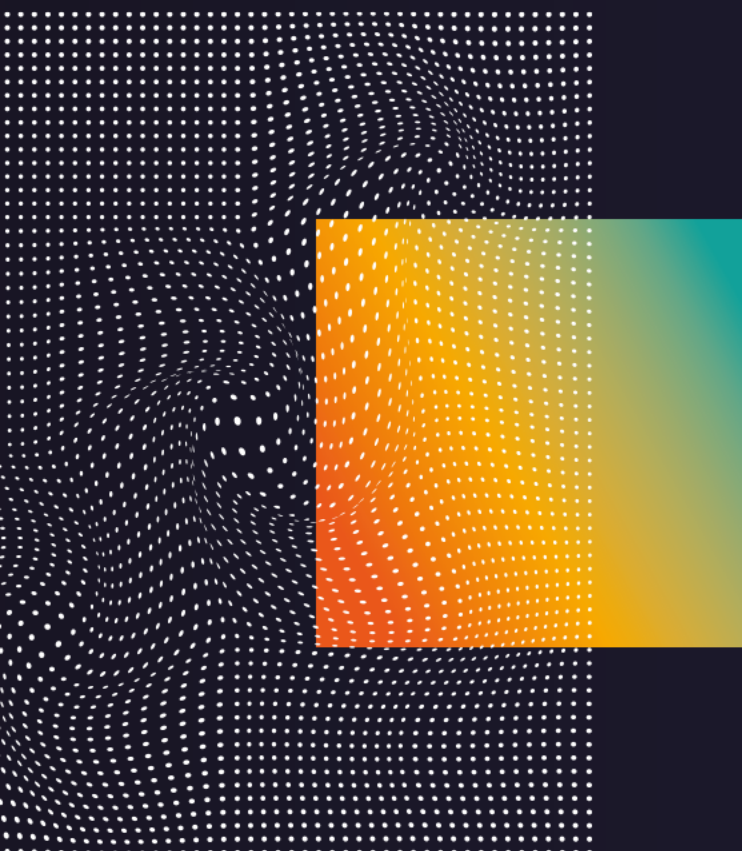




Urban Digital Twins and Data Spaces: Shaping the Future of Sustainable Cities

Prof. Sylvia Ilieva
GATE Institute, Sofia University

October 2025



Big Data for Smart Society (GATE) Institute

From 2019, Develop Big Data and AI applied research, innovation and education in collaboration with government, industry and entrepreneurs

СОФИЙСКИ УНИВЕРСИТЕТ
„СВ. КЛИМЕНТ ОХРИДСКИ“



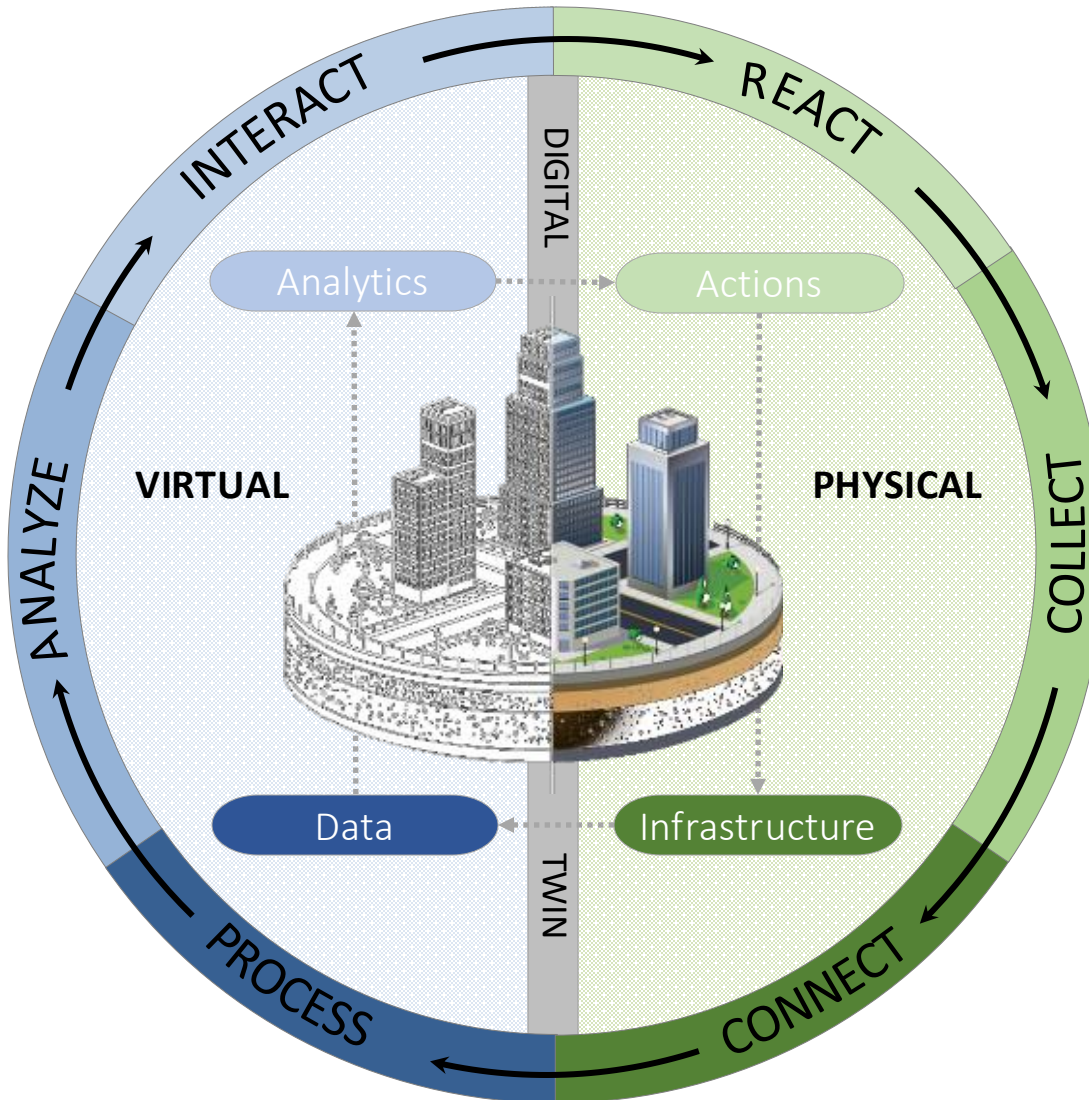
CHALMERS
UNIVERSITY OF TECHNOLOGY



CHALMERS
INDUSTRITEKNIK

GATE

Urban Digital Twin in Action



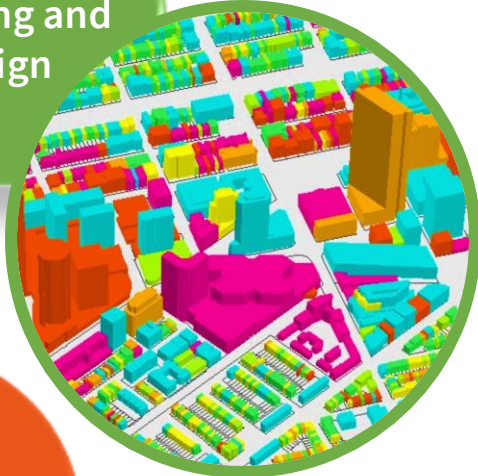
**to be reactive
to near-real-
time changes**

Urban Digital Twin Technological Architecture

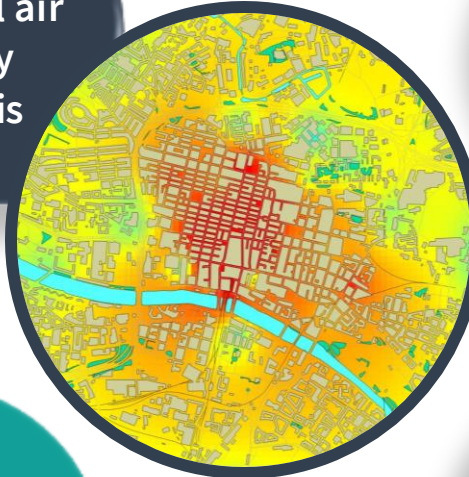


Digital Twin Use Cases

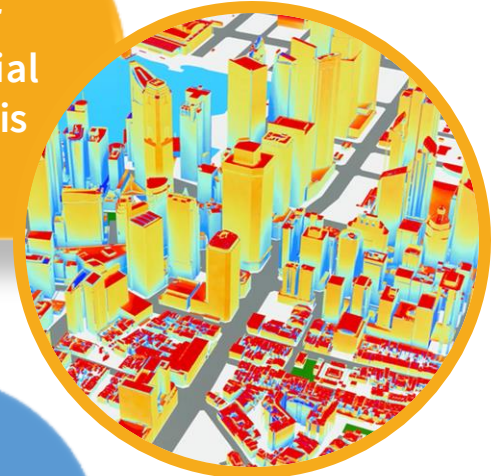
Urban
planning and
design



Spatial-
temporal air
quality
analysis



Solar
potential
analysis



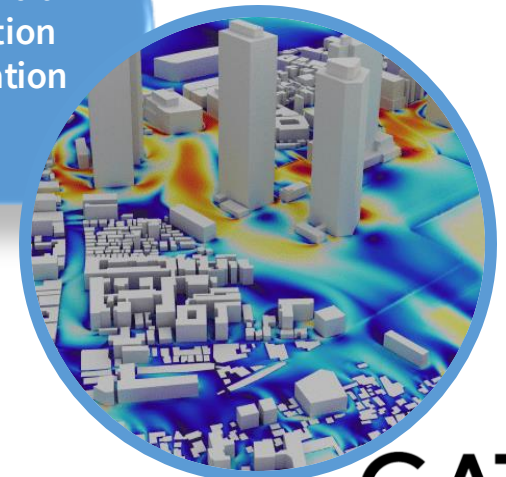
Urban Heat
Islands



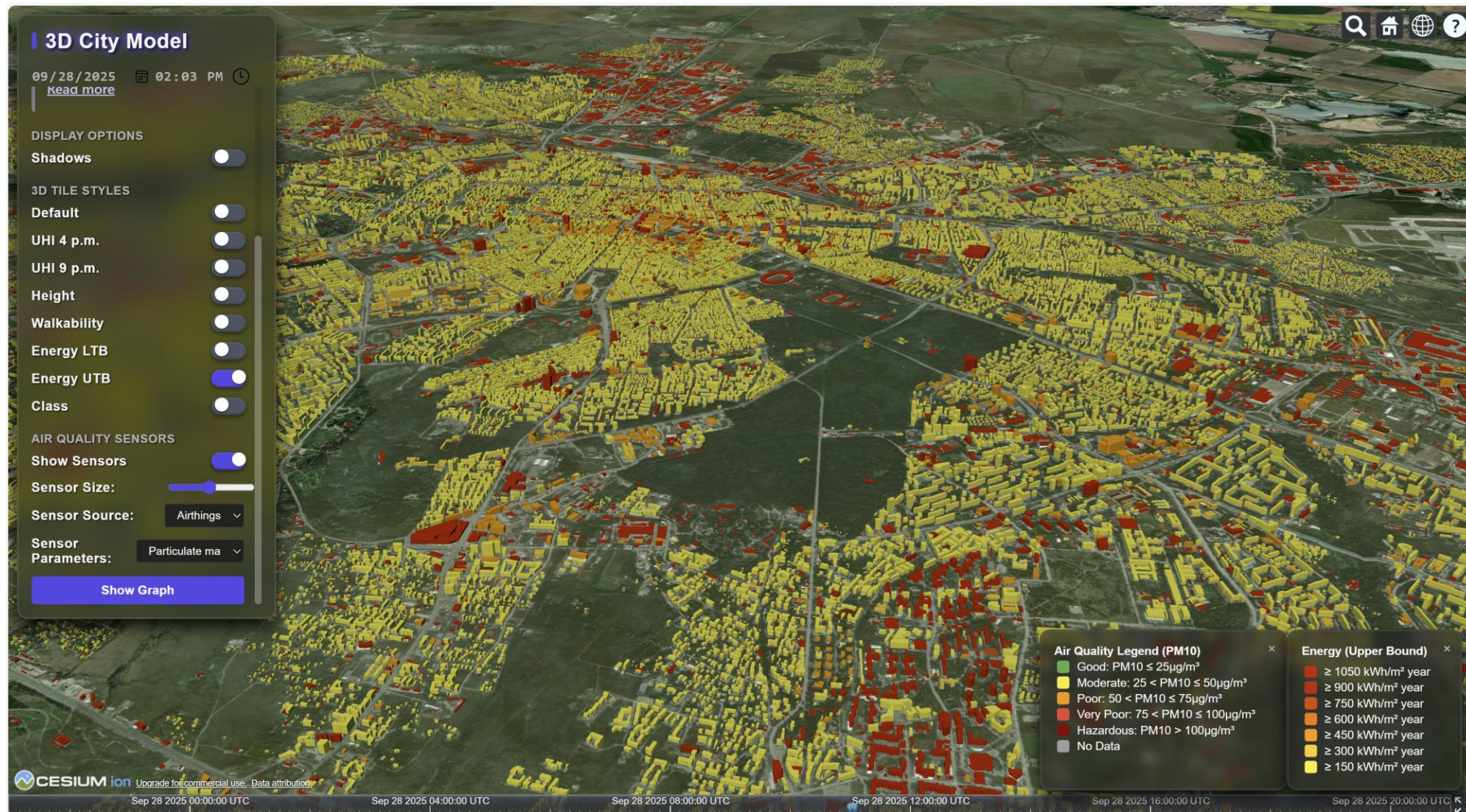
Mobility and
walkability



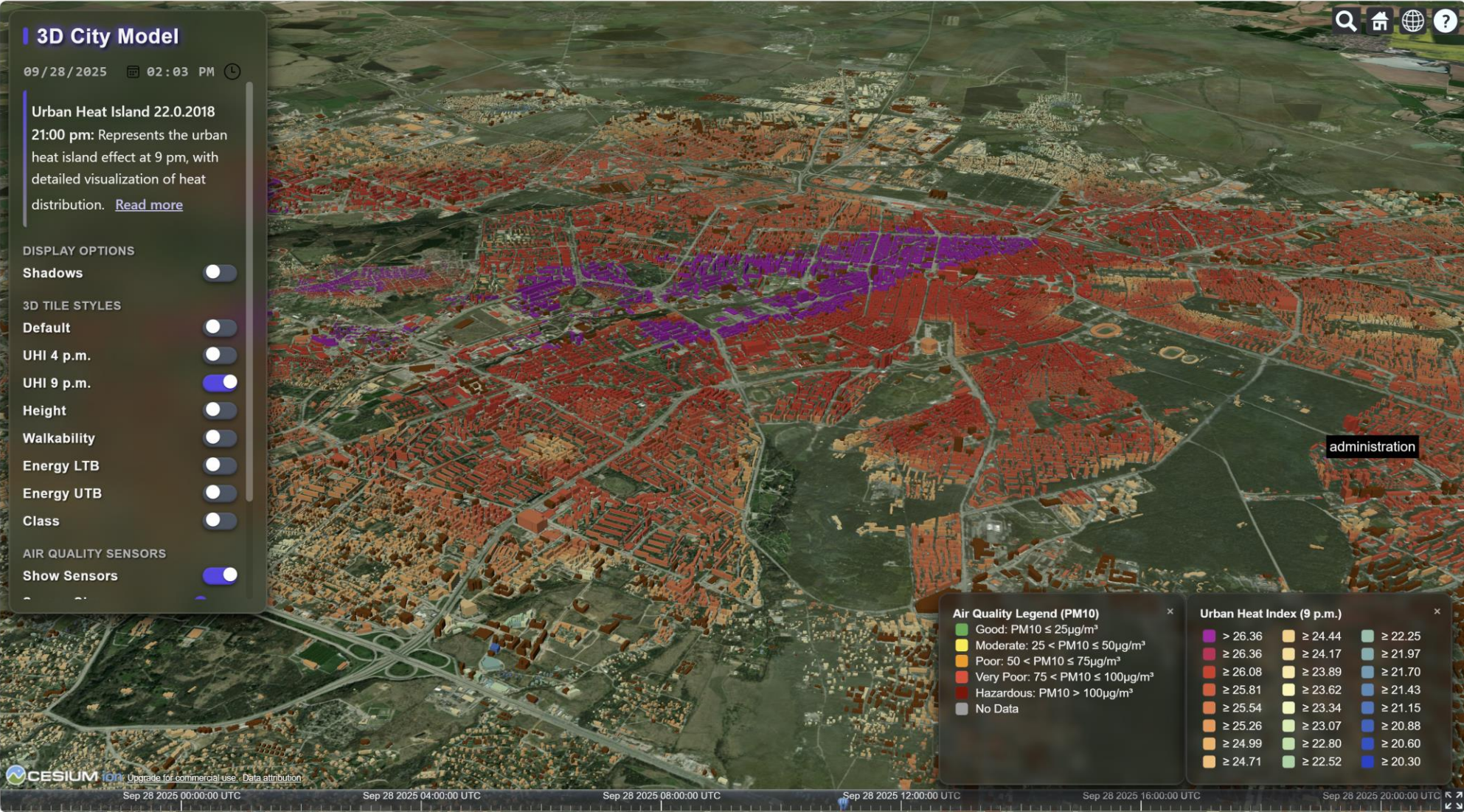
Wind and air
pollution
simulation



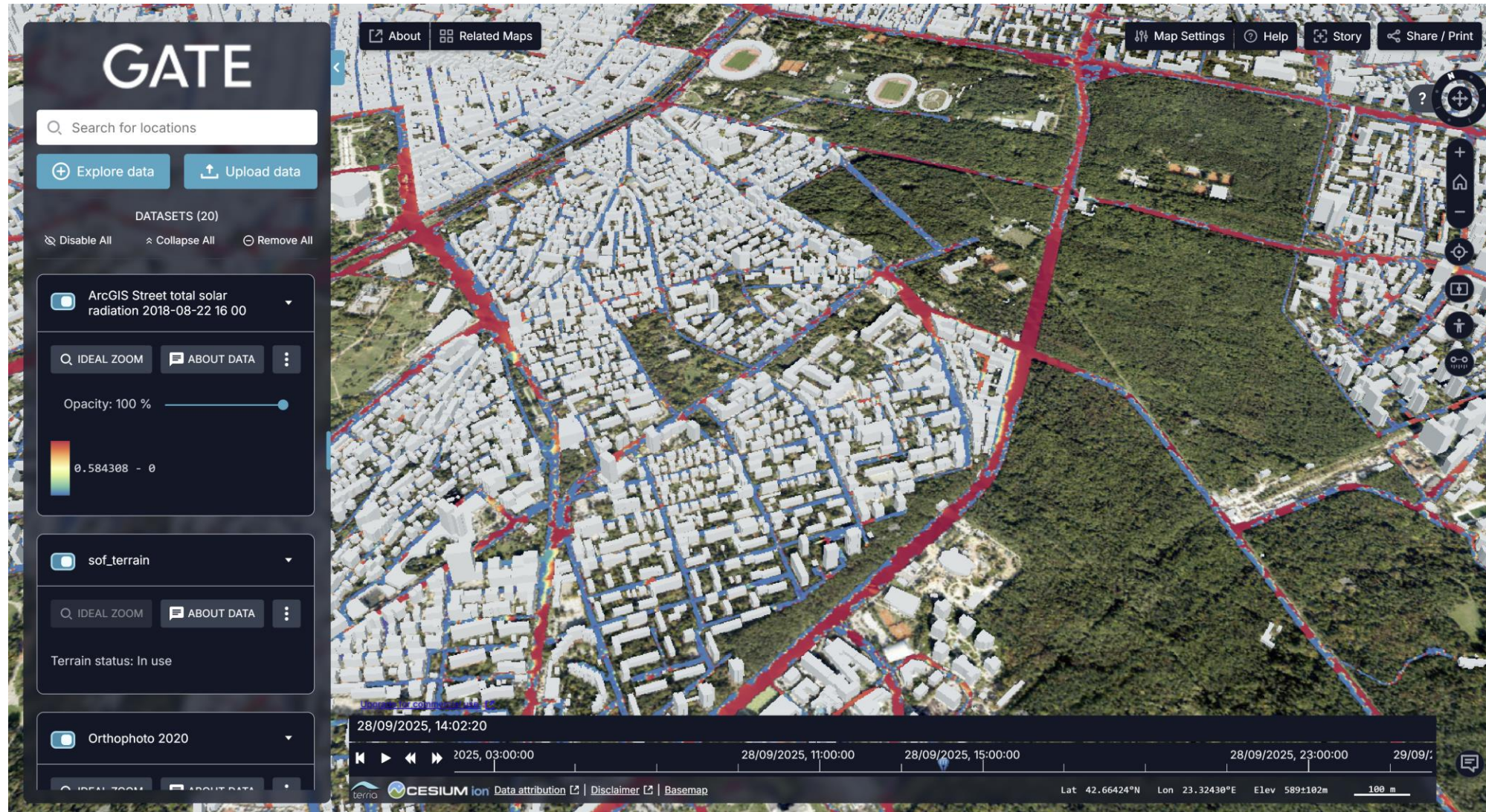
Energy Consumption @ 3D City Model



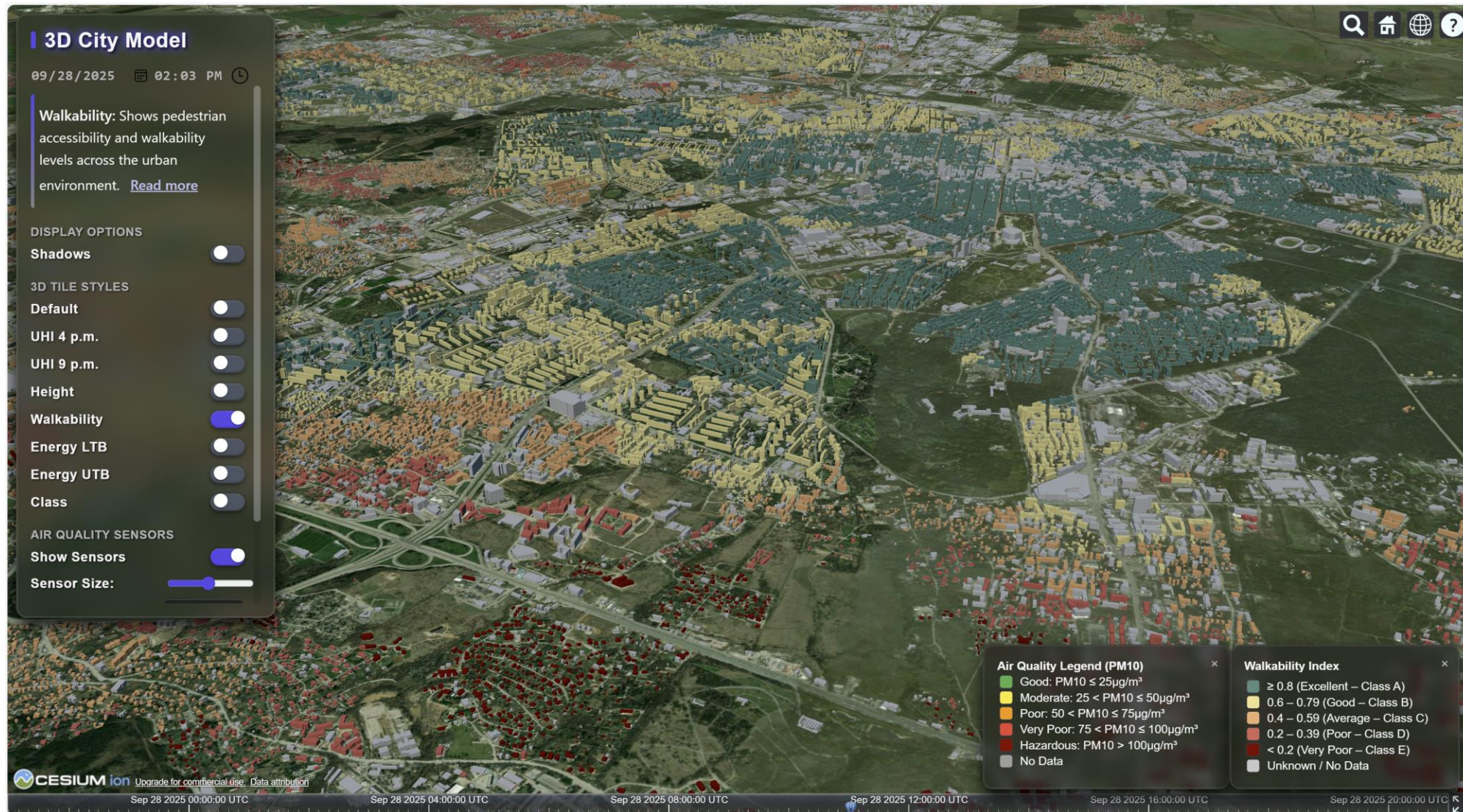
Urban Heat Island @ 3D City Model



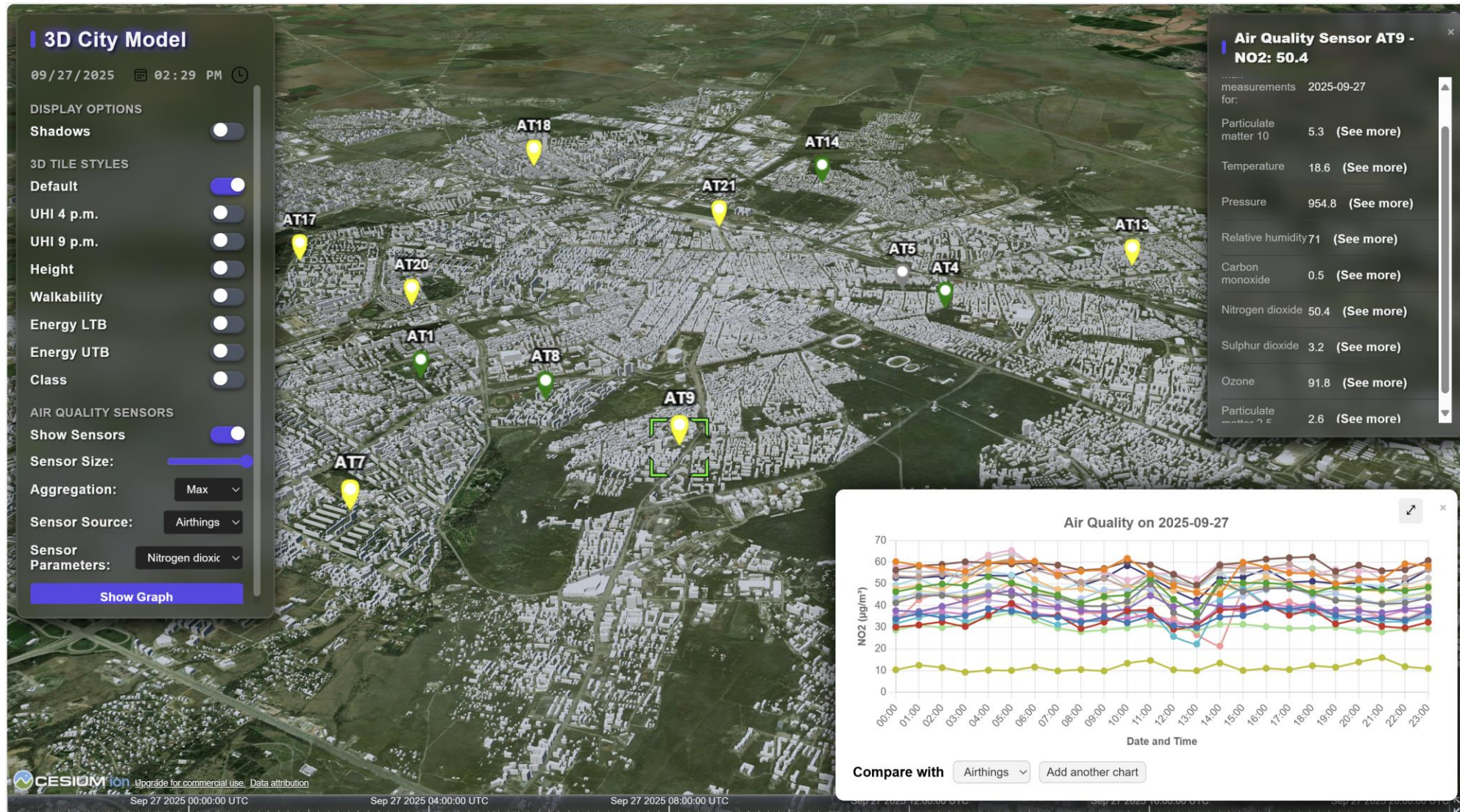
Streets Solar Radiation @ 3D City Model



Walkability @ 3D City Model



Air Quality @ 3D City Model



CFD Wind Simulation @ Unreal Engine

Visualization Options

Colormap

Particle Size: 7

Velocity Range: [0,7.708]

Camera Selection Camera 4

Moving Pathlines ☒

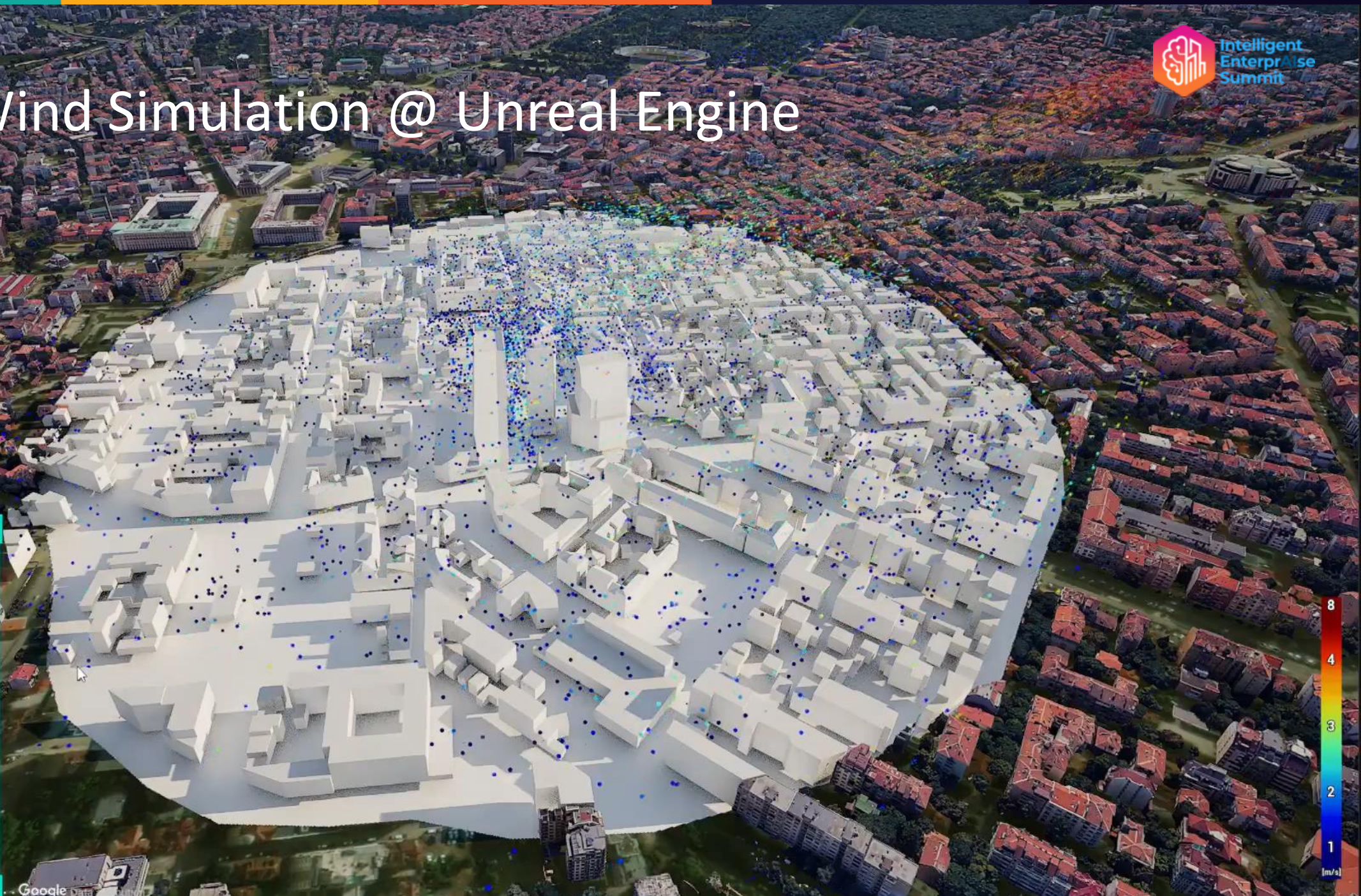
Vertical Plane Velocities ☐

Horizontal Plane Velocities ☐

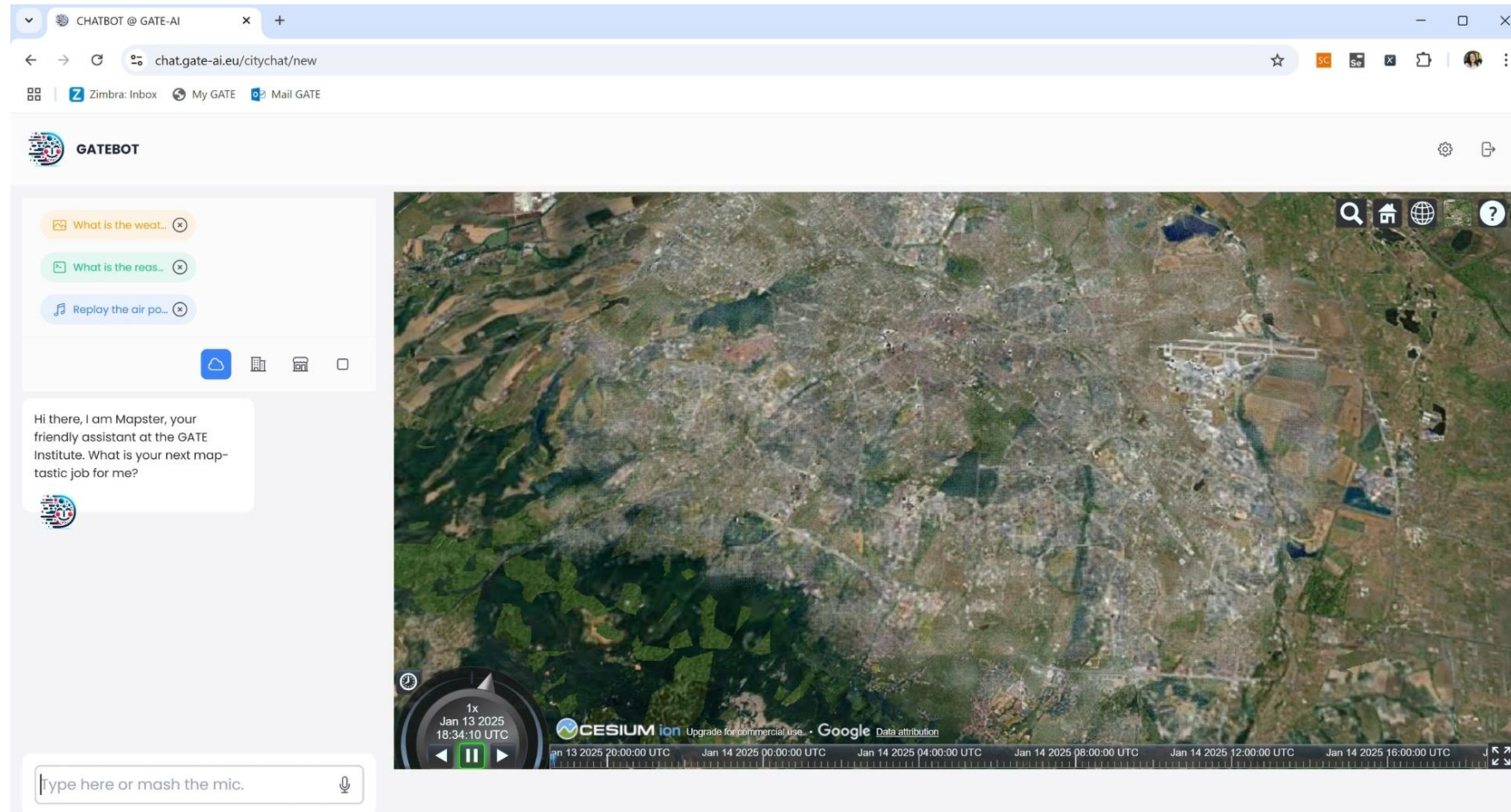
Boundaries ☐

Urban Heat Islands ☐

Google Data



The 'Talking' City



LLAMA 3.1 (70B), QLoRA fine-tuned

Urban Digital Twin @ Data Space



One-Stop-Shop for Data | Trust, Transparency and Sovereignty | Security | Added Value

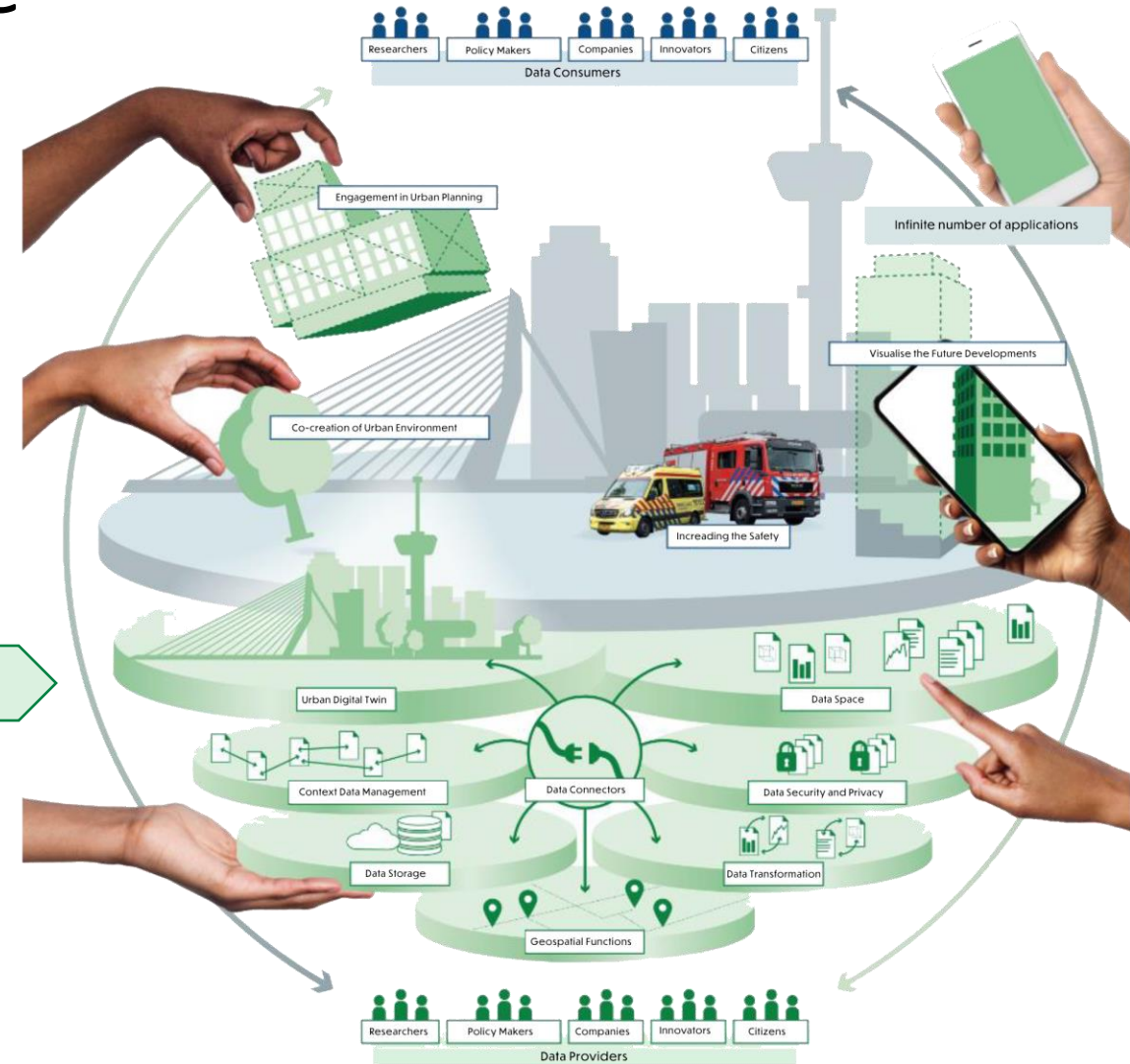
Physical City



Data space



Virtual City



Adopted from Digital City Rotterdam, Roland van der Heijden

European Mobility Data Space (deployEMDS)

Mobilising Europe using data space infrastructure



Barcelona



Budapest



Flanders



Île-de-France Region



Lisbon



Milan



Sofia



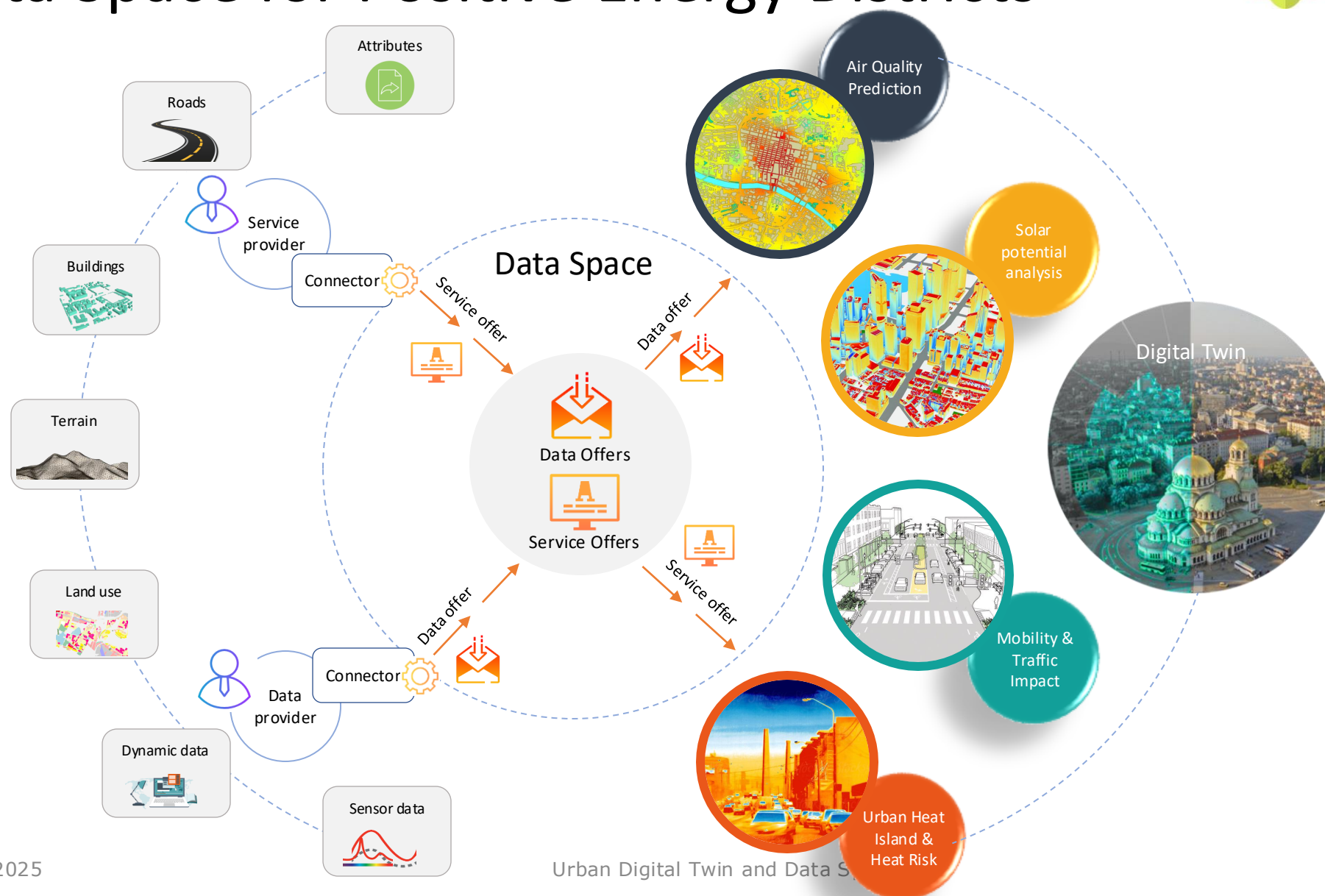
Stockholm



Tampere



Data Space for Positive Energy Districts



Urban Digital Twins Powered by Human- Centric AI

- Adapt
 - Continually learn by itself
- Think
 - Make strategic decisions
- Talk
 - Chat with people in natural language

...like a Human



A woman with long dark hair is wearing a VR headset and has her arms raised in a gesture of wonder or excitement. She is looking upwards with a smile. The background is a dark, starry space with glowing light rays and small white squares floating around. A semi-transparent circular overlay is positioned in the upper left quadrant, containing the text "Looking forward to the future!" and "Q&A".

Looking
forward to
the future!

Q&A