

Northern Eurasia Earth Science Partnership Initiative (NEESPI).

URL: <http://neespi.org>

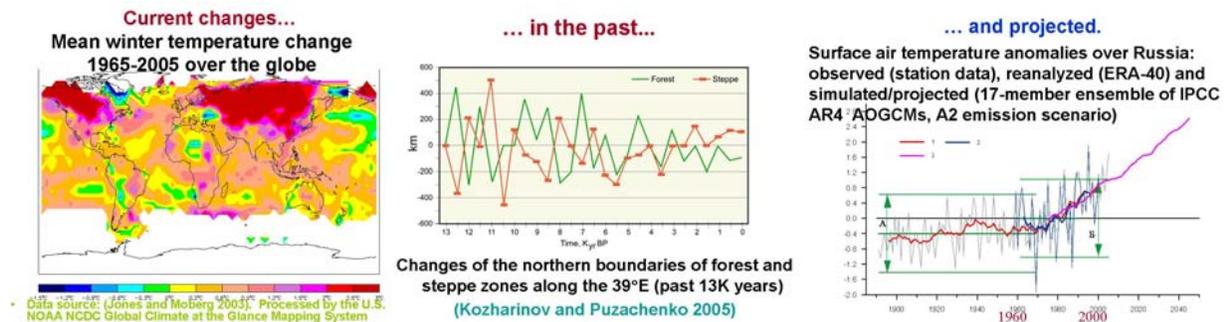
NEESPI study area includes: Former Soviet Union, Northern China, Mongolia, Fennoscandia, & Eastern Europe



Northern Eurasia as defined in the NEESPI Program. Moderate Resolution Imaging Spectroradiometer (MODIS) 1km true color composite from August 20-28 2004 data. Shaded relief adjustment using the Shuttle Radar Topography Mission (SRTM) GTOPO30 elevation dataset. Shades of green correspond to vegetated land. Light brown and yellow indicate sparse vegetation and arid areas. Produced by Dr. Mutlu Ozdogan (NASA GSFC).

I. NEESPI Overview

Rationale.

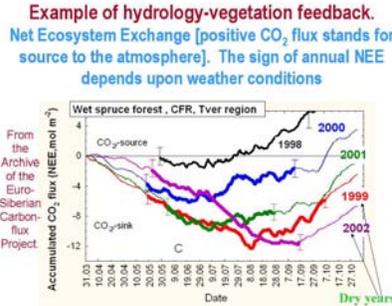
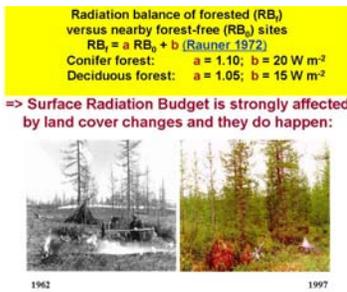


Northern Eurasia is undergoing rapid and significant changes associated with warming climate and with socio-economic changes during the entire 20th century. Climatic changes over this largest landmass in the northern extratropics (and ~ 20% of the global land mass) interact and affect the rate of the global change through atmospheric circulation and through strong biogeophysical and biogeochemical feedbacks. These feedbacks arise from changes in surface energy, water, and carbon budgets of the continent. How *this carbon-rich, cold region component of the Earth system* functions as a regional entity and interacts with and feeds back to the greater global system is to a large extent unknown. Thus, the capability to predict future changes that may be expected to occur within this region and the consequences of those changes with any acceptable accuracy is currently uncertain and hampers projections of the Global Change rates which are among the WCRP major objectives. One of the primary

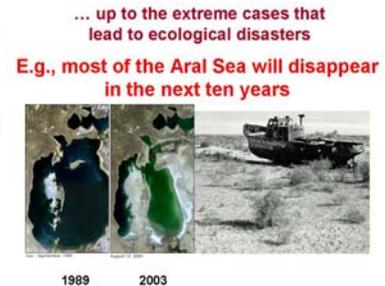
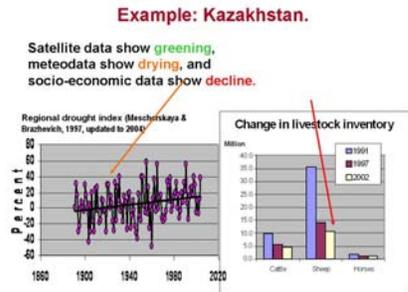
reasons for this lack of regional Earth system understanding is the relative paucity of well-coordinated, multidisciplinary and integrating studies of the critical physical and biological systems. Furthermore, the critical measurements needed to monitor changes in the area are not available.

Introduction of the biosphere and socioeconomic changes into the framework of Global Change is among the most challenging problems for society as well as for the Earth Science community. In the Northern Eurasian domain we have both challenges:

- strong hydrology-biosphere feedbacks that may (and do) affect sign of changes in surface energy budget and/or net ecosystem exchange and



- socioeconomic changes that several times during the past century dramatically affected land use and water management practices causing changes that far exceeded (in some cases) climate variability and affected the societal well-being and environmental health.



Lack of concise efforts to deliver both understanding and information for Northern Eurasia makes studies of climatic changes in this region an important contribution to reduction of uncertainties in our understanding of the Global Change far beyond the Northern Eurasia domain.

There are specific science challenges that are built on the past GEWEX experience in the NEESPI domain which (when resolved) may feed back to the progress of energy and water cycle studies elsewhere. Among them are:

- **Energy and Water Budget studies in Russia.** Energy and water budgets of Russia were intensively studied twice. In the 1960s-1970s, Soviet Scientists completed Atlas of the Surface Heat Balance (1963), Heat Budget of the Forested Land Studies (1972), and World Water Budget and Water Resources of the Earth (1978). A legacy of these studies is approximately 20 monographs, expansive paper archives, and networks of heat balance and water balance stations¹ spread across the former USSR, many of which are still operational. The second intensive research cycle started with the GEWEX Asian Monsoon Experiment in Siberia (*GAME-Siberia*, 1995-2001) when a new modern instrumentation (flux towers) was first introduced to the region. Being unable to cover the entire region with modern observations, the GEWEX researchers settle with a few locations in order to capture major features of energy and water cycles over the large part of the NEESPI domain (the Lena River Basin). While a large amount of information was accumulated, the high logistic costs, the large spatial variability, the absence of "in between" information as well as failing to use² the research and knowledge of Russian

¹ Some of these water balance stations (e.g., Valdai, Podmoskovnaya) were later used in the GEWEX PILPS Project.

² Most probably, "failing" is not a fair term to describe the unavailability of past research publications (many volumes in Russian) to a new generation of GEWEX scientists who came to the region from "the outside". But, whatever the term is used here the need for further in depth studies will not disappear.

specialists who were working in the region for decades made this research incomplete. After 2001, most of the GAME activities shifted southward away from Siberia. A legacy of this study is a CD ROM with the Project data (distributed in 2003), numerous publications in international journals, and the following research projects (addressing permafrost, carbon fluxes, forest fire disturbances, land cover, and, glaciology) that are continuing in Siberia up to date beyond the GAME (GEWEX) framework. We believe that these studies should be continued and enhanced. The NEESP Initiative plans and has capabilities to do better in these regards

- by involving a lot of local scientists as equal participants in the research,
 - by enlisting multinational research teams on a coherent corroborated basis (thus avoiding duplication),
 - by using for data storage the institutions that have among their major responsibilities the data archiving function (NOAA National Climatic Data Center, USA, Research Institution for Hydrometeorological Information, Russia, and Beijing Climate Center, China)³, and
 - by providing (promoting, supporting) the work based upon an unified Science Plan (that is being and will be gradually transform itself into an implementation plan with more than 50 funded NEESPI projects being active in the region) with an overall goal to cater to a few NWP and Global Earth System Modeling Centers that will be the ultimate users of the NEESPI research to address global (continental) scale problems that are being confronted by the Global Change research community.
- **Long-term studies in the part of the NEESPI domain (e.g., within BALTEX).** NEESPI plans to use intensive GEWEX-supported research within the Baltic Sea Basin as an example for hydrological studies in the other parts of the domain where the observational networks are less dense and where environmental controls of the water cycle as well as a human impact on the land use and hydrological regime are different. This cross- checking of the methodology accuracy and applicability is expected to be mutually beneficial.

Initiative Objective in a nutshell.

The Northern Eurasia Earth Science Partnership Initiative (NEESPI), an interdisciplinary program of internationally-supported Earth systems and science research, was established to address large-scale and long-term manifestations of climate and environmental change. NEESPI considers all Northern Eurasian ecosystems and needs to draw on all environmental scientific disciplines during the coming decade. *NEESPI strives to understand how the land ecosystems and continental water dynamics in Northern Eurasia interact with and alter the climatic system, biosphere, atmosphere, and hydrosphere of the Earth.* Its overarching Science Question is: How do we develop our predictive capability of terrestrial ecosystems dynamics over Northern Eurasia for the 21st century to support global projections as well as informed decision making and numerous practical applications in the region? The foci of the NEESPI research strategy are the deliverables, which support both national (e.g., the National Climate Change Science Programs) and international science (e.g. IGBP) programs. A synergetic approach to projections of the future changes is a core of the NEESPI. Major NEESPI-related research deliverables, in approximately ten years, will be a suite of process-oriented models for each major terrestrial process in all its interactions; a suite of global and regional models that seamlessly incorporate all major regionally specific feedbacks associated with terrestrial processes; an integrated observational knowledge data base for environmental studies; and an environmental hazards warning system in place that can serve the emergency needs of the society. A synergetic approach to projections of the future changes is a core of the NEESPI.

NEESPI Science Plan Preparation Team (that worked in 2003-2004) included more than 90 scientists from 11 countries with the majority of them being from the United States and Russia. After external review and extensive editing the NEESPI Science Plan (~260 pages) has been published on the web at <http://neespi.org> in December 2004. An Executive Overview of the Science Plan (18 pages) is available at the same web site in three languages (English, Russian, and Chinese) and has been published in *Global and Planetary Change* Journal (Groisman, Bartalev, and The NEESPI Science Plan Development Team 2006, available at <http://www.ScienceDirect.com>). The NEESPI Science Plan structure is presented in Appendix 1. ***Two of key NEESPI Science Plan topics (Surface Energy and Water Cycles and Cold Land Region Processes) are among the foci of GEWEX.***

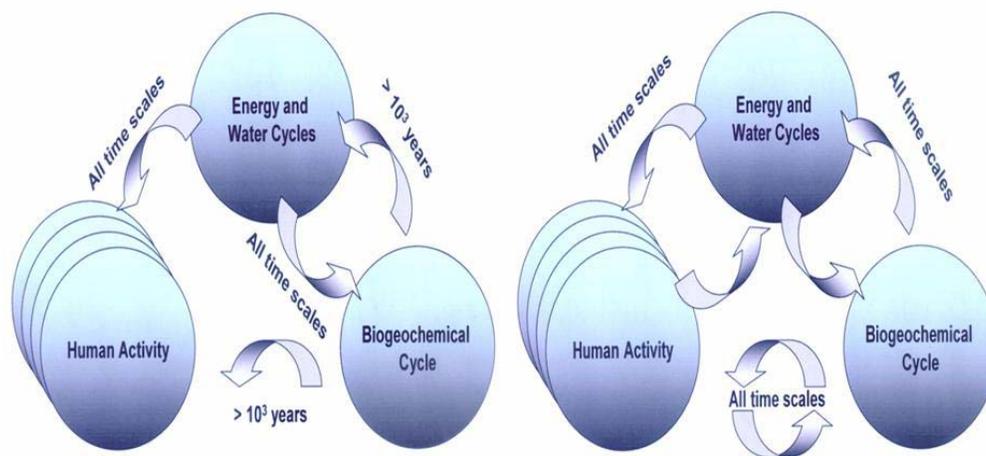
³ Currently, all links to the GAME-Siberia data on the GEWEX web site are not functional.

II. NEESPI Relevance to GEWEX.

The NEESPI Science Plan (SP) is focused on surface and near-surface processes in the Northern Eurasian region and addresses the overarching theme of the Northern Eurasia Earth System Partnership Initiative (NEESPI), which is Terrestrial Ecosystem Dynamics and its Interactions with the Global Earth System. Assuming that the functioning of the Global Earth System can be considered as an interaction of three major types of processes (cycles):

- **Energy and Water Cycles**, which affect the transfer of energy, water, aerosols, and trace gases between the atmosphere, land surface, hydrosphere, and cryosphere.
- **Biogeochemical Cycles**, which affect the composition of the atmosphere and ocean, the formation of soils, and the evolution of biomes.
- **Human Activity**, which began to strongly affect the planetary system on the regional level (first of all land processes) with the establishment of the first agricultural civilizations, now includes effects on the Global Earth System.

Pre-industrial and present interactions in the Earth Global System



The SP states that studying any one of these cycles or activities often requires analyses of its interaction with the other two and of the transitional (non-equilibrium) character of these interactions. Therefore, Energy and Water Cycles studies embedded into the NEESP Initiative being also an objective of the GEWEX Project can contribute and/or complement both GEWEX and NEESPI. Currently there are 21 NEESPI Projects listed on the NEESPI web site (<http://neespi.org>) with major focus on *hydrology* and another 14 projects with a major focus on *cryosphere* studies. However, this separation is not rigid and most individual NEESPI projects are interdisciplinary addressing (in addition to hydrology and cryosphere) other aspects of the Earth System studies.

Two examples of NEESPI Projects (clusters of Projects) are presented below:

Example 1. Example of the NEESPI funded integrative project.

Understanding the role of changes in land use/land cover and atmospheric dust loading and their coupling on climate change in the NEESPI study domain drylands

This integrative project brought together 12 senior scientists from 8 countries to address the land-atmospheric interaction processes over the southern half of the NEESPI domain. Regional atmospheric modeling, modeling of the land cover transformation under the natural and human-induced desertification processes, modeling of the dust storm formation and transport (including transcontinental transport), and finally, modeling of the climatic change resulting from the interaction of all these processes

Example 2. Example of the NASA-NSF funded cluster of NEESPI projects that are ready for integration

1. *Diagnosis and Prognosis of Changes in Lake and Wetland Extent on the Regional Carbon Balance of Northern Eurasia.*
2. *An integrated understanding of the terrestrial water and energy cycles across the NEESPI domain through observations and modeling.*
3. *Role of land cover and land use change in hydrology of Eurasian Pan-Arctic.*
4. *Permafrost dynamics within the Northern Eurasia region and related impacts on surface and sub-surface hydrology*
5. *Collaborative Research: Understanding Change in the Climate and Hydrology of the Arctic Land Region: Synthesizing the Results of the ARCSS Fresh Water Initiative Projects*
6. *Study of Dam/Reservoir-Induced Hydrologic Changes in Large Siberian Watersheds: Regional Analysis to Pan-Arctic Synthesis*
7. *Current climate changes over Eastern Siberia and their impact on permafrost landscapes, ecosystem dynamics, and hydrological regime*
8. *Continuous fields of snow cover characteristics derived through coupling satellite data with snowpack model. Application in the river runoff modeling over NEESPI domain*

These eight projects funded individually to four US Institutions jointly address a significant fraction of large-scale hydrological studies in the boreal zone of Northern Eurasia and its relation to the cryospheric changes.

Major science questions related to Surface Energy and Water Cycles were formulated in SP as follows:

- What is the relative importance of the major drivers and feedback mechanisms that control the variability and changes of the surface energy and water cycles at local, regional, and continental scales?
- What are the details of surface energy and water cycle dynamics in Northern Eurasia, and how do they improve our understanding of how this region interacts with global cycles?

Priorities in surface energy and water cycle studies were set according to two criteria.

First, attention must be

paid to the processes that directly feed back to the global Earth system. This justifies the interest of the international community in environmental changes in Northern Eurasia. These processes (**listed in insert 1**; note

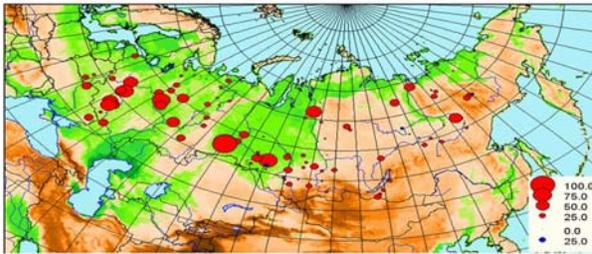
Insert 1. Importance of studying Northern Eurasia from the Global Change perspective

- Accelerated climatic changes across Northern Eurasia may cause changes in global atmospheric circulation and meridional heat transfer.
- Changes in surface albedo (snow/ice cover, shifts in vegetation, land use change) and atmospheric humidity may change the Earth's heat and water balances.
- About half of the Northern Eurasian terrain has permafrost that controls the hydrosphere and biosphere of the eastern half of the continent. Thawing of permafrost may change the soil carbon cycle and the entire ecosystem above it and, thus, the concentration of greenhouse gases in the atmosphere. It also would produce major changes in land cover and hydrology.
- Advance/retreat of the forest line, increase/decrease of conditions conducive for forest fires, wind-throw, bogging, and logging may lead to global biogeochemical, energy, and water cycle changes.
- Changes in the hydrological cycle over the continent control the fresh water transport to the World Ocean and interior lakes. Changes in the fresh water transport to the Arctic Ocean may affect the World Ocean thermohaline circulation.
- Deglaciation in the mountain systems of Central Asia and the Caucasus, increasing water withdrawal, and increasing dryness of steppe and semi-arid zones will affect surface albedo and water resources and their quality of the interior areas of the continent and, thus, the global climate and society.
- Drying of bogs over expansive areas in West Siberia and the Great Russian Plain may result in their degradation as well as affect the global carbon cycle and runoff formation.
- If we are to understand the global carbon cycle and other biogeochemical cycles, we must know how they function in the NEESPI region which holds more than half of the total pool of terrestrial carbon.
- Boundary exchange of fresh water, organic and inorganic matter may affect biochemical processes in the shelf seas and interior lakes. Intensive erosion (currently up to 10 m yr⁻¹ in some areas) and other coastal line changes may affect life conditions and cause enormous economic damage.
- Ongoing aridization of the continental interior may cause a massive aeolian aerosol input into the troposphere that can affect the Earth's heat balance and generate direct biospheric and societal impacts thousands of kilometers away from the origin of these dust storms
- Human activity has changed ecosystem types over most of the steppe and forest-steppe zones and over part of the forest zone causing numerous biogeochemical and biogeophysical feedbacks, near-global environmental changes, and affecting environmental health and quality of life.

that the first 7 of these processes have direct connections with the GEWEX and/or Global Change objectives) are also very important on regional and larger scales. In most cases, the feedbacks to the Global Earth System are only feeble manifestations of enormous changes within the subcontinent that “spill out” across the regional borders. Furthermore, by affecting the Global Earth System, they, by definition, affect Northern Eurasia. The fundamental study of land-atmosphere exchange in this region incorporates the need to evaluate the natural dynamics in contrast to large scale land use changes affecting the land-atmosphere exchanges. ***Second, the processes of major societal importance must be addressed.*** They may or may not affect the Global Earth System, but for the region’s population, they are of pivotal importance. These include extreme weather events, water supply, thaw of permafrost, desertification, and impacts on agriculture and air and water quality. Major deficiencies in surface energy and water cycle knowledge and observing systems will be addressed by (a) using modern tools of environmental monitoring, (b) integration the results from historical data sets, present observational systems, and process studies into a unified knowledge base, (c) development of an interactive suite of the land surface models that can account for major land surface process dynamics in Northern Eurasia and interactively feed back to regional and global climate, environmental, and economic models, and (d) performing all necessary studies to make this suite of models a viable working tool.

An issue of global concern: The Arctic fresh water budget

Fresh water transport to the Arctic is increasing



Winter runoff deviations for the 1978-2000 period compared to the long-term mean for ~ previous 55 years (Georgievsky et al. 2003)

Coastal zone processes

•Inundation; Land-ocean exchange; Impact on biota; Eutrophication; Impact on quality of life; and Coastal erosion

Coastal erosion in the Arctic is rampaging



20 years ago these oil tanks were 60 m away from the coast of The Pechora Sea (Ogorogov, 2003)

Addressing the GEWEX CSE Scientific Criteria (proposed for 2006)

1. *Observe, simulate, and predict the diurnal, seasonal, annual and interannual cycles.*
2. *Determine climate system variability and critical feedbacks.*
3. *Demonstrate improvements in predictions of water-related climate parameters.*
4. *Demonstrate the applicability of techniques and models for other regions.*
5. *Assess the human impact on hydroclimate variations, including vulnerability to climate change.*

All the above are among the major foci of NEESPI researchers and/or informational system builders. Exactly the missing links, insufficient data flow, poor understanding of critical feedbacks that might be of global importance, strong human component in hydroclimate variations, the needs of improvement of land surface schemes and hydrological models in the region making them integrated with modern (first of all remote sensing) products, were outlined in the NEESPI SP and targeted by the NEESPI scientists in their successful proposals.

It is too early to claim that the first tier of these proposals has already “demonstrated improvements in predictions of water-related climate parameters” but methods that are proposed and are currently applied in these projects (use of regional climatic models, sophisticated land surface schemes, field experiments to calibrate/quantify new generation of remote sensing products, new observation networks to infill data gaps, and a general improvement of the hydrometeorological information distribution to users) have proved to work everywhere providing “improvements in predictions of water-related climate parameters”.

The “applicability of techniques and models for other regions” requirement has a natural restriction due to numerous unique features of society-climate-ecosystem interactions specific to Northern Eurasia. With this exception, in the NEESPI region techniques will be used and calibrated mostly by the same methods, models, and instruments that were used worldwide. But, the need for understanding and accounting for different controls and feedbacks that play

critical roles here (while in other parts of the world their effects are negligible) will require (a) more detailed blocks of these models and (b) an early introduction of socioeconomic factors that were unique in Northern Eurasia during most of the 20th century and accounting for their aftermath still requires special treatment in the models.

Addressing the GEWEX CSE Technical Criteria (proposed for 2006). These seven criteria are listed below and each of them is accompanied with a brief explanation of how NEESPI is meeting and/or planning to meet them.

1. Numerical Weather Prediction Center for provision of atmospheric and land surface data assimilation.

There are two major NWP Centers in the NEESPI domain that will benefit (and contribute to) the NEESPI activities: Beijing Climate Center (BCC, Beijing, China) and HydrometCenter of the Russian Federation (Moscow, Russia). The results of the NEESPI studies should assist these two Centers

- to reliably downscale weather forecasts and
- to ingest (improve interpretation of) remote sensing products that are currently exist but are not used for operational purposes).

However (as it hints by the experience in Europe and North America), the most beneficial for these Centers will be

- a development of high quality land surface schemes with progresses in the NEESP Initiative research and their incorporation into operational practice of Weather and State of the Environment Prediction.

In winter 2006, the BCC leadership has agreed to become among the NEESPI Science and Data Support Centers with major responsibility for East Asia. In order to make collaboration between CAS Institutions involved in NEESPI and BCC mutually beneficial, two Workshops (Nov. 7-8, and Nov. 13, 2006) have been conducted. As a result of these workshops, a memorandum of understanding is being prepared that includes (among other items) (a) plans to establish of joint research projects with participation of BCC and CAS institutions (using the recently established in Beijing NEESPI Focus Research Center for Dry Processes Studies as a major mechanism) and (b) development of joint formats of data exchange between BCC and Russian and American NEESPI Science and Data Support Centers.

There are plans within the Russian Federal Service for Hydrometeorology and Environmental Monitoring (Roshydromet) to establish (in few months) Regional Climate Center for the Commonwealth of interested Newly Independent States (RCC-Moscow) on the basis of HydrometCenter of the Russian Federation and several other Institutions under the WMO guidelines (see **Insert 2**). Preliminary agreement between NEESPI Project Scientist (Pavel Groisman) and HydrometCenter Leadership (Dr. Dmitry Kiktev) is that with the advance of these plans and progress in NEESPI individual projects, both entities will coordinate and specify avenues for collaboration.

Insert 2. Rationale of the Roshydromet Plans for Regional Climate Center - Moscow are as follows:

- Since the economic transition began, the capacity of Roshydromet (Russian State Committee for Hydrometeorology) and similar institutions in the Commonwealth of Independent States (CIS) to provide services to their nations and globally have declined and their capacity to help prevent economic and human losses deteriorated. In the last few years, the Russian Government has made a renewed commitment to improve Roshydromet's performance and a large-scale Roshydromet modernization project is being started. Therefore, the Roshydromet's potential for provision of Regional Climate Center for Northern Eurasia in the boundaries of CIS (RCC) functions is expected to increase.
- Specific features of Northern Eurasia from the point of view of RCC services that separate them from other regions are: Enormous territory with a great diversity of weather and climate conditions; quite non-uniform observational network and data exchange facilities; presence of elements of integration between the former USSR countries (Automatic System of Data Transfer (ASDT) of Roshydromet for data exchange among the CIS members who have access to operational data circulating via ASDT and transmit their data to Roshydromet; absence of serious lingual barriers between Russia and other CIS countries; and a relatively low ENSO influence on climate variability and in general a relatively low predictability on seasonal time scale for the most part of Northern Eurasia (thus, given the current low level of seasonal forecasts skill in extra-tropics, the relative role of their interpretation might not be on the foreground of RCC functions for this area). These specifics; a preference for the Russian economy to be served by one RCC responsible for the whole nation; existing elements of RCC infrastructure in the Commonwealth of Independent States; unique environmental data bank and facilities – World Data Center Obninsk; already developed spectrum of prognostic and diagnostic climate products; and finally new money from coming technical modernization of Roshydromet were among major reasons for the Russian Government for establishment of RCC in Russia.

Using the above rationale, the Roshydromet Leadership proposed the following structure of RCC-Moscow for the region of Russia (initially) with the following expansion to the CIS territory in the future: The RCC-Moscow will have a distributed structure unifying (at the 1st stage) several well established Research Institutions in Russia: Hydrometcentre of Russia (Moscow), Main Geophysical Observatory (St. Petersburg), Institute for Global Climate and Ecology (Moscow), and All-Russian Research Institute of Hydrometeorological Information – World Data Center (Obninsk).

2. Atmospheric-hydrological models for studying transferability and climate variability

A variety of hydrological and SWAT models are currently used by NEESPI researchers depending upon diverse tasks and objectives that are tabled (e.g., permafrost and snow modeling, water management, land-atmosphere exchange, and runoff formation). Efforts are made to bring these models together in order to (a) secure exchange of the results and findings among the groups and (b) to guarantee seamless data ingest from modern observational platforms (e.g., automated stations and remote sensing). For example, more and more NEESPI researchers switch to WRF as their Regional Atmospheric Model of choice and the availability of the open source of the VIC hydrological model makes it easier to adopt and implement it by hydrological groups across the NEESPI domain. However, special sophisticated hydrological models for mountainous Central Asia and permafrost areas of Siberia are currently employed in the NEESPI domain and efforts will be conducted to link them with VIC.

3. Mechanism for collecting and managing adequate hydrometeorological data sets

This mechanism for collecting and managing adequate hydrometeorological data sets within NEESPI is based on 5 virtual Science and Data Support Centers located at:

- *NOAA National Climatic Data Center, Asheville, North Carolina, USA*
- *Beijing Climate Center, Beijing, China*
- *Research Institute for Hydrometeorological Information, Obninsk, Kaluga Area, Russia;*
- *SCANEX Corp., Moscow, Russia*
- *Goddard Space Flight Center, Greenbelt, Maryland, USA*

Within each of these institutions, there are dedicated projects and personnel who are tasked to provide appropriate service to the NEESPI researchers as well as to the entire scientific community.

4. Participate in the open international exchange of scientific information and data

NEESPI data policy adopted by the NEESPI Science Advisory Panel and published on the NEESPI web site encourages the open international exchange of scientific information and data. For convenience, this document is attached below in Appendix 3. Furthermore, acting in the framework of WMO and GEO rules, an intent is to make

5. Interaction with hydrological services and related groups

There is an organizational diversity of hydrological services across the NEESPI domain. For example, while in the former USSR and Mongolia, hydrological services are embedded into joint State Hydrometeorological Services, in China, major hydrological services are managed on the provincial level. By the nature of services provided, hydrological research requires a close collaboration with regional Hydrological Services and Institutions. Therefore, a close collaboration has been established between NEESPI and The State Hydrological Institute (St. Petersburg, Russia); Institutes of Water Problems of the Russian Academy of Sciences (Moscow, Russia) and of the Uzbek Academy of Sciences (Tashkent, Uzbekistan); The Mongolian Institute of Meteorology and Hydrology; as well as with Scientific Information Center of Interstate Coordination Water Commission, Tashkent, Uzbekistan.

The NEESP Initiative was fortunate to enlist to work on its scientific objectives a number of prominent internationally-renown hydrologists and glaciologists, who are carrying out individual funded NEESPI projects and/or collaborating with the Principal Investigators: Vörösmarty, Kotlyakov Lettenmaier, Kuchment, Wood, I. Shiklomanov, Hinzman, J. Liu, Polevoy, Shmakin, R. Dickinson, A. Dai, Dukhovny, Aizen, E. Makhmudov, and many others. Their research groups are well plugged into hydrological services of their countries and worldwide. NEESPI foresees a close collaboration with the **BALTEX** researchers. In the Report of the First NEESPI Science Advisory Panel Meeting (Feb. 1, 2006) it is stated "NEESPI will seek further cooperation with well established projects that include (are included in, or partially overlap) the NEESPI domain (e.g., BALTEX-II, ...). *For example, mutual understanding has been established during this Science Team Meeting that a rich experience in hydrological modeling during the decade of studying the Baltic Sea Basin within BALTEX could be transferred to other Sea (Lake) Basins of the NEESPI domain while ongoing and projected activities in terrestrial ecosystem modeling might be of interest to our BALTEX colleagues*".

Evaluation of GEWEX global data products

Several GEWEX global data products (e.g., ISCCP, SRB) are essential for success of NEESPI studies associated with Surface Energy and Water Balance component of the NEESP Initiative. Performance of other GEWEX products

over the NEESPI domain (e.g., "global" precipitation data sets) are currently under scrutiny (e.g., Rawlings et al. 2006, 33, GRL, L07403, doi:10.1029/2005GL025231) and will require further work. It must be said here that without additional resources to the Principal Investigators of the presently funded NEESPI projects it would not be fair to ask them to do additional work that would be a diversion of their carefully designed and tightly budgeted research. Therefore, the NEESPI leadership will include the provision of "*Evaluation of GEWEX global data products*" in the future NEESPI calls for proposals and recommendations for new projects that are joining the Initiative. The currently funded Projects will be cordially asked to volunteer assisting our GEWEX colleagues in this task but we have no mechanisms to reinforce this request.

6. Contribution to CEOP in situ, remote sensing and model output databases.

The NEESPI Science and Data Support Centers will be tasked to orderly transfer the NEESPI-generated data sets to CEOP to infill the regional gaps over Northern Eurasia. When accepted into the GEWEX family, NEESPI representatives in these Centers will propose to their funding Agencies a support to this effort. The earliest possible coordination (first of all in data formats) will be required for this effort. The CEOP Reference Sites within the NEESPI region will be (when possible) complemented with the NEESPI "points of interest" (e.g., the TSP permafrost sites that are being installed right now and will continue to be installed and maintained for the years to come). The dense network of synoptic and special observations currently available to (inherited by) the NEESPI researchers will be used as a supporting network for CEOP Reference Sites expanding their representativeness toward the surrounding areas.

At their inception, NEESPI and GEWEX were designed differently and have, therefore, different structures. However, there are already several overlapping CSE-related groups within both Projects whose efforts will complement and/or match each other creating important synergies (Table 1).

Table 1. NEESPI research directions focused around the appropriate Topical and/or Regional Focus Research Center (FRC) and/or Science and Data Support Centers and their correspondence to GEWEX research groups.

| GEWEX groups | Water System | Integration | Biogeochem. | Cold Land | Dry Land | Atm. Aerosols | Science Data |
|---------------|--------------|-------------|-------------|-----------|----------|---------------|--------------|
| BSRN | | | | | | X | X |
| GACP | | | | | | X | X |
| GPCP | X | | | | | | X |
| SRB, Landflux | | X | | X | X | | X |
| WGDMA | | X | | | | | X |
| WEBS | X | X | | | | | X |
| WISE | X | | | | X | | X |
| WRAP | X | | | | X | | |
| HAP | X | | | X | X | | X |
| TWG | X | X | | | | | X |
| GLASS | X | X | | | | X | |
| CEOP | X | X | X | X | X | X | X |

III. Current NEESPI Status

From the beginning, three terms characterize the NEESPI: *Global, Interdisciplinary, and Active*.

- **Global** - Priorities were assigned to projects and topics that address regional changes that affect (or may affect) Global Earth System
- **Interdisciplinary** –It was early recognized and shown in examples, that strong interactions within the system terrestrial ecosystem, hydrosphere, cryosphere, atmosphere, and human society in the region require interdisciplinary studies
- **Active** - Preparation of the NEESPI Science plan (2003-2004) occurred simultaneously with pilot projects initiation and the writing of proposals (some of them have been already funded)

Since 2004, NEESPI participants were able to seed a first set of proposals to the international (NATO, European Union, GEF) and national funding agencies and institutions (e.g., in the United States, Russia, Japan, UK, Germany, Finland, and Hungary), and to the International Polar Year (IPY). Some of these proposals have already been funded and officially joined NEESPI (54 of them), other proposals have been funded (more than 20 of them) and a process of their recognition by NEESPI is on the way, but a large group of proposals is still under review. Generally, there are two modes of NEESPI expansion: dedicated calls for proposals and freely joined projects that benefit or anticipate benefits from the NEESPI membership such as:

- *Improved links to collaborators in Northern Eurasia and to US and EU scientists working on similar problems*
- *Exchange of ideas, datasets, and knowledge with other team members working on similar problems*
- *Synergistic approach in working on complex problems*
- *Priority access to remote sensing and in situ data collected over Northern Eurasia*
- *Student exchange, doctoral and post-doc positions sharing among the Team Institutions*

Among the first NEESPI public steps were:

- Presentations at the International Conferences, including Open Science Sessions at the American Geophysical Union Fall Meeting (San Francisco, USA, December 2004) and at the 31st International Symposium on Remote Sensing of Environment (St. Petersburg, Russia, June 2005),
- Several successful proposals to the International Polar Year,
- Preparation of the special NEESPI issue of "Global and Planetary Change" journal Establishment of the network of the NEESPI Focus Research and Science Support Centers in the United States, Russia, China, and Germany,
- The 1st NEESPI Science Team Meeting in IIASA, Laxenburg, Austria (February 22-24, 2006), and
- Several regional NEESPI Workshops (St. Petersburg, Russia; San Francisco, California; Fairbanks, Alaska; Odessa, Ukraine; and Beijing, China).

As a result of these steps, NEESPI is widely recognized and endorsed as being potentially valuable to the international scientific community for development of the scientific plan that fostered regional research and has already created scientific research partnerships around the world. During the past 18 months, the NEESPI program has been endorsed by several Earth System Science Partnership Program (ESSP) Programs and Projects: International Geosphere and Biosphere Programme (IGBP), World Climate Research Programme (WCRP) through the Climate and Cryosphere Project, Global Water System Project, Global Carbon Project, Global Land Project, and Integrated Land Ecosystem – Atmosphere Processes Study. Thereafter, the NEESPI program has requested from ESSP the status of *an ESSP Integrated Regional Study* in the northern part of Eurasia.

In addition to several meetings and workshops for year 2007, there are anticipated the following NEESPI activities:

- an establishment of the NEESPI International Secretariat in Europe,
- further growth of the Initiative with new members (projects) included, and
- an establishment of the NEESPI Focus Research Center for Integration of the NEESPI Results and Modeling Studies.

IV. Strategy of further NEESPI development

Increase of the number of funded projects and their diversity creates a real challenge with scientific coordination among the projects and access to their data. Therefore, in summer-autumn 2005, the NEESPI community realized a need for clustering the research (and researchers) around Thematic and Regional Focus Research Centers and Science and Data Support Centers (Appendix 2). These Centers (14 of them (2 under construction), and 3 more projected) began gradually evolving around the lead scientists with funded NEESPI Projects who are linked to international Research Projects (GLP, GWSP, CliC, etc) and/or to major World Data Centers in Russia, the United States, and China. These Centers are securing scientific and informational support of NEESPI and it is anticipated that they will continue doing it in the future. Nevertheless, the NEESPI Science Advisory Panel is seriously concerned with the problem of integration across the diversity of the NEESPI projects and tasked the Leaders of NEESPI FRCs to address this issue. At present, critical for the Initiative are:

- Further development of NEESPI integrative projects and
- Strengthening of the Initiative Organizational structure.

V. Summary:

- There are many areas for mutually beneficial collaborative studies between GEWEX and NEESPI at regional (e.g., BALTEX) and global (e.g., role of terrestrial biosphere and human activity in Global Change) scales.
- NEESPI is endorsed by iLEAPS, GCP, GWSP, and GLP, represents an integrated Earth Science activity and has a potential to bring these ESSP Projects and GEWEX closer together.
- GEWEX has many types of expertise and products that could benefit NEESPI. NEESPI needs to learn the types of collaborative mechanisms that would facilitate mutual beneficial projects.

Therefore: We propose that GEWEX formally recognize NEESPI as either (a) a **GEWEX/CEOP CSE**, or (b) a collaborator which will jointly plan field campaigns in Eurasia, direct the current and potential NEESPI participants' research towards the GEWEX goals, and participate in GEWEX meetings.

Appendix 1. NEESPI Science Plan Structure.

1. INTRODUCTION
2. SCIENTIFIC QUESTIONS AND MOTIVATION
3. **MAJOR SCIENTIFIC TOPICS** <http://neespi.org>
 - 3.1. Terrestrial ecosystem dynamics
 - 3.2. Biogeochemical cycles
 - 3.3. Surface energy and water cycles
 - 3.4. Land use interactions: societal-ecosystem linkages
 - 3.5. Ecosystems and climate interactions
 - 3.6. Topics of special interest
 - 3.6.1. Cold land region processes
 - 3.6.2. Coastal zone processes
 - 3.6.3. Atmospheric aerosols and pollution
4. REMOTE SENSING
5. MODELING **TOOLS**
6. DATA AND INFORMATION TECHNOLOGY
7. EDUCATION
8. RESEARCH STRATEGY
 - Scientific Background Appendix

Appendix 2. NEESPI Infrastructure and Leaders:

NEESPI Topical Focus Research Centers:

- *Center for Cold Land Processes and Arctic Coastal Studies*, Leader: Prof. Vladimir Romanovsky (University of Alaska-Fairbanks, Alaska, USA)
- *Center for Water System Studies*, Leader: Prof. Charles Vörösmarty (University of New Hampshire, Durham, New Hampshire, USA)
- *Center on Atmospheric Aerosol and Air Pollution Studies*, Leader: Prof. Irina Sokolik (Georgia Institute of Technology, Atlanta, Georgia, USA)
- *Center for Land Use Studies*, Leader: Prof. Dennis Ojima (Colorado State University, Fort Collins, Colorado, USA)
- *Center for Biogeochemical Cycle Studies*, Leader: Prof. Martin Heimann (Max Planck Institute for Biogeochemistry, Jena, Germany)
- *Center for Land Cover Studies*, Leader: Prof. Christiane Schmullius (Fridrich Schiller University, Jena, Germany)

NEESPI Regional Focus Research Centers:

- *Regional Center for Dry Land Processes Studies*, Leader: Prof. Jiyuan Liu (The Institute of Geographic Science and Natural Resources Research, Chinese Academy of Sciences Beijing, China)
- *Regional Center for Boreal Forest and Tundra Processes Studies.*, Leaders: Academicians Alexander S. Isaev and Vladimir M. Kotlyakov (Institute of Geography, Russian Academy of Sciences, Moscow, Russia) [*under construction*]

- *Regional Focus Research Center for NEESPI Studies in East Europe*, Leader: Prof. Scaba Mátyás (The University of West Hungary, Sopron, Hungary) [*under construction*]

NEESPI Science and Data Support Centers:

- *NOAA National Climatic Data Center*, Asheville, North Carolina, USA
- *Beijing Climate Center*, Beijing, China
- *Research Institute for Hydrometeorological Information*, Obninsk, Kaluga Area, Russia;
- *SCANEX Corp.*, Moscow, Russia
- *Goddard Space Flight Center*, Greenbelt, Maryland, USA

Projected NEESPI Focus Research Centers

- Two Regional FRCs in Vladivostok and Krasnoyarsk, and
- NEESPI Focus Research Center for Integration of the NEESPI Results and Modeling Studies.

NEESPI Chairs and other Leaders

- Acting NEESPI Project Manager: Richard Lawford (International GEWEX Project Office, Washington, DC, USA)
- Chair of the NEESPI Science Advisory Panel: Prof. Christiane Schmutz (Friedrich Schiller University, Jena, Germany),
- Project Scientist: Pavel Groisman (UCAR at NCDC, Asheville, North Carolina, USA)
- Chief Scientists: Herman H. Shugart (University of Virginia, USA) and Alexander Isaev (CEPL, Moscow, Russia)

The list of NEESPI senior scientists (funded projects only) is provided at the NEESPI web site (<http://neespi.org>). As of April 6, 2006, 353 scientists from 186 institutions from 30 countries have been participating in 52 funded projects. Additionally two national mega-projects of the Russian Academy of Sciences have joined NEESPI in February 2006 and several more projects are in the process of the NEESPI recognition.

Publications:

- The NEESPI Science Plan (260 pp.) and its Executive Summary (18 pp.) have been published at the NEESPI web site (<http://neespi.org>). Executive Summary is also dubbed in a refereed publication by the NEESPI SP Editors, Groisman and Bartalev in Special issue of "Global and Planetary Change" journal.
- The special NEESPI issue of "Global and Planetary Change" journal is currently in press.

List of NEESPI meetings, workshops, and conference sessions:

- **December 12, 2006: Open Science Session at the American Geophysical Union Fall Meeting (San Francisco, USA, December 2006)**
- November 13, 2006: NEESPI Science Services and Data Support Centers Workshop, Beijing, China
- **November 7-8, 2006: First Regional NEESPI Focus Research Center on Dry Land Processes Studies Workshop, Beijing, China**
- September 18-20, 2006: "International Symposium: Environmental change in Siberia: Insights from Earth Observation and modeling" is being organized by Sib - ESS-C (SIBERIA-II Earth System Science Cluster Group)
- May 11-16, 2006 "NATO 'Science for Peace' Program and NEESPI Joint Workshop on extreme precipitation events: their origins, predictability and societal impacts.", Odessa, Ukraine
- April 11-13, 2006 "NASA Land-Cover and Land-Use Change Science Team Meeting
- **April 6 - April 8, 2006 NEESPI Cold Land & Arctic Coast (CLAC) Focus Research Center. First Workshop, IARC, Fairbanks, Alaska, USA**
- **February 22-24, 2006 The 1st NEESPI Science Team Meeting in IIASA, Laxenburg, Austria**
- December 4, 2005 NEESPI Briefing for the IGBP Leadership, San Francisco, California, USA as a pre-meeting workshop at the AGU Fall Meeting
- June 18-19, 2005, Regional GOF-C-GOLD workshop "Observations of Land Cover and Needs of Research Projects in Northern Eurasia". St. Petersburg, Russia

- June 19, 2005 NEESPI Briefing for Lead Scientists and Representatives of Other Programs, St. Petersburg, Russia, as a pre-symposium workshop at the 31st International Symposium on Remote Sensing of Environment
- June 20-24, 2005, NEESPI Special Session at the 31st International Symposium on Remote Sensing of Environment, St. Petersburg, Russia.
- June 7, 2005, Second NEESPI Inter-Agency Meeting, Washington DC, USA
- February 3-5, 2005, "International Conference on Land-Cover and Land-Use Change Processes in North East Asia Region" Harbin, China
- December 13-17 2004, NEESPI Special Session at AGU Fall Meeting, San Francisco. USA
- December 9-10, 2004, First Inter-Agency Northern Eurasia Earth Science Partnership Initiative and Science Review Meeting for the U.S., Europe and Eurasia, Washington DC, USA
- September 6-9, 2003, "The NEESPI Science Plan Review" Meeting by an International Panel of External Reviewers with the authors of the First Draft of the NEESPI Science Plan, Yalta, Ukraine
- April 21-25, 2003, First NEESPI Planning Workshop, Suzdal, Russia

Appendix 3. NEESPI Data and Publication Policies and Data Policy Implementation

Introduction. The data collected by the NEESPI scientists represent a significant public investment in research (in this context the term "data" includes the observation data, metadata, products, information, algorithms, documentation, models, images, and research results). NEESPI scientists hold these data in a public trust to promote comprehensive, long-term Earth science research. Accordingly, NEESPI has adopted data policies consistent with existing international policies and data exchange principles to maximize access to data and to keep user costs as low as possible. This policy applies to all data archived, maintained, distributed or produced by the NEESPI scientists/institutions. We, however, make a distinction between the Datasets created or substantially modified through NEESPI and those that have been a property of the NEESPI scientists/institutions prior to their joining the Initiative.

NEESPI data and publication policies are as follows:

1. **Data generated by NEESPI** will become public domain and will be permanently archived in the NEESPI country where the research was conducted and at the centralized (or distributed) NEESPI **Science and Data Support Centers, (NSDSC)**. Only validated and accepted for distribution data will be archived at NSDSCs. These Centers will provide data documentation and tools for searching and distributing these data. Implementation of the NEESPI data policy will be tasked to NSDSCs.
2. NEESPI researchers are encouraged to share all NEESPI-related data with other NEESPI partners during research and validation but prior to submission to NSDSC, thus utilizing advantages of collaborative NEESPI environment. We do not expect that the data that have been a property of the NEESPI scientists/institutions prior to their joining the Initiative will become automatically available to all NEESPI researchers. However, if these data holdings were a prerequisite to join the NEESPI Research Team, it is expected that (a) the data holders will be partners of the researchers, (b) the research projects, which involve the use of these data, have to allocate resources to modernize (update, quality control, describe, and make the data useable for particular tasks of these projects), and only thereafter, (c) a new modernized data set became a part of the **NEESPI generated datasets**. As a rule, only validated and accepted for distribution data will be archived at NSDSCs.
3. There will be no periods of exclusive rights to publish NEESPI results. Exceptions are possible for students where graduation requirements prohibit publication of results prior to acceptance of a Thesis.
4. Individual investigators may make their own data more widely available at any time. Outside investigators (i.e., non-NEESPI researchers) will be given access to these data as soon as the data have been submitted to any of the NSDSCs after validation.

5. Each NEESPI module is responsible for establishing a time schedule for data exchange within the projects and data delivery to one of the NSDSCs. The time limit for data delivery to the NSDSCs will be no more than one year.
6. Data should be analyzed cooperatively by all scientists involved in obtaining them. Cooperation across disciplines and among Northern Eurasian, European, Japanese, and North American researchers should be encouraged. Publications resulting from work under NEESPI should be co-authored by all scientists who have participated substantially in the work, unless some participants choose not to be on the authors' list. The same applies to presentations at meetings. Users of unpublished data should contact the data providers well in advance of producing and submitting a manuscript, in order to inform the providers of intended use. Special efforts by each non-Northern Eurasian researcher should be put into integration of Northern Eurasia researchers in their work and in the publication of the results.
7. Where data are used for modeling or integrating studies, the scientist collecting the data will be credited appropriately, either by co-authorship or by citation. The data collectors should be informed of publication plans well in advance of submission of a paper, given an opportunity to read the manuscript, and be offered co-authorship. In cases where data from other investigators are a minor contribution to a paper, the data should be referenced by a citation. Users of the data will always have to state the source of the data.
8. Specific constraints for certain data sources (e.g., satellite products, global meteorological analysis, etc.) may be subject to copyright restrictions, which are more limiting than this NEESPI data policy. It is up to the NEESPI Steering and Coordination Committee (NSCC) or their designee to take the first steps in making contacts with officials and institutions in order to prepare specific agreements that will allow NEESPI scientists to use the data.

Implementation of the NEESPI data policy will be mostly provided via the NEESPI Science and Data Support Centers, NSDSC. These Centers are tasked to provide all possible support within the area of their responsibility to the current NEESPI researchers and to promote the NEESPI, thus facilitating further involvement of prominent scientists and research groups in the studies that address the objectives outlined in the NEESPI Science Plan. A suite of funding requests have been (will be) submitted to National Agencies to secure this task.