerite” with the French-Polish crew (capt. Janusz Kurbiel, Joëlle Kurbiel, Maria Olech, Tomasz Kosiński). Lichens are considered as biomonitoring organisms, which particularly accumulate radioisotopes, as a result they are used to determine activity level of radioisotopes. Samples of lichens were collected in several locations on islands and peninsulas along the route. After identification of species samples are dried, homogenized and analyzed by means of low background gamma spectrometry in aim of determination of gamma emitters, mostly anthropogenic ¹³⁷Cs, activity. The next stage of research will be also measure and determine activity level of another radionuclides, which are alpha (Pu, Th, U, Am) or beta (Sr) emitters.

Bartosz Czernecki¹, Maciej Kryza²,
Leszek Kolendowicz¹, Krzysztof Migala²

¹Adam Mickiewicz University, Poznań
nwp@amu.edu.pl

²University of Wrocław

Application of the WRF model for Svalbard area: sensitivity to domain and physics configuration

In this work the Weather Research and Forecasting (WRF) model is applied for the area of Svalbard, for recognition of selected atmospheric phenomena (sea level pressure, wind speed and temperature). The main aim of this study is to diagnose a components of the model which impact on simulations' quality taking into account:

- (1) domains' configurations (sensitivity to spatial range of boundary and initial conditions);
- (2) domains' resolution (especially for main and nested domains);
- (3) selected Planetary Boundary Layer (PBL) schemes.

June 2008 is selected for tests of the WRF model with the GFS FNL data used as initial and boundary conditions. The results of simulations are compared with in-situ meteorological data gathered at synoptic stations running in the nested model domains.

Three independent simulations, with increasing size of the main domain (latitudinal, each wider of around 5°) let to choose the best suited domains' configuration and optimize computational efficiency. Furthermore, it was possible to test the sensitivity of downscaling results in each of nested domains with horizontal resolution of 45 km, 15 km and 5 km. Three additional simulations assess the role of chosen PBL schemes for model's accuracy. In result it is possible to quantify the role of different WRF's settings for polar regions, which may be useful for long-term climatological mesoscale simulations as a tool for recognition of local aspects of Svalbard's climate.

Joanna Ćwiakała¹, Mateusz Moskalik², Piotr Zagórski³

¹Pedagogical University of Cracow, Kraków

cwiakala.joanna@gmail.com

²Institute of Geophysics, Polish Academy of Sciences, Warszawa

³Maria Curie-Skłodowska University, Lublin

The glacial history of the Svalbard archipelago from late Vistulian to the present time in late Holocene

The scientists often study the glacial history of the Svalbard archipelago, but the articles usually refer to a particular piece of Svalbard. The authors studied many of scientific articles based on the researches to find and collect this history.

Svalbard is located in the Arctic, at the edge of the continental shelf of Europe. The end of shelf boundary occurrence of ice caps in the past glaciations. In turn, the main elements of the landscape of the archipelago are glaciers that are currently in a recession. Spitsbergen sets the limit of Pleistocene glaciations, and the current state of glaciers allows determining the place where the recession is intense.

The main aim this study is to show this history only from the late Vistulian to the present time. Stadials and interstadials vary start time, duration in different places, according to various authors. Therefore, it is hard to collect all information and describe this history. By knowing the history of glaciation, such periods can be distinguished in the late Vistulian as Last Glacial Maximum (LGM), Bølling/Older Dryas/Allerød and Younger Dryas (YD). The maximum extent of ice sheet in late Vistulian was during LGM, after this period ice sheet began to retreat from the continental shelf. The last advance of glaciers was in YD, about 11 000 years BP. In YD, the glaciers did not advance in the west part of Spitsbergen. In the Holocene yet occurred Holocene Climatic Optimum (in the meantime short Cooling Holocene), Revdalen Stadial, Medieval Warm Period, Little Ice Age (LIA) and XX-century warming. The maximum extent of glaciers in Holocene was in LIA. This extent of glaciers was bigger than in YD. About 1900 AD XX-century warming started, as evidenced by the recession of glaciers into fjords. This interstadials continues until now.

Wojciech Dobiński

University of Silesia, Sosnowiec
wojciech.dobinski@us.edu.pl

Cryology and the rule of uniformitarianism

Cryology for many decades includes research not only the surface of the Earth, but also other celestial bodies. The presence of ice and permafrost on many of them is obvious.

This knowledge is analogous to the experience derived from the Earth research. The expansion in cognition of the cosmos should induce reverse feedback: how the knowledge of other celestial bodies affect the understanding the Earth in Space.

Understanding of the cryospheric components of other celestial bodies forced to verify their perception on Earth, their prevalence is there much larger and more varied. This knowledge compels the reversal of the analogy used in scientific cognition. No Earth but other celestial bodies should constitute a reference point in determining the role of ice on the planet. The uniformitarianism principle is the basis for the correct classification of ice. It is the assumption that the same natural processes and laws that operate in the universe now have always operated in the universe in the past, and are applied in all the universe. The modification can be in the following: the Earth should not be the reference point in analogous studies of the geological structure of celestial bodies as it has a unique status in the cosmos in this regard. It is the cosmos and celestial bodies that constitute the reference area for the Earth and its geological structure. It can be called the principle of spatial uniformitarianism. Adopting it will unify the treatment of the cryospheric components on Earth and in Space. It will allow for:

- (1) Correct understanding of the role of ice on the Earth surface as a component of the lithosphere,
- (2) Ultimate recognition of the Antarctica as a continent.
- (3) Sustain the unity of science and understanding between research disciplines.

Wojciech Dobiński

University of Silesia, Sosnowiec
wojciech.dobinski@us.edu.pl

IPA – IGS consultations in order to determine potential possibilities of cooperation. Polish proposition

In fifty years that passed since the first International Conference on Permafrost which took place in November 11–15, 1963 in Lafayette w Indiana, the progress in the research on permafrost is tremendous. Its occurrence noticed not only in cold continental regions of Asia and Northern America. The 20 century was a period of development of permafrost research in mountainous permafrost and little in extraterrestrial environment, where Mars is the best example. Today we know, that permafrost occurs in all latitudes on Earth.

Correct understanding of the basic issues associated to the occurrence of permafrost is not less important than the applied research that dominate today. Maintaining the relative proportions of these studies will allow to sustain the unity of science and avoid conflict, which sometimes appear. Far-reaching specialization of research results in fact, that the same elements of the environment such as ice perceived differently by permafrost scientist, glaciologist and in space research. It need to be avoided.

Cooperation objective between International Permafrost association and International Glaciological Society would be identification and elimination of inconsistencies between glaciology and permafrost sciences and agreement on a common terminology in the field of interdisciplinary research. The subject of the debate can be in particular:

- (1) Relation between glacier and permafrost and possibility of permafrost occurrence in glacial environment,
- (2) Genetic types of ice in glacial and periglacial environments,
- (3) Movement of glaciers and forms containing ice (i.e.. rock glaciers)
- (4) Cryosphere of the celestial bodies, and others.

Wojciech Dobiński, Michał Glazer

University of Silesia, Sosnowiec
wojciech.dobinski@us.edu.pl

Discrepancy in permafrost extent on Earth

There are significant differences in the evaluation of the area occupied by permafrost on Earth. According to the extreme values reported by some researchers it is 14% to 26% of the exposed land surface. Analysis of the literature has been performed to answer the question: why in the early twenty-first century, there are such large discrepancies in the assessment of the area occupied by permafrost? In carried discussion, starting from the definition of permafrost proposed by the International Permafrost Association, different kinds of permafrost occurrence has been taken into consideration. Main focus in the discussed subject has been placed on the significant role of the subglacial permafrost.

Analysis of the permafrost maps took a special part in presented discussion. Particular attention has been placed in modeling based on available climate data which inevitably relate only to the modern, shallow lying, active permafrost. This way the relict permafrost, strongly associated with the subglacial one, is somehow omitted. In this context, for example, the occurrence of permafrost in the Suwałki region provides new aspect in this discussion.

In the conducted considerations unique approach in which glaciers are considered to be monocrystalline geological rock also has been presented which in this circumstances gives new look on permafrost matter. Differences has been shown in approach to perception of permafrost thus proving the need for verification and final settlement within its appearance on the Lands.

Ksenia Dobrowolska

University of Silesia, Sosnowiec
kseniadobrowolska@gmail.com

Comparison of types of weather in Verkhoyansk and New Siberian Islands

The paper presents comparison of the structure of the weather types in Verkhoyansk and Ostrov Kotelnij (New Siberian Islands) adopting the method by J. Ferdynus (2004, 2013). In order to define weather types 4 meteorological elements were used: air temperature, cloudiness, precipitation and wind. The data for covering the period of Dec 1999-Nov 2011 were taken from the OGIMET. Both stations represent the Siberian Arctic region. The first located on the Island Kotelnij, the Arctic Ocean, is the Koppen climate classification within the Arctic tundra climate ET. Second on the Asian continent, near the Arctic Circle (67° N), in subarctic continental climate with very cold winters DFD (Martyn, 2000). Recognized as one of the poles of the cold on northern hemisphere. In this study, frequency of groups, subgroups, classes and types of weather were specified. It was researched that more varied structure of the weather types is characterized by the Verkhoyansk. Both stations have a large number of types of weather, most of which was characterized by a low frequency. In the case of Ostrov Kotelnij, up to 30% of the observed types appeared only once. The occurrence of weather types were most focused on the Island Kotelnij autumn, and in Verkhoyansk in winter. The highest frequency of occurrence at Ostrov Kotelnij was exceptionally frosty weather, partly clouded, without precipitation and light breeze (2201), while in Verkhoyansk extremely frosty weather, with blue sky, without precipitation and with calm or light air (1100). The sequences of the same weather type were also analyzed, which showed that in either case the most common were the sequences of 2 or 3 days long.

Maria Drewniak¹, Witold Szczuciński¹,
Mateusz Czesław Strzelecki²

¹Institute of Geology, Adam Mickiewicz University in Poznań
maria.drewniak@wp.pl

²Institute of Geography and Regional Development, University of Wrocław

Record of extreme waves generated by iceberg roll events and landslide in Arctic beach sedimentology – examples from Western Greenland

The typical Arctic beach is a rather poorly developed beach system controlled by ice and frost processes and consisting of a mosaic of poorly sorted sediments of various grades and origins (glacial, periglacial and marine sources). Prolonged sea-ice cover, binding of sediments by permafrost, constraining topography of many fjords and embayments restrict or even eliminate the influence of large storm waves on coastal morphodynamics. However, this does not mean that development of Arctic beaches is devoid of impact of large waves; indeed the unstable nature of Arctic landscapes in terms of landslides and also the existence of calving glaciers and icebergs provide potential extreme wave sources, especially in fjord-settings where constraining topography can amplify wave heights at the local scale. Rolling icebergs and paraglacial landslides are main triggers of extreme waves formed along the Arctic coasts.

In this paper we describe the sedimentary evidences of iceberg rolls and landslides which were found along several beaches developed along Vaigat Strait and Ilulissat Icefjord in Western Greenland. Vaigat Strait has a recent history of tsunami waves caused by landslides as well as rock avalanches, whereas coastal zone of Ilulissat Icefjord is frequently affected by waves produced by icebergs calving from Jakobshavn Isbrae. Our aim was to test if there exist the significant sedimentological and morphological differences between effects waves induced by landslides and iceberg roll events.

Using a combination of geomorphological mapping and sedimentological analyses in SEDIMETRICS software we present a detailed interpretation of changes in beach sedimentology observed along the beach transects.

Our results suggest that both, rolling iceberg and landslides waves, record similar characteristics in sediment grain size, what makes the geomorphological mapping essential to interpret these impacts. However research indicate, that important role in formation of beach sediments perform not only catastrophic waves but also offshore processes, like erosion by periodic streams, which has huge influence on preservation of previous impact records.

The study was funded by Polish National Science Centre grant No. 2011/01/B/ST10/01553. Fieldwork was supported by the Arctic Station, Disko (Danish Polar Centre).

Anetta Drzeniecka-Osiadacz, Piotr Muskała, Krzysztof Migala,
Magdalena Korzystka-Muskała, Tymoteusz Sawiński

Institute of Geography and Regional Development, University of Wrocław
anetta.drzeniecka-osiadacz@uni.wroc.pl

A case study on meteorological conditions in PPS Hornsund and surrounding area during Solar eclipse, 1st August 2008

Solar eclipse gives a good chance to examine short term changes of meteorological parameters, especially short term temperature fluctuations and structure of Atmospheric Boundary Layer. This is of a great importance in surroundings of PPS Hornsund, where complex environmental mosaic hinders discrimination of heat fluxes and distinction between local and synoptic factors shaping topoclimatic diversity. At Svalbard Archipelago the Solar eclipse on 1 August 2008 was one of the largest since 1954. The total eclipse covered only a small part of the Archipelago – NE part of Spitsbergen. In Hornsund it was approximately 90% and lasted from 8:38 – 10:43 UTC. Maximum extent of the eclipse in Hornsund took place at 9:40 UTC. Meteorological data (solar radiation, air temperature at different heights above ground level, ground temperature, wind velocity and direction) from 8 measurement points localized in surroundings of PPS Hornsund were used for analysis. The measurement sites were set to represent different land cover and types of terrain. This allowed to describe thermal dynamics both in horizontal and vertical profiles. Generally, 1 August 2008 was a very warm day (only three days with higher average temperature were recorded during that season). The weather at Hornsund was driven by a high pressure ridge, that caused slow inflow of warm air from the West. In such conditions a detailed analysis of temperature variation at different elevations and land cover during rapid changes in solar radiation was possible. Solar eclipse reduced solar radiation from 300 W/m² (before start of the eclipse) to 30 W/m². After the eclipse it raised to the daily maximum (500 W/m²). Emphasis was placed on the response of near ground air temperature to the abrupt change of the solar radiation. Solar radiation changes reflected particularly in air temperature and near surface layer of the ground. Air temperature changed differently for each location on the rapid changes in solar radiation caused by Solar eclipse. The time lag between the occurrence of the temperature minimum and eclipse maximum extent was caused by the thermal inertia of the air and the ground. The atmospheric stability however, did not change significantly due to the eclipse.

Moustafa Hassan El-Mehlawy, Jerzy Rokicki*

* University of Gdańsk
rokicki@univ.gda.pl

Morphological and ecological analysis of the parasitic copepoda *Eubrachiella antarctica* (Quidor, 1906) [Copepoda: Lernaepodidae] from Antarctic fish

The records of parasitic copepods on fish of the south Atlantic area are insufficient and the description are poorly detailed. Genus *Eubrachiella* Wilson, 1915, contains four species. Two of them are very closely related, *E.gaini*(Quidor, 1912) and *E.antarctica*(Quidor, 1906) The morphology of the copepods from the genus *Eubrachiella* was studied on the specimens collected from *Notothenia gibberifrons*, *Dissostichus eleginoides* and *Champsocephalus gunnari* from South Georgia. On the posterior margin of the trunk of the young female it is possible to recognize two small tubercles. A revision of the preserved slides specimens of *Brachiella antarctica* from the Paris Museum for the same label numbers as described by Stadler (1986) showed that endopodite of the second antenna bearing ventro-laterally one tubercle in addition of observed tubercle should be remarked only from dorsal position with addition to the short spine and stronger one on the dorso lateral side. The exact examination of the morphology of the male and dissected mouth parts of *E. antarctica* proves a defect of the previous description of *E.Antarctica* and erroneous taxonomical position of *E.gaini*.

Weronika Erdmann*, Jerzy Smykla, Milena Roszkowska,
Krzysztof Zwierucha, Łukasz Kaczmarek

* Adam Mickiewicz University in Poznań
weronika.erdmann@gmail.com

Intra- and interpopulation variability in Antarctic tardigrade *Acutunctus antarcticus* (Richters 1904)

Acutunctus antarcticus, belongs to monophyletic genus in the family Hypsibiidae. It is a typical species for Subantarctic, Antarctic archipelagos and also for continental Antarctica, where is a dominant species in most of habitats.

A. antarcticus can be characterized by: (a) the presence of oral cavity armature, (b) two macroplacoids in pharynx, (c) absence of microplacoid, (d) presence of Hypsibius type claws for the inner claws of the first three legs and anterior claws of the fourth pair of legs and Isohypsibius type claws for the outer claws of first three legs and posterior claws of the fourth pair and (e) presence or absence of lunules under claws.

Specimens of *A. antarcticus* has been collected from several locations on the Antarctic continent. Individuals from thirty different locations in the area of Southern Victoria Land (Ross Sea region) were examined for differences in morphometry. The main aim of this study is to estimate intra- and interpopulation variability (in the populations of *A. antarcticus* which occupy habitats in different distances from each other).

These populations were examined to see if the morphometrical differences among individuals from distant populations were larger than between specimens of a population of slightly away from each other.

For the analyses were measured: lengths of the body, buccal tube, internal and external claws and macroplacoids, distance of stylet support insertion points, external and internal width of buccal tube.

Łukasz Franczak*, Waldemar Kociuba, Grzegorz Gajek

* Maria Curie-Skłodowska University, Lublin
lukasz.franczak@poczta.umcs.lublin.pl

Effect of climate drivers on extreme Arctic river flows during floods (melt season 2013)

The objective of the study was to analyse the origin and course of an extreme flood recorded in the Scott river basin (central part of the west coast of Spitsbergen – NW part of the Wedel Jarlsberg Land) of glacial (90%) hydrological regime in relation to the major climatic factors and rate of glacial ablation. The object of the research was the Scott River, with a length of 3.3 km, an average downfall of 0.028 m m⁻¹, and a catchment area of 10.1 km², taking its origin in the Scott glacier (with an area of 4 km²).

In the summer season 2013, meteorological observations of the following conditions were conducted: precipitation, air temperature, air humidity, and wind speed and direction. The volume of ice ablation was simultaneously measured based on a network of ablation poles. In the hydrometric cross-section located in the lower course of the river, the following parameters were measured: water levels by means of limnigraphs, and flows by means of an ultrasonic flow meter of OTT ADC type.

In the second decade of August 2013, an extraordinary increase in runoff was recorded in the Scott River catchment. The flood, exceeding the bankful state, was maintained from 14 to 16 August 2013. The observed flows exceeded the mean multi-annual values for the analysed area several times. Comparable extreme flows were recorded in the summer seasons of 1987, 1989, and 1993.

The obtained results suggest that the event was caused by climatic factors, i.e. the simultaneous occurrence of intense and long-lasting precipitation and a rapid increase in air temperature. This resulted in an increase in the intensity of the ablation of Scott glacier, determining the above-average flow efficiency.

The study was conducted in the scope of the 25th Polar Expedition of the Marie Curie-Skłodowska University in Lublin to Spitsbergen, involving the implementation of the grant of the National Science Centre, entitled: Mechanisms of fluvial transport and delivery of sediment to the Arctic river channels with different hydrologic regime (SW Spitsbergen), No. 2011/01/B/ST10/06996.

Gajek Grzegorz*, Kociuba Waldemar, Franczak Łukasz

* Maria Curie-Skłodowska University, Lublin
gajcy@poczta.umcs.lublin.pl

Changes in Scottbreen geometry in the light of archival cartographic materials and the latest TLS measurements

In summer 2013, during the Polar Expedition of the University of Maria Curie-Skłodowska University in Lublin, work to determine the geometry changes (the ones in the surface and within the front) of Scott Glacier (north-western part of Wedel Jarlsberg Land, southern Spitsbergen) was carried out.

For this purpose, the traditional method based on a network of ablation poles arranged in the longitudinal profile of the glacier was used and precise DGPS measurements of the terminus position scope were made. In addition, within the front part of the tongue of the glacier terrestrial laser scanning was performed, using the Leica ScanStation C10. The results of field measurements were compared with data obtained on the basis of vectorisation of archival cartographic materials in GIS software.

Scott Glacier from the end of the Little Ice Age, when it reached its maximum Holocene range, is subject to gradual recession. The analysis of archival cartographic materials show that the glacier front retreated during the years 1880–1936 an average of 140 meters, giving an annual average recession of 3 m per year.

In the 1936–1990 recession accelerated the pace to an average of 11 m per year, leading to a decrease of 600 meters in Scottbreen range. The frontal part of the glacier retreated the fastest over the past 23 years, when the rate of regression was estimated at 23 m per year. At the same time followed the lowering of the glacier surface, particularly evident in the frontal part. In the period of 1936–1990 thickness decreased by 57 meters (1 m a year). In the years 1990–2013 further thinning of the glacier took place. In the frontal part, the surface of the glacier decreased by 58 meters, giving an average annual value of 2.3 meters.

A long-term trend of the changes in Scottbreen geometry was confirmed by TLS measurements of the front part of the tongue, conducted in 2013. Two measuring sessions, carried out at the interval of 20 days, proved extremely fast pace of undercutting the glacier surface of the frontal part (over 2 meters), and a significant rate of retreat of the glacier front (about 10 meters in the measurement period).

The study was conducted in the scope of the 24th Polar Expedition of the Marie Curie-Skłodowska University in Lublin to Spitsbergen, involving the implementation of the grant of the National Science Centre, entitled: Mechanisms of fluvial transport and delivery of sediment to the Arctic river channels with different hydrologic regime (SW Spitsbergen), No. 2011/01/B/ST10/06996.

O. Głowacki*, G.B. Deane, M. Moskalik, P. Blondel, J. Tęgowski

* Institute of Geophysics, Polish Academy of Sciences, Warszawa
oglowacki@igf.edu.pl

Acoustic signatures of different calving modes: results from spectral analysis

Ice-water interactions in the contact zone between marine-terminating glaciers and the ocean surface are characterized by their dynamic and unpredictable character. Submarine melting and calving of tidewater glaciers represents a significant source of fresh water, which contributes to sea level rise and causes great variability in hydrological conditions in glacial bays and fiords. However, these processes are still poorly understood and progress in the field requires the development of new research methods.

The main study goal is to identify and describe different types of calving modes using hydroacoustic measurements synchronized with time-lapse photography. Data was collected on August 20, 21 and 24, 2013 in the Hans Glacier front using an acoustic buoy equipped with an omnidirectional hydrophone with sensitivity -165 dB re 1 V/ μ Pa and frequency response of 2 Hz – 30 kHz. Time-lapse photographs were taken every 0.5 s from a rock located less than 200 meters from the ice cliff. More than 20 calving events were photographically and acoustically documented. Of these, the events most representative of typical subaerial, slipping and submarine modes were selected for spectral analysis.

The study shows that each calving mode has its own distinctive acoustic signature, which is identifiable through its frequency content and spectral slopes. These results demonstrate the potential of hydroacoustic methods to yield new information about the dynamics of calving tidewater glaciers. The work has been conducted under project No. UMO-2011/03/B/ST10/04275, National Science Centre, Poland.

D. Górniak*, H. Marszałek, J. Dunalska, B. Jaworska, J. Tunowski

* University of Warmia and Mazury in Olsztyn
gorniak@uwm.edu.pl

Biological diversity of microbiocenoses in aquatic ecosystems formed as a result of deglaciation

Microbiological investigations of 17 small, freshwater reservoirs of different age and degree of ecological succession advancement were carried out during the summer season of 2010 and 2011. Studies were conducted in the spatial gradient of the Werenskiöld glacier foreland (West Spitsbergen) from proglacial to supraglacial zone including aquatic ecosystems formed and transformed as a result of its deglaciation.

The main aim of the study was to investigate the processes of colonization, succession and interaction between the aquatic microbiocenoses, occurring in the primary area exposed from the retreating glacier. An important element was to determine the factors generating biodiversity of microorganisms. Both, biotic and abiotic parameters were determined.

Selected physical and chemical features of water as temperature, pH, conductivity, oxygen content and its saturation were measured directly in the field. The other 18 physico-chemical parameters including DOC, chlorophyll a, mineral suspensions, nutrients, main ions and microelements contents were measured in laboratory. The biological features of the reservoirs as abundance, biomass, structure, vitality and respiration activity of prokaryotes were determined. The quantitative assessment of viruses, picoplankton, phytoplankton and zooplankton was made in the further studies. The ribotyping methods based on 16S rRNA subunit were used for evaluation of bacteria biodiversity. In situ hybridization using fluorescently labeled molecular probes (FISH) and PCR with bacterio-specific primers and denaturing gradient gel electrophoresis (PCR-DGGE) have been carried out as well.

It has been shown that pioneer microorganisms, colonizing freshwater bodies newly formed in the glacial foreland, may have its origin both, from the water of melting glacier and from neighboring niches, where they are transmitted primarily by birds.

This succession takes place with the reconstruction of all microbiocenoses, both prokaryotes and eukaryotes and usually leads to increased eukaryotes biodiversity and simplification of the bacteria biodiversity. The studied ecosystems are significantly influenced by birds (mainly geese), inhabiting them in the summer, and whose droppings provide easily absorbable organic matter and nutrients to the water. This effect was confirmed during the field experiment.

Mariusz Grabiec¹, J. A. Jania¹, D. Ignatiuk¹, T. Budzik¹,
P. Głowacki², D. Puczek³

¹Faculty of Earth Sciences University of Silesia, Sosnowiec
mariusz.grabiec@us.edu.pl

²Institute of Geophysics Polish Academy of Sciences, Warszawa

³Institute of Geophysics Polish Academy of Sciences, since 2012:
Institute of Biochemistry and Biophysics Polish Academy of Sciences, Warszawa

Hydrothermal evolution of Svalbard glaciers

The hydrothermal structure of glaciers are derived from their heat balance as a result of present and past climatic conditions. Polythermal type of ice masses is the most common in Svalbard however glaciers permanently frozen in their whole volume can be also found. Thermal conditions of glaciers on Southern Spitsbergen were studied by means of radio echo-sounding in period 2007-2013. Results of radar profiling were compared to previous surveys performed on selected glaciers (Hansbreen, Werenskioldbreen) in late 1990-ties. Results are showing that the upper limit of the cold ice layer on glaciers' surface tends to move upward simultaneously with the shift of equilibrium line due to climate warming. This expansion of the cold ice layer on the surface separates lower ice layers from meltwater percolating down the ice and thereby from latent heat of freezing. Changes of cold ice thickness are also conditioned by an ice dynamics. In the zone of compression ice flow the cold ice layer thickens gradually, whereas in an area of tension movement the cold ice is stretched and thinner. More intense ablation of lower parts of ice tongues is also a factor of thinning of the cold ice layer there. In fractured parts of glaciers or around moulins where abundant meltwater penetrates into the glacier body, temperate ice diapirs surrounded by the cold ice are created. Together with the evolution of glaciers' geometry from tidewater to land based, the frontal zone freezes to the bedrock and expands with time. The general trend of thermal evolution of Svalbard glaciers caused by climatic changes and shrinkage of glaciers leads to gradual transition from the polythermal to the cold type of glaciers. The paper presents some examples of consequences of presented direction of glacier's hydrothermal evolution in drainage, dynamics and other features of glacier systems in Svalbard.

Joanna Grzela

Jan Kochanowski University, Kielce
a_grzela@poczta.onet.pl

The Role of Greenland in the Arctic

In recent years there have been great changes in the High North as result of global warming and climate change. Thawing of ice in the High North is changing the geostrategic position of the Arctic. This has drawn increased attention towards the region from various global actors, among them the actual Arctic states, international organizations and non Arctic states. Activity in the region demonstrate countries unrelated to it yet. These non-Arctic stakeholders make that boundaries of interest in the Arctic are extending considerably. The Arctic will become one of the main areas of international cooperation in the coming decade. Its geopolitical and geoeconomic importance is growing. Interested countries may attempt to influence the future of the region, so there is a need to know about their ambitions to the Arctic. Individual countries have different approaches to the Arctic. What they share is a belief that this area is important for their future. Some are very active, others less. All draw attention to the dilemma of security defined broadly in the Arctic, and highlight the need to strike a balance between economic and environmental factors, pointing to the potential opportunities and threats of commercial activity in this area. Countries such as China, South Korea or Japan and India although they do not have territories in this region but more and more loudly are “knocking at the Arctic door” seeking there a place for themselves. Among them, noteworthy Arctic policy of Japan.

Jakub Grzesiak*, Marek K. Zdanowski,
Dorota Górniak, Aleksander Świątecki,
Magdalena Żmuda-Baranowska, Piotr Borsuk

* Polish Academy of Sciences, Warszawa
jgrzesiak@arctowski.pl

Arctic and Antarctic psychrophilic isolate collection

The Institute of Biochemistry and Biophysics has a central collection of strains. It comprises of a bacterial, yeast and plasmid database. It's newest acquisition is the Arctic and Antarctic psychrophilic collection (<http://kolekcja.ibb.waw.pl/index.php?page=arctic.ListView>). This collection, which currently consists of 1500 bacterial and fungal strains, includes isolates from various polar habitats: sea bird guano, decaying sea weeds, glacier ice and cryoconite holes, postglacial and tundra soil, lakes and streams. Over 300 strains are identified on a genus level based on their 16S rDNA gene fragment, over a 100 have a physiological property profile based on API 20NE and API ZYM tests. Taxonomically the collection consist of isolates belonging to four bacterial types : Proteobacteria, Actinobacteria, Bacteroidetes and Firmicutes. Arthrobacter, Psychrobacter, Polaromonas, Pseudomonas and Cryobacterium are among the most numerous genera. Many of them secrete proteo-, lipo-, chitino- and cellulolytic enzymes, produce different pigments and carry unique genetic elements. Their growth temperature ranges from 4 to 15°C, often exceeding 22°C. These isolates pose an opportunity for screening of properties for applications in many fields of biotechnology.

Jakub Grzesiak*, Marek K. Zdanowski,
Dorota Górniak, Aleksander Świątecki,
Tamara Aleksandrzak-Piekarczyk, Katarzyna Szatraj

* Polish Academy of Sciences, Warszawa
jgrzesiak@arctowski.pl

Microbial community changes along Hans and Werenskiöld glaciers' ablation zone

Microbial community changes were investigated on Hans and Werenskiöld glaciers. Surface ice and cryoconite sediment were sampled from transects running up the glaciers' ablation zones. Microbial abundance was assessed by the direct count method, taxonomic bacterial diversity was investigated using denaturing gradient gel electrophoresis and the functional diversity was measured by Biolog EcoPlates. Lowest bacterial numbers were noted near glacial terminus - ice: TC = 104/ml, - cryoconite sediment: TC = 107/g.d.w; highest bacterial numbers were noted in upper sites; in the highest sampling site the numbers increased ten times. The PCR-DGGE method showed a substantial taxonomical diversification of the ice and cryoconite bacteria. Surface ice yielded 33 OTU's, and the cryoconite sediments 28 OTU's. The metabolic diversity tests showed that in terms of positive response numbers, the cryoconite microbial community (72%) was more active than the surface ice community (10%). The quantitative, taxonomic and metabolic changes within glacier surface microbiocenoses in response to ice exposure after snow melt indicate a high adaptability of supraglacial arctic ecosystems.

Laura Grzonka*, Maciej Mańko, Anna Panasiuk-Chodnicka

* University of Gdańsk
laura.grzonka@interia.pl

Population structure, and morphometric differentiation of some Siphonophora (Cnidaria) in the Antarctic waters (Admiralty Bay; South Shetland Islands)

Analyses of Siphonophora species distribution, and abundance are performed relatively rarely, especially in polar regions, like Antarctic waters. This is mainly due to the fact, that colonies of these animals tend to break up in plankton nets. As a result morphometric data, and population structure studies are also very scarce. Presented research was conducted on two calycophoran siphonophores species occurring in Antarctic waters - cosmopolitan *Dimophyes arctica* and endemic *Diphyes antarctica*. The main goal was to examine how unique Antarctic hydrological conditions (high productivity and low temperatures) impact the population structure, and morphometric characteristics of both calycophorans.

Siphonophora specimens were collected in Admiralty Bay during the summer, and winter seasons in 1995, using WP2 net. Investigated animals were counted, measured, and all individuals were divided by developmental stage (eudoxids, posterior, and anterior nectophores) in addition to further population structure analysis.

The most abundant calycophoran was *Dimophyes arctica*. Our results showed the dominance of anterior nectophores, followed by eudoxids. The abundances of both of these forms decreased in monthly routine. The peak of polygastric stages was observed in January, which probably justifies high number of eudoxids in February. Comparing our results with literature data, from other oceanic regions, we found some differences in the population structure, and lengths of individuals of this species. Probably it is connected to temperature, and food availability.

The highest abundance of *Diphyes antarctica* was also noted in January. Generally, anterior nectophores were the most numerous, but the differences in number of anterior nectophores, and eudoxids was small, which could be the effect of different reproduction strategy of this species.

Concluding, lower abundances of these two calycophorans in Admiralty Bay, as comparing to other Antarctic regions, may suggest that the specific fjord conditions in the investigated area can limit populations of some siphonophores.

Dawid Hamryszczak, Wojciech Drzewicki, Małgorzata Malkiewicz

University of Wrocław
dawid_hamryszczak@interia.pl

Paleoclimatic conditions reconstruction basing on isotopic analyses of $\delta^{13}\text{C}$ and palynological analyses of the bog from the southwestern part of Spitsbergen (preliminary results)

In the recent years, global warming and climate changes issue is more and more popular. Wetlands and peat bogs studies can be helpful to follow tempo of changes. Bogs from polar regions give information about paleoclimatic past periods thanks to their specific and unique forming conditions. In the studies of paleoclimatic conditions reconstruction, carbon isotopic analyses ($\delta^{13}\text{C}$) are very important. Thanks to isotopic analyses, it is possible to follow climate changes and important environmental episodes. Complementary to geochemical studies, palynological analyses of bog profiles are very useful.

Analyses were carried out on bog profiles gathered in Hornsund located in the southwestern part of Spitsbergen (Norwegian Svalbard archipelago, Arctic Ocean).

The sediments of profile T4 were the subjects of palinological study. 24 peat samples (every two centimeters) were taken for the analysis. Samples were treated with 30% Perchlorate, and then macerated with Erdtmans acetolysis. At first step 12 samples were collected for palynological analysis. Frequency of pollen material was variable, hence the total sum fluctuated in the range from 50 to 300 pollen grains of trees, shrubs and herbaceous plants. The results of pollen analysis are shown on the pollen histogram. POLPAL palynological software was used to create the percentage pollen diagram and histogram.

Obtained pollen image shows the development of tundra communities, with varying participation of herbaceous plants. The presence of pollen of *Betula*, *Corylus*, *Alnus*, *Tilia* and *Pinus* may be associated with the distant transport from much warmer areas.

Anna Iglukowska*, Piotr Kukliński, Joanna Przytarska,
Joanna Piwowarczyk, Maria Włodarska Kowalczyk, Paul Renaud,
Michael Carroll, Richard Bellerby, Jarosław Stolarski

* Marine Ecology Department, Institute of Oceanology Polish Academy of Sciences, Sopot
iglukowska@iopan.gda.pl

POLNOR – The Changing Ocean of the Polar North

The study area, Arctic is the region most influenced by ongoing global climate change. Sea ice retreat in the central Arctic Ocean due to warming is leading to higher $p\text{CO}_2$ values in the surface waters, reduced CaCO_3 saturation states and increased biological production. The proposed project will provide an assessment of how the Arctic ecosystem will respond to multiple stressors arising from ocean warming and chemistry change caused by ocean acidification (OA). OA is a decrease in pH in the oceans caused by the uptake of anthropogenic CO_2 from the atmosphere and is recognized to have negative effects on many groups of marine invertebrates with calcareous skeletons. These effects may be expressed as changes in calcification rate, decrease in abundance, recruitment and survival rates. The project will investigate the control of ocean carbonate chemistry, hydrology, primary productivity and energy transfer on biogenic carbonates and carbonate producers. It will investigate the effects of ocean acidification on the biodiversity and structure of benthic systems through analysis of spatial patterns of diversity coupled with geochemical properties of the water column. By investigating record of geochemical signatures in marine sediments and organism skeletons that can indicate anthropogenic changes over time including OA, warming and food supply, we will be able to build comprehensive predictive models. Such information will improve simulations of future changes. Our goal is to develop new knowledge of future tipping points and thresholds for marine production and resource management.

The project is implemented in collaboration of Polish (Institute of Oceanology PAN and Institute of Paleobiology PAN) and Norwegian partners (NIVA – The Norwegian Institute for Water Research and Akvaplan-niva).

Dariusz Ignatiuk¹, J. A. Jania¹, M. Cieřy¹, M. Błaszczuk¹, D. Puczko²

¹Faculty of Earth Sciences University of Silesia, Sosnowiec
dignatiuk@gmail.com

²Institute of Geophysics Polish Academy of Sciences, since 2012:
Institute of Biochemistry and Biophysics Polish Academy of Sciences, Warszawa

Short term fluctuations of the Hansbreen ice-cliff position

Short term fluctuations of ice cliff during ablation season and polar night were studied. Since measurements of movement of the calving glaciers in polar night are very difficult, new techniques have been developed to observe velocities at cliff terminus. The researches were carried out on Hansbreen, which is a medium size (area of c. 53 sq. km, up to 400 m thick) polythermal tidewater glacier located in South Spitsbergen. Complex analyses of marine, meteorological and glaciological factors, which influence the short term ice-cliff fluctuations, have been conducted. Measurements were carried out by the Riegl FG21-LR laser distance ranger, Garmin panoramic radar and Canon EOS 1000D time lapse cameras. Additional measurements of oceanic factors were performed in front of Hansbreen. Dynamic on the glacier were collected by dGPS measurements on the front and in the middle part of the glacier (stake 4). Significant role of marine factors in the process of calving has been noticed. Influence of liquid precipitation and positive temperatures on cliff position were observed. Preliminary results show relatively high velocity of the glacier flow near terminus during dark winter and significant speed up events associated to warming spells with rainfalls and increase of water temperature in the fiord. Dynamics of tidewater glacier terminus during dark winter is more vigorous than previously thought.

Aleksandra Jakiel, Tomasz Borszcz

University of Lodz
aleksandrajakiel@wp.pl

Unravelling variability of Antarctic echinoid dominant *Sterechinus neumayeri* from Admiralty Bay (Admiralty Bay, King George Island, Antarctica)

Knowledge on natural variability and plasticity in ecologically important marine organisms is crucial for understanding their evolution and sensitivity to projected changes in future oceans. In this paper we investigated phenotypic plasticity of apical disc, height/diameter ratio. We found that ocular plates display high variability in their position and were found in 12 distinct combinations with different frequencies. Detected frequencies point that investigated populations are dominated by single arrangement with three additional ocular plate combinations while other are rather rare (below 2%). Existence of positive correlation between position of ocular plates and size of skeletons link their variability to growth process. Quantification of height: diameter ratio, known from pre-existing experiments on some echinoid taxa to be plastic show that both parameters are strongly correlated and do not differ between sites representing various environmental conditions.

Jacek A. Jania¹, M. Cieply¹, D. Ignatiuk¹, M. Błaszczuk¹, E. Welty²

¹Faculty of Earth Sciences, University of Silesia, Sosnowiec
jam.jania@gmail.com

²INSTAAR, University of Colorado, Boulder, USA

Calving modes of tidewater glaciers (with special reference to Spitsbergen ones)

Warming of the Arctic climate is proved by meteorological data series. Dynamic response of Arctic glaciers to climate warming accelerates production of icebergs. This process influences global sea level rise. Problem of formulation of a general calving law is unsolved yet. Better understanding of calving mechanism leads throughout detailed observations of processes at and near ice cliffs of tidewater glaciers. Hans Glacier in Southern Spitsbergen is one of better studied one. This medium size polythermal tidewater glacier located close to the Polish Polar Station. Frontal part of the glacier is studied since 1982. Recently, monitoring system of the frontal part of this glacier has been developed. Analysis of time lapse photos from summer seasons of 2007, 2008 and 2009 and year round pictures since December 2009 (including polar night periods) made possible detection of sequence of events before breaking off of icebergs. More limited data sets were collected for the Paierl Glacier and other Hornsund glacier using satellite images. Development of calving stages has been determined from consecutive of pictures. Types of calving modes have been distinguished and documented. Relations to features of glaciers and their environmental setting are presented in the paper. Factors affecting calving modes and intensity of iceberg production are defined for grounded tidewater glaciers in S Spitsbergen. Glacier dynamics, depth of sea at the ice cliff and temperature of the sea water seems to be driving factors for calving of Spitsbergen glaciers. Comparison to other calving modes described from the Arctic is discussed in the presentation.

Michal Janouch*, Ladislav Sieger, Martin Stanek, Hector Ochoa

* Czech Hydrometeorological Institute, Hradec Králové, Czech Republic
janouch@chmi.cz

The Detection of the State of the Earth's Ozone Layer and UV-radiation in Antarctica

In February of 2010 The Solar and Ozone Observatory of the Czech Hydrometeorological Institute in cooperation with the Argentine Antarctic Institute installed the Brewer ozone spectrophotometer (double MKIII) No. 199 at the Marambio Base - Argentina, Antarctica. The Brewer spectrophotometer (the Brewer) is a fully automated instrument.

The aim of the present work is to improve scientific knowledge for global assessments on ozone depletion and climate change for the Montreal Protocol and the Vienna Convention, better understanding of processes in the upper troposphere and lower stratosphere through modelling and data analysis and studies of the long-term variability in extratropical large scale transport are also being performed to improve long-term predictions of mid and high latitude ozone and UV radiation.

Marek Jaskólski, Łukasz Pawłowski, Mateusz Czesław Strzelecki

Institute of Geography and Regional Development, University of Wrocław
marek.jaskolski@op.pl

Assessment of impact of coastal hazards on scientific and community infrastructure in polar regions using remote sensing, geoinformation and new geomorphological mapping methods - project aims and potential impacts

Present-day Arctic coastal landscapes are modified by increased degradation of permafrost accelerated sediment supply from deglaciated catchments, and prolonged periods of open-water conditions and wave activity. Since the second half of 20th century there is also an observed increase in the number and intensity of storms entering the Arctic particularly in summer months when coastlines are free of protective ice cover. Studies from Greenland on landslide-generated tsunamis, potentially a result of warmer air temperatures in the past century demonstrate that Arctic coasts are vulnerable to such extreme events. In addition, glacier calving and iceberg roll events provide potent tsunami sources, especially in confined fjord settings where constraining topography can amplify wave heights at the local scale.

Despite the potential significance of these coastal hazards on the security of scientific (research bases and devices) and community (ports, airports, roads, buildings) infrastructure on Svalbard, relatively little is known on the present-day rate of Svalbard coastal zone changes and how they might impact the nearshore infrastructure in the future.

In this paper we summarise the research aims of HOMING PLUS project recently funded by the Foundation for Polish Science.

The major scientific aim of the project is to apply state-of-the-art geoinformation and remote sensing techniques together with new field-based geomorphological mapping methods to examine the impact of coastal hazards on scientific and community infrastructure along the coasts of Svalbard Archipelago, High Arctic. The research will also result in a risk assessment for development and protection of human infrastructure along the coasts of Svalbard under scenarios of climate change, sea level rise, changes to the frequency of storms entering the region and variations in sea ice extent. The project is also intended to promote ideas for Svalbard Integrated Arctic Earth Observing System through the development of the coastal hazard monitoring research group on Svalbard.

Bartłomiej Jerzak

University of Gdańsk
b.jerzak@ug.edu.pl

Feeding activity of Antarctic herbivorous copepods in response to change in phytoplankton community composition (Admiralty Bay, South Shetland Islands) – a preliminary results

In Antarctic waters diatoms form a main food source for free living copepods, such as *Calanoides acutus* and *Calanus propinquus* which are dominants among the herbivorous copepods. Diatoms are also considered to be an important part of diet of omnivorous copepods, e.g. *Metridia gerlachei*. Recent results of phytoplankton monitoring in Admiralty Bay revealed a diminished percentage contribution of diatoms in the phytoplankton assemblages in comparison to the earliest studies. Also the lowering contribution of the larger diatoms ($> 20\ \mu\text{m}$), such as *Fragilariopsis kerguelensis*, *F. obliquecostata* or *Chaetoceros spp.* has been shown. These phenomena may be related to wider shift in phytoplankton community structure documented in coastal waters along the Antarctic Peninsula. Intense glacial melt-water runoff reduce surface water salinity and cause an increase in water turbidity resulting in more favorable conditions for flagellates and cryptophytes to dominate the phytoplankton assemblages. This marked shift in size distribution of the phytoplankton community are potentially of great importance for the pelagic filter-feeders of the Admiralty Bay. It could presumably impact the feeding of herbivorous copepods, as copepods grazing efficiency is highly dependent on food density and size of its particles.

The aim of the study is to examine and compare feeding behavior from three different periods of four copepod species – *Calanoides acutus*, *Calanus propinquus*, *Rhincalanus gigas* and *Metridia gerlachei* in Admiralty Bay. During presentation a preliminary results of the studies on feeding activity (estimated as a percentage of copepods with food in gut) of four mentioned copepod species will be shown. This initial findings will be a part of the major research which purpose will be to determine whether the documented shift in size distribution of the phytoplankton community affect the populations and feeding behavior of phytoplankton grazers.

Bartłomiej Jerzak

University of Gdańsk
b.jerzak@ug.edu.pl

Taxonomic and population diversity of Chaetognatha of the Admiralty Bay (South Shetland Islands, Antarctica)

The chaetognaths are marine organisms, with a wide range of distribution and represent an important element of pelagic ecosystems. Knowledge of the chaetognaths in the polar regions, particularly in the neritic waters is scarce, this also refers to Admiralty Bay. The aim of this study is to examine the quantitative, qualitative and population diversity of chaetognaths occurring in Admiralty Bay.

The studies were performed on samples from Admiralty Bay, taken during the period from December 1994 to June 1995. The presence of six chaetognaths species was revealed: *Eukrohnia hamata*, *Eukrohnia bathypelagica*, *Eukrohnia fowleri*, *Sagitta marri*, *Sagitta gazellae* and *Sagitta maxima*. There has been a marked decline in the average number of the chaetognaths from 425 ind./1000 m³ in the middle of the Antarctic summer to 1 ind./1000 m³ at the beginning of the Antarctic winter. Most frequent and most abundant species was *E. hamata*. It was the only species which abundance was sufficient for population structure analysis. The major part of its population consisted from younger individuals (development stage I-III) with a dominance of the youngest ones. The other populations wasn't abundant enough for such analysis. Although, it's worth mentioning that only in *Sagitta marri* older individuals (stage IV) were noted and there was no fully mature individuals (stage V) observed in any of the populations. These organisms could occur in investigated area for all months, but in very small quantities, which makes them difficult to obtain. The lack of fully mature organisms may be due to the fact that they dwell in waters deeper than the total depth of Admiralty Bay. Both the taxonomic composition and the contribution of individual taxa, including the dominance of *E. hamata*, are similar to the results of earlier research carried out in the West Antarctica.

Marzena Józefczyk

Institute of Geography and Regional Development, University of Wrocław
majozefczyk@gmail.com

The Tradition of Polar Ecosystems Research in Wrocław

The main purpose of the presentation is to assess the input of the University of Wrocław to the global research on polar ecosystems. The main areas of Wrocławian polar studies will also be presented. Wrocław has a long history of polar research that reaches the beginning of the 1930's. At that time Henryk Arctowski was the head of Geography at the University of Jan Kazimierz in Lwów and Aleksander Kosiba was his PhD student. After the political changes that followed the II World War, Kosiba moved to Wrocław, along with his interest and experience in polar ecosystems research. In 1949 his former student Alfred Jahn joined him in Wrocław. Thanks to those two researchers Geographical Institute of the University of Wrocław took part in the first Polish expedition to Spitsbergen after the II World War. A mile stone for polar research in Wrocław was a series of expeditions to Spitsbergen in 1970–1974 lead by Stanisław Baranowski, prof. Jahn's alumni. During this period the Wrocławian polar station 'Werrenhus' was funded and build by Baranowski with the help of the Geographical Institute. The researches were continued in the late 1970s and 1980s. 1990s were a long brake in Wrocławian presence on Spitsbergen, only in 2003 a new era in this area started and continues till now. The biggest event during that time was International Geophysical Year (IGY) 2007–2008 in which University of Wrocław participated.

Cezary Kabala¹, Bartosz Korabiewski²

¹Institute of Soil Science and Environmental Protection,
Wrocław University of Environmental and Life Sciences
cezary.kabala@up.wroc.pl

²Institute of Geography and Regional Development, University of Wrocław

Cryoturbated soils development on uplifted marine terraces in SW Spitsbergen

Among the 14 raised marine terraces, well recognizable on the western coast of Spitsbergen, three lowest (2, 4.5–6, and 8–12 m a.s.l.) were developed during Holocene deglaciations. The aim of study was to testify differences in soil development on these terraces, with particular emphasis on the cryoturbation features. Recently and poorly developed soils (sandy- and gravelly-textured) on the youngest terrace (2 m a.s.l.) are in general free of cryoturbation features. Tundra environments located on the main terraces (4.5–6 and 8–12 m a.s.l.) involves a mosaic of texturally differentiated soils (from gravelly-, through sandy- to silt-loamy-textured), with varying drainage and abundance of organic matter. Loamy- and silt-loamy-textured soils are in general cryoturbated (Turbic Cryosols) and have several forms of sorted/patterned grounds on the surface, on the terrace 4.5–6 m a.s.l., or are the parts of gelifluction lobes, in particular on the terrace 8–12 m a.s.l. Plain, well-drained fragments of tundra are covered with soils morphologically similar to the brown earths with shallow humus horizon and clearly marked rusty-brown horizon. Although the permafrost occurs in these soils in summer at a depth of more than 150 cm, common are the signs of cryogenic processes of varying scale and intensity (Cambic Turbic Cryosols). Strong cryoturbations in soils on the marine terraces 4.5–6 and 8–12 m a.s.l. developed during the LIA and partly disturbed formerly formed genetic horizons of interglacial soils on these older Holocene terraces.

Paula Kacprzak*, Justyna Wawrzynek, Anna Panasiuk-Chodnicka,
Maria Iwona Żmijewska

* University of Gdańsk
paulakacprzak90@gmail.com

Horizontal variability and population structure of Pteropoda in the Subarctic waters (Barents Sea)

Pteropoda play a key role in the trophic relations of the Arctic food web, with the domination of *Limacina helicina*, *Limacina retroversa* and *Clione limacina* species. Usually, these animals occur in a significant abundance in this region throughout the whole year. Population studies of pteropods are very rare and they were mainly carried out about 30, 40 years ago. The main goal of this study is to fill the gap in the knowledge by investigating population structure of pteropods. In our studies investigated animals were collected in the Barents Sea in August 2011 using the Bongo net. Subsequently, species composition, abundance and developmental stages were determined. We founded only one race of gymnosomatous pteropod *Clione limacina*. Poly-trochous larvae of this species were differentiated based on their length (1 mm – 15 mm) and presence of ciliary bands on the trunk. In addition, larger specimens were separated into two categories - small and large adults. Thecosome pteropods – *Limacina helicina* and *Limacina retroversa* - were also noted in a high abundance in studies area. These specimens used to be describe as protandric hermaphrodites. In all stations juvenile pteropods were mainly found, however several males and females specimens were also recognized. The maximum densities of *Limacina helicina* (12584 indiv./1000m³) were at the higher latitudes. Conversely, *Limacina retroversa* (51826 indiv./1000m³) and *Clione limacina* (267 indiv./1000m³) occurred in the highest number in the vicinity of the Norwegian coast.

Marcin Kalarus, Maria Iwona Żmijewska

University of Gdańsk
mkal@ug.edu.pl

Taxonomic differentiation of larvacea on African – Antarctic transect during Antarctic summer 2010

Due to some problems in taxonomic identification and conservation knowledge about biology and ecology of appendicularians are still relatively poor and fragmentary, especially in the Antarctic region. In recent decades there is an increase in interest regarding this taxa, this is mainly due to their capability of utilizing picoplankton and nanoplankton-sized particles and high filtration rates. Larvacea play an important role in functioning of microbial loop and energy transfer from lower trophic levels and are considered an important source of food for many fish larvae.

Biological material used in this study was collected on Cape Town – Weddell Sea transect during summer 2010, with use of WP2 plankton net (100 µm mesh size) during the Russian research expedition on r/v Akademik Ioffe. Presented results are part of the more complex studies focusing on variations in the distribution of main zooplankton taxa in relation to hydrological conditions in the Atlantic sector of Southern Ocean.

Results showed a clear patchiness in horizontal distribution of Appendicularia, which occurred in high densities on some stations. There were also observed changes in species distribution along the transect corresponding with the changes in hydrology of water masses, especially with temperature, and probably food distribution. The identified taxa were typical representatives of the larvacean fauna of this region in particular *Oikopleura gaussica*, *Fritillaria borealis* and *F. haplostoma*. Most of the noticed individuals belonged to family Fritillariidae.

Marek Kasprzak

Institute of Geography and Regional Development, University of Wrocław
marek.kasprzak@uni.wroc.pl

DEMs based analysis of moraines degradation, the Werenskioldbreen case study (SW Spitsbergen)

The Werenskiold glacier, located on Wedel-Jarlsberg Land, and its foreland are a place of glaciological and geomorphological observations conducted by researchers from more than half a century. In mentioned period of observations, rapid retreat of the glacier face and dynamic changes in the morphology of the glacier foreland were frequently noticed and published.

Apparent changes in the morphology of the Werenskiold foreland concern the largest of existing forms here – a terminal moraine, lateral moraines and medial moraine. All of them include ice-cores. Moraines are degraded mainly by melting of the ice-cores and landsliding processes on the surface. This situation conducive to fluvial and thermoerosional processes.

The aim of the study is to identify main areas of the Werenskiold glacier moraines where their degradation took the largest value, and to determine a rate of this process, and secondary, an attempt to answer reasons for observed spatial differentiation of these processes. Therefore, I have created two digital elevation models (DEMs) corresponded to terrain surface in years 1957–1959 and a morphological situation in 2010. A basis for their creation was a Lipert's 1:5000 topographic map (Werenskioldbreen Glacier The Foreland) with contour lines at 1.25 m and a stereo pairs of aerial photographs purchased from Norwegian Polar Institute. The first model is a result of manual digitization of contour lines and an application of Topo to Raster module (ArcGIS). The second model was created in Agisoft PE software, dedicated to aerial photographs process and construction of spatial models. For the validation of second model geodetic measurements conducted in 2012 by W. Ciężkowski, Grudzińska and P. Zagożdżon were used.

As a result of application of DEM of Difference (DoD) it was calculated a surface decrease and indicated a spatial distribution of the processes. The biggest changes in topography relate to a medial moraine and its connection to the terminal moraine. This situation result from a ratio between an ice and a rock material builds the moraines. To exclude an impact of an aspect an exposure, I have modeled an Incoming Solar Radiation Potential.

Grzegorz Karasiński*, Tomasz Wawrzyniak, Bartłomiej Luks,
Magdalena Bloch, Dariusz Puczko

* Institute of Geophysics, Polish Academy of Sciences, Warszawa
gkaras@igf.edu.pl

Validation, homogenization and evaluation of meteorological data from Polish Polar Station at Hornsund

The meteorological observations at Hornsund Polish Polar Station at Hornsund fiord started on the 1st of July 1979. Since the 15th of August 1982 permanent and systematic observations and measurements are carried out continuously. Among others, the database called Htermin was created, covering all available results of measurement and observations done every day at 0, 3, 6, 9, 12, 15, 18 and 21 o'clock UTC (Coordinated Universal Time UTC).

Through many years data were entered to database manually. Since then, there was no advanced data validation performed on this dataset. In the season 2012/2013 the Htermin meteorological dataset was used as a support for lidar measurements performed in the Station. During this task many errors were found. Only small part of data, matching lidar measurements, was validated. As the work of lidar laboratory progressed, there was need for temperature and humidity profiles, which were derived from meteorological models. At this moment validation of numerically modeled dataset has been necessary. The simplest way was to compare modeled values to measurements at Station. It had to be proceeded by validation of available meteorological data.

Since our motivation was to use the data only for lidar laboratory purposes, only temperature, relative humidity and air pressure at the Station level has to be validated. Additionally during the validation process other corresponding meteorological components were also corrected i.e. dew point temperature, water vapour partial pressure, pressure reduced to mean sea level and values of absolute air pressure change.

Apart to the validation and homogenization of the data series, also evaluation of the data was performed. The results are related to the climate change and seasonal characteristics of the climate in the vicinity of Polish Polar Station at Hornsund.

W. Kellmann-Sopyła^{1,2}, J. Szewczyk¹,
M. Nowicki¹, I. Giełwanowska^{1,2}

¹Department of Plant Physiology, Genetics and Biotechnology
University of Warmia and Mazury in Olsztyn
wioleta.kellmann@uwm.edu.pl

²Institute of Biochemistry and Biophysics PAS, Department of Antarctic Biology, Warszawa
and Polish Antarctic Station "H. Arctowski"

Germination ability of diaspores of polar Caryophyllaceae and Poaceae species under different temperature conditions

The aim of this study was to determine germination capacity of diaspores of five polar flowering plants under different temperature conditions. The studied species are representatives of Caryophyllaceae family (*Colobanthus quitensis*, *Cerastium alpinum* and *Silene involucrata*) and Poaceae family (*Deschampsia antarctica* and *Poa annua*).

Examined diaspores were collected during two growing seasons, in years 2010-2012. Germination tests were performed at two fluctuating (20/7°C; 30/20°C) and two constant (12°C; 20°C) temperatures, 8 months after diaspores collection. For *C. quitensis*, *D. antarctica* and *C. alpinum* diaspores the effect of two-month cool stratification (4°C and darkness) on germination capacity was examined. Counting of germinated seeds was carried out daily for one month. Thereafter, the final germination percentage and the mean germination time were determined.

The seeds of studied polar vascular plants showed highly varied germination ability, from definitely weak (*C. alpinum*, maximum 8%), weak (*D. antarctica*, maximum 30%), medium (*P. annua*, maximum 50%), high (*C. quitensis*, maximum 79%), to extremely high (*S. involucrata*, maximum 99%). The largest differences depending on the temperature were observed among *C. quitensis* seeds, which at fluctuating temperature 20/7°C germinated at 70%, while at other temperature treatments their germination did not exceed 11%. Considerable differences were also observed in case of *P. annua* caryopses. Their germination capacity was the highest at 12°C and at the same time it was about two times higher than at other studied treatments. Two-month cool stratification significantly stimulated the germination and reduced the mean germination time of *C. quitensis* and *D. antarctica* diaspores, while it did not stimulate the germination of *C. alpinum* seeds.

The obtained results show that studied diaspores are characterized by different adaptive strategies to hard environmental conditions occurring in polar regions. Probably, *C. quitensis* seeds are in non-deep physiological dormancy, while diaspores of *C. alpinum* and *D. antarctica* are in deep primary dormancy.

Natalia Kochman¹, Teresa Noga², Jadwiga Stanek-Tarkowska³,
Anita Pajączek³, Łukasz Peszek⁴, Maria Olech⁴

¹International Doctoral Studies in Natural Sciences, Faculty of Biology and Agriculture,
University of Rzeszów,
kochman_natalia@wp.pl

²Department of Biological Foundations of Agriculture and Environmental Education,
Faculty of Biology and Agriculture, University of Rzeszów

³Department of Soil Studies, Environmental Chemistry and Hydrology,
Faculty of Biology and Agriculture, University of Rzeszów

⁴Zdzisław Czepe Department of Polar Research and Documentation, Institute of Botany,
Jagiellonian University, Kraków

Soil diatom communities development on the Sphinx Glacier foreland (King George Island, Antarctica)

The glacier recession causes the exposure of new areas that can be colonized in the process of primary succession. King George Island is the largest (1150 km²) island of South Shetland Islands. Sphinx Glacier is situated in central part of ASPA 128 on western coast of Admiralty Bay. The Sphinx Glacier forefield is bottom moraine with numerous braided streams, which very often change their river beds. It is made by the soil of skeleton type (regosols) with a low organic matter content. This foreland is devoid of bird nests or penguin colonies. They could be occupied only by the pioneer communities. The aim of this study was to research the soil diatoms diversity on Sphinx Glacier forefield.

The 56 samples have been collected from ice-free areas of Sphinx Glacier foreland from 2005 to 2009, during Antarctic Expeditions. In studied soil samples the organic matter content was very low. Physicochemical analyses shown some small fluctuation in pH H₂O (6,5–8,0). Inconsiderable increase in pH was observed in following years.

In studied material 133 taxa were noted. Thirty eight taxa were determined on 4 sites in year 2005/2006. In years 2006/2007 and 2007/2008 on 25 study sites along two different transects 102 taxa were identified. One year later from 27 samples collected from the same two transects only 58 taxa were noted. Twenty of them were not recorded in previous years.

The most abundant dominants (at least 50 cells of all noted in sample) were: *Achnantes coarctata* (Bréb.) Grunow, *Halamphora* sp., *Luticola nivalis* (Ehrenb.) D.G. Mann, *Luticola quadriscribulata* Van de Vijver, *Navicula austroshetlandica* Carlson, *Pinnularia australomicrostauron* sp. nov. and *Pinnularia subantarctica* var. *elongata* (Manguin) Van de Vijver & Le Cohu.

Waldemar Kociuba

Maria Curie-Skłodowska University, Lublin
waldemar.kociuba@umcs.pl

Bedload transport in a High Arctic gravel-bed river (Scott River, Svalbard SW)

The article presents results of measurements of bedload transport rate, performed during the main part (34 day) of ablation season 2013, in the proglacial gravel-bed river catchment (Scott River, Svalbard). The study revealed temporal and spatial variability of bedload transport rate. It varied from 0.1 to 169.4 kg m⁻¹ day⁻¹ at individual measurement sites. Channel-mean bedload transport rate (q_a) amounted from 8.8 to 20.4 kg m⁻¹ day⁻¹, and the mean value at individual sites varied from 0.05 to 47.1 kg m⁻¹ day⁻¹. In the period analysed, in the cross-profile closing the Scott River catchment at the river's mouth, the river discharged a total of approx. 2571 kg of bedload, with mean daily (Q_b) of approx. 92 kg day⁻¹. The mass of bedload and rate of transport were dependent on hydrodynamic conditions and stream regime, directly related to weather. Also the effect of Scott Glacier retreat on discharge rate was emphasised, along with the indicative character of bedload transport rate. It responds to changes in the rate and magnitude of processes in a glacial catchment quite rapidly, and therefore can be treated as a good indicator of transformations occurring in the arctic zone. The study was conducted in the scope of the 25th Polar Expedition of the Marie Curie-Skłodowska University in Lublin to Spitsbergen, implementing grant of the National Science Centre "Mechanisms of fluvial transport and delivery of sediment to the Arctic river channels with different hydrologic regime (SW Spitsbergen)" No. 2011/01/B/ST10/06996. The paper was prepared in the scope of promotion of the project POIG.01.03.02-00-082/10 "Providing European patent protection for the device for measuring bedload transport in river beds" implemented by MCSU in Lublin, co-financed from the resources of the European Union in the scope of the Operational Programme Innovative Economy, years 2007-2013, Priority 1. 'Research and development of modern technologies'.

Waldemar Kociuba¹, Grzegorz Gajek, Łukasz Franczak,
Sara Lehmann, Żaneta Polkowska

¹Maria Curie-Skłodowska University, Lublin
waldemar.kociuba@umcs.pl

The distribution and changeability of sediment yield and its delivery at the small glacial catchment (Scott River, Svalbard SW)

The paper presents results of 42-day measurements of sediment yield, performed during the main part of ablation season 2012 in the small glacial catchment (Scott River) and its relationship to the environmental conditions. The catchment studied, with an area of approx. 10 km², drains the NW part of the Wedel-Jarlsberg Land (Spitsbergen). The field research on the variability of sediment transport rate was conducted in two cross-profiles: upper (above the alluvial fan) and lower (below the alluvial fan), located in the lower part of valley. Monitoring of the sediment transport covered cyclical measurements of water levels and discharge rates in representative cross-sections. Samples for analyses of suspension and total mineralization was taken every 24 hours. The methodology of estimation of concentrations of solutions and suspensions was referred to works conducted in previous years. Water samples was taken by means of a water-bottle sampler at half depth in the mainstream zone. Suspension concentration was determined by means of the method of filtration and weighing drains. Solution concentration – by means of the conductometric method. The specialist analyses requiring the application of precise scientific equipment was carried out in the laboratory of the Department of Analytical Chemistry - Gdansk University of Technology in based on water samples. The applied method of measurement in the designated sections of the channel cross-profile permits the determination of the reasons for the spatial and temporal changeability and mechanisms of sediment transport. The study was conducted in the scope of the 24th Polar Expedition of the Marie Curie-Skłodowska University in Lublin, implementing grant of the National Science Centre “Mechanisms of fluvial transport and delivery of sediment to the Arctic river channels with different hydrologic regime (SW Spitsbergen)” No. 2011/01/B/ST10/06996. The paper was prepared in the scope of promotion of the project POIG.01.03.02-00-082/10 implemented by MCSU in Lublin.

Piotr Köhler

Jagiellonian University, Kraków
piotr.kohler@uj.edu.pl

Polish expedition to Torell Land, Spitsbergen, in 1934 in the light of archival materials

The expedition had the dual nature: scientific and mountaineering. Seven persons participated in it: Witold Biernawski (1898–1957) – filmmaker and radio operator, Stefan Bernadzikiewicz (1907–1939) – the manager, Henryk Mogilnicki (1906–1999) – photographer and a radio operator, Zbigniew Stefan Różycki (1906–1988) – geologist, Stanisław Siedlecki (1912–2002) – weather observer, Sylwester Bohdan Zagajski (1892–1940) – triangulator, Antoni Rogala-Zawadzki (1896–1974) – topographer-fotogrammetrist.

The aim of the expedition was to collect data in the field of geology and cartography and, to a lesser extent, of glaciology, botany, zoology, and of meteorology. The expedition lasted from 20 May to 16 September 1934 (20 June – 28 August – on Spitsbergen), in the Torell Land.

Results: The hitherto unexplored area of approximately 300 km² was covered with grid of triangulation measurements and photogrammetric photographs. Geological surveys covered an area of about 500 km². Also were collected geological specimens of a total weight of ca. 800 kg. Two maps (1: 50 000 and 1: 200 000) were published on the basis of the study. Expedition gave new names for different topographic objects on the area of Torell Land; the names were associated with Polish culture. During the expedition was made about 2000 photographs and a film. In addition to scientific papers, participants also published diaries of the expedition.

Archival materials collected in the Prof. Z. Czeppe Department of Polar Research and Documentation of the Jagiellonian University in Kraków consist mainly of correspondence of the expedition organisers with Adolf Hoel (1879–1964), director of the Norwegian Institute for Research in Svalbard and the Polar Seas. On the basis of these documents one can trace the development of ideas concerning course of the expedition, area of its operation, tasks, and even the number of participants and the type of equipment.

Małgorzata Kolicka, Krzysztof Zawierucha

Adam Mickiewicz University in Poznań
malgorzata.kolicka@gmail.com

Gastrotricha from the Spitsbergen – one new genus and four new species of freshwater Chaetonotida (Gastrotricha)

Gastrotricha is a phylum of monophyletic, microscopic, acoelomate metazoans ranging from 50 µm to 3500 µm in length. Hitherto, ca. 800 nominal species of Gastrotricha divided into two orders, Chaetonotida and Macrotrichida, have been described. They are a common component of meiofauna communities and constitute a constant and significant component of benthic, psammon, and epiphytic ecosystems. Despite the fact that gastrotrichs are ubiquitous, the state of knowledge on their biodiversity and biogeography is very heterogeneous. The main factor accounting for this low level of investigation of these animals is the small number of taxonomic specialists of this group. From the Spitsbergen, freshwater gastrotrichs were studied twice, but they have never been determined to species level.

In a single sediment sample collected in August 2013 from Longyearbyen, 308 individuals belonging to 8 species, 2 genera and 1 family were found. Six species and one genus are new to science. All of the newly observed species differ from other known freshwater Chaetonotida by having a specific cephalion construction, wider cilia in the posterior cephalic tuft and a strongly developed, thicker chorion on the eggs. Moreover, the new genus is very highly specific via its slender, bottle-shaped body with a hummock in the furcal appendages; thin, one-lobed scales with spines which after a short, straight base segment curve strongly and become bifid at the curvature, thus becoming two separate spines of equal length that taper towards their hair-like ends; thick, rigid adhesive tubes; a mouth ring, a pharynx, intestine junction and enzymatic section construction.

The absence of planktonic larvae in gastrotrichs and isolation of the Svalbard archipelago from Europe and Greenland can influence fast speciation of this group in the studied area. Thus, the Gastrotricha fauna of Spitsbergen has been underestimated and studies conducted in other aquatic habitats can yield more new species.

Krzysztof Kolon, Bronisław Wojtuń,
Aleksandra Samecka-Cymerman

Department of Ecology, Biogeochemistry and Environmental Protection, University of Wrocław
bronislaw.wojtun@biol.uni.wroc.pl

Multivariate exploratory technique (PCCA) as a tool in the classification of the metals composition in various types of tundra vegetation, SW Spitsbergen, Norway

Arctic environments are usually considered to be relatively clean because of slightly local human activity. However, these areas receive air pollution from lower latitude regions. Our goal was to make the classification of the metals composition in various types of tundra vegetation. Accordingly we determined concentrations of 10 metals (Cd, Co, Cr, Cu, Fe, Hg, Mn, Ni, Pb, and Zn) in dominant species of vascular plants, mosses, lichens, algae, and in the biological soil crust (BSC), and topsoil (0–3 cm) from various types of tundra in the southwestern part of Spitsbergen, Norway. Differences among sampling sites in concentrations of elements in types of collected biota and soil were evaluated by nonparametric ANOVA Kruskal–Wallis analysis. Multiple comparisons of mean ranks for types of investigated material were then calculated. The matrix of concentrations of 10 metals in plant, lichen, algae, and BSC samples from 35 sites after Box–Cox transformation and standardization was subjected to ordination to reveal possible gradients of element levels by means of the principal component and classification analysis (PCCA). Principal component analysis (PCA) often is used in ecology to reduce the data and stabilize subsequent statistical analyses. PCCA is based on PCA and offers a practical and clear classification of a set of data for a number of objects. Plot of PCCA ordination of the samples and projection of the concentrations of elements on the factor plane gives information about similarities between samples and shows correlations between the original variables and the first two factors, practically and clearly classifies a set of data for a number of objects. PCCA analysis revealed that the BSC, *R. lanuginosum*, *S. uncinata*, and *S. stramineum* accumulated the highest concentrations of Co, Cr, Cu, Fe, Hg, Mn, Ni, and Pb in their tissues growing in polygonal tundra, initial cyanobacteria-moss wet tundra, snow bed cyanobacteria-moss tundra, and flow water moss tundra alimented by melting ice or snow. This implicates the probability that metal contaminants observed to bioaccumulate in these species originate from atmospheric deposits; therefore, a high degree of metal accumulation can be linked to greater wetness of habitats. *P. crispus* and *S. polaris* were the best accumulators of Cd and Zn. Mosses accumulate significantly higher concentrations of metals than lichens.

Magdalena Komorowicz¹, Andrzej Fojutowski¹,
Hanna Wróblewska¹, Aleksandra Kropacz¹, Andrzej Noskowiak¹,
Grzegorz Gajek², Łukasz Franczak², Leszek Łęczyński³

¹Wood Technology Institute, Poznań
m_komorowicz@itd.poznan.pl

² Maria Curie Skłodowska University in Lublin

³University of Gdańsk, Institute of Oceanography, Gdynia

Properties of driftwood from Bellsund coast (Svalbard) – Preliminary results

All types of wood fragments drifting with the currents of rivers and seas and finally deposited on the coast far away from the place of origin are referred to as driftwood. Significant amounts of wood logs appear on the shores of the treeless areas, also on coasts of the fiords of Svalbard. Driftwood is a very interesting material for tracking of marine currents and changes on the coast lines. It is also analyzed in terms of its origin and properties. In order to recognize some of the selected physical, mechanical and chemical properties, ten driftwood samples were taken from Bellsund coast (Svalbard) during the Maria Curie-Skłodowska University in Lublin polar expedition in 2012. Anatomical studies have led to the identification of three species of wood within the sampled driftwood: spruce (*Picea* sp.), larch (*Larix* sp.) and Scots pine (*Pinus silvestris* L.). Pine was represented by seven discs from three different logs and thus it was subjected to further research. Preliminary studies of selected physical and mechanical properties of Scots pine wood included: density, the strength of compression along the grain and equilibrium moisture content. Main chemical components of wood, such as cellulose, lignin, water and ethanol soluble substances, mineral substances (ash) and pH value were tested. The study also included heat of combustion and calorific value analyses. The biological properties of driftwood were tested in terms of its susceptibility to decay caused by Basidiomycetes fungi. The results of the research on driftwood were compared with data obtained from the analysis of recent Scots pine wood samples. The study showed the differences between the physical, chemical and biological properties of analyzed Scots pine driftwood, and the same properties of the pine control wood.

M. Korzystka-Muskała¹, T. Sawiński¹, J. Zelinka²,
P. Muskała¹, J. Piasecki¹

Institute of Geography and Regional Development, University of Wrocław
magdalena.korzystka@uni.wroc.pl

²Štátna ochrana prírody Slovenskej republiky, Slovak Caves Administration, Slovakia

“Arctic” conditions in non-arctic regions – an example from entrance area of Dobšinská Ice Cave (Slovak Paradise, Slovakia)

In the mid-latitudes Arctic-like environmental conditions are usually referred only to high mountains with alpine climate, but similar microclimatic conditions – although in micro scale – may also occur in lower regions with generally warmer microclimate. Entrance area of Dobšinská Ice Cave (a limestone cave located at 969 m a.s.l. with 110 000 m³ of ice accumulated inside) may be depicted as an example of such situation. It has a form of a small karst depression, with diameter of about 20 m, depth of 7 m and NW exposure. At the bottom of the entrance area there is located the cave entrance. Despite the open form, which potentially allows the influence of external conditions, the microclimate of the entrance depression and its surroundings differs significantly. In Winter half-year thermal conditions inside the entrance area are similar to the surroundings. In the contrary, throughout the whole summer half-year the air temperature in the deep part of the depression remains at the level of 0–1 °C, while average external temperature is 11.9 °C. Detailed studies carried out since 2003 as a part of a broad research program on the Dobšinská Ice Cave climate system have shown, that specific microclimate of the entrance depression is formed as a result of seasonal changes in cave ventilation processes, driven by the chimney effect. Winter inflow of external air into the cave cool down the whole entrance area, while summer continuous outflow of air from the “glaciated” cave interior preserve the cold inside the depression. Under the influence of this extraordinary climatic conditions, inside the entrance area of the cave a specific environment is formed, untypical, among others, due to clear micro-scale vegetation inversion and presence of cryophilic plants in the depression bottom part.

Katarzyna Kozak*, Małgorzata Szopińska,
Łukasz Stachnik, Marek Ruman, Sara Lehmann,
Stanisław Chmiel, Żaneta Polkowska

* Gdańsk University of Technology
katarzynakozak.gda@o2.pl

Chemeometric studies on the metals concentration levels in the surface water samples collected in the Revelva River catchment

The chemometric analyses is a perfect tool using statistical and numerical methods in data treatment. Thanks to it it is possible to obtain useful information on the multidimensional datasets. In the monitoring studies on the environmental quality of the Arctics it is extremely important to assure continuity of the measurements that give reliable picture of the environment. Object of the studies was a set of data obtained due to seasonal studies on metals migration in the arctic tundra conducted in 3 years (2010–2012) on the basis of the Revelva catchment. The studies combined detection and determination of concentration levels of numerous microelements (Ag, Al, As, B, Ba, Bi, Ca, Cd, Co, Cr, Cu, Cs, Mo, Ni, Pb, Sb, Se, Sr, Tl, U, V, Zn), physicochemical parameters (pH, conductivity) and summarized ones (TOC) in the surface water samples. In the study the characteristics of fluctuations of concentration levels of metals was presented. Differing tendencies for particular elements were observed, with special attention paid to microelements of very high toxicity level and potential danger to organisms: Cd, Pb, Cu, Zn, Cr. Furthermore relationship between metal content and organic matter is presented. Results obtained are visualized with relationships present in the multidimensional dataset and internal structure of the data is given. Results of studies of chemicals concentration levels in the abiotic elements and living organisms may constitute the well documented basis to undertake actions preventing farther expansion of particular metals. Only long-term monitoring of the environment enables verification of the changes in the environment and constitutes a tool in identifying sources of pollutants emission.

The project was funded by the National Science Centre allocated on the basis of the decision number DEC-2013/09/N/ST10/04191. Also, the authors desire to thank for help in collecting a portion of the samples: Zbigniew Sobierajski.

Katarzyna Kozak*, Małgorzata Szopińska,
Łukasz Stachnik, Marek Ruman, Sara Lehmann,
Stanisław Chmiel, Żaneta Polkowska

* Gdańsk University of Technology
katarzynakozak.gda@o2.pl

Recognition of the atmospheric precipitation role in the proces of POPs migration on the example of PAHs and PCBs in relation to the arctic catchment (Hornsund, Svalbard)

The sophisticated character of the arctic catchment is connected with the presence of bi-lateral dependence between particular components. Results of studies, next to cognitive character, may constitute the basis to undertake proper actions aimed at reduction of intensity of these relations and, if possible, elimination of the pollution sources. Studies on the polar regions may serve as a tool to forecast changes accuring in the environment. Studies on chemistry of the samples of precipitate and surface waters can contribute very detailed information on the magnitude of pollutants load in given area. Perfect example are arctic catchments that represent cycle the pollutants make during their transport in the environment starting from emission and finishing with imission of the pollutants. The phenomena of the atmospheric circulation and pollutants transport for long distances make the polar regions an important indication region which enables determining persistence and accumulation availability of POPs in the environment. Studies on the environment condition aim at learning impact of different pollutants on the ecosystems' equilibrium. Atmospheric precipitation constitute an important element in the process of atmosphere clean-up. It also plays an important role in pollutants transport – mainly as the transportation medium. Special attention should be paid to problems of pollutants transfer in the environment of the arctic tundra.

The project was funded by the National Science Centre allocated on the basis of the decision number DEC-2013/09/N/ST10/04191. Also, the authors desire to thank for help in collecting a portion of the samples: Zbigniew Sobierajski.

Krzysztof Kubiak

University of Lower Silesia, Sosnowiec
herkub@wp.pl

Russian Icebreakers. Present day and future

Russia has the greatest flotilla of icebreakers all over the world. The group consists conventional (diesel – electric) ships and nuclear ones. The main task of the vessels is to maintain sea lines of communication at the Arctic Ocean. Thanks to the icebreakers Russia can control the North East Passage (Northern Sea Route). The vessels play also important military role because they are able to assist warships during operation at the North. The nuclear icebreakers are also the very valuable element of Russia's Arctic Search and Rescue system. It must be underlined that Russian Federation develops its SAR (Search and Rescue) possibilities at the Far North. At present SAR operations, as well as oil spill response actions on the tracks of the Northern Sea Route are organized by Ministry of Transport of Russia. Directly for SAR task is responsible State Marine Emergency Rescue Service of Russia through the Marine Operations Headquarters. There are two such Headquarters: in the Western sector of the Arctic – on the basis of the Federal State Unitary Enterprise "Atomflot" in the Eastern sector of the Arctic – on the basis of "Far Eastern Shipping Company". The first company has, among other values, six nuclear icebreakers the second one has four diesel-electric icebreakers. Usually in disposition of SAR service are four nuclear and one diesel-electric icebreaker. The rescue group with special diving and oil spill response equipment are carried by ships (one nuclear and one diesel-electric). The paper shows the present day of Russian icebreakers and the future development of these group of vessels.

Grzegorz Kusza*, Leszek Łęczyński, Piotr Zagórski,
Łukasz Franczak, Grzegorz Gajek, Tomasz Opara

* Department of Land Protection, University of Opole
Grzegorz.Kusza@uni.opole.pl

Magnetic susceptibility of soils and sediments in the fjord region of Bellsund (Spitsbergen)

Magnetic susceptibility is a physical quantity that describes the ability of a substance to change the magnetization under the influence of an external magnetic field. The magnetic susceptibility value indicates the amount and type of magnetic minerals in the investigated sample of soil or sediment. Magnetic susceptibility is a very useful parameter that could be used for a rapid determination of the presence of ferromagnetic minerals in soils and sediments. The paper presents the results of the analyzes the selected magnetic parameters, such as the field and mass magnetic susceptibility, in soils and sediments collected in the vicinity of the fjord of Bellsund (Spitsbergen). Sediment samples were collected from three lagoons: Josephbukta, Chamberlindalen and Recherche. Soils were collected from the Calypsostranda (Western Spitsbergen), which is a coastal plain slightly inclined towards the north-east, consisting of many raised marine terraces. Sediment samples were collected on the basis of the prior bathymetric analysis of the seabed, regarding the existing geomorphological system. At each site the coordinates were specified, and then sediments were collected by means of Van Veen grab. Field magnetic susceptibility of the investigated soils and sediments were measured using MS2 Bartington meter with MS2B Dual Frequency Sensor (for sediments) and MS2C Core Logging Sensor (for soils). The obtained values of field magnetic susceptibility were converted into mass magnetic susceptibility, considering the density of the sample. Field magnetic susceptibility (κ) is a dimensionless value expressed as [10^{-5} SI], whereas mass magnetic one as [$10^{-8} \text{m}^3 \text{kg}^{-1}$]. The work was financed by the National Science Centre project No N N 306 703840, leader: Piotr Zagórski, Ph.D.

Sara Lehmann*, Łukasz Franczak, Grzegorz Gajek,
Leszek Łęczyński, Katarzyna Kozak, Żaneta Polkowska

* Gdańsk University of Technology
sara.lehmann8@gmail.com

Arctic lakes as a sink of anthropogenic pollutants (Bellsund, SW Spitsbergen)

The present studies concerns contamination of Arctic water by atmospheric pollutants. Water samples of more than thirty closed-drainage water bodies were collected in NW part of Wedel Jarlsberg Land (SW Svalbard Archipelago). Lakes were located at the forefields of Scott and Renard Glaciers, and on the periglacial plain Calypsostranda in the vicinity of the Research Station of Maria Curie-Skłodowska University in Lublin-Calypsobyen. In this work the physico-chemical parameters (total organic carbon) and concentrations of organic pollutants (sum of phenols, formaldehyde) in various genetic types of arctic lakes were examined. Samples were collected from 13.07 till 23.08 of 2012.

Arctic lakes functioning in various environmental conditions determining the genetic type of the basins: supraglacial, ablation, moraine, coastal, tundra, kame and outwash plain, were examined on presence of pollutants. High Arctic lakes respond rapidly to slight changes in environmental conditions. Due to progressive warming and long range transport of pollutants from urbanized and industrialized Eurasia areas, polar lakes and ponds are becoming a sink for wide range of xenobiotics.

The results of water samples from the area of Scott and Renard Glaciers catchments indicate the presence and spatial distribution of pollutants being of interest. The conducted researches shows that physicochemical parameters and levels of pollutants differs between each other's due to the genetic type of the basins in which lakes are functioning and also dependent on their localization. Concentration levels of TOC exceed the corresponding to oligotrophic lakes. Presence of xenobiotics suggest that Arctic lakes may play a role of sink of pollutants.

The study was conducted in the scope of the 24th Polar Expedition of the Marie Curie-Skłodowska University in Lublin to Spitsbergen, implementing grant of the National Science Centre "Mechanisms of fluvial transport and delivery of sediment to the Arctic river channels with different hydrologic regime (SW Spitsbergen) No. 2011/01/B/ST10/06996".

Sara Lehmann*, Waldemar Kociuba, Grzegorz Gajek,
Łukasz Franczak, Katarzyna Kozak,
Jacek Namieśnik, Żaneta Polkowska

* Gdańsk University of Technology
sara.lehmann8@gmail.com

Organic compounds of anthropogenic origin present in a small glaciated catchment of Scott Glacier

The study area covered the NW part of the Wedel Jarlsberg Land (SW part of the Svalbard Archipelago). The primary study object was the catchment of the Scott Glacier in the vicinity of the Research Station of Maria Curie-Skłodowska University in Lublin – Calypsobyen. The Scott River catchment (of glacial hydrological regime) has an area of approximately 10 km², 40% of which is occupied by the valley Scott Glacier in the phase of strong recession.

The present study concerns the determination of physicochemical parameters (total organic carbon) and concentrations of organic pollutants (PCB's, PAHs). Various elements of the glacier catchment (glacier surface, moraine lakes, glacier river, tributary of the glacier river) were examined in order to fully understand the spatial distribution of xenobiotics in water environment. Samples of firn and surface waters (supraglacial runoff, lakes, river, stream) were collected from 13.07 till 23.08 of 2012.

The results of firn and water samples from the area of Scott Glacier catchment indicate the presence and spatial distribution of pollutants being of interest. The conducted researches show that the concentration of TOC is lower than the average value of TOC assumed for the Arctic climate rivers. TOC value is much higher in stagnation waters than in flowing waters. Presence of PCBs and PAHs in analyzed samples proves that long range transport of pollutants through the atmosphere (LRTAP), from urbanized and industrialized areas of lower altitudes to polar areas, is still a current issue and Arctic cannot be consider anymore as area free from pollutants.

The study was conducted in the scope of the 24th Polar Expedition of the Marie Curie-Skłodowska University in Lublin to Spitsbergen, implementing grant of the National Science Centre "Mechanisms of fluvial transport and delivery of sediment to the Arctic river channels with different hydrologic regime (SW Spitsbergen) No. 2011/01/B/ST10/06996".

Sara Lehmann*, Grzegorz Gajek, Łukasz Franczak,
Waldemar Kociuba, Leszek Łęczyński, Stanisław Chmiel,
Katarzyna Kozak, Żaneta Polkowska

* Gdańsk University of Technology
sara.lehmann8@gmail.com

Spatial distribution of metals present on the surface of Scott and Blomli glaciers (Bellsund, SW Spitsbergen)

Studies on presence of inorganic pollutants on the surface of glaciers were conducted in NW part of the Wedel Jarlsberg Land (SW Svalbard). The main objects were two glaciers in strong recession phase. The basins of the glaciers occupies approximately an area of ca 10 km² (40% of which is covered by the valley Scott's Glacier) and 7 km² (25% of which is covered by valley Blomli's Glacier), respectively. The Blomli Glacier is located to the north-west of the Scott Glacier. The Scott Glacier accumulation zone has a common firn field with Blomli Glacier while the glaciers tongues are exposed to the north-east and north, respectively.

In this work the physicochemical parameters (pH, conductivity) and concentrations of inorganic pollutants (metals) were examined in surface firn and ice samples. In order to understand distribution of metals on the glacier surface and influence of specific conditions related to glaciers slope and accumulation zone extent. Samples of surface firn and ice were collected from the Scott and Blomli Glaciers in ablation season of 2012.

The results of surface firn and ice samples from the area of Scott and Blomli Glaciers basin indicate the presence and spatial distribution of inorganic compounds being of interest. Their low levels of concentrations may be related to various process, for example migration of chemical compounds into the deeper layers of firn and ice cover of the glacier in a consequence of percolation. This allow us to expect higher concentration levels of metals inside of the glaciers ice.

The study was conducted in the scope of the 24th Polar Expedition of the Marie Curie-Skłodowska University in Lublin to Spitsbergen, implementing grant of the National Science Centre "Mechanisms of fluvial transport and delivery of sediment to the Arctic river channels with different hydrologic regime (SW Spitsbergen) No. 2011/01/B/ST10/06996".

Michał Łuszczuk

Jan Kochanowski University, Kielce
mluszczuk@gmail.com

Development of hydrocarbons resource in the Arctic. Much ado about nothing?

Production of hydrocarbons in Arctic region is very diversified: e.g.: Russia holds most of the region's natural gas reserves, while reserves in Alaska are dominated by oil; onshore resources have been produced for decades, while in terms of offshore extraction, Arctic is a largely frontier region. What is common is that the prospects of extraction of the Arctic's hydrocarbon resources are currently quite uncertain, and this is especially true for offshore exploitation.

Some parts of the Arctic waters are becoming more accessible owing to improved technologies, as well as changes in sea-ice in result of the climate change. Concurrently, interest in developing offshore hydrocarbons in the Arctic has grown in recent years. Largely untapped to date, the resource base is estimated as significant yet the technical and environmental aspects and high costs of operating in severe conditions present many challenges. Additionally, investments in exploration and production are influenced by global markets and prices, energy demand and policies concerned with economic development, energy security nexus and climate change, among other dynamic variables. So the extent and timing of development in the Arctic hydrocarbons exploitation is not easy to predict. Yet it is clear that extraction of those resources may have important influences on the Arctic environment, economies, geopolitics and the last but not least on societies. The prospect of the Arctic oil and gas exploitation also may have broader, even global implications.

This paper, referring primarily to the hydrocarbons production in the European and Russian parts of the Arctic (from Greenland to Yamal) aims to provide a concise analysis of these issues, focusing on the drivers for increased interests, the recent developments in the field, and possible impacts. It is concluded that development of hydrocarbons resources in the Arctic on large scale is a question of further future.

J. Maczukin¹, W. Kellmann-Sopyła^{1,2}, M. Domaciuk³, E. Szczuka³,
J. Perkowska¹, J. Szewczyk¹, I. Giełwanowska^{1,2}

¹Department of Plant Physiology, Genetics and Biotechnology,
University of Warmia and Mazury in Olsztyn
jola@maczukin.pl

²Institute of Biochemistry and Biophysics PAS, Department of Antarctic Biology, Warszawa
and Polish Antarctic Station "H. Arctowski"

³Department of Plant Anatomy and Cytology, Maria Curie-Skłodowska University, Lublin

Modification ways of development of the female generative structures Antarctic grasses, native *Deschampsia antarctica* Desv. and alien *Poa annua* L.

Both grasses, native *Deschampsia antarctica* Desv. and alien *Poa annua* L., in the maritime Antarctic produce bisexual flowers which develop into viable diaspores. These diaspores are of a very small size and are compact-shaped. Inflorescence and flower buds differentiate during the whole growing season. In the ovaries of these species tenuinucellate ovules are formed, which are characteristic of representatives of Poaceae.

In ovule nucellus of *D. antarctica*, facultative diplospory with atypical meiotic prophase in the megasporocyte was observed. In the development of megaspores, apart from typical, linear arrangement of tetrad postmeiotic cells, a T-shaped arrangement also occurred. In the ovules of Antarctic hair grass, the process of megasporogenesis initiated from single archesporial cell showed irregular arrangement of functional megaspores. Similar to *P. annua*, the development of embryo sac of *D. antarctica* proceeded mostly according to Polygonum type, although in about 30% of examined Antarctic hair grass ovules two megaspores took development into embryo sac and they were either chalazal megaspores, e. g. terminal and medial, or two micropylar megaspores or one chalazal and one micropylar megaspores.

At the stage of young embryo sac of *D. antarctica*, atypical arrangement of callose deposits at micropylar region of nucellus was observed. The anatomy of mature embryo sac showed the presence of starch in the egg cell.

In the examined mature embryo sacs of Antarctic hair grass the polyploidisation of three antipodal cells and their lateral arrangement, usually beyond chalazal region, was observed. In contrast, in *P. annua* intensive development of cells and forming of typical antipodal tissue with big, polyploid cell nuclei with many nucleoli took place.

In the young ovule nucellus of examined grasses, at the stage of 2-4 nuclear embryo sac, the presence of starch in the micropylar region was found. In the course of further development of embryo sac starch grains also appeared around the entire nucellus and were also visible in the mature embryo sac.

In the buds of *D. antarctica* disturbances of megaspores development and defective embryo sacs, e. g. with degenerative egg apparatus cells, polar nuclei and developing multinucleated antipodal cells, were observed. In the buds of *P. annua* similar defects were not observed.

Magdalena Madej

Jagiellonian University, Kraków
magdalena.m.madej@gmail.com

Arctic Council and the ecosystem-based management approach

The Arctic Council is a high-level intergovernmental forum that addresses issues faced by the Arctic governments and the indigenous people of the Arctic. In May 2011, Arctic Council Ministers called for the establishment of an expert group on ecosystem-based management for the Arctic environment. In accordance with the Arctic Council's definition ecosystem-based management is the comprehensive, integrated management of human activities based on best available scientific and traditional knowledge about the ecosystem and its dynamics, in order to identify and take action on influences that are critical to the health of ecosystems, thereby achieving sustainable use of ecosystem goods and services and maintenance of ecosystem integrity.

The Arctic region consists of a number of distinct marine and terrestrial ecosystems, which vary significantly in ecological and demographic ways. There are many existing and potential pressures, which make the Arctic ecosystems vulnerable. The Arctic climate is warming rapidly. Its impacts like thinning and reduced extent of sea ice has significant implications for Arctic wildlife and human populations. The other threats are pollution and increased economic activities such as oil and gas exploration or shipping.

To address these challenges, Arctic, as the planet's most vulnerable and fragile ecosystem, needs a flexible and adaptive management approach. Due to the Arctic Council's report, this approach has to recognize cultural and regional differences, apply an integrated and interdisciplinary approach to understanding and managing these ecosystems, and ultimately maintain the resilience of Arctic ecosystems and communities. The aim of this article is to present the ecosystem-based management approach and to explain why is it so important in the Arctic region, especially in the time of ongoing climate change.

Elżbieta Majchrowska

Faculty of Earth Sciences, University of Silesia, Sosnowiec
emajchrowska@us.edu.pl

Freshwater of Werenskioldbreen drainage basin compared to other studied glaciers on Svalbard

Monitoring in arctic hydrology comprising surface runoff, water balance, erosion, sediment transport, sedimentation and water temperature are extremely scarce in these regions. The main reason is due to the extreme climate conditions, but also a lesser need of commercial data from these areas. There is still general need for a better understanding of cold climate hydrology as a small but significant factor for better insight into the global environment.

A hydrological monitoring program in watershed of Werenskiold Glacier (SW Spitsbergen) is the part of an interdisciplinary effort led to the understanding of functioning of the glacier system in the high-Arctic. The paper describes characteristics of annual hydrographs for basin draining area of 44 km² (including 27 km² coverage of the glacier). Measurements were conducted by author since 2007 and the results show that the supply of freshwater from studied glacier is avg. about 1500 mm/yr.

The runoff from catchments with glaciers depends on meteorological conditions (especially precipitation) and on the mass balance status of the glaciers. The mean outflow on Spitsbergen as indicated by results from hydrometric and glaciological measurements, ranges between 300–350 mm in the low-lying areas to 1200–1500 mm in front of many glaciers (Pettersson, 1994, Hodgkins, 1997, Killingtonveit A, 2003, Sund M. 2008 et. al). This implies that glaciers located in the southern region belong to the reservoirs supplying the most of the freshwater. The position close to the terminus of the North Atlantic Current causes that Werenskioldbreen is under the influence of transported mild air and average annual temperature and precipitation are higher than in northern regions.

Hodgkins R., 1997. Glacier hydrology in Svalbard, Norwegian High Arctic. *Quaternary Science Reviews*, vol.16, 957-973.

Killingtveit A., Pettersson L.E., Sand K., 2003. Water balance investigations in Svalbard. *Polar Research* 22, 161-174.

Patterson, W.S.B., 1994. *The physics of glaciers*. Pergamon, Oxford, England, 285.

Sund M. 2008. Polar hydrology. Norwegian Water Resources and Energy Directorate's work in Svalbard. NVE Report 2. Oslo: Norwegian Water Resources and Energy Directorate.

Jakub Małecko

Faculty of Earth Sciences, University of Silesia, Sosnowiec
emajchrowska@us.edu.pl

Why is Svenbreen more resistant to climate warming than other small glaciers in Svalbard?

Melting Svalbard glaciers have been recognized as an early indicator of climate change. Large parts of these arctic islands remain however seldom investigated, including little glacier-covered Dickson Land in the interior of Svalbard. Impact of quasi-continental climate features on evolution of small local glaciers is poorly understood. The aim of the research was to investigate climate-glacier links in Dickson Land. For the object of detailed fieldworks Svenbreen has been chosen, representing a typical size for the region (4 km²).

Analysis of topographic data showed that several Dickson Land glaciers have been thinning at average rates of -49 ± 22 cm a⁻¹ between 1960 and 1990, while in the more recent interval 1990–2009 a distinct acceleration of their mass loss was noted (-78 ± 21 cm a⁻¹), linked to progressively warming climate in the region. Svenbreen showed relative resistance to increasing temperature by the least negative elevation changes (-32 ± 19 cm a⁻¹ and -61 ± 17 cm a⁻¹ respectively for both analysed epochs). Local factors reducing its mass loss were studied in detail i.e. with mass balance and energy budget methods. Observations of winter accumulation on Svenbreen revealed that the glacier receives significantly more snow, than neighbouring glaciers. Stake measurements gave enough data to draw an original temperature-ablation curve for Svenbreen, making it possible to reconstruct its summer balance until 1976, which confirmed much slower melting than on other glaciers in the archipelago. Reduced ablation is well explained by peculiar energy balance conditions.

The study concludes, that quasi-continental climate of central Svalbard, modified by local environmental factors, is well manifested in functioning of Svenbreen and that some small glaciers may be less sensitive to climate change, than it is commonly claimed for Svalbard. Further investigations are however needed to verify representativity of the presented records for regional extrapolations.

The presented work was part of the project "Dickson Land ice masses evolution (Svalbard) after the termination of the Little Ice Age and their present-day state and functioning" (N N306 062940) funded by the Polish National Science Centre."

Maciej Mańko, Angelika Słomska, Anna Panasiuk-Chodnicka

University of Gdańsk
mmanko@interia.pl

Influence of climate fluctuations on gelatinous zooplankton population structure, distribution, and diversity in polar regions

Pelagic coelenterates, and thaliaceans are acclaimed for performing immense population outbreaks, so called blooms. Therefore their presence, and distribution pattern strongly affect ecosystem functioning, simultaneously remaining environmentally determined phenomenon. Numerous inquiries revealed that certain planktonic organisms may be used as a climate dependent change indicators. However little is known about gelatinous zooplankton usage in such context.

Literature data suggests susceptibility of polar ecosystems to climate driven alterations. Remarks on gelatinous zooplankton populations in such areas are often given, however long-term trends, and their impact on other pelagic organisms persist unrevealed.

Herein we would like to present some results of our most recent studies of gelatinous plankton in polar regions with a literature review background. We confirmed that species composition of jelly-like taxa in both Arctic, and Southern Oceans is profoundly environmental dependent. For certain species distribution expands, and substantial increase in their populations size have been detected. Interspecies relations (i. e. *Salpa thomsponi* – *Euphausia superba*; *Aglantha digitale* – *Bougainvillia superciliaris*) in the context of both anticipated environment change, and trophic web reorganization have been proven. Finally our newest discovery of certain gelatinous species indicator character of water mass distribution, and therefore their potential in global/climate change monitoring has been described.

Henryk Marszałek*, Michał Rysiukiewicz,
Lech Poprawski, Dorota Górniak

* Institute of Geological Sciences, University of Wrocław
henryk.marszalek@ing.uni.wroc.pl

Warm springs of Disko Island (Western Greenland)

Geothermal activity of Disko Island is related to Paleogene basaltic pile and Precambrian gneisses. Warm spring located in south-western part of island, with temperature of maximum 18°C, represents typical fissure groundwater of deeper circulation under permafrost layer. Hydrogeochemically, warm waters vary compared with fresh waters of springs, recharged from thaw of ice or snow. Warm waters have higher mineralization (electrical conductivity EC up to 1712 $\mu\text{S}/\text{cm}$) and temperature (in tested springs to 14,4°C). The predominant hydrogeochemical type of water is Cl-Na-Ca. In opposite to them the fresh waters of springs have low mineralization (EC ranged from 25 to 76 $\mu\text{S}/\text{cm}$) and temperature depending on air temperature. In chemical composition HCO_3^- and Ca^{2+} ions predominate.

Warm and fresh waters are the environment of different aquatic habitats for microbial communities. In water samples taken from warm and cold springs during the July of 2012, abundance and biomass of bacteria were low, and typical for ultraoligotrophic environments of polar regions. Extremely low number of bacteria occur in the cold waters reaching 0.51×10^5 cells ml^{-1} , whereas in the shallow lake of south Disko the highest number of bacteria (4.91×10^6 cells ml^{-1}) was found. Very large size of bacterial cells ($0.14 \mu\text{m}^3$ in maximum), usually almost twice than in the lakes, was typical for springs. Cold water of one Disko spring was dominated by rods (80%), but curved forms was hardly noted. In some of the warm spring percentage of cocci and curved cells was similar. The lowest number (only 4) of Operational Taxonomic Units (OUT) was observed in the spring with temperature of 1,7°C and the highest one - in waters of three warm springs, respectively 18, 16 and 15 OTU.

Krzysztof Michalski¹, Krzysztof Nejbert²,
Justyna Domańska-Siuda², Geoffrey Manby³

¹Institute of Geophysics PAS
krzysztof.michalski@igf.edu.pl

²Faculty of Geology UW

³Natural History Museum of London

Integration of palaeomagnetic, structural and geochemical studies to understand Svalbard Caledonian Terranes assemblage (PALMAG project 2012-2015) – preliminary results

The main aim of the PALMAG project is to quantify time and place of the Svalbard Caledonian Terranes amalgamation from integrated palaeomagnetic-isotopic-structural studies. This should provide data to reconstruct the geotectonic events which led to formation of the northern branch of the Caledonides. Investigations are being focused on the linkage between isotopic ages and secondary NRM (Natural Remanent Magnetisation) overprints of the terranes. The time of activity of the large scale faults bounding the terranes is being dated by Laser Ablation ICP Mass Spectrometry (LA-ICP-MS) method.

Palaeomagnetic results from Hornsund Cambrian Sofiekammen Formation (Michalski et al., 2012) suggests amalgamation of Central Svalbard Terrane (*sensu* Harland, 1997) with Baltica at least from Silurian (430 Ma). This has been also confirmed by Ar-Ar LA-ICP-MS dating of mylonites of Billefjorden Fault, which suggests that significant movements along the fault ceased around 450 Ma (Michalski et al., 2012). Preliminary results of PALMAG project from metamorphosed carbonates and metadolerites of the Western Terrane (*sensu* Harland 1997) reveal that main magnetic carriers of the samples are pyroterite and magnetite. Similar to Hornsund Slaklidalen Fm, extensive remagnetisation of the Western Terrane is related to Caledonian metamorphism. Stable horizon of the Caledonian remagnetisation allowed to distinguish between Caledonian and Cretaceous-Paleogene deformations in different locations of the Western Terrane.

Project PALMAG is founded by Polish National Science Centre – grant number 2011/03/D/ST10/05193, subsidy: 596 590 PLN.

Mateusz Moskalik, Oskar Głowacki*,
Agnieszka Promińska, Joanna Ćwiąkała

Institute of Geophysics, Polish Academy of Science, Warszawa

* oglowacki@igf.edu.pl

The effect of Hansbreen tidewater glaciers on the hydrology of Isbjørnhamna (Hornsund, Svalbard)

Progressive climate changes cause intensive recession of tidewater glaciers and the supply of subglacial and inglacial fresh water. These processes significantly modify hydrological conditions in the fjord. Oceanographic and meteorological conditions changes may influence the intensity of such outflows. They generate fluctuations in temperature, salinity and suspended material in the fjord. Knowledge of the flow direction, its velocity and changes with depth allows to estimate such processes.

Isbjørnhamna was chosen as a place of study. In order to obtain the required information about hydrological conditions in the bay, Acoustic Doppler Current Profiler (ADCP) was used on parallel and perpendicular profiles to Hansbreen cliff. Furthermore, temperature and salinity (CTD) measurements were performed on seventh vertical profiles on transect perpendicular to the face of the glacier. CTD probe was also used on horizontal profiles, just below the surface of the sea water along the ADCP profiles. Information about the bathymetry was based on the Norwegian Hydrographic Service data (Permit number 13/G722). These studies allows us to determine the locations and intensity of fresh water outflows from Hansbreen and their impact on the hydrological conditions in the bay.

This study was supported by: NCN 2011/03/B/ST10/04275 (ADCP measurements), NCN 2012/04/A/NZ8/00661 GAME and Polish-Norwegian AWAKE 2 (CTD measurements) Projects based on Polish Polar Station in Hornsund. Bathymetric data were purchased in statutory activities of Institute of Geophysics PAS.

Anna Mozer*, Krzysztof P. Krajewski, Zoltán Pécskay

* Institute of Geological Sciences, Polish Academy of Sciences, Warszawa
amozer@twarda.pan.pl

Eocene age of the Baranowski Glacier Group on King George Island, South Shetland Islands: New data from the Red Hill section

The vast majority of geochronology data collected from King George Island (KGI) indicate that the spike subduction-related volcanic activity in the north-eastern part of the South Shetland Islands magmatic arc was widely confined to the Eocene epoch. Dates suggesting Paleocene and Oligocene volcanism are sparse, and reported from the Fildes Peninsula and the King George Bay areas, respectively. However, there are also persistent reports of older (Late Cretaceous) volcanics from the western side of Admiralty Bay in the so-called Warszawa tectonic block. On the geological map of Admiralty Bay (Birkenmajer, 2003), the volcanogenic successions with supposed Late Cretaceous ages have been classified into the Paradise Cove Group and the Baranowski Glacier Group (including several units in the formation rank), though a part of this classification has been contested in subsequent publications (Nawrocki *et al.*, 2011).

In this presentation, we document that the Baranowski Glacier Group exposed in slopes and rocky walls of Red Hill facing the Bransfield Strait west of Admiralty Bay is of late Early to Middle Eocene age. Nine whole-rock K-Ar analyses of fresh volcanic (basaltic) rocks from the Red Hill section gave us consistent ages between 51 Ma and 42 Ma. No ages older than Ypresian have been obtained.

The Baranowski Glacier Group at Red Hill comprises a c. 150 m thick volcanoclastic succession composed of alternating terrestrial lava flows of basaltic to basaltic andesite composition and fine to coarse tuffs, lapilli tuffs and breccias. This succession overlies a massive volcanic substratum of considerable thickness, for which only the topmost part is exposed. These two parts of the Baranowski Glacier Group can be tentatively attributed to the Llano Point and Zamek formations, which were distinguished within the group further north along the western coast of Admiralty Bay (Birkenmajer, 2001). In the lower part of the section at Red Hill (lower part of Zamek Formation), there occur tuffaceous sandstones and siltstones containing coal seams (up to 5 cm thick) and coaly layers with plant detritus. The coal shows dominant vitrinitic composition. The plant fossils are poorly preserved due to mechanical degradation in flowing water. Among the dominating undeterminable plant fragments, remains of ferns and angiosperms, including *Nothofagus* leaves were identified. The Red Hill section shows facies and floral composition similarities to the Zamek Formation at Zamek, the latter has been considered so far to represent the only undoubted Late Cretaceous flora on KGI. Our new data strongly suggest that these floras are of Eocene age, and similar to Eocene floras described from other parts of KGI (Ezcurra Inlet Group in Ezcurra Inlet, Point Hennequin Group at Wawel in Admiralty Bay, Lions Cove Formation in King George Bay).

Birkenmajer K. 2001. Mesozoic and Cenozoic stratigraphic units in parts of the South Shetland Islands and Northern Antarctic Peninsula (as used by the Polish Antarctic Programmes). *Studia Geologica Polonica* 118: 5–188.

Birkenmajer K. 2003. Admiralty Bay, King George Island (South Shetland Islands, West Antarctica): A geological monograph. *Studia Geologica Polonica* 120: 5–73.

Nawrocki J., Pańczyk M. and Williams I.S. 2011. Isotopic ages of selected magmatic rocks from King George Island (West Antarctica) controlled by magnetostratigraphy. *Geological Quarterly* 55(4): 301–322.

Anna Mozer*, Krzysztof P. Krajewski, Zoltán Pécskay

* Institute of Geological Sciences, Polish Academy of Sciences, Warszawa
amozer@twarda.pan.pl

Geology and preliminary dating of Red Hill exposure of King George Island (SSI), West Antarctica

Red Hill area is located in the southern part of King George Island (South Shetland Islands, northern Antarctic Peninsula), on Bransfield Strait coast. Rock succession that revealing at Red Hill was determined thus far as Baranowski Glacier Group, Late Cretaceous age. Within this group were distinguished two formations (Llano Point and Zamek), whose record is known from outcrops located on the western coast of Admiralty Bay (Birkenmajer, 2001). Red Hill profile comprises a c. 150 m thick volcanoclastic succession composed of alternating terrestrial lava flows of basaltic to basaltic andesite composition and fine to coarse tuffs, lapilli tuffs and breccias. In the lower part of the section occur tuffaceous sandstones and siltstones containing coal seams (up to 5 cm thick) and coaly layers with plant detritus. Among the coals prevail those of a composition similar to vitrinite. The sequence contains a poorly preserved fossils, damages are probably caused by the flowing water. The degree of fossils degradation and their low numbers have allowed only to determinate a small amounts. Among the dominating undeterminable plant fragments, plant remains sparse ferns and angiosperms, predominantly *Nothofagus* leaves were identified. Upper part of section is dominated by thick lava flows, which some exhibits amygdules, and the other columnar joint. Between the lavas appear alternation of breccias and/or laminated sediments.

New radiometric dating indicates that succession was formed from about 51 Ma to 42 Ma (K-Ar ages) and no ages older than Ypresian have been obtained. The dating results of Red Hill area, therefore, seems to provide an Early to Middle Eocene age, which redefine the position of this volcano-clastic succession in geologic time scale. New stratigraphic position and lithofacies development of Red Hill exposure strongly suggest the possible correlation with other Eocene formations containing fossil plant and coal beds, occurring on KGI.

Anna Mozer

Institute of Geological Sciences, Polish Academy of Sciences, Warszawa
amozer@twarda.pan.pl

Paleoecology of preglacial sequences of King George Island, West Antarctica

Attempt to carry out the reconstruction of plant communities and environmental conditions (especially climate) prevail on King George Island (KGI) during Paleogene were taken on the basis of preserved plant remains, the petrographic-geochemical analysis and further interpretation of selected indices of chemical weathering. Sedimentary sequences of Arctowski Cove, Point Thomas, Mount Wawel and Lions Cove formations contain relatively rich fossil flora remains and represent a transitional period of climatic conditions in the region of the Antarctic Peninsula. Eocene fossil assemblages contain plant remains included Araucariaceae, usually co-occur with the remains of other conifers (Podocarpaceae), various laurophyllous plants, Equisetum, numerous ferns and angiosperms, predominantly Nothofagus leaves. Forests grow on the slopes of stratovolcanoes, and at higher altitudes passed in loose stands of southern beech (Nothofagus) with the participation of coniferous and ferns in the undergrowth. Taphocoenosis are characterized by the presence of mixed flora similar to the South American and Australian-New Zealand floras, that are characteristic for the moist and moderately warm subtropical climate. The chemical weathering indices was applied to identify the type and intensity of weathering and prevailing climatic conditions. The relatively high values (0.65–0.90) of the Chemical Index of Alteration (CIA), Plagioclase Index of Alteration (PIA) and Chemical Index of Weathering (CIW) obtained for the lower parts of the sedimentary rocks in analyzed profiles confirmed the domination of warm, moist climatic conditions, enabling the development of intense chemical weathering processes. Low values (0.50–0.67) of the indices obtained for the upper parts of analyzed sections indicate that there was cooling at the time, since physical weathering dominated associated with the climatic conditions deterioration and relatively dry regime. Mechanical decomposition of rocks led to the development of mantle rock covers on weathered lava flows surfaces and the emergence of regoliths then. Reconstruction of the terrestrial environments on KGI were conducted with combination of paleobiologic and geochemical data, that indicate domination of warm, ice-free during the early Eocene climate and the subsequent cooling stage.

B. Mysłek-Laurikainen*, H. Trzaskowska,
M. Kubicki, A. Odziemczyk

* National Centre for Nuclear Research, Otwock
b.laurikainen@cyf.gov.pl

The role of natural like ^7Be and anthropogenic radionuclides in Global Electrical Circuit(GEC) of the Earth based on the selected measurements in polar regions and medium geographic zone

The presence of radioactive aerosols in air is one of important factors of air ionization. Electrical conductivity of air which is one of main component of Global Electrical Circuit (GEC) depends on number of ions, in particular light ions formed in various processes of air ionization. Electrical field and current generated in magnetosphere, ionosphere could be mapped to Earth surface. They manifest their presence in measured fields and currents in near surface level in the degree dependent on ionization and connected with them air column up to 50–60 km height. The measurement of selected electrical parameters of atmosphere and radionuclides concentration at Polish Polar Station at Hornsund and Geophysical Observatory IGF PAN at Świdler near Otwock and radioactive monitoring data, one can conclude that the changes of electrical conductivity of ground level air and electrical field intensity appear with high radionuclides concentration. One can presume that concentration of ^7Be in the region of its formation can influence the earth electricity in global scale. The contribution of nuclear accidents and release will be discussed on the example of Fukushima origin radioactive release.

The seasonal changes of the discussed parameters and spatial and temporal distributions will be presented in short and long terms intervals.

This work was done partially due to NCN 2011/01/B/ST10/07118 project.

Katarzyna Najda*, Agnieszka Kijewska, Joanna Dzido,
Kestas Plaуска, Jerzy Rokicki

* University of Gdańsk
katarzyna.najda@biol.ug.edu.pl

Differences between *Ascaridoidea* in Arctic Atlantic and Pacific

Some of nematodes belonging to the superfamily *Ascaridoidea* (*Nematoda: Secernentea*) are marine parasites. They are widespread in the Pacific and Atlantic Ocean. The research on algae, polychaetes, and geology have been shown the exchange between the Atlantic and the Pacific was rendered difficult by the tectonic closure of the connection between the two oceans about 3Myr. In the northern hemisphere, the presence of ice and other environmental conditions limit the possibility of a stable connection between the Atlantic and the Pacific. Therefore, we can assume a permanent physical barrier limiting the exchange of species or genes between two oceanic populations of nematodes. The nematode fauna of 20 fish species belonging to families: *Pleuronectidae*, *Gadidae*, *Sebastidae*, *Macrouridae*, *Rajidae*, *Cyclopteridae*, *Anarhichadidae*, *Zoarctidae*, *Lotidae*, *Argentinidae* and *Salmonidae* from Atlantic and Pacific was studied. Parasites were identified by morphological and molecular analysis. Species identification (PCR-RFLP) was based on sequences of the rDNA region (ITS1-5.8S-ITS2). Differences in the species composition of parasites were noticed for genus *Contracaecum* sp. Different subpopulations of anisakids like *Anisakis simplex* s.s. were found in both oceans. Geographic distribution of parasitic nematodes provides evidence that the Arctic reservoir is dominated by parasites from the Atlantic Ocean. These two reservoirs are linked by the same food chain determined by the geographical distribution of the definitive hosts like *Phocidae* and *Delphinidae*.

This study was supported: by the National Science Centre grant No. DEC-2011/01/B/NZ8/04194 and from European Social Fund in as a part of the project "Educators for the elite – integrated training program for PhD students, post-docs and professors as academic teachers at University of Gdansk" within the framework of Human Capital Operational Programme, Action IV.

T. Niedźwiedź*, E. Łupikasza, Ł. Małarzewski

* University of Silesia, Sosnowiec
tadeusz.niedzwiedz@us.edu.pl

The dynamic of atmospheric circulation over the Greenland Sea and its impact on air temperature

Depending on air pressure distribution, atmospheric circulation is considered to be one of the fundamental natural climate drivers. This study aims at recognition of the atmospheric circulation variability over the Greenland Sea and its impact on air temperature changes in the period 1979-2013. Daily atmospheric pressure and temperature data from four meteorological stations (Danmarkshavn, Hornsund, Hopen and Bjornoya) and daily values of NAO and AO indices were used.

The relations between atmospheric circulation expressed by both the indices said and air temperature are assessed. The dynamic of atmospheric circulation over Greenland Sea is described by the zonal circulation index and southern circulation index. The southern circulation index is calculated as a daily pressure gradient between Hornsund station located in the Western Spitsbergen and Danmarkshavn station located at the eastern coast of Greenland. The zonal circulation index is determined on the basis of pressure differences between Bjornoya station and Hornsund station.

In order to assess the relation between the atmospheric circulation and air temperature the circulation indices said as well as AO and NAO are used.

Marcin Nowak*, Ireneusz Sobota

* Nicolaus Copernicus University in Toruń
m.nowak@doktorant.umk.pl

An application of the artificial neural networks in proglacial runoff simulation; a case study of Waldemar River (Svalbard)

An artificial neural networks were applied to simulate runoff from the glaciated part of the Waldemar River catchment (Svalbard) in summer seasons of 2009–2012. Continuous discharge monitoring was performed at about 1 km from the glacier snout, in the place where the river leaves the marginal zone. Averaged daily values of discharge and selected meteorological variables in a number of combinations were used to create several models based on the feed-forward multilayer perceptron (MLP) architecture. Due to specific conditions of melt water storing and releasing, two groups of models were established: first, based on meteorological inputs only, and second which includes also the preceding-day's mean discharge. Analysis of the MLP simulation performance was made in comparison to the multivariate regression (MVR) method on the base of several criteria, including coefficient of determination, error analysis, Nash-Sutcliffe coefficient of efficiency and index of agreement. Performed study showed that non-linear estimation realized by the MLP gives more accurate results than standard linear regression approach in both groups of inputs.

M. Nowicki¹, J. Maczukin¹, J. Perkowska¹, I. Giełwanowska^{1,2}

¹Department of Plant Physiology, Genetics and Biotechnology,
University of Warmia and Mazury in Olsztyn
m.nowicki2@wp.pl

²Institute of Biochemistry and Biophysics Polish Academy of Sciences, Warszawa
and Polish Antarctic Station "H. Arctowski"

Germination performance and cultivation of polar flowering plants belonging to family Caryophyllaceae

In the Department of Plant Physiology, Genetics and Biotechnology at the University of Warmia and Mazury in Olsztyn germination tests and growth experiment of polar vascular plants were conducted. The following species, *Colobanthus quitensis*, *Cerastium alpinum*, *C. arcticum* and *Silene involucreta*, representatives of family Caryophyllaceae, were investigated

Germination trials were conducted on the seeds collected both in natural habitats, in the Antarctic and in the Arctic, and in the greenhouse laboratory in Olsztyn. Before the start of the germination tests the seeds were stored for different period of time (from 6 to 54 months) and at different temperatures (4°C or 20°C). The seeds were sown in Petri dishes lined with wet filter paper, kept at constant (20°C) and at alternating (20°/7°C) temperatures and exposed to 16h photoperiod. The number of germinated seeds and frequency of infection were checked daily for 30 days. Germination capacity of species studied was significantly differentiated. It ranged from 0% (*C. quitensis*) to almost 100% (*S. involucreta*). Dry, long-term storage at 4°C in the darkness considerably stimulated the germination of *C. alpinum* seeds, while dry storage at 20°C for several months caused more than 10-fold decrease of germination capacity of *S. involucreta* seeds in comparison to seeds of this species stored at 4°C.

In growth experiment, the cuttings, taken from mature plants growing in the greenhouse, were planted in pots containing a mixture of garden soil, sand and peat (1:1:1). The pots with cuttings were placed in the greenhouse, at room temperature and under natural photoperiod. The plants were watered once for a three days. Once a week, the growth measurements and photo documentation were taken. In fifth and sixth weeks of cultivation the first flower buds of *Colobanthus quitensis* were observed.

Magdalena Opała¹, Krzysztof Migąła², Piotr Owczarek²

¹Department of Climatology, Faculty of Earth Sciences, University of Silesia

²Institute of Geography and Regional Development, University of Wrocław
piotr.owczarek@uni.wroc.pl

Tree rings of *Betula pubescens* from Troms Region (Norway) as proxies for past temperature changes in the Low Arctic

Dendrochronology is very useful method for environmental reconstruction, especially in the areas located in the vicinity of the northern tree line. These regions are very sensitive to contemporary climate changes. The main goal of our study is to analyze the potential of downy birch (*Betula pubescens*) growth rings as proxies of past climate change. Four research sites located in the northern part of the Scandinavian Peninsula (Troms Region) were chosen for detailed research. We collected 100 samples in different topoclimatic conditions: glacial valley, plateau, sea coast and narrow ridge. The life span of collected samples range from 91 to 193 years. The constructed local chronologies are characterized by high intercorrelation (0.53–0.76). Climatic data from Tromsø spanning 1925–2013 and the NAO Index were used for response function calculations. The topoclimatic conditions modified the dendroclimatic signal, however the common growth pattern was observed. The plateau site, which is exposed to macroclimatic conditions due to lack of orographic barriers, has shown the highest correlation with temperature. This 164-years tree-ring width chronology, covering the time span 1850–2013, was choose for further dendroclimatological analysis. The growth of birch responds to summer temperatures ($r_{\text{Jun}}=0.47$, $r_{\text{Jul}}=0.40$, $r_{\text{Aug}}=0.24$, $r_{\text{JJ}}=0.55$). Dendroclimatic analysis has also shown high values of cross-correlation function between tree rings and seasonal NAO index (MJJ). The obtained values of moving correlation in the 30-years moving window vary from 0.5 to 0.7. The observed responses are not time stable, weakening of the correlation values from the beginning of 1990s is observed. From the 2006 up to the end of the chronology very good agreement between series can be observed again. This study demonstrates that *B. pubescens* can be applied as an excellent indicator for summer temperature in the Low Arctic over the past centuries, however the last 20 years should be excluded from the calibration of the proxy. The obtained dendrochronological record can be used for the reconstruction of June-July temperature prior to the instrumental record (1850–1925).

Piotr Owczarek¹, Magdalena Opała², Krzysztof Migąła¹

¹Institute of Geography and Regional Development, University of Wrocław, Poland
piotr.owczarek@uni.wroc.pl

²Department of Climatology, Faculty of Earth Sciences, University of Silesia, Poland

Climatic factors influencing the tree-ring growth of *Salix polaris* in Hornsund area (SW Spitsbergen, Svalbard)

Tundra plants are strongly affected by climatic factors. The climate change and increase of temperature in the High-Arctic area is evident and influence of shrub expansion and growth-ring variations. The aim of this study is to determine the climatic factors influencing polar willow (*Salix polaris* Wahlenb.) growth rings from SW Spitsbergen. This plant is a deciduous, prostrate, creeping dwarf shrub, usually less than 8 cm tall. Wood samples (n=45) were collected from 10 sites located on the flat raised marine terraces at the elevation of 12-28 m a.s.l. in the vicinity of the Polish Polar Station in Hornsund. Processing of the samples included: microtome cross-sections preparation with serial sectioning, digital photographs of the micro-sections, measurements of ring widths along two or three radii for every slide, development of standardized tree-ring-width indices using different standardization procedures, dendroclimatological analysis. After truncation up to min. 3 series, the constructed chronology covers the years 1951-2011. The meteorological data from the Hornsund station (ca.10 km from the sampling sites), covering the period 1980–2011, were obtained from the Hornsund GLACIOTOPOCLIM Database (2014). From the beginning of the 1980s an increase of the mean and maximum growth ring width is observed and correlate well with increase of temperature on the study area. There is a strong influence of absolute extreme temperatures in July. However, no significant relationships between mean temperature during the growing season and ring width were found. The radial growth of the polar willow from the investigated site is highly dependent on August precipitation and air humidity in March. These climatic factors can be reconstructed on the basis of growth ring variability of *S. polaris*. The presented study show great potential of tundra dwarf shrubs in climatic and environmental reconstructions, especially in the areas where instrumental observations are absent or limited.

Michał Oźmiński, Krzysztof Zawierucha*, Marta Ostrowska

* Adam Mickiewicz University in Poznań
k.p.zawierucha@gmail.com

First observation of quill mites (*Acari: Syringophilidae*) from Arctic birds *Rissa tridactyla* (L.) and *Branta leucopsis* (Bechstein, 1803)

Family Syringophilidae (*Acari: Prostigmata: Cheyletoidea*) is a group of parasitic, highly specialized mites inhabiting the feather quills. Because of the wide spectrum of the avian hosts quill mites are still largely unexplored. In the birds inhabiting Arctic regions these parasitic mites have never been studied. In this study we present first observation of quill mites from two Arctic birds: *Rissa tridactyla* (L.) and *Branta leucopsis* (Bechstein, 1803).

Infected covert feathers of *Rissa tridactyla* collected in Longyearbyen (Spitsbergen, Svalbard archipelago) have been found. Feathers were infected by *Philoxanthornea* Kethley, 1970. This genus is associated with chadriiform birds of the family *Laridae*. The next remiges feathers from *Branta leucopsis* were collected in Perdalen. They were infected by *Chenophila* Kethley, 1970. This genus is associated with anseriform birds (Anseriformes) of the family Anatidae. Up to now only three species from both, *Philoxanthornea* and *Chenophila* genus have been described.

Because of poor knowledge on the parasite mites among Arctic birds, the number of new bird hosts can be discovered in future especially in the large colonies of *Alle alle* (L.) and *Uria aalge* (Pontoppidan, 1763). Additionally, quill mites can be source of knowledge on the potential pathogens within Arctic host populations.

Joanna Pawłowska*, Franck Lejzerowicz, Philippe Esling,
Witold Szczuciński, Marek Zajączkowski, Jan Pawłowski

* Polish Academy of Sciences, Sopot
pawłowska@iopan.gda.pl

Ancient DNA provides new insight into the Svalbard fossil foraminiferal record

Foraminifera are widely used for reconstructing diverse types of past marine ecosystems. They are good indicators of particular conditions like temperature, salinity, food supply, current activity, or oxygen availability. However, micropaleontological studies are focused on hard-shelled (fossilizable) taxa, ignoring the soft-shelled (monothalamous) species, which are abundant in polar and subpolar assemblages.

In order to include monothalamous species into paleoceanographical study of Arctic foraminifera we analyzed foraminiferal record from the last millennium from the Hornsund fjord (Spitsbergen). We compared the diversity of foraminiferal microfossil assemblages with the diversity of aDNA sequenced from subsurface sediment samples. Ancient DNA data contained almost all species reported for the Hornsund fjord by previous investigations. Despite the fact that the abundance of ancient DNA sequences and fossil specimens of corresponding species differed considerably, both records are mutually complementary. The richness of foraminiferal communities revealed by molecular analysis was much higher than in the fossil record, mainly due to the detection of non-fossilized monothalamous taxa, small-sized species and juvenile forms. Our study provided first insight into the past diversity of monothalamous foraminifera. There is growing evidence that they might be a reliable indicator of glacier-proximal conditions. Moreover, ancient DNA research provide insight into the past diversity of small-sized, agglutinated taxa usually considered as rare in classical micropaleontological studies. In our study sequences of *Reophax* spp and *Spiroplectamina* spp were extremely abundant. Those species are potential sea-ice indicators, as some authors related their occurrence to extensive ice covers.

Our study proved that foraminiferal DNA-based survey is an effective tool in investigating Arctic foraminiferal communities. Molecular analysis gained an access to the hidden diversity of benthic foraminifera and thus might serve as an important tool to validate or refine paleoecological information obtained with traditional proxies.

Joanna Pawłowska*, Marek Zajączkowski

* Polish Academy of Sciences, Sopot
pawłowska@iopan.gda.pl

In a changing climate: paleoceanographic record of environmental changes after the Little Ice Age in the Hornsund fjord

The recent global warming, impacting widely Arctic regions, has been demonstrated as significant mass loss of the Greenland ice sheet, melting of the permafrost and progressive decrease of sea ice over the last 30 years. In the fjords of Svalbard, climate – induced changes are displayed mostly in the rapid glacier retreat and decreasing sea – ice cover. Climate warming affects the functional properties of the whole ecosystem and leads to the changes in sediment accumulation rate, productivity and biodiversity.

The main aim of the presented study was to reconstruct the environmental changes in the glaciated fjord in the context of recent climate warming. We focused on the reaction of environment induced by the cryosphere changes. The glaciers retreat in Hornsund during the last century was faster than elsewhere on Svalbard and the recession rate increased significantly in the last decade. Massive glaciers surges were observed especially in the 1960s – 70s and 1980s – 2000 (Błaszczuk et al. 2013, Polish Polar Research).

Two sediment cores, spanning approximately 120 years, were retrieved in the central part of Hornsund fjord. The investigation was completed by the use of classical paleoceanographical proxies: biodiversity of foraminifera, stable isotope ($\delta^{18}\text{O}$, $\delta^{13}\text{C}$) composition, properties of the sediment and hydrology of the studied fjord. Our results correlates well with the changes in mean annual temperatures in Spitsbergen and the glaciers recession rate. The beginning of the century was relatively cold and the foraminiferal biodiversity reached its minimum. Warmer periods, related to the main surge events, were characterized by increased IRD delivery and enhanced productivity, resulting in increased foraminiferal abundance and diversity. The effects of increased glaciers activity were most pronounced in the 1970s and in the first decade of the 21st century.

The project was funded by the Polish Ministry of Science and Higher Education, grant no. 2011/01/N/ST10/06533.

M. Pełlicki*, C. Kinnard, S. Zambra, J. Abermann

* Institute of Geophysics, Polish Academy of Sciences
petlicki@igf.edu.pl

Area-volume scaling of calving based on terrestrial laser scanning and video data

Calving, the mechanical loss of ice from glaciers and ice shelves is the largest component of ablation. Even though recently there has been an important progress in modeling of the long-term calving rates, still little is known about the volume distribution of calving at the scale of single events. One of the reasons for that is the difficulty to collect field data and thus quantify the calving processes. The long-term studies are generally based on remote sensing methods rather than direct field measurements and usually have time resolution coarser than the processes involved. Detailed quantitative observations at the timescale of single events are still missing. The method that has been among the most used is the time lapse photography as it provides data in a relatively high spatial resolution and usually up to hourly sampling interval. Nevertheless, usually it is unable to produce quantitative results as a stand-alone method. Terrestrial laser scanning (TLS) offers many advantages over other surveying techniques, among others its speed, precision, spatial resolution and range.

Calving from Air Force Glacier, Greenwich Island, Antarctica, is investigated using a combination of terrestrial laser scanning and video monitoring. In this work we present a new method of calving monitoring based on a statistical calving volume-area model calibrated with TLS and video data. Area, volume and frequency distribution of calving events was quantified over a calibration period of two weeks. A series of repeated TLS surveys of the glacier front was done in order to calculate the ice volume lost by calving over the time elapsed between individual scans. The quantitative classification into individual events was done by analysis of the video and manual delineation of calved area on a video frame taken immediately after calving took place. The measured number of pixels that a single ice-block covered on the video frame was then related to the volume change as measured by TLS. In this way, after the volume-area scaling relation was estimated over a calibration period, the size- and volume distribution of calving events can be deduced using only the video sequence.

We observed 61 calving events over a period of 21 January – 4 February 2012, of which 12 were used for the calibration of volume-area scaling. The total measured volume of calving during this period was $37520 \pm 5400 \text{ m}^3$, while the sum of individual event volumes calculated by volume-area scaling is $41330 \pm 11630 \text{ m}^3$, giving the relative error of $10 \pm 31\%$

R. Przybylak, A. Arażny, P. Ulandowska-Monarcha*

* Nicolaus Copernicus University in Toruń
patrycja.mona@gmail.com

Spatial diversity of relative air humidity in the Kaffiøyra region (NW Spitsbergen) from August 2010 to August 2013

In recent years, a significant rise in interest in topoclimatic studies in Svalbard has been witnessed. The relative air humidity at this archipelago is high due to its low temperatures and the proximity of open sea water. The spatial diversity of this variable is quite great in-land, where significant transformation of incoming air masses is caused by ground moisture conditions, surface relief features, vegetation and local atmospheric circulations.

Although studies of the spatial diversity of air humidity in the Kaffiøyra region date back to the summer season of 1978, they have rarely focused on this variable alone, usually concentrating on other variables, such as air temperature or precipitation, as well.

One of the main purposes of this paper is to describe the spatial diversity of relative air humidity on the Kaffiøyra region in the period from August 2010 to August 2013 and its reasons (including the influence of atmospheric circulation).

For the analysis, hourly data from 7 sites located in the Kaffiøyra region (beach, tundra, foreground of glacier, glacier and mountain ridges) have been used, with standard climatological methods utilised for the statistical analysis. Results are presented for four seasons: autumn (September – October), winter (December – March), spring (April – May) and summer (June – August), as well as for the whole year. In order to study the influence of atmospheric circulation on the spatial diversity of relative air humidity the catalogue of daily synoptic types for Svalbard developed by Tadeusz Niedźwiedź has been used.

In the period from September 2010 to August 2011, the highest value of relative air humidity was recorded on the mountain ridges (89%) and at the sites located near the seashore (88%). On the other hand, the lowest value of this parameter was observed at the tundra site located near the terminal moraine of the Waldemar Glacier (79%). The spatial relationship described there was also observed throughout all the seasons, however in spring the mountain sites were markedly more saturated by water vapour than the other sites.

Grzegorz Rachlewicz*, Alfred Stach, Krzysztof Rymer,
Ireneusz Sobota, Piotr Weckwerth, Marcin Nowak

* Adam Mickiewicz University in Poznan
grzera@amu.edu.pl

Short-term changes in temperature and thickness of active layer of permafrost in Petuniabukta Region, central Spitsbergen, Svalbard

Petuniabukta is the most north-eastern part of Isfjorden system in central Spitsbergen (Svalbard), the region, the least glaciers covered within all parts of the archipelago, influenced by dry, quasi-continental climate of the inner-fjord area of the island.

The thickness of permafrost active layer has been monitored in several places around Petuniabukta. Measurements presented here were carried over 100x100 m test fields, realizing requirements of CALM program, one of which is located on the raised marine terrace 5 m a.s.l. (dry site – DS), and another on the proglacial river terrace, close to the river mouth 1.5 m a.s.l. (wet site – WS).

The measurements of the temperature and humidity of the active layer (ground) were made with the use of automatic temperature loggers installed at the measurement sites at various depths (temperature: 5, 10, 20, 50, 100 and 130 cm (DS), 145 cm (WS); humidity 5 and 10 cm). Automatic weather station (AWS) was installed in the vicinity of test sites. AWS was equipped with data-loggers and following sensors: atmospheric pressure, air temperature and humidity, wind speed and direction, precipitation, total and UV radiation.

On the basis of short-term measurements in summer 2013, a differentiation in the thermals and dynamics of the active layer of permafrost in diverse conditions were found. From the mid-summer to the fall thaw depth changed at DS from the range between 91 and 120 cm to 110-145 cm and at WS from 86-145 to 102-well below 145 cm. While in dry ground conditions the thaw dynamics seems to be constant, in the water-soaked, low-lying, coastal-close terrain, presumably influenced by infiltrating brackish ground water, permafrost table development is unpredictable, partly with elevated ice lenses formation and partly with unfrozen water above. According to constant data acquisition, following seasons will bring more complex approach with modelling possibilities.

Grzegorz Rachlewicz*, Wiesław Rygielski, Mariusz Sprutta, Aleksander Dominiczak, Krzysztof Pleskot

* Adam Mickiewicz University in Poznań
grzera@amu.edu.pl

Sulphate karst and ground water circulation in Billefjorden region (Central Spitsbergen, Svalbard)

The term “sulphate karst” was introduced to international scientific community by Klimchouk & Andrejchuk (1996) but earlier commonly used in Russian terminology (syarcha|novy |kras). Calcium sulphate and its hydrated form are common on the Earth and undergo intensive karstification on the surface as well as underground. In polar regions ground water circulation and karst processes are limited in depth because of permafrost occurrence blocking permeation. However, especially in gypsum/anhydrite rocks, due to their very high solubility, karst landscape and rock voids may develop.

Effects of sulphate rocks solution were observed in the surroundings of Billefjorden (Isfjord system, central Spitsbergen), where gypsum and anhydrites, among other, are a part of Gipsdalen Group, representing a marine deposits complex varying in facies development and thickness. It is divided onto three formations, within which evaporate outcrops of morphologic meaning belong only to mid-Carboniferous Ebbadalen Formation (Cutbill & Challinor 1965).

In the upper parts of mountain massifs gypsum/anhydrite rocks form very steep outcrops, in some parts sculptured with rills. More distinct forms are visible in the lowest, sub-slope areas, where permafrost active layer reaches up to 2 m of thickness. Proglacial and pronival streams infiltrate into bedrock partly covered with eluvial or mounded sediments, creating ponors, sinkholes or rock goafs.

In 1987 we have found and mapped a 34 m long cave, developed on nodule-anhydrite intra-layer joint, widened by corrosion, draining water reservoirs blocked with lateral moraines of Horbye glacier, no longer than since its maximum advance during the Little Ice Age. Permeation deeper than in other areas might have been caused by insulation caused by overlying ice and debris masses. The place revisited after 26 years, revealed the cave collapse, confirming high rate of denudation processes in morphodynamic expression.

Dorota Richter*, Mirosława Pietryka, Jan Matuła

* Wrocław University of Environmental and Life Sciences
dorota.richter@up.wroc.pl

The relationships between cyanobacteria and green algae communities and different type of tundras from the West Spitsbergen (Archipelago Svalbard)

The paper presents research of cyanobacteria and green algae communities and their relations with different type of tundras, which were so far described on the basis of mosses and vascular plants communities.

Phycological studies were conducted on Fuglebergsletta marine terrace and Fuglebekken outwash plain situated on the north sea-coast of Hornsund fjord (West Spitsbergen, Archipelago Svalbard). The research was carried out during summer in years 2005, 2007-2009, 2011, 2013. The locations chosen for the study differed in physicochemical properties and humidity and were situated in different type of tundras.

The data on the phycoflora was analyzed numerically including hierarchical-accumulative classification using the MVSP 3.1 software and using the direct ordination method (PCA). The statistical analyses were performed using the CANOCO 4.5 program and ordination diagrams were created using CanocoDraw software.

107 cyanobacteria and green algae were observed in the research area in total. The majority of the identified species were connected to special habitats, and were consequently the indicator of distinguishing individual habitats. This allowed grouping the studied locations with similar phycoflora structure. The classification of studied habitats with regard to cyanobacteria and algae is in accordance with earlier classifications of tundras in this region by Wojtuń and Matuła (unpublished data).

Milena Roszkowska*, Marta Ostrowska, Jerzy Smykla,
Krzysztof Zwierucha, Łukasz Kaczmarek

* Adam Mickiewicz University in Poznań
mil.roszkowska@gmail.com

Preliminary studies on water bears (Tardigrada) from Continental Antarctica (Ross Sea region)

Antarctica, on average, is the coldest, driest, and windiest continent, and has the highest average elevation of all the continents. Antarctica is considered a desert, with annual precipitation of only 200 mm along the coast and far less inland. The temperature in Antarctica has reached -89°C . Terrestrial invertebrate life includes microscopic mites like the *Alaskozetes antarcticus*, parasitic lice, nematodes, tardigrades, rotifers and springtails. The flightless midge *Belgica antarctica*, up to 6 millimetres in size, is the largest purely terrestrial animal in Antarctica.

Tardigrada, known as water bears, are a phylum of micrometazoans that inhabit various ecosystems throughout the World, from the deepest seas to the highest parts of the Himalayas. Terrestrial tardigrades are found in mosses, lichens, hepatics, leaf litter, soil and on glacier mice). Aquatic species inhabit marine and freshwater plants and sediments as well as small water bodies on the glaciers like cryoconite holes. Currently, the majority of ca. 1,200 known species are known from terrestrial ecosystems.

First studies of Antarctic tardigrades were conducted by Murray in 1906, who described four new species from this region. Later, tardigrades in Antarctic regions were studied only occasionally and up to now only ca. 50 tardigrade taxa is known from Antarctic and Sub-Antarctic.

In 31 moss, soil, algal and mixed (soil/moss) samples collected on Victoria Land (Ross Sea region) six tardigrade taxa were found (including one species new for science). The most abundant tardigrade was *Acutuncus antarcticus* (ca. 90% of all specimens). The new species belongs to the genus *Macrobotus* (harmsworthi group) but it differs from other members of the harmsworthi group by egg morphology and some morphometrical characters. In our samples also a one specimen of *Eshiniscus testudo* was found. This species is typical for Holarctic regions and can be potentially considered as invasive species.

Krzysztof Rymer

Adam Mickiewicz University in Poznań
krym@amu.edu.pl

Characteristics of aeolian and niveo-aeolian deposits in central Spitsbergen (Ebba valley)

During the period between summer 2010 and summer 2013 measurements of aeolian accumulation and transportation were conducted. Studies were realised in Ebba valley (central Spitsbergen). For this part of Svalbard archipelago dry polar climate type is distinctive. Aeolian deposits samples were collected from the ground surface, pits made in the niveo-aeolian and aeolian covers and from the sediment collectors localised throughout the valley. Standard laboratory analyses of grain size distribution were realised, showing inter alia the domination of 0.125 mm fraction within the deposited material. Average wind velocities for summer periods amounted to 4 m/s, with wind gusts exceeding 20 m/s. Winds from the south-west dominate. It merely confirms earlier findings stating that there are no permanent conditions extorting to aeolian activity during summer in the analyzed area. Wind reaches velocities greater than 5 m/s only temporally and moderately well sorted fine sands are mainly transported. It is interesting that the biggest amount of aeolian material is not transported from the south-west but from the north (38%), northeast (28%) and northwest (18%), so from the direction where strongest winds were observed. There is still lack of a clear and quantitative data defining the role of niveo-aeolian and aeolian accumulation in the periglacial zone modelling, especially in more dry polar climate variant.

Tymoteusz Sawiński

Institute of Geography and Regional Development, University of Wrocław
tymoteusz.sawiński@uni.wroc.pl

Arctic pilot Jan Nagórski – the hundredth anniversary of the flight in 1914

On 21 August 2014 is the 100th anniversary of the first flight over the Arctic. This feat was made by Jan Nagórski, a Polish pilot serving in the Imperial Russian Navy. The starting place was at Krestovaya Guba, on the West coast of Severny Island in the Novaya Zemlya archipelago (74°18' N, 55°19' E). The pioneer flight conducted onboard the aircraft Farmann MF.11 equipped with floats proclaimed the introduction to a much larger air operation carried out by Nagórski between 21 August and 13 September 1914 as a part of wide search for three lost Russian Arctic expeditions: Sedov's, Brusilov's and Russanov's. The originator of using an aeroplane was one of the search coordinators – admiral Zhdanko. Detailed conception and plan of whole flight operation was prepared by Nagórski.

Besides the pioneering nature of Nagórski's mission it can be called an air operation in a full contemporary meaning. Choice of the proper aircraft and its good preparation, adequate logistic support provided by vessels Pechora, Andromeda and Gertha as well as good planning of flights enabled efficient leading of air operations in a very wide scale, as for the then opportunities. During the operation Nagórski together with his mechanic Kuzniecov made a series of search and reconnaissance flights in the area of Novaya Zemlya. In five longest flights he covered a total distance of 1060 km. Although the search action failed, the flights undoubtedly demonstrated the possibility of large scale air activity in hard Arctic conditions and usefulness of aircrafts in search and rescue actions. Indeed they also convicted the use of aircrafts for recognizing ice conditions for vessels cruising in waters covered by ice pack. During the flights also a lot of practical information about aircraft operation in Arctic conditions was collected.

Jacek Siciński*, Piotr Józwiak, Krzysztof Pabis, Anna Jażdżewska

* University of Lodz
sicinski@biol.uni.lodz.pl

Polychaete and amphipod diversity along depth and sediment gradients in an Antarctic fjord (Admiralty Bay, South Shetlands)

Diversity of benthic communities in polar fjords is affected by a combination of various factors. Depth and sediment type are amongst the most important environmental drivers of the community structure, species richness and diversity. Polychaetes and amphipods are the most abundant and diverse groups of benthic macrofauna in the Southern Ocean. They are also considered good surrogates of overall biodiversity as well as an indicators of ecosystem response to changes in environmental conditions. The aim of this study was to analyze abundance, species richness and diversity of those macroinvertebrates along a depth and sediment gradients in Admiralty Bay. Eighty Van Veen grab (0.1m²) samples collected in the summer season of 1985 were used in the analysis. Patterns of species richness (expressed as a number of species per sample), evenness (Pielou Index) and diversity (Shannon Index, Hurlbert rarefaction) and abundance (density) were analyzed. Sampling stations covered the full depth range of Admiralty Bay (from the shallowest sublittoral to about 500 m depth) as well as a full range of sediment types (from silty clay bottom deposits of the glacial bays to the coarse sediments in the areas not influenced by glacial sedimentation).

Edwin Sieredziński

University of Warsaw
colonelvolf@gmail.com

Possibilities of non-biting midges (Chironomidae) detecting in Antarctica

Non-biting midges were detected in some extreme environments, for example Diamesiinae are known as snow entomofauna element. Part of species develops in salt water (case of some Tanytarsini and Orthocladinae). Some bloodworms were derived in large depths in seas. Subsequently, one may ask about possibilities of new Chironomidae species detection in Antarctica. Otherwise, the biggest Antarctic terrestrial animal is apterous chironomid *Belgica antarctica* (Orthocladinae).

These midges exhibit a number of adaptations, which predestinate to dwell in such extreme habitats. Some chironomids have terrestrial larvae developing in decaying organic material (e. g. mentioned *Belgica antarctica*). Another species are halophilic and/or cryophilic. Moreover, many taxa are sparsely recognized, therefore presence of them is not excluded. It appertains to remind some common genera were described relatively late (case of *Bryophaenocladus*), so mentioned lack of data does not consist argument *ad ignorantiam*. Additional adaptation in Antarctic environment could have been wing atrophy. In this family it emerges either radical specialization (as *Pontomyia*) or life in low temperature (case of some *Diamesa* and *Belgica*). Last above-mentioned phenomenon leads that brachypterous or apterous species should be discovered.

Ecological variety of larvae and imagines is hallmark of non-biting midges, therefore one can infer *a posteriori* about appreciable possibilities of non-biting midges detecting even in Antarctic environment.

Edwin Sieredziński

University of Warsaw
colonelvolf@gmail.com

Wingless flies from sub-Antarctic archipelagos – phylogeographical view?

Some apterous flies were described in sub-Antarctic archipelagos, especially from Kerguelen Islands. There were detected wingless Sphaeroceridae (genus *Anatalanta*), Ephydriidae (*Tauromina mountwilhelmi* and *Amalopteryx maritima*) and Drosophilidae (*Hypselothyrea aptera*). Lack of wings is relatively simply to explain by strong wind and low temperature. However more complex issue consists origin of these flies and explanation of range in phylogeographical categories.

Genetic population research of *Anatalanta aptera* and *Anatalanta crozetensis* proved weak population variability (low Nei's distances). This data pertain to differences within species. Otherwise, it is lacking results on high level of species and genera. As is known, phylogeographic thesis formulation of colonization becomes impossible – nevertheless these flies have ancestors on one of continents – Africa, Australia or Southern America. This issue explanation would allow settling mechanisms islands and evolution in isolated ecosystems.

Ireneusz Sobota*, Piotr Weckwerth, Marcin Nowak,
Grzegorz Rachlewicz, Alfred Stach, Krzysztof Rymer

* Nicolaus Copernicus University, Toruń
irso@umk.pl

Short-term changes in temperature and thickness of the active layer in the Kaffiøyra Region, NW Spitsbergen, Svalbard

Since 1975 the thickness of the active layer has been monitored in a few fixed measurement points on the Kaffiøyra Plain around of the Nicolaus Copernicus University (NCU) Polar Station.

The thickness of the active layer has been monitored in several places on the Kaffiøyra Plain. Measurements presented here were carried over 100×100 m test fields, realizing requirements of CALM program, one of which is located on the sandy beach, about 2 m a.s.l. (dry site), and another on the tundra plain, about 3 m a.s.l. (wet site).

The measurements of the temperature and humidity of the active layer (ground) were made with the use of automatic temperature loggers installed at the measurement sites at various depths (temperature: 5, 10, 20, 50 and 100 cm; humidity 5 and 10 cm). The new automatic weather station (AWS) was installed in the vicinity of test sites. AWS was equipped with data-loggers and following sensors: atmospheric pressure, air temperature and humidity, wind speed and direction, precipitation, total and UV radiation.

This study is a part of the project started in 2013: “Cryosphere reactions against the background of environmental changes in contrasting high-Arctic conditions on Svalbard”. One of its aims is to determine seasonal and sub-seasonal changeability of the structure, dynamics and the temperature distribution of the active layer and its substratum.

On the basis of short-term measurements in summer 2013, a large differentiation in the thermals and dynamics of the active layer in these areas was found. From the mid-summer to the fall thaw depth changed at the dry site (the sandy beach) from the range between 119 and 157 cm to 125-170 cm and at the wet site the (tundra plain) from 113–184 to 116- below 225 cm.

Piotr Sobolewski, Janusz Krzyścin*

* Institute of Geophysics, Polish Academy of Sciences, Warszawa
jkrzys@igf.edu.pl

The long-term variability of biologically weighted UV radiation from the ground-based measurements at Polish Polar Station, Hornsund, (77°00' N, 15°33' E) for the period 1996–2013

The erythemal UV measurements at Hornsund were carried since 1996 up to 2001 by the Solar Light biometer and since 2005 up to now by the Kipp and Zonen biometer. To estimate instrument sensitivity loss, due to its aging, the UV data have been homogenized by a comparison of the observed erythemal dose rates taken during clear-sky days in spring with the hypothetical ones based on the radiative model simulations. The following input data were used for the calculation of correction factor: daily values of total ozone (from NOAA satellite observations), aerosol optical depth (from ground based observations by the CIMEL instrument at Hornsund), and prescribed seasonal values of snow albedo (monotonically decreasing values between 0.6 in early spring up to 0.3 in the mid June). The least-squares fit of a straight line to the monthly means of UV Index (daily maximum of UV irradiance) and to the monthly means of daily erythemal doses for the period 1996–2013 shows statistically significant positive trends (about 1–2% per year) for the UV index in July, August and September, whereas the negative trends for the erythemal doses (about –1% per year) in May, June and July. The maximum UV index and daily dose reached ~3.5 and ~3000 J/m² in late spring for the period 1996–2013, respectively. UV index over 3 was found every year within a few days in that period. It means that for a typical white-skinned person out-door activities for period longer than ~1 hour could result in sunburned skin.

L. Stachnik*, D. Ignatiuk, M. Kondracka, J.C Yde

* Jagiellonian University, Kraków
lukasz.stachnik@gmail.com

Evolution of icings and their relationship to the subglacial drainage system based on water chemistry and GPR surveys (Werenskioldbreen, SW Svalbard)

Proglacial icings are situated in front of glaciers where winter drainage occurs. During the ablation season melting of icings supplies solutes to streams in glaciated catchment and thereby constitute an important part of the glacier hydrochemical cycle. This study aims to evaluate the chemistry of ice and water from the icings as a solute input in glaciated basin of Werenskioldbreen (SW Svalbard). Location and water chemistry were used to compare with the summer outflows. The fieldwork was performed from March to May 2013 at four sites in the proglacial area: northern - Kvisla part, middle – Moraine and Central parts, southern – Angell. A Kovac Mark II drill was used to collect ice from the icings and ice profiles were described together with sampling. At the Angell site, surveys with GPR MALÅ (100 Hz antenna) and Leica dGPS were conducted to determine the shape and thickness of icings. The GPR/dGPS surveys revealed a convex form of the icings at the glacier foot. Icing structures and their evolution were analysed, indicating that two steps of icing growth existed. Filtered water samples were analysed for macro-ions at the Hornsund station. The water chemistry from underneath the icing shows greater changes in the Kvisla and Central parts of the basin than in the Angell and Moraine sites, indicating spatial heterogeneity in the winter evolution of the icings. Ion concentrations along ice profiles tended to decrease from the bottom towards the top of the profile. Partial pressure of CO₂ (pCO₂) of liquid water appear to be higher than the atmospheric level (pCO₂=-3.5). Elevated ions concentration and evidence of episodic break-up of icings suggest that the linked subglacial-proglacial drainage system is relatively active during the winter. This work was supported by two Arctic Field Grants No. 1885 and 227580 (Research Council of Norway).

L. Stachnik*, A.P. Nawrot, D. Ignatiuk

* Jagiellonian University, Kraków
lukasz.stachnik@gmail.com**Hydrological and chemical coupling in proglacial and subglacial conditions of glaciated basin (Werenskioldbreen, SW Svalbard)**

This study aims to elucidate similarities and differences in chemical denudation processes under subglacial and proglacial conditions at a High-Arctic polythermal glacier (Werenskioldbreen, SW Svalbard). Fieldwork was conducted during ablation season in 2011 and consisted of water sampling from subglacial outflows (New, Black Spring, Kvisla main) and at a hydrometric station. Water discharge at the Hydrometric station and the glacier ablation rate were determined. Filtered water samples were analysed for macro-ions by Metrohm 761 Compact IC and alkalinity by Metrohm 702 SM Titrino. At the hydrometric station, the relationships between discharge and $\text{Ca}^{+2}+\text{Mg}^{+2}$, $\text{SO}_4^{-2}/(\text{SO}_4^{-2} + \text{HCO}_3^{-})$ exhibited two distinct groups during the ablation season: The first group comprised samples collected at the beginning and middle part of the ablation season (July-first decade of September), whereas the second group consisted of samples from the end of the sampling period (last three decades of September). The latter had pronouncedly higher concentrations at similar discharges than the first group. Similarly, the slopes of ions associations $[\text{HCO}_3^{-}:\text{SO}_4^{-2}]$ and $[\text{Ca}^{+2}+\text{Mg}^{+2}:\text{SO}_4^{-2}]$ showed increased steepness above 1.5, while the intercepts decreased below 0.3 meq/L. Higher intercepts and lower slopes in the first period indicates that processes such as sulphide oxidation coupled to carbonate dissolution or carbonation of carbonates are prevailing. At Kvisla main and New outflow, both ions associations showed slopes close to 2.0 and intercepts of approximately 0.2 meq/L, indicating sulphide oxidation coupled to carbonate dissolution. Consequently, intercepts and slopes at the end of the ablation season were similar to those noted in the subglacial outflows at Kvisla main and New. This suggests that the water chemistry composition in the proglacial area evolve from a variety of different chemical processes at the begin-middle ablation season to primarily sulphide oxidation at the end of the season. This is reversed in subglacial outflows, where sulphide oxidation is supposed to dominate throughout the season. These investigations were supported by the Research Project N N306 792040.

Jadwiga Stanek-Tarkowska¹, Natalia Kochman², Teresa Noga³,
Anita Pajączek¹, Łukasz Peszek², Maria Olech⁴

¹Department of Soil Studies, Environmental Chemistry and Hydrology,
Faculty of Biology and Agriculture, University of Rzeszów
jagodastanek@wp.pl

²International Doctoral Studies in Natural Sciences,
Faculty of Biology and Agriculture, University of Rzeszów

³Department of Biological Foundations of Agriculture and Environmental Education,
Faculty of Biology and Agriculture, University of Rzeszów

⁴Zdzisław Czeppe Department of Polar Research and Documentation, Institute of Botany,
Jagiellonian University, Kraków

Preliminary description of soil diatoms communities growing near penguin colonies on Windy Glacier forefield (South Shetlands Islands, Antarctica)

Glaciers recession in the Antarctic Region is regarded to one of the most important effect of the global climate changes. New ground are colonize in the process of primary succession. Windy Glacier is situated on King George Island, in the southern part of Antarctic Specially Protected Area No. 128.

Since years the Windy Glacier foreland is the subject of primary succession research. The Patelnia Peninsula region is overgrown by plants characteristic for fourth stage of succession: nitrophilous algae, ornithocoprophilous communities of epilithic lichens, mosses and the grass *Deschampsia antarctica*.

Moreover there are numerous penguin colonies on the forefield of Windy Glacier. In addition, there are numerous colonies of penguins, which can have a significant impact on the formation of ornithogenic soils in this area.

The aim of this study was to investigate the diatom diversity on ornithogenic soils of Windy Glacier foreland.

The nine samples have been collected from Windy Glacier forefield, during Antarctic summer 2005/2006. The area of Patelnia Peninsula has revealed by retreating glacier for almost 40 years. All studied samples were characterized by acid reaction (pH H₂O: 3.4–5.8).

In all samples 96 taxa were noted, of which the most numerous genera were *Luticola* and *Pinnularia*. The most abundant species (more than 40 cells of all noted in sample) in studied samples were: *Chamaepinnularia krookiiformis* (Krammer) Lange-Bert. & Krammer, *Luticola australomutica* Van de Vijver, *L. muticopsis* (Van Heurck) D.G. Mann, *Navicula lanceolata* Ehrenb., *Pinnularia austroshetlandica* (Carlson) Cleve and *P. borealis* Ehrenb. var. *borealis*

V. Starkov

Institute of Archaeology RAS, Russia
starko-vadim@yandex.ru

Russian naval moves in the sea of the Arctic Ocean

Period XV-XVII centuries was the beginning of development of the northern territories of Eastern Europe and Asia. It was at this time, residents of the Russian north have started development of remote areas of the Arctic. This was an important consideration for the development of economic (commercial) activities related to the extraction of the polar fox and sable furs, walrus tusks, beluga fat in northern Siberia and the islands of the archipelago of Novaya Zemlya and Spitsbergen.

This was accompanied by a genuine development of land where to build residential buildings, design nautical charts and sailing directions, saw the formation of a specific northern fleet.

The main sea route to the northern part of Western Siberia was so-called marine Mangazeya town - a way to Tazovsky town, which was built on the Taz river (east of the Ob river). It was a complicated nautical run: the coastal part of the Arctic Ocean, along the rivers Ob and Taz overcoming land portages.

In the second half of XVII century these roads were extended to the Yenisei river. The second area was the remote fisheries island of Novaya Zemlya. It was a difficult sea route, first to Cape Kanin and further to Novaya Zemlya. Most developed and active use of the sea route was the so-called progress Grumlsky - the way to the archipelago Spitsbergen.

Katarzyna Stepanowska

Department of Hydrochemistry and Aquatic Biological Resources,
West Pomeranian University of Technology Szczecin,
Department of Antarctic Biology, Polish Academy of Sciences, Warszawa
greyseal@o2.pl

Effects of starving the antarctic fish *Notothenia rossii* (richardson, 1844) on selected biochemical components of blood and body chemical composition

Starvation fish is a common phenomenon in both culture conditions and natural conditions. Under natural conditions, numerous fish species undergo long-lasting periods of starvation, associated mainly with seasonal changes in food availability, spawning migrations, preparation to spawning, and seasonal changes in water temperature.

The study was carried out at the PAS Henryk Arctowski Polar Station during the 29th Antarctic Expedition in 2005. The experiment involved 12 individuals of *Notothenia rossii* caught in the Admiralty Bay. Prior to commencement of the experiment, blood was sampled from 6 individuals and assayed for contents of protein, glucose, triacylglycerols as well as cholesterol and its HDL fraction. The fish body was analysed for its proximate chemical composition as well. Six individuals were placed in a 400 dm³ working capacity aquarium filled with constantly aerated sea water kept at $0.0 \pm 0.5^\circ\text{C}$. The fish were starved for 21 days. On termination of the experiment, the fish blood and body were re-assayed. The data obtained were subjected to statistical treatment involving 1-way analysis of variance (ANOVA) and LSD test. The analyses were performed using the STATISTICA for Windows computer software.

During three weeks of starvation, lipids were most probably the first and major source of energy for *Notothenia rossii*. This was directly manifested in the reduced blood triacylglycerol and total cholesterol concentrations and a decrease in the body lipid content.

Anna Stępień*, Piotr Kukliński, Maria Włodarska Kowalczyk

* University of Lodz
stepie.anna@gmail.com

Bryozoan size structure across a gradient of thermal regimes in the Northern Hemisphere (DWARF) – an overview of the project

Arctic and boreal region are amongst the fastest warming areas on Earth. Environmental changes that occurred over the past 50–100 years have a great influence on marine fauna including the broad scale consequences for physiological process. Decline of body size of various organism is considered as one of the most important types of responses to global warming. It is assumed that body size reduction will affect biological productivity, energy flow and in consequence it will alter the entire food-web. However, there is still a considerable lack of studies concerning this subject, especially in polar regions. DWARF (Declining Size – a general response to Climate Warming in Arctic Fauna) a project funded by Norwegian Funding Mechanism will explore the variability in size in Arctic organisms in response to changing thermal regimes.

Bryozoans are colonial invertebrates, dominant in shallow hard bottom habitats. Their colonies are composed of functional modules called zooids. Some earlier studies indicated correlation between zooid size and temperature, however there are no similar analysis conducted for the bryozoan fauna in the polar regions. Variation of the zooid size will be studied basing on old samples housed in natural history museums and new samples collected at sites distributed along the latitudinal/thermal gradient between the Southern Norway and the Northwest Spitsbergen. The museum historical material collected at the beginning of the XXth century will serve as a reference point and will allow for the comparison with the new material collected during this project. It will allow to consider zooid size as an indicator of environmental changes, and will help to describe spatial and temporal patterns of bryozoan response to global warming in the Northern Hemisphere.

M.C. Strzelecki¹, W. Szczuciński², A.J. Long³, N. Rosser³,
T. Lawrence³, A. Buchwal⁴, M. Drewniak²,
S. Dunning⁵, E. Norman³, P. Ćwik²

¹Department of Geomorphology, University of Wrocław, Poland
mateusz.strzelecki@uni.wroc.pl

²Institute of Geology, AMU Poznań, Poland

³Department of Geography, Durham University, UK

⁴Cryosphere Research Department, AMU Poznań, Poland

⁵Faculty of Engineering and Environment, Northumbria University, UK

Catastrophic events shaping polar coasts - impact of recent tsunamis in Greenland

Most polar regions are sufficiently far from the major plate boundaries to have escaped significant impact by tsunami generated by large earthquakes such as the recent Indian Ocean (2004) and Japanese (2011) events. However, the unstable nature of polar landscapes in terms of landslides and the existence of calving glaciers and rolling icebergs provide potential tsunami sources.

In the Disko Bay area (western Greenland) on November 21, 2000 AD, a large landslide took place that caused a tsunami reaching 50 meters above the sea level. The wave destroyed the town Qullissat on the opposite site of the strait, however, material losses were observed in distant places by as far as 150 km from the landslide. The same region is also one of the most threatened by large, often over 5 - meters high incident long waves, which are caused by calving glaciers and icebergs overturning. Most of the icebergs in the area are produced by the fastest ice-stream in the northern hemisphere - the Jakobshavn Isbrae.

In this paper we present the selected results of the novel study of the morphological, sedimentological and environmental effects of modern tsunamis caused by landslides and collapsing icebergs in Western Greenland. The project was conducted by Polish-British research team during two expeditions that focused on the documentation of the effects of historical tsunamis, the monitoring of the contemporary processes and the search for traces of past events. Presented results are of importance for risk assessment, as almost all the infrastructure situated along a narrow coastal strip.

Funding for the project was provided by Polish National Science Centre grant No. 2011/01/B/ST10/01553.

M. Szumny, D. Ignatiuk

mszumny@poczta.wp.pl

Spatial distribution and changes of snow cover in the Hornsund area in winter 2012/2013

In the winter season 2012/2013 monitoring of spatial variability of snow cover in the height profile from the coast to the slopes Fuglebergen was conducted in Hornsund Fjord area in the South Spitsbergen. The aim of the study was to determine the diversity of the distribution of snow cover and its evolution depending on terrain and distance from the sea. Measurements of snow thickness and density were carried out using the patch with an accuracy of 1 cm and a density gauge WS-43 once or twice a month. Meteorological data were obtained from the Polish Polar Station Hornsund, located approximately 500 m from the area of the measurements. The results allowed to quantify the winter accumulation of band ice and taking into account the meteorological factors affecting the physical properties of the snow cover. Presented study showed the dominance of aeolian accumulation of snow and numerous winter warming effect on the formation of winter band ice and its significant contribution at the base of snow cover. Terrain has a major impact on the thickness of the snow cover, the diversity of the section 700 m can range from 120.0 cm to 11.2 cm with changing density from 0.23 to 0.42 g/cm³ (for data from 01.03.2013). Determination of the presence of significant quantities of ice ribbon has an important impact on the size of the estimated winter accumulation on the unglaciated parts of Spitsbergen.

Z.M. Świrad*, P.Migoń, M.C. Strzelecki

* Scott Polar Research Institute, University of Cambridge, England
zswirad@gmail.com

Coastal embayments between Werenskioldbreen and Hansbreen (Hornsund, Svalbard): morphology, development and controls

The 17.4km-long shoreline of north-western Hornsund is composed by 13 embayments separated by rocky headlands. Embayments vary in size (areas of 14,500–400,000 m²) and shape. Their groundplan morphology is described by 13 parameters, including length of shoreline, area, depth, width, orientation, coefficient of asymmetry, form factor, and sinuosity index. This part of Hornsund coast is composed of strongly folded metamorphic rocks: quartzites, schists, amphibolites, paragneisses and marbles. Local geology seems to play a major role in shoreline development. The hardest rocks form prominent headlands, spits and stacks, while less resistant lithologies associate with poorly developed sections of shoreline, inner parts of embayments and areas of skerries. Areas of greatest depths are associated with structural discontinuity zones. If high dip value is accompanied by strike parallel to the shoreline, the shore is additionally protected, while perpendicular strike allows water to operate between layers. Moreover, external factors influence the development of the embayments. Asymmetry of embayments in the inner part of Hornsund can be explained by the strong eastern wind waves. On the other hand, western embayments are prone to direct action of long oceanic waves. Sea ice and ice foot protect the shore from wave erosion, but icebergs brought by wind waves form calving Hornbreen and Hansbreen may erode the shore during open sea season. Two creeks, Revelva and Gangpassbekken, seem to play a role in shaping the shoreline at their mouths. We analyzed the shape of past shorelines, approximated by the relict cliffs bounding the raised marine terraces of 4.5–6 and 8–12m asl, formerly active wave-cut platforms. Shoreline morphology is adjusted to the geological pattern, proving the key role of rock control on north-western Hornsund shoreline. Due to climate change, low-energy arctic coasts may experience intensive erosion in the near future. A change in the NAO pattern may result in more frequent and stronger storms in northern Atlantic regions. Moreover, raised temperature of sea water limits the extent and time of presence of sea ice, exposing arctic coasts to intensified wave action.

Z.M. Świrad, A. Séjourné

* Scott Polar Research Institute, University of Cambridge, England
zswirad@gmail.com

Ice-related landforms on Mars

Numerous evidences show that Mars is an ice-rich planet. Water ice is present in the polar layered deposits of both polar caps and has been detected by a Gamma-Ray spectrometer in the top 0.5 m subsurface in mid- and high-latitudes. Moreover, water ice has been directly observed by the Phoenix Lander and exposed by recent impacts at mid-latitudes. Daily average surface temperatures throughout whole planet are lower than 0°C, which makes permafrost ubiquitous. However, as Martian atmosphere is thin and pressure extremely low (ca. 1% of that terrestrial), liquid water is not stable near the surface. Consequently, the top permafrost layer is dry and can only exceed >0°C around noon, which limits cryoturbation processes. Terrestrial analogue for Martian climate are hyper-arid Antarctic Dry Valleys. Present Martian obliquity is about 28°, but it can change dramatically, reaching up to 42°. In times of higher obliquity, ice-rich polar regions warm and water-ice deposits are redistributed equatorward. Presence of young ice-related landforms in the mid-latitudes of Mars, which are in disequilibrium with current climate, proofs that obliquity-driven climate has changed remarkably. These landforms are associated to: ice deformation (glacier-like features, rock glaciers, moraines, 'softened' morphology), thermal contraction (polygonal patterned grounds, ice wedges), ice sublimation (pits, closed depressions, scalloped terrains), ice melting (recent gullies) and freeze-thaw cycle (sorted stone circles, solifluction lobes, pingos). At present, the origin and the magnitude of the different climate changes as well the distribution of the ice-related landforms and characteristics of the ice-rich regolith (amount of ice, nature of sediments, etc.) are poorly understood. Therefore, a strategic, targeted geomorphological mapping is required. Several European universities are starting a new mapping project using high-resolution satellite imagery to study geology and stratigraphy of selected regions, with particular reference to the role of ground ice has played in their recent geological history.

Magdalena Tomala

Jan Kochanowski University, Kielce
magdalena2828@gmail.com

The Role of Greenland in the Arctic

Along with the progressive warming of Arctic climate the importance of Greenland as a relevant element in geopolitical system of Arctic region will grow. The increasing availability of local energy resources and rare earth metals will result in increased interest of the island by the outside parties: China, EU, Denmark and other. Active political and economic factors aimed at Nuuk will thus be gaining momentum. This occurrence will be accompanied by the increasing desire of Greenland to a full of a political sovereignty. This article discusses the interests and relationship of Greenland in three areas: with Denmark, EU and China.

The analysis answers the following questions: Can Denmark follow the rapidly increasing international interest in Greenland? What are the challenges facing the Danish-Greenlandic relationship? Is Greenland with limited capabilities able to handle further interest from major global powers?

While the Arctic is a laboratory of the challenges at stake in 21st century, Greenland appears as a laboratory of the challenges that the Arctic is facing: climate change, natural resources, competition between global powers, shipping routes, security issues.

Arkadiusz M. Tomczyk

Adam Mickiewicz University in Poznań
atomczyk@amu.edu.pl

Frost waves in north-western Spitsbergen

The thesis analysed weather conditions causing occurrence of frost waves in north-western Spitsbergen exemplified by Ny-Ålesund station. The study used daily values of the maximum, minimum, and mean daily air temperatures for Ny-Ålesund between 1980 and 2010. The source material was obtained from the Norwegian Meteorological Institute datasets, available at e-klima portal (eklima.met.no). A frosty day was defined as a day with the maximum temperature below 5 annual percentile, which was $<-16.8^{\circ}\text{C}$ in Ny-Ålesund, and a sequence of at least 5 days of the aforementioned category was considered a frost wave. In order to determine barometric situations favouring the occurrence of frosty days, the values of daily sea level pressure (SLP) and the height of isobaric surface 500 hPa (z500 hPa) were used. Additionally, for days with $T_{\text{max}} < -16.8^{\circ}\text{C}$ circulation types were determined according to the calendar of circulation types for Spitsbergen by Professor Niedźwiedź. In the analyzed multi-annual period, there were 538 frosty days, including 25 frost waves, which total duration was 187 days. The research showed a statistically significant decrease in the number of frosty days, which was 6.7 days/10 years. The occurrence of frost waves was more often connected with cyclonic circulation (57.4%), than with anticyclonic one (39.4%). On the analysed days, the inflow of air masses from the northern and eastern sector was dominating, which was confirmed both by the drawn-up maps of SLP, and by determining circulation types.

Waldemar Walczowski*, Agnieszka Promińska

* Institute of Oceanology of the Polish Academy of Sciences, Sopot
walczows@iopan.gda.pl

Project AWAKE-2 – origin, aims and realisation

Being a link between land and ocean, Arctic fjords are highly vulnerable to warming and are expected to exhibit the earliest environmental changes resulting from anthropogenic impacts on climate. In the Arctic, the inshore boundary of fjords is usually dominated by glaciers while its offshore boundary is strongly influenced by warm oceanic waters. Improved understanding of the fjords-ocean exchange and processes within Arctic fjords is of a highest importance because their response to atmospheric, oceanic and glacial variability provides a key to understand the past and to forecast the future of the high latitude glaciers and Arctic climate.

AWAKE-2 is a continuation and extension of the Polish-Norwegian AWAKE (Arctic Climate System Study of Ocean, Sea Ice and Glaciers Interactions in Svalbard Area) project. The aim of the AWAKE-2 is to understand the interactions between the main components of the climate system in the Svalbard area: ocean, atmosphere and ice to identify mechanisms of interannual climate variability and long-term trends.

The main hypothesis is that the Atlantic Water inflows over the Svalbard shelf and into the fjords have become more frequent during the last decades due to changes in the ocean and atmosphere. The integrated effect of these events results in new regimes and changes in atmosphere, ocean, sea ice and glaciers in Svalbard. Furthermore, changes in the cryosphere and geosphere create feedback effects in ocean and atmosphere.

To achieve the project's aims, the dedicated, multidisciplinary approach is to be adopted by carrying out the coordinated meteorological, oceanographic, glaciological and geophysical observations in Hornsund, adjacent shelf and open sea.

Project is coordinated by the Institute of Oceanology, partners are the Norwegian institutes: Nansen Environmental and Remote Sensing Center, The University Centre in Svalbard, Norwegian Polar Institute, the Norwegian Meteorological Institute and Polish: Silesian University, Nicolaus Copernicus University, Institute of Geophysics.

A. Wasiłowska, M. Rzepecki, A. Tatur*

* University of Warsaw
tatura@interia.pl

Changes of biotic and abiotic features in Antarctic fjord (Admiralty Bay KGI)

Local melt of winter land-fast ice in Ezcurra Inlet (of Admiralty Bay) at the beginning of summer 2009/2010 triggered a diatom bloom that dominated the biogeochemical processes during the season in the fjord. The course of the succession is substantially different than during other ice-free seasons with regular distribution of primary production. Comparing this case to the “common” situation, we can speculate about the impact of climate changes on the functioning of coastal ecosystems in the “hot spot” of global warming. It is likely that summer seasons with diatom blooms at the beginning of summer will become less frequent when warm winters become more frequent.

Piotr Weckwerth, Ireneusz Sobota, Katarzyna Greń*

* Faculty of Geography and Regional Studies, University of Warsaw
katarzyna.gren@wp.pl

Basal decoupling and soft-sediments deformations: contributors to Aavatsmarkbreen movement (Kaffiøyra, Svalbard)

Aavatsmarkbreen is located in the northern part of Oscar II Land, Kaffiøyra, northwest of Spitsbergen. The snout of Aavatsmarkbreen terminates in Hornbaek Bay and partly is ending on the land, where the well-developed glacial and fluvioglacial forms were recognized. As a result of sedimentological studies two lithological complexes were distinguished in research sites within marginal zone of Aavatsmarkbreen. These complexes represent sediments which were deposited in fluvioglacial and in glacial depositional environments. These also were gravitationally and glacially deformed before and during glacier advance.

In outcrop located in the end-moraine were distinguished massive sandy and silty diamictos of the total thickness of 3.5 m. The deformed contact between these diamictos is underlined by drag folds, reflecting changes in a net strain. The dip direction of the folds axial plane indicate the northeast direction of glacier flow. In the second research site, located in the niveo-fluvial valley that cuts into flat morainic plain, two lithological complexes were found. The first is represented by horizontally laminated fine-grained sands silts of a thickness up to 5 m. These fine sediments were deposited in proglacial lake and were deformed due to a gravitationally unstable gradient of bulk density and due to non-uniform confining pressures from overlying sediments. In the upper part of glaciolacustrine complex were recognized overturned folds and reversed faults that were generated as a result of horizontally increased shear stresses in subglacial condition. The second lithological complex lies above the glaciolacustrine deposits and consists of glaciofluvial sediments which are undeformed and covered by subglacially deposited diamicton.

It can be assumed that glaciofluvial series were deposited in subglacial cavities. Thus temporary basal decoupling by meltwater layer (indicated by undisturbed fluvioglacial sediments) were responsible for glacier flotation causing rapid ice movement by basal sliding.

Sebastian Westermann*, Bartłomiej Luks,
Tomasz Wawrzyniak, Adam Nawrot

* University of Oslo
sebastian.westermann@geo.uio.no

Snow Monitoring using Automatic Camera Systems at Svalbard key sites (SMACS) - preliminary results

Point measurements of snow depth and parameters can be misleading due to the strong spatial variability of snow depths caused by strong wind drift of snow, so that the snow melt dates are generally not representative for large areas. On the other hand, satellite images can cover large spatial domains, but are generally restricted to few acquisition dates determined by the satellite operators and to clear-sky conditions, so that the temporal evolution of the snow melt cannot be sufficiently monitored. On Svalbard, the rugged topography with high mountains rising steeply above most of the research areas provides the unique opportunity to observe snowmelt over large spatial domains from terrestrially-based “remote sensors” located on mountain tops. SMACS will install automatic camera systems on mountains overlooking key research areas in Ny-Ålesund and Hornsund. To evaluate the snow distribution and snow melt patterns from the obtained images, operational orthorectification and image analysis algorithms will be developed and operationalized. In order to capture the spatial variability of the snow cover, SMACS will focus on two scales: on the catchment scale (several kilometers), the snow distribution can be related to hydrological processes, as well as a range of remote sensing products, e.g. land surface temperature, surface reflectance or radar backscatter signal. The SMACS target resolution for the orthorectified images is on the order of 5–10 m, thus facilitating to distinguish snow drifts and bare-blown spots. In Ny-Ålesund, the catchment scale camera will overlook most of the Bayelva catchment. In Hornsund, the Fuglebekken catchment directly adjacent to the research station with extensive measurements of meteorological parameters, as well as projects on hydrology and snow distribution will be in the focus. On the plot scale, the orthorectified images can be related to the position of individual sensors and other scientific installations above or below ground.

Michał Węgrzyn*, Paulina Wietrzyk

* Jagiellonian University, Kraków
michal.wegrzyn@uj.edu.pl

Snowbed tundra communities of Spitsbergen in the classical phytosociological approach

Intensive development of phytosociological studies of vegetation in Svalbard has occurred in the 20th and the beginning of the 21st century (Hadač 1946). Since then, many times there have been attempts to create the uniform phytosociological system of the arctic plant communities for Spitsbergen (Hadač 1946, Hadač 1989, Möller 2000, Nilsen i Thannheiser 2013). The recent attempts to develop this system are still not complete (Nilsen and Thannheiser 2013).

The appearance of significant statistical problems in some syntax is the result of the following: using different phytosociological systems; the differentiation of the releves area; the representativeness of research results for the entire area of Spitsbergen; not taking into account the cryptogamic species (especially lichens), and therefore not including them as characteristic species for plant associations and alliances.

With such different literature data, it is extremely difficult to create a uniform and transparent system, in which described syntax will be hierarchically arranged, unique and representative for the whole area of Spitsbergen. Despite these difficulties, but through the use of the modern statistical and syntaxonomic computer applications, detailed studies were conducted on the series of 135 phytosociological releves, own and different authors. These releves were taken during the 20th and early 21st century in Spitsbergen. The analysis process was focused on the alliances *Luzulion nivalis* Nordh. 1936 and *Luzulion arcuatae* Elvebakk 1985, which are related to snow beds communities (Elvebakk 1994), and whose existence as a result of numerical analysis has been statistically confirmed. However, separate plant groups did not reflect the classification which was proposed by Elvebakk (1994). Plant communities assigned to the *Luzulion nivalis* Nordh. 1936, after statistical analyses, have been grouped into three plant associations, while within the alliance *Luzulion arcuatae* Elvebakk, from eight plant communities only two plant associations were distinguished. The legitimacy of the presented division derives from an objective numerical analysis of the species composition similarity for the each phytosociological releves.

J.M. Węsławski*, C.Lydersen, H. Steen, M. Włodarska-Kowalczyk,
J. Berge, L. Stempniewicz

* Institute of Oceanology of the Polish Academy of Sciences, Sopot
weslaw@iopan.gda.pl

Tidal glaciers a refugium for Arctic marine ecosystem?

The well documented melting of tidal glaciers in Svalbard leads in many cases to the retreat of ice onto shore and thus loss of the tidal water front. When these tidal glaciers retreat onto shore the environmental conditions in the neighboring (adjacent?) coastal marine waters change. . Glacial bays are known to be of high importance for foraging seabirds and marine mammals. Locally induced upwelling together with mixing outflow, fresh with marine water, makes a hydrological trap for plankton, with massive death and sinking of marine stenohaline species. Specialised benthic carnivores feed on this supply, in the area that is generally impoverished in terms of biomass and species richness. Some of the specific physical functions of the glacial bay might be substituted by river discharge (fresh and sea water mixing, estuarine circulation), while others (sedimentation regime, upwelling, iceberg sediment scouring) will be lost. This presentation will show possible scenarios for the evolution of marine biodiversity connected with glacial fronts on Svalbard.

A. Z. Wojtal*, A. Pociecha, J. Piątek, A. Józefowska,
T. Janecki, I. Satoshi

* Institute of Nature Conservation Polish Academy of Sciences, Kraków
wojtal@iop.krakow.pl

Together and/or apart: microorganisms (algae and invertebrates) in soil and its plant cover of King George Island (Southern Shetlands, Antarctica)

Microorganisms play a crucial role in the terrestrial ecosystems of the Maritime Antarctica. Grasses and mosses affect and modify the soil, which they overgrown, in many ways.

The soil samples overgrown by grass *Deschampsia antarctica* (locality 1), *D. antarctica* and moss *Sanionia uncinata* (locality 2) and moss *Warnstorfia laculosa* (locality 3) and samples of these plants were considered. The structure of communities of diatoms, chrysophytes and rotifers in soil habitat and in neighboring layers of plants were compared.

In the soil of locality 1 with the lowest total nitrogen content and the highest (5.0) pH value, accompanied by the highest Zn and Pb ion concentrations only few individuals of one rotifer species *Macrotrachela insolita* were observed. At this locality the highest diatom diversity (25 species) was recorded. The most abundant was *Staurosira alpestris*, until now reported almost exclusively from aquatic environments. Contrastingly, in the plant cover (*D. antarctica*) only 15 diatom species and few individuals of rotifer *Keratella cochlearis* were found.

Chemical parameters of soil at locality 2 were similar to locality 1 with an exception of the highest Na concentration and distinctly lower lead concentration. In the material collected from plant layer overgrown by *D. antarctica* (50%) and *S. uncinata* (50%) four rotifer species and ten diatom ones were observed. *Eunotia paludosa*, the diatom common in acid waters of low conductivity dominated (49%) here, but was rare (less than 1%) in soil. The most abundant in the soil was alkalophilous *Staurosira alpestris*, the diatom common in waters of moderate conductivity.

In the soil of locality 3 overgrown by moss *W. laculosa* the highest concentrations of total carbon, total nitrogen and Cu ions and the lowest (4.0) pH value were noted. The most abundant diatoms in soil were *Eunotia paludosa* and *Pinnularia subantarctica* var. *elongata*. The highest diversity of the chrysophyte stomatocysts, including one stomatocyst new for science and four rotifer species were observed here. In the mosses overgrowing the soil at this locality seven rotifer species were recorded, which were very abundant here. The most numerous among diatoms were *Staurosira alpestris* and *Navicula gregaria*. It is worth mentioning that *N. gregaria* was very rare in the soil beneath the moss cover.

Bronisław Wojtuń¹, Grzegorz Skrzypek², Dorota Richter³,
Aleksandra Samecka-Cymerman¹

¹Department of Ecology, Biogeochemistry and Environmental Protection, University of Wrocław
bronislaw.wojtun@biol.uni.wroc.pl

²West Australian Biogeochemistry Centre, School of Plant Biology,
The University of Western Australia

³Department of Botany and Plant Ecology,
The Wrocław University of Environmental and Life Sciences

Nitrogen availability constraints for tundra vegetation diversification in the Arctic

Plant growth and tundra development in the high Arctic, besides a cold climate and short growing season, are limited by nitrogen availability. Therefore, identification of the relative contributions of different N-sources to total N-pool available for plants is critical for understanding the reasons of spatial distribution of tundra vegetation types. The study was carried out in the Wedel Jarlsberg Land (SW Spitsbergen, 77°00'N 15°30'E) within an unglaciated Fuglebekken catchment at the fjord of Hornsund. This catchment is characterized by a highly diverse plant cover with ten major types of tundra vegetation. Three major N-sources (birds, atmospheric deposition, and N₂-primary fixation) for tundra plants were sampled across the catchment; their stable nitrogen composition was analyzed ($\delta^{15}\text{N}$) and compared with tundra plants. The $\delta^{15}\text{N}$ values of plants in the studied catchment widely varied from -5.45‰ (lichen *Cladonia rangiferina*) to 14.24‰ (moss *Tetraplodon mnioides*), reflecting different contributions from three major N-sources available for plants in different types of tundra. The percentage of the tundra N-pool provided by birds, ranged from 0-26% in Patterned-ground tundra and Geophytic initial tundra to 100% in Ornithocoprophilous tundra and Wet moss tundra located just beneath Little Auk colony. The average relative contribution from the three N-sources in the Fuglebekken catchment was 41% from birds, 45% from atmospheric deposition, and 14% from atmospheric N₂ fixation. The stable nitrogen isotope mixing mass balance is indicating the ratio between the actual N-loads acquired by plants from different N-sources and therefore significantly enhances our understanding of importance of different N-sources for the Arctic tundra.

Piotr Zagórski*, Mateusz Czesław Strzelecki, Jan Rodzik

* Maria Curie-Skłodowska University, Lublin
piotr.zagorski@umcs.lublin.pl

Mechanisms controlling the development of polar coasts in post-glacial periods (post-LGM and post-LIA) – southern Bellsund, Svalbard – similarities and differences

Arctic coasts are very sensitive and important zone of interaction between land and sea geoecosystems. The understanding of mechanisms controlling polar coastal zone evolution is crucial for proper deciphering of landscape changes and associated shifts in sediment fluxes triggered by climate fluctuations.

This study attempts to characterise the southern coast of Bellsund in Svalbard Archipelago. The coastal landscape is very diverse and includes extensive coastal plains with series of well-preserved raised marine terraces, sections of cliffed coasts formed in rocks and unlithified deposits as well wide gravel-dominated barriers. Coastal landscape can be divided into relict coastal zone (palaeo-coasts) and modern coastal zone. The relict coastal zone includes: raised cliffs and marine terraces with relict beaches and shore platforms, covered with old storm ridges, former lagoons and palaeoskerries. Higher terraces adjoin the even higher denudation-structural levels, usually separated by steep old relict cliffs. The main features of modern coastlines include: underwater rocky shore platforms with a width of between several dozen and several hundred meters, rocky skerries, rocky cliffs, as well as abrasion-accumulation shores and accumulation shores such as gravel-dominated barriers and tidal flats.

This paper will determine:

- (1) main tendencies in coastal zone changes over the Holocene
- (2) influence of morphogenetic factors on coastal zone changes, which are often superimposed and intensify or reduce coastal zone transition
- (3) rate of morphogenetic processes, in particular marine and glacial processes operating within coastal zone during periods of significant shifts in climatic conditions such as termination of Little Ice Age or the end of Vistulian glaciation (last glacial period) and early Holocene deglaciation.

Over 25 years of geomorphological investigations of Bellsund coasts supported by long series of hydrological, meteorological and glaciological observations make them one of the best studied coastal environments in Svalbard. The coasts of Bellsund provides a superb opportunity to quantify how High Arctic coasts responded to the Holocene sea-level and climate changes and to monitor their adjustment to the ongoing environmental change.

Project funded by National Science Centre NN306703840 led by Piotr Zagórski, and Project funded by Research Council of Norway 'HACOSE'. led by Mateusz Cz. Strzelecki.

Piotr Zagórski*, Jacek Jania, Małgorzata Błaszczuk, Piotr Głowacki,
Mateusz Moskalik, Jarosław Tęgowski

* Maria Curie-Skłodowska University, Lublin
piotr.zagorski@umcs.lublin.pl

Surge behavior of the Recherche Glacier (W Spitsbergen) and its submarine record

Glacier surges are often identified on Svalbard. Direct observations of rapid ice mass transfer along glaciers are very rare. Therefore, indirect evidence on past surges are very valuable for studies of nature and feature of the phenomena. While geomorphic and geological traces of past surges are quite easy recognizable as looped medial moraines, fluted basal moraines and frontal pushed moraines, such evidences for tidewater glaciers are difficult to obtain without detailed studies of submarine forefield of glaciers. We present case of Recherche Fjord, southern tributary to Bellsund located in W Spitsbergen, where submarine evidence of past surges could be compared with historical observations of the La Recherche Expeditions from 1938 and later archive maps.

In the late Holocene, the decisive role in the formation of the bottom of the Recherche Fjord was played by the Recherche Glacier which had direct contact with the fjord waters. Bathymetric images of the fjord floor, obtained in 2011 and 2012 with the use of a Multibeam Echo Sounder Seabeam 1000 installed on the ship MS Horyzont II, revealed the occurrence of a moraine area with a push moraine ridge, glacial debris flow, bottom crevasse fill ridges and glacial lineation. These forms indicate several surges of the Recherchebreen in the late Holocene (particularly the Little Ice Age). A similar behaviour was probably shown by the Renardbreen that had had contact with the fjord waters up to the 1990s. Based on archive data, it can be inferred that the advances of the front of the Recherchebreen occurred before 1838 (La Recherche Expeditions); between 1918 and 1936 (analysis of archive maps) and in 1945. This is confirmed in the record of the submarine landforms (floor landforms) found on the floor of the fjord. During its maximum range in the Little Ice Age, the Recherchebreen and Renardbreen filled the Recherche Fjord reducing its area to about 19 km², i.e. 53% of its current area (36.7 km²).

Projects funded by National Science Centre: NN306703840 and 2013/09/B/ST10/04141

Krzysztof Zawierucha

Adam Mickiewicz University in Poznań
k.p.zawierucha@gmail.com

Current state of knowledge of the glacier invertebrates

Currently, glaciers and ice sheets can be treated as independent biome with cryoconite holes considered as an independent ecosystems, which seems to be a biodiversity hot-spots on the surface of glaciers. The development and functioning of such habitats is possible thanks to a decrease of albedo on the surface of cryoconite – covered glaciers. Biological activity periods on glacier surfaces and in cryoconite holes is rather short and restricted only to summer. In spite of this, “ice” is suitable habitat for invertebrates, which can live directly on the glacier surfaces or can inhabit bottoms of cryoconite holes. Up to date, faunistic studies in such habitats were rather occasional and took place mainly in Arctic, Antarctic, Alpine, Himalayan and Patagonian regions. Lists of taxa from these extreme habitats includes Rotifera, Nematoda, Enchytreidaea, Tardigrada, Collembola, Insecta and Copepoda. Moreover, glacial ecosystems are inhabited by cyanobacteria along with microalgae, diatoms, bacteria and fungi which are food base for microscopic invertebrates. Species which can be found in/ on ice can be considered as endemic or have very wide geographical ranges. Due to extreme conditions, these invertebrates have special physiological and behavioural adaptations to life in glaciers habitats. Our knowledge on the cryophilic invertebrates is rather poor, because of low number of faunistic/ ecological studies conducted on the glaciers. However, all previous studies as well as own observations indicate that the microscopic invertebrates are constant and important elements in glacial ecosystems. The main aim of this presentation is to summarize the knowledge on the invertebrates inhabiting surface of glaciers and cryoconite holes.

Krzysztof Zawierucha*, Marta Ostrowska, Małgorzata Kolicka,
Łukasz Michalczyk, Łukasz Kaczmarek

* Adam Mickiewicz University in Poznan
k.p.zawierucha@gmail.com

Tardigrada of the Svalbard archipelago – testing the theory of island biogeography – preliminary results

The theory of island biogeography, presented by MacArthur & Wilson in 1963, predicts the following: a) the number of species inhabiting an island increases with island area, b) the number of species inhabiting an island decreases with the distance from the mainland, and c) the number of new immigrants decrease as the colonisation progresses.

The Svalbard archipelago, located in the European part of the Arctic, constitutes a suitable model to test the theory of island biogeography as its largest island, Spitsbergen, can be a source of migrants for many smaller islands in the neighbourhood.

Water bears (Tardigrada) are a phylum of microinvertebrates inhabiting a great majority of ecosystems throughout the World. They constitute a persistent element of polar ecosystems. In the Arctic they inhabit aquatic environments such as lakes or cryoconite holes, as well as terrestrial environments (e.g. mosses or lichens).

Up to now, the studies on the tardigrades of Svalbard were conducted on seven islands of the archipelago, with a considerable emphasis on Spitsbergen. Here, we present preliminary results of comprehensive study of the tardigrade diversity on Svalbard: first ever records of Tardigrada from the islands of Fuglesangen and Phippsøya, and new records from the island of Nordaustlandet. In thirty four lichen and moss samples fifteen species of the two orders, Eutardigrada and Heterotardigrada, have been found. One of the species, *Isohypsibius glazovi* Biserov, 1999, is a new record for the Svalbard archipelago, whereas the remaining species were previously found on Spitsbergen. So far, no significant differences in the fauna composition between islands were observed.

M. K. Zdanowski*, J. Grzesiak, R. Gromadka, J. Gawor,
A. Świątecki, D. Górniak

* Institute of Biochemistry and Biophysics Polish Academy of Sciences, Warszawa
mzdanowski@arctowski.pl

Bacterial diversity of Ecology Glacier (King George Island, Antarctica) in the age of global warming, revealed by classical and metagenomic analyses

The surfaces of glaciers hosts diverse microbial communities, which lose their habitat as global temperatures rise and glaciers retreat. This applies to Ecology Glacier, whose retreat, since 1978, increased rapidly. The aim of this presentation was to demonstrate how bacterial diversity changes from the gradually disappearing front of the glacier towards the ablation/accumulation zone border. The spatial distribution of bacterial abundance tended to increase with distance from the glacier front and a slight decrease close to the equilibrium line. This was related to both the total number of bacteria and their morphological diversity and has been observed in the ice and in the cryoconite holes. Relatively high frequency of dividing cells (1.3–35.59%), randomly distributed in both habitats, signals significant rate of growth of glacial bacterial communities. Metagenomic analysis performed by sequencing of DNA isolated directly from the ice was used to assess the taxonomical structure of microbial communities. The obtained sequences were compared using the BLAST program, with reference to 16S Microbial NCBI database. For the interpretation of the results the MEGANE program was used. Most of the sequences obtained belonged to types: Proteobacteria, Bacteroidetes, Actinobacteria and Cyanobacteria. Among Proteobacteria the largest group were the families: Acetobacteraceae, Comamonadaceae and Xanthomonadaceae, while among Bacteroidetes families: Cytophagaceae, Chitinophagaceae and Sphingobacteriaceae. Along the transect qualitative and quantitative differences were observed inter alia in the ability of communities of psychrophilic microorganisms from different zones to assimilate substrates constituting the sole carbon source.

Wiesław Ziaja

Jagiellonian University, Kraków
wieslaw.ziaja@uj.edu.pl

Main changes of the western Sørkapp Land (south Spitsbergen) landscape and ecosystem since the 1980s

There are two main factors of the peninsula's current transformation: climate warming and legal nature protection. Their impacts are both direct and indirect. The recession of glaciers, a quicker melting of snow in summer, a deeper thaw of the active layer on permafrost and plant succession on the unglaciated polar desert are the direct results of the warming. Its indirect implications, in turn, are: the origin of a new landscape (with completely new landforms, Quaternary deposits, water bodies and drainage) in areas abandoned by glaciers, a bigger outflow of water (both underground and in streams) and a smaller overland flow, animal colonization, soil formation, and further plant development. The regeneration of species which were a game for trappers and the destruction of their stations are the direct results of the establishing the South Spitsbergen National Park in 1973. The indirect results of that are changes in the vegetation, soil structure and fauna. The geomorphic sea action has increased considerably after the shortening the sea-ice season. The most intensive sea accumulation appears in the bays south of Palffyodden, and the Tørrflya plain undergoes the quickest abrasion (the coastline changes reach up to 1 m per year there). New coasts of different types have originated in the fore-fields of the tidewater Körberbreen and Olsokbreen glaciers, flooded by the sea. Their ice cliffs retreat and lower, and the bays broaden at their fronts. The quick summer melting of snow on nival moraines enables moss and lichen succession on them. Since the 1990s, regeneration of reindeer has induced changes: in vegetation (plant communities) due to overgrazing, in slope micro-relief and soil structure due to ground trampling, and in animal world because of removing a big part of birds from coastal plains due to trampling their nests. To sum up, in the western Sørkapp Land, ecosystem has changed everywhere, and the landscape has changed mostly in the low-lands but much less in the mountains.

A. Zmarz¹, M.Korczak-Abshire², S. R. Karlsen³, M. Rodzewicz⁴,
R. Storvold³, Z. Goraj⁴, K.J. Chwedorzewska²

¹Faculty of Geography and Regional Studies, University of Warsaw

²Institute of Biochemistry and Biophysics Polish Academy of Sciences, Warsaw

³Northern Research Institute Tromsø, Norway

⁴Faculty of Power and Aeronautical Engineering, Warsaw University of Technology

Remote sensing techniques for monitoring the King George Island

In recent years it has been possible in practical terms to use unmanned aerial vehicles (UAVs) for obtaining different type data e.g.: images, orthophotos and 3D, which are useful in various fields. The main applications of such devices are related to the widely-understood environmental monitoring also in such as the Arctic or Antarctica. Due to limitations resulted from inaccessibility of some regions and safety of the observers, covering biggest research areas than by ground measurements. Creating the unique workshop has the chance to contribute to improvement of or support for performing monitoring for the polar regions. It will enable to include large and previously inaccessible areas, as well as ensure safety of observing team in difficult weather condition, eliminating necessity of moving over dynamically changing frozen areas.

Flight tests were conducted using Skywalker X8 platform equipped with ArduPilot autopilot and digital Canon Powershot SX 230 HS RGB compact camera. Tests allowed to determine the ground resolution sufficient to extract *Pygoscelis* penguin phantoms from the background. Flights were performed in different weather conditions (full cloud cover or clear day) and the use of different backgrounds (with and without snow).

[ISBN 978-83-62673-39-1

