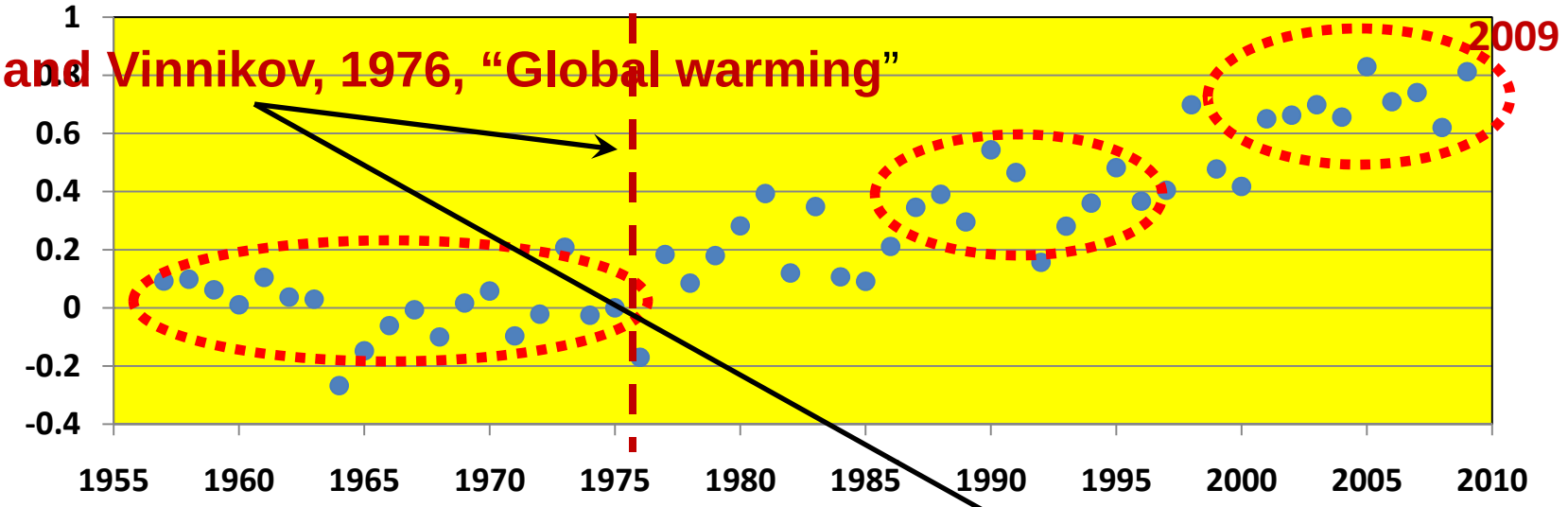
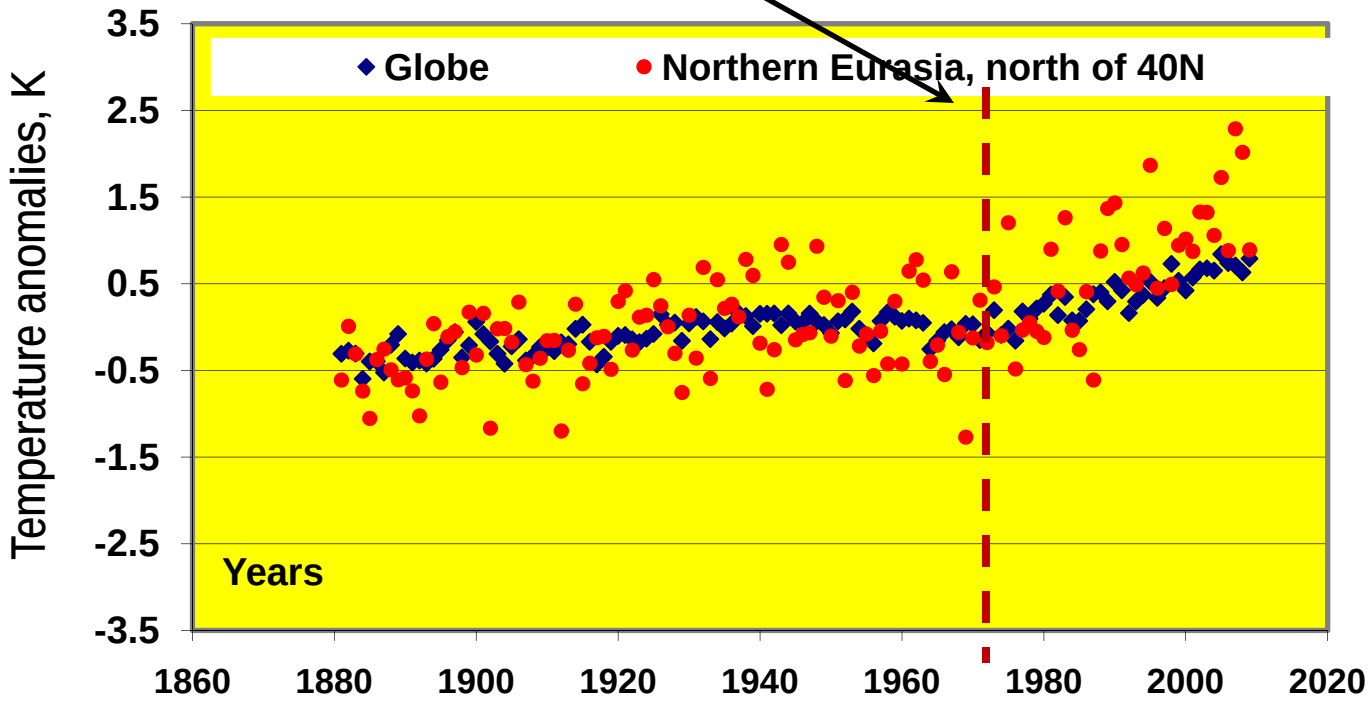
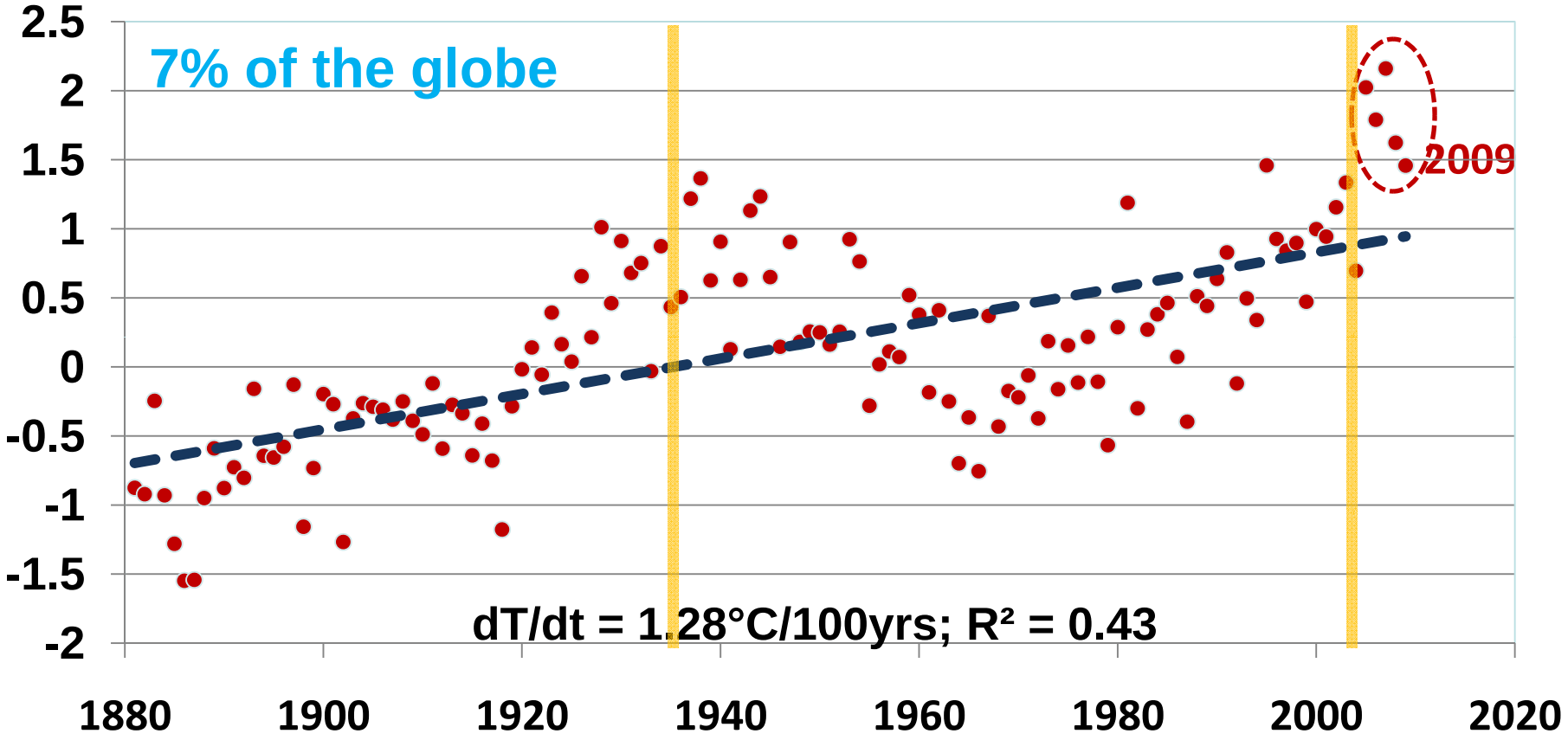
Global Surface Air Temperature Anomalies, °C



Rates of increase of annual temperature for the "globe" (60°S to 90°N) and Northern Eurasia are 0.86 °C/129 yr and 1.4 °C/129 yr respectively. (Lugina *et al* 2007, updated).

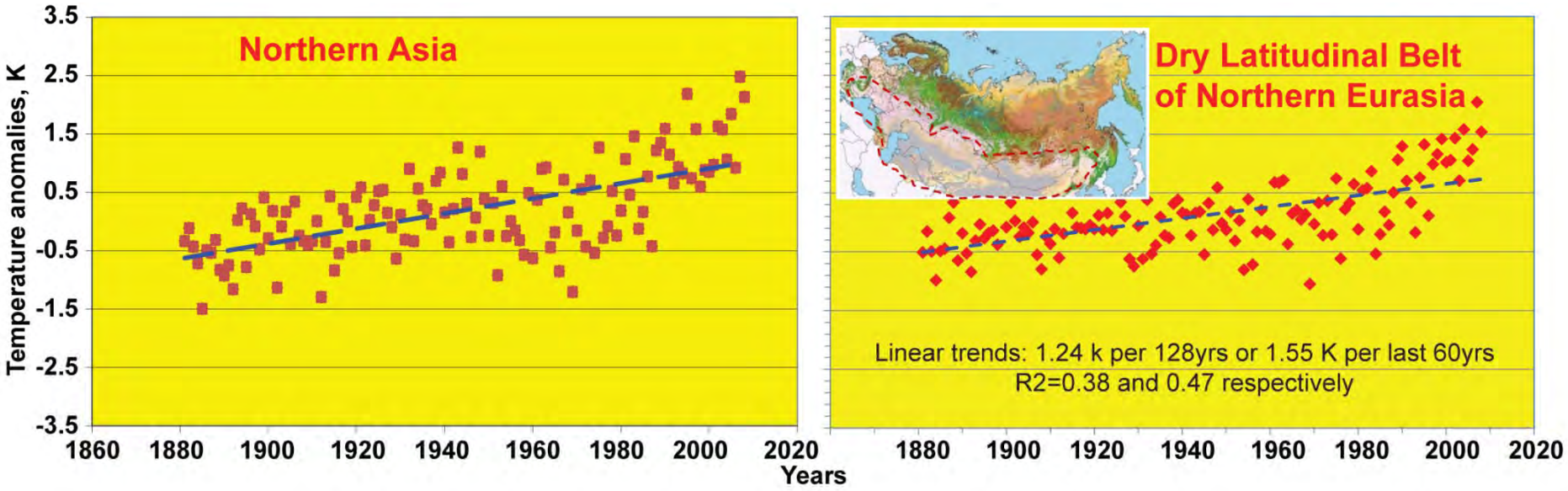


Annual surface air temperature area-averaged over the 60°N - 90°N latitudinal zone (Arctic)



Linear trend for the entire period of instrumental observations is 1.65°C/129 yr (R^2 = 0.43) but there were periods (e.g., 1936-2004) when there was no statistically significant linear trend (Groisman *et al* 2006, updated).

Annual surface air temperature anomalies and their linear trends area-averaged over Northern Asia, north of 40°N and over the Dry Latitudinal Belt of Northern Eurasia shown in insert to the panel



Warming trends for the period of record are statistically significant at 0.01 or higher level. Anomalies are taken from the 1951-1975 reference period. Updated time series from Archive of Lugina *et al* (2007).

Northern Eurasia Earth Science Partnership Initiative (NEESPI): Focus on dry lands

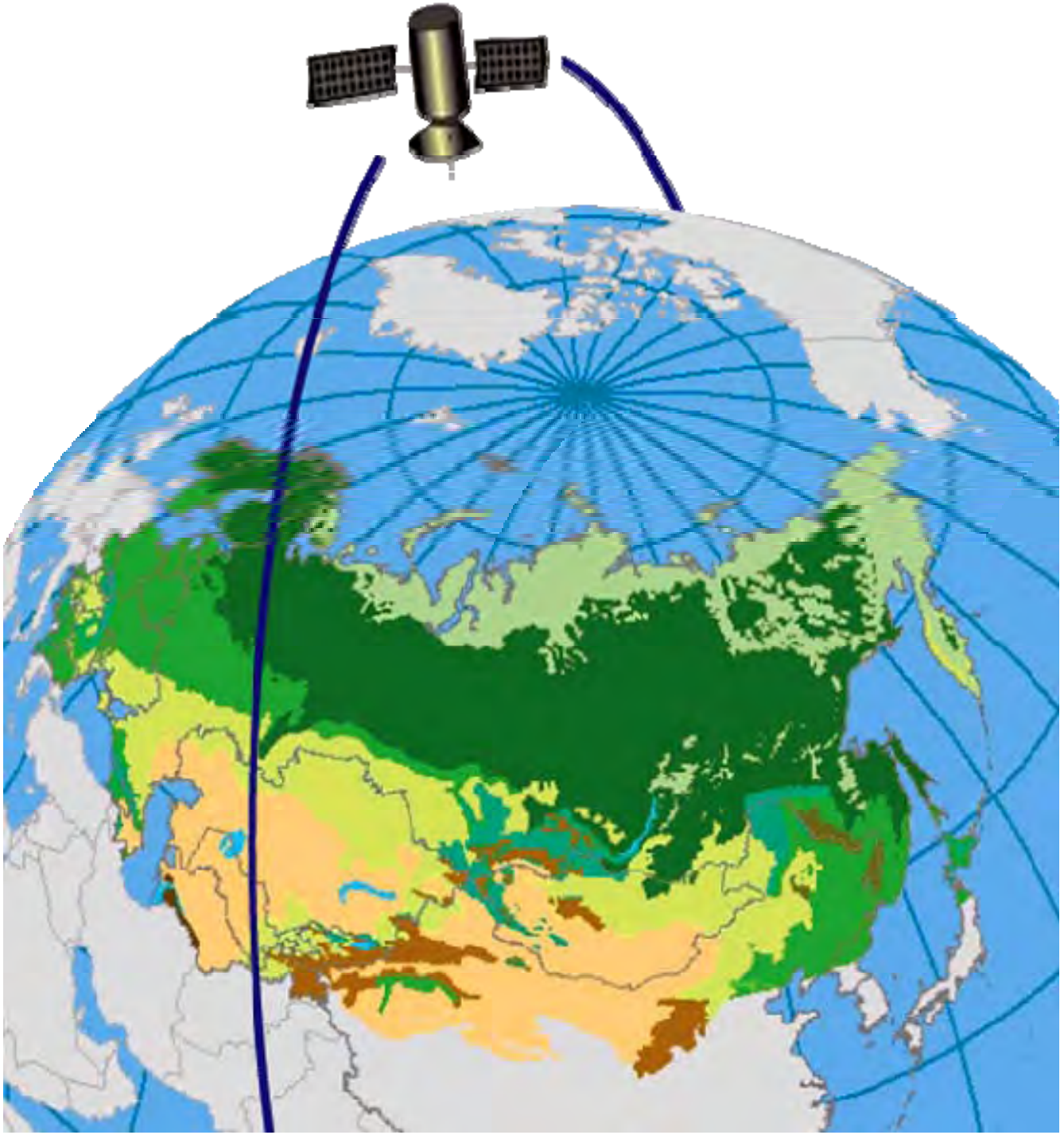
Pavel Ya. Groisman
UCAR Project Scientist at NOAA National Climatic Data Center, Asheville, USA
(Pasha.Groisman@noaa.gov)

Sergiy V. Ivanov
State Environmental University, Odessa, The Ukraine
Anna V. Metscherskaya
Voeikov Main Geophysical Observatory, St. Petersburg, Russia
and
Vyacheslav N. Razuvaev
Russian Institute for Hydrometeorological Information, Obninsk, The Russia

International Conference "Global and Regional Climate Changes", Kyiv, Ukraine, 16-19 November , 2010

Northern Eurasia Earth Science Partnership Initiative (NEESPI)

Recognition



The NEESPI Study Area

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)

Rationale for NEESPI

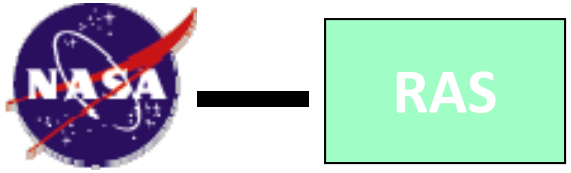
1. Strong interactions in the system **terrestrial ecosystem - atmosphere hydrosphere - cryosphere - human society** and feedbacks to **global energy, water, and carbon cycles in the region**

2. **Strong climatic and environmental changes….**

Problem was not the large changes themselves but in **understanding** of their causes and timely **projections**

NEESPI AND ITS PAST

NEESPI and the actions to develop its Science Plan were initially promoted by NASA and Russian Academy of Sciences (2003-2004).



Since early 2005, the NEESPI community has worked to make NEESPI inter-agency (in the U.S.) and international.

The NEESPI Science Plan (available on http://neespi.org) has elements that address concerns of WCRP, IGBP, IHDP, and DIVERSITAS Programs

The overarching NEESPI science question:

- **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?**

Our concern is that the changes in this region have the potential to affect the entire Earth System and may already be doing so.

NEESPI Deliverables:

to have in ~10 years

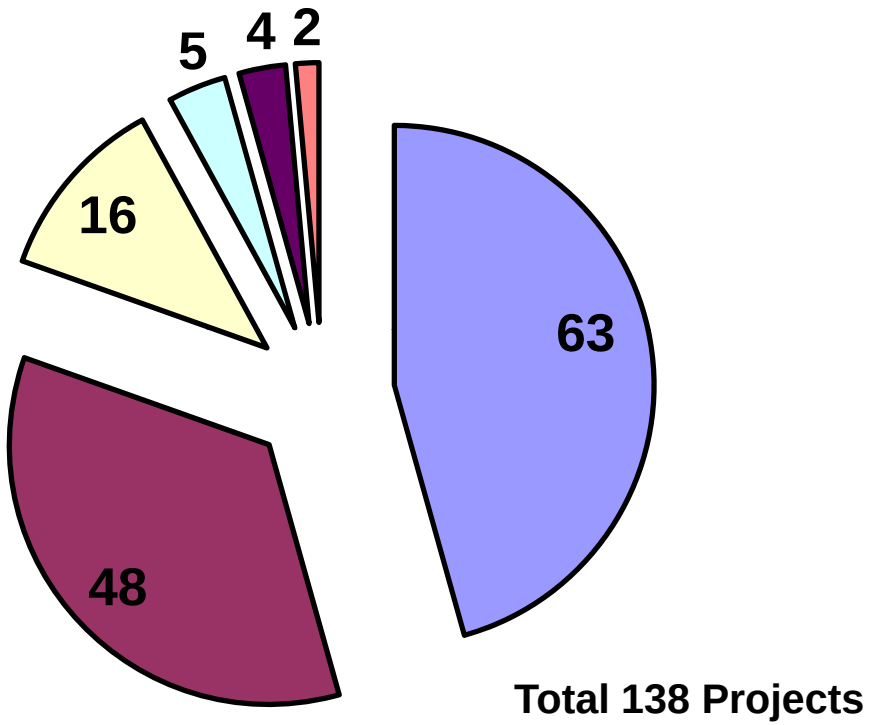
- **A suite of process –oriented models for each major terrestrial process in all its interactions**
- **A suite of global and regional models that seamlessly incorporate all regionally specific feedbacks associated with terrestrial processes**
- **An integrated observational knowledge data base for environmental studies in the region**
- **Bringing the Earth System research in the region to the level it deserves**

Current NEESPI Statistics (September 2010):

More than 560 scientists from more than 200 institutions of 30 countries are working (or worked) on more than 135 individual funded projects under the Initiative umbrella (with annual budget ~$15M), several more projects are in the process of joining NEESPI. Four major sponsors of NEESPI remain: the United States, Russia, European Union, and Japan.

Additionally, NEESPI receives in kind assistance from EU, US, Russian, Chinese, Japanese, Ukrainian and International Agencies and Institutions.

Listed NEESPI Projects by country (or group of countries) September 2010



Two modes of NEESPI expansion

- Dedicated Calls (recent NASA and RAS and perspective in the NIS, EU, and China)
- Freely joined projects
- Benefits of the NEESPI membership
  - 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
  - Education: student exchange, doctoral and post-doc positions sharing among the Team Institutions

NEESPI Outreach, http://neespi.org

During the past 3 years, ~25 dedicated NEESPI Workshops and 6 NEESPI Open Science Sessions at the International Meetings were convened and more than 350 papers and books were published (the total number of publications exceeds 500).

In April 2007: 1st Special NEESPI issue (13 papers) in *Global and Planetary Change*

In December 2007: 2nd NEESPI Special issue in *Environmental Research Letters* (**15** papers)

In April 2009: Book "*Regional Aspects of Climate-Terrestrial-Hydrologic Interactions in Non-boreal Eastern Europe*" Groisman and Ivanov (Eds.) published by Springer Verlag.

In May 2009: An overview NEESPI paper in *Bull. Amer. Meteorol. Soc.*

In October 2009 through March 2010: the 3rd NEESPI Special issue in *Environmental Research Letters* (**34** papers)

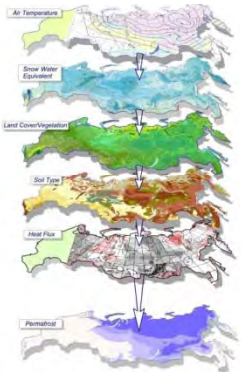
Current situation:

- **Two books are *in press*** *and scheduled for the end of 2010*.
  Both of them are devoted to Eurasian Arctic (land and sea shelf)
- Book "Environmental Changes in Siberia: Regional Changes and their Global Consequences" is in preparation

NEESPI is built around two documents

- The NEESPI Science Plan published in 2004 (http://neespi.org)
- The Second Programmatic paper in the *Bull. Amer. Meteorol. Soc*. (Groisman et al. 2009) based on the Aspen Brainstorming Workshop in Aug. 2007.

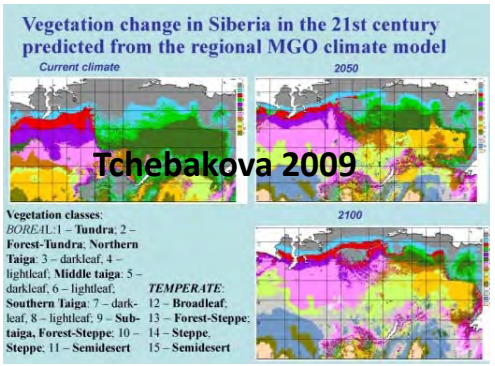
First phase foci of NEESPI were monitoring and analyses. After the NEESPI Workshop in August 2007 at the Aspen Global Change Institute, a new course was accepted towards strengthening of the NEESPI research focus on projections... i.e., focus on modeling…



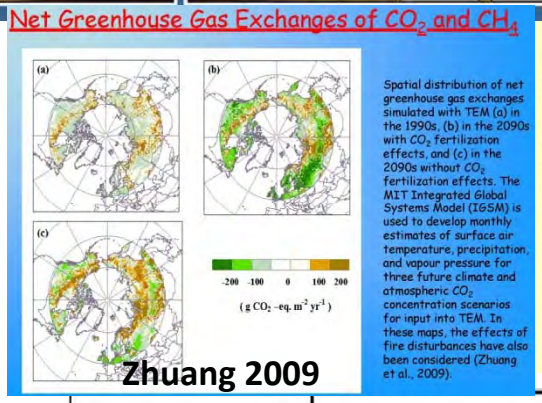
GIPL-2 Model

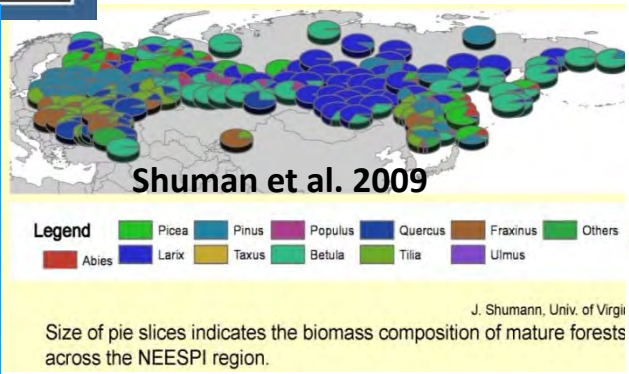
The GIS multi-layered Data Base interactive model for Spatially Distributed Permafrost and Active Layer Dynamics modeling in the Northern Eurasia.

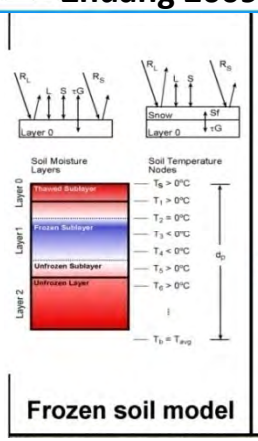
(Marchenko et al., 2008)

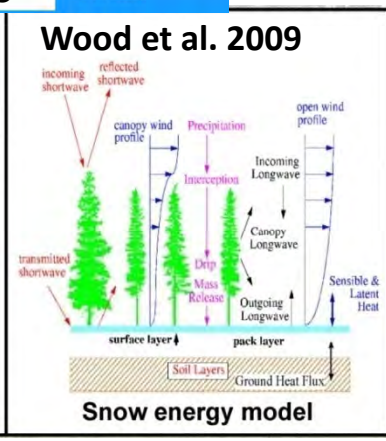


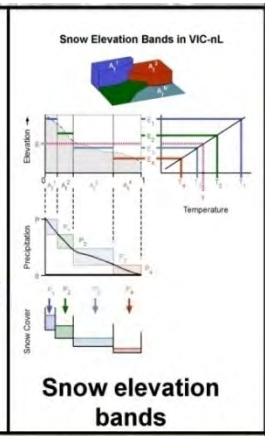
Efforts are made to blend modern RCMs with vegetation, carbon flux, permafrost, hydrological, and dust production models within a North Eurasia modeling suite and link it to the MIT Earth System model.

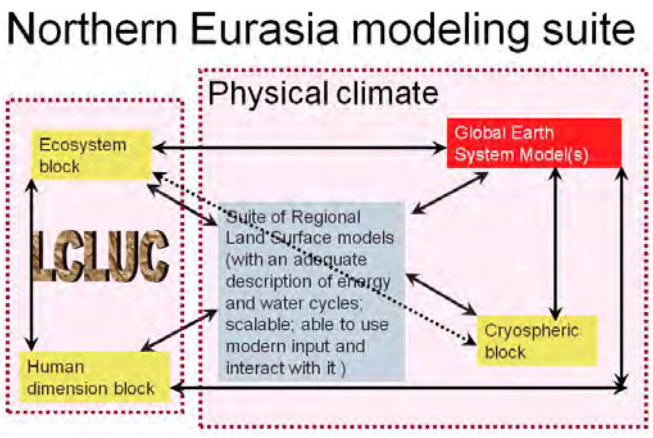




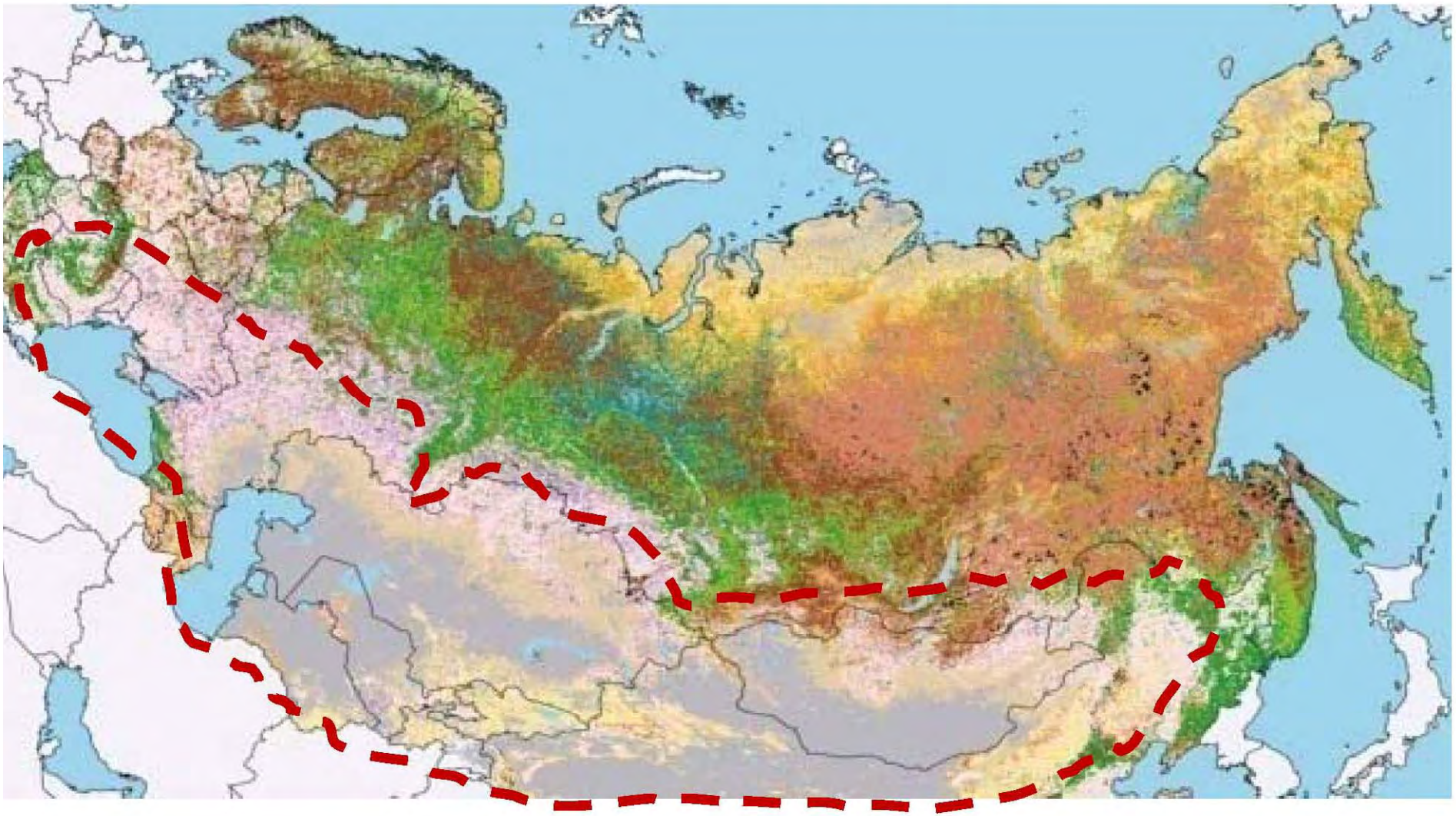








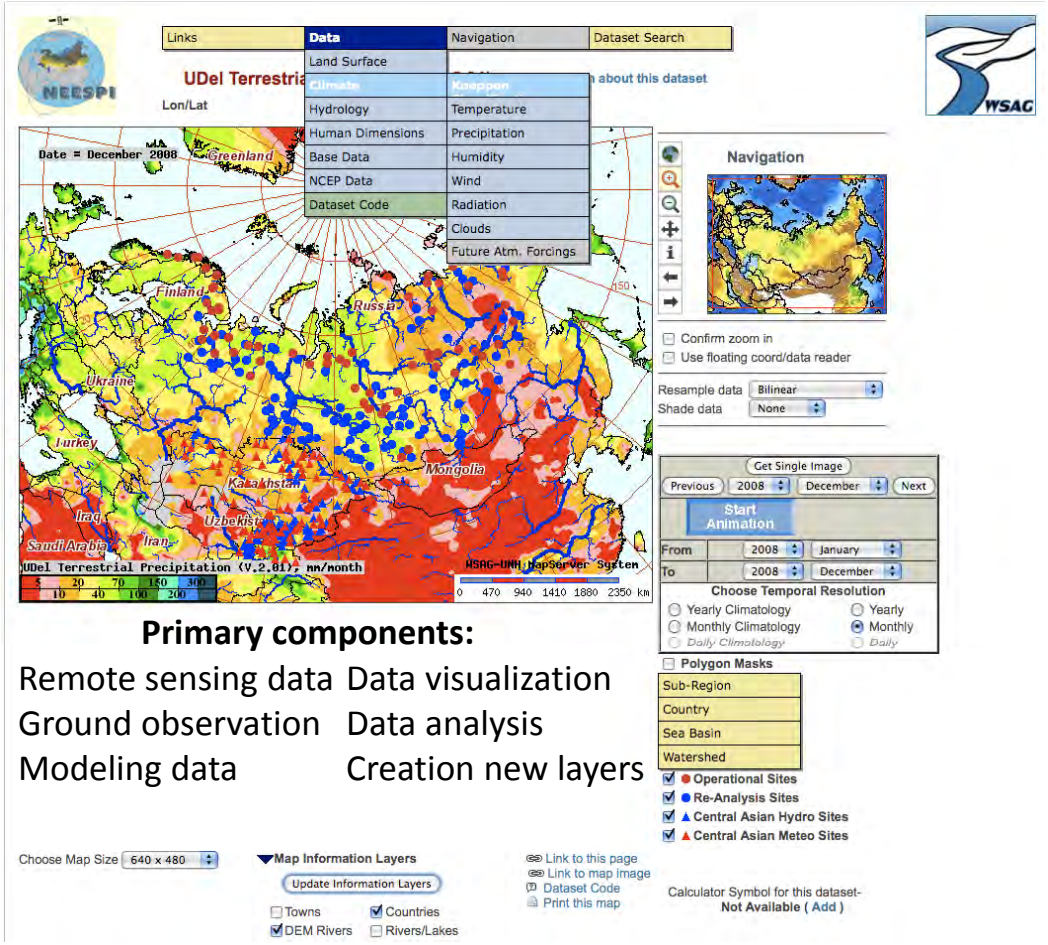
Dry Latitudinal Belt of Northern Eurasia, DLB



Major concerns in DLB

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

New Regional Integrated Monitoring and Analysis System for North Eurasia developed in UNH with SHI and NOAA collaboration.

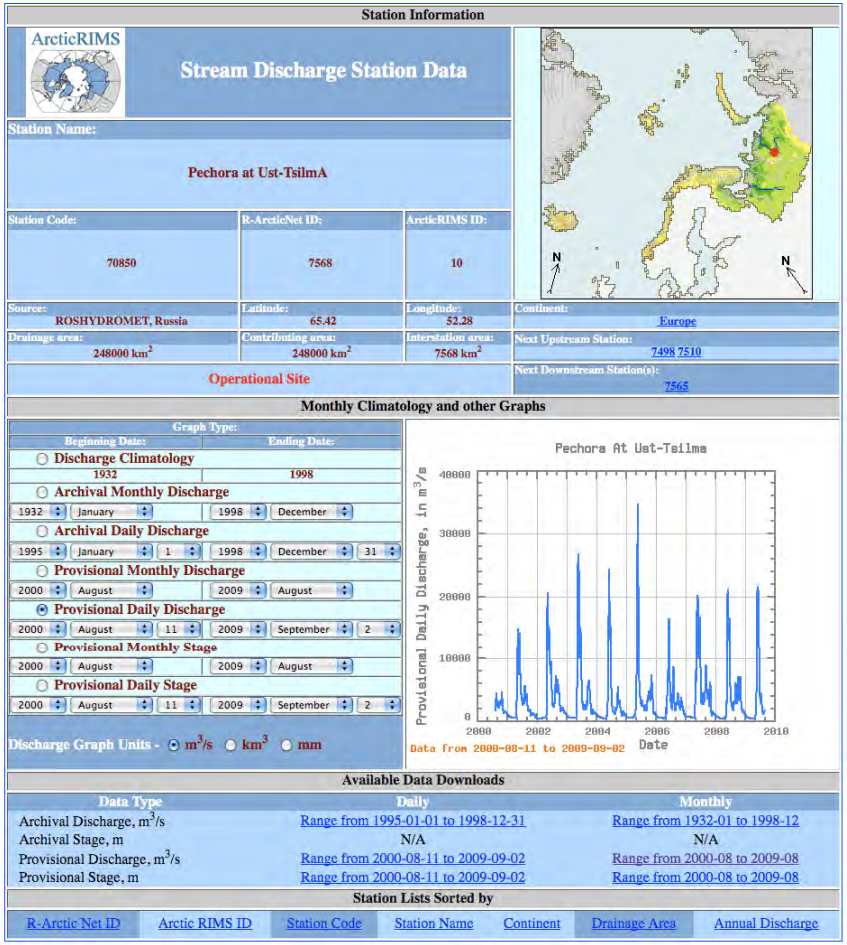


Primary components:

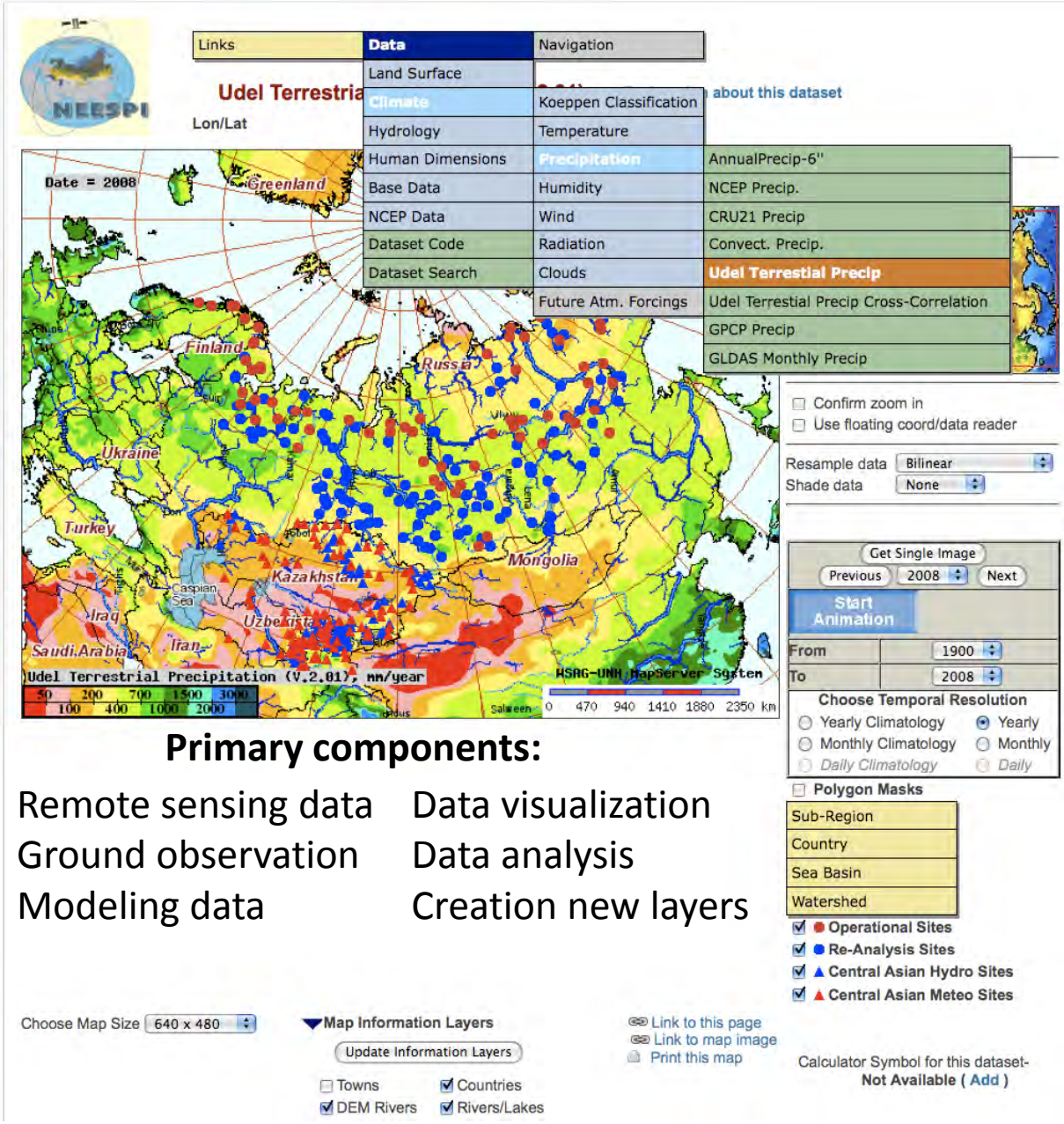
Remote sensing data Data visualization

Ground observation Data analysis

Modeling data Creation new layers



Data consolidation and harmonization on new website for water system studies in Northern Eurasia



Primary components:

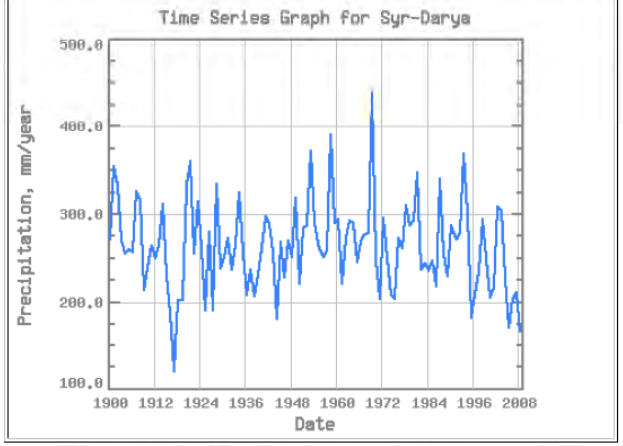
Remote sensing data
Ground observation
Modeling data

Data visualization
Data analysis
Creation new layers

Time Series Graph for Area Aggregation

Dataset	Udel Terrestrial Precipitation (V.2.01)		
Time Scale	Yearly	Start Date	1900-00-00
Lon, Lat	64.01 45.66	End Date	2008-00-00
Polygon	Syr-Darya Global (riverbasinmask_207)		

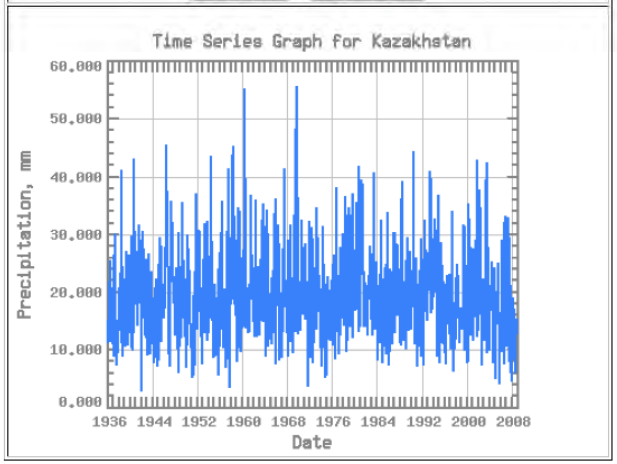
Date Offset: 0 Step: 1 Update Graph
Save Graphics Save Graph Data



Time Series Graph for Area Aggregation

Dataset	Udel Terrestrial Precipitation (V.2.01)		
Time Scale	Monthly	Start Date	1936-01-00
Lon, Lat	61.28 50.32	End Date	2008-12-00
Polygon	Kazakhstan Global (country_6min)		

Date Offset: 0 Step: 1 Update Graph
Save Graphics Save Graph Data



NEESPI FRC on
Atmospheric Aerosols and Air Pollution

Foci: ***Aerosol- and air pollution-induced interactions and feedbacks in the land biosphere-atmosphere system and their role in climate change…***

- ***What are the key aerosol- and air pollution-induced processes and feedbacks that have been affecting the energy, water and carbon fluxes over Northern Eurasia (their mechanisms, temporal and spatial scales)?***
- ***How will the future changes in terrestrial ecosystem dynamics, climate and human factors affect the above processes in Northern Eurasia?***

• NEESPI-funded and –related projects cover major aerosol types relevant to climate

Dust

Industrial and urban pollution

Wildfire smoke

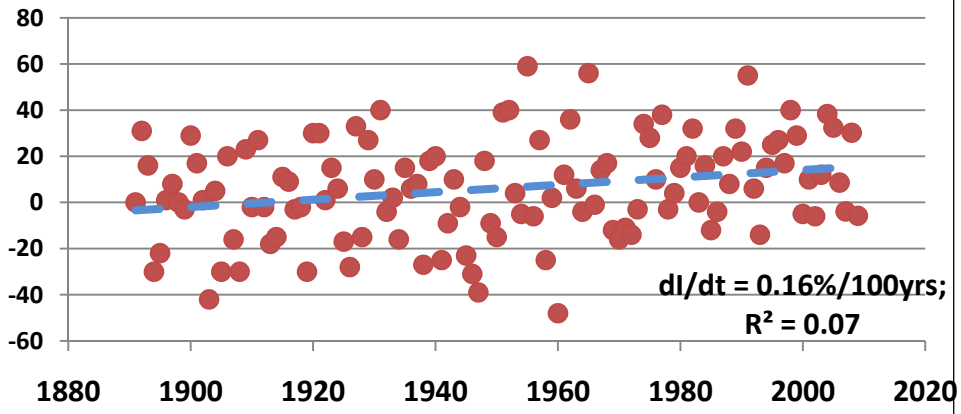
Volcanic ash

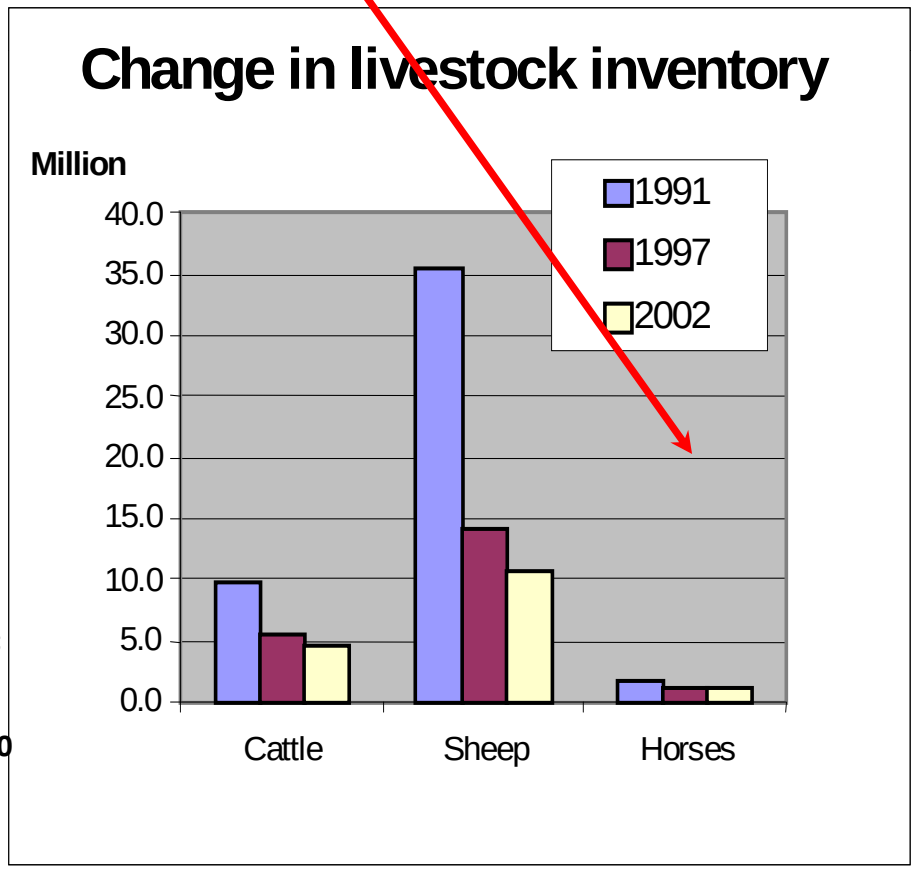
Sulfates | Black carbon | Organic carbon

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

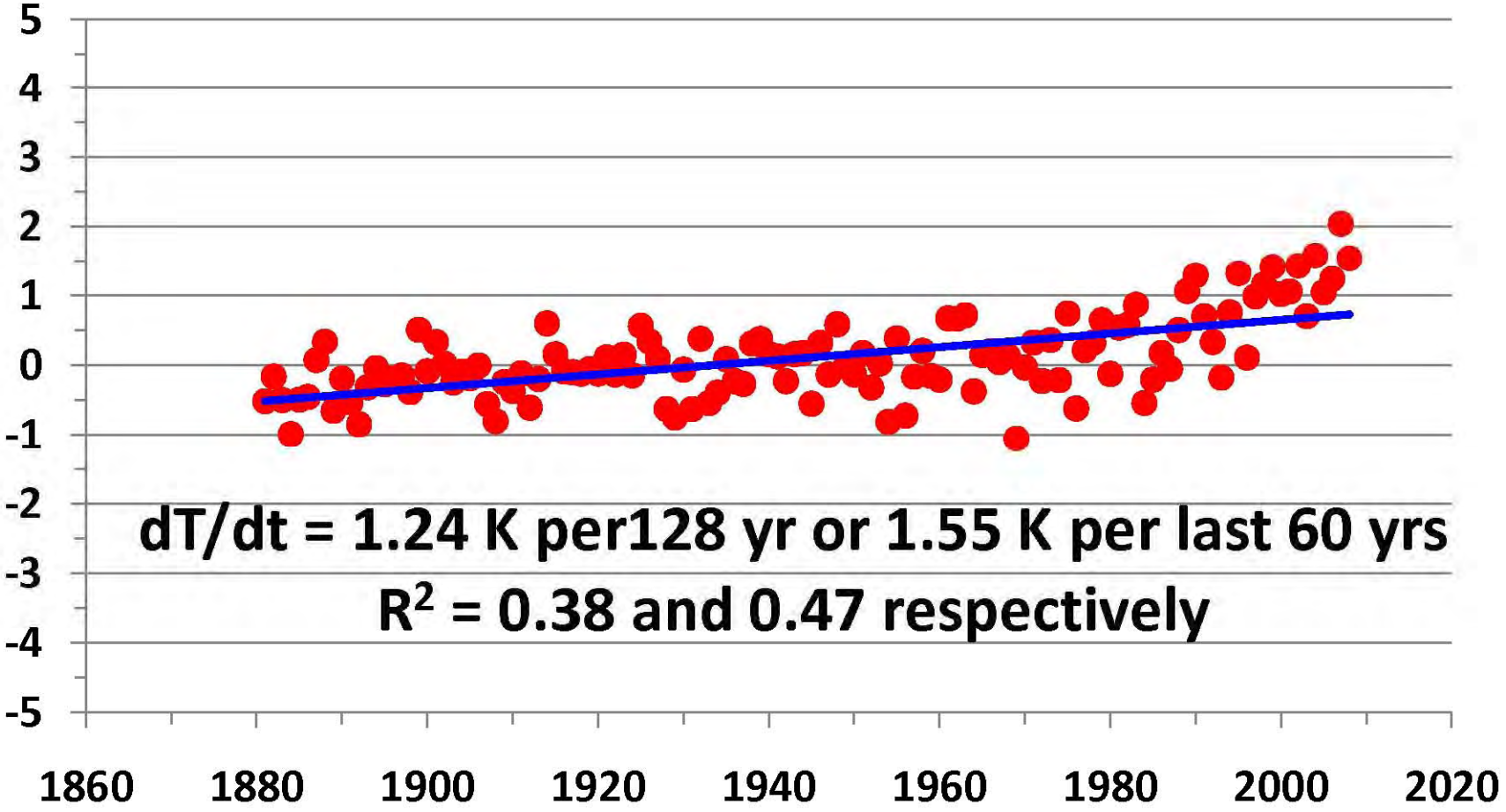
Satellite data show greening, meteodata show drying, and socio-economic data show decline.

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

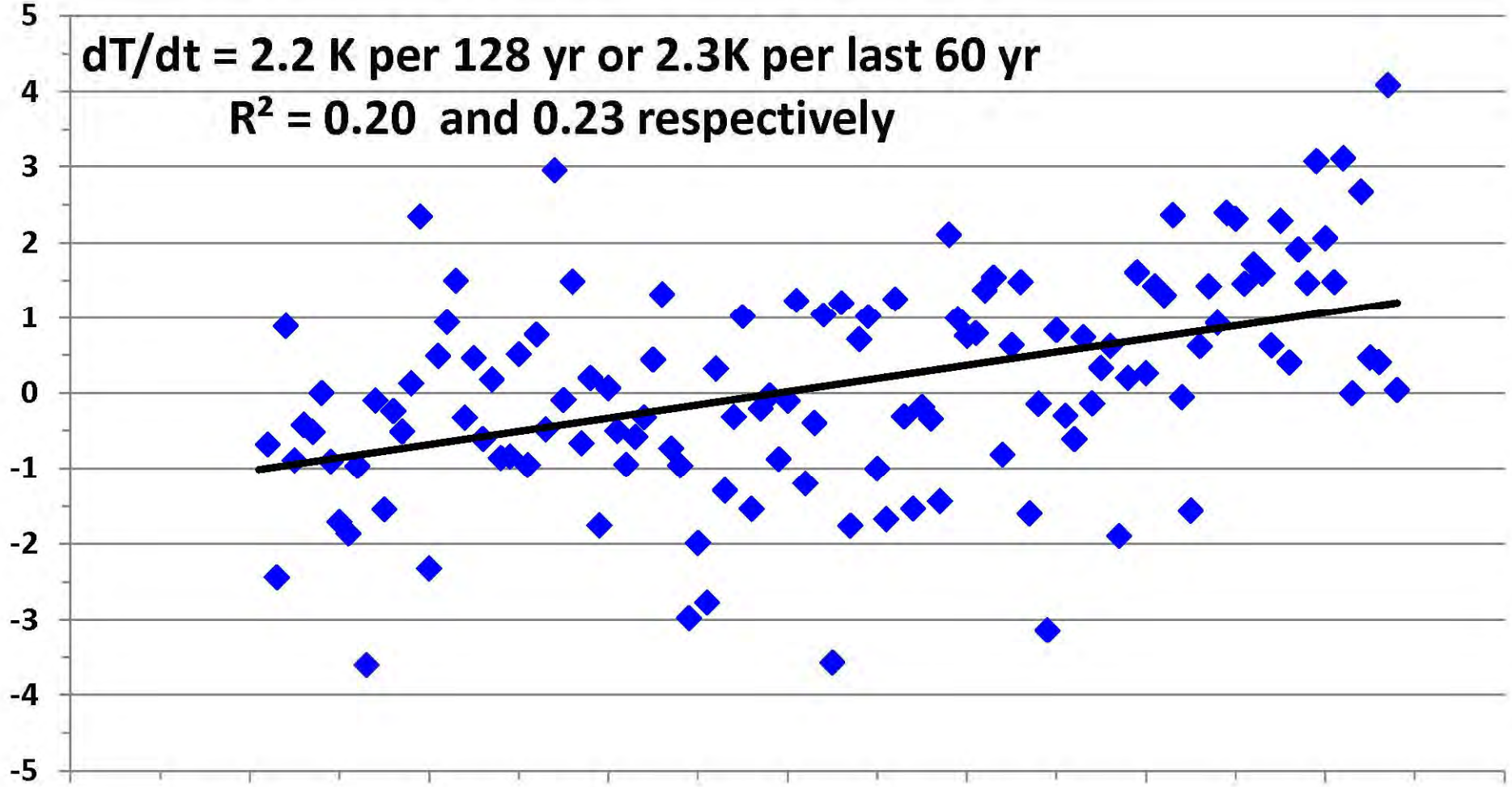




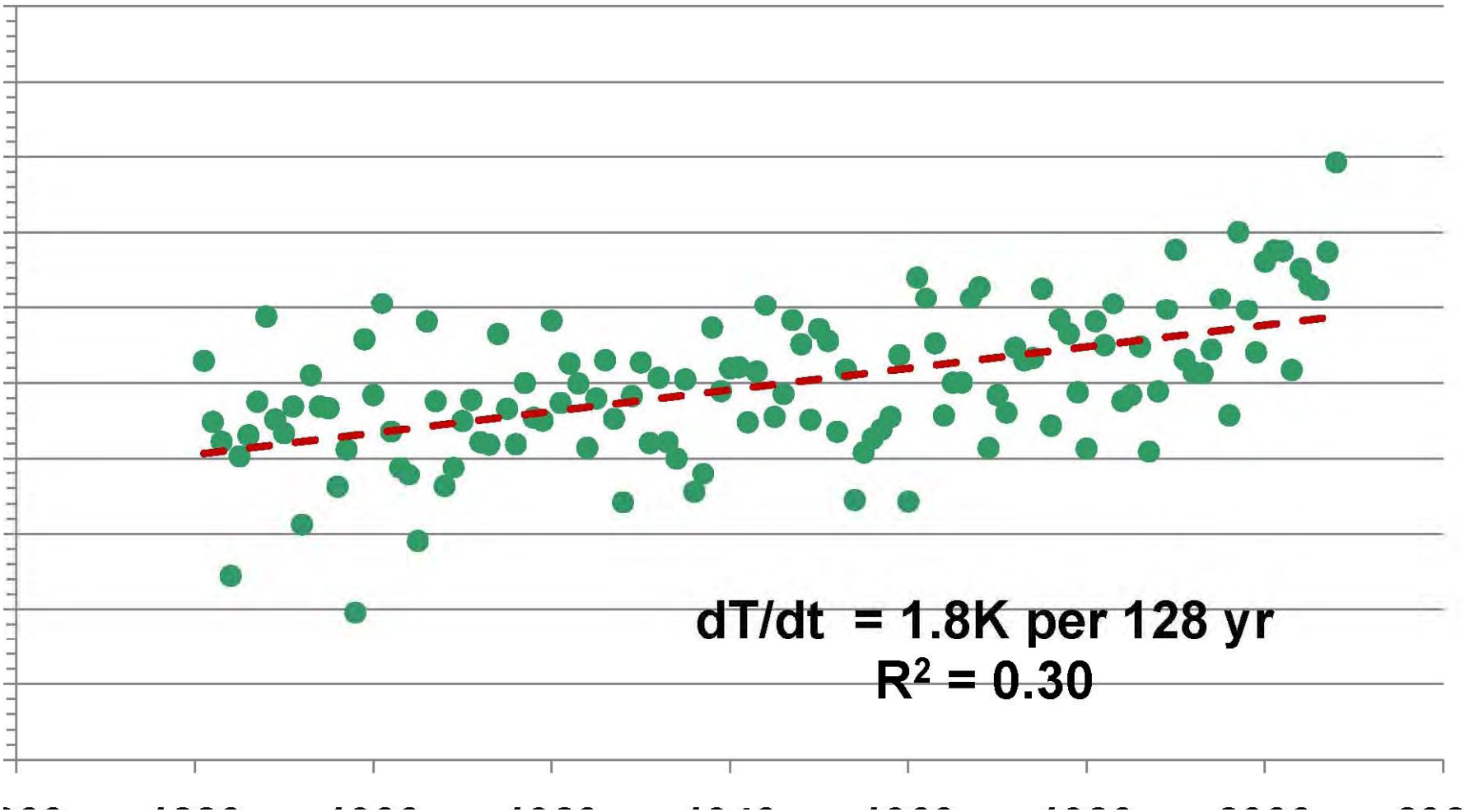
Annual surface air temperature anomalies over the DLB



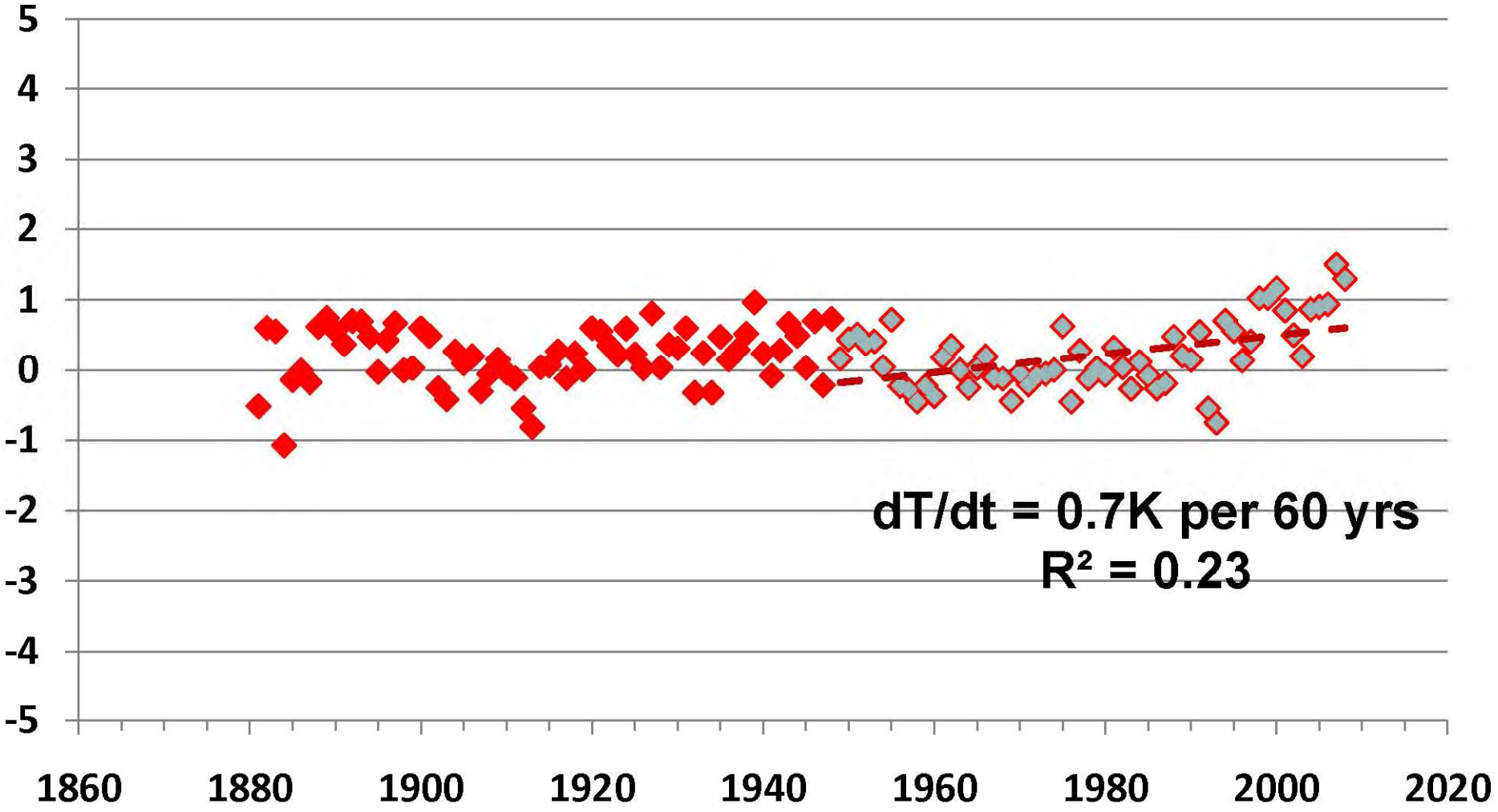
Winter surface air temperature anomalies over the DLB



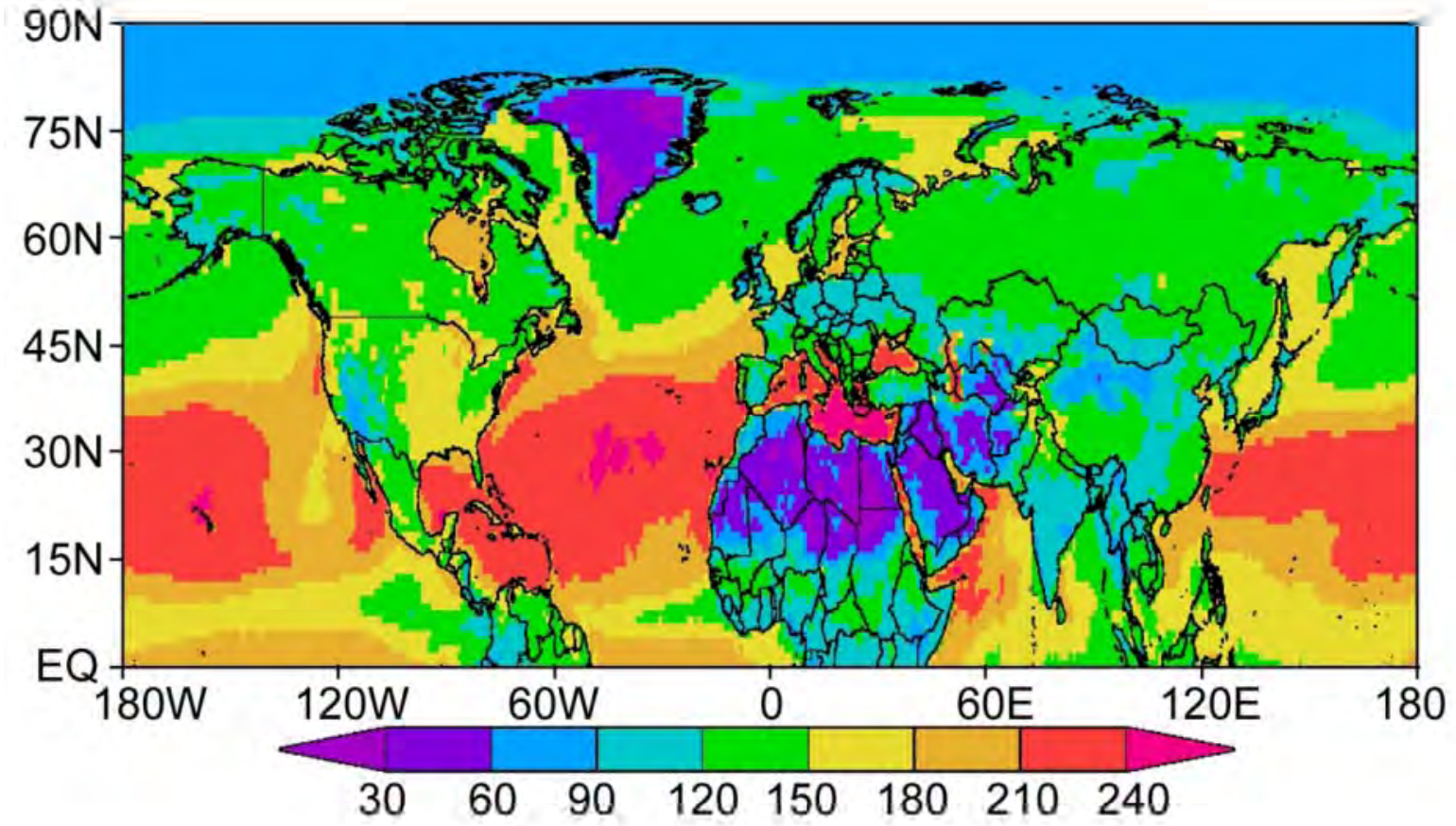
Spring surface air temperature anomalies over the DLB



Summer surface air temperature anomalies over the DLB

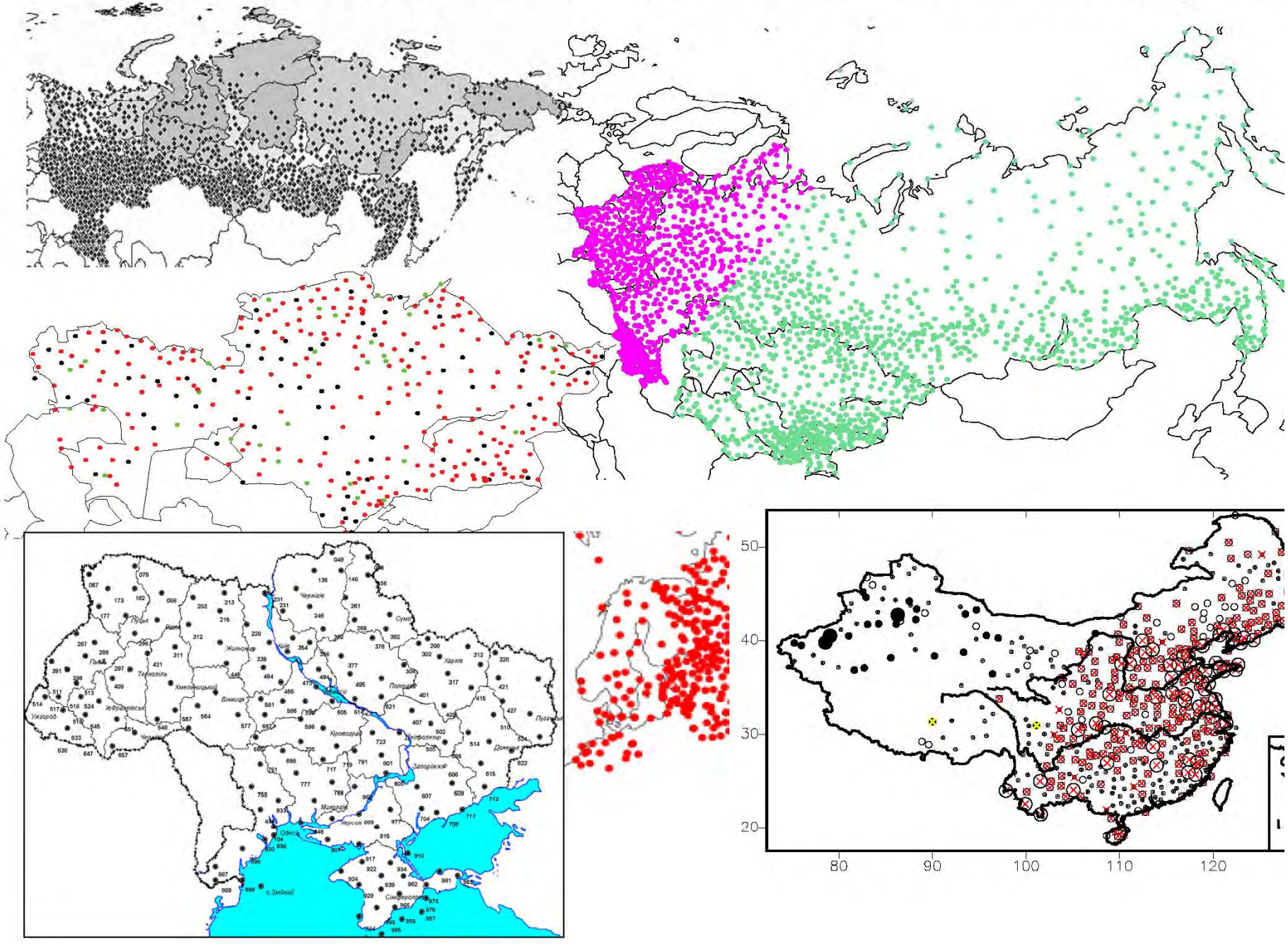


Total net July irradiance, W m^{-2} (solar net + thermal infrared net).

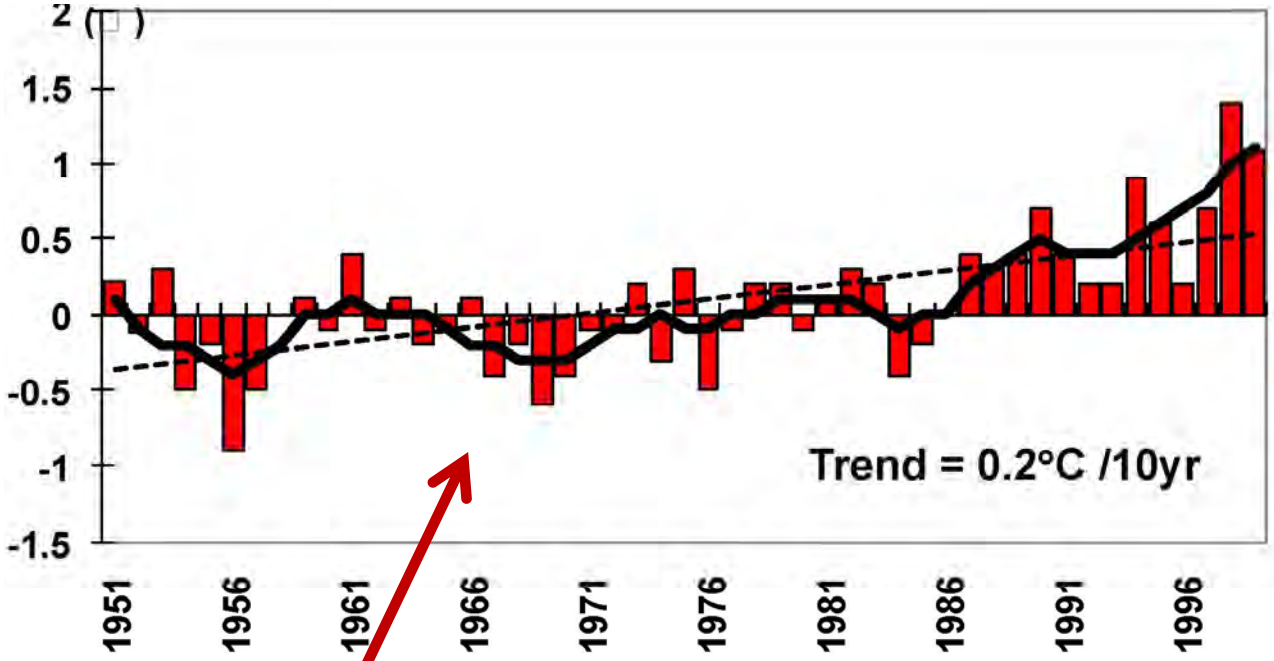


Data from NASA/GEWEX Surface Radiation Budget project. Courtesy of Dr. Paul Stackhouse Jr. and Colleen Mikovitz, NASA Langley Research Center.

Regional networks used for these analyses

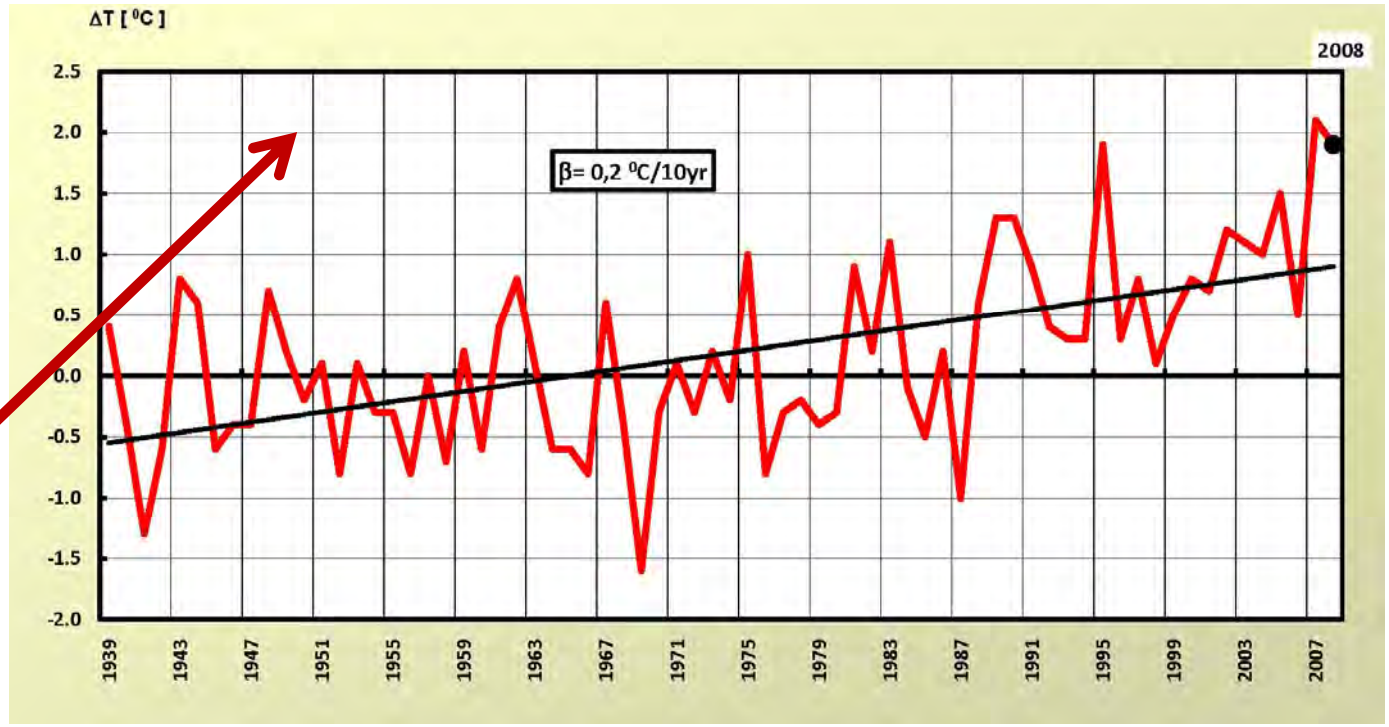


Mean surface air annual temperature changes

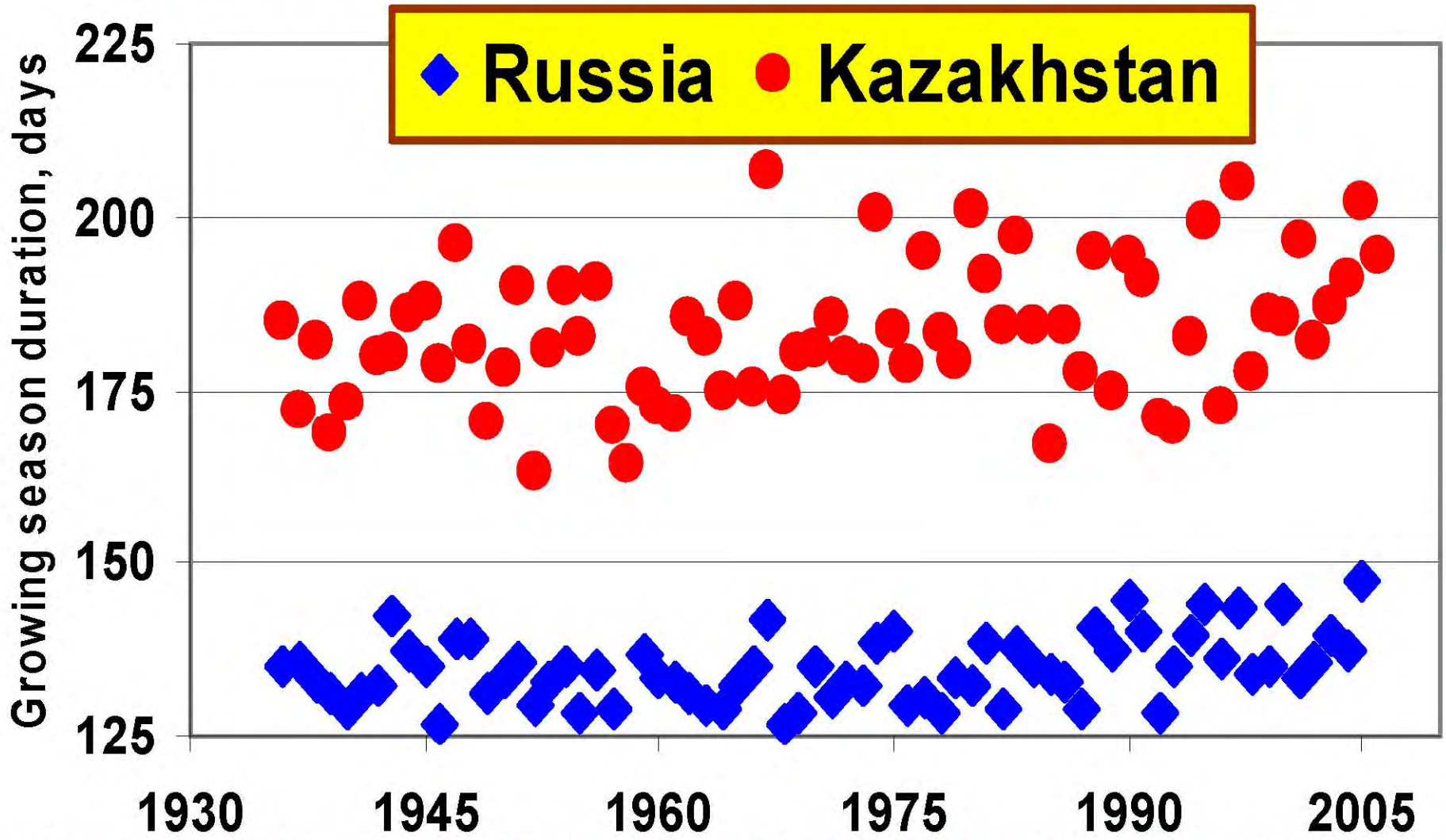


China

Russia

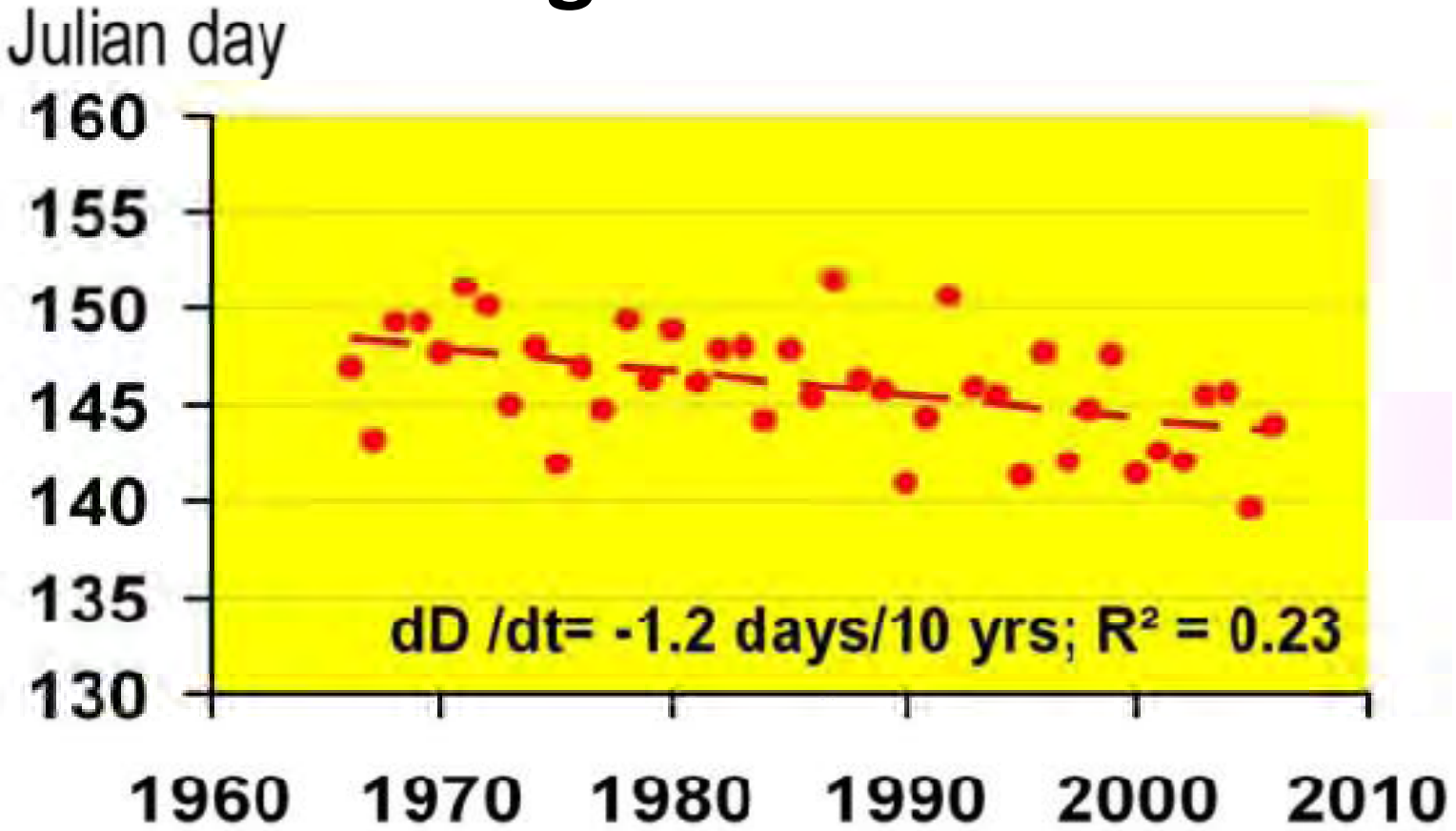


Duration of the growing season area-averaged over Russia and Kazakhstan

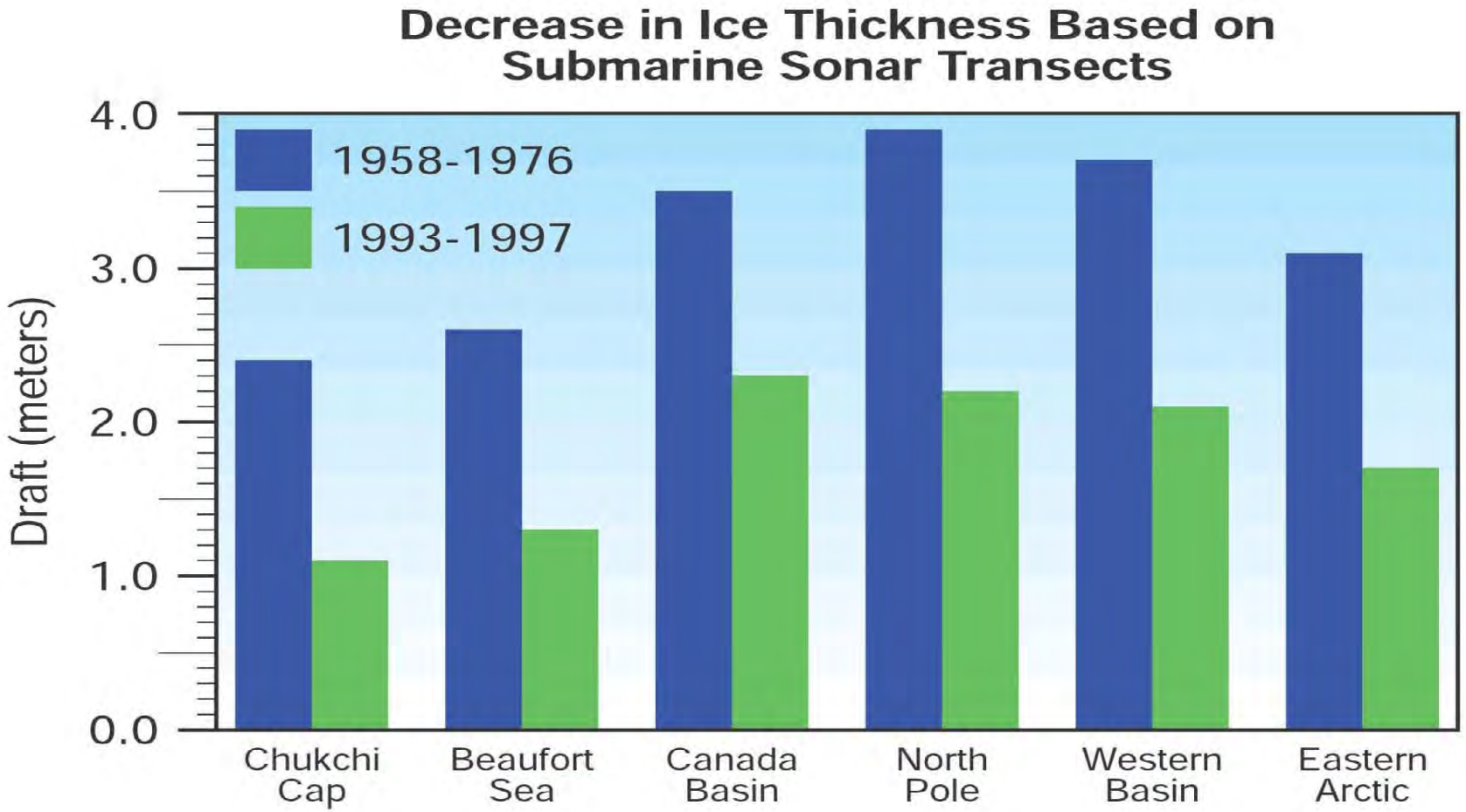


During the past 70 years, significant changes by 6 to 11 days (or by 5% to 6%)

Dates of the spring onset (D) area-averaged over Russia



D is defined as a spring date when mean daily temperature stably passes 5°C (nationwide mean D-date is ~ May 25th). During the past four decades changes in D have not matched with changes in the dates when the snowmelt start (defined as a late winter date when mean daily temperature stably passes -5°C; nationwide mean date is ~April 15th).



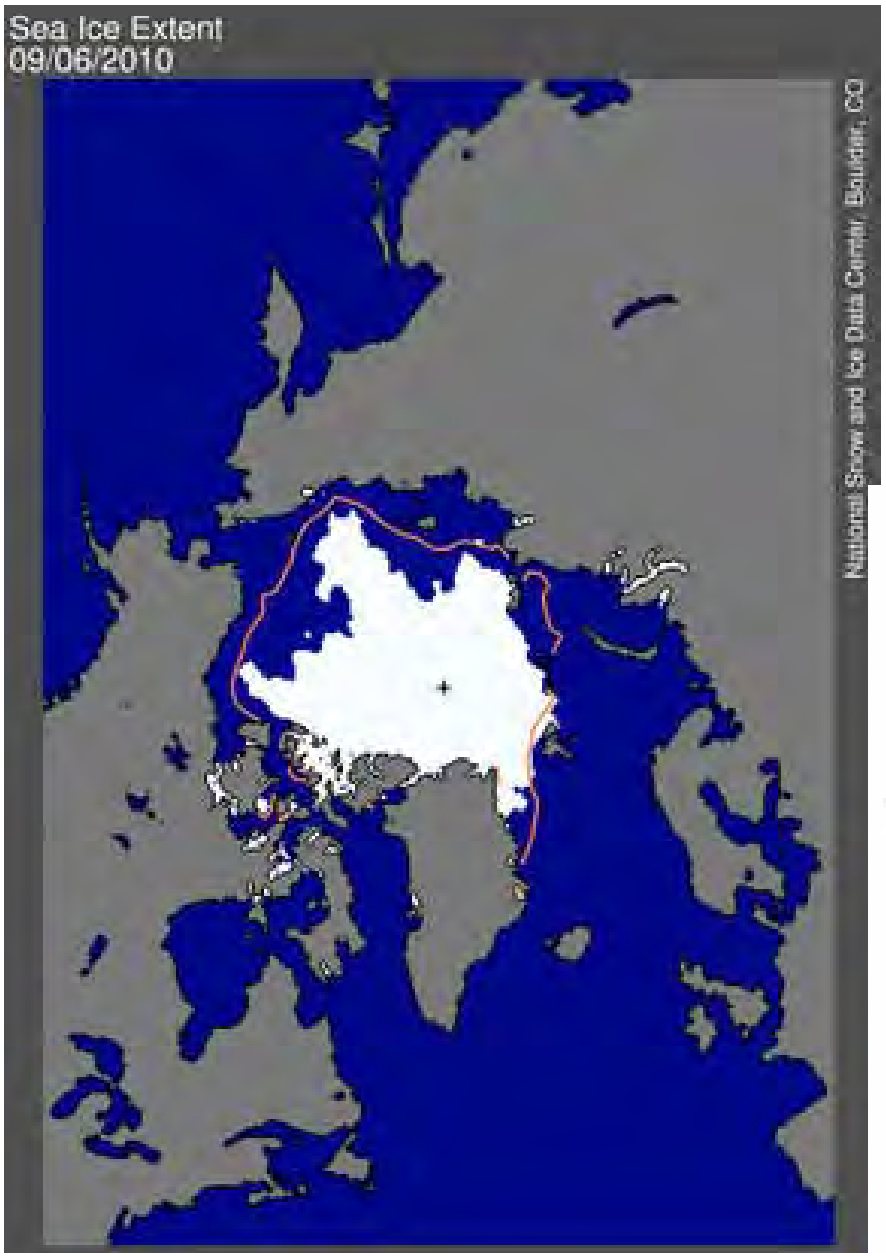
✓ Mean ice drafts at places where early cruises were (nearly) collocated with cruises in the 1990s.

✓ Decrease in sea ice thickness

✓ Sampling error issue not fully resolved

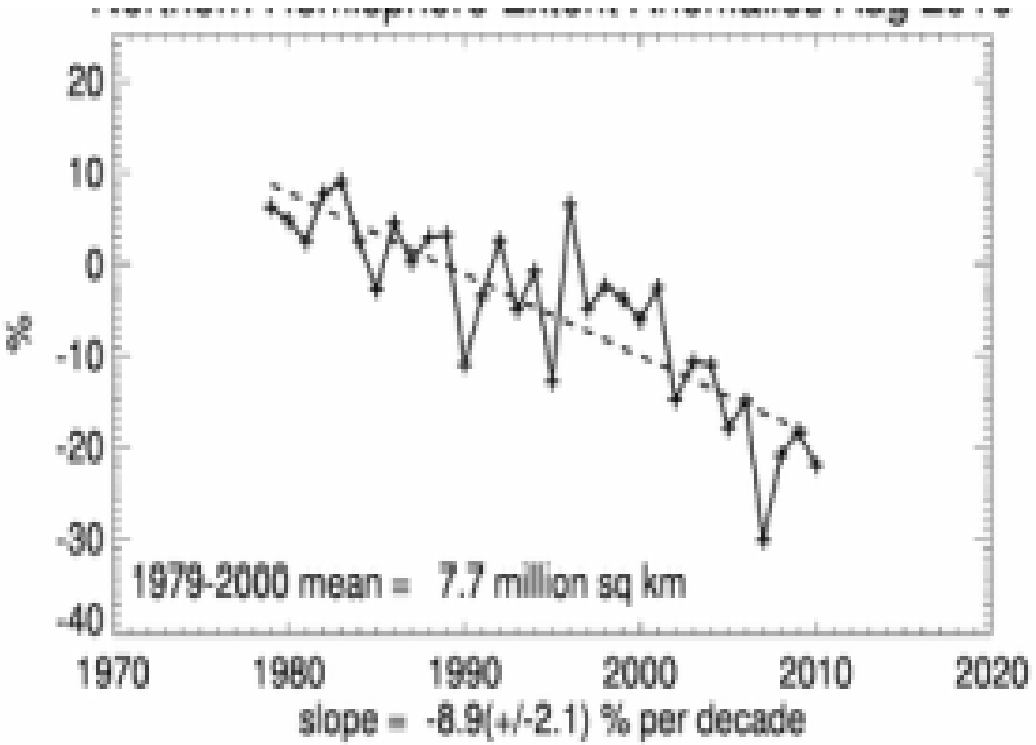
Archive of Yu et al. 2004

The Arctic Sea Ice Extent

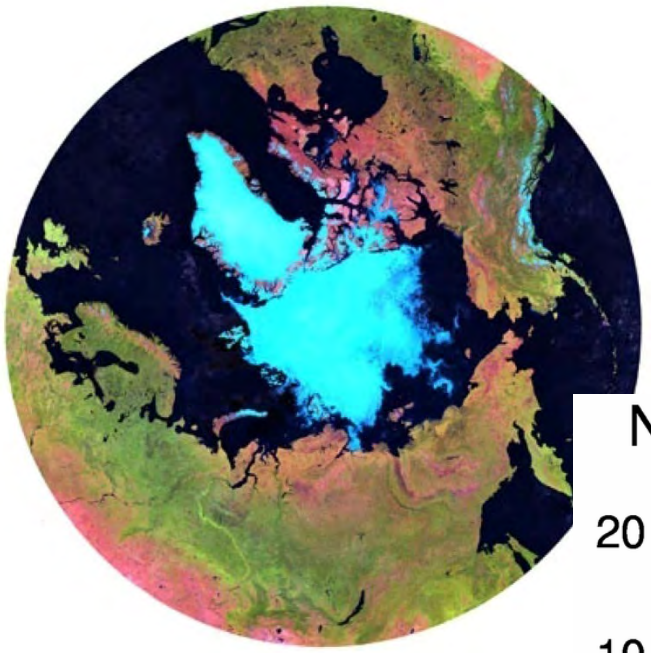


← As on Sept. 6, 2010

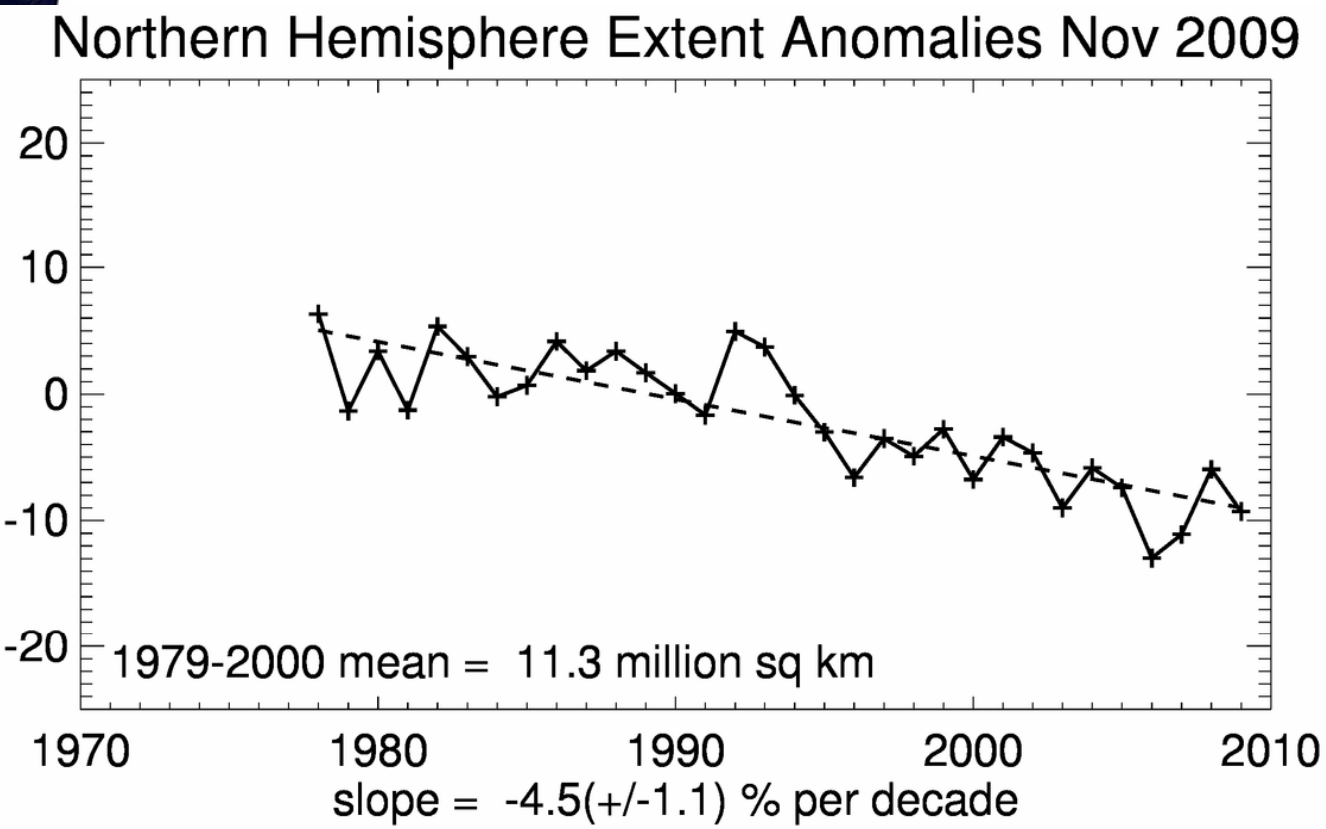
Arctic Sea Ice extent anomalies at the end of August (up to 2010)



Autumn sea ice extent changes (%)

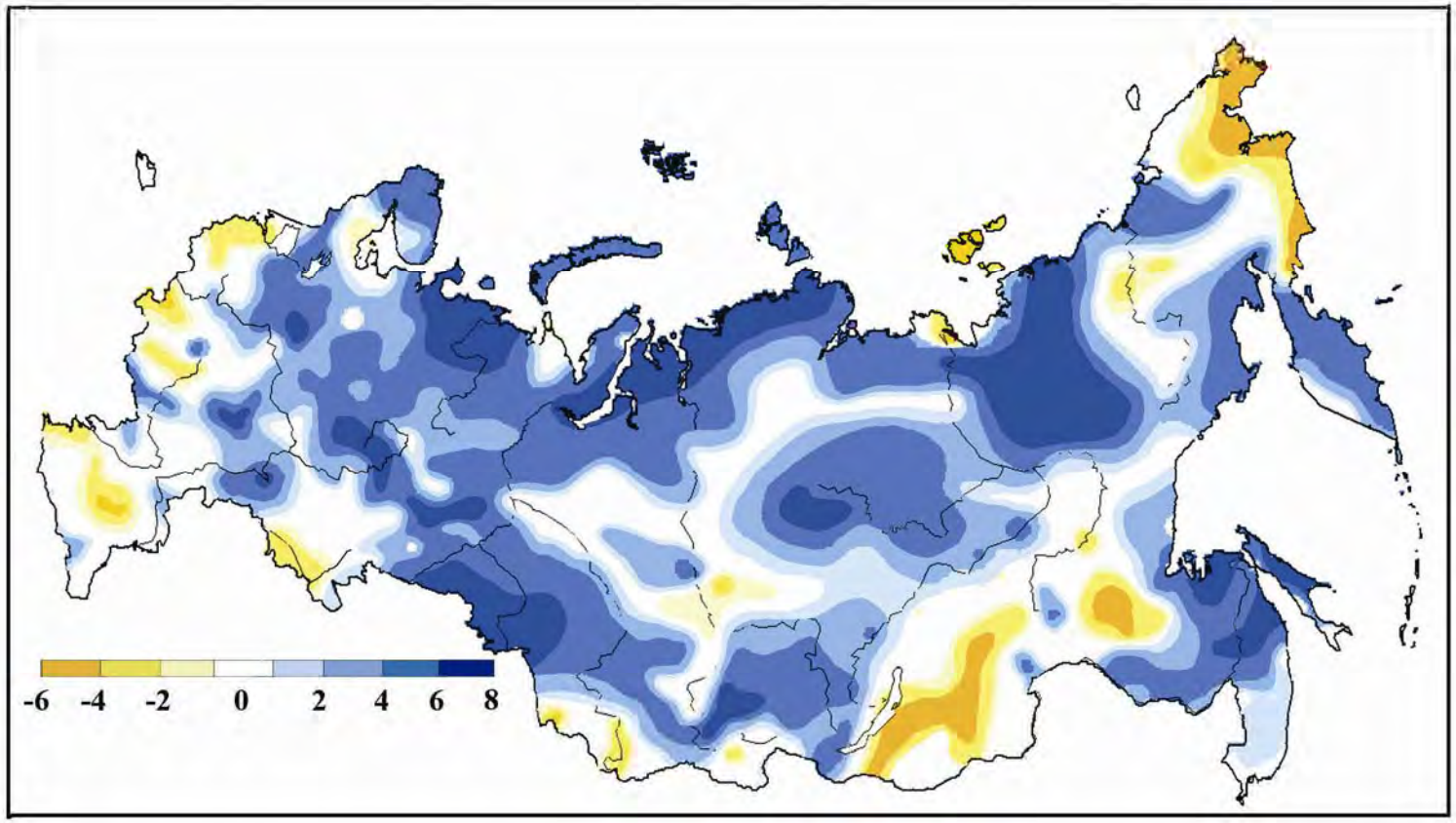


Terra-MODIS RGB, July-Sept 2008, 250 m resolution. Cloud free composite. (Trishchenko *et al* 2009). Please, note large areas of ice-free water in the Arctic during this three-months-long season.

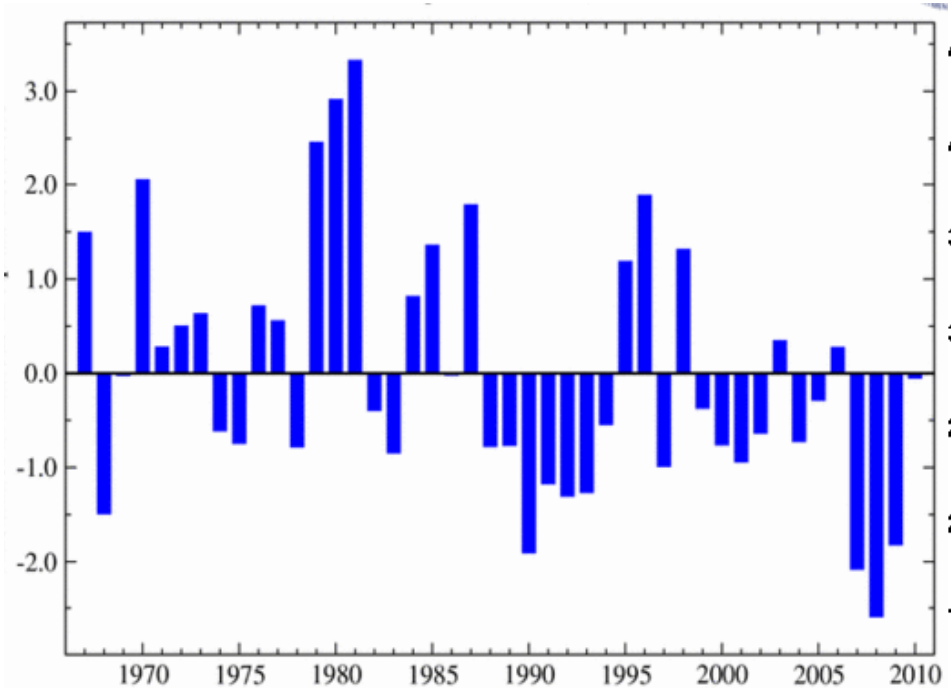


Source: http://nsidc.org/data/seaice_index/

Linear trend coefficients in the time series of the number of days with snow cover exceeding 20 cm for 1951-2006 (Bulygina et al. 2009)

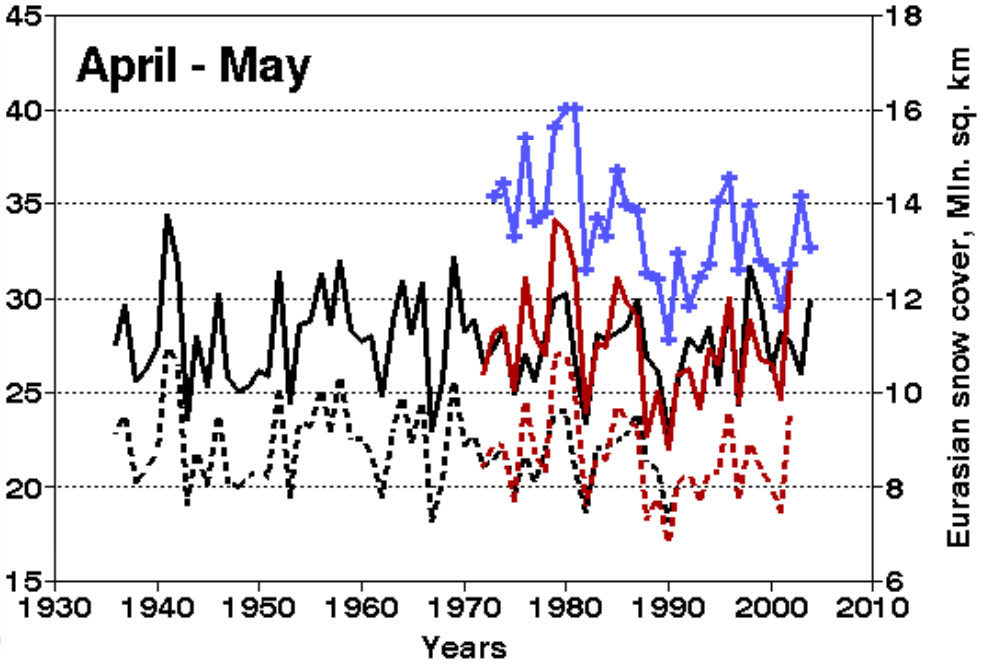


April snow cover extent anomalies over Eurasia



Snow cover extent from NOAA satellites for 1967-2010. NOAA NCDC 2010: State of the Climate. Global Analysis April 2010. [Avail. at *http://www.ncdc.noaa.gov/sotc/index.php?report=global&year=2010&month=apr*]

April-May snow cover duration over the former USSR and Russia



Snow cover duration over the former USSR (dashed lines) and Russia (solid lines) from satellite (red and blue lines) and in situ observations (black lines) (Groisman et al. 2006).

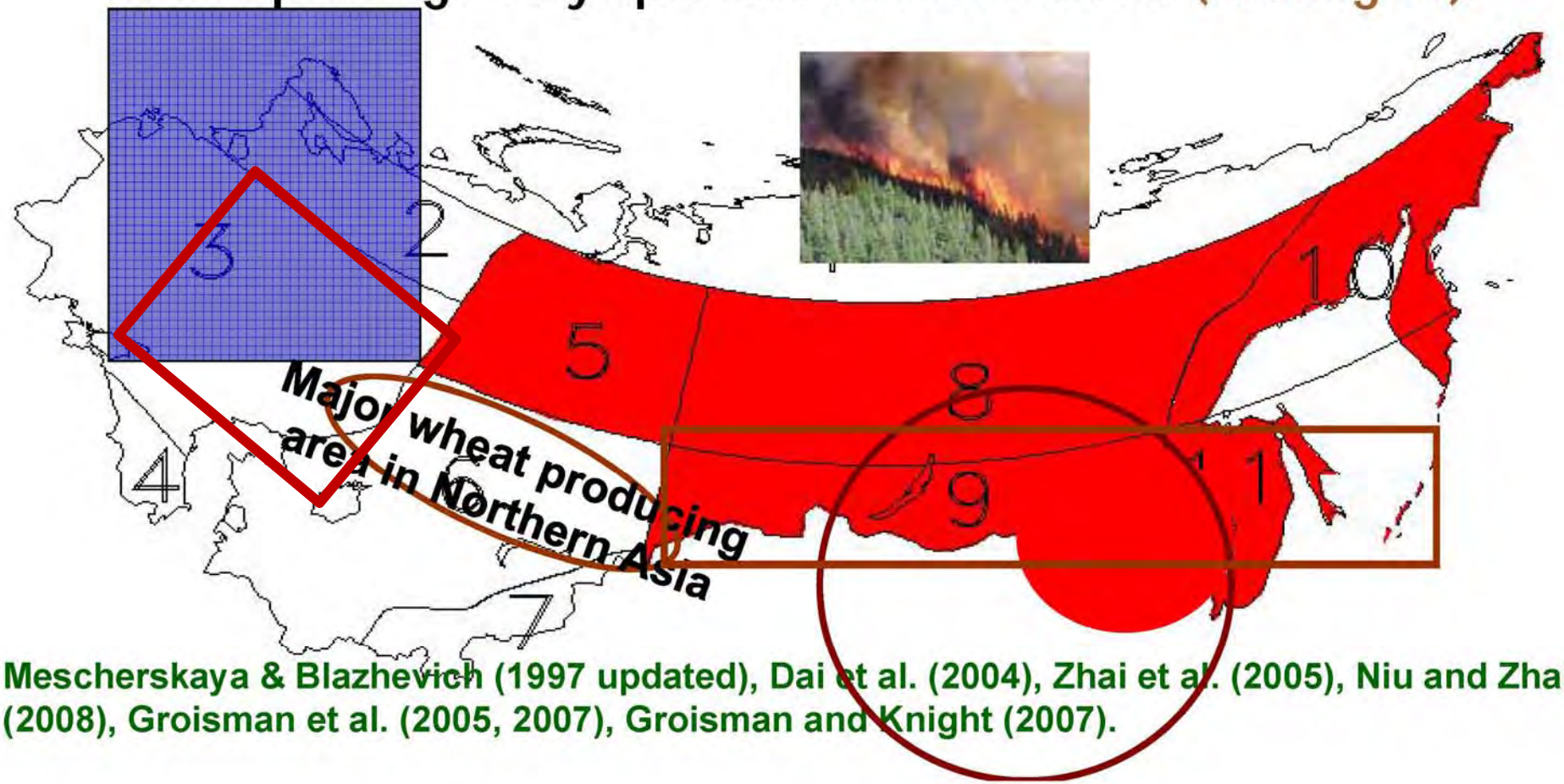
Forest fire danger.

In the northern extratropics we have:

- Up to two-digit (%) increase in growing degree-days → evapotranspiration may **grow**
- Earlier snowmelt & more frequent thaws → more cold season precipitation becomes unavailable in the warm season
- Only moderate increase in precipitation but increase in thunderstorm activity → more warm season precipitation goes into runoff
- All the above → possibility of drier summer conditions → **increase in forest fire danger**

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

Regions with more humid conditions (blue), regions where potential forest fire danger has increased in the 20th century (red), the region where agricultural droughts have increased (circled), and the region where prolonged dry episodes have increased (rectangled).

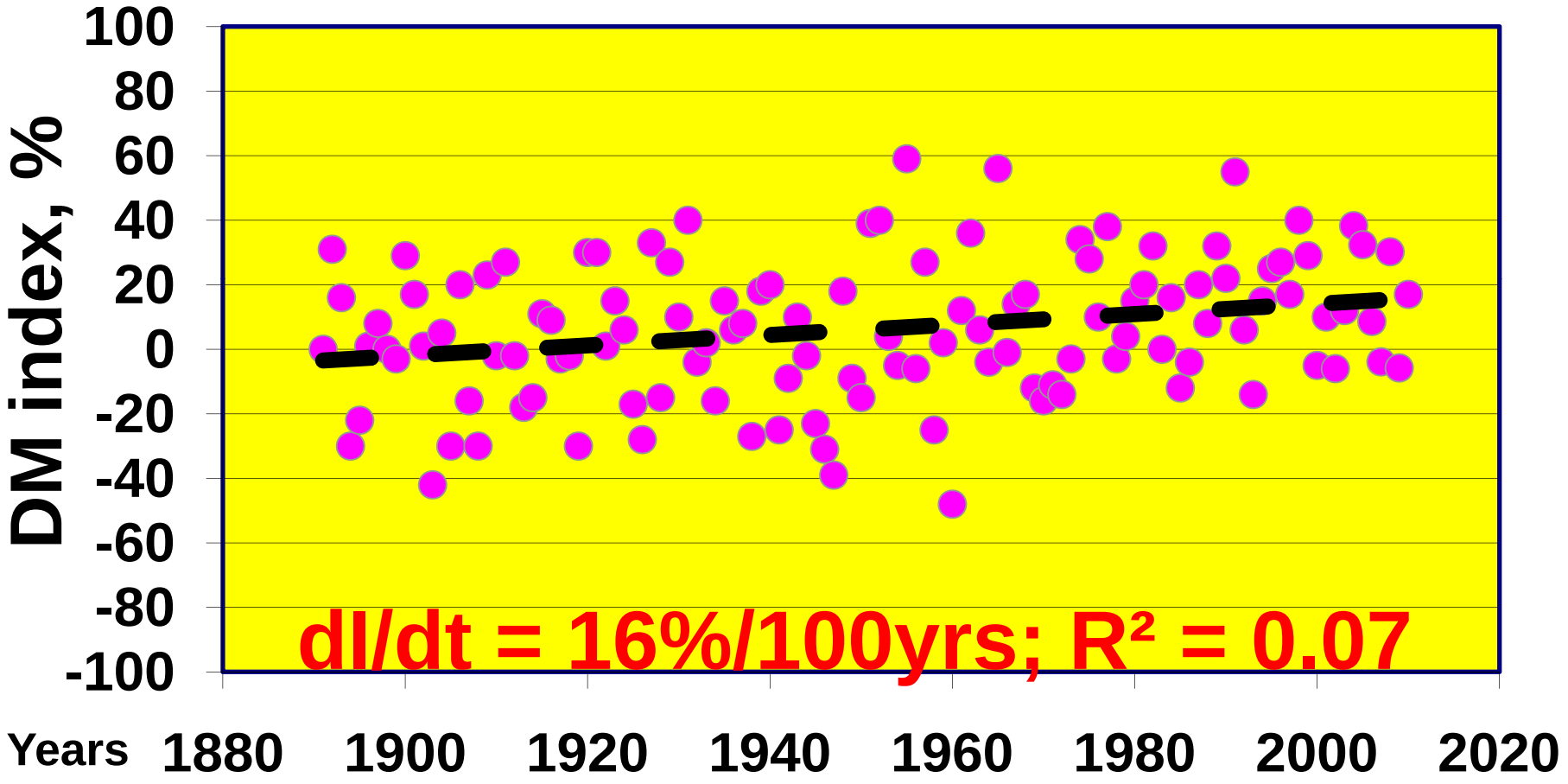


Mescherskaya & Blazhevich (1997 updated), Dai et al. (2004), Zhai et al. (2005), Niu and Zhai (2008), Groisman et al. (2005, 2007), Groisman and Knight (2007).

East of the Ural Mountains

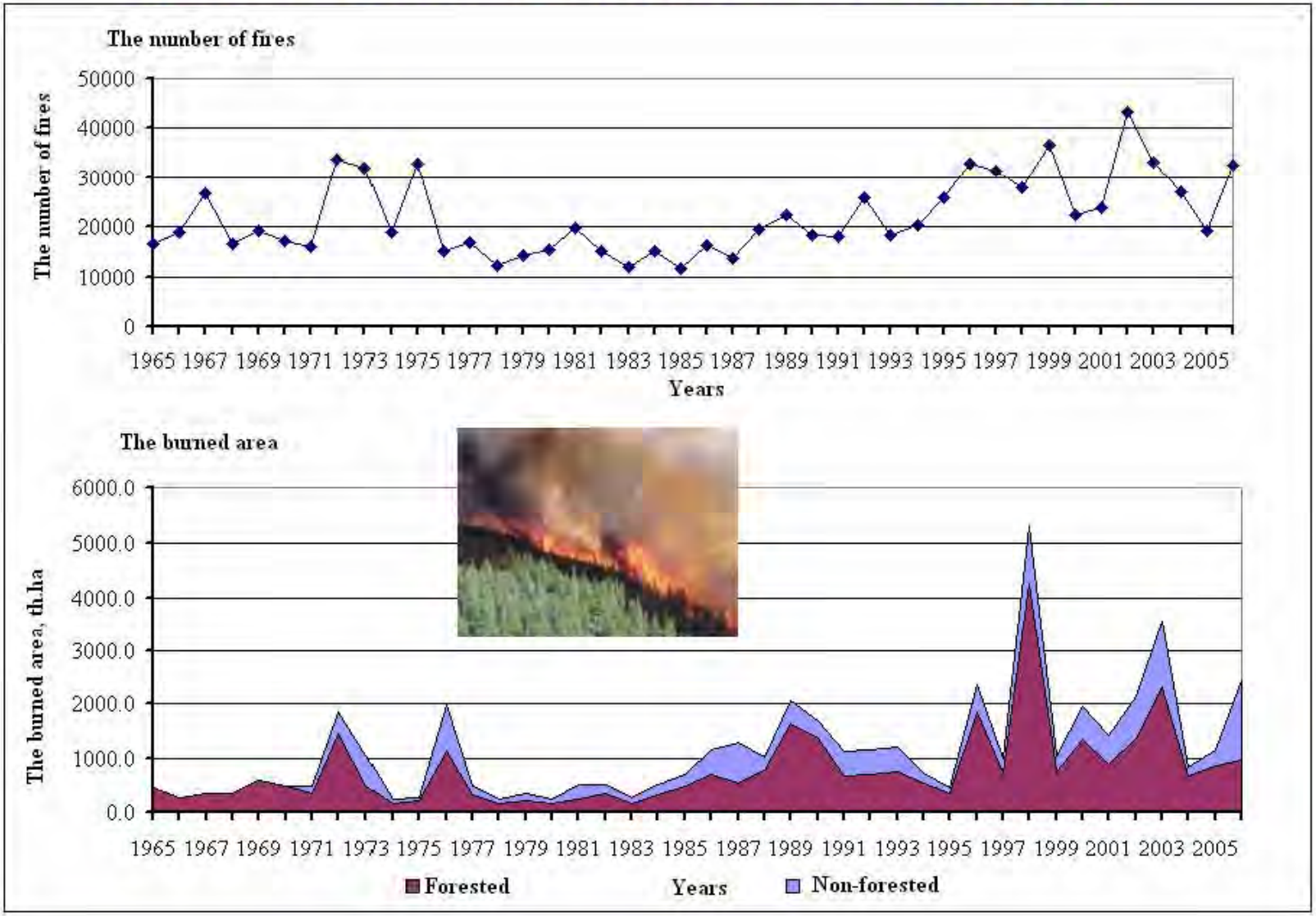
Agricultural regions of West Siberia and Northern Kazakhstan. May – July Drought Index.

Meshcherskaya and Blazhevich, 1997, updated to 2010



Areas with excessively dry conditions minus areas with excessively wet conditions, (% of total area)

DYNAMICS OF FIRES NUMBERS AND BURNED AREA (PROTECTED TERRITORY OF RUSSIA)

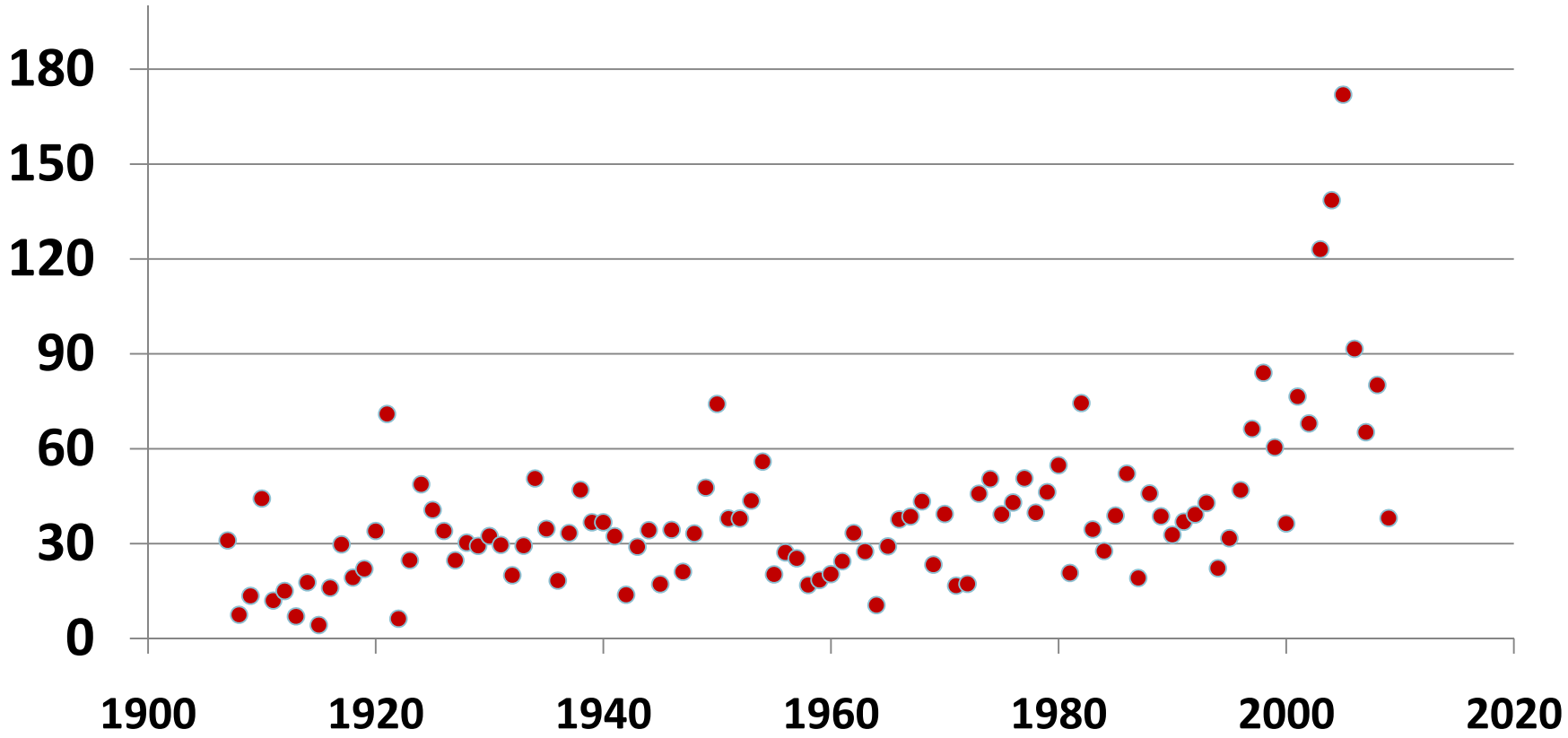


Korovin and Zukkert 2003, updated

Potential Fire Danger Increase

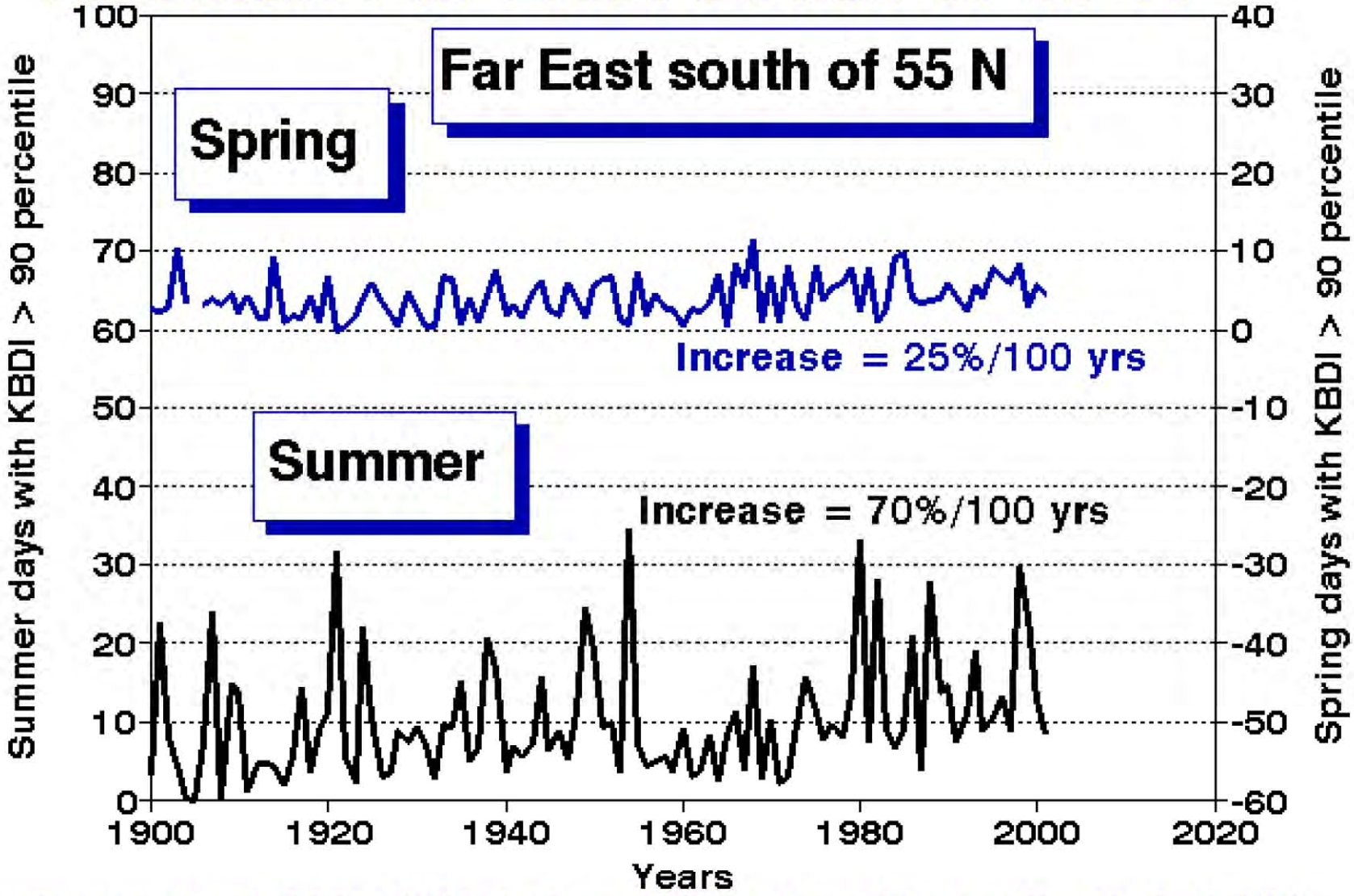
Annual number of days with KBDI > upper 10%-ile

Russian Far East south of 55N



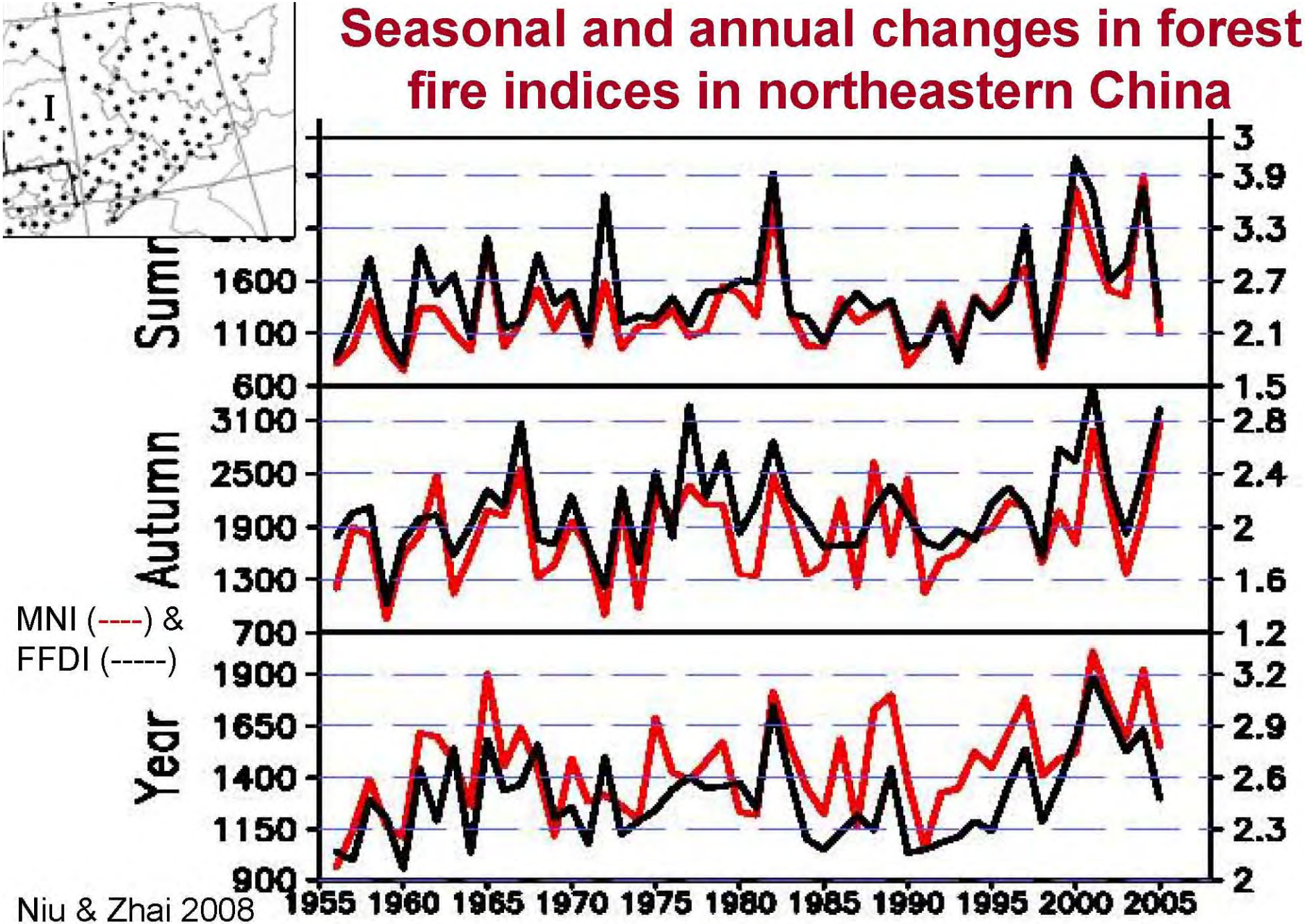
Potential Forest Fire Danger Increase:

Russian Far East south of 55°N



Groisman et al. 2007, "*Global and Planetary Change*", 56, 371-386.

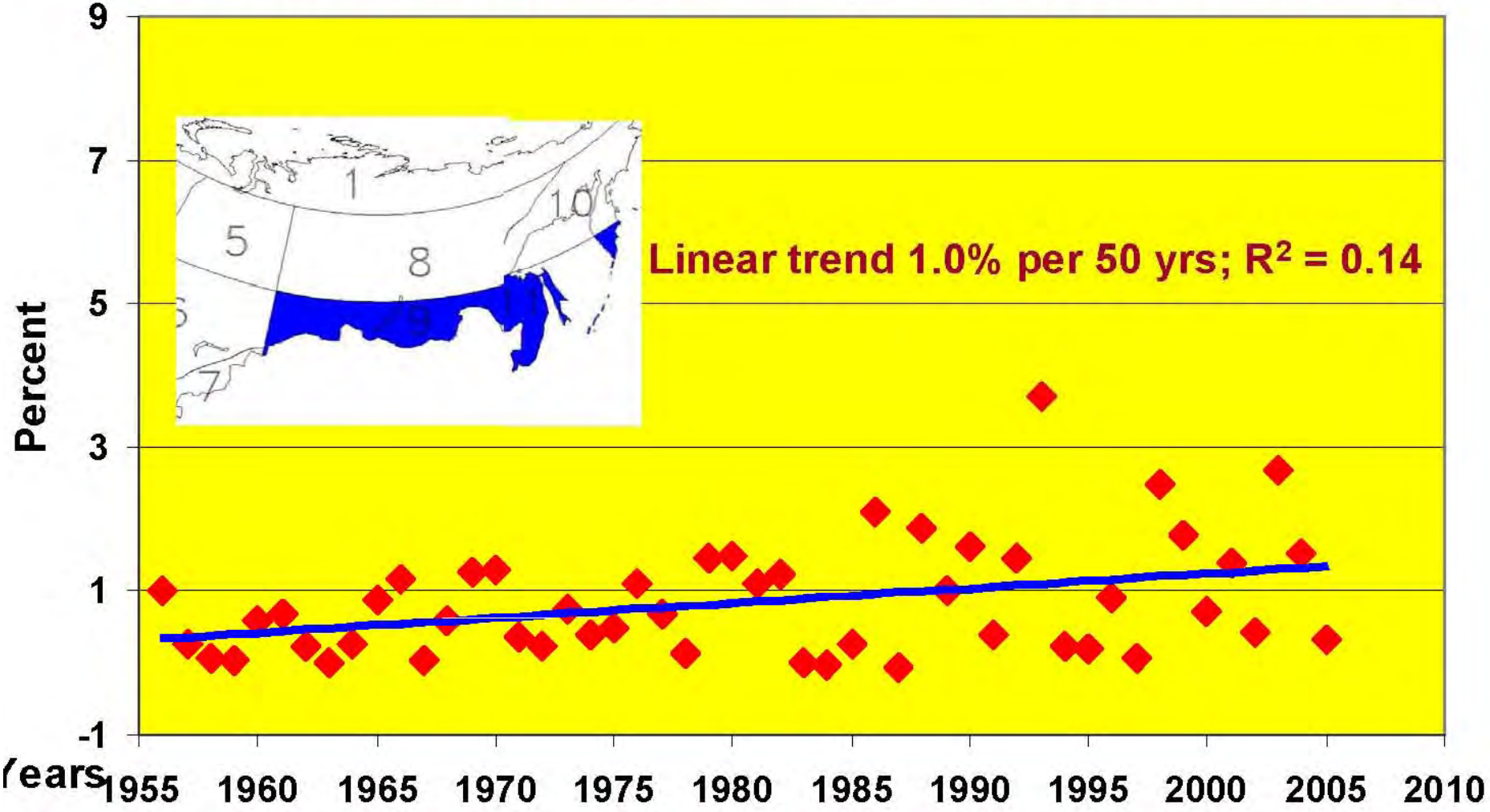
Seasonal and annual changes in forest fire indices in northeastern China



MNI (----) &
FFDI (-----)

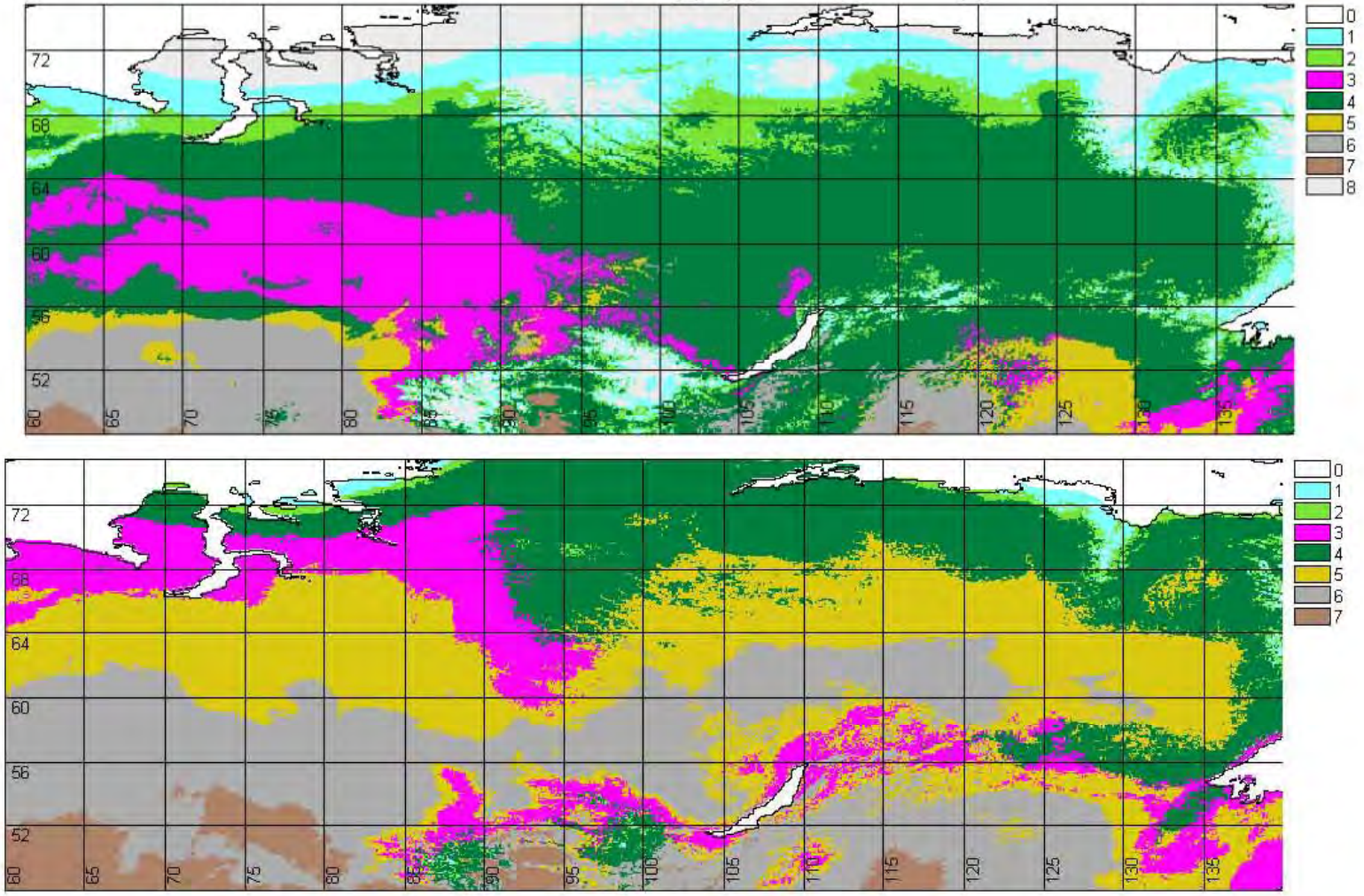
Niu & Zhai 2008

Russia east of 85°E, south of 55°N



Dry episodes above 30 days during the warm season

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



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


Central Yakutia

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