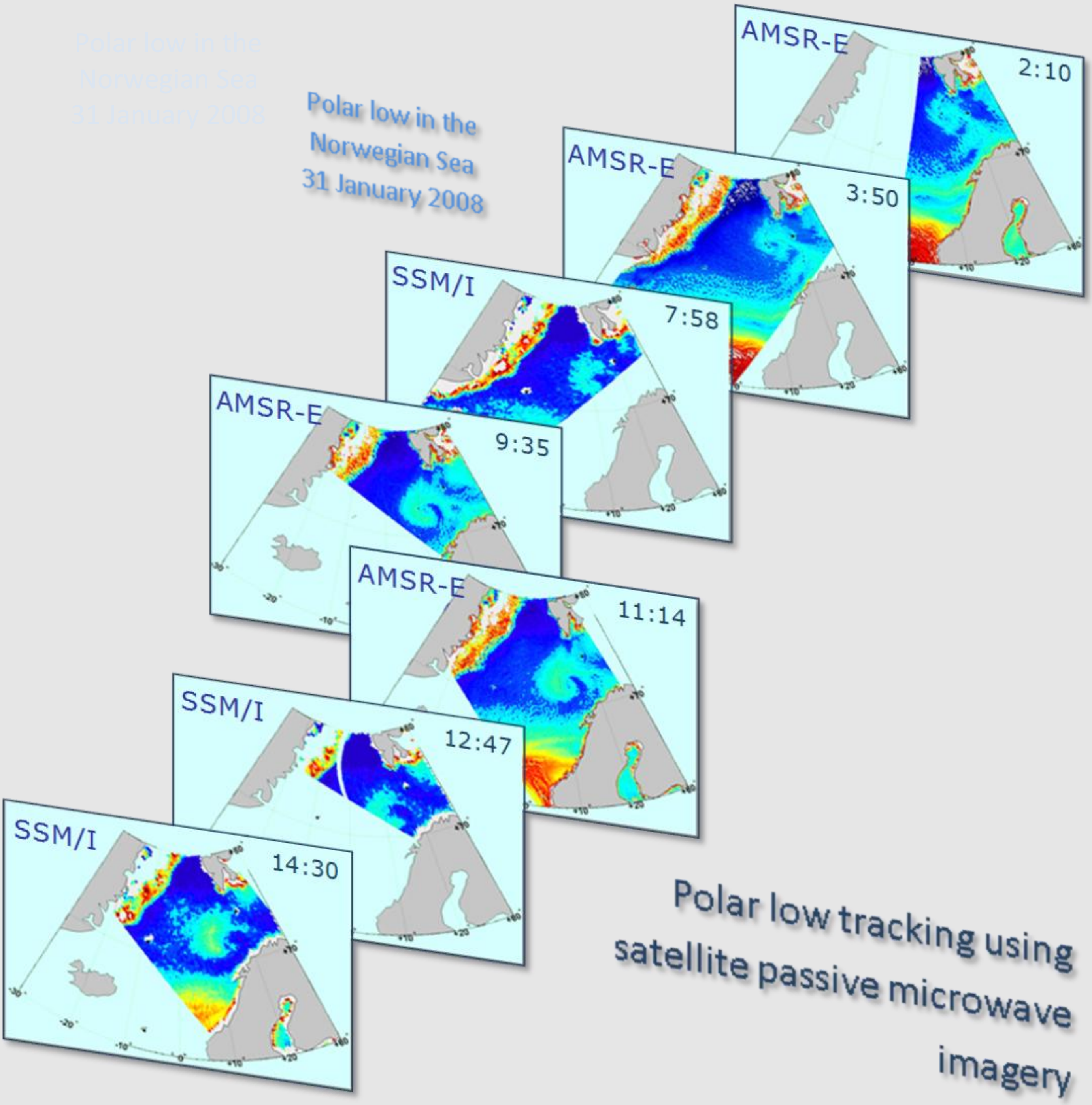
Annual Report 2010

Nansen International Environmental and Remote Sensing Centre

St. Petersburg, Russia

a non-profit international research institute for environmental and climate research

Founded in 1992



Polar low tracking using satellite passive microwave imagery

Founders of the Nansen Centre

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Bergen, Norway

Max Planck Society
Munich, Germany

Nansen Environmental and Remote Sensing Centre
Bergen, Norway

Northern Water Problems Institute of Russian Academy of Science, Karelian Research Centre
Petrozavodsk, Republic of Karelia, Russia

Saint-Petersburg State University
Saint-Petersburg, Russia

Scientific Research Centre for Ecological Safety of Russian Academy of Science
Saint-Petersburg, Russia

Director

Dr. Leonid P. Bobylev

NIERSC Leader Team

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Head of Climate Group

Prof. Dmitry V. Pozdnyakov, Deputy Director,
Head of Aquatic Ecosystem Group

Dr. Dmitry V. Kovalevsky, Research Director,
Head of Socioeconomic Group

Prof. Vladimir N. Kudryavtsev, Research Director,
Head of Atmosphere-Ocean Interaction Group

Dr. Vladimir A. Volkov. Research Director,
Head of MetOcean Group

Ms. Maria V. Samsonova, Chief Accountant

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Prof. Ola M. Johannessen

Founding President of NIERSC, Founding Director and Chairman, Nansen Environmental and Remote Sensing Centre, also Professor Emeritus at the Geophysical Institute, University of Bergen, *Bergen, Norway*

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St. Petersburg, Russia

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Director, Scientific Centre for Earth Operational Monitoring, Roscosmos, *Moscow, Russia*

Mr. Kaare Rommetveit, *Bergen, Norway*

Report from the General Meeting of Founders

Vision

The Scientific Foundation "Nansen International Environmental and Remote Sensing Centre" (Nansen Centre, NIERSC) vision is to understand, monitor and predict climate and environmental changes in the high northern latitudes for serving the Society.

Major Research Areas

- Climate Variability and Change in High Northern Latitudes
- Atmosphere-Ocean Interaction
- Aquatic Ecosystems in Response to Global Change
- Applied Meteorological and Oceanographic Research for Industrial Activities
- Socioeconomic Impact of Climate Change

Organization

NIERSC is an independent non-profit international research foundation established by Russian, Norwegian and German research organizations. NIERSC conducts basic and applied environmental and climate research funded by the national and international governmental agencies, research councils, space agencies and industry. Additionally, the Nansen Centre receives basic funding from its Founders and the Nansen Scientific Society.

NIERSC was founded in 1992 and re-registered at the St. Petersburg Administration Registration Chamber into a non-profit scientific foundation in 2001. The Centre got accreditation at the Ministry of Industry, Science and Technology of the Russian Federation as a scientific institution in 2002 and was re-registered in 2006 according to a new legislation on Non-Commercial Organizations of the Russian Federation.

NIERSC got a license for conducting meteorological and oceanographic observations from Roshydromet in 2006.

In 2008 Nansen Centre received also a license from Roscosmos for conducting the space-related research activities.

Staff

At the end of 2010 the NIERSC staff incorporated 31 employees comprising core scientists, including three full Doctors of Science and five with a PhD degree, part-time researchers, and administrative personnel. 12 Nansen Fellowship PhD-students are supervised and supported financially, 7 of them holding also part-time positions of Junior Researchers at NIERSC.

Production

During the year 2010, totally
73 publications were published including one book, two chapters in books,
7 papers in peer reviewed journals,
12 papers in other journals and
51 conference proceedings (see the Reference list).

Doctor of Sciences Dissertation at NIERSC

On 30 September 2010 ***Dr. Vitaly Yu. Alexandrov*** successfully defended his Doctor of Sciences (Dr. Sci.) thesis in Oceanography. The title of his thesis is ***"Satellite Radar Monitoring of the Sea Ice Cover".***

The defense was carried out at the Scientific Council of Arctic and Antarctic Research Institute (AARI). The Higher Certifying Commission of the Russian Ministry of Science and Education gave Dr. Vitaly Yu. Alexandrov a qualification of Doctor of Physical and Mathematical Sciences (see a summary of the Dr. Sci. thesis in the Scientific Report).

Awards

Dr. Natalia Yu. Zakhvatkina received in 2010 ***the Academician Kupfer Award*** from Roshydromet Service for her research work *"Arctic Sea Ice Identification using Satellite SAR Data".*

Socioeconomic Workshop

On 2 November 2010 a Workshop ***"Ecological and Economic Issues in the Context of Climate Change"*** was held at NIERSC. The primary focus of the Workshop was on the economics of climate change, with special emphasis on economic modelling. The presentations were delivered by key experts from St. Petersburg and Moscow.

Meetings and Workshops on Remote Sensing

Dr. Elizaveta V. Zabolotskikh took part in ***Algorithm comparison for atmospheric water vapor and cloud liquid water retrievals*** to be used for AMSR-2/GCOM-W satellite (Japan 2011) data processing (Japan, Tokio, JAXA, 10-17 January 2010)

Dr. Leonid P. Bobylev and ***Dr. Elizaveta V. Zabolotskikh*** represented NIERSC at the Taiwan-Russia Workshop ***"Remote sensing of physical and biological processes: Application for waters around Taiwan"*** (National Taiwan Ocean University, Keelung, Taiwan, 15-16 October 2010).

National and International Activities

NIERSC has a long-lasting cooperation with Russian organisations such as St. Petersburg State University, institutions of the Russian Academy of Science, Federal Space Agency, Federal Service for Hydrometeorology and Environmental Monitoring including the Northern Water Problems Institute, Scientific Research Centre for Ecological Safety, Arctic and Antarctic Research Institute, Russian State Hydrometeorological University, Voeikov Main Geophysical Observatory, Murmansk Marine Biological Institute, Research Centre of Operational Earth Monitoring and other, totally about 40 institutions.

Fruitful relations are established also with a number of foreign and international organizations, universities and institutions including Max-Planck Institute for Meteorology, GKSS Research Centre, Friedrich-Schiller-University in Jena, Germany, Finnish Institute of Marine Research, Institut Français de recherche pour l'exploitation de la mer (IFREMER) in Brest, France, European Climate Forum, and especially with the NIERSC founders. Close cooperation is established with the Nansen Centre in Bergen. Most of scientific results described below are achieved within the joint research activities of both Nansen Centres, in St. Petersburg and Bergen, and cooperating partners.

Nansen Fellowship Programme

The main objective of the Nansen Fellowship Program (NFP) at NIERSC is to support PhD-students at Russian educational and research institutions, including Russian State Hydrometeorological University, St. Petersburg State University, Arctic and Antarctic Research Institute, and others. The research areas are climate and environmental change and satellite remote sensing, including integrated use of satellite Earth observation techniques in combination with supporting *in situ* observations and numerical modeling for studies of the Earth system.

NFP provides the PhD-students with:

- Russian and international scientific supervision
- financial fellowship
- efficient working conditions at NIERSC
- training and research visits to international research institutions within the Nansen Group and beyond
- involvement into international research projects.

The postgraduate student activity is supervised by at least one Russian and one international senior scientist. All NFP PhD-students have to publish their scientific results in the international refereed journals and make presentations at the international scientific symposia and conferences.

20 young Russian PhD-students have since 1997 got their doctoral degree under the NFP.

NFP is sponsored by core funding from the Nansen Center in Bergen, Norway (NERSC) and the Nansen Scientific Society.

Research Projects

Below is the list of the research projects implemented at NIERSC in 2010. Most of them were implemented in close cooperation with other national and international scientific institutions.

Completed projects

Developing Arctic Modeling and Observing Capabilities for Long-term Environment Studies (DAMOCLES, EU FP6, 2006-2010, *Project Leader: Jean-Claude Gascard, UPMC*)

Maritime resources of the Barents Sea: satellite data driven monitoring in the context of increase of commercial efficiency of the fishery (MAREBASE, Research Council of Norway, 2008-2010, *Principal Investigators: Prof. Stein Sandven, NERSC / Prof. Vladimir N. Kudryavtsev, NIERSC / Dr.Sci. Oleg V. Titov, PINRO / Dr. Alexandr S. Averkiev, RSHU*)

Software development for satellite sun glitter image processing (Contract with IFREMER, 2010, *Principal Investigator: Prof. Vladimir N. Kudryavtsev, NIERSC*)

Meteor-3 (Contract with NTsOMZ, 2010, *Principal Investigator: Prof. Dmitry V. Pozdnyakov, NIERSC)*

Federal Program "World Ocean" (Sub-contract with RSHU, 2010, *Principal Investigator: Prof. Vladimir N. Kudryavtsev, NIERSC*)

CPA Algorithm (Contract with Michigan Technical University, 2010, *Principal Investigator: Prof. Dmitry V. Pozdnyakov, NIERSC*)

On-going projects

Arctic and sub-Arctic climate system and ecological response to the early 20th century warming (ARCWARM, Research Council of Norway, 2007-2011, *Project Leader: Prof. Ola M. Johannessen, NERSC*)

Descartes Program (EU Descartes Award fund, 2007-2011, *Project Leader: Prof. Ola M. Johannessen, NERSC*)

MyOcean (EU FP7, 2009-2012, *Project Coordinator: Pierre Bahurel, Mercator Océan)*

Assessing the sensitivity of Arctic coastal dynamics to change (RFBR – Helmholtz-Gemeinschaft, 2009-2012, *Project Leaders:Dr. Pier Paul Overduin, AWI / Dr. Stanislav A. Ogorodov, MSU*)

New projects

Agent-based modeling of climate-socioeconomic system with applications to the sustainability of Russian economy (ECF/NERSC, incl. donation by Prof. Hasselmann, 2010-2011, *Principal Investigator: Dr. Dmitry V. Kovalevsky, NIERSC*)

Deterministic and stochastic models of economic dynamics (RFBR, 2010-2011, *Project Leader: Dr. Dmitry V. Kovalevsky, NIERSC*)

Economics of climate change in a multiregional integrated assessment model for the Russian Federation (RFBR, 2010-2012, *Project Leader: Dr. Dmitry V. Kovalevsky, NIERSC*)

Monitoring and Assessing Regional Climate Change in High Latitudes and the Arctic (MONARCH-A, EU FP7, 2010-2013, *Project Coordinator: Prof. Johnny A. Johannessen, NERSC*)

New Research Areas

In 2010 new research areas and topics were established at NIERSC:

- Natural and anthropogenic variability and change of the Arctic glaciers
  (Research funded through MAIRES project, EU FP7, *Project Leader: Prof. Stein Sandven, NERSC*)
- Permafrost remote sensing from satellites: tundra lake monitoring using ENVISAT ASAR WS data
  (Research funded through NFP, conducted in cooperation with *Prof. Christiane Schmullius, FSU-Jena*)

Prospects for 2011

The interdisciplinary studies of the High North will remain the main focus of NIERSC research in 2011. NIERSC staff is encouraged to further increase the number of publications in peer reviewed journals in 2011.

St.Petersburg, 19th May 2011

Jean-Pierre Contzen, UNIFOB, *President*

Valentin Meleshko, VMGO, *Co-President*

Hartmut Grassl, Max-Plank Society, *Co-Vice President*

Lasse H. Pettersson, NERSC, *Co-Vice President*

Valery Astakhov, SPbSU

Vladislav Donchenko, SRCES RAS

Nickolay Filatov, NWPI RAS

Leonid P. Bobylev, *Director*

SCIENTIFIC REPORT

Climate Variability and Change

Surface air temperature variability and trends in the Arctic

Dr. Svetlana I. Kuzmina

Prof. Ola M. Johannessen (NERSC, Norway)

Dr. Leonid P. Bobylev

Dr. Olga G. Aniskina

In the framework of ARCWARM project we examined the Arctic surface air temperature (SAT) variability and trends using unique long-term records of *NansenSAT* dataset. Arctic regions were determined by statistically justified manner using hierarchical Cluster Analysis. The magnitude of Arctic amplification was estimated and the role of different Arctic regions in this amplification was analysed. It was shown that the annual Northern Hemisphere (NH) and Arctic SAT had increased since 1900 with the warming rate of ~0.7 C/100yr. The greatest SAT changes in the annual course occurred in winter for the polar region (~1.3 C/100yr). Absolute SAT maxima for all seasons occurred in 1990s and 2005-2007. However, recent winter polar SAT anomaly did not exceed one occurred in 1944. Over the past 100 years the Arctic amplification was observed during all seasons, except summer. It was the most pronounced during early warming and cooling periods. Ongoing warming is characterized, till now, by significantly less magnitudes of the Arctic amplification than previous warming and cooling. But there is a clear tendency for the Arctic amplification strengthening during the latest period for all seasons, especially for winter (Fig. 1).

Analysis of climate changes in Saint-Petersburg using observational and modelling data

Dr. Svetlana I. Kuzmina

Dr. Olga G. Aniskina

Dr. Leonid P. Bobylev

An assessment of past and current state of the climate of St. Petersburg has shown that the rate of change of surface air temperature and precipitation in the late 20th and early 21st century significantly exceeds the trends noted earlier. The analysis of future changes in heat and water balance according to a new generation of climate models CMIP3 was performed. The probability of future extreme events was estimated. The long-term risk of Neva flooding to 2090 was analysed. Climate model results indicate a significant increase of SAT and precipitation, especially during the winter. Increasing proportion of rainfall at the end of 21st century is 20% in summer and 50% in winter. SAT growth by the end of the 21st century is about three degrees in summer and about 9 degrees in winter (Fig. 2). Recommendations for the environmental policies of the city were developed. The obtained results permit to get new insights about the peculiarities of manifestation of global warming and assess the trends of climate change and anthropogenic influence on climatic characteristics of the metropolis. *This study is summarized in a paper submitted to Meteorology and Hydrology.*

Polar low study using multi-sensor approach

Dr. Elizaveta V. Zabolotskikh

Dr. Leonid P. Bobylev

PhD-student Julia Ye. Smirnova

Prof. Vladimir N. Kudryavtsev

Prof. Johnny A. Johannessen (NERSC, Norway)

In the frame of DAMOCLES Project the enhanced techniques for polar low monitoring, developed at NIERSC during 2008-2009, were applied for further research associated with these adverse weather events. In 2010 the main efforts in the area of polar low studies were aimed at the involvement of the data from new sensors from different satellites. As in the previous years, the general research methodology was based on the usage of satellite passive microwave measurements of SSM/I and AMSR-E onboard DMSP and Aqua satellites correspondingly. The high potential of these data had repeatedly been confirmed by numerous case studies. The availability of high accuracy Neural Network Arctic polar algorithms allowed the detection of those polar lows that could not be identified by any of the other instruments. Besides, multi-sensor approach was further developed

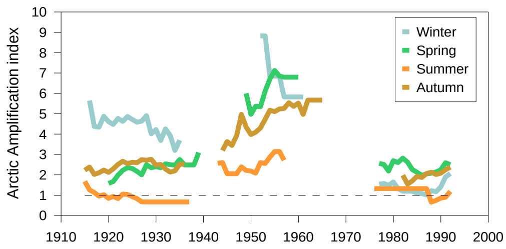

Fig. 1. Time evolution of the Arctic Amplification Index (AAI) – ratio between 30-year polar and NH SAT linear trends. Dashed black line shows AAI = 1, where NH trend is equal to the Arctic trend

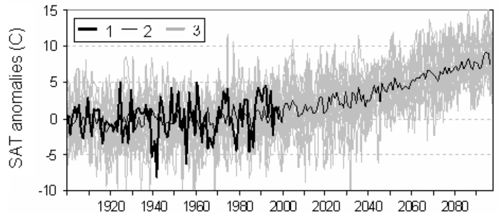

Fig. 2. Time evolution of winter temperature anomalies for 20th and 21st centuries (IPCC STRES A2 scenario): (1) – observations; (2) – model mean; (3) – individual model realisations

providing the most complete knowledge about the polar lows: the highest temporal resolution and all available parameter estimation. This approach now uses data from the following instruments: Envisat ASAR for high resolution wind speed retrieval; QuikSCAT/SeaWinds (before November 2009) and Metop ASCAT for low resolution additional wind speed data; Terra and Aqua MODIS, NOAA AVHRR data for the study of the polar low cloud structure; DMSP SSM/I, Aqua AMSR-E, NOAA AMSU-B for various geophysical parameter estimation; radiosonde reports and surface analysis maps as supplementary data; NCEP/NCAR re-analysis data for construction of pressure fields and searching for correlation between mesoscale lows found using satellite remote sensing data and low pressure areas in re-analysis data.

The results of the study are summarized in a number of publications, including:

Bobylev L., E. Zabolotskikh, *L. Mitnik, M. Mitnik . IEEE Trans. Geosci. Remote Sensing,* 2010, Vol. 48, No. 1, pp. 283–294;

Bobylev L., E. Zabolotskikh, *L. Mitnik, M. Mitnik . IEEE Trans. Geosci. Remote Sensing,* 2011, Vol. 49, No. 9, pp. 3302–3310.

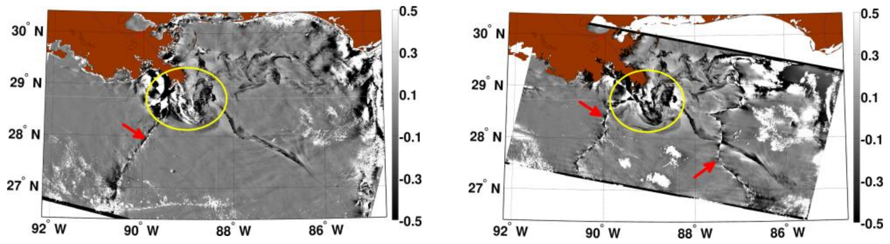

Fig. 3. The MSS anomalies $\tilde{s}^2/s^2$ derived from the MERIS (left plot) and MODIS (right plot) images. Red arrows indicate zones of the inversion of contrasts where reconstructed MSS have singular values (without physical meaning). MSS anomalies confined to the yellow contours are presumably not true, because the oil film thickness in this area is too large relative to the red light wavelength. Since the considered method does not take this effect into account, bright/dark features inside the yellow contours should be considered as artifacts

Permafrost reference map

Dr. Elena V. Shalina

Dr. Leonid P. Bobylerv

Ms. Lyudmila S. Lebedeva

Mr. Kirill E. Zemeszirks

The work has been carried out in the frame of the MONARCH-A FP7 Project. NIERSC work is concentrated within two main tasks: 1) to create and deliver a digital “reference permafrost map from historical sources” which could be used as a point of reference in the evaluation of permafrost changes, and 2) to assess changes occurred in the permafrost over the last 30 years.

Permafrost is a critical element of land surface processes at high latitudes, affecting land cover, hydrology and snow dynamics. Its melting under climate warming will cause (and to some extent is causing now) potentially dangerous releases of greenhouse gases, as well as changing high-latitude hydrology and affecting human activities.

In order to collect data that could be the base for a reference permafrost map NIERSC team has produced an inventory of existing permafrost data sets and maps, including Russian historical maps and data from local sampling worldwide. Available and relevant for MONARCH-A Russian historical paper maps (totally 317 maps) have been collected and archived, data from local measurements of permafrost available on the Web has been downloaded. All maps of the archive are accompanied by metadata/commentary.

About 50% of the collected maps had been created in 1980s. Most of maps are for limited areas of Russian Federation, however a part of them are for the territory of the former Soviet Union or Russia. Comparison of collected maps demonstrates some differences in permafrost description that have to be analyzed. The paper map created by I. Baranov in 1977, a scale 1:5 000 000, was chosen as a base map for digitizing parameters of permafrost.

Atmosphere-Ocean Interaction Studies

Impact of ocean spray on the dynamics of the marine-atmospheric boundary layer

Prof. Vladimir N. Kudryavtsev

The impact of ocean spray on the dynamics of the marine-atmospheric surface boundary layer (MABL) in conditions of very high (hurricane) wind speeds is investigated. To that end a model of the MABL in the presence of sea-spume droplets is developed. The model is based on the classical theory of the motion of suspended particles in a turbulent flow, where the mass concentration of droplets is not necessarily small. The description of the spume droplets generation assumes that they, being turn off from breaking waves, are injected in the form of a jet of spray into the airflow at the altitude of breaking wave crests.

The droplets affect the boundary layer dynamics in two ways: via the direct impact of droplets on the airflow momentum forming the so-called “spray force”, and via the impact of droplets on the turbulent mixing through stratification. The latter is parameterized applying the Monin–Obukhov similarity theory. It is found that the dominant impact of droplets on the MABL dynamics appears through the action of the “spray force” originating from the interaction of the “rain of spray” with the wind velocity shear, while the efficiency of the stratification mechanism is weaker. The effect of spray leads to an increase in the wind velocity and suppression of the turbulent wind stress in the MABL.

The key issue of the model is a proper description of the spume droplet generation.

It is shown that, after the spume droplet generation is fitted to the observations, the MABL model is capable of reproducing the fundamental experimental finding – the suppression of the surface drag at very high wind speeds.

We found that at very high wind speeds a thin part of the surface layer adjacent to the surface turns into regime of limited saturation with the spume droplets, resulting in the leveling off the friction velocity and decrease of the drag coefficient as U_{10}^{-2}, where U_{10} is the wind speed at 10 m height.

Joint sun-glitter and radar imagery of surface slicks

Prof. Vladimir N. Kudryavtsev

PhD-student Alexander G. Myasoedov

Prof. Johnny A. Johannessen (NERSC, Norway)

This activity, carried out in the framework of IFREMER contract, is targeted on development of an advanced synergistic approach for analysis of SAR and optical scanner data focusing on study of oil spills surface signatures (Fig. 3).

In general, the main oceanographic applications of satellite optical data (e.g. from MODIS and MERIS instruments) are associated with ocean color studies. In such cases the sunlight reflected from the sea surface is a major part of upward radiation which creates significant difficulties for ocean color retrieval algorithms. On the other hand, sun glitter contains valuable information on statistical properties of the sea surface roughness, its mean square slope (MSS), skewness and kurtosis. A method is proposed to retrieve and interpret fine spatial variations of the sea surface roughness in sun glitter imagery. Observed sun glitter brightness anomalies are converted using a transfer function determined from the smoothed shape of sun glitter brightness. The method is applied to MODIS and MERIS sun glitter imagery of natural oil seeps and the catastrophic Deepwater Horizon oil spill in the Gulf of Mexico (Fig. 4).

The short-scale roughness variations in the presence of mineral oil slicks are consistently retrieved and compared to variations associated with the biogenic slicks. In doing so, the wind speed

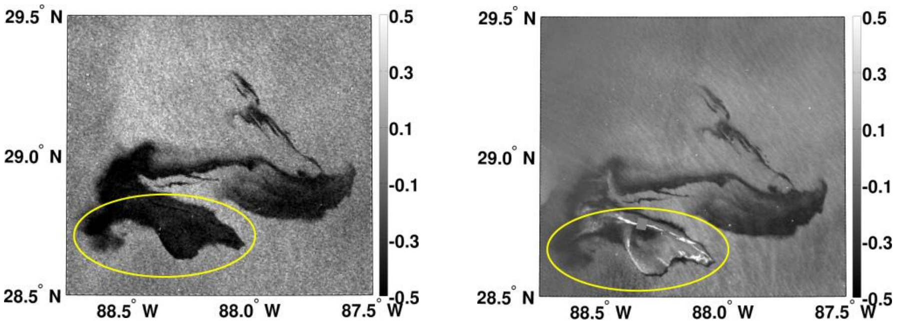

Fig. 4. Enlarged fragments of the ASAR 15:58 GMT (left) and MERIS 15:56 GMT (right) images of the oil spill in the Gulf of Mexico on 26 April 2010 containing the oil spill and represented in terms of the NRCS (linear units) and MSS contrasts. The yellow contour confines the slick area where the oil film thickness is presumably large relative to the red light wavelength

dependency on the roughness anomalies is also taken into account. A comparison to normalized radar cross section (NRCS) anomalies taken from the corresponding high resolution ASAR images is performed, and similarities as well as differences are investigated. The results document significant benefit from the synergistic use of sun glitter and radar imagery for detection and monitoring of surface slicks. Results of this study are presented in: ***Kudryavtsev V., A. Myasoedov,*** *B. Chapron, J. Johannessen, F. Collard*. Joint sun-glitter and radar imagery of surface slicks. *Remote Sensing of Environment (accepted for publication);* ***Myasoedov A., V. Kudryavtsev.*** Sun glitter imagery of ocean phenomena. *Scientific Transactions of the Russian State Hydrometeorological University,* Vol. 16, pp. 94-114, 2010 *(in Russian).*

Envisat ASAR imaging of coastal upwelling in the Baltic Sea: case study with modeling

Prof. Vladimir N. Kudryavtsev

PhD-student Igor Ye. Kozlov

PhD-student Alexander G. Myasoedov

An analysis of Envisat Advanced Synthetic Aperture Radar (ASAR) and Aqua/Terra Moderate Imaging Spectrometer (MODIS) infrared (IR) imagery of coastal upwelling in the southeastern Baltic Sea is presented (Fig. 5). It is found that upwelling signatures are well distinct in SAR images, and the leading mechanism is the change of the marine-atmospheric boundary layer (MABL) stratification over the sea surface temperature (SST) front. This finding is supported by model calculations of the MABL transformation supplemented with the SAR calculations based on CMOD4 model. An empirical dependence of the SAR contrasts over upwelling on the wind speed and the SST drop is suggested. Surface slicks accumulated in the sea surface current convergence zones generate additional upwelling features in SAR imagery. This effect is interpreted within the frame of the coastal current circulation model based on analysis of the SST snapshot. Results of the study are summarized in: ***Kozlov I., V. Kudryavtsev,*** *J. Johannessen, B. Chapron, I. Dailidiene,* ***A. Myasoedov.*** ASAR imaging for coastal upwelling in the Baltic Sea. *Advances in Space Research,* 2011. DOI:10.1016/j.asr.2011.08.017 *(published online).*

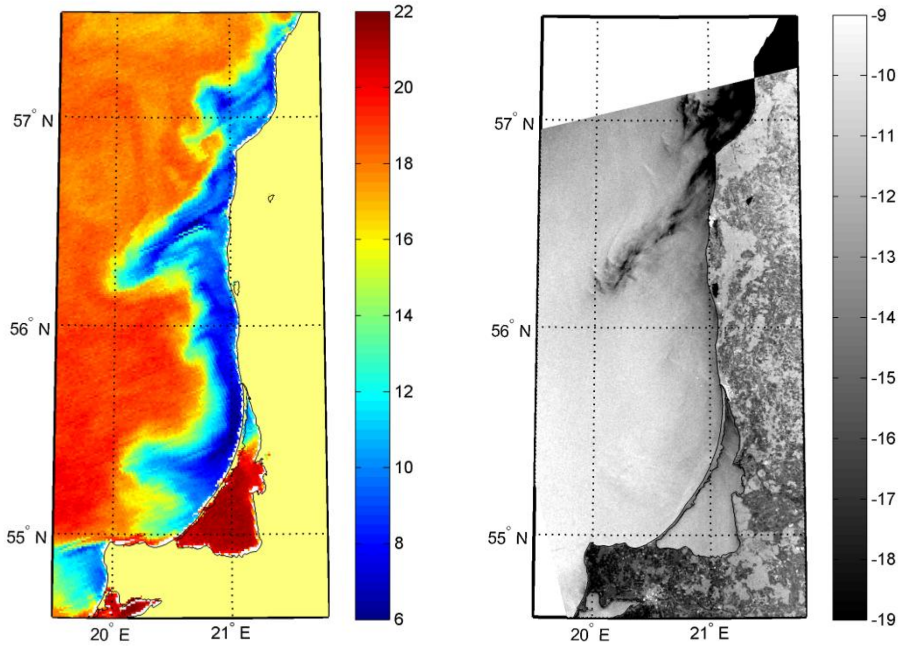

Fig. 5. Upwelling manifestation in the south-eastern Baltic Sea in concurrent MODIS Terra and Envisat ASAR data on 16 July 2006. Left plot: MODIS SST map (C) acquired on 16 July 2006 at 19:40 UTC (© NASA); right plot: Envisat ASAR image (dB) acquired on 16 July 2006 at 20:05 UTC (© ESA)

Aquatic Ecosystems in Response to Global Change

Seasonal and multi-year phytoplankton dynamics in the Bay of Biscay as established from space

PhD-student Evgeny A. Morozov

Prof. Dmitry V. Pozdnyakov

Mr. Lasse H. Pettersson (NERSC, Norway)

Prof. Hartmut Grassl (MPI-M, Germany)

The Bay of Biscay plays a significant economic role for France and Spain: the bay's coastal and pelagic zones accommodate highly productive ecosystems providing habitat for various fish, and mollusks important on industrial scales.

Based on the major assets of satellite remote sensing, we investigated in detail (i) *seasonal* and *spatial* variations in phytoplankton community (including *L. chlorophorum,* which was identified only recently and subsumed under the category of harmful algae) and total suspended matter in the coastal zone as well as (ii) spatio-temporal regularities in blooms of the *E. huxleyi* (also assumed harmful) in the off-coastal zone. Through the bridging approach, several (past and still operating) ocean colour sensors were used to trace down decadal patterns in temporal variations of the above constituents of bays' water. Via a synergistic use of satellite data from some non-ocean-colour sensors (providing information on sea surface temperature and on direction and speed of near surface winds), *in situ* and modeling data reported in the literature, as well as NCEP (National Centre for

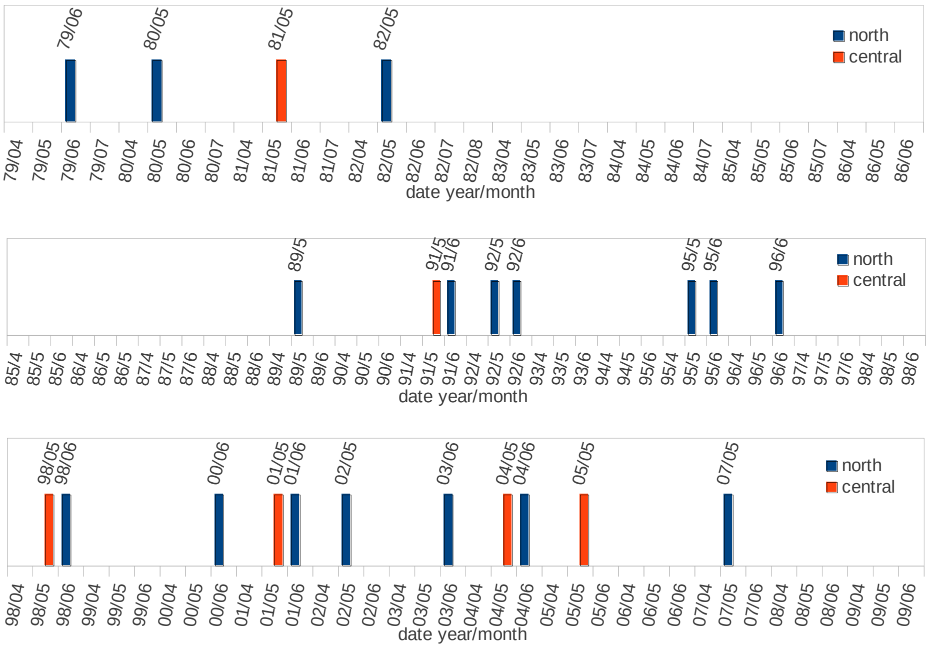

Fig. 6. Multi-decadal occurrence of E. huxleyi blooms in the northern and central parts of the Bay of Biscay as revealed from CZCS, AVHRR, SeaWIFS and MODIS ocean colour bridged data

A paper on the results of this research is being prepared for a refereed international journal.

Assessing the sensitivity of Arctic Coastal Dynamics to Change

PhD-student Evgeny A. Morozov

Prof. Dmitry V. Pozdnyakov

Dr. Anton A. Korosov (NERSC, Norway)

Pursued under the Helmholtz-RFBR project, our work was focused on processing ocean colour data with the NIERSC/NERSC BOREALI algorithm for eventual generation of monthly and annual maps of terrigenous suspended mineral (*sm*) matter distribution in the coastal zone of the Kara Sea and dissolved organic matter (*dom*) across the entire sea as well as sea surface temperature and wind (NASA

Environmental Predictions) reanalysis data, we established the main forcing factors that conditioned the investigated water constituents temporal variations observed from space throughout decades. In particular, bridged four decades data from ocean colour sensors CZCS, AVHRR, SeaWIFS and MODIS explicitly indicate that climate warming has indeed resulted in increasingly frequent and extensive blooms of *E. huxleyi* (Fig. 6). Climatic impact is also detected in the spatio-temporal variations of phytoplankton and suspended matter within the shelf zone. These are absolutely new findings never established before.

The research results are summarized in the paper submitted to the journal *Continental and Shelf Research.*

Spaceborne assessment of primary productivity and its decadal trends in the Arctic Basin

PhD-student Dmitry A. Petrenko

Prof. Dmitry V. Pozdnyakov

Dr. Svetlana Milutinovic (NERSC, Norway)

Dr. Francois Counillon (NERSC, Norway)

The research was undertaken under MONARCH-A FP7 project. The Arctic Ocean is experiencing alterations of its ecosystem due to undergoing climate change. This also regards the fundamental level of the inherent biological community – phytoplankton.

Due to various and not yet completely understood mechanisms of external forcing-biota interactions, the primary production inevitably responds to climatic signals. Determination of the ecosystem's response and assessment of its trend are vitally important from many points of view, possibly, first and foremost, elucidation of forward and feedback interactions in the atmosphere-ocean system. An unprecedented size of *in situ* and modeling data related to phytoplankton primary production (PP) and satellite ocean colour data were used for quantification of PP via application of a number of algorithms/models, comparison of PP retrieval results with the available *in situ* measurements, selection of a most adequate tool of PP quantitative assessment, and finally, establishment of the PP interannual variation trends (see Fig. 7). Importantly, the trend is differentiated between the pelagic and shelf zones in order to assess separately for each type of zone the annual PP rates and their responsiveness to climate change. The availability of extensive and unique in their size *in situ* data permitted an unprecedented thorough validation of the PP retrievals imparting high credibility to the established trend.

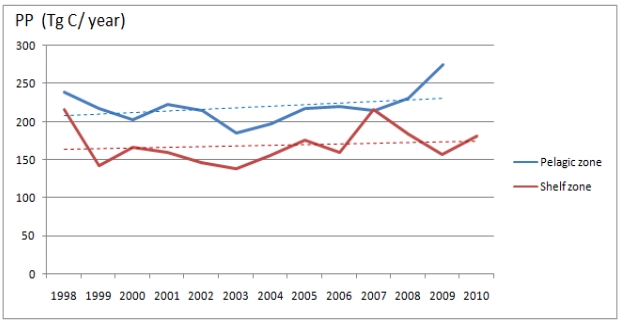

Fig. 7. Time series of PP in pelagic and shelf zones of the Arctic Ocean retrieved with the Behrenfeld algorithm (1997). SeaWiFS and MODIS-Aqua blended data

algorithms). The maps are drawn for the period 1998-2009, and intended for the establishment of the multi-year trend of transport of the terrigenous matter into the sea, as a reflection of coast and riverbank erosion due to climate warming in the Arctic Basin.

With verification purposes, the results of *sm* and *dom* retrievals are compared with the available statistically reliable historical data on *sm* and *dom* concentrations in the Kara Sea; and the comparisons proved to be very good.

Fig. 8 illustrates the time series of *sm* for

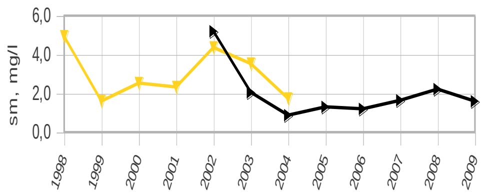

Fig. 8. Time series of sm concentration variations in July for a selected area (in the vicinity of the Ob River). SeaWiFS (yellow) and MODIS-Aqua (black) blended data

a selected area (in the vicinity of the Ob River). The variations shown in Fig. 8 explicitly indicate that there is a steady tendency of the *sm* concentration decline during the period 1998-2007.

Importantly, we succeeded in discrimination of terrigenous (allochthonous) and pelagic (autochthonous) *dom* produced by phytoplankton and quantified the respective fluxes. In essence, this innovative approach can be employed for other marine environments provided underpinning *in situ* data are available.

A paper on the results of this research is being prepared for a refereed international journal.

Development of a methodology for retrieval of water quality parameters in optically shallow waters

Prof. Dmitry V. Pozdnyakov

The research was performed under the 2010 bilateral contract between the Michigan Technological University (USA) and NIERSC. The developed methodology is based on the equations of light propagation through the water column. The new algorithm retrieves simultaneously not only water quality parameters (i.e. concentrations of *chl*, *sm* and *dom*) but also the bottom depth provided the bottom type (e.g. silt/grass/mud/sand) is known.

In 2011 this methodology is to be exploited for Lake Michigan, and the results are to be summarized in a paper for a refereed international journal.

Development of a software package for producing specialized information products restored from the KMSS KA "Meteor·M" No. 1 monitoring data on ice cover and marine environment ecological state

Dr. Anton A. Korosov (NERSC, Norway)

Prof. Dmitry V. Pozdnyakov

This Design and Development Work (DDW) was accomplished under the 2010 contract between the Russian Space Agency (RSA) (via Research Center for Earth Operative Monitoring, Corporation "Russian Space Systems") and NIERSC. A special methodology has been elaborated: Neural Network (NN) emulators were developed as operational algorithms for automated retrieval of cloudiness parameters, normalized spectral radiance emerging from the water body and water quality parameters inherent in the Caspian Sea. NNs were trained using the relevant MODIS data. Fig. 9 illustrates that the KMSS KA data thus processed is in a good compliance

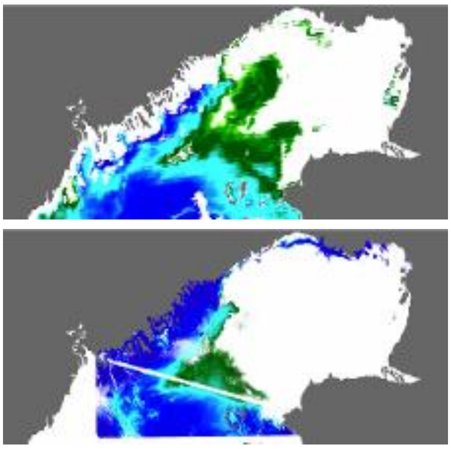

Fig. 9. MODIS and KMSS KA "Meteor·M" sm retrieved fields comparison (upper and lower penal correspondingly)

with the respective data from MODIS. Thus, due to the elaborated approach, KMSS KA "Meteor·M" No. 1 data can be used not only for qualitative but also quantitative assessment of water quality and in water optical parameters for a wealth of practical applications.

MetOcean Group

Development of methodology for sea ice drift variability analysis and modeling results validation

Dr. Vladimir A. Volkov

PhD-student Denis V. Demchev

Prof. Stein Sandven (NERSC, Norway)

In 2010 MetOcean Group continued activity on development of methods for sea ice cover monitoring in the Arctic, processing and interpretation of sea ice satellite images. At the same time, developing a modern statistical methodology of the sea ice drift variability analysis and modeling results validation was the main task of the MetOcean Group activities. The work was carried out under MyOcean FP7 project. In particular, the task on estimation of quality of a modeling results of TOPAZ forecasting system (Norway) was solved.

Data of operating drifting buoys, including located on the "North Pole" stations, and 2-daily gridded ice drift data from IFREMER with 32,5 km steps for winter periods from 2002, as well as data of the global climate set of the ice drift fields–Pathfinder with a step of 25 km from 1998 for winter and summer time, were used for comparison with TOPAZ modeling results. Gridded data were prepared using satellite images in the visible, IR and microwave ranges (AVHRR, SMMR, SSMI) and buoy data (IAPB).

All drift data were consolidated by NIERSC under special MyOcean oceanographic information system, and special software for operating with the archived data was developed.

The vectorial-algebraic approach developed with the assistance of Prof. V. Rozhkov was chosen as a fundamental method for analysis of the ice drift series and for the first time was adopted for validation of the modeling results. The vectorial-algebraic approach allows significantly compress the initial information and most adequately describe the vector time series of full-scale and model data restricted by a set of statistical characteristics in the invariant form.

Results of such statistical analysis describe in detail a variability of drift fields and identify some zones characterized by different dynamics and intensity of carryover ice transport, and some sea ice circulation systems for

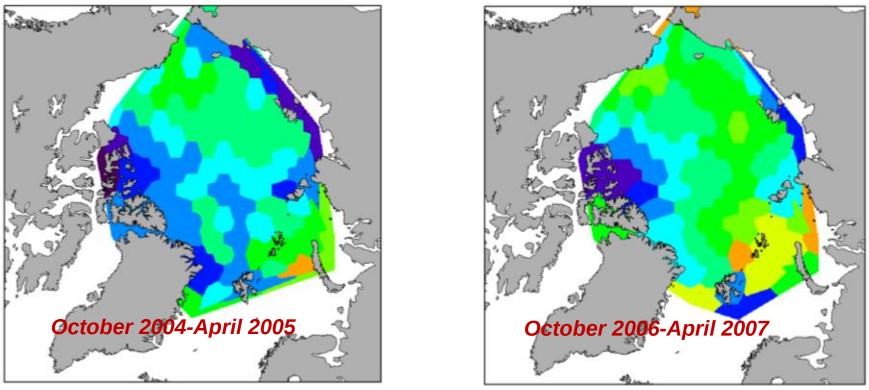

Fig. 10. Fields of I_1-invariant (mean square deviation for a vector process) of ice drift for winter seasons 2004-2005 (left panel) and 2006-2007 (right panel), km/day

different time intervals. In Fig. 10 a map of I_1 invariant is shown as an example describing a total variability of ice drift fields for two winter seasons. It is possible to see that a dispersion of ice drift in area of the Transarctic Current is increased essentially from 2004-2005 to 2006-2007 winter season when a minimum of old ice in the Arctic was recorded.

For comparison of calculated and observed drift fields a system of simplified correlation indexes (Nikolay Eu. Ivanov, AARI) was used. Analysis of fields of this correlation indexes demonstrates that the TOPAZ forecasting system describes very well the drift fields in central regions of the Arctic Ocean and a little bit worse in a coastal zones. It might be caused by a quality of wind reanalysis fields or desired boundary conditions.

The developed methodology could be applied for identification of some areas where modeling results are less accurate and for correction of parameters of existing models.

The results of the study are summarized in a paper by ***Volkov V.A.,*** *N.Ye. Ivanov,* ***D.M. Demchev*** (submitted to *Journal of Operational Oceanography).*

Satellite radar monitoring of the sea ice cover

(summary of Dr. Sci. Thesis)

Vitaly Yu. Alexandrov, Dr. Sci.

The major objective of the study consists of elaborating the concept of sea ice monitoring on the base of satellite Synthetic Aperture Radar (SAR) data and developing techniques of processing and interpretation of sea ice satellite radar images, as well as synthesis of remote sensing data in different bands of electromagnetic waves.

The thesis consists of seven chapters. Chapter 1 *"Theoretical basis of radar sea ice remote sensing"* deals with analysis of methods of sea ice radar remote sensing, theoretical estimates of hydrometeorological object influence on signal reflected from the sea ice. The ranges of the backscatter for the major ice types at C-band are determined.

Chapter 2 *"Interpretation of sea ice satellite radar images"* is devoted to analysis of the possibilities to derive major sea ice parameters from satellite radar images at X-, C-, and S-bands. SAR signatures of the principal sea ice types and features have been specified and verified. During winter, several stages of ice development and ice forms, areas of level, slightly deformed, moderate deformed and heavily deformed ice, fast ice boundary, shore and flaw polynyas, leads and large icebergs can be detected. During summer ice edge position and ice concentration can be derived, single ice floes and ice stripes are identified.

Chapter 3 is *"Automatic thematic processing of satellite radar images of the sea ice".* Our approach consists of developing algorithms for derivation of major sea ice parameters – ice type, total ice concentration and partial concentration of multiyear ice, characteristics of leads, and ice drift. After their verification these algorithms will be included into technology of SAR image interactive processing. Algorithms of sea ice classification in SAR images are based on neural network approach, linear discriminant analysis and Bayesian method.

Chapter 4 *"Combined analysis of sea ice satellite images in different spectral bands"* deals with developing technique of joint analysis of different remote sensing data - SAR, optical and passive microwave data, as well as SAR images acquired at different frequencies and polarizations. It is found that X-band is optimal for ice type discrimination. Icebergs and ice morphology features are better identified at L- and meter bands. Identification of water surface, young and first-year ice is improved by analyzing SAR C-band images at HH- and VV-polarizations. Leads in multiyear ice and icebergs among wind-roughened open water are reliably detected from co-polarization ratio. Combined interpretation of SAR and optical images allows unambiguous identification of ice type in leads and polynyas, as well as icebergs.

Chapter 5 *"Application of satellite radar data for studies of the ice cover"* deals with studies of climate and ice conditions in the Arctic on the base of satellite radar information. The seasonal and interannual variability of sea ice exchange between the Laptev Sea and the Arctic Ocean in the period 1979-1995 have been investigated based on joint analysis of satellite radar images, passive microwave radiometer data and the large-scale dynamic-thermodynamic sea ice model. Verification of multiyear ice parameters, calculated from SSM/I data using NORSEX algorithm, was done by means of comparison with the estimates derived from "Okean" and RADARSAT radar images.

Chapter 6 *"Practical applications of satellite radar images for supporting navigation in the ice"* is devoted to demonstration of SAR images for selecting optimal ship route in the ice and analysis of their efficiency for solving this problem.

In Chapter **7** ***"****Development of system and methods of sea ice monitoring"* methods of processing and fusion of data, acquired by various satellite, airborne and in situ remote sensing systems are described.

Economic Modelling

Dr. Dmitry V. Kovalevsky

Prof. Klaus Hasselmann (MPI-M, Germany/ ECF)

Prof. Carlo Jaeger (PIK, Germany/ ECF)

Research in microeconomics and economic growth theory was conducted in 2010 in the frame of two projects funded by RFBR. A modification of the seminal Scarf's model (a counter-example of a globally unstable general equilibrium model of an exchange economy) with an arbitrary number of economic agents and the proportional-integral price adjustment mechanism was studied analytically and numerically with a special focus on stability properties. The Structural Dynamic Economic Model SDEM proposed by *Hasselmann et al.* was upgraded to a model SDEM-2 which takes proper account of impact of human capital accumulation and learning-by-doing effect (see the DEGIT-XVI Conference paper by ***D.V. Kovalevsky*** (2011) at http://www.degit.ifw-kiel.de/papers/folder.2011-09-12.2623700498/c016_043.pdf).

In close cooperation with Klaus Hasselmann an actor-based system-dynamic Integrated Assessment model MADIAMS was updated to include business cycles and boom-and-bust cycles. Impact of key imbalances introduced in socioeconomic module of MADIAMS on model dynamics was studied numerically.

A comparative study of price (carbon taxes) and quantity (emission trading schemes) economic instruments of state mitigation policy was conducted, in line with an overview of practices of imposing the national carbon taxes in different countries. New trends in Russian climate policy were continuously monitored in 2009-2010 with an ultimate goal to update and extend the ECF-NIERSC Working Paper on the subject (2009, a follow-up is in preparation)

PUBLICATIONS

Refereed Papers

Alexandrov V.Yu., S. Sandven, J. Wahlin, O.M. Johannessen. The relation between sea ice thickness and freeboard in the Arctic. *The Cryosphere,* Vol. 4, pp. 373-380, 2010

Bobylev L.P., E.V. Zabolotskikh, L.M. Mitnik, M.L. Mitnik. Atmospheric water vapor and cloud liquid water retrieval over the Arctic Ocean using satellite passive microwave sensing. *IEEE Transactions on Geoscience and Remote Sensing,* Vol. 48, No. 1, pp. 283-294, 2010. DOI 0.1109/TGRS.2009.2028018

Fujimura A., A. Soloviev, V. Kudryavtsev. Numerical simulation of the wind stress effect on SAR imagery of far wakes of ships*. Geoscience and Remote Sensing Letters,* Vol. 7, No. 4, pp. 646-649, 2010

Hessen D.O., J. Carroll, B. Kjeldstad, A.A. Korosov, L.H. Pettersson, D.V. Pozdnyakov, K. Sørensen. Input of organic carbon as determinant of nutrient fluxes, light climate and productivity in the Ob and Yenisey estuaries. *Estuarine, Coastal and Shelf Science*, Vol. 88, pp. 53-62, 2010

Kosnik M.V., V.A. Dulov, V.N. Kudryavtsev. Generation mechanisms for capillary–gravity wind wave spectrum. *Izvestiya RAS, Atmospheric and Oceanic Physics,* Vol. 46, No. 3, pp. 369–378, 2010

Morozov E., A. Korosov, D. Pozdnyakov, L. Pettersson, V. Sychev. A new area-specific bio-optical algorithm for the Bay of Biscay and assessment of its potential for SeaWiFS and MODIS/Aqua data merging. *International Journal of Remote Sensing,* Vol. 31, No. 24, pp. 6541-6565, 2010

Soloviev Yu.P., V.N. Kudryavtsev. Wind-speed undulations over swell: Field experiment and interpretation. *Boundary Layer Meteorology,* DOI 10.1007/s10546-010-9506-z, 2010

Books

Johannessen O.M., V.A. Volkov, L.H. Pettersson, V.S. Maderich, M.J. Zheleznyak, Y. Gao, L.P. Bobylev, A.V. Stepanov, I.A. Neelov, V.P. Tishkov, S.P. Nielsen. Radioactivity and Pollution in the Nordic Seas and Arctic Region: Observations, Modelling and Assessment. Springer-PRAXIS, 408 p., 2010

Melentyev V.V., V. Chernook. Multi-spectral satellite-airborne management of ice form marine mammals and their habitat in the presence of climate change: Using a "Hot Spots" approach. Chapter in "Spatial Complexity, Informatics, and Wildlife Conservation", S.A. Cushman, F. Huettmann (Eds.). Tokyo, Springer Japan, pp. 409-429, 2010 *(chapter in the book)*

Romeiser R., J. Johannessen, B. Chapron, F. Collard, V. Kudryavtsev, H. Runge, S. Suchandt. Direct surface current field imaging from space by along-track InSAR and conventional SAR. Chapter in "Oceanography from Space", V. Barale, J.F.R. Gover, L. Alberotanza (Eds.).DOI 10.1007/978-90-481-8681-5. Springer, pp. 73-92, 2010 *(chapter in the book)*

Other Papers

Alexandrov V.Yu. Analysis of sea ice characteristics from Envisat ASAR Alternating Polarization images. *News of Meteorology*, Vol. 3, No. 1(6), pp. 7-16, 2010 (in Russian)

Bobylev L.P., V.Yu. Alexandrov, O.M. Johannessen, S. Sandven. Satellite radar monitoring of sea ice fields along the Northern Sea Route. *Regional Ecology*, Vol. 3(29), pp. 90-97, 2010 (in Russian)

Kovalevsky D.V. A multidimensional Scarf's model with Walrasian and proportional-integral price adjustment mechanisms. *Herald of ENGECON, Ser. Economics,* 2010, No. 7, pp. 164-177 (in Russian)

Kovalevsky D.V. Problems of regionalization of agent-based, system dynamics integrated assessment models. *Izvestiya of St. Petersburg State Polytechnical University, Ser. Economics,* 2010, No. 6, pp. 253-256 (in Russian)

Kovalevsky D.V., L.D. Kovalevskaya. Application of computable general equilibrium models to regional economic policy impact assessment. *Terra Economicus,* Vol. 8, No. 1, pp. 176-181, 2010 (in Russian)

Kozlov I.E., I. Dailidienė. Study of coastal upwelling in the Baltic Sea using satellite optical and SAR data. *Current Aspects of Remote Sensing of Earth from Space: Physical Basics, Methods and Monitoring Technologies of the Environment, Potentially Dangerous Phenomena and Objects,* Vol. 7, No. 3, Moscow, "DoMira Ltd.", pp. 161-168, 2010

Kozlov I.E., V.N. Kudryavtsev, S. Sandven. Some results of studying the internal waves in the Barents Sea by means of radar remote sensing from space. *Problems of the Arctic and the Antarctic,* No. 3(86), pp. 60-69, 2010 (in Russian)

Kshevetskaya M.A., A.V. Poberovsky. The system of archiving of solar high-resolution IR spectra for remote sensing problems of atmosphere. *Herald of St. Petersburg State University,* Ser. 4, Iss. 3, pp. 100-104, 2010 (in Russian)

Kudryavtsev V.N., V.K. Makin. Dynamics of the marine atmospheric boundary layer at high wind conditions. *KNMI Scientific Report,* WR 2010-01, 23 p.

Morozov E., D.V. Pozdnyakov, V.I. Sychev. Satellite observations of multi-year variations in some ecosystem variables in the Bay of Biscay. *Scientific Transactions of the Russian State Hydrometeorological University*, Vol. 14, pp. 147-161, 2010 (in Russian)

Myasoedov A., V. Kudryavtsev. Sun glitter imagery of ocean phenomena. *Scientific Transactions of the Russian State Hydrometeorological University*, Vol. 16, pp. 94-114, 2010 (in Russian)

Zabolotskikh E.V., L.P. Bobylev, A.V. Dikinis, L.O. Neyolova, J.E. Smirnova. Features of formation and classification of the storm mesoscale eddies. *Scientific Transactions of the Russian State Hydrometeorological University,* Vol. 16, pp. 59-76, 2010 (in Russian)

Proceedings

Alexandrov V.Yu., O.M. Johannessen, S. Sandven, L. Bobylev, A. Yarygina, V. Volkov, N. Zakhvatkina. Complex analysis of sea ice SAR images. *Abstracts of the Oceans from Space Symposium, 23-26 April 2010, Venice, Italy,* pp. 13-14

Alexandrov V., S. Sandven. Analysis of Arctic ice thickness, freeboard and snow cover from the data of Russian Sever expeditions. *Abstracts of ESA Living Planet Symposium, 28 June – 2 July 2010, Bergen, Norway*

Alexandrov V.Yu., S. Sandven, O.M. Johannessen, L.P. Bobylev. Changes of the Arctic ice thickness from the data of "Sever" expeditions. *Abstracts of the IPY Oslo Science Conference, 8-12 June 2010, Oslo, Norway*

Alexandrov V., S. Sandven, O.M. Johannessen, L. Bobylev, A. Yarygina, V. Volkov, N. Zakhvatkina. Methodology of complex analysis of sea ice SAR images. *Abstracts of ESA Living Planet Symposium, 28 June – 2 July 2010, Bergen, Norway*

Alexandrov V.Yu., S. Sandven, J. Wahlin, O.M. Johannessen. The relation between sea ice thickness and freeboard in the Arctic. *Abstracts of the IPY Oslo Science Conference, 8-12 June 2010, Oslo, Norway*

Alexandrov V.Yu., S. Sandven, J. Wahlin, O.M. Johannessen, L.P. Bobylev. Analysis of ice and snow thickness data in the Arctic from "Sever" expeditions*. Abstracts of the Scientific Conference "Marine Studies of the Earth Polar Regions during the IPY 2007/2008", 21-23 April, 2010, St. Petersburg, Russia,* p. 151

Bobylev L.P. Educational activities/young scientist promotion at the Scientific Foundation "Nansen Centre". *Proceedings of the International Conference "50 Years of Education and Awareness Raising for Shaping the Future of the Oceans and Coasts", 27-30 April 2010, St. Petersburg, Russia,* pp. 182-184

Bobylev L.P., O.M. Johannessen, S.I. Kuzmina. Transformation of the Arctic sea ice from satellite observation and modelling data. *Abstracts of the Joint Symposium on Taiwan-Russia Research Cooperation "Remote Sensing of Physical and Biological Processes: Application for Waters around Taiwan", 15-16 October 2010, Keelung, Taiwan*

Bobylev L.P., S.I. Kuzmina, O.M. Johannessen. Comparison of modelled and observed Arctic sea ice. *Abstracts of the Scientific Conference "Marine Studies of the Earth Polar Regions during the IPY 2007/2008", 21-23 April 2010, St. Petersburg, Russia,* p. 163

Bobylev L.P., S.I. Kuzmina, O.M. Johannessen. Comparison of modelled and observed Arctic sea ice. *Geophysical Research Abstracts, Vol. 12, EGU2010-9355, European Geosciences Union General Assembly 2010, 2-7 May 2010, Vienna, Austria* (on CD)

Bobylev L.P., S.I. Kuzmina, O.M. Johannessen. Comparison of observational data and modelling results for the Arctic sea ice. *Abstracts of the IPY Oslo Science Conference, 8-12 June 2010, Oslo, Norway*

Bobylev L.P., V.A. Volkov, V.Yu. Alexandrov, E.V. Shalina, E.V. Zabolotskikh, D.V. Kovalevsky. Satellite monitoring of the Arctic: climatological and practical aspects. *Abstracts of the Fourth St. Petersburg Congress "Professional Education, Science, Innovations in the 21st Century", 18-19 November 2010, St. Petersburg, Russia*

Bobylev L.P., E.V. Zabolotskikh, L.M. Mitnik. Polar low monitoring. *Geophysical Research Abstracts, Vol. 12, EGU2010-9649, European Geosciences Union General Assembly 2010, 2-7 May 2010, Vienna, Austria* (on CD)

Dagestad K.-F., V. Kudryavtsev, J. Johannessen, M. Wergeland Hansen. Retrieval of quantitative properties of oceanic internal waves from Synthetic Aperture Radar imagery. *Abstracts of ESA Living Planet Symposium, 28 June – 2 July 2010, Bergen, Norway*

Glazovsky A. Arctic glaciers in changing climate: Results of recent studies. *Abstracts of International Science Seminar "Glaciers and Sea Ice in Global Climate and Environmental Change Studies", 11-12 November 2010, St. Petersburg, Russia*

Korablev A.A., A.V. Smirnov. Climatology of the Northern seas based on unstationary approaches: methodology and results. *Abstracts of the Scientific Conference "Marine Studies of the Earth Polar Regions during the IPY 2007/2008", 21-23 April 2010, St. Petersburg, Russia,* pp. 102-103

Kovalevskaya L.D., **D.V. Kovalevsky**. Optimization of tax policy by using regional computable general equilibrium models. *Proceedings of the 7th All-Russian Conference "Topical Problems of Regional Economics Management", 23 April 2010, St. Petersburg, Russia,* Part 2, pp. 33-35 (in Russian)

Kovalevsky D.V., O.G. Aniskina. Human capital dynamics and learning-by-doing in model SDEM-2. *Proceedings of the 2nd All-Russian Conference "Economic Growth, Resource Dependence and Socioeconomic Inequity", 27-29 October 2010, St. Petersburg, Russia,* pp. 72-74 (in Russian)

Kovalevsky D.V., L.P. Bobylev, O.G. Aniskina. Macroeconomic dynamics in MADIAMS model system. *Proceedings of the 2nd All-Russian Conference "Economic Growth, Resource Dependence and Socioeconomic Inequity", 27-29 October 2010, St. Petersburg, Russia,* pp. 74-77 (in Russian)

Kozlov I., *I. Dailidienė,* **V. Kudryavtsev**. Advancing coastal upwelling observations with use of SAR data: case study from SE Baltic. *Abstracts of the 4th IEEE/OES Baltic Symposium 2010, 25-27 August 2010, Riga, Latvia*

Kozlov I., V. Kudryavtsev, *I. Dailidienė.* Case study of coastal upwelling imaged by multi-satellite sensors. *Abstracts of the 38th COSPAR Scientific Assembly 2010, 18-25 July 2010, Bremen, Germany*

Kozlov I., V. Kudryavtsev, *J. Johannessen.* SAR signatures of upwelling. *Proceedings of the "SeaSAR 2010", Frascati, Italy, 25-29 January 2010 (ESA SP-679, April 2010)*

Kozlov I.E., V.N. Kudryavtsev, *S. Sandven.* Oceanic inner wave observations in the Barents Sea using satellite radar images. *Abstracts of the Scientific Conference "Marine Studies of the Earth Polar Regions during the IPY 2007/2008", 21-23 April 2010, St. Petersburg, Russia,* p. 67

Krainukov I., *N. Zernov,* **V. Alexandrov**. The reflection of electromagnetic waves from a randomly inhomogeneous medium. *Abstracts of the Conference "Reliability and Statistics in Transportation and Communication", 20-23 October 2010, Riga, Latvia*

Kudryavtsev V., A. Myasoedov, *B. Chapron, J. Johannessen.* Synergy of SAR and optical imagery in studies of mesoscale dynamics. *Abstracts of ESA Living Planet Symposium, 28 June – 2 July 2010, Bergen, Norway*

Kudryavtsev V., A. Myasoedov, *B. Chapron, J. Johannessen, F. Collard.* Synergy of SAR and optical imagery in studies of meso-scale ocean dynamics. *Proceedings of the "SeaSAR 2010", Frascati, Italy, 25-29 January 2010 (ESA SP-679, April 2010)*

Melentyev V.V., L.P. Bobylev, *K.V. Melentyev, V.Yu. Tsepelev, L.H. Pettersson, P.O. Bednov.* Dangerous ice phenomena investigated by using satellite SAR survey. *Abstracts of the 20th IAHR Ice Symposium, 14-18 June 2010, Lahti, Finland*

Melentyev V.V., L.P. Bobylev, *V.Yu. Tsepelev, Yu.M. Kolesov, K.V. Melentyev, P.V. Polischuk, P.O. Bednov.* Ecologically significant and dangerous ice events in the Gulf of Finland. *Proceedings of the 11th International Ecological Forum "Baltic Sea Day", 21-23 March 2010, St. Petersburg, Russia*

Melentyev V., L. Bobylev, *V. Tsepelev, K. Melentyev, P. Bednov*. Pseudo-thermal bar in poorly salted autumnal waters of the Gulf of Finland from satellite-airborne SAR/ASAR/ALSAR survey. *Geophysical Research Abstracts, Vol. 12, EGU2010-1451, European Geosciences Union General Assembly 2010, 2-7 May 2010, Vienna, Austria*

Melentyev V., *V. Chernook, K. Melentyev,* **L. Bobylev,** *L. Pettersson.* Envisat ASAR technology for monitor of habitat of ice-associated marine mammals as measure stability of living Arctic. *Abstracts of ESA Living Planet Symposium, 28 June – 2 July 2010, Bergen, Norway*

Melentyev V., *V. Chernook, K. Melentyev,* **L. Bobylev,** *L. Pettersson, S. Sandven.* ASAR catalogue ice parameters valid for sustainable development harp seals White Sea, Newfoundland, Jan-Mayen population. *Abstracts of ESA Living Planet Symposium, 28 June – 2 July 2010, Bergen, Norway*

Morozov E., O. Aniskina, D. Pozdnyakov, *L. Pettersson.* MODIS-reveals green dinoflagellate blooms in the English Channel and the Bay of Biscay: Identification algorithms and spatio-temporal analyses of the phenomenon. *Abstracts of the Oceans from Space Symposium, 23-26 April 2010, Venice, Italy*

Morozov E., D. Pozdnyakov, A. Korosov, *V. Sychev.* Monitoring some of the ecosystem status parameters in the Bay of Biscay using ocean colour data. *Abstracts of the Eighth All-Russia Open Door Conference on "Contemporary Problems of Remote Sensing of the Earth from Space", 15-19 November 2010, Moscow, Russia*

Myasoedov A., V. Kudryavtsev, *B. Chapron, J. Johannessen.* SAR and optical imagery of mesoscale ocean currents. *Abstracts of ESA Living Planet Symposium, 28 June – 2 July 2010, Bergen, Norway*

Myasoedov A., V. Kudryavtsev, *B. Chapron, J. Johannessen.* Sun glitter imagery of the ocean phenomena. *Proceedings of the "SeaSAR 2010", Frascati, Italy, 25-29 January 2010 (ESA SP-679, April 2010)*

Petrenko D., D. Pozdnyakov, *L. Karlin.* Assessment of feasibilities of some models for quantification of primary production in the Arctic from space. *Abstracts of the Eighth All-Russia Open Door Conference on "Contemporary Problems of Remote Sensing of the Earth from Space", 15-19 November 2010, Moscow, Russia*

Polyakov A.V., A.V. Poberovsky, M.V. Makarova, Ya.A. Virolaynen, A.V. Rakitin, **M.A. Kshevetskaya,** *D.V. Ionov, S.I. Osipov, Kh.Kh. Imkhasin, I.S. Yagovkina, Yu.M. Timofeev.* Complex ground-based measurements of gaseous composition of the atmosphere for satellite data validation. *Abstracts of the Eighth All-Russia Open Door Conference on "Contemporary Problems of Remote Sensing of the Earth from Space", 15-19 November 2010, Moscow, Russia*

Pozdnyakov D., Eu. Morozov, *L. Pettersson, V. Sychev.* Observations of multi-year spatial dynamics of biochemical variables in the Bay of Biscay from space. *Abstracts of the ESA Living Planet Symposium, 28 June – 2 July 2010, Bergen, Norway*

Sandven S., O.M. Johannessen, **L.P. Bobylev**. Arctic Regional Ocean Observing System (Arctic ROOS). *Abstracts of International Science Seminar "Glaciers and Sea Ice in Global Climate and Environmental Change Studies", 11-12 November 2010, St. Petersburg, Russia*

Shalina E.V., L.P. Bobylev, *S. Sandven.* Current state of the Arctic sea ice observed by satellites. *Abstracts of the Scientific Conference "Marine Studies of the Earth Polar Regions during the IPY 2007/2008", 21-23 April 2010, St. Petersburg, Russia,* p. 162

Smirnov A.V., *A.A. Korablev.* Relationship between mixed layer characteristics and heat fluxes at the atmosphere-ocean boundary layer in the Northern Seas. *Abstracts of the Scientific Conference "Marine Studies of the Earth Polar Regions during the IPY 2007/2008", 21-23 April, 2010, St. Petersburg, Russia,* pp. 130-131

Smirnova Yu.E., E.V. Zabolotskikh, L.P. Bobylev, V.N. Kudryavtsev. Analysis of Polar Lows by remote sensing data using synergetic approach. *Abstracts of the International Scientific Conference "Water, Ecology and Hydrology Safety" under the Auspices of UNESCO, 24-26 November 2010, St. Petersburg, Russia*

Smirnova J.E., E.V. Zabolotskikh, V.N. Kudryavtsev, L.P. Bobylev. Synergetic of the studying polar cyclones on the base of remote sensed data. *Proceedings of the International Conference "50 Years of Education and Awareness Raising for Shaping the Future of the Oceans and Coasts", 27-30 April 2010, St. Petersburg, Russia,* pp. 588-605

Sudakov I.A., *R. Wania,* **L.P. Bobylev,** *O.M. Johannessen, S.A. Beresnev.* Modelling methane emissions from Siberian permafrost peatlands. *Abstracts of the IPY Oslo Science Conference, 8-12 June 2010, Oslo, Norway*

Zabolotskikh E.V., L.P. Bobylev. Polar low study using satellite passive and active microwave remote sensing. *Proceedings of the 11th Specialist Meeting on Microwave Radiometry and Remote Sensing of the Environment (MicroRad 2010), 1-4 March 2010, Washington, DC, USA* (on CD)

Zabolotskikh E.V., L.P. Bobylev, *L.M. Mitnik,* **O. Aniskina**. Polar lows in the Arctic: Intensification due to climate change. *Abstracts of the IPY Oslo Science Conference, 8-12 June 2010, Oslo, Norway*

Zabolotskikh E.V., L.P. Bobylev, *L.M. Mitnik, M.L. Mitnik.* Satellite passive microwave neural-network-based retrieval algorithms and their application to study atmospheric phenomena and oceanic parameters. *Abstracts of the Joint Symposium on Taiwan-Russia Research Cooperation "Remote Sensing of Physical and Biological Processes: Application for Waters around Taiwan", 15-16 October 2010, Keelung, Taiwan*

Zabolotskikh E.V., L.P. Bobylev, *L.M. Mitnik,* **Ju. Smirnova**. Satellite passive microwave data usage for creation of the polar low climatology. *Abstracts of the Eighth All-Russia Open Door Conference on "Contemporary Problems of Remote Sensing of the Earth from Space", 15-19 November 2010, Moscow, Russia*

Zabolotskikh E.V., L.P. Bobylev, *L.M. Mitnik,* **Ju. Smirnova, A. Myasoedov**. Development of the multi-sensor approach for polar low study. *Abstracts of the ESA Living Planet Symposium, 28 June – 2 July 2010, Bergen, Norway*

Zakhvatkina N., V.Yu. Alexandrov, *S. Sandven, O.M. Johannessen.* Sea ice identification in the Arctic Ocean using SAR data. *Abstracts of the IPY Oslo Science Conference, 8-12 June 2010, Oslo, Norway*

Zakhvatkina N., V.Yu. Alexandrov, *V.G. Smirnov.* Exploration and verification of Neural Networks approach for sea ice classification using satellite images of the Arctic Ocean. *Abstracts of the Scientific Conference "Marine Studies of the Earth Polar Regions during the IPY 2007/2008", 21-23 April, 2010, St. Petersburg, Russia*, p. 164

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