Understanding the Increase in Tabular Iceberg Sightings in the North Atlantic and the Implications for Shipping Activities

***Daghir, Lucy**; McConnell, Martha and Hicks, Mike

Understanding iceberg formation and movement is critical for Arctic transportation safety, and is a concern for the United States Coast Guard and the International Ice Patrol. Typically associated with the Antarctic, tabular icebergs have more recently been spotted in the North Atlantic, between Canada and Greenland, which drift toward shipping lanes. The increase in tabular icebergs has the potential to alter observational areas. This study analyses the International Ice Patrol database in the North Atlantic to understand the increase in sightings of tabular versus non-tabular icebergs from 1960 to the present day. Further the study will assess if there is correlation between sightings and observed calving events. The changes in training and technology are taken into account in the analyses. International strategies for monitoring and observing glaciers and their potential for calving events is critical for understanding if there is a new regime of tabluar icebergs in the North Atlantic and how this will affect the increase in shipping activity.

Capital Investments versus Present and Planned Infrastructures in the Arctic

***Peace, Taylor E.** and McConnell, Martha C.

As the sea ice extent decreases, and the Arctic Ocean opens, more nations are looking to Arctic waterways for economic adventures such as deep sea drilling and increased shipping traffic. With the increased human presence and associated risk to the Arctic ecosystem, infrastructure to support the present and forecasted ventures as well as appropriate response (spill cleanup, and search and rescue) resources is critical. Infrastructure to support observations and monitoring of the Arctic marine environment is essential for safety, security, and stewardship. While international agreements have been made designating research, oil spill response, and search and rescue as responsibilities of individual nations with group cooperation, there is little guidance on what the response capability minimums are in terms of response time and equipment. This research evaluates the landscape of increased capital ventures, such as oil and gas exploration and vessel traffic, to supporting infrastructure, those being communications, deep water ports, ice breaking capable vessels and other equipment, in the US Arctic and the progress toward new infrastructure.

Integrating and coordinating Arctic vegetation monitoring: CBMP Vegetation Expert Network Initiatives

***Beamish, Alison**; Doyle, Marlene; Ibarguchi, Gabriela; Fossa, Anna Maria; Hik, David; Henry, Greg; Svala, Ingibjörg; Barrio, Isabel; Stewart Laerke; Aronsson, Mora; Wookey, Philip; Elmendorf, Sarah; Heidmarsoon, Starri; Taylor, Jason; Ravolainen, Virve and Razzhivin, Vladimir

The Circumpolar Biodiversity Monitoring Program (CBMP) is an international network of scientists, government agencies, indigenous organizations and conservation groups making a concerted effort to harmonize and integrate efforts to monitor the Arctic's living resources. Between 2011 and 2013, an Arctic Terrestrial Biodiversity Monitoring Plan was developed which identified priority Focal Ecosystem Component attributes to monitor and a multi-scaled, interdisciplinary approach toward coordinated Arctic biodiversity monitoring. A CBMP Terrestrial Steering Group and biotic group and species-based expert networks facilitate implementation of the plan. In 2015, the Terrestrial Steering Group developed and tested a preliminary terrestrial site-based sampling approach intended to generate baseline data of identified Focal Ecosystem Component attributes as identified by the Terrestrial CBMP plan. The Vegetation Expert Network identified a simplified set of vegetation monitoring protocols to track vegetation community composition, abundance, diversity, phenology to complement and integrate on-going, long-term site based monitoring. Core activities of the Vegetation Expert Network included support for identification of priority remotely sensed products to track change in Arctic vegetation and terrestrial ecosystems, a needs assessment for Arctic vegetation data, and a detailed monitoring inventory and gap analysis related to the availability of existing data to meet the identified needs. Future initiatives will include the development of a vegetation section in a planned State of the Arctic Terrestrial Biodiversity Report.

Analyzing winter migration of wild Taimyr reindeer using historical census data and satellite telemetry

***Francis, Emily T.**; Petrov, Andrey N.; Kolpashchikov, Leonid A.; Madsen, Michael and Kochkarev, Pavel

The Taimyr Reindeer Herd (TRH) is the largest wild reindeer population in the world, and is located in the very northern central region of Siberian Russia. Previous research has been conducted using aerial surveys during the three seasons for reindeer: calving, summer and winter. Winter is the most difficult season to conduct research and has a much smaller amount of historical data. However, recent use of satellite telemetry by employing Argos collars have produced almost 11 months of tracking data. These efforts produced data for eleven reindeer that were successfully tracked. A subset of reindeer within this sample will be further analyzed to determine behavior of seasonal movements, migration distance and direction. This will be completed using the historical census and the satellite telemetry data, as well as NASA's MERRA data and DEMs of the Taimyr region to analyze migration routes chosen by reindeer. The results will be utilized to better understand the site selection for migration, eating and resting and give clues to understanding the activities and survival of the TRH during the harsh Siberian winter.

Air Pollution in the Arctic: Climate, Environment and Society (PACES)

***Arnold, Steve**; Brock, Chuck and Law, Kathy

Air pollutants in the Arctic have impacts on climate change, ecosystems, regional air quality, and human health. They include aerosol particles such as black carbon and trace gases such as tropospheric ozone. Rapid changes to and complex interactions within the Arctic environment due to global warming and socio-economic drivers mean that there is an urgent requirement to improve understanding of sources of Arctic air pollutants. Atmospheric pollution contributes to Arctic environmental change, but Arctic change also has implications for atmospheric pollution. Changes in atmospheric aerosol particles and tropospheric ozone have likely contributed substantially to rapid warming of the Arctic over recent decades (Shindell and Faluvegi, 2009). Increased accessibility due to reducing sea-ice is leading to increased local pollutant emissions from activities such as oil and gas extraction or shipping. The balance between Northern Hemisphere mid-latitude pollution sources and sources within the Arctic is changing, the latter being already important in some regions, and likely to grow rapidly in the future. It is crucial to improve quantification of the relative contributions of different pollutant sources to provide a sound scientific basis for sustainable solutions and adaptive strategies. Deficiencies in predictive capability and a lack of observations at high latitudes present major challenges to advancing this understanding, and to making credible near- and long-term projections of Arctic environmental change. This poster describes a new international initiative - air Pollution in the Arctic: Climate Environment and Societies (PACES) (see http://www.igacprojects.org/PACES), recently launched under the auspices of the International Global Atmospheric Chemistry project (under Future Earth) and the International Arctic Science Committee (IASC/Atmosphere WG).

Scientific Stationary "Ice Base Cape Baranov "- a new member of the Arctic observatories network

***Sokolov, Vladimir**

Organization of the International Network of Arctic observatories (IASOA) had been launched in 2005 during preparation of the International Polar Year (IPY). Basically, its creation ended in 2011, when the site http://www.iasoa.org, where the main data of observatories belonging to the network are placed, had been created by NOAA. The main objective of IASOA is coordinating comprehensive studies of the atmosphere and land surface on circumpolar network of stations, performing by scientific organizations of Canada, Denmark (Greenland), Finland, Norway, Russia, and USA, and aiming at the study and understanding of climate-forming processes in the Arctic and its impact on weather and climate of middle latitudes. Until recently, the Russian participation in IASOA had been presented by investigations at the International Hydrometeorological Observatory in Tiksi. Research Stationary "Ice base “Cape Baranov," was opened by AARI in the fall 2013. Now it is real integrated observatory, conducting comprehensive studies in practically all areas of Earth Sciences, from free atmosphere to sea ice and sea bottom and from glaciers to permafrost. It is one of the first candidates for IASOA in the nearest future. In presentation some preliminary results of field work on the Baranov Island performing in 2014 - 2015 years are presented.

Polish Snow Research Program on Svalbard

***Grabiec, Mariusz**; Migała, Krzysztof and Members of the Polish Snow Research Program on Svalbard

Snow is an important component of the Arctic and global environment. It determines numerous processes, both natural as well as related to a human activity. Current climate change implies very dynamic evolution of snow cover extend and nival processes. That, on the other hand, through the network of feedbacks enforces adaptation of other elements of environment. Significance of those mechanisms is noticed by numerous initiatives aimed to their better understanding, eg. as roadmap element of ICARP III, or integrated monitoring (ESSEM COST Action ES1404). Polish research activity on Spitsbergen have their own long history, based on year-round operation of the Polish Polar Station in Hornsund (since 1978) and the network of research stations managed by universities. Specific dispersed activity of Polish research groups over Spitsbergen gives an unique opportunity to comprehensive overview on processes taking place in one of the key areas of the Arctic. In 2015 under the umbrella of the Polish Polar Consortium, the initiative of coordinated research by institutions focused on the broad scope of snow studies on Spitsbergen. Cooperation within the Polish Snow Research Program on Svalbard has integrated several scientific and education centers, 5 field stations on Spitsbergen and research vessel s/y “Oceania”. The program purpose is: a multifaceted analysis of polar environment of Spitsbergen determined by variable snow properties; and a study of regularities and couplings in snow-environment system, using classical and novel investigation methods. Feedbacks of snow and atmosphere, cryosphere, lithosphere, terrestrial hydrosphere, ocean, marine and terrestrial ecosystems are undertaken under the program. The common studies include physical, chemical as well as microbial snow properties. Thanks to the integration, members of the program can fully exploit the potential of the Polish field activity on Spitsbergen, acquire mutual access to databases, conduct consistent and synchronized studies, benefit from common equipment and research infrastructure. The program is open to a wider and international cooperation with other entities involved in snow studies for joint application and implementation of the scientific and education projects.

The Arctic Boreal Vulnerability Experiment (ABoVE)

***Goetz, Scott**; Miller, Charles; Griffith, Peter; Kasischke, Eric; Larson, Elisabeth; Hoy, Elizabeth; Hodkinson, Dan; Hibbard, Kathy and Margolis, Hank

ABoVE is a large-scale NASA-led study of environmental changes in the arctic and boreal region of western North America and the implications of those changes for social-ecological systems. A concise experiment plan, completed in 2014, outlines the conceptual basis for ABoVE and expresses its scientific rationale and societal relevance. An implementation plan is being completed that addresses the specific objectives formulated to answer the science questions laid out in the ABoVE experiment plan, as well as the specifics of the study design and activities that will address them. The overarching ABoVE science objectives are: 1 developing a fuller understanding the vulnerability and resilience of Arctic and boreal ecosystems to environmental change in western North America, and 2 providing the scientific basis for informed decision-making to guide societal responses at local to international levels. Research conducted as part of ABoVE will link field measurements and process-level studies with geospatial data products derived from airborne and satellite sensors, providing a foundation for improving the analysis and modeling capabilities needed to understand and predict ecosystem responses and societal implications within and beyond the ABoVE domain. The implementation of ABoVE is expected to take place in three phases over the period 2015 to 2025. In August 2014 some 21 core ABoVE research projects were funded as part of the first Phase 1 round of NASA research support. These complement 7 pre-ABoVE data product generation activities and another 9 closely related NASA supported projects in the study domain. Currently there are 100 funded ABoVE investigators and some 130 affiliated collaborators, collectively representing over 100 organizations. Research is organized around science themes that largely represent disciplinary efforts, around which Working Groups (WGs) have been organized. The overall research strategy and approach of the WGs is based on a study design in which targeted field measurements, remote sensing and modeling studies are integrated according to the scale and information content needed to advance the science, assess vulnerability, and support land management and decision making. As part of ABoVE, NASA is looking to develop partnerships and/or collaborations with organizations who are conducting or sponsoring significant research activities in Alaska and western Canada, and who wish to coordinate these activities with those being funded by NASA. Additional information is provided on the ABoVE web site: above.nasa.gov.

The 2015 Arctic Observing Open Science Meeting (AOOSM) – Community achievements, goals, and advancements toward a thriving, collaborative network of Arctic observations

***Sheffield, Guy L.** on behalf of the 13-member AOOSM Organizing Committee

The Arctic Observing Open Science Meeting (AOOSM) held in Seattle, Washington during 17-19 November 2015 provided an opportunity for the Arctic science community to present and discuss findings and advances in Arctic observing. A diverse agenda of plenary presentations, parallel sessions with extended discussion, and a poster session provided a forum for Arctic scientists, managers, and stakeholders to examine the state of the science. Recent achievements were presented and future directions and collaborations were explored. A panel of eight agency representatives addressed the unique objectives of each organization, and the overarching goal of achieving an interagency Arctic observing system. The meeting was organized by the Arctic Research Consortium of the United States (ARCUS) and a 13-member Organizing Committee, and supported by NSF's Arctic Observing Network program and other contributors. Meeting products are in progress, and abstracts and downloadable presentation files for plenary, parallel, and panel presentations are available now on the ARCUS website (https://www.arcus.org/search-program/meetings/2015/aoosm/agenda).

Toward an Arctic component of the Global Ocean Observing System

***Bourdages, Line**; Buch, Erik and Fischer, Albert.

The ocean plays a central role in Arctic economic activity, development, and livelihoods. To support these activities, efficient and timely ocean operational and climate services are necessary but are often hindered by the lack of extensive observation networks that would allow ocean observations on appropriate temporal and spatial scales. In fact, the size of the region, harsh climate, remoteness, and complex political context are some of many reasons why Arctic observations have historically been sparse and incomplete. In the context of an Arctic undergoing rapid transformation, the vulnerability of Arctic residents, visitors, and ecosystems is increased, further emphasizing the need for sustained oceanic and coastal observations. The Global Ocean Observing System (GOOS) is a permanent global system for observations, modelling, and analysis of marine and ocean variables to support operational ocean services worldwide. It provides a framework for ocean observations, based on the strategic prioritization of Essential Ocean Variables (EOVs) and a maximization of social benefit. While some observation networks are already following GOOS guidelines in the Arctic, there is a strong need for coordination and strategic planning of current and future efforts. The development of an Arctic regional component to the GOOS would provide a platform where research, operational and user communities would collaborate for maximized mutual benefit and added-value for investment. Based on the GOOS expertise on best practices, standards, and data sharing, such a system would identify, enable, and develop sustained ocean monitoring and services to meet regional and national priorities in the Arctic.

Multispectral satellite imageries and in-situ spectra for mapping cryospheric surfaces in Ny-Ålesund and environ, Svalbard

***Jawak, S.D.** and Luis, A.J.

The deteriorating state of glaciers, polar ice caps, snowfall, oceans, and lakes in the Arctic, Antarctic, and mountainous regions of our planet are at the very core of many environmental conditions being monitored. Snow, glacier and ice remote sensing utilizing satellite sensors and field data acquisition allows for process modeling by researchers observing and trending changes in the Earth's cryosphere. The present study explores the usage of multispectral satellite imageries captured by Disaster Monitoring Constellation for International Imaging (DMCii) and Landsat series of satellites for mapping cryospheric surfaces in Ny-Ålesund and environ. The broad objective of this study is to gain a better understanding of the usage of in-situ spectra to discover multispectral satellite image classifications for characterization of cryospheric surfaces to infer and quantify climate change in Arctic regions. Multispectral images (in particular Landsat data) have been extensively used to classify and study cryospheric surfaces. This study uses full-spectrum in-situ surface reflectance data from Ny-Ålesund region coupled with DMCii and Landsat ETM+ imagery to inform and explore cryospheric surface classification. Such simulation of DMCii and ETM+ data would lead to new semiautomatic and rapid method for sustained and multi-temporal Arctic observations, and comparisons can be drawn with existing techniques. Ours research also focuses on spatio-temporal cryospheric surface change detection studies in Arctic.

Surface- and UAS-Based Observations at the Oliktok Point Observatory

***de Boer, Gijs**; Ivey, Mark; Lawrence, Dale; Curry, Nathan; Finamore, William; Elston, Jack; Palo, Scott; Argrow, Brian; LoDolce, Gabriel; Mack, James and Schmid, Beat

The US Department of Energy (DOE) Atmospheric Radiation Measurement (ARM) program has deployed its third ARM Mobile Facility (AMF3) to Oliktok Point, Alaska. This site features a variety of instrumentation process-level observing of the Arctic atmosphere, including characterization of clouds, aerosols, atmospheric state, and radiation. Additionally, this facility provides a unique opportunity to profile the lower troposphere as well as provide information on spatial variability of atmospheric and surface parameters as the result of areas of restricted airspace. These airspace regions are being exploited using unmanned aircraft (UAS), manned aircraft, and tethered balloon systems. The authors have been involved with two recent UAS campaigns at Oliktok Point. The two campaigns used the Datahawk UAS, developed at the University of Colorado, and took place in October 2014 ("Coordinated Observations of the Lower Arctic Atmosphere"; COALA) and August 2015 ("Evaluation of Routine Atmospheric Sounding Measurements using Unmanned Systems"; ERASMUS). These campaigns sampled very different environmental conditions, with COALA occurring during the formation of sea ice on the Beaufort Sea, and ERASMUS occurring during the "warm" summer months. In addition, the second phase of ERASMUS is scheduled for April 2016, and will involve measurement of thermodynamic, aerosol and radiation measurements using the University of Colorado Pilatus UAS. In this poster, we will provide an overview of the facility and its instrumentation, provide insight into the sort of process-level studies currently being undertaken at the Oliktok Point and Barrow NSA facilities, and provide an overview of the recent and upcoming UAS campaigns. Included in the presentation will be details on the instrumentation and platforms, the scientific goals and achievements of these projects, and the logistical hurdles associated with flying UAS in the Arctic.

Microbuoys in Arctic Sensing: novel instruments for low-cost and low-impact observing of the upper ocean

***Bradley, Alice**; Palo, Scott; LoDolce, Gabe; Weibel, Doug; Lawrence, Dale and Maslanik, Jim

Small, instrumented buoys known as microbuoys provide a low cost means of acquiring measurements from the upper Arctic Ocean. They carry a small sensing suite (including GPS), a low-power microprocessor, a limited battery package, and a satellite modem or other radio for data retrieval. The microbuoy concept was demonstrated in the Arctic during the 2013 MIZOPEX campaign, a NASA-supported program that, among other things, deployed eight Air Deployed Microbuoys from unmanned aircraft in the Beaufort Marginal Ice Zone. The ADMB system is described, along with some results from the 2013 deployment related to the unique sensing capabilities of the small buoys: observations of strong temperature gradients in the top two meters of the ocean and drift tracks that show inertial oscillations in the surface-level Ekman currents. The presentation also includes updates on ongoing microbuoy development and the potential role of microbuoys in the Arctic observing system.

LiDAR Detection of Permafrost Change

***Hiemstra, Christopher**; Gelvin, Arthur; Newman, Stephen; Douglas, Thomas; Bjella, Kevin and Wagner, Anna

Permafrost is a dominant feature of Arctic and boreal landscapes. When ground ice thaws, volume displacements occur and the surface often subsides. Our objective was to detect surface changes and identify where they occur to assess the potential for permafrost thaw and attendant terrain subsidence elsewhere. A short (less than 3 years) time series of airborne LiDAR measurements were used to investigate permafrost-geomorphology interactions at three permafrost-dominated sites near Fairbanks, Alaska. Readily identifiable changes resulting from surface subsidence and inundation were observed. Notably, distinct and relatively rapid changes in surface elevation were tied to record precipitation received in summer 2014. Hydrologic events and the landscape's response to them are a growing concern for infrastructure design and development in areas with permafrost.

Improving snow observations using snow patterns and smaller manned aircrafts or UAVs

***Wagner, Anna**; Hiemstra, Christopher; Sturm, Matthew and Parr, Charles

Year after year snow depth patterns repeat on landscapes, with deeper snow in water tracks and swales, and shallow snow on windswept ridges with sparse vegetation. Snow pattern repeatability and detection has been proved successful at smaller scales (up to 6 km2) in Imnavait Creek watershed, Alaska, using manual snow measurements. Satellite imagery collected for the same areas include snow cover from Landsat (30 m) from 1982-present and fine-resolution commercial imagery (0.5-3 m) from 2002-present show promise detecting snow patterns at a larger scale using mid-melt images. Water availability estimations in larger regions can be improved if snow patterns can be determined at a larger scale. The missing link when estimating the water availability for larger Arctic regions using satellite imagery is estimating the actual snow depths. The snow depths can be determined by measuring snow depths using Lidar from unmanned airborne vehicles (UAVs) or smaller manned aircrafts prior to winter snowfall (bare earth) and during deepest snow depth using strategic transects. Once this snow depth difference is known, snow patterns, as determined from satellite imagery during mid-melt, can be used to estimate the water supply for larger Arctic regions.

The CRREL Permafrost Experimental Station at Farmer's Loop: 60 years of permafrost geotechnical and geomorphological investigations

***Douglas, Thomas**; Bjella, Kevin; Wagner, Anna and Hiemstra, Christopher

The Farmer's Loop Permafrost Experiment Station near Fairbanks, Alaska (64.877N, 147.670W) was established in 1945 by the U.S. Army for geotechnical, geophysical and engineering studies of permafrost. The Station includes 30 acres on the north side of Farmer's Loop Road and 90 acres on the south side of the road. The site has a rich history and was designated as a National Geotechnical Experimentation Site in 2003. The site includes the three "Linell Plots" where in 1946 vegetation was stripped from two different one acre sized plots to investigate the relationship between vegetative cover and permafrost degradation. A third plot was left as a pristine representation of interior Alaska permafrost. In 2005 a Circumpolar Active Layer Monitoring Network (CALM) site was established in the undisturbed Linnell plot. Thaw depths are measured in early October at 121 locations on an 11 by 11 meter grid with 3 meter spacings. Moss thickness and total thaw depth are measured and recorded at each probe location. A 10 meter borehole was installed at one of the disturbed Linnell sites in the fall of 2007 and thermal measurements have been recorded hourly at eight different depths. In the summer of 2013 twenty five thermistors were installed across the site to monitor vegetation and soil temperatures from the upper five centimeters to three meters at locations representing a variety of soil and vegetation types. Recently, airborne LiDAR and hyperspectral measurements have been conducted at the site. In addition, a one kilometer long trench was excavated and strung with fiber optic cable in the summer of 2015 to initiate long term measurements of soil temperatures and ground subsidence. Numerous 30 meter deep boreholes and more than 5 kilometers of electrical resistivity tomography measurements have been collected from the site in the last five years. An experimental tussock removal experiment was initiated in 2015 to investigate the thermal connections between tussock vegetation and permafrost.

Arctic Ocean winter ecology – the big black box!

***Søreide, Janne**; Gradinger, Rolf; Niehoff, Barbara; Ilka, Peeken; Bluhm, Bodil; Gabrielsen, Tove; Johnsen, Geir and Berge, Jørgen

Our knowledge on Arctic marine ecosystems is mainly based upon studies from spring, summer and autumn. For most of the year, however, Arctic winter conditions rules, particularly in the Arctic Ocean. Virtually nothing is known about how Arctic marine ecosystems operate in winter. For instance, the overwintering strategies of key species in the Arctic Ocean, and their dependence on sea ice during the polar night and winter period is not known, leading to contradicting predictions of their future under a decreasing sea ice-cover. New winter observations shows that Arctic marine organisms are much more active than previously assumed. Diel vertical migration is still detectable meaning that the biological carbon pump is still active, and non-visual predators likely operate as usual. In the coming years there will be several international initiatives working actively for filling our knowledge-gaps when it comes to winter ecology in the Arctic Ocean. New initiatives such as the international working group "Big Black Box: Marine ecological processes during the polar night", the plan of having a one year Central Arctic Ocean drift study within the big international initiative MOSAiC: Multidisciplinary drifting Observatory for the Study of Arctic Climate, as well as the larger innovative Norwegian-led project Arctic ABC (Arctic Ocean ecosystems - Applied technology, Biological interactions and Consequences in an era of abrupt climate change), where new technology will be developed to easier study biological processes. Here we present plans for coming field surveys and development of a new autonomous observational platforms to study important biological parameters year-round in the hostile Arctic Ocean.

Using the Past to Inform the Future: Investigating Pacific Walrus Foraging Across 2,500 Years

***Clark, Casey T.**; Horstmann, Lara A. and Misarti, Nicole

Recent declines in Arctic sea ice and previously unrecorded sea ice minima have led to concerns regarding the future health of ice-dependent animal populations. Pacific walruses (Odobenus rosmarus divergens) use sea ice as a platform for giving birth, molting, and resting between foraging bouts, thus are particularly vulnerable to warming climates and reduced sea ice coverage. This study uses stable isotopes of carbon and nitrogen (δ 13C and δ 15N) in walrus bones, as well as trace element analyses of walrus teeth, to investigate changes in diet and feeding location across three time periods (prehistoric, historic, and modern). Samples were obtained from walrus remains collected in association with archaeological digs, housed in museum collections, and from Native subsistence harvests in Alaska. Major climatic anomalies, including the Roman Warm (2200 – 1900 BP, calibrated years before present), the Medieval Warm (1100 – 800 BP), and the Little Ice Age (450 – 150 BP) are encompassed by the prehistoric samples, while historic and modern samples span ~100 years and a series of major regime shifts in the North Pacific and Bering Sea. Preliminary stable isotope values differed significantly among all three eras (δ 13C: $P < 0.001$; δ 15N: $P < 0.001$), and analyses of eight fine-scale time periods revealed significant changes in both δ 13C and δ 15N within the prehistoric and historic eras. Analysis of trace elements allows for differentiation among observed changes in stable isotope ratios caused by trophic shifts and those caused by geographic movements. We used an Agilent 7500ce Inductively Coupled Mass spectrometer to measure concentrations of barium, cadmium, cesium, cobalt, copper, iron, lead, manganese, molybdenum, nickel, strontium, and zinc in walrus teeth. This study is first of its kind and provides novel insight into the impacts of climate change on walrus foraging.

Incorporating geophysics into long-term permafrost monitoring

***Lewkowicz, Antoni**

The Global Terrestrial Network on Permafrost (GTN-P), a component of GCOS and GTOS, is the only major international program currently in operation for long-term monitoring of changes in permafrost. Its two essential climatic variables are active layer depth and permafrost thermal state. The former is influenced by inter-annual variability while the latter is an excellent integrator of the net heat flux into the ground resulting from environmental change over years to decades. However, permafrost temperatures become progressively more insensitive to net ground heat fluxes as they approach 0°C because of the requirement to satisfy latent heat due to phase change. Repeated Electrical Resistivity Tomography (ERT), a straightforward geophysical technique, is being explored as an alternative method to monitor permafrost change at temperatures close to the point of thaw. ERT can theoretically detect increases in the unfrozen moisture content of cryotic soils from both seasonal temperature cycling and long-term change. Results from sites in the discontinuous permafrost zone where changes are expected first, are very promising. However, the cost of the specialized equipment needed for ERT surveys currently remains a barrier to integrating the technique into long-term observing networks in the Arctic.

Which comes first in the U.S. Arctic – the tidal datum or the shoreline position?

***Kinsman, Nicole** and Overbeck, Jacquelyn

The U.S. arctic coast extends more than 50,000 km (tidally-influenced, 1:63,360 scale) along the Arctic Ocean (1 active tide station), Beaufort, Bearing and Chukchi Seas (3 stations), and includes the Aleutian Island Chain (5 stations). The best available vector that defines this regulatory, ecological and navigational boundary is a compilation of Mean High Water (MHW) features that have been visually interpreted from satellite or aerial imagery. Despite documented rates of rapid shoreline change in the arctic, the vast linear extent, remoteness, and limited ice-free season create unique challenges in maintaining an updated shoreline vector for the Alaska coast; this is compounded by a lack of high resolution digital elevation models (DEMs) and topography of the sea surface grids to conduct datum-derived shoreline mapping using elevation-intercept techniques widely employed elsewhere. Best-available shoreline positions in arctic Alaska span a wide temporal range with 32% dating from before statehood (1959), 33% from 1960-2010, 16% of unknown age, and only 19% of the total extent has been mapped since 2010. We present a hybrid approach to update shoreline vectors that uses co-registered orthoimagery and DEMs to obtain a local MHW tidal datum approximation by sampling the average elevation along a manually-digitized High Water Line (HWL) segment and applying appropriate corrections for beach slope and local wave climate. This elevation is used to conduct an automated, elevation-based shoreline extraction in the immediate vicinity of the sample and the process is iteratively repeated in segments along the coast. Preliminary results suggest that shoreline vectors derived in this manner are comparable to existing, contemporary MHW vectors (< 4 m horizontal offset in low-grade coastal environments); this technique can accelerate map updates and also produces a more repeatable shoreline position in data-sparse regions that are undergoing rapid change. Furthermore, by exploiting known relationships between HWL and the MHW datum (proxy-datum bias corrections), we can provide tidal to geodetic datum conversion approximations to areas without water level records for use in preliminary inundation modeling and coastal flood decision support.

Sea ice thickness retrieval from SMOS and CryoSat-2: validation and application

***Kaleschke, Lars**; Tian-Kunze, Xiangshan; Maaß Nina; Wernecke, Andreas; Hendricks, Stefan; Ricker, Robert; Tonboe, Rasmus; Mäkynen, Marko; Heygster, Georg; Bertino, Laurent; Xie, Jiping and Drusch, Matthias

The aims of the SMOS+ Sea Ice project funded by ESA's Support To Science Elements (STSE) are 1) to further improve the retrieval of sea ice thickness from SMOS brightness temperature, 2) to combine the SMOS together with CryoSat-2 data to generate a synergistic product, and 3) to assess the benefit of using the new sea ice products for the initialization in forecast models. Brightness temperatures at 1.4 GHz (L-band) measured by the Soil Moisture and Ocean Salinity (SMOS) Mission have been used to derive the thickness of sea ice. The retrieval method is applicable only for relatively thin ice and not during the melting period. A validation based on field data from an extensive campaign in the Barents Sea in March 2014 showed that two different SMOS sea ice thickness products reproduce thickness gradients in the ground truth measurements but substantially underestimate the thickness of deformed ice. A sea ice thickness retrieval algorithm based on a combined thermodynamic and radiative transfer model takes variations of ice temperature and ice salinity into account and corrects for the statistical thickness distribution function derived from high-resolution ice thickness measurements. Improvements to account for the vertical temperature and salinity gradients in the ice, the effect of ice concentration and the snow layer are currently under development. SMOS and CryoSat-2 provide complementary information because of their different spatio-temporal sampling and resolution, and because of the complementary uncertainty due to the fundamental difference of the radiometric and altimetric measurement principle. The main limitations of the ice thickness retrieval depend on the emission e-folding depth and the vertical resolution of the effective radar pulse-length, respectively. It was shown that the combination of SMOS and CryoSat-2 considerably reduces the uncertainty with respect to the products derived from the single sensors. An optimal interpolation method was developed which will be used to generate a combined sea ice thickness product. The impact of using the new sea ice product in terms of improved forecast quality is assessed for the TOPAZ system, an operational coupled ocean-sea ice data assimilation system in the Copernicus Marine Services. The initial results on ice concentration and ice thickness forecasts are positive.

Micro-UAS as a tool for observing the Arctic Environment

***de Boer, Gijs**; Cassano, John and Lawrence, Dale

Unmanned aircraft systems (UAS) are rapidly becoming a popular tool for scientific measurement of the atmosphere, cryosphere, oceans, and Earth surface. The ability to obtain high-resolution, in-situ and remotely sensed datasets without the need for large, expensive manned research aircraft is attractive to scientists across disciplines. Currently the US Federal Aviation Administration (FAA) considers platforms lighter than 55 lbs. as small UAS (sUAS). Within this framework also lies the "micro" (mUAS) category, consisting of platforms with a net weight under 4.4 lbs. These mUAS are generally very low-cost and allow a variety of measurement operations. Included in this category are the DataHawk (Lawrence and Balsley, 2013) and SUMO (Reuder et al., 2009) UAS. The DataHawk was originally developed at the University of Colorado – Boulder by Professor Dale Lawrence, and has a ~1.2 m wingspan, a total weight of ~1kg, and a total parts cost of around $950. The SUMO is a modified version of the commercially available Multiplex Funjet, with a wingspan of 0.8 m, a total weight of 580 g and an approximate cost of $5000. These platforms require very limited infrastructure for operations. Flights generally involve two people, including one pilot and one observer, a laptop ground station, an antenna, and a bungee launcher. Both platforms can be hand-launched, either by throwing the aircraft or using a bungee launcher system. Navigation can be fully autonomous using onboard autopilot systems programmable from the surface both before and during flight. The low cost of these platforms makes them perfect candidates for high-risk operations, where successful recovery of the aircraft is not necessarily guaranteed. In this poster we will provide some technical background on two mUAS, the DataHawk2 and the SUMO UAS. In addition, we will provide examples of data from polar deployments of these systems, and discuss their potential utility in a broader Arctic observing framework.

Estimation and Modeling of Heavy Metal Accumulation Observation Results in the Arctic Ecosystems

***Kudrjashov, Vladimir A.**

A heavy metal pollution of Arctic ecosystems is one of the important problems at present. Heavy metals are moved from the other parts of Earth to the Arctic by means of trans-border transfer with air, rivers and sea flows. They are accumulated in the natural environments and then enter into the trophic chain of the Arctic ecosystems. There is a process of heavy metal biomagnification in the ecosystems. The heavy metal concentrations increase continuously from one trophic chain level to another one as a result of this process. In addition, the heavy metals concentration can remain at the high level for the long period of time. The investigation was executed with the aim to develop a new approach to the treatment of the observation results concerning the spatial distribution of heavy metal accumulation in the pan-Arctic ecosystems. Spatial analysis and modeling of the observation results of heavy metal pollution were carried out by means of ArcGIS software environment. The heavy metal set that includes mercury, lead, cadmium and arsenic was used in the studies. The polluted areas containing various concentrations of heavy metals in the different components of sea and land ecosystems were calculated. The obtained data were represented as interactive histograms in the GIS analysis software environment. In addition, to estimate the heavy metal pollution level the lines of heavy metal limiting values were added on the histograms. Accumulation coefficients of heavy metals in various components and at different levels of trophic chains of Arctic ecosystems were calculated. While calculating the innovation procedures of resampling were applied to improve the calculation accuracy and reliability. Resampling procedures were executed in the R software package environment designed for statistical programming and analysis. It has been found that the exponential and power types of heavy metal accumulation take place in the trophic chains and natural environments of Arctic ecosystems.

A Pan-Arctic Airborne Sea Ice Observation System

***Hendricks, S.**; Haas, C.; Gerland, S.; Herber, A; Krumpen, T.; Mahoney, A.; Eicken, H. and Gerdes, R.

We present an Arctic sea-ice observation system that focuses on unique direct observations of sea ice plus snow thickness. A network of research institutions, the Alfred Wegener Institute, York University and the Norwegian Polar Institute, maintain an observation system that is embedded in several national and international projects and supported by research partners. Activities in the field include the use of long-range polar research aircraft and helicopter operations from research icebreakers and bases on land. Data collections are based on electromagnetic induction sounding and consistent time series are available in key regions of the Arctic Ocean since 2001. The increased use of polar research aircrafts in recent years has resulted in several initiatives that aim for long-term observations of ice thickness during seasonal minimum and maximum sea-ice extent in the Arctic. The scientific payload of the research aircraft of type Basler BT-67 and its capability to fly low-altitude surveys makes it an ideal tool for the validation and on-going verification of various satellite remote sensing products. The availability of airborne sea-ice thickness information spans the periods of different satellite sea-ice thickness retrieval concepts, such as the radar altimeters from Envisat and CryoSat-2 as well as the laser altimeter from ICESat-1 and -2. Wherever possible, the airborne surveys are accompanied by in-situ observations on the ice surface to compile a hierarchy of validation data from local to basin scales. Results of the observation network have found broad use for studying inter-annual variability and changes of sea ice thickness as well as the validation of satellite data products. We identify a gap of observations over the multi-year sea ice zone during the melt season and early freeze-up. We also stress the need for the continuation of a coordinated observational program that has produced a time series of sea ice thickness only paralleled by submarine observations. We plan to augment the observation system by simultaneous measurements of snow depth and to investigate opportunities for technological advances, such as the utilization of unmanned aerial systems.

Salinity for cold waters

***Gabarro, Carolina**; Olmedo, E. and Turiel, A.

The launch of the Soil Moisture and Ocean Salinity (SMOS) mission, in 2009, marked the dawn of a new type of space-based microwave observations. Although the mission was originally conceived for hydrological and oceanographic studies [1,2], SMOS is also making inroads in the cryospheric sciences. SMOS carries an L-band (1.4 GHz, or 21-cm wavelength), passive interferometric radiometer (the so-called MIRAS) that measures the electromagnetic radiation emitted by the Earth's surface, at about 50 km spatial resolution, full polarization, continuous multi-angle viewing, large wide swath (1200-km), and with a 3-day revisit time at the equator, but more frequently at the poles. With the new algorithms, recently developed at BEC to improve the SMOS quality, we can now, for the first time, produce cold water SSS maps from SMOS data. These algorithms include: improvement of the image reconstruction by a reduction of sidelobe levels and ripples caused by abrupt changes of brightness temperatures (at level 1); empirical correction of the instrumental systematic biases (land-sea and ice-sea contamination) (at level 2); use of synergistic and multifractal approaches for increasing the spatial and temporal resolution (at levels 3 and 4). The new maps will be presented at the conference together with a thorough assessment of their quality.

The development of a multi-scale spatial database on the pollution of the Russian Arctic

***Medvedev, Andrey** and Alexeenko, Natalia

Over the past decades there has been a quantitative accumulation of maps on the topics related to the environmental quality in the Russian part of the Arctic. However, in most cases it is hard to figure out which indicators were actually taken into account and how reliable were the sources. Besides, these maps are usually small-scale. On the contrary practical interest and the need for sustainable development require local research and large-scale mapping. This would help to identify the precise effects that various types of pollution have on environmental components in the Arctic ecosystems. This research is devoted to the developing of a multi-scale spatial database, containing data on sources of anthropogenic pollution in the Russian Arctic. These sources are diverse and heterogeneous. They are defined by the levels of their impact: local, regional, national. Some of these sources may be monitored on a regular basis while others are not monitorable. The aim of the research was to evaluate and systematize spatial data on the sources of pollution. In the course of the work the following tasks were solved: analysis and classification of selected data (cartographic and statistical data, remote sensing data); analysis and ranking of pollution sources; the development of the database structure taking into the account the obtained knowledge about pollution sources.

The Canadian Consortium for Arctic Data Interoperability (CCADI)

Murray, Maribeth and ***Vossepoel, Shannon**

The CCADI is composed of a group of Canada's foremost Arctic scholars and Arctic data managers at the University of Calgary (Arctic Institute of North America), the University of Waterloo (Canadian Cryospheric Information Network and Polar Data Catalogue), Carleton University (Geomatics and Cartographic Research Centre), the University of Manitoba (Centre for Earth Observation Science), Université Laval (Centre d'études nordiques), Inuit Tapiriit Kanatami, and Polar Knowledge Canada. CCADI members are also leading contributors to the Arctic Data Committee (ADC) of the International Arctic Science Committee and Sustaining Arctic Observing Network, the International Study of Arctic Change (ISAC), the Canadian Network of Northern Research Operators (CNNRO), ArcticNet, and the Polar Libraries Colloquy. It is well-positioned to take leadership in advancing collaboration, nationally and internationally, through development of an integrated national data management system that facilitates information discovery, establishes metadata and data sharing standards, enables interoperability among existing data infrastructures, and that is accessible to the broadest possible audience of users.

First results from IAOOS ocean-ice-snow-atmosphere integrated observing project

Provost, Christine; Pelon, Jacques; Sennechael, Nathalie; Koenig, Zoé; Mariage, Vincent; Villacieros-Robineau, Nicolas and ***Thomas, Jennie L.**

It is essential to document and understanding change in the Arctic, including continuous monitoring of the ocean-ice-snow-atmosphere system. The due to the high cost of field deployments in the Arctic, autonomous observations and observations by satellite must be used to ensure cost effective solutions for continuous observations of on-going changes. The IAOOS project (Ice Atmosphere Ocean Observing System, http://www.iaoos-equipex.upmc.fr, http://iaoos.ipev.fr/) is a nine-year ongoing effort (2011-2020) that aims to provide and maintain autonomous observations of the Arctic Ocean over 5 years (2015-2019). The IAOOS project collects synoptic and near real time information related to the state of the atmosphere, the snow, the sea-ice, snow, and the ocean. Each IAOOS platform consists of 3 elements for oceanographic, snow/sea-ice, and atmospheric vertical soundings. The first three years of the project have been devoted to the development and in situ testing of IAOOS platform prototypes. Major tests were performed by deploying platforms at the North Pole in April 2012, 2013, and 2014. These platforms drifted from the North Pole in April to Fram Strait (September, October) providing spring summer and autumn field data. In addition, IAOOS platforms were deployed as part of the Norwegian ice camp on board the R/V Lance from January to June 2015 as part of the N-ICE 2015 project. N-ICE provided an excellent opportunity to thoroughly test the IAOOS platform in winter. During N-ICE scientists and engineers were on site to test the platform configurations and to collect additional information to ensure data quality from the autonomous system in order to foster data interpretation. The first IAOOS array deployments took place from RV Araon (Korean vessel) in July 2015 and from the RV Polarstern (German vessel) in late summer 2015. Further evolutions of the platform are planned and include additional observation capabilities in the atmosphere, ice, and ocean as well ad co-depoyment with other complimentary autonomous platforms and as part of field campaigns in the future. Example first results from the IAOOS deployments are presented and opportunities for model validation and model improvements using these results are discussed.

Using an Iridium Satellite Telemetered Gage (iGage) for Hydrologic, Snowfall, and Coastal Storm Surge Measurements to Support Forecast Operations in Alaska

***Plumb, Edward** and Johnson, Crane

Data sparseness in Alaska poses a challenge for National Weather Service (NWS) meteorologists and hydrologists responsible for the forecasting of hazardous weather and flooding conditions. Reliable real-time hydrometeorlogic data is critical information needed by forecasters when issuing warnings to the public for river or coastal flooding, heavy snow events, and other hazardous weather. In cooperation with the U.S. Army Corps of Engineers and the State of Alaska, the NWS developed and tested a compact, low cost, ultrasonic iridium satellite telemetered gage (iGage) that is used to measure hourly snow depth, river stage, and coastal water levels. The iGage is battery and solar powered and can quickly be mounted to a static structure over a water or snow surface. The NWS has successfully installed the iGage on highway bridges across Alaska during the summer open-water season and now receives stage data on previously ungaged rivers and streams. The iGage is removed from the bridges in the autumn and deployed elsewhere to provide forecasters with hourly snowfall and snow depth in the winter. In addition, iGages have been mounted on bridges over estuaries in coastal Alaska and provide tidal and storm surge data during the fall Bering Sea storm season. The NWS also tested an iGage from a stationary position on a riverbank that took oblique river stage measurements with the intention of deployment in rural, riverine communities off the road system that lack bridges. This poster will discuss how the iGage has improved NWS forecaster situational awareness, decision support services for customers and stakeholders, and verification of hazardous weather events in Alaska

Developing and implementing an automated information system of monitoring and forecasting the atmospheric chemical composition of the Arctic zone

Mikheev, Valeriy; Smyshlyaev, Sergey; Dikinis, Aleksandr; ***Kuzmin, Vadim** and Rozanova, Marya

Atmospheric chemistry is a very important scientific area for the United States and Russian Federation, because operational monitoring and forecasting chemical composition of the atmospheric air is critical for many applications. Therefore, development and implementation of a new air quality monitoring and forecasting automatic information system for the Arctic might be a solid technological base for efficient and mutually useful collaboration of the United States and Russian Federation in this region regardless various political issues and risks. The proposed information system could be based on the RSHU chemical composition model of the atmosphere for the polar and sub-polar regions. Such system could acquire various air quality data in the Arctic, including those obtained in situ and remotely, NWP models output, forecasts etc. Being under joint U.S. and Russian control, it might integrate and assimilate the mentioned data and then generate the air quality observation and atmospheric chemical composition forecast arrays with desirable spatial and temporal resolution. Another useful option is generating ensembles/scenarios of the overall atmospheric air quality and evolution of particular chemicals depending on meteorological forecasts as well as industrial activity in the Northern Hemisphere. Such scenarios might be very useful for automatic decision support for the policymakers and involved stakeholders. All the mentioned system's output data should be available online for any users who have an Internet access. To promote this system, Russian and American researchers as well as stakeholders interested in aerial chemistry should jointly optimize and accommodate the surface observation network resolution and observation system. Further, the system might be significantly enhanced step by step based on gradual improving the surface observational network, gauging equipment, forecasting tools, model parameterization, visualization technologies etc. It's quite evident that such system cannot be implemented by a single country, because it requires vast and detailed input and produces as well as generous output. The Arctic, perhaps, is the most vulnerable part of this fragile world. The more hands will hold it – from all sides, with love, and very gently! – the better for it and all of us.

Permafrost Active Layer Seismic Interferometry Experiment (PALSIE) and Satellite Observations

***Knox, Hunter**; Abbott, Robert; James, Stephanie; Lee, Rebekah and Cole, Chris

We present findings from a novel field experiment conducted at Poker Flat Research Range in Fairbanks, Alaska that was designed to monitor changes in active layer thickness in real time. Results are derived primarily from seismic data streaming from seven Nanometric Trillium Posthole seismometers directly buried in the upper section of the permafrost. The data were evaluated using two analysis methods: Horizontal to Vertical Spectral Ratio (HVSR) and ambient noise seismic interferometry. Results from the HVSR conclusively illustrated the method's effectiveness at determining the active layer's thickness with a single station. Investigations with the multi-station method (ambient noise seismic interferometry) are continuing at the University of Florida and have not yet conclusively determined active layer thickness changes. Further work continues with the Bureau of Land Management (BLM) to determine if the ground based measurements can constrain satellite imagery, which provide measurements on a much larger spatial scale.

Quantifying aircraft noise in caribou harvest areas for the community of Nuiqsut using a soundscape ecology approach

***Stinchcomb, Taylor R.** and Brinkman, Todd J.

Nuiqsut is an Inupiaq community on Alaska's North Slope experiencing multifaceted environmental change. In addition to changes in the physical landscape, changes in the soundscape threaten to disrupt traditional subsistence practices. The community expresses particular concern about aircraft noise and how it may be altering access to caribou (Rangifer tarandus) populations. Using a soundscape ecology approach, this study aims to quantify aircraft activity in caribou harvest areas and determine the impact on hunter behavior and movements. Under this approach, acoustical monitoring systems record continuous environmental sound to capture the frequency and intensity of aircraft fly-overs. Systems were piloted in July 2015 at three sites identified by the Nuiqsut community as important locations for caribou harvest. Soundscape profiles and aircraft signatures were captured successfully at two pilot sites. Audiovisual analysis of the soundscape profiles showed a daily average of 17.6 aircraft fly-overs at the Fish Creek site (3.5 jets, 5.6 propeller planes, 8.5 helicopters) and 11.2 aircraft fly-overs per day at the Itkalik site (4.2 jets, 6 propeller planes, 1 helicopter). The mean fly-over event was audible for two minutes, independent of aircraft type. These preliminary results indicate that soundscape analysis is an effective method for measuring aircraft noise disturbance. Following guidance by the community of Nuiqsut, monitoring efforts will expand in the summer of 2016 in order to establish a baseline for aircraft activity across the caribou harvest area. This study will provide the Nuiqsut community with essential information to engage in and inform resource management discourses and decisions, respectively.

Neuromorphic, Low Cost, Wireless Sensor Networks for Arctic Monitoring

***Cenek, Martin**; Mobley, Michael; Devins, Matthew and Rodriguez, David

Climate change significantly effects vast regions of the sensitive arctic landscape. As a result, previously inaccessible locations will open up for commerce, research, natural resource exploration and recreation with increase of human traffic and environmental impact. The ability to monitor the effects of these activities in these regions is vital for environmental monitoring, resource management, disaster response, and patterns of use. The arctic region's vast size, harsh environmental conditions, lack of reliable power, and sparse communication infrastructure requires monitoring with a cheap and redundant sensor architecture to detect and located the environmental changes or events of interest. We designed and implemented a proof of concept of a low-cost off the shelf programmable sensor network that uses radio frequency for peer-to-peer communication that will detect desired events or conditions in a decentralized and asynchronous manner. The sensor nodes propagate the information through the network to the read-out terminals to interpret the data. The hardware architecture design is augmented with an agent based model to simulate different sensor network configuration and validate the network operation. We successfully configured the hardware and implemented software that effectively and efficiently detects and routes data through the network. Currently, an event localization with a minimum error is begin investigated due to the challenges of the sensor node limitations, the irregular network topology and the asynchronous network communication. This research will provide a low cost option for event monitoring in the arctic regions with minimal power, communication and accessibility requirements. The wide range of sensor options will make this remote monitoring architecture suitable for a variety of monitoring scenarios.

Ecosystem model of the entire Beaufort Sea marine ecosystem: a spatial and temporal tool for assessing food-web structure and marine mammal changes from 1970 to 2014

***Suprenand, P.M.** and Hoover, C.

The Beaufort Sea coastal-marine ecosystem is approximately a 476,000 km2 area in the Arctic Ocean, which extends from -112.5 to -158° longitude to 67.5 to 75° latitude. Within this Arctic Ocean area the United States (Alaskan) indigenous communities of Barrow, Kaktovik, and Nuiqsut, and the Canadian (Northwest Territories) indigenous communities of Aklavik, Inuvik, Tuktoyaktuk, Paulatuk, Ulukhaktok, and Sachs Harbour, subsist by harvesting marine mammals, fish, and invertebrates from the Beaufort Sea to provide the majority of their community foods annually. The ecosystem in which the indigenous communities harvest is considered a polar habitat, which includes many specialized species of animals, such as polar bears that rely on sea-ice for foraging activities and denning, or ice algae that are attached to the cryosphere. However, the polar habitat has been experiencing a diminishing sea-ice extent, age, and seasonal duration, with concomitant increases in sea surface temperatures (SSTs), since the 1970s. Changes in sea-ice and SST have consequences to the Beaufort Sea coastal-marine ecosystem, which includes animal habitat losses, alterations to trophodynamics, and impacts to subsistence harvesting community harvesting. The present study was aimed at capturing trophodynamic changes in the Beaufort Sea coastal-marine ecosystem from 1970 to 2014 using a fitted spatial-temporal model (Ecopath with Ecosim and Ecospace) that utilizes forcing and mediation functions to describe marine mammal trophodynamic relationships with sea-ice and sea surface temperature, as well as individual community harvesting efforts. Model outputs revealed similar trends in animals population changes and changes in apex predator diets over time.

Arctic Gravity Project 2016

Forsberg, René; ***Gabbert, Rose**; Beale, James and Holmes, Simon

The Arctic Gravity Project (ArcGP) is an international effort dedicated to the compilation of a public-domain 5'x5' grid of the Arctic gravity field north of 64° N. The focus of the gravity grid is the Arctic Ocean, Greenland, and the continental margins of the Asian and North American continents. This international effort is being led by René Forsberg of the Technical University of Denmark and consists of contributions from numerous public and private institutions worldwide. ArcGP provides a high-quality gravity grid to help fill the polar data gap that exists in some satellite data (GOCE) and in planning new gravity satellite missions such as GRACE and GRACE II. The establishment and maintenance of a freely available uniform gravity grid of the Arctic is also in line with the President of the United States' Arctic initiatives and assists researchers and students in developing their own earth system models.

Identification of key marine habitats for migratory eider ducks in the Eastern Canadian Arctic

***Jean-Gagnon, Frankie**; Forbes, Mark and Gilchrist, Grant

Arctic sea ice cover has undergone major changes in recent decades in response to global warming and the rate at which the summer sea-ice has declined in the Arctic has exceeded model projections. Closely associated with this ongoing sea ice decline, is the growth of shipping activity necessary to support resource development in the Canadian Arctic. All projects must however adhere to strict federal and territorial environmental policies before proceeding, including research of how shipping may interact with marine wildlife. Using satellite tracking data, we aim to investigate the migratory patterns of eider ducks during migration to identify their use of key marine habitats in the Hudson Strait, Nunavut, CA. This region is an area of interest for year-round shipping for resource extraction and other related activities. We will evaluate stopover sites used by eiders through: i) coastal sea ice conditions measured using Radarsat satellite images, and ii) food resources determined by boat-based benthic invertebrate sampling. This project, developed in collaboration with Environment Canada, Inuit communities, Canadian universities and Industry Partners (Baffinland Iron Mines) will contribute important information when developing mitigation and emergency response measures related to year-round marine shipping activities in our study region. In the actual context of accelerated development and change in the Arctic, it is of paramount importance to identify the factors that affect coastal seabird distribution to ensure the identification and protection of critical habitat that contributes to biodiversity conservation.

The functional status' observation of oil and gas workers during the shift-in period the Arctic

Korneeva, Y.; Simonova, N. N.; Tyulyubaeva, T. O. and others at Northern (Arctic) Federal University [named after M.V. Lomonosov, Arkhangelsk]

The human work in the Arctic, particularly when using shift (fly-in-fly-out) forms of work, characterized by a high professional load, significantly exceeds the standard for normal conditions. The combination of adverse environmental, social and occupational factors impedes workers' adaptation to the Arctic conditions, which may lead to an increase in morbidity and reduction of disability rights. The research purpose is to study the functional status' observation of oil and gas workers during the shift-in period the Arctic. The study involved 70 employees of oil and gas companies in the Nenets Autonomous Okrug (the length of the shift-in 30 days) between the ages of 24 to 60 years (mean age 38,7 ± 9,7) from March to April 2015. Work experience in shifts surveyed ranging from 0.5 years to 31 years (9,53 +/- 7,6). Methods are questioning, testing, psycho-physiological tests, descriptive statistics, multivariate analysis of variance MANOVA. Treatment was carried out using the software package SPSS 22.00. Studying the functional states' dynamics of oil and gas employees during the period shift led to the conclusion that, despite the increase in the efficiency by the end of the shift period, there has been a pronounced decline in of working capacity for all employees (which is confirmed by both psycho-physiological and psychological methods). The group at highest risk about level of efficiency and its reduction by the shift end include: drivers, operators of oil and gas, engineering and technical workers (due to the high intensity and complexity of the activity).

Extractive Industries and the Arctic: Community experiences and environmental legacies

***Panikkar, Bindu**

This project explores the key science, policy, legal and ethical debates raised during the large mine permitting process in the State of Alaska. Obtaining the permits and approvals needed to build an industrial-scale mine is a process that is highly scientific, economic, political, legal and social. It is a crucial stage in any technological development project, where fundamental and long-reaching decisions are made on controversial issues. It is where various competing interests are mediated: between the fishing industry and the resource extraction industry, the Native people of Alaska and the state, and the State of Alaska and the Federal government; over objective assessment of risk and benefits, over the rights of nature, preservation of food sustainability, legal authority, and environmental justice. Based on a close analysis of current mines under exploration and permitting such as Pebble, Donlin, Chuitna, Wishbone Hill, Teller and Ambler and in-depth interviews with the key industrial, state, federal, civil, and the scientific community involved in these permitting debates, this research examines how risks vs. benefits are interpreted, discussed, debated, disputed and mediated amongst the social, scientific, economic, political and the legal community. This project promises to provide important new information on the permitting processes of mining resource-rich habitats.

Arctic Remote Energy Network Academy

Roe, George; Holdmann, Gwen and Sheets, Brent

ARENA is supported by the Arctic Council's Sustainable Development Working Group. The program addresses the integration of affordable, reliable, renewable energy for the 700+ arctic communities that are not grid connected. The program will deliver a broadly available suite of web-based seminar and two-track on-site classroom and field experience working within a powerplant setting for a selected group of fellows following an application process. Participants will gain, and share, arctic-relevant knowledge, skills, and tools, and establish a network of collaborators that will facilitate integrating clean energy technologies in their communities and improve management of their fossil-based generation as well.

Observing Arctic Freshwater Habitat Dynamics in the Fish Creek Watershed, Alaska

***Arp, Christopher**; Whitman, Matthew and Jones, Benjamin

The Fish Creek Watershed drains a 4500 km2 region of the Arctic Coastal Plain in northern Alaska. This watershed is composed of abundant lakes, wetlands, beaded streams, and alluvial rivers set atop permafrost soils, which provide diverse mosaic of freshwater habitats for fish and waterbirds. Though almost entirely roadless and de facto wilderness, this hydrologic unit is entirely within the National Petroleum Reserve – Alaska (NPR-A), and thus is a focal area for future petroleum development. Accordingly, the Bureau of Land Management (BLM) in partnership with University of Alaska Fairbanks (UAF), the U.S. Geological Survey (USGS) and other agencies have gradually developed an environmental monitoring network to track responses to climate change and establish a baseline prior to petroleum development. Included in this program is the Circum-Arctic Lakes Observing Network (CALON; an Arctic Observing Network (AON) program) with nodes of six lakes in the upper and lower portions of the watershed. This expanding network of lake buoys, stream and river gauges, and climate stations not only is helping to understand hydroclimatic changes in the Arctic, but also provides an ideal framework to initiate hypothesis driven research programs. Such projects include studies of fish foraging and migration through a stream-lake system, a watershed-scale analysis of aquatic habitat responses to climate and land-use change, and focused investigation of lake ice interactions with permafrost and climate. Continuation of the Fish Creek Watershed Observatory (FCWO) will focus on sustaining climate, hydrologic, permafrost, and biological inventory and monitoring to capture the coupled responses of land-use and climate change in Arctic Alaska.

The critical role of natural history collections in documenting biodiversity of the Arctic in the past, present and future

***Saarela, Jeffery**

Changes in the diversity, distribution and ecology of species in the Arctic are predicted and/or already being documented in response to global change. Baseline biodiversity data from the past and present can provide critical points of reference in time and space for measuring change. Core components of biodiversity data are specimens in natural history collections. Natural history specimens are data themselves, documenting the distribution of species in time and space; they serve as vouchers for datasets, allowing future workers to go back to original material to confirm or revise identifications; and they are also sources of new data (morphology, anatomy, toxicology, genetic information, etc.). Biological specimens from the Arctic are a diverse, valuable and irreplaceable component of the polar information spectrum, yet Arctic specimens were collected more frequently in the past than they are today. Core functions of museums are the collection, long-term preservation, stewardship and curation of specimens, and facilitating access to these specimens, both physically and digitally. The Canadian Museum of Nature, founding member of the international Arctic Natural History Museums Alliance, houses the largest – and continually growing – collection of natural history specimens from the Canadian Arctic, with ca. 260K Arctic specimens (including >550 type specimens). Arctic Observing programs on biodiversity should document field observations with specimens whenever possible, and should engage with natural history museums to ensure these specimens are properly preserved and accessible to future generations of researchers. Reciprocally, natural history museums should be more involved in Arctic science discussions to raise awareness and increase usage of their rich collections-based resources, and should engage with researchers who require a permanent repository for their Arctic field collections.

Visualization, Strategic Assessment, and Decision Support for Arctic Observing: The Arctic Observing Viewer (AOV)

***Manley, William F.**; Gaylord, Allison G.; Kassin, Ari; Villarreal, Sandra; Barba, Mauricio; Cody, Ryan; Dover, Mike; Escarzaga, Stephen; Habermann, Ted; Kozimor, John; Score, Roberta and Tweedie, Craig. E.

To better assess progress in Arctic Observing made by U.S. SEARCH, NSF AON, SAON, and related initiatives, an updated version has been released for the Arctic Observing Viewer (AOV; http://ArcticObservingViewer.org). This web mapping application and information system conveys the who, what, where, and when of "data collection sites" – the precise locations of monitoring assets, observing platforms, and wherever repeat marine or terrestrial measurements have been taken. Over 7700 sites in AOV encompass a range of boreholes, ship tracks, buoys, towers, sampling stations, sensor networks, vegetation plots, stream gauges, ice cores, observatories, and more. Contributing partners are the U.S. NSF, ACADIS, ADIwg, AOOS, a2dc, AON, CAFF, GINA, IASOA, INTERACT, NASA ABoVE, and USGS, among others. While focusing on U.S. activities, information exchange with international groups is welcomed for mutual benefit. Users can visualize, navigate, select, search, draw, print, view details, and follow links to obtain a comprehensive perspective of environmental monitoring efforts. We continue to develop, populate, and enhance AOV. Recent improvements include: a more intuitive and functional search tool, a modern cross-platform interface using javascript and HTML5, and hierarchical ISO metadata coupled with RESTful web services &; metadata XLinks to span the data life cycle (from project planning to establishment of data collection sites to release of scientific datasets). Use a companion application, the Arctic Research Mapping Application (ARMAP; http://armap.org), to view project locations for all Arctic science rather than data collection sites for Arctic Observing. AOV is founded on principles of interoperability, such that agencies and organizations can use the AOV Viewer and web services for their own purposes. In this way, AOV complements other distributed yet interoperable cyber resources, and helps science planners, funding agencies, investigators, data specialists, and others to: assess status, identify overlap, fill gaps, optimize sampling design, refine network performance, clarify directions, access data, coordinate logistics, and collaborate to meet Arctic Observing goals.

Sea Ice Matters: Science Communication through the SEARCH Sea Ice Action Team

***Druckenmiller, Matthew**; Francis, Jennifer and Huntington, Henry

The Study of Environmental Arctic Change (SEARCH) aims to develop scientific knowledge to help society understand and respond to the rapidly changing Arctic. In September 2015, the SEARCH Sea Ice Action Team (SIAT), with a focus on science communication, developed a strategy for mobilizing the research community to organize, synthesize, and disseminate scientific knowledge for a broad range of Arctic sea ice stakeholders. Key elements are to 1 support and promote SEARCH and the SIAT as a trusted and timely source of information about Arctic sea ice and impacts of its loss, 2 develop sustained, sophisticated dialogues between the research community and decision-makers, and 3 co-communicate the importance and state-of-the-art of Arctic research using a range of voices beyond those of scientists. The core product of the strategy will be a website to comprehensively communicate why and how sea ice matters. This website will provide tiered access to sea ice information, organized across a series of high-level topics via a hierarchical, pyramid structure based on increasing levels of scientific complexity. This resource will depend on collaboratively developed, peer-reviewed, and concisely edited scientific content, which will serve to coordinate the scientific community, disseminate important findings to broad audiences, and provide a take-away "go-to" resource for decision-makers and the media. In addition, Sea Ice Matters will host guest perspectives from across the science and stakeholders communities and provide timely information on emerging high-interest topics, such as notable weather events or recent science publications. Evaluating the project through targeted outreach and user feedback represents a strategic focus for the Team. Most importantly, this communication endeavor will require organizing complementary interests and efforts within SEARCH and across related organizations and broader science communities.

Physically based hydrological modeling to assess changes in surface water connectivity in an Arctic catchment

***Gädeke, Anne**; Liljedahl, Anna; Arp, Christopher; Daanen, Ronald; Alexeev, Vladimir; Cai, Lei and Whitman, Matthew

It is expected that a changing climate leads to rapid transformations of hydrological processes in Arctic environments. Thawing permafrost combined with increased evapotranspiration may lead to a regime shift with less surface and more subsurface water availability in the future (affecting e.g. surface water connectivity which is vital for fish migration). In order to gain a deeper understanding of the linkages between climate, surface water connectivity and fish migration on the watershed scale, a thorough measurement network was set up in the Crea Creek watershed (30 km2) which is a sub-watershed of the Fish Creek watershed (4900 km2) located in the National Petroleum Reserve Alaska. Discharge, snow depths, and meteorological variables have been measured since 2009. A LiDAR digital elevation model of 0.25 m horizontal resolution facilitates the representation of micro-topographic landscape features (i.e. ice wedge polygons). In addition, 1052 fish were captured and 781 fish were tagged using a passive integrated transponder. The observations have not only allowed analysis of fish migration patterns [Heim et al., 2014; Heim et al., 2015], but can also be utilized as input to drive the physically based hydrological model WaSiM (http://www.wasim.ch/en/index.html). Using WaSiM, all aspects of the water cycle are simulated as well as heat processes in the subsurface. The analysis specifically addresses changes in surface water connectivity (lakes and streams) under past, present and future climate. The analyses will ultimately provide regional stakeholders (e.g. Bureau of Land Management) with information on the hydrologic impacts of climate change within the National Petroleum Reserve Alaska to mitigate impacts on aquatic ecosystems as well as the local population. The experience gained in this study may also serve as a benchmark for future studies and developments in similar environments.

The need for stakeholder engagement in understanding impacts of observed changes in the timing of coastal freeze-up

***Rolph, Rebecca** and Mahoney, Andy

For Arctic coastal communities, freeze-up of the adjacent ocean is a significant annual event that directly affects subsistence activities and the severity of the impacts of fall storms. The transition from open water to ice cover changes both the prey species available and the means by which they are harvested, while the presence of sea ice reduces the energy of waves and the erosion they can cause. Moreover, the duration of the transition period from open water to ice thick enough to travel on marks a window where neither boat nor snow mobile are useable. Small changes in the timing of freeze-up can therefore lead to significant impacts on the residents of these communities. Thus, information from local stakeholders points to the importance of the onset and duration of freeze-up as key variables for Arctic observing networks. The recently available Alaska Sea Ice Atlas provides an observational dataset of sea ice concentration that can be used to analyze changes in freeze-up timing since 1953. These data show that most coastal communities in Arctic Alaska have experienced a trend toward later freeze-up in recent decades. In Shishmaref, for example, the date of freeze-up appears to have become over 5 weeks later over the course of the record. However, while such changes sound dramatic, it is difficult to attribute or quantify their effects on any community without additional observations from the local stakeholders. For example, while the target and mode of subsistence activities may change, the balance of subsistence effort versus success may be unaffected by delays in freeze-up. Thus, identifying a key observable such as the timing of freeze-up is only the first step of stakeholder engagement that is necessary for producing actionable information that can help sustain Arctic observations.

Developing, implementing, and assessing a communication strategy designed to increase diverse stakeholder engagement in arctic relevant observation networks

***Hum, Richard E.** and Timm, Kristin

Arctic science can benefit from developing strong relationships with diffuse stakeholder groups, 1) research questions can be formulated more precisely-- helping to identify key factors, relevant measurements, and cross-scale boundaries, 2) results can be conveyed efficiently back to invested groups, and 3) the resulting communication can inform new, more optimized, research directions. Strong stakeholder relationships require careful communication and trust building. Principals of "network priming" suggest that diffuse stakeholder networks, of the type often developed through organizational use of social media, can act as a catalyst for stronger relationships in times of need. This study tests several methods for how organizations can extend the diversity of their stakeholder networks, individually and in coalition via strategic social media use. A communication strategy is defined and assessed by 1) analyzing stakeholder mission statements using natural language processing techniques, 2) network engagement via frequency and function of messaging, and 3) network diversity via network analysis. The efficacy of aligning social media messaging to targeted overlaps in stakeholder mission statements and engagement patterns is tested through changes in network dynamics over time. Targeted messaging is expected to increase the size of an organization's stakeholder network for discreet periods of time as a function of the ratio of the mission statement and engagement pattern overlap.

Scenarios to prioritize observing activities on the North Slope, Alaska, in the context of resource development, climate change and socio-economic uncertainties

***Lee, Olivia**; Payne, John; Lassuy, Dennis; Eicken, Hajo and Vargas-Moreno, Juan Carlos

The North Slope of Alaska is experiencing rapid changes in response to interacting climate and socioeconomic drivers. The North Slope Science Initiative (NSSI) is using scenarios as a tool to identify plausible, spatially explicit future states of resource extraction activities on the North Slope and adjacent seas through the year 2040. The objective of the scenarios process is to strategically assess research and monitoring needs on the North Slope. The participatory scenarios process involved stakeholder input (including Federal, State, local, academic, industry and non-profit representatives) to identify key drivers of change related to resource extraction activities on the North Slope. While climate change was identified as a key driver in the biophysical system, economic drivers related to oil and gas development were also important. Expert-reviewed informational materials were developed to help stakeholders obtain baseline knowledge and stimulate discussions about interactions between drivers, knowledge gaps and uncertainties. Map-based scenario products will allow mission-oriented agencies to jointly explore where to prioritize research investments and address risk in a complex, changing environment. Scenarios consider multidecadal timescales. However, tracking of indicator variables derived from scenarios can lead to important insights about the trajectory of the North Slope social-environmental system and inform management decisions to reduce risk on much shorter timescales. The inclusion of stakeholders helps provide a broad spectrum of expert viewpoints necessary for considering the range of plausible scenarios.

Biodiversity and ecosystem monitoring come of age

***Ibarguchi, Gabriela**

Monitoring includes the systematic collection of data using standardised methods to detect environmental change over time, with specific objectives, such as for comparison with a previously-established standard or baseline. Ideally, monitoring includes time scales that capture natural cycles and environmental variability, and spatial scales that include control sites/states and early-warning sites/states. We increasingly recognise the importance of long-term observations contributed through Traditional Knowledge, community-based programs, citizen science, the incorporation of historic samples and archives, and coupled with remote sensing approaches, sensor networks, and continuous and/or real-time data capture (data loggers), all key components in global monitoring initiatives. These activities and tools complement traditional site-based surveys and focal ecological studies, and in conjunction with DNA analyses (including DNA barcoding, environmental DNA and ancient DNA), analyses of stable isotope and trace elements, and other studies, our ability to track change through time has improved greatly in the past decade, fueling rapidly-growing fields such as environmental informatics and biosensor technology. Our limited international and inter-disciplinary coordination in previous decades, and lack of accurate baselines for tracking change, particularly in remote, rapidly-changing polar, arid and alpine environments, have resulted in disparate responses in monitoring and management. Shifted baselines are being used to meet modern targets or when original baselines are not realistic. However, alternative and more positive approaches include efforts to use surrogate baselines and historical data, to integrate monitoring using ecosystem-based approaches, to locate complementary data sources to corroborate results, to build partnerships, and to support new global-scale, Earth observation initiatives.

Terrestrial Environmental Observing Network (TEON) – the Kuparuk River, Alaska's Arctic, USA

***Stuefer, Svetlana** and Arp, Christopher

There are two major difficulties that are widely acknowledged when the Arctic observing systems are being discussed: 1) sparse observational network and 2) changes in the observational network over time. This poster presents long-term hydrologic monitoring network in the Kuparuk River and adjacent watersheds. This network has been maintained by the Water and Environmental Research Center (WERC) at University of Alaska Fairbanks (UAF) led by Dr. Douglas Kane and funded by numerous research projects. The data collection was initiated in 1985 in the small Imnavait Creek watershed just north of the Brooks Range. Over the years, data collection extended to include the Upper Kuparuk River watershed in the early 1990s, the entire Kuparuk River watershed in the late 1990s and then the adjacent watersheds in 2000s. As of today, observational network includes the Kuparuk River, Putuligayuk River and Roche Mountannee Creek watersheds to obtain continuous hydro-climatological data streams for a new program funded by the Arctic Landscape Conservation Cooperative (U.S. Fish and Wildlife Service). This newly directed observation effort, the Terrestrial Environmental Observing Network (TEON), joins the legacy of hydro-climatic monitoring and research in the Kuparuk with new permafrost and vegetation observation programs to start building integrated datasets to benefit a variety of Arctic Alaska stakeholders.

The TAMANI project: Assessing needs and opportunities for inclusive pan-arctic monitoring of seabirds and terrestrial vertebrates

***Wheeler, Helen**; Berteaux, Dominique; Furgal, Chris; Parlee, Brenda; Rodrigues, Ana; Yoccoz, Nigel and Gremillet, David

The arctic is experiencing rapid change in climate and human activity. Rapid change in the arctic affects wildlife and habitats, local practices and culture. Pan-arctic monitoring programs have the potential to generate positive impacts for people and the environment. However, to achieve these objectives, goals need to be clearly defined in a way that includes multiple stakeholders in the arctic environment and arctic observation and recording. Also, in order to produce accurate understanding of the state of the arctic, monitoring programs at a pan-arctic scale must be representative of the conditions and changes in the arctic. Furthermore, evaluation of the process of monitoring need to be performed to evaluate how the approach taken in monitoring affects whether the ultimate goals are achieved. The TAMANI project will address these issues through interviews of stakeholders in the arctic environment and monitoring and spatial analysis of the current distribution of monitoring sites relating to seabirds and terrestrial vertebrates. We present the core objectives of our stakeholder interviews cornering pan-arctic monitoring of seabirds and terrestrial vertebrates and initial results from an analysis of the coverage of existing monitoring of seabirds. We highlight our aims to identify the strengths and weaknesses of existing arctic monitoring, the desirable impacts that monitoring could generate and the approach that should be taken for pan-arctic monitoring networks. We then provide an overview of some of the gaps in current monitoring coverage of seabirds across space.

Impacts of changes in the Arctic on stakeholders both inside and outside Arctic regions

***Cavazos-Guerra, C.**; Keil, K.; Valeeva, V. and Chabay, I.

Arctic change strongly affects ecosystems, people and communities both inside the Arctic and at lower latitudes. We propose a study of the impact of climatic change on the environment and human activities - specifically resource development- in the Arctic with the purpose of improving stakeholders' capacity to adapt to climate change. The study considers three areas - Yamal LNG project, the Kharyaga oil project and the Achimgaz project- located in prominent regions in the West Russian Arctic in terms of ongoing and future oil and gas development and experiencing to the full extent negative and positive consequences of climatic, environmental and economic changes. Our goal is to characterize the perspectives, concerns and expectations about resource development in the case study areas (e.g. on perceived risks, uncertainties, costs and benefits) among different stake and right-holders groups, including communities, local decision-makers, indigenous peoples. The engagement of and dialog among interested groups is a central part of this transdisciplinary impact study and a very important arena for collaboration in terms of risk assessment and prospects for sustainable development. Engagement with rights- and stakeholders is also essential for data gathering of both biophysical data on black carbon emissions and health from measurements and social data from interviews to co-design and develop a combined sets of scenarios, including economic analyses, legal and policy considerations, and impacts from air pollution. These scenarios are intended as tools for better decision-making by local and international Arctic rights- and stakeholders, who are the intended end-users of this study.

Building upon cooperative prospects amongst stakeholders for fighting Arctic marine invasion challenges

***Kourantidou, Melina**; Kaiser, Brooks; Fernandez, Linda; Sundet, Jan and Vestergaard, Niels

Biological invasions in Arctic marine environments are expected to noticeably affect the way the ecosystem will look and function in coming years. Along with many other rapid changes taking place in these previously isolated ecosystems, invasions of which we are both aware and unaware may have irreversible repercussions. The intentional introduction of the Red King Crab Paralithodes camtschaticus and the more recent unintentional introduction of Snow Crab Chionoecetes opilio into the Barents Sea are examples with identifiable ecosystem impacts especially in soft benthic bottom fauna ecosystems. We expect that game theoretic environmental economic tools can help illuminate aspects of invasive species management significant for sound decision-making processes. Building blocks of such a game theoretic approach include the different players (stakeholders) involved. In our case study, we take into account the existing different management practices (for RKC) and the different market interests (based on consumer demand and fishing industry effort) as well as the ecosystem itself. At a minimum the following stakeholders have interdependent payoffs affecting not only the human actors but also environmental quality outcomes: Norwegian and Russian fishermen, Live and frozen crab markets, and Society, representing all possible beneficiaries of a healthy and well-sustained marine ecosystem in the Barents Sea as well as those in areas to which the invasion may spread. These actors must make decisions under significant uncertainty; sustained Arctic observation data of crab populations and spread, ecosystem quality and related productivity parameters improve decision-making capability and increase clarity of the trade-offs involved. We identify the stakeholders' involved and trace out their roles in the decision making process to help articulate incentive-compatible ecosystem management strategies that are adaptive to new information garnered from sustained Arctic observations.

Wildfire research to enhance ecological and community resilience under changing Arctic fire regimes

***Jandt, Randi R.**; Miller, Eric A.; Bourgeau-Chavez, Laura L.; Loehman, Rachel A.; Shanks Rodrigues, Alyssa V.; Miller, Mary E.; Prakash, Anupma and York, Alison D.

Polar amplification of climate warming is bringing with it an increase in wildfire (Wolken et al. 2011). More fire disturbance may provide a mechanism by which climate warming could rapidly alter the structure and function of high northern latitude ecosystems. Observational data is mounting to support changes to fire weather (summer temperatures, convection, snow-free days) leading to more acres burned in Alaska and Canada. In 2015, 5.1M acres (2.1M ha) burned in Alaska, the 2nd largest fire season on record. The Wildfires Collaboration Team (WCT) of the Interagency Arctic Research Policy Commission is interested in identifying potential impacts to communities and human well-being from this increased burning, which models project to more than double in the next 3-5 decades (Balshi, et al. 2009). The WCT is especially interested in identifying areas of rapid, fire and climate-driven ecological change, systems exhibiting resilience or adaptation, and potential fire/land management planning for unwanted impacts that can be assisted with data and research studies. Here we illustrate, in brief, four broad areas of where additional observations and research can 'make a difference' for high-latitude ecosystems and communities: 1) Knowledge needed to predict and prepare for extreme events: For example, Alaskan agencies charged with fire protection are especially interested in changes in fire weather indices projected for the future, in better daily, weekly and seasonal prediction tools, and in the real-time ability to track fuel moisture trends—especially in deep organic layers. 2) What are the ecological impacts of altered fire regimes in the tundra terrestrial eco-hydrological system and how will they affect management planning and human activities: Can we anticipate the timing, rate, and magnitude of trajectories of change? Can management activities make a difference? Some of these ecological relationships are unique to the high latitudes and are understudied relative to the number of fire severity studies in more temperate zones yet may play an essential role in global carbon balance and feedback mechanisms as well as having immediate implications for infrastructure. 3) Economic impacts to state and federal management agencies and to communities: What is the economic impact of fire now and what will it be in the future? Are strategies available to mitigate the impact? 4) The role of residents and communities in preparing for direct fire threat and increased smoke exposure: what adaptive vegetation management strategies are being used, how can arctic residents participate in fire management planning, how may subsistence resources and access to those resources change with more fire disturbance?

Seasons of stress: towards understanding people's ability to respond to change and surprise

***Penn, Henry J. F.**; Loring, Philip A. and Gerlach, S. Craig

Climate change is impacting coastal communities in rural Alaska in myriad ways. Ethnographic research done with municipal workers, community leaders, and other local experts in the Bristol Bay region of Alaska suggests that these impacts interact with local social and environmental circumstances in ways more nuanced than can be captured by common frameworks for vulnerability analysis. We explore the usefulness of two analytical concepts: community capacity and cumulative effects, for more effectively describing how people experience climatic and environmental change, assuming that new climate and weather-driven challenges will interact with one another and with other social and cultural factors, and that they will accumulate, additively or synergistically over time and space. One of the most critical findings of our research shows the importance of the temporal aspect of environmental change in rural Alaska, with temporality having both ecological significance and social and cultural relevance in terms of how and under what conditions people in rural communities design or manage effective responses to change. In the simplest terms, there are multiple factors that play into whether and how a community will be affected by some climatic or environmental stress, and that this is linked directly to the highly seasonal aspects of life in rural Alaska. This means that the impacts of environmental stresses will differ depending on where, when, and how frequently they occur.

Arctic resource development: a sustainable prosperity project of co-management

***Arruda, Gisele**

The Arctic plays a key role in the global climate. As the ice retreats the current challenges concerning the environment, maritime safety, tourism and oil and gas activity will intensify even more the effects of climate change on ecosystems and communities. Climate change and modernization have thus become two intrinsically linked forces that severely alter the context in which the indigenous populations of the region sustain a livelihood (van Voorst, 2009). Local animal and plant species are of dietary importance, while hunting, fishing or foraging are all of cultural and social value. The availability of many species that the Arctic indigenous people rely on for food has become limited due to climate change and the receding ice cover. The assessment of potential impacts of resource development should to some extent rely on traditional knowledge and could benefit climate change researchers in Western academia and policy-making circles as well as help the indigenous communities to tackle the difficult task of promoting their local adaptation. A joint assessment and management on impacts issues must be performed based on mutual consent, information exchange, responsible coordination and cooperation. Social impact assessment (SIAs) serve as means of determining how and to what extent specialized social groups will become better or worse off as a result of certain externally generated actions. Assessments have been largely about indigenous people, not by them (Cochran et al, 2013:558). This is why it becomes crucial to enrich SIAs with detail and context that focus on the indigenous perspective, in which economy and culture are more closely intertwined. The benefits of the Arctic emerging economy may be seen in the creation of economic development, but it must be part of a sustainable prosperity project of co-management with triple gain to economy, environment and communities.

The Sustainable Development of Communities-in-Transition in the Arctic Region of Russia (Case Study of the Sakha (Yakutia) Republic)

Mikheev, Valeriy L.; ***Rozanova-Smith, Marya S.** and Gretsov, Andrey G.

The poster presents the gradual inclusion of the Russian Arctic region into the global economic, social, and cultural processes, as well as explores the multifaceted challenges that the local communities-in-transition are facing (at the example of Sakha (Yakutia) Republic, Russia). As a result of climate change, economic globalization and emergence of the new transportation routes (NSR), the local communities will be inevitably getting involved into intercultural collaboration and international cooperation, as well as into the process of transition from traditional towards modern/configurative (in terms of M. Mead) culture. The author is focusing mainly on communities-in-transition in Sakha (Yakutia), and presenting the results of the fieldwork conducted together with Dr. Andrey Gretsov in 2013-2015. The presentation will include the socio-cultural and ethno-psychological specific features of these communities-in-transition, as well as the problems coming along with identity crises and its consequences in search of strategies of adaptation and integration into the diverse multicultural urban communities, and forms of co-existence with the global communities. Also, the author describes the federal and regional policies in Russia that are aimed to provide sustainable development and comprehensive support to the peoples of the Russian North, as well as the necessity of interstate collaboration and interaction in the Arctic region and ways to resolve common problems in the field of preservation and sustainable development of the human capital in the Arctic region.

Adapting every day: An undergraduate Climate Change Course for Western Alaska

***Radenbaugh, Todd A.**

The communities of Western Alaska are experiencing significant weather variability and extreme geographic events attribute to climate change. Because of this, most western Alaskans not only accept the fact that the climate is changing, but are adapting to it. However, to better adapt, there is a desire to know more about the current science of climate change and the range of potential influences to their subsistence way of life and the ecosystems they depend. The University of Alaska Fairbanks (UAF) College of Rural and Community Development (CRCD) serves the educational needs of this region and in the Fall 2015 semester, a pilot course entitled: Climate Change in Western Alaska was offered across Alaska. Given the low human population density, limited road network, and expensive transportation, the course was offered using modern distance education methods. The course was based on AMS Climate Studies textbook and curriculum, but used local examples and case studies that were tailored to western Alaska. Western Since this region is changing rapidly and is vulnerable, it is in need of more baseline data to help in decision making. A courses such as this train students to be important recorders of climate change and assist in observational research activities such as UAF's Scenarios Network for Alaska and Arctic Planning (SNAP) program and Alaska Native Tribal Health Consortium's Local Environmental Observer (LEO) Network. Students at UAF rural campuses live daily interacting with weather extremes so they are ideal candidates to cooperate with organizations who need local eyes on the rapid changes occurring.

Observational needs for regional downscaling in Alaska

***Bieniek, Peter**; Bhatt, Uma; Walsh, John; Rupp, Scott and Lader, Rick

Dynamical downscaling is an effective method to derive local climate information from coarse spatial and temporal climate data. Understanding the climate from the local perspective is necessary for climate adaptation and mitigation planning for locations throughout Alaska and the Arctic. Downscaling of global climate models requires significant evaluation based on sparse observations to quantify potential biases and uncertainties for the products to be most useful to stakeholders. Dynamical downscaling efforts at the Alaska Climate Science Center have been undertaken to help to provide the needed local information to stakeholders throughout Alaska for past and future projected climate. An improved, robust and long-term set of observations of temperature and precipitation are needed to better evaluate these downscaled data as many gaps exist. Observations at high elevations sites are needed to better evaluate model performance in mountainous regions. Additional variables such as those to identify the characteristics of snow or icing as well as radiative fluxes are also needed at all of the existing stations and more.

The “Greenland Ice Sheet Monitoring Network (GLISN)” Initiative

***Kanao, Masaki**; Tsuboi, Seiji; Toyokuni, Genti; Himeno, Tetsuto; Tono, Yoko and Anderson, Kent

The Greenland ice sheet and its response to climate change have potentially a great impact upon mankind, both through sea-level rise and modulation of fresh water input to the oceans. Monitoring a dynamic response of the Greenland ice sheet to climate change is a fundamental component of long-term observations in global science. “Glacial earthquakes” have been observed along the edges of Greenland with strong seasonality and increasing frequency in the last one decade. During last decade, over 200 glacial earthquakes were detected, but 95% occurred on Greenland with the remaining in Antarctica. Greenland glacial earthquakes are considered to be associated with major outlet glaciers at the margins of the continental ice sheet. The occurrence patterns of earthquakes are positively correlated with seasonal hydrologic variations, significantly increased flow speeds, calving-front retreat and thinning at many outlet glaciers. Seismicity around Greenland including tectonic events was investigated by applying a statistical model to the globally accumulated data. The detection, enumeration, and characterization of smaller glacial earthquakes were limited by the propagation distance to global stations of GSN. Glacial earthquakes have been observed at stations within Greenland, but the coverage has been sparse. In order to define the fine structure and detailed mechanisms of glacial earthquakes, a broadband, real-time network needs to be established throughout the ice sheet and perimeter. The International Polar Year (IPY) was a good opportunity to initiate the program with international collaboration. The “Greenland Ice Sheet Monitoring Network (GLISN)” was initiated for identifying the dynamic response of Greenland ice sheet to climate change. Japanese GLISN-team has a significant task to maintain the Ice-S station (69.1N, 39.6W, altitude 2930m) on the ice cap of the large Island from 2011, in order to provide precious data to the global involving communities.

Observed changes in arctic terrestrial wildlife linked to 20th century warming

***Tape, Ken**

Data linking climate change to observed changes in arctic marine and terrestrial wildlife populations are scarce, despite substantial changes in sea ice and arctic vegetation that constitutes wildlife habitat. Here, we mine observational records from the Alaskan Arctic to identify changes in distribution or behavior of many terrestrial wildlife species during the last century. We show that the increase in productivity of arctic vegetation and expansion of deciduous shrubs resulting from longer and warmer summers starting in the mid-1800s triggered the establishment of novel tundra herbivores moose in the 1930s and snowshoe hares in the 1970s, both which depend on shrubs protruding above the snow for forage in winter. Earlier spring onset has led to a 3-10 day earlier return of 16 species of migratory birds since 1964, though the effect of the altered timing on population sizes is unknown. We expect that other boreal species such as beaver or red fox are also shifting into treeline and tundra habitats. The decline in shrub-free tundra is meanwhile reducing habitat for endemic tundra species such as the Alaska marmot, caribou, and a variety of small mammals and birds, which will also have to contend with new competitors arriving from the south. Complicated interactions associated with predation, disease, trophic mismatch, competition, and other factors render most predictions (including those herein) suspect unless based on past observations, underscoring the need to analyze observed wildlife changes and to maintain long-term studies.

ICESat GLAS Elevation Changes and ALOS PALSAR InSAR Line-Of-Sight Changes on the Continuous Permafrost Zone of the North Slope, Alaska

***Muskett, Reginald**

Measuring centimeter-scale and smaller surface changes by satellite-based systems on the periglacial terrains and permafrost zones of the northern hemisphere is an ongoing challenge. We are investigating this challenge by using data from the NASA Ice, Cloud, and land Elevation Satellite Geoscience Laser Altimeter System (ICESat GLAS) and the JAXA Advanced Land Observing Satellite Phased Array type L-band Synthetic Aperture Radar (ALOS PALSAR) on the continuous permafrost zone of the North Slope, Alaska. Using the ICESat GLAS exact-repeat profiles in the analysis of ALOS PALSAR InSAR Line-Of-Sight (LOS) changes we find evidence of volume scattering over much of the tundra vegetation covered active-layer and surface scattering from river channel/banks (deposition and erosion), from rock outcropping bluffs and ridges. Pingos, ice-cored mounds common to permafrost terrains can be used as benchmarks for assessment of LOS changes. For successful InSAR processing, topographic and tropospheric phase cannot be assumed negligible and must be removed. The presence of significant troposphere phase in short-period repeat interferograms renders stacking ill suited for the task of deriving verifiable centimeter-scale surface deformation phase and reliable LOS changes. [Ref. Muskett, R.R., ICESat GLAS Elevation Changes and ALOS PALSAR InSAR Line-Of-Sight Changes on the Continuous Permafrost Zone of the North Slope, Alaska. International Journal of Geosciences, in press Oct. 2015.]

Active-Layer Soil Moisture Content Regional Variations in Alaska and Russia by Ground-Based and Satellite-Based Methods, 2002 Through 2014

***Muskett, Reginald**; Romanovsky, Vladimir; Cable, William and Kholodov, Alexander

Soil moisture is a vital physical parameter of the active-layer in permafrost environments, and associated biological and geophysical processes operative at the microscopic to hemispheric spatial scales and at hourly to multidecadal time scales. While in-situ measurements can give the highest quality of information on a site-specific basis, the vast permafrost terrains of North America and Eurasia require space-based techniques for assessments of cause and effect and long-term changes and impacts from the changes of permafrost and the active-layer. Satellite-based 6.925 and 10.65 GHz sensor algorithmic retrievals of soil moisture by Advanced Microwave Scanning Radiometer – Earth Observation System (AMSR-E) onboard NASA-Aqua and follow-on AMSR2 onboard JAXA-Global Change Observation Mission – Water-1 are ongoing since July 2002. Accurate land-surface temperature and vegetation parameters are critical to the success of passive microwave algorithmic retrieval schemes. Strategically located soil moisture measurements are needed for spatial and temporal co-location evaluation and validation of the space-based algorithmic estimates. We compare on a daily basis ground-based (subsurface-probe) 50- and 70-MHz radio-frequency soil moisture measurements with NASA- and JAXA-algorithmic retrieval passive microwave retrievals. We find improvements in performance of the JAXA-algorithm (AMSR-E reprocessed and AMSR2 ongoing) relative to the earlier NASA-algorithm version. In the boreal forest regions accurate land-surface temperatures and vegetation parameters are still needed for algorithmic retrieval success. Over the period of AMSR-E retrievals we find evidence of at the high northern latitudes of growing terrestrial radio-frequency interference in the 10.65 GHz channel soil moisture content. This is an important error source for satellite-based active and passive microwave remote sensing soil moisture retrievals in Arctic regions that must be addressed. [Ref: Muskett, R. , Romanovsky, V. , Cable, W. and Kholodov, A. (2015) Active-Layer Soil Moisture Content Regional Variations in Alaska and Russia by Ground-Based and Satellite-Based Methods, 2002 through 2014. International Journal of Geosciences, 6, 12-41. doi: 10.4236/ijg.2015.61002.]

Future development and challenges on Arctic Data archive System(ADS)

***Yabuki, Hironori**; Sugimura, Takeshi; Terui, Takeshi and Enomoto, Hiroyuki

The easy access use is made possible from the industrial and the social public using research results (thesis and research data, etc.) using a public research fund, and a concept as open science aiming at linking it to creation of innovation by opening the new way as well as promoting a scientific technical research effectively is showing a rapid expanse to creation of worldwide. And the principle opening to the research result and data by a public research fund by GRC (Global Research Council), OECD(Organization for Economic Cooperation and Development) and G8 in 2013 etc. Under these background, Arctic Data archive System (ADS: https//ads.nipr.ac.jp), through proceed with the visualization and the development of online analysis system of integrated big data, aiming for integrated analysis information platform, not only as a mutual distribution platform of data, we have developed a system that enables open access research data and scientific knowledge obtained in the Arctic research. The share of research data and scientific knowledge in the Arctic and non-Arctic nations, there are need for coordination of data repository and data center in a various country.

Japanese contribution to the Polar Prediction Project (PPP)

***Inoue, Jun**; Sato, Kazutoshi and Enomoto, Hiroyuki

To evaluate the impact of additional observation on the predictability of weather and sea-ice patterns, Japan has contributed to establishing an experimental Arctic observing network as part of an international collaboration (the Arctic Research Collaboration for Radiosonde Observing System Experiment: ARCROSE). It was shown that the incorporation of additional Arctic observations improves the initial analysis and enhances the skill of weather and sea-ice forecasts, the application of which has socioeconomic benefits. Based on these achievements, Japan will extend this activity during the Year of Polar Prediction (YOPP) under the Japanese flagship project, called ArCS (Arctic Challenge for Sustainability). Using RV Mirai and data assimilation technique under international collaborations, the impact of additional Arctic observations on predicting extreme evens in local (e.g. along Northern Sea Route) and remote regions (e.g. mid-latitude severe winters) will be assessed, contributing to optimizing a sustainable Arctic observing network on a cost-benefit basis.

Arctic Dust: observations, impacts and future initiatives

***Bullard, Joanna**; Darlington, Eleanor and members of the High Latitude and Cold Climate Dust Network

Natural dust is often associated with hot, subtropical deserts, but there are 5 million km2 of cold deserts on Earth. Significant dust events have been reported in the Arctic from Alaska, Canada, Iceland and Greenland. There has been little research on the impacts of Arctic dust and no attempt to quantify systematically the expanse, characteristics or dynamics of dust sources. This limits our ability to assess their current and future significance, in a changing climate. Meteorological stations record up to 10 dust events per year in parts of the Arctic and satellite observations reveal that Arctic dust storms can be extensive, covering areas >50,000 km2. Field campaigns suggest dust emission rates can exceed those in some hot desert regions and that short-term high latitude dust deposition rates are amongst the highest in the world. However these observations are sparse. Cloud cover restricts satellite coverage in spring and autumn, which are the typical Arctic dust storm seasons, and most field campaigns last only a few weeks. Arctic dust storms affect natural and anthropogenic activities. For example, in 2008 in Reykjavík, Iceland, one third of all air quality exceedences were caused by dust storms. In south central Alaska air quality regularly exceeds recommended limits (>150 μ g m3) due to dust storms from glacial river plains, with some dust concentrations >500 μ g m3. Dust travelling over oceans can contribute nutrients to the marine system when it is deposited; one event in 2006 is estimated to have input 60-400 tons of soluble iron to the Gulf of Alaska. Dust redistribution in the landscape via dust storms can affect rates of soil formation and contribute nutrients to Arctic lakes. In southwest Greenland, the rate of organic carbon input to lakes from dust deposition is estimated to be 50 mg C m-2a-1. To consolidate current understanding of high latitude dust emissions and impacts, the High Latitude and Cold Climate Dust Network (http://www.hlccd.org) is creating a comprehensive database of contemporary high latitude dust sources. The database will be used to integrate diverse sources of data and identify new, strategic research goals. One such goal, focused on achieving a better understanding of the magnitude, frequency and significance of Arctic dust events, is the establishment of a pan-Arctic network of dust observing stations.

JAXA's Arctic Observation from Space

***Koide, Michihiro**; Hori, Masahiro; Ito, Norimasa and Kaneko, Yutaka

Remote sensing from space plays a key role in monitoring recent environmental changes occurring in the Arctic region. Japan Aerospace Exploration Agency (JAXA) is now operating various polar orbiting earth observing (EO) satellites for the Arctic monitoring. For example, Global Change Observation Mission-Water (GCOM-W) satellite which carries the Advanced Microwave Scanning Radiometer 2 (AMSR2) and was launched in May 2012 has observed the historic shrinkage of the Arctic sea ice in September 2012 at the finest spatial resolution as passive microwave sensor. Global Precipitation Measurement (GPM) core observatory, the JAXA/NASA joint development mission, was launched in Feb. 2014 and has started observation of rainfall at high latitude regions up to 66 degrees north. Advanced Land Observing Satellite-2 (ALOS-2) carries the L-band synthetic aperture radar (PALSAR-2) and was launched in May 2014. PALSAR-2 is a successor of PALSAR onboard ALOS satellite and is now acquiring various observation data for cartography, regional observation, disaster monitoring, and resource surveys. In 2017 JAXA will launch the Global Change Observation Mission-Climate (GCOM-C) which carries multi-spectral optical radiometer named Second Generation Global Imager (SGLI). SGLI has special features of wide spectral coverage from 380nm to 12 μ m, a high spatial resolution of 250m, a field of view exceeding 1000km, two-direction simultaneous observation, and polarization observation. The GCOM-C mission aims to improve our knowledge on the global carbon cycle and radiation budget through high-accuracy observation of global vegetation, ocean color, temperature, cloud, aerosol, and snow and ice. Those EO series satellites of JAXA will contribute to understanding the mechanism of the Arctic climate changes.

Seedbank recruitment windows of opportunity in thaw slump thermokarsts near Toolik Lake, Alaska

***Huebner, Diane C.** and Bret-Harte, Marion S.

As the Arctic warms, erosional disturbances due to permafrost thaw (thermokarst) are observed with increasing frequency, yet plant reproductive responses in cryo-disturbed tundra are not well understood. Understanding plant reproductive mechanisms is a key component to Arctic studies, and thermokarsts may help explain how some arctic plants find windows of opportunity to recruit new populations from seed. Increased tundra shrubification over the last 50 years coincides with arctic climate warming and tall (>1m) deciduous shrubs forming dense colonies inside thermokarst scars. Thermokarsts provide ground free of competing vegetation, deep active layers, and high soil moisture. Under such conditions, seedlings can potentially germinate and establish new populations. In 2012-2013, I measured standing seedling cover and germination capacity of surface soil seedbanks in thermokarst lobes of different ages at two sites near Toolik Lake, Alaska. Standing seedling cover was positively correlated with deeper active layers and exposed mineral soil, and negatively correlated with increased vegetative cover. Germination trials demonstrated significantly higher germination of thermokarst seedbanks versus seedbanks from undisturbed tundra. Percent germination at one site was 1.3 to 5 times greater in the younger themokarst lobe compared to older lobes and undisturbed tundra, but percent germination was unrelated to seedbank size. Live seedling presence and seedbank germination capacity differences in thermokarsts over time demonstrate dynamic processes that may promote greater recruitment and establishment of plant populations from seed in a warming Arctic.

AMBON (Arctic Marine Biodiversity Observing Network)

***Iken, Katrin**; Grebmeier , Jacqueline; Danielson, Seth; Hopcroft, Russ; Cooper ,Lee; Mueter, Franz; Kuletz, Kathy; Stafford, Kate; Collins, R. Eric; Moore, Sue; Bluhm, Bodil A. and Bochenek, Robert

In November 2014, the National Ocean Partnership Program sponsored three Marine Biodiversity Observation Networks (MBON) as demonstration projects for such an operational and sustainable network on regional, national and global levels. One of these projects is the Arctic Marine Biodiversity Observing Network (AMBON) with focus on the Chukchi Sea continental shelf, funded through an interagency agreement between NOAA, BOEM and Shell Industry. AMBON closes some taxonomic gaps by sampling biodiversity from microbes to whales, it builds on and integrates with existing data, and continues ongoing time series sampling. This work provides important information for scientists, decision makers, resource managers, industry, and other stakeholders with essential data through a publicly accessible database. Beyond the regional scale, AMBON works as a global initiative through links to the Group of Earth Observations – Biodiversity Observing networks (GEO BON). Examples for the international links are the Circumpolar Biodiversity Monitoring Program (CBMP), a working group of the Arctic Council's Conservation of Arctic Flora and Fauna (CAFF), the pole-to-pole BON initiative, BON in a box, and others. Here we present examples on how the AMBON project contributes to biodiversity monitoring networks from regional to global scales.

Indian efforts on Arctic Aerosol Research: Current status and Future plan

***Mukunda, M. Gogoi** and Babu, Suresh S.

In view of the increased concern on the climate change related issues in polar environment, development of research infrastructure, observations and mitigation strategies are vital, especially over the Arctic. Arctic, being an integral part of the global climate system, the long-term monitoring and research of atmospheric aerosols and their interaction with radiation, cloud and cryosphere holds global relevance, besides providing a background condition against anthropogenic emissions. In this context, India has extended the concerted efforts on polar aerosol measurements, enriching its decades of experiences and instrumentations in operating a network of aerosol observatories (ARFINET) over India. The present study over the Svalbard region of Norwegian Arctic, employing data over a period of 5-years have shown a consistent spring-time enhancement in both scattering and absorption coefficients, leading to high columnar aerosol loading. It is found that long-range transported biomass burning aerosols contribute as high as 25% to the high aerosol absorption in spring. On the other hand, the influence of local activity in the region are pronounced during summer affecting the near surface aerosol absorption. In a global perspective, the seasonal variations of atmospheric BC concentrations at Arctic are similar to those seen at the high altitude Himalayas; even though the concentrations are much lower at Arctic. In near future, collaborative programs of ground based measurements and improvement on satellite monitoring will put additional arms to study the direct effect of aerosols. In addition to this, comparative study on the influence of aerosols in changing planetary Albedo due to their interaction with cloud and snow over the polar and tropical environments will improve our understanding on aerosol indirect effects.

Sediment plumes: a remote method of detecting meltwater discharge from marine terminating glaciers

***Darlington, Eleanor F**. and Hodgkins, Richard

Marine terminating glaciers form a dynamic interface between terrestrial ice and tidal fjord waters. Through interactions with both the atmosphere and ocean, dramatic changes have been observed in marine terminating glaciers, affecting their dynamic stability at annual timescales. They affect much of the northern terrestrial cryosphere and due to discharging meltwater directly into fjords, they have major implications for sea level rise. Therefore, understanding their behaviour, and how this may change under future climate scenarios, is of great societal importance. Yet obtaining high-resolution data sets of both the cryospheric and oceanic elements of marine terminating glaciers is impeded by logistical constraints: access to glacier termini is difficult owing to ice melange in fjords, active iceberg calving and the high costs associated with extensive field campaigns. Monitoring sediment plumes, which are discharged from the grounding line of marine terminating glaciers, have shown to be a valuable tool for investigating meltwater discharge. This is achieved by calibrating MODIS satellite images with in-situ measurements of spectral reflectance and total suspended solids. Such a method extends spot in-situ field measurements over large spatial scales and increases temporal insights to >10 years. Recent work in Svalbard and Iceland has provided a measure of the seasonal and interannual variability of meltwater discharge. In addition, links between melt production at the glacier surface and discharge can be drawn. This has been achieved by relating measured and modelled surface melt to the sediment plume extent. These results have highlighted that hydrological signals can be remotely detected. Such remote monitoring is an evolving technique, which addresses many of the constraints associated with working in such a dynamic environment. To fully determine the potential of sediment plume studies, further field locations are required for calibration measurements. Previous up-scaling efforts in Greenland reveal that in-situ measurements are key in forming strong calibrations and an accurate measure of meltwater discharge. Additional study sites for calibration measurements would assist in forming a more accurate pan-Arctic assessment of meltwater discharge from marine terminating glaciers.

Application of IASOA circumpolar observations in studies of atmospheric transports into and out of the Arctic

***Vihma, Timo**; Uttal, Taneil; Walden, Von; Cox, Christopher; Starkweather, Sandy; Makshtas, Alexander and Key, Jeff

The International Arctic Systems for Observing the Atmosphere (IASOA) is an International Polar Year legacy consortium that focuses on coordinating measurements of the Arctic atmosphere collected at ten observatories in the U.S., Canada, Russia, Norway, Finland, and Greenland. The IASOA data portal and collaboratory process support thematic expert groups that work towards common goals for utilizing interoperable data products across the observatories. In addition to detailed surface observations and upper-air radiosonde program, some of the IASOA observatories collect information on the vertical profiles of moisture, cloud boundaries, cloud water/ice contents, and aerosols using radars, lidars ceilometers and radiometers. Collectively the IASOA network provides a unique source of information that can be utilized in order to provide the best possible empirical estimates of the horizontal atmospheric transports of momentum, heat, moisture, cloud water, cloud ice, and aerosols into and out of the Arctic Ocean region. These can be used in turn to support the evaluation of atmospheric reanalyses, weather and climate models, and satellite remote sensing products, and subsequently studies on the interaction between the Arctic and lower latitudes including the role of mid- and low-latitude forcing on the Arctic amplification of climate warming and the effects of Arctic changes on mid-latitude weather and climate. In addition, the IASOA data are valuable for the evaluation of gridded products (reanalyses, models, and satellite data) with respect to Earth surface variables, such as snow depth, soil moisture, surface temperature, radiative fluxes, albedo, as well as turbulent fluxes of sensible heat, latent heat, CO2, and CH4. Evaluation of surface fluxes is a vital to complement the evaluation of horizontal transports. These together will yield a comprehensive assessment of the quality of available gridded products in representing atmospheric budgets of heat, moisture, greenhouse gases, and aerosols in the Arctic. The IASOA thematic study will be a unique approach as Arctic transport studies have so far been addressed without full utilization of direct observations; it is expected that this activity will directly support the objectives of global initiatives such as the WMO Year of Polar Prediction (YOPP).

Improving sea ice predictions along the Northern Shipping Route using observation data

***Mudunkotuwe, Dulini Yasara**; De Silva, Waruna Arampath and Yamaguchi, Hajime

We have improved the accuracy of sea ice predictions in the Arctic Ocean by assimilating sea ice variables in an ice-ocean coupled model. Accurately predicting sea ice conditions is essential to safely navigate along the Northern Shipping Routes (NSRs). The ice-ocean coupled model (Ice-POM) we have developed accommodates middle and high resolutions (25 kms and 2.5 kms). The ice model in Ice-POM reflects the ice discrete characteristics along the ice edge area. The ocean part of ice-ocean coupled model is a primitive equation model based on Princeton Ocean Model (POM). However, the results of the model only predictions are bound by the uncertainties in initial conditions and forcing data. To minimize these uncertainties, sea ice concentration, sea ice thickness and sea ice velocity were assimilated in this study. Sea ice observations were obtained from AMSR2-data sets. The assimilation method that was used is an improved nudging method that minimizes the observation errors and model errors. As a result of assimilation, the ocean conditions have been greatly improved. This was evident in resulting ocean salinity and ocean temperature. Compared with the other assimilated variables, sea ice concentration assimilation could yield better results. The ice extent and ice thickness are also improved by assimilation and are not identical to the observations. The assimilation time interval was also altered in daily weekly, monthly and yearly intervals. Weekly assimilation could also produce better results compared to the model only predictions.

Arctic sea ice camp study for observing suspended materials

***Ha, H.K.**; La, H.S.; Son, E.Y. and Im, J.

A series of the short-term (1-4 days) sea ice camp has been performed on the drifting Arctic sea ice in summer of 2011, 2014 and 2015. The mooring package comprises the acoustic Doppler velocity profiler (ADCP), laser holographic camera, and conductivity-temperature-depth profiler, which are used to understand the dynamic behavior of sea ice and spatial-temporal variation of suspended materials under the sea ice. The acoustic backscatter observed by the acoustic Doppler current profiler and beam attenuation from transmissometer revealed the increased concentration of suspended particulate materials in the mixed layer. Also, it was found that a clear diel vertical migration from 20- to 40-m depth under sea ice following a daily cycle of solar radiation.

Introduction of “Long-term plan for Arctic Environmental Research”

***Kodama, Yuji**; Enomoto, Hiroyuki; Yamanouchi, Takashi; Ohata, Tetsuo and Ikeda, Motoyoshi

More than 140 JCAR members and scientists joined in writing and proof-reading. The planning, writing, reviewing and publishing took more than 1.5 years. It was completed in September 2014. Four research subjects were chosen to be attacked next 10-20 years: 1) Elucidation of abrupt environmental change in the Arctic associated with the on‐going global warming, 2) Elucidation of environmental change in relation to biodiversity, 3) Broad and important subjects on the Arctic environment, and 4) Development of methods enabling breakthroughs in environmental research. Necessary networks and infrastructures, and improvement of research foundation are also revealed. Each subject has review, several scientific questions and their justification.

Sustainable seamless monitoring in the Arctic

***Kodama, Yuji**; Enomoto, Hiroyuki and Yamanouchi, Takashi

Research monitoring of the Arctic environment has been carried out as two elements, remote sensing including satellite and in situ observation. Environmental change in the Arctic is important with regard to its influences in global scale. However, in situ field observations are hampered by the harsh environment of the Arctic, resulted in the sparseness of observing stations and large areas with no data. Although, due to the recent progress, satellite monitoring has been producing new information, there are still many factors that need to be observed in situ. The most important point of monitoring is to collect continuous and representative data. International cooperation is essential in implementation of the continuous and high density measurements, and Japan must be ready for playing a major role. This report is extracted and moderated from “Long-term Plan for Arctic Environmental Research” published by Japan Consortium for Japan Consortium for Arctic Research.

The Ozone Hole and World Avoided

Newman, Paul A.; Chipperfield, Martyn P.; Manney, Gloria L.; Simpson, William R. and ***Collins, Richard L.**

The depletion of the stratospheric ozone layer is one of the major environmental issues of modern times. In 1974, Molina and Rowland suggested that man-made chlorofluorocarbons (CFCs) could deplete ozone. This finding was followed by an intense research effort that solidified scientific understanding of ozone depletion. The discovery of the Antarctic ozone hole in 1985 accelerated ozone research activities, and policy makers responded by agreeing to the Montreal Protocol in 1987. Because of the Montreal Protocol, CFCs and other ozone-depleting substances (ODSs) have been slowly declining since the mid-1990s, and the ozone hole is predicted to disappear by about 2070. In this poster we consider what would have happened to the ozone layer if ODSs had not been regulated. We show results from a "world avoided" model simulation where the ozone layer is steadily destroyed through the twenty-first century as levels of ODSs continue to increase. By 2065, two-thirds of the ozone layer has been depleted, and large ozone depletions occur year-round in the polar regions. We then present results from studies using the observed meteorology of the past two decades that show that by 2013 the Montreal Protocol had already achieved significant benefits for the ozone layer and ultraviolet exposure. While presenting the results of these studies over the entire globe, we highlight the effects in the Arctic.

Ozone Loss and Ozone Holes in the Arctic

Manney, Gloria L.; Rex, Markus; Simpson, William R. and ***Collins, Richard L.**

Chemical destruction of ozone occurs in both the Antarctic and Arctic during the winter and spring. Each year in the Antarctic there is complete removal of ozone in the lower stratosphere and the formation of an ozone hole. In the Arctic, ozone loss varies significantly from year-to-year and is much more limited. This contrast arises from the difference in meteorology between the Antarctic and Arctic: the Antarctic polar vortex is stronger, larger, colder and more persistent than that in the Arctic. However, in spring 2011 there was unprecedented ozone loss in the Arctic. Unusually long-lasting cold conditions led to a persistent enhancement of ozone-depleting substances (ODSs) with loss of over 80% of the ozone in the lower stratosphere. Chemical ozone loss in 2011 reached a level that was identifiable as an Arctic ozone hole. Despite temperatures that are significantly higher than those in Antarctic winter, Arctic chemical ozone loss in 2011 rivaled that in some Antarctic ozone holes. The impact of the Artic ozone hole on human health is increased by the possibility of it moving over densely populated regions in the mid-latitudes as it did in 2011. In this poster we present results from recent studies that document meteorological conditions that give rise to ozone loss in the Arctic and highlight the conditions that contributed to the unprecedented Arctic ozone loss in 2011. We discuss these results in in relation to the large variability in, and unpredictability of Arctic meteorological conditions.

Observing the Arctic Ozone Layer, Stratosphere, and Mesosphere

Simpson, William R.; ***Collins, Richard L.**; Li, Jintai; Triplett, Colin; Harvey, V. Lynn; Petropavlovskikh, Irina; McConville, Glen; McPeters, Richard D. and Evans, Robert D.

The wintertime meteorology of the Arctic stratosphere and mesosphere is highly variable. Warm winters with little ozone loss are found following cold winters with significant ozone loss. This variability in the meteorology remains a major challenge to our current understanding of the atmosphere. Understanding this meteorology requires documenting both the dynamical processes and chemical species. In this poster we draw on observational studies at the University of Alaska Fairbanks to illustrate how studies of the ozone layer and the associated meteorology of the stratosphere and mesosphere are conducted. We highlight both the unique aspects of the meteorology in the Arctic and how the Arctic provides a natural laboratory for understanding meteorological processes globally.

Analysis of the Spatiotemporal Dynamics of Wildfire Activity in the Tundra Biome Using MODIS Data (2001-2015)

***Masrur, Arif** and Petrov, Andrey

Climate change has increased the area affected by wildfire events in different parts of the Arctic. Recent studies suggest an exacerbated wildfire scenario both for the boreal forests and tundra. Although tundra wildfires have an important impact on Arctic ecosystems, there is comparatively little knowledge about their geography and characteristics. Since tundra vegetation is very slow to recover, wildfires can substantially alter the biomass and animal abundance in affected areas. This study uses MODIS-derived active fire data to analyze spatial and temporal patterns of tundra wildfires between 2001 and 2015. The dataset incorporates locations of active fire events and estimates of fire radiated power. The tundra wildfires exhibit seasonality with most fires occurring in July and August. We observed inter-year fluctuations when a fire season either started earlier (in June) or lasted longer (in to September). In terms of spatial distribution, the wildfires demonstrate a strong tendency to cluster, although year-to-year locations of clusters vary. In near future, we will analyze possible bio-climatic (using MERRA climate reanalysis) factors that determine spatiotemporal variation of arctic wildfires occurrence and intensity. Finally, we intend to develop a real time and predictive model to estimate the amount of carbon emission with these arctic tundra wildfire events.

Covariance between atmospheric state regimes, Arctic low clouds, and sea ice

***Taylor, Patrick**; Kato, Seiji; Xu, Kuan-man and Cai, Ming

How do clouds respond to variations in sea ice? The answer to this question depends significantly on the characteristics of the Arctic circulation. Sea ice-cloud interactions are important for modeling the Arctic climate. Specifically, understanding the cloud response to sea ice change is necessary for understanding the Arctic surface radiation budget. Previous work has primarily addressed this problem from the interannual variability perspective. A novel perspective of sea ice-cloud interactions in the Arctic is provided here through a satellite footprint-level quantification of the covariance between sea ice and Arctic low cloud properties from NASA A-Train active remote sensing satellite data. The influence of atmospheric state on the cloud field must be considered. The covariance between Arctic low cloud properties and sea ice concentration is quantified by first partitioning each footprint into one of four atmospheric regimes defined by thresholds of lower tropospheric stability and mid-tropospheric vertical velocity. A statistically significant covariance between cloud fraction, cloud liquid water, cloud ice water, cloud total water and their vertical distributions is found with sea ice concentration in each atmospheric regime and season. Results indicate, however, that magnitude of any cloud response to changes in sea ice concentration is at least an order of magnitude smaller than the response of clouds to a change in the atmospheric dynamic and thermodynamic state. The results indicate that the atmospheric dynamic and thermodynamic environment is the most important factor determining the cloud influence on the surface radiation budget and therefore sea ice variability. Lastly, the cloud-sea ice interaction is evaluated in CMIP5 Historical simulations. The results suggest that climate models simulate a cloud response to a change in sea ice that is stronger than observations and that the offset of the surface albedo feedback by an increase in Arctic cloudiness is likely too strong.

Surface Currents on the Northeastern Chukchi and Western Beaufort Sea Shelves as Detected by High Frequency Radars

***Potter, Rachel**; Fang, Ying-Chih; Statscewich, Hank and Weingartner, Thomas

High-resolution high-frequency radar (HFR) measurements of surface currents during the open water season in the northeastern Chukchi Sea and, more recently, the western Beaufort Sea have revealed enormous spatial and temporal complexity in the surface circulation. This variability is associated with the Alaskan Coastal Current within Barrow Canyon and its interaction with the flow over the western Beaufort Sea shelf, as well as eddies and fronts over the Chukchi Sea shelf. In the Chukchi, HFR suggests a front along 71.5°N, that likely separates summer Bering Sea water from ice meltwater that has not been entirely flushed from the region. North of the front the water column is heavily stratified, and the circulation is typically weaker and more variable in direction than the more easterly (and less stratified) flow south of this latitude. This eastward flow feeds central shelf waters toward Barrow Canyon and appears to persist even under westward winds that are <6 m/s. Moored data suggest that the HFR measurements reflect flow throughout the water column in unstratified areas, while in heavily stratified regions, the HFR velocities are a good proxy for flow in the upper 20 m of the water column occupied by the meltwater. At the juncture of the Chukchi and Beaufort seas the northeastward Alaskan Coastal Current flow emanating from the Chukchi shelf interacts with the typically westward flow on the Beaufort shelf to form a number of complex circulation features. These often include an anticyclonic eddy offshore of Cape Simpson where historical observations indicate that bowhead whales often feed. The eddy may aggregate zooplankton and thus enhance the feeding efficiency of bowheads in this region.

Satellite and ground-based monitoring of terrestrial ecosystem structure and phenology in Arctic and sub-Arctic regions

***Kobayashi, Hideki**; Yang, Wei; Yunus, Ali; Nagai, Shin; Ono, Yuhsaku; Sugiura, Konosuke; Nasahara, Kenlo; Kim, Yongwon; Van Dam, Brie; Nagano, Hirohiko; Zona, Donatella; Harazono, Yoshinobu; Bret-Harte, M. Syndonia; Ichii, Kazuhito; Ikawa, Hiroki; Iwata, Hiroki; Oechel, Walter; Ueyama, Masahito and Suzuki, Rikie

In the Arctic and sub-Arctic regions, the increased trend in surface temperature in the region over the past decade is twofold higher than that in the whole northern hemisphere. It is of particular interest whether the carbon uptake by terrestrial vegetation increases or decreases due to the change in ecosystem structure and phenology under climate change. Observation of plant phonological events (start of growing season (SOS), end of growing season (EOS), and growing season length) and boreal forest overstory and understory structure (e.g. leaf area index) provide essential information on how terrestrial vegetation responds to climate changes. In this presentation, we emphasize two important items regarding the terrestrial vegetation monitoring: leaf development (leaf area index) and seasonality (phenology). Because most of boreal forests are sparse, the influence of forest floor vegetation cannot be negligible and separate monitoring of forest overstory and understory, therefore, are desirable. We have been developing two independent algorithms of overstory and understory leaf area index in two distinct boreal forests (larch and black spruce). We show some preliminary results of overstory leaf area index map in North Americas spruce and Siberian larch. Regarding the monitoring of plant seasonality, we quantified the latitudinal gradients (61 to 71 deg-N) of SOS and EOS from satellites (Terra-MODIS and SPOT-VEGETATION) and time-lapse camera images and found that they were consistent. The satellite-derived SOS and EOS were 3.5 to 5.7 days degree-1 and -2.3 to -2.7 days degree-1, which corresponded to the spring (May) temperature sensitivity of -2.5 to -3.9 days/°C in SOS and the autumn (August and September) temperature sensitivity of 3.0 to 4.6 days °C-1 in EOS.

The AOOS Arctic Data Portal: A Gateway to Contemporary and Historical Arctic Data Resources, Analysis and Visualization Tools

***Janzen, Carol D**.; McCammon, Molly; Dugan, Darcy; Bochenek, Rob and Koeppen, Will

One key effort by the Alaska Ocean Observing System (AOOS) since its inception in 2004 has been to develop and provide the infrastructure necessary to support a centralized regional data assembly center (DAC) with web-based analytical and visualization tools and products. The AOOS Ocean Data Explorer, available on the AOOS website (http://www.aoos.org), successfully acts as the key data portal exchange for the entire Alaska State region, and is extending its coverage beyond international boundaries, particularly in the Arctic. It serves real-time, contemporary and historical data assets from international, federal, state, and regional governmental programs, as well as research and observing activities conducted by private industry (oil and gas, shipping and fishing), non-governmental organizations and international research cooperatives. It also acts uniquely as a data conduit and archive for community based observing groups including those incorporating traditional knowledge. With additional funding from NOAA, AOOS and partners developed data visualization tools specifically for Alaska's Arctic, helping lead to the development of the Arctic Data Integration Portal (an enhanced subset of the Ocean Data Explorer). The portal uses an Arctic specific data layer catalogue that links to a library of regional data resources, and provides users access to an interactive tool that can be used to graphically explore individual data sets with a mouse-controlled "virtual sensor." The Arctic Portal provides access to over 200 data layers, with resources continually being added, including data from international programs such as the Russian-American Long Term Census of the Arctic. A demonstration of the AOOS Arctic Portal capabilities are provided in this presentation, but can also be instantly experienced at the AOOS website Arctic Portal link (http://portal.aoos.org/arctic).

Arctic-UNified Integrated Observing Network (Arctic-UNION)

Karcher, Michael; ***Wilkinson, Jeremy**; et al.

In the light of the historic COP21 Paris Agreement the need to monitor Arctic change is needed now more than ever. However at present a coherent and well-integrated pan-Arctic observing system does not exist. The good news is that many of the pieces that will eventually make up this observing system are present in some shape or form, but they need to be brought together. We present a proposed programme of work that addresses the recent call by the European Union regarding "An integrated Arctic observation system". Our programme of work, entitled Arctic-UNION (Arctic-UNified Integrated Observing Network), will collaborate with the established national and international organisations to ensure that in the spirit of cooperation we can identify and fill gaps in the network so that a sustainable pan-Arctic observing system becomes a reality. Our poster describes our vision and work structure within Arctic-UNION proposal.

The Fram Strait Arctic Outflow Observatory

Dodd, Paul A.; de Steur, Laura; Granskog, Mats; Fransson, Agneta; Chierici, Melissa; Pavlov, Alexey and ***Gerland, Sebastian**

Fram Strait is the largest gateway and only deep connection between the Arctic Ocean and the subpolar oceans. Monitoring the exchanges through Fram Strait allows us to detect and understand current changes occurring in the Arctic Ocean and to predict the effects of those changes on the Arctic and Subarctic climate and ecosystems. Polar water, recirculating Atlantic Water and deeper water masses exported from the Arctic Ocean through western Fram Strait are monitored year-round by an array of moored instruments along 78°50'N, continuously maintained by the Norwegian Polar Institute since the 1990s and complimentary annual hydrographic sections have been repeated along the same latitude every September. Biogeochemical tracer measurements along repeated sections are used to identify freshwater from different sources and reveal the causes of variations in total volume of freshwater exported e. g.: pulses of freshwater from the Pacific. Recently, coloured dissolved organic matter (CDOM), dissolved organic carbon (DOC) and inorganic carbon parameters, such as alkalinity (TA) and total dissolved inorganic carbon (DIC) have been collected to determine the composition of carbon and ocean acidification state in waters exported from the Arctic Ocean. Upward looking sonars (ULS) provide continuous monitoring of the sea-ice thickness across the array. These reveal significant inter-annual variability in ice export as well as a shift between dominant ice thickness classes with a strong reduction in thickness of older deformed ice. ULS measurements are complemented by in situ measurements of sea ice and snow thickness and physical properties. Recently, additional airborne sea ice thickness surveys have given new insights into the regional thickness distribution and local gradients in thickness. After a discovery of warm water near the 79N glacier in 2012/14, ocean-glacier interaction has also become a theme within the observatory. This poster gives an overview of recent highlights.

Supersite for eco-hydrological observations at Poker Flat Research Range, Alaska

***Suzuki, Rikie**; Kim, Yongwon; Kobayashi, Hideki; Nagai, Shin; Saito, Kazuyuki; Sugiura, Konosuke; Iwahana, Go and Busey, Robert

This poster introduces the supersite for eco-hydrological observations at Poker Flat Research Range (PFRR) located about 35km northeast from Fairbanks city that was established by the collaboration study between Japan Agency for Marine-Earth Science and Technology (JAMSTEC) and International Arctic Research Center (IARC), University of Alaska Fairbanks (UAF) (JAMSTEC-IARC Collaboration Study: JICS). A 17m scaffold tower (called JICS tower), equipped by sensors for general meteorological measurements and fluxes in the atmospheric boundary layer, was constructed in the black spruce forest of PFRR in 2010. The sensible and latent heat fluxes are monitored at two levels: above the forest canopy by the JICS tower and on the forest floor by the tripods. Snow, precipitation, and soil temperature/moisture were continuously monitored. A distributed temperature sensing (DTS) system with fiber optics monitors spatially continuous surface and ground temperatures. The floor-level carbon dynamics are monitored with the automated open/close chamber (AOCC) system that has 16 chambers. Tree census survey was conducted at the 30m x 30m quadrat of the black spruce forest near the JICS tower in 2010 and 2014 to delineate the forest structure. This supersite also plays a role in acquiring the ground-truth for satellite remote sensing. The spectral reflectance of the leaf and the stem of black spruce tree and plants on the forest floor were measured for validating the satellite-sensed spectral reflectance. The forest landscape is being monitored by the automatic digital fisheye lens camera installed on the top of the JICS tower with 3 hours interval. These biogeochemical observations are integrated with the hydro-meteorological observations of the supersite, and data are utilized for the study of biogeochemical modeling. The knowledge, understandings, and data which are created based on the supersite observations are enhancing the eco-hydrological study on Arctic climate system.

Intercomparison study between a regional climate model, two versions of the 20CR reanalysis, and surface-based observations on Franz Josef Land during the Early Twentieth Century Warming

***Wyszyński, Przemysław**; Klaus, Daniel; Dethloff, Klaus; Przybylak, Rajmund; Rinke, Annette and Handorf, Dörthe

The HIRHAM5 regional climate model, developed at the Alfred Wegener Institute (AWI), with its pan-Arctic domain (including most areas north of 60N) was initialized and run over the time period from January 1, 1915 to December 31, 1940 with 6-hourly "NOAA-CIRES Twentieth Century Global Reanalysis Version 2" (20CRv2) forcing at the lateral boundaries. Sea-ice concentration and sea-surface temperature were prescribed based on daily 20CRv2 fields. Historical surface-based observations for the Arctic were collected and transcribed by Nicolaus Copernicus University (NCU) within various data-retrieval projects (e.g. AWAKE, AWAKE-2, ArcRu). With the aid of the 6-hourly HIRHAM5 model output, 20CRv2 reanalysis data, and surface-based observations carried out at Franz Josef Land stations, e.g. Tikhaya Bay (52.8E, 80.32N), the reproducibility of the early Arctic warming has been checked. Both the model and reanalysis have been evaluated by comparison with the measured sea level pressure, 2m air temperature, 2m specific humidity, and 10m wind speed. More importantly, the vertical baroclinic structure of the atmosphere has been analyzed by use of radiosonde data that have been acquired in the framework of ERA-CLIM. Finally, the upgraded Twentieth Century Global Reanalysis dataset (20CRv2c), has been also taken into account. The latter was improved not only by assimilating additional surface pressure data (e.g. from Teplitz Bay 1899-1900, provided by NCU) but also by using the Centennial Observation-Based Estimates of SST version 2 (COBE-SST2) instead of the Hadley Centre Sea Ice and Sea Surface Temperature data set (HadISST1.1) to prescribe sea-surface temperature and sea-ice concentration. It can be expected that HIRHAM5 performs equally well as the 20CRv2 data, but it is unclear whether the model is even able to reproduce the station observations with the same quality as the improved 20CRv2c (corrected 20CRv2) reanalysis data. If the model has the skill to perform comparably or even better than 20CRv2c this might give evidence of a more realistic simulation of Arctic clouds, which will be checked as well. Acknowledgements: The research work was supported by a grant funded by the National Science Centre by decision No. DEC-2012/07/B/ST10/04002.

Observing lake ice regime changes on Alaska's coastal plain with synthetic aperture radar (SAR)

***Engram, Melanie J.**; Arp, Christopher D. and Jones, Benjamin M.

Since the late 1970's, radar remote sensing has been a useful tool to determine whether or not lake ice is frozen to the lake bed (bed-fast) or whether liquid water remains under the ice all winter (floating ice), because radar return from bed-fast ice is low and from floating ice is radar return is high. The advent of space borne synthetic aperture radar (SAR) platforms in the early 1990's has facilitated repeated observations of lake ice regimes on a landscape scale. Lake ice regime changes can impact winter water supply, overwintering fish habitat, heat exchange, and permafrost integrity in the Arctic landscape. Our research using SAR observations is aimed to determine if lake ice shows any thinning or thickening trends, if lakes that froze to the bottom in the early 1990's still freeze to the bottom, and whether the percentage of bedfast ice and floating ice has changed over the years. We used C-band SAR from five satellites: ERS-1/2, RADARSAT-1/2, and Sentinal-1, spanning 1992-2016 to examine a time-series of lake ice regimes in five areas of the Alaska Arctic Coastal Plain. Lakes in these areas have been targeted by the Circum-Arctic Lake Observation Network (CALON) and Arctic Lake Ice Systems Science (ALISS) researchers for field measurements of ice thickness and water depth since 2011, supplying ground truth measurements for SAR remote sensing validation.

Design of hydrothermal and biogeochemical observation network in Northeastern Siberia

***Park, Hotaek**; Iijima, Yoshihiro and Fedorov, Alexander

The Northeastern Siberia is characterized by significant changes associated to recent climate changes. Two Institutes, JAMSTEC (Japan) and MPI (Russia), have been cooperating long-term joint research using observational network over the northeastern Siberia to assess changes in land surface processes over the region. Our long-term observations revealed that permafrost environment in the northeastern Siberia have clearly degraded, resulting in wetting climate. The humidified permafrost environment likely causes a number of changes in hydrological and biogeochemical processes in that region. To quantify the permafrost related changes, we are planning a research of both vessel cruises sampling water along Lena River and installation of new observation sites at boreal–tundra transition zone to monitor vertical profiles of soil temperature, moisture, physical and thermodynamic properties, and carbon contents. The expanded network enables us to increase our knowledge on the spatial and temporal changes in permafrost and landscape, including meteorological and hydrological conditions along boreal-tundra transition zone in Lena River. The observational data will be combined with historical observational data in Russia, consequently contributing the improvement of land surface process model in terms of physical and biogeochemical processes. The joint research will reduce uncertainties in the model for regional estimation on current and future changes in freshwater fluxes in relation to permafrost and land surface changes in boreal-tundra transition zone.

Observations from field to space: a new integrated high-latitude hyperspectral laboratory for surface water and vegetation characterization in Alaska's Arctic and boreal regions

***Cristobal, Jordi**; Buchhorn, Marcel; Prakash, Anupma and Graham, Patrick

Alaska's Arctic and boreal regions, largely dominated by tundra and boreal forest, are witnessing unprecedented changes in response to climate warming. However, the intensity of feedbacks between the hydrosphere and vegetation change are not yet well quantified in the Arctic regions. This lends considerable uncertainty to predictions of how much, how fast, and where the Arctic and boreal hydrology and ecology will change. Also unknown is how vegetation change will impact water resources and climate dynamics in Arctic and boreal Alaska. With a very sparse network of observations (meteorological, flux towers, etc) in the Alaska Arctic and boreal regions, remote sensing is the only technology capable of providing the necessary quantitative measurement for surface water and vegetation monitoring from local to global scales in a feasible economic way . Over the last decades, the University of Alaska Fairbanks (UAF) has become the research hub for high-latitude research. UAFs newly established Hyperspectral Imaging Laboratory (HyLab) currently provides field observations, acquisition and processing of multiplatform airborne and satellite multispectral and hyperspectral remote sensing as well as ecological modelling to help unravel seasonal and spatio-temporal variability in surface water and energy balances and vegetation biophysical properties from local to global scales Arctic and boreal regions. More information is available at http://www.hyperspectral.alaska.edu.

Comparative study in forest soil properties among circumpolar regions

***Matsurua, Yojiro**; Ono, Kenji; Fujii, Kazumichi; Noguchi, Kyotaro; Makita, Naoki; Morishita, Tomoaki and Toriyama, Jumpei

We estimated soil organic carbon (SOC) storage and analyzed the relationship between SOC and C/N ratio in circumpolar forest ecosystem soils. Broad patterns of SOC and C/N were regulated by past geological processes and the origin/nature of soil parent materials. The combinations of forest type and permafrost condition were i) larch (deciduous conifer) dominant forest on continuous permafrost, ii) black spruce dominant forests on continuous/discontinuous permafrost, iii) pine/spruce dominant forests on sporadic/non-permafrost regions. iv) pine/spruce forests on permafrost-free regions, including peatland forests. Estimated SOC and CN ratio were varied among regions. SOC storage regime in larch forests on continuous permafrost in eastern and central Siberia is larger than those of other regions. The lacking of glacier ice sheet in Pleistocene era and development of deep permafrost may be critical environmental condition to affect forest dominant type and SOC storage regime. Upland soils derived from weathered rock fragment have higher C/N than those of deposit origin soils in plain topography.

N-ICE2015: Observational study on drifting Arctic sea ice north of Svalbard from winter to summer

Steen, Harald; Granskog, Mats A.; Duarte, Pedro; ***Gerland, Sebastian**; Hudson, Stephen R.; Smedsrud, Lars H. and Spreen, Gunnar

The Arctic Ocean is shifting to a new regime with on average less, thinner and younger sea ice. During autumn and winter, freezing temperatures form the sea ice. Atmospheric and oceanic forcing as well as the insulating snow cover affect the sea ice growth. So far, maximum winter sea ice extent has not decreased as much as summer sea ice extent. Consequently, the older, thicker multi-year sea ice is replaced by a younger and thinner sea ice. The change of Arctic sea ice has substantial consequences for ecosystems, energy fluxes and ultimately the weather and climate. To study the effects of the changing Arctic the Norwegian Polar Institute launched from January to June 2015 the Norwegian Young Sea ICE cruise 2015 (N-ICE2015). N-ICE2015 was a multi-disciplinary cruise aimed at observing and studying the effect of the changing Arctic. Observations included simultaneous studies of processes and parameters related to ocean, sea ice, snow, atmosphere, ecosystems and water chemistry. The research vessel “Lance” was frozen into drifting sea ice north of Svalbard at about N83 E25, drifting passively with the ice until she was broken loose from the ice. In total four drifts were conducted. The second and third drifts started from the same area as the first drift, while the last drift took place in the marginal ice zone. RV “Lance” served as a living and working platform for the international team of scientists and engineers, observations and sampling was carried out, and measurement systems were set up above, on, in and beneath the sea ice. One aim of N-ICE2015 is to present a comprehensive dataset on the first year sea ice-dominated system available for the scientific community describing the state and changes of the Arctic sea ice system from freezing to melt. The relevance of N-ICE2015 and similar studies for Arctic observations will be discussed and highlighted.

GlobPermafrost – how space supports understanding of permafrost?

***Bartsch, Annett**; Grosse, Guido; Kääb, Andreas; Westermann, Sebastian; Strozzi, Tazio; Wiesmann, Andreas; Duguay, Claude and Seifert, Frank Martin

The GlobPermafrost project (2016-2019) develops, validates and implements information products to support the research communities and related international organisations like IPA and CliC in their work on understanding permafrost better by integration of EO data. Permafrost cannot be directly detected from space, but many surface features of permafrost terrains and typical periglacial landforms are observable with a variety of EO sensors ranging from very high to medium resolution in various wavelengths. Prototype cases will cover different aspects of permafrost by integrating in situ measurements of subsurface permafrost properties (active layer depth, active layer and permafrost temperatures, organic layer thickness, liquid water content in the active layer and permafrost), surface properties (vegetation cover, snow depth)and modelling to provide a better understanding of permafrost today. The techniques will extend point source process and permafrost monitoring to a broader spatial domain, to support permafrost distribution modelling and mapping techniques implemented in a GIS framework and will complement active layer and thermal observing networks. Initial user requirements have been gathered at the DUE-IPA-GTNP-CliC workshop in Frascati in February 2014, which have been further consolidated within the Permafrost community during 2014 in request of the WMO Polar Space Task Group. A subset of these requirements will be demonstrated within GlobPermafrost and assessed by user organisations: Circumpolar permafrost extend; permafrost dedicated land cover class prototype; local investigations around long term monitoring sites; regional transects for “hot spot” identification; and mountain permafrost areas. The initial observation scenario is presented, discussing challenges in methods as well as data availability.

An AON for Human Health: International Circumpolar Surveillance System for Infectious Diseases

***Hennessy, Thomas W.**; Bruce, Michael G.; Rudolph, Karen and Zulz, Tammy

Networks with a human health focus provide another dimension to Arctic Observing Systems. The International Circumpolar Surveillance (ICS) system is an endorsed project of the Arctic Council and was begun in 1999 as a network of hospital and public health reference laboratories throughout the Arctic and subarctic. The goal of ICS is to collect, compare and share uniform laboratory and epidemiologic data on infectious diseases among humans to assist with prevention and control efforts. ICS augments existing national disease surveillance systems and is an outgrowth of collaborations through the International Union for Circumpolar Health. We track five invasive bacterial pathogens of that are of public health importance because of high mortality or morbidity, emerging antimicrobial resistance that complicates treatment, or because vaccines are available or under development to control the infections. A quality control program was begun in 1999 among reference laboratories to ensure that identification, sub-typing and antimicrobial susceptibility testing is accurate and consistent across the system. In 2006, a tuberculosis surveillance working group was added and undertook a comparison of surveillance methods used and data available in each country. The ICS collaboration has led to aligned research collaborations on viral hepatitis, Helicobacter pylori (the causative agent for stomach cancer) and climate-sensitive zoonotic infections. Some notable successes of the ICS collaboration include: detecting a dispersed outbreak of invasive serotype 1 pneumococcal infections, characterization of a unique Arctic strain of Hepatitis b, and detecting the emergence of severe infections due to Haemophilus influenzae type A among Arctic indigenous children which has led to efforts to create a new vaccine. For nearly 2 decades, ICS has served as a prime example of an Arctic Observing Network for human health monitoring and collaborative action.

Ecosystem impact on thermal state of permafrost in Alaska

***Kholodov, Alexander**; Romanovsky, Vladimir; Natali, Susan and Loranti, Michael

To understand influence of ecosystem on thermal state of permafrost an examination of temperature differences between the air, ground surface and permafrost table was combined with ecosystem survey at the long-term monitoring sites. Two main indexes were calculated and analyzed. The first index (Dts) gives us information about the influence of snow during the snow-covered period. During the growing season, comparison of Dts in different ecosystems allows us to estimate insulation effect of canopy and surface vegetation and their input into the surface radiation balance. Combination of Dtal with measurements of soil physical properties and thickness of organic layer as well as organic content in mineral soil provides the data for an estimation of the relationship between active layer temperature and soil organic content. Results of our investigation show that highest gradient in system atmosphere – ground surface – permafrost corresponds to the above ground level (Dts). Difference between mean annual air and ground surface temperatures ranges from 1.5 to 9°C and is mostly caused by the warming impact of snow during winter season (Dts winter) which consists of 3 to 13°C. In the boreal forest zone the cooling effect of vegetation during the growing season (Dts summer) due to shading effect and surface insulation can be as high as -5°C, which is comparable in magnitude to snow influence. It leads to lower values of mean annual Dts in the boreal forest zone in comparison with tundra. Processes of heat transfer within the active layer generate negative mean annual temperature gradient between the ground surface and the permafrost table for all investigated ecotypes. This difference value varies from -2.8°C in boreal forest to -0.7°C in tundra and has strong positive correlation with carbon content in the active layer soil. In general, systems with higher bioproductivity show more resilience of permafrost thermal state.

What can bone steroid hormones tell us physiologically? A physiological look through time using Pacific walrus bone

***Charapata, P.**; Horstmann, L. and Misarti, N.

The Pacific walrus (Odobenus rosmarus divergens) is an iconic Arctic marine mammal that Alaskan Natives rely on as a food, economic, and cultural resource. A decrease in critical sea ice habitat and unknown population numbers have led to walruses being listed as a candidate for the Endangered Species Act, but there is no clear understanding of how walruses might be affected by climate change. In this study, steroid hormone concentrations (e.g., progesterone, testosterone, estradiol, and cortisol) from walrus bone collected over the past 3,600 years were analyzed to track potential fecundity and stress response changes throughout current and past climate warming events. Cortical bone preserves for thousands of years, has a low turnover rate (~3%/year), and contains lipophilic steroid hormones. Progesterone and estradiol were the primary factors contributing to significant differences among decades. Mean progesterone concentrations ranged from 783 (ng/g) in 2010s to 29,644 (ng/g) in 1960s. Mean estradiol concentrations ranged from 2,403 (ng/g) in 2010s to 6,148 (ng/g) in 1970s. Hormone concentrations in archeological walrus bones were similar to mean historical concentrations from various other decades. High progesterone and estradiol levels in the 1960s and 1970s correlate to a rapid increase in the walrus population during this period and may be indicative of high fecundity and calf production. Relatively low progesterone and estradiol concentrations in the current decade correspond to low fecundity and calf production that has been described throughout the recent literature and hunter observations. Our results give insight into past physiological resiliency of walruses and provide a new tool to track steroid hormone concentrations of marine mammals through time. Specifically, female reproductive hormones including progesterone and estradiol may prove to be a powerful walrus population monitoring and management tool.

Biocomplexity Nexus: Food and Contaminants along the Yukon River Watershed

***Duffy, Lawrence K.**

River watersheds are among the most complex terrestrial features in Alaska, performing valuable ecosystem functions and providing services for human society. Rivers are vital to both estuarine and aquatic biota and play important roles in biogeochemical cycles and physical processes. The functions of watersheds have been used as indicators for ecosystem health. The Yukon River watershed has a long history of human activity, but has not been given the holistic and interdisciplinary research attention of the other great American river systems. By using hypothesis based monitoring of key watershed functions, we can gain insights to regime shifting stresses such as fire on nutrients, toxins, invasive species and human resilience. The Yukon watershed provides a broad scale research opportunity for baseline study against which future change can be more accurately assessed.

Engaging rural communities in permafrost and climate monitoring in the Upper Kuskokwim region, interior Alaska

***Panda, Santosh K.**; Kholodov, Alexander; Dubay, Charlene and Hanson, Teresa

Alaska's land, water, plants, wildlife, and seasons are undergoing a great upheaval, and its people, especially the tribal communities living in remote villages are directly and severely impacted by these widespread environmental changes. Especially environmental changes occurring in and around the remote communities are directly affecting the tribal livelihood and subsistence practices. In order to detect, monitor and forecast these environmental changes to better prepare the communities for inevitable critical changes we need to engage the community members in scientific monitoring and assessment process. We could potentially build adaptive and resilient communities by observing and monitoring processes and indicators that the communities want to monitor. With the above strategy in mind, the Geophysical Institute Permafrost Laboratory at University of Alaska Fairbanks and Telida Village Council secured funding from the National Science Foundation in September 2015 to build community capacity to monitor permafrost related environmental changes in the vicinity of the communities in the Upper Kuskokwim region of interior Alaska. The overarching goal of this project is to help the tribal communities take the lead in assessing and responding to the environmental changes that are coming with warming climate and thawing permafrost. The project will help build the tribal capacity to monitor changes in local climate and permafrost by providing the Tribes the scientific knowledge and skills necessary to acquire, analyze, and interpret scientific data through training and education. The project will establish local climate and permafrost observation system and map land cover and permafrost in the Upper Kuskokwim region. It will also develop a geo-hazard map for the region to facilitate safe subsistence and recreational practices and land use.

Proposed Process for Use of Western Science, Citizen Based Monitoring, and Traditional Knowledge in Ecosystem Models

Markon, Carl and ***Skean, Vanessa**

Ecosystem modelling is often used for predicting the potential impacts of climate change on the landscape. As input to these models, landscape conditions and trends are commonly used as inputs, made possible from various monitoring networks and potentially the integration of data obtained through western science, citizen based monitoring, and traditional knowledge. All of these types of data collection build capacity for identifying, understanding, predicting, and responding to diverse environmental changes throughout the Arctic. Ecosystem modeling may be especially important to indigenous northern communities that rely on local ecosystem services for subsistence resources, including food security, the location and type of which may change as a result of a changing climate. Because traditional knowledge spans multiple generations and entails a more holistic approach to monitoring, it may be of special use in ecological modeling. The inclusion of traditional knowledge into the assessment of ecosystem change and potential adaption strategies as a result of climate change remains a challenge. To meet the challenge, the Interagency Arctic Research Policy Committee (IARPC; http://www.iarpccollaborations.org/index.html) Terrestrial Ecosystem Collaboration Team (TECT) is working on a potential process that would bring monitoring data and information from a wide variety of sources together, including traditional knowledge, and evaluate their input to existing climate and ecosystem models to assess potential spatial and temporal aspects of climate predictions and ecological change. When possible, traditional knowledge will be utilized to evaluate and enhance the modeled predictions. The climate and ecosystem models will, in turn, be available to traditional knowledge holders to assess projected changes in subsistence resources and use and as an aid to fish and wildlife management.

Towards implementing an Arctic social indicators monitoring program: the promise of a short-form harvest survey

***Braem, Nicole**

Researchers — based in governmental agencies, the academy, NGOs and private contracting businesses — have spent considerable time and expense in the last 30 years documenting socio-economic conditions in Arctic Alaska. Much of the research was driven by information needs related to proposed industrial development, state and federal fish and wildlife management regimes, not to mention the aspirations of thousands of graduate students. While these efforts have resulted in an impressive quantity of empirical data, the disparate sampling approaches, methods and frequency of data collection have confounded efforts to use them. More recently the Arctic Human Development Report, Arctic Social Indicators (ASI) and ASI-II, the Survey of Living Conditions in the Arctic, the ADF&;G Division of Subsistence, and others have contributed to the development of coordinated, methodologically rigorous approaches. One consensus is on the need for an affordable, appropriate set of measures that could be administered regularly in the Arctic. This presentation will focus on how a radically shortened subsistence harvest survey may be a cost-effective means by which to collect information needed in two domains: material-well being and closeness to nature. Combined with a clustered sampling approach, it may be possible to achieve the frequency of data collection suggested by the Arctic Social Indicators projects and others, while minimizing respondent fatigue.

An retrospective and integrative health index for Narwhal

***Black, Sandra**; Barclay, Robert; Wynne-Edwards, Kathy; Cattet, Marc; Goldstein, Tracey; Stephen, Craig; Ferguson, Steven; Raverty, Stephen; Boisvert, Richard; Janz, David M.; Apprill, Amy and Duignan, Padraig.

The objective of this study is to create an integrative population health assessment tool, using established and innovative measures of health (traditional knowledge, community monitoring, medical and pathological data) and stress (blubber cortisol and other steroid hormones, skin expression of stress related proteins and skin bacterial microbiomes) for this culturally and economically important Arctic marine mammal. By utilizing archival and current data and samples, this cross-disciplinary approach will enable a predictive assessment of adaptation to future regional ecologic and climatic change and economic development. Narwhal are apex predators in the Arctic marine ecosystem, and as such, can serve as sentinels for the whole. The population of interest summers in the waters off north Baffin Island, Nunavut, Canada and whales are harvested primarily by the communities of Kanngiqtugaapik (Clyde River), Mittimatalik (Pond Inlet), Ikpiarjuq (Arctic Bay) and Qausuittuq (Resolute Bay), areas which are being impacted significantly by climate change, increased shipping traffic and resource extraction activities. Narwhal are listed by IUCN as "near threatened" and are considered one of the species most sensitive to climate change, yet we lack knowledge of past and current health markers which could facilitate evidence based policy decisions in this area. Preliminary data on hematology, serum chemistry and respiratory tract flora are presented from live whales captured for telemetry studies conducted over a 10 year period. A pathology study of harvested whales examined in collaboration with the Mittimatalik Hunter and Trappers Organization in 2013 revealed no food safety issues, however respiratory pathology and neoplasia were identified. Analysis of corticosteroid levels in blubber samples and microbiomes of skin are underway. We believe this new health index will assist policy makers and communities to promote economic development in an environmentally sustainable manner by providing evidence of stable or changing health status earlier than reliance on crude measures of mortality or changing biological indices.

Uninvited guests in the Arctic: invasive and unusual species observed by hunters and fisher in the Bering Sea Sub Network in 2009-13

***Gofman-Wallingford, Victoria** and Quinlan, Becky

As Arctic environment continues to change at an unprecedented rate, timely capture of changes is needed to enable a better societal response. Species habitat is one of these changes. Can hunters and fishermen, often first witnesses of change, contribute their observations to a higher level observation system? BSSN (eight communities in Russia and Alaska) was created as a means for remote indigenous villages to communicate their observations on the environment and subsistence harvest. Data were gathered in a semi-structured survey that inquired, among other topics, about new species. The number of responses indicating unusual species sightings was not high; because of this and due to BSSN scale and scope, the reported sightings may not get a spot light in project reports. However, individual responses are captivating. We would like to highlight these findings, particularly statistically significant changes in Nikolskoye on Bering Island, in this poster. We present a geospatial distribution of sightings accompanied by respondents' comments. BSSN was not a rapid response project and a significant time was required to process data. Having these observations relayed in real time to scientists and stakeholders would enable timely responses. There are projects that already focus on this, e.g. LEO Network, but inter project cooperation is challenging due to project structures, competing interests and logistics. Developing a depository for such ancillary data gathered by the studies not focused on invasive species and novel sightings would be beneficial for maximizing utilization of gathered observations.

Toward Best Practices in Arctic Social and Ecological Sustainability: A Critical Evaluation of Community-Based Monitoring Programs

***Spiers, Kent Gordon**

The goal of this study is to critically evaluate Community Based Monitoring (CBM) programs in order to understand the features that best address the needs of communities within the context of scientific research concerning the nature of Arctic ecosystem change. Community Based Monitoring (CBM) involves the systematic collection of quantifiable data such as, the measurement of sea ice thickness to assess stability for travel. It may also focus on the collection of largely qualitative Indigenous, local or Traditional Knowledge, (TK) or a combination of approaches. CBM programs promote community empowerment and capacity building through local participation in research that affects social and biological wellbeing within communities. My research will provide an assessment of CBM methods that work toward ensuring best practices for data gathering of high quality, which in turn will benefit Arctic social and biophysical integrity.

SmartICE: sea ice monitoring and forecasting in support of community well-being under changing climate and shipping conditions

***Bell, Trevor**; Angnatok, Joey; Arreak, Andrew; Braithwaite, Leah; Briggs, Rob; Clausi, David; Dawson, Jackie; Elverum, Shelly; Haas, Christian; Laing, Rodd; Ljubicic, Gita; Tivy, Adrienne and Wilson, Katherine

SmartICE (Sea-ice Monitoring And Real-Time Information for Coastal Environments) is a community-academic-government-industry collaboration that seeks to address the limitations in technologies and services currently used to map coastal sea-ice conditions. The overall goal of SmartICE is to develop an integrated, near real-time monitoring and dissemination system that informs decisions about coastal sea-ice travel and shipping, thereby improving safety. We are currently piloting SmartICE technologies and operations in Nunatsiavut (Nain) and Nunavut (Pond Inlet). Although primarily designed to support ice-travel safety, SmartICE observations may also inform winter fishery and harvesting programs, search-and-rescue operations, climate change adaptation planning, ecosystem monitoring, and sea-ice technology validation. SmartICE directly involves Inuit in all aspects of its operation and most importantly strives to integrate Inuit Qaujimajatuqangit (knowledge) about sea-ice conditions.

Circumpolar Coastal Communities Observatory Network

***Forbes, Donald**; Bell, Trevor; LeTissier, Martin; Overduin, Paul; Petrov, Andrey; Atkinson, David; Couture, Nicole; Eerkes-Medrano, Laura; Kraev, Gleb; Larsen, Joan Nymand; Marino, Elizabeth; Pulsifer, Peter; Rasmussen, Rasmus Ole; Riedlsperger, Rudy; Schweitzer, Peter; Vlasova, Tatiana and Wilson, Katherine

The Circumpolar Arctic Coastal Communities Observatory Network (CACCON) functions as the Arctic Regional Engagement Network for Future Earth Coasts. In partnership with other Arctic knowledge networks and programs, CACCON promotes consensus and collaboration to advance local knowledge availability and accessibility for adaptation planning and sustainable development in Arctic coastal communities and regions. Components of the CACCON agenda include: integrative analyses of sustainability challenges in Arctic coastal communities using co-developed situational and sustainability indicators; solutions-oriented research for actionable, proactive adaptation policies in Arctic coastal communities; sharing insights among existing community-based research and resilience programs; responding to community-based agendas and building resilience by growing local and regional knowledge co-production and dissemination capacity. These activities use an approach rooted in the Future Earth principles of co-design and co-production of knowledge involving a broad cross-section of stakeholders and consensus-building on pathways for transformation to more sustainable strategies for enhanced present and future well-being on Arctic coasts.

How can traditional ecological knowledge and western science be effectively mobilized to understand and respond to change in Arctic environments?

***Wilson, Katherine**; Bell, Trevor; Ljubicic, Gita; Braithwaite, Leah; Arreak, Andrew and Elverum, Shelly

Over the past decade there has been a positive shift in acknowledging the value of traditional ecological knowledge (TEK) in evidence-based decision making for a range of Arctic issues. Although well intentioned, the complexities of collecting, analyzing and integrating TEK observations from local experts with western science methods have proven difficult. This has resulted in large amounts of TEK data that have been collected and generously shared with trust and expectation, but never fully analysed or integrated into research, leaving northerners and researchers frustrated with the underutilization of this valuable information. The purpose of this research is to better understand the barriers and enablers in mobilizing TEK, and to examine approaches and methodologies to better capture and integrate TEK into research and monitoring programs. These approaches and methodologies are being evaluated as part of the SmartICE (Sea-ice Monitoring And Real-Time Information for Coastal Environments) project in Pond Inlet, Nunavut (see conference abstract and poster on SmartICE). As this is a community directed project, and TEK is a key ingredient in the decision-making process for safe sea-ice travel, the community will determine the TEK components of the SmartICE project. This research is still in its initial design phase – please visit the poster to discuss the successes and challenges of mobilizing TEK.

Technology, Science and Indigenous Knowledge; Tracking Sea Ice and Its Use at Barrow, Alaska

***Kaufman, M.**; Lee, O.; Mahoney, A. R.; Jones, J.; Eicken, E.; Dammann, O. and Shapiro, L. H.

As the Pacific Arctic continues to experience some of the most pronounced changes in sea ice cover, there is growing interest in how these changes are being experienced by the people and animals that call this region home. We analyze community‐based observations by Alaskan indigenous ice experts, satellite data and ground‐based measurements to begin assessing impacts of ice‐cover changes on coastal communities and ecosystems on seasonal to decadal timescales. Observations are based on ice uses and information about ice conditions, weather, ocean state and animal behavior that is relevant to hunters and community members. Daily logs kept during the ice season have been archived since 2006, with key variables extracted for sub-categories pertaining to weather and ice observations, ice-related activities and wildlife. Our poster discusses aspects of data management and multiple uses of such observations as relevant to the aims of the Arctic Observing Summit.

Raising the Stakes for Stakeholders

***Overbeck, Jacquelyn**; Maio, Christopher and Buzard, Richard

The majority of Alaska's rural communities are located near oceans, rivers, and lakes for transportation, subsistence, and income purposes. The United States General Accounting Office reported in 2004 that flooding and erosion affects 184 out of 213 (86%) of Alaska Native villages, and most of these are coastal communities. As ongoing processes and emerging climate-driven perturbations to the natural environment shape the land at the water's edge, more information is needed about how those changes will affect the resiliency of coastal communities. Alaska's extensive coastlines are inconsistently monitored and under-instrumented for the evaluation of coastal flooding and erosion leaving them vulnerable and lacking the necessary tools for appropriate mitigation and adaptation strategies. By combining coastal education programs, traditional ecological knowledge (TEK), and community-based monitoring systems, not only can scientists potentially lengthen the historical record of sea levels, storms, and sea ice extent back to the early 19th century, but can sustain a higher frequency of measurements for longer-term efforts and promote the awareness of coastal processes. Additionally, the inclusion of elder-derived TEK and community-based monitoring also serve to develop positive relationships with community stakeholders enhancing their ability to interpret, understand, and act upon research results.

Education, Resilience, and Scenarios: Creating Capacity for Community-Based Observations through Youth Engagement

***Cost, Douglas** and Lovecraft, Amy

Education and learning possess powerful potential in affecting future resilience and community-based monitoring. This research focuses on examining the connections and feedbacks between social-environmental systems (SESs), resilience, and compulsory education. We suggest scenarios development as a way to link local-scale interest in change to education and monitoring of key variables for resilience. SESs have been problematized as frequently having a poor fit between environmental change and policy solutions. This has led to discussion and debate over the role of schools in addressing local knowledge, environmental changes, and community priorities. In Alaska and other Arctic countries, the role of public schools in improving this fit has been largely overlooked. This research explains that as extensions of governments, public schools offer an opportunity to create better linkages between societies and environments through governance. Secondarily, at the individual level, education is a vital component of resilience, but such education must embrace multiple perspectives in its curriculum in order to honor and access the diversity offered by local, traditional ecological knowledge and Western methods. Scenarios are inherently transdisciplinary processes that integrate different knowledge perspectives as participants consider what matters the most and what is most uncertain in the long-range future. We report research results from two linked scenarios project. The Northern Alaska Scenarios Project drew resident expert participants from the North Slope and Northwest Arctic Boroughs and the Arctic Future Makers project that completed a scenarios exercise with high school students from across the Northwest Arctic Borough.

Community-based Adaptive Wildlife Management in Sakha Republic, Russia, under the Global Warming Condition

Tatsuzawa, Shirow; Okhlopkov, Innokentiy, M.; Solomonov, Nikita G.; Isaev, Arcady, P.; Nikolaev, Egor A.; Kirillin, Egor V.; Kirillin, Ruslan A.; Mamaev, Nikolai V.; Vladimirtseva, Maria V. and Germogenov, Nikolai I.

In the Arctic region of the Sakha Republic, a rapid change in avian and mammalian faunas has occurred in the past 30 years. Under global warming conditions, many “southern species” have gone up to the Arctic Circle and new prey-predator relationships have appeared. In addition, habitat selections of migratory or wandering species such as reindeer and polar bears have been destabilised and serious conflicts between northern indigenous peoples or their livestock and these "southern species" have also increased. Under such circumstances, hitherto we reduced the initial cost by introducing satellite tracking techniques, and hunters and citizens became able to more easily participate in monitoring activities. For example, wild tundra reindeer (Rangier tarandus), which make seasonal migrations of 3000 km, their migration routes and distribution area are changed yearly by unstable weather and physical conditions worsened by global warming. However, since 2011, we have been able to get their positions by satellite tracking and to provide them quickly to local stakeholders, so that we could set a new protected area for their wintering grounds. In addition, hunting areas around the protected area could be controlled safety by their uniform management by a local manager. This monitoring and management system should increased the possibility of sustainable use of this important resource animal population by local indigenous people. Currently, we are building a flexible multi-species management system based on the annual monitoring information from local governments, indigenous people and scientists.

Blubber and beyond - contribution of ice derived fats to bowhead whales

***Horstmann-Dehn, Lara**; Stimmelmayr, Raphaela; Wooller, Matthew and George, Craig

Bowhead whales (Balaena mysticetus) are the largest animal occupying ice-covered waters in the Arctic; they are exceptionally long-lived and migrate between arctic and sub-arctic waters. Bowheads feed on small zooplankton prey, such as copepods and euphausiids, and rely on high prey densities to balance energy expense during filter feeding and energy gain. Changes in sea ice abundance are well known to affect primary productivity in the Arctic, and copepod biomass appears to be increasing as a result. Bowhead health and food availability in the Arctic ecosystem are inextricably linked. The bowhead population has recovered substantially since commercial whaling in the mid-19th century and may be approaching pre-exploitation numbers. Consequences of the increasing whale population to abundance and quality of their prey are poorly understood. We therefore characterized annual variability of bowhead fatty acid (FA) signatures and overall lipid stores, as well as their reliance on sympagic food webs to fill important knowledge gaps. We sampled full thickness blubber cores from adult, non-pregnant whales in 2004–2014. Only whales harvested in Barrow, AK during the fall Native subsistence hunt were included. We then extracted and transesterified lipids and quantified up to 65 FAs. In addition, we used compound specific stable isotope (SI) analysis to examine the carbon SI ratio of specific primary production FA (i.e., 20:5n3) to describe the relative importance of sympagic or pelagic primary production to bowheads. Our preliminary data show no significant difference in blubber %lipid among years ($p=0.58$), although mean %lipid in 2014 was higher than any other year (71.14% ± 9.96 in 2014 versus 62.68% ± 9.82 for 2004–2013 combined). This agrees with projected increases in available bowhead prey biomass and abundance during early sea ice retreat and higher sea surface temperatures. The copepod FA markers 20:1n9 and 22:1n11 as well as the primary production marker 20:5n3 were variable among years. Interestingly, 16:1n7 appeared to be associated with relatively lower blubber lipid content, and has been described as an important player in lipolysis, potentially making it a useful indicator of body condition in bowheads. Compound specific SI analyses are currently underway.

Recruitment windows of opportunity in thaw slump thermokarsts near Toolik Lake, Alaska

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As the Arctic warms, erosional disturbances due to permafrost thaw (thermokarst) are observed with increasing frequency, yet plant reproductive responses in cryo-disturbed tundra are not well understood. Understanding plant reproductive mechanisms is a key component to Arctic studies, and thermokarsts may help explain how arctic plants find windows of opportunity to recruit new populations from seed. Increased tundra shrubification over the last 50 years coincides with Arctic climate warming and tall (>1m) deciduous shrubs forming dense colonies inside thermokarst scars. Thermokarsts provide ground free of competing vegetation, deep active layers, and high soil moisture. Under these conditions, seedlings can potentially germinate and establish new populations. In 2012-2014, I measured standing seedling cover and germination capacity of surface soil seedbanks in thermokarst lobes of different ages at two sites near Toolik Lake, Alaska. Standing seedling cover was greater in younger thermokarsts, including 30%-100% tall shrub Salix spp. and dwarf birch (Betula nana), indicating that young RTS do support Salix and Betula seedlings. Seedling cover was positively associated with exposed mineral soil, while lower seedling cover in older and undisturbed tundra was correlated with greater vegetative cover. Germination trials demonstrated significantly higher germination of thermokarst seedbanks relative to undisturbed tundra. Percent germination at one site was 1.3 to 5 times greater in the younger thermokarst lobe compared to older lobes and undisturbed tundra. Across sites Betula and sedge seeds were common to all seedbanks but Betula germination was < 6% vs. 44% sedge. Betula and Salix germination averaged 1-6 % under greenhouse conditions, suggesting actual recruitment rates of Betula and Salix in RTS may be low. Sites varied in cover and abiotic conditions, seedbank species composition, seedbank size, and percent germination suggesting species may have different requirements to remain viable in the seedbank. Greater germination of evergreens was positively associated with greater deciduous shrub cover, suggesting plant-plant interactions may facilitate seedbank viability of later successional species.

Effect of meteorological and sea ice conditions on the chemical composition of Arctic aerosols during late winter – a case study

***Thakur, Roseline C.** and Thamban, Meloth

Several studies in the Arctic have highlighted the importance of size segregated chemistry of winter aerosols for a qualitative and quantitative understanding of the aerosol formation and deposition pathways. During the polar winters, frost flowers over the freshly formed sea ice act as a sea-salt source and thus alter processes important to the atmospheric and snow chemistry. However, no such studies have been undertaken in the Svalbard region, Arctic to account for the effect of frost flowers on the size-dependent ionic composition of these aerosols. Thus, to investigate such processes during the late Arctic winter, aerosol sampling was carried out at Ny-Alesund, Svalbard during February - March 2011 through a nine staged cascade impactor. Eight aerosol samples were collected covering 48 hours time periods with sizes ranging from 0.4 μ m - >10 μ m. Ion chromatography analysis revealed that the late winter – Arctic aerosols were characterized with dominant SO42- species with concentration ranging from 0.6-2.8 μ g m-3 marking haze effect on the aerosols, followed by Na+ (0.3-1.3 μ g m-3). Frozen fjord and sea ice conditions during the study period suggested a a significant frost flower contribution in the coarser mode particles (5.8-9.0 μ m). The nssSO42- and nssCa2+ estimates revealed highly negative values on days when the thickest sea ice conditions prevailed during March 2011. This resulted in low sea salt in coarse mode particles. Such observations were made on days when the air mass arriving in Ny Alesund travelled over the frozen Arctic Ocean with frost flowers. However, the aerosol chemical composition was not only affected by the frost flower contribution, but also by polluted air masses. Low sea salt with sulphate enrichment was seen on the high wind speed- sampling days, when the air mass arrived from North-Western Europe and North East Russia. Significantly, Cl- depletion was biased towards the finer fraction since 67% of Cl- depletion was observed in coarse mode and 71% in fine mode particles. The results suggest a size dependence of the fractionation of sea salt aerosols originating from frost flowers. Further long term process studies need to be undertaken to understand this size dependent transport of aerosols from frost flower covered areas to inland Polar Regions.

Distribution characteristics and indicator significance of Dechloranes in multi-matrices at Ny-Ålesund in the Arctic

***Na, Guangshui**; Wei, Wei and Yao, Yao

In recent years, Dechloranes have been widely detected in the environment around the world. However, understanding and knowledge of Dechloranesin remote regions, such as the Arctic, remain lacking. Therefore, the concentrations of 5 Dechloranes in surface seawater, sediment, soil, moss, and dung collected from Ny-Ålesund in the Arctic were measured with the concentrations 93pg/L, 342 pg/g, 325 pg/g, 1.4 pg/g, and 258 pg/g, respectively, which were much lower than those in Asian and European regions. The mean ratios of anti-Dechlorane Plus (DP) to total DP (fanti) in seawater, sediment, soil, moss, dung, and atmospheric samples were 0.36, 0.21, 0.18, 0.27, 0.66, and 0.43, respectively. Results suggested that the main source of DP in seawater, sediment, soil, and moss was long-range atmospheric transport. However, the ratio identified in dung was different, for which the migration behavior of the organism is probably the main source of DP.

Pan-arctic ice-wedge degradation in warming permafrost and influence on tundra hydrology

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Ice-wedges are common permafrost features formed over hundreds to thousands of years of repeated frost cracking and ice vein growth. We used field and remote sensing observations to assess changes in areas dominated by ice-wedges, and we simulated the effects of those changes on snow accumulation and runoff. We show that top melting of ice-wedges and subsequent ground subsidence has occurred at multiple sites in the North American and Russian Arctic. At most sites, melting ice-wedges have initially resulted in increased wetness contrast across the landscape, evident as increased surface water in the ice-wedge polygon troughs and somewhat drier polygon centers. Most areas are becoming more heterogeneous with wetter troughs, more small ponds (themokarst pits forming initially at ice-wedge intersections and then spreading along the troughs) and drier polygon centers. Some areas with initial good drainage, such as near creeks, lake margins, and in hilly terrain, high-centered polygons form an overall landscape drying due to a drying of both polygon centers and troughs. Unlike the multi-decadal warming observed in permafrost temperatures, the ice-wedge melting that we observed appeared as a sub-decadal response, even at locations with low mean annual permafrost temperatures (down to −14 °C). Gradual long-term air and permafrost warming combined with anomalously warm summers or deep snow winters preceded the onset of the ice-wedge melting. To assess hydrological impacts of ice-wedge melting, we simulated tundra water balance before and after melting. Our coupled hydrological and thermal model experiments applied over hypothetical polygon surfaces suggest that 1 ice-wedge melting that produces a connected trough-network reduces inundation and increases runoff, and that 2 changing patterns of snow distribution due to differential ground subsidence has a major control on ice-wedge polygon tundra water balance despite an identical snow water equivalent at the landscape-scale. These decimeter-scale geomorphic changes are expected to continue in permafrost regions dominated by ice-wedge polygons, with implications for land-atmosphere and land-ocean fluxes of water, carbon, and energy.

Climatic and environmental factors influencing tardigrade communities in Svalbard Archipelago

***Zawierucha, Krzysztof**; Kaczmarek, Łukasz and Ostrowska, Marta

Water bears (Tardigrada) are a cosmopolitan phylum of microscopic metazoans ranging from ca. 100 to 2200 μm in size. Many species are known to live in extreme conditions, such as highest mountain peaks or the surface of glaciers. In total, 310 moss, lichen, soil and cryoconite sediment samples were collected from different localities of Svalbard. Samples were analyzed in terms of tardigrade taxonomy, ecology and biogeography. The most important results are: (a) endemic species were noted only in the localities influenced by warm (Isohypsibius coulsoni), or cold (I. glazovi) ocean currents (b) redescription of Tenuibiotus voronkovi and changes in their distribution during last three decades, (c) changes in the tardigrade diversity and distribution along altitudinal gradients, (d) seabirds colonies are the most abundant tardigrade microhabitats. Because of the high spatial heterogeneity in several environmental factors (e.g. tundra fertilisation, cold and warm ocean currents), diversification of invertebrate communities and low risk of human influence, the Svalbard Archipelago is a promising place to conduct more advanced studies on tardigrade biology and ecology. Long term studies on the tardigrade communities on Svalbard, are perfect to observe the response of terrestrial fauna to recent climate changes.

Tardigrada in Arctic cryoconite holes (Spitsbergen, Svalbard) – diversity and abundance

***Zawierucha, Krzysztof**; Ostrowska, Marta; Vonnahme, R. Tobias; Devetter, Miloslav; Nawrot, Adam; Kosicki, Jakub Z. and Kolicka, Małgorzata

Despite the fact that the surface of glaciers are frozen for most part of year and temperatures do not exceed 1 °C, glaciers are inhabited by many organisms including invertebrates. The highest biological activity on glaciers is observed in cryoconite holes. The development and functioning of these habitats is possible because of the decrease in albedo. This can be caused by mineral and organic dust coverage or the presence of pigmented microorganisms on the glacier. Water bears (Tardigrada), a group of micrometazoan extremopihiles, are widely distributed in cryoconite holes. Fifty three sediment samples were collected from cryoconite holes on six glaciers on Spitsbergen. Additionally, depth, area and elevation were measured on each location. Tardigrades were found in 46 samples (87% of all samples). The mean (±SD) tardigrade density was 24.9±33.0 individuals per gram of wet sediment. Four taxa of Tardigrada (Eutardigarada) were found, belonging to all trophic levels. Two of them have only been found in cryoconite holes and they could be seen as endemic fauna on glaciers. The presence of these unique cryoconite species supports the hypothesis of cryoconites as distinctive habitats. The proportion of cryoconite holes inhabited by tardigrades indicate that they are adapted to life on a glacier rather than transported there by accident as hypothesized earlier. Area, depth and elevation as independent variables cannot explain Tardigrada abundance in cryoconite holes alone (GRM, $F = 0.71$, $p = 0.54$, $R2=0.059$). Most likely because of the rapid melting of the glacier surface and the constant flushing of cryoconite sediments.

Barcoding DNA – a tool to study diversity of tardigrades in Arctic

Roszkowska, Milena; Ostrowska, Marta; ***Zawierucha, Krzysztof** and Kaczmarek, Łukasz

Water bears (Tardigrada) are a cosmopolitan phylum of microscopic metazoans inhabiting diverse habitats throughout the world. In Arctic ecosystems tardigrades can be found in high densities in mosses, lichens, soil and freshwater sediments. In present study species from the Macrobiotus harmsworthi group were examined. Species from this group are very common (not only in Arctic ecosystems) and can be differentiated only based on faint features revealing mainly in the egg chorion morphology. The main aim of this study was to use one nuclear (ITS) and one mitochondrial (COI) DNA fragments to look at the genetic distances between morphologically similar subspecies (nominal M. harmsworthi harmsworthi and M. harmsworthi obscurus) and resolve the problem with their taxonomic status. Barcodes have proven to be very useful in resolving taxonomic problems between closely related species and have showed that even very small morphological differences are the 'species specific'. Barcoding DNA is a very promising tool to study a cryptic diversity of tardigrades, especially in extreme habitats, where the field studies are difficult and the collected material is not very rich. Moreover, a correct and fast species identification, as the basis in all ecological and zoogeographical studies, can help us to better understand the functioning of tardigrade communities in general.

Freshwater Chaetonotidae (Gastrotricha) from West Greenland

Kolicka, Małgorzata and ***Zawierucha, Krzysztof**

Gastrotricha is a cosmopolitan phylum of aquatic and semi–terrestrial invertebrates which comprises about 820 described species. They inhabit all types of aquatic and semi-terrestrial ecosystems all over the world. Currently, freshwater gastrotrichs have not been the subject of faunistic or taxonomic research in the polar regions and knowledge about them were extremely scarce. Only few works mentioned these organisms from the Svalbard Archipelago, but most of them concerns undetermined taxa. Also from Greenland are no extant data regarding Gastrotricha, except single faunistic work about marine species. During our investigations we analyse both type of substrates inhabiting by gastrotrichs, bottom sediments as well as submerged macrophytes. In the recorded material 19 individuals from bottom sediment and 75 specimens from submerged plants belonging to 11 new species and only 4 species which representing morphospecies previously known. Interestingly, despite the samples were collected from shallow reservoirs, high variation between gastrotrichs assemblages in sediments and from the macrophytes were observed, when diversity between location were relatively low. It is very likely that further research on this area will still bring recording of more taxa new to science. It is also possible that investigating the diversity of gastrotrichs in young Arctic habitats will help to expand the knowledge on diversity and speciation within the entire group of Chaetonotidae, as well as to provide information on the ecological tolerance and adaptive and dispersive capacity of these poorly researched invertebrates.

The occurence of integrons in bacteria isolated from cryoconites and soil samples from Spitsbergen

Makowska, Nicoletta; Nadobna, Paulina; ***Zawierucha, Krzysztof**; Koczura, Ryszard and Mokracka, Joanna

Cryoconite holes are cylindrical water-filled depressions in the surface of a glacier. They constitute independent freshwater ecosystems colonized by a variety of cryophilic organisms and microorganisms. Integrons are bacterial DNA regions mediating the capture of gene cassettes that code for antibiotic resistance. They are located on transposons and plasmids, which facilitates spreading of resistance determinants through bacterial population via horizontal gene transfer. As the integron system has the ability to create novel combinations of genes, it may be a dynamic force in the evolution of bacteria. The aim of the study was to determine the frequency of integrons and their gene content in bacteria cultured from cryoconites and soil samples from Spitsbergen. The presence of integrons was determined by multiplex PCR assay for detecting intI1, intI2 and intI3 integrase genes. Primers complementary to the conserved regions of class 1 and 2 integrons were used for amplification of variable regions. The gene cassettes were cloned using pGem-Teasy Vector System (Promega) and sequenced. Bacterial strains (1024) were isolated from 17 soil and cryoconite samples from Spitsbergen. The occurrence of class 1 integrons integrase gene was confirmed in 10.1%. isolates, whereas class 2 integrase gene was detected in one strain. Analysis of the variable regions revealed the presence of genes encoding proteins of different, mostly physiological functions: transcriptional regulators, histidine permeases, DNA repair protein RadA, and hypothetical proteins of unknown functions. Integrons are present in the genomes of psychrotolerant bacteria isolated from environments with no apparent anthropopressure. Gene cassettes present in the integron platform encode proteins, that may increase phenotypic fitness of the strain and enable adaptation to cold environment and high UV radiation.

Northern Seas: Inventorying Historic Logs for Arctic Climate and Ecosystem Data Reconstruction

Murray, Maribeth; ***Wells, Patricia** and Ibarguchi, Gabriela

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Integrating Culturally-Responsive, Locally Relevant Learning and Citizen Science through Arctic and Earth SIGNs

***Sparrow, Elena B.** and Spellman, Katie V.

Integrated science, technology, engineering and math (STEM) solutions and effective, relevant learning processes are required to address the challenges that a changing climate presents to many Arctic communities. Learning that can both enhance a community's understanding and generate new knowledge about climate change and it's impacts at both local and continental scales are needed to efficiently build the capacity to navigate these changes. Citizen science, the process whereby citizens (including K-12 students) are involved in science as researchers, presents a possible mechanism to meet this need. However, hypothesis-driven models of citizen science have been criticized for a disconnect between scientific agendas and the priorities and needs of diverse communities. The new education and research program at the University of Alaska Fairbanks, entitled Arctic and Earth SIGNs (STEM integrating GLOBE and NASA), provides new opportunities for K-12 students, pre- and in-service teachers and lifelong learners from diverse communities to engage in citizen science learning. The citizen science learning addresses the climate change challenges arising within their unique community, and is supported by culturally responsive curriculum and research collaboration with scientists. The program trains teachers and community members on climate change concepts and observing protocols in face-to-face or online workshops. More focused learning on the core climate change issues in the participant's community continues through modules that include GLOBE (Global Learning and Observations to Benefit the Environment) protocols that best fit the issue, traditional ecological knowledge, historical and current NASA data, direct contact with NASA subject matter experts, and collaboration with a team of UAF scientists and other partners such as the Association of Interior Native Educators, 4-H program, the Bonanza Creek Long Term Ecological Research program, Alaska Experimental Program to Stimulate Competitive Research, the Polar Learning and Responding Climate Change Education Partnership and school districts.

Chukchi-Beaufort Seas High-Resolution Atmosphere Reanalysis (CBHAR): Data Verification and Climate Analysis

***Zhang, Xiangdong**; Zhang, Jing; Krieger, Jeremy R.; Shulski, Martha; Liu, Fuhong; Tao, Wei and Stagall, Steve

The Chukchi–Beaufort Seas and the North Slope region has experienced drastic changes over recent decades. These changes may increase threats to the environment and the economic activities. To better understand these regional climate changes, there is an impressive need to obtain the best estimate of high-resolution atmospheric state in this data-sparse region. We therefore conducted a regional reanalysis project. Under this project, a physically-optimized, Arctic-processes-enhanced Weather Forecasting and Research (WRF) model and WRF-based data assimilation system have been established; a meteorological buoy was successfully deployed over the highly sea-ice-dynamic Beaufort Sea; a quality-controlled observational database was developed from available sources; and, finally, the high-resolution Chukchi–Beaufort Seas High-Resolution Atmospheric Reanalysis (CBHAR) was constructed for the period 1979–2009. We verified the CBHAR data against various observations. The results indicate that the CBHAR represents an improved estimate of the regional atmospheric state throughout the study area. Climate analysis using CBHAR reveals that winds, particularly extreme winds, have enhanced over the Chukchi–Beaufort Seas, especially during autumn. CBHAR also provides a unique opportunity to analyze mesoscale processes. We found that intensified onshore winds have occurred during summer due to combined sea and mountain breezes along the eastern Brooks Range and Chukotka Mountains. During winter, the mesoscale cold-air damming effect diverts the synoptic northeasterly winds to the southeast along the northern slope of the Chukotka Mountains. In the Brooks Range, downslope winds are the predominant driver of the surface wind field.

Exploring Children's Environmental Identity Development in an Subarctic Boreal Forest

***Green, Carrie**

This poster explores Environmental Identity Development (EID) through the lens of young children. EID considers the natural-world socialization of children, that is, how children interpret, relate with, and experience the natural world and how such interactions inform who they are (Green, Kalviatis, &; Worster, 2015). Using photos and video footage captured through GoPro Tours, this participatory phenomenological study provides a unique view of children's play and exploration in a subarctic boreal forest, revealing how children see, hear, and interact with the natural world. Findings will be used to explain and conceptualize the four progressions of children's EID (Trust in Nature vs. Mistrust in Nature; Spatial Autonomy vs. Environmental Shame; Environmental Competency vs. Environmental Disdain, and Environmental Action vs. Environmental Harm). This research not only provides insight into children's emotional, cultural, and psychosocial encounters with nature, it also reveals how wearable GoPro cameras can be used as an innovative tool for capturing children's (and other actors and stakeholder's) views, perspectives, and experiences of their environment. As agents of culture and change, the children of today will take an active role both now and in the future in responding to the drastically changing environments and communities of the Arctic. It is important now, more than ever to understand how children relate with, perceive, and interact with the natural world.

Monitoring Environment in Polar Regions --- An introduction to Chinese Arctic Observations

Yuansheng, Li and ***Beichen, Zhang**

The rapid change of the Arctic environment, especially the decrease of sea ice due to global climate change has great impact on the weather system in China and great implications on international trade development among East Asia, North America and Europe. This provides opportunity for Chinese polar scientific expedition to monitor the Arctic environment and contribute to the understanding of the global system. The regular Chinese national scientific activities in the Arctic regions are introduced. These include the operation of the Arctic Yellow River Station and 6 Arctic Ocean Expeditions to the present. Based on these activities, the Arctic polar key programs, i.e., Programmes of the Comprehensive Investigation and Assessment of Polar Environment were carried out in the last five years. The international cooperation and representative scientific achievements relating to the programmes are introduced.