Northern Eurasia Earth Science Partnership (NEESPI)

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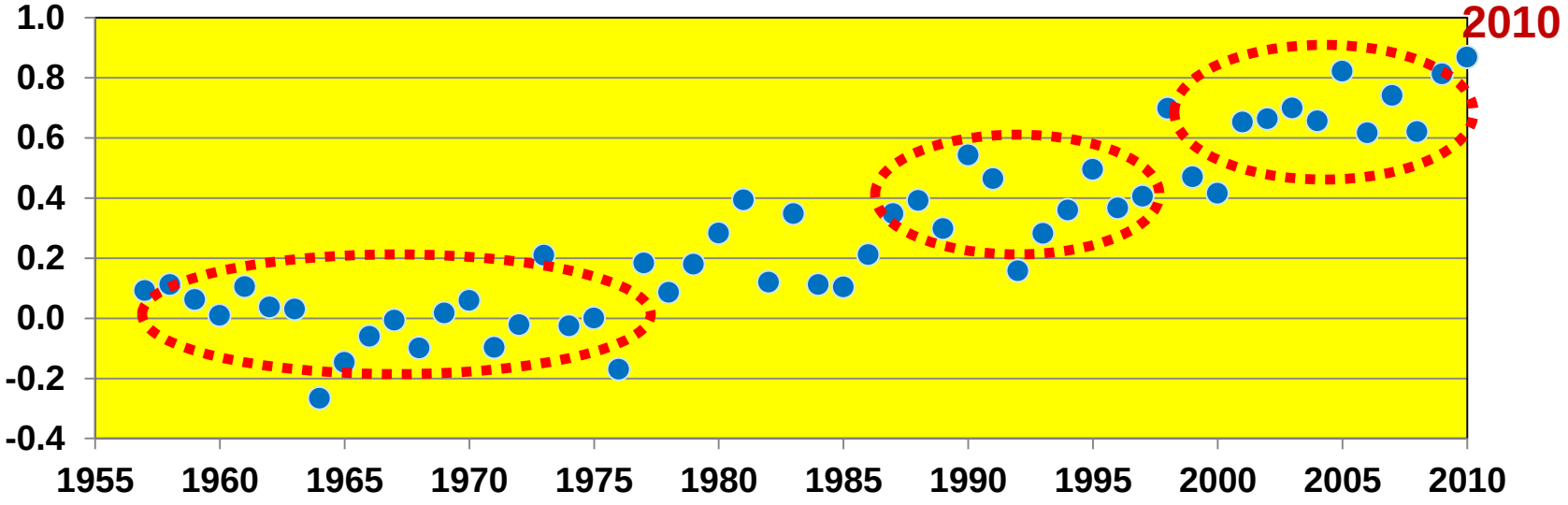
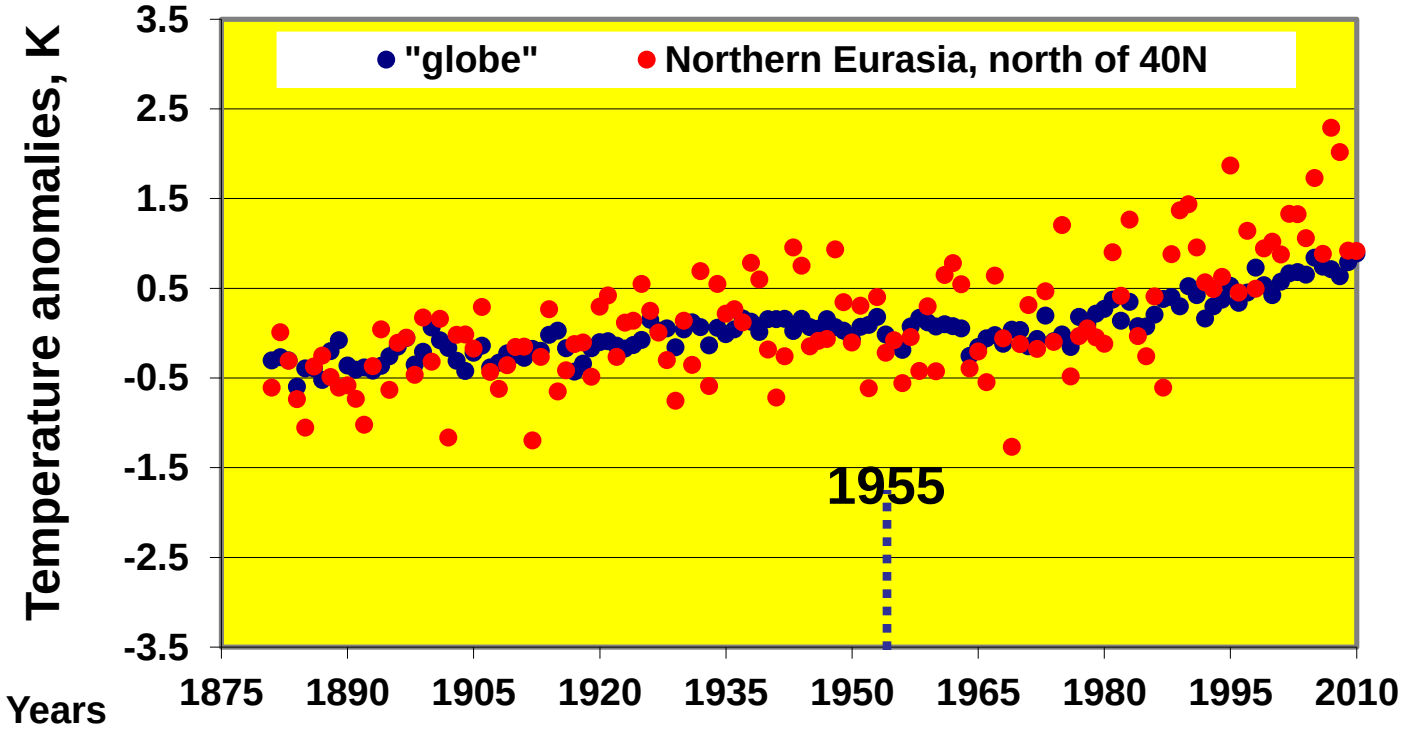
Recognition

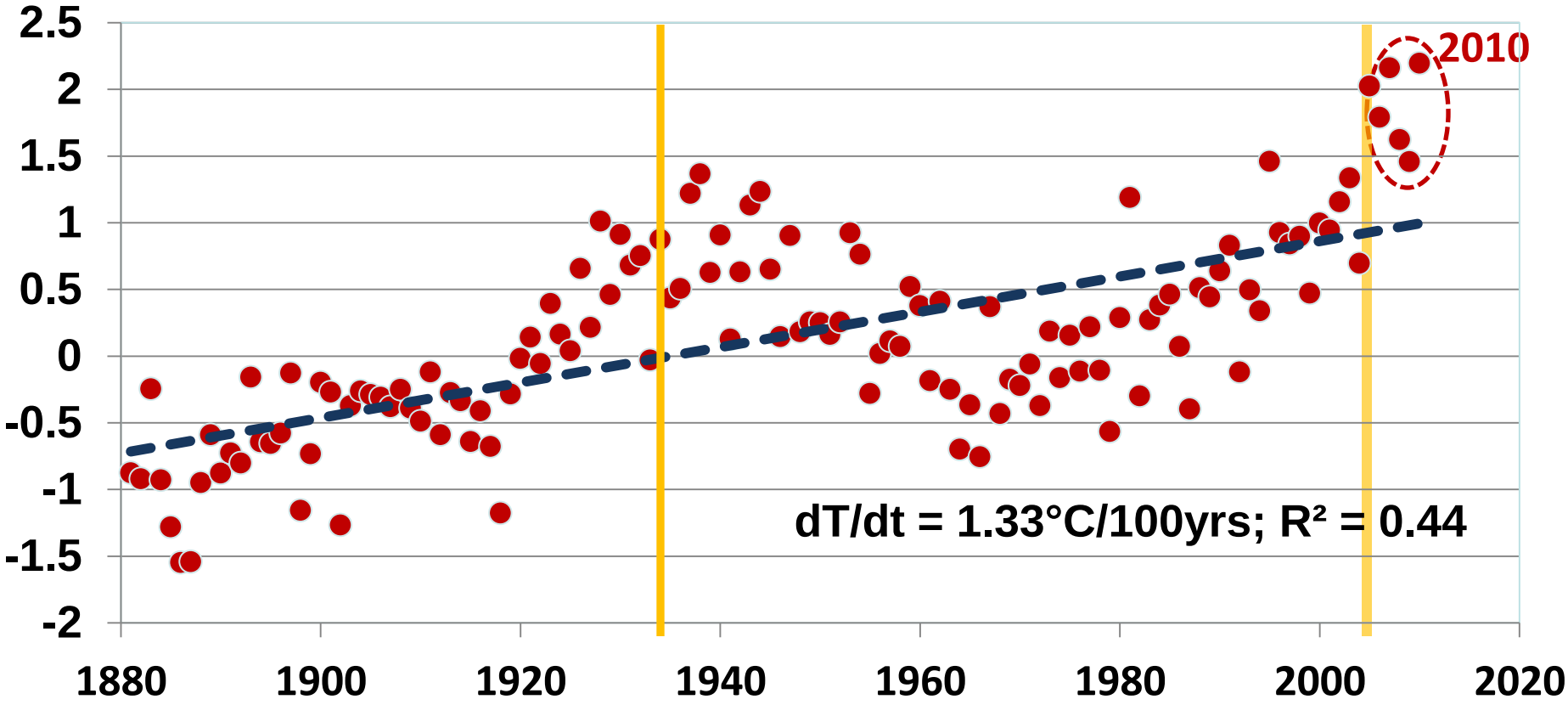
Global Surface Air Temperature Anomalies, °C



Rates of increase of annual temperature for the "globe" (60°S to 90°N) and Northern Eurasia are 0.91 °C/130 yr and 1.5°C/130yr respectively. (Lugina *et al* 2007, updated).

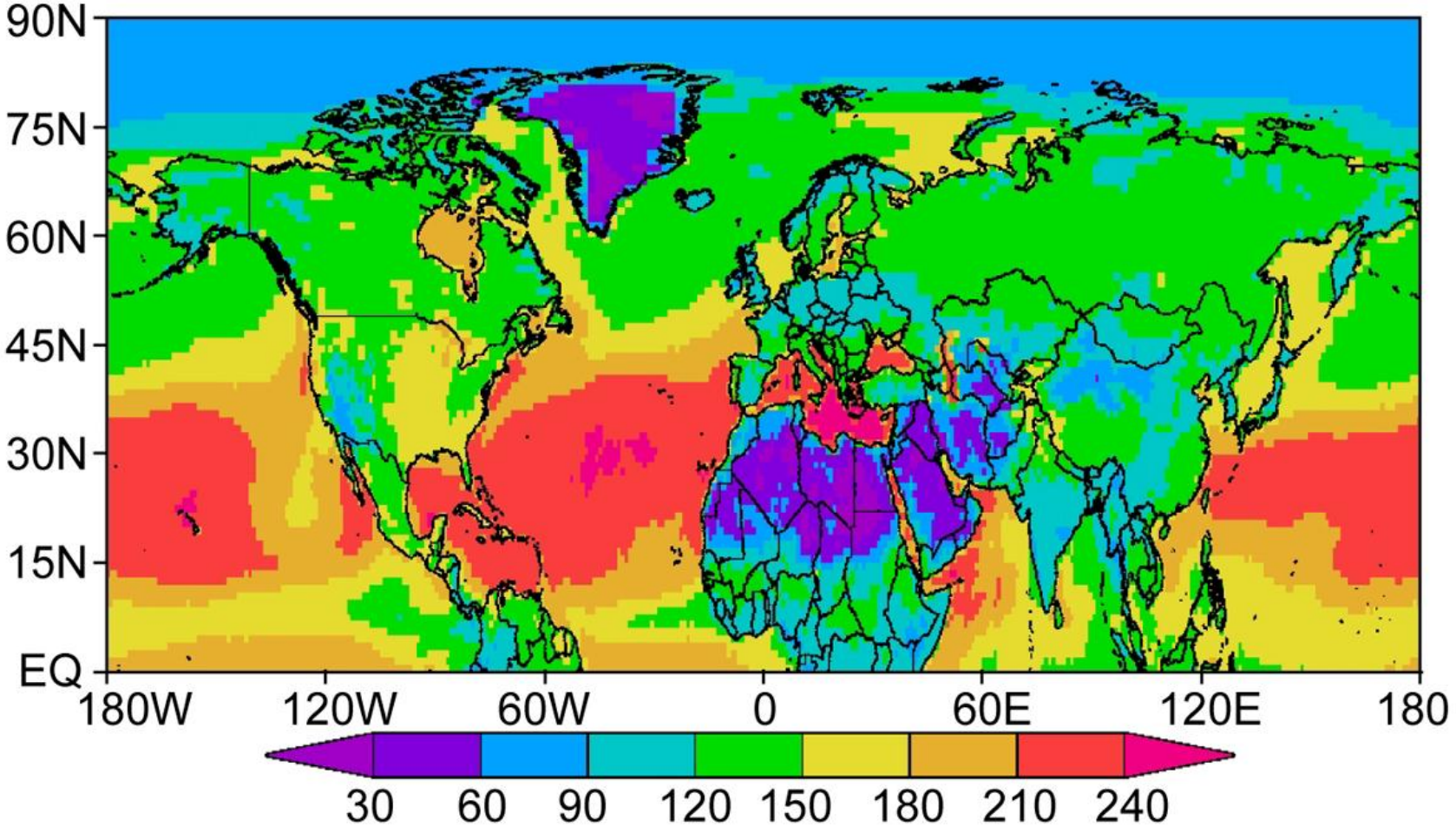


Annual surface air temperature area-averaged over the 60°N - 90°N latitudinal zone (Arctic)



Linear trend for the entire period of instrumental observations is 1.73°C/130 yr but there were periods (e.g., 1936-2004) when there was no statistically significant linear trend (Groisman *et al.* 2006, updated).

July total net irradiance (solar net + thermal infrared net)

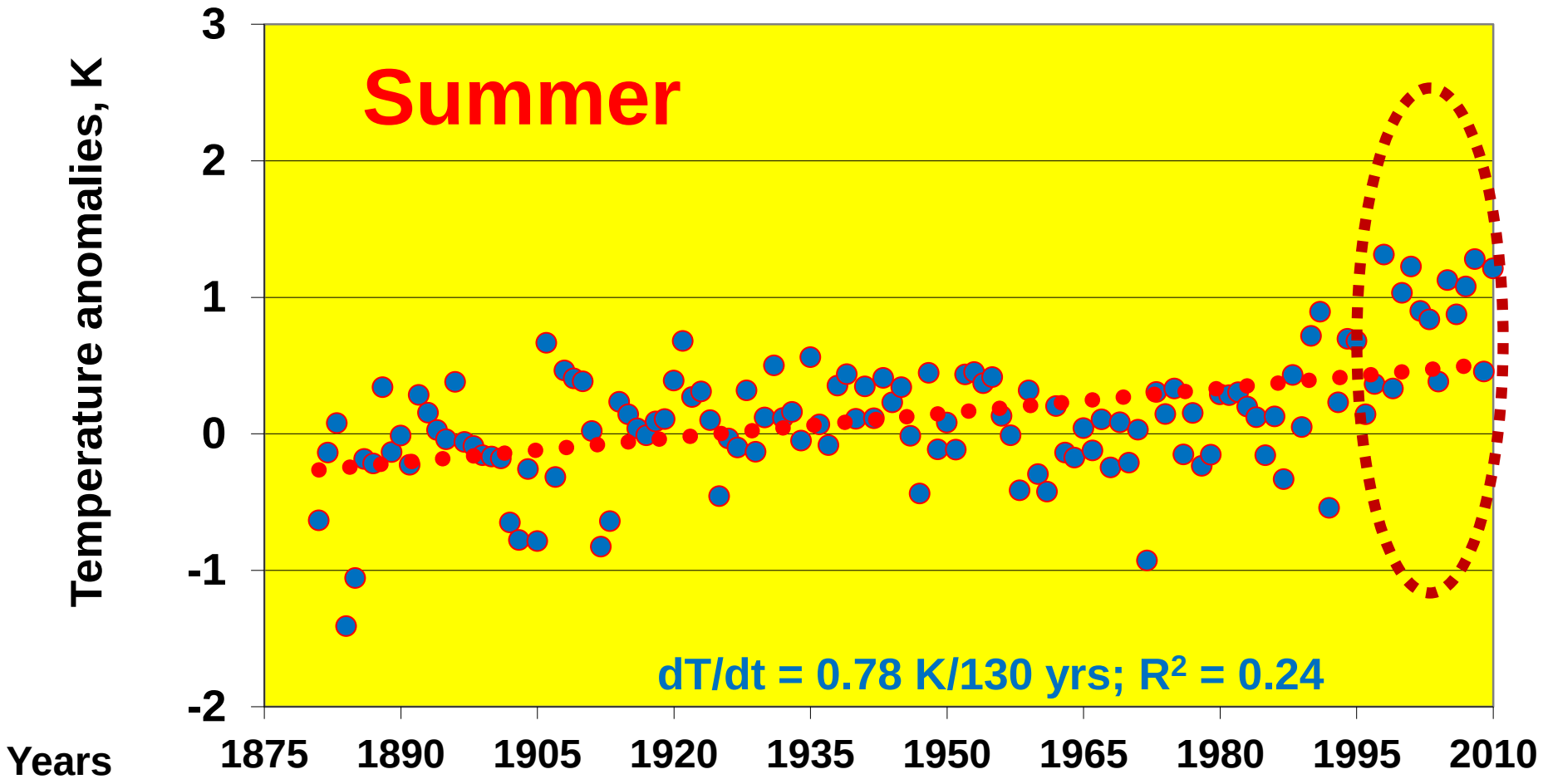


The 22 year average from the NASA/GEWEX Surface Radiation Budget project.

Courtesy of Paul Stackhouse Jr. and Colleen Mikovitz, NASA Langley Research Center

Northern Asia, north of 40°N

Summer temperature anomalies for the past 130 years; 1951-1975 reference period



Archive of Lugina et al. 2007, updated

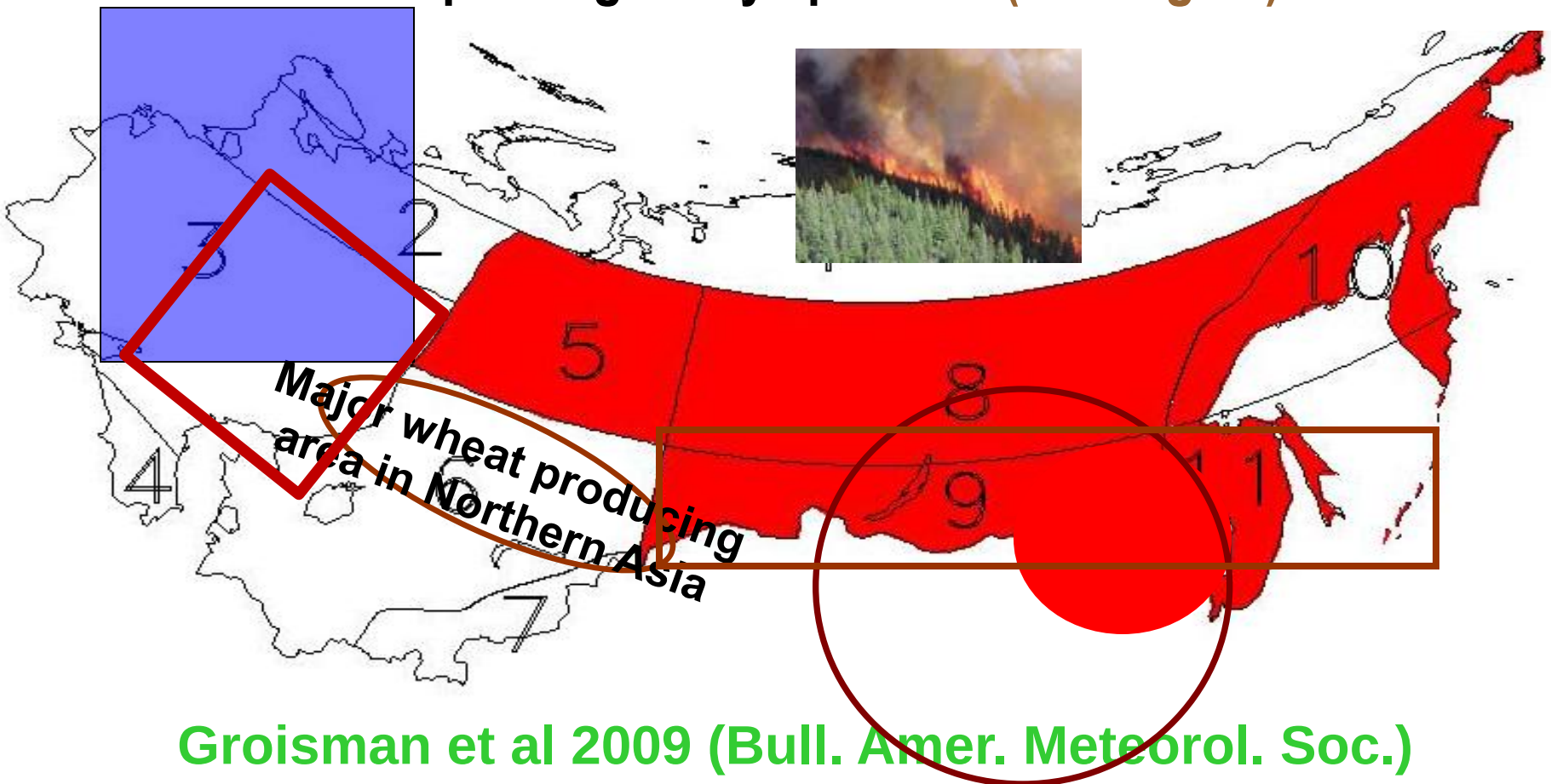
Changes in the surface water cycle over Northern Eurasia that have been statistically significant in the 20th century

More humid conditions (blue),

more dry conditions (red),

more agricultural droughts (circled),

more prolonged dry episodes (rectangled).



Groisman et al 2009 (Bull. Amer. Meteorol. Soc.)

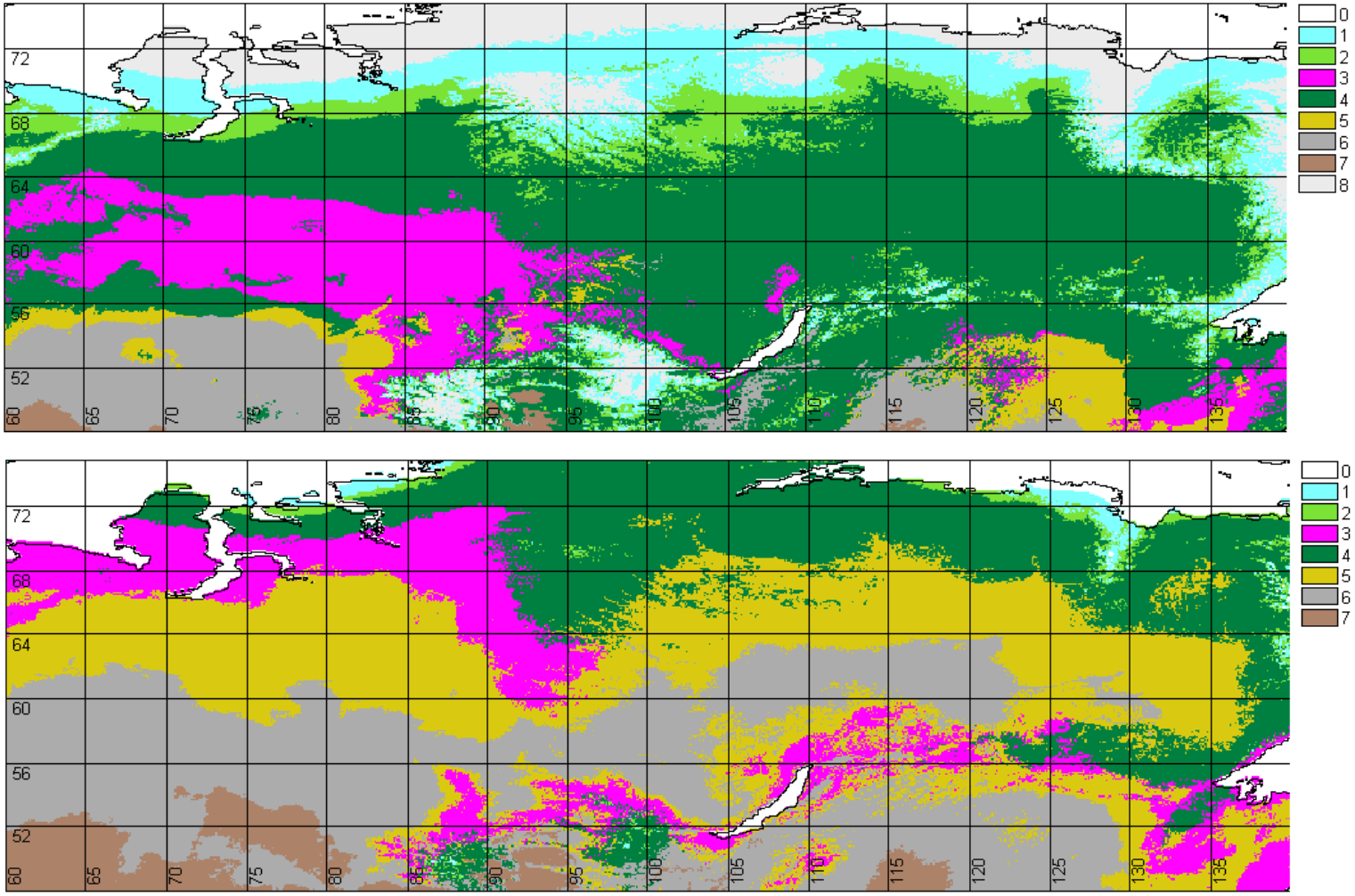
Intense fire in a *Pinus sylvestris* forest, resulting in a likely conversion to steppe

- **Left**, no regeneration after several years; **right**, no regeneration after 20 years (Siberia) **Tchebakova et al. (2009)**

Landscape after forest fires

- **Thawing of ice-rich permafrost, triggered by forest fire in Central Yakutia, transforms boreal forest into steppe-like habitats (photo by Vladimir Romanovsky)**

Biome distribution over Siberia in current (a) and 2090 (b) climates (Vygodskaya et al. 2007)



Water (0),Tundra (1), forest-tundra (2), darkleaf taiga (3) and lightleaf taiga (4), forest-steppe (5), steppe (6), semidesert (7), and polar desert (8).

Why we have to be expedient in our research?

Firstly:

the changes are already here and they have been large!

Secondly,

- **We are facing a non-linearity in environmental and climatic changes in Northern Eurasia right now due to**
  - **Dramatic retreat of the Arctic sea Ice that is causing**
    - **rampaged coastal erosion (up to 10 m yr^{-1})**
    - **release of carbon (both, methane and CO_2) stored in the frozen shelf and coast (Shakhova et al. 2009), and**
    - **additional source of heat and moisture in early winter**
  - **Impact on the World Ocean thermohaline circulation due to changes in the fresh water inflow into the Arctic Ocean**
  - **Feedbacks to the global carbon budget & climate** due to
    - **Permafrost thaw**
    - **Wetlands transformation**
    - **Land cover changes and**
    - **Ecosystems shift**

Processes in Northern Eurasia that directly feed back to the Global Earth System

- Accelerated climatic changes
- Changes related to snow cover changes
- Thawing of permafrost
- Deglaciation in the mountain systems of Central Asia, increasing water withdrawal, and increasing dryness of steppe and semi-arid zones
- Ongoing aridization of the continental interior forest fires and dust storms
- Changes in the boreal forest ecosystem
- Drying of bogs
- The fresh water transport to the Arctic Ocean
- Changes in surface energy and water balance related to vegetation changes, shift of ecological zones, and land use changes

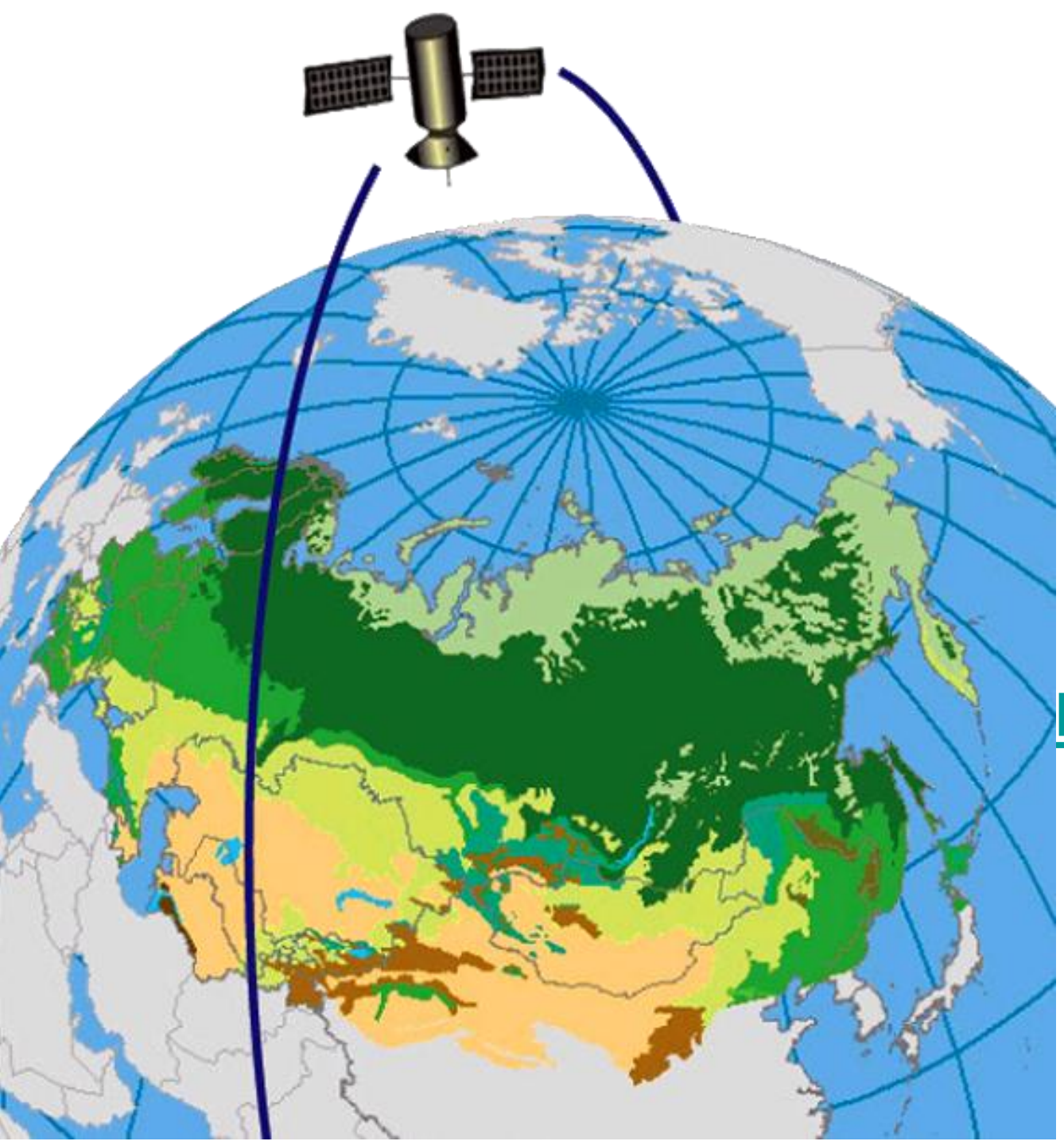
PART 2

Northern Eurasia Earth Science Partnership Initiative (NEESPI) as an answer to the challenges of regional climatic and environmental changes

NEESPI is an interdisciplinary program of internationally-supported Earth systems and science research that addresses large-scale and long-term manifestations of climate and environmental change.

NEESPI Study Area includes: Former Soviet Union, Northern China, Mongolia, Fennoscandia, & Eastern Europe

NEESPI duration ~ 10 years (started in 2004)



The NEESPI Study Area

http://neespi.org

Background

- Seven years ago NEESPI was established to address large-scale and long-term manifestations of climate and environmental change in Northern Eurasia **(http://neespi.org).** This web site contains the NEESPI history, presentations at the NEESPI past conferences, the NEESPI Science Plan (260 pp.) and its Executive Summary (18 pp.; also dubbed in 2007 as a refereed publication in the Special NEESPI issue of "*Global and Planetary Change*").
- The NEESPI domain is shown in the map.
- NEESPI Science Plan includes elements of WCRP, IGBP, IHDP и DIVERSITAS.

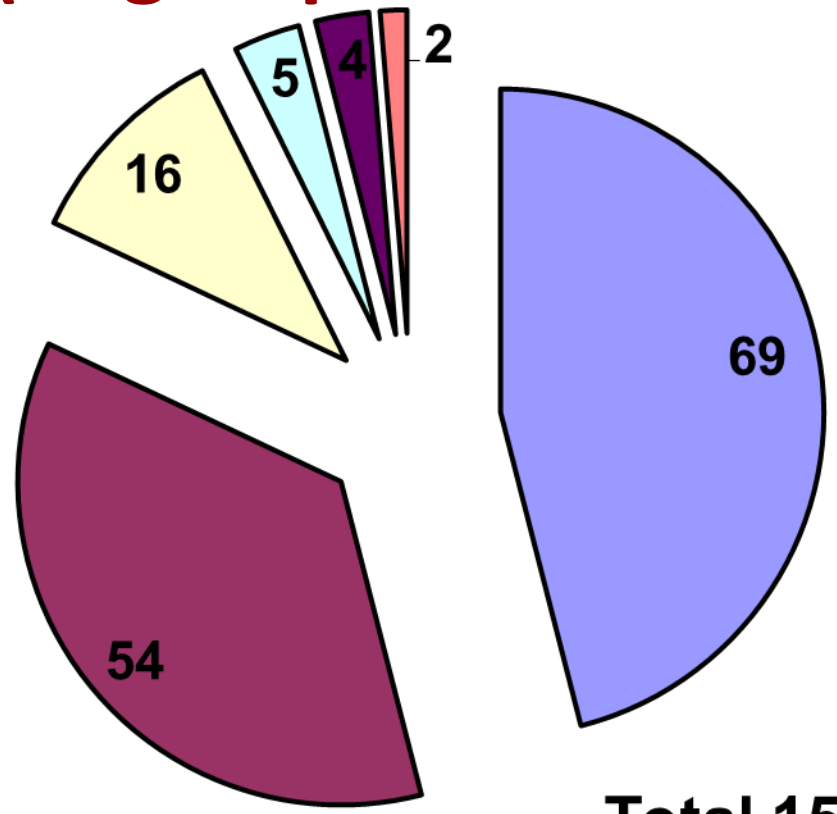
NEESPI Recognition

- NEESPI is widely recognized and endorsed by several Earth System Science Partnership (ESSP) programmes and projects: the International Geosphere and Biosphere Programme, the World Climate Research Programme through the Global Energy and Water Cycle Experiment and Climate and Cryosphere Projects, the Global Water System Project, Global Carbon Project, Global Land Project, and the Integrated Land Ecosystem—Atmosphere Processes Study and become an entity in intergovernmental collaboration plans in the United States, Russia, and Ukraine.

NEESPI Statistics

- Throughout its duration, NEESPI served and is serving as an umbrella for about **150 individual research projects (always with an international participation)** with an annual budget close to 15 million US dollars (cf., the next Figure, where international NEESPI projects are grouped by the major national funding source). More than **700 scientists from more than 200 institutions of 30 countries** worked or are working under the Initiative umbrella.
- **A new crop of NEESPI projects was launched in 2010/2011 to compensate for the projects that have been completed.**

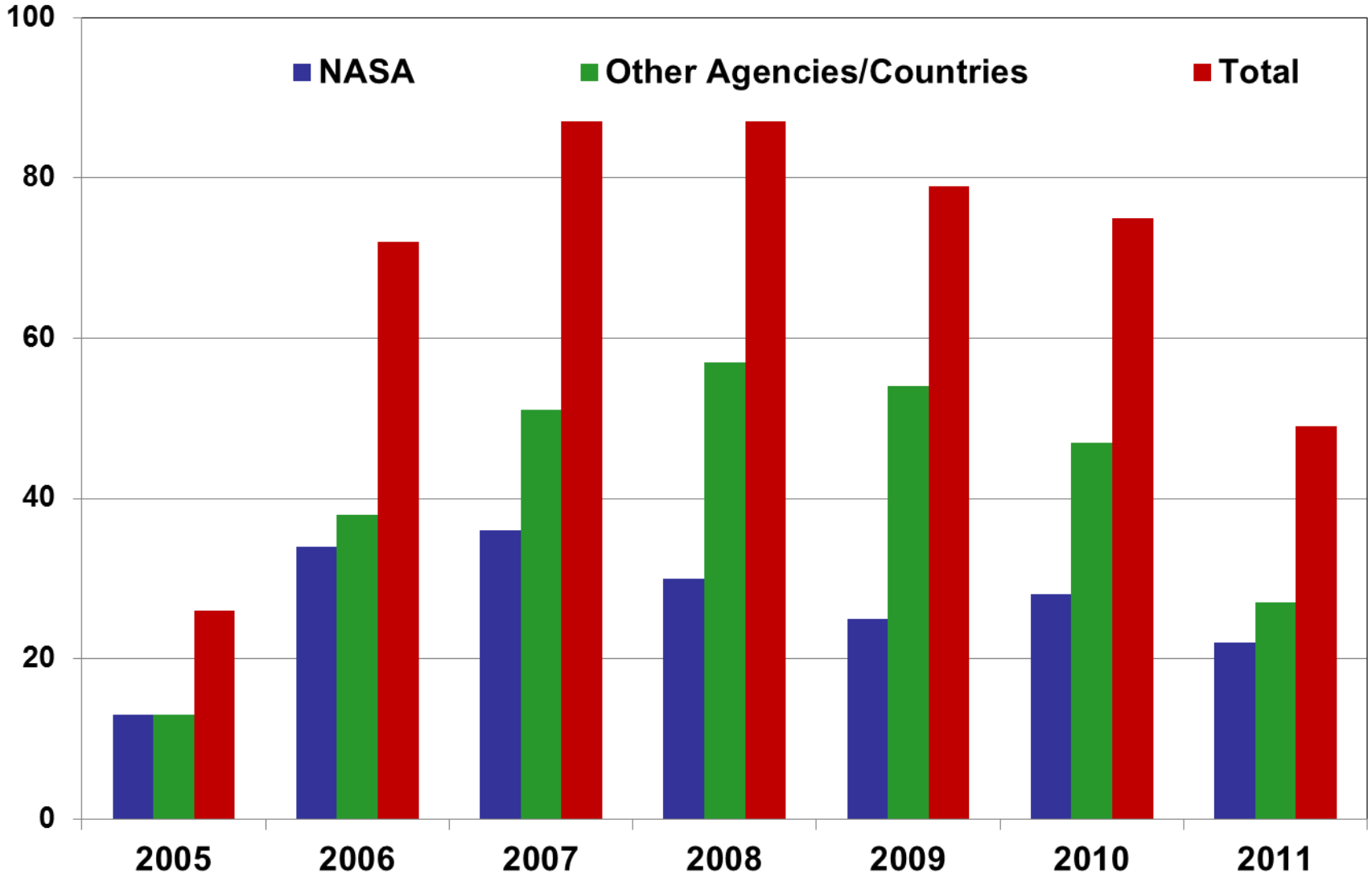
Completed and ongoing NEESPI Projects by country (or group of countries), March 2012



Total 150 Projects

- All US Agencies
- All Russian Agencies
- All EU Agencies
- All Japanese Agencies
- All Chinese Agencies
- Canada

Active Projects per year



NEESPI Data Distribution

- **NEESPI keeps promoting the data exchange among the NEESPI participants *via* the existing NEESPI Science and Data Support Centers in Russia, China, and the United States. The results of this data exchange materialized in a new set of publications and conference presentations that are currently using these data.**
- **A stellar addition to the NEESPI data distribution Services in 2010, became a new Data Analysis and Exploring System for Hydrology of the NEESPI domain developed by the Water Systems Analysis Group at University of New Hampshire – Durham (http://neespi.sr.unh.edu/maps/). An unrestricted web-based access to the System makes it a useful tool for any hydrological assessment within Northern Eurasia.**

NEESPI Outreach, http://neespi.org

During the past 6 years, 34 dedicated NEESPI Workshops and 12 NEESPI Open Science Sessions at the International Meetings were convened and more than 700 papers and books were published. The past two years were extremely productive in the NEESPI outreach. Several PhD students defended their theses while working within the NEESPI framework. In 2010 and in 2011, *more than 300 peer-reviewed papers and/or book chapters were published* or are in press (this list is still incomplete and is anticipated to increase; cf., http://neespi.org/science/NEESPI_publications.pdf)

In particular:

A suite of 34 peer-reviewed NEESPI articles were published in the third Special NEESPI Issue in ***Environ. Res. Lett*. (2009, No. 4, and 2010, No.1).**

Several books and White Papers were published by Springer (**Balzter, ed., 2010; Gutman and Reissell, eds., 2011**), the National Academy of Science of Ukraine (**Lyalko, 2010**), and FAO (**Mátyás, 2010**).

Books and thematic journal Issues in 2012

Published:

- The 4th (the third ERL) *Environ. Res. Lett*. NEESPI focus issue has been publishing on line. This Special Issue has **24** accepted manuscripts, ***twenty one*** of them have been already ***published*** **(**cf**.,** **http://iopscience.iop.org/1748-9326/focus/NEESPI3)**

In press:

- Groisman, P.Ya. and V.I. Lyalko (eds.), 2012: "*Earth System Change over Eastern Europe*" "Naukova Dumka" Publ. House, Kiev, Ukraine (in English; to be published May 2012).
- Groisman P.Ya. and G. Gutman, 2012: *"Environmental Changes in Siberia: Regional Changes and their Global Consequences*" , Springer Publishing House, Amsterdam, The Netherlands (to be published in late summer - autumn 2012).

In preparation:

- Chen et al.,eds., 2013: **"***Dryland East Asia: Land Dynamics Amid Social and Climate Change*" is scheduled to be submitted to the "Springer" Publishing House this summer.

NEESPI Meetings, Workshops, Sessions in the past 12 months prior to April 2012

- **April 3-8, 2011 , Vienna, Austria.** NEESPI Session at the EGU Assembly
- **May 22-27, 2011, Makuhari Messe, Japan.** Japanese Geoscience Union Annual Meeting. Special NEESPI Multidisciplinary Session
- **July 3-13, 2011, Tomsk, Russia. "**CITES 2011" Event (International Conference and Young Scientists School on Computational Information Technologies for Environmental Sciences)
- **July 18-20, 2011, Kaifeng, China.** Workshop on Dryland Ecosystems in the NEESPI/MAIRS Domains
- **August 15-21, 2011, Krasnoyarsk, Russia.** International Boreal Forest Research Association (IBFRA), Science Conference
- **December 5-9, 2011, San-Francisco, USA.** NEESPI Session at the Fall Annual AGU Meeting
- **February 7-8, 2012, St. Petersburg, Russia.** NEESPI Regional Workshop: "Hydrological consequences of changes in climate and land cover across Northern Eurasia"

Numerous research proposals to national and international funding agencies were conceived at these gatherings.

Ongoing and Future NEESPI Meetings/Sessions:

- **April 22-27, 2012, Vienna Austria**. European Geosciences Union Annual Assembly. There we shall have four special NEESPI Sessions
- **May 20-25, 2012, Makuhari Messe, Japan.** Japanese Geoscience Union Annual Meeting. Three special NEESPI/MAIRS Multidisciplinary oral and poster Sessions
- **June 18-22, 2012, Yoshkar-Ola, Russia.** Regional Conference: "Impacts of extreme weather on natural, socio-economic, and land-use systems".
- **June 24 - July 2, 2012, Irkutsk, Russia**. Summer Scientific and Educational Event "*ENVIROMIS*" and the APN Workshop on extreme events in Eurasia.
- **December 3-7, 2012, San Francisco, USA**, Open NEESPI Session at the Annual Fall AGU Meeting.

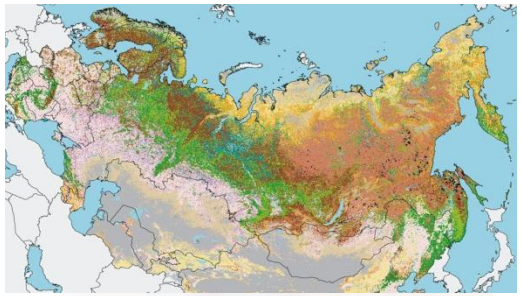
Session proposed to the Global Environmental Change Focus Group component of the AGU Fall Annual Meeting 2012 Program (December 2012)

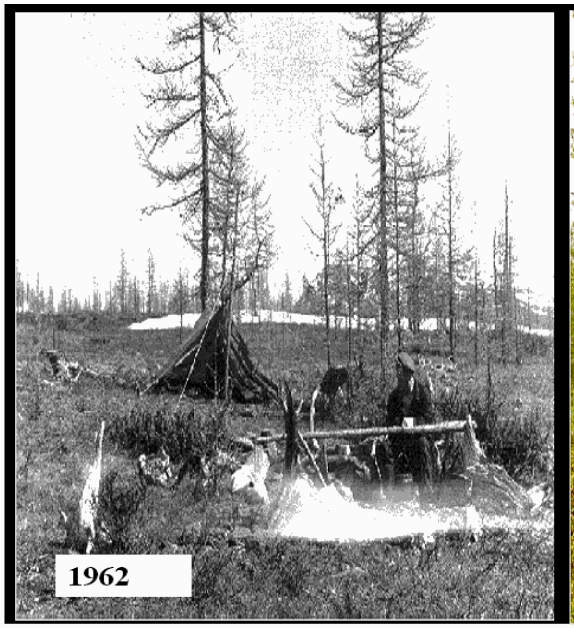
"Environmental, socio-economic and climatic change in Northern Eurasia and their feedbacks to the Global Earth System"

- **We invite presentations on climate and terrestrial ecosystems interactions in Northern Eurasia and regional impact studies of environmental changes and the feedback studies of societal and land use changes on regional and global environment and climate.**
- **Presentations by the early career scientists are particularly welcome.**
- **The foci of this Session are:**
  - **Advance in our ability to understand (monitor, model, project) processes specific to the Northern Eurasia dry land areas;**
  - **Interactions between human and natural systems; and**
  - **Regional integrative multi-disciplinary studies especially those with focus on extreme weather events dynamics and projections.**

Monitoring the biogeochemical cycles, land use, and land cover

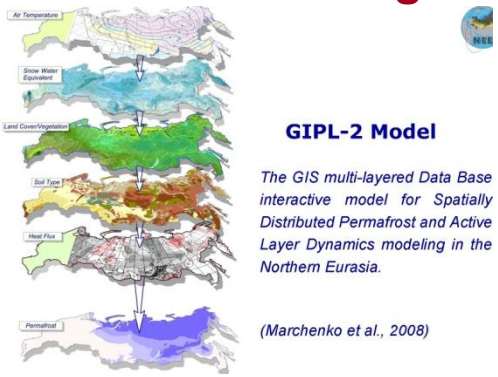
300-m tall flux tower in Siberia

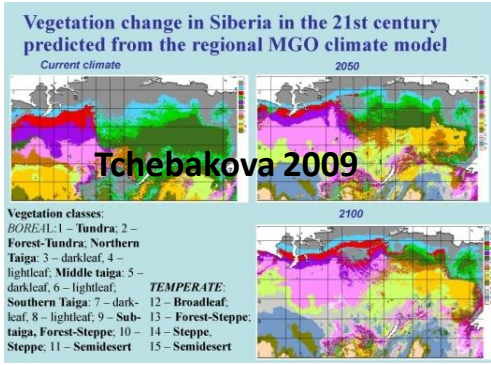




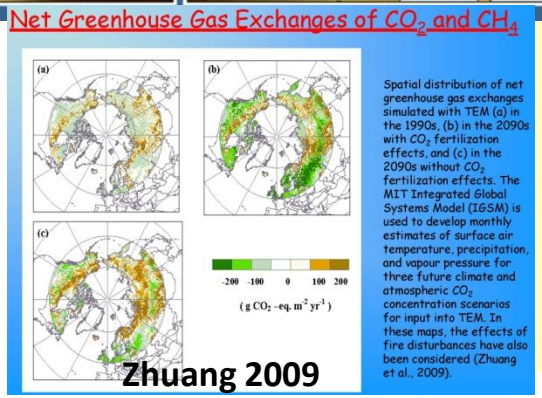
Aral Sea retreat

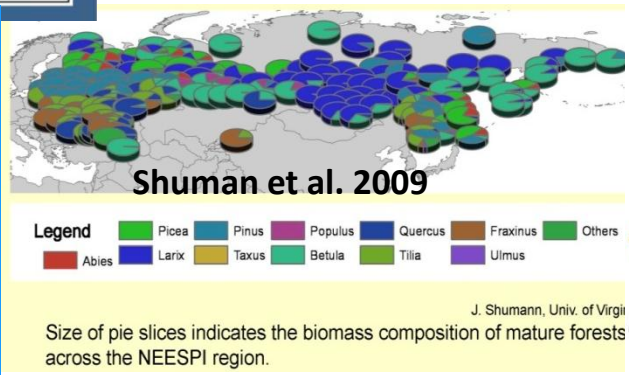
First phase foci of NEESPI were monitoring and analyses. **After the NEESPI Workshop in August 2007 at the Aspen Global Change Institute, a new course was accepted towards strengthening of the NEESPI research focus on projections... i.e., focus on modeling…**

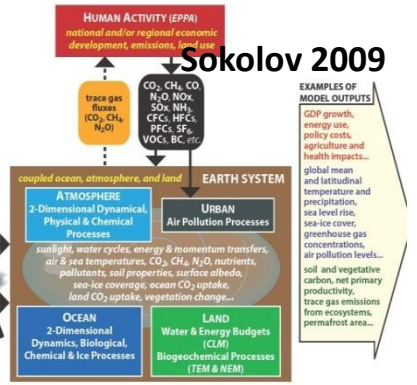


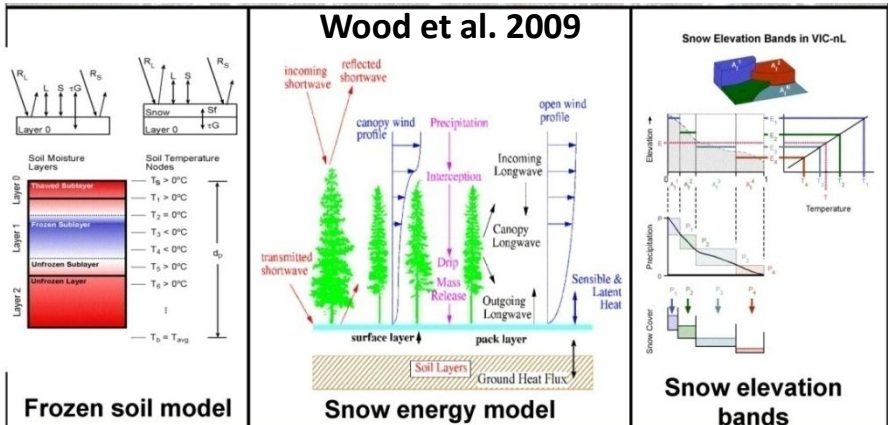


Efforts are made to blend modern RCMs with vegetation, carbon flux, permafrost, hydrological, and dust production models within a North Eurasia modeling suite and link it to the MIT Earth System model.

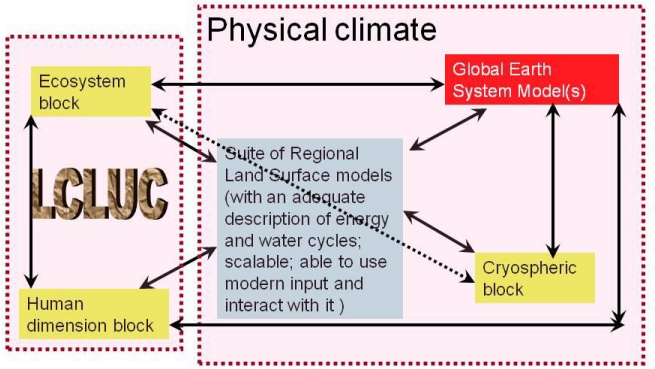








Northern Eurasia modeling suite



Future Plans

- Focus on Modeling (i.e., on projections)
- Data and Scientific Results Dissemination
- Outreach
- Large NEESPI Conference in 2015 that will summarize the 10 years of NEESPI studies
- Integrative studies (Siberia, Eastern Europe, **Central Asia, Dry East Asia**)

PART 3

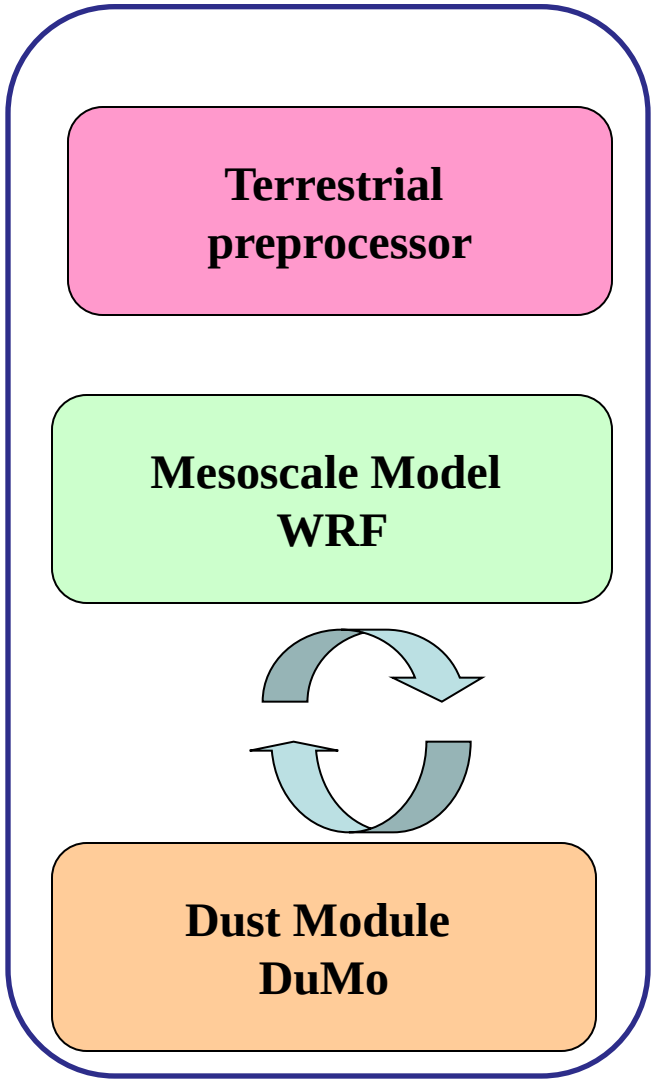
Two aspects of integration studies

Monitoring and projection of dust storms and air pollution

Increasing frequency of dust storms and increasing rate of soil erosion.

Air pollution. Fine aerosol particles are responsible for causing the greatest harm to human health.

A coupled regional modeling system WRF-DuMO (developed at EAS GaTech)



- Adjustable water/land cover mask to reproduce different historical LULC scenarios in Central and East Asia;
- Data base of land properties for dust emission

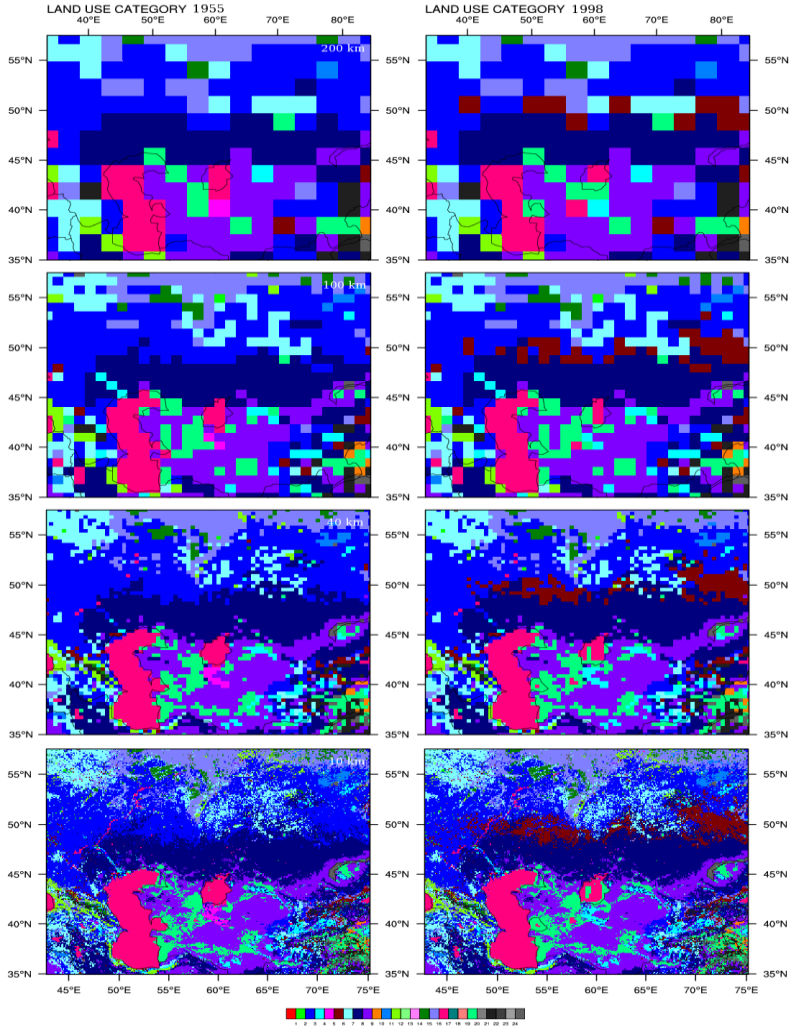
- Flexible nesting capability (down to 1 km)
- Driven by re-analysis data (NCEP or ECMWF)

- Physically based-dust production schemes (coupled with the land model)
- Physically based-treatments of size-resolved dust composition

Darmenova, K., I.N. Sokolik , Y. Shao, B. Marticorena, and G. Bergametti, 2009: Development of a physically-based dust emission module within the Weather Research and Forecasting (WRF) model: Assessment of dust emission parameterizations and input parameters for source regions in Central and East Asia . *J. Geophys. Res.*, 114, D14201, doi:10.1029/2008JD011236.

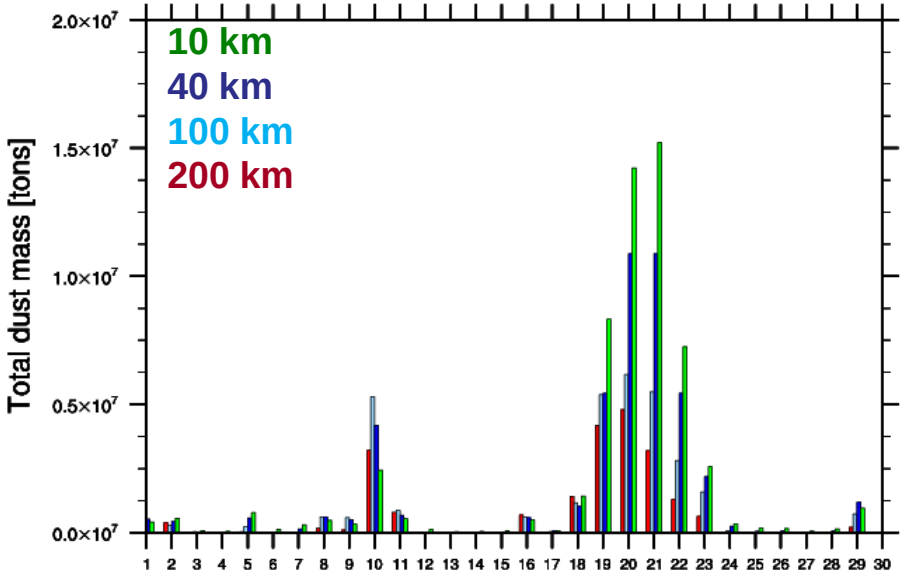
Dust emission modeling with WRF-DuMo (Sokolik et al. 2009)

Land-use/land-cover changes in Central Asia
1950s vs. 1990s
Model's grid size: 200, 100, 40 and 10 km



WRF-DuMo simulations performed for representative grid sizes reveal that GCM-like models significantly underpredict dust emission and hence dust burden in the atmosphere and associated impacts.

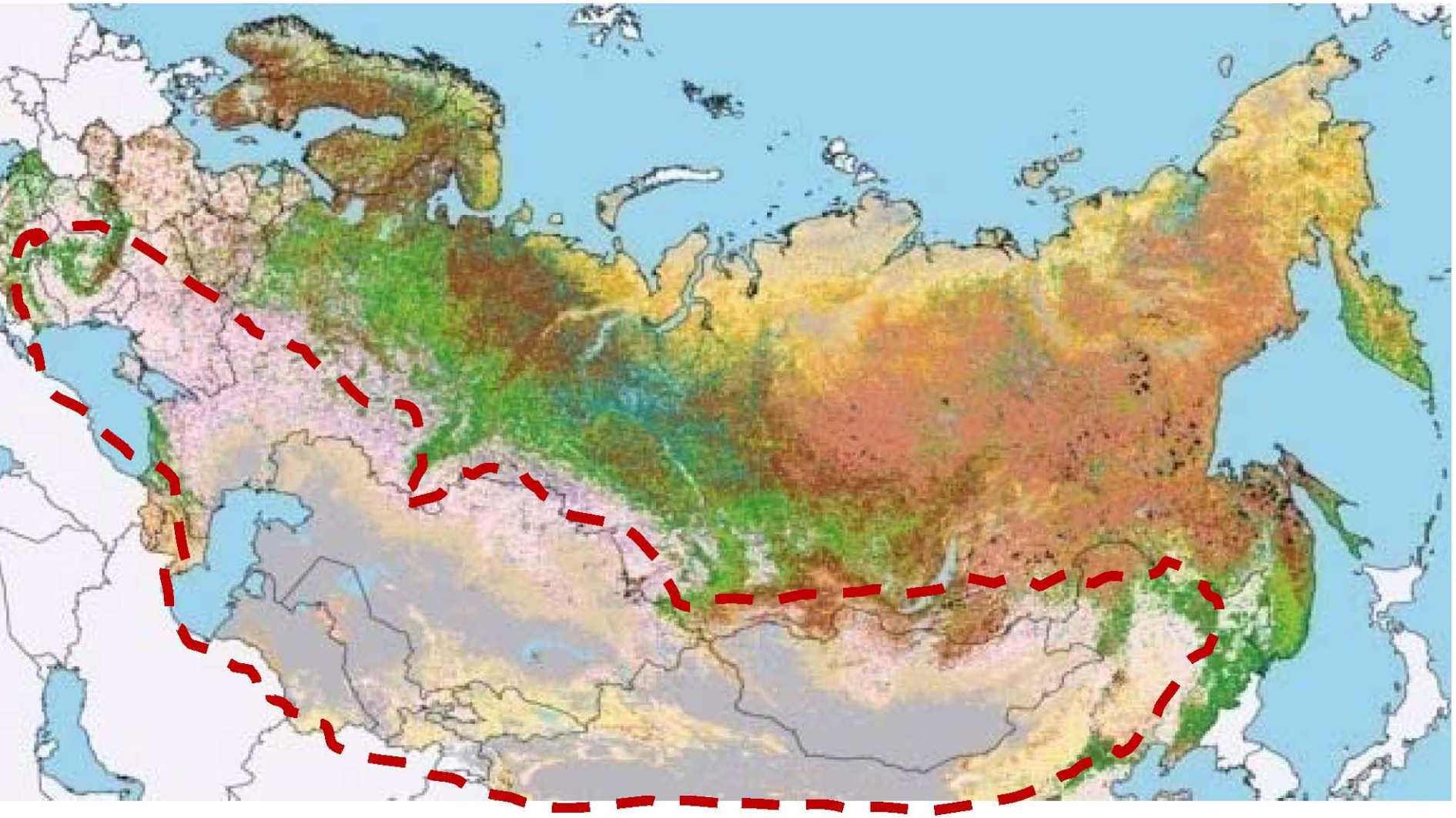
IPCC assessments (performed with GCMs) of radiative forcing of dust aerosol impacts on climate have significant biases, especially in regions affected by land-cover/land-use changes.



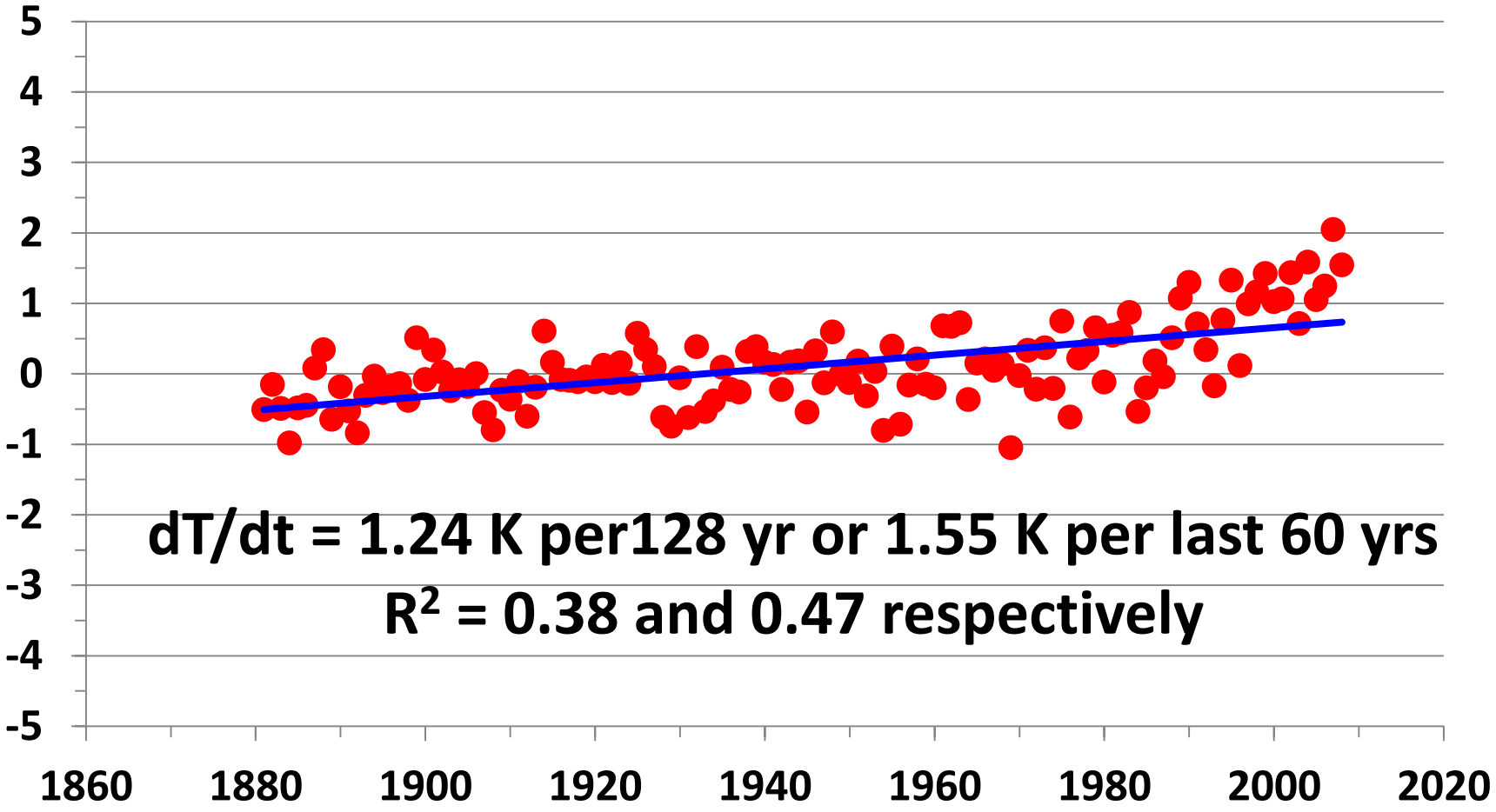
Time series of daily dust loadings simulated with WRF-DuMo at four model grid sizes (April 1955)

Integrative study should be able to answer the “future” and “what if” questions

Dry Latitudinal Belt of Northern Eurasia, DLB



Annual surface air temperature anomalies over the DLB



Major concerns in DLB

- Water supply and storage (including the cryosphere)
- Soil erosion (including dust storms)
- Infrastructure fabric (societal sustainability)

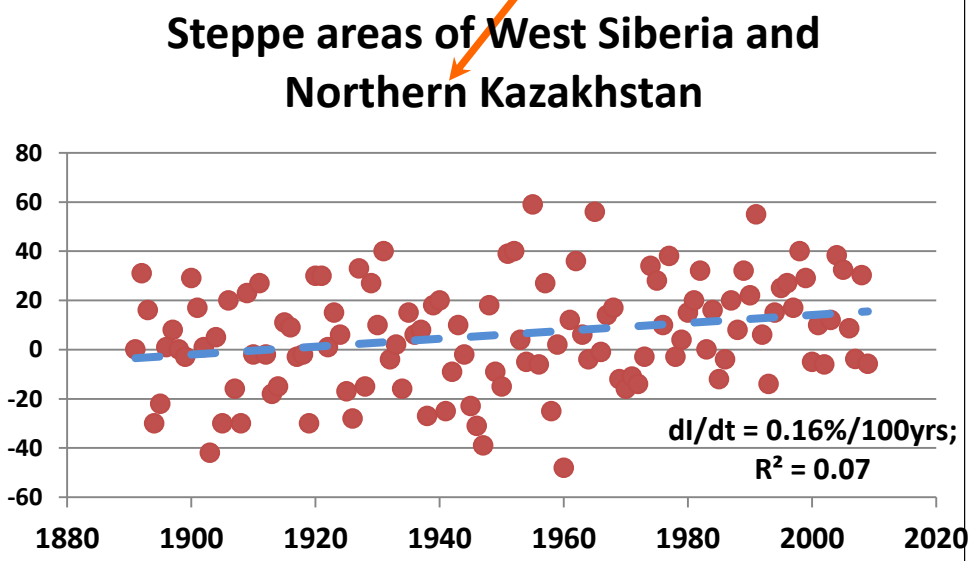
Who has to be on the team?

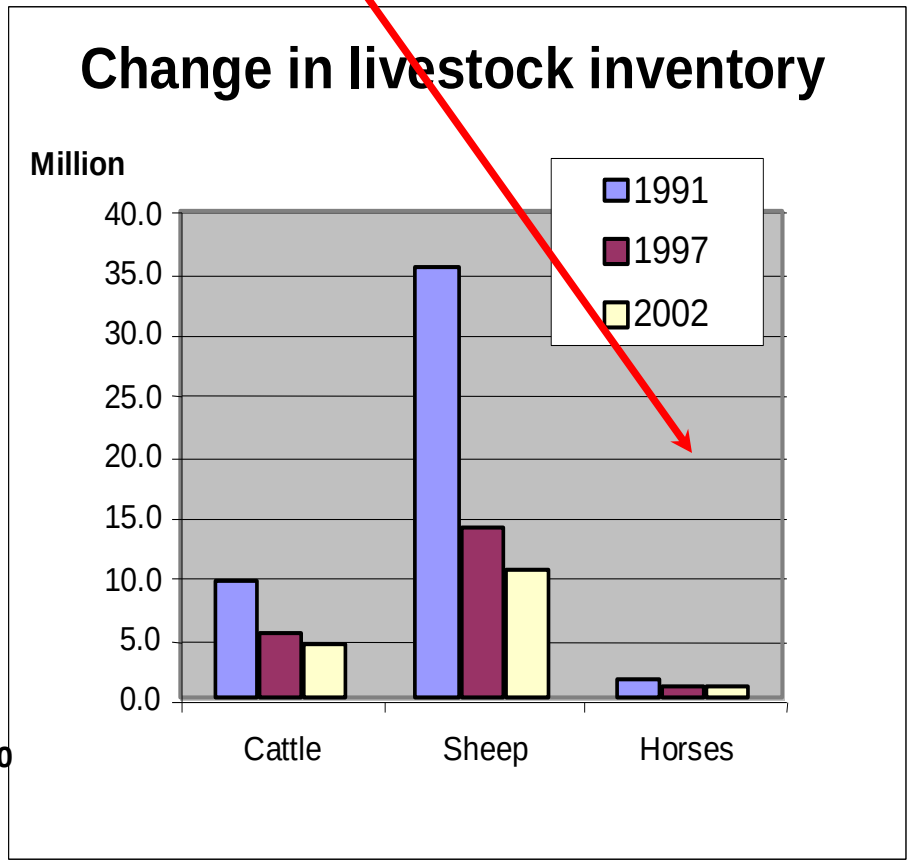
- Earth system /climate/RCM modelers
- Hydrologist, climatologist, glaciologist
- Agronomist, ecologist, social scientist

“Social Shocks” superimposed with environmental changes (example: Kazakhstan).

Satellite data show greening, meteodata show drying, and socio-economic data show decline.

Regional drought index (Mescherskaya & Brazhevich, 1997, updated to 2009)

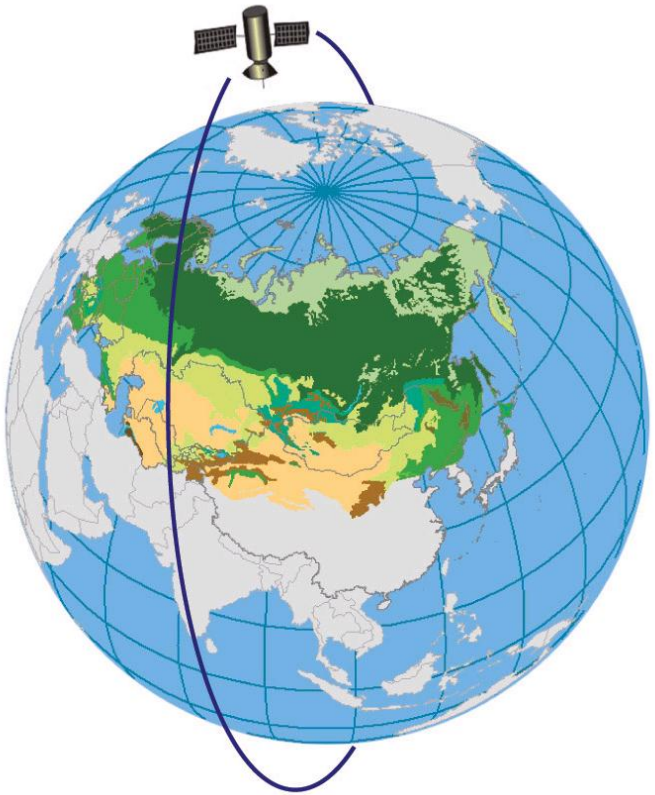




- It would be worthwhile to “outsource” the social aspects of our LCLUC studies to national authorities and professionals; for most of the NEESPI domain this is probably the best strategy.
- Integrative proposals are vulnerable from a variety of directions.

FOR MORE INFORMATION SEE THE NEESPI WEB SITE:

http://neespi.org



Side Note:

"NEESPI" is pronounced approximately like the Russian phrase for

"Don't sleep "

Northern Eurasia Earth Science Partnership Initiative

Thank you!