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DAFNI-powered Digital Twin of Sheffield Traffic

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Project Aims



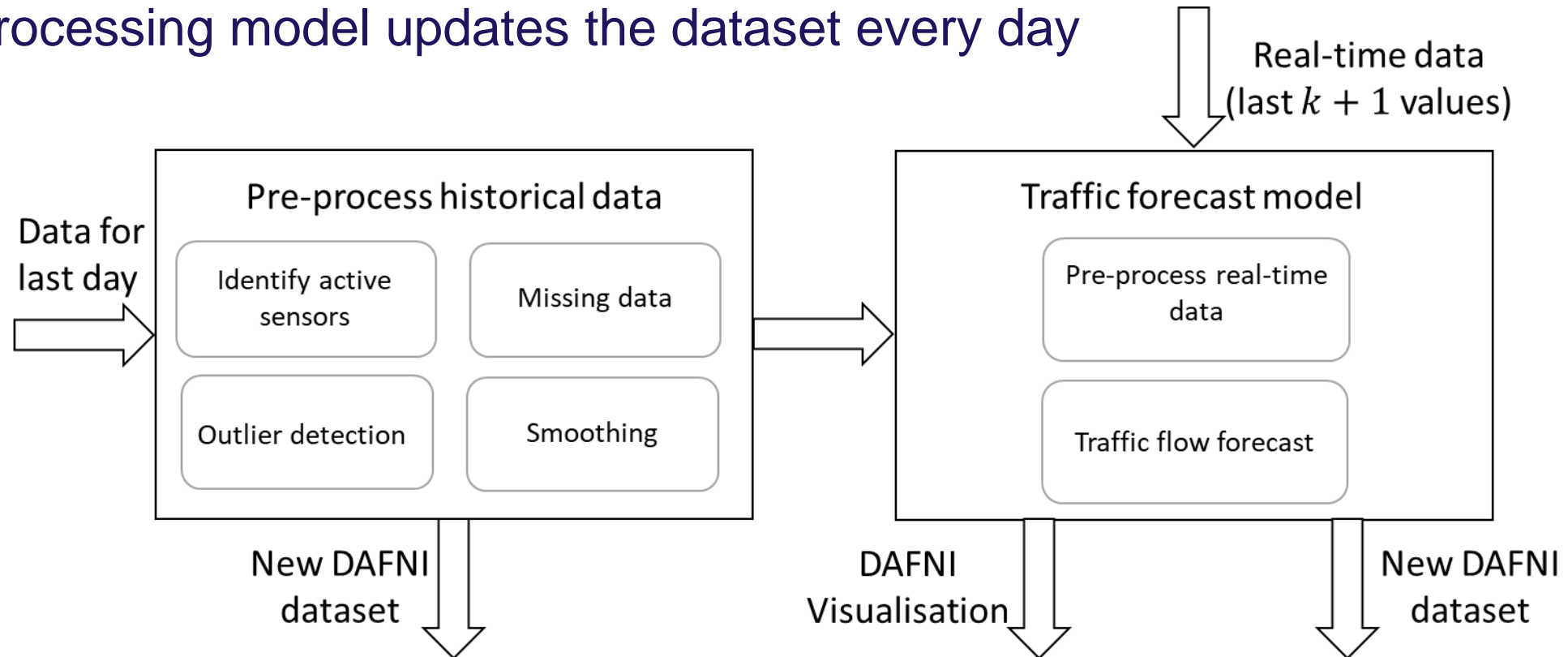
- Implement on DAFNI a data-driven model for real-time forecasting of urban traffic to evaluate the platform's capabilities for DT development
- Inform on new functionalities required for full-scale DTs
- Build the foundation for a Traffic DT in Sheffield
 - Create a digital replica of Sheffield's traffic and identify areas where congestion will occur



Data

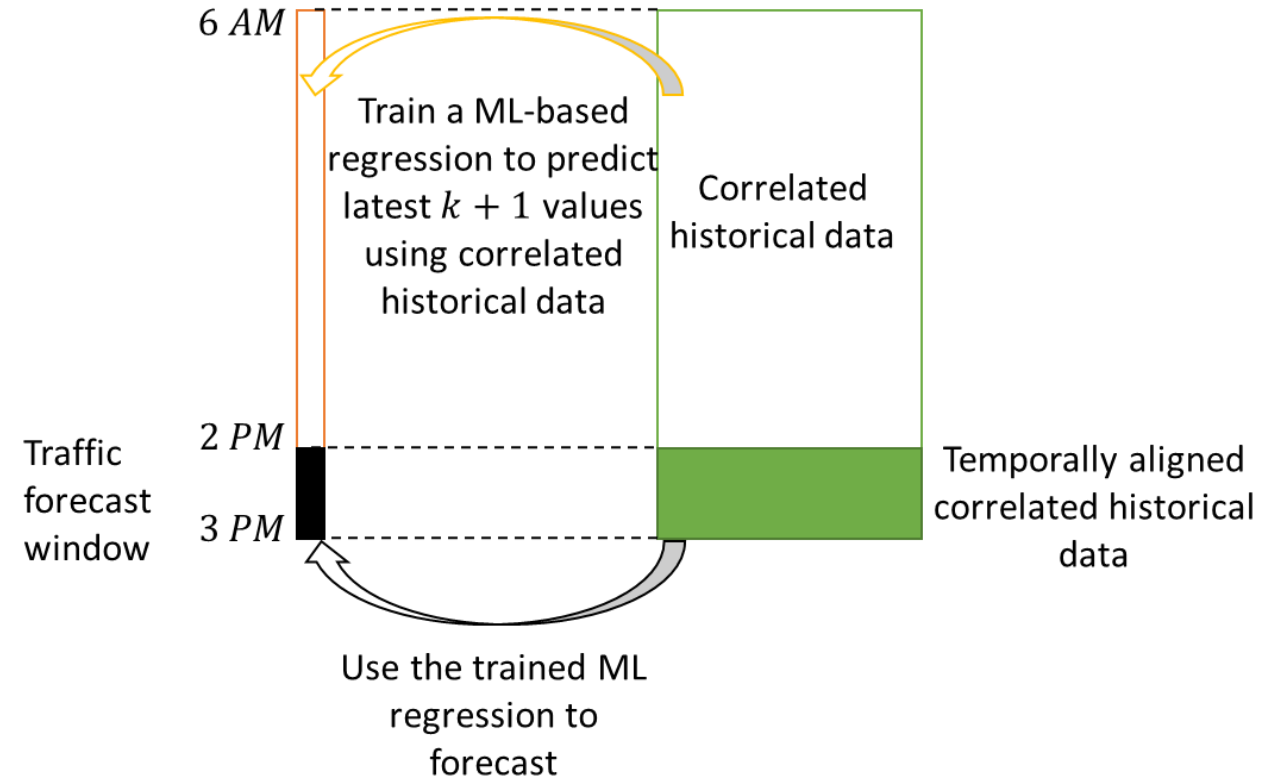
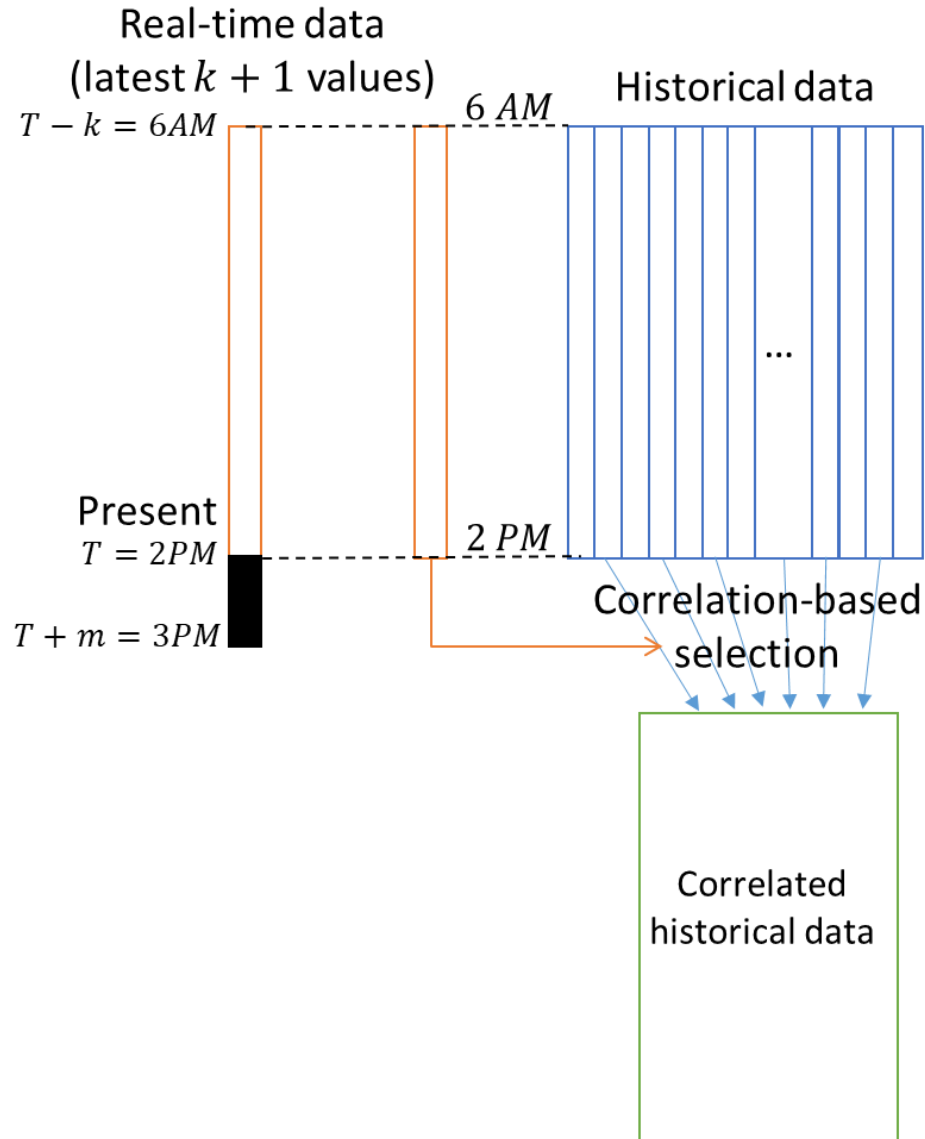


- Data is stored in a matrix format such that each column contains traffic flow values for a particular day and a particular sensor
- Pre-processing model updates the dataset every day





Traffic Forecast Model





Traffic Forecast Model



- Benchmarked performance and computational time for: Support Vector Regression (SVR), Gaussian Processes Regression (GPR), Long short-term memory (LSTM) and matrix completion-based algorithm (BSVT)
- GPR gives best performance and lowest computational time (1.2 seconds per sensor)
- DAFNI has the computational power to scale this up by running parallel sessions of the model for all the traffic sensors

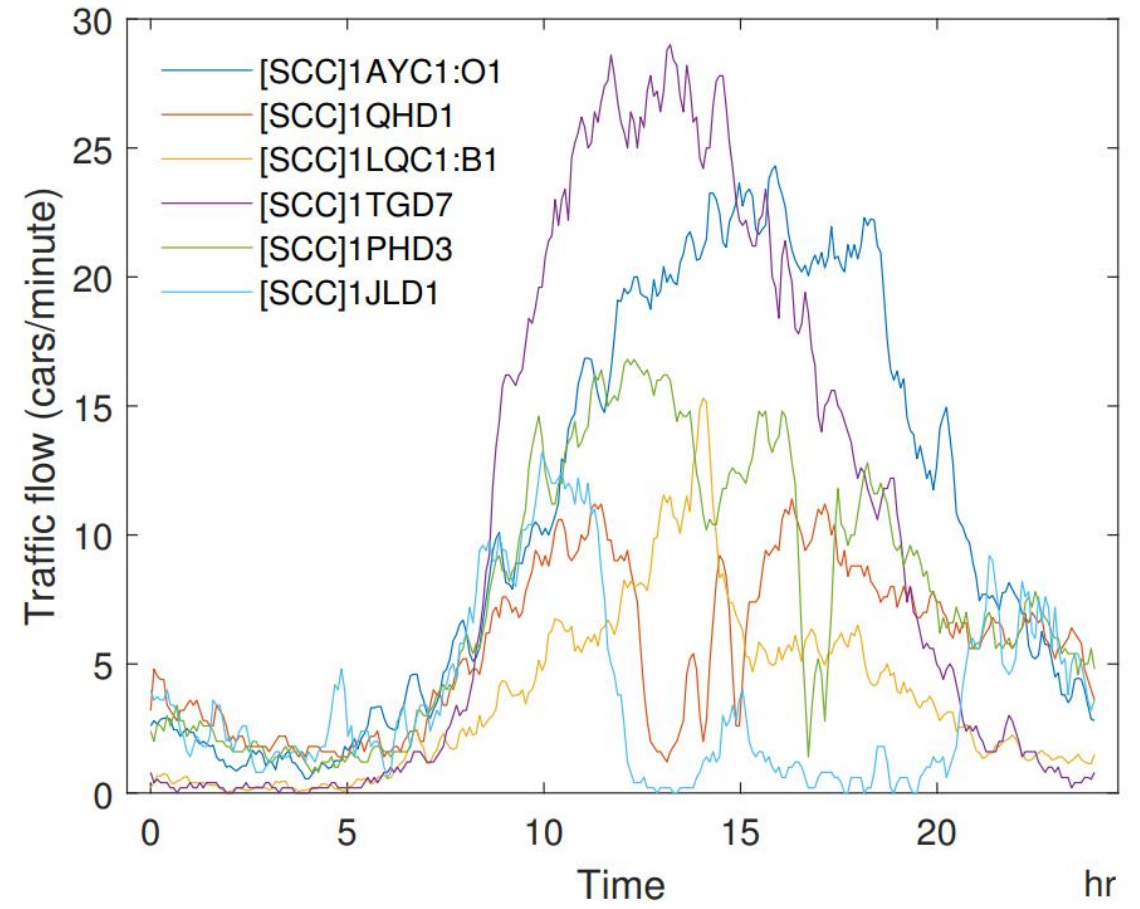


Forecast Performance



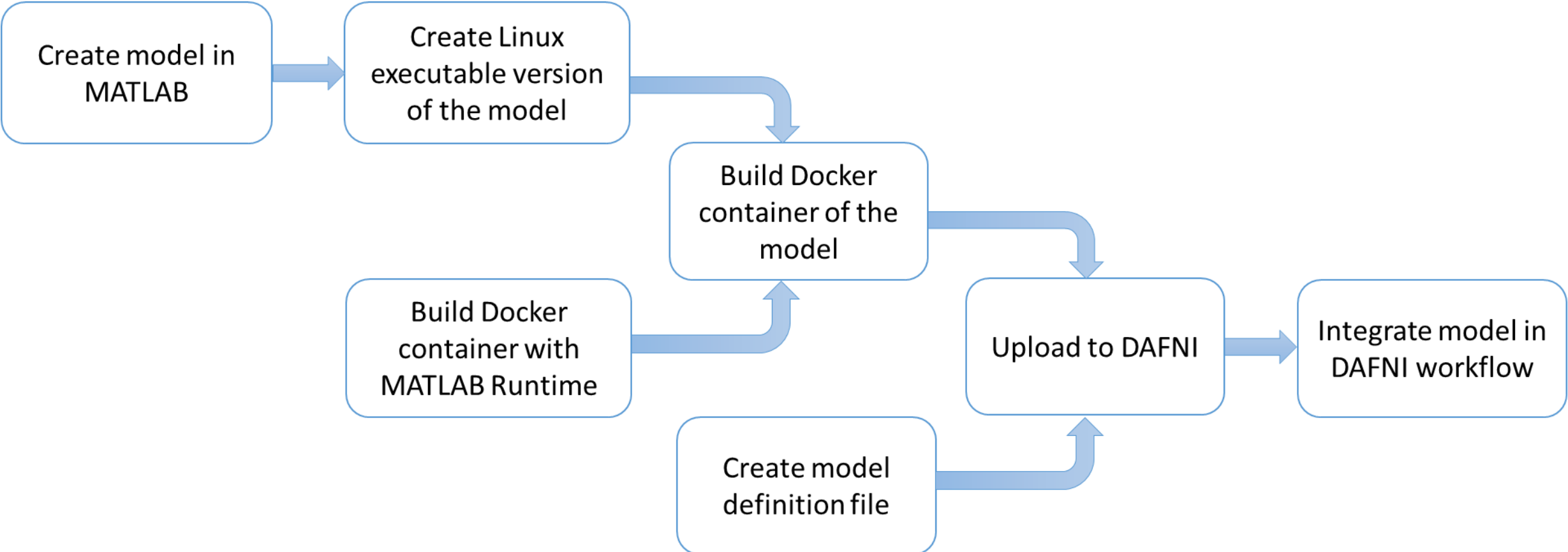
Mean Relative Error over 24-hours

Sensor id	5 min ahead	15 min ahead
[SCC]1AYC1:O1	7.4%	15.2%
[SCC]1QHD1	13.6%	28%
[SCC]1LQC1:B1	13.9%	24.5%
[SCC]1TGD7	13.2%	28.1%
[SCC]1PHD3	11.2%	20.8%



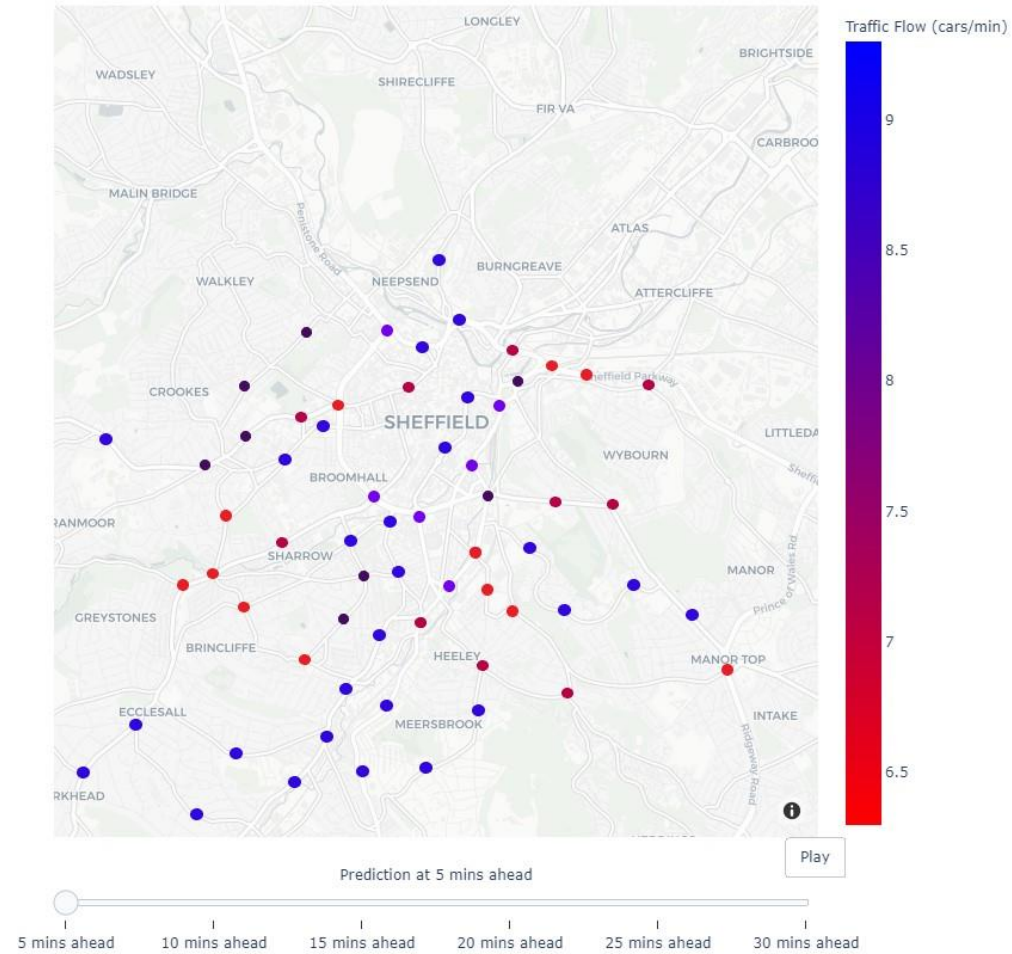


Model Upload on DAFNI





Visualisation





Future Work



- Scale up the model to calculate predictions (in parallel) for multiple sensors
- Automatically update the pre-processed historical dataset
- Add new types of data (occupancy)
- Integrate the DT in a real-time GUI
 - Update predictions as new data becomes available
 - Focus on regions of interest
 - Create custom output datasets based on user's needs
- Close the loop through interventions (adjust traffic light timing) in areas where congestion is predicted to happen



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