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GEOINFORMATICS RESEARCH DAYS 2021
5.5.2021

A NEW URBAN METABOLISM APPROACH:

COMBINING SATELLITE DATA AND URBAN METABOLISM ASSESSMENT FOR PROMOTING SUSTAINABLE URBAN DEVELOPMENT

Pro gradu 2021
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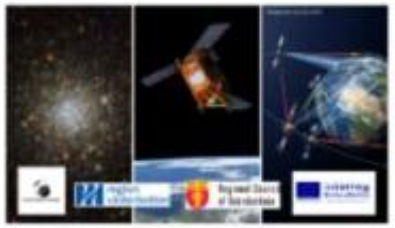


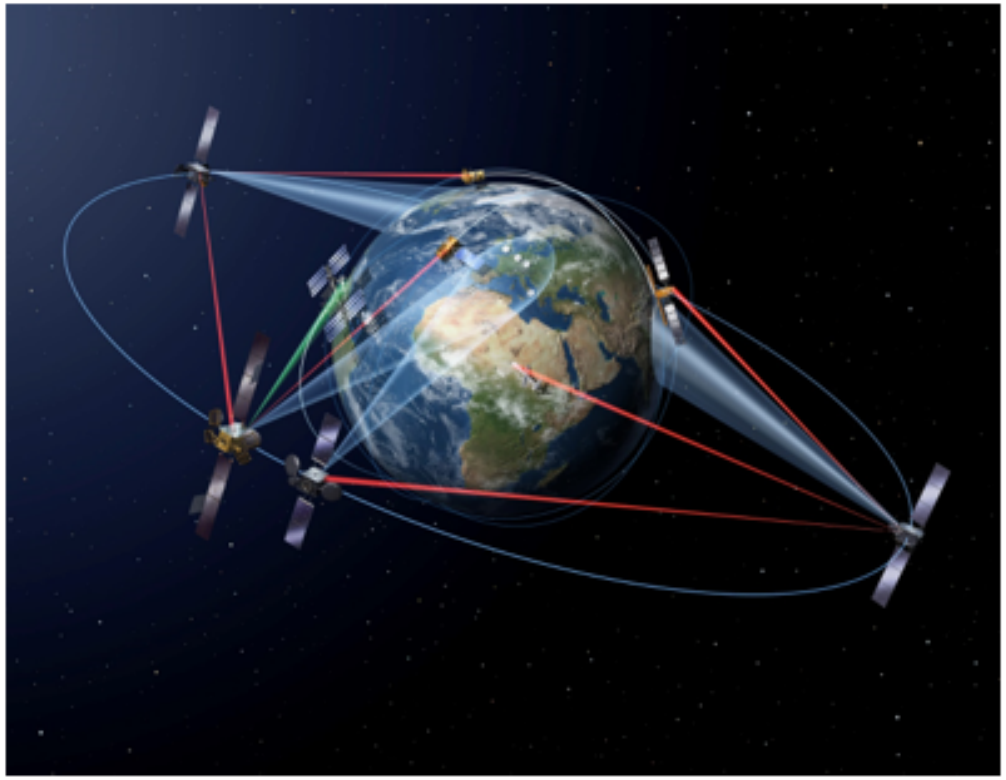
Welcome to boost your business with space-based data!

New Space Digital Economy Innovation Center (KvarkenSpaceEco)

"Kvarken Space Center"

www.kvarkenspacecenter.org

Kvarken Space Center Goals



Foster long term space based data utilization in the area

Develop local expertise and local and international co-operation networks

Provide initial and long term industry support

Demonstrate capability

- Data portal and the KvarkenSat ground station in Vaasa
- The KvarkenSat cubesat mission

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A New Urban Metabolism approach: Research background

- Urban areas are responsible for
  - *¾ of the global consumption*
  - *~ 70% of global CO_2 emissions*
  - *most of the goods are produced <u>outside</u> the urban boundaries*

(Mohan, Amulya & Modestra 2020)

We are overusing our natural resources about 1.75 times faster than our planet can re-generate

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Research objectives

- To develop further urban metabolism concept with satellite data
- Scrutinise usability of satellite data in sustainable urban research
- To fit the created framework into urban policies to promote use of urban metabolism assessment and satellite data when aiming towards sustainability

Methods: Literature review & focus group discussion

Sentinel-2 RBG image of Vaasa

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Urban metabolism

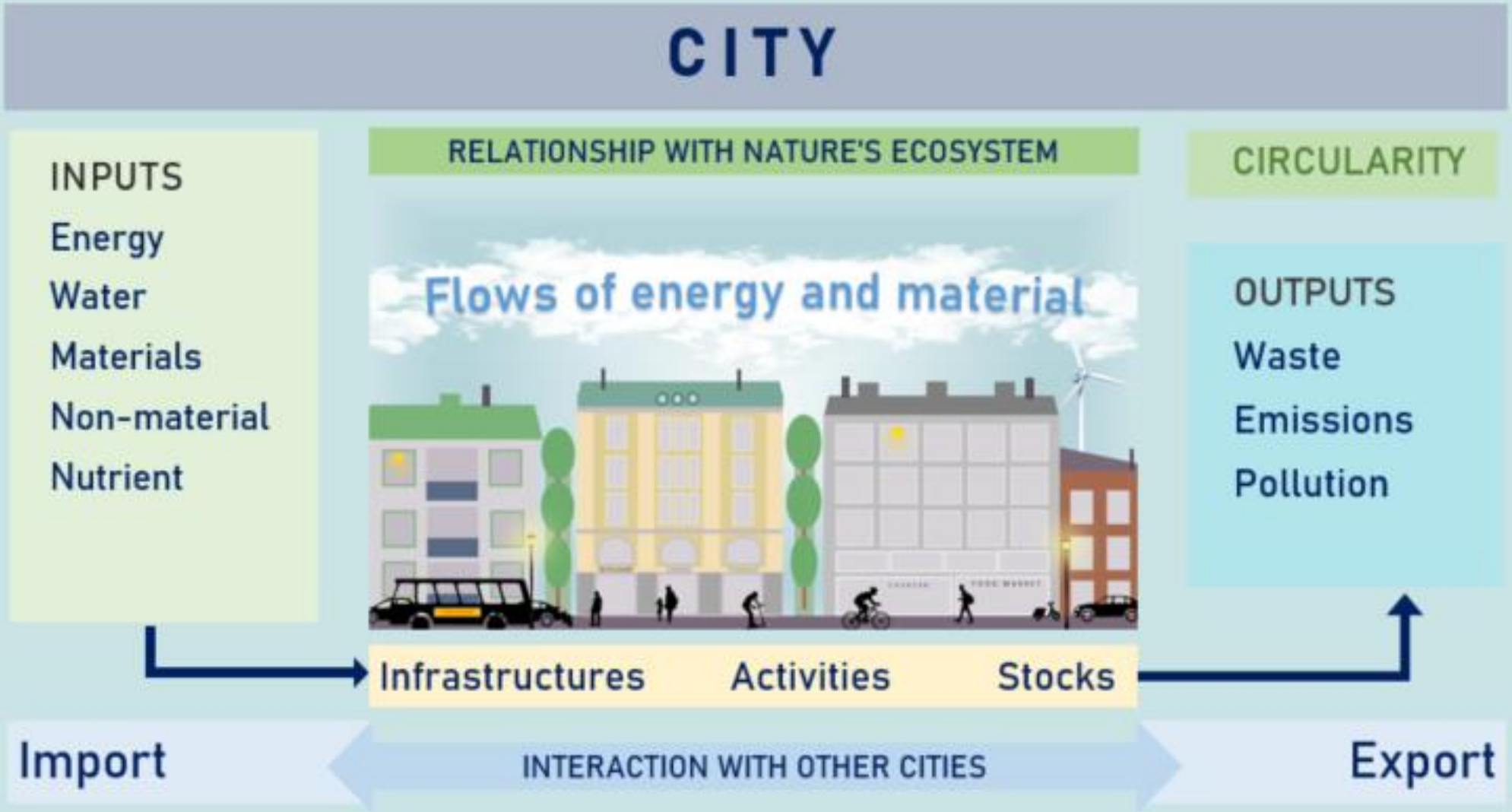
- Describes the **material and energy flows** entering the city, their circulation in a city and output of flows

"the sum total of the **technical** and **socio-economic** processes that occur in cities, resulting in growth, production of energy, and elimination of waste"

Christopher Kennedy et al. (2007)

- **Defining and evaluating** urban system and its sustainability
- **Overall view of city's efficiency** across multiple sectors within city
- Analysis and results provides **support for policy and decision-making**

Urban metabolism



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Satellite-based data

EARTH OBSERVATION (EO) AND REMOTE SENSING (RS)

- **Earth observation** is gathering information of the physical, chemical and biological systems
- **Satellite data**/imaginary is gathered via remote sensing technologies
- **Remote sensing** is obtaining and monitoring the physical properties of an area (sea, land & air) without being there

Sources: NASA, ICEYE and GIS Geography

Satellites are collecting different types of data about Earth activities e.g., CO_2 emissions, climate, vegetation, population and city infrastructure

How is space-based data used?

Kvarken Space Center

SPACE TECHNOLOGIES ARE USED FOR:

MONITORING DISASTERS

Earthquakes, forest fires or floods and detection of oil spills

COMMUNICATION

Mobile phones, satellite TV, internet access in remote areas

TRANSPORT

Navigation systems, transport safety, monitoring of shipping routes

AGRICULTURE AND LANDUSE

Precision farming, control of fishery stocks, forestry

ENVIRONMENTAL MONITORING

Vegetation, ocean currents, water quality and the atmospheric composition

SAFETY AND SECURITY

Search and rescue, marine emergencies, border control

SCIENCE AND RESEARCH

Fundamental research and applied research

URBAN AND REGIONAL PLANNING

Sustainability, urban metabolism

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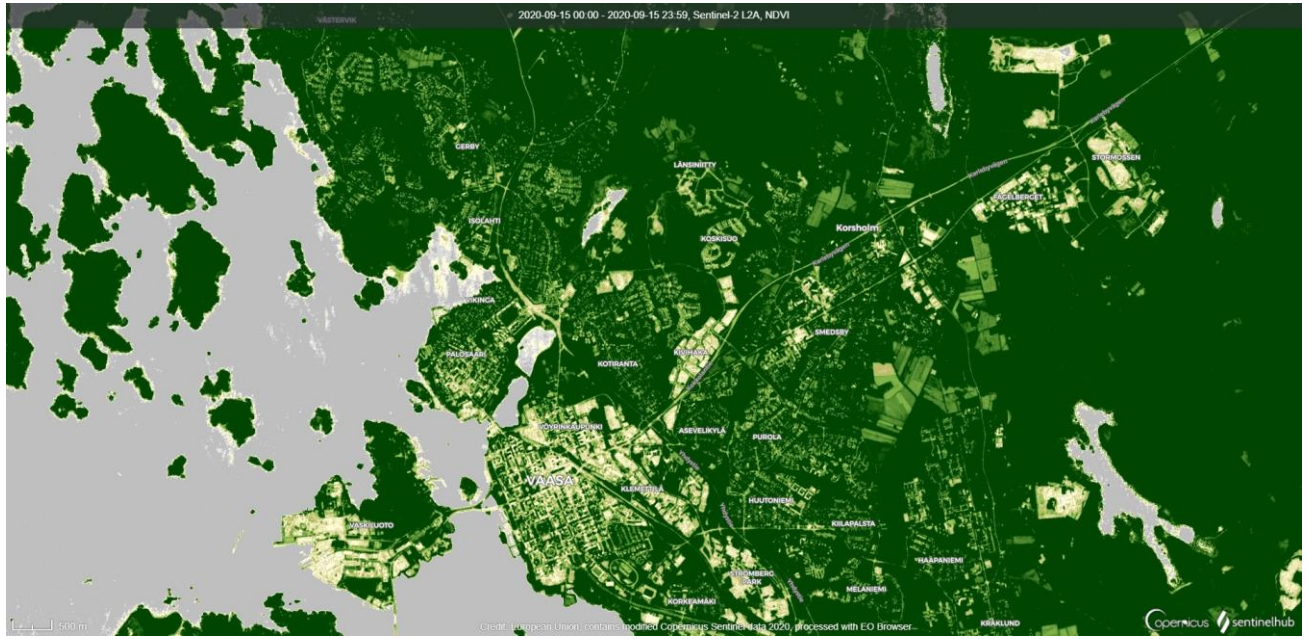
ESA Sentinel 1 radar data
provides size and shape information

Satellite images can be combined with different datasets (e.g. energy use) in GIS applications e.g., to produce urban classification models, and to predict and quantify city's sustainability



ESA Sentinel 2
NDVI image of Vaasa
provides (normalized difference vegetation index) vegetation health metric

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Key findings made in Master's thesis

I

Urban metabolism is currently a leading method for quantifying the energy consumption and material usage in urban ecosystem

Urban metabolism assessment helps in identification of urban sustainability challenges

However, it does not solve urban problems per se and it is not comprehensive – practical use of UM requires collaboration between different stakeholders and multi-disciplinary approach

II

Urban metabolism assessment requires a lot of data to build an overall picture of urban ecosystem

The commercialisation and development of satellite technology help urban assessment since the data is mostly free, open, and has wide spatial and temporal scope.

Satellite data has great opportunities and benefits, although it requires investments in human knowledge and data handling capacities

III

The knowledge gained in urban metabolism assessment helps policymakers understand the local urban ecosystem and their use of resources

Urban metabolism is a good approach to be integrated with urban sustainability projects as well as in setting goals

The new approach to urban metabolism assessment has major opportunities for cities therefore its use should be promoted via urban policies

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THANK YOU!

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