Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)


MIS003-01 Room:104 Time:May 26 14:15-14:40

# International studies in the East-Siberian Arctic Shelf during the last eleven years (1999-2010): An overview

Valentine Sergienko[1*], Natalia Shakhova[2], Igor Semiletov[2]

[1]Far Eastern Branch Russ. Academy of Sci., [2]International Arctic Research Center

The Arctic Ocean is surrounded by permafrost, which is being degraded at an increasing rate under conditions of warming which are most pronounced in Siberia and Alaska. A major constraint on our ability to understand linkages between the Arctic Ocean and the global climate system is the scarcity of observational data in the Siberian Arctic marginal seas where major fresh water input and terrestrial CNP fluxes exist. The East-Siberian Sea Arctic Shelf (ESAS) has never been investigated by modern techniques despite the progress that has been made in new technologies useful for measuring ocean characteristics of interest. In this multi-year international project which joins scientists from 3 nations (Russia-USA-Sweden), and in cooperation with scientists from other countries (UK, Netherlands), we focus on the ESAS which is a poorly explored area located west from the U.S.-Russia boundary. In this report we overview the main field activities and present some results obtained during the last eleven years (1999-2010).

Siberian freshwater discharge to the Arctic Ocean is expected to increase with increasing temperatures, potentially resulting in greater river export of old terrigenous organic carbon to the ocean. Our working hypothesis was that rivers integrate the variability in the components of the hydrometeorological regime, including soil conditions, permafrost seasonal thaw, and thermokarst development. All these variables determine atmospheric and ground water supply into the rivers and chemical weathering in their watershed. We found that 1) carbon dioxide and methane fluxes are significant (and non-accounted) components of the carbon cycling in the Arctic Ocean; 2) transport of eroded terrestrial material plays a major role in the accumulation of carbon in the ESAS; 3) the seabed is a major CH4 source over the ESAS; 4) eroded carbon is biodegradable; 5) oxidation of eroded carbon onshore and offshore is a strong source of carbon dioxide. Thus, studying carbon cycling in the East Siberian Arctic shelf seas has a high scientific priority for quantification of the regional carbon budget and evaluation of the role of the Arctic in the global carbon cycling. These studies in the coastal zone are of a special importance, because there the characteristics of carbon exchange with atmosphere are not yet known and a redistribution of carbon between terrestrial and marine environments occurs. Initial scientific plan for the next decade will be presented.

Our studies have been supported by the Russian Foundation for Basic Research (since 1994), International (Soros) Scientific Foundation, ISF (1994-1995), Russian Government and ISF (1995), McArthur Foundation (2000-2001), Far Eastern Branch of the Russian Academy of Sciences (since 2003), International Arctic Research Center (since 2001), NSF (since 2003), NOAA (since 2005), Stockholm University (since 2007), and Wallenberg Foundation (since 2008).

Keywords: Arctic Ocean Shelf, carbon cycle, permafrost thaw, methane, East Siberia

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)


MIS003-02 Room:104 Time:May 26 14:40-15:00

# Methane emission observations and inventory for West Siberian mires

Shamil Maksyutov[1*], Irina Kleptsova[2], Oleg Krasnov[3], Mikhail Glagolev[4]

[1]NIES, Tsukuba, [2]Yugra State Univ., Khanty-Mansyisk, [3]Inst Atm. Optics, Tomsk, [4]Moscow State Univ, Moscow

West Siberia is one of the most paludified regions in the world with the mire area of 68.5 Mha. Since the previously published estimations of the regional CH4 flux varied widely from 2 to 22 MtCH4yr$^{-1}$, long-term and large-scale investigations of $CH_4$ emission were established to complement existing data. About 1900 methane flux measurements were made during the summer-autumn of 2007-2010 by a static chamber method. Seasonal variation is observed at one site with automatic chambers for various micro-landscapes. All variety of wetland types was reduced to 8 micro-landscape types: palsas, peat mats, ponds, forested bogs, fens, poor fens, oligotrophic hollows and ridges. Mire micro-landscapes of 36 key sites distributed in 7 zones of West Siberia were observed. Emission data were generalized into a spatial emission model based on a fractional area coverage map of mire micro-landscapes, methane emission periods for each zone and methane flux probability density distributions for each micro-landscape type in these zones. The methane emission map with the resolution 0.5x0.5 deg was created. It was confirmed that palsas, forested bogs and ridges had the lowest methane fluxes (1st/2nd/3rd quartiles are -0.04/0/0.05 mg$CH_4$m$^{-2}$h$^{-1}$ for palsas, 0.06/0.26/0.7 mg$CH_4$m$^{-2}$h$^{-1}$ for forested bogs, 0.01/0.28/0.67 mg$CH_4$m$^{-2}$h$^{-1}$ for ridges) while the peat mats and non-forested mires had the highest ones (2.05/4.1/5.89 mg$CH_4$m$^{-2}$h$^{-1}$ for peat mats, 1.23/2.84/5.55 mg$CH_4$m$^{-2}$h$^{-1}$ for fens combined with poor fens and oligotrophic hollows). Very high fluxes, reaching hundreds of mg$CH_4$ m$^{-2}$h$^{-1}$, were observed in some ponds (1.44/7.85/33.84 mg$CH_4$m$^{-2}$h$^{-1}$). The version Bc8 of the model estimates the total flux from all Western Siberia mires at 3.91 Mt$CH_4$yr$^{-1}$.

Keywords: emission inventory, methane, flux map, Siberia

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)


MIS003-03 Room:104 Time:May 26 15:00-15:20

# Projected Change in Hydrological Extremes in China Under Climate Change Scenarios

Qingyun Duan[1*], Chiyuan Miao[1]

[1]Beijing Normal University, Beijng, China

Over last 40 years, China's climate has undergone noticeable changes. It is particularly evident that North China has seen a persistent decline in annual precipitation amounts. This is accompanied by increases in flooding in South China and overall temperature increase over entire China. In this paper, we look to quantify the changes in precipitation and temperature extremes in China over the past 40 years using observations and model outputs from CMIP3 data archive. We will also investigate how these changes may manifest in the 21st century under various climate change scenarios. We will employ the Bayesian multi-model ensemble methodology developed by Duan and Phillips to obtain the expected changes as well as the uncertainty estimates. The Bayesian multi-model ensemble methodology and preliminary results will be presented at this meeting.

Keywords: Climate change, hydrological extremes, Bayesian multi-model ensemble

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)


MIS003-04 Room:104 Time:May 26 15:20-15:40

# Data set of physical snow parameters obtained by snow surveys in Siberia

Konosuke Sugiura[1*], Tetsuo Ohata[2]

[1]JAMSTEC/IARC UAF, [2]JAMSTEC

Snowpack conditions in Siberia are sensitive to a change in a climate because Siberia faces the Arctic Ocean and is underlain by discontinuous permafrost. The snow surveys in Siberia have been carried out for clarifying the differences of snow-cover characteristics in Siberia and Alaska, for better understanding snow processes in the Arctic Climate System and for reducing the uncertainty of reliably estimating the amount of snow in the cryosphere. The traverse lines in Siberia were set to the south of Yakutsk for Neriungri and to the east of Yakutsk for Oymyakon. The snow depth using a sounding rod, the snow water equivalent using a cylindrical snow sampler with a cross-sectional area of 0.005-m2, the snow surface hardness using a push gauge, the snow type and size using a snow grain size gauge, the altitude, latitude and longitude using a handy-type GPS were measured. In addition, the maximum, the minimum, and the mean of the particle size of each snow layer were recorded, and the photograph of the snow particles of each snow layer and the snowpack view is saved. It was found that the types of the upper snow layer in Siberia are composed of decomposing and fragmented precipitation particles and faceted crystals and that of the lower snow layer is typically well-developed depth hoar. The snow water equivalents in Siberia slightly increase with an increase in altitude. The increase ratio of the snow water equivalent due to altitude in the east of Yakutsk for Oymyakon is smaller than that in the south of Yakutsk for Neriungri. This presentation will describe the progress and present preliminary results of snow surveys in Siberia, including this winter. The snow surveys in Siberia are continuously planned. These continuous snow survey data will enable us to further analyze and provide the in-situ date for calibration and validation of satellite observations and climate models.

Keywords: snow survey, Siberia, snow depth, snow water equivalent, snow density, snow type

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)


MIS003-05 Room:104 Time:May 26 15:40-16:00

# Changes in Snow Cover Characteristics over the Asian part of Russia

Olga Bulygina[1*], Pavel Groisman[2], Richard Knight[3], Vyacheslav Razuvaev[1]

[1]RIHMI-WDC, Obninsk, Russian Federation, [2]UCAR at NOAA NCDC, Asheville, NC, USA, [3]STG, Inc,. Asheville, NC, USA

Since 1881, the annual surface air temperature in Northern Eurasia has increased by 1.5K and in the winter season by 3K. In the Northern Asia and over the interior of the continent (in Siberia) this warming has been ”slightly” weaker in winter and stronger annually and in all other seasons (e.g., during the past 130 years with standard instrumental observations in Siberia, the annual and winter surface air temperatures have increased by 1.8K and 2.4K respectively). Nearby to the north in the Arctic Ocean, the late summer sea ice extent decreased by 40% exposing a near-infinite source of water vapor for the dry Arctic atmosphere in early cold season months. Both large-scale processes, global warming and the Arctic sea ice retreat, substantially affected the cold season climate in this part of the world. Its duration, severity and frequency of cold spells, frequency of thaws and ”cyclonic” days favorable for snowfall (with negative but relatively mild temperatures) have changed in the past several decades causing changes in various snow cover characteristics over the interior regions of Eurasia, first of all over the Russian Federation east of 60E (Asian Russia). Presentation will describe the contemporary changes of these characteristics for the 1966-2010 period.

For our analyses we used the NOAA snow cover satellite monitoring data from October 1966 to 2010, a standard suite of synoptic observations that for snow cover includes snow depth, snow type, state of the ground at the meteorological site and its surroundings and the national snow survey dataset archived at the Russian Institute for Hydrometeorological Information. This dataset has routine snow surveys run throughout the cold season each decade (during the intense snowmelt, each 5 days) at all meteorological stations of the former USSR, thereafter, in Russia since 1966. Prior to 1966 snow surveys are also available but the methodology of observations had substantially changed at that year. Therefore, this analysis includes only data of stations within the Asian part of Russia (i.e., east of 60E) from 1966 to 2010. Surveys run separately along all types of environment typical for the site for 1 to 2 km, describing the current snow cover properties such as snow density, depth, water equivalent, and characteristics of snow and ice crust.

During the past several decades, the following changes in snow cover characteristics over Asian Russia have been observed: (a) in autumn the dates of the onset of snow cover have not changed noticeably despite the strong temperature increase in this season; (b) in late spring, snow cover extent has decreased over most of the region (but somewhat increased in the southeastern areas of Asian Russia); (c) in the cold season, maximum snow depth and snow water equivalent (SWE) at open areas have increased, and (d) days with winter thaw became more frequent. The snowmelt process over Asian Russia can be lengthy but even the first such melt initiates a process of snow metamorphosis on its surface changing snow albedo and generating snow crust as well as on its bottom, generating basal ice crust layer. In the Asian part of Russia, the entire process of the spring snowmelt has become shorter in duration and (taking into account a parallel rise in the maximum snow depth and snow water equivalent) more intense.

Keywords: snow cover, snow water equivalent, snow depth, Siberia, climatic change

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)


MIS003-06 Room:104 Time:May 26 16:00-16:15

# Northern Eurasia Earth Science Partnership Initiative (NEESPI): An Overview of the Current Studies in Northern Asia

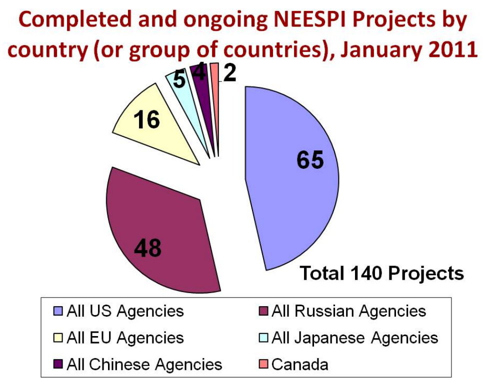
Pavel Groisman[1*], Garik Gutman[2], Vladimir Kattsov[3], Richard Lawford[4]

[1]UCAR at NOAA NCDC, Asheville, NC, USA, [2]NASA Headquarters, Washington, DC USA, [3]VMGO, St. Petersburg, Russian Federation, [4]U. . Manitoba, Winnipeg, MB, Canada

Six years ago NEESPI was launched with the release of its Science Plan (http://neespi.org). Gradually, the Initiative was joined by numerous international projects launched in EU, Russia, the United States, Canada, Japan, and China. Throughout its duration, NEESPI served and is serving as an umbrella for more than 140 individual research projects (always with an international participation) with an annual budget close to 15 million US dollars (cf., Figure, where international NEESPI projects are grouped by the major national funding source). Currently, the Initiative is in full swing. A new crop of NEESPI projects was launched in 2010 to compensate for the projects that have been completed and the total number of the ongoing NEESPI projects (76) changed but slightly compared to its peak (87 in 2008). Since 2008 NEESPI has been receiving an intergovernmental level of support in Russia, the United States, and Ukraine.

The past year was extremely productive in the NEESPI outreach. In 2010, more than 100 peer-reviewed papers and/or book chapters were published or are in press (this list is still incomplete and is anticipated to nearly double). A suite of 34 peer-reviewed NEESPI articles were published in the third Special NEESPI Issue in Environmental Research Letters (ERL; 2009, No. 4, and 2010, No.1). Several books and White Papers were published by Springer (Baltzer ed., 2010; Gutman and Reissell eds., 2010), and the National Academy of Science of Ukraine (Lyalko, ed. 2010), and FAO (Matyas, ed., 2010). Two more books devoted to Siberia and Eastern Europe prepared by the members of the NEESPI team are scheduled to appear before the end of this year. Preparations have been started to complete the circle of regional monographs on Environmental Changes in the NEESPI domain with a book focusing on the dry land areas of Northern Eurasia. Submissions, reviews, and publication process for a new Special NEESPI ERL Issue ”Environmental, socio-economic and climatic changes in Northern Eurasia and their feedbacks to the Global Earth System” are ongoing.

The description of the NEESPI Program will be complemented with an overview of the results presented in book ”Regional Environmental Changes in Siberia and Their Global Consequences” scheduled to be submitted to Springer at the time of this Symposium.




Keywords: NEESPI, Northern Asia, environmental changes, climate changes, international projects

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)


MIS003-P01 Room:Convention Hall Time:May 26 10:30-13:00

# Influence of Land Cover Change on Regional Water and Energy Field in Eastern Siberia

Ryuhei Yoshida[1*], Masahiro Sawada[1], Takeshi Yamazaki[1], Takeshi Ohta[2], Tetsuya Hiyama[3], Gen Inoue[3]

[1]Grad. Sci., Tohoku Univ., [2]Grad. Bioagri. Sci., Nagoya Univ., [3]RIHN

According to IPCC AR4, Eastern Siberia is thought as an area of great future change in the environment compared with other area. However, environment change has already occurred, such as water surface expanding and forest area decrease. From meteorological stand points, land surface state can be written by land surface parameters: surface albedo, evaporative efficiency, roughness length, heat capacity and thermal conductivity. With land surface change, these parameters vary and water/energy balance also varies at the same time. Moreover, according to previous study on water recycling ratio, more than 60% of precipitation source is supplied by evapotranspiration from land surface and this trend becomes stronger in Eastern Siberia than Western Siberia. Water movement occurs between land surface and the atmosphere, thus three-dimensional model is required to make clear effect of land surface change on water and energy field.

Our study has two objectives:

1) to make clear what land surface parameter has strong impact on water and energy field

2) to estimate water and energy field change with land surface change.

To achieve first objective, above five land surface parameter impacts on water and energy field is investigated using three-dimensional atmospheric model (JMA-NHM). Using routine station precipitation data, calculation duration is set from 2000/07/07 to 2000/07/17. Here, defining parameter impact as ratio of perturbation of latent heat flux and perturbation of land surface parameter, surface albedo and evaporative efficiency were dominant parameters among five land surface parameters. Calculation duration was changed to June 2000, August 2000, July 2001 and July 2002 (from 7th to 17th) and parameter impact was derived for each durations. Parameter impact of surface albedo and evaporative efficiency took larger value among these durations and there was no dependency on season and year.

Based on first experiment result, water and energy field change with water surface expanding was analyzed. Considering water and grassland area distributes almost 20% of lowland Central Yakutia, water and energy field difference between grassland 20% run and water surface 20% run was investigated. Here, land surface distribution of grassland, water surface and original is denoted as (G, W, O). There was linear increase of latent heat flux with water surface expanding from (G, W, O) = (0.2, 0.0, 0.8) to (0.0, 0.2, 0.8) and degree of latent heat flux increase was 1.2 W m-2 (2.4%). To understand what parameter played important role for this result, each land surface parameter effect was estimated from parameter impact and parameter change. Surface albedo and evaporative efficiency were impactful parameter on water and energy field, however, surface albedo was not effective parameter for water surface expanding because degree of actual surface albedo change was not so large compared with other surface parameters. Surface albedo has higher parameter impact, but its actual parameter change was lower value. Thus it did not become impactful parameter. Similar discussion can be done for thermal conductivity; it had lower parameter impact and higher actual parameter change. On the other hand, evaporative efficiency had larger parameter impact and actual parameter change, thus it was dominant parameter with water surface expanding.

At last, latent heat flux and precipitation change with deforestation and water surface expanding was investigated using parameter impact and virtual land surface data. When all lowland area that was less than 250 m became grassland, latent heat flux increased 0.1 W m-2 from (G, W, O) = (0.2, 0.0. 0.8), however, it was 0.5 W m-2 from (G, W, O) = (0.2, 0.0, 0.8) to (0.0, 0.2, 0.8). Thus land surface change to grassland does not have strong impact to water and energy field, but land cover change that contains water surface enhances latent heat flux strongly.

Keywords: Eastern Siberia, Land Surface Change, Evapotranspiration, Precipitation, Heatbalance

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)


MIS003-P02 Room:Convention Hall Time:May 26 10:30-13:00

# Evaluation of West Siberian wetland CH4 emission in inverse modeling

Heon-Sook Kim[1*], S. Maksyutov[2], D. Belikov[2], M.V. Glagolev[3], T. Machida[2], P.K. Patra[4], K. Sudo[5], G. Inoue[1]

[1]RIHN, [2]NIES, [3]Moscow State University, [4]JAMSTEC, [5]Nagoya University

West Siberia contains the largest wetland area in the world with large peat deposits and the wetland area is equivalent to 27% of total area of West Siberia. Recently, Glagolev et al. (2010) published the CH4 emission data from West Siberian wetlands at 0.5 deg resolution, using in situ measurements for each bioclimatic zone and a detailed wetland classification. Annual mean CH4 flux from West Siberian wetlands was calculated to be 3.2 Tg/yr in the updated version of Glagloev et al. (2010) (called Bc7) with strong wetland CH4 flux concentrated in Southern taiga. While a double magnitude of wetland CH4 flux estimated in Bc7 inventory was calculated in GISS inventory of Fung et al. (1991) with strong wetland CH4 flux in Northern and Middle taiga. In GISS inventory, wetland CH4 flux was estimated by emission seasons and emission rates calculated based on the climatology of monthly surface air temperature and precipitation with the global distribution of the simplified five wetland types published in Matthews and Fung (1987).

In this study, we estimate CH4 flux through inverse modeling for West Siberian wetlands with two different bottom-up inventories. Two airborne observations in West Siberia are used in verification for the inversed fluxes: at Surgut over wetlands in Northern taiga and at Novosibirsk near wetlands in Subtaiga. In forward simulations, the individual monthly CH4 surface sources for each region are emitted for a single month then discontinued for the remainder of the 6-year simulation to consider the response of atmospheric CH4, using interannually repeating OH and winds for the analysis year. The NIES transport model (Maksyutov and Inoue, 2000) simulates a total of 288 tracers for CH4, representing a combination of 12 land regions and 12 months for two source categories.

Annual mean CH4 flux of West Siberian wetlands is estimated to be 2.9 Tg/yr and 2.6 Tg/yr in inversions using GISS and Bc7 inventories, respectively. The inversed wetland flux well constrained is good agreement with the wetland flux in Bc7 inventory, but a large difference of the inversed flux to the wetland flux in GISS inventory. The inversed flux estimated using GISS inventory is only 45.0% of the prior flux with large decrease in June-August and it indicates the overestimated wetland flux in GISS inventory. As compared with the overestimated CH4 concentrations in forward simulations with GISS inventory, the mismatch between observed and predicted CH4 concentrations in inversion using GISS inventory is reduced with the decreased wetland flux by data constraint, but still higher CH4 concentrations at Surgut than observations. Larger mismatch between observed and predicted CH4 concentrations at Surgut is shown in inversion using GISS inventory than that for Bc7 inventory, while CH4 concentrations closer to observations at Novosibirsk are predicted in inversion using GISS inventory. These results suggest that GISS inventory includes the overestimated wetland CH4 flux in Northern and Middle taiga, implying that Bc7 inventory is more reasonable in the spatial distribution of West Siberian wetland CH4 flux with stronger CH4 flux from wetlands over Southern taiga than that for Northern and Middle taiga.

Keywords: Wetland methane emission, West Siberia, Inverse modeling

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)


MIS003-P03 Room:Convention Hall Time:May 26 10:30-13:00

# Analysis of CH4 and CO2 concentrations simulated by NIES TM over Siberia

Dmitry Belikov[1]*, Shamil Maksyutov[1]

[1]NIES

We simulated methane (CH4) and carbon dioxide (CO2) concentration using NIES (the National Institute for Environmental Studies) three-dimensional off-line Transport Model (TM). Used initial distribution, fluxes, sinks and chemical reactions are described in the Protocol for TransCom CH4 intercomparison (Patra et al., 2010) and in the Protocol for CONTRAIL transport model intercomparison (TMI) (Niwa et al., 2008). Current version of the model (denoted as NIES-08i) is implemented on a hybrid isentropic vertical coordinate systems containing 33 levels up to a pressure level of 2 hPa and supplied with a climatological heating rate to calculate the stratospheric diabatic transport. Isentropic vertical coordinate helps to prevent extra mixing between troposphere and low stratosphere, resulting in the mean age of the air in agreement with observation and better vertical distribution simulation. Although the model phenology is driven by reanalysis data (JMA-JCDAS 6-hourly meteorology and 3-hourly planetary boundary layer height from the ECMWF Interim reanalysis (Belikov et. al., 2010)) it is reproducing seasonal cycle phase and amplitude. Tracers growth rates and tropospheric/stratospheric losses are well simulated by the model. The detailed model results analysis and intercomparisons using GLOBALVIEW-CH4 and Siberian aircraft observation data will be shown in the meeting.

Keywords: atmospheric tracer transport modeling, carbon dioxide, methane

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)


MIS003-P04 Room:Convention Hall Time:May 26 10:30-13:00

# Possible new crops in southern Siberia under climate change

Nadezhda Tchebakova[1*]

[1]Institute of Forest, Russian Academy, [2]Institute of Geography, Russian Academy, [3]National Climatic Data Center, [4]NASA Langley Research Center

The southern portion of Siberia is a subboreal forest-steppe and steppe ecozone and is known to have high agroclimatic potential due to favorable climatic and soil resources. Potential northward forest shifts over the plains and upslope in the mountains were modeled using our Siberian bioclimatic vegetation model (SiBCliM) in 2020, 2050 and 2080 coupling climate predictions from the Hadley A2 and B1 scenario projections. At the expense of forests, approximately 40% of Siberia was predicted to be covered by forest-steppe and steppe ecozones by the end of the century. Crops of food, forage, and biofuels primarily reside in steppe and forest-steppe zones in southern Siberia, and these crops are resistant to frequent droughts and the cold climate. Our goals are: 1) to evaluate ongoing climate change in southern Siberia from observed data: pre-1960; in the baseline period 1960-1990; in 1990-2010; and to predict related hot spots of potential agriculture change in the contemporary climate; 2) to predict agriculture in the future from the Hadley 2020, 2050 and 2080 climate change projections; and 3) finally, to develop a new agroclimatic zonation (agricultural regions) based on a new agroclimatic potential that may evolve as climate changes. Potential agricultural lands are modeled to appear in new forest-steppe and steppe habitats, extended and shifted northwards. A Siberian agri-crops model was developed that predicts ranges of major Siberian traditional crops (wheat, barley, vegetables, etc) and some exotic crops (melons and gourds, grapes, horticulture) currently non-existent but potentially important in a warming climate. In the model, four basic climatic constrains control crop distributions: growing degree-days and growing season length represent temperature requirements for plant growth and development, negative degree-days define winter cold tolerance, and a moisture index characterizes resistance to moisture stress. The model was applied to the pre-1960, 1960-1990, 1990-2010, 2020, 2050 and 2080 climates to predict potential distributions for both traditional and new crops in southern Central Siberia. Our analyses show that during the century traditional crops could be gradually shifted as far as 400 km northwards (about 50 km per decade) and new crops may be introduced in the very south with a significantly prolonged growing season and thus enlarged growing degree-days which may necessitate irrigation.

Keywords: southern Siberia, climate change, potential crops, traditional crops, exotic crops