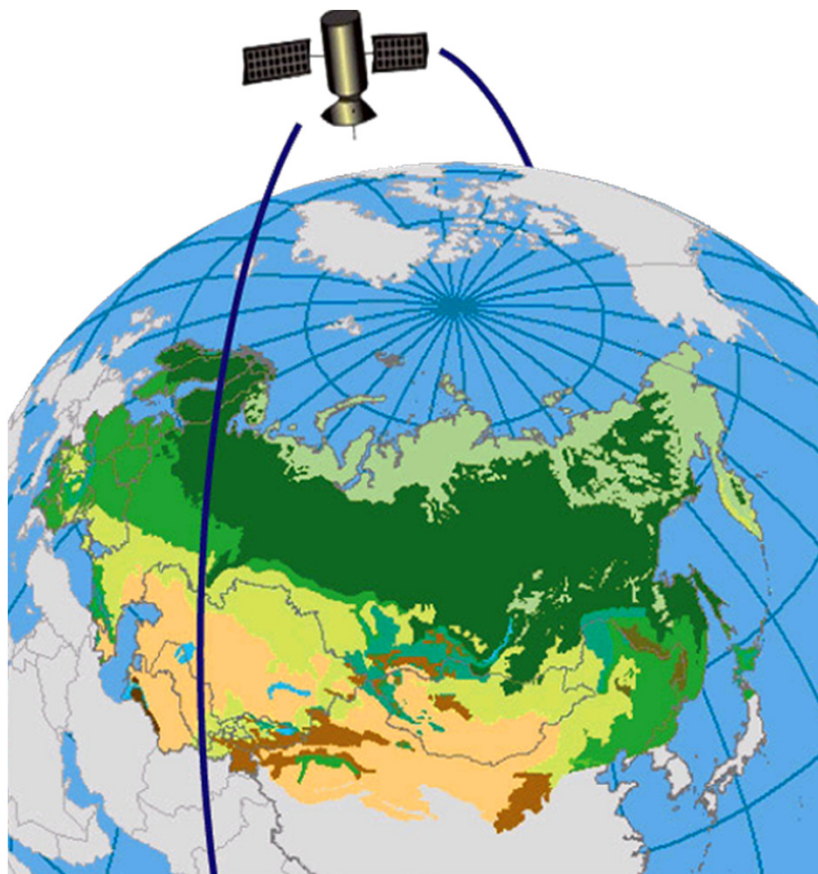


Northern Eurasia Future Initiative (NEFI) Focus on Human-Associated Extreme Events

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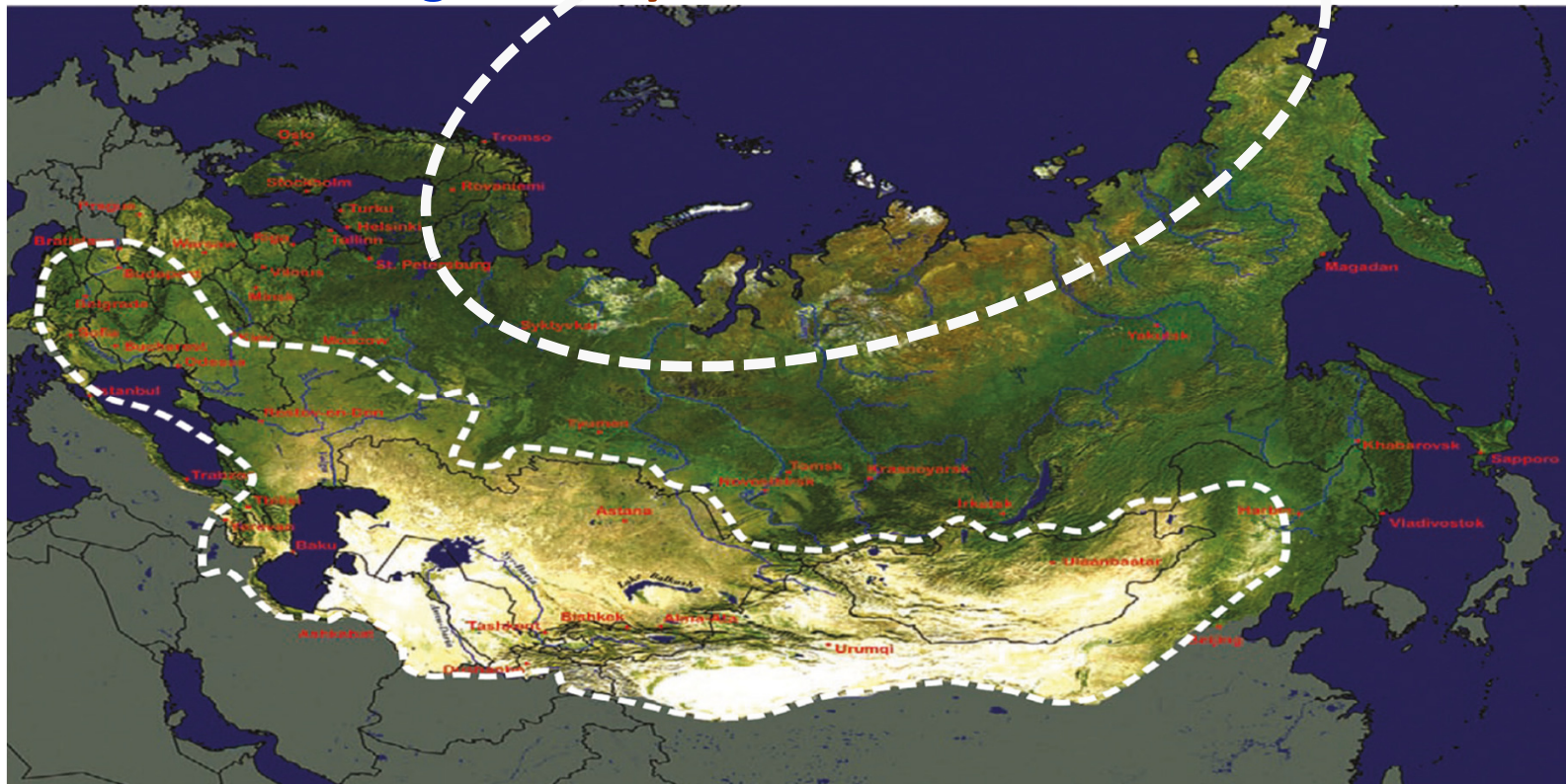
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- 6. National Center for Space Research and Technologies, Almaty, Kazakhstan**



North Eurasia Earth Science Partnership Initiative (NEESPI) was the predecessor project. Its Study Area is shown on the left; <http://neespi.org>.

The NEFI Study Area is the same.

- **Dry Land Belt (DLB) of Northern Eurasia, the largest region with acute water deficit in the extratropics.**
- **Boreal Forest zone northward of DLB is the largest storage of terrestrial carbon.**
- **The Eurasian Arctic is the region of the most prominent natural changes. Ecosystems' boundaries here are unstable.**



NEESPI was launched in 2004 with scientific horizon of 10-12 years.

During the past decade, NEESPI has included 172 individual projects and more than 1500 peer-reviewed publications. Now it is gradually discontinued by attrition (no new projects are accepted).

The Science Plan of NEESPI is available at <http://neespi.org/science/index.html>

NEFI was launched in 2016

Currently NEFI includes 22 (+4) international projects and is open for new funded projects.

The NEFI Core Science Plan (White Paper) is available at <http://nefi-neespi.org/NEFI-WhitePaper.pdf> and

in Groisman *et al.* PEPS (2017) 4:41 [DOI 10.1186/s40645-017-0154-5](https://doi.org/10.1186/s40645-017-0154-5).

The overarching science questions:

- **NEESPI:** How do Northern Eurasia's terrestrial ecosystems dynamics **interact** with and alter the biosphere, atmosphere, cryosphere, and hydrosphere of the Earth?
- **NEFI:** How to provide in Northern Eurasia a sustainable societal development (economy well-being, activities, health, and strategic planning) in changing climate, ecosystems, and... societies?

Foci of new NEFI research

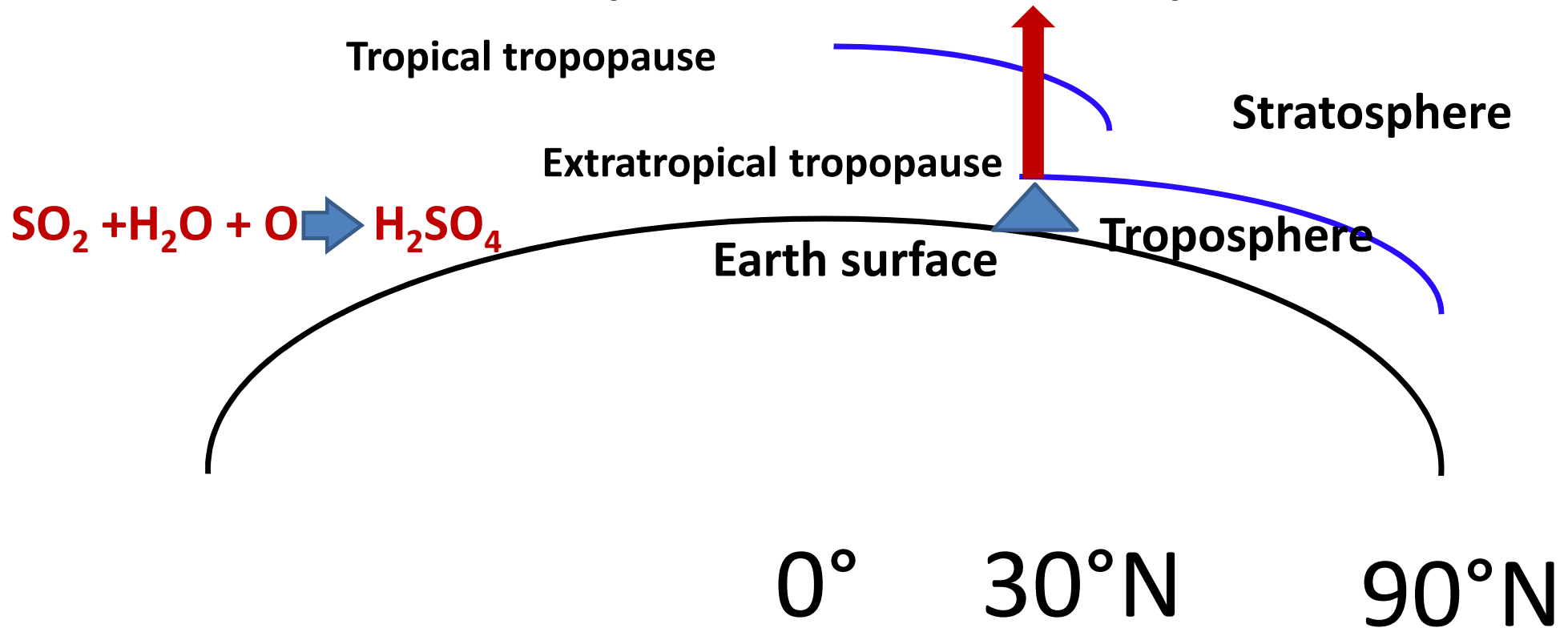
1. Global change, particularly the warming of the Arctic
2. Increasing frequency and intensity of extremes and changes in the spatial and temporal distributions of inclement weather conditions
3. Retreat of all components of the cryosphere
4. Changes in the terrestrial water cycle
5. Changes in the biosphere
6. Pressure on agriculture and pastoral production
7. Changes in infrastructure
8. Societal actions to mitigate negative consequences of the environmental change and to benefit from positive consequences
9. Quantification of the role of Northern Eurasia in the global Earth and socioeconomic systems to advance research tools with an emphasis

Definitions

Human-associated events are the events that affect human health, wealth, societal well-being and activities; they can be natural or/and be caused by human activity

- If these events are **rare**, then we name them **extreme** events
- If these events are **inevitable**, then we name them **troublesome** and fight back (dams, bypasses, culverts, construction code, air condition, heating, storage of resources, evacuation routes, etc.)
- If these events are **man-made**, then we name them **involuntary crimes** and (a) study the errors, (b) develop mitigation routines, and (c) try to avoid the future consequences of such events.
- **Natural catastrophes** (e.g., asteroids, earthquakes, volcanic eruptions, *floods, droughts, fires, etc.*)

Catastrophic volcanic eruptions

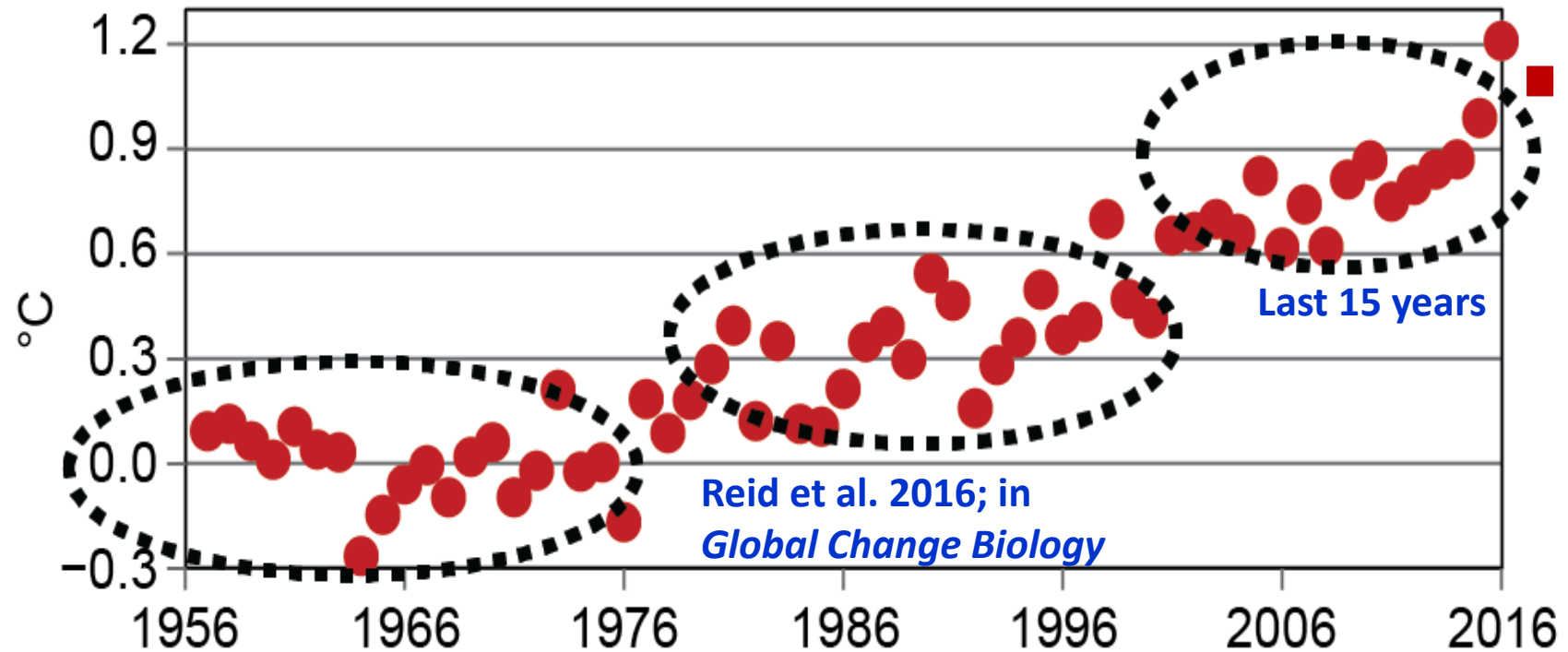


- Krakatau 1883; El Chichón, 1982; Pinatubo 1992; **Huaynaputina 1600**

Part 1. What is going on?

- Environmental Changes
 - Global Temperature
 - Arctic temperature
 - Arctic sea ice cover
 - Terrestrial cryosphere
- Global population changes
 - Land use
 - Urbanization
 - Global wealth

Global Annual Surface Air Temperature Anomalies, °C

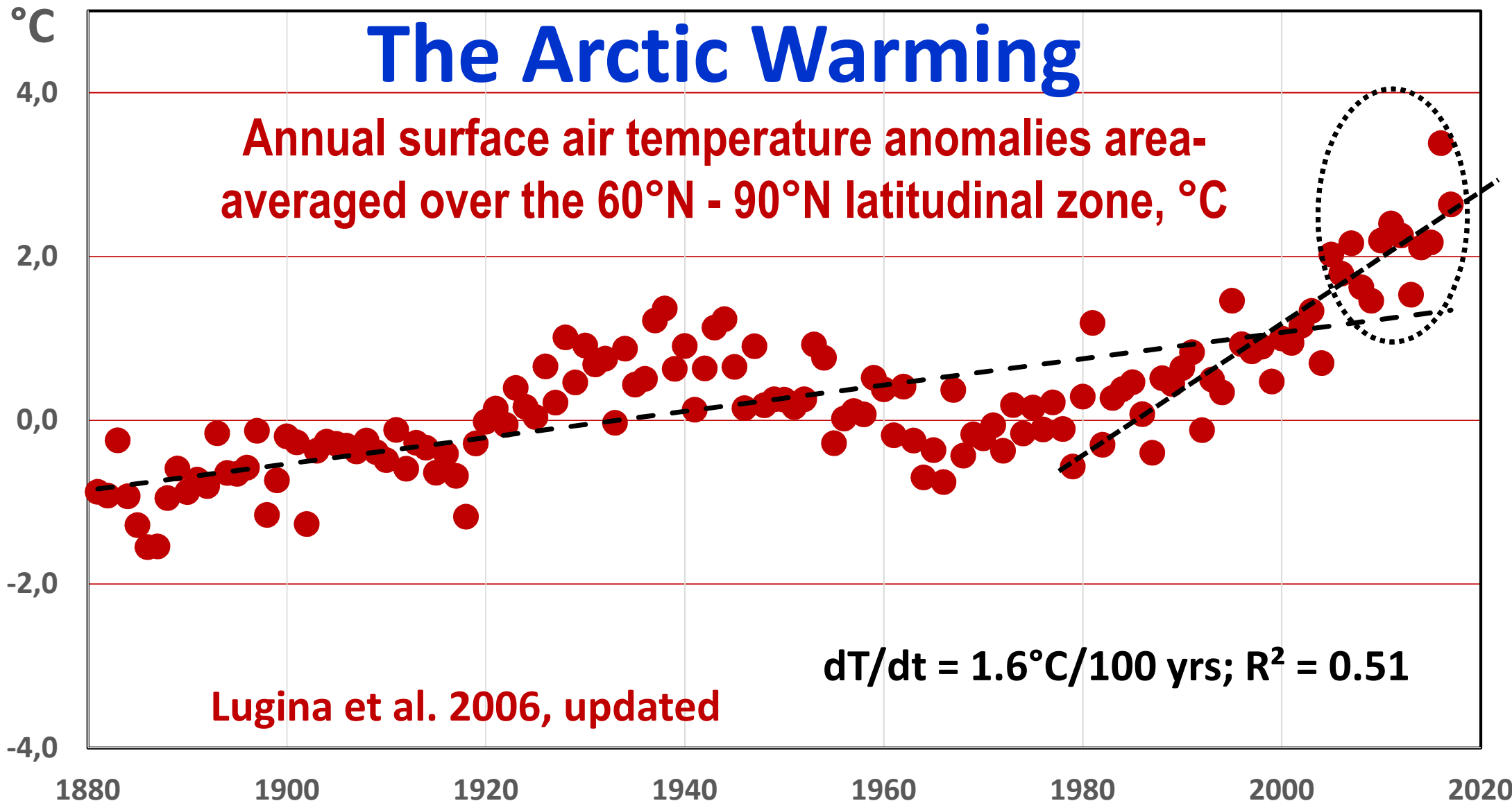


Lugina et al. 2006, updated.

Anomalies from the long-term mean values for 1951-1975

The Arctic Warming

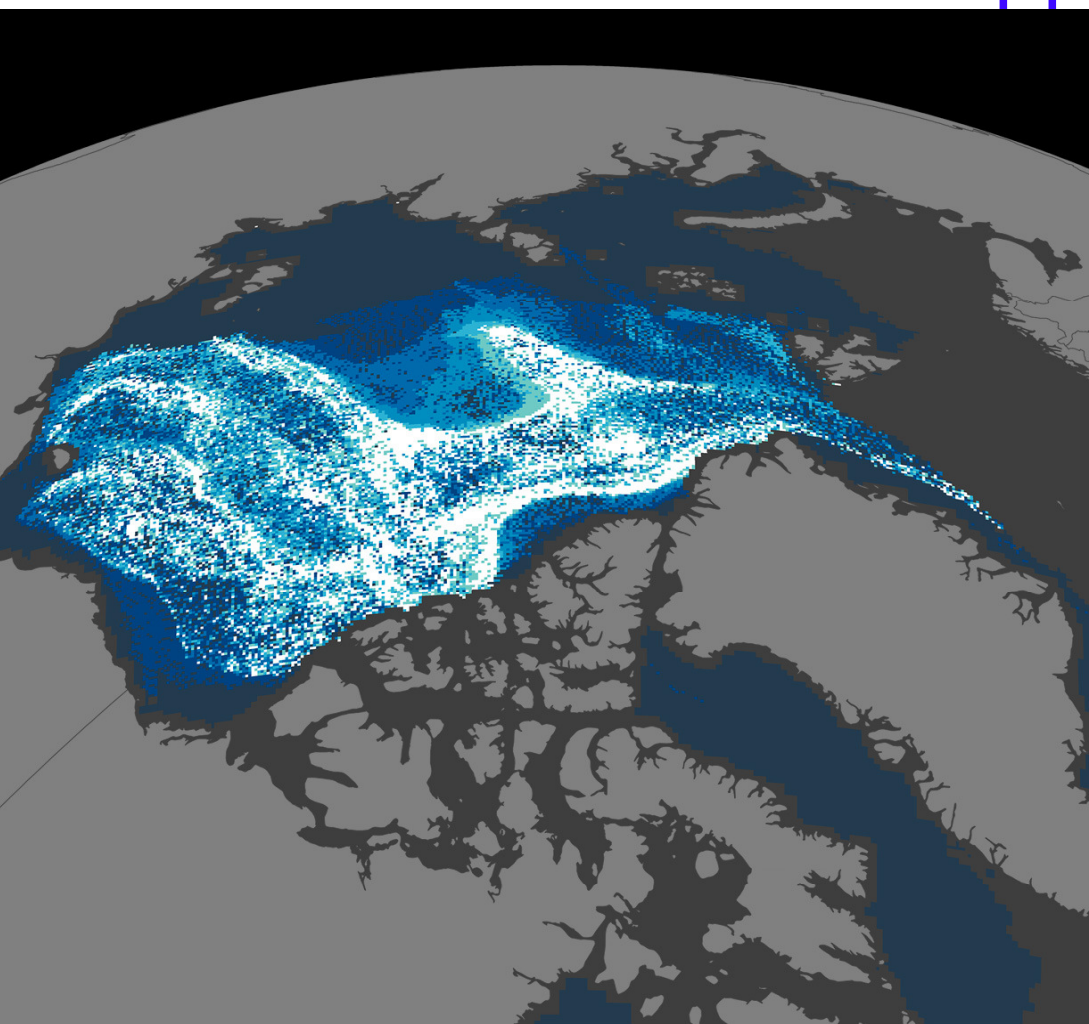
Annual surface air temperature anomalies area-averaged over the 60°N - 90°N latitudinal zone, °C



$dT/dt = 1.6^{\circ}\text{C}/100 \text{ yrs}; R^2 = 0.51$

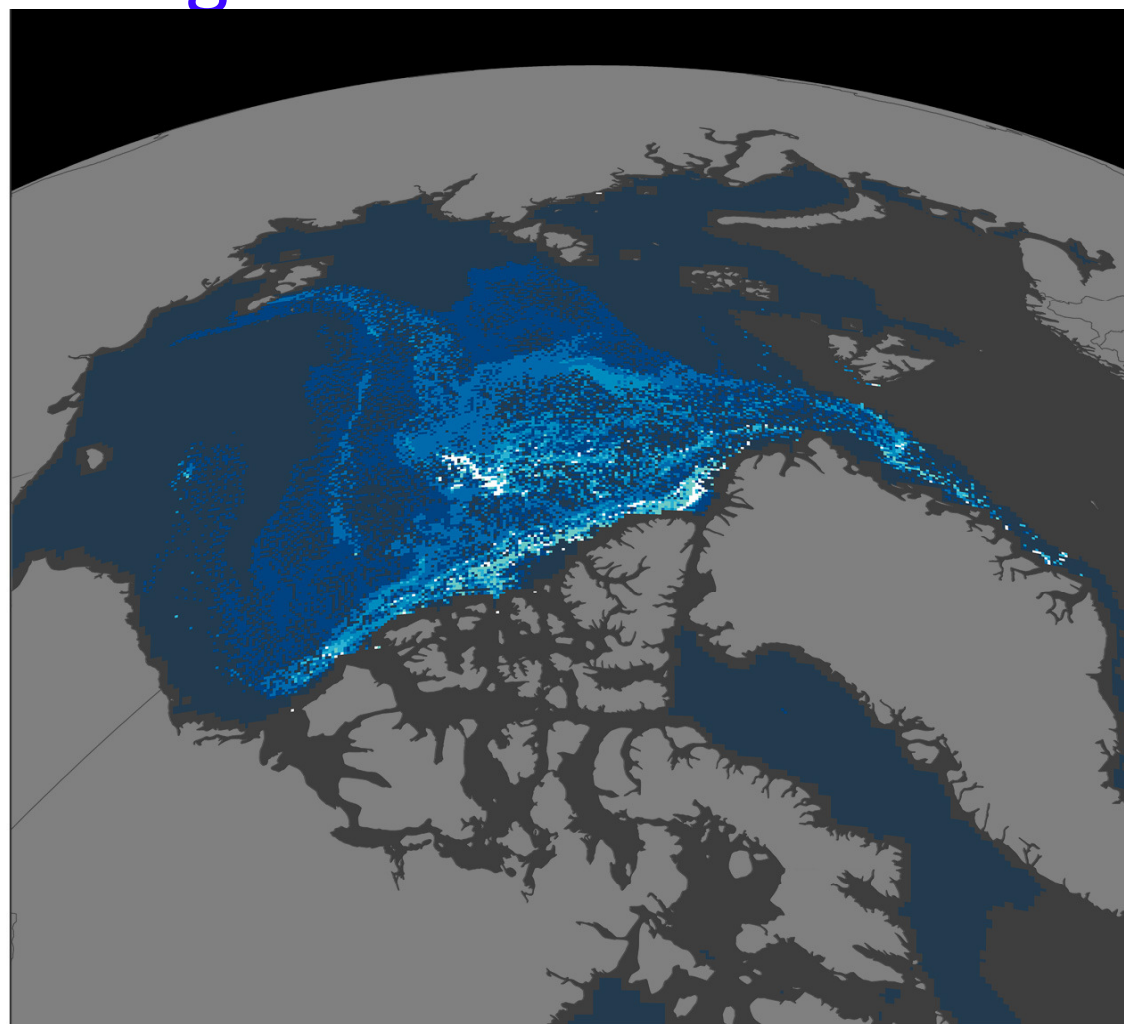
Lugina et al. 2006, updated

Old sea ice continues disappearing from the Arctic Ocean



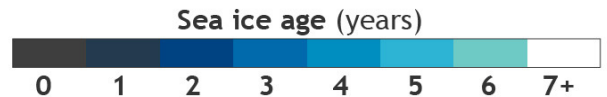
early March (week 9) 1984

Early March 1984



early March (week 9) 2018

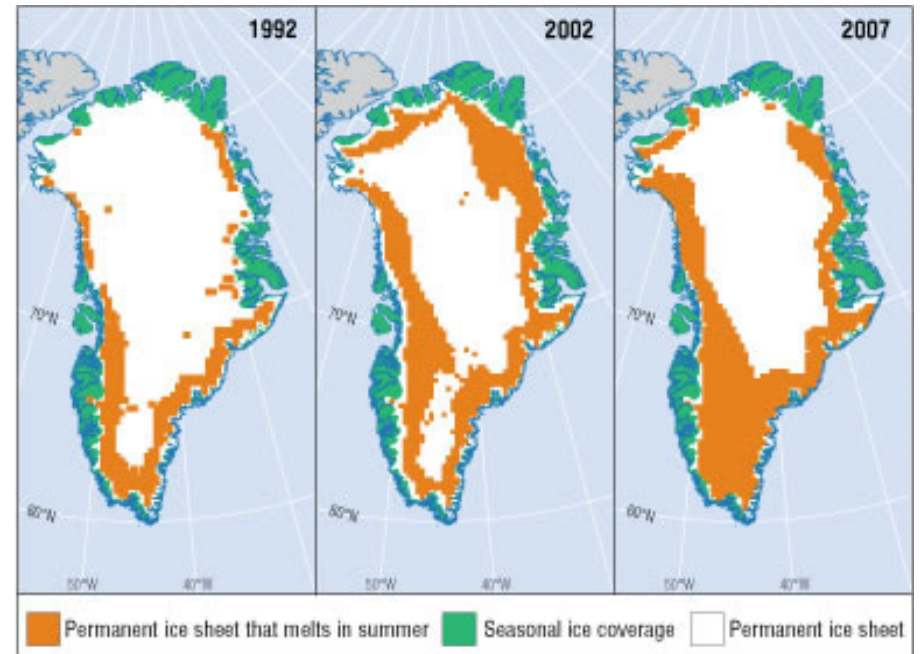
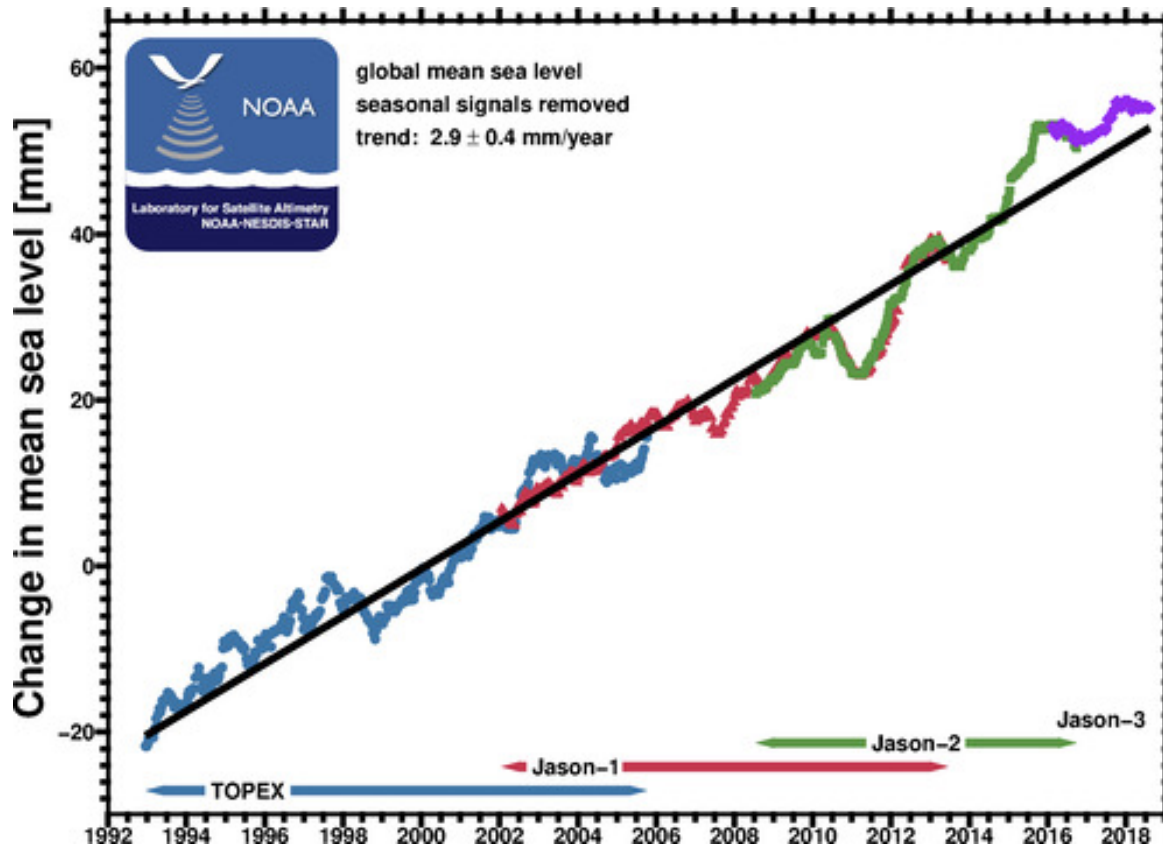
Early March 2018



Data: NSIDC
NOAA Climate.gov
Data: Mark Tschudi/NSIDC

Global mean sea level (MSL) from TOPEX/Poseidon, Jason-1, and Jason-2

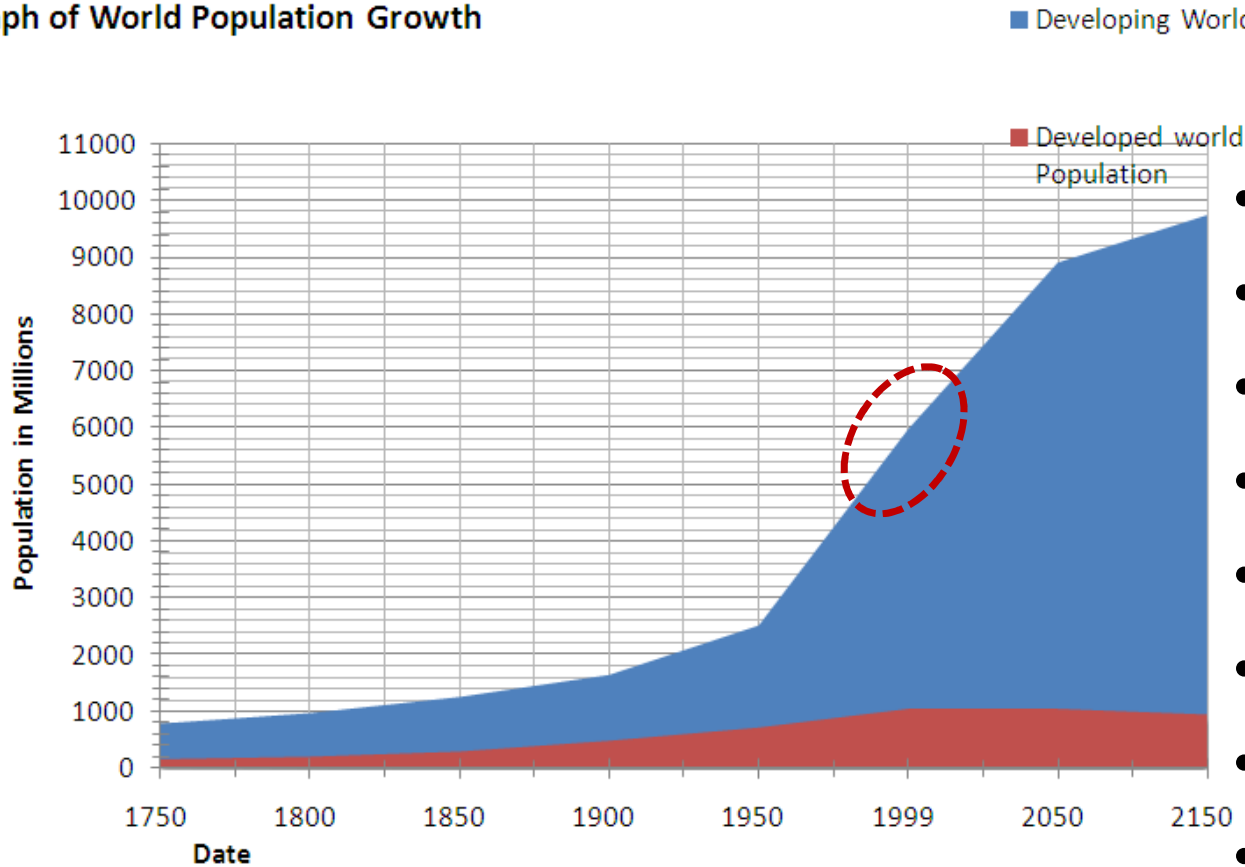
According to NASA, Greenland Ice Sheet loses 53 mi³ annually.



<http://brian-mountainman.blogspot.com/2011/02/demise-of-ice-sheet.html> (if this ice sheet melt =>MSL rises by 6 m)

World population growth

A Graph of World Population Growth



- Year
 - 1540
 - 1750
 - 1900
 - 1950
 - 2000
 - 2012
 - Present:
- Population
- 300 million.
- 791 million.
- 1.7 billion.
- 2.5 billion.
- 6.2 billion.
- 7.0 billion.
- 7.6 billion.**

Source: <http://themasites.pbl.nl/tridion/en/themasites/hyde/basicdrivingfactors/population/references.html>

http://www.coolgeography.co.uk/A-level/AQA/Year%2012/Population/Population%20change/Global_Population_Change.htm

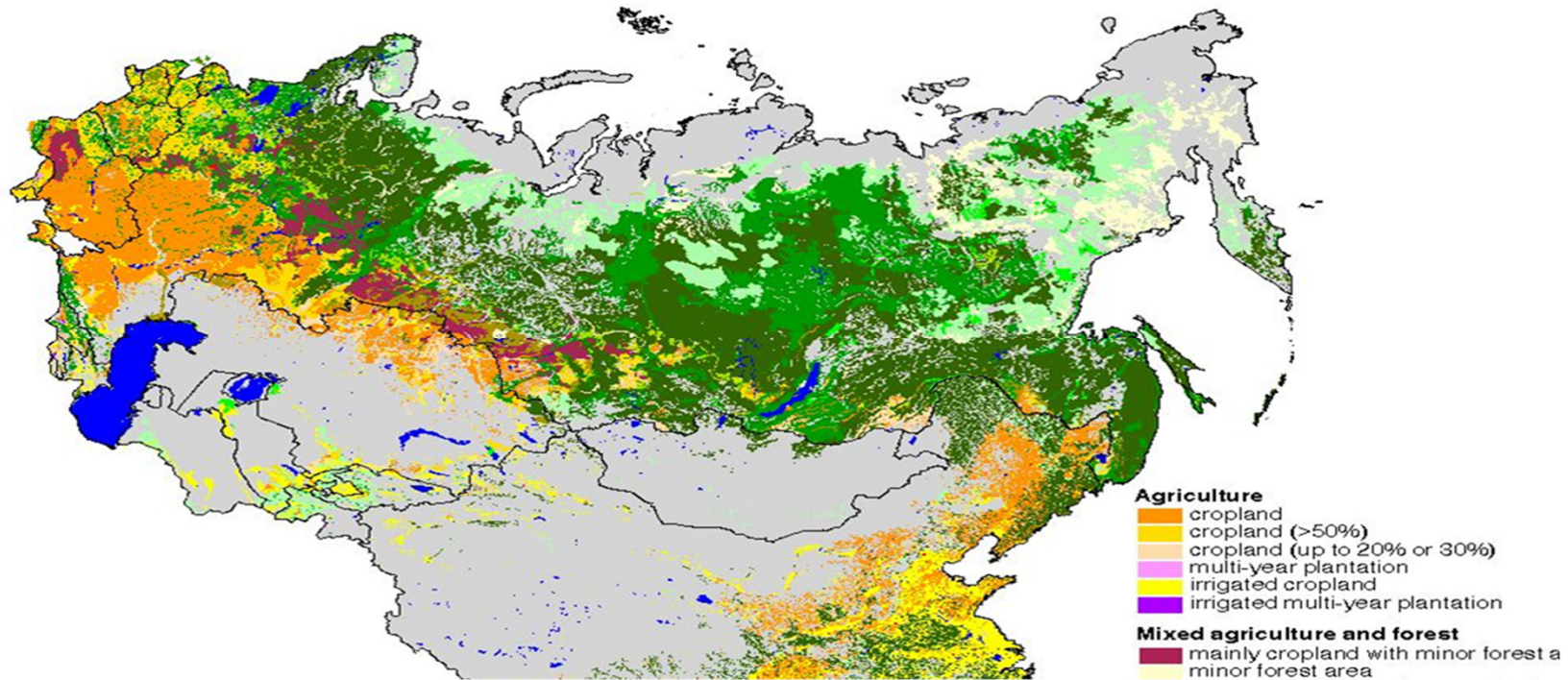
Increase in World Production of Top Ten Major Commodities (1969 – 2009) (million metric tons).

Crop	1969	2009	Percent Increase
Sugar Cane	538	1,661	209%
Maize	270	819	203%
Wheat	309	686	122%
Rice, paddy	296	685	131%
Cow Milk	358	583	63%
Potatoes	278	330	19%
Vegetables	71	249	251%
Cassava	95	234	146%
Sugar Beets	217	227	5%
Soybeans	42	223	431%
Total	2,474	5,697	130%

Source: U.N. Food and Agriculture Organization (FAO)

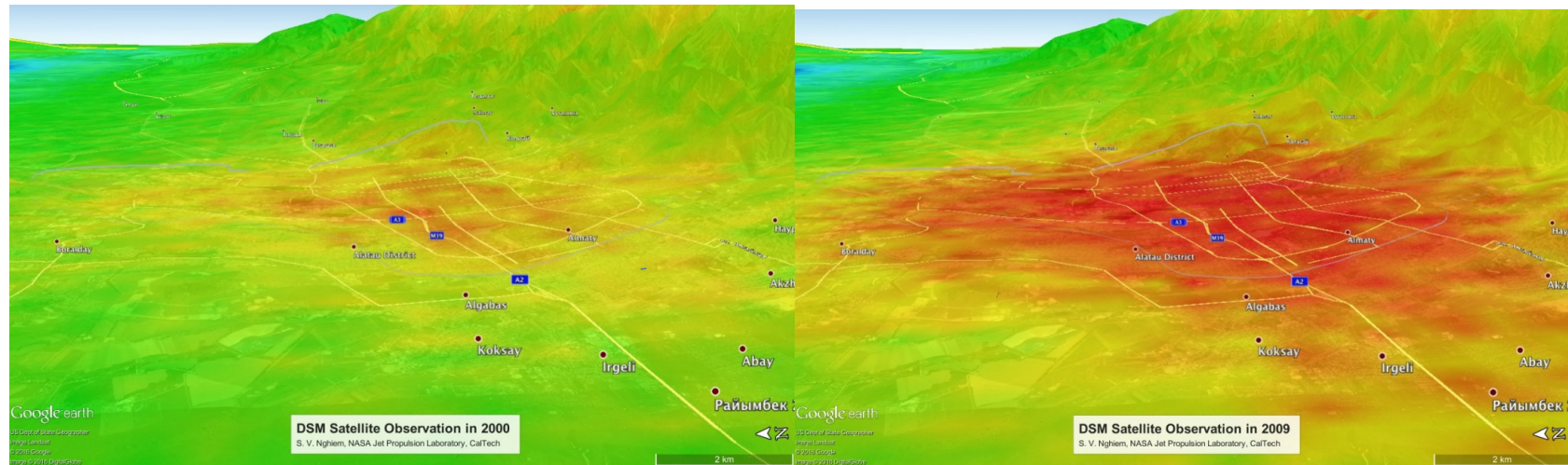
Large-scale land use changes caused by human activity:

For example: More than 90% of steppe and forest-steppe zones in Northern Eurasia is currently cropland (orange areas in the map) [Rozenzweig et al. 2003]



Intense urbanization

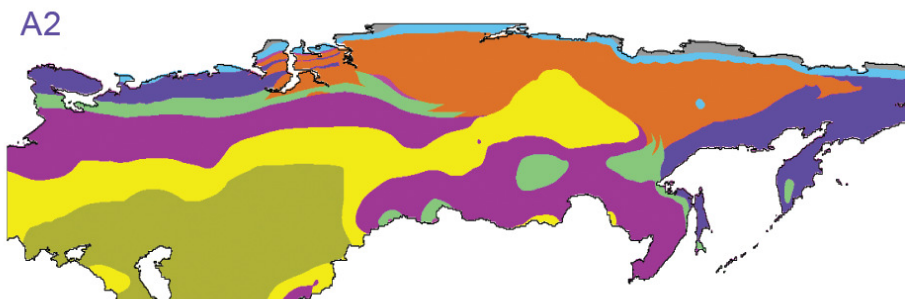
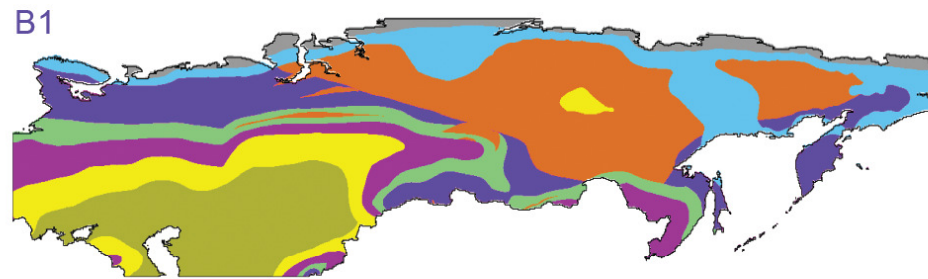
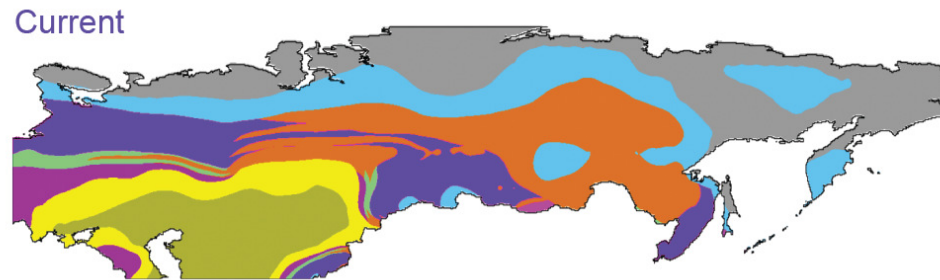
Almaty, Kazakhstan urban extent expansion that occurred between 2000 and 2009 (Nghiem et al. 2016)



Almaty urban region in Kazakhstan from DSM satellite observations in 2000 (left) and 2009 (right), translucently draped over 3D topography.

Red represents main urban areas, transitioned into **orange** for urban area with less development, then to **yellow** for suburban, and finally to **green** for rural/natural/wilderness areas. **Blue** indicates surface water (lakes, reservoirs, etc.).

Scenarios of projected Ecosystems' Shifts to 2090



Vegetation classes



Vegetation distribution under present conditions and equilibrium vegetation distribution under future climate conditions (scenarios) over Northern Eurasia in current climate and by year 2090 (Archive of Tchebakova et al. 2016).

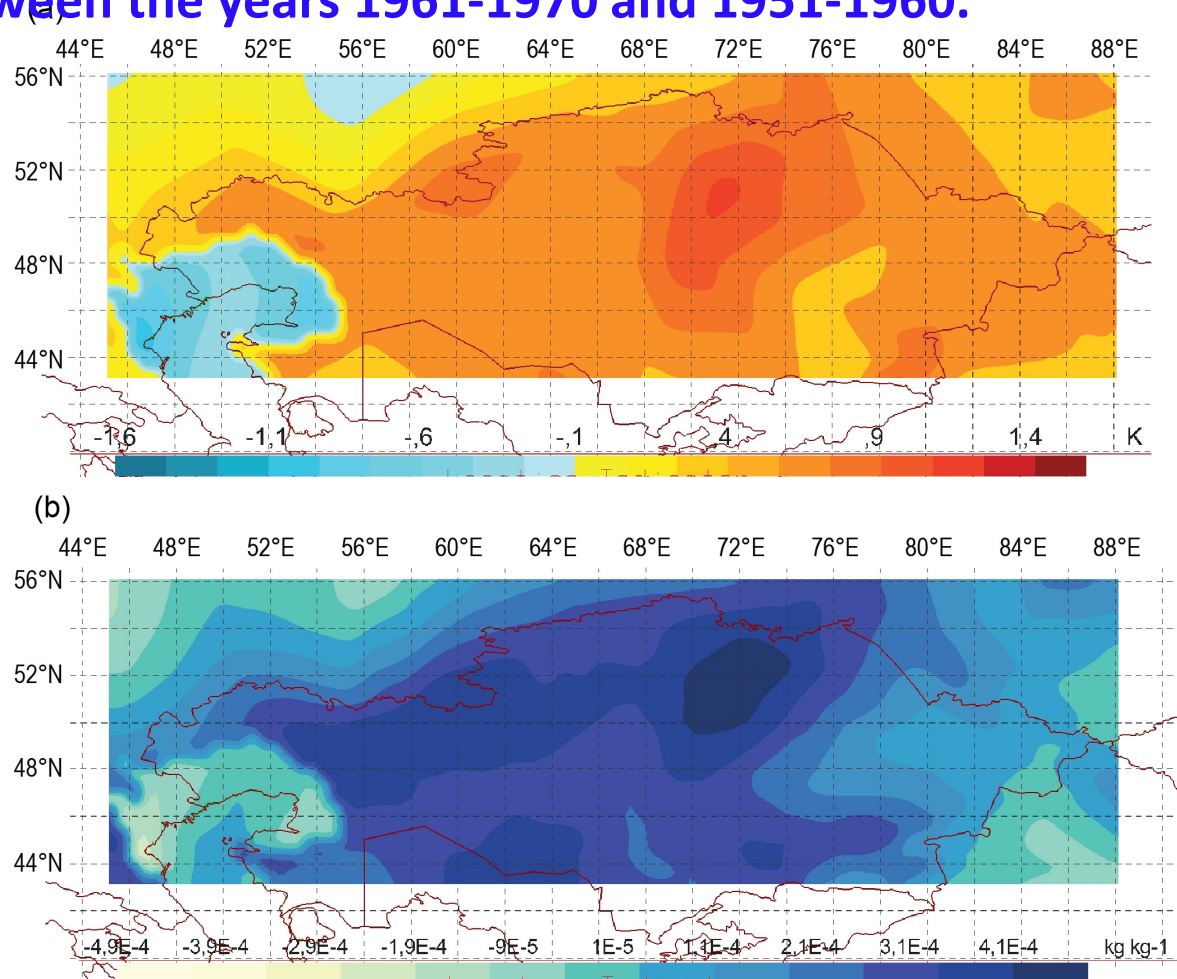
Part 2. Environmental changes to which human activity sizably contribute

Virgin lands development in late 1950s – early 1960s:

- 1. One mln poods of additional grain harvest (1 pood = 16 kg), but*
- 2. Dust storms*
- 3. Large part of the fertile upper soil layer was lost*

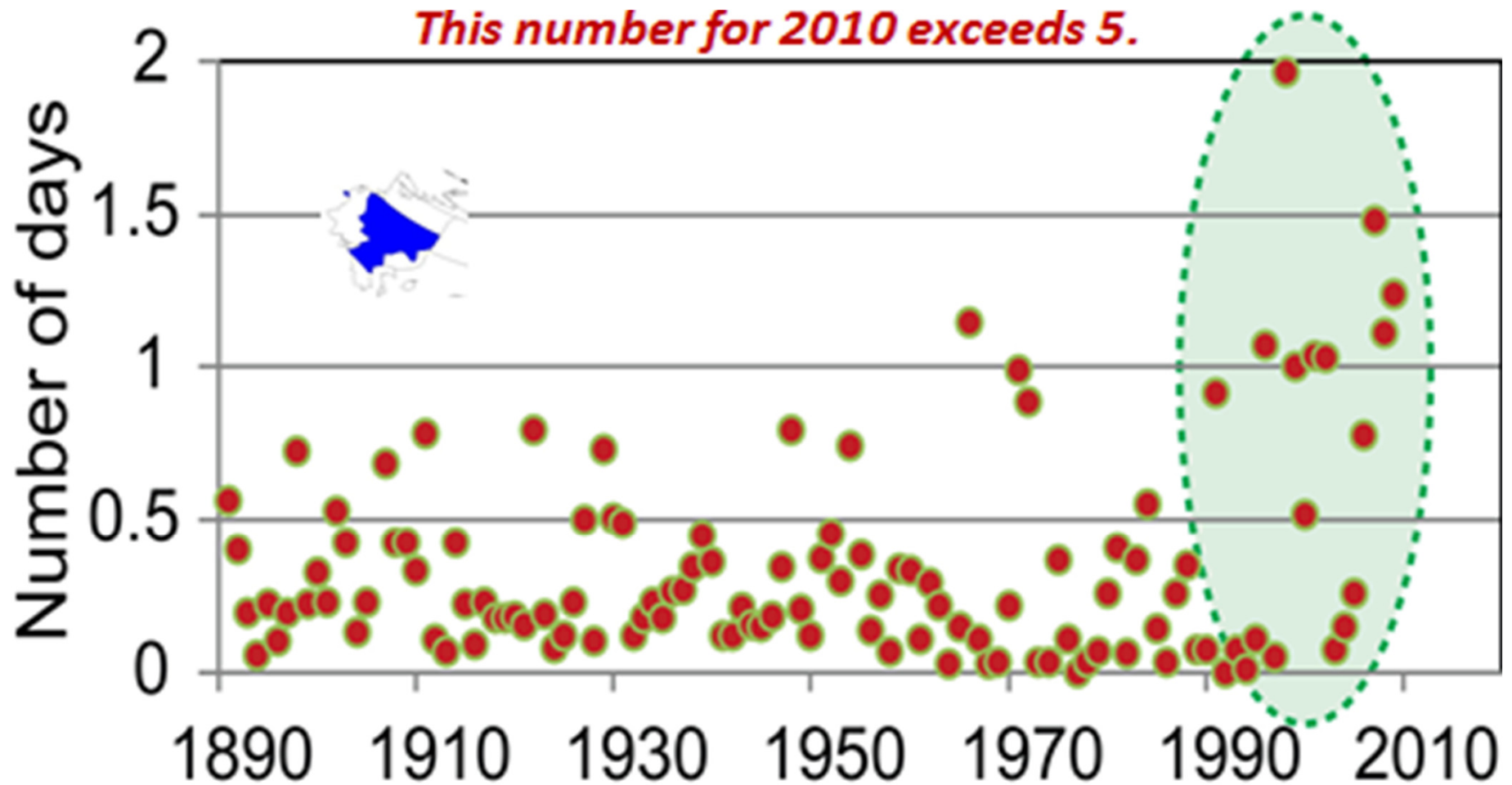
Differences of averaged near surface temperature (a) and near surface specific air humidity fields (b) between the years 1961-1970 and 1951-1960.

Climate has changed after the virgin lands development: temperature increased and land began release (loosing) its moisture (Yesserkepova and Kaipov 2018)



Kazakhstan. Impact of the virgin lands development in the late 1950s

Days with “hot” nights ($T_{\min} > 23.9^{\circ}\text{C}$ [75F]) over European Russia south of 60°N



Effects on human life caused by human activity

environmental illiteracy

- 1950s: mass melioration of wetlands

• 1972

- Abandoned dry turf areas around the Shatura Power Station and elsewhere were sources for **turf** fires
- Turf fires and smog over Moscow remained up to the end of August

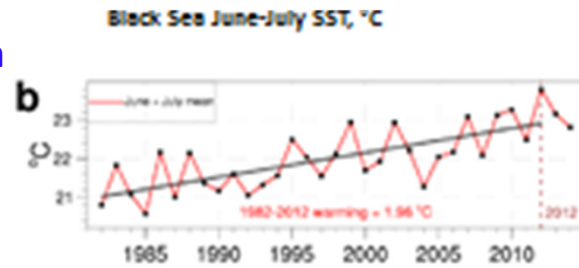
irresponsibility

• 2010

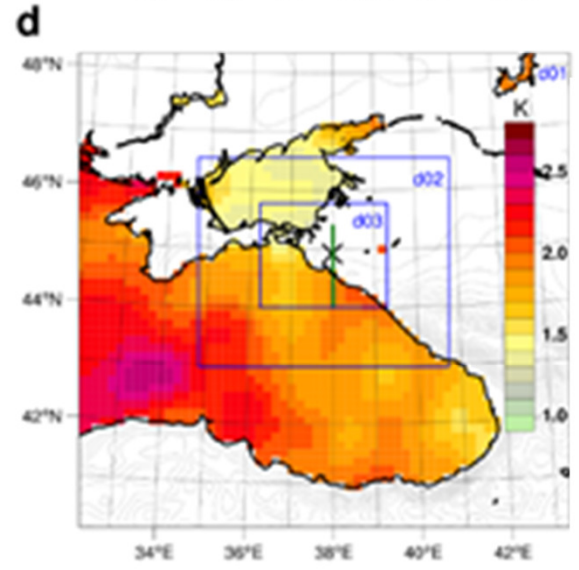
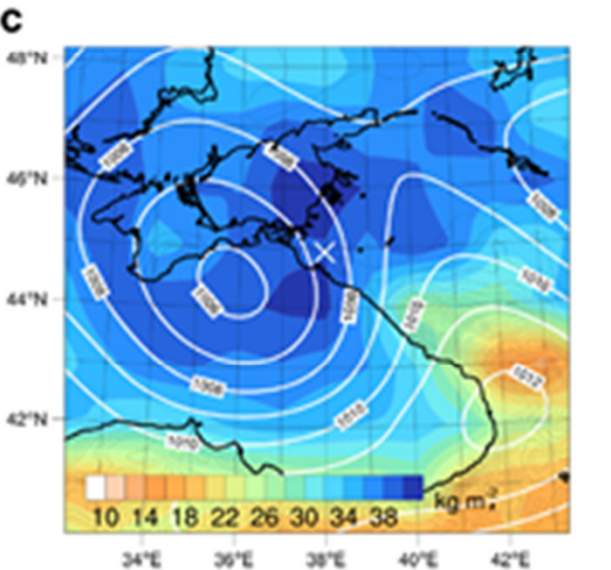
- Turf fires began about in the same areas => **there were 38 years to react !**
- **Lost of life due to smog and hot weather: ~ 50,000**



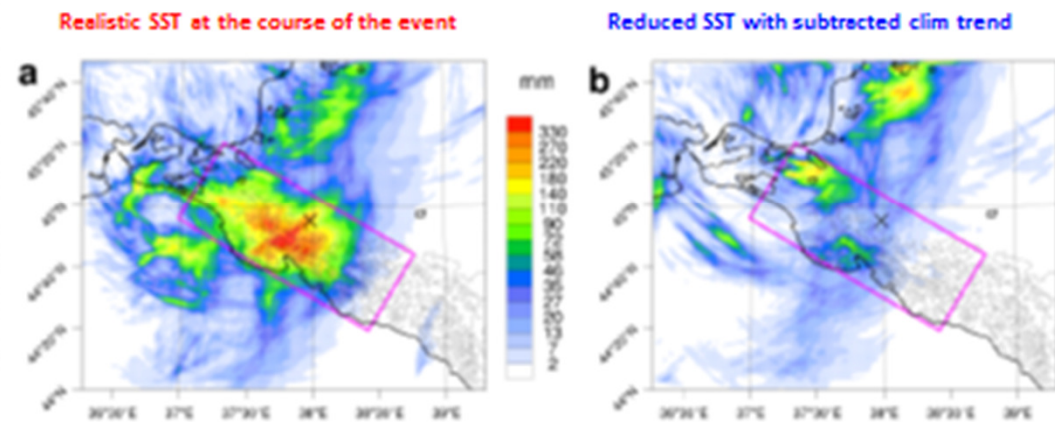
Effects on human life caused by human activity (inactivity):



- No clearing of the Adagum Creek Valley from brush
- Building the road with small culverts
- Allocation of land for house construction on flood plain



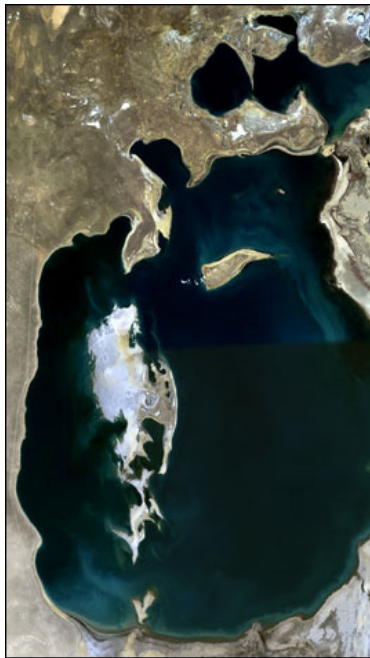
Total simulated precipitation from 6th July at 03Z to 7th July 2012 at 12Z



Krymsk Flood Russia, July 7, 2012 (Meredith et al. 2015). From 158 to 171 victims

Water use that led to ecological disasters

For example, most of the Aral Sea has already disappeared in the past twenty years



July - September, 1989

1989



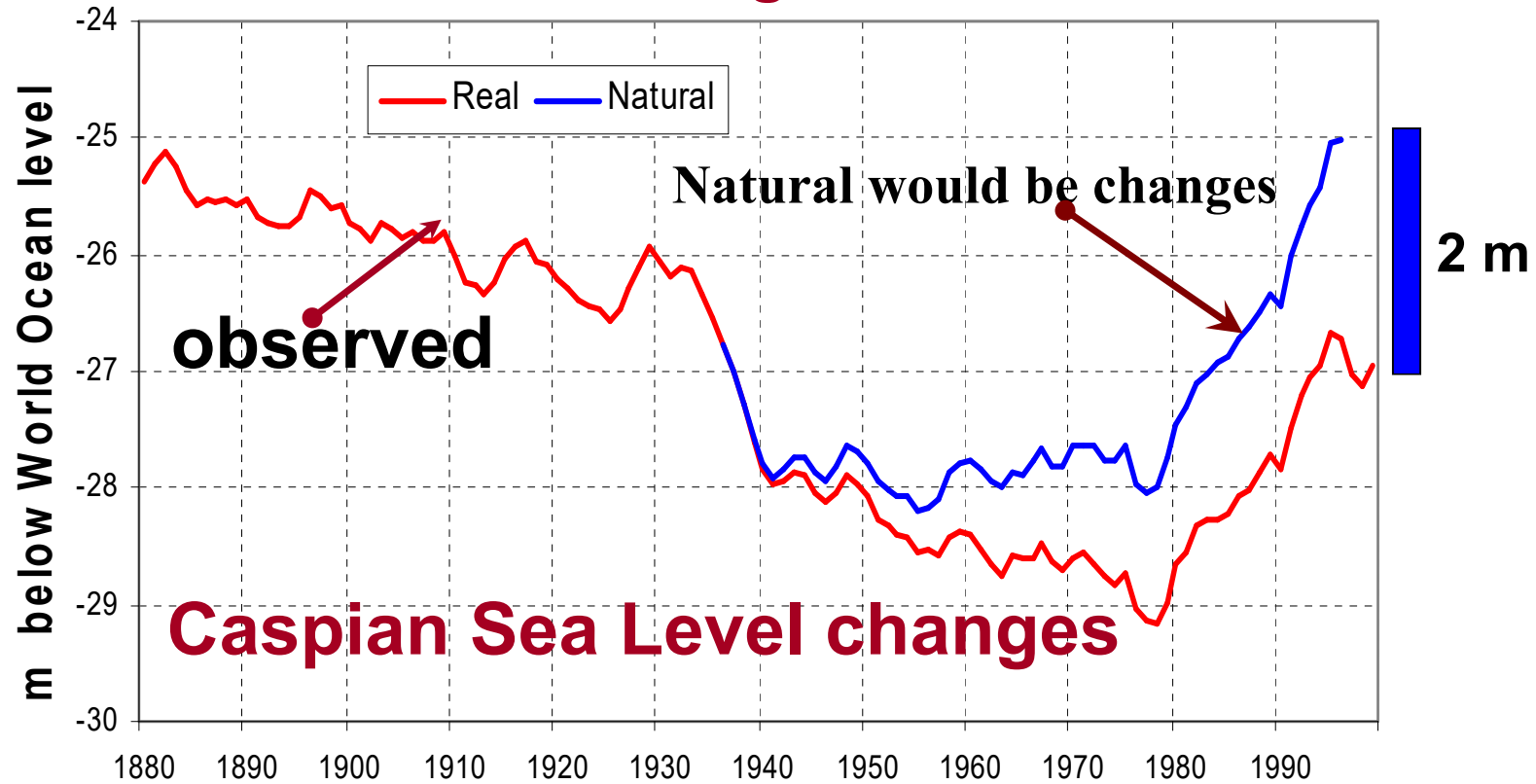
August 12, 2003

2003



Gone in 2016; switched to
“blinking” regime

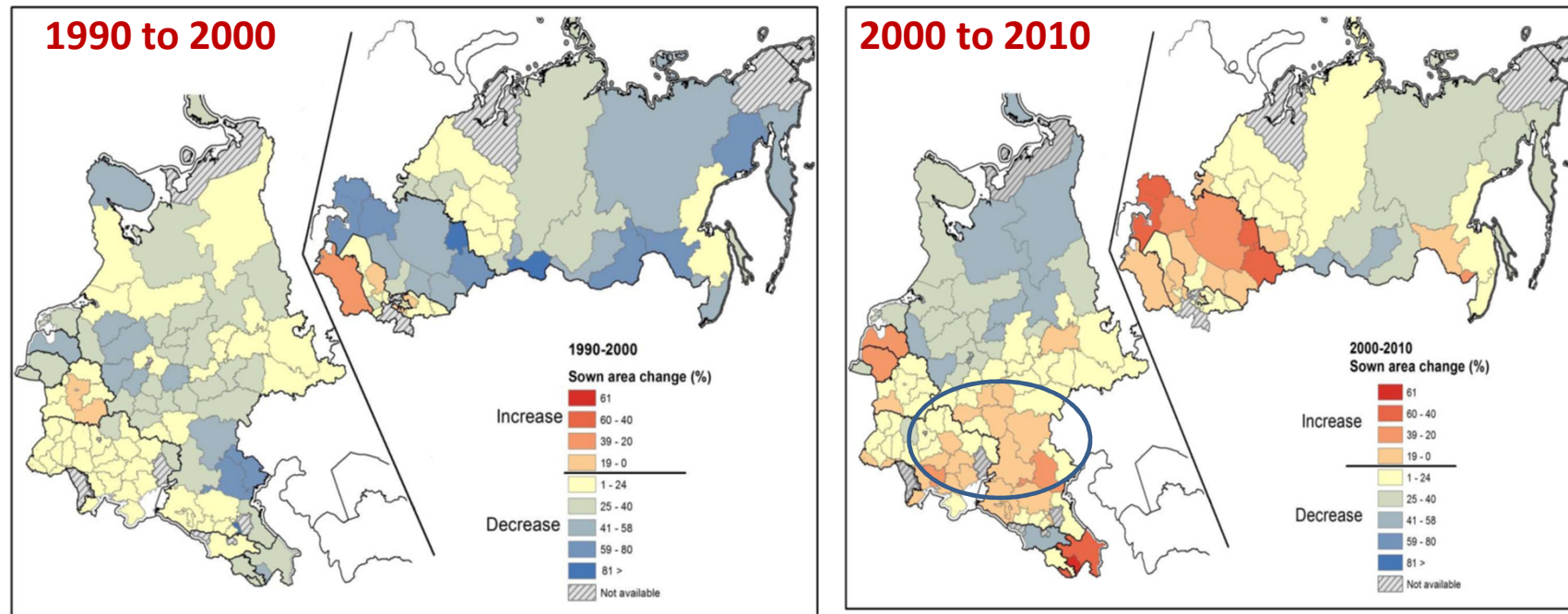
Observed and “natural” changes in the level of the largest in the world lake are significant and of similar magnitudes



Source: Shiklomanov (1976)

Update: Shiklomanov and Georgievsky (2003)

LAND ABANDONMENT DYNAMICS over the former Soviet Union since 1990



Changes (%) in sown areas (left) from 1990 to 2000 and (right) from 2000 to 2010. Areas of abandoned sown areas from 1990 to 2010 are: **40 Mha in Russia; 5.4 Mha in Ukraine; and 13 Mha in Kazakhstan** (Prishchepov *et al.* 2017).

Key words: **governance, integrated research**

- Prevention (building code, land use)
- Risk management (storage, communication)

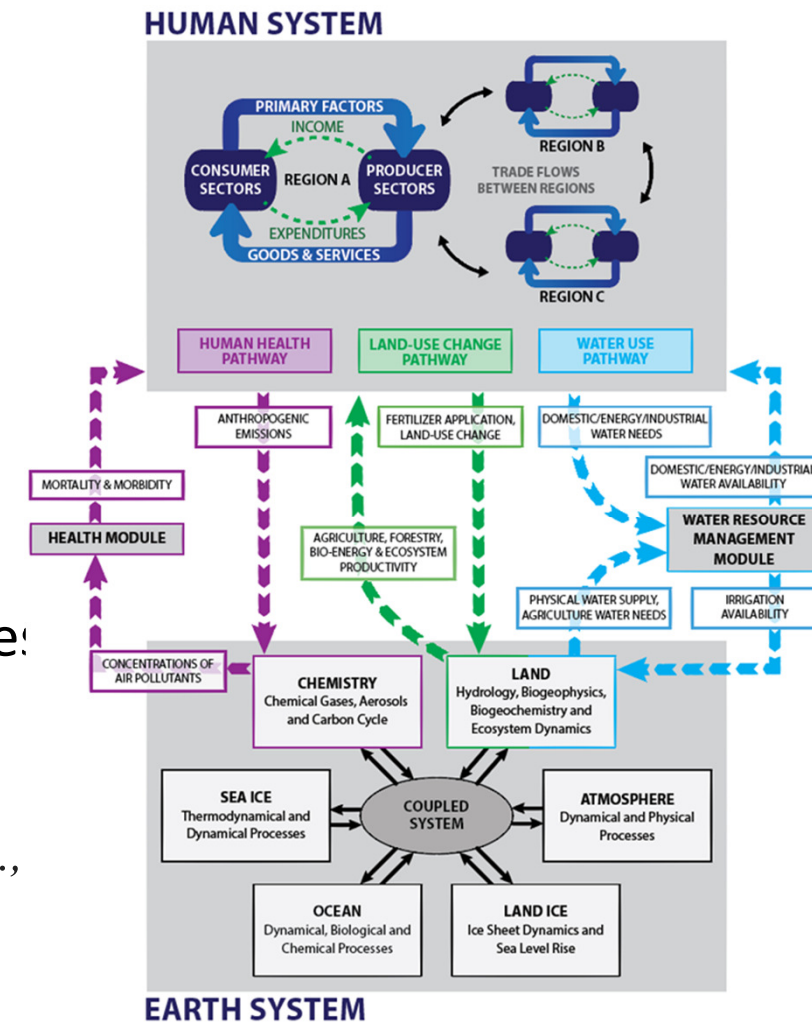
Examples

- Bog and forest fires around Moscow (1972, 2010)
- Earthquake readiness (e.g., Tokyo):
 - San Francisco (1989, 6.9; 130 victims) versus
 - Spitak/Kirovokan (1988, 6.8; 38,000 victims)
- Droughts/floods: irrigation, dams, community service:

Integrated Earth-Human System Models

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

<http://iopscience.iop.org/article/10.1088/1748-9326/aa7aae/meta>





**Let us be close to
our nature and
keep it at any cost!**

Increase in World Population

(projection by *The World Bank and international Food Policy Research Institute*)

	Fertility Rate	Population projections (million)	
Country	2009	2010	2050
United States	2.1	314	399
China	1.6	1,369	1,434
India	2.7	1,189	1,580
Philippines	3.2	91	142
Russia	1.5	140	116
United Kingdom	2.0	66	78
Argentina	2.2	41	51
Nigeria	5.6	149	272
Democratic Republic of Congo	5.9	67	145

Canola Discussion: Made of genetically modified rapeseed, a plant in the mustard family, canola oil has often been thought of as a healthier choice for cooking because it's low in saturated fat and has been shown to reduce cholesterol when compared to diets with higher saturated fat contents.

- **First concerns:**
- <https://uk.news.yahoo.com/alzheimer-apos-symptoms-worsened-canola-210701246.html> According to the National Institutes of Health, patients with the Alzheimer's disease develop the plaques after the toxic beta-amyloid 42 clump together in the brain, inhibiting normal function.
- "Amyloid beta 1-40 neutralizes the actions of amyloid 1-42, which means that a decrease in 1-40, like the one observed in our study, leaves 1-42 unchecked," Dr. Praticò explained in MedicalXpress. In simple terms, the Amyloid beta 1-40 wasn't able to offer its normal protection against amyloid 1-42 because there were fewer of the 1-40 molecules acting as a buffer, which scientists believe could be due to eating canola oil.
- **Resistance:**
- "Independent scientists assure consumers that they can "forget" about misleading reports originating from a Dec. 7 study on canola oil and Alzheimer's disease by Temple University researchers as the data do not support negative claims about the oil. The links between canola oil and weight gain, worsened memory and dementia in humans suggested by this 22-mouse study are unfounded", notes [the nonprofit U.S. Canola Association](#)



The above is one of many concerns related to GMO products