Belmont Forum

E-INFRASTRUCTURES & DATA MANAGEMENT
Collaborative Research Action

ARCTIC climate change and its impact on Environment, infrastructures and Resource Availability
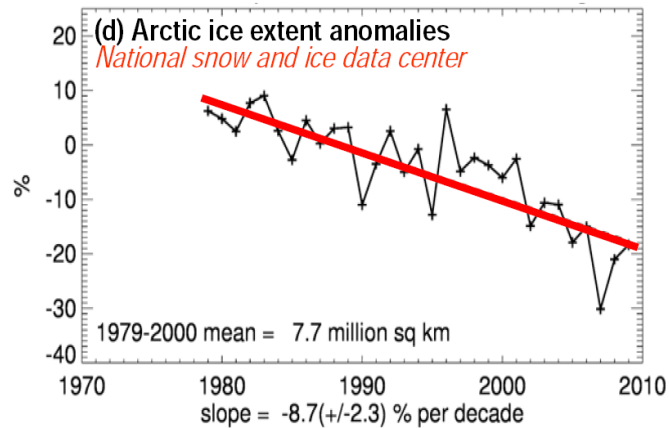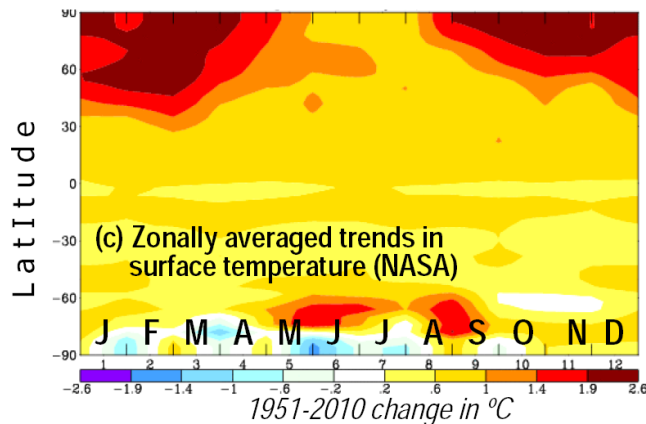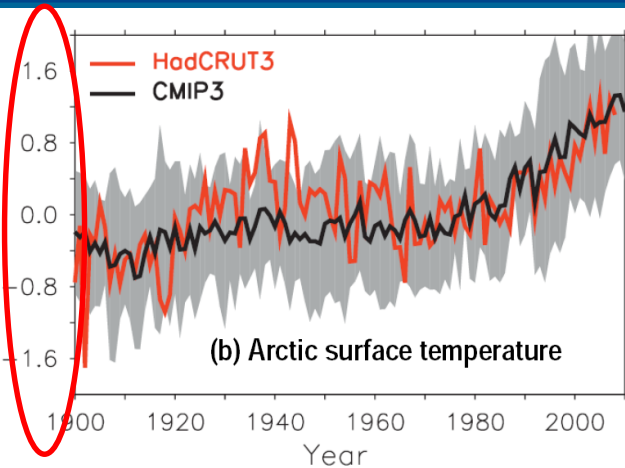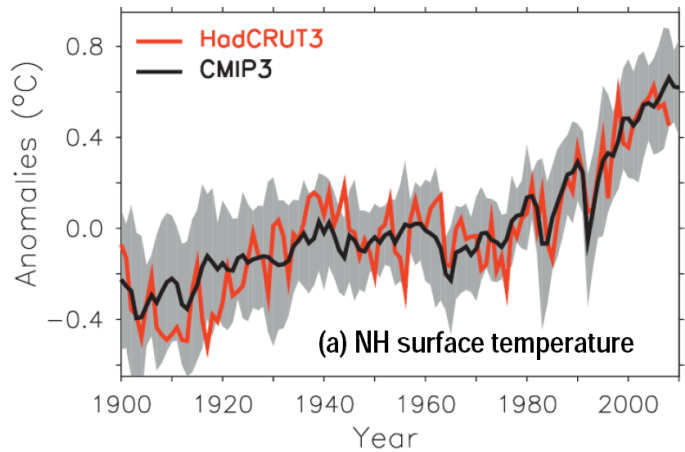**ARCTIC-ERA**
PI, Olga Zolina, LGGE/UGA, Grenoble, France

Scoping Workshop
November 28-29, 2016
ANR, Paris

ARCTIC-ERA focus on the estimation and forecasting of the climate and environmental changes in the Arctic region and their impact on the human wellbeing, industrial activities and infrastructure.

(a) NH surface temperature

(b) Arctic surface temperature

(c) Zonally averaged trends in surface temperature (NASA)

1951-2010 change in °C

(d) Arctic ice extent anomalies
National snow and ice data center

1979-2000 mean = 7.7 million sq km

slope = -8.7(+/-2.3) % per decade

Observed Arctic climate phenomena:

In both observations and models the warming trend in the Arctic is more than 2 times stronger compared to the global pace of temperature change

This amplification is largely due to cold season

Unprecedented loss of the Arctic sea ice (about 25% during the last 30 years)

Research key objectives

➢**Utilization of all available observations and modeling products to quantitatively assess changes in meteorological and environmental variables** that directly affect ongoing and future social and economic development in the coastal areas of the Circumpolar Arctic.

➢**Identification and evaluation of the climatic and environmental changes' impact on the social and economic development of the Arctic coastal areas** including fossil fuels and mineral extraction, maritime and land transportation, industrial fishing, and infrastructure development.

➢**Quantitative assessment of the magnitude and spatial pattern of climate change and its positive and negative implications on economic development in the Circumpolar Arctic**.

➢**Development of a set of recommendations** on mitigation and alleviation of the negative climate-induced effects on the Arctic communities and their adaptation to the impacts above to provide for a sustainable development of indigenous peoples and all Arctic communities and nations.

Project consortium

LGGE (Laboratoire de Glaciologie et Géophysique de l'Environnement), France
project leader, natural science partner, climate dynamics and modelling

IORAS (P.P.Shirshov Institute of Oceanology), Russia
natural science partner, climate and environmental changes

GWU (The George Washington University), USA
environmental and socio-economy science partner

IEFRAS (Institute of Economic Forecasting), Russia
economy and social science partner

HS&S (Hydrology Science and Servises), USA
industrial and consultancy end user

E-INFRASTRUCTURES & DATA MANAGEMENT

Data - I: Climatology/oceanography/meteorology

> **In-situ observations: (precipitation, temperature, radiation)**
> **Satellite measurements**
> **Global and regional reanalyses**
> **Grenoble ocean model (NEMO/ORCA output)**

Data - II: Permafrost data / snow cover data

> **Instrumental measurements in few locations**
> **Model data of the depth of freezing and snow characteristics**

Data - III: Climate projections

> **IPCC CMIP-5 and CMIP-6 global model data output**
> **Output from IPCC Regional climate models**
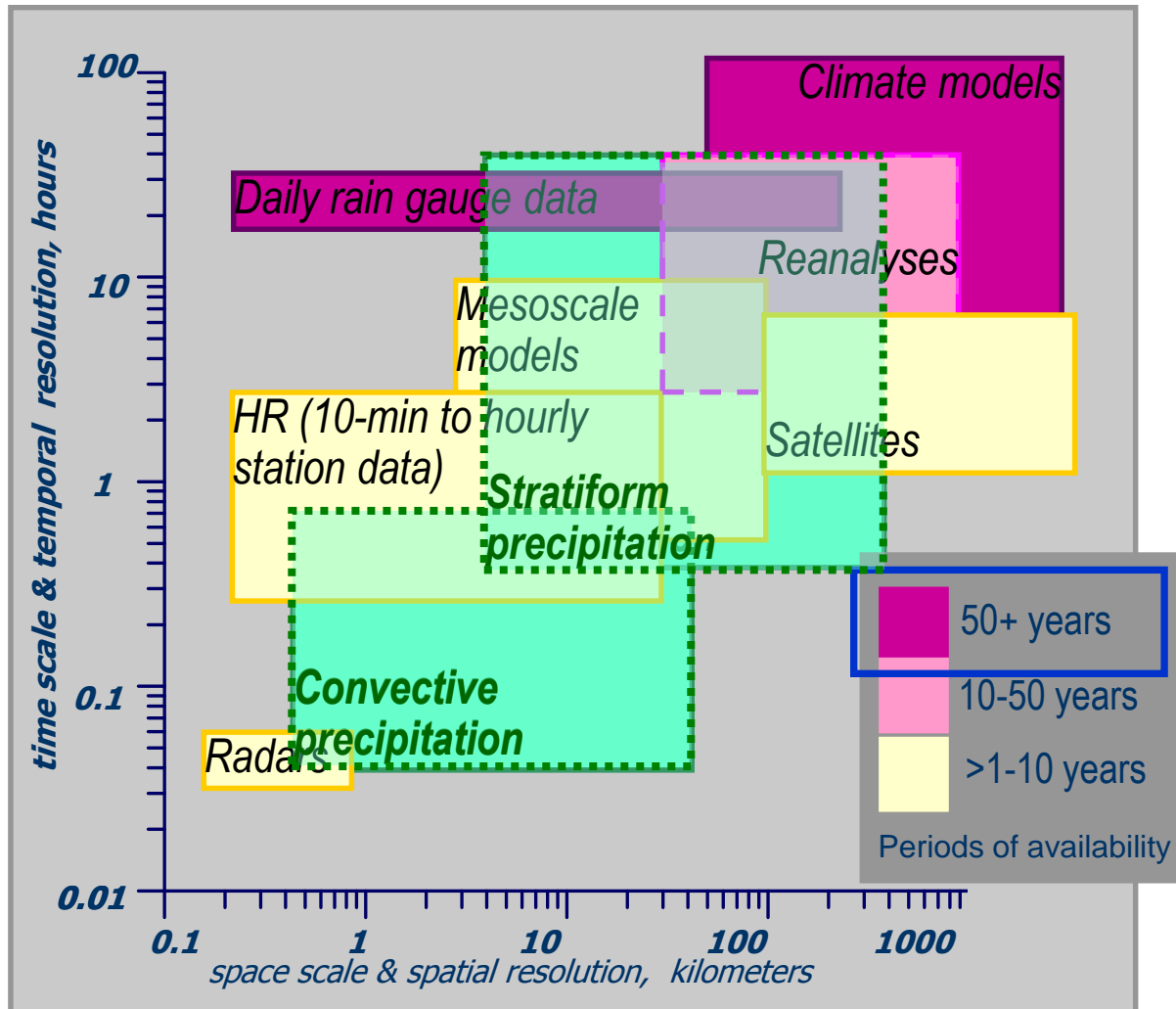
Data - IV: Socio-economic data

> **National agency reports**
> **NSR (North Sea Route) traffic data**

Data - I: Climatology/oceanography/meteorology

Space time scales and data availability

Requirements:

10-min to hourly resolution in time

<1-km (complex terrain) to 3-5-km (over plains) space resolution

Global coverage over several decades

Never happens

Available:

20+ years of global daily data

10 to 1000 km spatial resolution

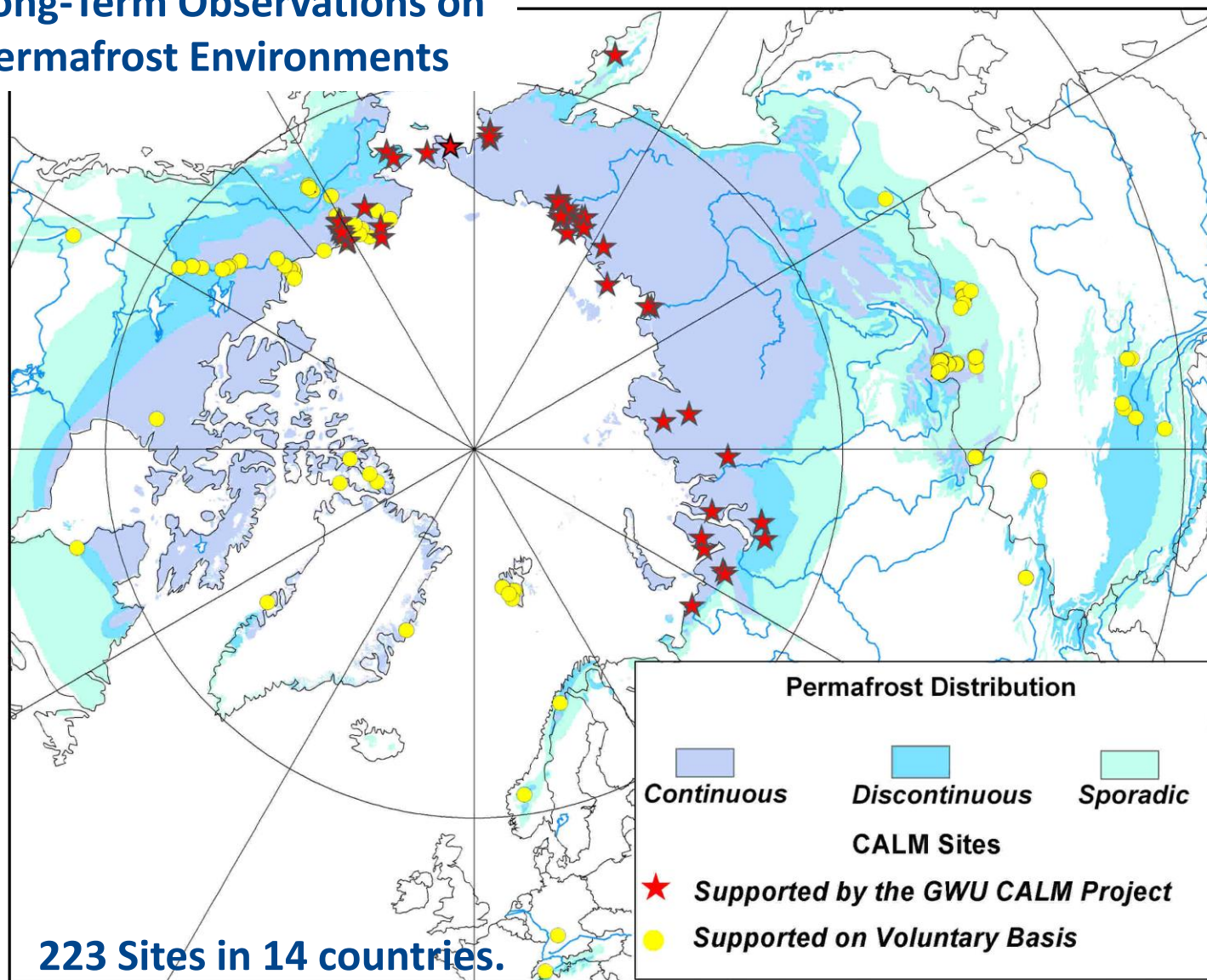Mixture of collections, lack of metadata
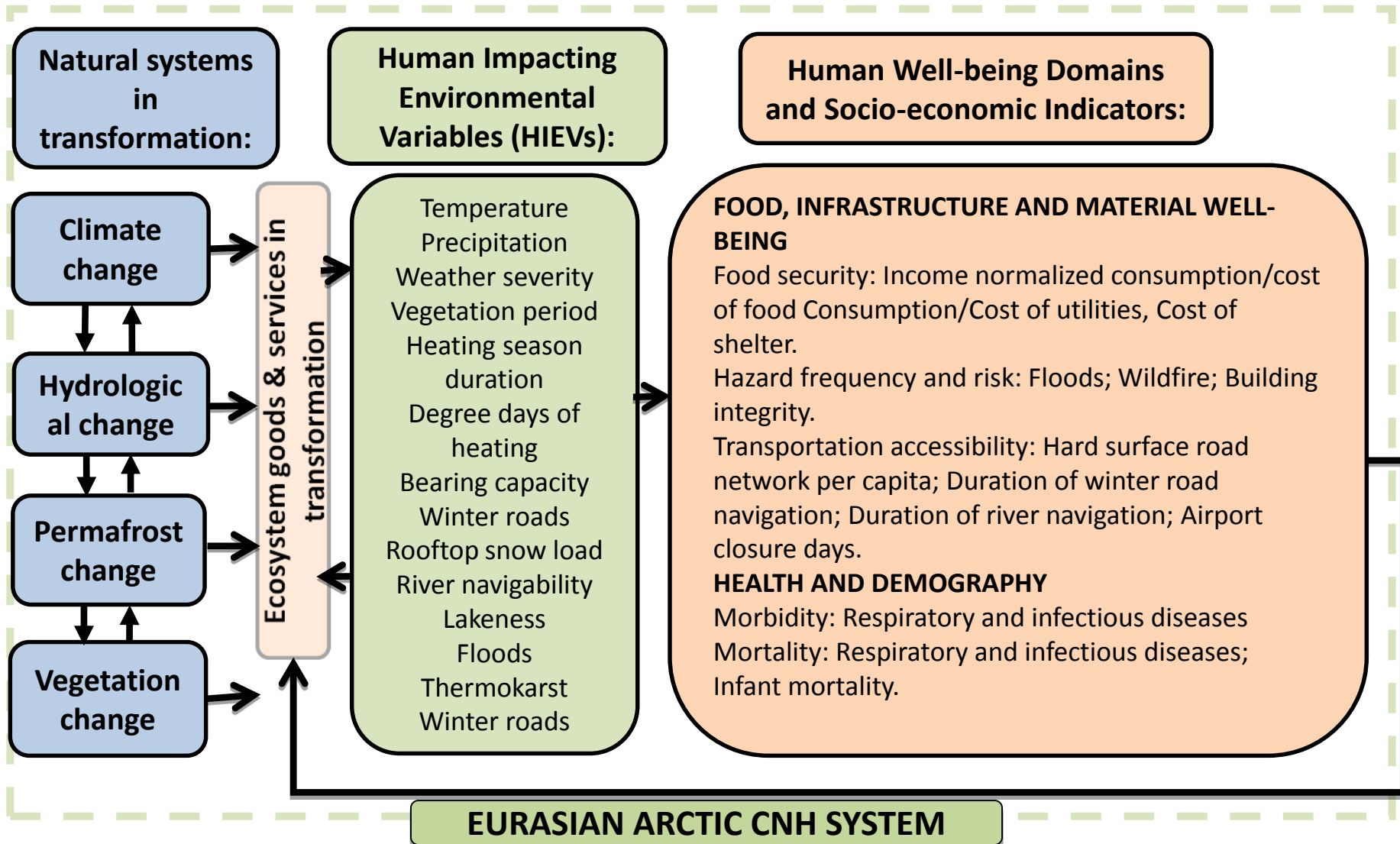
Most data are not

freely available

Data - II: Permafrost data / snow cover data

Long-Term Observations on Permafrost Environments

223 Sites in 14 countries.

Framework for connecting ecosystem change and human well-being

Natural systems in transformation:
- Climate change
- Hydrological change
- Permafrost change
- Vegetation change

Ecosystem goods & services in transformation

Human Impacting Environmental Variables (HIEVs):
- Temperature
- Precipitation
- Weather severity
- Vegetation period
- Heating season duration
- Degree days of heating
- Bearing capacity
- Winter roads
- Rooftop snow load
- River navigability
- Lakeness
- Floods
- Thermokarst
- Winter roads

Human Well-being Domains and Socio-economic Indicators:

FOOD, INFRASTRUCTURE AND MATERIAL WELL-BEING
Food security: Income normalized consumption/cost of food Consumption/Cost of utilities, Cost of shelter.
Hazard frequency and risk: Floods; Wildfire; Building integrity.
Transportation accessibility: Hard surface road network per capita; Duration of winter road navigation; Duration of river navigation; Airport closure days.

HEALTH AND DEMOGRAPHY
Morbidity: Respiratory and infectious diseases
Mortality: Respiratory and infectious diseases; Infant mortality.

EURASIAN ARCTIC CNH SYSTEM

Data - IV: Socio-economic data

Winter Roads: Change in Length of Operation

Change Between 1965-1975 & 1995-2005

- decrease of 10 days or more
- decrease of 5 to 10 days
- decrease of 0 to 5 days
- increase of 0 to 5 days
- increase of 5 to 10 days
- increase of 10 days or more
- Large Cities
- roads
- rivers
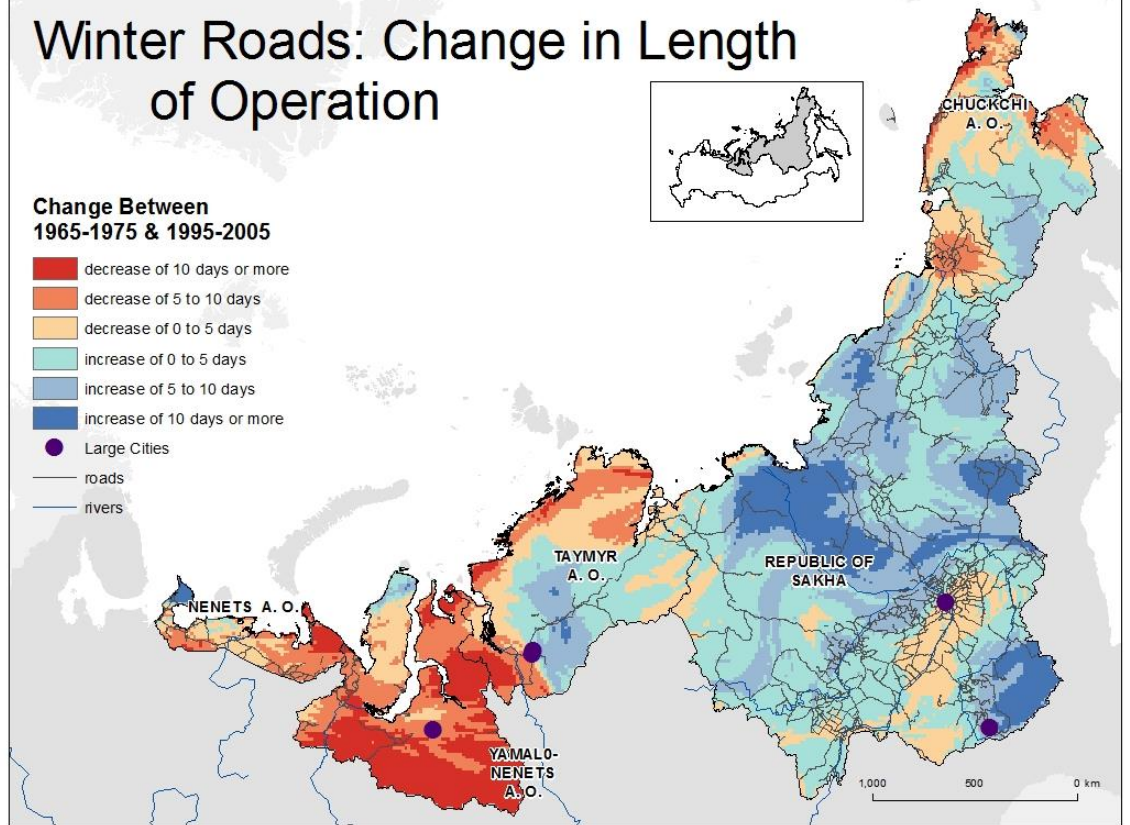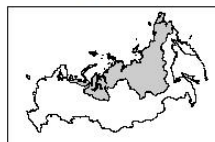
TRANSPORTATION: Change in length of winter road operational season. Days include time from when winter road construction begins in the fall and are operational until the spring when temperatures reach 0°C.

Percent Change	Chuckchi AO	Nenets AO	Taymyr AO	Yakutia	Yamalo-Nenets AO	Study Area	Percent Change	Chuckchi AO	Nenets AO	Taymyr AO	Yakutia	Yamalo-Nenets AO	Study Area
< -4%	4	2	0	0	4	10	< -4%	15,900	20,200	0	0	228,500	264,600
-2 - -4%	6	1	3	4	9	23	-2 - -4%	23,600	7,000	189,800	36,100	158,100	414,600
0 - -2%	1	0	2	11	0	14	0 - -2%	400	0	62,600	245,400	0	308,400
no change	1	0	0	1	0	2	no change	400	0	0	7,700	0	8,100
0 - 2%	1	0	0	30	0	31	0 - 2%	3,200	0	0	279,100	0	282,300
2 - 4%	1	0	0	18	0	19	2 - 4%	2,600	0	0	43,500	0	46,100
> 4%	0	0	0	3	0	3	> 4%	0	0	0	11,400	0	11,400
TOTAL	14	3	5	67	13	102	TOTAL	46,100	27,200	252,400	623,200	386,600	1,335,500

EXPECTATIONS FROM E-I&DM CALL

More pressure on the national metoffices for making in-situ meteorological and hydrological station data open for public

Consolidation of the metadata with the data files for all types of meteorological observations (issue for the national data centers and national metoffices)

A special action needed to provide digitizing of the national and municipal reports containing relevant economic and social information

A quicker access to the traffic data for the NSR (and other high latitude passes/routes) from fleet operations agencies