My Schedule Table of Contents

One-off sessions

[M-IS02] Environmental, socio-economic and climatic changes in Northern Eurasia
[E] Oral

[MIS02-01] Change in metals speciation in waters of Arctic lakes (1975-2018): climate, anthropogenic loads, geochemical feature

*Marina I Dinu[1] (1.Russian, Vernadsky Institute of geochemistry and analytical chemistry)

[MIS02-02] Revised methane emission estimate for West Siberia based on Landsat mapping of wetland types

*Shamil Maksyutov[1], Irina E Terentieva[2], Alexander F Sabrekov[2], Ilya Filippov[3], Mikhail V Glagolev[4,5] (1.National Institute for Environmental Studies, Tsukuba, Japan, 2.Institute of Ecology and Evolution, RAS, Moscow, Russia, 3.Yugra State University, Khanty-Mansyisk, Russia, 4.Institute of Forest Science, RAS, Uspenskoe, Russia, 5.M.V. Lomonosov Moscow State University, Moscow, Russia)

[MIS02-03] A climatological study on freezing rain, freezing drizzle, and freezing fog in northeastern China

Yang Bai[1], *Tetsuya Hiyama[2], Hatsuki Fujinami[2] (1.Graduate School of Environmental Studies, Nagoya University, 2.Institute for Space-Earth Environmental Research, Nagoya University)

[MIS02-04] Economic Assessment of Permafrost Degradation Effects on Road Infrastructure Sustainability under Climate Change in the Russian Arctic

*Dmitry Olegovich Eliseev[1], Boris Nikolaevich Porfiriev[2], Dmitry Andreevich Streletskiy[3] (1.Russian New University (RosNOU), Moscow, Russia; Sochi scientific research center, Russian Academy of Sciences, Sochi, Russia, 2.Institute of Economic Forecasting, Russian Academy of Sciences, Moscow, Russia, 3.George Washington University, Washington, United States; Earth Cryosphere Institute, Tyumen' Scientific Center, Siberian Branch, Russian Academy of Sciences, Tyumen' , Russia)

[MIS02-05] Informal use of linear road infrastructure of the extraction of natural resources in Eastern Siberia.

*Viktor Bogdanov[1] (1.Institute of geography V.B. Sochava Siberian Branch of the Russian Academy of Sciences)

[MIS02-06] **Characterization of contemporary fire regimes in Russian boreal forest under impact of climate change and anthropogenic alterations: Thematic study of the Sakha Republic (Yakutia)**

*Kiunnei Kirillina[1], Wanglin Yan[1] (1.Graduate School of Media and Governance, Keio University SFC)

[M-IS02] Environmental, socio-economic and climatic changes in Northern Eurasia
[E] Oral

[MIS02-07] Analysis of CMIP6 Multi-model Climate Change Smulations and Projections Over Northern Eurasia

*Qingyun Duan[1], Xuewei Fan[2], Chenwei Shen[2], Chiyuan Miao[2] (1.Hohai University, 2.Beijing Normal University)

[MIS02-08] Evaluation of a snow scheme in Integrated Land Simulator

*Tomoko Nitta[1], Kei Yoshimura[1] (1.Institute of Industrial Science, the University of Tokyo)

[MIS02-09] **Closing water budgets of the three great Siberian River Basins**

*Pavel Shabanov[1], Ambroise Dufour[1], Olga Zolina[2], Sergey Gulev[1], Martin Wegmann[3] (1.Shirshov Institute of Oceanology, Russian Academy of Sciences, 2.Institut des Géosciences de l' Environnement, Université Grenoble Alpes, 3.World Meteorological Organisation, Geneva)

[MIS02-10] Evaluation of orographical precipitation over Central Asia and its super-ensemble and downscaling simulations to evaluate precipitation change under the warming environment

*Akiyo Yatagai[1], Saki Yanagisawa[1], Kumar Vinay[2], Ayano Senda[1], Minami Masuda[1] (1.Hirosaki University, 2.Texas A&M University)

[MIS02-11] **ENVIRONMENT CHANGES IN THE EURASIAN ARCTIC**

*Pavel Groisman[1,2,3], Sergey Gulev[2], Ambroise Dufour[2], Ge Peng[1], Dmitry Streletskiy[4], Nina Speranskaya[5], Nadezhda Tchebakova[6] (1.North Carolina Institute for Climate Studies, North Carolina State University, USA, 2.Institute of Oceanology, Russian Academy of Sciences, Russia, 3.Hydrology Science and Services Corporation, USA, 4.George Washington University, USA, 5.State Hydrologic Institute, Russia, 6.Forest Institute of the Siberian Branch of the Russian Academy of Sciences, Russia)

[MIS02-12] How much variation in land surface phenology can seasonal climate oscillations explain at pasture scale in Kyrgyzstan?

*Monika Anna Tomaszewska[1], Geoffrey M. Henebry[1,2] (1.Center for Global Change and Earth Observations, Michigan State University, East

My Schedule Table of Contents

Lansing, MI 48823, USA, 2.Department of Geography, Environment, and Spatial Sciences, Michigan State University, East Lansing, MI, 48824, USA)

[M-IS02] Environmental, socio-economic and climatic changes in Northern Eurasia

[E] Poster

[MIS02-P01] BIOAVAILABILITY OF METALS DEPENDING ON THEIR SPECIATION IN NORTHERN LOW-SALINE WATER

*Tatyana I Moiseenko[1], Marina I Dinu[1] (1.Russian)

[MIS02-P02] Divergent responses of ecosystem water-use efficiency to extreme droughts over Northern Eurasia

*Mengtian Huang[1], Panmao Zhai[1] (1.Chinese Academy of Meteorological Science)

[MIS02-P03] Homogeneity analysis of air temperature and wind speed records of the Azov-Black sea region

*Natalia Alexandrovna Lemeshko[1], Vladislav P. Evstigneev[2,3], Maxim P. Evstigneev[2], Pavel Ya. Groisman[4] (1.SPBU, 2.IPTS, 3.SevSU, 4.IORAS)

[MIS02-P04] Soil response to sub centennial climate change

*Natalia Alexandrovna Lemeshko[1], Vladislav P. Evstigneev[2,3], Alexey V. Rusakov[1], Pavel Groisman[4] (1. SPBU , 2.IPTS , 3.SevSU, 4.IORAS)

[MIS02-P05] Climate change impacts on seed quality and distribution of light-needled *Pinus sylvestris* and *Larix* spp. in Northern Eurasia in a warming climate

*Nadezhda Tchebakova[1], Elena I. Parfenova[1], Elena V. Bazhina[1], Nina A. Kuzmina[1], Pavel Y. Groisman[2] (1.Institute of Forests, Siberian Branch, Russian Academy of Sciences, 2.NC State University Research Scholar)

[MIS02-P06] Northern Eurasia Future Initiative (NEFI), Update

*Pavel Groisman[1,2,3] (1.NC State University Research Scholar at NOAA National Centers for Environmental Information, Asheville, North Carolina, USA, 2.Shirshov Institute of Oceanology, Russian Academy of Sciences, Moscow, Russia , 3.Hydrology Science and Services Corporation, Asheville, North Carolina, USA)

[E] Oral | M (Multidisciplinary and Interdisciplinary) | M-IS Intersection

[M-IS02] Environmental, socio-economic and climatic changes in Northern Eurasia

convener:Pavel Groisman(NC State University Research Scholar at NOAA National Centers for Environmental Information, Asheville, North Carolina, USA), Shamil Maksyutov(National Institute for Environmental Studies), Evgeny P Gordov(Institute of Monitoring of Climatic and Ecological Systems SB RAS), Akiyo Yatagai(Hirosaki University)

Change in metals speciation in waters of Arctic lakes (1975-2018): climate, anthropogenic loads, geochemical feature

*Marina I Dinu[1]

1. Russian, Vernadsky Institute of geochemistry and analytical chemistry

Speciation of metals in natural waters is an important information about the level of toxicity of a natural object. According to numerous published data, the most dangerous form of migration of heavy metals (except mercury) is an ionic form.

However, the study of metals distribution forms in each water object is a task that requires a huge physical-chemical work.

Understanding the patterns of element distributions in surface water and the reasons for the increase in their concentrations at the regional and global level is one of the most urgent problems facing the environment. Enrichment of surface water by metals is the result of both natural processes and human activities. The anthropogenic impact in the discharge of trace elements in the environment has increased dramatically over the last century, which is associated with the ever-increasing volumes of extracted metals and their dispersal in the environment.

The aim of our research was to investigate the distribution of the metals speciation in water lakes on the Kola Peninsula under different anthropogenic load.

Samples of lakes near industrial sites were selected near the mining processing complex in Kovdor, from Lake Monche (Lovozero) near the copper-nickel manufacture. Natural waters characterized by high alkalinity and pH about 7. The iron ions at such pH values are more form hydrox- compounds and sorption aggregation compared with aluminum ions. Under conditions of high load anthropogenic, chromium ions characterized by sufficient complexing capacity, which may be due to an increase in the concentration of the metal is several times as compared with lakes without direct sources. Manganese in such conditions has a high capacity to form suspensions. The complexation of heavy metals (Cd, Pb, Cu, Zn) is modified as follows: as well as for lakes without a direct source of pollution, zinc is complexed by more than 50%, copper also forms complexes with organic matter actively due to a significant increase in concentration. Depending on the type of copper coming from the wastewater, copper may form sorption unit and the low-molecular inorganic compound.

Speciation of nickel in natural waters with a direct source of pollution range from units to sorption complexes with organic matter as was found. A significant increase in metal concentration shifts the equilibrium in the system towards formation of high-molecular compounds. An interesting feature of the distribution of elements on the forms such natural waters is increasing the complexation with organic matter for the elements of the lanthanide series. Lanthanide elements is associated elements of many rocks of the Kola Peninsula, which explains the increase in their concentration in the areas near the plant. The affinity of these elements to an organic substance as follows: Fe>Al>Zn>Ni>Cu>Pb>La>Ce>Co.

High content of technogenic elements –Ni, Cu - create conditions for competition for organic ligand and the other formation of charge. Zeta potential change occurs dynamically and not smoothly.

Middle waters (25 samples between the polluted area and the background) are characterized by 2 maxima of zeta potential. The color of the solution does not change. Turbidity and pH vary widely.
Trends 1990-2014-2018 for small lakes

Non-labile forms of nickel and cobalt are changing dynamically from 1990 to the present and this fact directly depends on episodes of maximum pollution and turbidity. The proportion of the soluble part of the iron and aluminum compounds is also reduced.

Trends 1990-2014-2018 for Imandra lake
The change in the labile forms of nickel, cobalt, and copper also fluctuates and is associated with competitive processes in Lake Imandra in certain years. It was in this lake that the highest labile cadmium contents were found in the middle of the study period.

Keywords: spetiation, metals, Arctic Lake

Revised methane emission estimate for West Siberia based on Landsat mapping of wetland types

*Shamil Maksyutov[1], Irina E Terentieva[2], Alexander F Sabrekov[2], Ilya Filippov[3], Mikhail V Glagolev[4,5]

1. National Institute for Environmental Studies, Tsukuba, Japan, 2. Institute of Ecology and Evolution, RAS, Moscow, Russia, 3. Yugra State University, Khanty-Mansyisk, Russia, 4. Institute of Forest Science, RAS, Uspenskoe, Russia, 5. M.V. Lomonosov Moscow State University, Moscow, Russia

Quantifying boreal wetland extent and wetland methane emissions is important for estimating the amplitude of methane emission feedback to climate change and the relative contribution of natural and anthropogenic emissions at the national scale. Fine-scale heterogeneity of wetland landscapes and methane emission rates poses a serious challenge for producing regional-scale estimates of greenhouse gas fluxes based on point observations and wetland maps. In order to reduce emission uncertainties at the regional scale, we mapped wetlands and water bodies in the West Siberian lowland (WSL) using a supervised classification of Landsat imagery. Mapping was guided by training data composed of high-resolution images and field data collected at 41 test areas visited for observations of methane emissions with a static chamber method. The classification scheme suited for methane emission inventory included 7 wetland ecosystem types distinguishable on high resolution (1-2 m) images constituting 9 different wetland complexes distinguishable at the Landsat resolution. To support the use of 30 m Landsat images, fractional coverage of wetland ecosystems within each wetland complex type was estimated using high-resolution images. The total area of the WSL wetlands and water bodies was estimated to be 70.78 Mha. Various oligotrophic environments are dominant among wetland ecosystems, while different fens cover only 14% of the taiga area. In WSL, taiga contributes 85% to regional methane flux and tundra only 8%. Elevated environments as forested bogs and ridges emit at the lowest rates. They account for only 2% of the regional total emissions occupying almost 40% of the wetland area. Applying the new map resulted in total methane emissions of 4.6 TgCH4/yr which is higher than the earlier estimate based on paper maps, due to larger area fraction of mesotrophic open wetlands found in the middle taiga zone. The revision resulted from the changes in fractional coverages of methane emitting ecosystems due to the fill area coverage of the WSL with Landsat-based mapping.

Keywords: wetland mapping, Landsat, methane emissions, West Siberia

A climatological study on freezing rain, freezing drizzle, and freezing fog in northeastern China

Yang Bai[1], *Tetsuya Hiyama[2], Hatsuki Fujinami[2]

1. Graduate School of Environmental Studies, Nagoya University, 2. Institute for Space-Earth Environmental Research, Nagoya University

Freezing phenomena, which derive icy ground surface over a wide area, frequently occur in cold (winter) season. Freezing phenomena, more specifically freezing precipitation, are classified into freezing rain, freezing drizzle, and freezing fog. In 2008, huge freezing rain occurred in southeastern China from early January to early February, which caused enormous economic losses and casualties. In the winter of 2010, a huge freezing rain attacked northeastern China. As a result, many airports and highways were forced to closed. Since freezing phenomena have a great influence on human activities, it is very important to explore under which weather conditions freezing phenomena will appear from a climatological point of view. Previous studies have focused on freezing rain, and explored the generation processes of freezing rain while freezing drizzle and freezing fog were not concerned. In addition, previous studies mainly focused only on the mechanism of the extreme events. None of climatological researches has been conducted based on multiple cases including freezing drizzle and freezing fog.
In this study, we investigated almost all of the freezing phenomena events which occurred at four airports of the major cities in northeastern China (Harbin, Changchun, Shenyang, and Dalian), and we analyzed atmospheric circulation pattern when freezing phenomena appeared. The aim of this study is to demonstrate the climatological features of freezing phenomena in northeastern China. The aviation meteorological reports at the above four airports is used for this study and the study period is from the 2005 to 2018 (14 years). And, the ERA-Interim atmospheric reanalysis data is also used for the analysis of large-sale atmospheric condition. The civil aviation meteorological weather reports were recorded every 30 or 60 minutes. We used meteorological data such as wind direction, wind speed, air temperature, and dew point temperature. We defined a freezing phenomenon which continued for more than three hours as one event.
We found one freezing rain and one freezing drizzle event in 14 years. On the other hand, 238 events of freezing fog in total were extracted. We found the melting process was the main reason of the freezing rain process in Shenyang airport. This was the same process as in the large-scale freezing rain event in southeastern China. In the case of the freezing drizzle event at Dalian, we found the cold air intrusion into the humid atmosphere just after a rainfall event. The sudden cold air intrusion in association with the high pressure may play a key role for the formation of freezing drizzle. Thus, it was considered that freezing drizzle could appear in case that Dalian was covered by a high-pressure system just after passing a low-pressure system.
Most of the freezing fogs were detected from nighttime to the next morning. This might be related to the surface radiative cooling. On the day of the appearance in freezing fogs, high-pressure anomalies were found around northern Japan relative to the climatological mean (for 14 years from 2005 to 2018). This made northerly winds weaker near the surface in northeastern China than those in the climatological mean of winter. Interestingly, in case of the appearance of freezing fogs in midday, stronger high-pressure anomalies were detected around Japan.

Keywords: freezing rain, freezing drizzle, freezing fog

Economic Assessment of Permafrost Degradation Effects on Road Infrastructure Sustainability under Climate Change in the Russian Arctic

*Dmitry Olegovich Eliseev[1], Boris Nikolaevich Porfiriev[2], Dmitry Andreevich Streletskiy[3]

1. Russian New University (RosNOU), Moscow, Russia; Sochi scientific research center, Russian Academy of Sciences, Sochi, Russia, 2. Institute of Economic Forecasting, Russian Academy of Sciences, Moscow, Russia, 3. George Washington University, Washington, United States; Earth Cryosphere Institute, Tyumen' Scientific Center, Siberian Branch, Russian Academy of Sciences, Tyumen', Russia

Russian regions containing permafrost play an important role in the Russian economy, containing vast reserves of natural resources and hosting large-scale infrastructure to facilitate these resources' exploitation. Rapidly changing climatic conditions are a major concern for the future economic development of these regions. This study examines the extent to which the transport infrastructure are affected by permafrost in Russia. Three model scenarios of changes in road infrastructure sustainability under permafrost thawing and degradation due to global climate change in nine Russian Arctic regions are considered. Until the current mid-century, economic assessment of the aftermath of climate change in these regions was physicogeographically based on six model climate assessments of cryogenic conditions, reflecting the most negative (scenario RCP8.5) option of the IPCC global climate change forecasts, which best fits the conditions of the Russian Arctic. The data of Russia's Transport Strategy until 2035, updated by the authors, serve as the basis for predicting road infrastructure development. An inertial (conservative) scenario of road infrastructure development in 2020–2050 shows that capital costs to maintain road infrastructure sustainability and reduce damage risks under permafrost thawing and degradation will average at least 250 m US dollars a year and will exceed 350 m. and 470 m. respectively, under the moderate and modernization scenarios. The maximum indicators will be relevant for the Republic of Sakha (Yakutia), Magadan oblast, and the Chukotka Autonomous Okrug. The implementation of the modernization scenario will require revision of the existing standards, technologies, and entire economy of the road infrastructure and capital construction favoring the development of innovative standards and construction technologies, as well as the improvement of the proposed methodology and methods of cost estimation for these purposes.

Keywords: climate change, permafrost degradation, road infrastructure, risks, development scenarios, russian arctic

Informal use of linear road infrastructure of the extraction of natural resources in Eastern Siberia.

*Viktor Bogdanov[1]

1. Institute of geography V.B. Sochava Siberian Branch of the Russian Academy of Sciences

A study on the use of linear road infrastructure as an informal road network has not been sufficiently studied. It is especially relevant in areas of intensive extraction of various natural resources.

The objectives of our study: to calculate the change in transport accessibility in connection with the construction of a new linear road infrastructure, to identify the positive and negative aspects of its use for informal transportation purposes, make an inventory, classification, and creation of a road network database including both formal and informal roads. We consider informal roads as roads outside of the existing network of public roads built, maintained and used by various organizations and individuals based on private, special goals and or informal rules.

The study area is located in the northern part of the Irkutsk region within the boundaries of the Ust-Kut and Katanga regions. It is characterized by difficult natural conditions: adverse winter temperatures, discontinuous permafrost, bogging, etc. The area had very low transport accessibility, but with the extractive industrial development the linear road infrastructure is growing rapidly.

Methods

For the project purposes, we used existing topographic materials, oil and gas field technological road maps, and remote sensing data. The calculation of the transport accessibility of this territory was made by the method of isochrons - lines of equal time spent on overcoming the space concerning the given points, using open GIS "GRASS GIS". To study the influence of roads on natural landscapes, we conducted several in-situ observations.

Results

The study area is a community of the Evenk indigenous population, which is mainly engaged in hunting and fishing. In the last 10 years, intensive logging, exploration and production of oil and gas has been carried out in the area. Accordingly, a linear road infrastructure is being built to service fields and transportation of resources.

There is a pronounced sequence in the construction of linear infrastructure.

The study area has significant forest and oil and gas resources, the company operators have long-term plans for their development. As new oil and gas fields are built and deforestation felled to the north, previously constructed technological roads become transit roads with relatively intense year-round traffic.

At the same time, there are no year-round public roads; the municipality organizes only winter roads that partially pass through abandoned geological profiles and forest roads.

We calculated transport accessibility using the linear road infrastructure of extractive companies. The

time spent on a way from the studied settlements to the transportation hubs of the region decreased to 50% in the winter period, while the transport assimilation of the entire studied territory significantly improved.

At the same time, there are other positive and negative effects of improving the transport development of the territory: the municipality's costs for maintaining winter roads are reduced, as well as the cost of delivering goods, hunters have the opportunity to get to new lands, while poaching by non-local people also increases. Field studies in key areas of Tokma and Khanda revealed landscape disturbances, replacement of the original forests with secondary birch forests, the development of thermal caste in swampy valley areas, soil heaving due to disturbance of soil cover and vegetation, and as a consequence of the development of high roads. The development of erosion processes on the slopes is intensifying.

Therefore, the studies of informal road network development have significant importance for studies of social and environmental impact of the extractive industrial development.

Keywords: road infrastructure, transport accessibility, indigenous population

Characterization of contemporary fire regimes in Russian boreal forest under impact of climate change and anthropogenic alterations: Thematic study of the Sakha Republic (Yakutia)

*Kiunnei Kirillina[1], Wanglin Yan[1]

1. Graduate School of Media and Governance, Keio University SFC

Characterization of contemporary fire regimes is still a challenging scientific task, especially in the light of climate warming and increasing human alteration to forests. This research is the first study to characterize the contemporary fire regimes in the Sakha Republic of Russia. Due to dry climate, high regional lightning activity along with increasing anthropogenic pressure on forests and forested lands, the Republic is characterized by one of the highest forests burning in the country. At the same time, since 1960s, there was detected strong warming trend, especially in the transition spring season, which affected the duration of the fire season and overall fire intensity. The problem of forest fires in the region is escalated by the fact that in the Sakha Republic still does not exist digital, spatially explicit fire database, so our first task was to develop own fire database using combination of the regional fire statistics and satellite fire estimates based on NOAA AVHRR and MODIS products in order to construct the reliable data for fire regime characterization and further use by scientists and other stakeholders.

We carried out fire activity analysis for two institutional levels. First was the regional level (the Sakha Republic) and the second forestry district level. Analysis on forestry district level was performed with the aim to capture the regional changes in the fire regime and establish whether existing significant increasing trends in the main fire variables such as fire frequency and burned area. The main focus was on the burned area as more critical one in the terms of losses.

We developed a new approach for fire regime characterization based on common statistical analysis techniques, which can be applied to any region. The study period, 1996-2018, had not been chosen at random, since 1996 the Sakha Republic underwent rapid industrialization, which we are proposing impacted the fire activity and exist satellite fire estimates.

Changes in the fire regime of the Republic were analyzed with the aim to examine the historical and recent dynamics of main fire features such as number of fires and burned area. During the study period both number of fires and burned area showed increasing trends. The same increasing trends were found at local (forestry district) level. The spatial distribution of fires across the Republic shows that the highest fire activity was observed in Central and Western forestry districts affected by both climate warming and economic industrialization accompanied by involvement of more forested lands into industrial activities and large agroindustry.

The main original part of our research was the investigation of changes in the temporal evolution of fire regimes. This analysis was performed using the Rodionov regime shift detection method. We could identify not only the character of fire trends, but also the exact time when they were occurred. It helped us to identify the causes of the increase of fire activity. The other original part of our research was the fire seasonality analysis. Using combination of regional fire statistics and satellite fire estimates we found that the fire season in the recent decades (from 2009) was started from April and continues through October. As result, were increased both duration of the fire season and total burned area extent. In the most recent

fire seasons (2017 and 2018), the total burned area was increased more than twice. To capture the impact of climate warming on fires was done the comprehensive analysis of the fire weather during extreme fire seasons.

As a final result, were prepared projections of future fire weather based on the ensemble of climate models. They are showing a high possibility of the temperature increase and intensification of drought conditions on the whole territory of the Republic which can make future fire seasons even more severe. The results of projections of fire weather were used to estimate future burned area extent based on regression modeling.

Keywords: boreal forest, forest fires, fire regimes, fire seasonality and causes, climate change, climate change and forest fires

[E] Oral | M (Multidisciplinary and Interdisciplinary) | M-IS Intersection

[M-IS02] Environmental, socio-economic and climatic changes in Northern Eurasia

convener:Pavel Groisman(NC State University Research Scholar at NOAA National Centers for Environmental Information, Asheville, North Carolina, USA), Shamil Maksyutov(National Institute for Environmental Studies), Evgeny P Gordov(Institute of Monitoring of Climatic and Ecological Systems SB RAS), Akiyo Yatagai(Hirosaki University)

Analysis of CMIP6 Multi-model Climate Change Smulations and Projections Over Northern Eurasia

*Qingyun Duan[1], Xuewei Fan[2], Chenwei Shen[2], Chiyuan Miao[2]

1. Hohai University, 2. Beijing Normal University

Northern Eurasia has observed an above average increase in surface air temperature over the last century compared to other parts of the world and is the region most sensitive to climate changes as increased temperature has a huge impact on its water and energy cycles and on its ecosystem. This presentation summarizes an analysis of the climate simulations over the period 1901–2014 and climate change projections over the period 2015-2100 under four different Shared Socioeconomic Pathways (SSPs) from 16 global climate models (GCMs) participating in the sixth phase of the Coupled Model Intercomparison Project (CMIP6). Simulations and projections of surface air temperature and precipitation over the study regions were intercompared and were compared to multi-model consensus simulations and projections obtained by Bayesian Modeling Averaging (BMA) method. The results show significant differences among results of individual GCMs and BMA multi-model consensus results are the most reliable when compared to observations in terms of spatial averages and seasonal averages. BMA method is also useful in providing uncertainty information about the projections of future climate changes. Overall, CMIP6 results show an increasing trend in average air temperature over Eurasia.

Keywords: CMIP6, Multi-model consensus simulations and projections, Climate Change over Northern Eurasia

Evaluation of a snow scheme in Integrated Land Simulator

*Tomoko Nitta[1], Kei Yoshimura[1]

1. Institute of Industrial Science, the University of Tokyo

Accurate representation of land processes is crucial for many purposes, such as climate simulation, weather and flood prediction, and water resources assessment. To realize high-accuracy land simulations with rapid model development cycles, we have been developing a new land simulation framework, Integrated Land Simulator (ILS). ILS consists of multiple land components and an independent I/O component. They are executed based on an MPMD (Multiple Program-Multiple Data) approach using a general-purpose coupler Jcup. Currently, ILS includes a physical land surface model, Minimal Advanced Treatments of Surface Interaction and Runoff (MATSIRO), a next-generation river model, CaMa-Flood, and an independent I/O component. MIROC5 version of MATSIRO was rewritten in the modern structure. Using the reference site dataset prepared in ESM-SnowMIP project, we evaluated a snow scheme in ILS. The result shows that the reproducibility varies by sites but there are some systematic biases such as cold biases in soil temperature in winter. Future directions of the model improvement will be discussed in the presentation.

Keywords: land model, snow scheme

Closing water budgets of the three great Siberian River Basins

*Pavel Shabanov[1], Ambroise Dufour[1], Olga Zolina[2], Sergey Gulev[1], Martin Wegmann[3]

1. Shirshov Institute of Oceanology, Russian Academy of Sciences, 2. Institut des Géosciences de l' Environnement, Université Grenoble Alpes, 3. World Meteorological Organisation, Geneva

The basins of the three great Siberian rivers –Ob, Yenisei, Lena –have come under scrutiny as symptomatic of the effects of Arctic amplification on regional water cycles. As the air moistens, Zhang et al. (2013) report more vapour convergence and greater discharges into the Arctic Ocean. The thawing permafrost is also extremely relevant. However, the warming signal can display counterintuitive patterns (Wegmann et al., 2018) and the consequences on moisture fluxes are not straightforward (Dufour et al., 2016).

This study draws on several reanalyses including ERA-5 (Hersbach et al., 2019). The discharge data before 1999 comes from the Global Runoff Data Centre (GRDC, 2014) and from the Arctic Great River Observatory (Shiklomanov et al., 2018) hitherto. We also consider an intermediate product : river discharge from the Global Flood Awareness System at 0.1° resolution (GloFAS v2.1). This is the output of the HTESSEL land model and LISFLOOD river routing model, run at 0.1° resolution.

We replicate the significant moisture convergence trend found in Zhang et al., 2013 for the extended 1948-2018 period. However, the trend breaks down for the shorter 1979-2018 time windows and in other reanalyses except MERRA-2 over 1980-2018. The discharge observations summed over the mouths of all three rivers are significantly increasing in the long run but not during the satellite era. The initial findings appear sensitive to the starting and ending points of the study period. We believe part of the explanation is to be found in warm Arctic - cold Siberia pattern (Wegmann et al., 2018). The weak increasing trend in convergence and discharge is not driven by a straightforward global warming trend. Rather, it is the consequence of atmospheric variability which is inherently more noisy than thermodynamical signals.

Nearly all reanalyses exhibit significant negative net precipitation trend over the satellite era with the exception of NCEP NCAR R1 and MERRA-2. Further analysis indicates that these trends are due to a decrease in precipitation rather than an increase in evaporation. The decrease in precipitation occurred mainly in summer and is absent in the Global Precipitation Climatology Project. The conflicting trends between convergence and net precipitation indicate a severe unbalance of moisture budgets over Siberia. The GloFAS product also displays a decreasing net precipitation trend - a consequence of the HTESSEL land model being forced by reanalysis precipitation fields.

Over the Siberian river basins, there are weak long-term increasing trends of moisture convergence and river discharge. The reanalyses show perplexing negative precipitation trends in contradiction with the increasing/constant moisture transport. The causes of either tendencies are likely atmospheric variability and strong analysis increments.

Zhang, X., He, J., Zhang, J., Polyakov, I., Gerdes, R., Inoue, J., & Wu, P. (2013). Enhanced poleward moisture transport and amplified northern high-latitude wetting trend. Nature Climate Change, 3(1), 47.

Dufour, A., Zolina, O., & Gulev, S. K. (2016). Atmospheric moisture transport to the Arctic: Assessment of reanalyses and analysis of transport components. Journal of Climate, 29(14), 5061-5081.
Wegmann, M., Orsolini, Y., & Zolina, O. (2018). Warm Arctic —cold Siberia: comparing the recent and the early 20th-century Arctic warmings. Environmental Research Letters, 13(2), 025009.
Hersbach, H., Bell, B., Berrisford, P., Horányi, A., Sabater, J. M., Nicolas, J., ... & Dee, D. (2019). Global reanalysis: goodbye ERA-Interim, hello ERA5. ECMWF Newsl, 159, 17-24.
GRDC (2014): Global Freshwater Fluxes into the World Oceans / Online provided by Global Runoff Data Centre. 2014 ed. Koblenz: Federal Institute of Hydrology (BfG), 2014.
Shiklomanov, A.I., R.M. Holmes, J.W. McClelland, S.E. Tank, and R.G.M. Spencer. 2018. Arctic Great Rivers Observatory. Discharge Dataset, Version 20191228. https://www.arcticrivers.org/data
GloFAS v2.1, 2019-11-05, DOI: 10.24381/cds.a4fdd6b9

Keywords: water cycle, moisture transfer, reanalysis data

Evaluation of orographical precipitation over Central Asia and its super-ensemble and downscaling simulations to evaluate precipitation change under the warming environment

*Akiyo Yatagai[1], Saki Yanagisawa[1], Kumar Vinay[2], Ayano Senda[1], Minami Masuda[1]

1. Hirosaki University, 2. Texas A&M University

Following JpGU 2019 presentation, here we apply the multimodel superensemble (MMSE) technique to monthly precipitation of Central Asia(CA, 50E-85E/35N-60N). We focus on our results in spring. As reference datasets, we used GPCC monthly precipitation as well as APHRODITE precipitation. First we apply MMSE to CMIP5 “historical” precipitation according to each monthly precipitation. We use data for 1980 –1990 (11 years) and all registered 20 climate models from CMIP5 archive. We used 10 years data for “training” to decide weighting parameters according to APHRODITE, then we “simulate” the rest of 1 year with the parameters. Then we compared the “simulated” value with APHRODITE data of the year. We repeated this process for 11 times, so that every year’s data is forecasted by MMSE.

Comparison of each model precipitation pattern to observations, the correlation coefficients (CC) between MMSE results are higher than that of each models for all years. We also made SUP with top 6 models that show high CC between time series of CA mean precipitation and that of each model. Namely, we select the models that simulate interannual variation of total precipitation to the CA area, because it was reflected how each model simulate the dynamical structure by the observed force. In JpGU2019, we evaluate these CC over whole CA, however, now we focused on Tianshan/Pamir area (65-80E, 37-45N) to calculate horizontal pattern of monthly precipitation and temporal changes in areal mean precipitation.

Results show that highest correlation has been made by the airs with using APHRODITE for training than that of GPCC. However, the top 6 models for showing interannual variability showed minus correlation to the precipitation of validation years. Before applying the parameters to future forecasts, we need to evaluate the interannual variability of the precipitation change with a long-term dataset with APHRODITE type orographic precipitation.

Keywords: Precipitation, Central Asia, superensemble forecast

ENVIRONMENT CHANGES IN THE EURASIAN ARCTIC

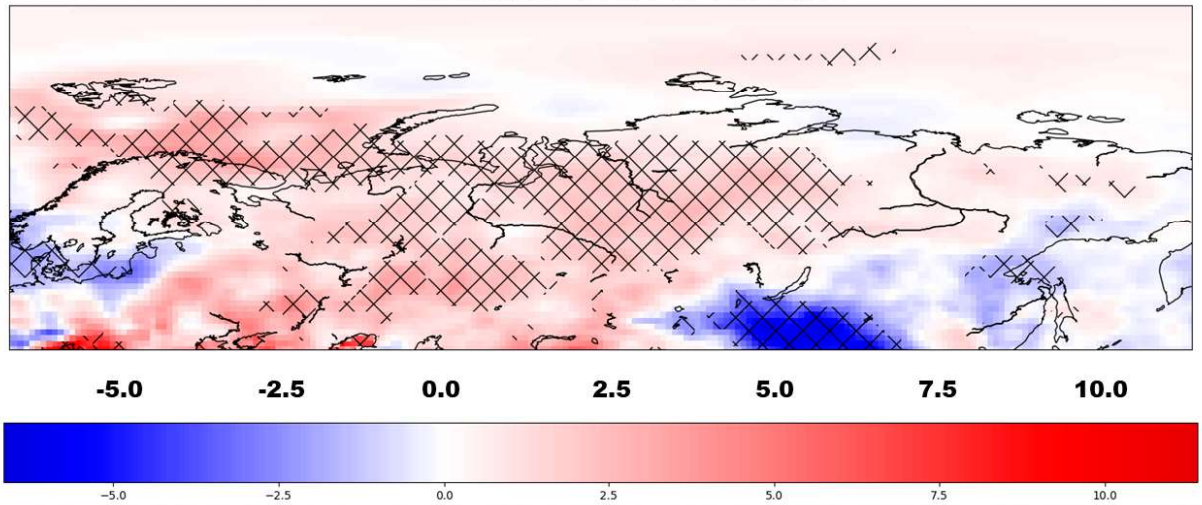
*Pavel Groisman[1,2,3], Sergey Gulev[2], Ambroise Dufour[2], Ge Peng[1], Dmitry Streletskiy[4], Nina Speranskaya[5], Nadezhda Tchebakova[6]

1. North Carolina Institute for Climate Studies, North Carolina State University, USA, 2. Institute of Oceanology, Russian Academy of Sciences, Russia, 3. Hydrology Science and Services Corporation, USA, 4. George Washington University, USA, 5. State Hydrologic Institute, Russia, 6. Forest Institute of the Siberian Branch of the Russian Academy of Sciences, Russia

Environment changes in the Eurasian Arctic are among the largest during the past century. Surface air temperature increases are most pronounced in spring and winter. In the winter season we observe the largest interannual temperature variability and in spring the warming is accompanied by a regional-wide increase in Convective Available Potential Energy (CAPE) in the atmosphere (see attached Figure). In other seasons, there is a steady temperature increase by 1 to 2°C per century. The cold season temperature increases play a relatively low direct role in the Arctic environmental changes. However, in the cold season, the Arctic temperatures controls the temperature difference between the tropics and the high latitudes. This difference has already significantly declined and impacted the strength of the westerlies and the heat transport from the North Atlantic Ocean into the continental extratropics. This decline, among others, results in higher winter variability over Northern Eurasia, including the strengthening of the winter blocking events. More and more frequently in the last winters, we observe destructions in the circumpolar atmospheric vortex that generally prevents the cold Arctic air masses to enter the lower latitudes. This may affect the entire cold season weather over the Northern Extratropics as we used to know. Average annual and summer rates of warming are 1.6°C and 1.2°C per 100 years respectively. During the last 60 years these rates have nearly doubled. The summer temperatures in the Eurasian Arctic began their rise only about 30 years ago and since 2005 their values in each year remained among the highest in the instrumental record. This summer warming plays a critical role in environmental changes in the Arctic. It controls the vegetation season onset and ecological zone shifts, the demolition of the multi-annual sea ice, and the permafrost thawing. The last factor impacts the well-being of man-made infrastructure in the Arctic. Vegetation season onset and ecological zone shifts have been observed across the entire Northern Eurasia. In warming and drying climates during the 21 century simulated by 2.6 and RCP 8.5 scenarios of the 20 GCMs ensemble of CMIP5, the northern zono-biomes (tundra, forest-tundra, northern woodlands) neighboring the Arctic were predicted to decrease and shift northwards while forest-steppe, steppe, and drylands were predicted to extend over Eurasia. In the end of each warm season in the Arctic, the extent of the Arctic sea ice is steadily declining at about 13.5% per decade since the time of establishment of the circumpolar satellite sea ice monitoring in 1979. Furthermore, the structure of the sea ice is changing leaving a lesser amount of multi-annual ice and making the sea ice cap thinner. For the Arctic as whole, melt onset and ice opening are getting earlier at a rate of over 5 days per decade, making it more transparent to the solar radiation and upward heat fluxes from the ocean. The permafrost warming rates in Northern Eurasia are among the highest documented globally. Permafrost degradation negatively affects well-being on communities upon it and has severe economic consequences. Recent study estimated that under RCP 8.5 scenario more than 50% of all residential housing and 20% of critical infrastructure will be severely affected by permafrost degradation by mid-21 century. The cost of mitigation due to permafrost degradation is likely to exceed 100 billion USD.

Keywords: Eurasian Arctic, regional climatic change, impact on infrastructure due to environment changes, environmental changes

Spring (MAM) Convective Available Potential Energy Trends (1979-2018)



◈ ERA interim reanalyses; CAPE trends (J kg^{-1} $decade^{-1}$); regions with statistically significant at the 0.05 level CAPE trends are hatched.

How much variation in land surface phenology can seasonal climate oscillations explain at pasture scale in Kyrgyzstan?

*Monika Anna Tomaszewska[1], Geoffrey M. Henebry[1,2]

1. Center for Global Change and Earth Observations, Michigan State University, East Lansing, MI 48823, USA, 2. Department of Geography, Environment, and Spatial Sciences, Michigan State University, East Lansing, MI, 48824, USA

Interactions of the atmosphere with the oceans play an essential role in shaping climate and its variability. Naturally-occurring dynamical modes result in teleconnections—correlated weather patterns between remote locations—that can account for a substantial amount of large-scale climatic variability, and can play significant roles in determining seasonal weather anomalies. In developing economies, where the rural resource base relies on favorable weather, such anomalies may be very deleterious. For example, in montane Central Asia, where the regional economy is grounded in agropastoralism and the climate is cool and dry due to elevation, precipitation received outside the growing season may determine the difference between success and failure in annual production.

We sought to assess whether the impacts of teleconnections are detectable and significant in early season dynamics of highland pastures across five rayons in Kyrgyzstan from 2001 through 2017. Specifically, we focused on the explanatory and predictive power of five seasonal (winter, spring, and summer) climatic oscillations on land surface phenology (LSP) based on fine spatial resolution data. We included two sets of environmental variables already shown to influence LSP in these highland pastures: two snow cover seasonality metrics derived from the MODIS snow cover product—the last date of snow (LDoS) and the number of snow covered dates (SCD)—and three terrain characteristics derived from the NASA SRTM Digital Elevation Model—elevation, slope, and the TRASP index, a linearization of aspect.

We characterized early season vegetation growth using two phenometrics derived from the LSP model that links the normalized difference vegetation index (NDVI) derived from Landsat data at 30 m with accumulated growing degree-days (AGDD) derived from MODIS land surface temperature data at 1 km: (1) the maximum modeled NDVI or Peak Height (PH); and (2) the quantity of AGDD required to reach the PH or Thermal Time to Peak (TTP).

We used Spearman’s rank correlation to assess the strength and significance of geographic differentiation of the phenometrics’ linkages to environmental variables. PH showed significant but weak correlations with TTP (positive in western rayons but negative in eastern rayons), and moderate positive relationships with LDoS and SCD appearing only in one northeastern rayon. Of the 15 seasonal indices we evaluated, only two showed significant (positive or negative) correlation with PH. In contrast, TTP showed consistently significant strong negative relationships with LDoS, SCD, and elevation, but very weak significant positive correlations with three winter modes and only in western rayons.

Second, we used Partial Least Squares regression to investigate how much of additional variation in LSP metrics can be explained by seasonal oscillation indices. PLS modelling showed that thermal time accumulation could be explained mostly by elevation and snow cover metrics, explaining 55–70 % of the observed variation in TTP. Only three oscillation indices (two summer and one spring) had a significant relationship with TTP, but contribution of each to the model’s predictive power was negligible. PLS models were able to explain no more than 29% of PH variability. Similarly, just two oscillation indices (one spring and one summer) were significantly linked to PH, but their predictive contribution was minimal. Influences of climate oscillations were too weak to provide effective seasonal prediction of LSP at fine spatial resolution. Rather, the effects of climatic oscillations on highland pastures phenology were overshadowed by terrain features (primarily elevation) and the timing of snow cover seasonality.

Whether seasonal climate oscillation indices may provide some useful information about growing season conditions remains a provocative question, particularly given the multiple environmental challenges facing agropastoralism as a sustainable livelihood in montane Central Asia.

Keywords: Land-atmosphere interactions, Snow seasonality, Montane Central Asia, MODIS, Landsat, Phenology modeling

[E] Poster | M (Multidisciplinary and Interdisciplinary) | M-IS Intersection

[M-IS02] Environmental, socio-economic and climatic changes in Northern Eurasia

convener:Pavel Groisman(NC State University Research Scholar at NOAA National Centers for Environmental Information, Asheville, North Carolina, USA), Shamil Maksyutov(National Institute for Environmental Studies), Evgeny P Gordov(Institute of Monitoring of Climatic and Ecological Systems SB RAS), Akiyo Yatagai(Hirosaki University)

BIOAVAILABILITY OF METALS DEPENDING ON THEIR SPECIATION IN NORTHERN LOW-SALINE WATER

*Tatyana I Moiseenko[1], Marina I Dinu[1]

1. Russian

The bioavailability and ecotoxicity of metals are determined by their speciation, which in their turn depend on the parameters of the aqueous environment: the content of calcium, humic acids, pH, temperature and a combination with other metals. The paper highlights metal speciation calculating model which is based on mathematical modeling of the chemical reactions in natural waters. Metal concentrations (Hg, Cd, Pb, Ni, Cu, Al, Sr) were determined and their speciation in water was calculated for 22 research areas in the Kola region. At these same points, the accumulation of metals in various systems of the fish was studied (as exemplified by whitefish). It is shown that the biogeochemical activity of metals determines the ratio of labile and unlabele speciation in water. In the zones of distribution of the non-ferrous industry effluents, metal aqua-ions of the studied metals prevail; during the distribution, the ratio changes in accordance with the metals activity. The bioavailability of metal speciation is estimated depending on the aqueous geochemical conditions and, accordingly, the speciation of metals (*in situ)* based on the results of original studies in the lakes of the Kola North of Russia. The connection between the metal contents in fish and metal content in water have been identified using multidimensional scaling and RDA-techniques.

Keywords: metals, accumulation, speciation

Divergent responses of ecosystem water-use efficiency to extreme droughts over Northern Eurasia

*Mengtian Huang[1], Panmao Zhai[1]

1. Chinese Academy of Meteorological Science

Water, as one of the most basic environmental factors of terrestrial ecosystems, is of significant importance for the thermal acclimation and metabolism of terrestrial vegetation. Water availability is a major limitation to the distribution and productivity of terrestrial vegetation. At the ecosystem scale, water-use efficiency (WUE) is generally defined as the ratio of annual gross primary productivity (GPP) and annual evapotranspiration (ET). It indicates the coupling of the carbon and water gross fluxes exchanged between ecosystem and the atmosphere, and monitors the adaptability of an ecosystem to variable climate conditions. Previous researches have concluded a significant positive trend in WUE in most areas of terrestrial ecosystems over the globe, as a result of the increasing CO_2 concentration and climate change during the past several decades. At the same time, extreme climatic events, such as heat waves, drought etc., occurred across the globe. These changes have likely altered the ecological functioning of terrestrial ecosystems, as well as the structure of plant communities. Nevertheless, how terrestrial ecosystem WUE responds to extreme climatic events is still poorly understood.

In this study, we examine the impacts of extreme drought events on ecosystem WUE during 1948-2008, with a particular focus on distinguishing response of different biomes over Northern Eurasia. The responses of ecosystem WUE to extreme droughts differed among different regions. For northern high latitudes (north of 50°N), hot days and increasing solar radiation were usually concurrent with droughts, which to some extent eliminate the limitations of low temperature and insufficient light on photosynthesis. In this case, vegetation productivity was potentially enhanced, with higher ecosystem WUE during drought years than during normal years. By contrast, for biomes in relatively arid climate conditions, extreme drought years tended to aggravate the water stress for vegetation growth. Consequently, in these regions, vegetation photosynthesis was largely suppressed with significantly lower ecosystem WUE observed. Our results, therefore, highlight that background climate is a crucial factor determining drought impacts on terrestrial carbon-water interactions. Further increases in baseline aridity could therefore exacerbate the impact of punctuated droughts on terrestrial ecosystems.

Keywords: water-use efficiency, droughts, terrestrial ecosystems

Homogeneity analysis of air temperature and wind speed records of the Azov-Black sea region

*Natalia Alexandrovna Lemeshko[1], Vladislav P. Evstigneev[2,3], Maxim P. Evstigneev[2], Pavel Ya. Groisman[4]

1. SPBU, 2. IPTS, 3. SevSU, 4. IORAS

In the study a homogeneity of long-term hydrometeorological data series of monthly air temperature and wind speed was tested using routine observations at thirteen sea coast stations of the Azov-Black Sea region for the whole period. Test for time-series homogeneity was carried out by method introduced by Wang et al. who used penalized maximal t - and F-tests to detect mean value shifts in the data with lag-1 autocorrelation. The method is implemented as a recursive testing algorithm within RHtestsV3 package for R software environment for statistical computing and graphics. Detection of inhomogeneity by means of RHtestsV3 was carried out in the mode “with a reference series” for monthly air temperature and in the mode “without a reference series” for monthly wind speed. As a result, inhomogeneity shifts supported by metadata were detected and adjusted. The main sources of heterogeneity of meteorological observations are as follows: meteorological site relocation, changes in instrument exposure due to urbanization, changes in instrument mounting and sheltering, changes in type of the instrument and terms of observations. Only 3 among 13 stations have homogeneous data series both for air temperature and wind speed. For all the rest stations, only homogeneous data series more accurately reflect climate change dynamics general for the Azov-Black Sea region. Therefore, application of adjusted climatic data series instead of initial one is reasonable for inference making about climatic tendencies in the region under study and is necessary stage of climate treatment. The validity of ready-to-use algorithm was confirmed enabling RHtestsV3 introduction into climatological datasets processing.

This work was supported by the RFBR project No. 18-05-01073

Keywords: data series inhomogeneity , climatological data series treatment, climatological inhomogeneity adjustment

Soil response to sub centennial climate change

*Natalia Alexandrovna Lemeshko[1], Vladislav P. Evstigneev[2,3], Alexey V. Rusakov[1], Pavel Groisman[4]

1. SPBU , 2. IPTS , 3. SevSU, 4. IORAS

The most inertial object of the climate system is the lithosphere, including soil. To study the impact of modern climate change on agricultural soils, which are currently under wild cenoses, a special technique is being developed. For its development, the vast territory of the Yaroslavl Volga region was selected, for which we have data on the morphological and genetic properties of agricultural soils for more than 40 years. In order to obtain a climate-dependent response of soils to the current scale of global warming, data on the evolution of soils, parent rocks, vegetation, and also the intensity of anthropogenic impact are used. The methodology is based on a comparison of the climatic component for two periods - 1961-1990 and 1991-2018. The analysis of the variability of air temperature, precipitation, temperature totals of more than 10 °C and agroclimatic indices for these periods. A joint analysis of changes in soil properties and climatic indicators will allow us to evaluate the speed of soil processes and soil fertility and become the basis for modeling soil climate for the future.

This work was supported by the RFBR project No. 19-29-05243.

Keywords: global warming, climate indicators, soil climate

Climate change impacts on seed quality and distribution of light-needled *Pinus sylvestris* and *Larix* spp. in Northern Eurasia in a warming climate

*Nadezhda Tchebakova[1], Elena I. Parfenova[1], Elena V. Bazhina[1], Nina A. Kuzmina[1], Pavel Y. Groisman[2]

1. Institute of Forests, Siberian Branch, Russian Academy of Sciences, 2. NC State University Research Scholar

Global simulations have demonstrated the potential for profound effects of climate change on the distribution of terrestrial ecosystems and individual species at all hierarchical levels. We modeled progressions of potential forest types, dominant tree species and their seed zones (climatypes) in Siberia during the 21st century. We developed and used large-scale bioclimatic models and statistical seed models to predict forest types and seed crops in a warming climate. All simulations were run for the baseline period 1961-1990 and for the mid- and end of the century. We ran twenty global circulation models from CMIP5 (AR5) and used two climate change scenarios RCP 2.6 (less warming) and RCP 8.5 (greater warming) to provide a range of warming. Ecological-bioclimatic modeling projects substantial vegetation changes: biomes shift northwards; area of conifer forest decreases and grasslands increases. The zone at risk of forest loss in Siberia would extend northwards. To minimize negative consequences and benefit from climate change in Siberian forests potential adaptive measures may be introduced depending on management goals. A genetic approach is to assist trees and forests to adapt to new climates by transferring seed to locations that are suitable to the seed zones of future climates. A bioclimatic model of *Pinus sylvestris* seed quality and productivity that relates seed weight and climates ($R^2 = 0.74$) was used to map the seed weight distributions in new CMIP5 RCP 2.6 and RCP 8.5 climates. Seed weight isolines would shift northwards in a warming climate: as far as 500 km in the moderate scenario and up to 1000 km in the extreme scenario. In the cold climate of Siberia pine and larch seed production may benefit from climate warming and would favor to expanding areas of productive forests.

The study was supported by RFBR grant # 20-05-00540.

Keywords: Climate change , Boreal forest, Seed zones , Seed quality and distribution, Pinus sylvestris and Larix spp. , Northern Eurasia

Northern Eurasia Future Initiative (NEFI), Update

*Pavel Groisman[1,2,3]

1. NC State University Research Scholar at NOAA National Centers for Environmental Information, Asheville, North Carolina, USA, 2. Shirshov Institute of Oceanology, Russian Academy of Sciences, Moscow, Russia , 3. Hydrology Science and Services Corporation, Asheville, North Carolina, USA

NEFI was conceived in 2015 as a successor of the Northern Eurasia Earth Science Partnership Initiative (NEESPI; ***http://neespi.org***). In 2016, a NEFI White Paper was posted at ***http://nefi-neespi.org/***. This White Paper was converted and expanded into two peer-reviewed programmatic NEFI Science Plan papers (Monier et al. 2017; Groisman et al. 2017). Being focused on the same region, the difference between two Initiatives stems from their major Science Questions: (1) NEESPI: How do Northern Eurasia' s terrestrial ecosystems dynamics interact with and alter the biosphere, atmosphere, cryosphere, and hydrosphere of the Earth? (2) NEFI: How to provide in Northern Eurasia a sustainable societal development (economy well-being, activities, health, and strategic planning) in changing climate, ecosystems, and societies? In other words, while NEESPI foci were on understanding of the processes that have and will be occurred over Northern Eurasia, NEFI foci are to answer questions about what should be done for the human well-being in the changing natural and social environments of the region. Currently, NEFI includes 30 international projects devoted to the Arctic, Eurasian boreal forest zone, and the Dry Land Belt of Northern Eurasia. Each year, the NEFI active organizes three or more dedicated NEFI Sessions at the AGU, JpGU and SCERT Conferences. NEFI Special Issue of the *Environ. Res. Lett.* is being published (currently, the Issue has 35 papers accepted and 23 manuscripts are in the review process). The deadline for the article submissions is June 30, 2020. Incomplete list of NEFI publications in 2018-2019 includes about 50 per-reviewed papers and book chapters. NEFI is open for joining of other research groups.

References:

Groisman et al. 2017: Northern Eurasia Future Initiative (NEFI): Facing the challenges and pathways of global change in the twenty-first century. *Progress in Earth and Planetary Science*, **4**:41.

Monier et al. 2017: A Review of and Perspectives on Global Change Modeling for Northern Eurasia. *Environ. Res. Lett.*, **12**: 083001.

Keywords: Northern Eurasia, Environment and socio-economic changes, Climate change