Coupling dynamic cities and climate

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Remote Sensing Lab, FORTH

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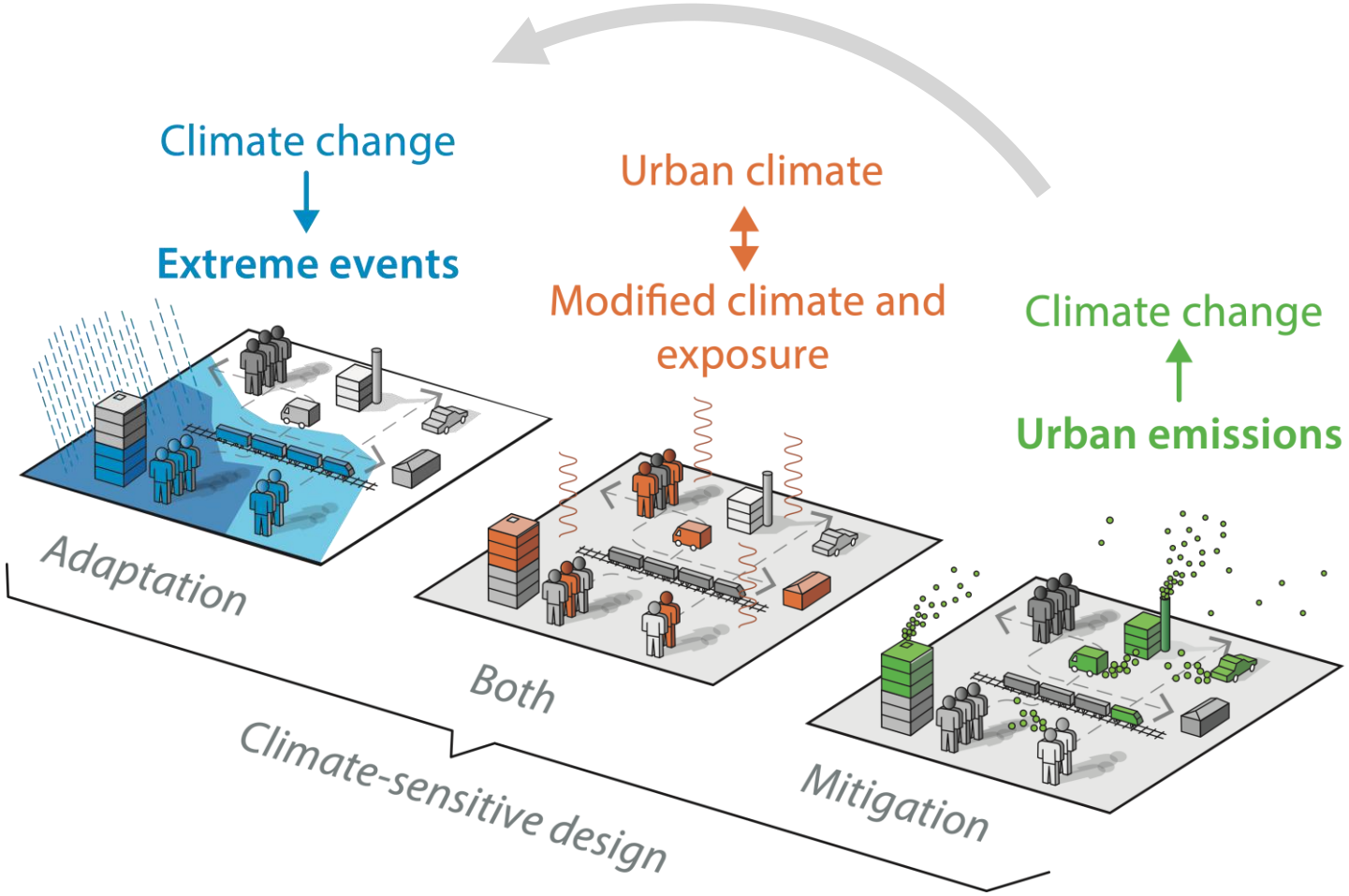
Learn more here:

HELLENIC REPUBLIC
MINISTRY OF DEVELOPMENT AND INVESTMENTS
GSRI GENERAL SECRETARIAT FOR RESEARCH AND INNOVATION

European Commission

Objectives

- **Understanding**, forecasting, and projecting feedbacks between climate change and drivers of urban transformation.
- **Exploring** how urbanization, human behaviour and technology changes **impact climate change**; and how impacts of climate change influence urban populations, their **vulnerability** and **adaptive capacity**.
- **Capturing** the complexity of urban dynamics to **chane** the way we represent cities in climate models.



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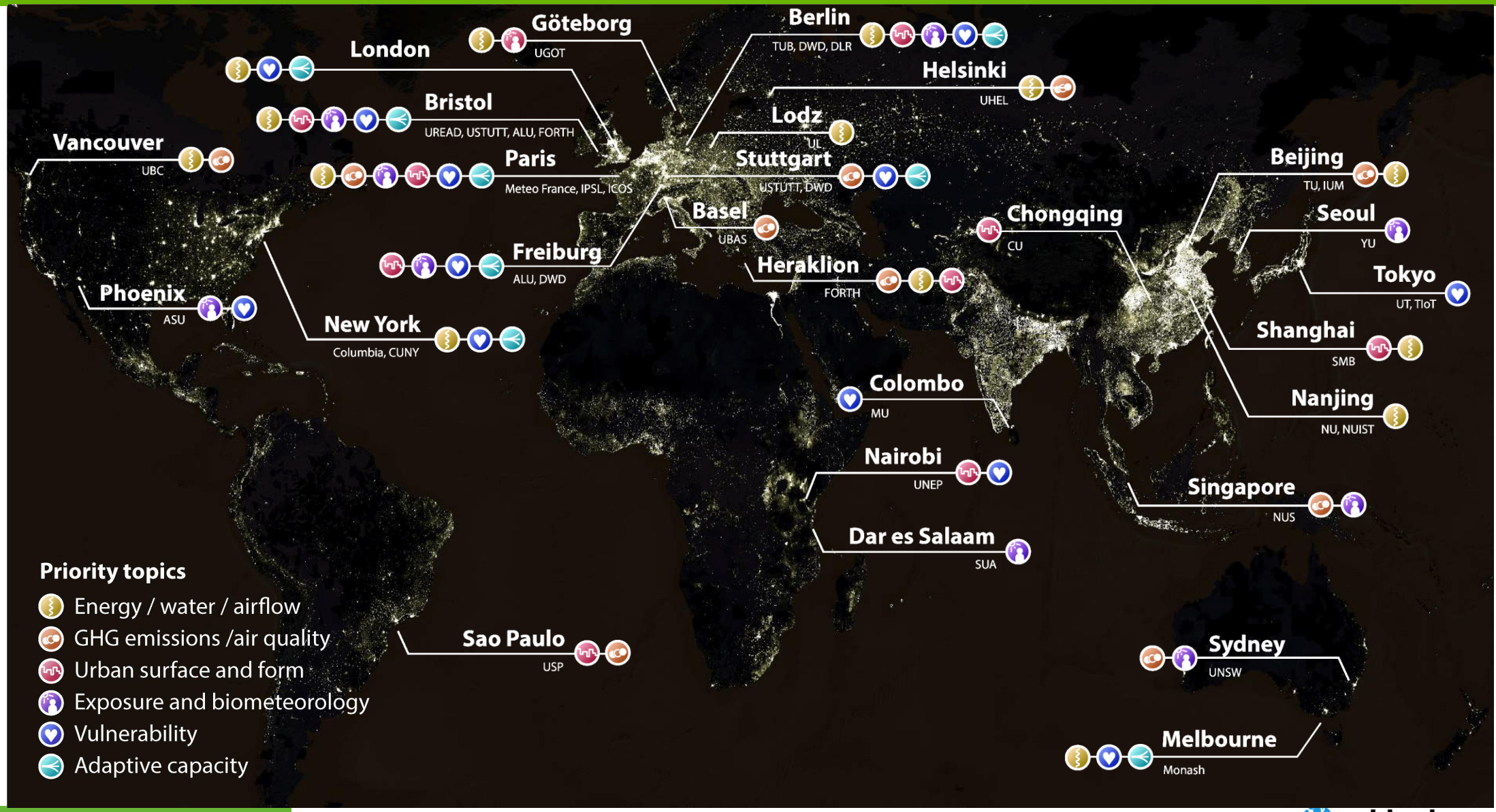
Case Studies



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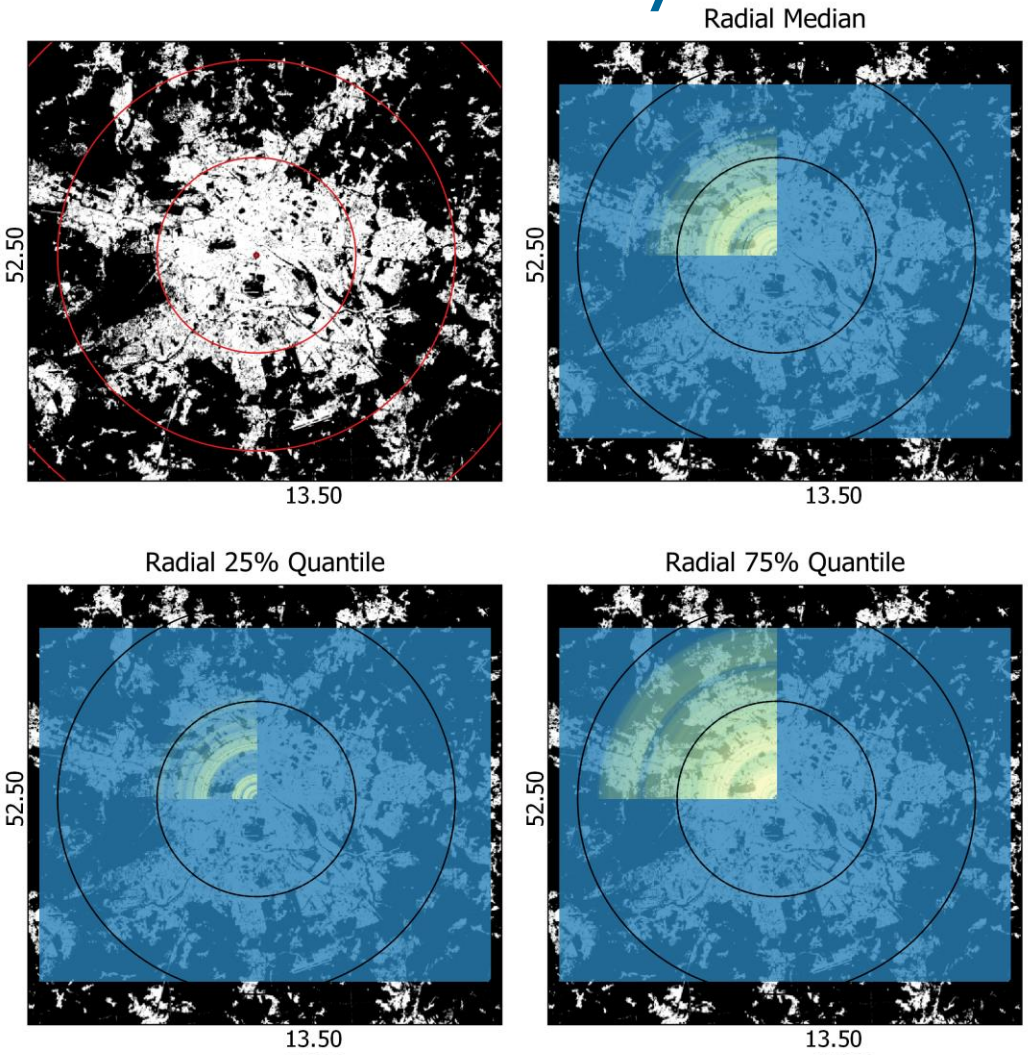
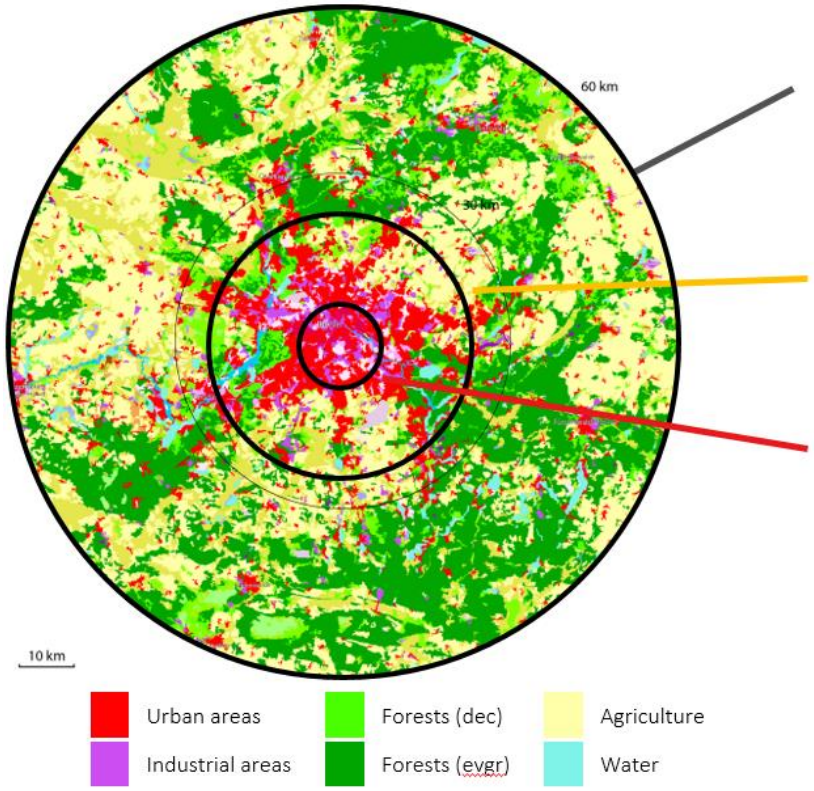
Where the city's boundaries are?





Source: Corine Land Cover

Domain A rural - 60 km radius

- Quantify regional impacts of cities on climate
- Sites upwind and downwind (urban plume)
- Background regional scale climate/ weather

Domain B urban - 20 km radius

- intra-city variation of city (people and urban form) and atmosphere above
- Sites: local scale climate and some intra-city variability

Domain C core - 5 km radius

- Central city
- Sites with additional instruments

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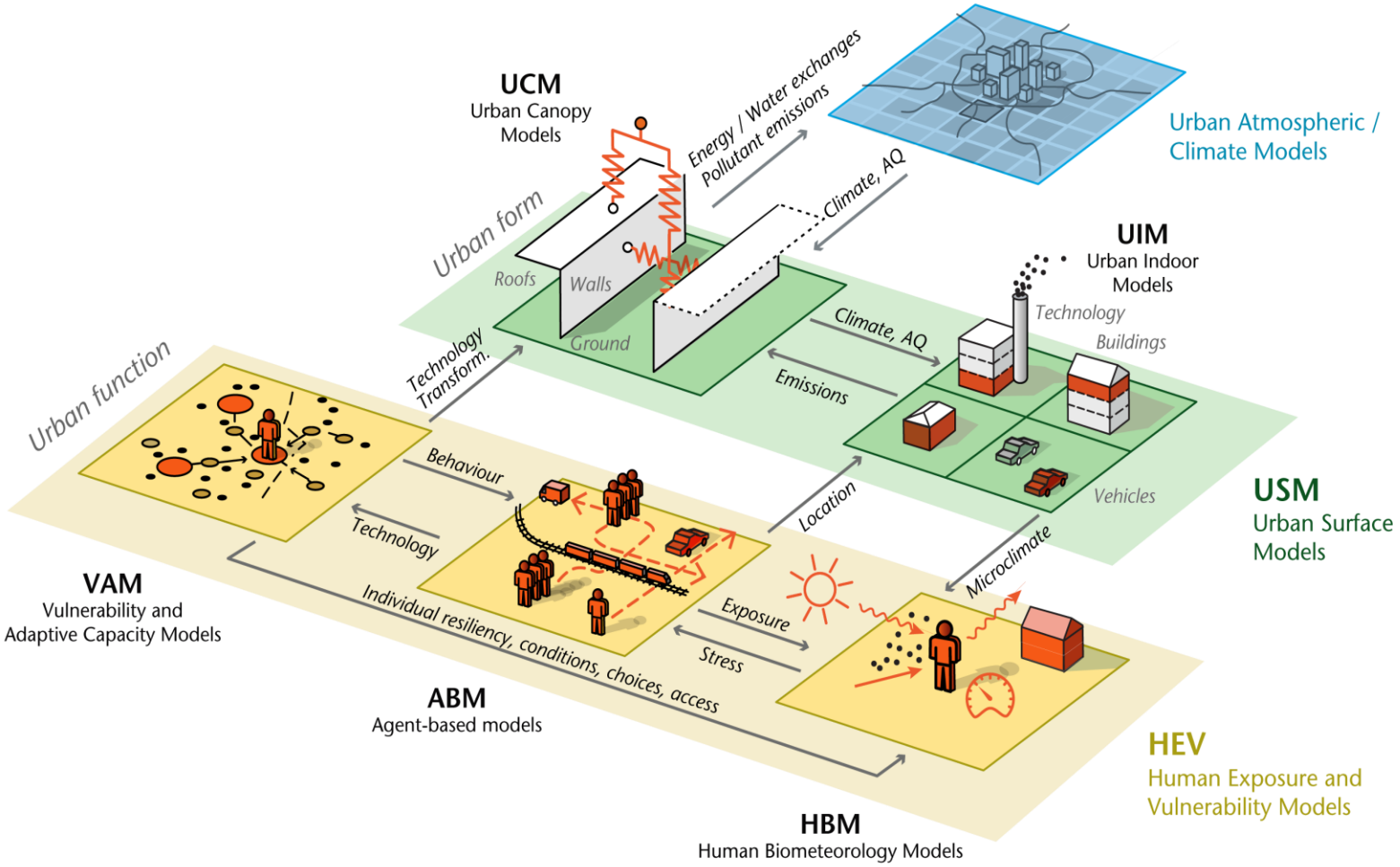
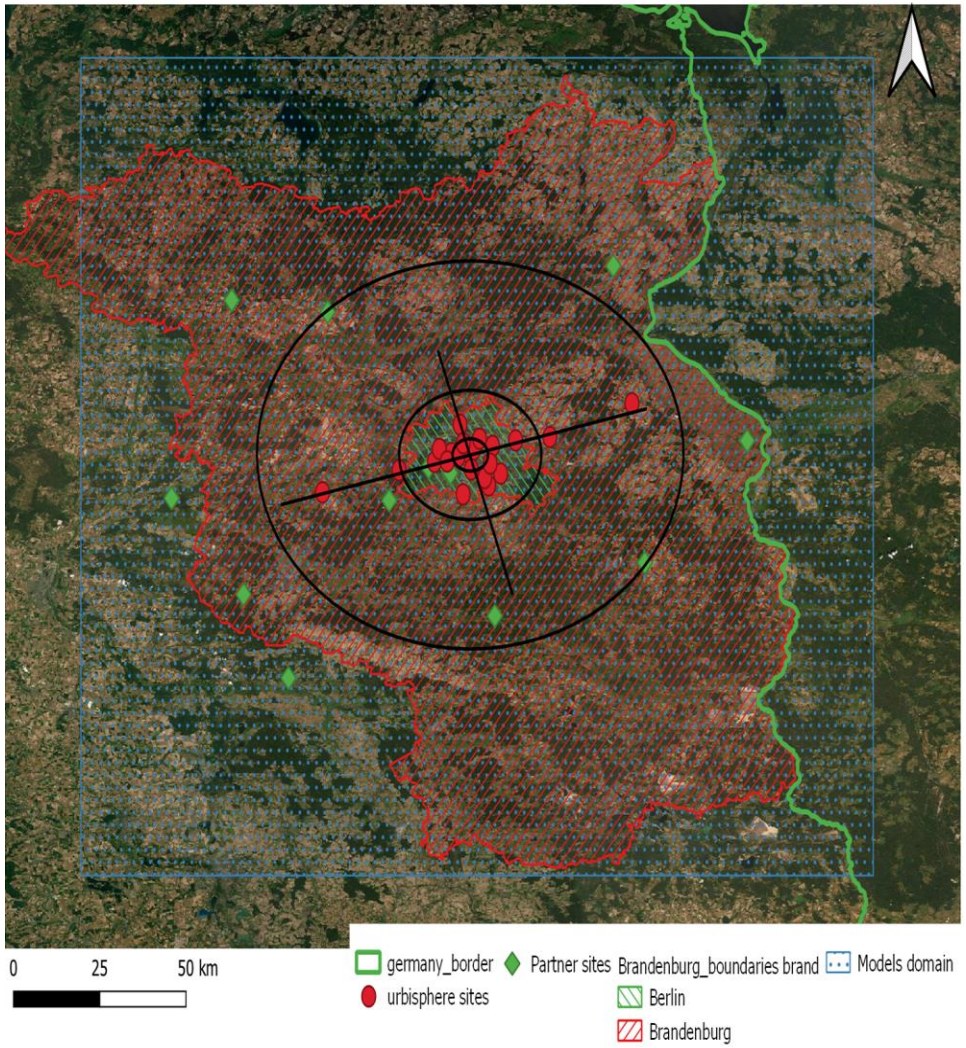
Modelling





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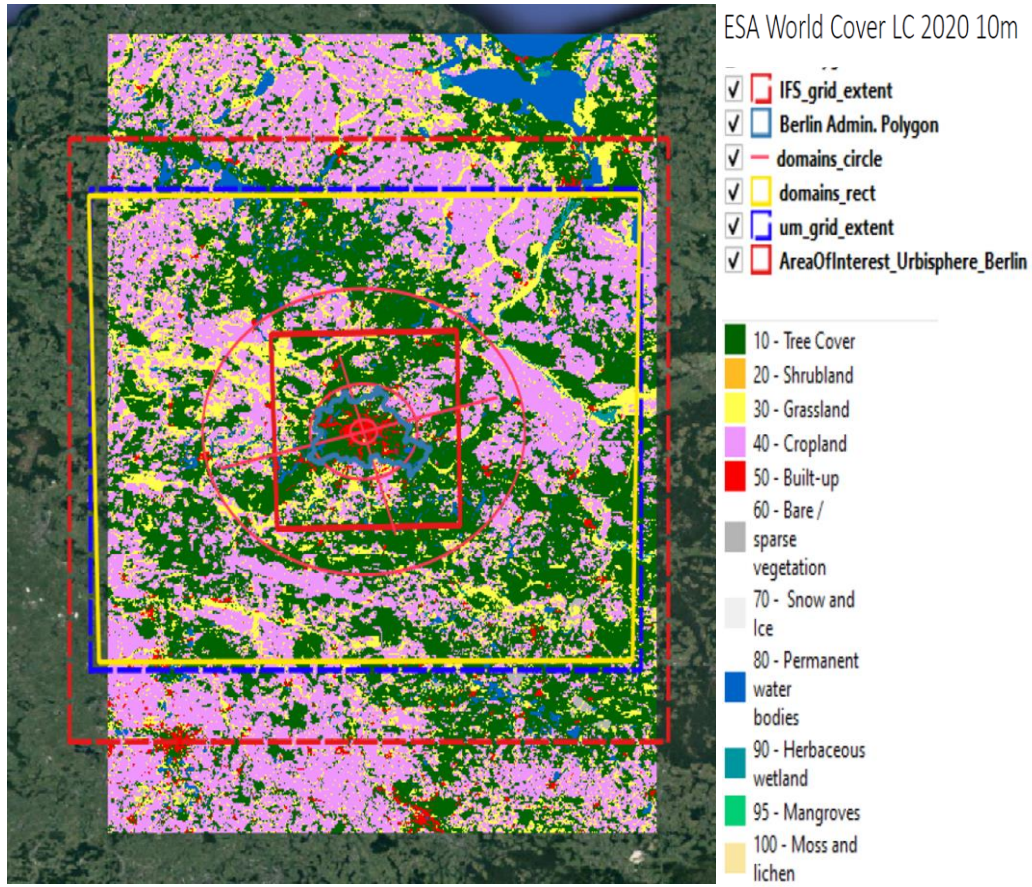
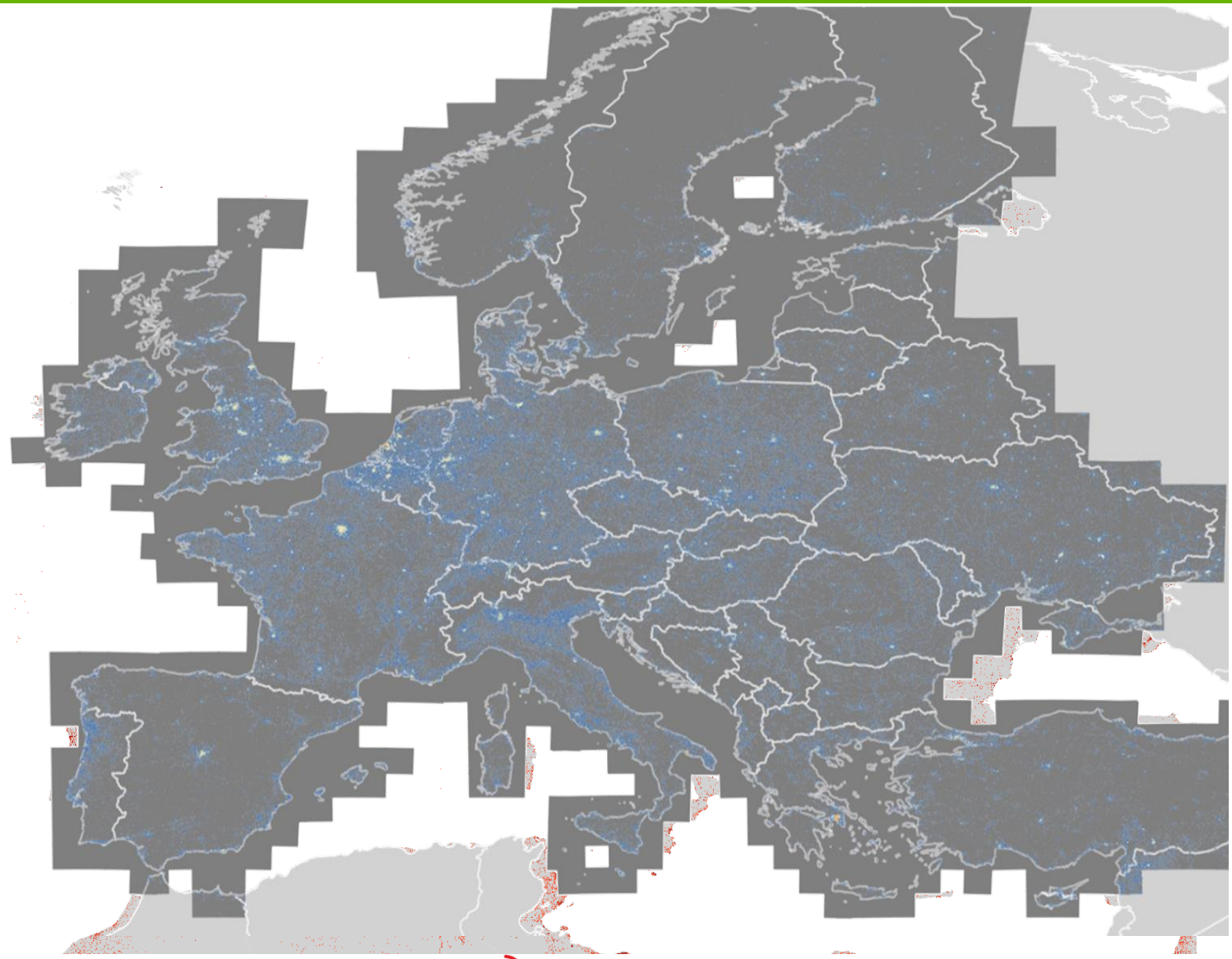
Modelling





CREODIAS powered by CloudFerro

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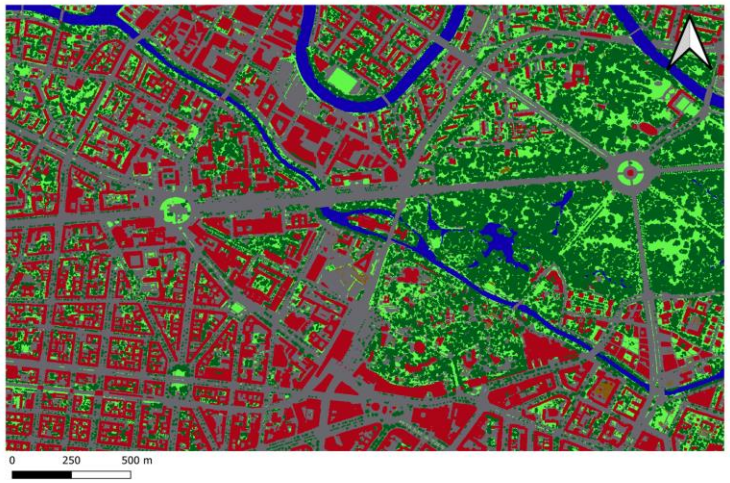
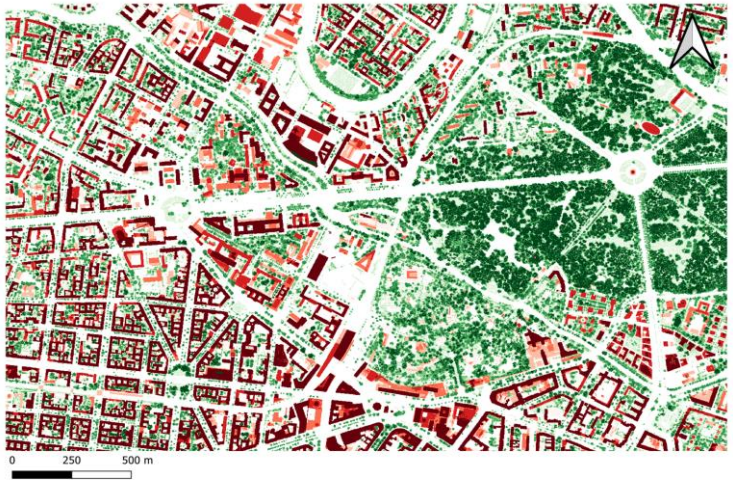
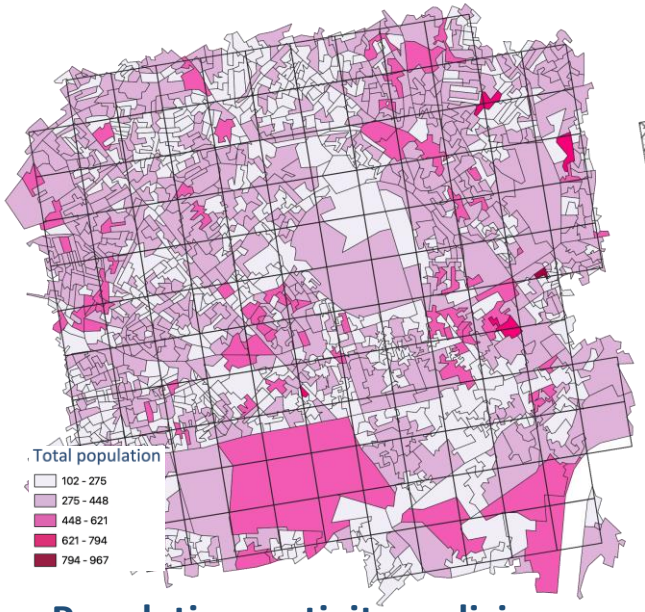
Modelling

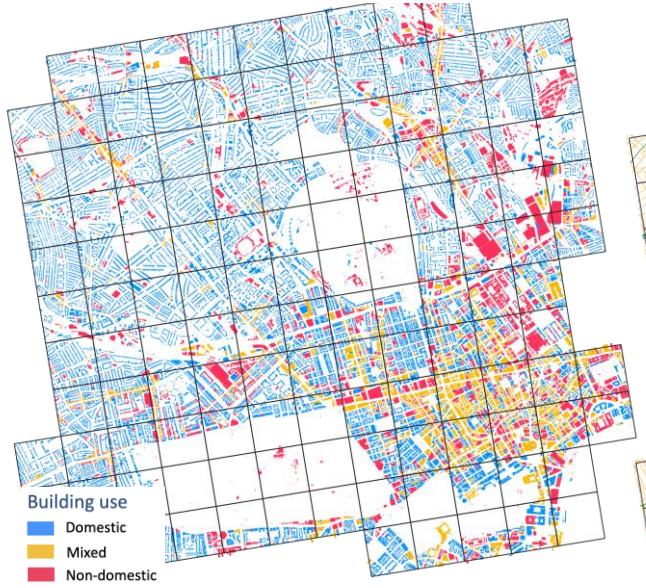






Population, activity, policies

Urban form



Urban function

Movement / travel

Grimmond et al. 2022

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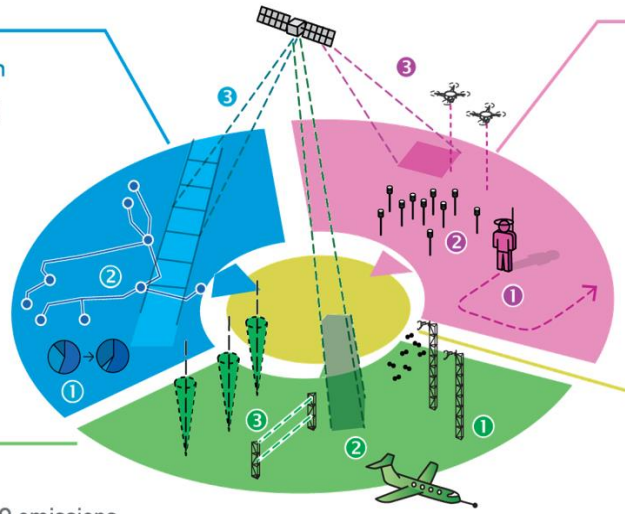
Module A
Observing Urban Form and Function

❶ Dynamics of socio-economic and demographic conditions
❷ Mobility patterns
❸ Multispectral, hyperspectral and laser-based EO to observe form and function

Module B
Observing Urban Emissions

❶ Flux towers to measure E/W/C/AQ emissions
❷ Concentration and isotope measurements on ground, in atmosphere and from satellites
❸ Wind LIDARS / ALC, Scintillometry

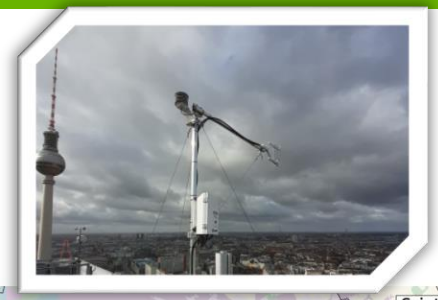


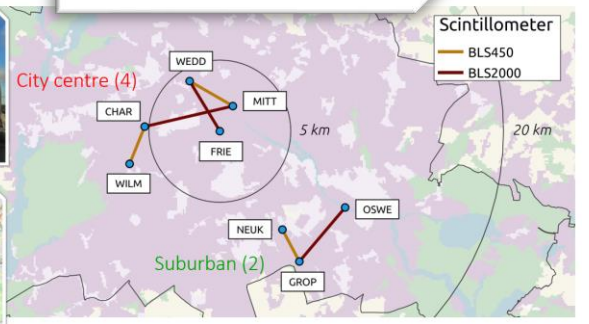
Module C
Observing Urban Exposure

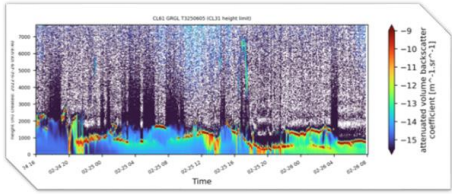
❶ Wearable sensors
❷ Indoor-outdoor massive sensor networks
❸ 3D- and satellite thermal remote sensing

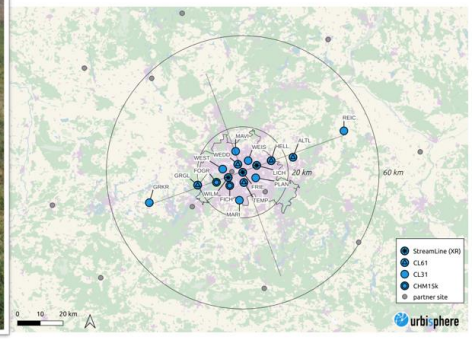
Module D
Integration

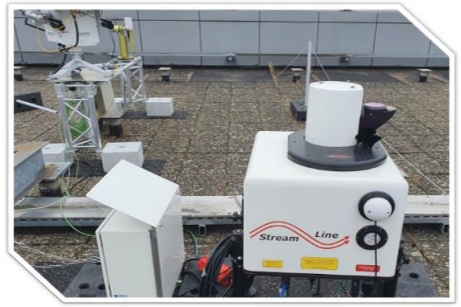
Calibration
Real-time communication
Storage and database

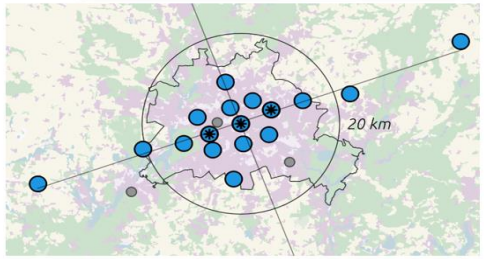


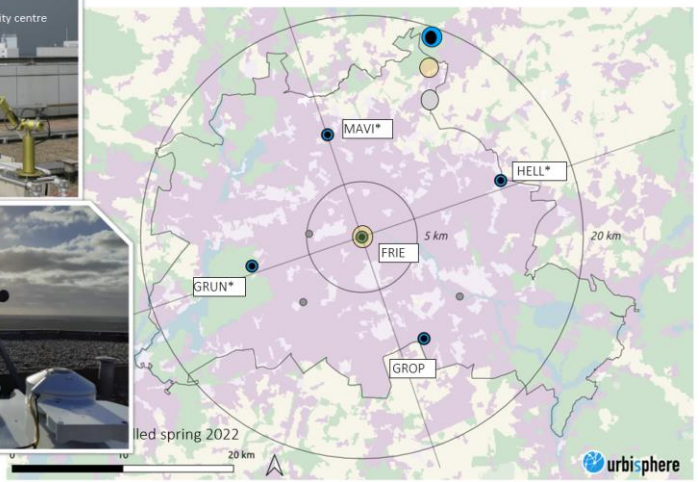












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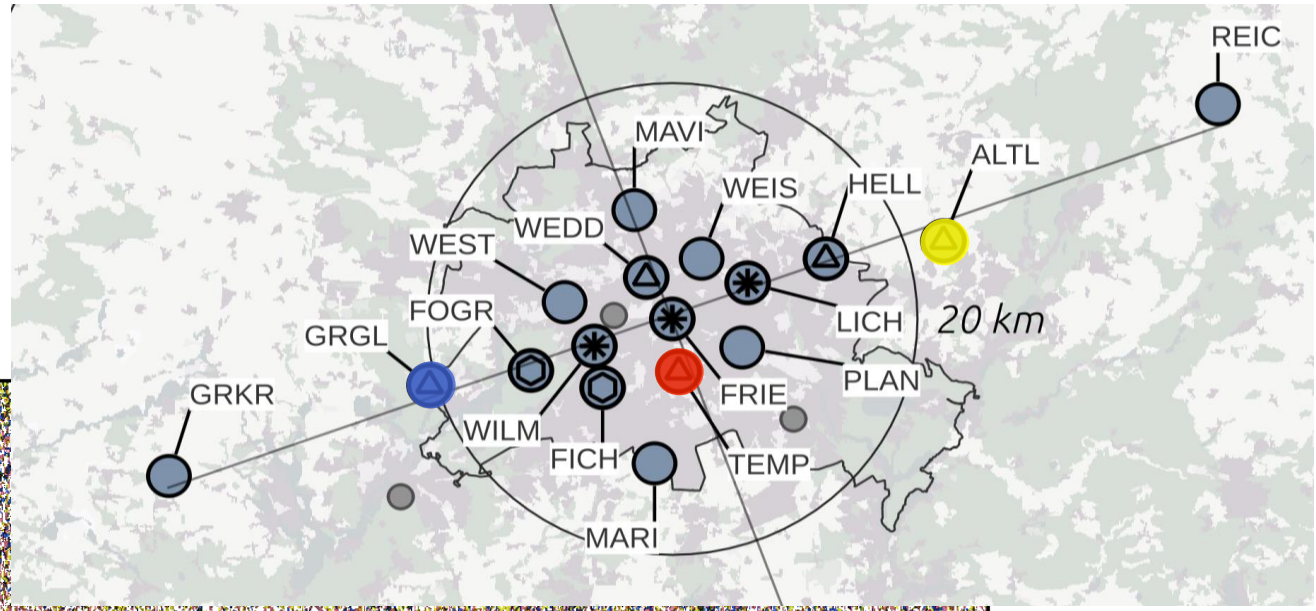

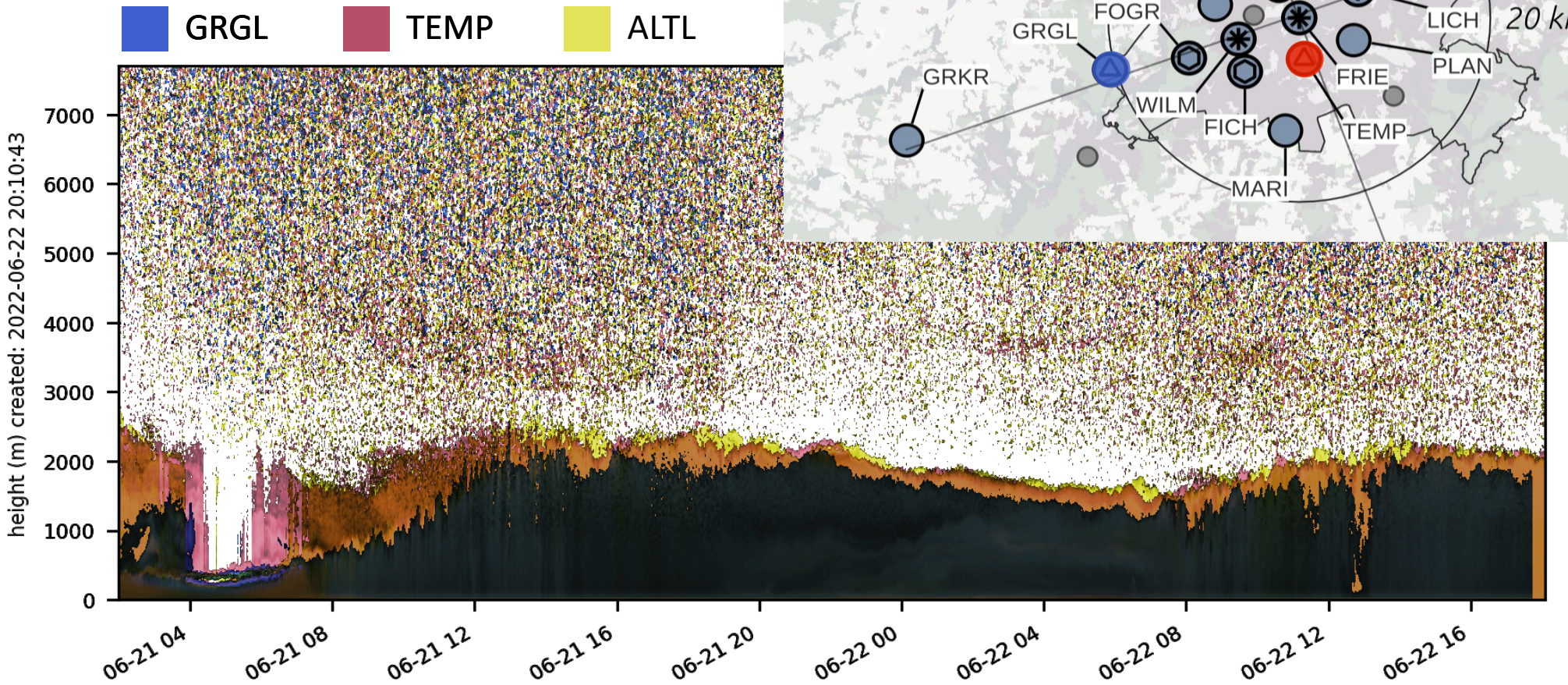

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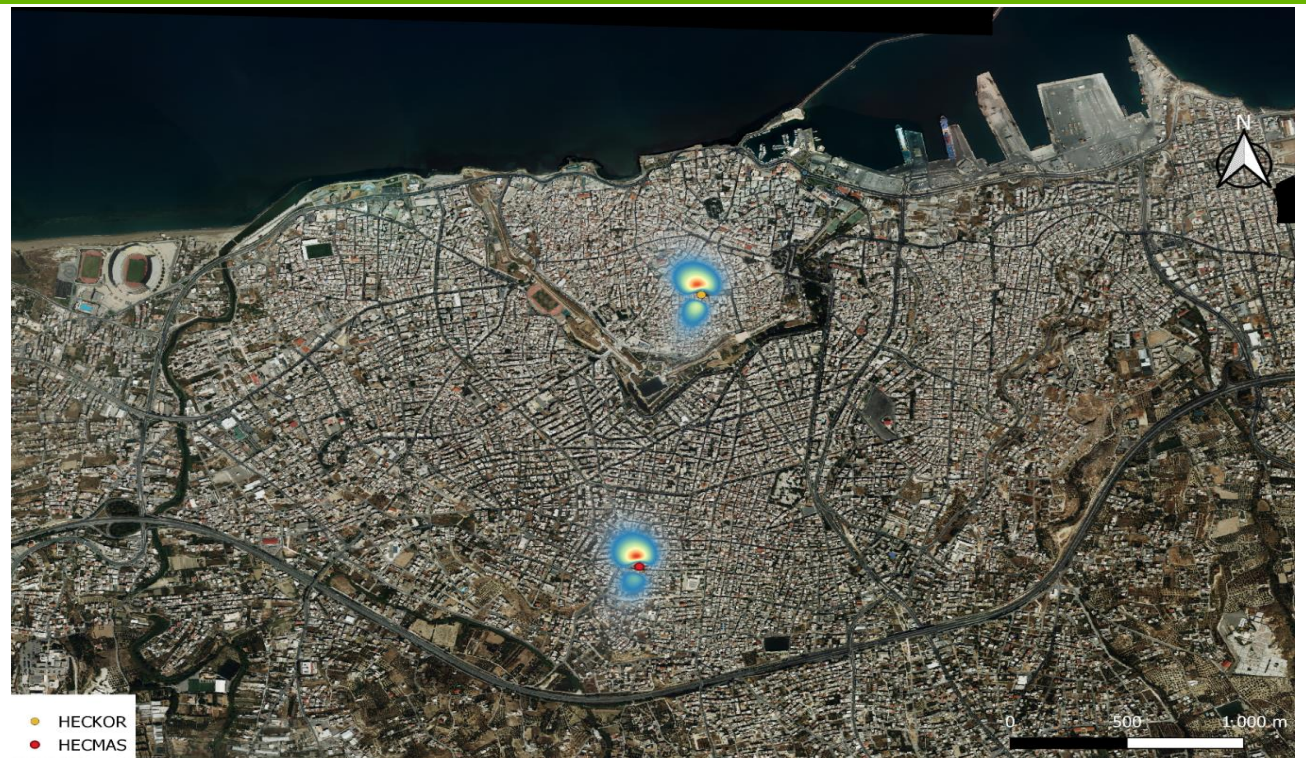
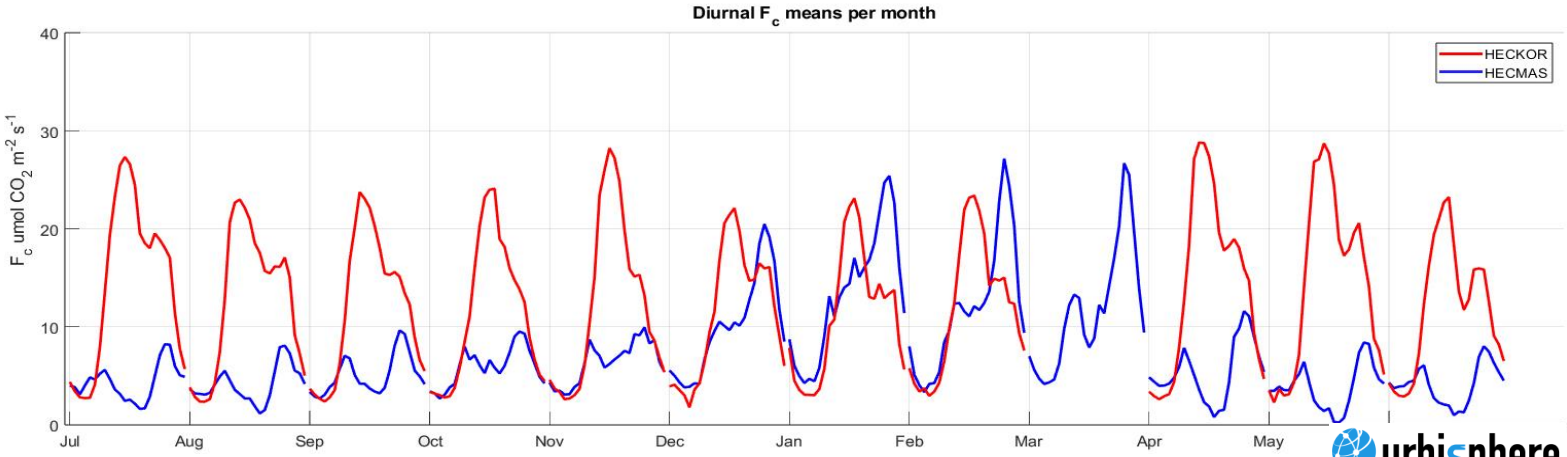
ICOS | INTEGRATED CARBON OBSERVATION SYSTEM





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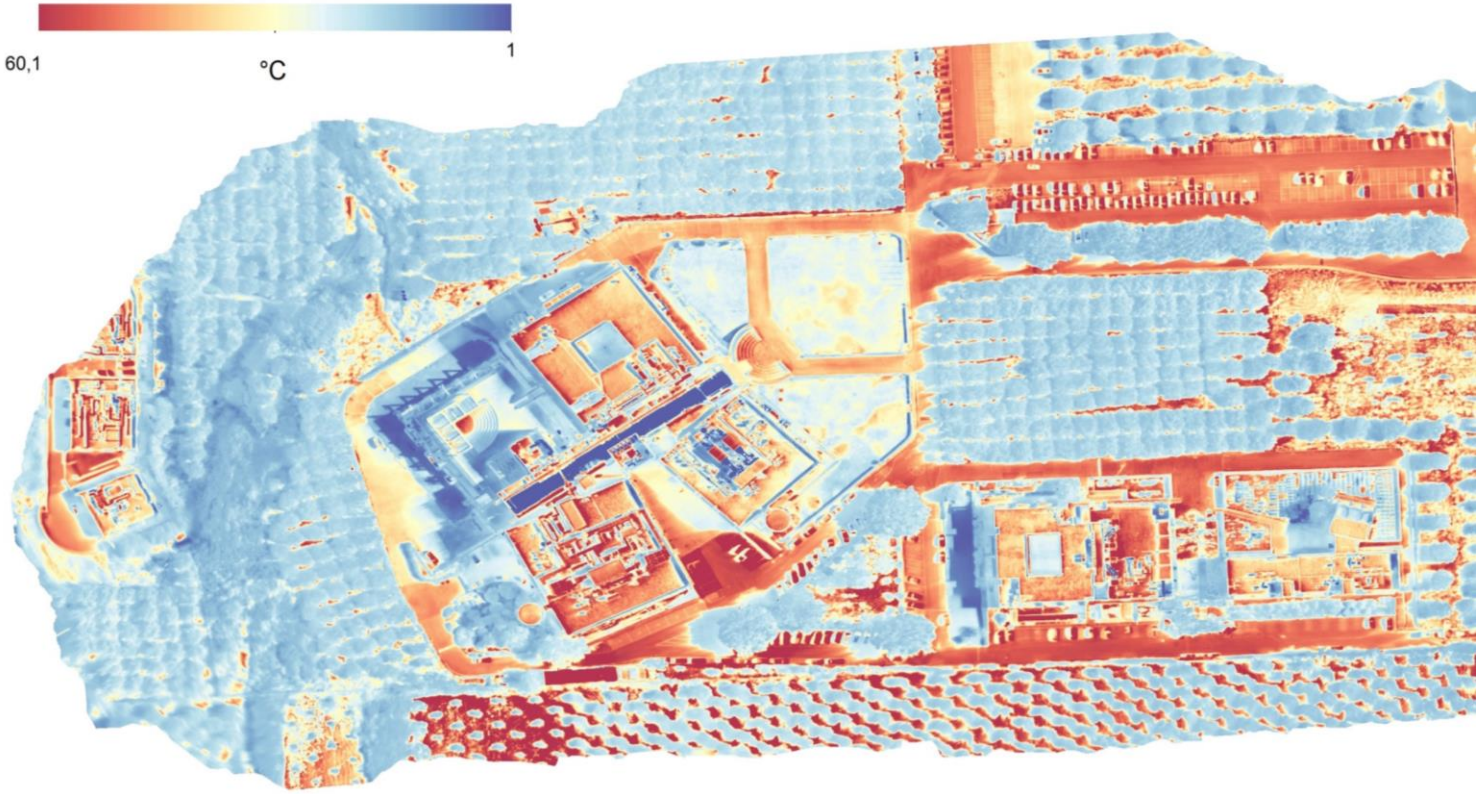

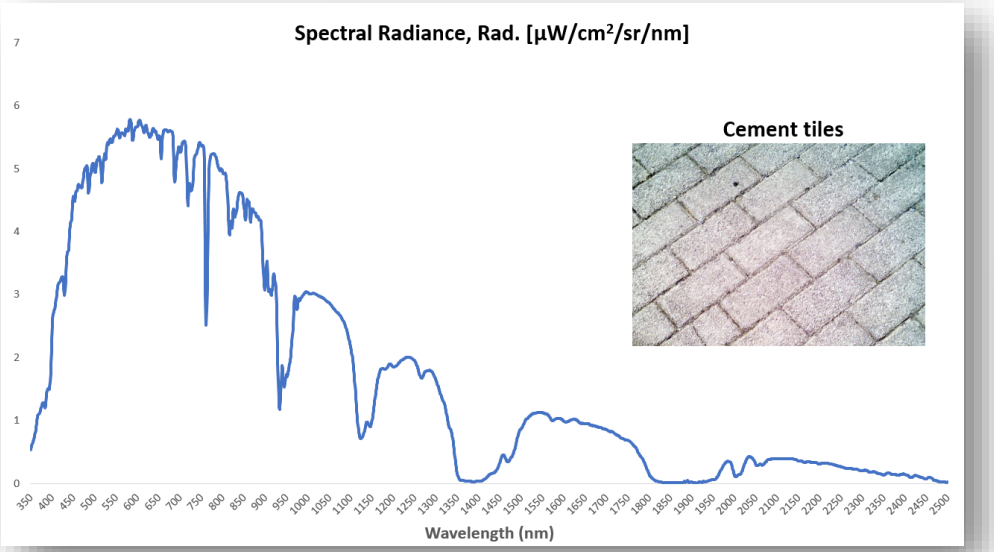

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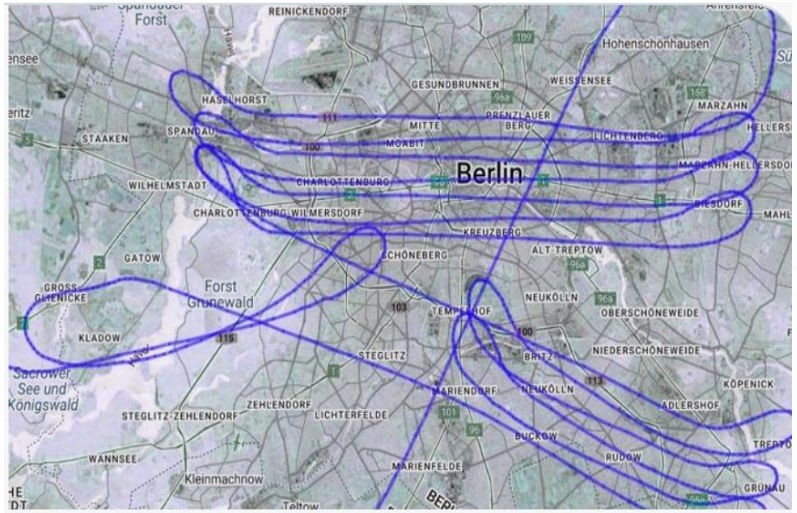
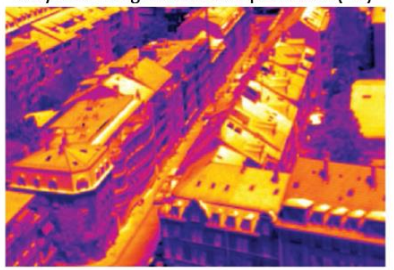
Campaigns

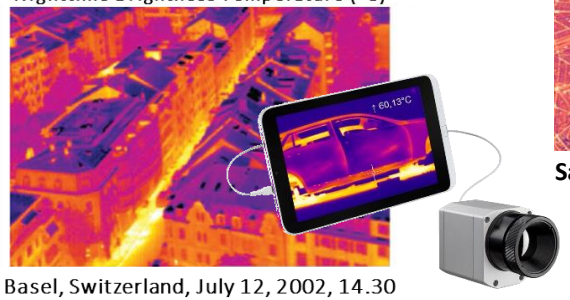
- Berlin 2022
- Paris 2023
- Bristol 2024
- Tier 2: 2025 -2026
- Tier 3: 2026 - 2027



Daytime Brightness Temperature (°C)

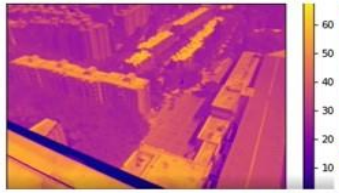


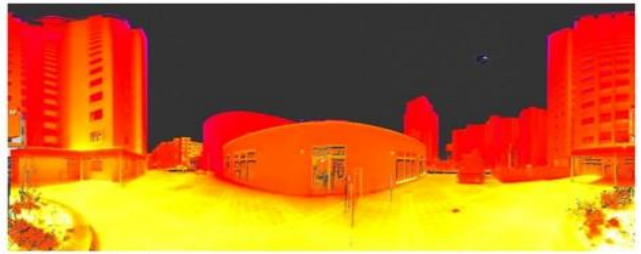
Nighttime Brightness Temperature (°C)

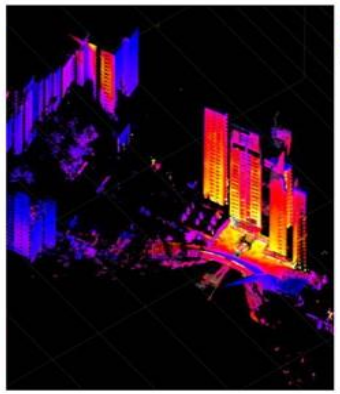


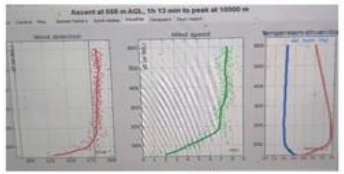
Basel, Switzerland, July 12, 2002, 14.30

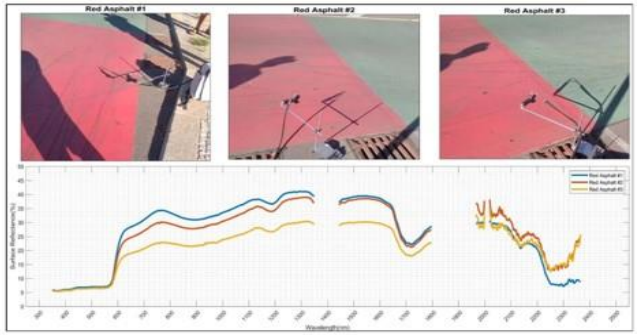
Sample SatVu Airborne Data, Berlin, 10/08/2022 21:24

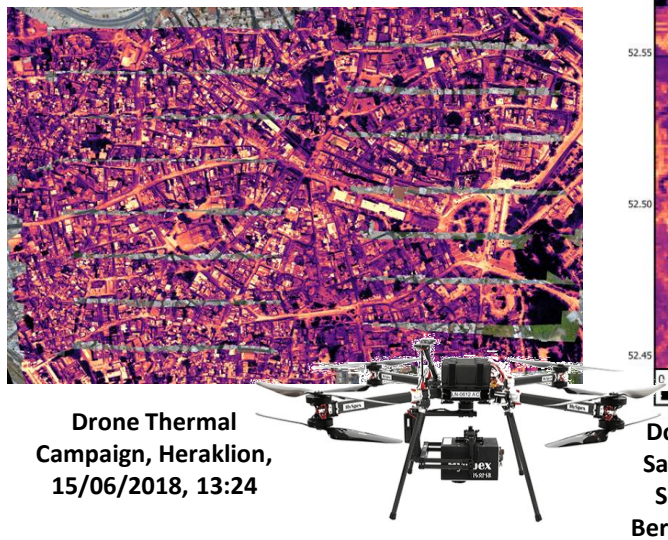




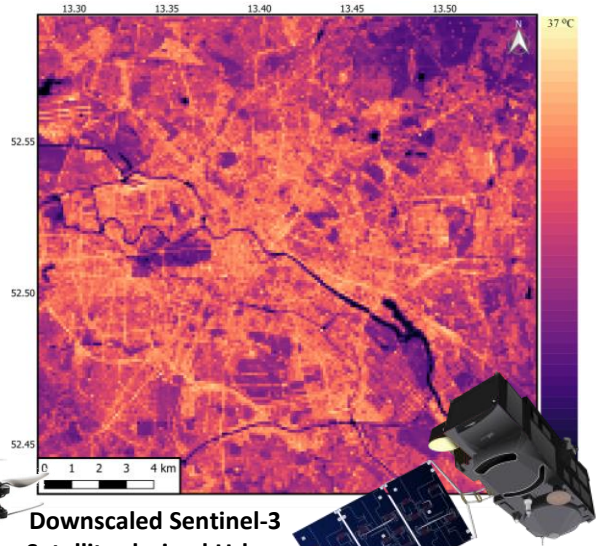








Drone Thermal Campaign, Heraklion, 15/06/2018, 13:24



Downscaled Sentinel-3 Satellite-derived Urban Surface Temperature Berlin - Berlin, 11.26 local time 30/05/2019

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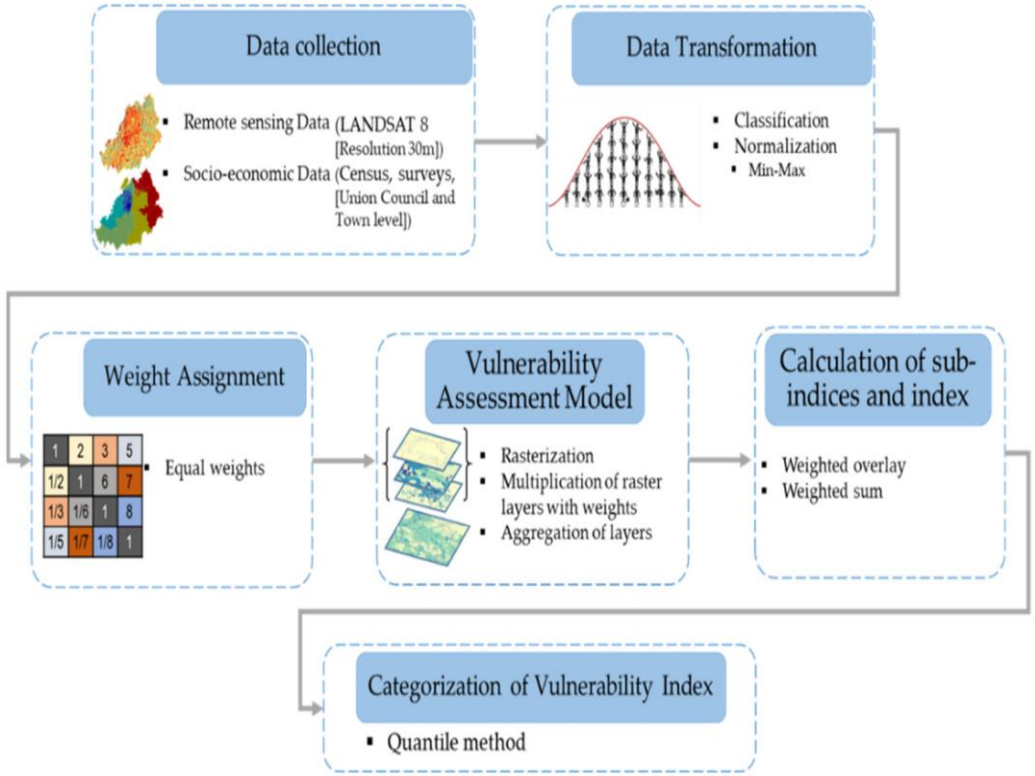
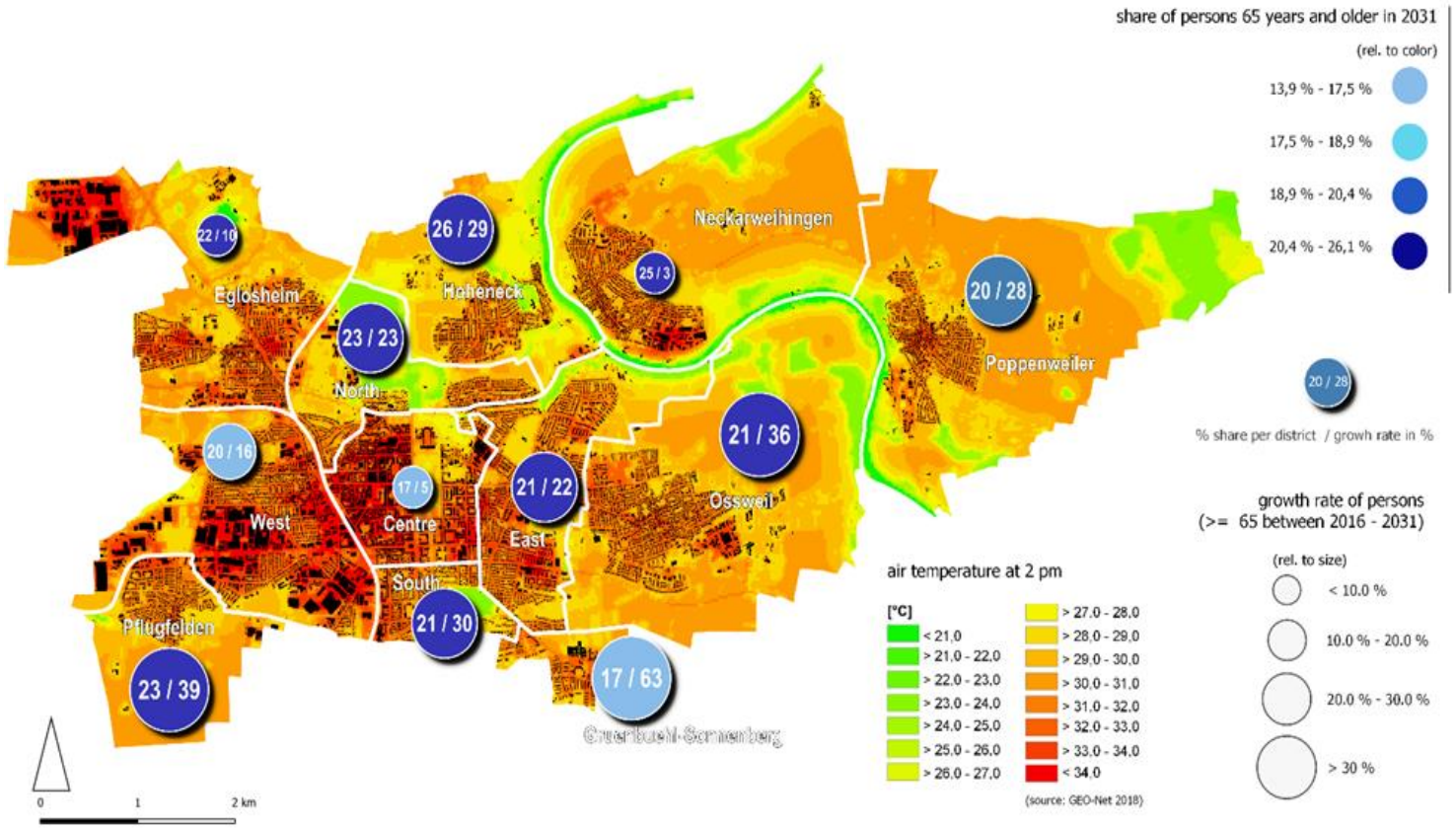
Scenario analysis: Aging, Heat Stress and Planning



Iqbal et al. 2022



Birkmann et al. 2018

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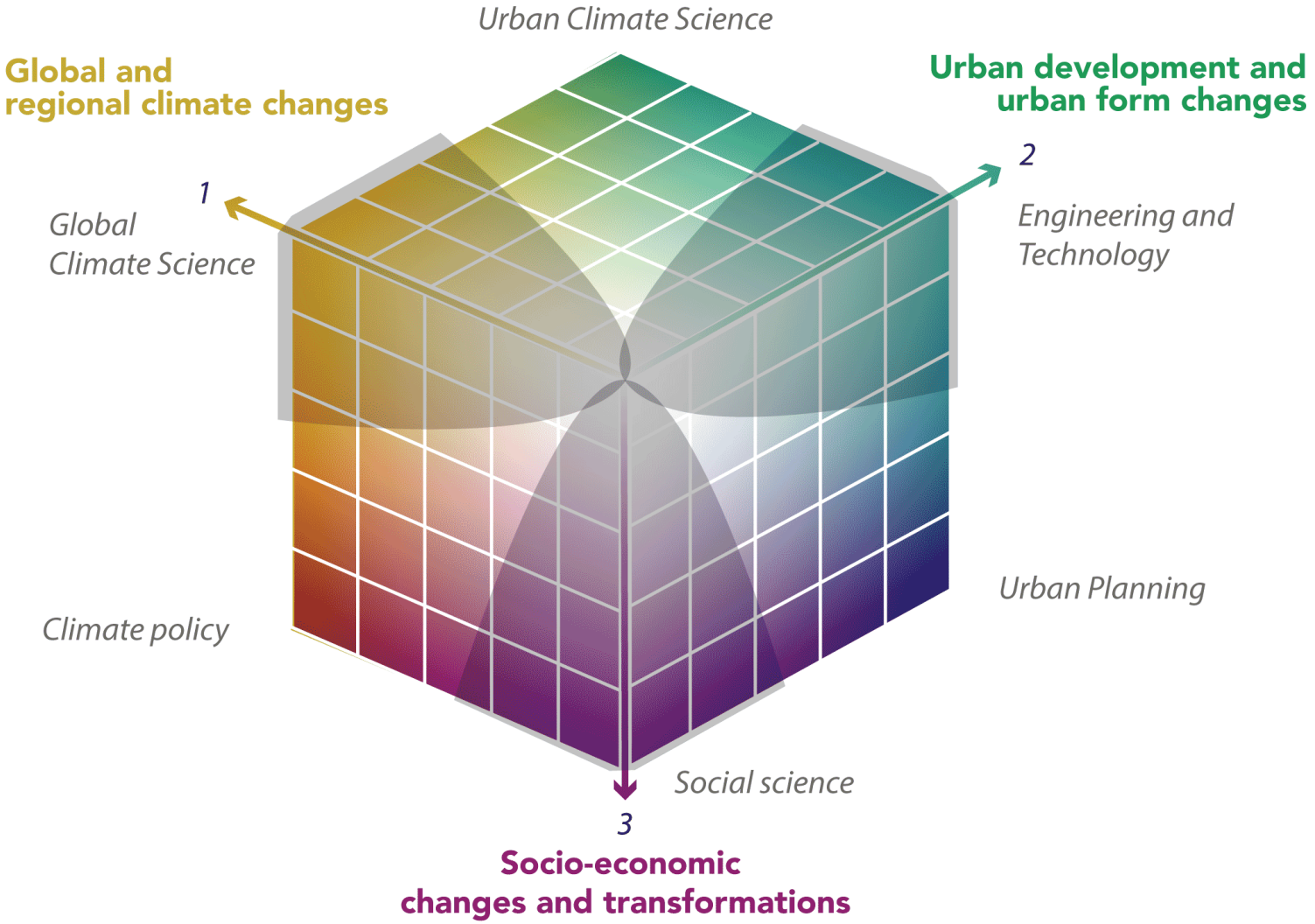
Main Outcomes

- **Deeper understanding** of socio-economic dynamics and human responses to climate, extreme events and urban transformation.
- **UDAs** that link different **neighbourhoods** considering **vulnerability, function** and **form**; and reacting to changes in urban development, socio-economic change and climate change.
- **Evaluated scenarios** of vulnerability, adaptive capacity and emerging risks from neighborhoods to **global cities**.



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