

Understanding the interactions between urban growth, land-use changes and greenhouse gas emissions

A case study in the Stockholm Region

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Stockholms
universitet

Motivations

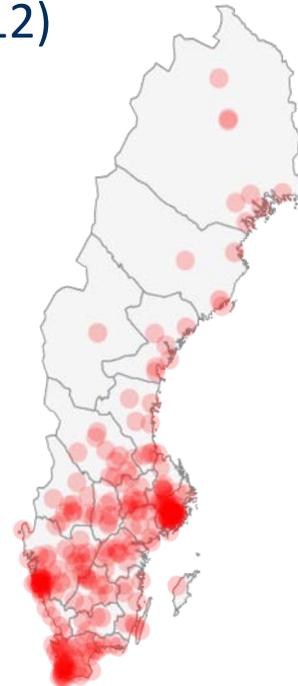


Urbanization

A total increase of 1.6 million people in Swedish urban areas by 2050 (UN, 2012)



Land Use Change



Sweden Population Density 2016

SDG 11 by 2030: making cities and human settlements inclusive, safe, resilient and sustainable

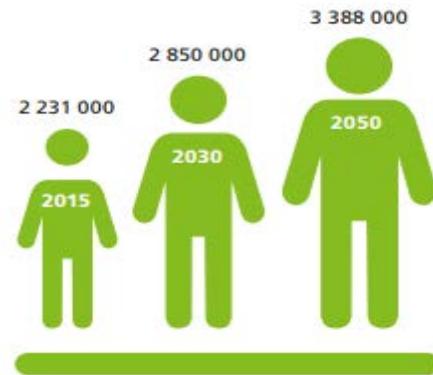
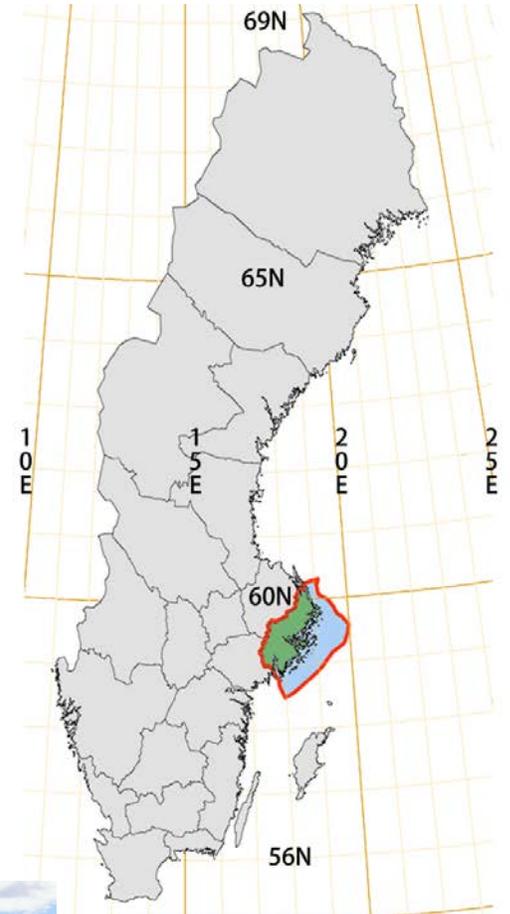
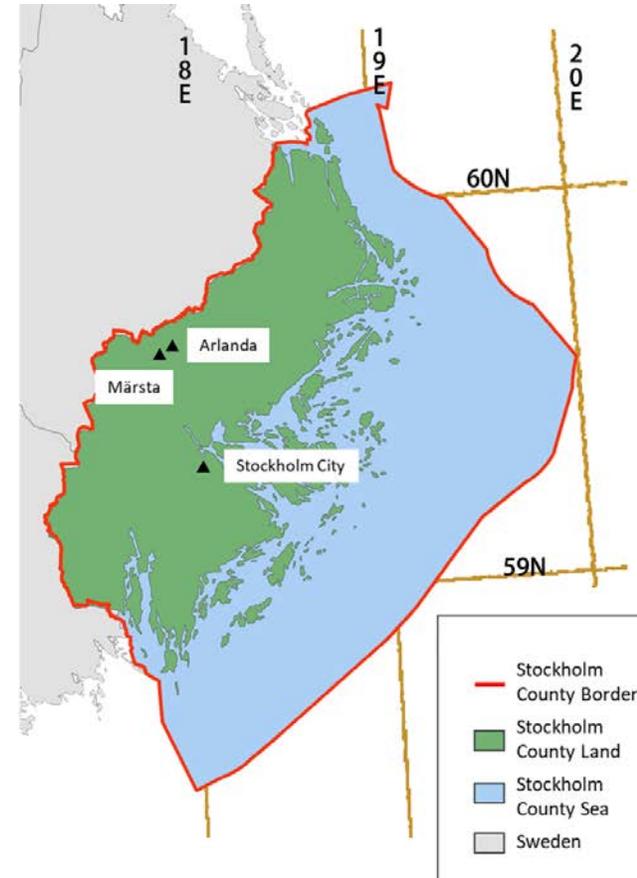
Target 11.3: Enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management



Area of 6,519.3 km²

Stockholm Region

- A rapidly growing region from 2.3 million in 2018 to a predicted 3.4 million by 2050
- Located on the Baltic Sea coast of Sweden
- Includes the capital city of Stockholm, as well smaller towns, industrial areas, and farmlands

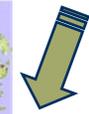
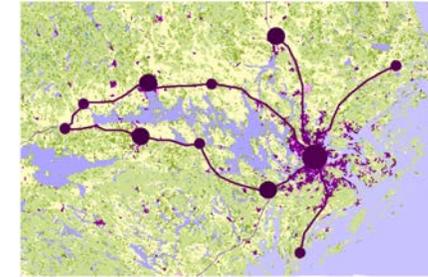


Sustainable urban development for Stockholm?

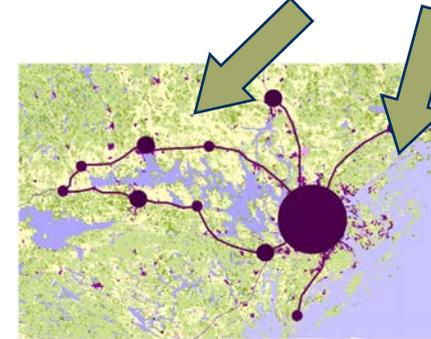
- Dense and energy-efficient city with short transport distances?
- Greenstructure with ecosystem services in the city?
- Renewable energy, water supply and water regulation services?
- Recreation and health?



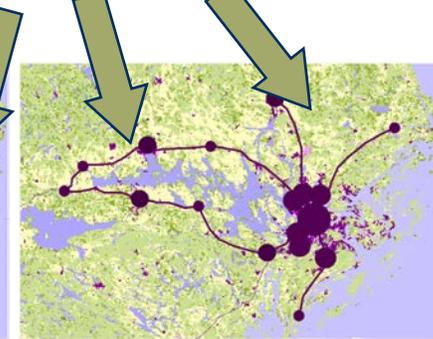
Source: Stockholm City Museum



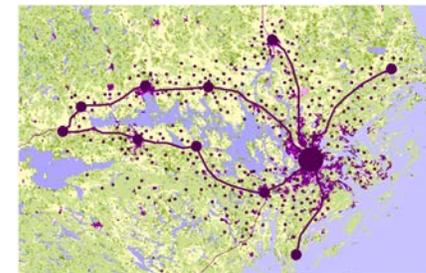
Present situation
DIRECTION OF CHANGE?



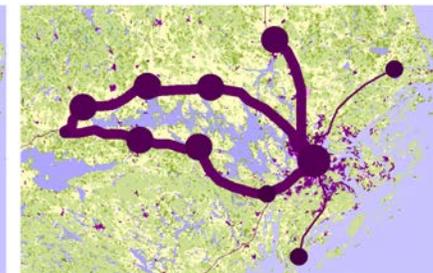
Scenario Dense



Scenario County Polycentric



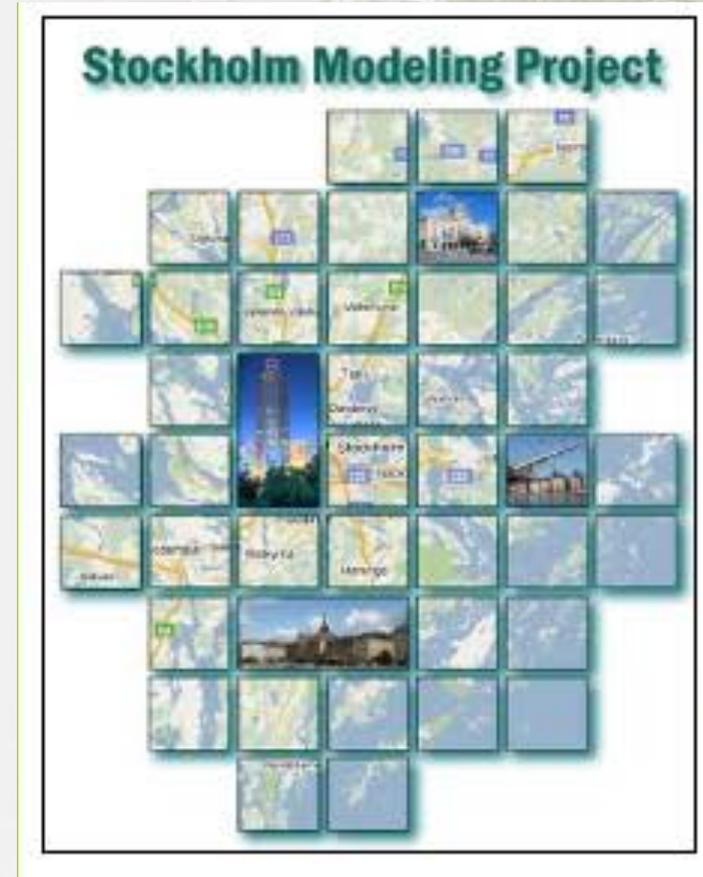
Scenario Diffuse



Scenario Region Polycentric

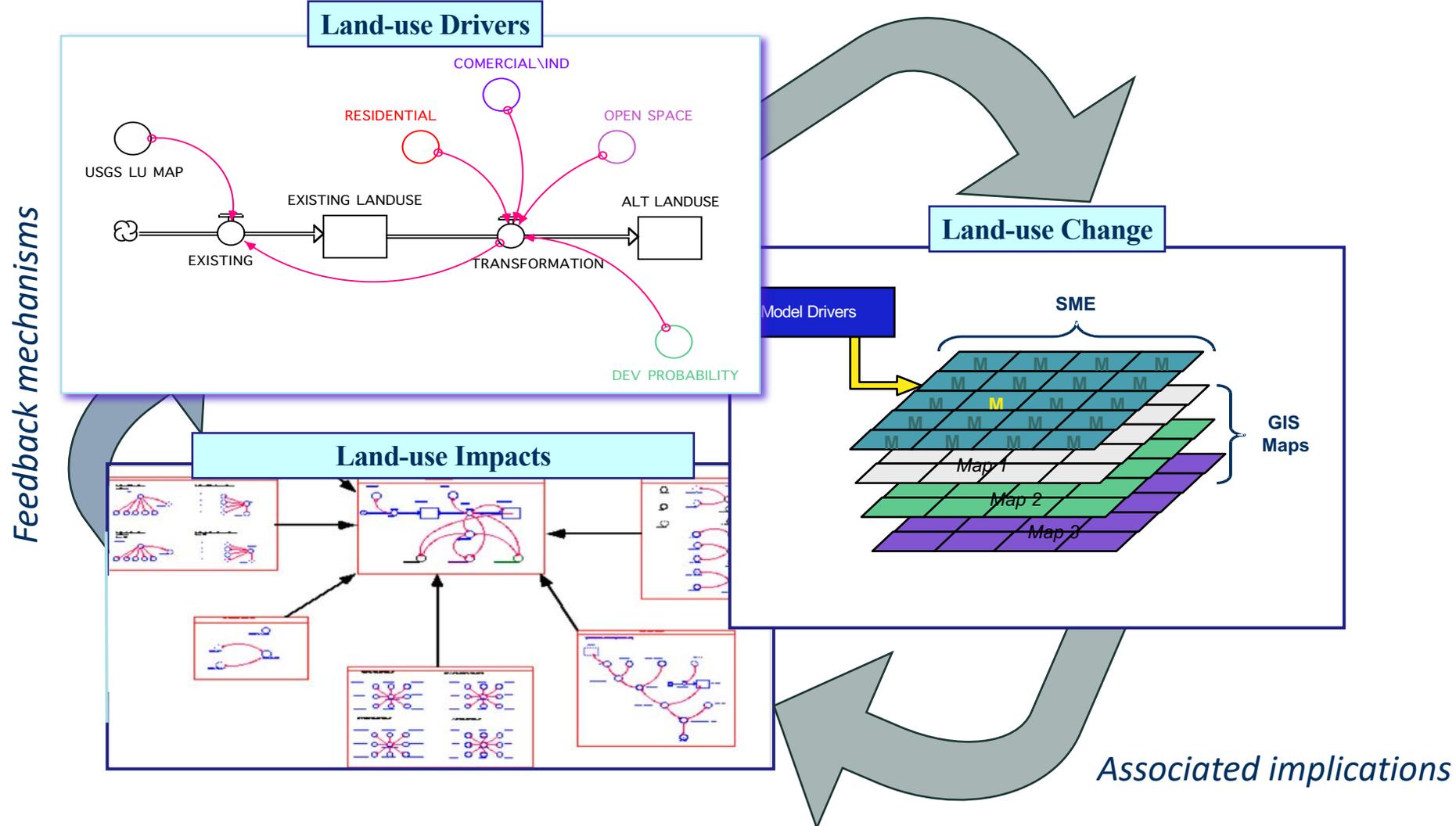
Develop sustainability analysis and planning support system for the Stockholm Region

- A model integration platform: Landuse Evolution and impact Assessment Model (LEAM)
- Applied for Chicago and other US cities, now Stockholm
- Empowered with models representing
 - urban form,
 - energy supply and use,
 - transportation
 - ecological processes and services
 - Water resource managementall related to the land use evolution
- Web-based and open for stakeholder inclusive mutual learning and visualisation

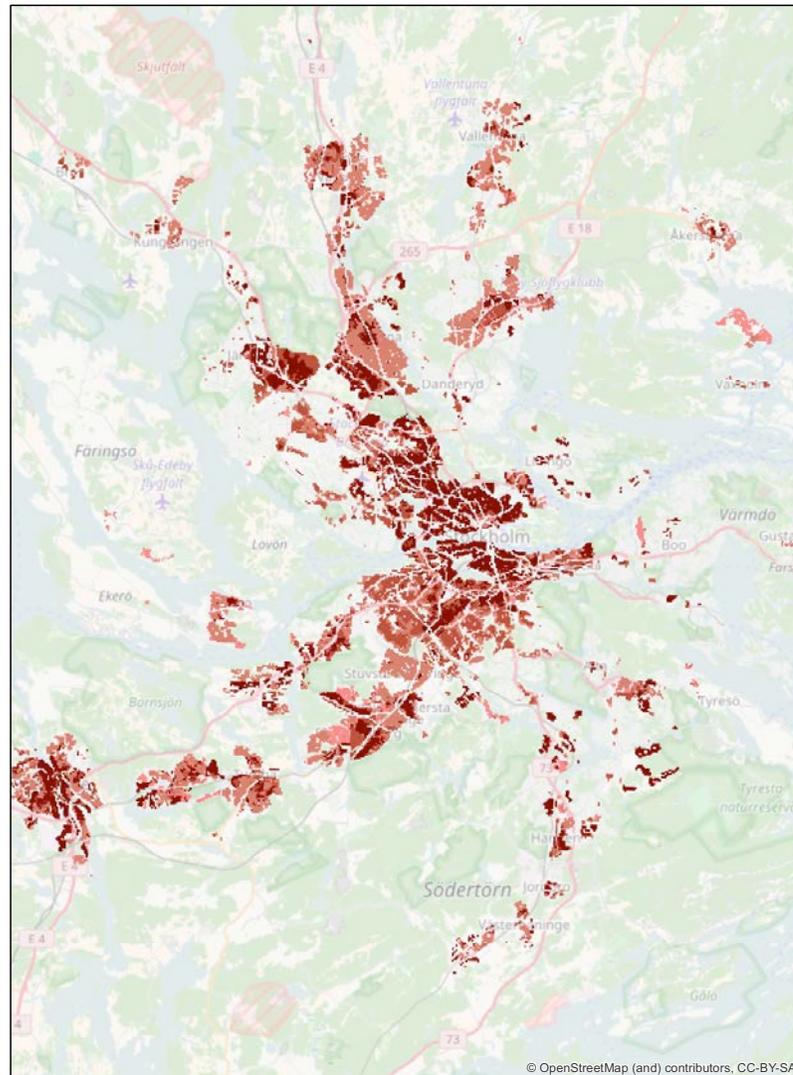


A Model Framework: An Analysis & Visualization Tool

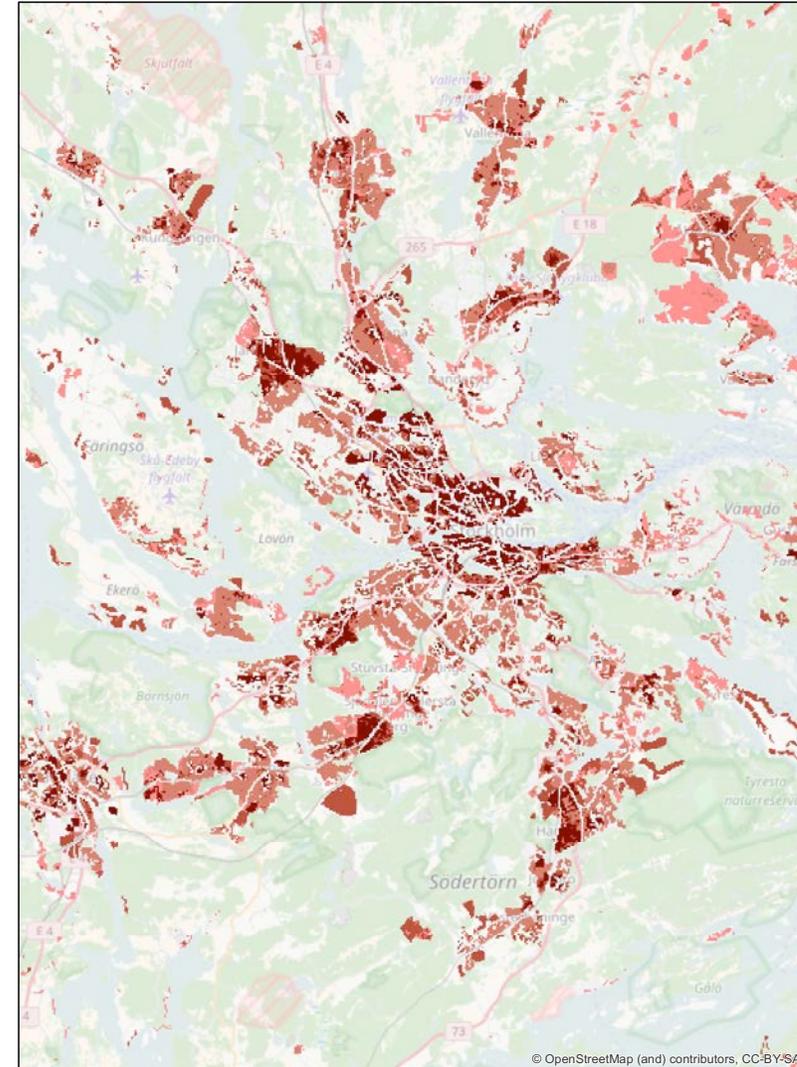
Future land use transformations



Urban development of the Stockholm Region by the year 2050



Dense Monocentric



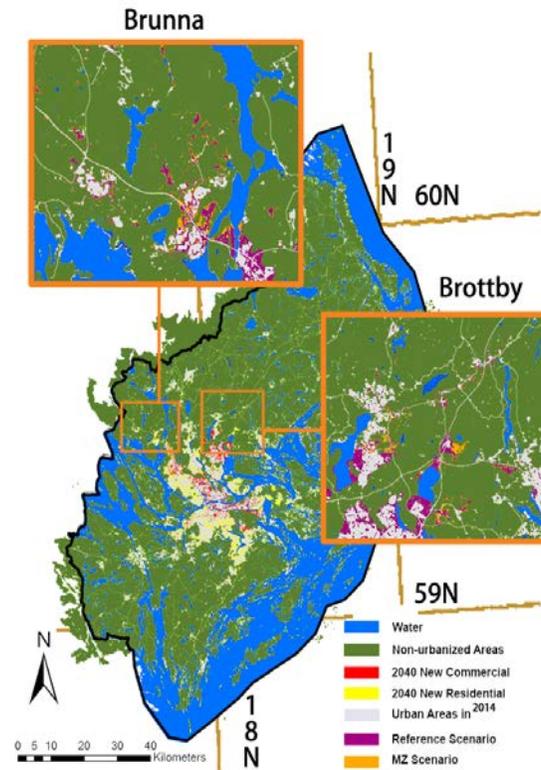
Dense Polycentric

Land-use change projection in the Stockholm Region

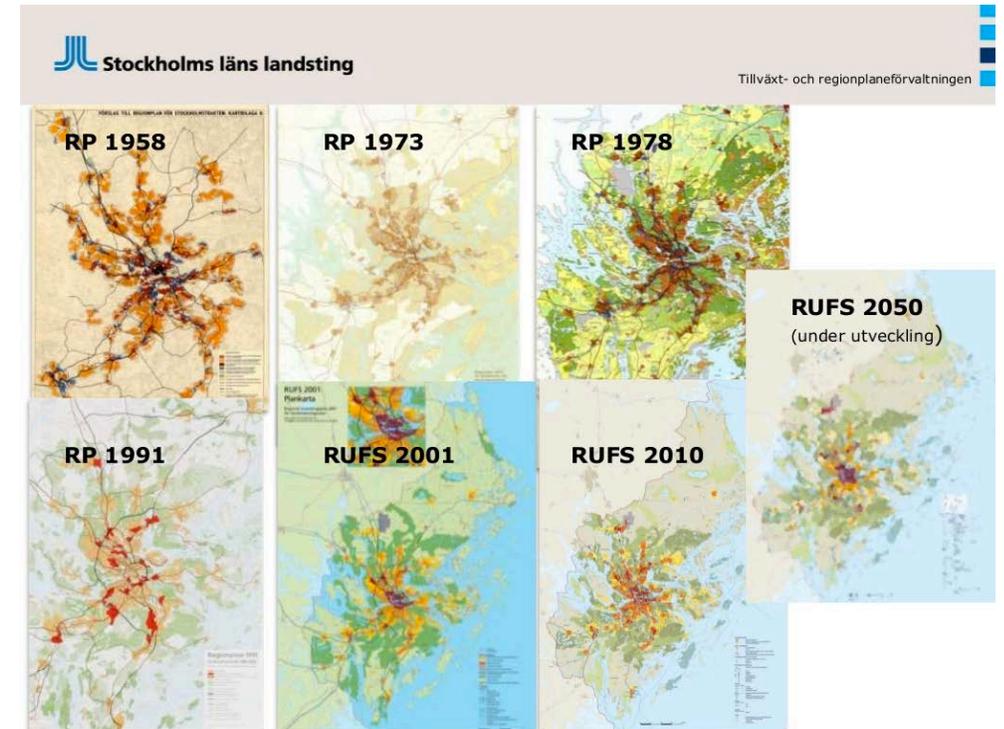
Current



2050



Regional development plan for the Stockholm region



Motivations

The ambition is to make Sweden one of the first fossil free welfare countries in the world by 2045



- Achieving carbon neutrality in urban systems is complex.
- It requires deep energy efficiency increases and renewable technology infusion.
- It requires green greenhouse gas (GHG) emission reductions from a wide array of urban systems: land-use changes, transport, construction, buildings, and urban-industrial processes.
- It also requires increases in carbon sinks and offset strategies.
- This is not easy.

The urban system interactions are large, complex, dynamic and wicked

What are the aggregated climate impacts (GHG emissions, carbon sink losses) of urban growth and land-use changes?

Can urban GHG emissions be effectively mitigated through policy intervention?

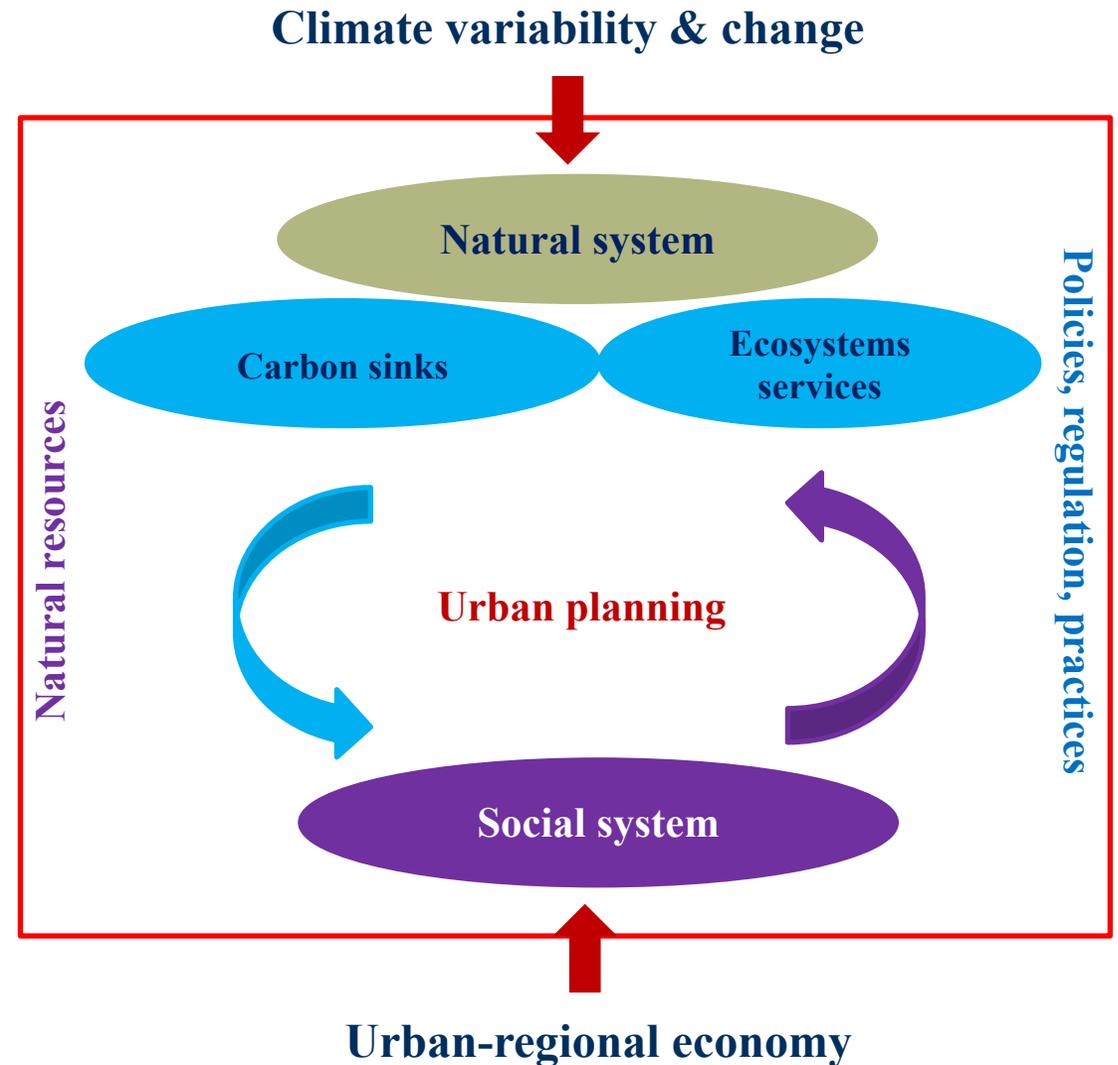


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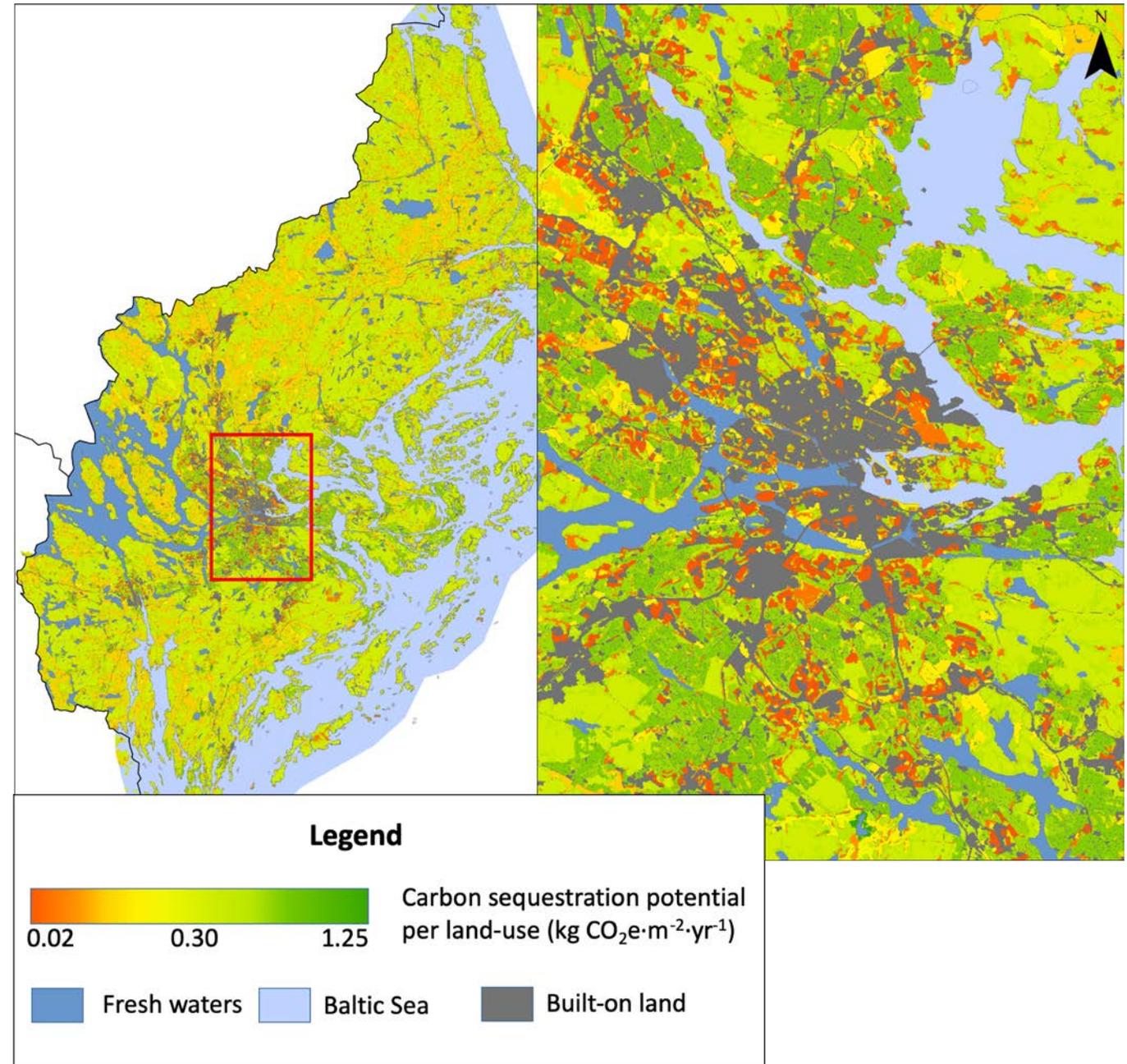
Develop a dynamic socio-ecological system to link

- human processes: socio-economic and land use policies
 - ecological processes: GHG emissions associated with human activities that have global climate impacts
- in complex urban environments.



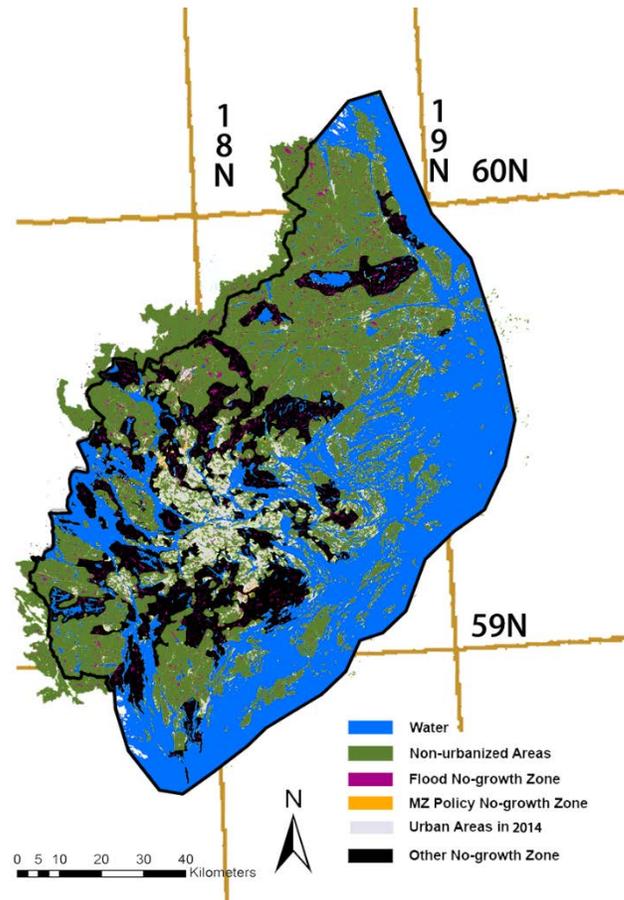
Terrestrial carbon sinks for different Land-use change scenarios

→ Mapping various land-uses in the county and assigning each land use to a carbon sink potential value based on the vegetative cover of the land



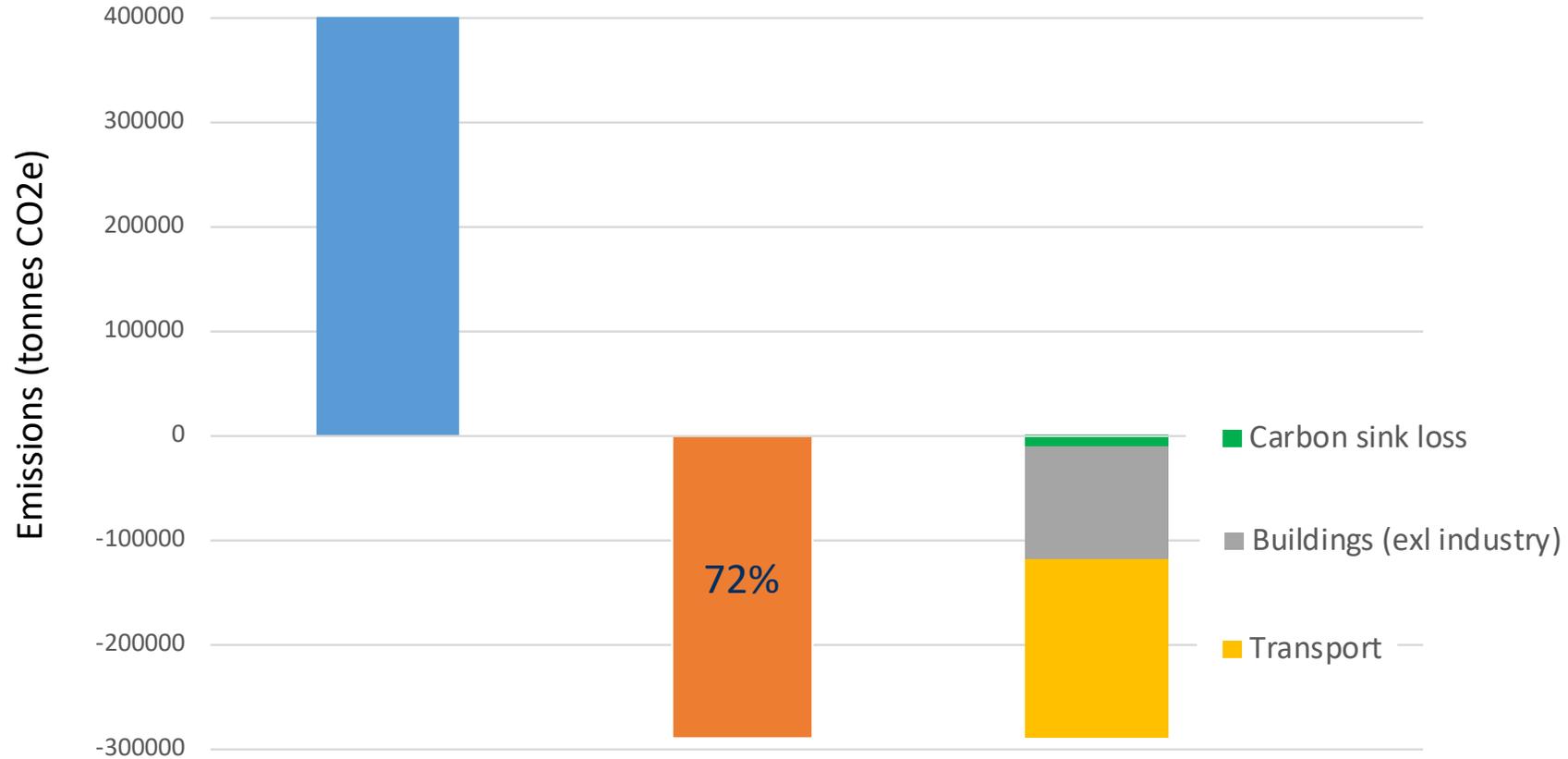
Urban development policies in the Stockholm Region

No-growth areas scenario



- Forest preserves, parks, and water bodies nearby areas with high emissions potential (e.g. large patches of forests occupied by urban development, regions far from urban cores)
- As a result, residential and commercial developments are shifted to places with lower emission

The estimated GHG emissions increase with urban growth and land use changes (2040)



The estimated GHG emissions reductions with Mitigation Zoning

An open source, cloud-based tool for computing urbanization scenarios and their impacts on GHG emissions

Welcome to LEAM Stockholm **Land Use Model**

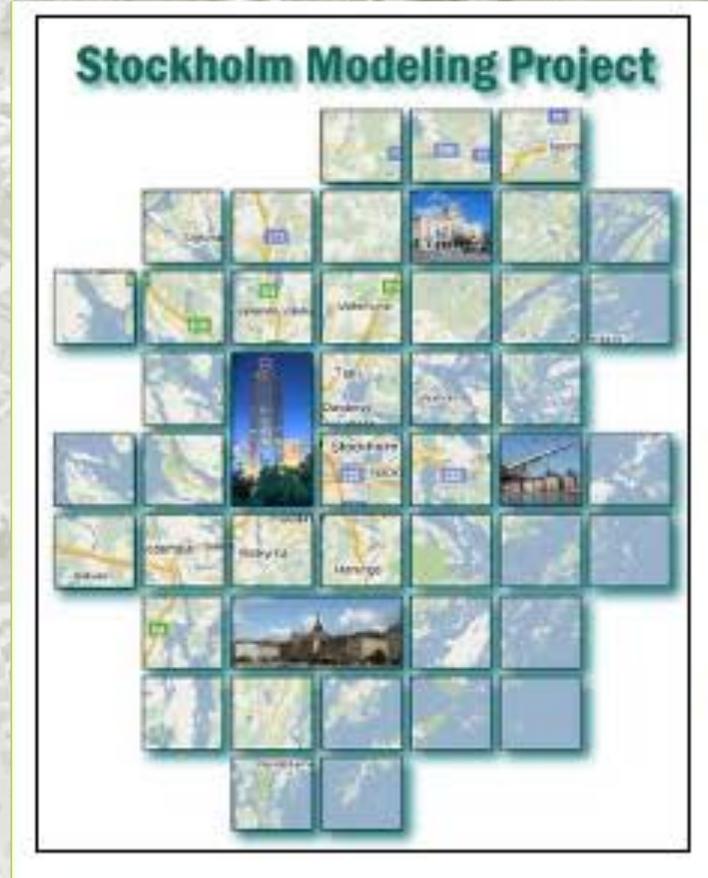
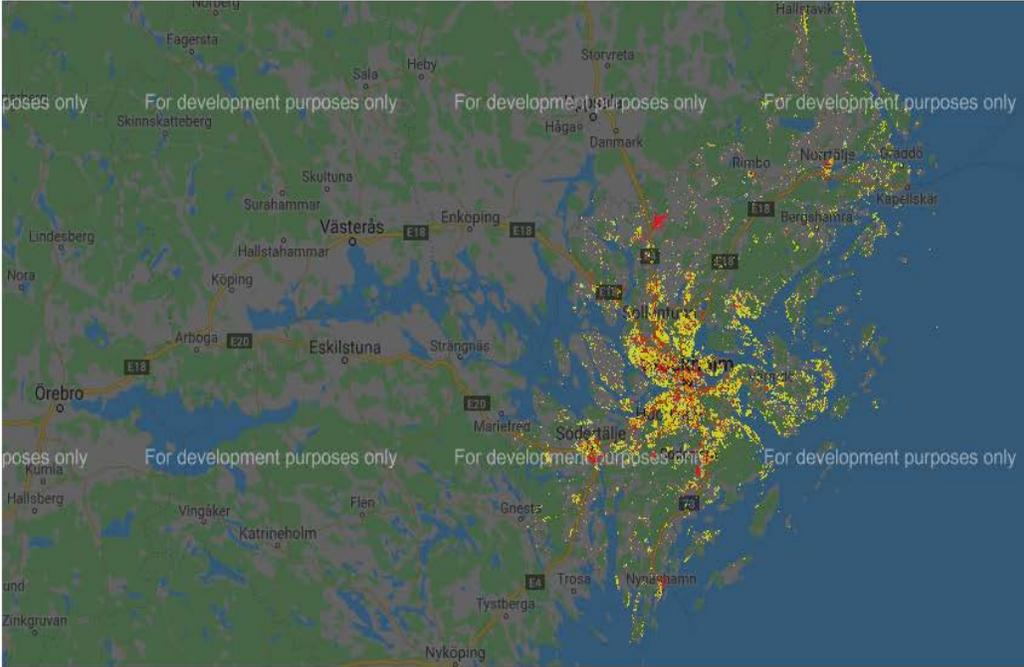
- Scenarios
- Subregional Projections
- Regional Drivers
- Post-Processing
- Resources
- Hydro Maps
- Click Here to Go Back to Step List
- Calibration
- Current Landuse Map**
- Predict Landuse Map

You are here: Home / Land Use Model / Current Landuse Map

View Edit Sharing

Current Landuse Map

by admin — last modified Sep 18, 2018 10:57 PM — History



Screenshot from
(portal.leam.illinois.edu/stockholm2017).

Digital decision support for carbon-neutral cities: climate effects of interactions between land and energy uses in the built environment

Welcome to LEAM Stockholm

Land Use Model

Drivers:

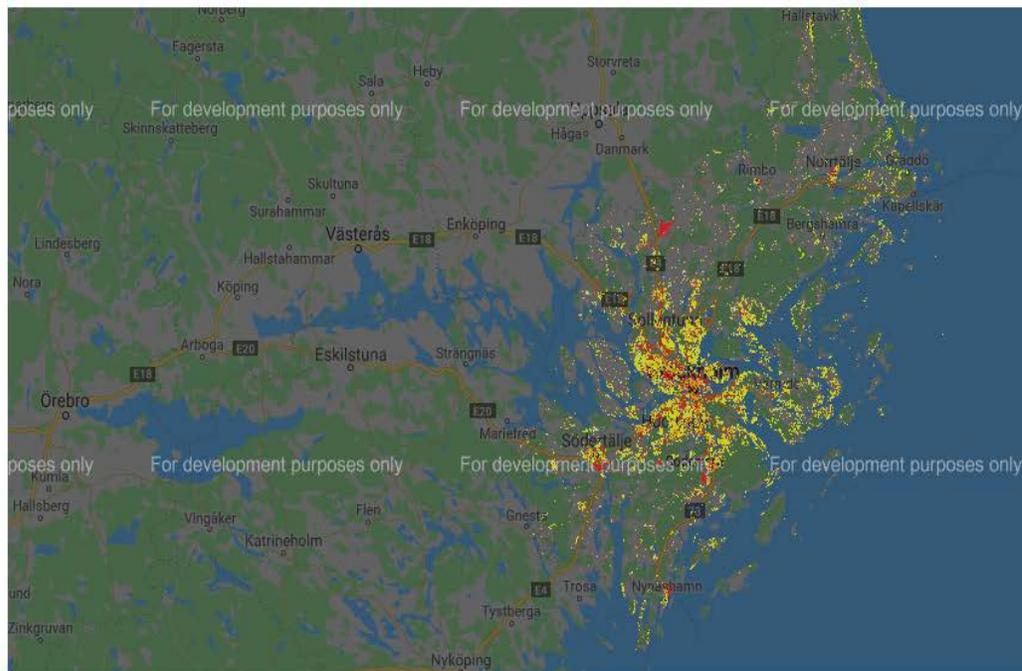
- Planning & policy
- Topography & land-use
- Planned & existing transport infrastructure
- Population growth predictions
- building energy-use and GHG emissions

You are here: Home / Land Use Model / Current Landuse Map

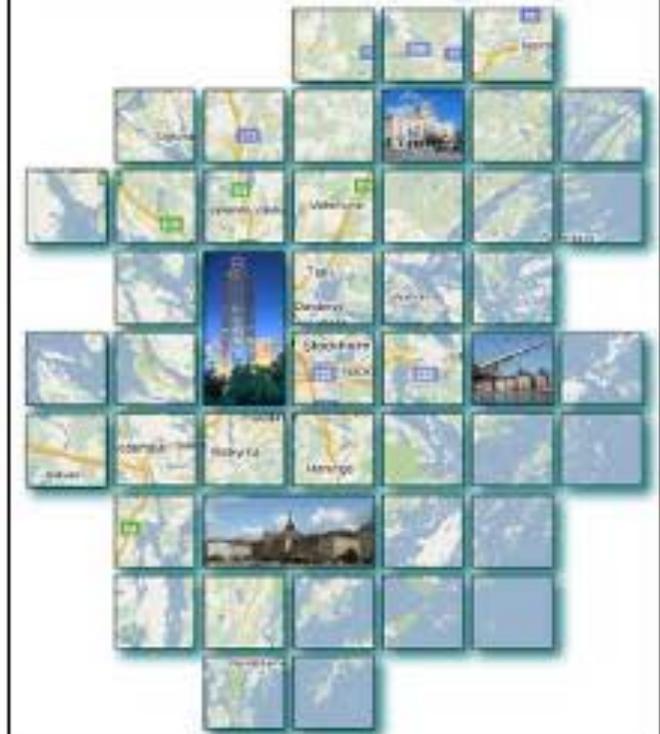
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Stockholm Modeling Project



Taking home messages

- ✓ Human-induced urban growth have implications for greenhouse gas (GHG) emissions that may not be included in conventional GHG accounting methods
- ✓ Improved understanding of this issue requires use of interactive, spatial-explicit social-ecological systems framework
- ✓ Our framework has improved our ability to pinpoint high-emission areas in order to the design of climate change mitigation/policies, by appropriately restricting land-use development
- ✓ This framework can be applied to other cities, by replicating the online cloud-based tool with a localization process
- ✓ This framework can be used as a decision support system for communicating results and policy implications with policymakers



Thank You!



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