PEEX international collaboration virtual-zoom-meeting

Statistical approach to solving socio-economic problems using remote sensing methods (few examples)

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Why statistics?

- open access to collected over a long period international archives of calibrated digital satellite images – BIG DATA;

- daily and seasons regular and random variations of environment state;

- decision-makers like statistically averaged information in very simple form. The best form is amount of profit or economical losses, calculated in Dollars, Euro, Rubbles.

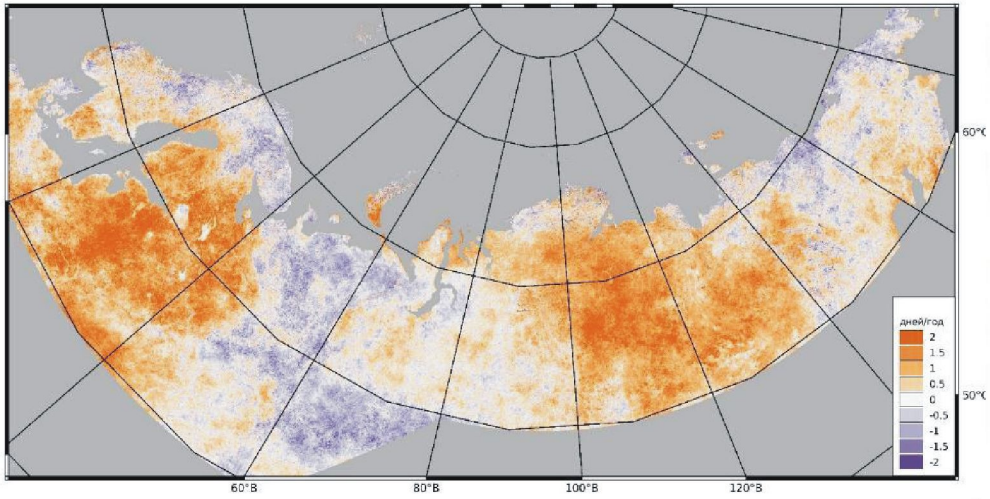
We consider remote sensing as a tool for information support of the management decision making system.

Our task: - to convert remote sensing data into maps of risks (probabilities) or statistically averaged economi-ecological losses

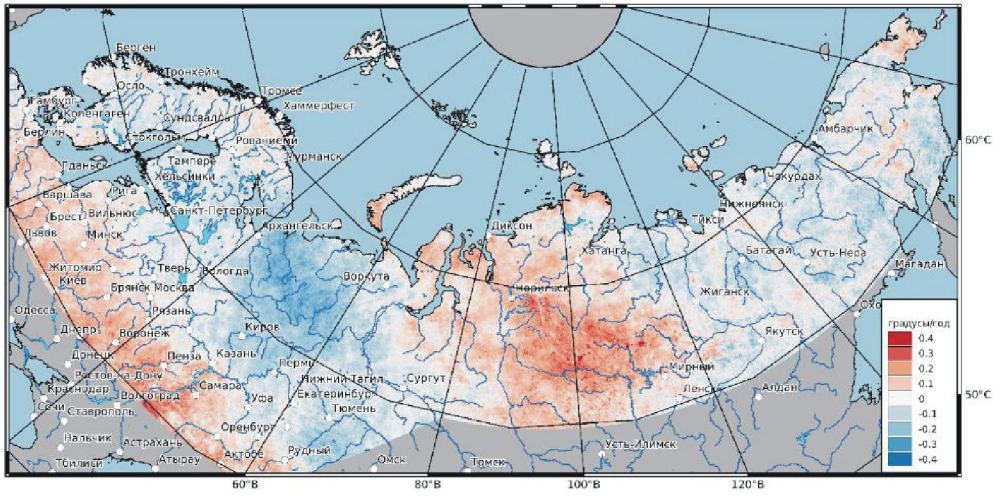
BIG DATA for the Northern Eurasia

Linear trends for 2000 -2020 years. Spatial resolution 1x1 km

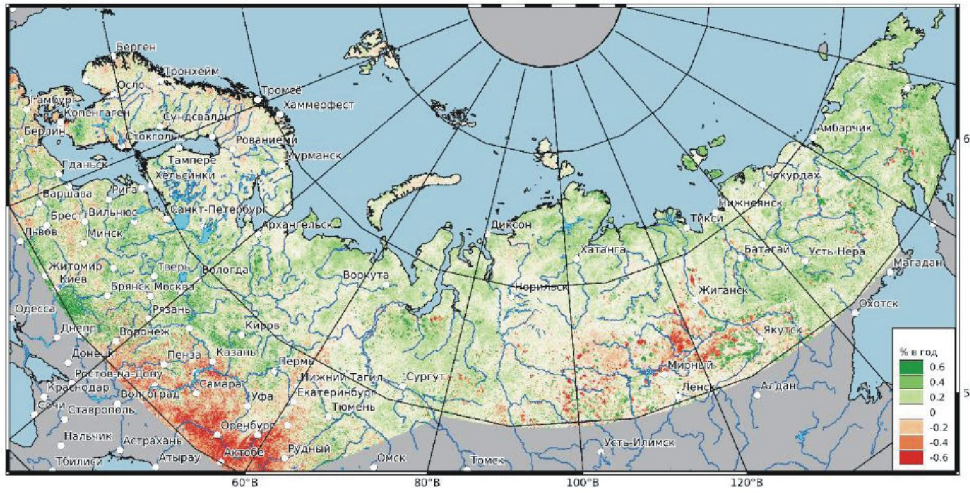
Vegetation period, Days/Year



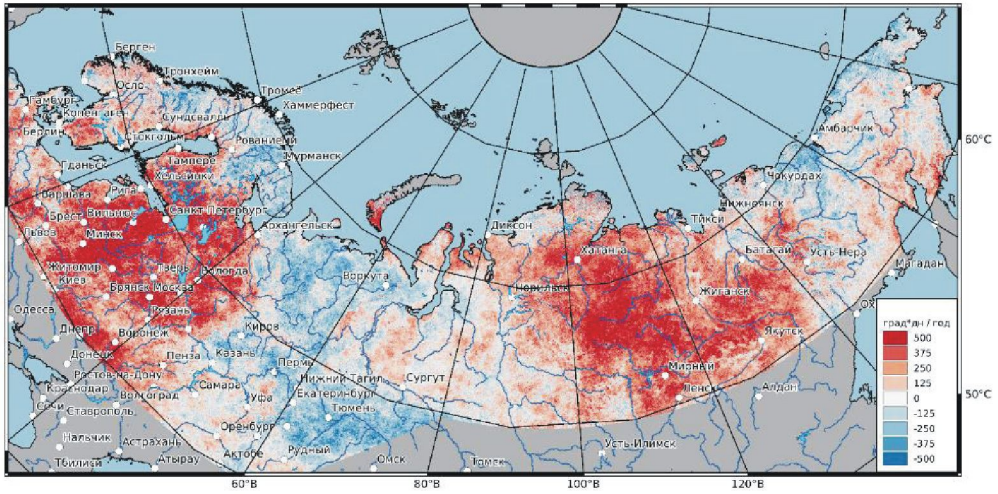
Daily averaged temperature of the most warm month, °C/Year



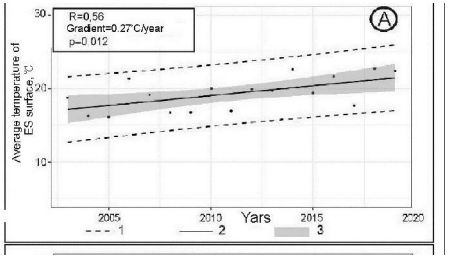
Vegetation index EVI, %/Year



Accumulated daily av. temperature of vegetative period, °C/Year



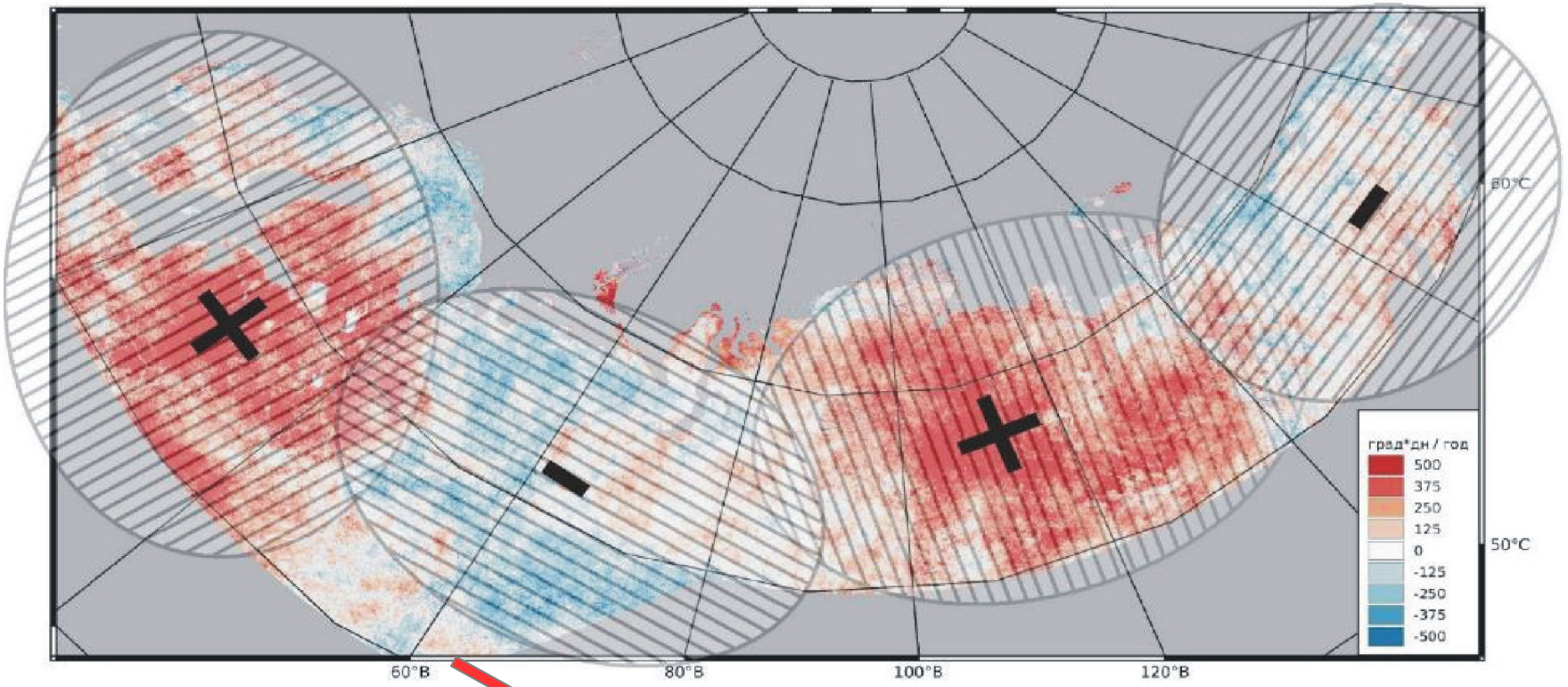
Linear trends of remotely sensed characteristics of ecosystems

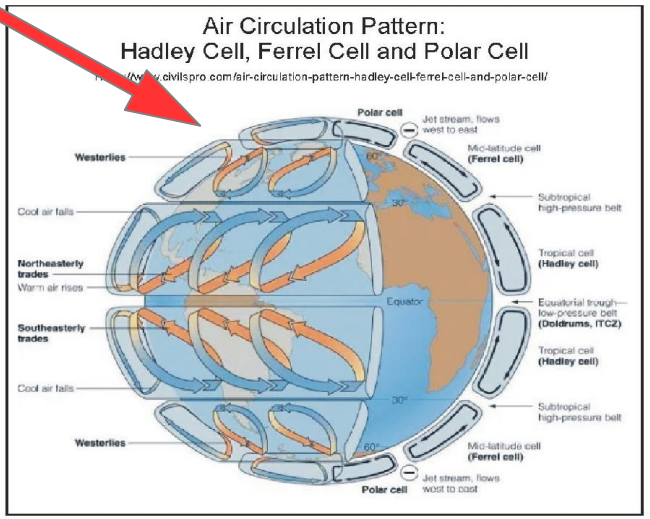


Each map:
235980 granules of Terra satellite and 198,720 granules of the Aura satellite.
1 granule = 1200x1200 pixels

BIG DATA for the Northern Eurasia

Hypothesis of Ferrell cell activation



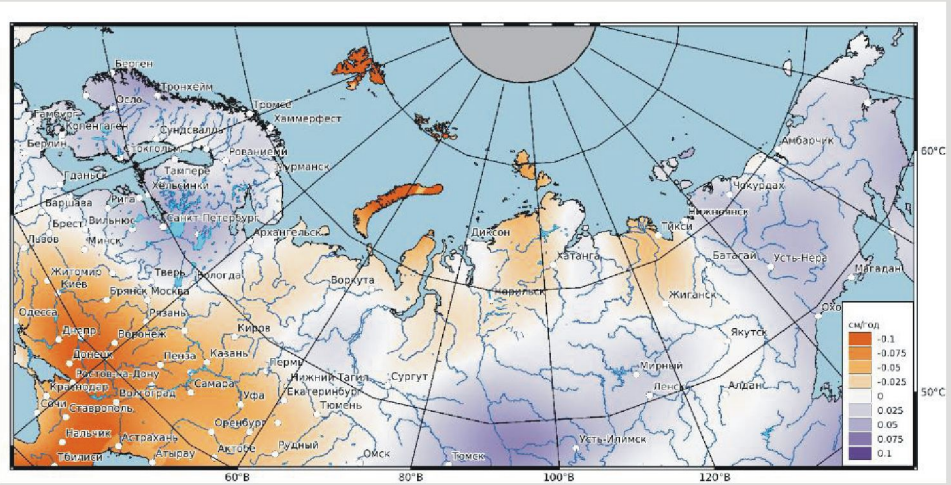


BIG DATA for the Northern Eurasia

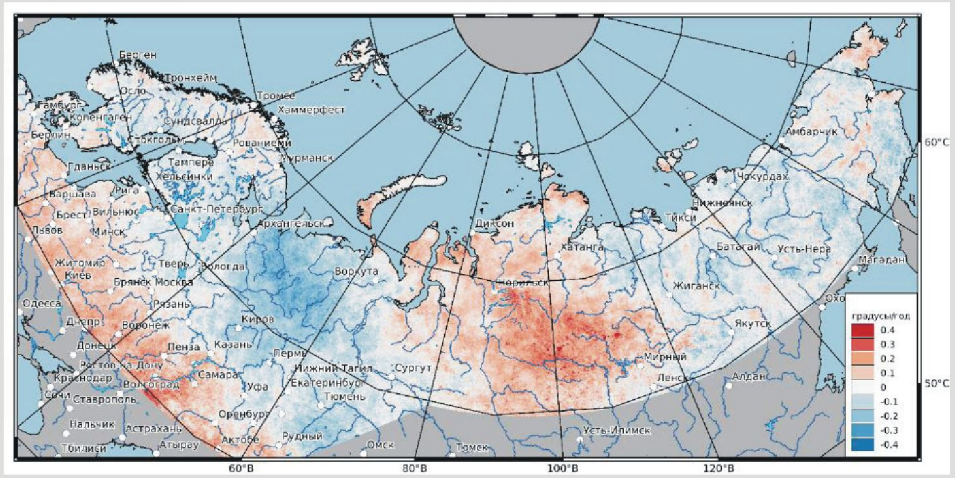
Permafrost melting?

GRACE satellite data

Trend of effective thickness of water layer for the period 2002-2017

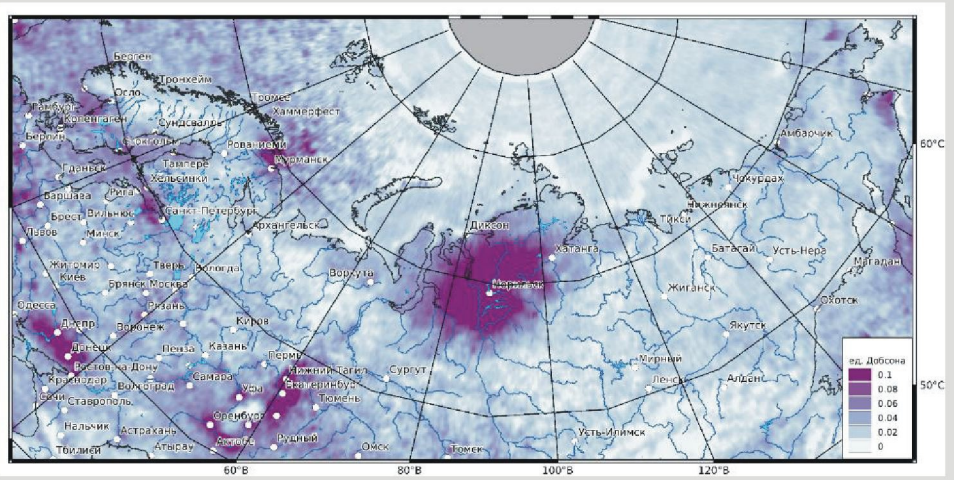


Daily averaged temperature of the most warm month, C/Year



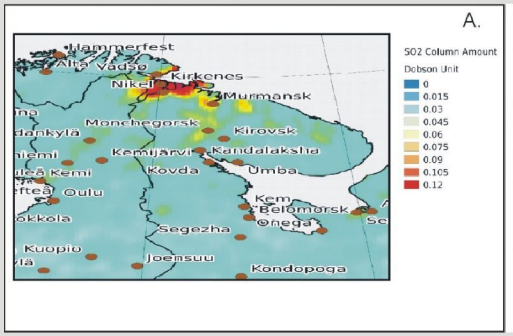
Air pollution

Concentration of SO_2 , averaged for the period 2004-2019

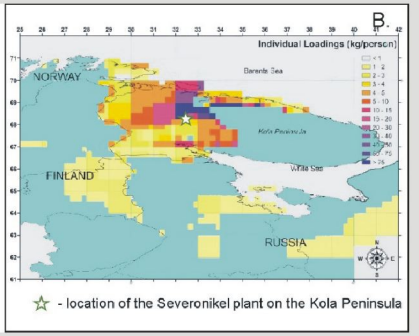


Combination of remote sensing and mathematical simulation

The map of the atmosphere pollution by SO_2, averaged 2005-2017



Annual mean deposition So2 (kg/person) from the Monchegorsk smelters



Prepared by SRCES RAS by processing 635 digital Summer time scenes of AURA satellite

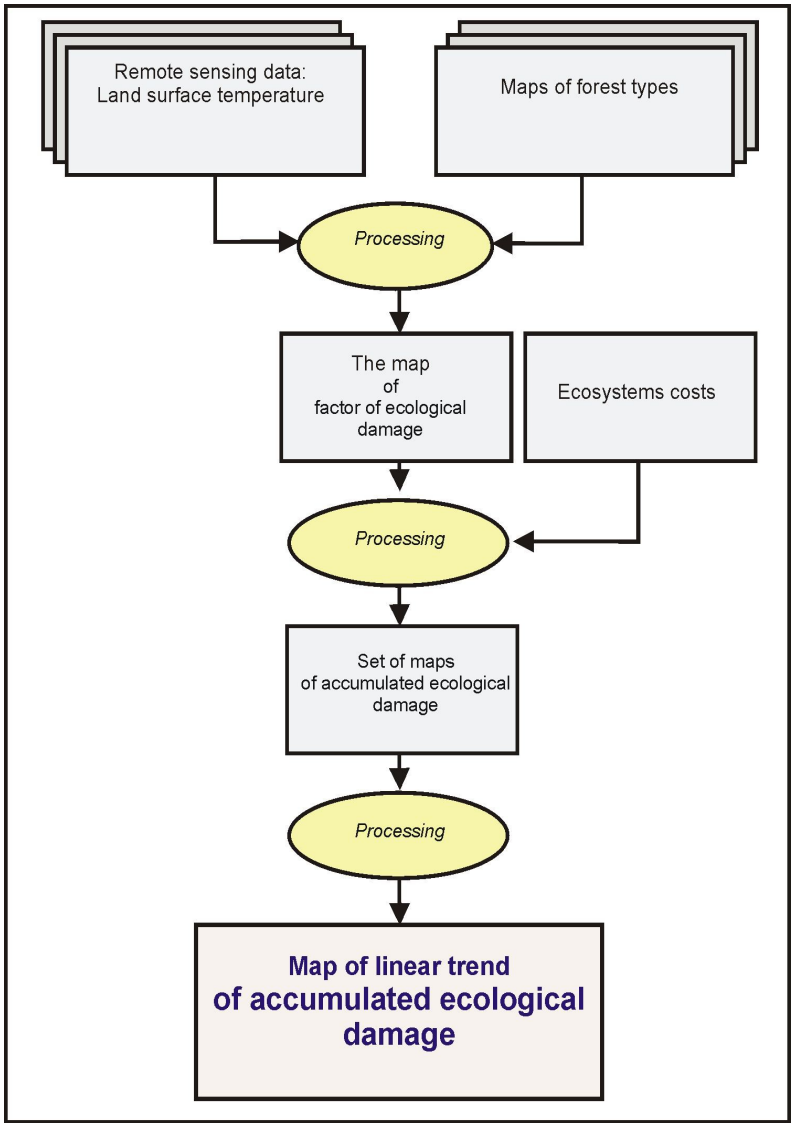
(Mahura et al., 2018, UHEL, WMO, EC, DG-JRC, UCPH)

Statistically averaged information in very simple form

Thermodynamic approach of ecosystem health mapping

(*Jorgensen J.S., Svirezhev Yu.M. Towards a Thermodynamic Theory for Ecological Systems. Oxford: Elsever, 2004. 366 p.)*

Cost of the accumulated ecological demage



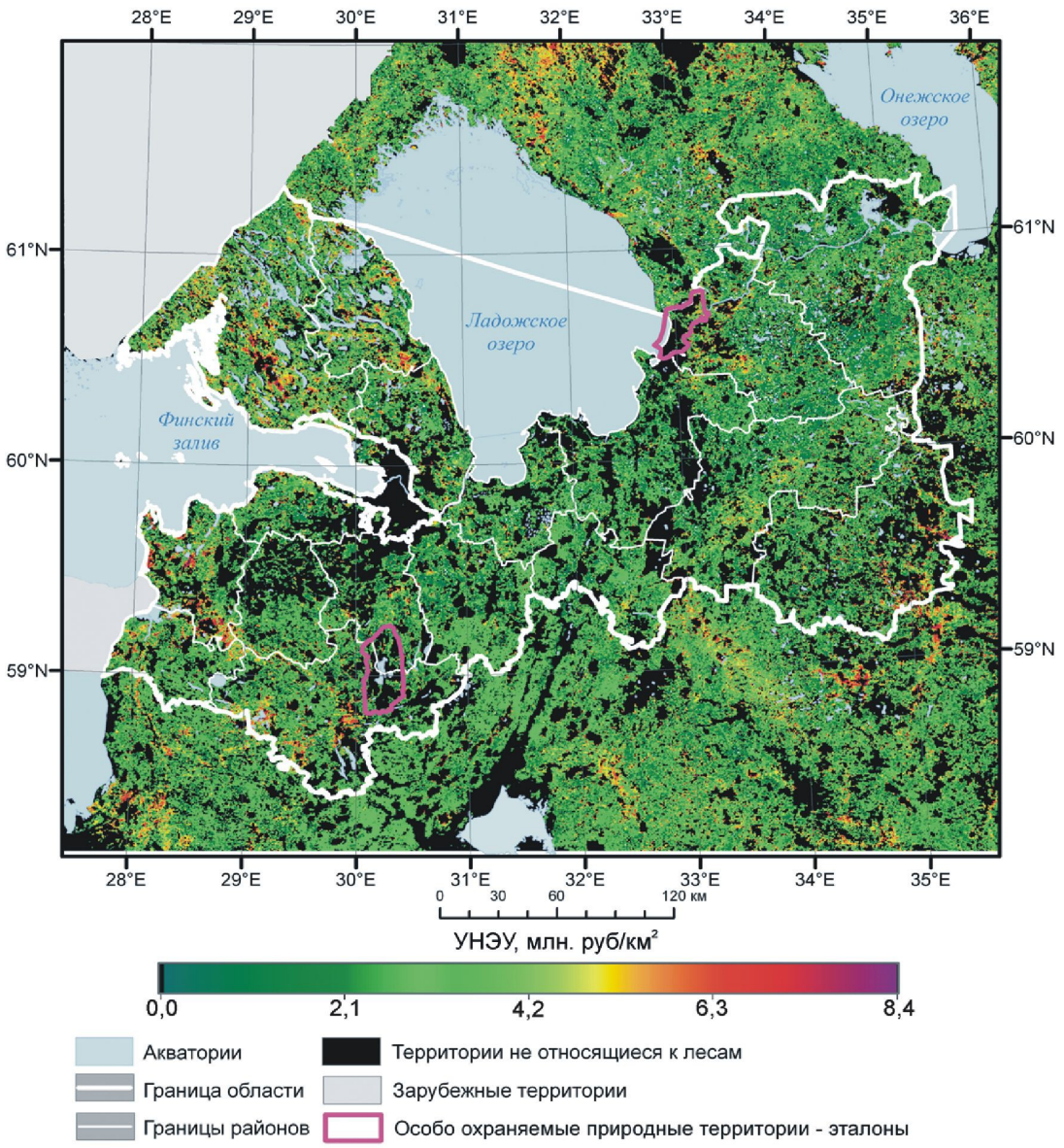
Main idea: evaporation rate is the measure of ecosystem damage

Linear trend reduces random fluctuations

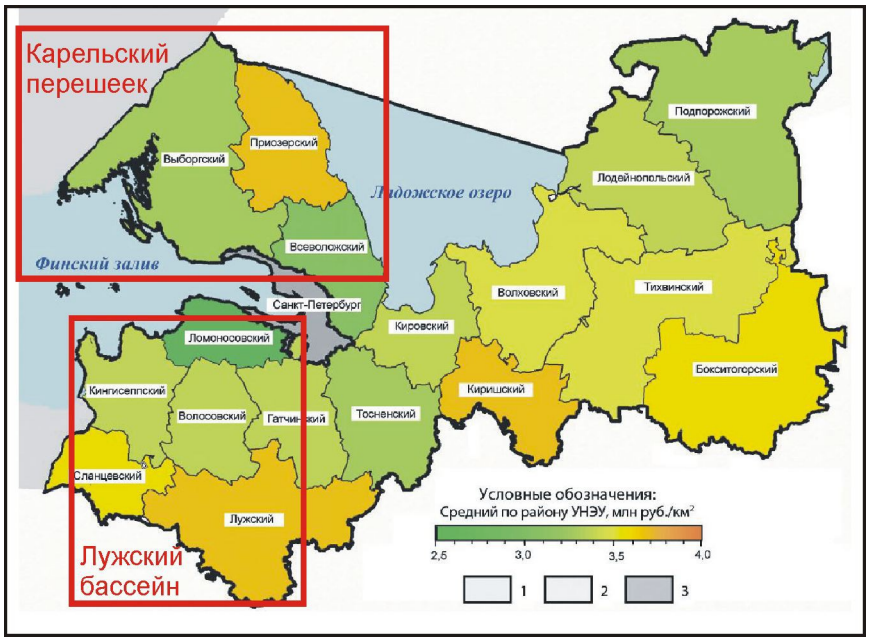
* *V. I. Gornyy, A. V. Kiselev, S. G. Kritsuk, I. Sh. Latypov, A. A. Tronin. Thermodynamic approach to satellite mapping of accumulated ecological losses of forest ecosystems // Sovremennye problemy distantsionnogo zondirovaniya Zemli iz kosmosa, 16(4), 2019. P. 124–136. DOI: 10.21046/2070-7401-2019-16-4-124-136*

Statistically averaged information in very simple form

Map of accumulated ecological losses Leningrad Oblast'



Administrative districts ranking

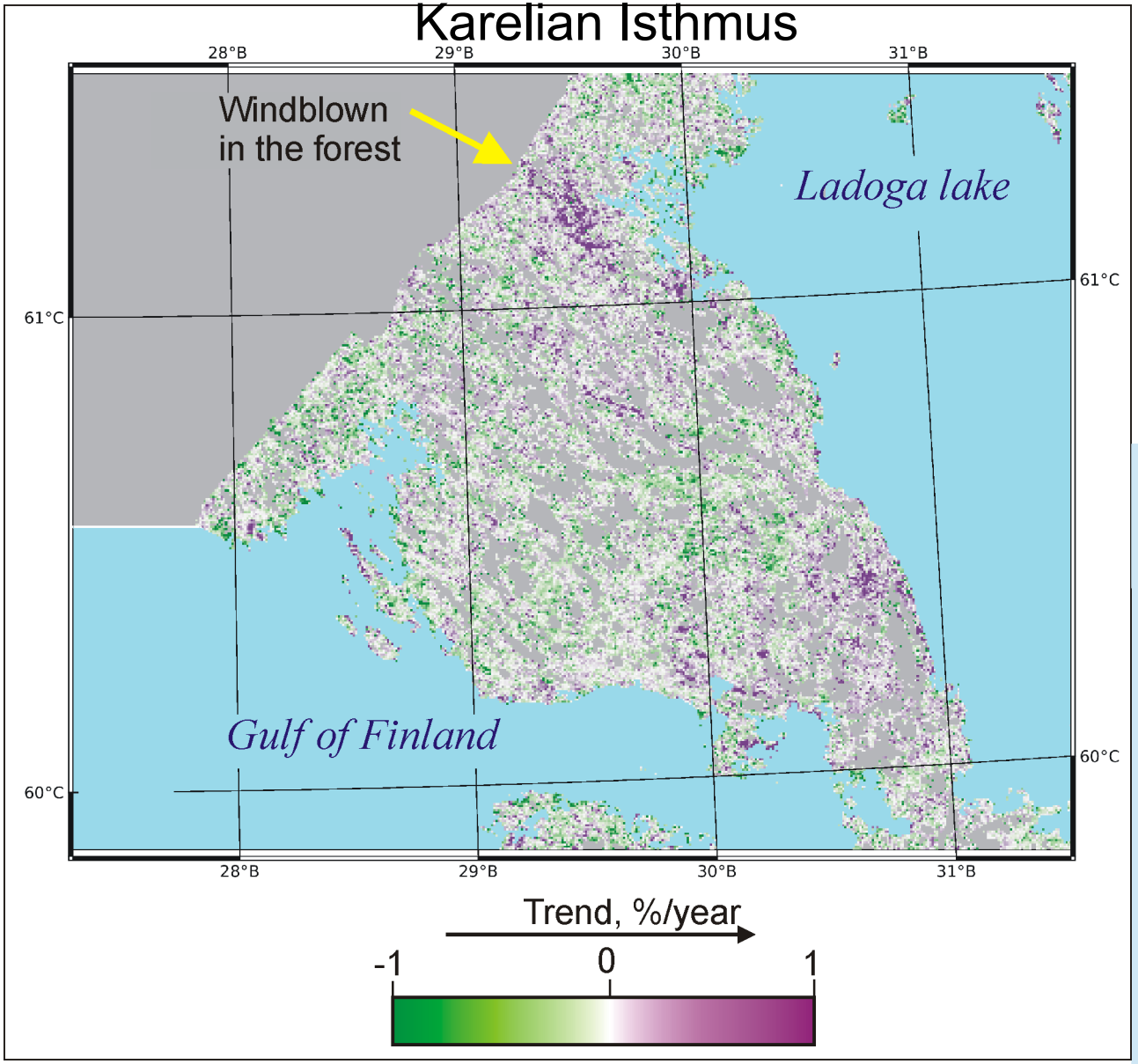


Data: *Mu Q., Zhao M., Running S. W. MODIS Global Terrestrial Evapotranspiration (ET) Product (NASA MOD16A2/A3). Algorithm Theoretical Basis Document. Collection 5. NASA Headquarters. Numerical Terradynamic Simulation Group, University of Montana, 2013. 55 p.*

Statistically averaged information in very simple form

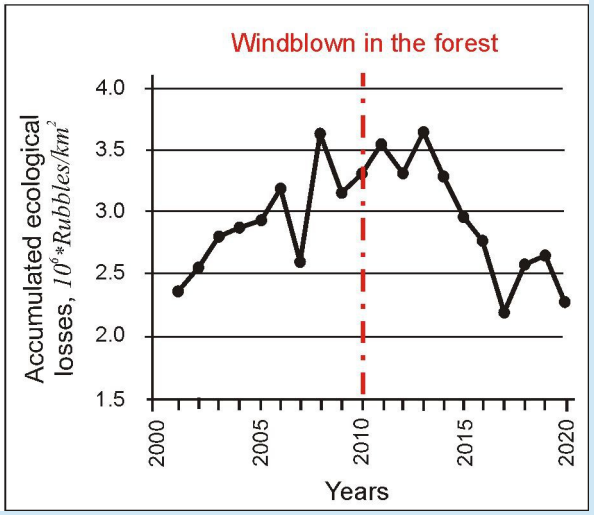
Natural factor

Trend of accumulated ecological losses (AEL)



Windblown in the forest
Harricane: July, 29-30, 2010

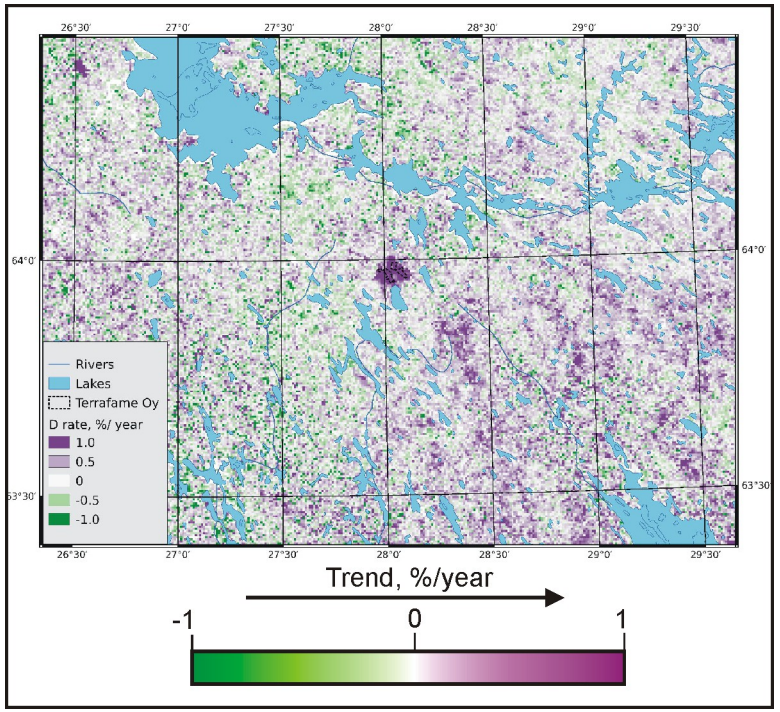
Year: 2013
Area: 628 km^2
AEL: 2.2 billion rubbles.



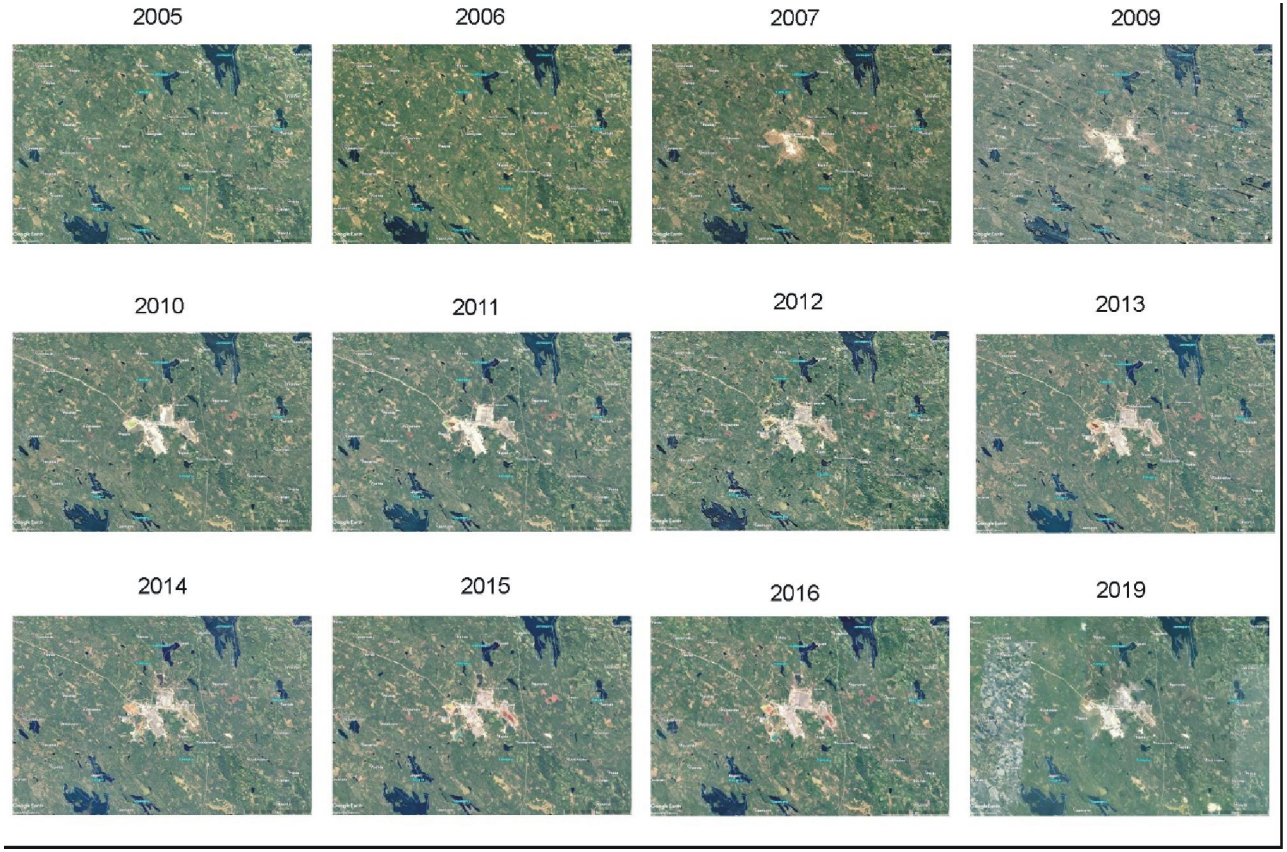
Statistically averaged information in very simple form

Technogenic factor

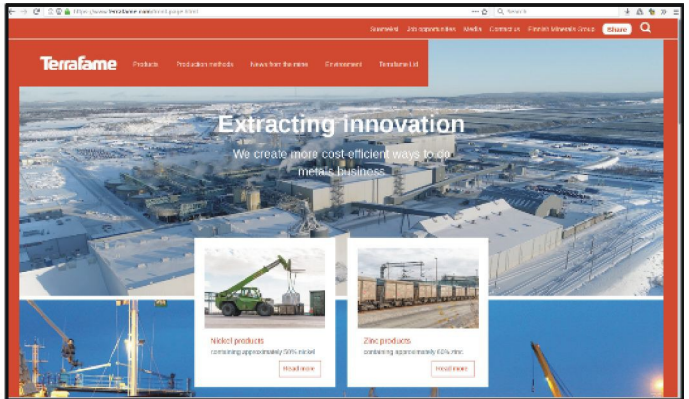
Central Finland



Start of construction



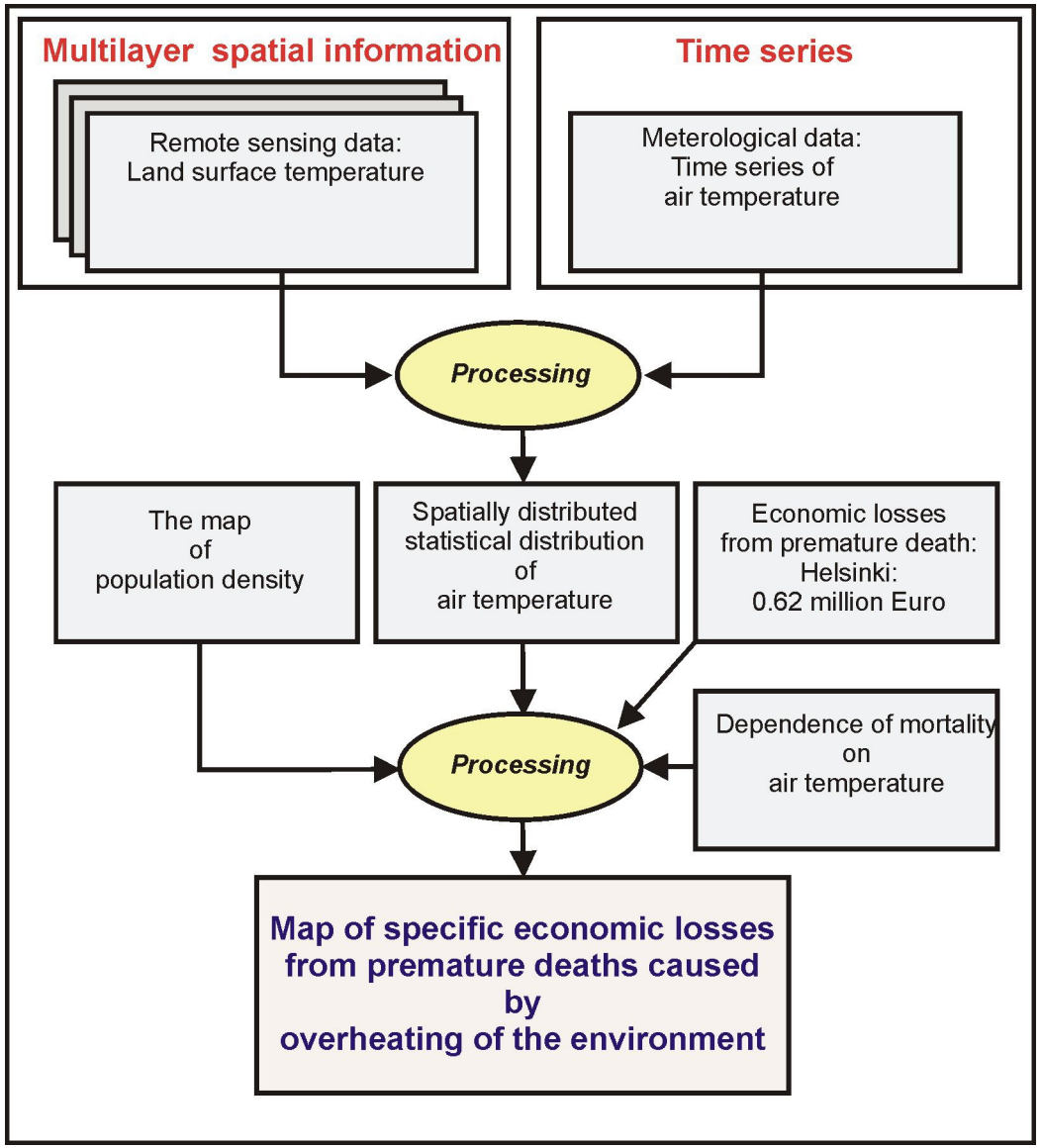
Terrafame mines (Zn, Ni)



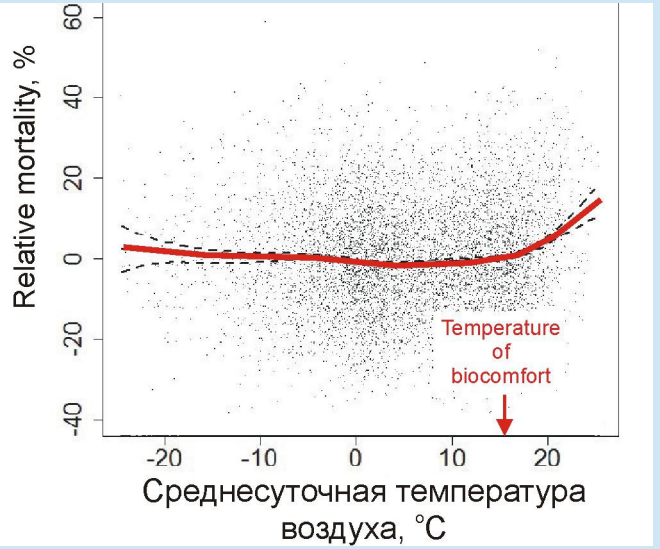
Daily and seasonal regular and random variations of environment state

Satellite mapping of economic consequences of premature deaths from heat waves in Helsinki

Algorithm



Dependance of relative mortalty on temperature in Helsinki

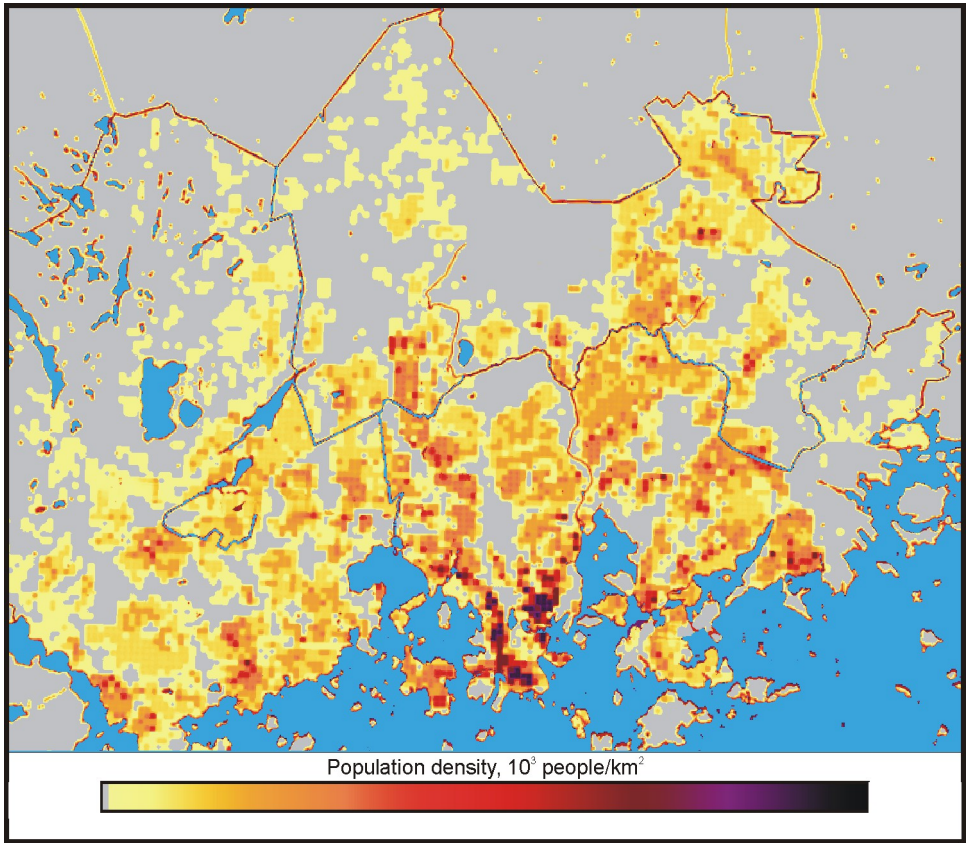


Reija Ruuhela et al. Biometeorological Assessment of Mortality Related to Extreme Temperatures in Helsinki Region, Finland, 1972–2014. Int. J. Environ. Res. Public Health 2017, 14, 944; doi:10.3390/ijerph14080944.
www.mdpi.com/journal/ijerph

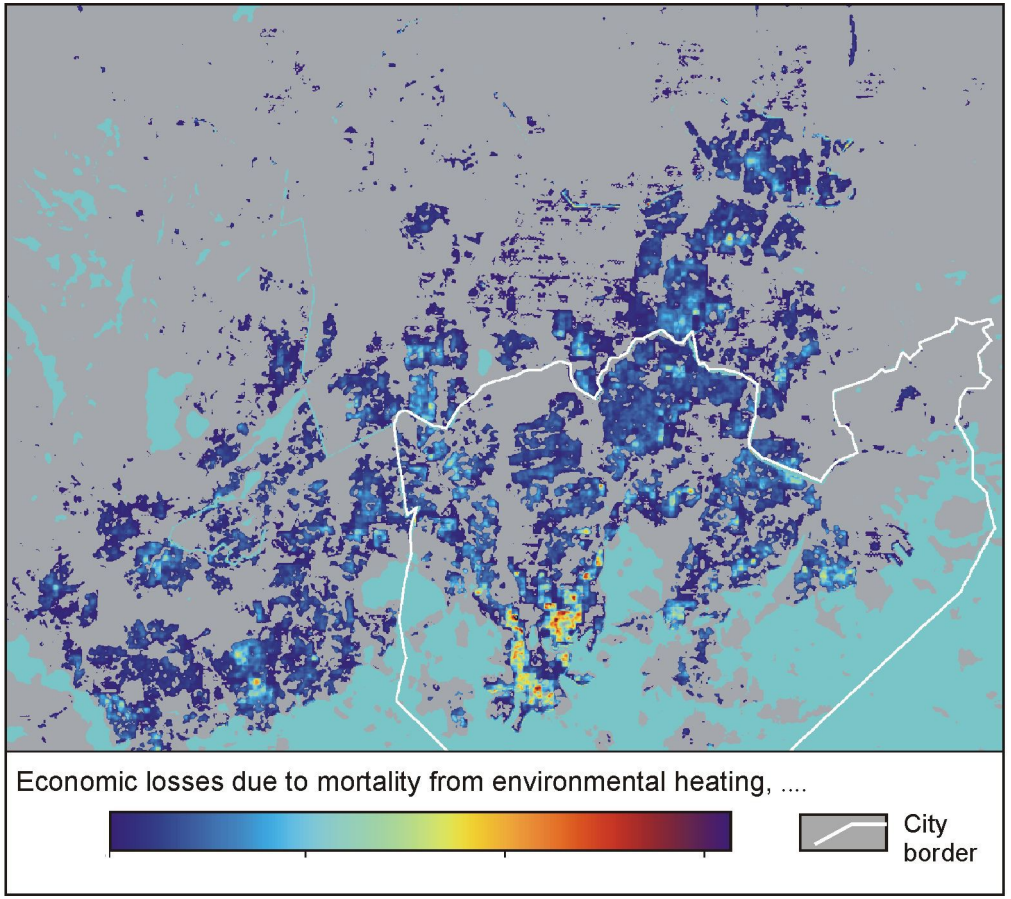
Daily and seasonal regular and random variations of environment state

Helsinki

Map of population density



Economic losses from mortality caused by overheating

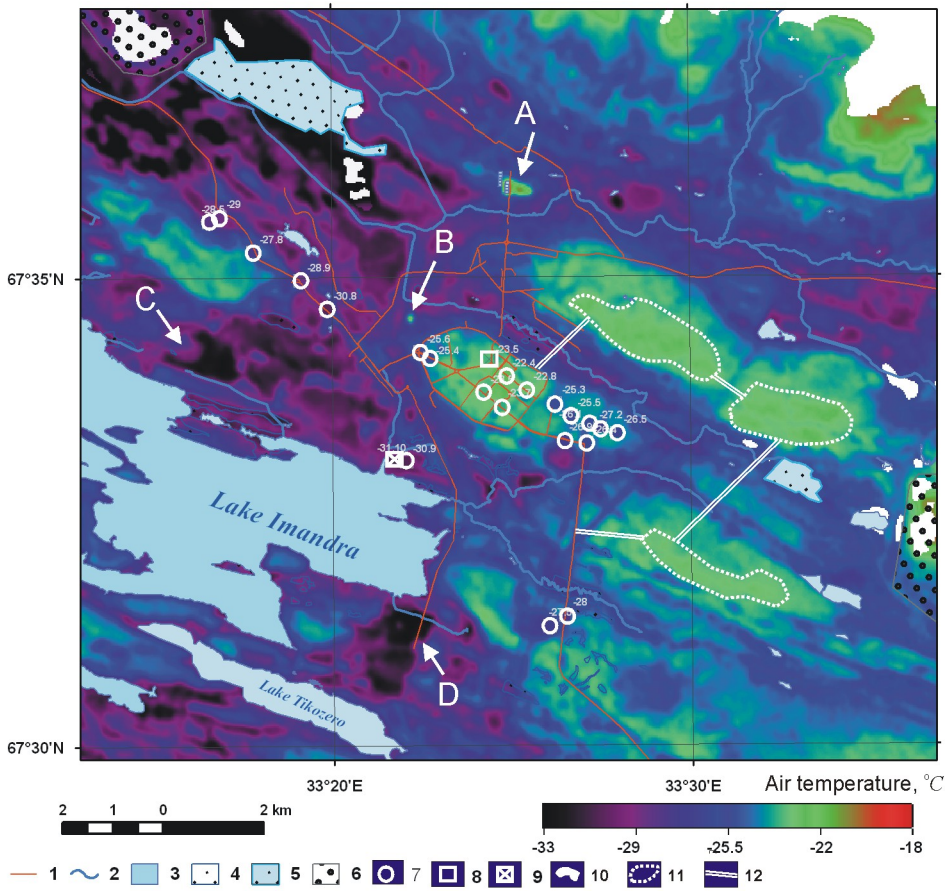


Benefits and possibilities of using satellite data archives

Satellite mapping of air temperature in Arctics

Town Apatity, Kola Peninsula

The map of air temperature
for the polar night time
00:00 GMT, 01.02.2018.



14 digital scenes of Landsat 7, 8 satellites was processed

Legent:

1.- roads;
2. - rivers & streams.
3. - lakes & ponds.
4. - wetlands.
5. – wet-tailing damps.
6. – dry-tailing damps.
7. – loggers,
8. – AWS.
9. – WMO.
10. – mask.
11. – proposed new districts.
12. – proposed high-way, connecting new districts

For the better biocomfort of Arctic population, it is advisable to build new settlements on the positive relief forms.

Thank you very much