Traffic Flow - An analysis of STGNNs through visualization

BACKGROUND

Traffic is a **highly dynamic system** containing:

- Temporal Patterns
- Spatial Patterns
- Random Events

Spatial Temporal Graph Neural Networks (**STGNNs**) model traffic as an evolving graph, capturing both spatial and temporal patterns

Current evaluation metrics (**MAE, RMSE, MAPE**) do not show model performance in real world scenarios

AIMS

- **Train and evaluate** baseline models against State of the Art **STGNNs** on 3 real world traffic datasets

Temporal Models	Baseline STGNNs	SOTA STGNNs
LSTM	AGCRN	DGCRN
TCN	Graph WaveNET	D2STGNN

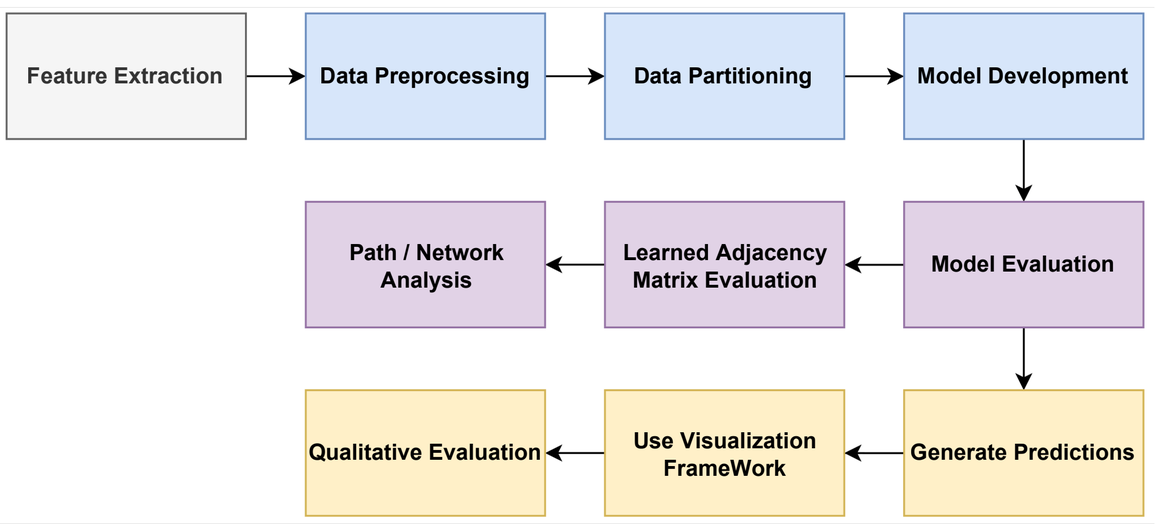
- Develop a **Visualization Framework** to visualize observed traffic and model predictions, to **improve evaluation** interpretability by showing model performance in real world scenarios

DATASETS

Sensors placed alongside roads record the **average speed** of passing vehicles per 5 minute time period

	METR-LA	PEMS-BAY	NE-BJ
Location	Los Angeles	San Fransisco	Beijing
Samples	34 272	52 116	6 509
Sensors	207	325	500
Metric	mph	mph	kph

EXPERIMENT PIPELINE

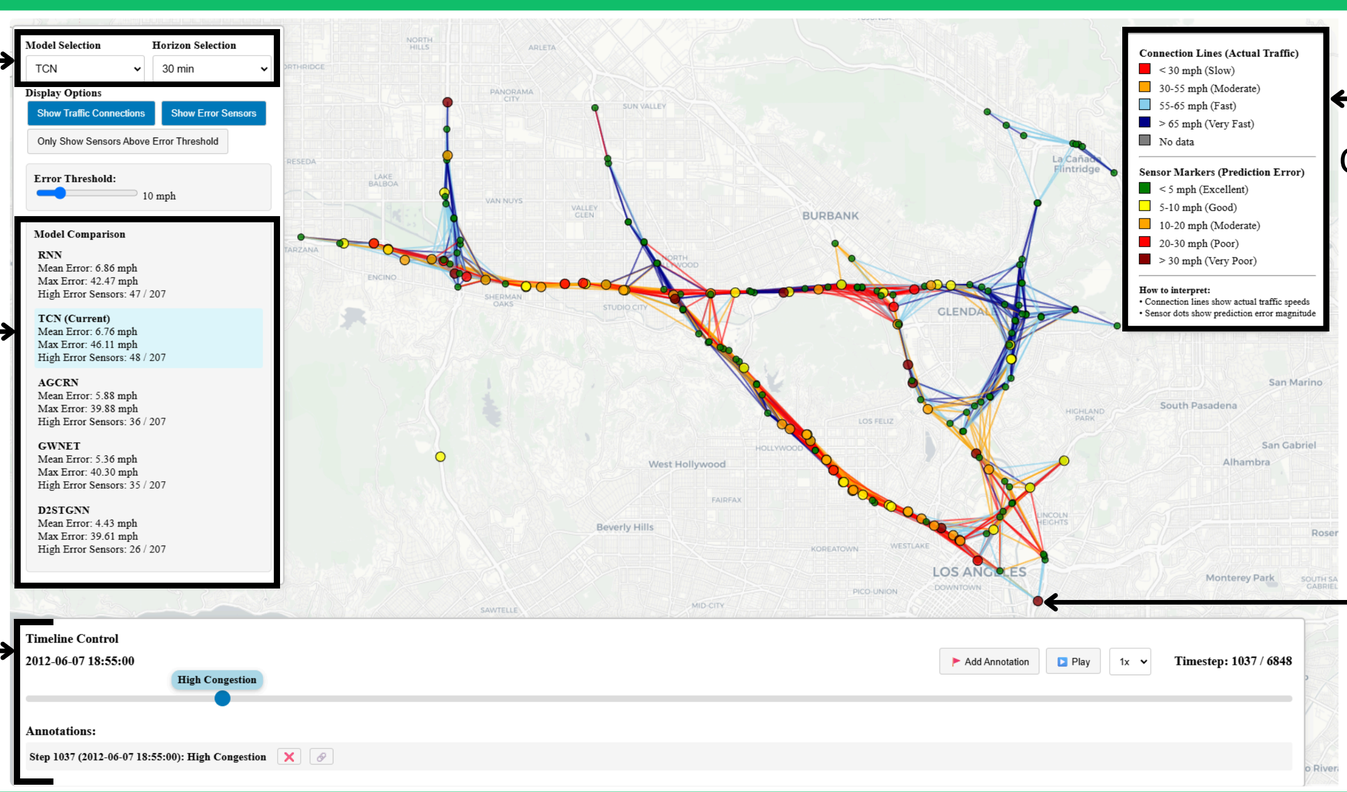


VISUALIZATION

Select Model and **Prediction Horizon** to visualize

Error dashboard of model predictions at selected time step and horizon

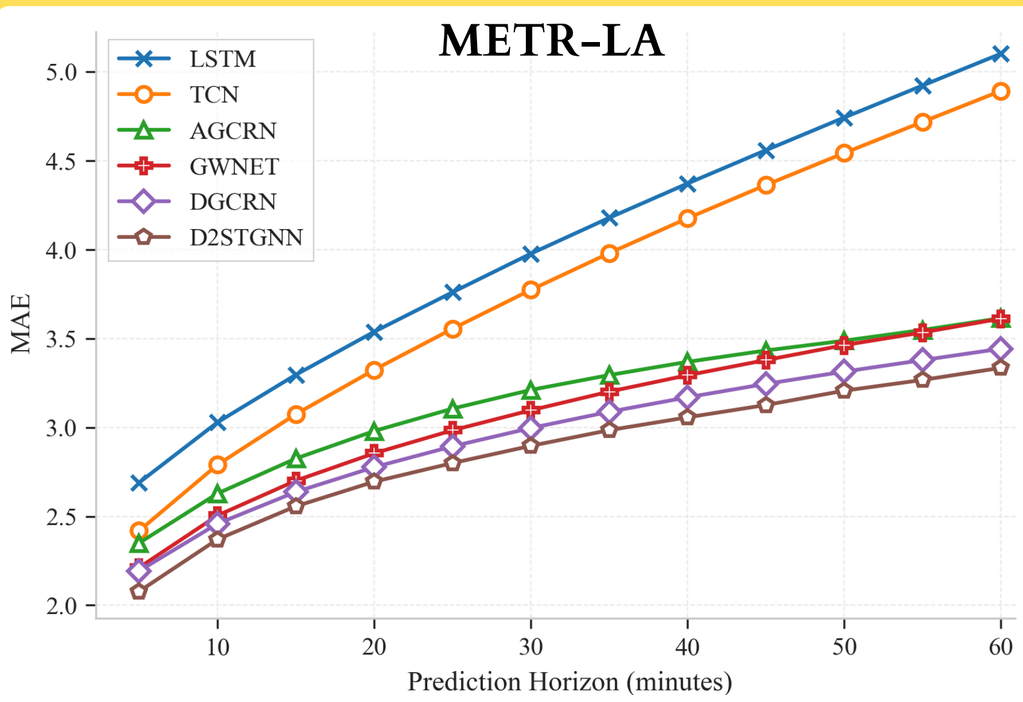
Traverse through the **dataset** and annotate interesting events to analyze



Colour Scale of observed values (lines) and model prediction errors (dots)

Individual sensor metrics

RESULTS



- **STGNNs outclass Temporal models** at high congestion intersections and at longer horizons because temporal models lack the ability to model traffic propagation
- **D2STGNN** has the **best overall performance**, but the visualization shows that it smooths out the impact of random events, limiting its real world applicability
- Sensors along the edge of the road network has the worst performance, indicating that **surrounding sensors are crucial** for accurate traffic prediction

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