Suggestion for IEAS research priority: Climate Smart and Sustainable Cities

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WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

WMO OMM
World Meteorological Organization
Organisation météorologique mondiale

ATMOSPHERE AND CLIMATE COMPETENCE CENTER

IEAS EUROPEAN CENTRE

Pan-Eurasian Experiment PEEX

International Eurasian Academy of Sciences (IEAS) meeting
ACCC Impact Week 7-10th December 2021 in Helsinki, Finland

United 4 Smart Sustainable Cities (U4SSC)

U4SSC is a United Nations Initiative coordinated by ITU and UNECE and supported by other 14 UN agencies to respond to the **Sustainable Development Goal 11: "Make cities and human settlements inclusive, safe, resilient and sustainable.**

It advocates for public policy to encourage the use of ICTs to facilitate and ease the transition to smart sustainable cities.

Supported by:

Convention on Biological Diversity

United Nations ECLAC

FAO

ITU

United Nations Economic Commission for Africa

UNDP Empowered lives. Resilient nations.

UNECE

UNESCO Montevideo Office

UN environment United Nations Environment Programme

UNEP FINANCE INITIATIVE

United Nations Framework Convention on Climate Change

UN HABITAT FOR A BETTER URBAN FUTURE

UNIDO

UNITED NATIONS UNIVERSITY UNU-EGOV Operating Unit on Policy-Driven Electronic Governance

UN WOMEN

World Meteorological Organisation

WMO for the UN New Urban Agenda

WEATHER CLIMATE WATER

WORLD METEOROLOGICAL ORGANIZATION

TOGETHER TOWARDS H III HABITAT III

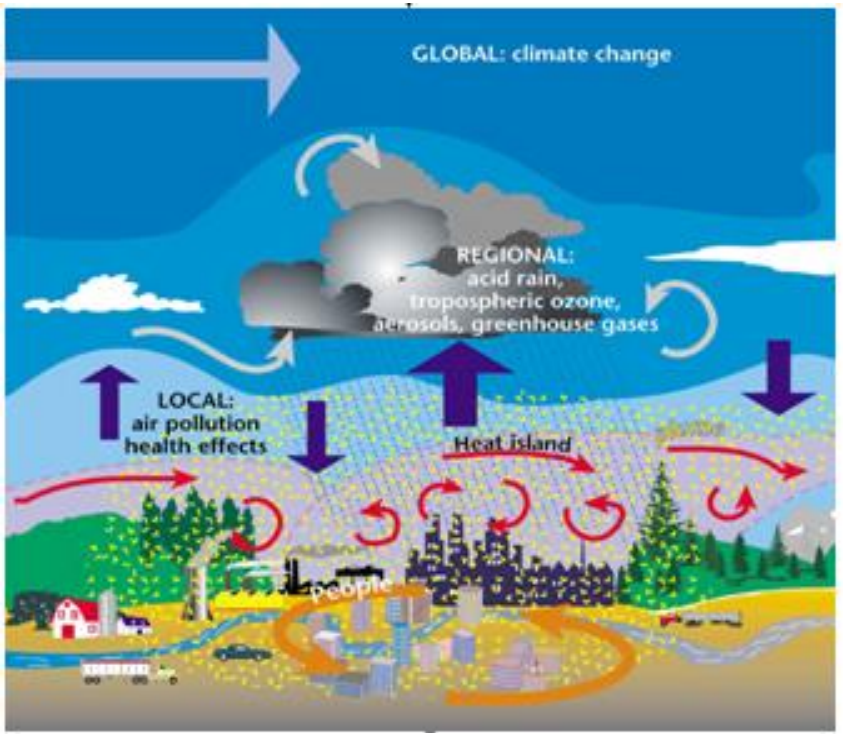
- 17th World Meteorological Congress (2015) Resolution 68: Establishing WMO Cross-cutting Urban Focus
- 18th World Meteorological Congress (2019) Resolution 32: Advancing Integrated Urban Services

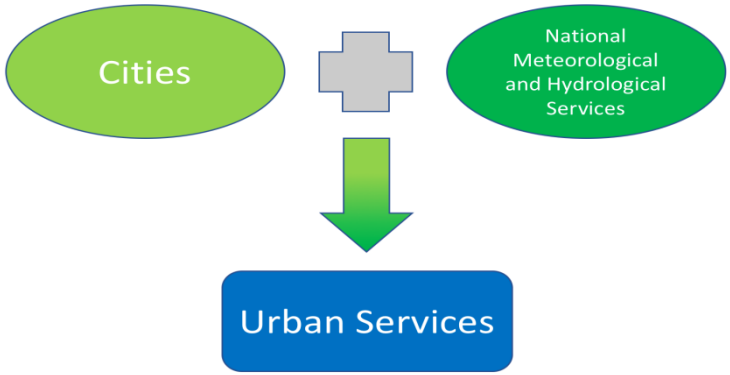
Welcome to contribute!

Goal: Science-based Integrated Urban Weather, Water, Environment and Climate Services (IUS) for sustainable cities

Statement of the Problem

- 90% of disasters for urban areas are of hydro-meteorological nature
  - increased with climate change
- 70% of GHG emissions generated by cities
- Strong feedback
  - Two phases should not be considered separately
- Critical need to consider the problem in a complex manner with interactions of climate change and multi-hazard disaster risk reduction for urban areas
- Mitigations, adaptation, early warning





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Hazards and Risks in the Urban Environment

- Poor air quality and peak pollution episodes
- Extreme cold/heat waves, human thermal stress
- High impact weather: hurricanes, extreme local winds
- Wild forest fires and smog pollutions
- Urban floods
- Permafrost melting due to climate change
- Energy and water sustainability
- Public health problems caused by the previous
- Climate change: urban emissions of GHG
- **Domino effect:** a single extreme event can lead to new hazards and a broad breakdown of a city's infrastructure

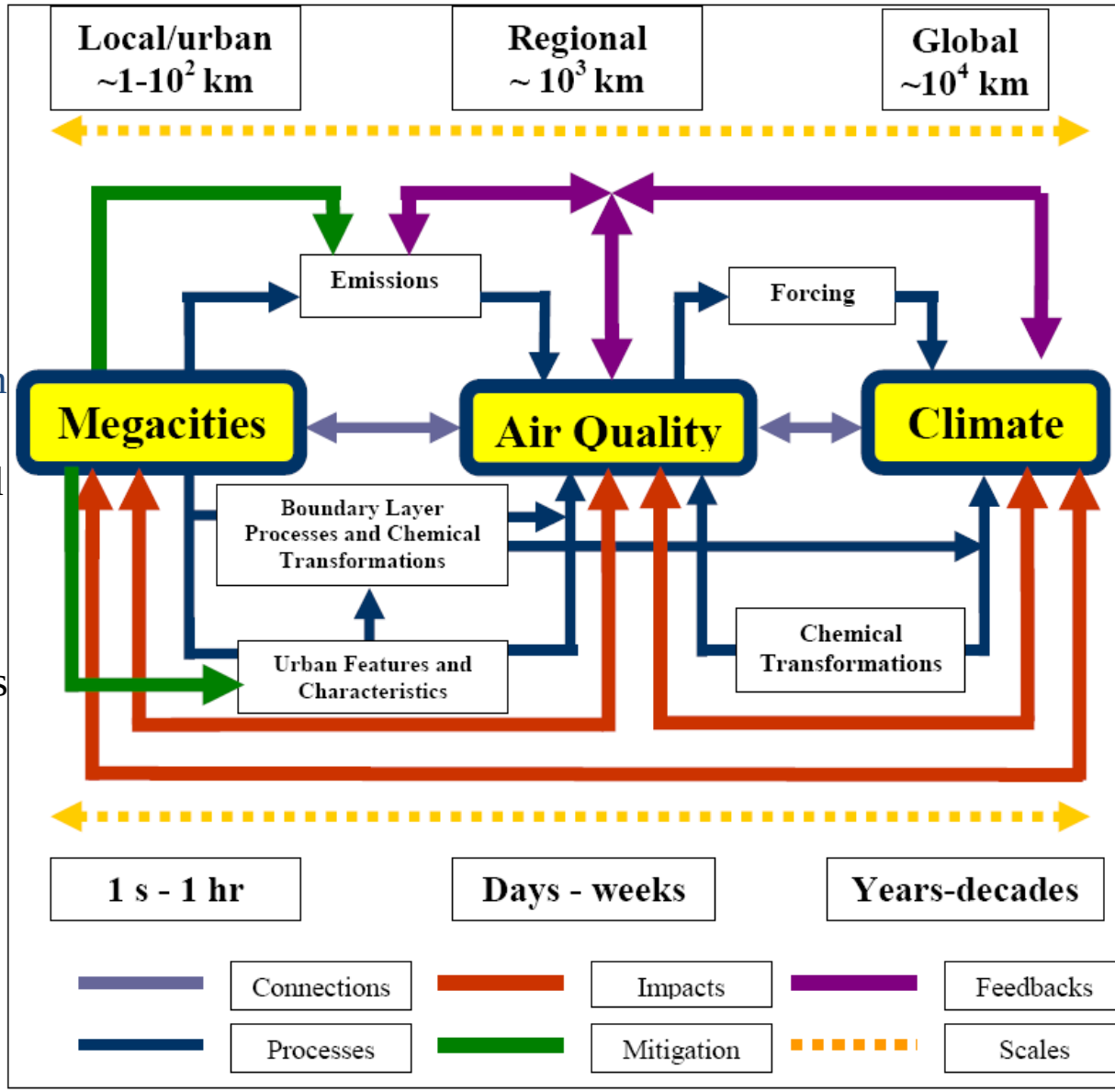
WMO OMM

MEGAPOLI: Connections between Cities, Air Quality, Weather & Climate:

The main aim:
(i) to assess impacts of growing megacities and large air-pollution "hot-spots" on air pollution and feedbacks between air quality, climate and climate change on different scales, and
(ii) to develop improved integrated tools for prediction of air pollution in cities.

- Science - nonlinear interactions and feedbacks between urban land cover, emissions, chemistry, meteorology and climate
- Multiple spatial and temporal scales
- Complex mixture of pollutants from large sources
- Scales from urban to global
- Interacting effects of urban features and emissions

see: Nature, 455, 142-143 (2008)
Web-site: megapoli.info



Moscow as a Demonstration City

- **WMO GURME Pilot Project for Moscow (2004):**

МЕТЕОРОЛОГИЧЕСКОЕ ОБЕСПЕЧЕНИЕ УСТОЙЧИВОГО РАЗВИТИЯ МОСКОВСКОГО МЕГАПОЛИСА

- Демонстрационный проект, посвященный измерениям и моделированию связей между погодой, качеством воздуха и климатом для окружающей среды Москвы.

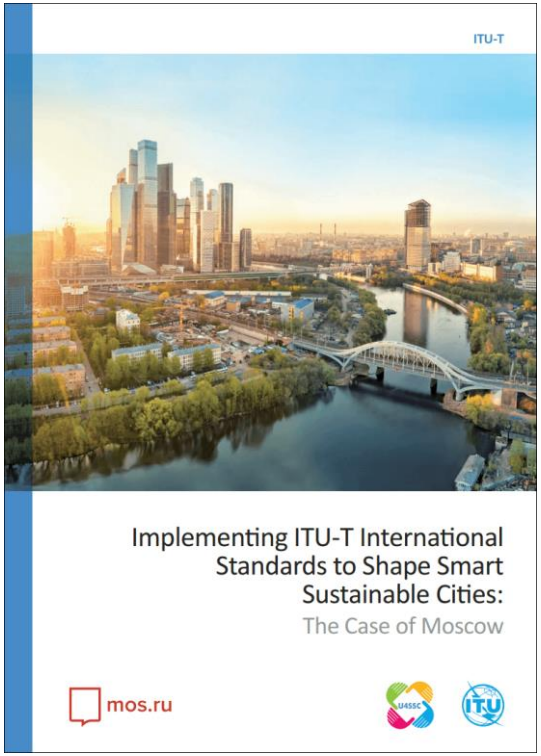
- **EU FP7 MEGAPOLI & RF MEGAPOLIS projects (2008-11):**

Megacities: Emissions, urban, regional and Global Atmospheric POLlution and climate effects, and Integrated tools for assessment and mitigation

- **Moscow Goverment Proposal for Demonstration project of Moscow in collaboration with WMO GURME (2019):**

- Innovative operational high resolution air pollution forecasting system for Moscow.

- **Moscow is considered as a Demonstration IUS Project for smart city**
- **MEGAGRANT MEGAPOLIS (Prof. Kulmala and MSU)**



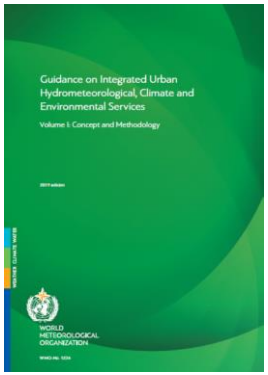
Moscow awarded status of smart sustainable city
October 10, 2019

WMO OMM

GURME
The WMO GAW Urban Research Meteorology and Environment Project

Integrated Urban Hydro-Meteorological, Climate and Environmental Systems and Services (IUS) for smart and sustainable cities

World Meteorological Organization
Weather · Climate · Water



[IUS Guidance Vol. I: Concept and Methodology]

Resilient

Sustainable

Multi-Hazard Early Warning Systems for Weather, Hydrology, Air Quality at Urban Scales

Long Term Planning
Climate Services for Weather, Hydrology and Air Quality at Urban Scales

Benefits of IUS - Useful, Usable, Used

1. Resiliency through Multi-Hazard Early Warning Systems
2. Sustainability through urban long term planning
3. Capability and capacity through cross-cutting services
4. Efficiency through infrastructure cross-cutting services
5. Consistency (hence, effective, efficient) through integration

[IUS Guidance Volume II: Demonstration cities]
30 cities considered **NO Arctic cities**

Mexico City
air pollution, hydrometeorological hazards, heatwaves, associated health and geophysical risks (e.g. flooding, landslides, wildfires)

Paris
heatwaves, river flooding, air quality

Toronto
extreme rainfall (convective weather), strong winds, thermal stress (heat/cold waves), air quality episodes, lake/river flooding

Hong Kong
tropical cyclones, convective weather events, extreme temperatures, coastal inundation and flooding, water scarcity, air pollution

CityIPCC 4 cities case studies: https://doi.org/10.1016/j.uclim.2020.10061

Hong Kong Local Experiences on IUS

Urban Integrated Services and Urban Design, Planning and Construction

Extreme Weather Events (HKO)
- Tropical cyclone and storm surge
- Thunderstorm and lightning
- Rainstorm, flooding and landslide
- Extreme hot & cold weather events
- Drought

Air quality modeling and forecast (EPD)
- Air Quality Health Index

Utilization of climate information (HKO)
- Climate change
- Disaster risk reduction (DRR)
- Urban climate evaluation

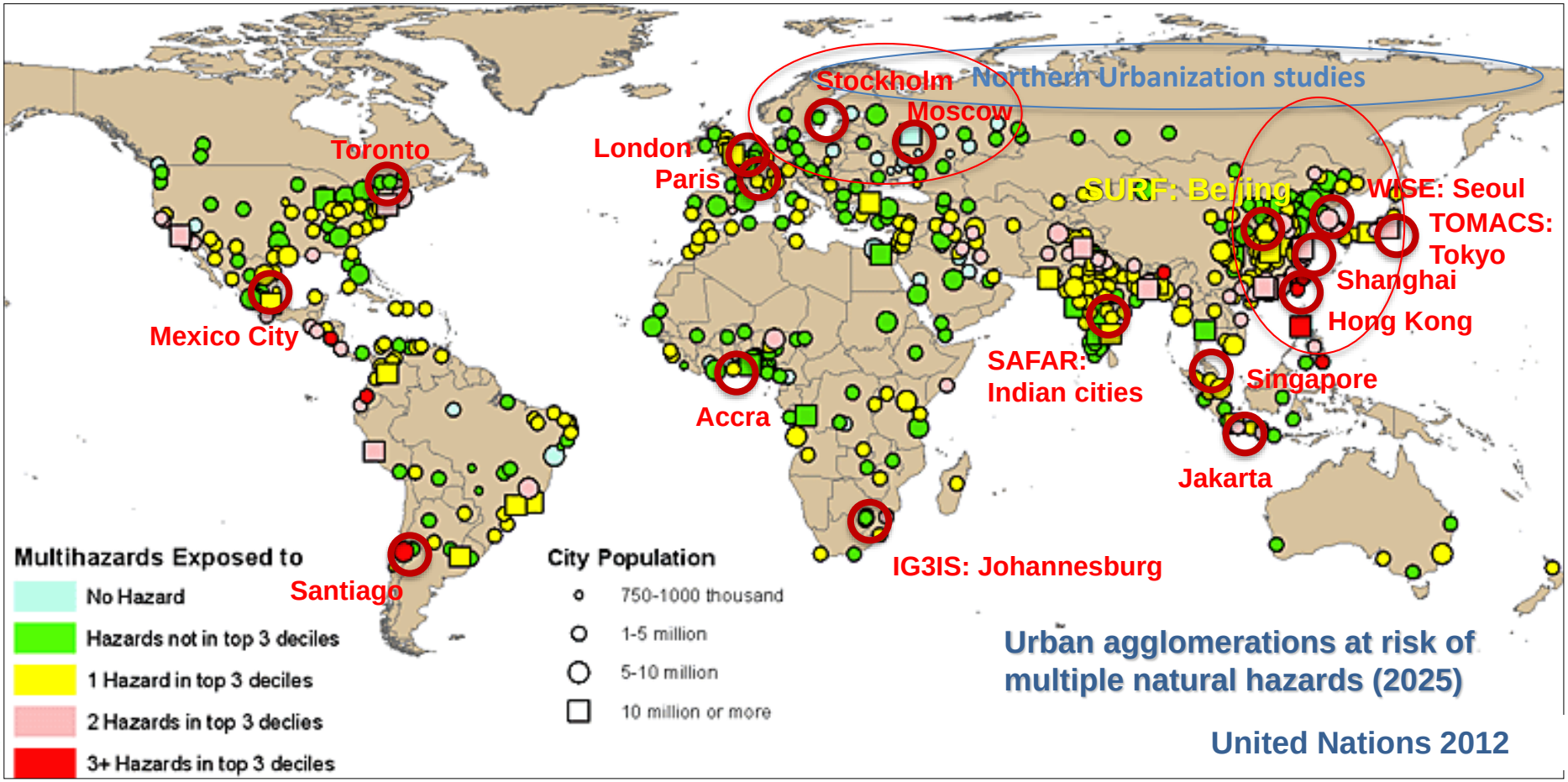
Evaluation
(Some examples)
- Wind load on buildings and infrastructures
- Coastal structure design
- Drainage system and slope safety
- Lightning safety
- Thermal comfort and health impact
- Energy demand / saving
- Water resources
- High air pollution area detection
- City resilience and disaster preparedness
- Urban heat island
- Air Ventilation Assessment (AVA)

Examples of Urban Planning & Infrastructure Construction
- Design standard and code of practices for buildings and infrastructures (e.g. "Building Wind Code", Drainage Master Plan, Port Work Design Manual, etc.)
- Mitigation measures to natural terrain landslides
- Drainage tunnels and Underground Stormwater Storage Tanks
- Blue-Green infrastructure
- Total water management strategy
- Climate change mitigation and adaptation measures
- Road networking design and urban density control
- Implementation of AVA and Urban Climatic Map into planning of new development and old district renewal

HKO - Hong Kong Observatory

EPD - Environmental Protection Department

WMO urban pilot projects and demonstration cities



New cities and countries are welcome to join the team.
Start realising Integrated Urban Systems for your city!

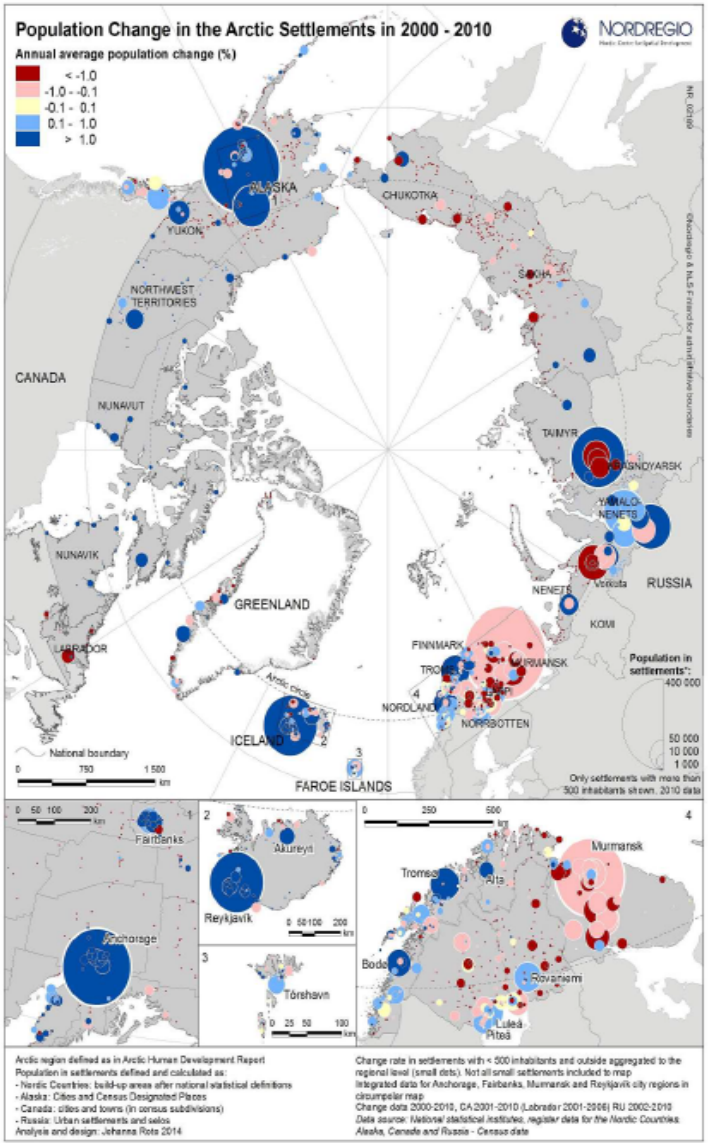
WMO OMM

Northern Urbanization

Arctic and Northern PEEX region are characterized:

- Much **lower population density** and not fast growing
- Highly urbanized with ≈ **90%** of population living in cities
- **Small size cities** are dominating, but not less problems
- About **100** urban settlements with > 5000 inhabitants
- Much **higher vulnerability** and lower sustainability
- **Cold climate is a dominant environmental factor**
- Urban nexus includes:
  - Snow – impact on management and planning
  - Frozen soil & permafrost – infrastructure stability
  - Frozen surface water – water supply and sewage
  - Dormant vegetation – reduced ecosystem services
  - Stagnant atmosphere – air pollution and urban heat island, stable boundary layer
  - Low temperatures – health issues and working routines
  - **high energy consumption**
- **Migration is a dominant societal factor** in the region
  - More than 60% of urban population are 1st generation migrants
  - High skills but little sense-of-place
  - External, unsustainable development agenda

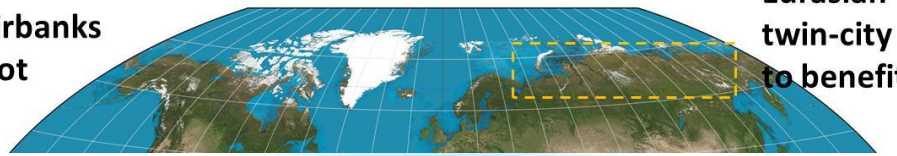
Baklanov et al., (2018-2019)



Northern Urbanization: Twin-cities Project

Pan-Eurasian Experiment
PEEX

Fairbanks pilot



Eurasian twin-city to benefit

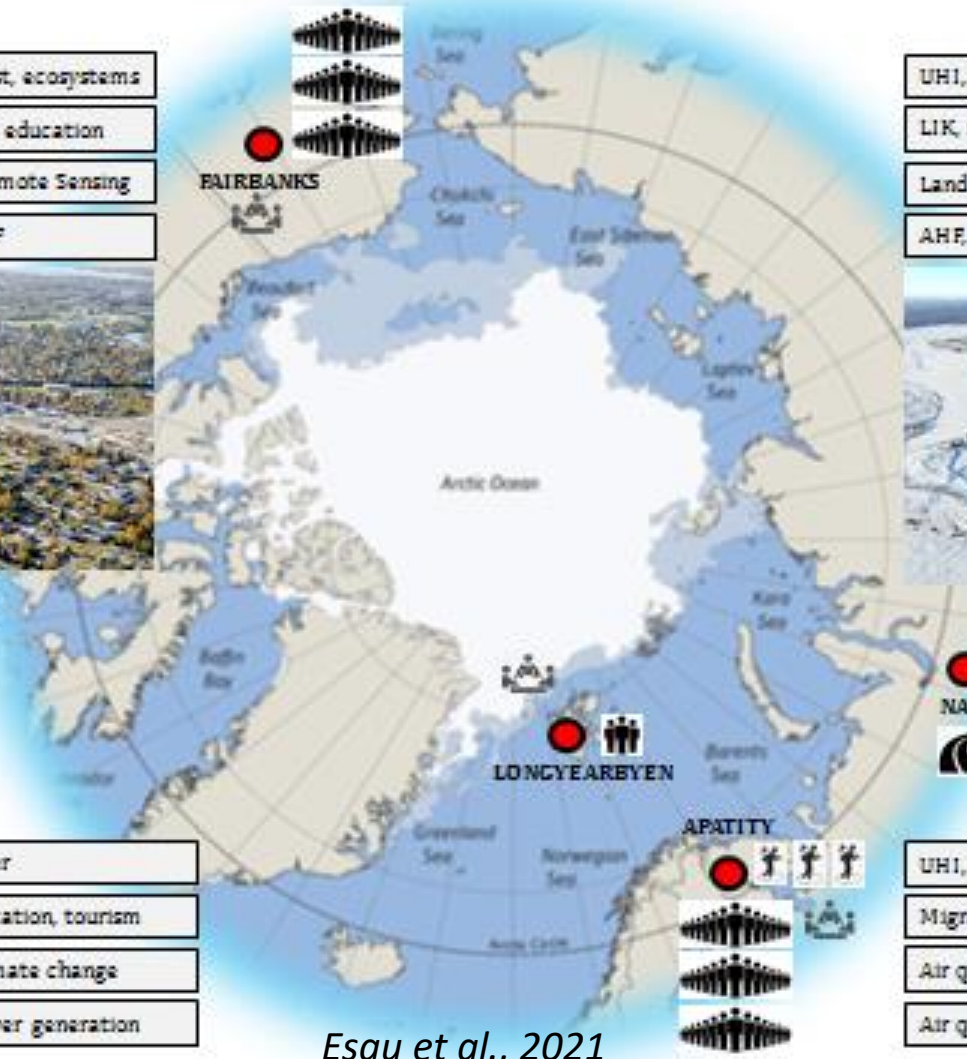
PACES
air Pollution in the Arctic:
Climate Environment and Societies

FAIRBANKS

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

NADYM

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



City population (thousands)

Infrastructure, scenario, new materials

Environmental damage

Higher education institutions

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

Esau et al., 2021

Open scientific questions relevant to development of Integrated Urban Systems

- Understanding how to take and use of observations in urban areas
- Representation of urban character in models
- Urban atmosphere scales requirements, coupling with hydrology
- Impact of cities on weather/climate/water/environment
- Impact of changing climate on cities and adaptation strategy
- Major geophysical hazards – dust storms/earthquakes/volcanic eruptions/space weather - interactions with meteorology
- Development of Integrated Decision Support Systems
- Communication and management of risk, multidisciplinarity
- Evaluation of integrated systems and services
- Understanding of the critical limit values
- New, targeted and customized delivery platforms

Kiitos

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Thank you

Gracias

Merci

Спасибо

谢谢

WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

WMO OMM

World Meteorological Organization
Organisation météorologique mondiale

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