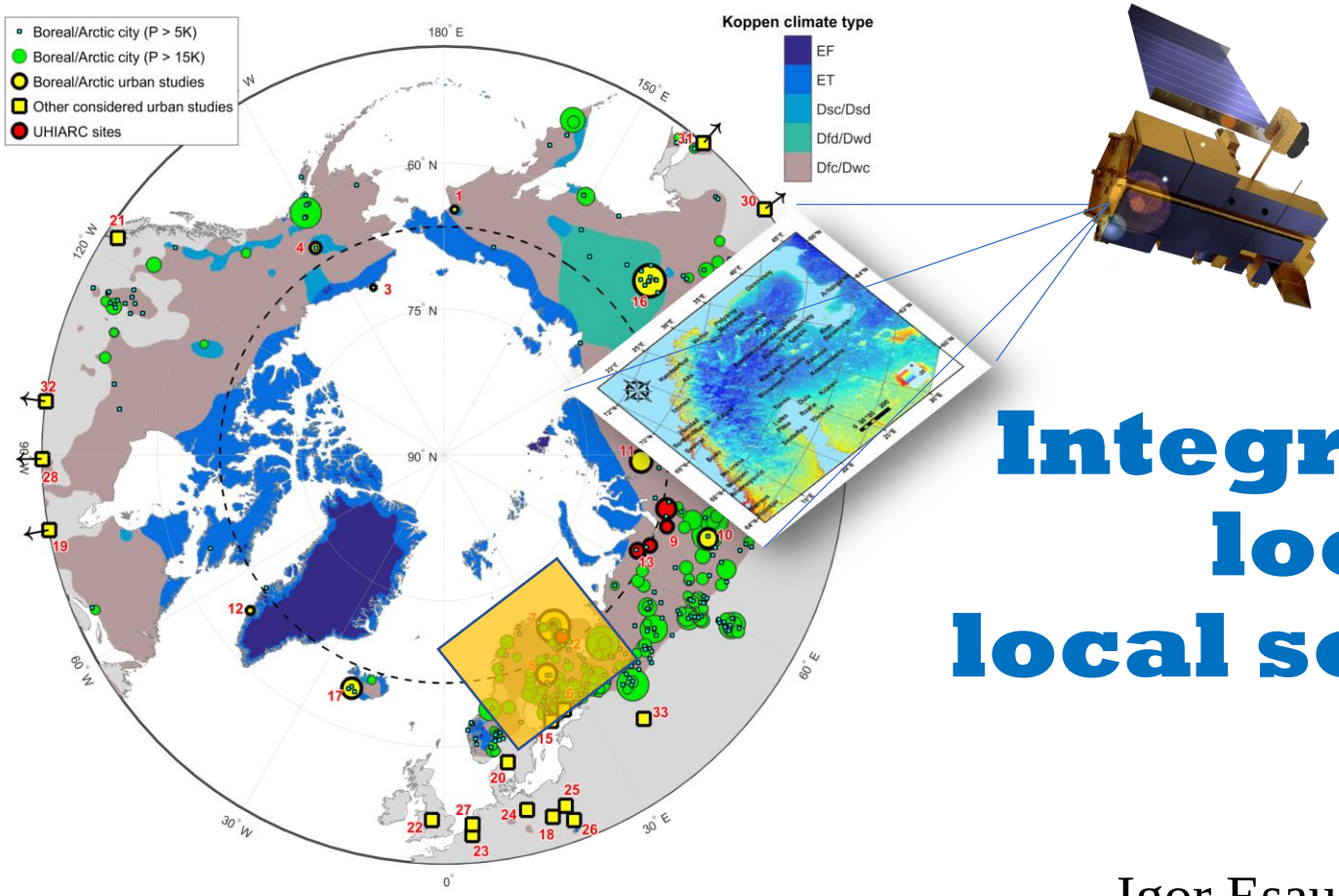


Integration of local data, local models and local socio-environmental scenarios

Igor Esau

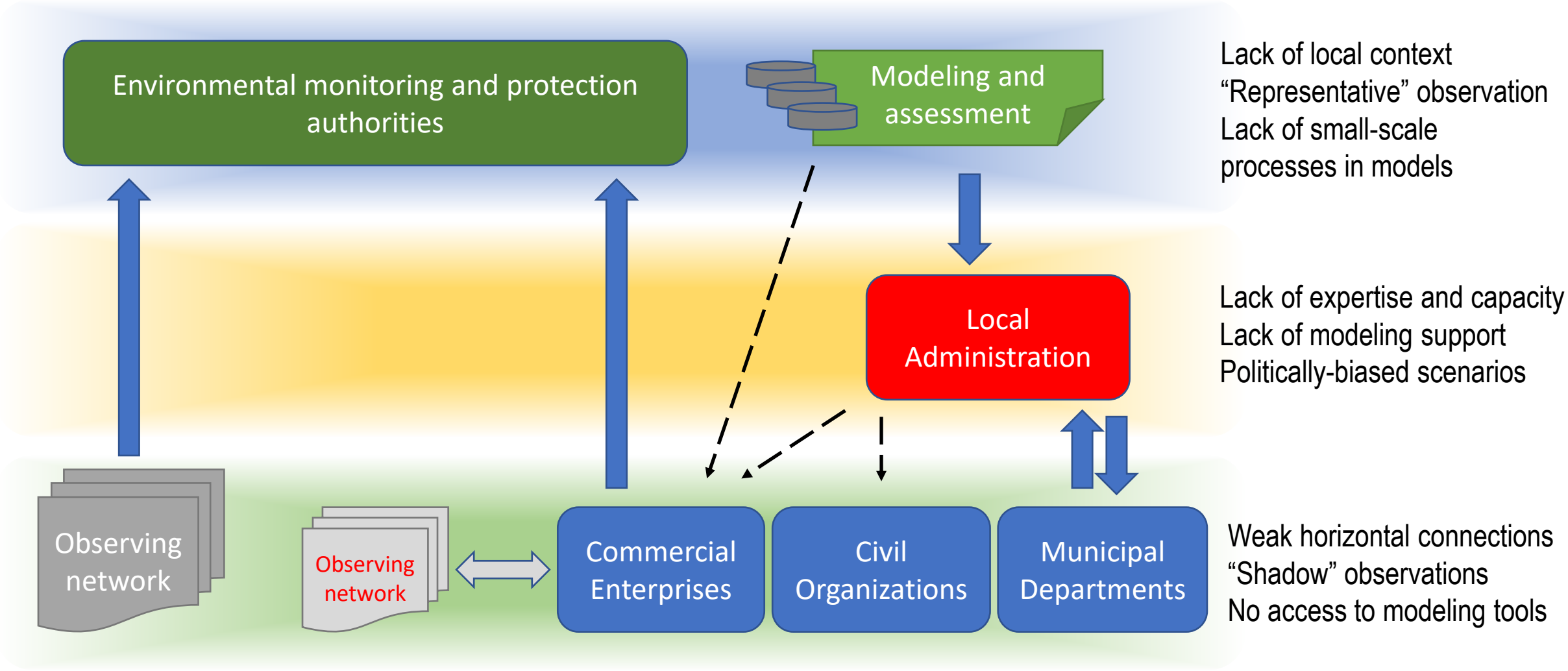
Nansen Center, Bergen, Norway

Workshop "*Holistic multi- and interdisciplinary approach in supporting the Arctic sustainable development*"

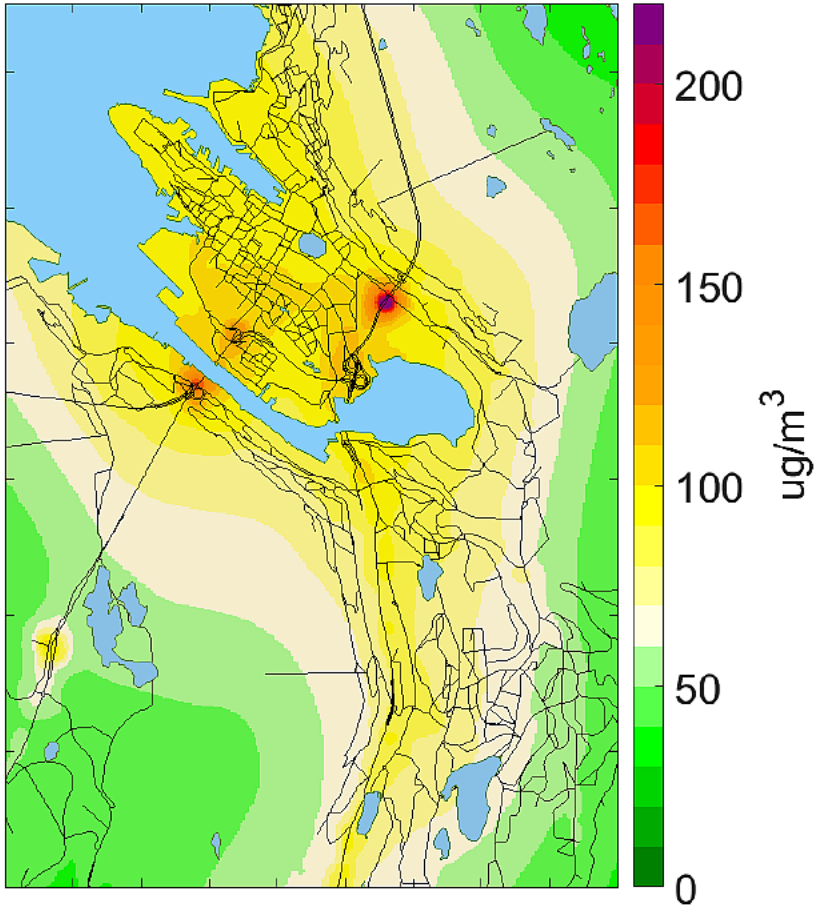
19 February 2021

hosted by the Univ Helsinki and Kola Science Center.

Siloed approach to environmental monitoring and response actions

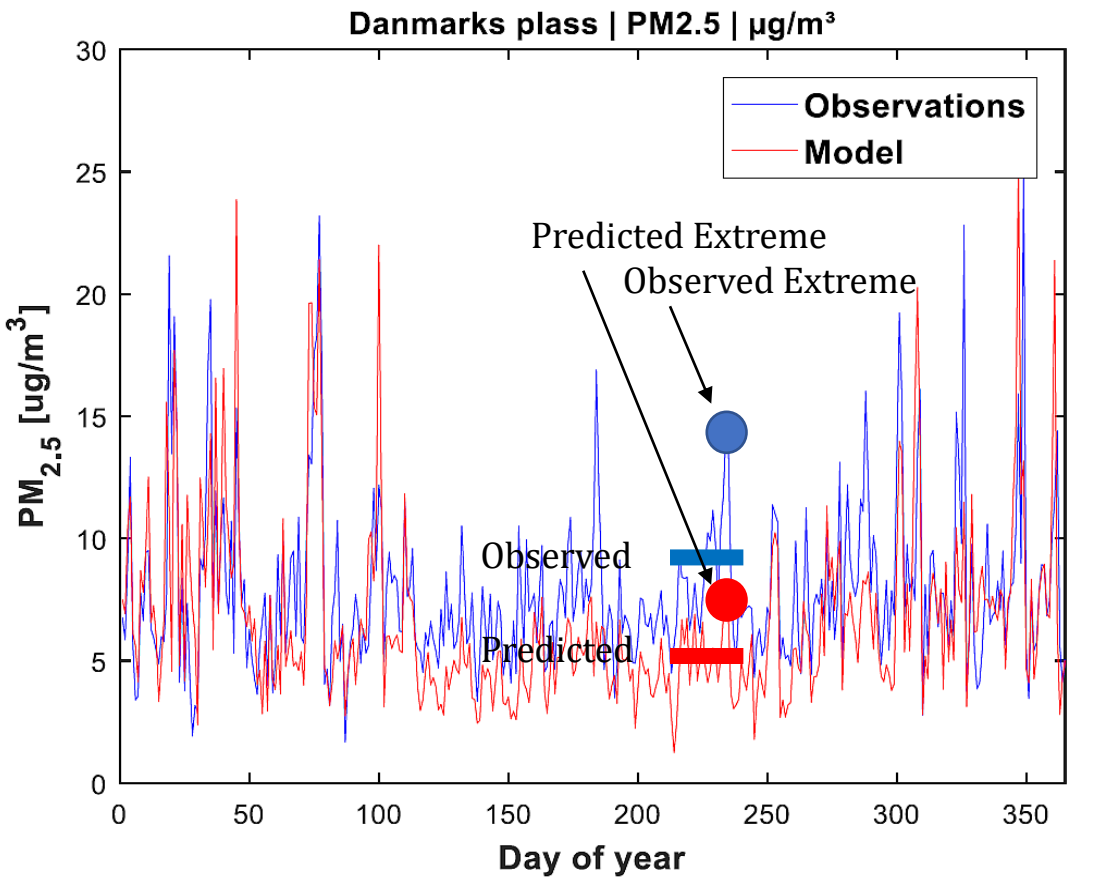


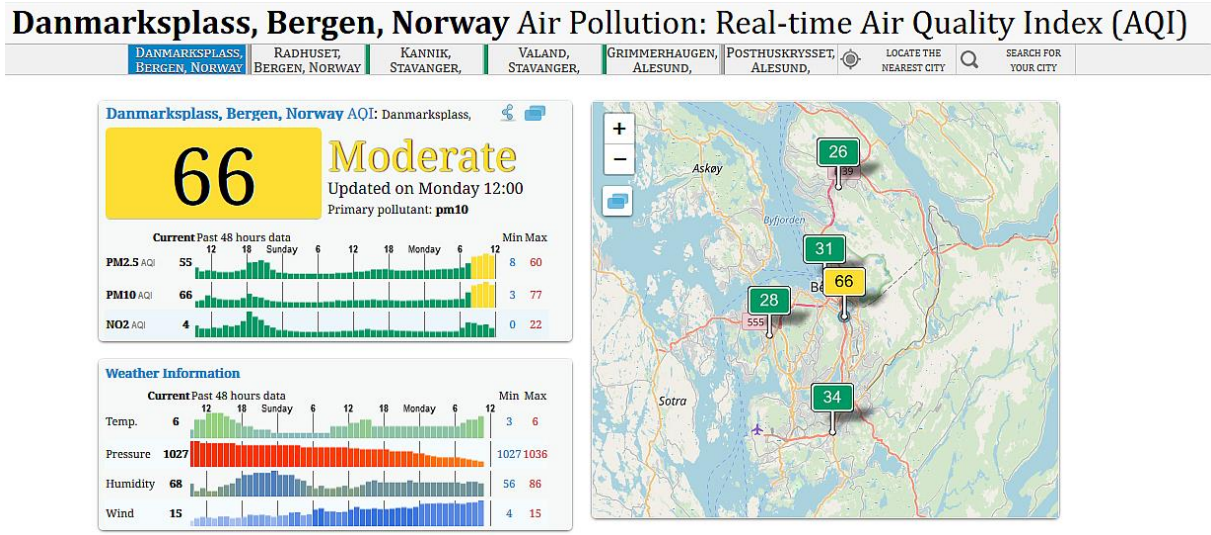
Challenges



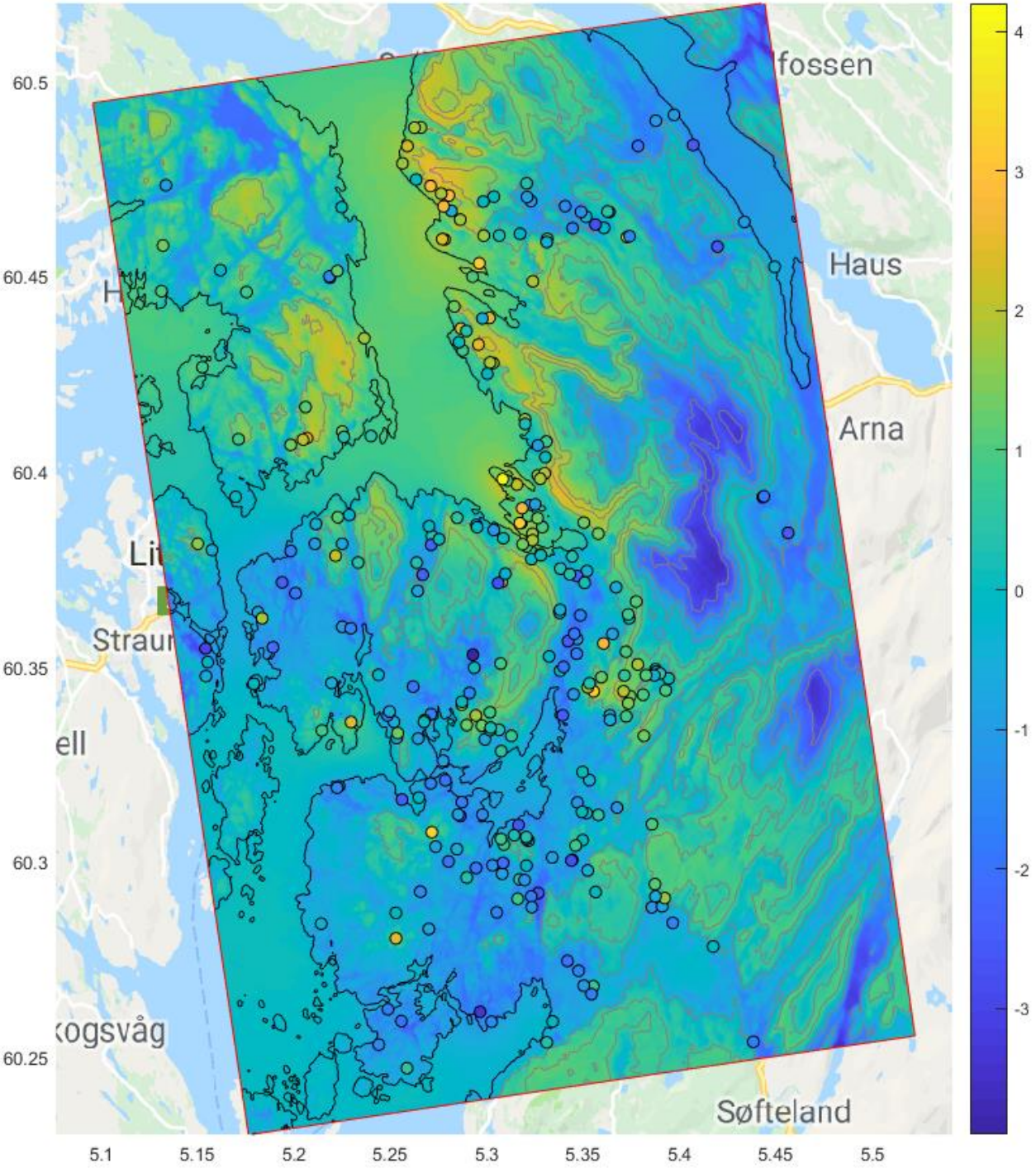
Statistical interpolation and downscaling.

Reference hourly-mean concentrations of NO2 in 2021 (scenario)
Source: NILU report no.15, 2017





Sources: waqi.info, aqicn.org



Local data – towards seamless data fusion

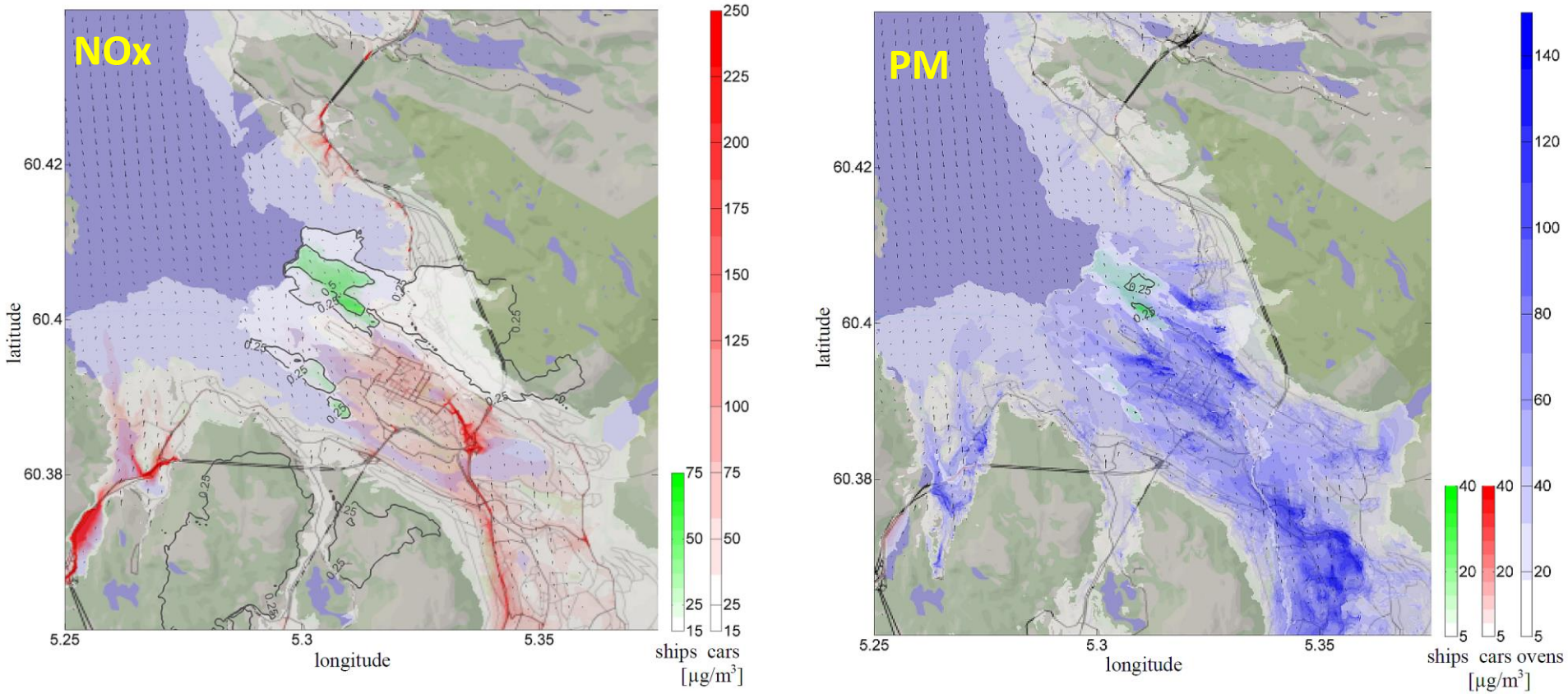
- Data:
  - Certified stations (3 AWS)
  - Regular non-certified (school) stations (55 Davis Pro)
  - Non-regular non-certified (citizen) sensors (196 NETATMO)
  - Satellite LST (COPERNICUS: Landsat, Sentinel) MODIS
- Model:
  - PALM model runs as the statistical drift
- Data fusion method:
  - Geo-spatial kriging with external drift
- Case study (under development):
  - Extreme air pollution under temperature inversions
- Specified emission inventory

Seamless data fusion as an environmental component of a "***smart city***"

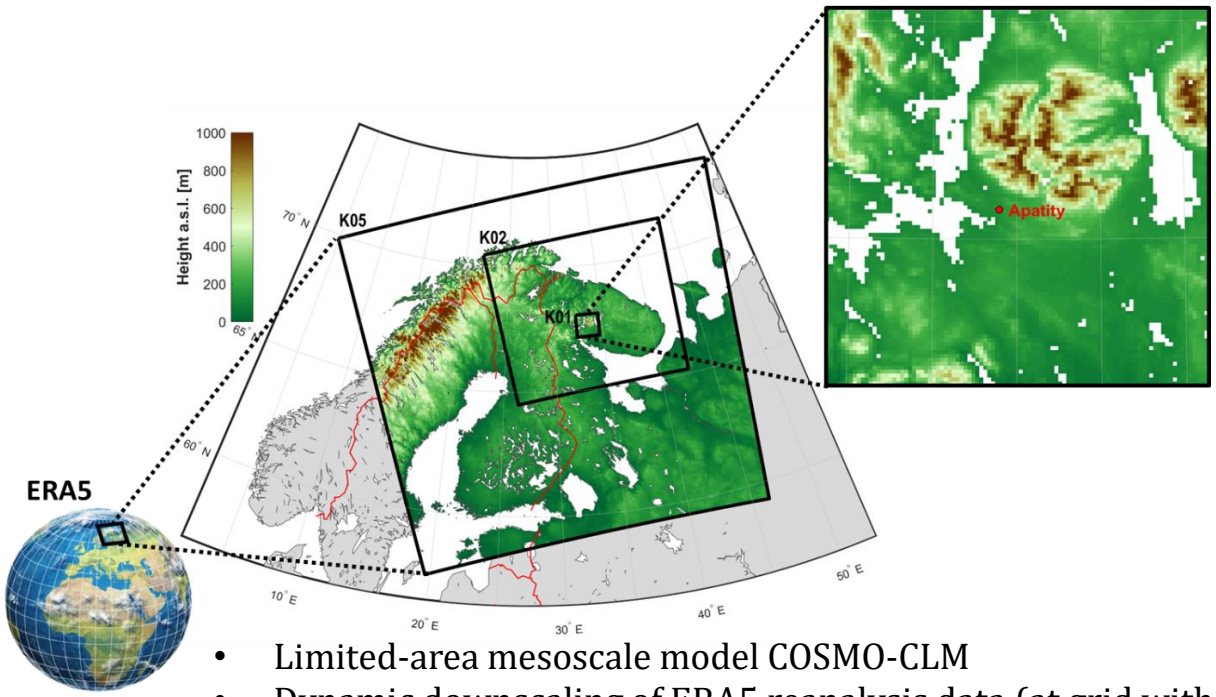
Monitoring

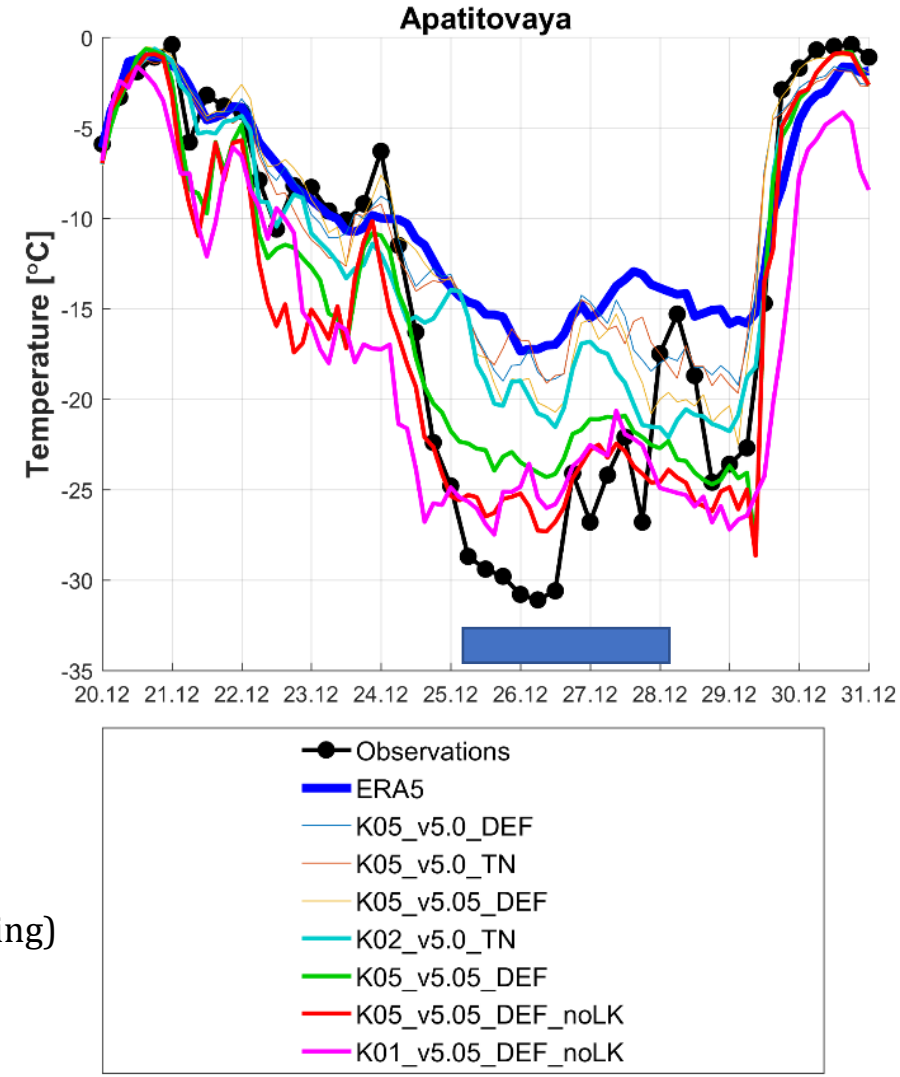
Local models – to integrated approach

Wolf, T., Pettersson, L. H., and Esau, I., 2020: A very high-resolution assessment and modelling of urban air quality, Atmospheric Chemistry and Physics, 20, 625–647, https://doi.org/10.5194/acp-20-625-2020



Downscaling model chain



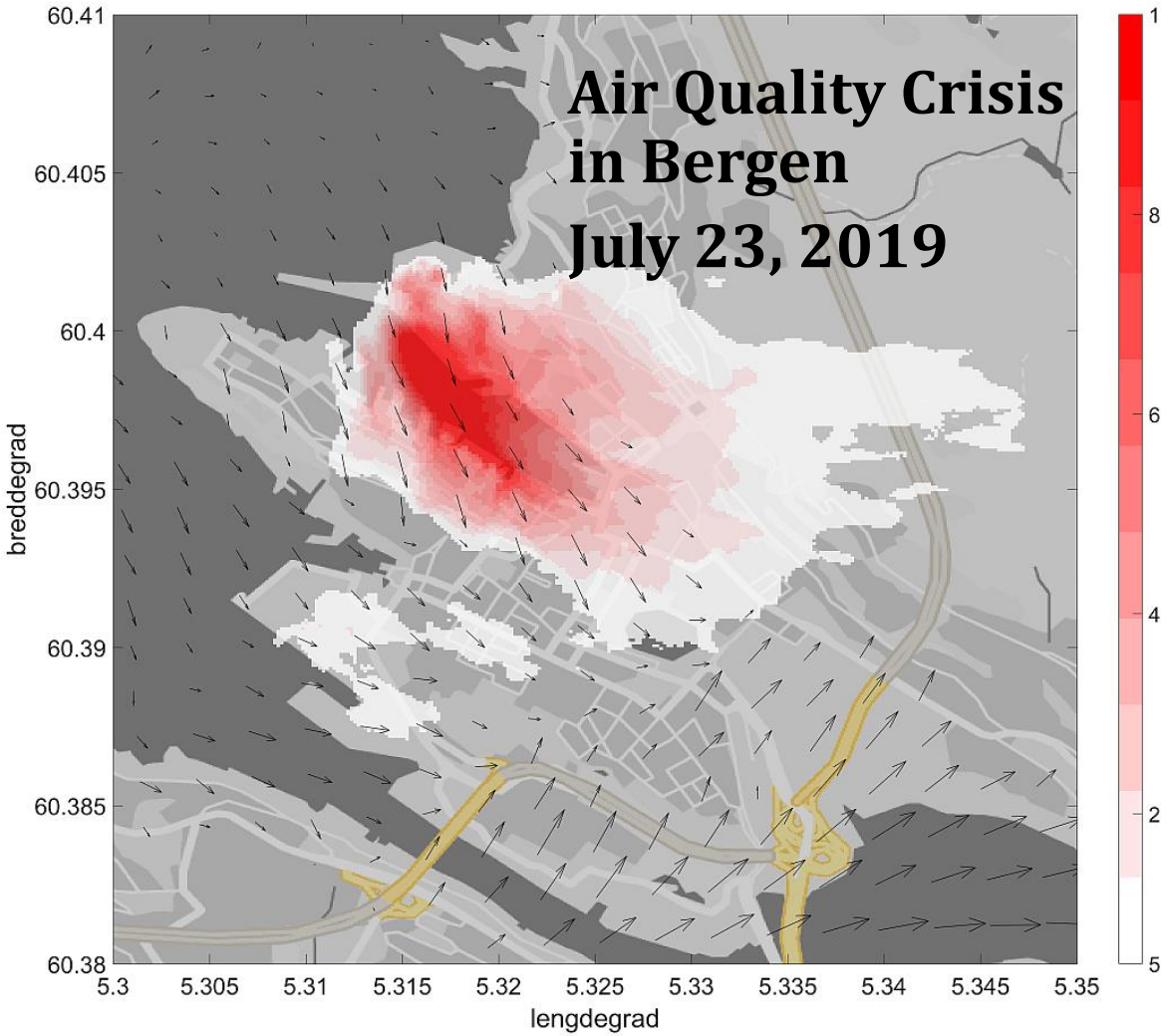


- Limited-area mesoscale model COSMO-CLM
- Dynamic downscaling of ERA5 reanalysis data (at grid with 30 km grid spacing)
- Chain of nested domains with grid step 5, 2 and 1 km (K05, K02 and K01)
- Simulation period 20-30 December 2017
- Computations at Lomonosov-2 computer of the Moscow State University

Only the simulations with new boundary layer physics, high spatial resolution and removed lakes **adequately reproduced the observed cold spell** (K02/K01_v5.05_DEF_noLK run)

Igor Esau and the TRAKT team; EMS Annual Meeting Abstracts, Vol. 16, EMS2019-3, 2019

Local socio-environmental scenarios



FORURENSNING OVER BYEN: Slik så det ut fra Laksevåg tirsdag ved 8-tiden. FOTO: HELGE MISJE JOHANNESEN

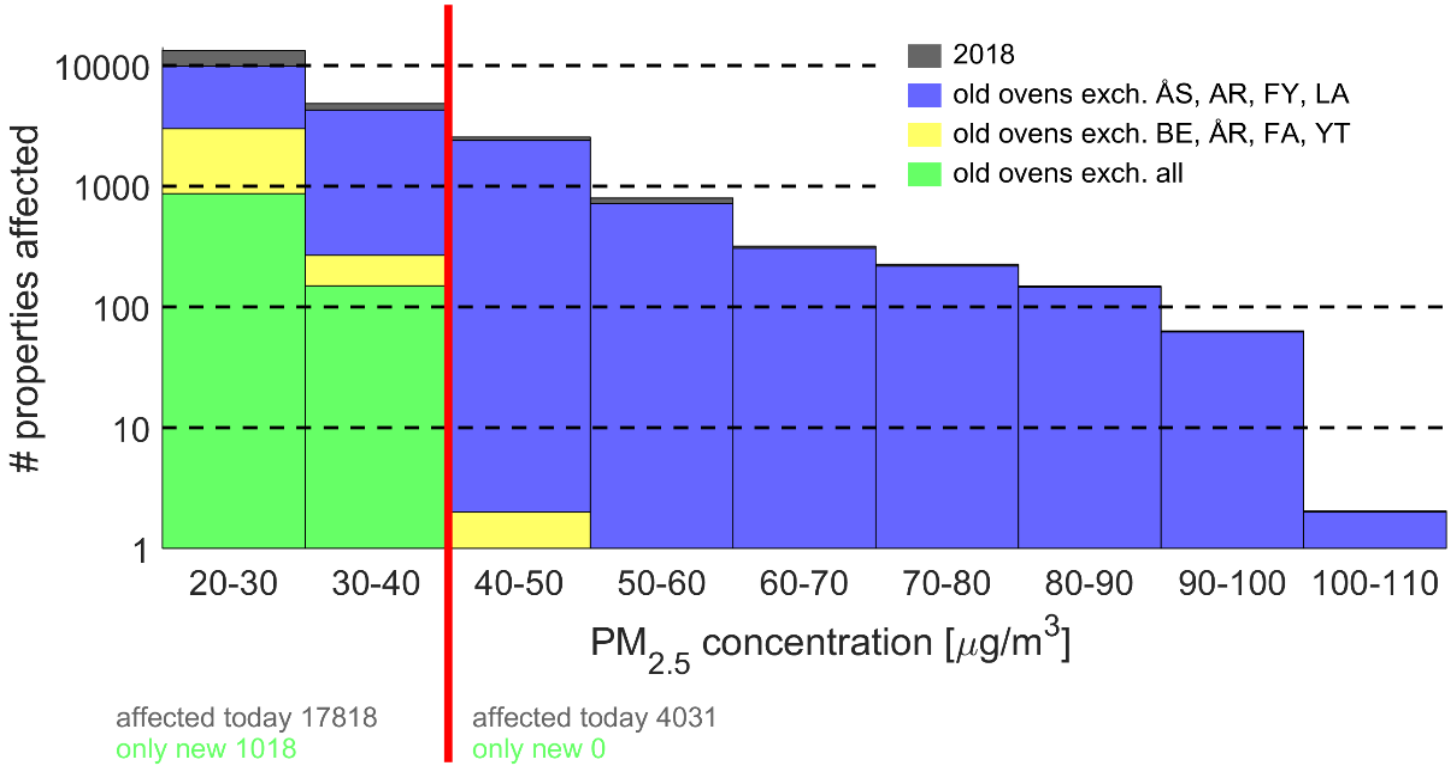
– Skipene som spyr ut forurensing burde vært senket for lenge siden

– Har ikke sett det verre i sommer. Dette kan vi ikke leve med. Rydd opp!

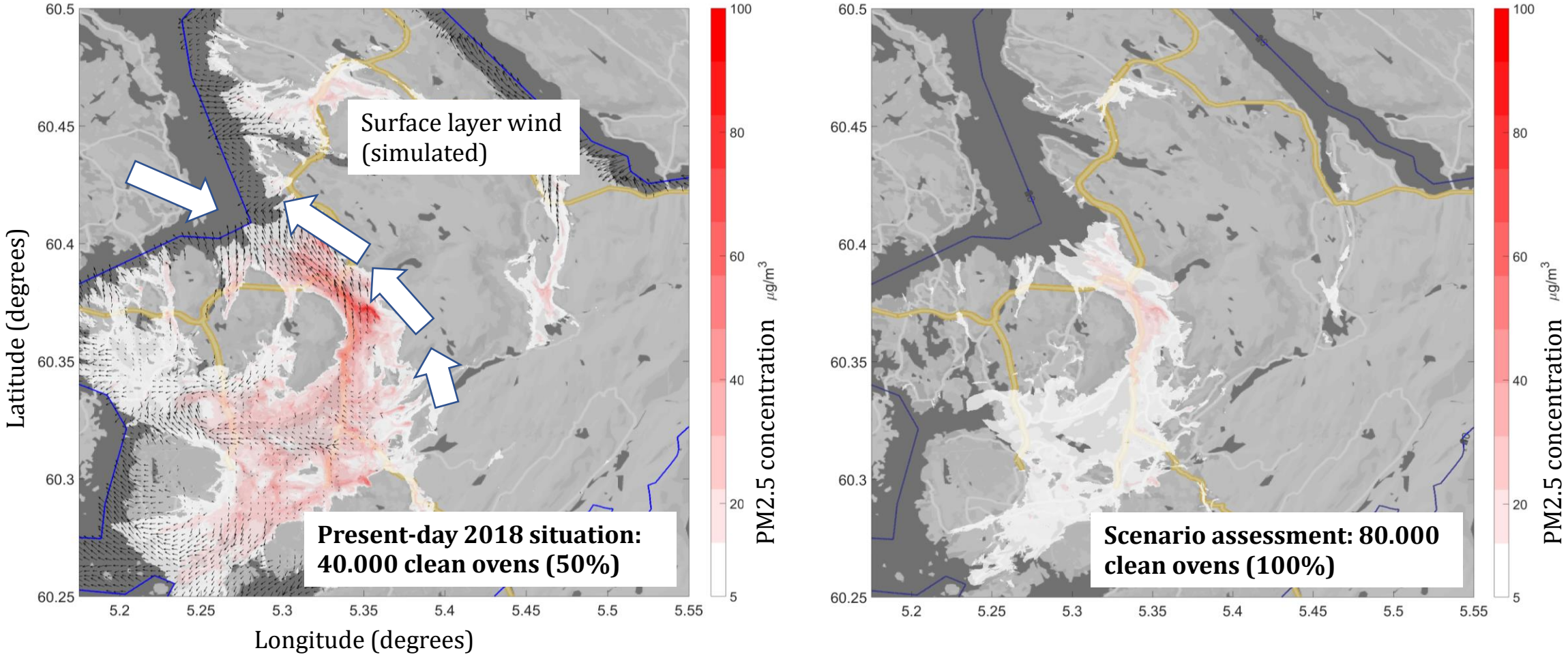
Informed and targeted polity actions

The effects of different policy measures (identified by colors) on the PM2.5 concentration exposures given in the number of affected households

Yellow policy measures: Policy and economic incentive focus on just a few central urban districts will lead to practical elimination of dangerous (40 mkg/m3 or more) level exposure of households

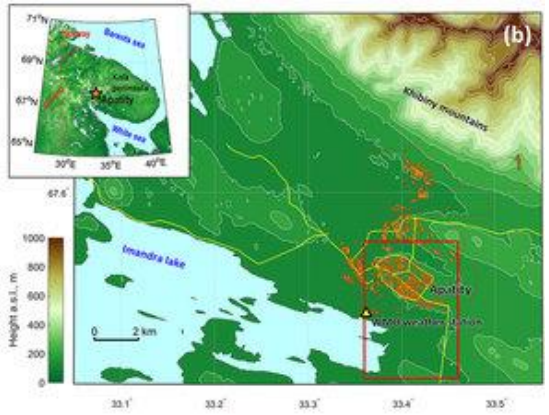


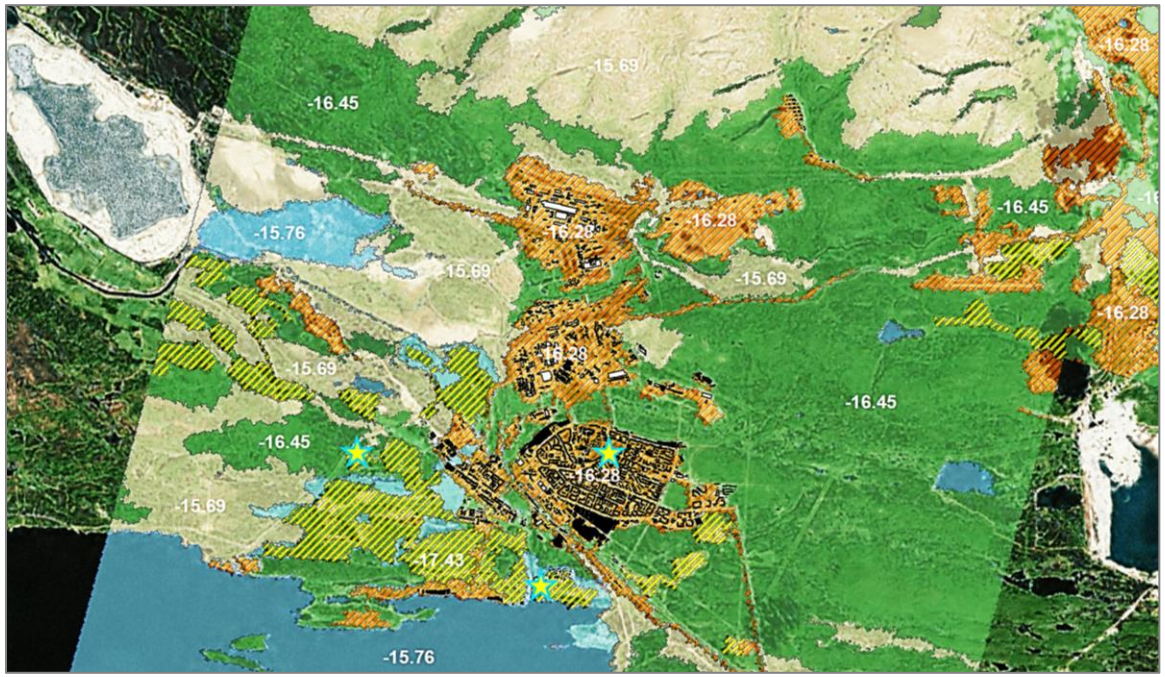
The effect domestic wood combustion

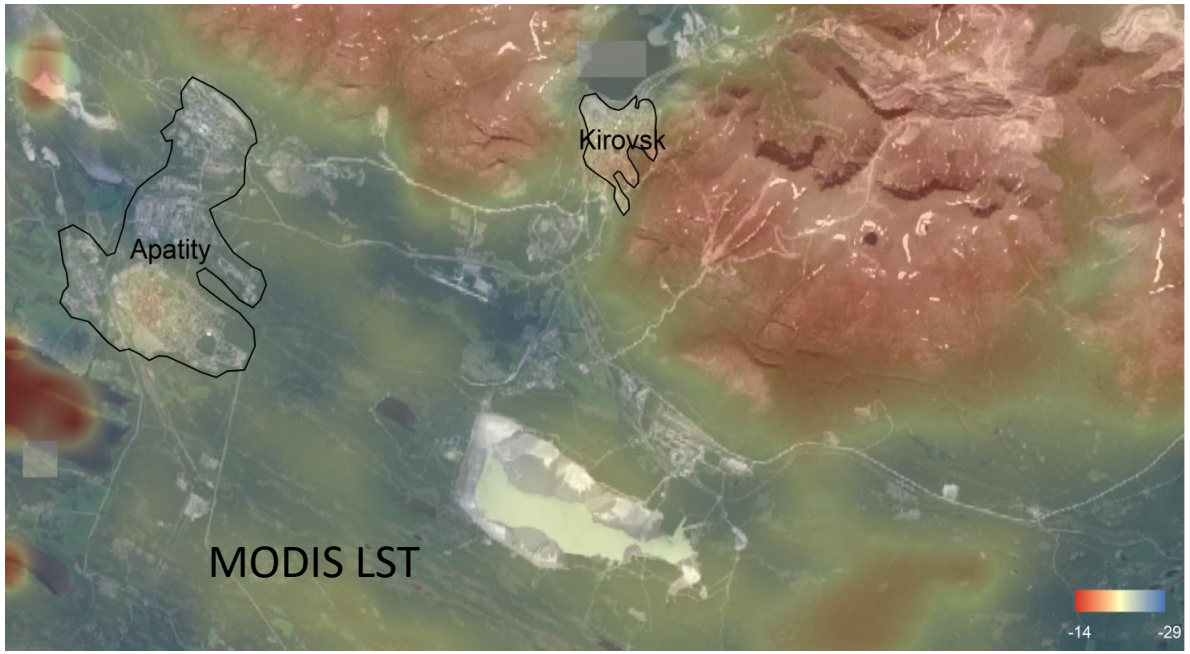


The PM2.5 concentrations from wood-burning household fireplaces (ovens): Present day oven composition impact (left panel) versus future composition impact (right panel) in the first typical **winter scenario**

Reflections from TRAKT-2018 project

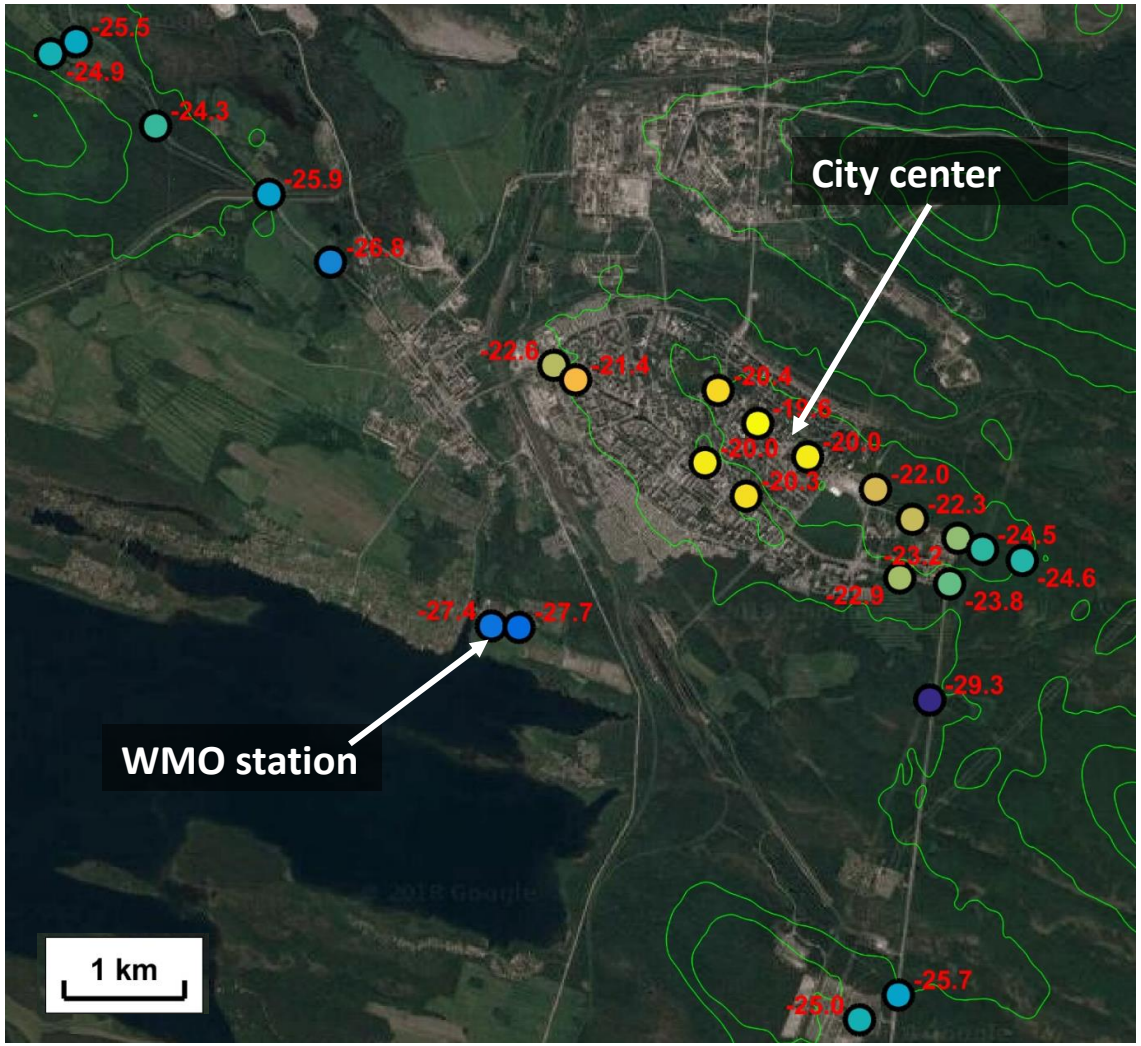






- Cultivated land
- Forest
- Grassland
- Shrubland
- Water bodies
- Artificial surfaces

UHIARC dataset:
An experience with inexpensive urban observational network

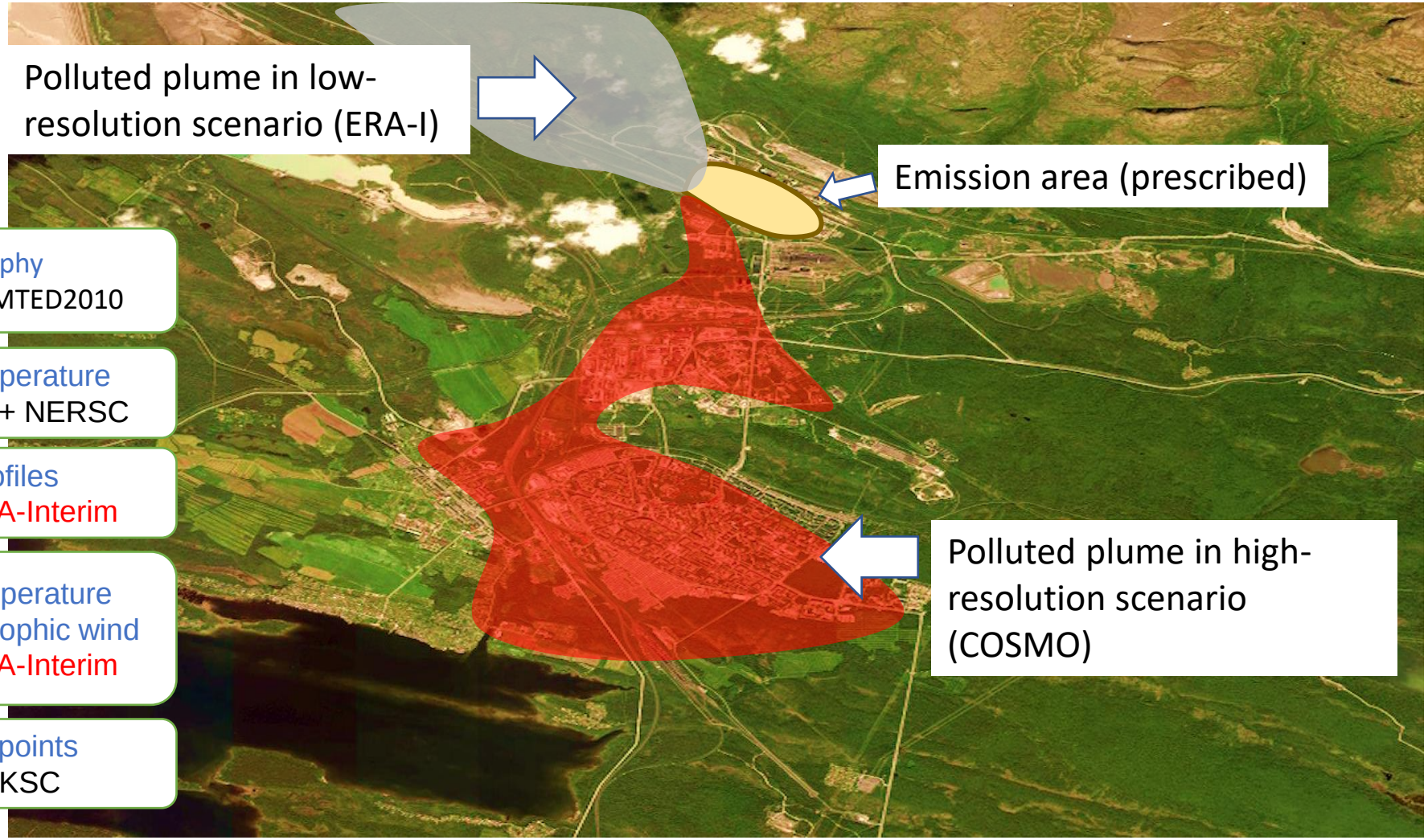


WMO station, AWS and 21 additional *iButton* temperature loggers

UHIARC – Urban Heat Island Arctic Research Campaign
(Konstantinov et al., 2018) http://urbanreanalysis.ru/uhiarc.html

High-resolution modeling PALM

Quick Bird image, 3 m. July 18, 2017



Topography
Arctic DEM, GMTED2010

Surface Temperature
MODIS, KSC + NERSC

Initial profiles
COSMO, ERA-Interim

Nudging temperature profiles, geostrophic wind
COSMO, ERA-Interim

Emission points
UHEL + KSC

Igor Esau and the TRAKT team; EMS Annual Meeting Abstracts, Vol. 16, EMS2019-3, 2019