

AI-Guided Noise Reduction for Urban Geothermal Drilling

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**INSTITUTE FOR MACHINE
LEARNING AND ANALYTICS**



1

Project Concept – KI-Bohrer

2

Assistance System and Project Architecture

3

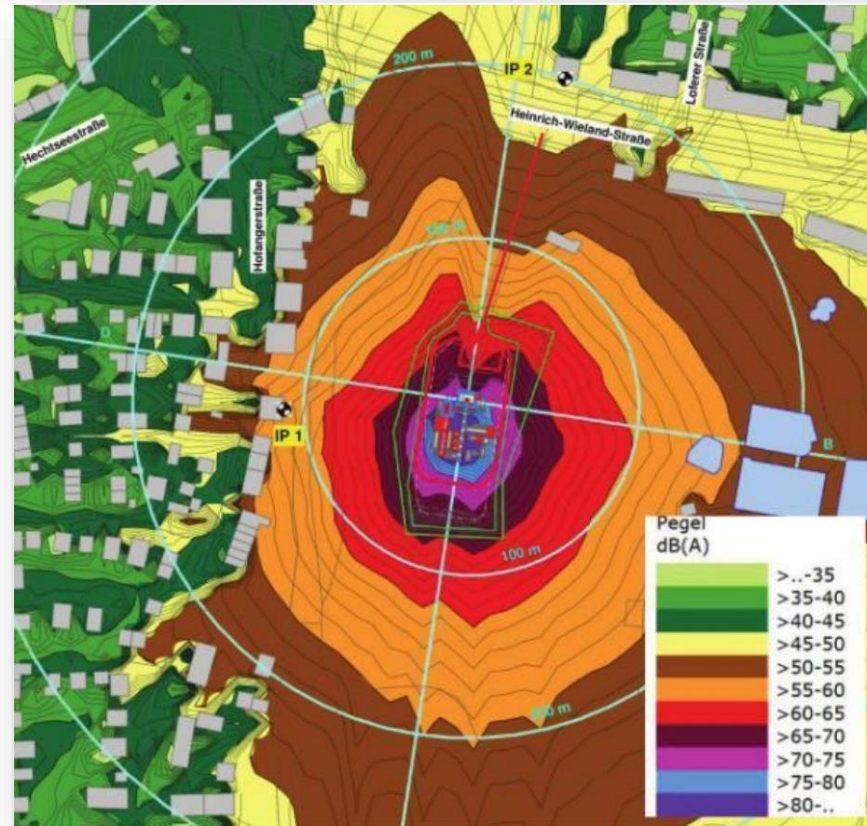
Sound Propagation with generative Models

4

Machine behaviour forecasting

5

Conclusion





GEFÖRDERT VOM





www.ki-bohrer.de

Assistance System - GUI Mockup

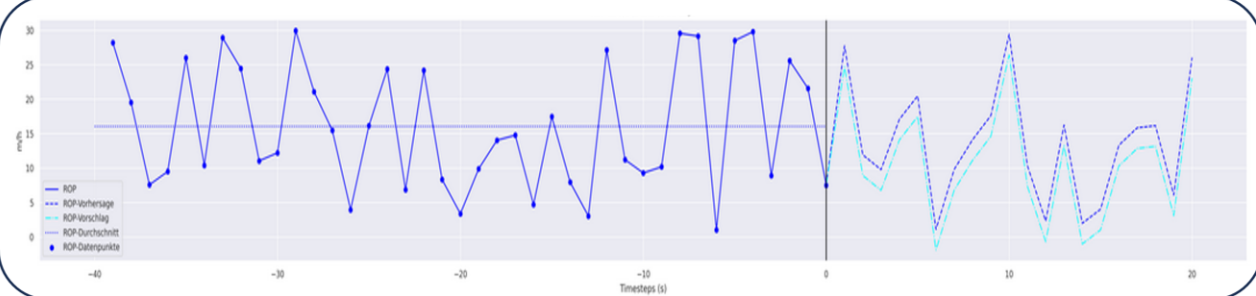
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 09.04.2024 – 15:12:23

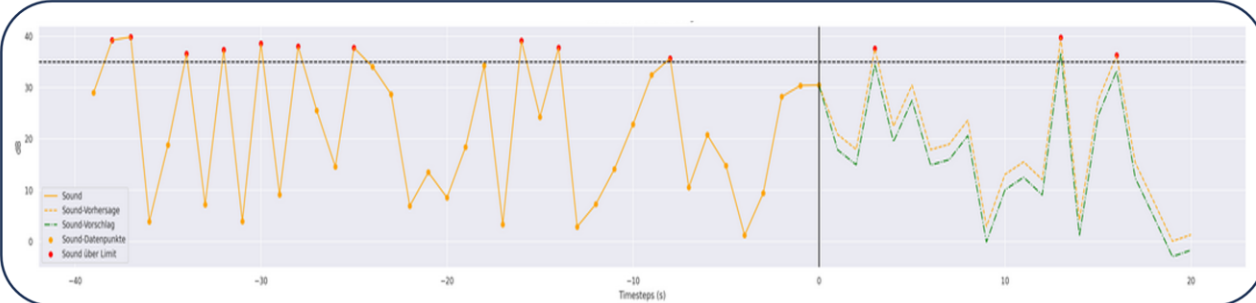

15 m/h
ROP

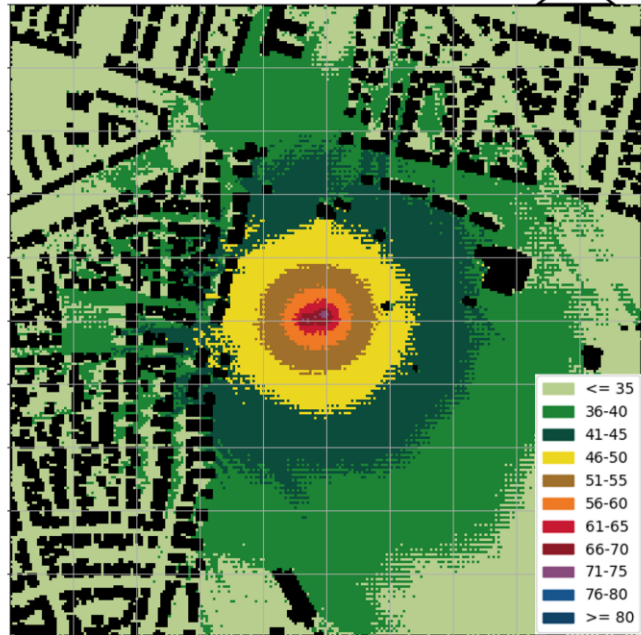

30 dB
Sound ✕

ROP





Sound







≤ 35
36-40
41-45
46-50
51-55
56-60
61-65
66-70
71-75
76-80
≥ 80

 Recommendation  Time since last recommendation - 2:13 min

Reduce Top Drive Poti

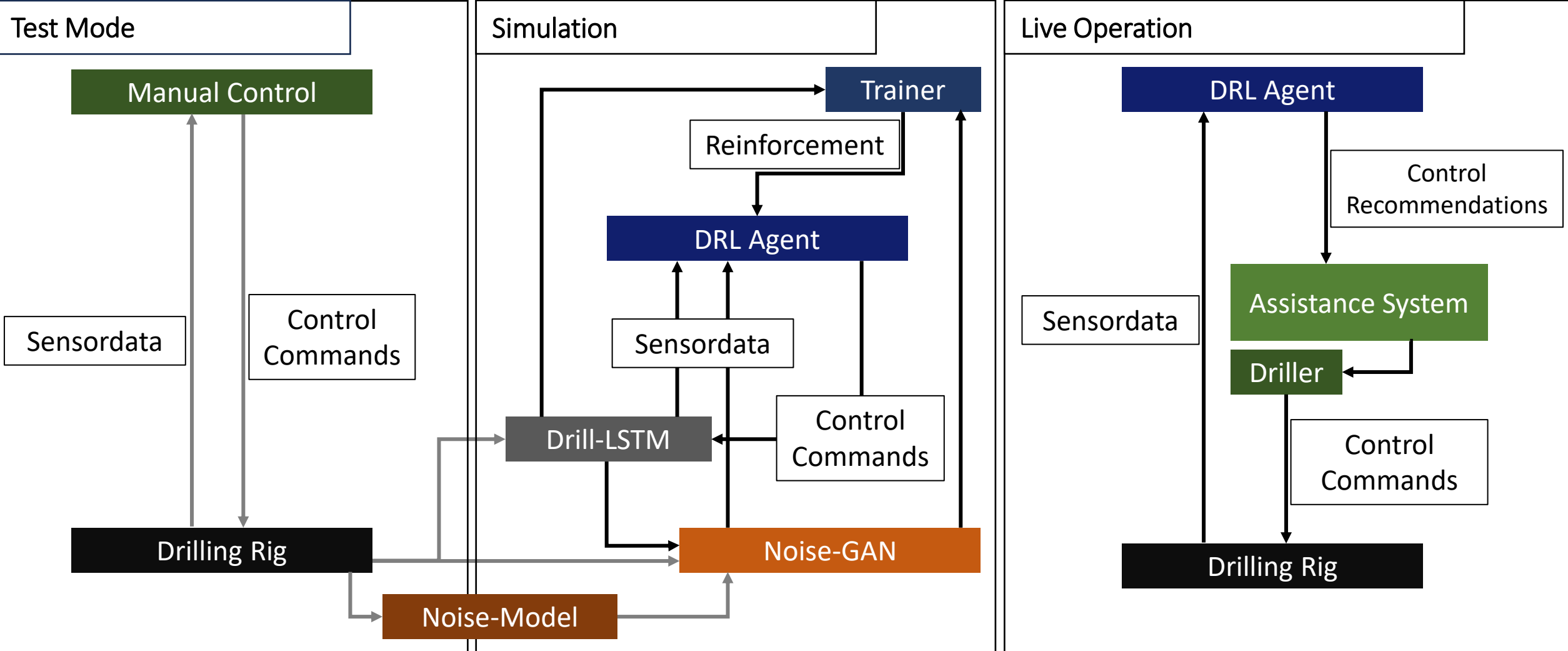
65 ↓

 Accept

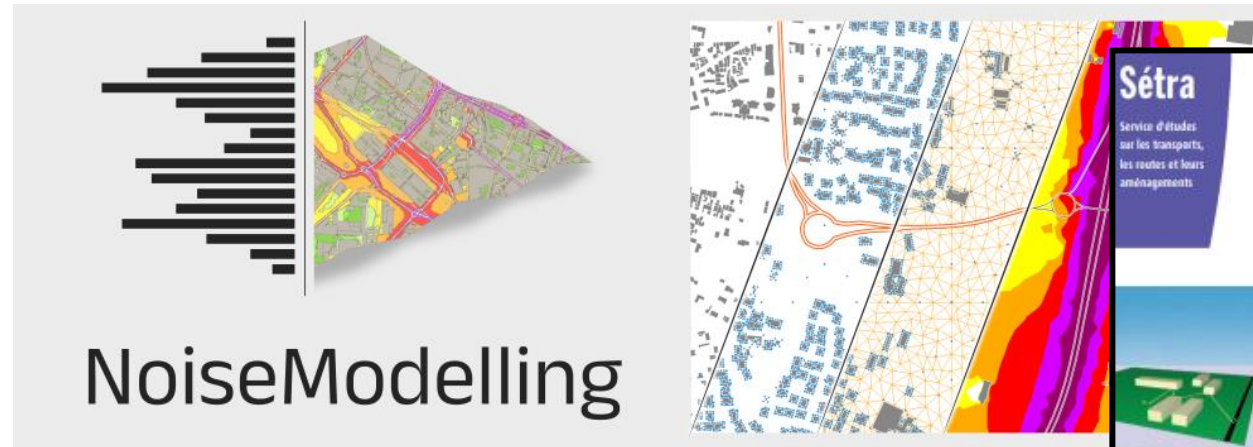
 Decline

14.11.2024 Upper Rhine AI Symposium 2024

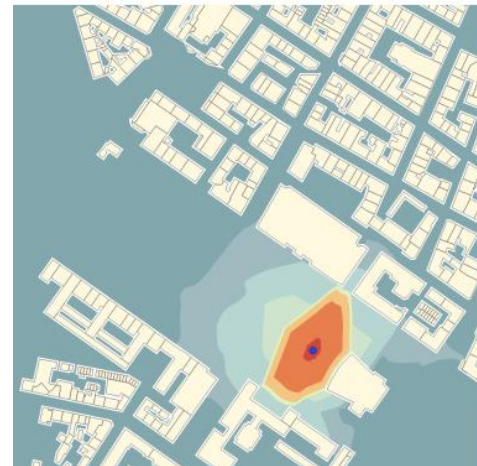
4



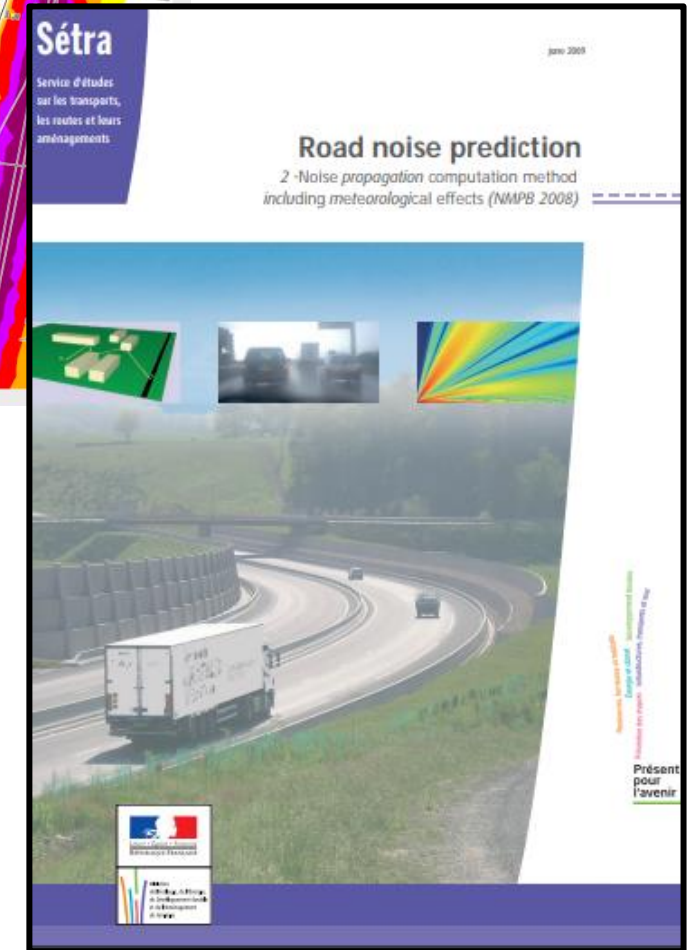
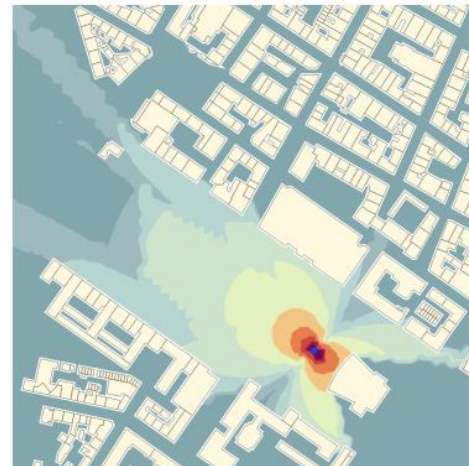
- Open-Source Library
- Free for scientific studies
- CNOSSOS-EU
- ISO 9613-1 Acoustics
- ISO 9613-2 Acoustics



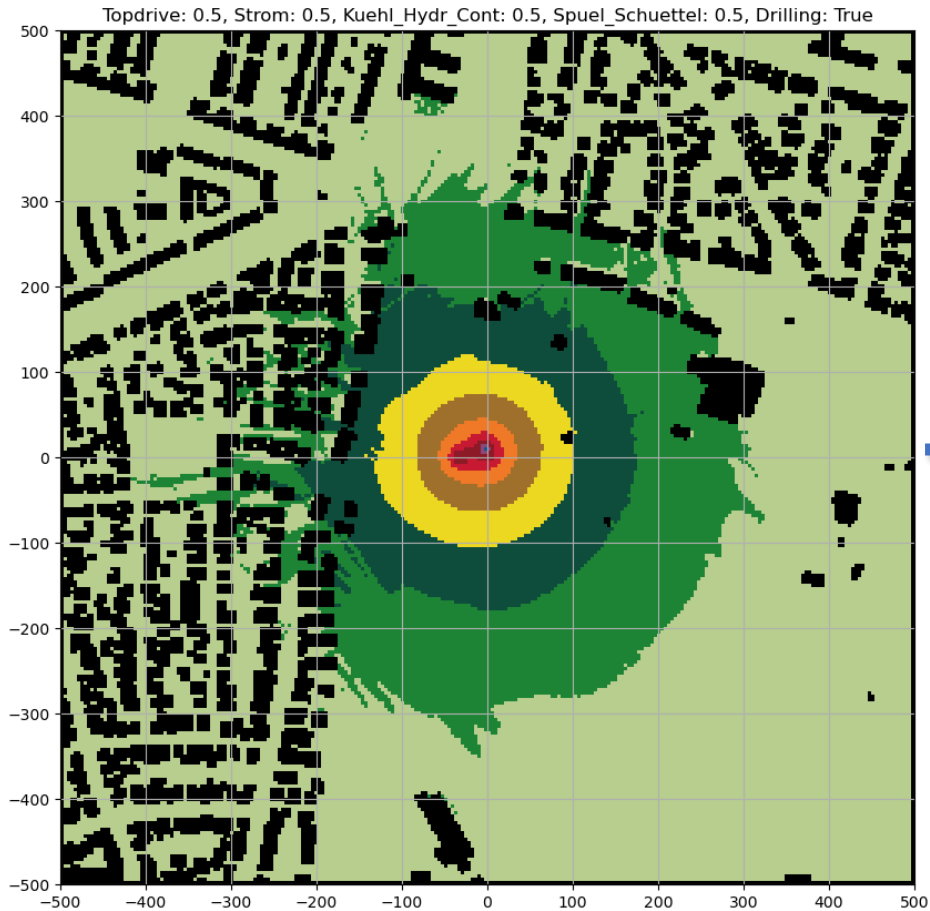
Isosurfaces, without directivity



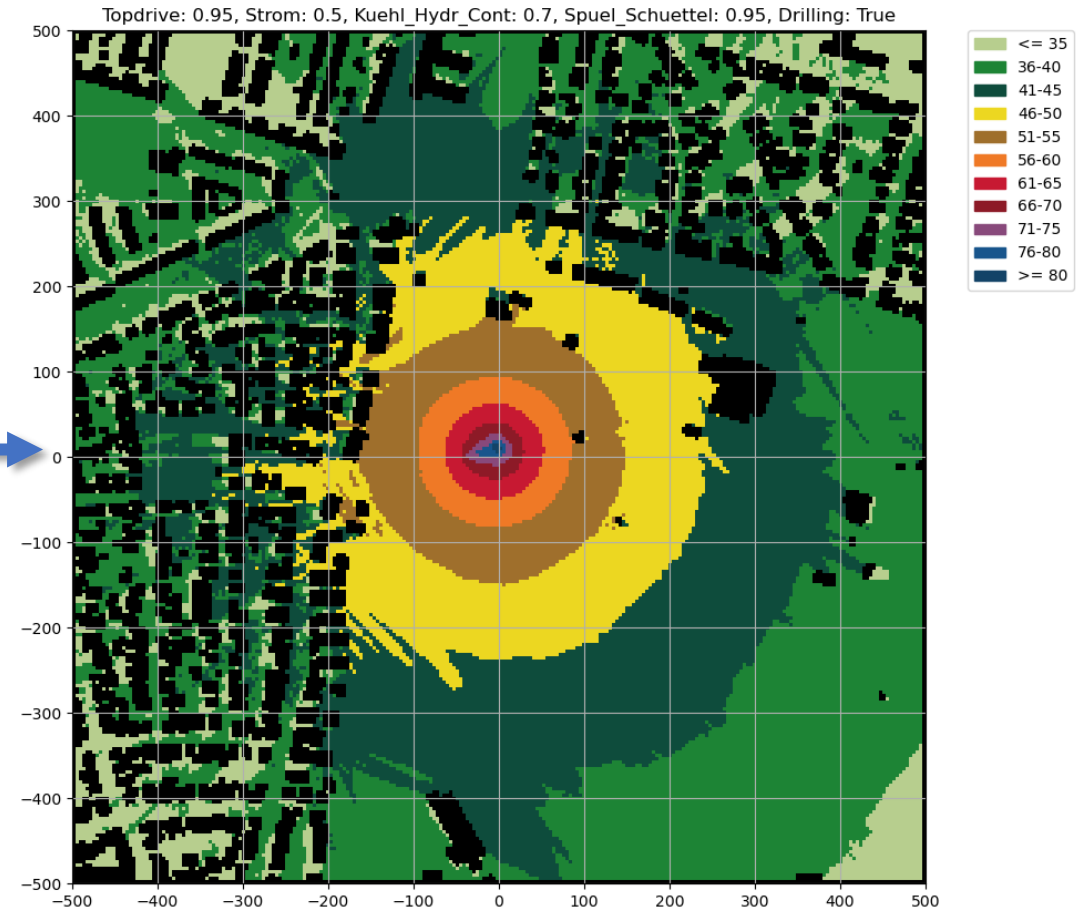
Isosurfaces, with directivity

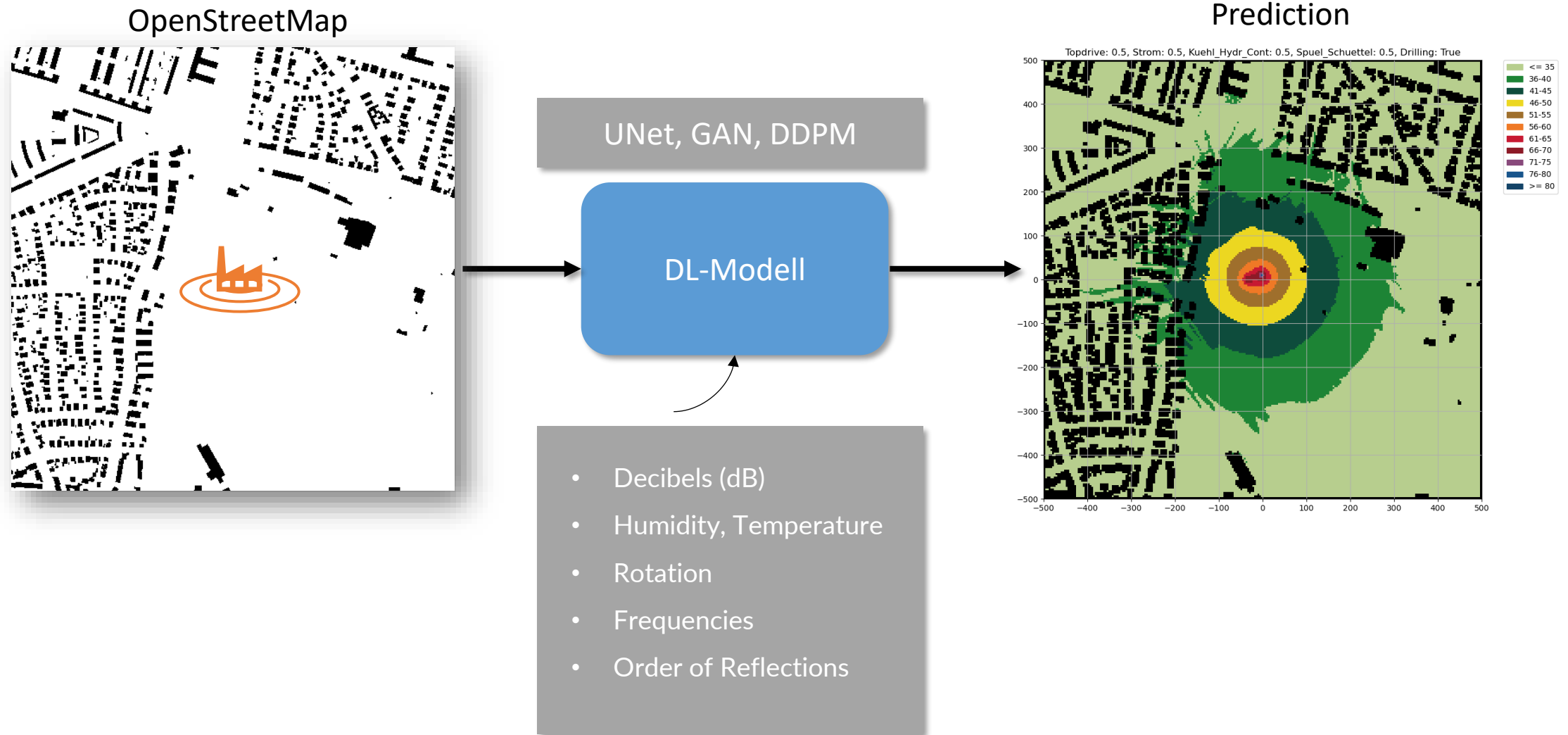


Machine Parameter and Sound expansion



Increased
Machine
Parameter





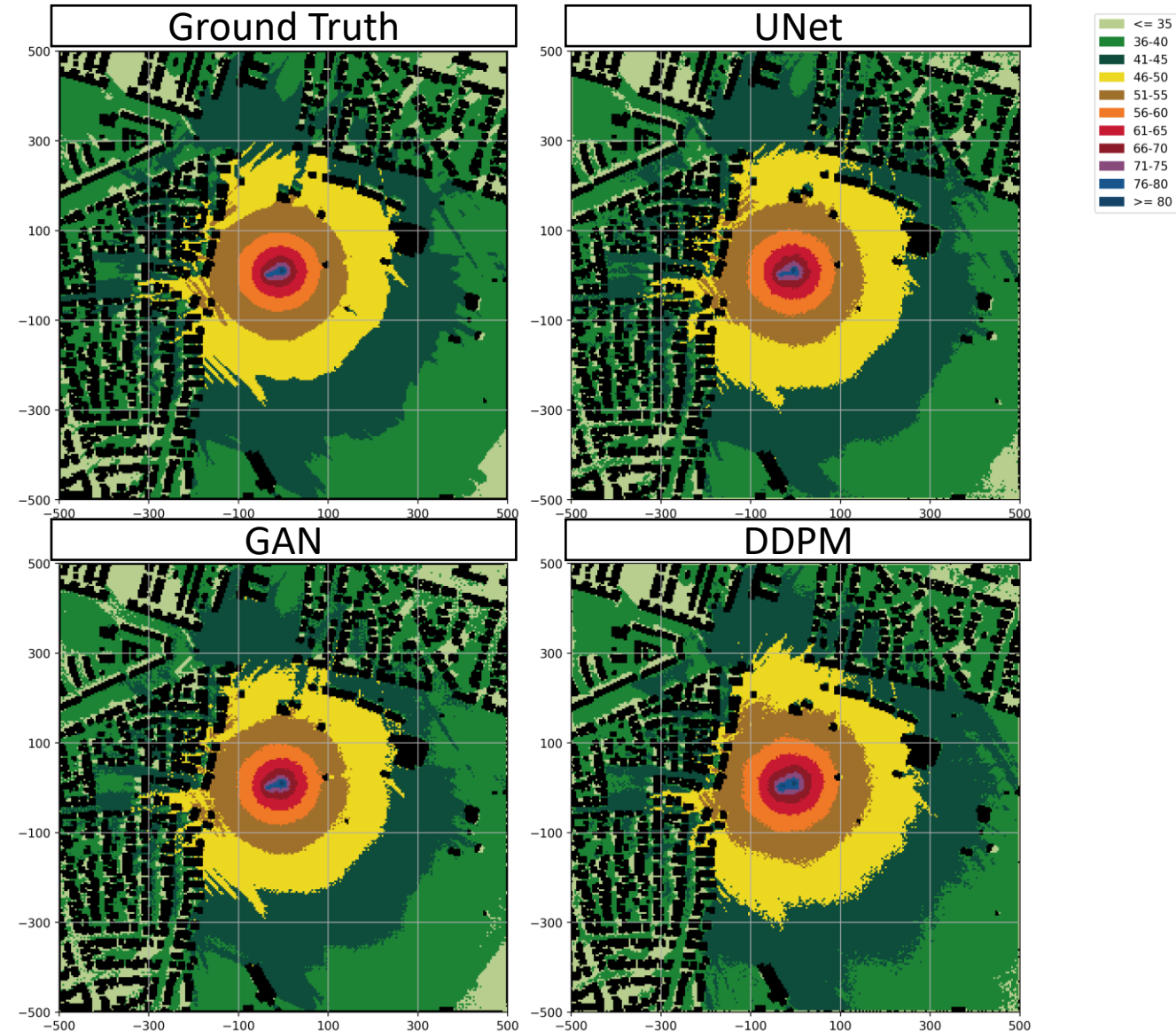
Sound model comparison

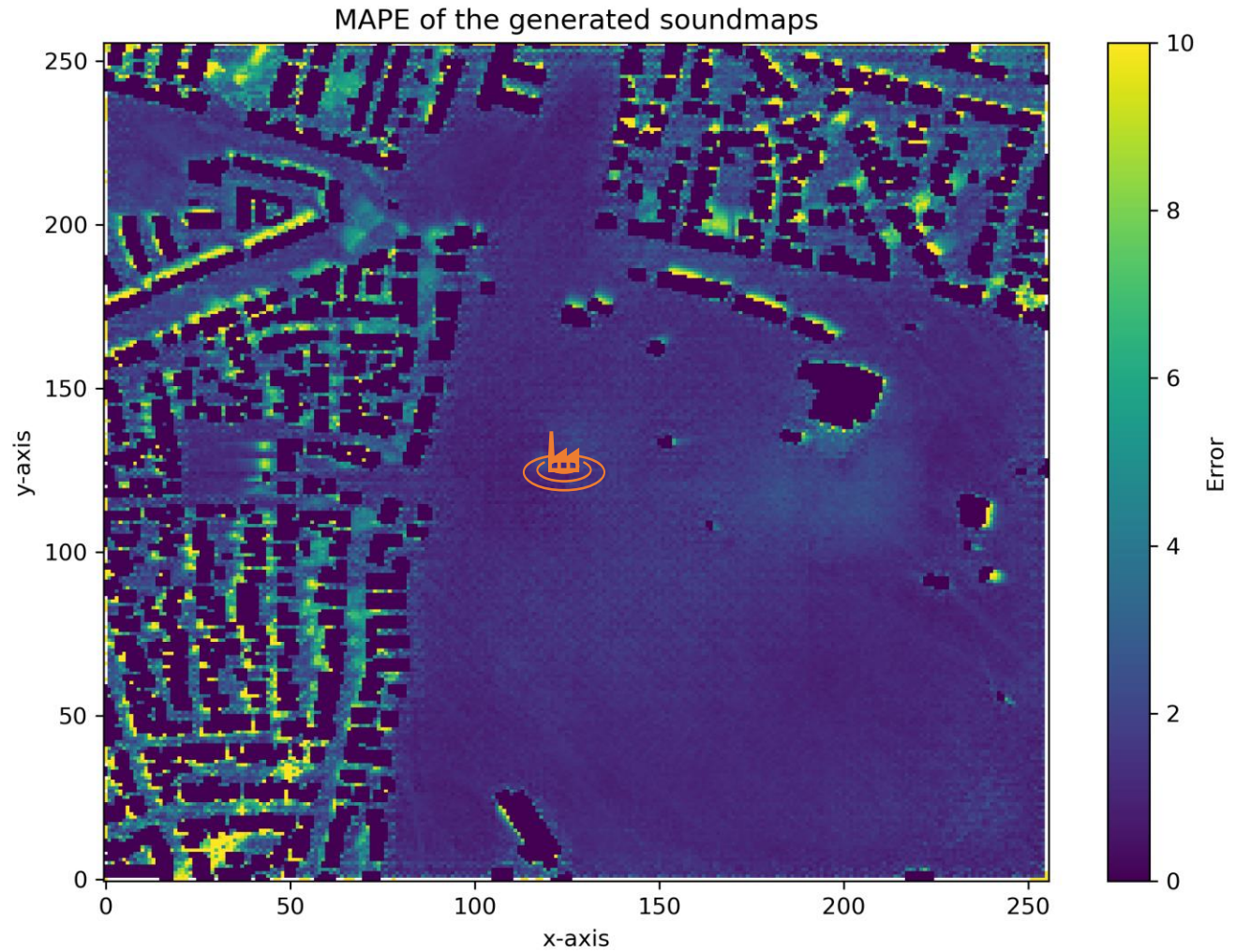
Error

Model	MAE	wMAPE
UNet	0.70	12.78
GAN	0.48	3.42
DDPM	1.19	24.94

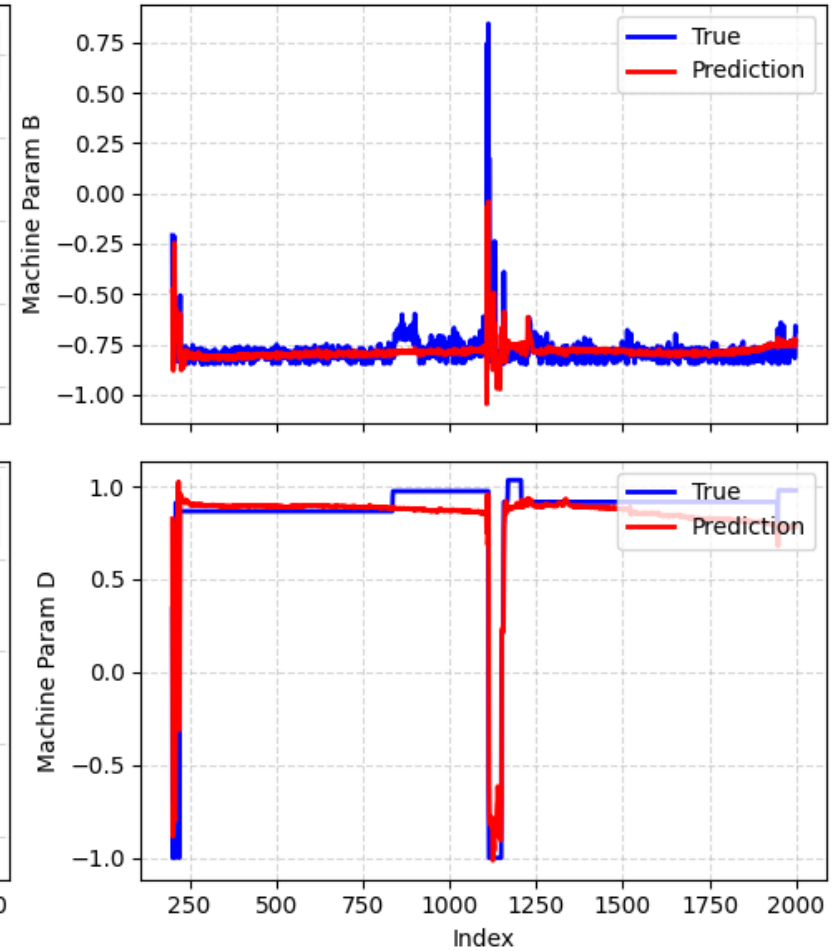
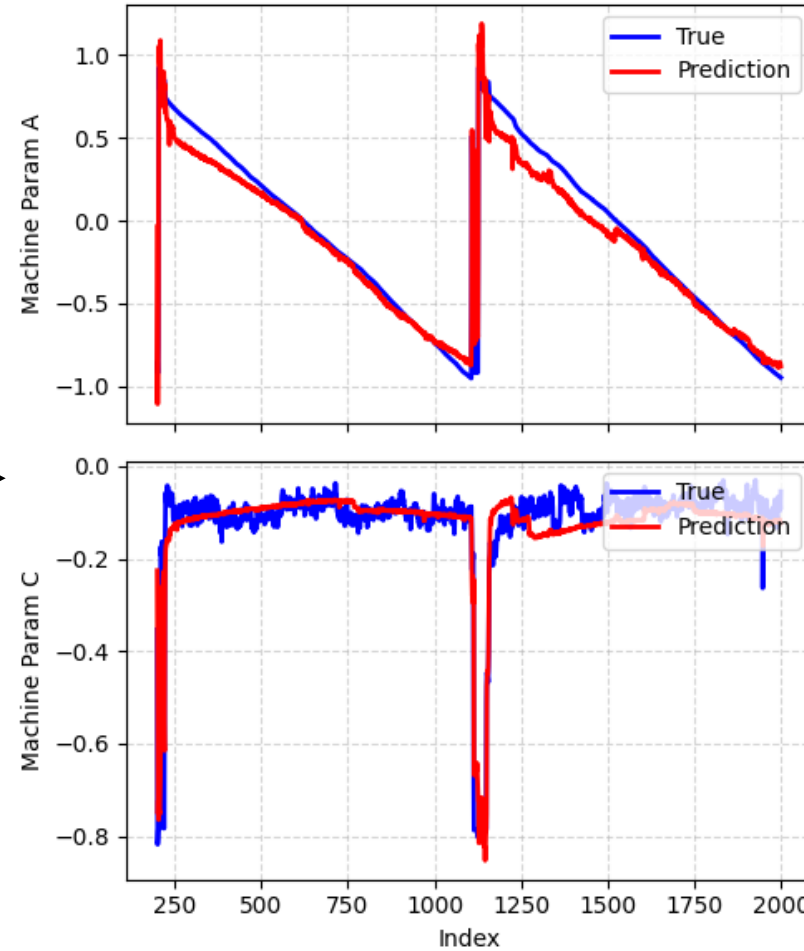
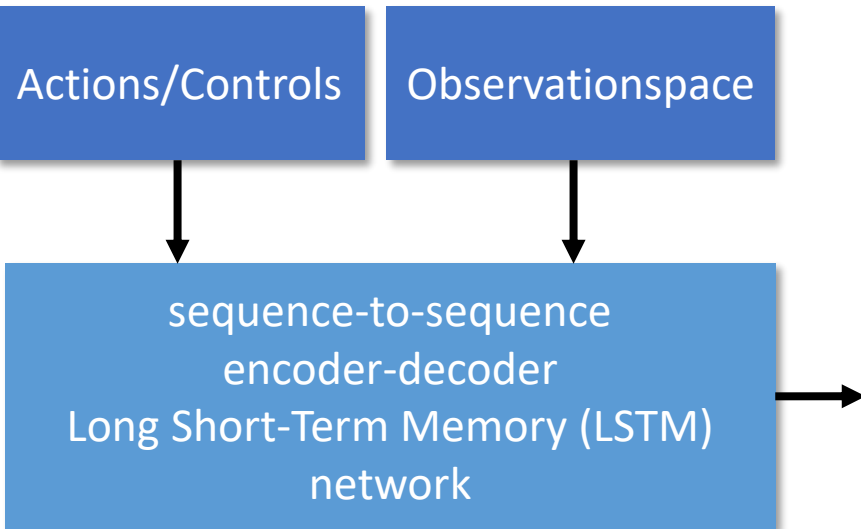
Runtime

Model	Mean Runtime (s)	Std. Dev. (s)
Unet	0.0126	0.0012
GAN	0.0095	0.0012
Diffusion	4.1560	0.0061
Simulation Single Source	186.2295	16.8491
Simulation Machine Setup	540	-





One step forecasting results



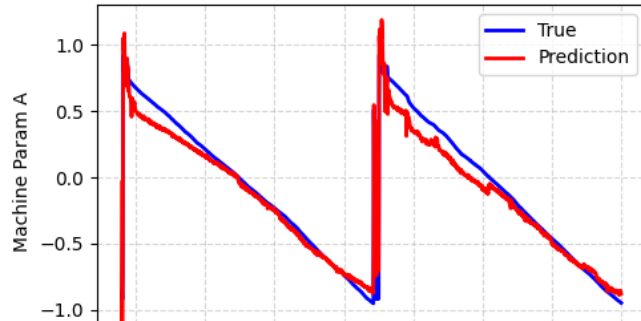
Deep Reinforcement Learning Agent - Requirements

Test Mode

Manual Control

Control

Sens



Drilling Rig

Noise-Model

Simulation

Trainer

Reinforcement

DRL Agent

Sensordata

Control Commands

Drill-LSTM

Noise-GAN

Live Operation

DRL Agent

Control Recommendations

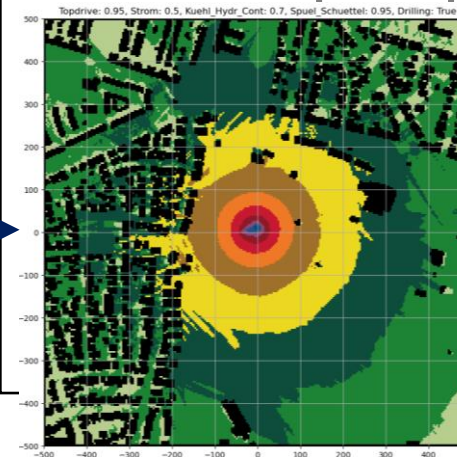
Assistance System

Driller

Sensordata

Control Commands

Rig



GUI Mockup – Model Overview



Monitoring Status: OK

09.04.2024 – 15:12:23

15 m/h
ROP

30 dB
Sound

Forecasting

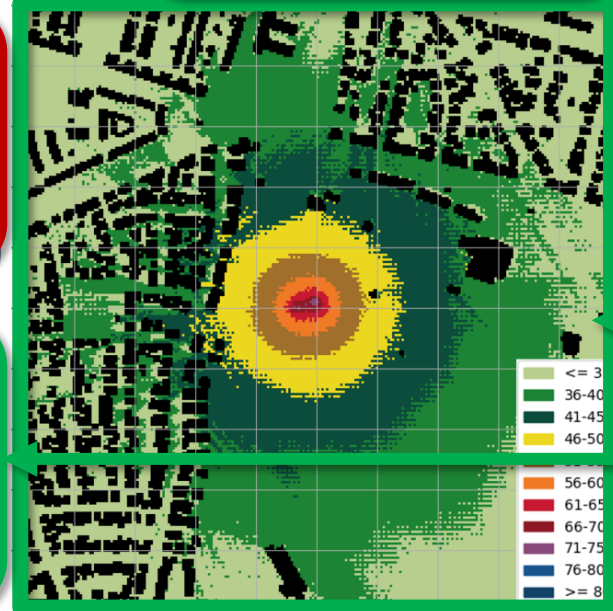
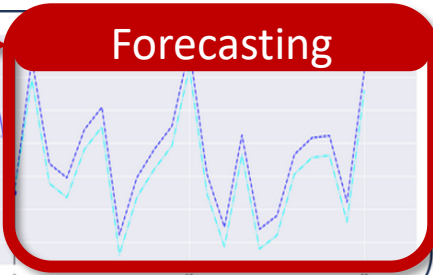
Sound

Recommendation Time since last recommendation - 2:13 min

Reduce Top Drive Poti 65 ↓

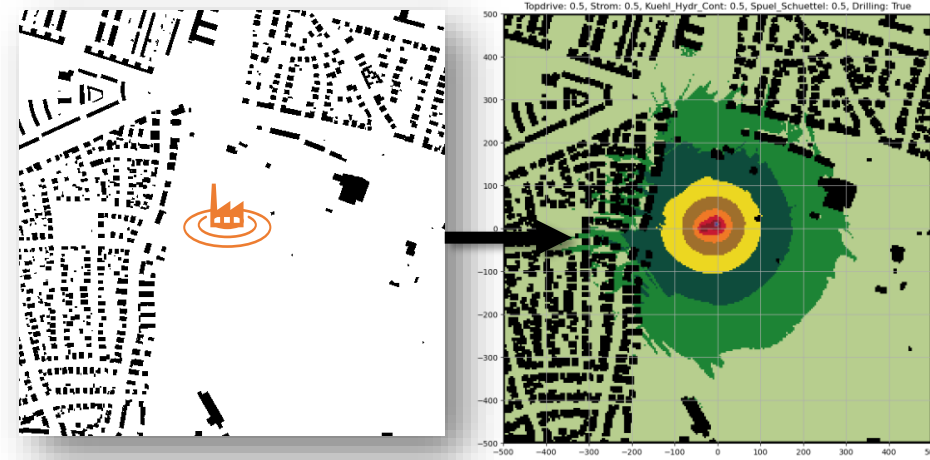
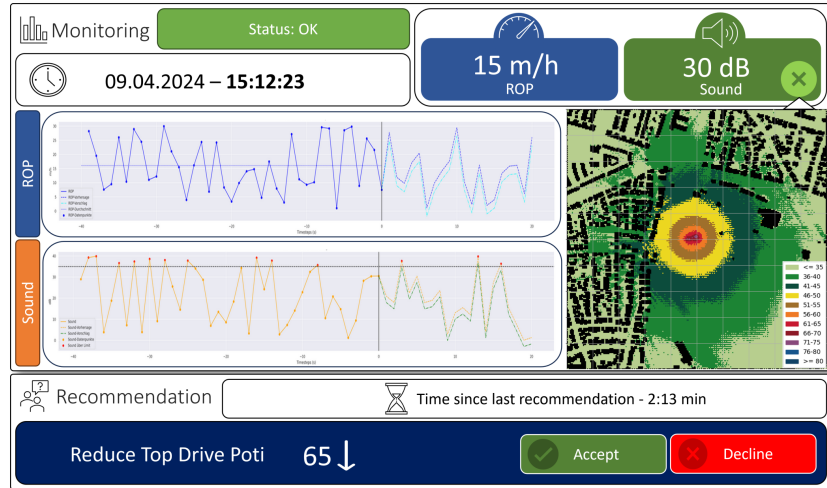
Accept Decline

DRILL-LSTM



NOISE-GAN

DRL-Agent

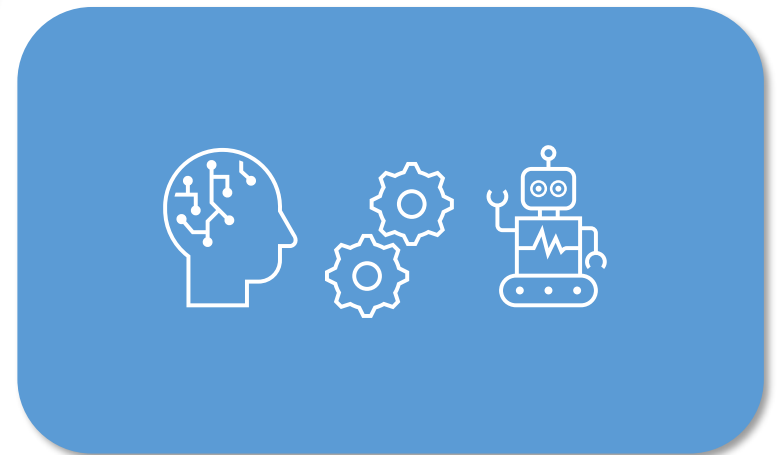
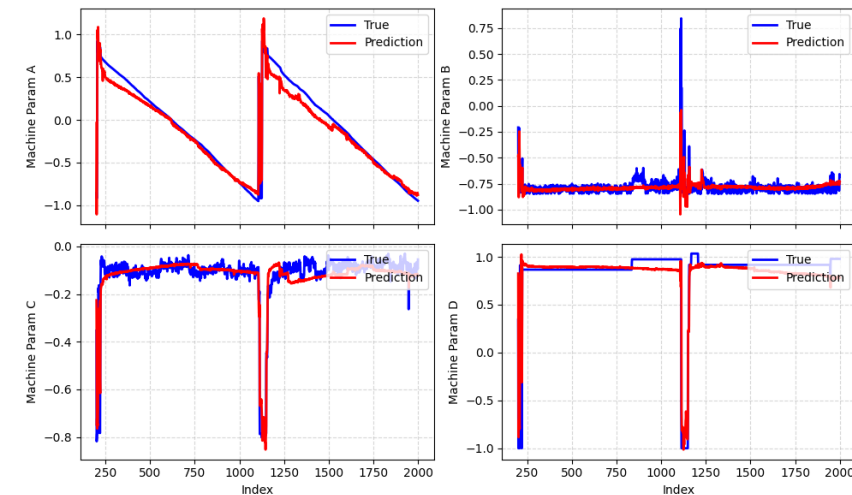


Assistance System UI

Noise expansion forecasting

Machine behaviour forecasting

Deep Reinforcement Learning Agent



Thank You!



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