



Green and Blue Urban Infrastructure
Innovation for Northern Eurasia
Transfer, Regionalisation, Planning Strategies and
Development Directions
WORKSHOP and ROUNDTABLE
SAINT PETERSBURG, RUSSIA | 2021 APRIL 19-20

Mapping and assessment urban ecosystem services in the city of Tyumen

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Introduction



[<http://www.worldbank.org/en/news/feature/2015/10/28/17sustainable-development-goals>]



Стратегия развития жилищной сферы

Российской Федерации
на период до 2025 года

Основные направления реализации стратегии:

Ипотека

Рост доступности жилья через снижение ставок и рост доли ипотеки в сделках с жильем
Развитие рынка ипотечных ценных бумаг

Коммерческое арендное жилье

Переход от «серого» рынка аренды к цивилизованному
Создание доходных домов, в том числе с привлечением коллективных инвестиций

Некоммерческое арендное жилье

От предоставления жилья в собственность к некоммерческой аренде
Реализация проектов, строительство некоммерческого арендного фонда

Городская среда

От строительства квадратных метров к жилью в комфортной городской среде

Строительство

От дефицита обеспеченности жильем к достижению стандарта комнатного расселения в жилых помещениях
От проблем дольщиков к созданию эффективного механизма гарантий прав граждан – участников долевого строительства и перехода на систему проектного финансирования с привлечением средств граждан через банковские инструменты
Создание механизмов стимулирования внедрения новых технологий и поэтапный отказ от устаревших методов строительства

Вовлечение земельных участков

От расширения городов к эффективному использованию застроенных территорий и пустующих участков внутри городских границ

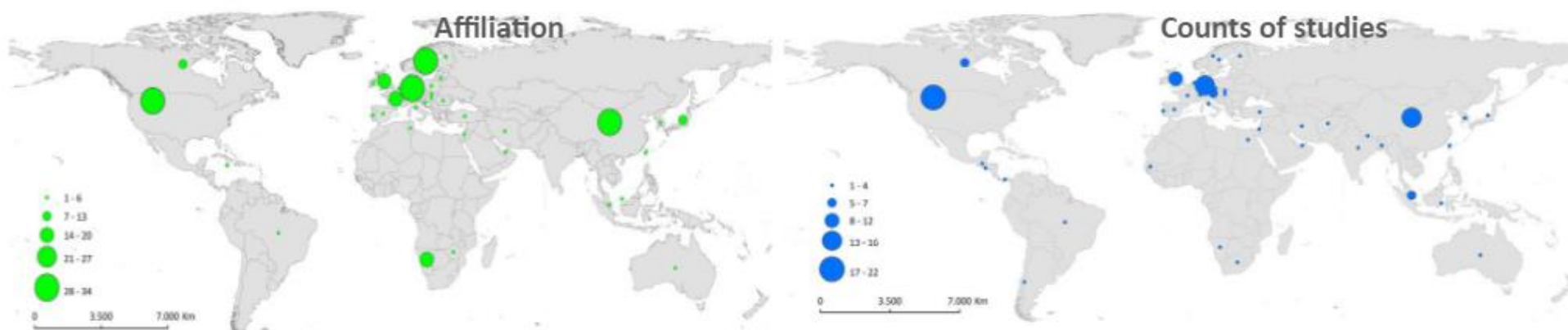


<https://habitat3.org/>

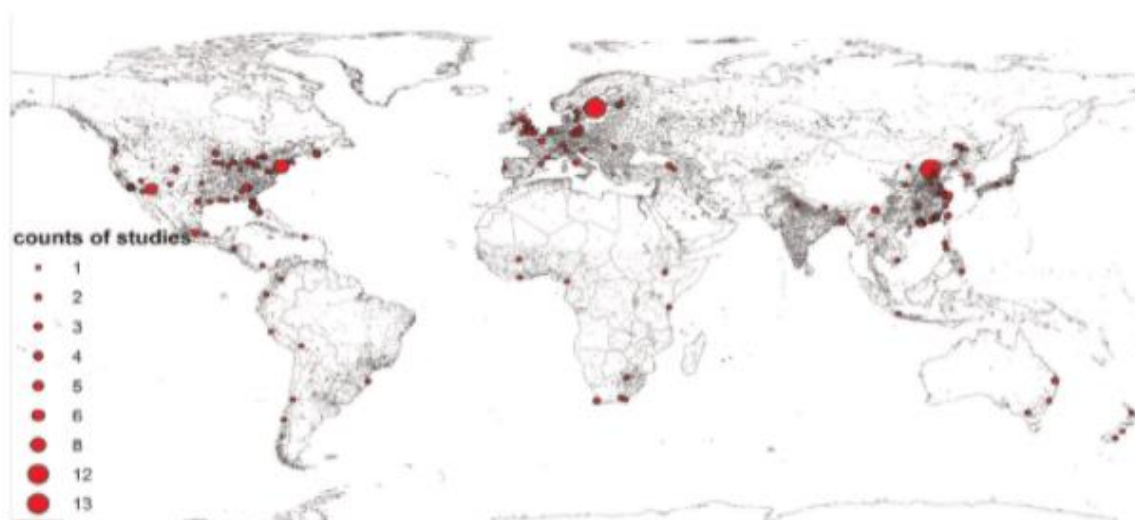
Importance of Urban Ecosystem services for Russian cities

Introduction

Global distribution of studies on ecosystem services conducted in urban areas



[Alavipanah S, Haase D, Lakes T, Qureshi S (2017) Integrating the third dimension into the concept of urban ecosystem services: A review. Ecological Indicators 72:374–398. <https://doi.org/10.1016/j.ecolind.2016.08.010>]



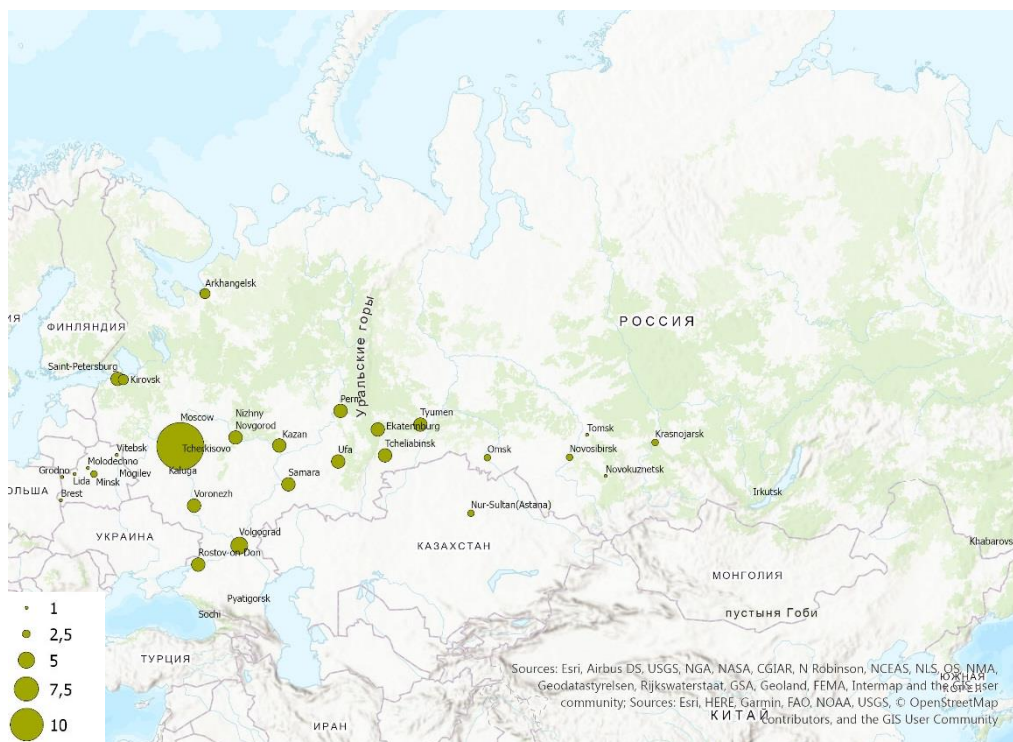
Russia is a white spot on the map of studies on urban ecosystem services...

...but probably because Russian scientists prefer Russian language?

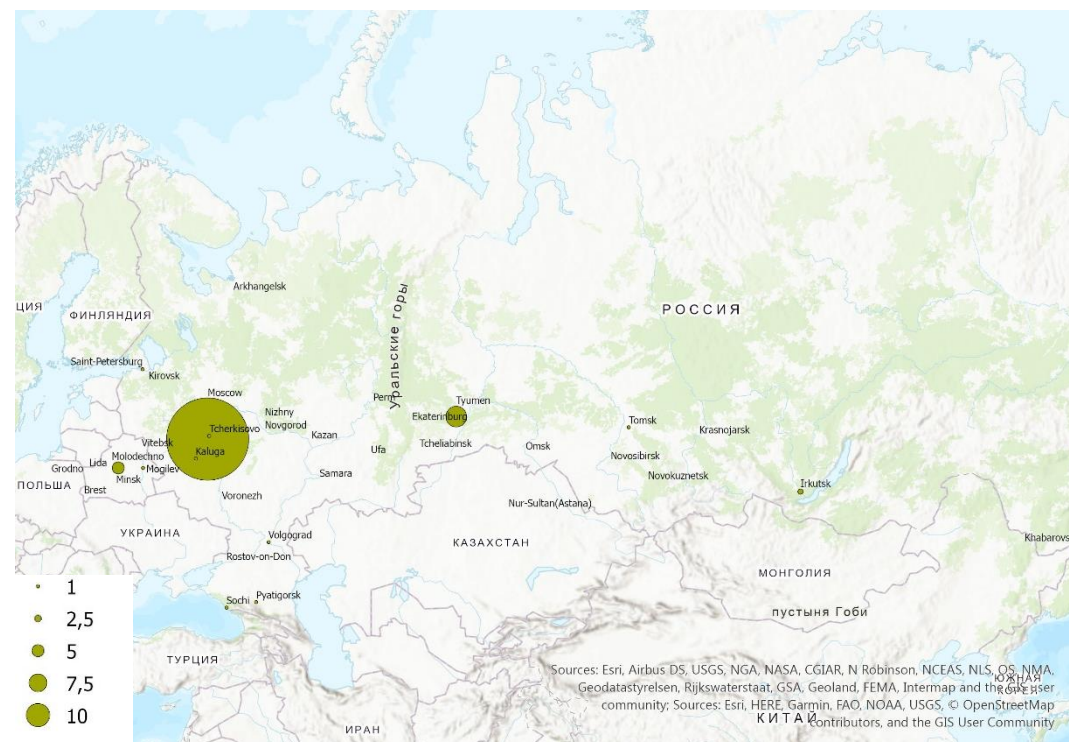
[C Luederitz, E Brink, F Gralla, V Hermelingmeier, M Meyer. A review of urban ecosystem services: six key challenges for future research. Ecosystem Services, 2015, 14, P. 98–112]

Introduction

Number of research papers about the city



Number of research papers by affiliation



[Done in collaboration with Diana Dushkova, Dagmar Haase, Dara Gaeva, Victor Matasov]



Regional schools and research are important for Urban Ecosystem services science in Russia

Case study area



Why Tyumen?

In Russia Tyumen is in the:

- 1 place - Index of happiness rating;
- 5 place - Rating of investments attraction;
- 19 place - Index of integral assessment.

BUT With poor city environment according to Urban environment quality index by

<http://индекс.дом.рф>



Materials and methods. Classification

Glossary

Ecosystem services - are all the benefits humankind gets from the ecosystem (fresh water and air, aesthetic view, etc.).

Ecosystem services provided in urban areas and cities and gained by urban inhabitants are defined as **urban ecosystem services**.

Since **urban ecosystem services** are relevant for urban areas and urban population, the main focus of research on urban ecosystem services is on **direct and locally generated ecosystem services**.



→ Ecosystem services

CICES

Towards a common classification of ecosystem services

Micro and regional climate regulation (**cooling effect**, regulation and maintenance CICES Section)

Physical and intellectual use of landscapes (seascapes) in different environmental settings (**everyday recreation**, cultural CICES Section).

Materials and methods. Initial data



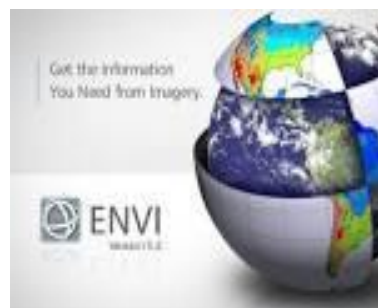
- waterbodies
- specially protected natural areas
- lakes
- large rivers
- land use
- surface types
- Vegetation
- land area

OpenStreetMap

The map of urban green and blue infrastructure

- the spatial distribution of green spaces and waterbodies;
- Type of green spaces and waterbodies (urban forest, park, lawn, garden, dacha, arable land, shrub, river valley, river, lakes, ponds, etc.)

USGS LandsatLook website:
LANDSAT 8 space imagery with minimum cloud cover (not more than 10%)



Geothermal scene: every pixel contains attributes in Celsius degrees



For the performance of the results

UHI map



- administrative boundaries
- buildings (with verified floors)

OpenStreetMap

the area of each residential buildings' polygons were multiplied by the number of floors and divided by the average living area (30 sq. m.); to facilitate the data aggregation we created the point layer with the centroids of the building polygons.

Map of the density of population in the city

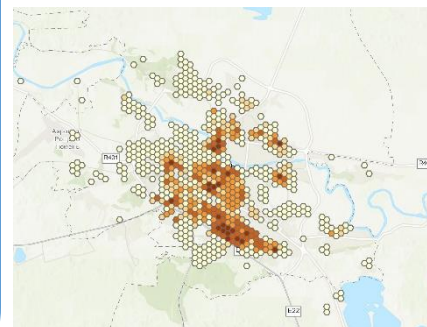
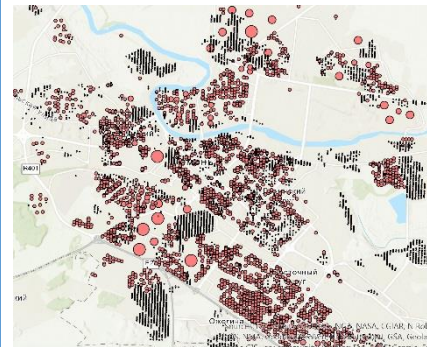
Materials and methods. Everyday recreation demand and supply assessment and mapping

DEMAND

amounts to 5% of inhabitants (number of people tending to recreate at the same time).

To calculate the demand for recreation the number of inhabitants in every residential building was multiplied by 0,05.

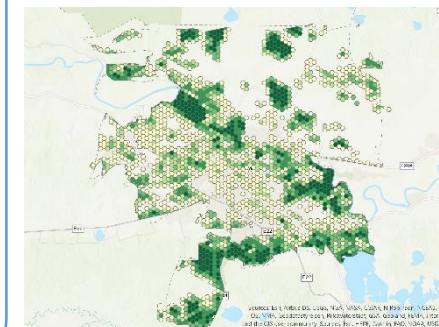
These results were aggregated by a hexagon fishnet with the 500 m.



Supply

1 hectare of urban blue and green infrastructure elements convenient for recreation (urban forest, park, garden, river, lakes, ponds, riparian zones) provides everyday recreation services for 50 recreants and for 2 recreant in case of specially protected zones.

These results were aggregated by a hexagon fishnet with the radius 500 m using the weighted sum method.

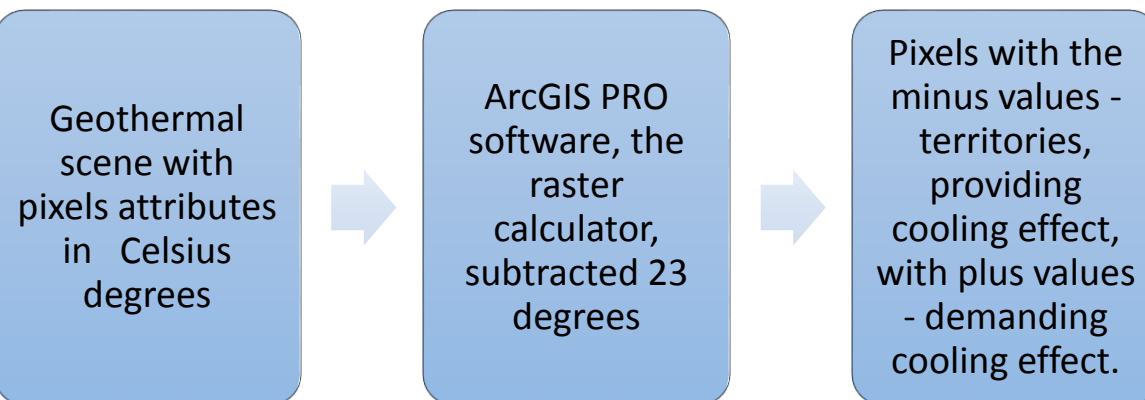


Materials and methods. Cooling effect demand and supply assessment and mapping

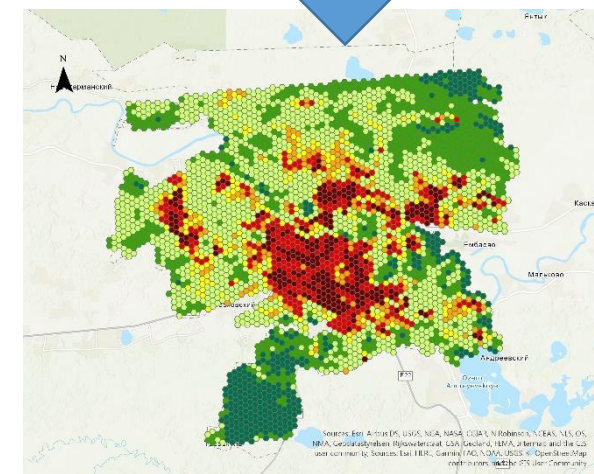
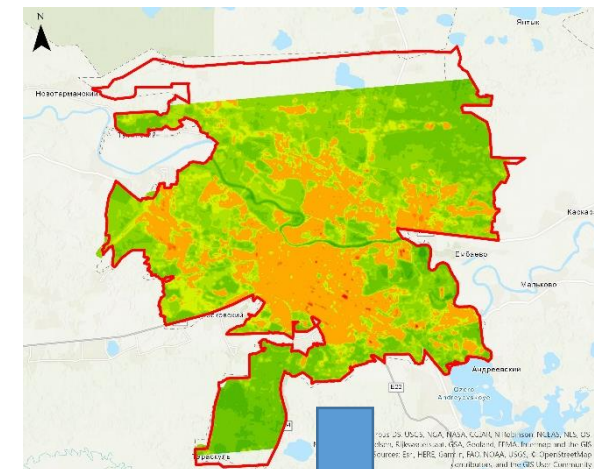
Temperature from 18 to 23 Celsius degrees does not create any thermal stress for the population.



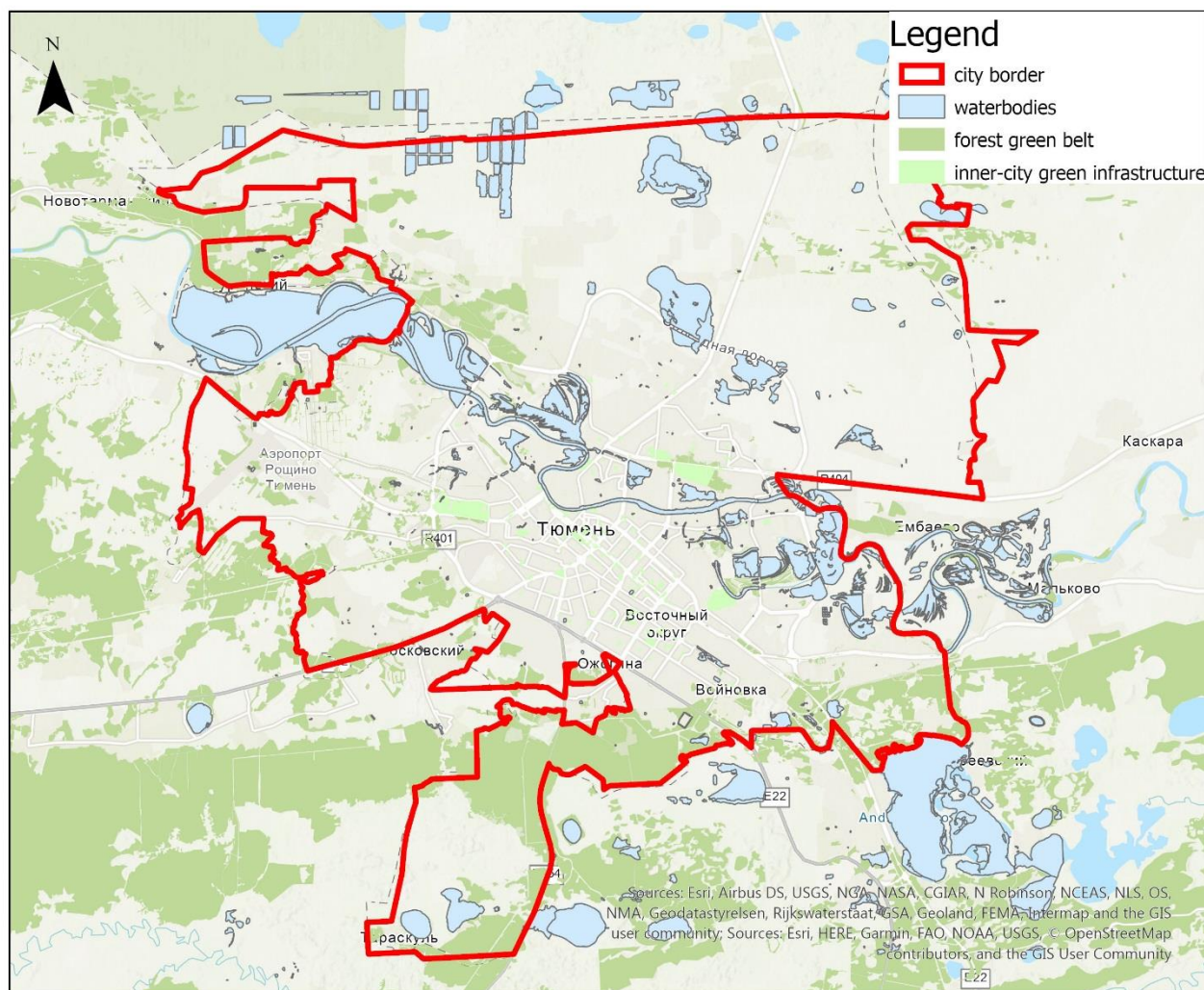
Cooling effect as a ES appears when the temperature is higher than 23 degrees Celsius



The values of each pixel were aggregated by a hexagon fishnet with the radius/side size - 500 m using the average value calculation method.



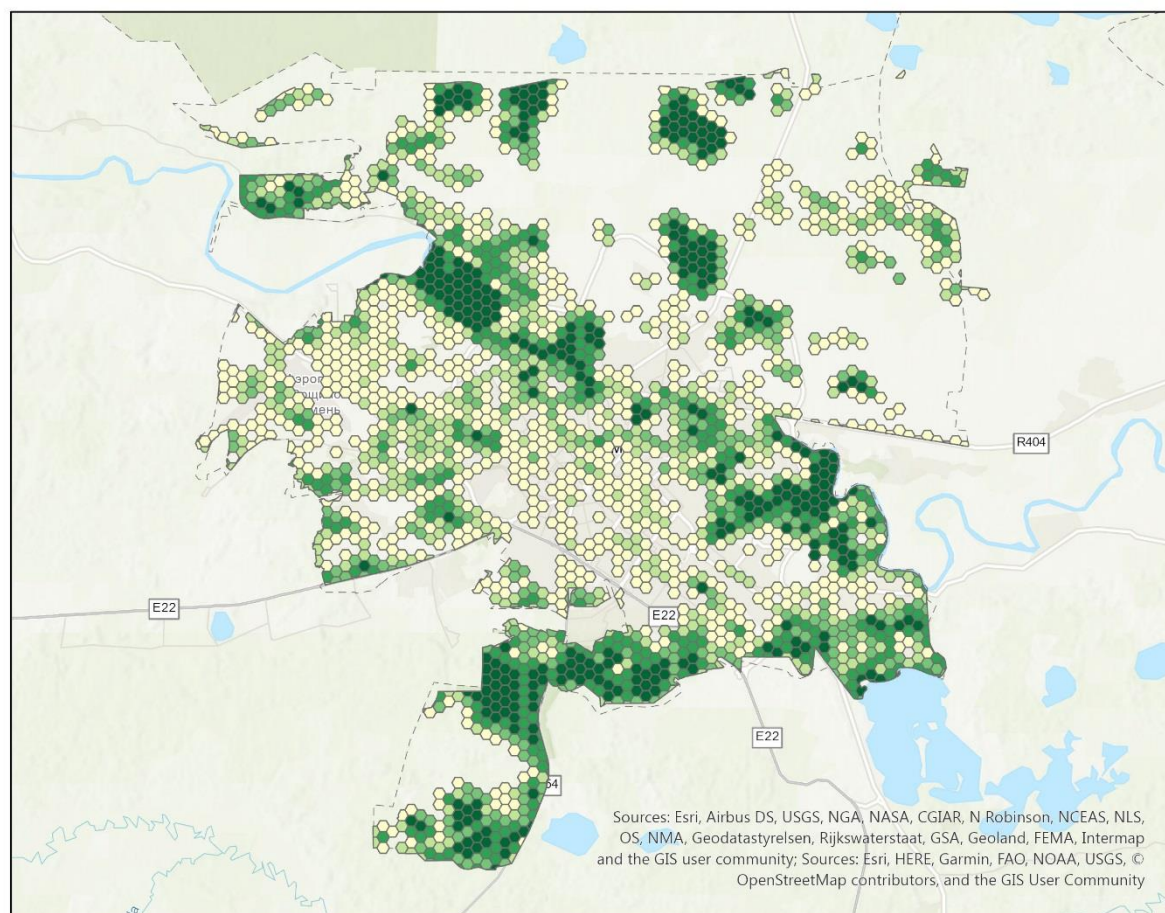
Results. Green and Blue infrastructure



The total area of the inner green infrastructure amounts to 478 hectares (0.68% of the urban district). The city's forest-green belt almost equal to the urban district area (66216 ha).

The blue infrastructure of the city includes the Tura River with small tributaries, lakes, and ponds.

Results. Everyday recreation supply



recreants supply

pSUM_recreants

≤167,056837

≤403,752019

≤671,571996

≤936,966133

≤1806,581478

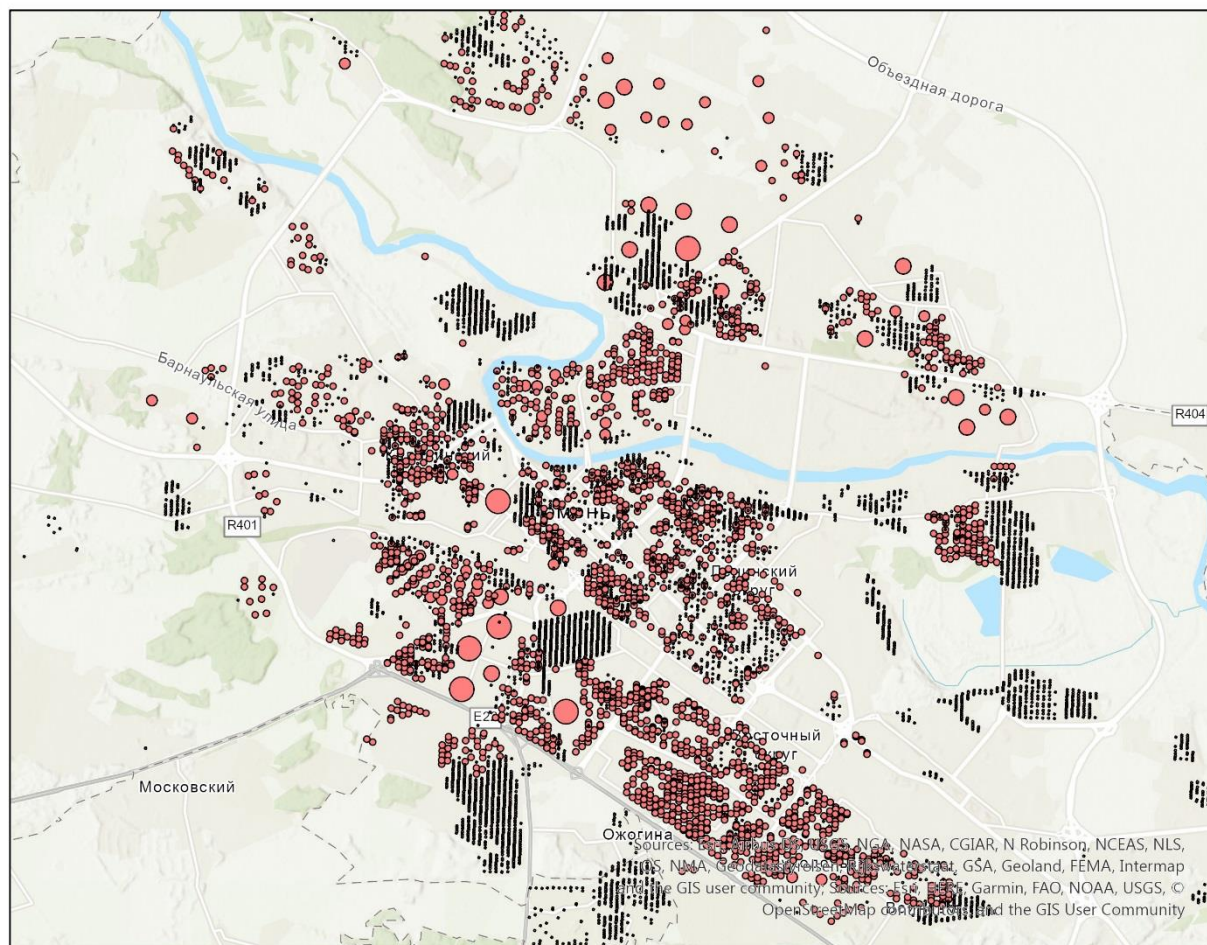
Green and blue infrastructure provide everyday recreation for 3700642 recreants.

The inner city green and blue infrastructure provide it only for 34034 recreants.



[Done in collaboration with Irina Akhmedova, Natalya Zherebyateva]

Results. Population density



person

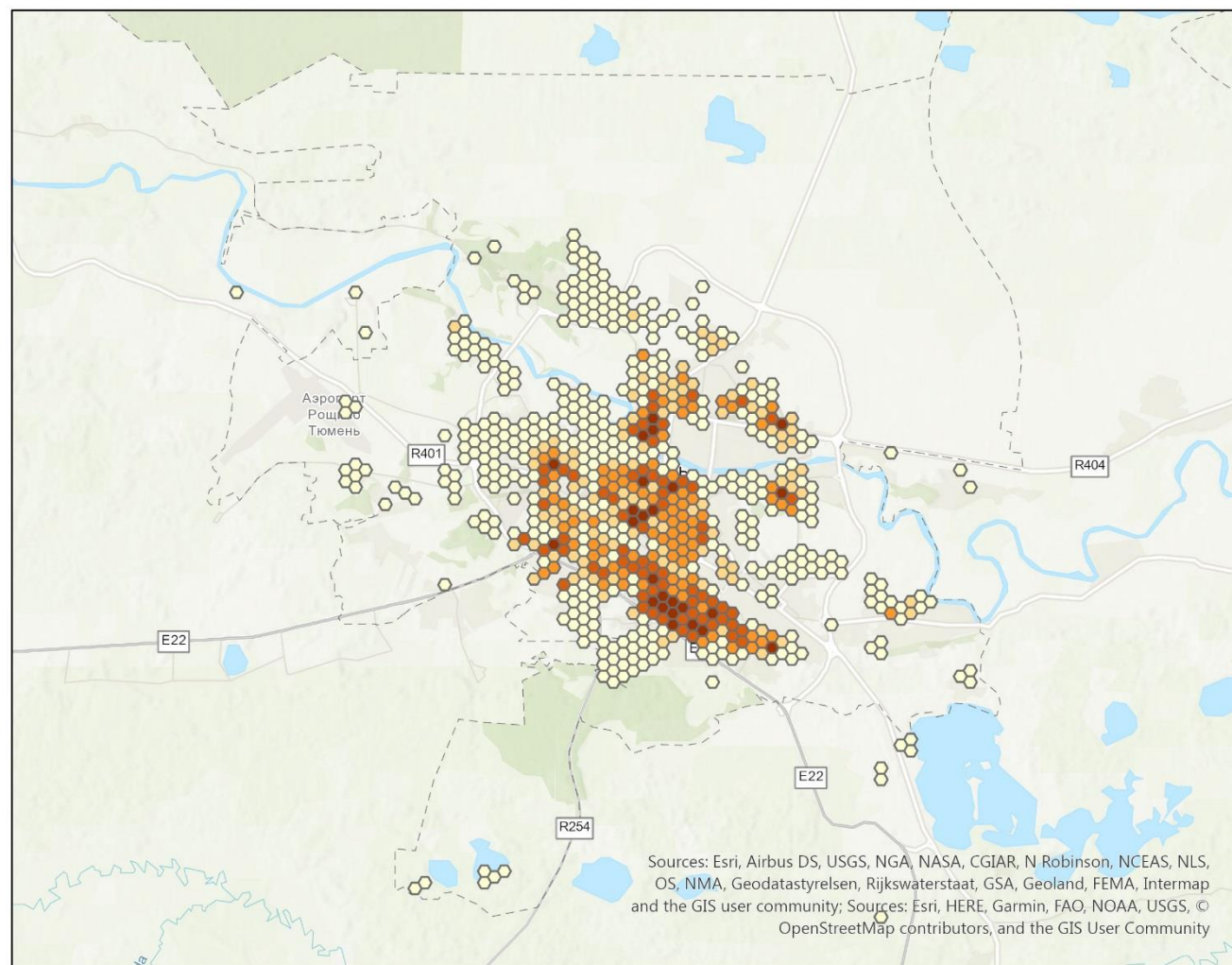
- ≤5
- ≤33
- ≤127
- ≤318
- ≤715

According to our method there were 711660 citizens in Tyumen in 2016 (720525 according to official statistics – 1% deviation)



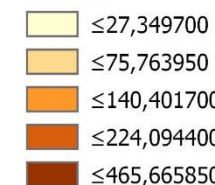
[Done in collaboration with Irina Akhmedova, Natalya Zherebyateva]

Results. Everyday recreation demand



recreants demand

SUM_recreants

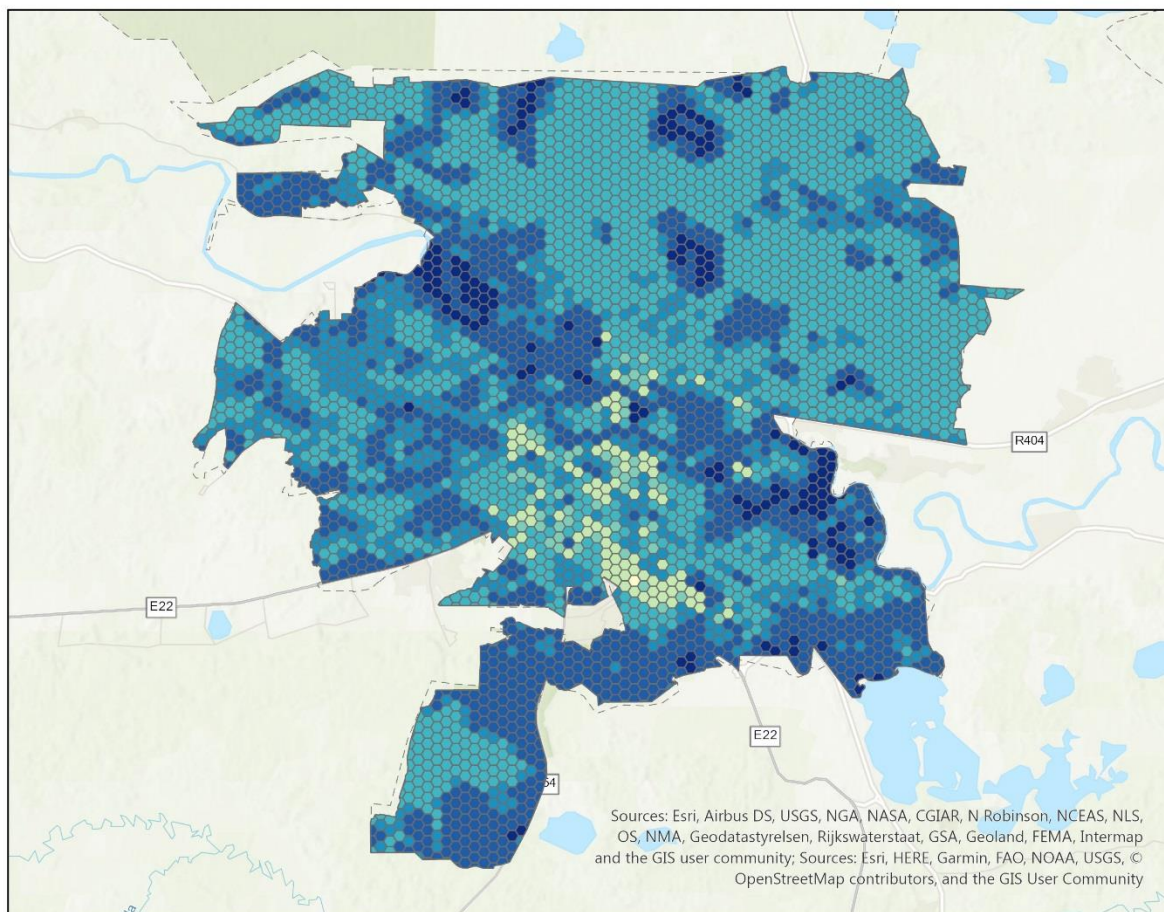


There are 35583 recreants, mostly living in the city center and new housing blocks

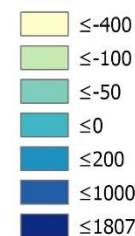


[Done in collaboration with Irina Akhmedova, Natalya Zherebyateva]

Results. Everyday recreation comparison of demand and supply



comparison
ratio



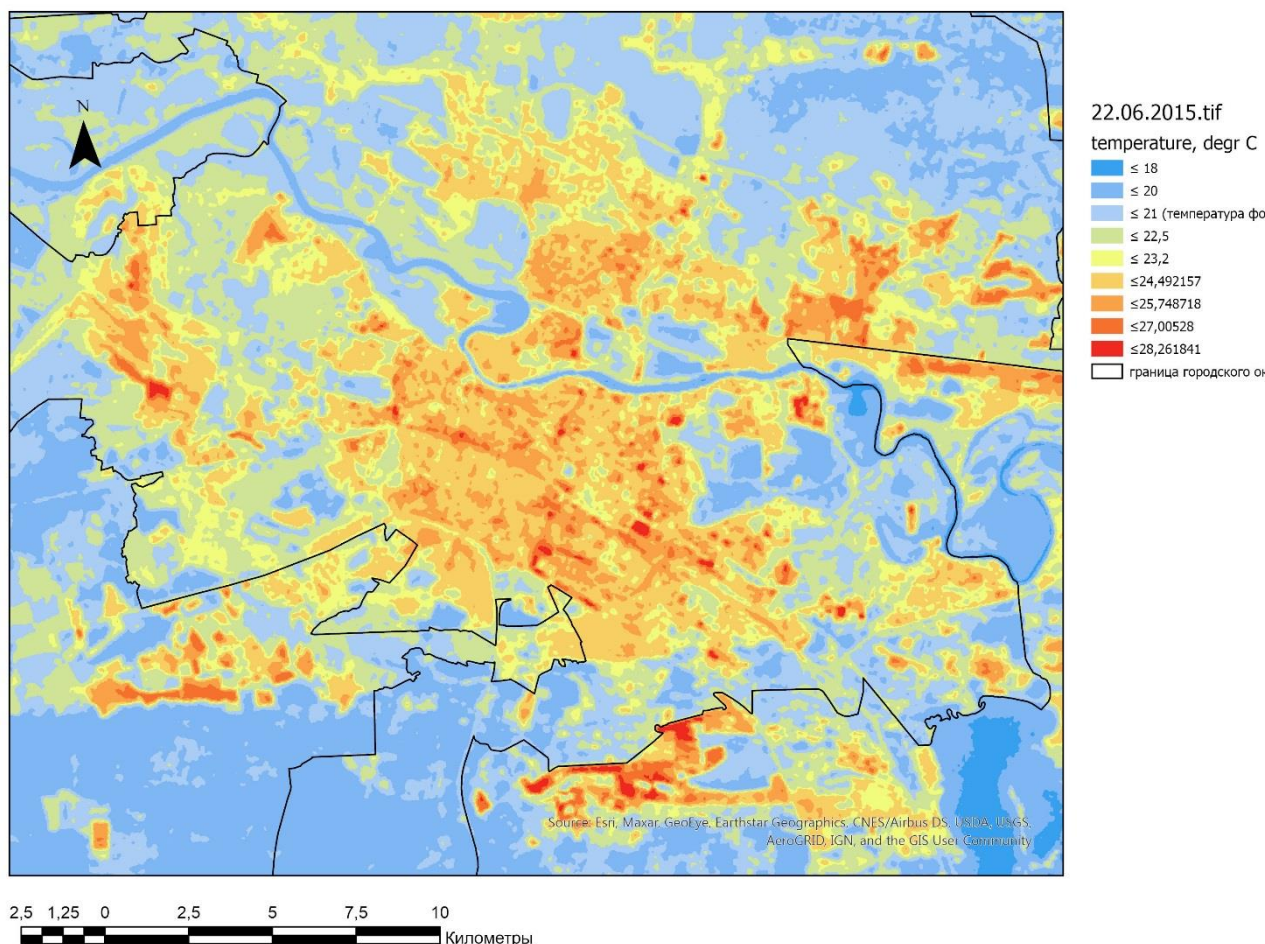
3700642 > 35583
Total supply demand
34034 ≈ 35583
inner supply demand

22460 recreants (63%, 449200 citizens)
did not have facilities for recreation
within 500 m zone.

The supply in the center of the city is
much lower than the demand, and in the
suburbs, the supply is higher. The spots
with a significant lack of ecosystem
services should be considered for
implementing green infrastructure sites.

Results

Geothermal scene for the city of Tyumen (22/06/2015)



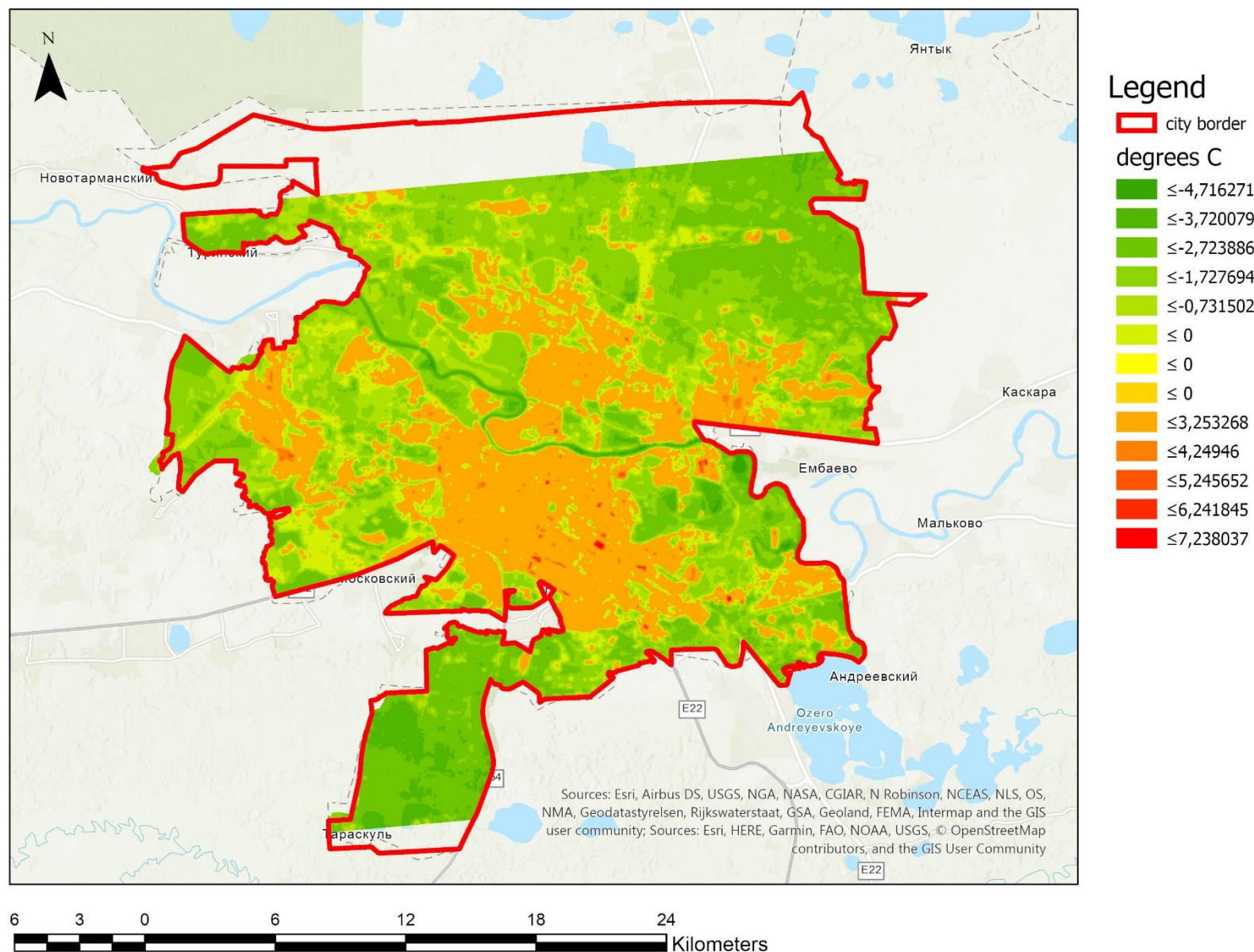
The temperature anomalies according to satellite imagery

Parameter	Temperature, °C
Physiological Equivalent Temperature	+23
Maximum temperature	+30,23 (industrial site)
Deviations from the average temperature (positive temperature anomalies)	+6,43
Minimum temperature	+17,23 (water bodies)
Deviations from the average temperature (negative temperature anomalies)	-6,57

[Done in collaboration with Irina Akhmedova, Natalya Zherebyateva]

Results

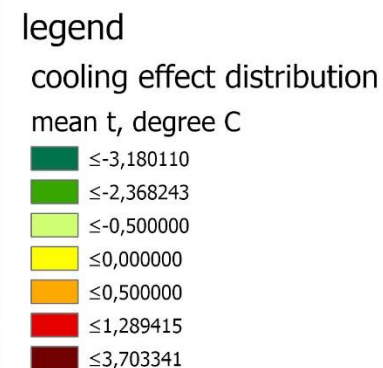
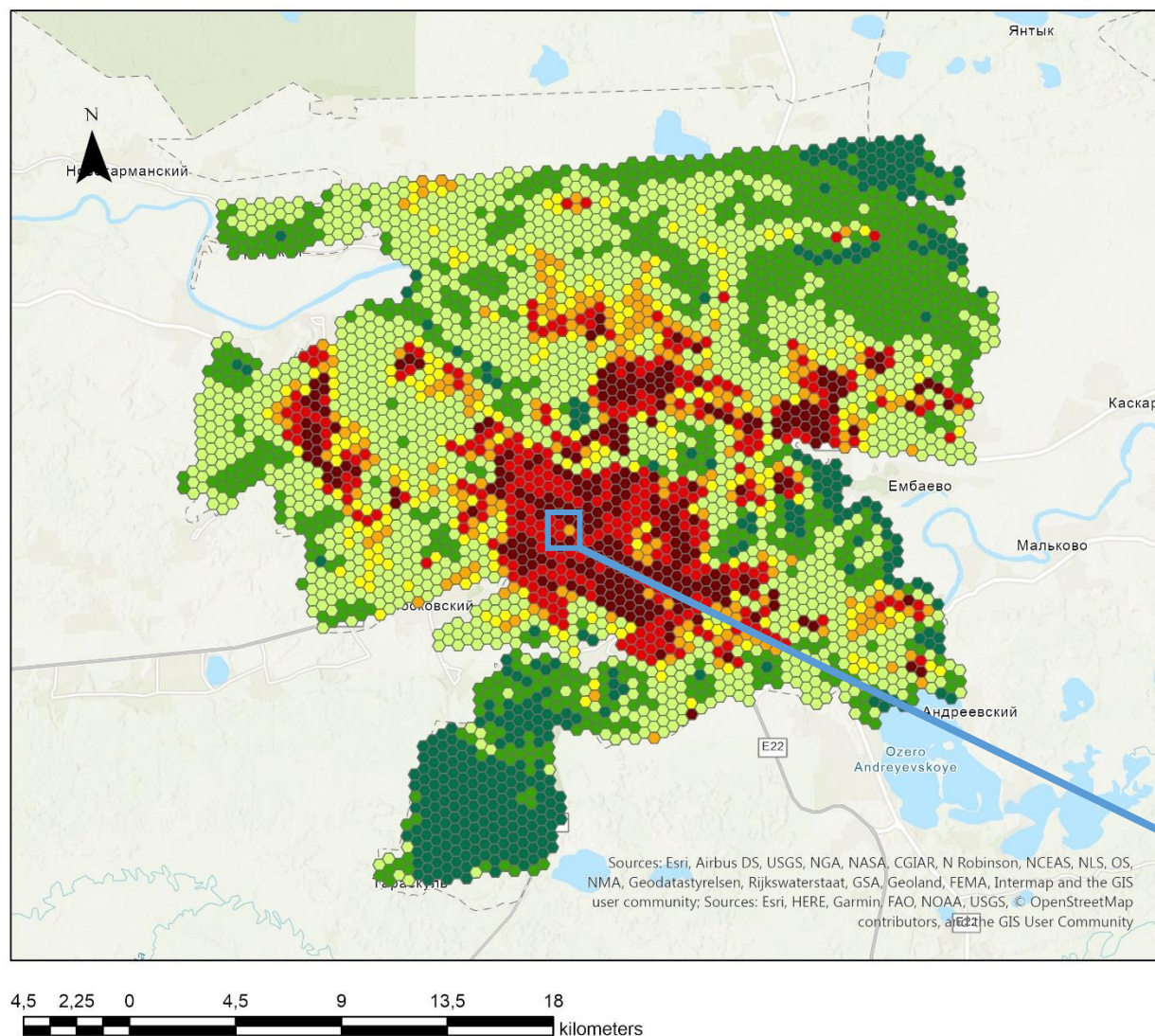
Difference from the maximum comfort temperature



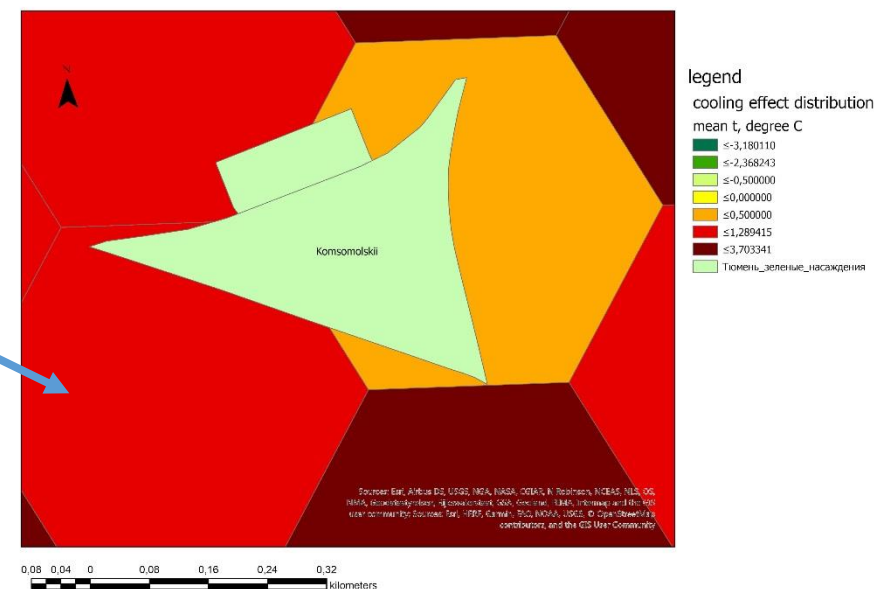
[Done in collaboration with Irina Akhmedova, Natalya Zherebyateva]

Results

Cooling effect demand (red) and supply (green) distribution



Only 23 % of the territory demand cooling effect, but 87 % of citizens are living there.



[Done in collaboration with Irina Akhmedova, Natalya Zhherebyateva]

Conclusions and discussion

1. Without considering the complexity and heterogeneity of the city environment, inner-city blue and green infrastructure and forest green belt of Tyumen provide much more ES than demanded by population.
2. Spatial analysis showed the supply of ES with high direct local significance (everyday recreation and cooling effect) in the inner part of Tyumen do not cover the demand.

This results could be used to emphasize the need for implementation of green and blue infrastructure in the inner part of the city.



Thank you for attention!