Open Research Day

9 April 2025

“

13:50-14:20

Parallel Sessions- *lightning talks followed by breakout session*

A108: Digitalized Built Environment II

Chair: Associate Professor Győző Gidofalvi, KTH

A123: Digitalized Health Care II

Chair: Professor Elena Gutierrez Farewik, KTH

A108: Digitalized Built Environment II

- Lightning talk: Session chair: Associate Professor Györö Gidofalvi, KTH

1. DIRAC: DynamIc uRban roAd traffiC noise simulation model using passive and publicly available data (Demo)
2. Faster-than-real-time and high-resolution simulation of fluid flow in engineering applications: indoor climate as a pilot (RP)
3. ChEss Machines For ElectriFiEd Construction SiTes – EFFECT
4. Improving resilience: Using insurance data to design better loss prevention (II)

DIRAC: DynamIc uRban roAd traffiC noise simulation model using passive and publicly available data

Zhenliang Ma, Associate Professor Transport Planning, ABE, KTH

Project team

Zhenliang Ma
Associate professor

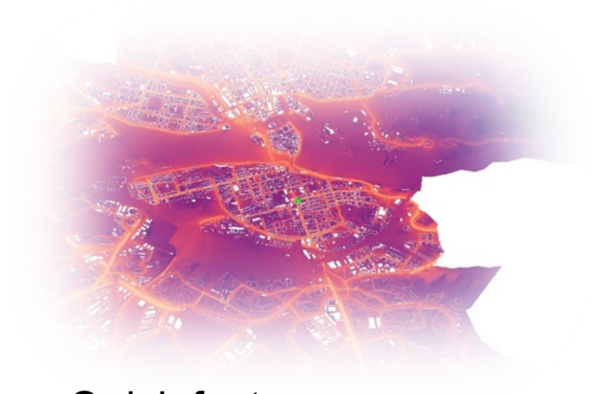
Romain Rumpler
Associate professor

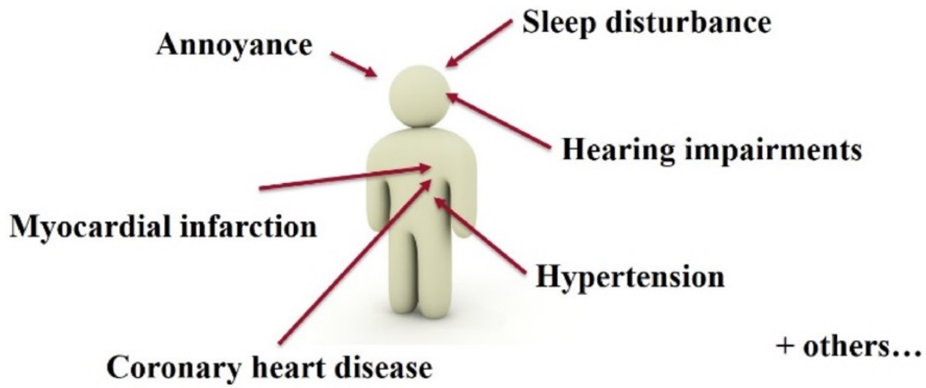
Sacha Baclet
PhD student

Jonas Jostmann
PhD student

Tong Mo
Master student

Noise in Urban Environments

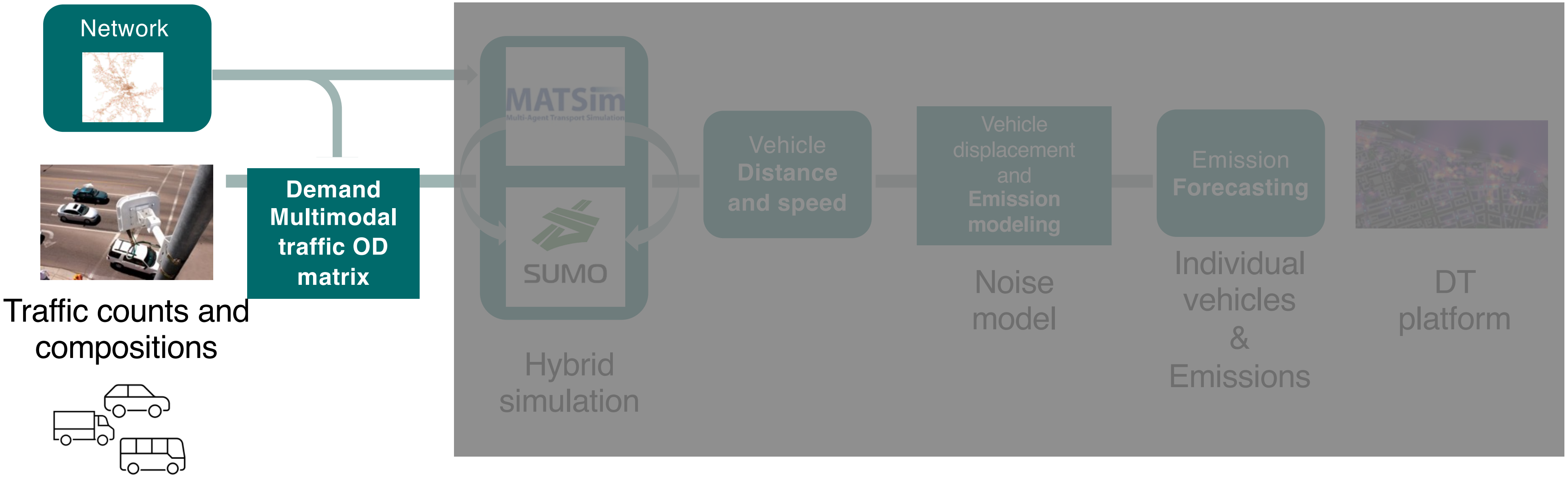




- Quick facts:
  - More than 20% of EU population exposed to harmful noise levels
  - UN Projection: Urban population growing from 55% to 68% by 2050
  - The noise in urban environment has major health and economic impacts

Need for detailed assessment, representation and innovative mitigation strategies

Full spectrum dynamic emission forecasting



Demand calibration

Historic OD demand for Södermalm

Current best OD estimate

Traffic Simulation

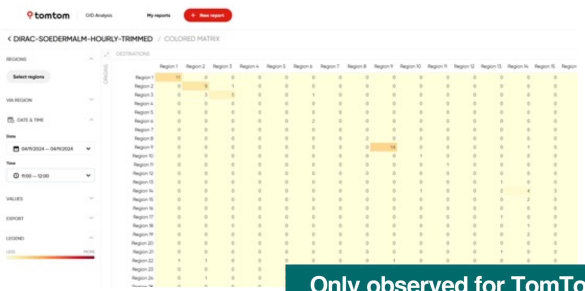
Simulated Traffic Flows

Compare simulated with real flow observations

Calibrated OD demand and traffic simulation

Scale OD Demand

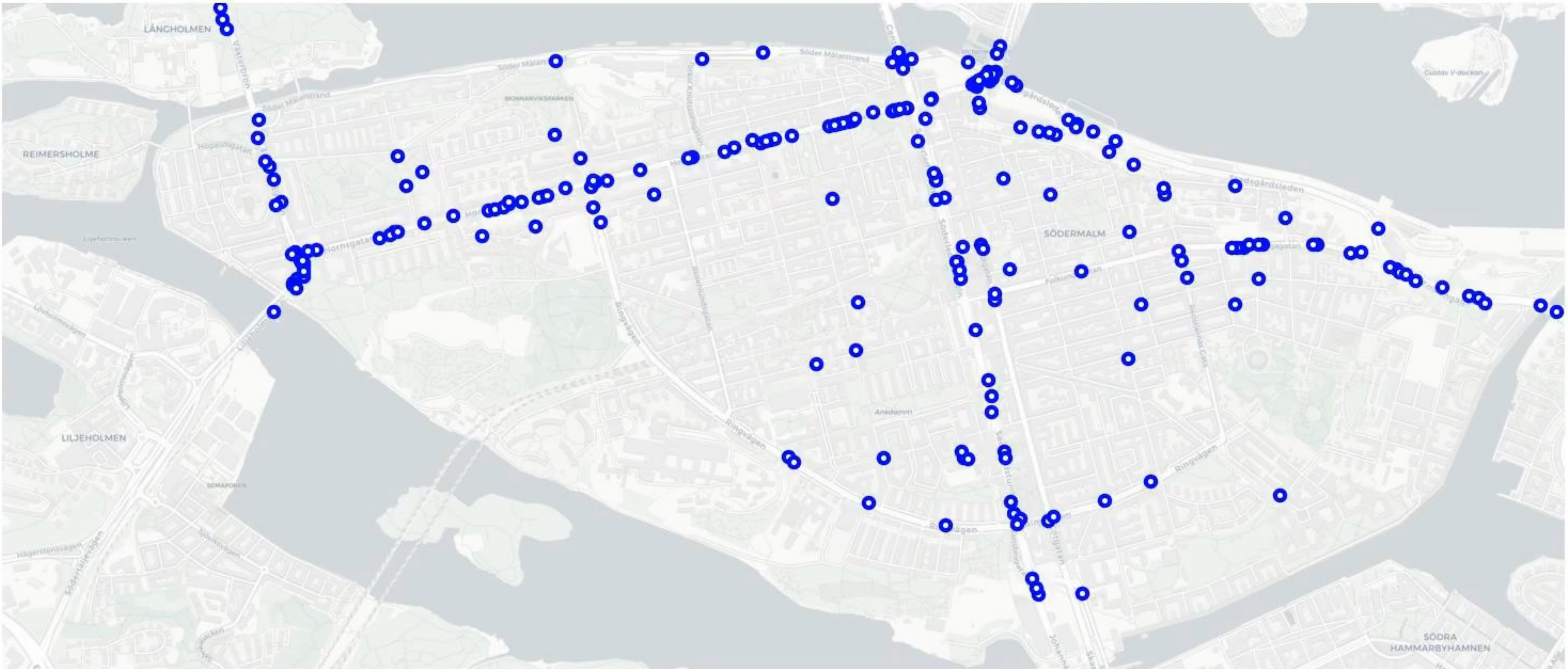
tomtom



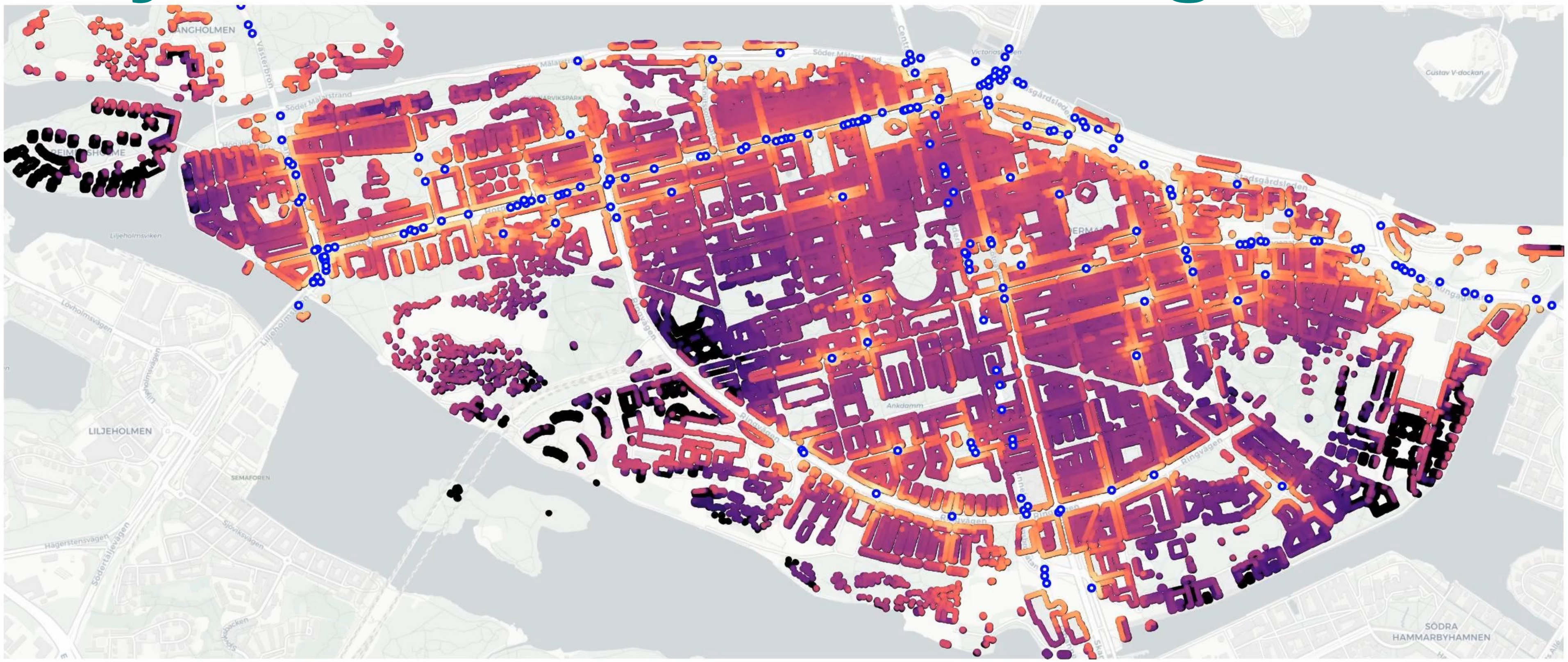
Only observed for TomTom equipped vehicles

Historic real flow observations

Micro-traffic results (SUMO)



Dynamic noise modelling



Standard metric: noise level

Advanced metric: noise events

Thank you for listening

Zhenliang Ma

zhema@kth.se


Thank you

Faster-than-real-time and high-resolution simulation of fluid flow in engineering applications

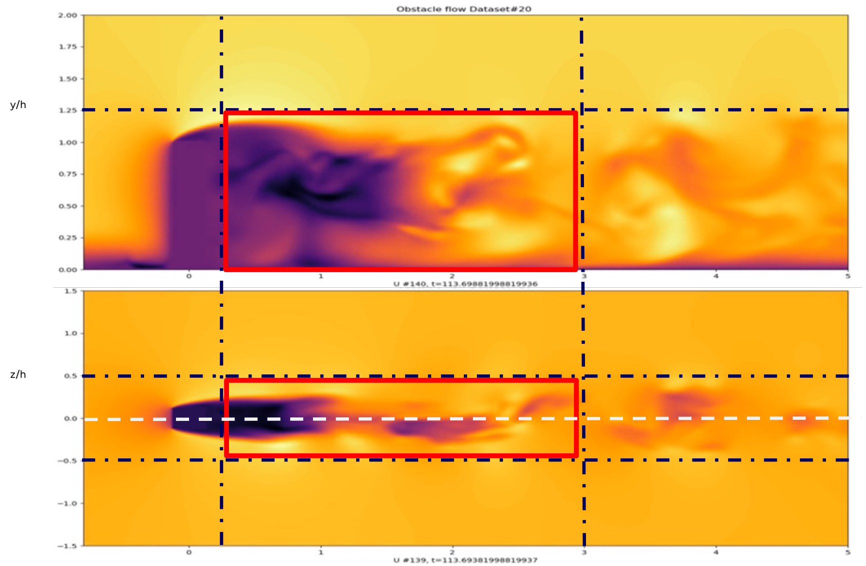
Miguel Beneitez
Abhijeet Y. Vishwasrao
Hossein Azizpour
Ricardo Vinuesa

Introduction

- **Goal**
  - To develop **R**educed **O**rder **M**odels (ROM) based on **Deep Gen**erative techniques (diffusion models) for fast and efficient sparse reconstruction of velocity flow fields in urban environments using measurements from optimally placed sensors.
- **Why?**
  - Many times we only have partial observations of flows in nature: sensor can only reach certain distance and we want to know how the whole flow behaves -> Planning the cities of the future
  - Faster than real-time computations since ROM are much quicker than direct numerical simulations: 100ms form vs 10,000ms for a direct numerical simulation step.
  - Knowing what are the main features needed for reconstructing the flow helps us decide what is important to measure: where to place the sensors

Datasets: One-obstacle Dataset

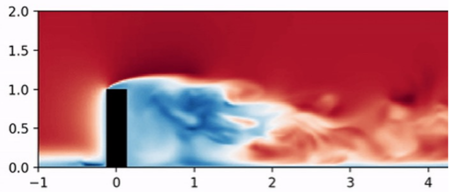
Streamwise velocity fields: side view, top view and 3D view (top to bottom)

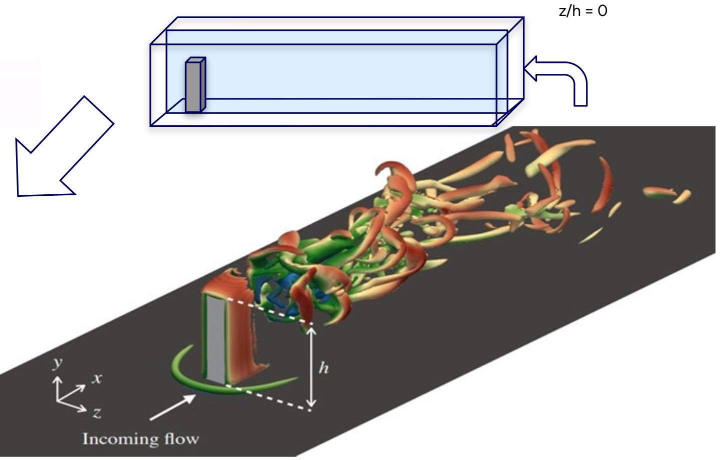


A.Martinez-Sanchez et.al, J. Fluid Mech. (2023), vol. 967

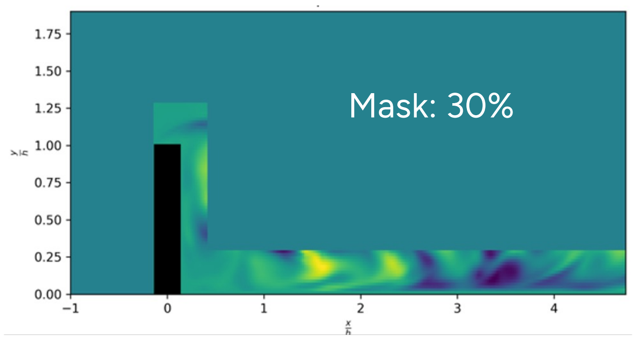
We will employ a database of the flow over a square cylinder immersed in incompressible boundary layer:

- Direct Numerical Simulation using Nek5000 with **21.8 M** grid points
- Spectrally interpolated on a uniform mesh with resolution (300, 100, 150)
- **Re** = 2000, **Δt** = 0.0001, **Δtsnap = 0.005**
- **O(30,000)** instantaneous flow fields **~ 130** convective time units





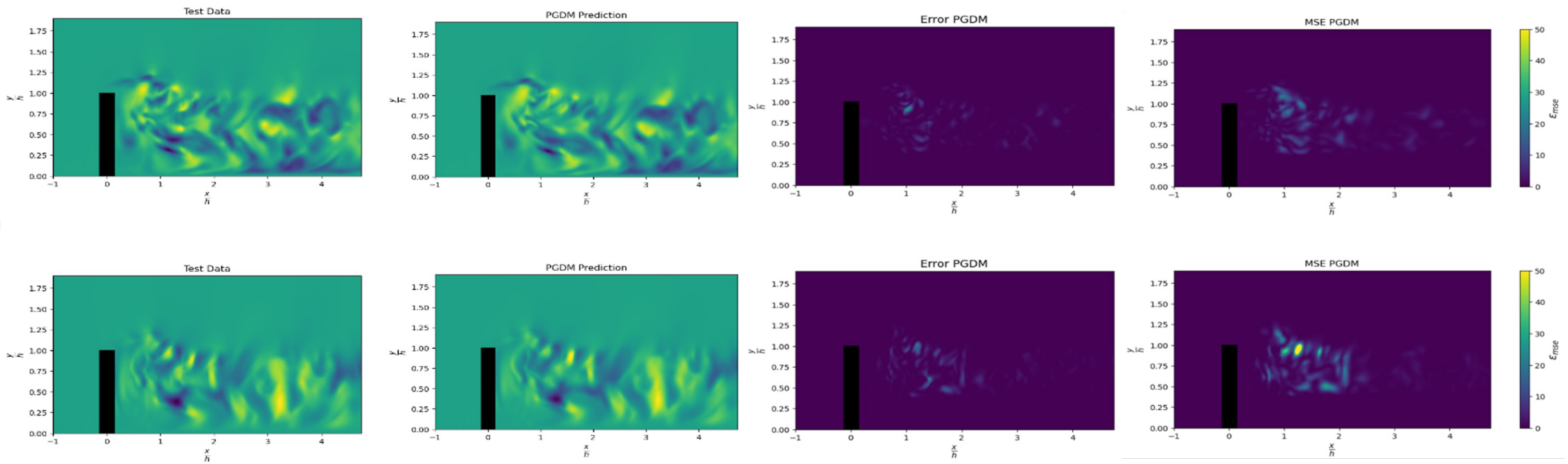
Results: PiGDM



Reconstruction **Inst. Error** **MSE**

u′

v′



Error ~ 1.5 %, Error in wake region ~ 5%

Conclusions and future steps

- We have trained models to generate full flow fields from only partial measurements. Physically realistic fields (good physical coherence even starting from noise).

- Reconstruction of full flow fields with PIGDM is very promising (less than 1.5% error) even when masking 70% of the region to the model.

- Faster than real-time generation of flow fields: 100ms form vs 10,000ms for a direct numerical simulation step.

- Next: Identify which are the most relevant regions for prediction of the future states using Shapley additive explanations values.

Thank you

EFFECT-Persika: ChEss Machines For ElectriFiEd Construction SiTes

Györö Gidofalvi[1], Jonas Mårtensson[2], Rasmus Hugosson[3]
KTH-ABE[1,3]/EECS[2] / ITRL[1,2] / Gordian[1]

Trends, problems & needs

- 4 billion people **in cities**, projected to increase to **6.5 billion by 2050**
- **23% of global GHG** emissions come from **city construction**
- Must find **sustainable ways** to **maintain**, **retrofit & create the built environment**
- How can electrification help?

EFFECT – Persika

Persika Living Lab of urban construction of **1200 apartments** with **2 electric excavators** (2x400 kWh) and **2 e-trucks** (230 & 350 kWh) and an **AC/DC charging station** (2x120 & 4x22 kW) **with battery storage** (240 kWh)

+

Digital Twin of Electrified Construction Operations (ECO)

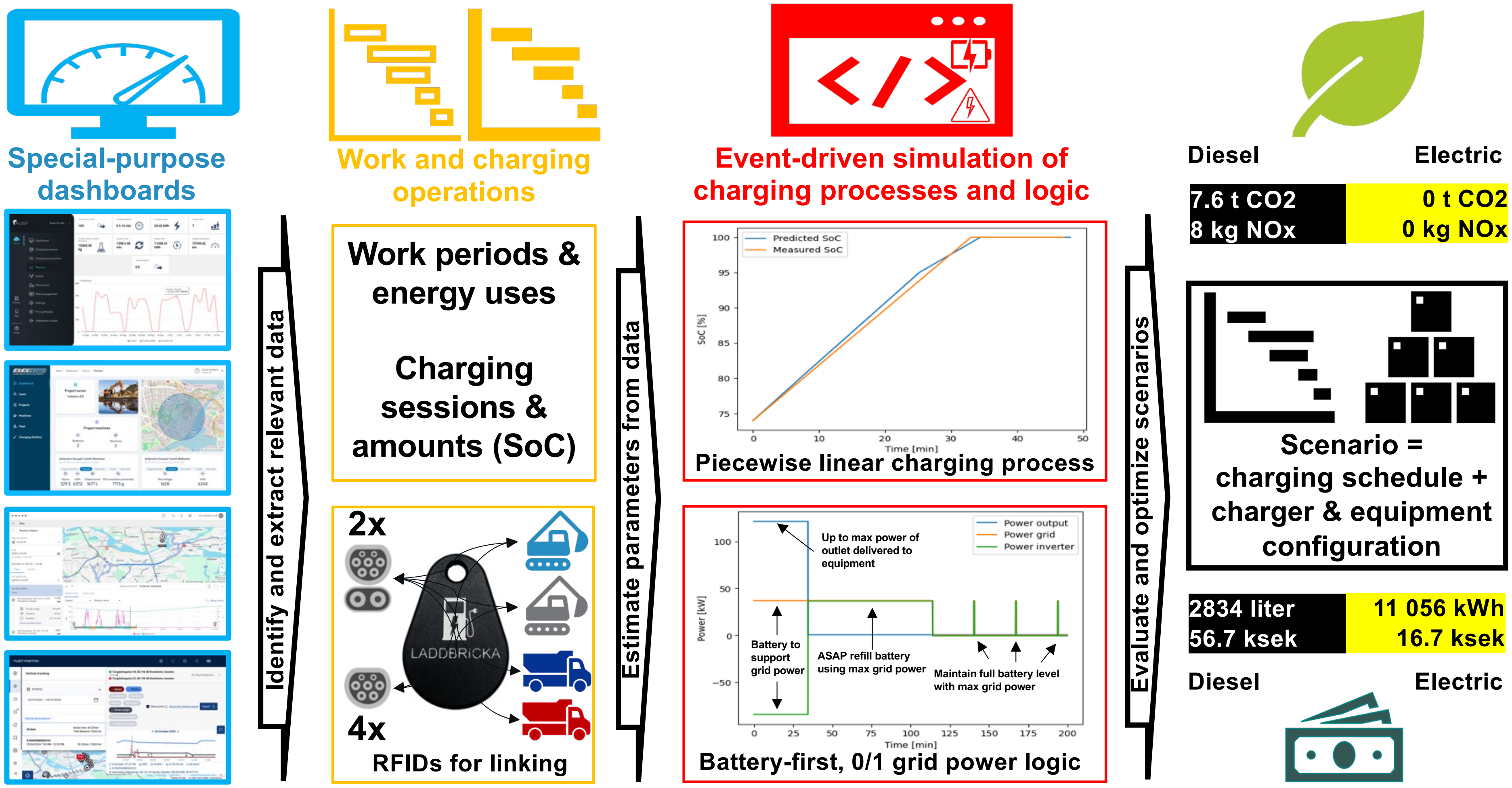
- **Insights into costs & benefits of ECO**
- **Methods to evaluate** & optimize **ECO**


KTH VETENSKAP OCH KONST · GORDIAN · Stockholms stad · PEAB · northvolt · ABEKO

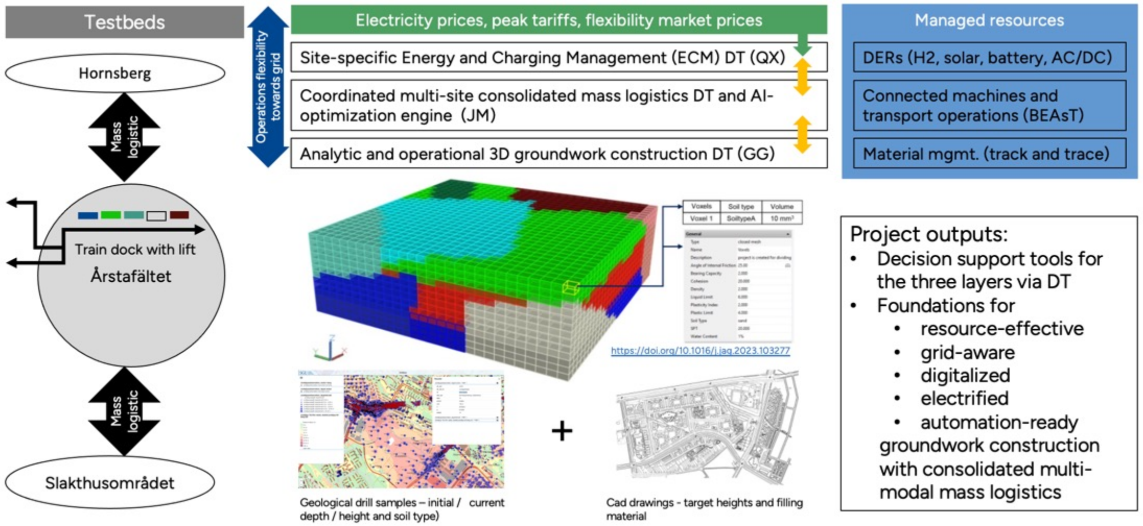
Research questions

- What are the **costs and benefits** of electrified operations compared to diesel?
- Would the electrified operations been **possible with another other configuration**, e.g.:
  - 50% less batteries in machines
  - 50% faster chargers
  - 25% more station battery
  - 50% less grid power
- What is the **minimal cost configuration** for an electrified operation?
- How can **smart charging** affect all this?

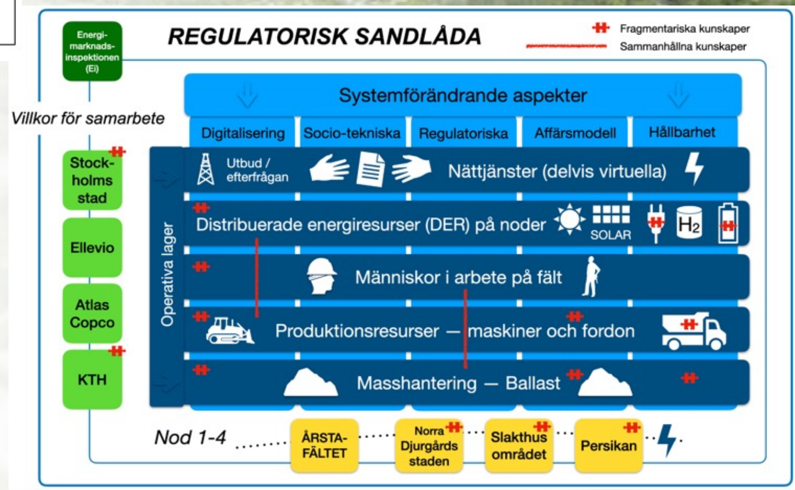
EFFECT – Persika approach



EFFECT – Persika: a seed



DIgital twinS, process optimization, and decision Support for flExible eleCTrified groundworks construction (DISSECT)



Regulatory sandbox to integrate a digitalized construction industry into the grid


Thank you

Improving resilience: Using insurance data to design better loss prevention

Christian Thomann
INDEK, KTH

Project team

Team

- PI: Christian Thomann (KTH) and Gustav Martinsson (Co PI)
- PhD Student: Jiyau Zhang (KTH)
- Partner: St Erik Försäkring AB (Stockholms Stad)
- 2024-2026

Project

How can insured losses be reduced?

Project partner City of Stockholm insures its properties via St Erik

- Among others 70,000 apartments
- Schools and Sports arenas
- Combine 20 years of insurance data with administrative data
- Study and design a targeted intervention to reduce losses
- Monitor intervention

Loss prevention and mitigation

Expected losses E(L)= $\sum_{i=1}^{N}(p_i * L_i)$

where:

p is probabilty and L is size of loss.

- Loss prevention reduces p
- Loss mitigation reduces L

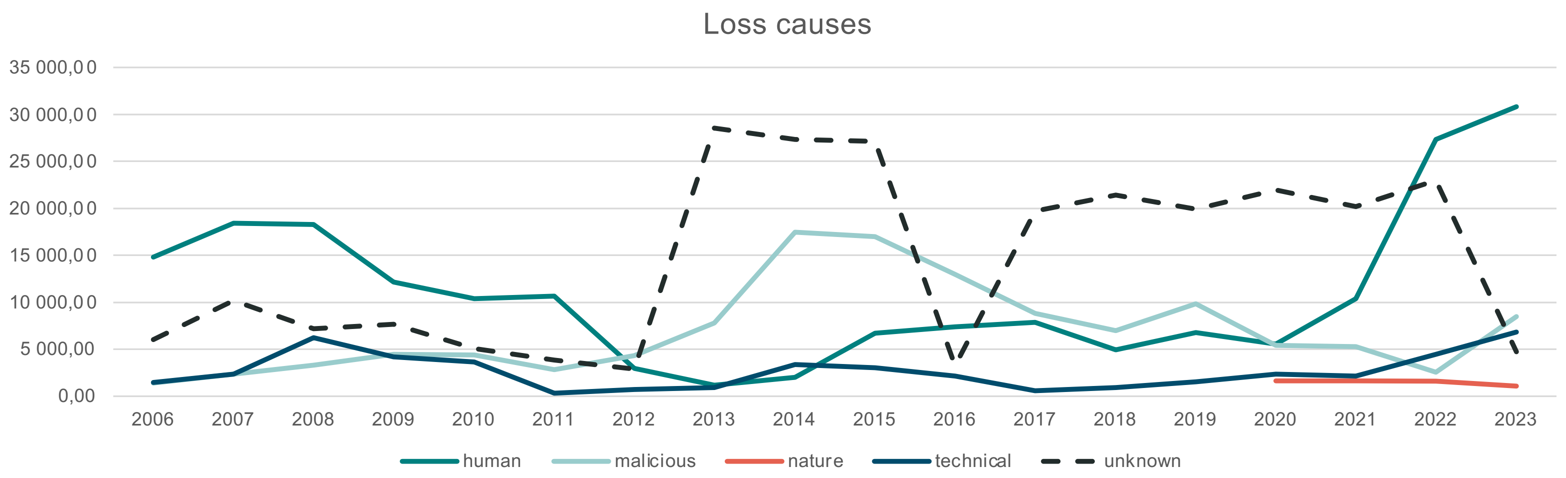
What is the cause insurance claims?

1. Accidents / acts of god
2. Human behaviour (inattention / malicious acts)
3. Technical failure

- Loss prevention is relevant for (2) and (3).
- Mitigation is relevant for all categories.

What causes the claims?

Claims development over time
(sum of claims)




Thank you

digital futures

PARTNERS

KTH VETENSKAP OCH KONST

RI. SE

Stockholm University