

Online calibration with SUMO for network-wide traffic and emission monitoring – Case study ITS Huainan

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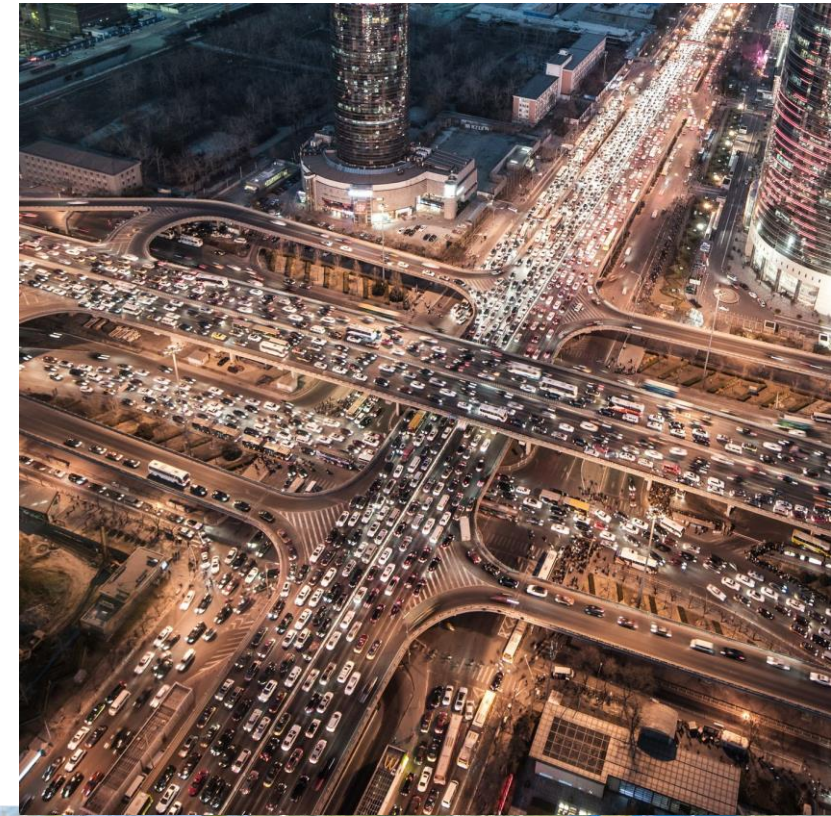


Knowledge for Tomorrow

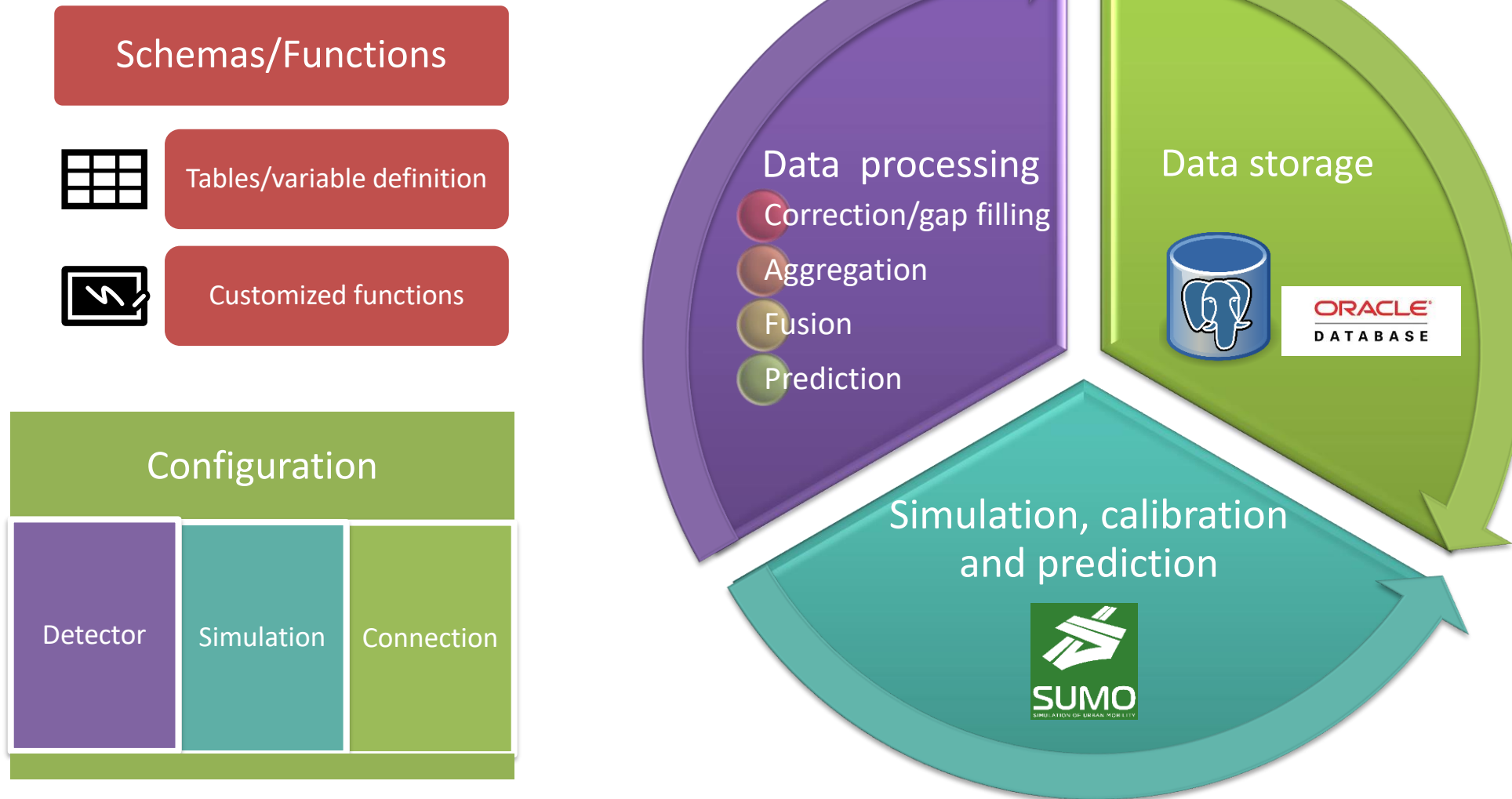


Introduction

- More and more real-time traffic data is available → still pointwise measurements
- Simulation is an adequate tool for providing area-wide traffic state, and has difficulty to consider
 - varied daily traffic demands (often absent)
 - unexpected events (incidents....)
- Online calibration can reflect real-traffic state in simulation
 - DLR's past fundamental projects Vabene and Vabene++
- City Huainan is building its ITS system with a real-time traffic and emission platform
 - DLR's keepMoving Portal
 - DLR' online calibration process with SUMO



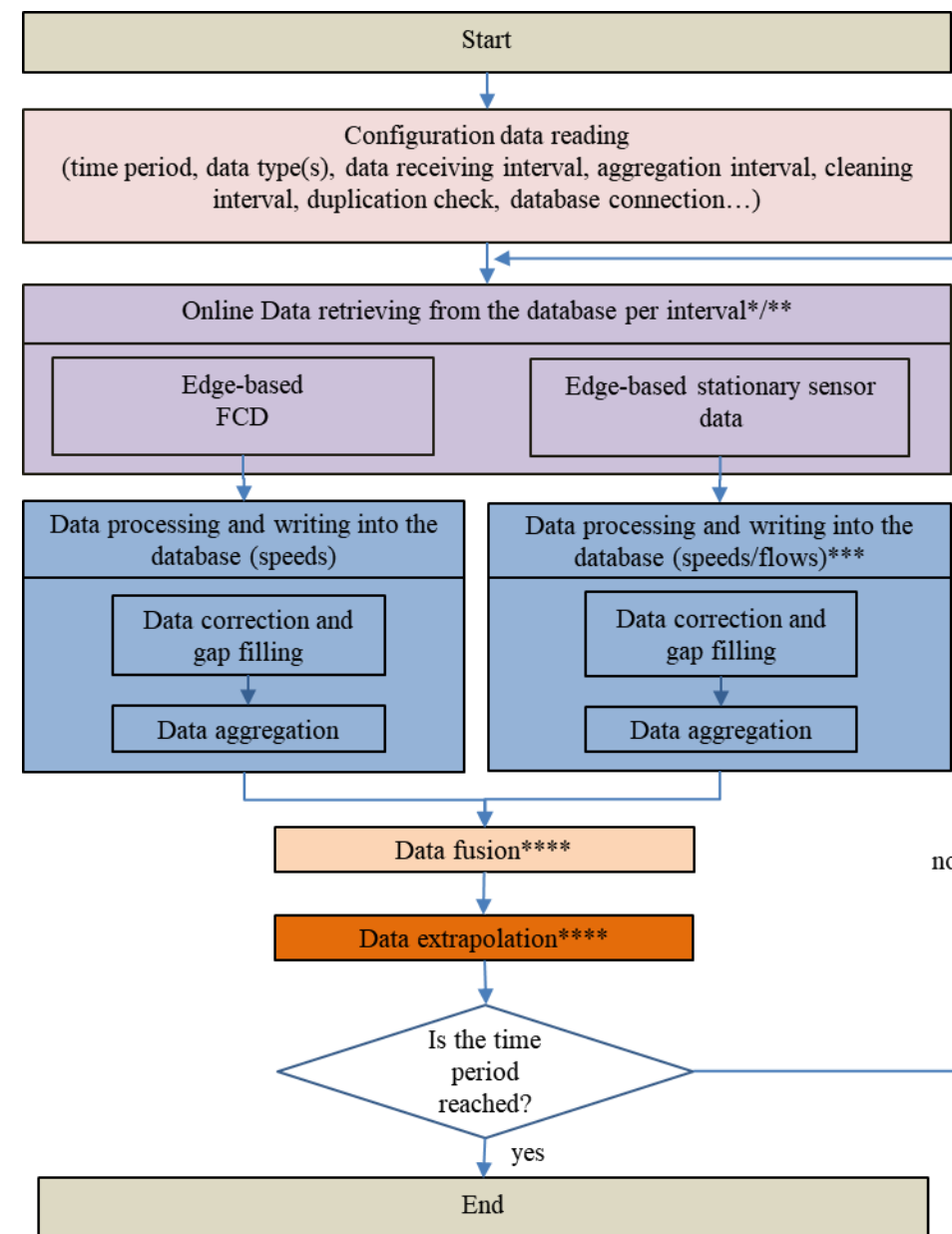
Online calibration – Concept



Online data processing

- Data aggregation is processed at
 - edge level and
 - interval level
- Traffic data from other sources can be processed with respective added tables.
- Vehicle types can be considered
 - Passenger car
 - Truck
- Data fusion and extrapolation are optional.

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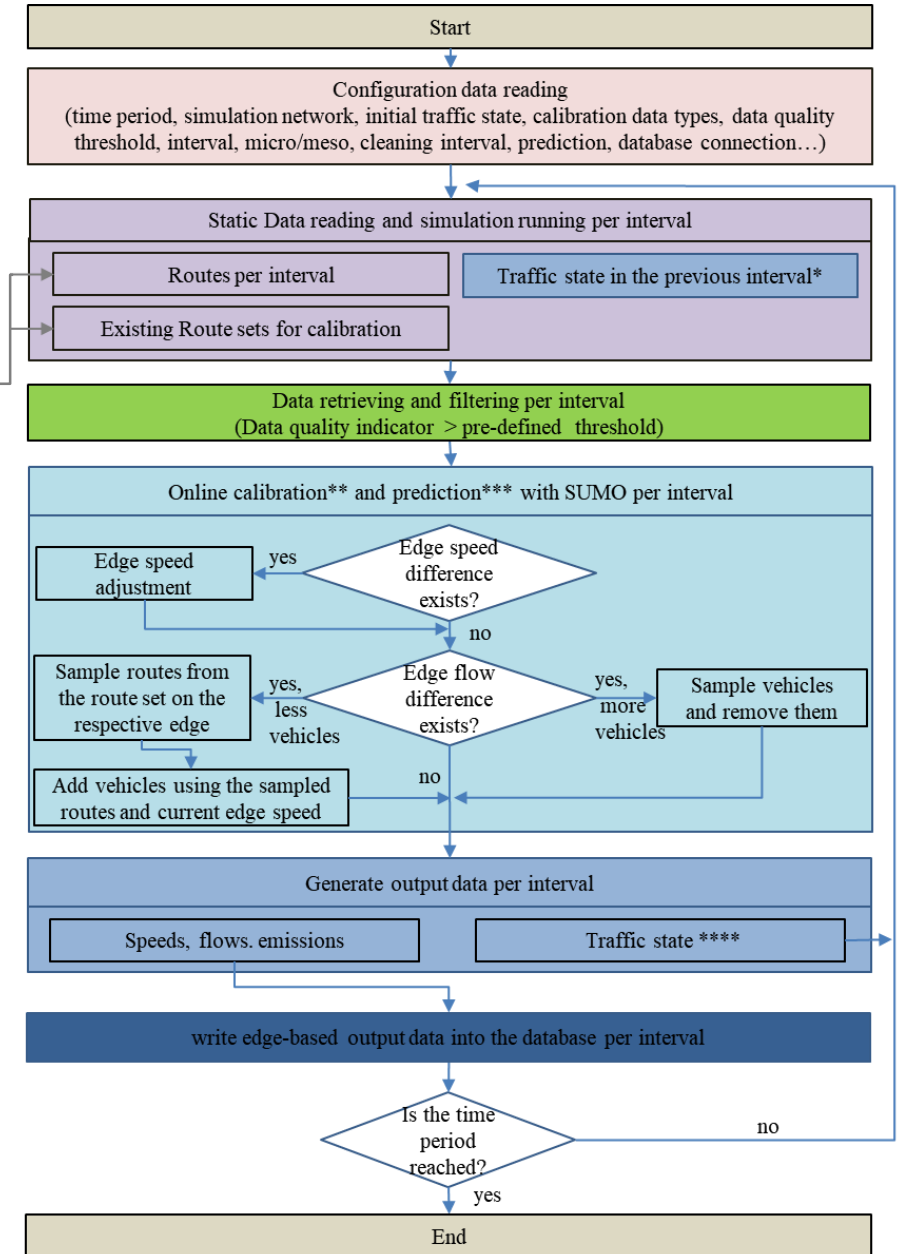
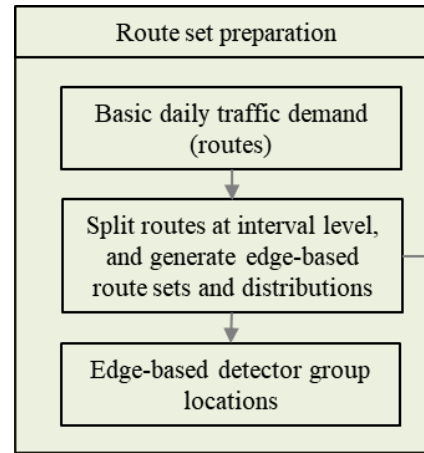


Online Calibration with SUMO

- Data preparation
 - Network
 - Traffic demand (routes)
- Route set preparation
 - Route splitting for each interval
 - Calibration route set for edges with sensors
- When online data is available
 - Speed adjustment
 - Flow adaptation

} in a defensive manner
- Output generation
 - Speeds
 - Flows
 - Emissions

} per edge/ per interval

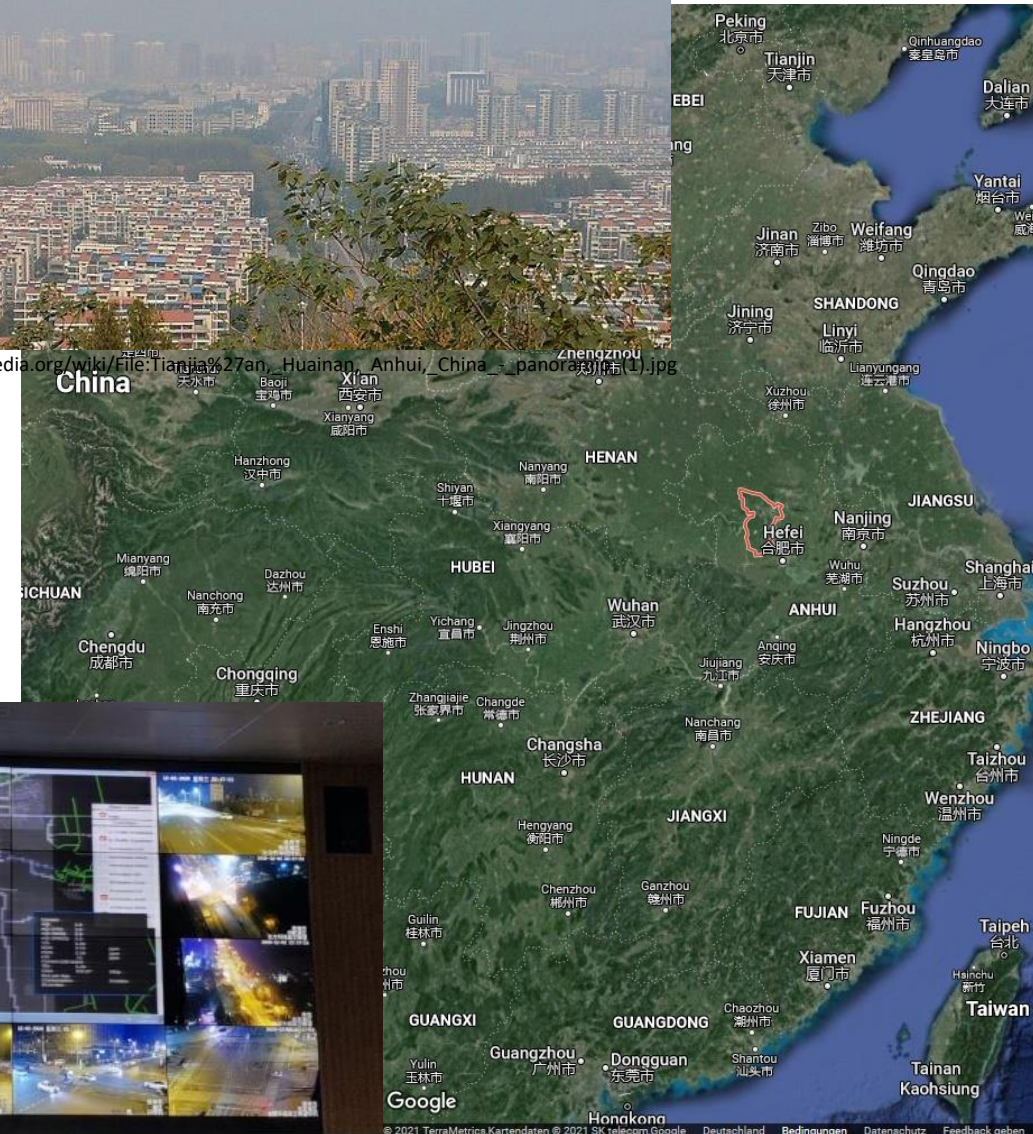


ITS Huainan

- City Huainan:
 - Anhui Province
 - Around 3.4 million residents (2020)
 - Area: 5,533 km²
 - Many on-going developments
- Real-time traffic monitoring platform
 - Cameras
 - KeepMoving portal
 - Online data
 - Simulation/prediction data
 - Accessibility map
 - Live streams with object-type identification and stay frequency at selected intersections ...

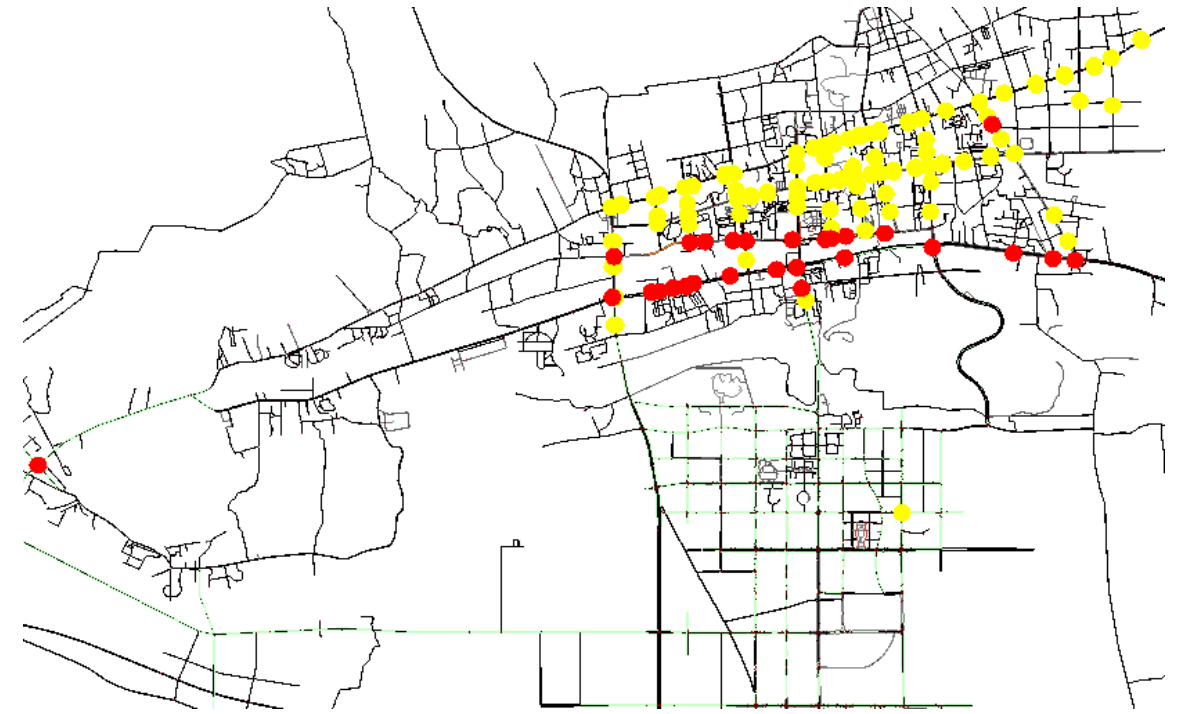
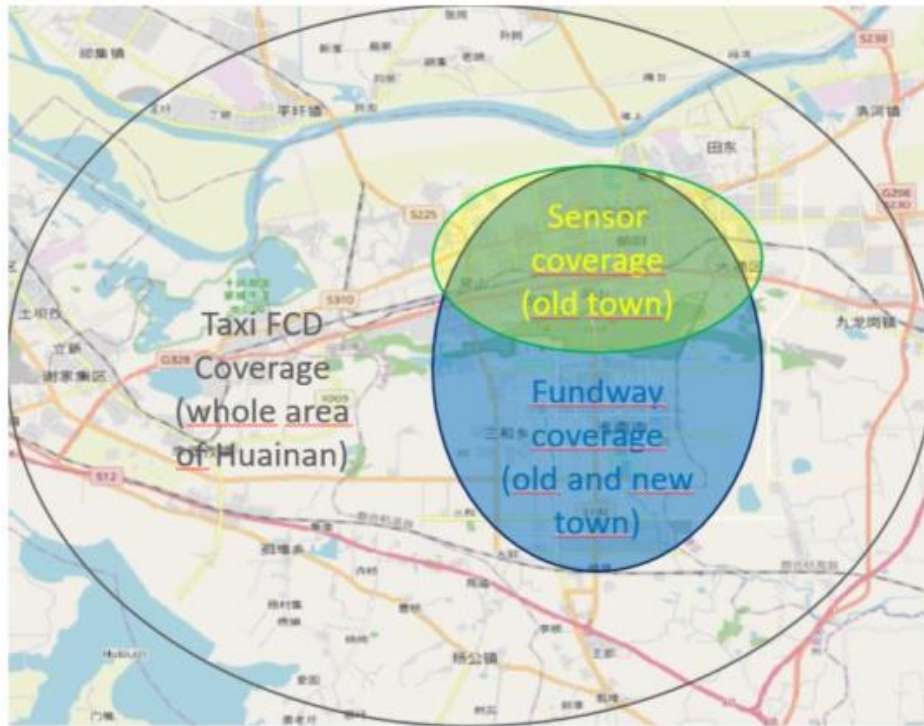
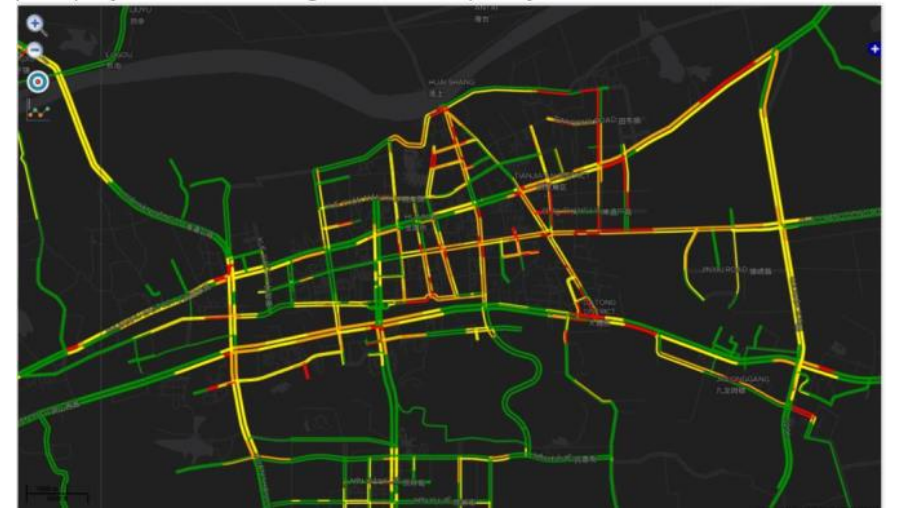


https://commons.wikimedia.org/wiki/File:Tianjia%27an_Huainan_Anhui_China_panorama.jpg



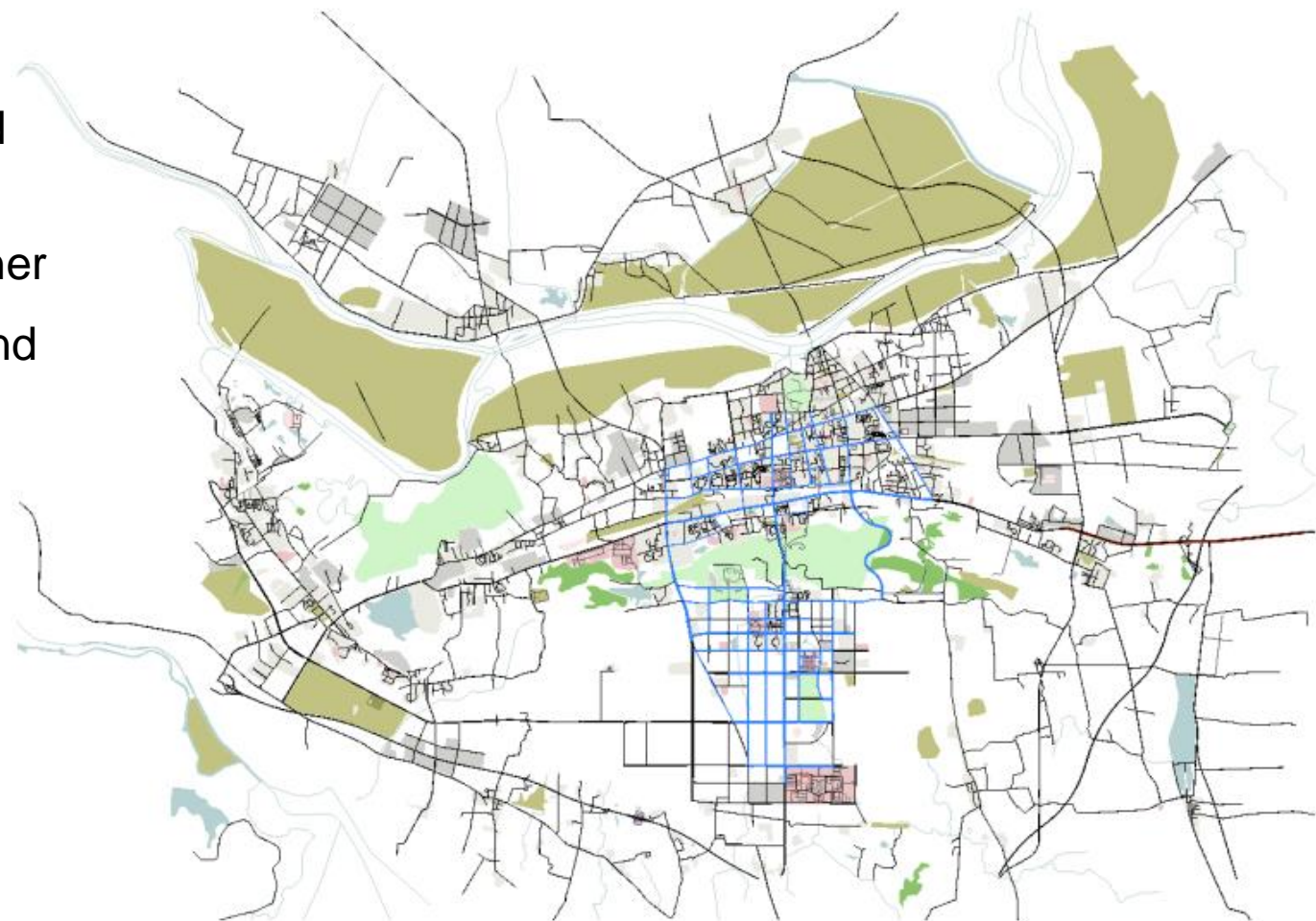
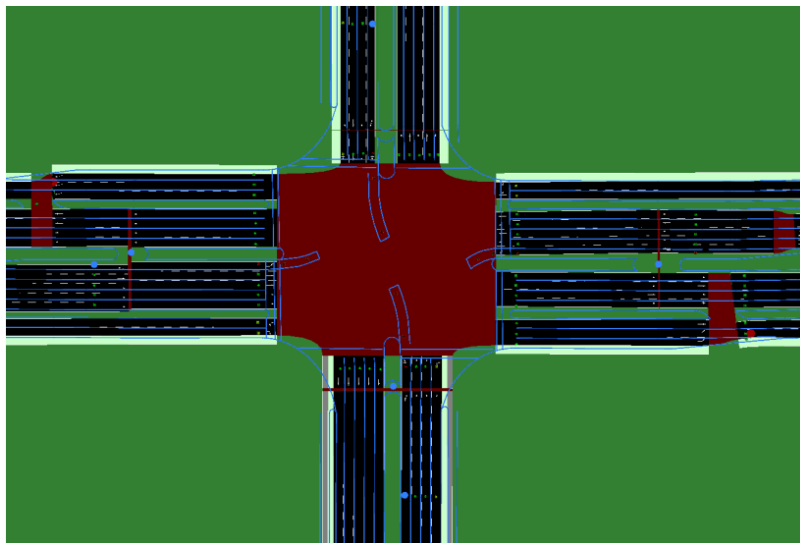
Online data

- Data sources
 - FCD: speeds
 - Sensors: speeds and flows
 - Microwave (509)
 - Camera (200)



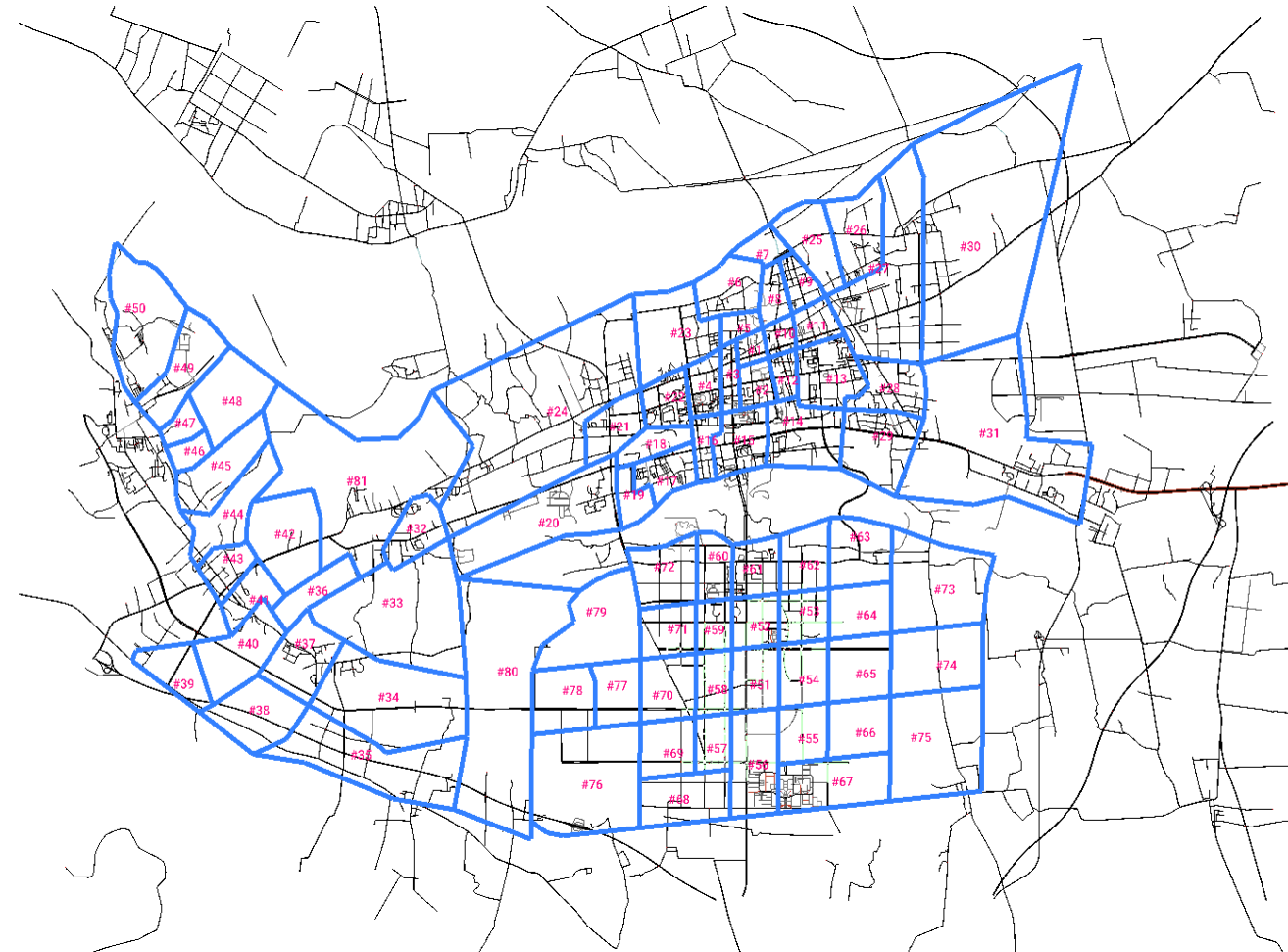
Simulation network

- OSM-based network (2019 Q3)
- Additional information
 - Detailed road geometries in the old town and the new center area (as marked in blue)
 - Traffic light information from the project partner
 - Satellite pictures and images from Google and Baidu



Traffic demand

- Based on the transportation planning work in 2009
- Peak-hour PCE matrix, estimated for 26 aggregated zones in 2020, is available (81 small TAZ is defined)
- Matrix was disaggregated for 81 TAZ according to the TAZ populations.
- Daily time series patterns were derived from the detected 5-min flow distributions both weekdays and weekends.
- Daily vehicular trips: 1.34 million



Simulation, calibration and predication

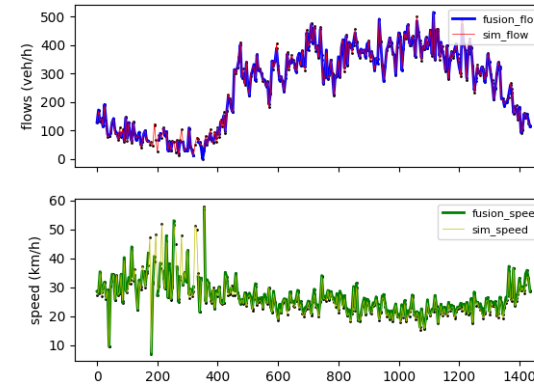
- Intervals
 - Simulation and calibration: 5 minutes
 - Prediction: 30 minutes
- Mesoscopic SUMO is applied.
- Data processing is also in operation.
 - The fused data is used for calibration
- Simulation duration
 - Around 70-90 sec
 - Maximum: 130 sec
- Total required time < 5 minutes
 - Data processing
 - Simulation, calibration and prediction
 - Output writing to the database



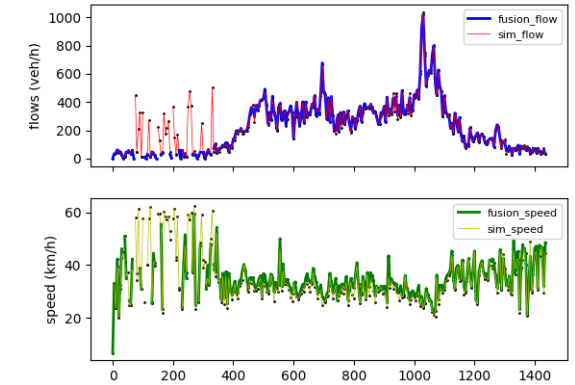
Evaluation

- The whole platform is under testing and maintenance phase.
- Data from 2021.01.14 to 2021.01.31 is used
- Absolute relative error (ARE)
 - 5-min interval evaluation
 - 80% of the calibrated flows and more than 95% of the calibrated speeds have an ARE < 15%
- GEH statistic
 - Hourly flow evaluation
 - Around 92% of the calibrated flows have a GEH-value ≤ 5

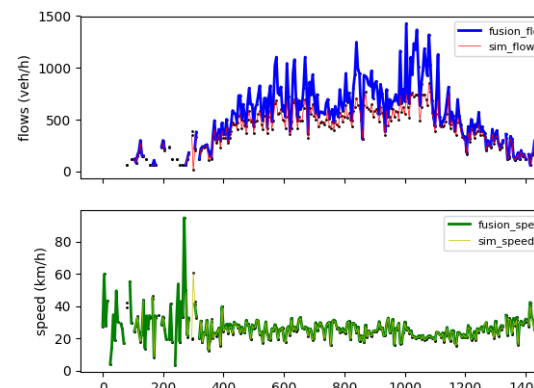
Examples:



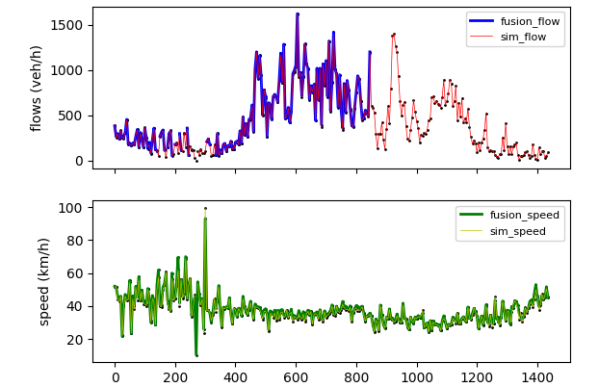
(a)



(b)



(c)



(d)



Summary and remarks

- The enhancement and extension for the online continuous calibration and prediction process has been carried out according to the scope of the project ITS Huainan.
- When conducting online calibration, failure in vehicle insertion may happen due to
 - lack of space on edges, and
 - the simulation's defensive manner
- The overall performance is principally still good under the aforementioned circumstance.
- City Huainan is continuously changing and the number of vehicle ownerships continues to increase
 - Continuously network updating
 - TAZ and daily traffic demand re-examining and updating



Thank you for listening!



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