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METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE

6GVISIBLE - INTELLIGENT MOBILITY FOR AUTONOMOUS DRIVING

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Virve Karsisto (virve.karsisto@fmi.fi)

Project summary

- Goals:
  - To develop better services for autonomous driving
  - To find out what 6G can provide for autonomous vehicles
- Partners:
  - University of Oulu
  - Finnish Meteorological Institute
- Summer 2023 – spring 2026
- Funded by Business Finland’s 6G Bridge program

6G VISIBLE

UNIVERSITY OF OULU

BUSINESS FINLAND

Introduction

- Autonomous vehicles' sensors include cameras, radars, and other technologies
  - These sensors are susceptible to weather conditions
    - Rain, fog, snow, and other adverse weather can reduce sensor functionality
- Slippery conditions increase accident risk
  - Slower speeds required
  - Route changing if better options available

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6G Flagship

- Communication, software and computing solutions are critical aspects in autonomous driving
- 6G provides considerably faster communication but all solutions must be thoroughly tested
- University of Oulu is well advanced in 6G research
  - World's first 6G research program: 6G Flagship
  - 5G/6G test environment

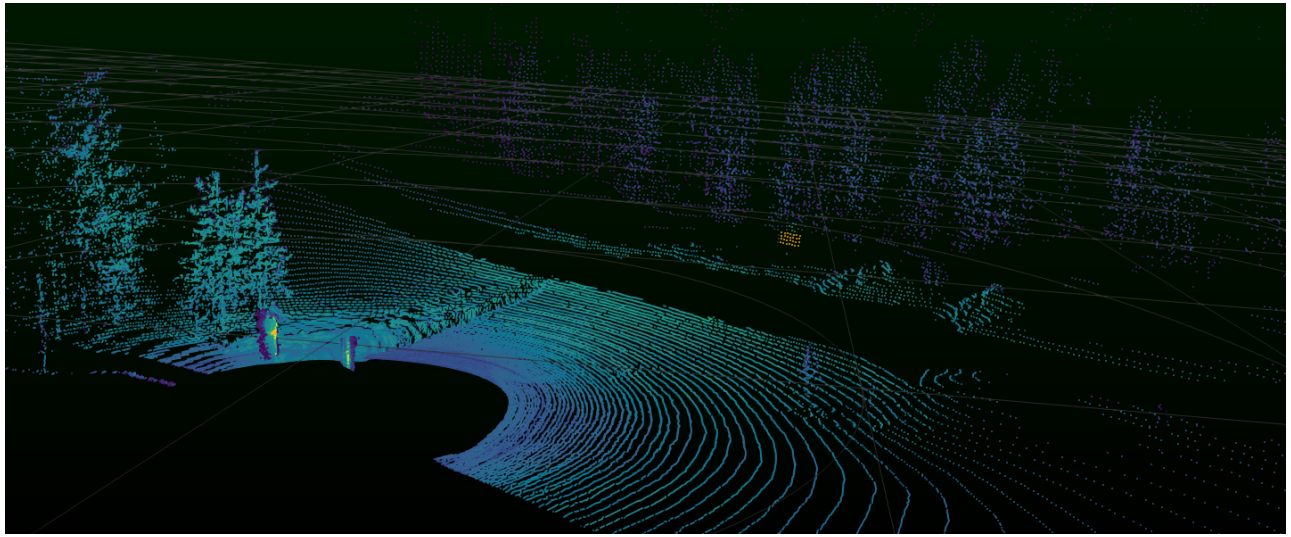
https://www.oulu.fi/en/news/university-oulus-project-combines-6g-technology-and-autonomous-cars

Weather related topics in practice:

1. Evaluation of autonomous vehicles' sensor systems sensitivity to harsh weather conditions
2. Development of road weather services for autonomous driving
3. Development of precipitation nowcasting web application
4. Using knowledge modelling to do route planning
5. Building machine learning model to quantify the effects of weather parameters on accident risk

LiDAR

- Special focus in the project will be on LiDAR instruments
  - Vulnerability to weather
  - Road sign recognition
  - Identifying snow cover & snowbank height monitoring
  - Road condition monitoring
  - Used in multiple locations:
    - Vehicle
    - Robotic platform
    - Drones



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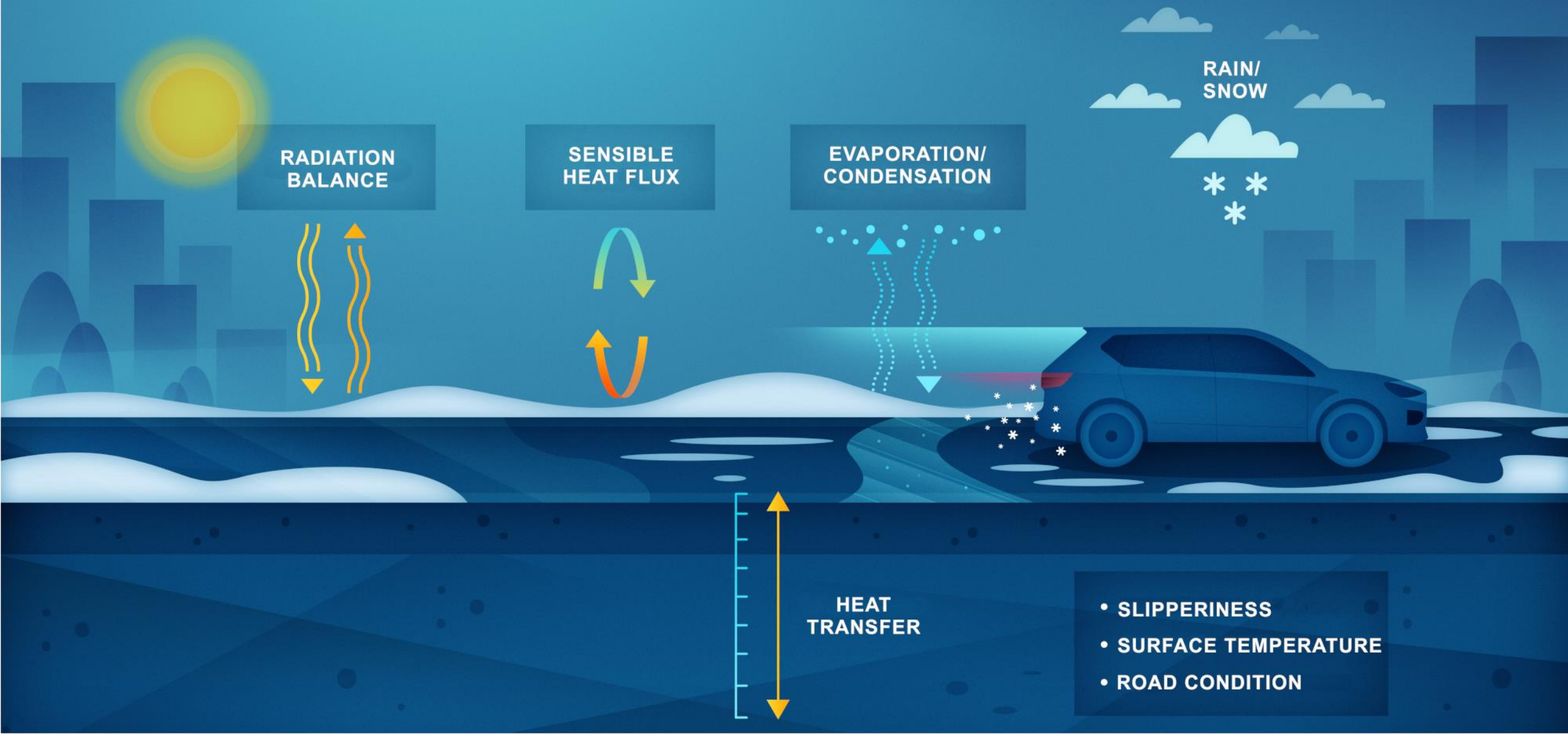
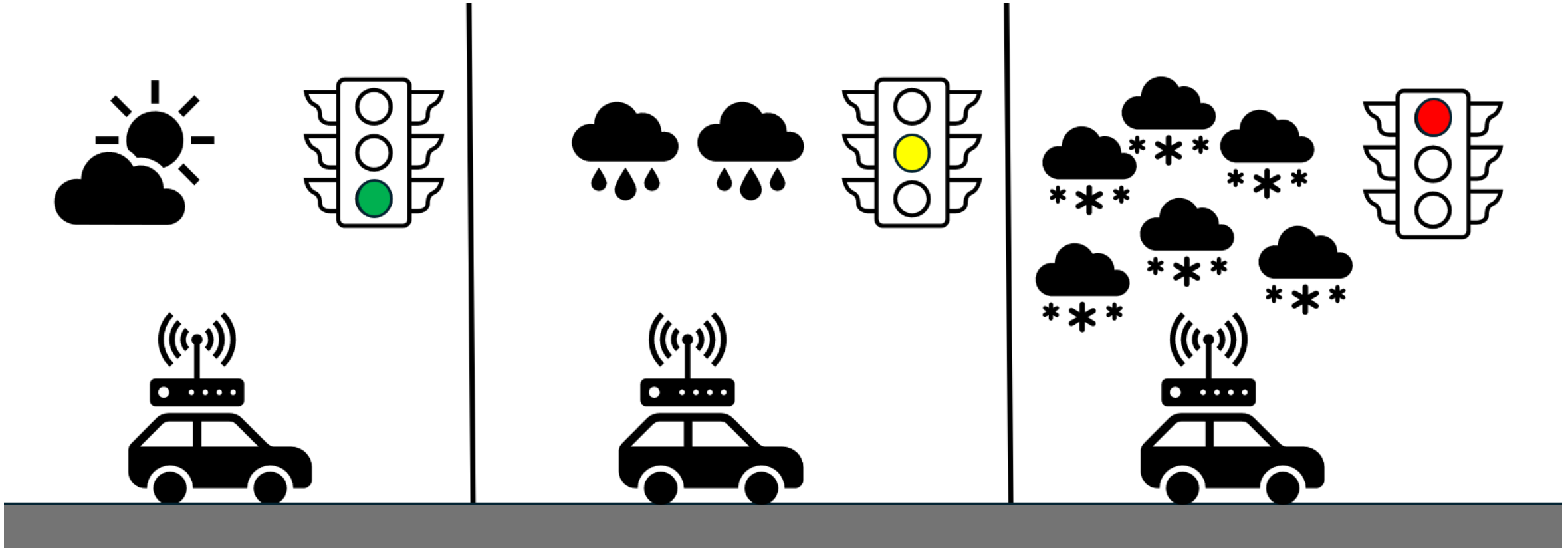
Road weather model

- One-dimensional heat balance model

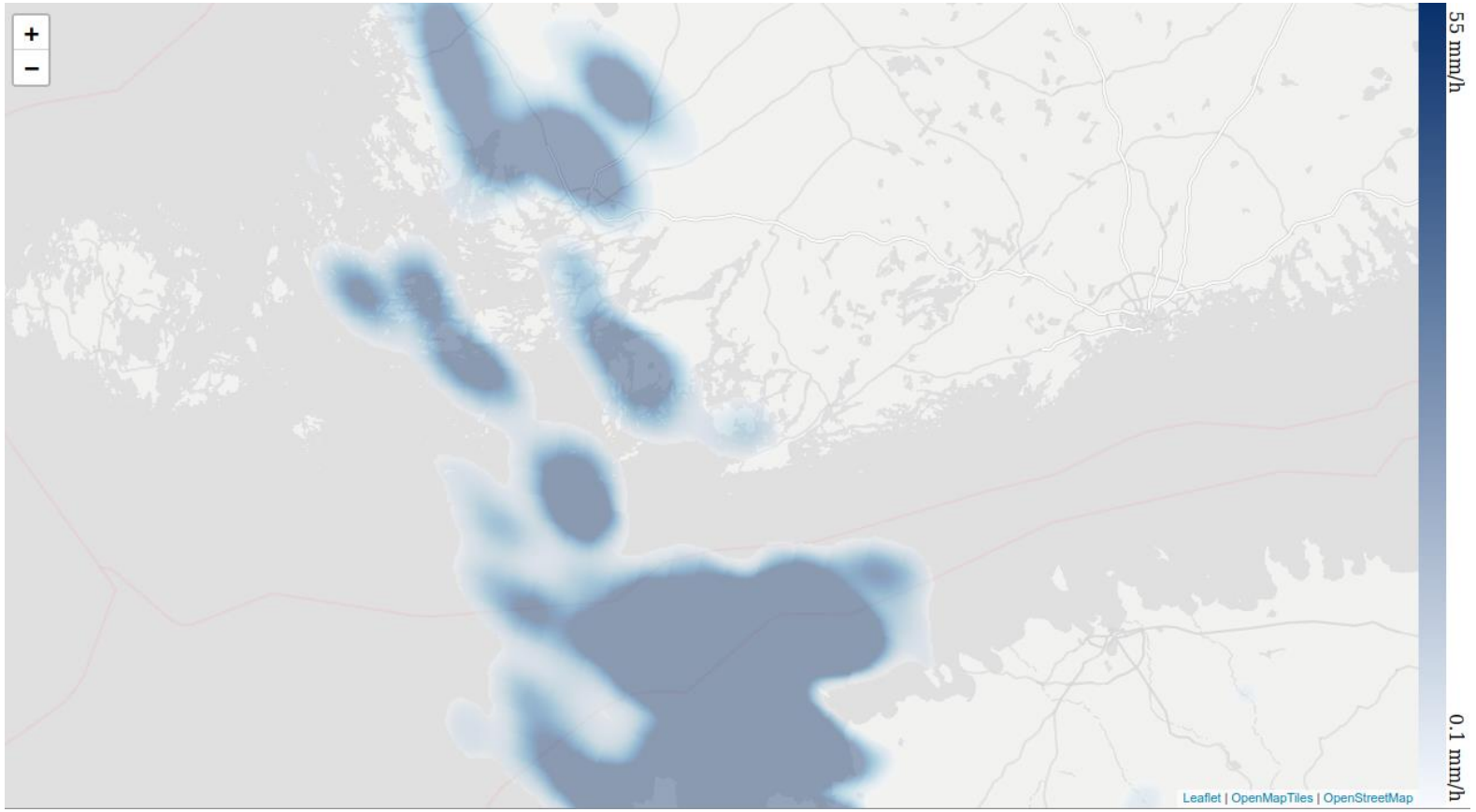


Vehicle tailored road weather services



Precipitation nowcasting web application

- Based on extrapolation of radar observations along the motion field estimated from past observations
- Will be tested in Linnanmaa region in Oulu
- Provided as input to road weather model



- Nowcasting provides better results than numerical weather prediction models on short time ranges (0-6 hours)
- Nowcasting models can produce reliable predictions of large scale stratiform rainfall up to 6 hours
  - Convective rainfall up to the next 30-60 minutes.
- Forecasting snowfall by using weather radars is still a challenging task

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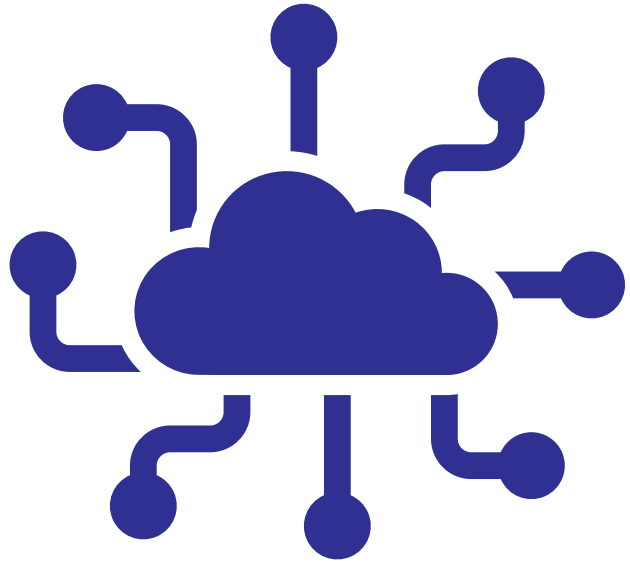
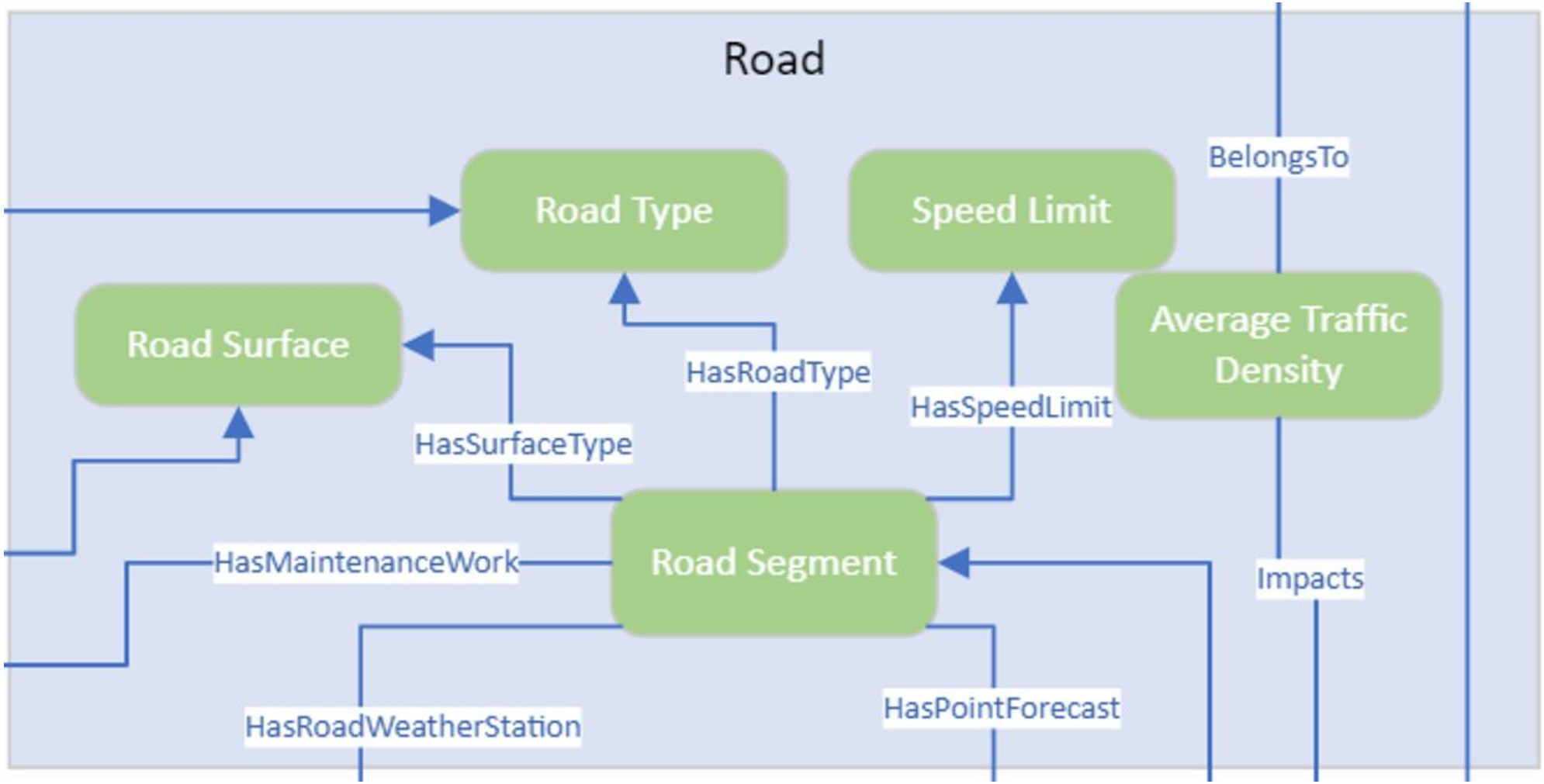
Route planning with knowledge modelling

- Knowledge graphs (KGs) are one of the driving powers for the development of artificial intelligence
  - Knowledge bases composed of many entities and relations between them
- In this project, we investigate the use of KGs for driving
  - Integration of near real-time data with a KG in driving scenarios
  - Benefits for automatic route planning

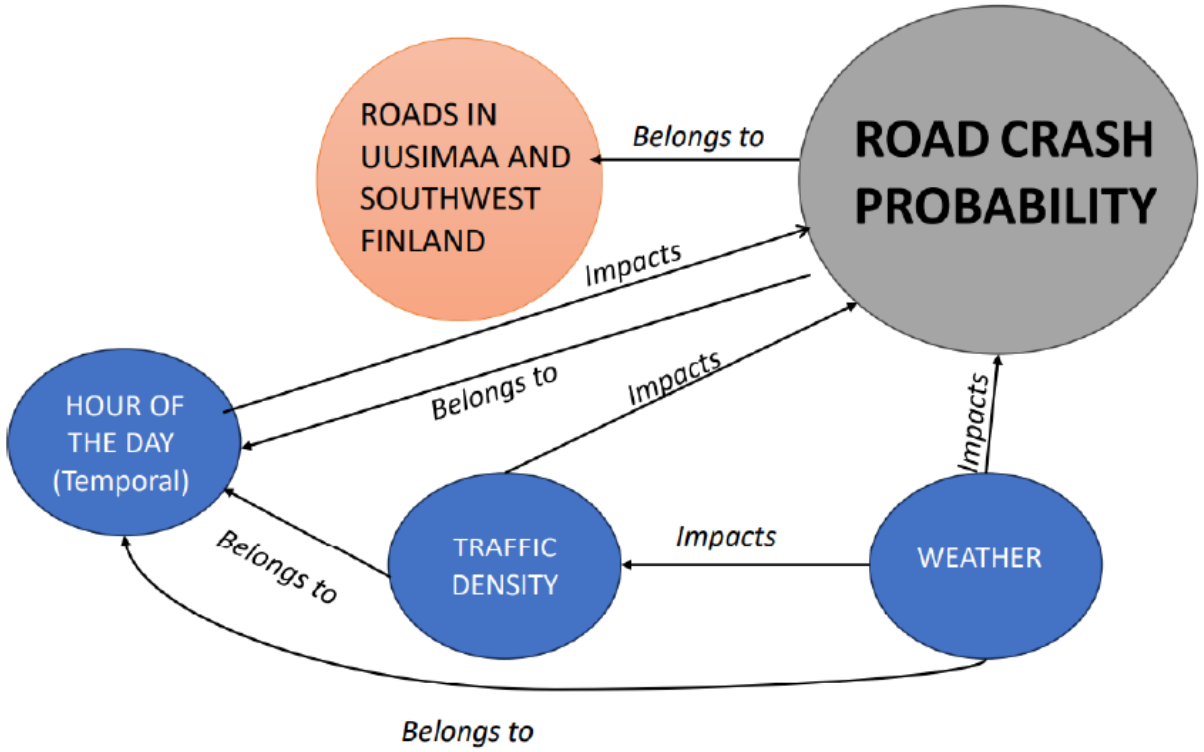


Part of knowledge graph



Predictive modelling of weather-related crashes

- Aim is to build a machine learning model that can forecast the probability of a road crash
- Generalized additive logistic regression model
- Final target to make a KG from the results to be implemented to route planning system



Road crash study setup

- Target area southern Finland
- 24-hour forecast window
- Inputs: MEPS weather data and forecasted traffic volume data
- Trained on five years of historical data (2017 - 2021)
- The results will tell us if certain areas or certain times of the day, as well as which weather factors, carry more risk for road safety

Expected results

- Forecast service for autonomous vehicles (project area)
- Precipitation nowcast web application
- Support system for route selection utilizing knowledge model
- Short-term forecast model for crash probabilities

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