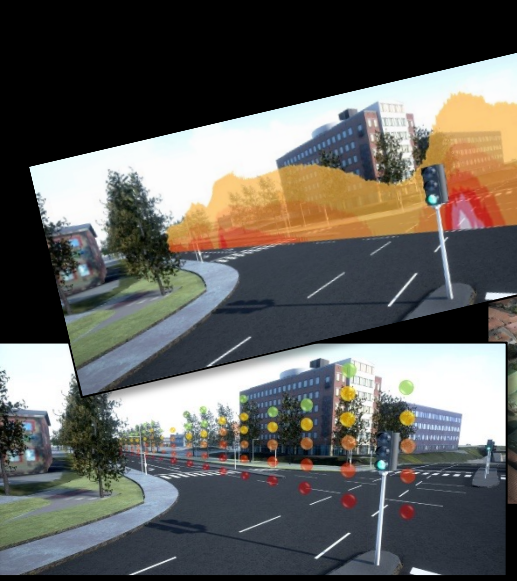
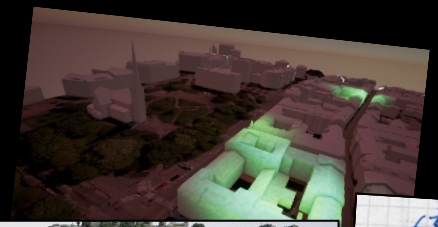
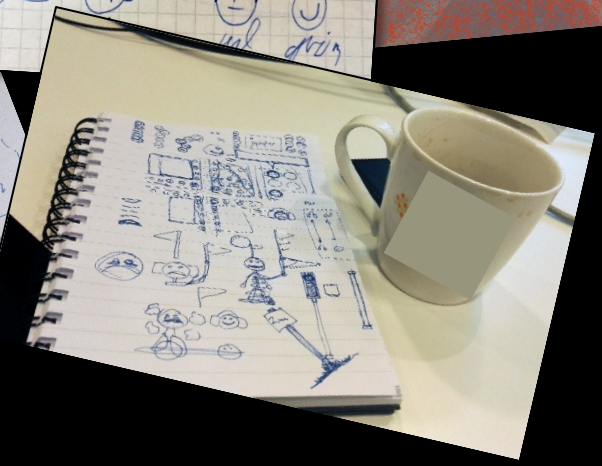
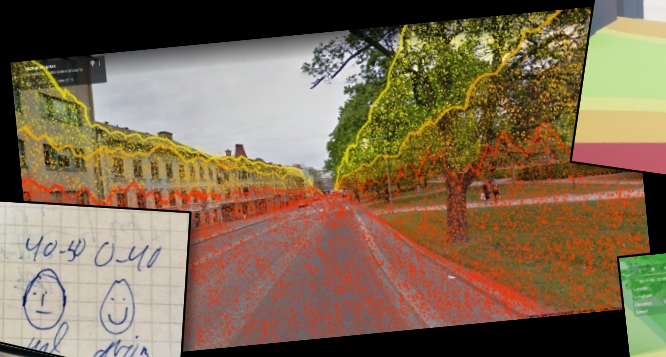
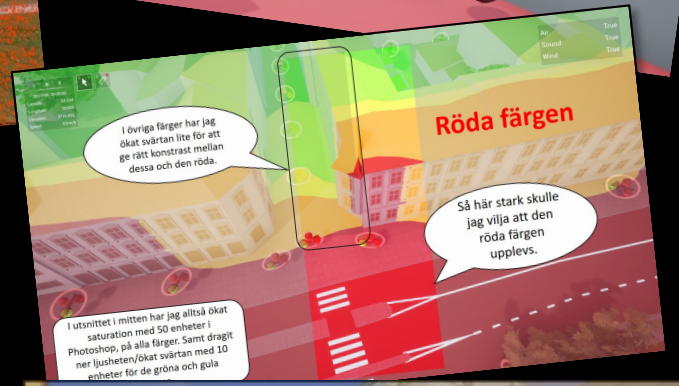
VISUALIZATION OF INVISIBLE PARAMETERS IN URBAN 3D-MODELS

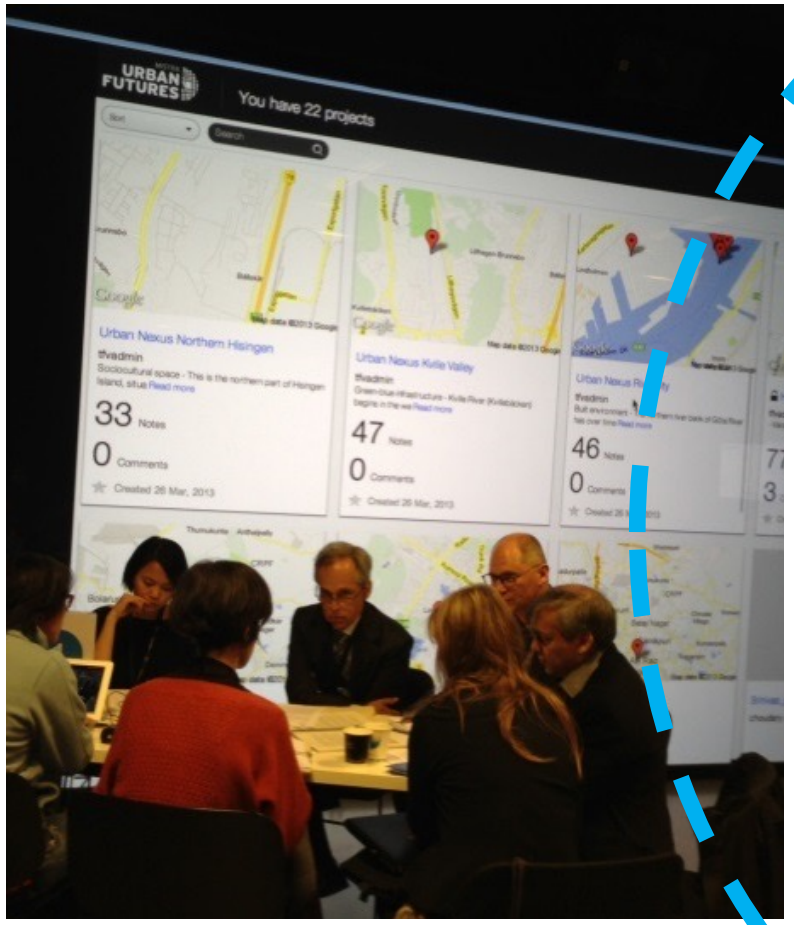





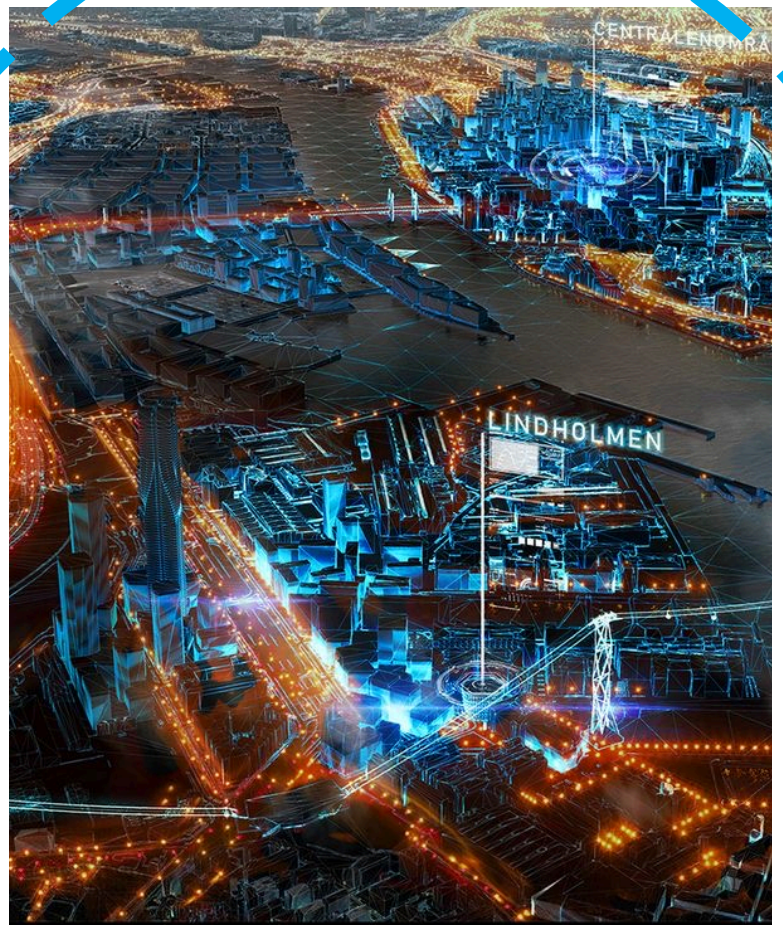
Monica Billger
Professor in Architecture and Visualization
Architecture & Civil Engineering, Chalmers
Digital Twin City Centre (DTCC)
InfraVis – National Research Infrastructure for Data Visualization

Images from project MiljöVis I+II:
https://research.chalmers.se/en/project/?id=10036
https://research.chalmers.se/en/project/?id=10448

Examples of dialouge tools for planning



Stakeholder workshop with urban planners.



Digital Twin City of Gothenburg (goteborg.se/wps/portal/start/goteborg-vaxer/poddar-och-video/filmer%20om%20stadsutveckling/virtuella-goteborg-stadens-digitala-tvilling)

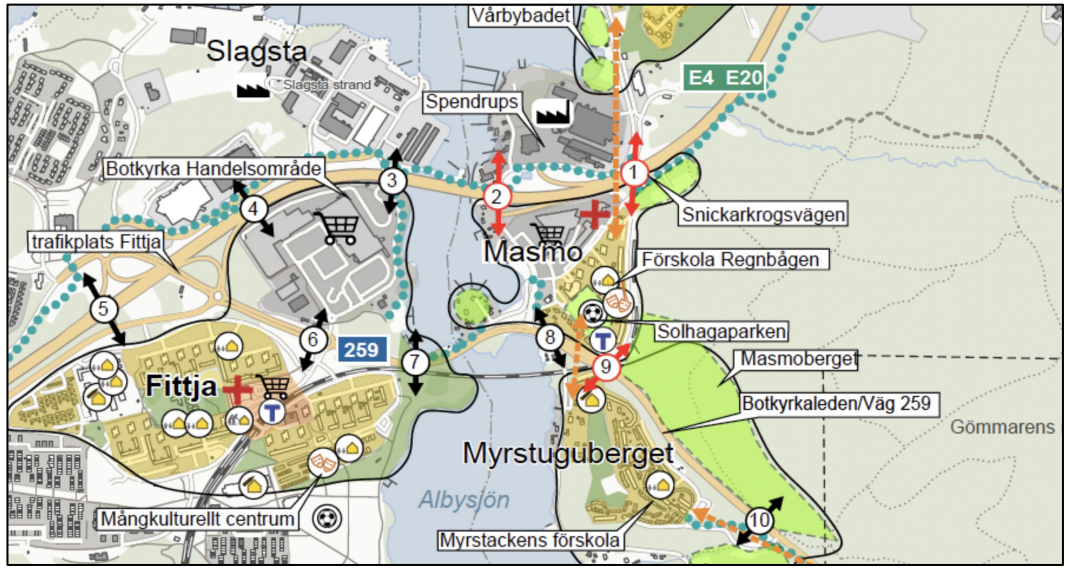
oleplay workshop with practitoners and researcher in an EU project.

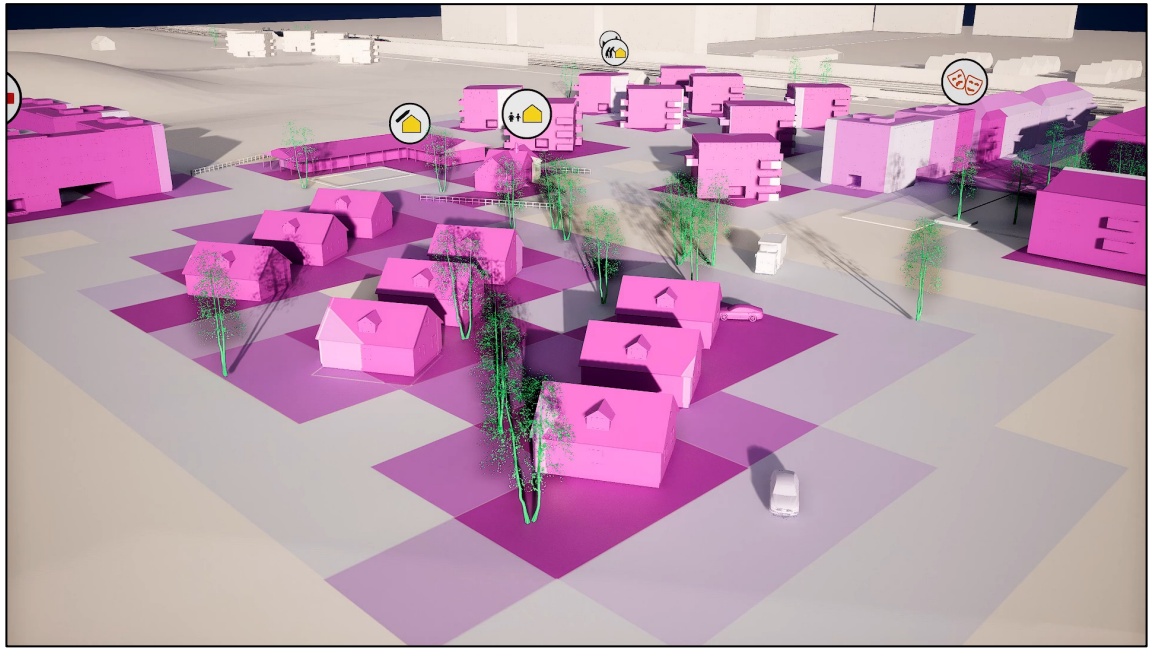
Interactive maps

3D-models

Serious games

From 2D to 3D visualization



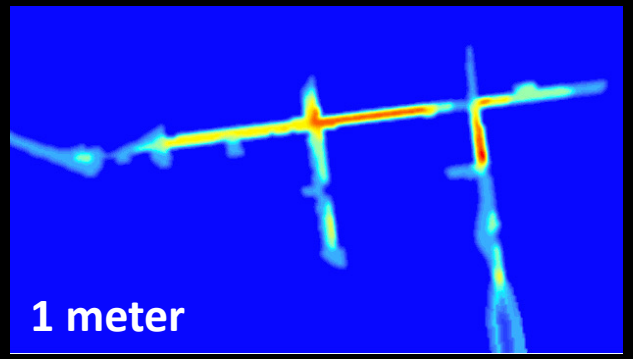


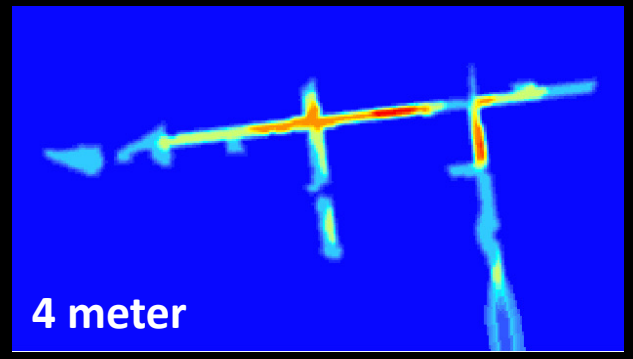
Challenges

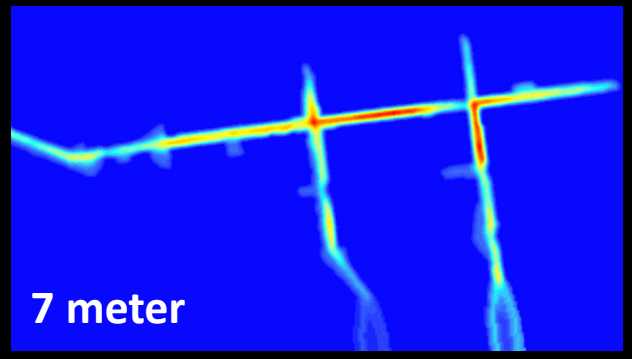
- To integrate, model and visualise qualitative and quantitative data to represent social and environmental parameters influencing urban qualities
- To find appropriate level of data visualisation and abstraction without losing richness of information, targeting different stakeholder groups

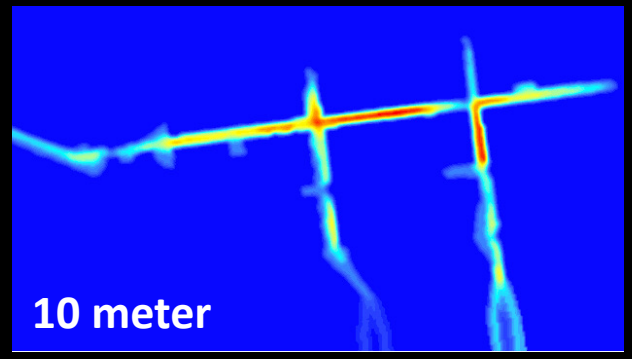
”the problem of displaying ”invisibile” data in an urban 3D model in a comprehensible way”

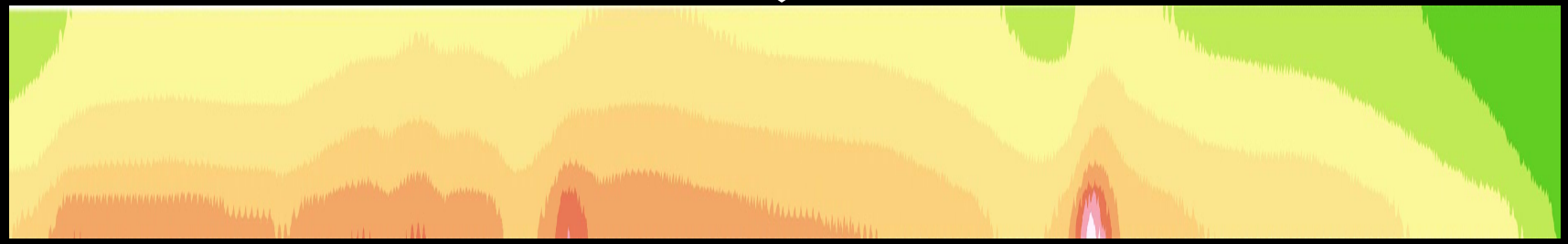
Earlier examples as background

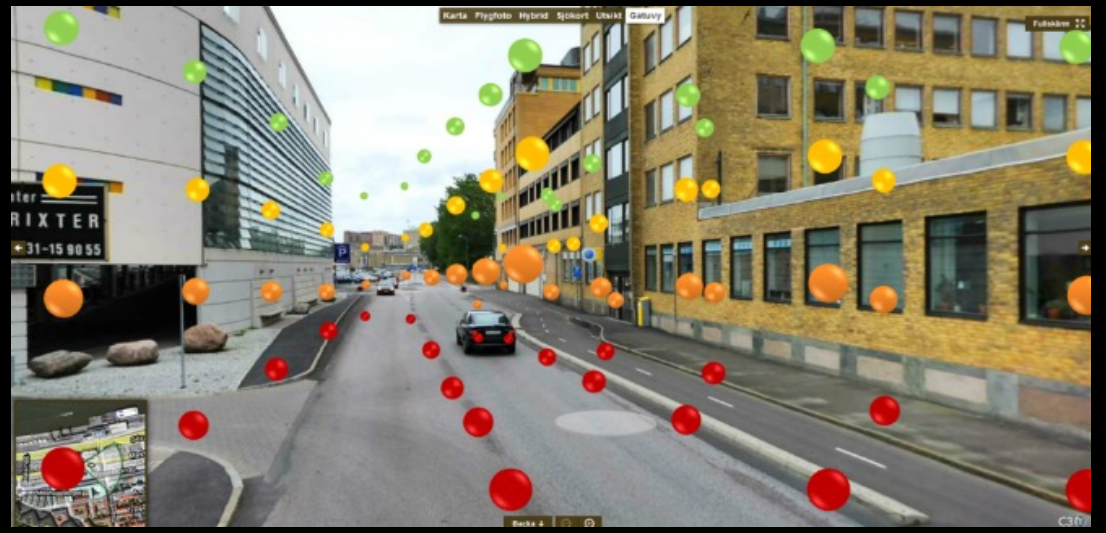

1 meter


4 meter


7 meter

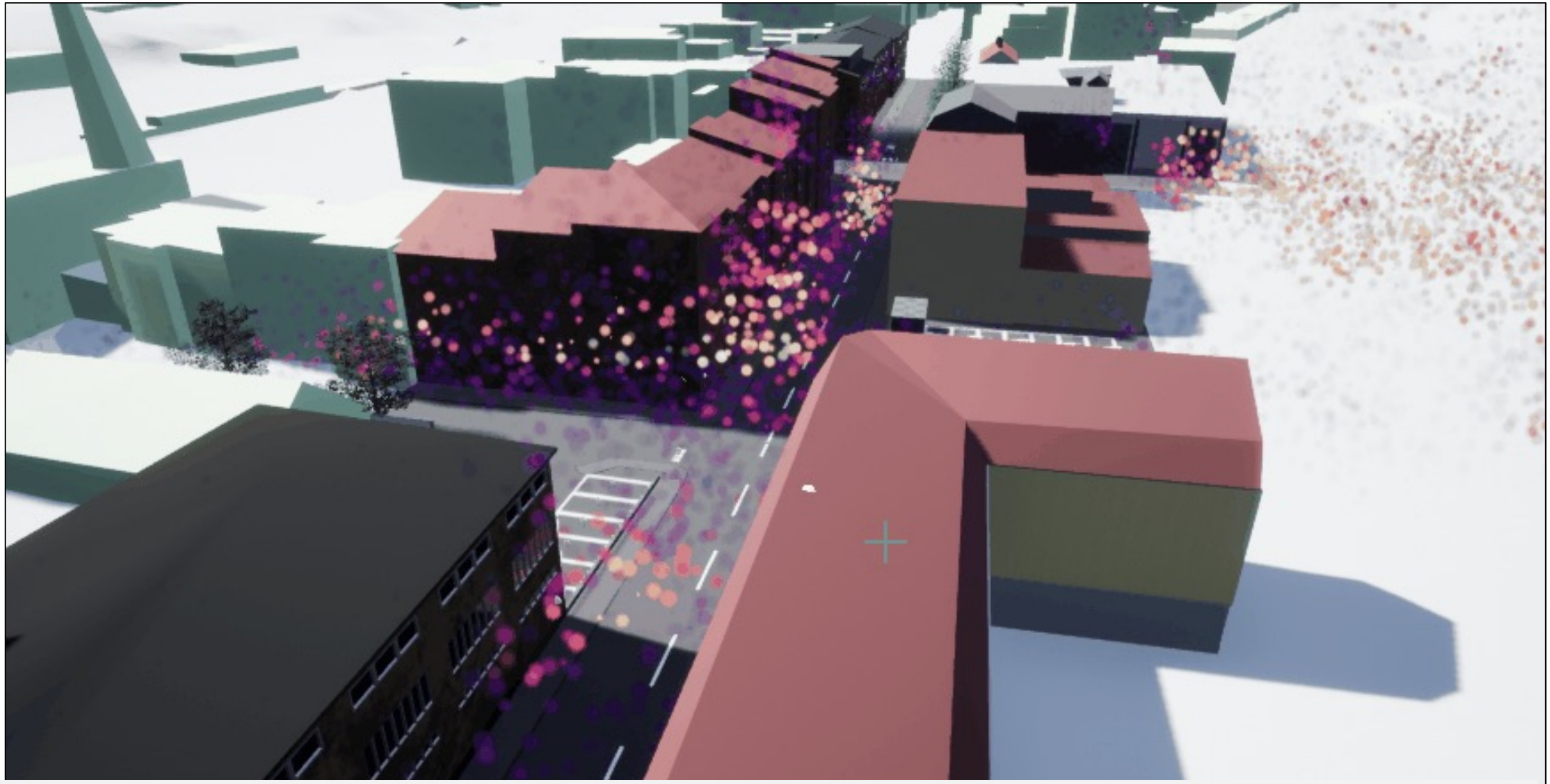

10 meter





DemoVirPen: Virtual planning and scenario analysis of noise in the city, Chalmers, youtube.com/watch?v=-4btcZW-g1c
Jens Forssen, Patrik Höstmad, Beata Stahre Wästberg, Monica Billger, Mikael Ögren, Vasilis Naserenting, Fabio Latina, Michael Heron, Orfeas Eleftherion, Luis Almeida

Example from CityAirSim: Visualizing impact of green structures on air quality
Projektledare Håkan Plejel, GU

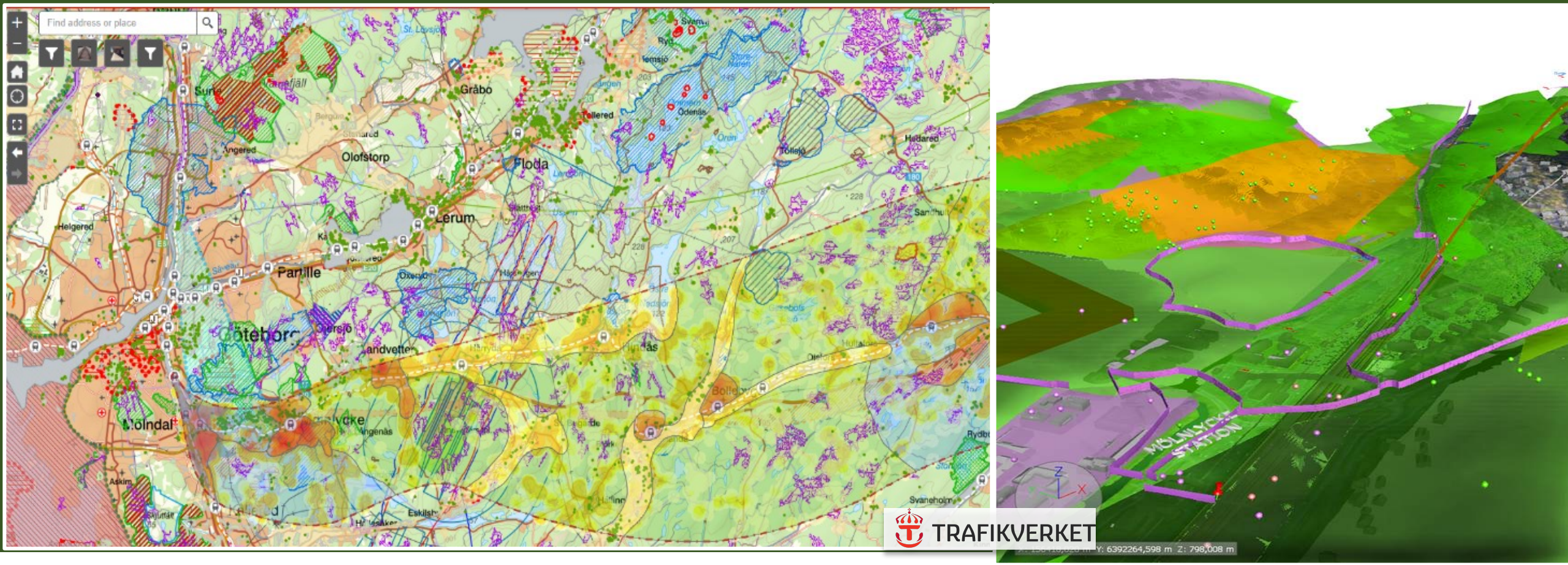


Clara Larsson et al 2023, Visualizing Invisible Environmental Data in VR: Development and Implementation of Design Concepts for Communicating Urban Air Quality in a Virtual City Model, CAAD Futures 2023:pp 253–267

On-going Projects

MiljöVis / MålVis/ FärgVis 2020-2024

Visualization of invisible parameters in large scale coordination models



CHALMERS

TRAFIKVERKET

DIGITAL TWIN CITIES CENTRE

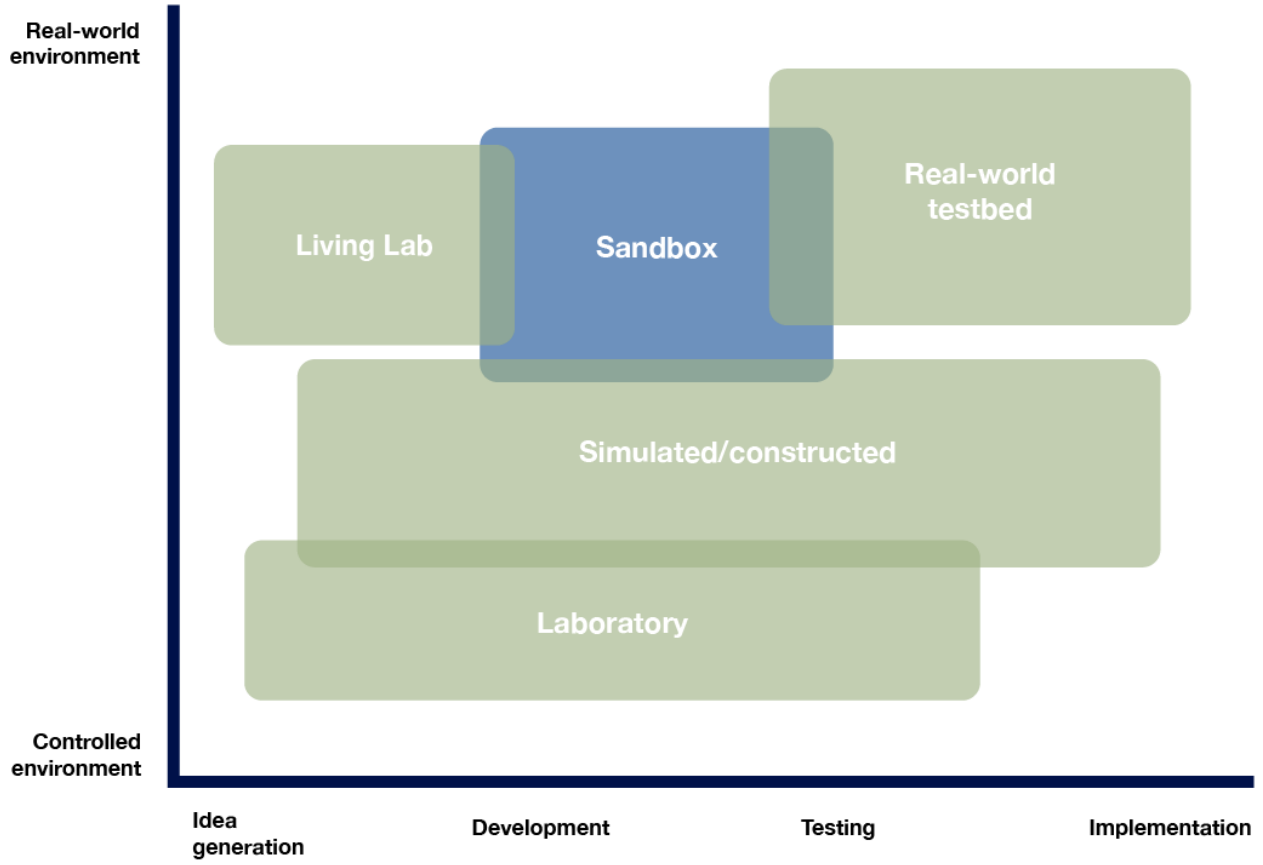
CENTRE FOR MANAGEMENT OF THE BUILT ENVIRONMENT

ADLERBERTSKA STIFTELSERNA

Research questions

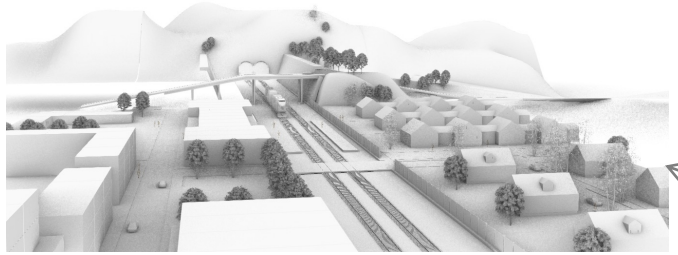
- How can we visualize invisible data (such as air, noise, and social consequences) in 3D-models?
- What is required of the visualization for different target groups to understand the information?

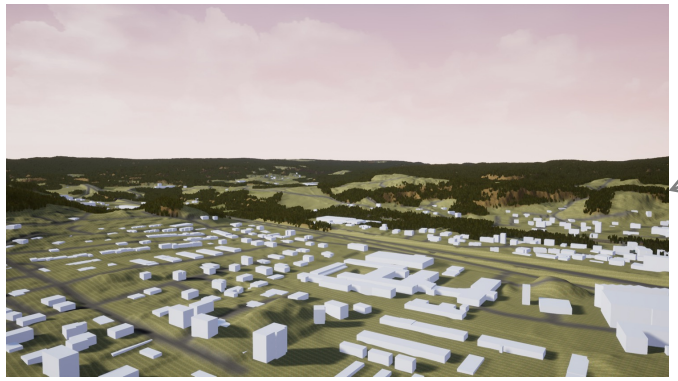
Potential exploratory **approaches**



After **Arntzen, S. et al:** Testing innovation in the real world: real-world testbeds (2019)

Concept development





Data to visualize

Noise
Air
Social consequences

Identification of target groups

Development platform (Unreal Engine)

Sketch model: ”sandbox”
Large scale model

Design elaborations

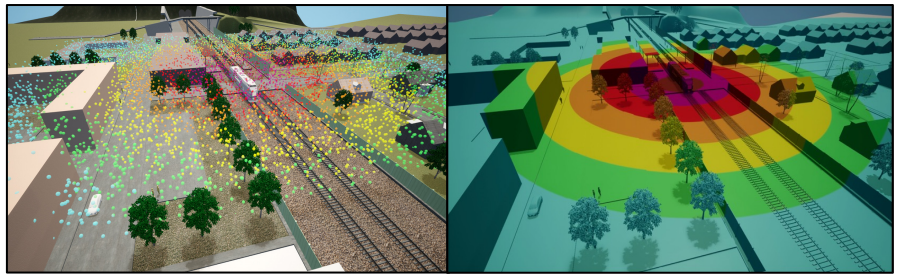
User testing

Workshops
Interviews

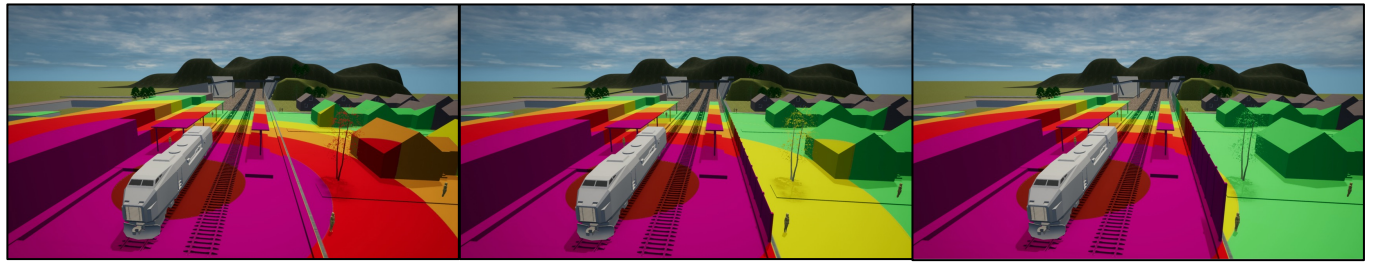
User tests in **workshops and interviews**

Examples of **design concepts** to test

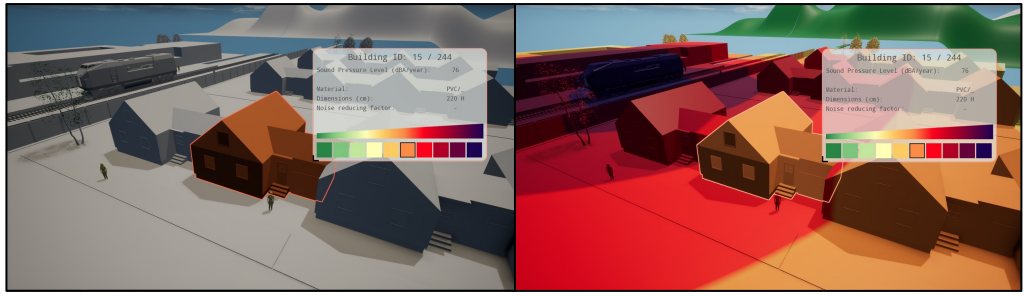
Shapes



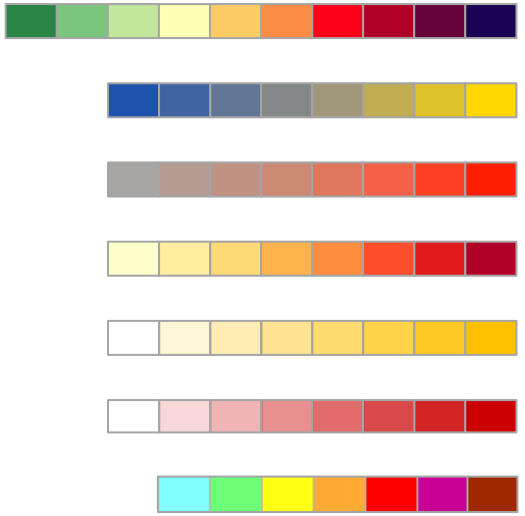
Scenarios



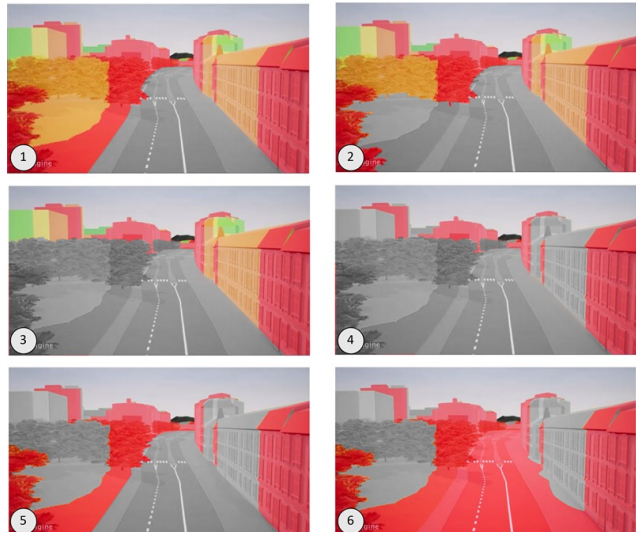
Levels of detail



Colour scales

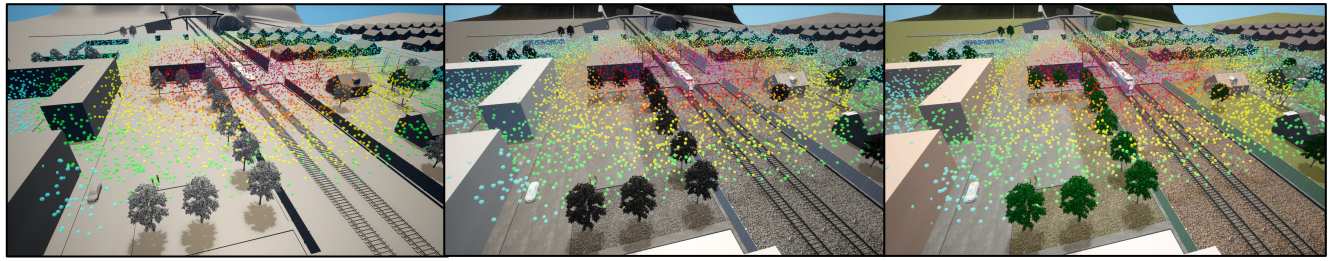


Filtrering of information



Symbols

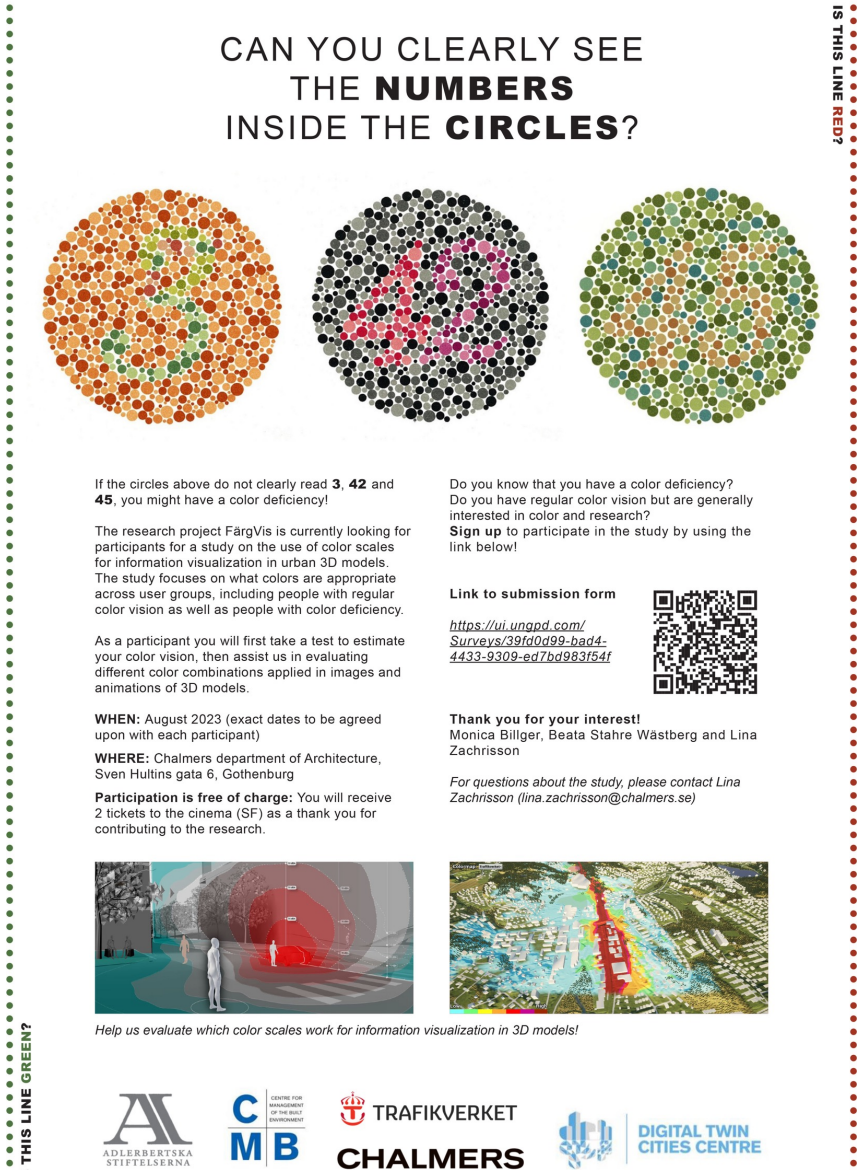
Background



DEEP

FärgVis color study

How the perception of color, depending on color vision, affects the visual saliency of geospatial information in urban 3D models.



To conlude…

How can we visualize invisible data (such as air, noise, and social consequences) in 3D-models?

What is required of the visualization for different target groups to understand the information?

Proposed workflow guidelines

Why?

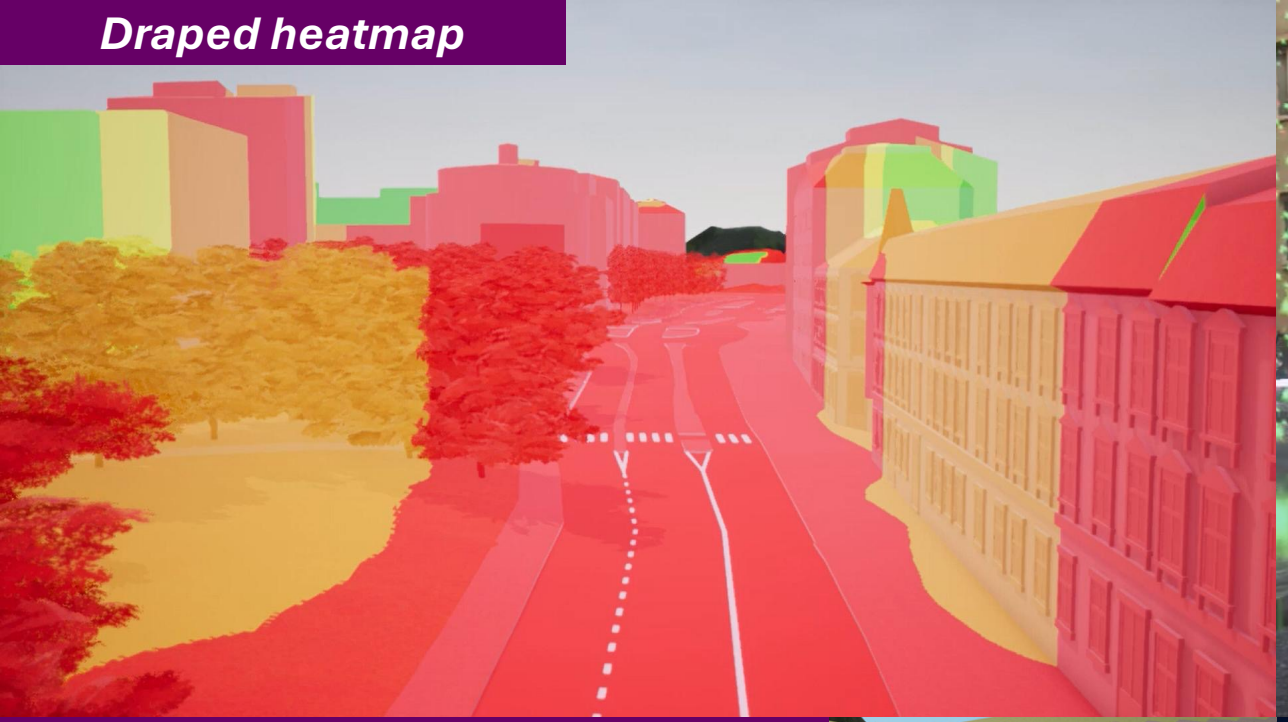
1. Motivation for visualizing data in 3D

For Whom/What?

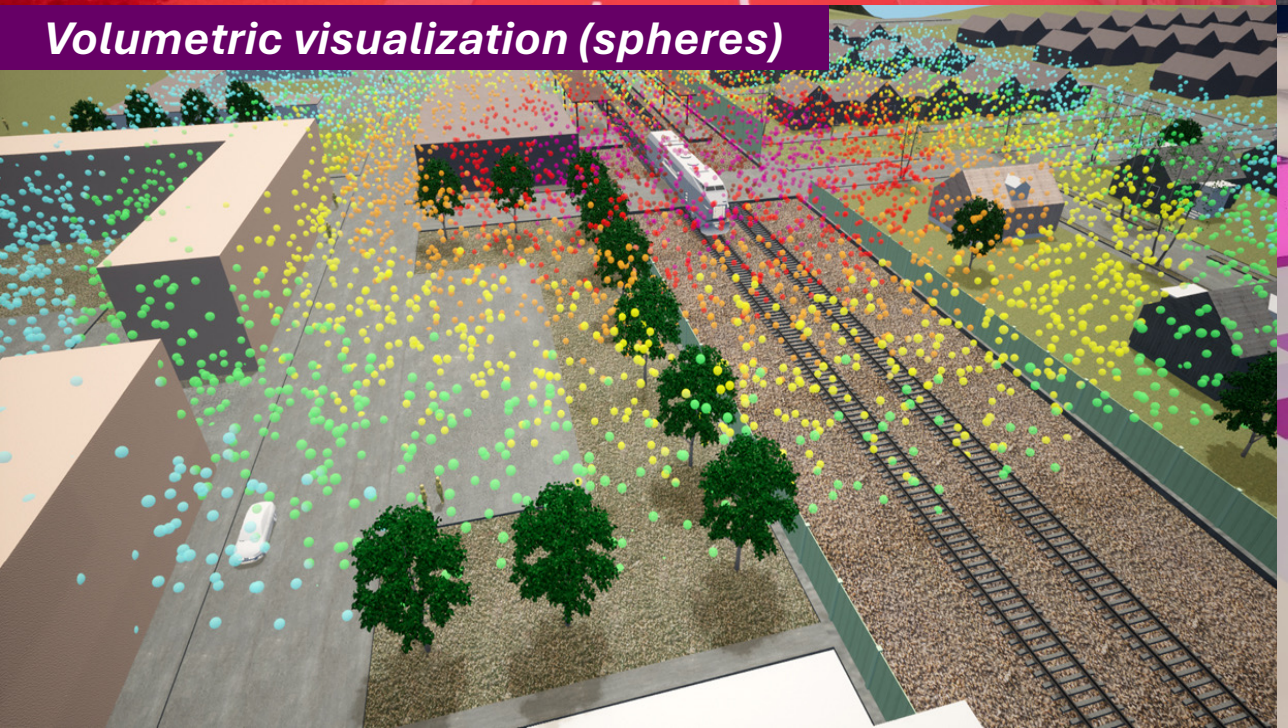
2. Identify and select **relevant target groups** and **ways of visualizing data**
3. Define **what kind** of data to focus on

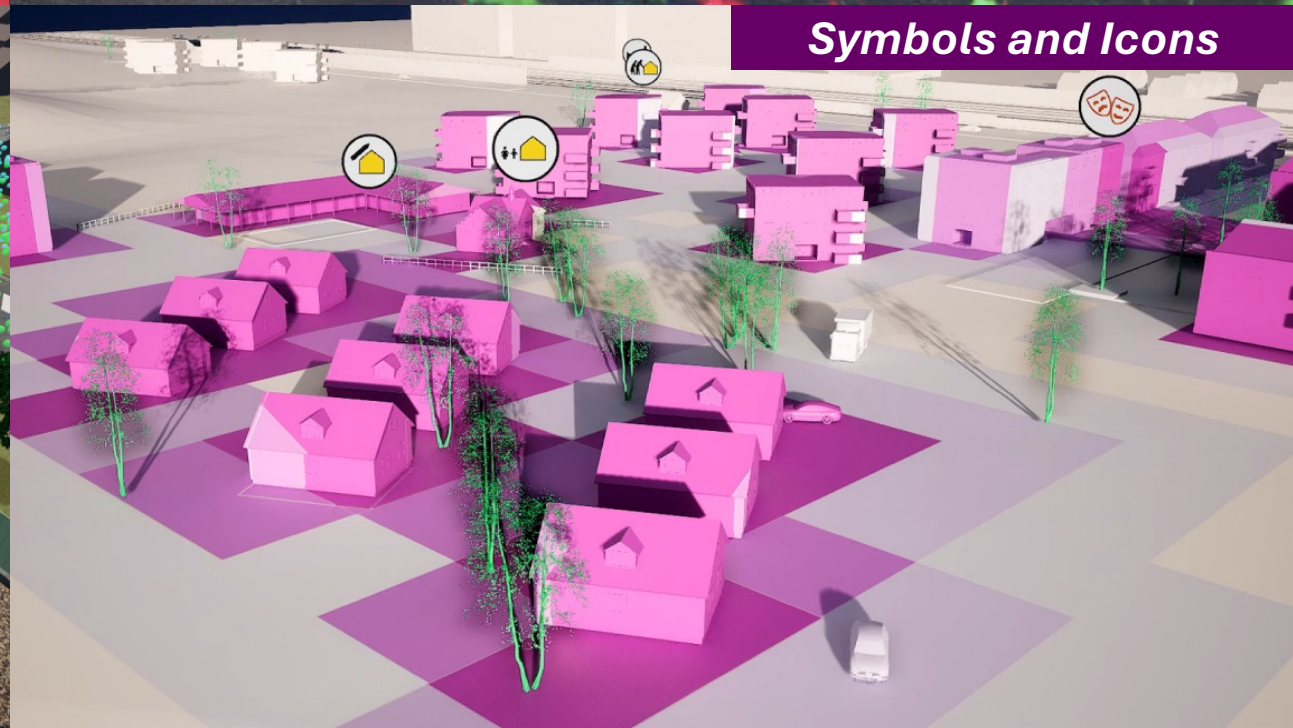
How?

4. Develop the sandbox model **before** developing the realistic location bound 3D-model
5. Develop **prototypes** for visualization of data
6. **Test** the data visualization prototypes in the sandbox model
7. **Adapt** the visualization to the needs of the target groups


Draped heatmap

Volumetric visualization (particles)


Volumetric visualization (spheres)


Symbols and Icons

MiljöVis publications

A proposed workflow for conceptual visualization studies in urban 3D-models

Beata Stahre Wästberg[1][0000-0001-8493-9231], Monica Billger[2][0000-0002-0067-1985], Liane Thuvander[2][0000-0002-9031-4323], Fabio Latino[1][0000-0001-6980-2034] and Susanne van Raalte[3]

[1] Chalmers University of Technology and University of Gothenburg, Department of Computer Science and Engineering, SE-412 60 Gothenburg, Sweden
[2] Chalmers University of Technology, Department of Architecture and Civil Engineering, SE-412 60 Gothenburg, Sweden
[3] Trafikverket, SE-405 33 Gothenburg, Sweden
lncs@springer.com

Abstract
Different types of invisible parameters, such as air quality and noise, are all affected by new constructions of infrastructure and buildings and should be considered as important aspects in the design of new urban environments. At the same time these parameters are difficult to communicate in a comprehensible way and their consequences can be difficult to grasp for non-experts. Effective visualization offers possibilities to include and create consensus among stakeholders in urban planning processes and thus contributes to a holistic view and more sustainable solutions. This paper presents and discusses a proposed method for conceptual explorations for visualizing environmental data, using a so-called sandbox model with fictitious data. One question is in focus: How can a sandbox model be used for the development of visualization concepts in urban 3D-models? In this paper we demonstrate our methodology using noise pollution data applied in one of our research projects carried out together with the Swedish Transport Administration (Trafikverket). This project explores new solutions for visualization of environmental data in Trafikverket's geographically large-scale 3D-models. In order to conduct design elaborations in an adapted environment a sandbox model was developed as part of the workflow. Here various concepts for visualization solutions were developed and tested in a series of user tests. Based on this developed methodology through application, we propose guidelines for conceptional elaborations in a sandbox model for visualization of data in urban 3D-models. This research approach contributes to developing new methodology for information visualization of environmental data in urban 3D-models.

Keywords: Sandbox-model, design research, data visualization, information visualization, urban 3D-models, urban planning

VisLab Universeum

MiljöVis / MålVis

Chalmers/Digital Twin Cities Centre (DTCC):

Beata Stahre Wästberg, Dept. of Computer Science and Engineering / DTCC Research Area (RA) 6

Monica Billger, Dept. of Architecture and Civil Engineering/ DTCC RA 6

Liane Thuvander, Dept. of Architecture and Civil Engineering / DTCC RA 6

Fabio Latino, Dept. of Computer Science and Engineering / DTCC RA 6

Orfeas Eleftheriou, DTCC RA 0

Vasilis Naserentin, Dept. of Mathematical Sciences / DTCC RA 0

Trafikverket:

Susanne van Raalte, Program Nya Stambanor, Subject area BIM/GIS

CHALMERS TRAFIKVERKET DIGITAL TWIN CITIES CENTRE CENTRE FOR MANAGEMENT OF THE BUILT ENVIRONMENT ADLERBERTSKA STIFTELSERNA