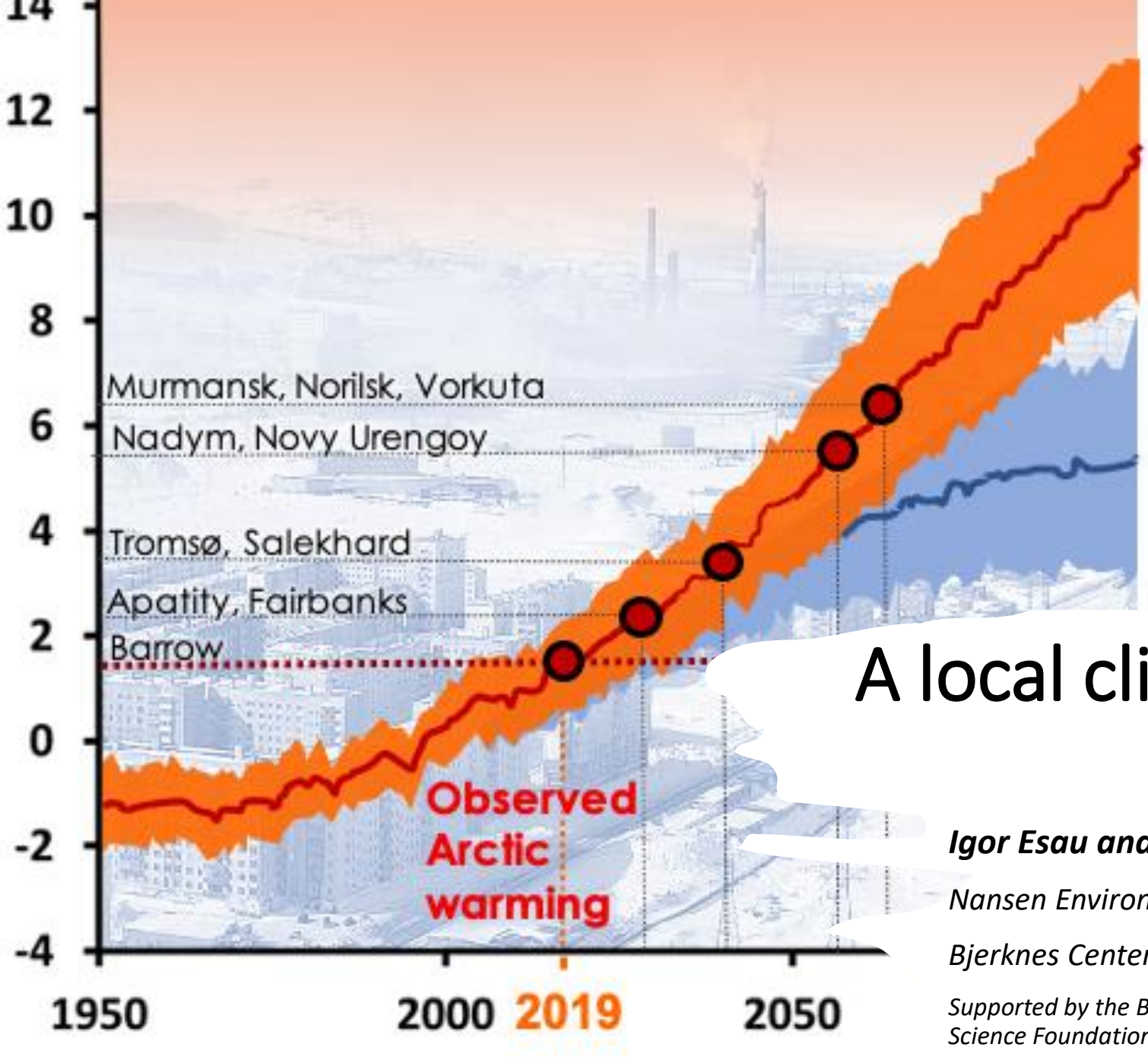

A local climate perspective from Arctic towns

Igor Esau and the SERUS project team

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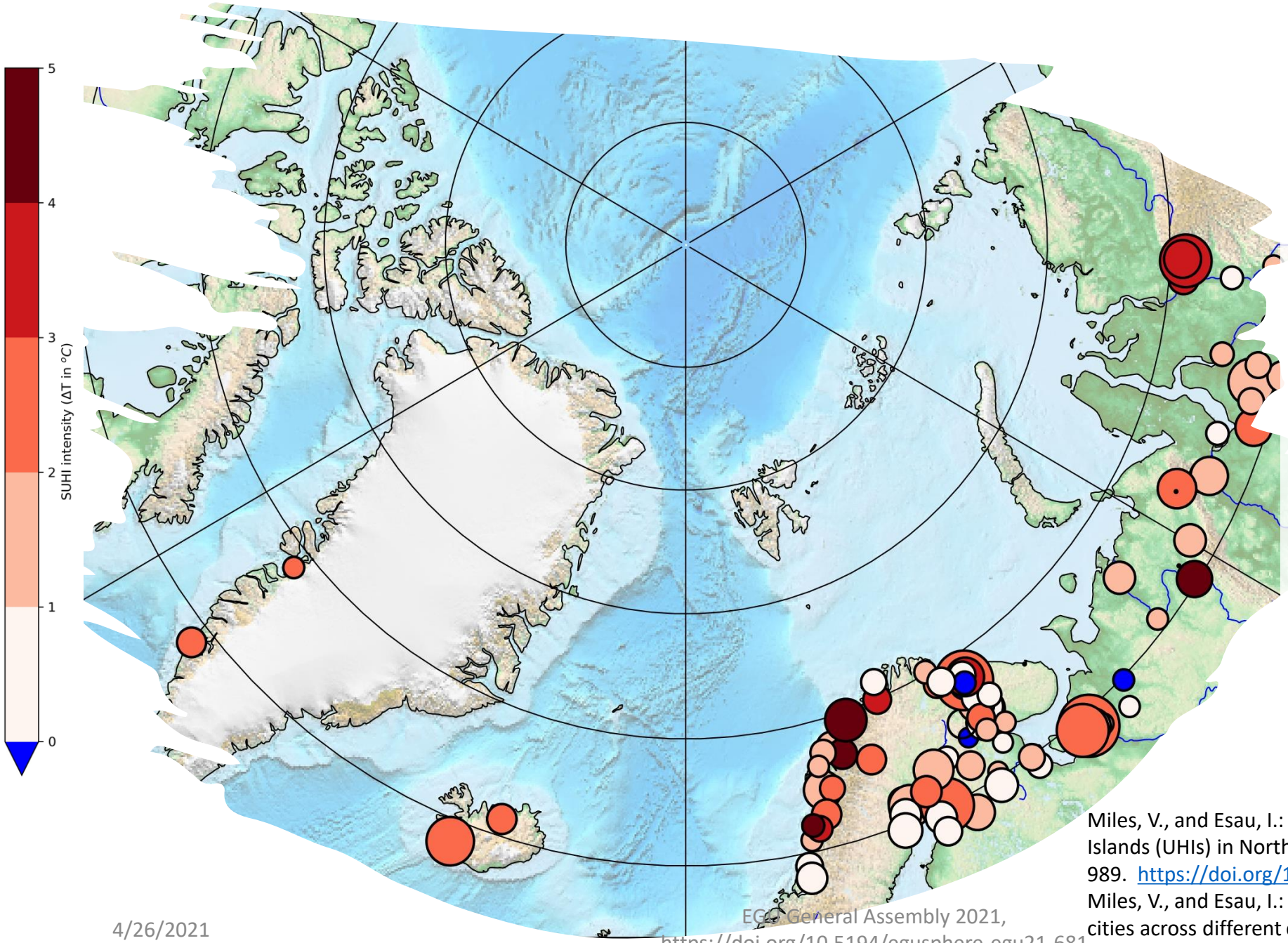
© Mikhail Varentsov (SERUS team member)

Abstract.

Across the Arctic, human settlements are challenged by rapid climate change and a broad range of environmental transformations. Some of them, such as Barrow (Utqiagvik, Alaska), must relocate; others, such as Norilsk (Russia), must restructure and rebuild. This presentation reports on local climate anomalies in 118 circum-Arctic cities and towns. For several key towns, a nexus review of the environmental consequences of the local warm anomalies is detailed. Longyearbyen (Svalbard), Apatity and Nadym (Russia) are in focus. For instance, Longyearbyen – the European “gate” to the Arctic – experiences one of the strongest climate change. The surface air temperature here has increased by almost 10°C over the last 100 years with more than 100 consecutive months being warmer than normal. Snowfall increases threatening with hazardous slab snow avalanches. The last extreme heat wave (July 2020) showed temperatures up to +21°C and massive flooding in the coal mine. This study synthesizes observational evidence of the climate change in the town from a local perspective. We relate meteorological conditions with sustainability issues. The study looks at local climate diversity and its role for society and economy of the settlement.



Results. The Surface Urban Heat Island (SUHI) is found in 118 Arctic towns (north of 63N) with more than 3000 inhabitants. The annual mean SUHI intensity varies in the range of 1-3 K for majority of towns. Extreme SUHIs exceed 4 K.

Data and Methods. Analysis of the MODIS (coll. 6) 1 km land surface temperature (LST) data product MOD11A2 over 2000-2018. SUHI is determined by the buffer method (Miles and Esau, 2017; 2020)

Free dataset. Miles, V.: Arctic surface Urban Heat Island (UHI), MODIS Land Surface Temperature (LST) data, 2000-2016. Arctic Data Center.https://doi.org/10.18739/A2TB0XW4T, 2020.

Miles, V., and Esau, I.: Seasonal and Spatial Characteristics of Urban Heat Islands (UHIs) in Northern West Siberian Cities, Remote Sensing. 9(10), 989. https://doi.org/10.3390/rs9100989, 2017.

Miles, V., and Esau, I.: Urban Climate Surface urban heat islands in 57 cities across different climates in northern Fennoscandia. Urban Climate, *31*, 100575. https://doi.org/10.1016/j.uclim.2019.100575, 2020.

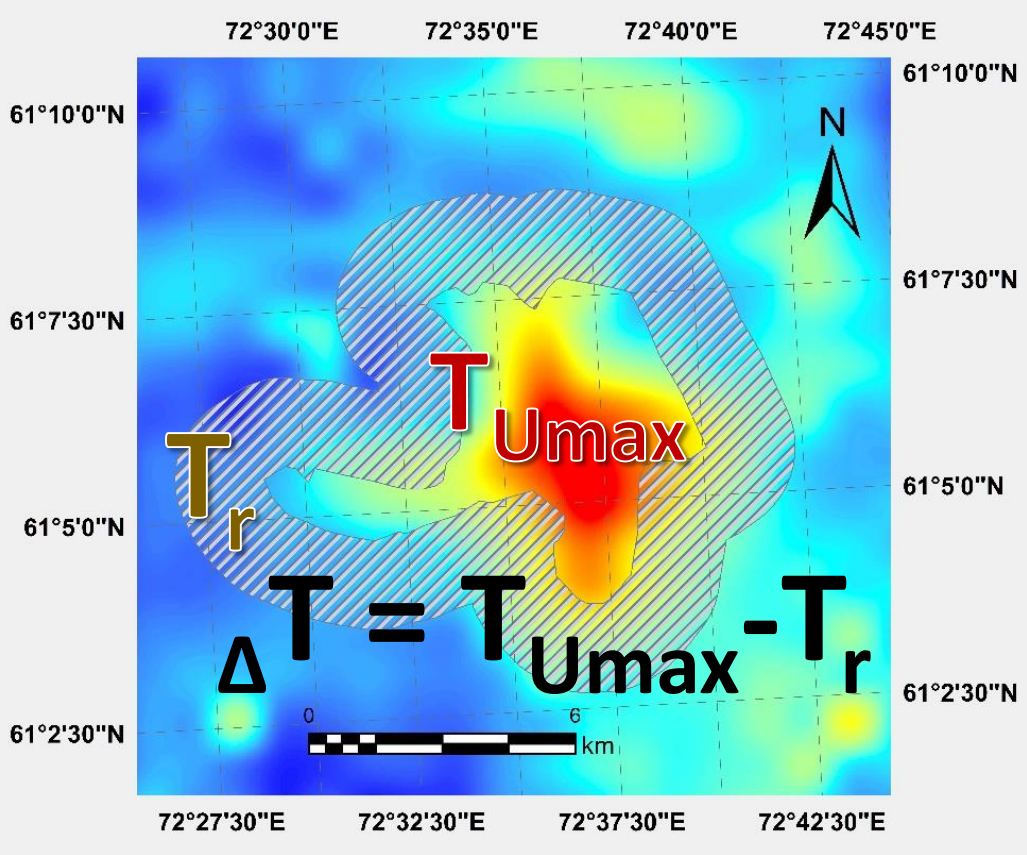
Data and method:

MODIS LST

- 1000 m spatial resolution,
- 8-day composites

T_{Umax} – ***maximum*** urban pixel temperature

T_r – ***mean*** rural buffer temperature

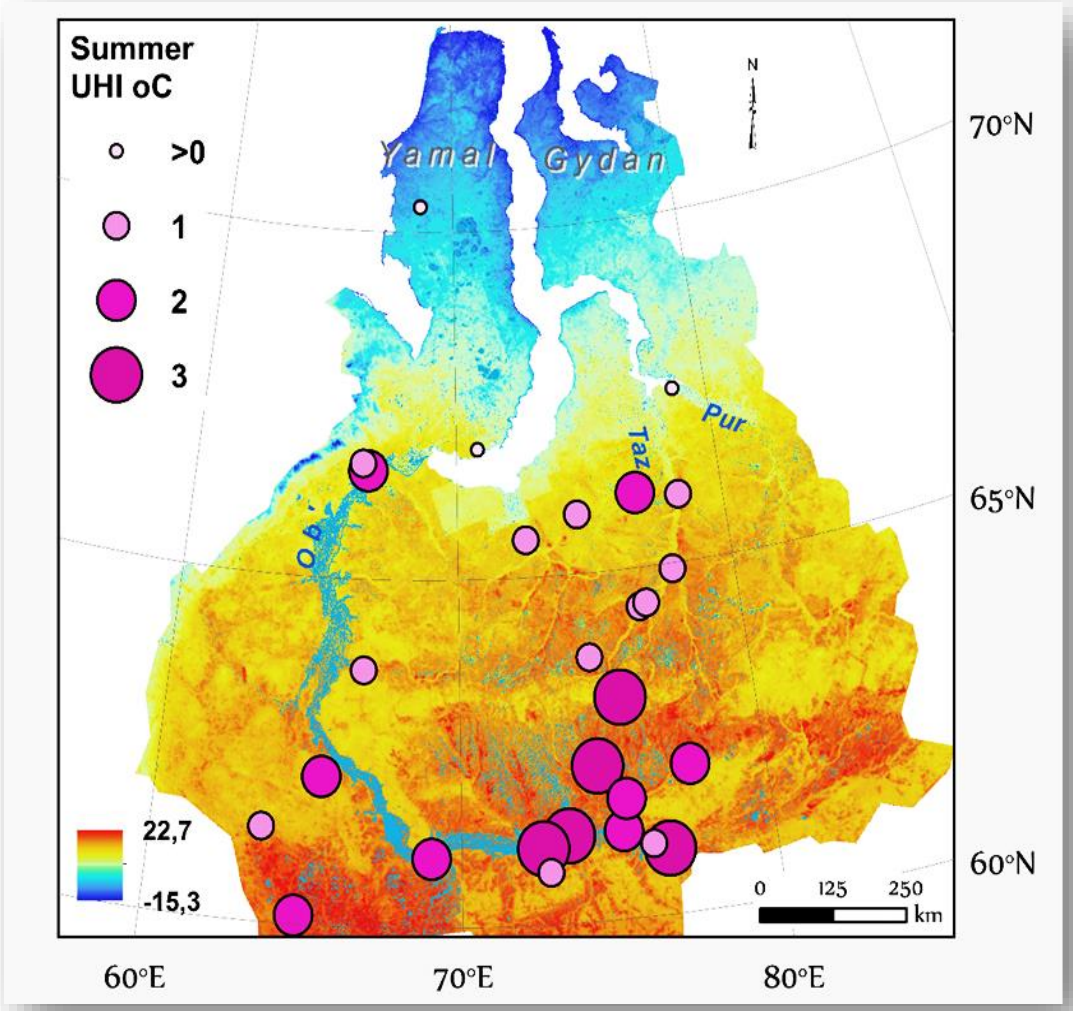


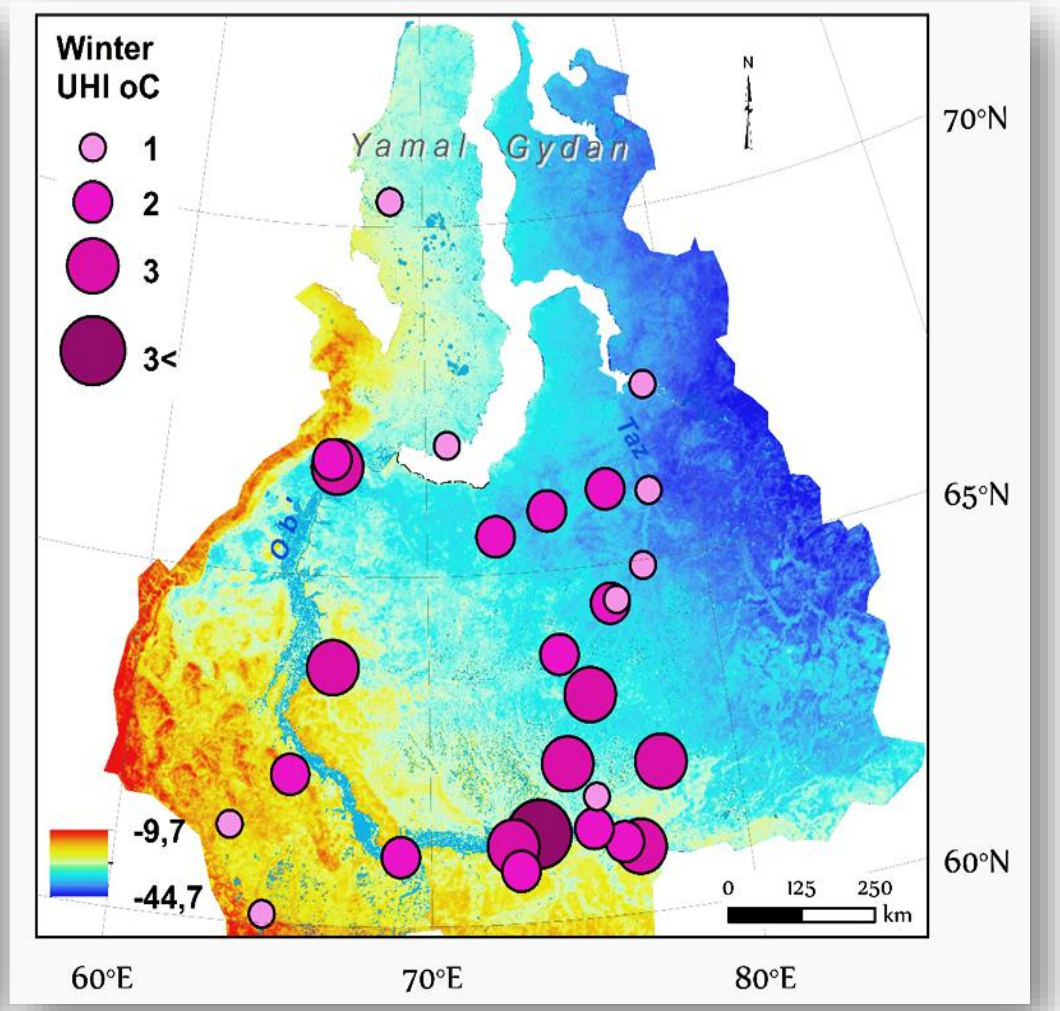
Urban polygon and 2 km boundary buffer

EGU General Assembly 2021,
https://doi.org/10.5194/egusphere-egu21-681

Urban Heat Island in 28 Siberian Cities

Miles V. and I. Esau, 2017, *Remote Sensing*, **9**(10), 989, doi:10.3390/rs9100989





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Urban Heat Island in 57 Fennoscandian Cities

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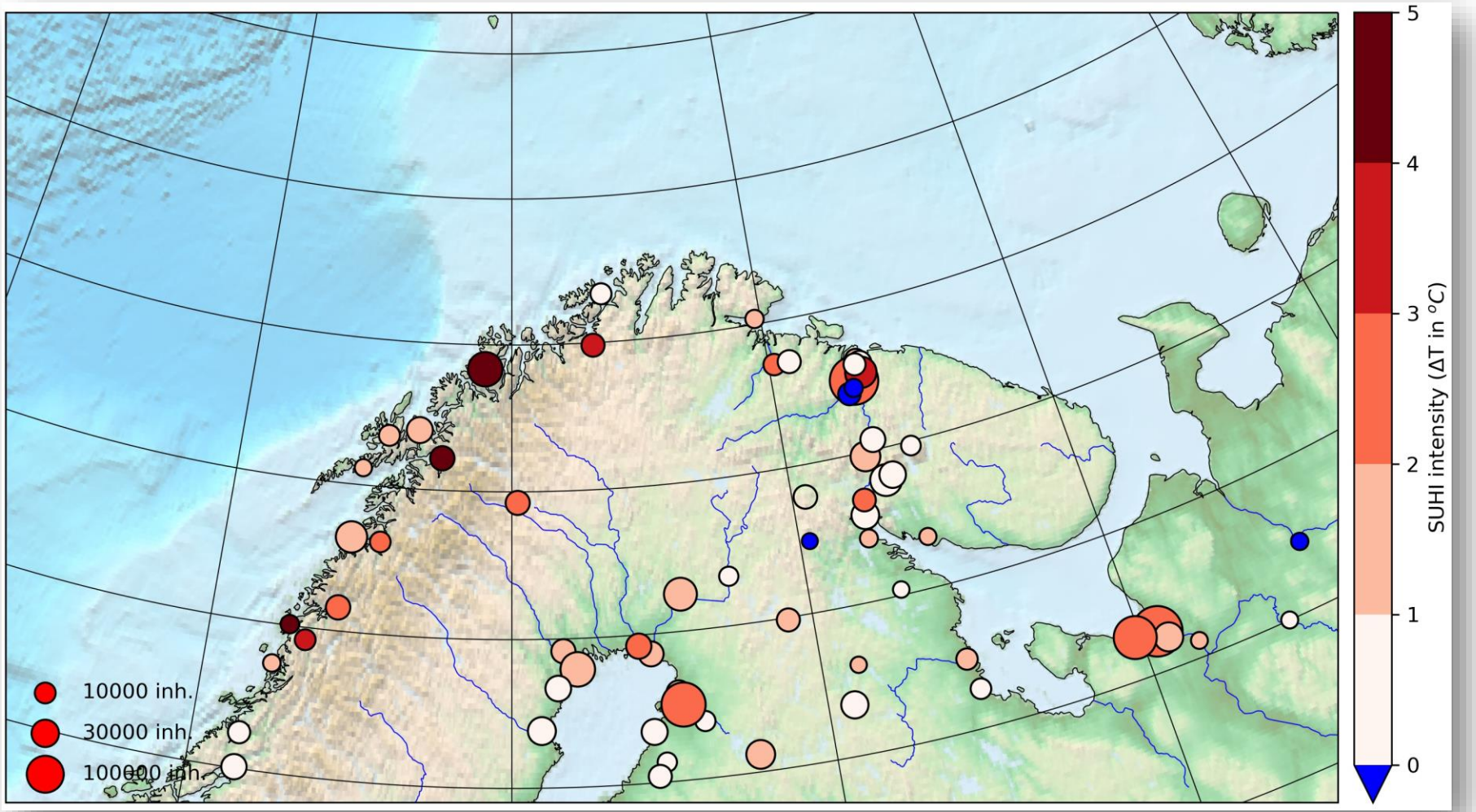
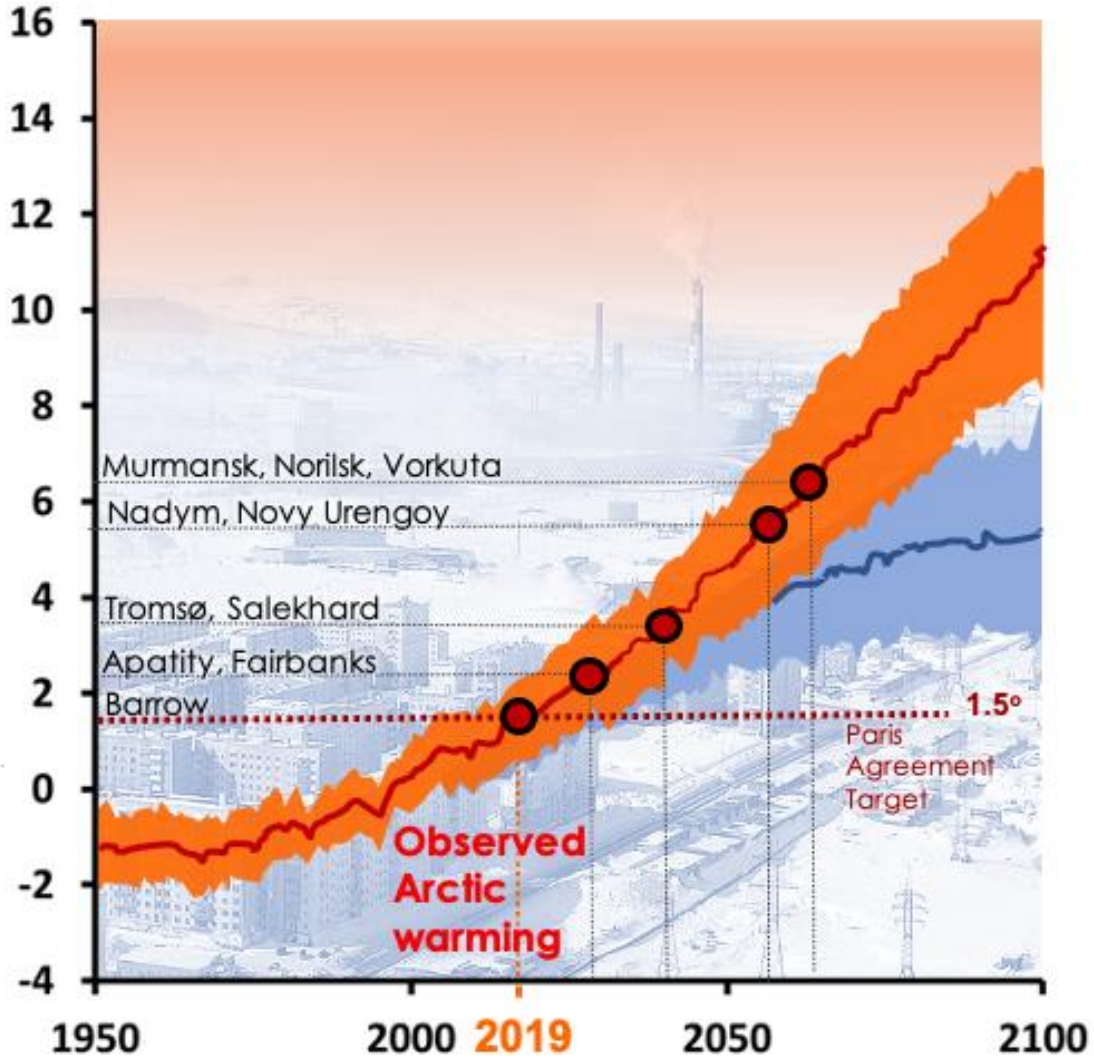


Urban climate temperature anomalies projected on the Arctic regional climate warming



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https://doi.org/10.5194/egusphere-egu21-681

SERUS

FAIRBANKS

Natural Resilience	UHI, permafrost, ecosystems
Social Resilience	LIK, migration, education
Knowledge Asset	Social data, Remote Sensing
Infrastructure	Air quality, AHF

City population (thousands)

Infrastructure, scenario, new materials

NADYM

UHI, permafrost, ecosystems	Natural Resilience
LIK, migration, education	Social Resilience
Land values, Observations	Knowledge Asset
AHF, new materials	Infrastructure

Field Work

Interview and work with stakeholders

GWU (USA) | **NERSC (NORWAY)** | **UTMN (RUSSIA)**

FAIRBANKS

LONGYEARBYEN

NADYM

APATITY

Bering Sea
Chukchi Sea
East Siberian Sea
Beaufort Sea
Laptev Sea
Kara Sea
Baffin Bay
Barents Sea
Labrador Sea
Greenland Sea
Norwegian Sea
Arctic Circle

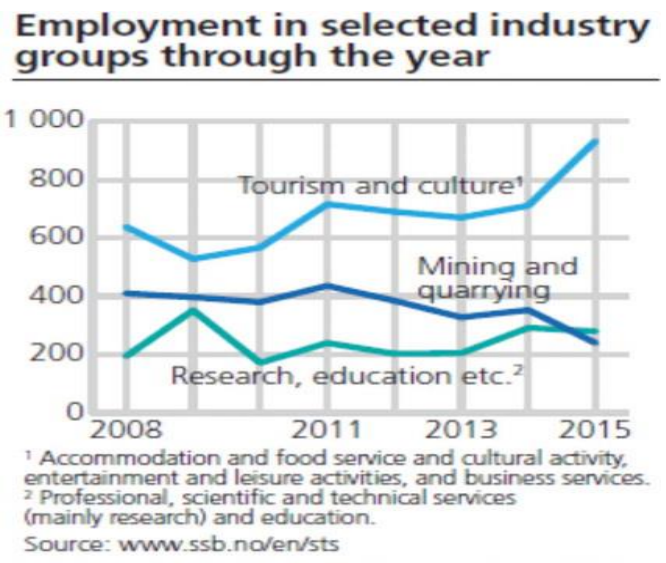
LONGYEARBYEN

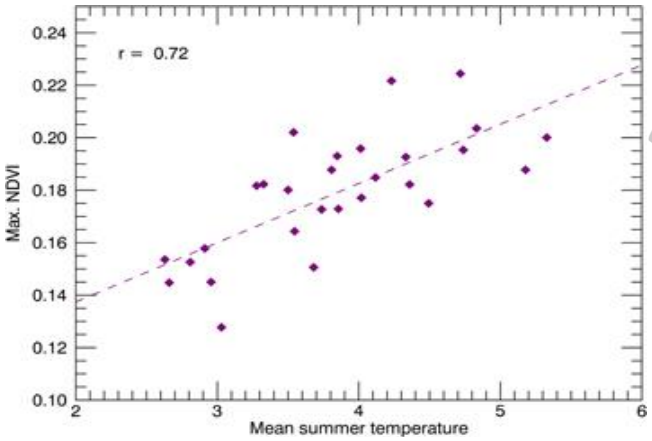
Natural Resilience	UHI, snow cover
Social Resilience	Migration, education, tourism
Knowledge Asset	Air quality, Climate change
Infrastructure	Air quality, power generation

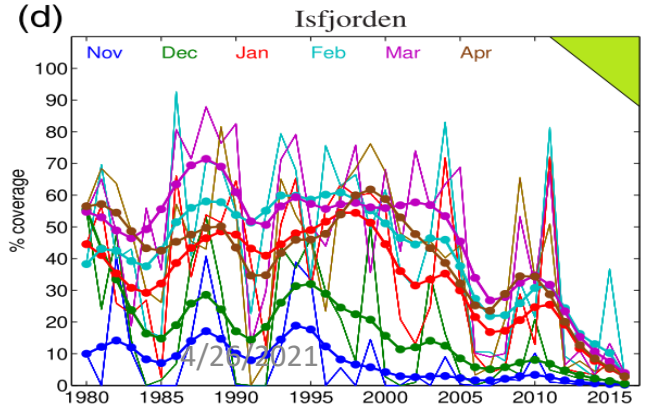
APATITY

UHI, ecosystems	Natural Resilience
Migration, education	Social Resilience
Air quality, AHF, Observation	Knowledge Asset
Air quality, dust, AHF	Infrastructure

EGU General Assembly 2021,
https://doi.org/10.5194/egusphere-egu21-4681







Industrial Development Pathway

(Trans-Arctic shipping, fisheries, mineral resources)

Public Services Pathway

(Administration, Research infrastructure)

Longyearbyen

Tourism and Conservation Pathway

(Cruises, nature-based solutions, cultural heritage)

Longyearbyen Industrial Area

Longyearbyen Science Park

Longyearbyen Cruise

EGU General Assembly 2021,
https://doi.org/10.5194/egusphere-egu21-681