Auckland Evacuation Model: Development and Calibration

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DEVORA

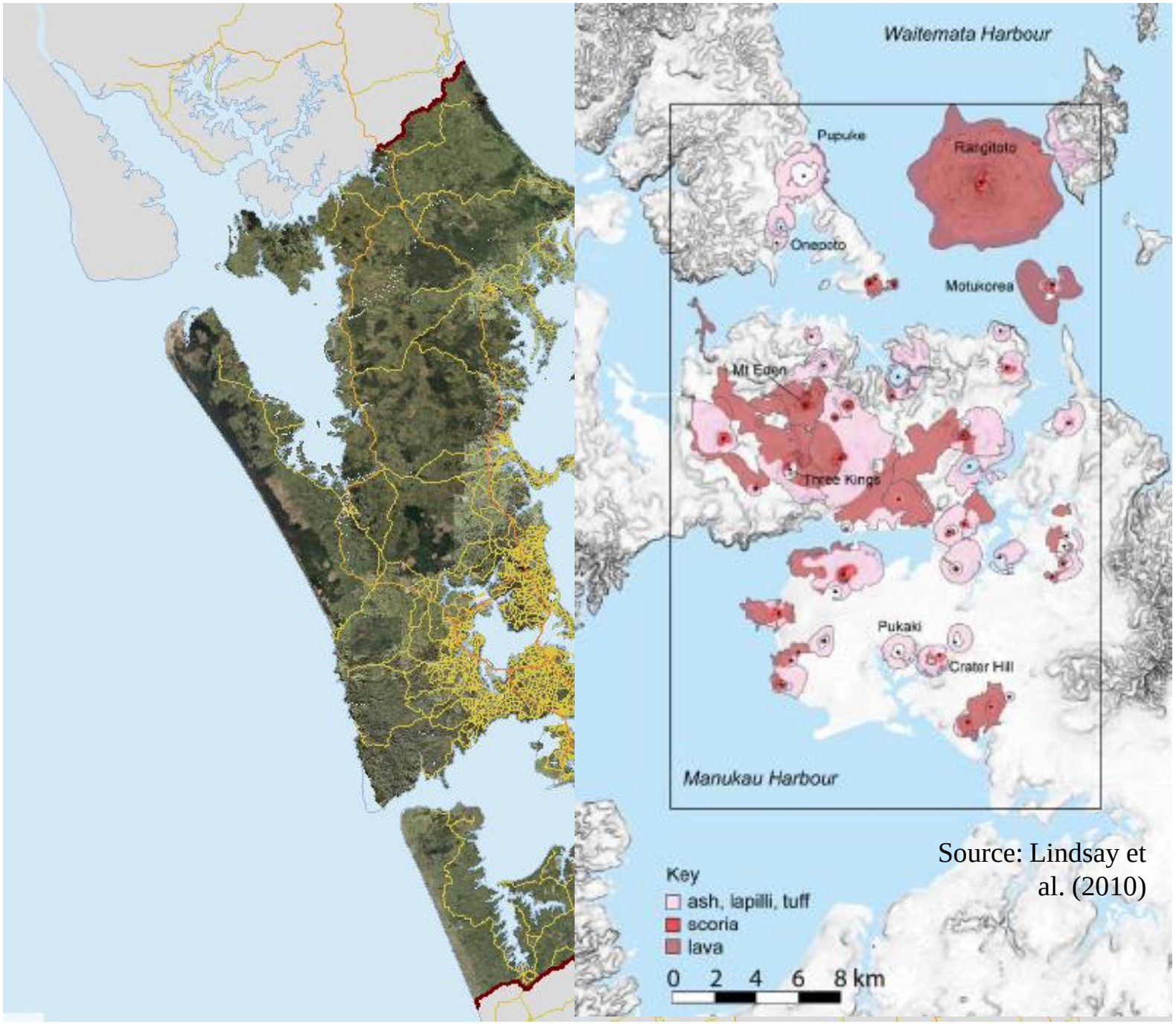
National SCIENCE Challenges
RESILIENCE TO NATURE'S CHALLENGES
Kia manawaroa – Ngā Ākina o Te Ao Tūroa

Background

The main aim of this research is to evaluate mass evacuation of Auckland under impending natural hazard (volcanic eruption) using traffic simulation.

Auckland Characteristics:

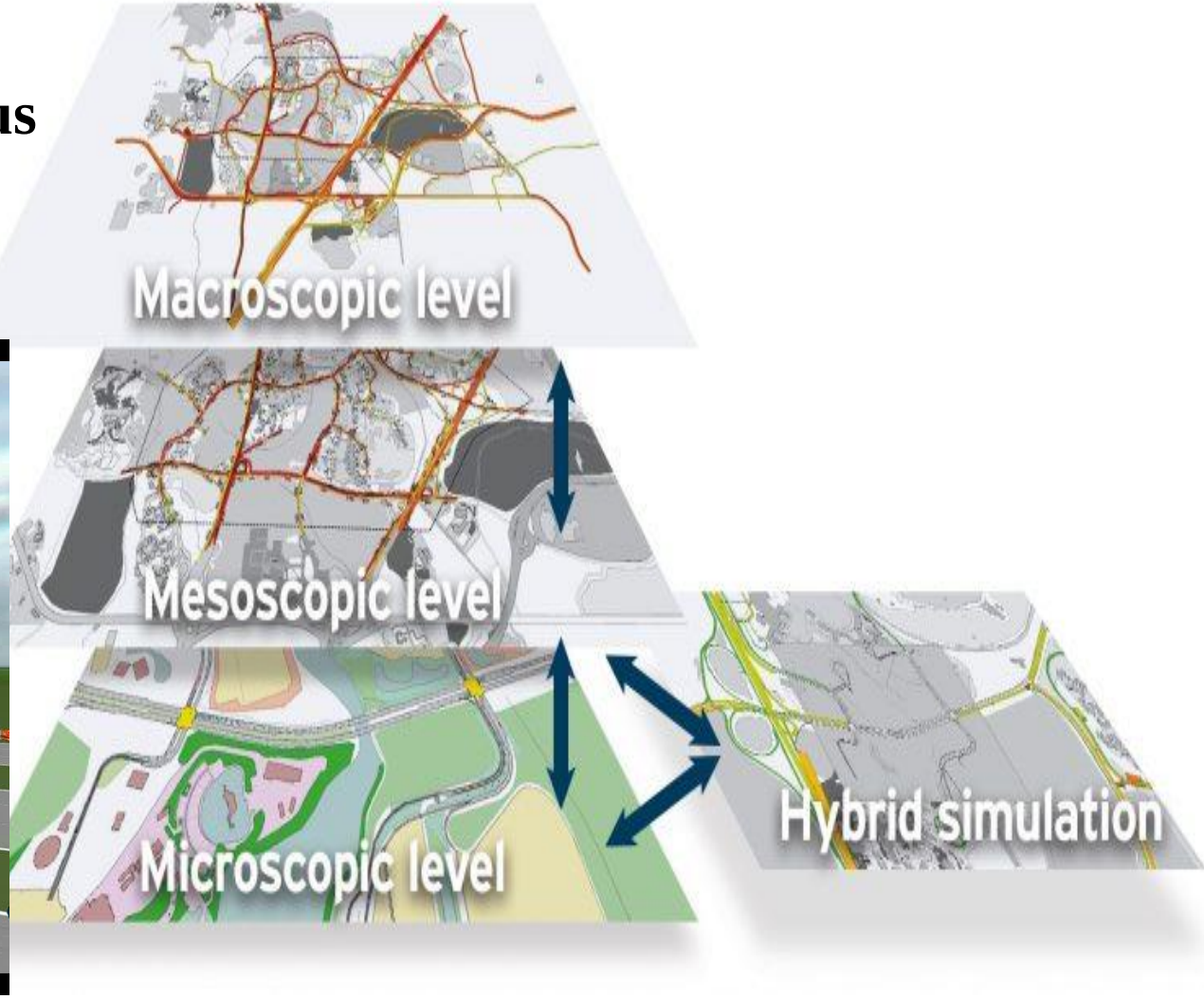
- Isthmus
- 4,894 Km^2 land area
- 411 unit areas
- 6,531 km sealed roads as of July, 2016



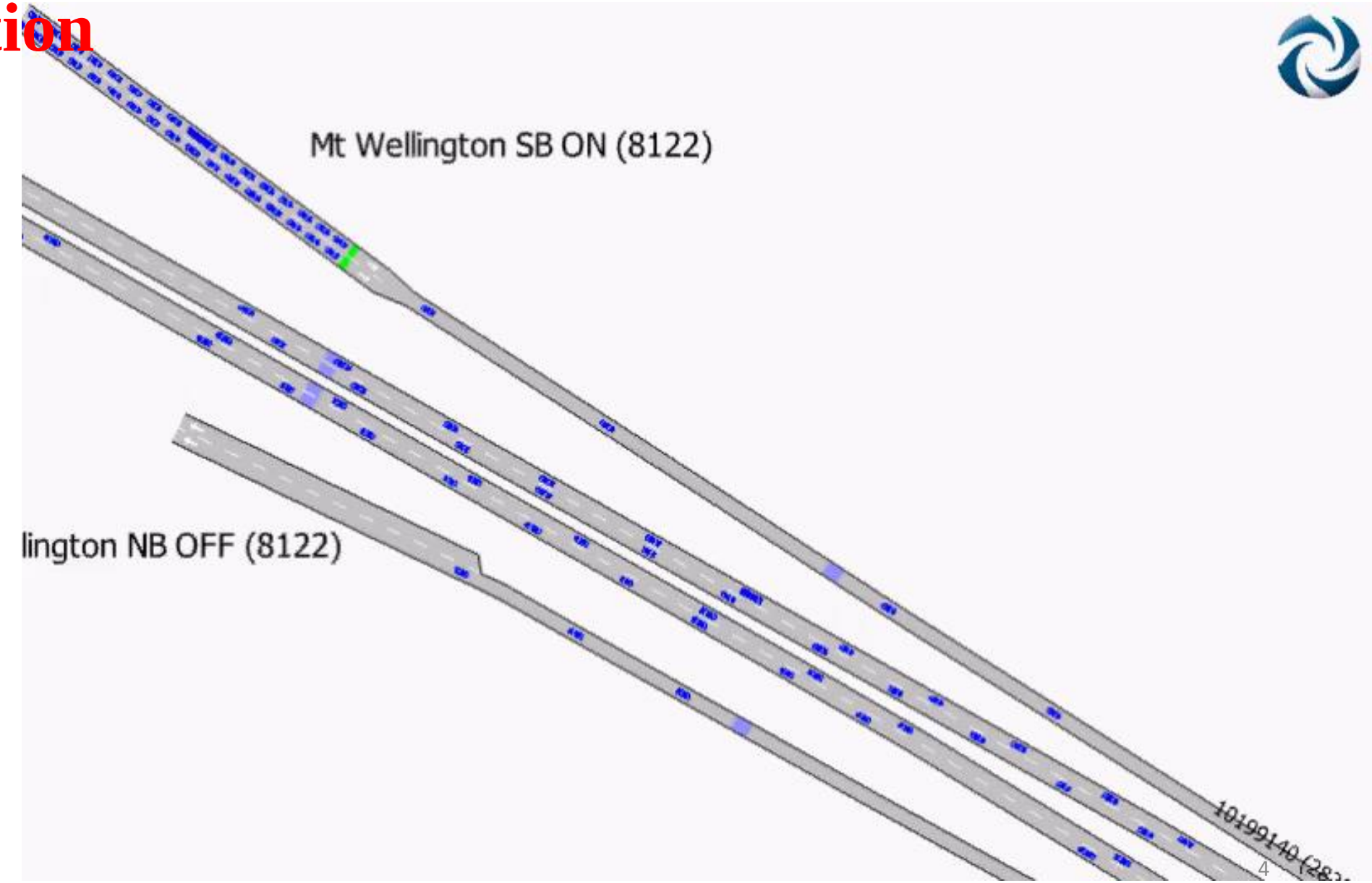
Source: Lindsay et al. (2010)

AIMSUN Traffic Simulation Model

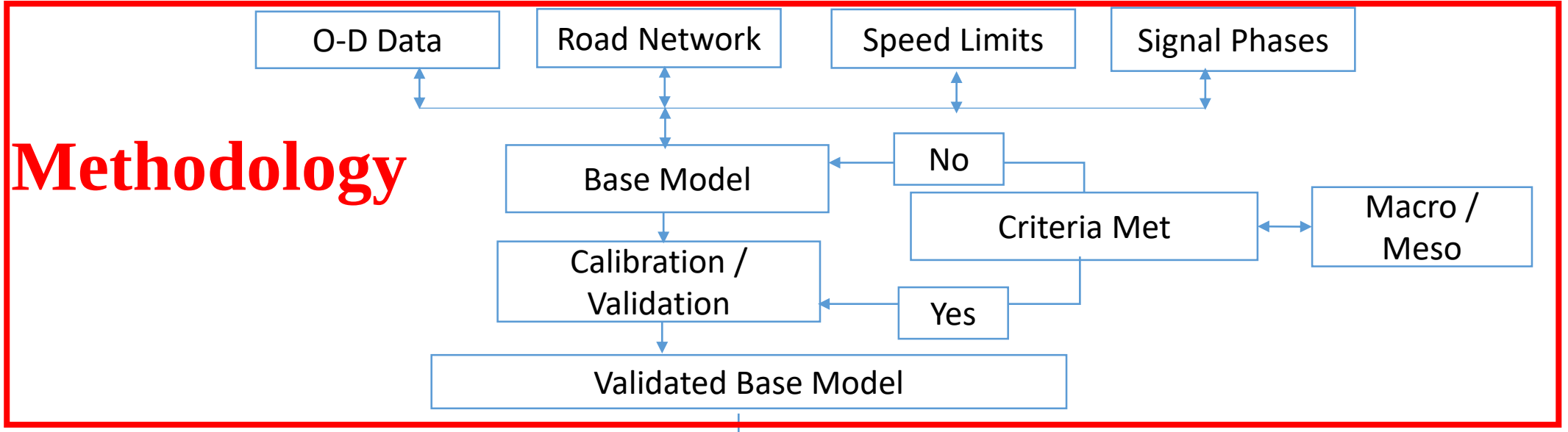
The AIMSUN simulator gives **simultaneous macroscopic, mesoscopic and microscopic (2D, 3D)** simulation



2D Visualization



Methodology

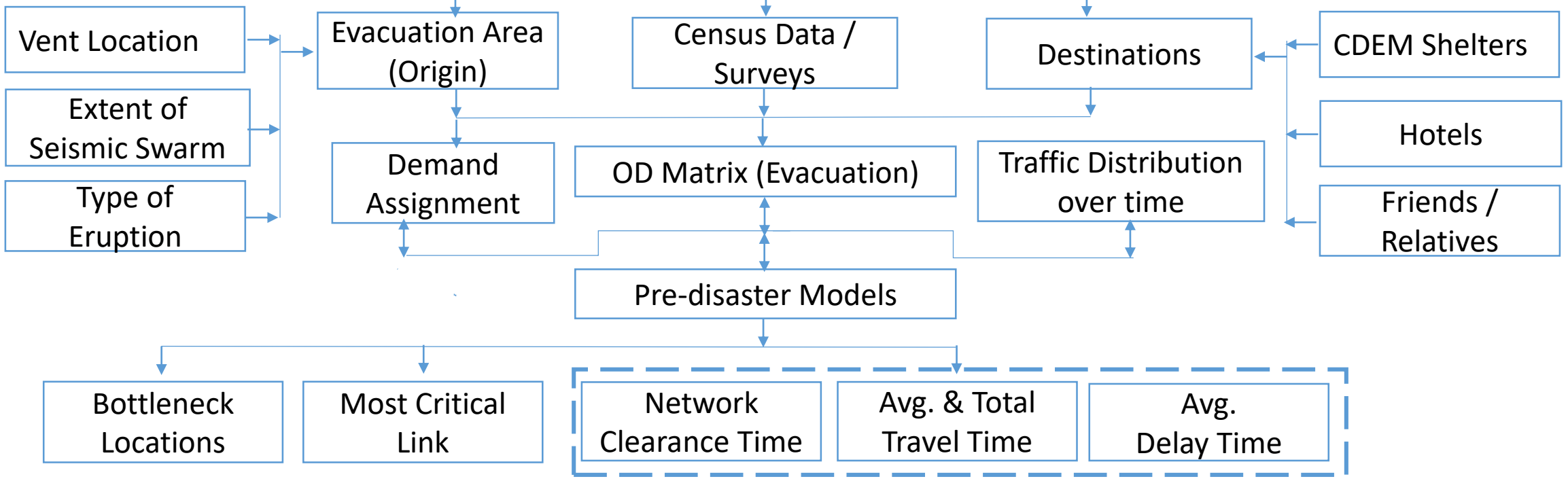


Criteria

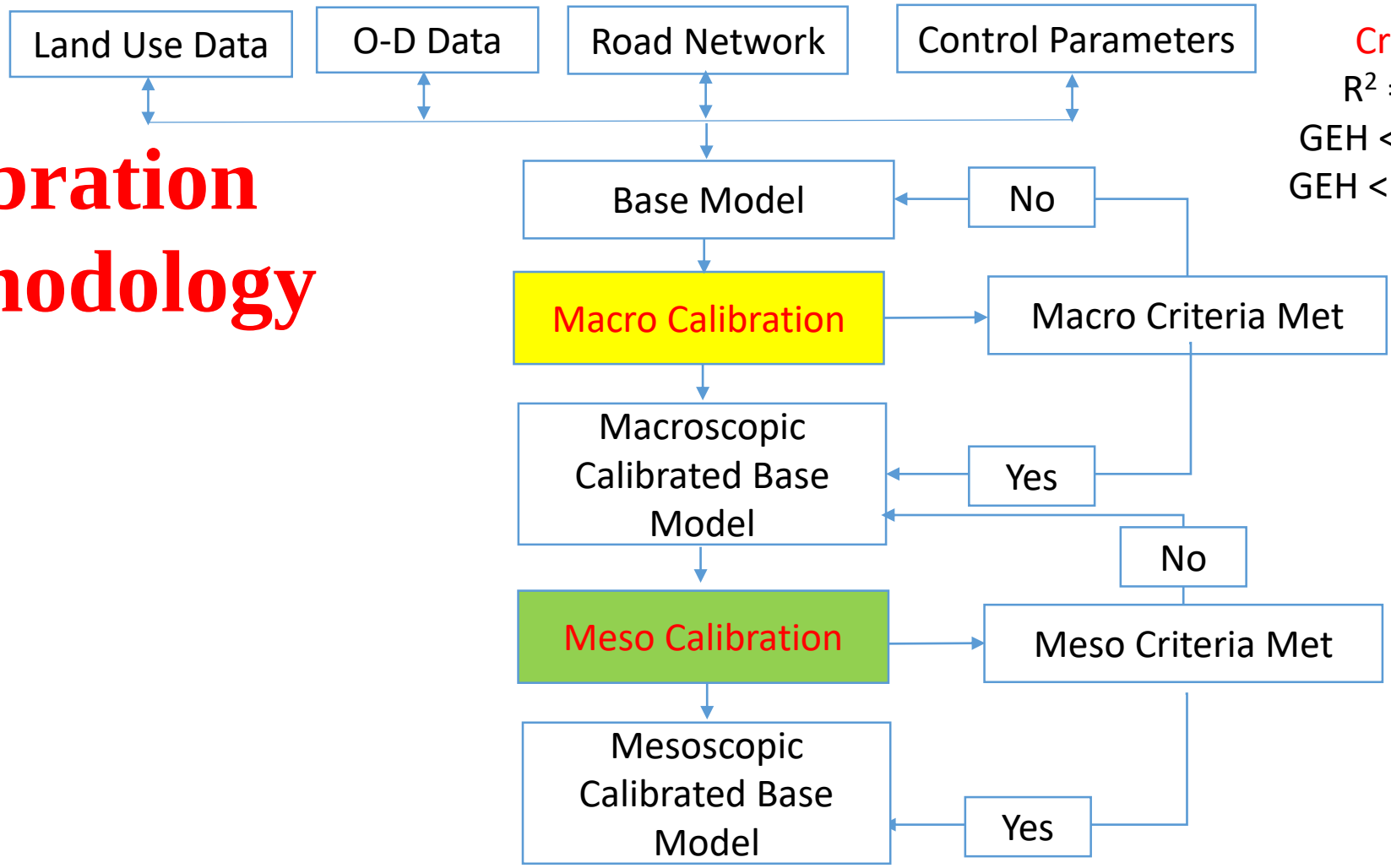
$R^2 = 0.85$

GEH < 5 (60%)

GEH < 10 (95%)



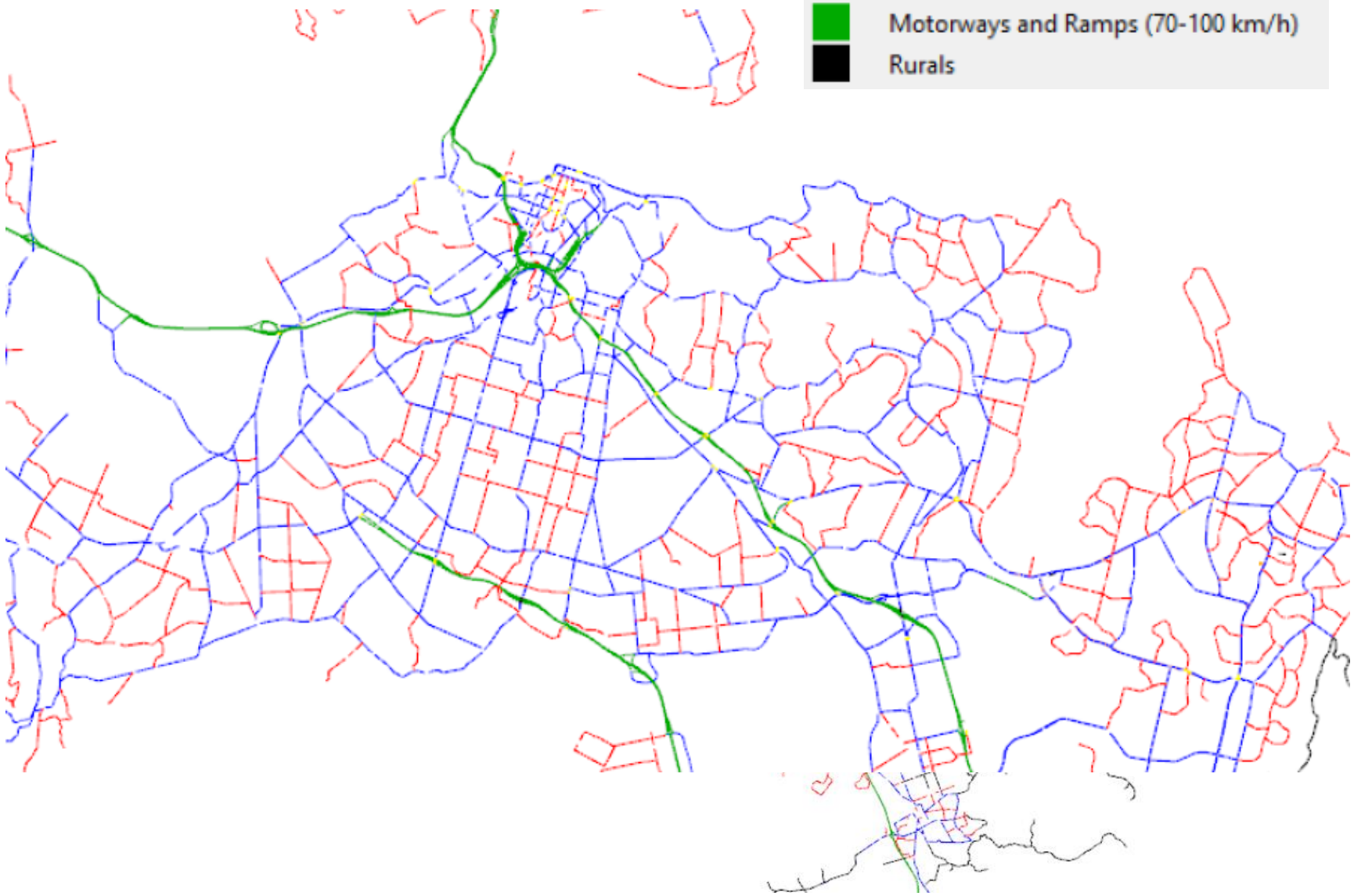
Calibration Methodology



Auckland Model (AIMSUN)

Network Modeled:

- ❑ Open Street Maps
- ❑ Google Maps

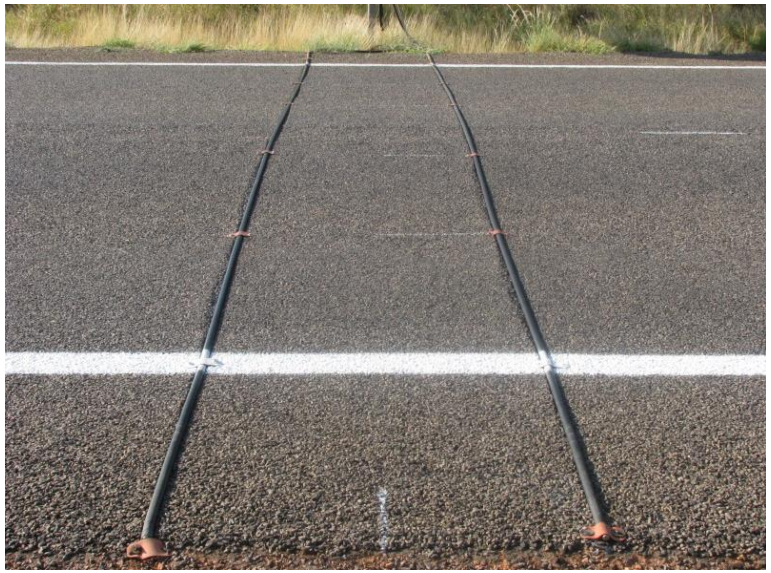


Traffic Count Data in Auckland

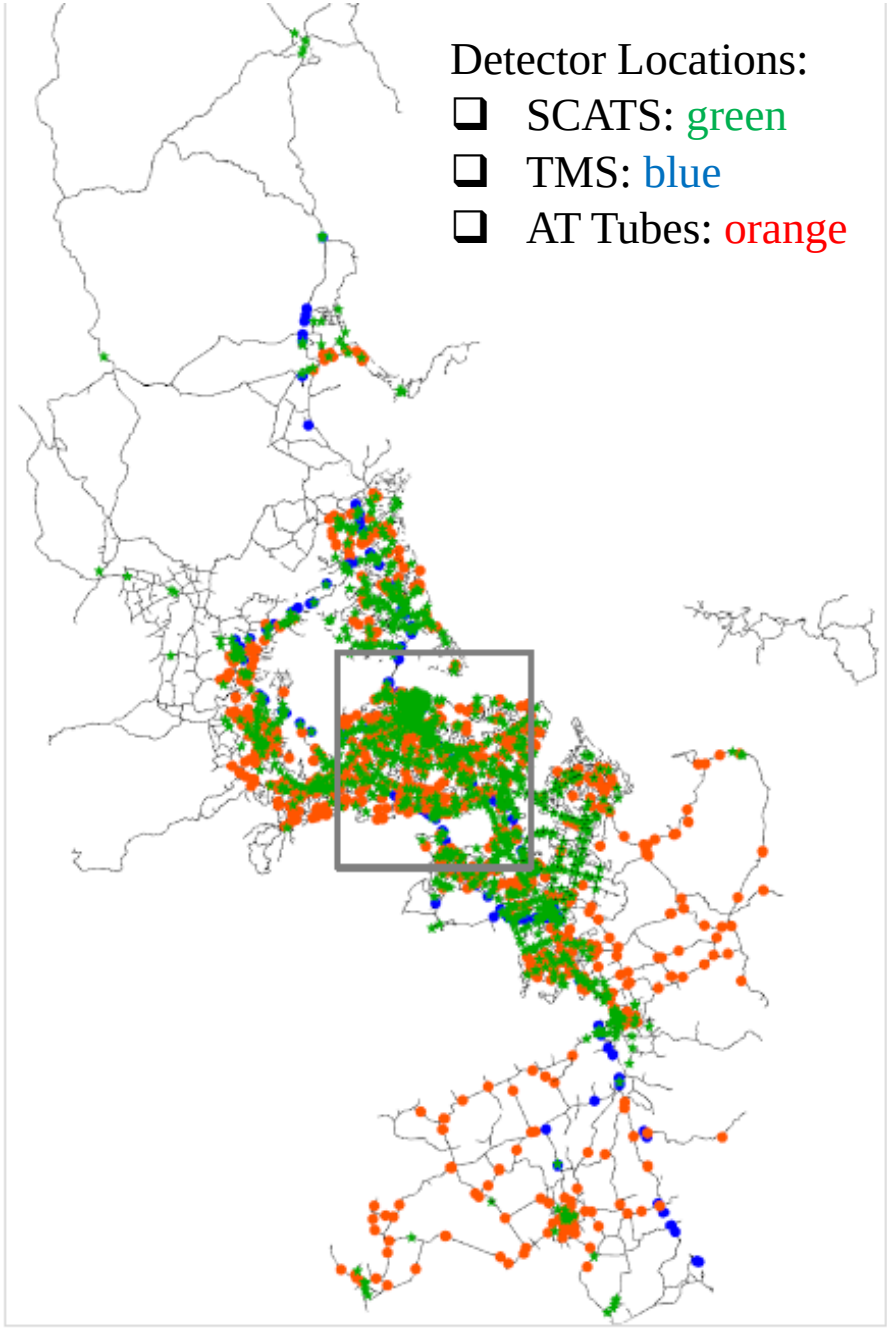
DATA Type:

- ❑ SCATS (signalized intersection)
- ❑ TMS (motorways and state highways)
- ❑ AT Tubes (collector and local roads)
- ❑ Total detectors: 817

Inductive Loops



Road Tubes



Source: Auckland Forecasting Centre

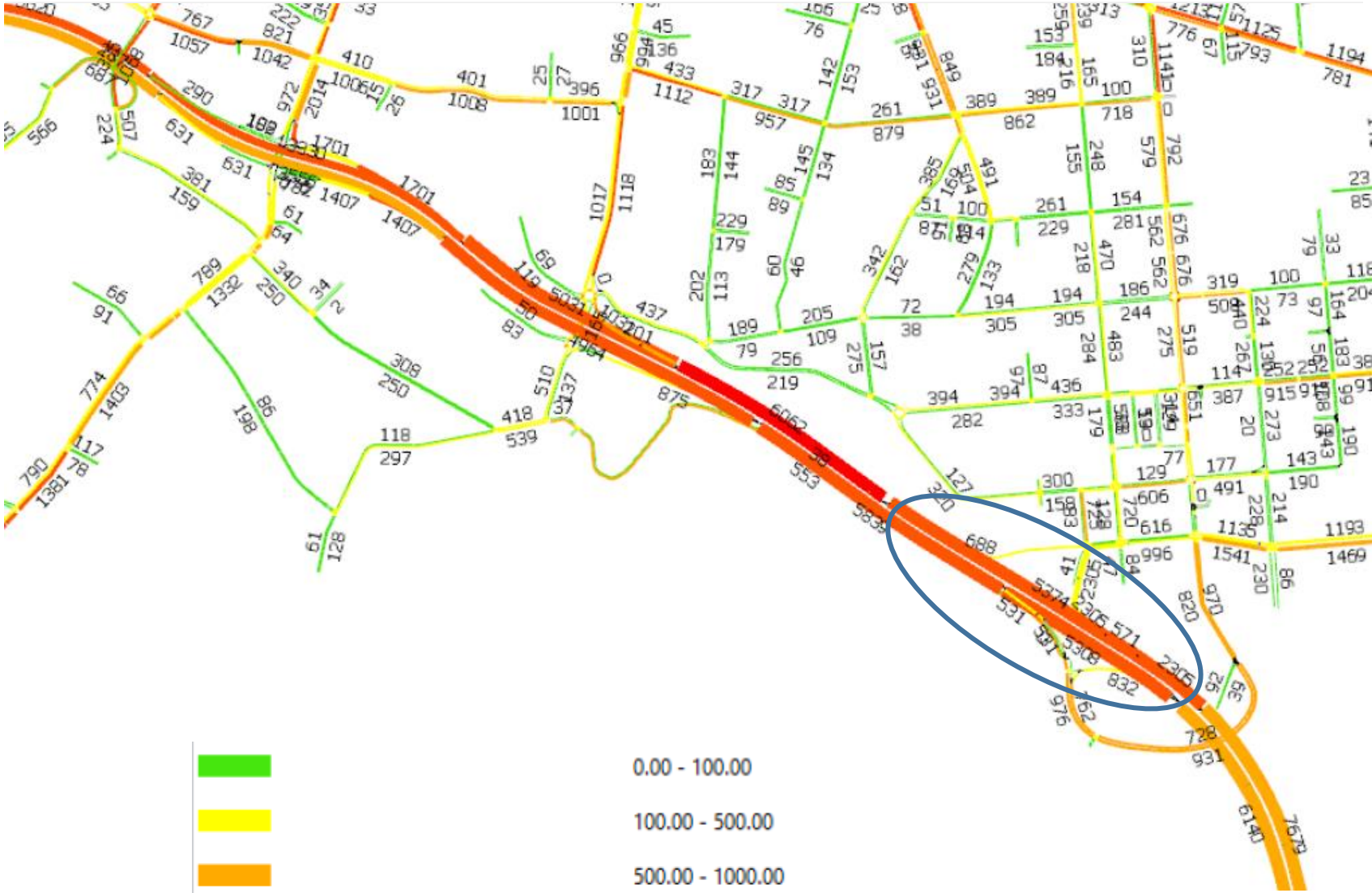
Macro Simulation

General Information

- Base year: March, 2016
- No. of signalized intersections: 691
- No. of detectors: 817
- PM Peak

Network Fine Tuning

- R^2 Value
- Comparing assigned vs real data (observed)
- Number of iterations 30
- South western motorway example

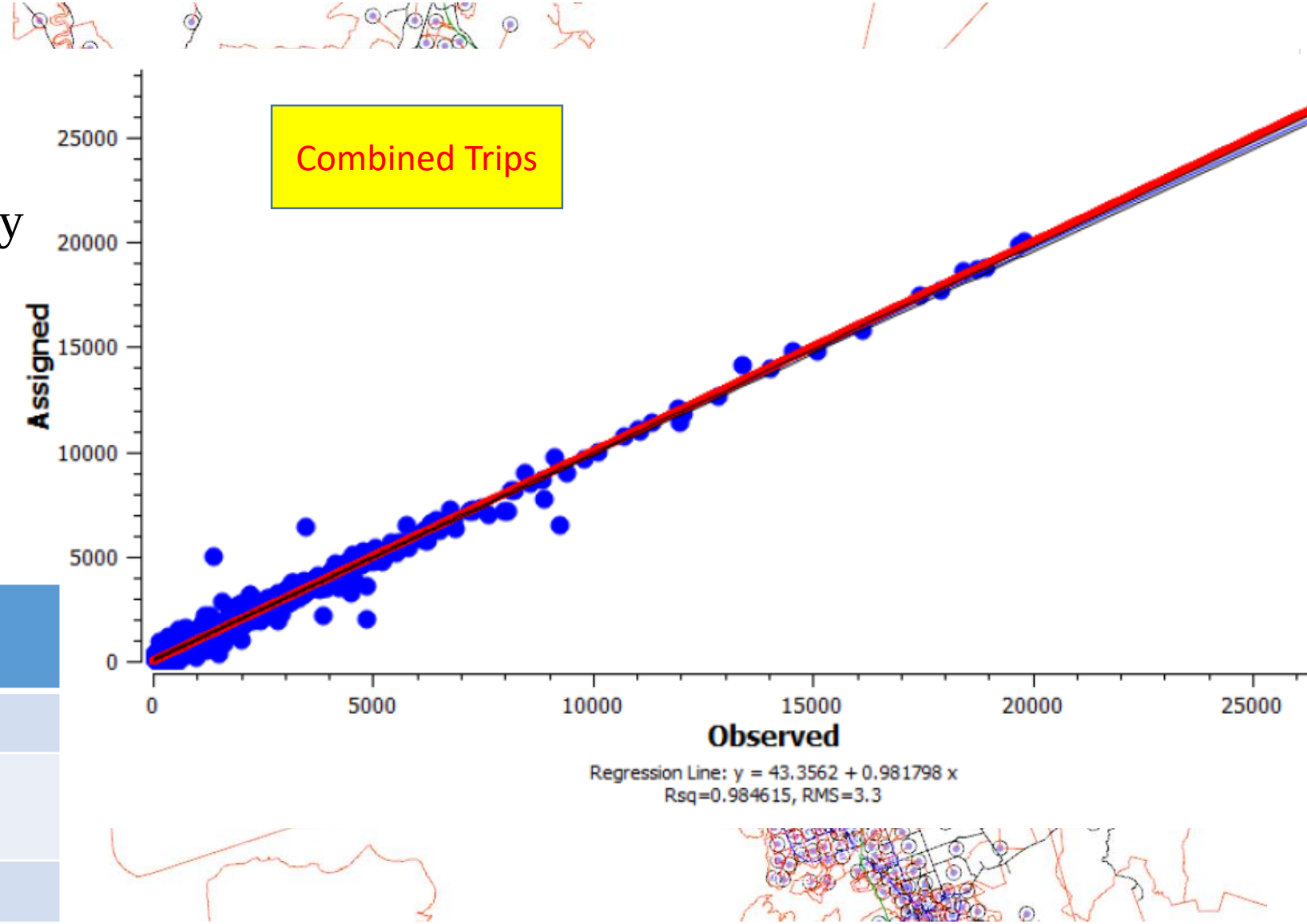


Origins & Destinations

OD is Adjusted Macroscopically

- ❑ Frank and Wolf Assignment
- ❑ Number of iterations 30
- ❑ NHBW, HBW and Trucks Trips

Total Demand	PM Peak (3pm- 7pm)
Pre- Adjustment (Vehicle)	11,43,390
Post-Adjustment (Vehicle)	11,24,800
Change (Vehicle)	18590
Change (%)	1.62 %



Macro Calibration

Network fine tuning

- R^2 Value
- Comparing assigned vs real data (observed)
- Number of iterations 30
- South western motorway example

Outputs:

Calibrated Network

Adjusted OD Matrix

Path Assignments

Calibration Meso Model

General Information

- ❑ Warm up time 30 minutes
- ❑ Static path assignment generated during OD adjustment
- ❑ Cost calculated after 30 minutes
- ❑ Dynamic User Equilibrium (Gradient Based Model)
- ❑ Master control plan created from volume based actuated signal control plans
- ❑ Arrival: Exponential

Calibration Criteria

- ❑ Satisfy: $R^2 > 0.85$
- ❑ Satisfy: GEH < 5 (60%)
  GEH < 10 (95%)

$$GEH = \sqrt{\frac{2(q_{model} - q_{obs})}{(q_{model} - q_{obs})}}$$

Where q_{obs} = observed hourly flow

q_{model} = modeled hourly flow

Meso Calibration

Sr. No.	Parameters (Aimsun Standard Value)	Range			Sensitivity	Comments
1	Reaction Time (RT) Factor (1.20)	1.15	1.2	1.25	very sensitive	1.15 to 1.25 recommended range
2	Reaction Time Factor at Traffic Light (1.60)	1.6	2.1	2.8	less sensitive	2.8 for 50km/h recommended
3	Jam Density (section parameter)	200	180	160	moderate sensitive	depends upon local condition
4	Final Safety Margin (turn parameter)	3	4.5	6	moderate sensitive	must be lower to improve turning flow
5	Initial Safety Margin (turn parameter)	6	7.5	9	don't know	
6	Traffic Assignment Model Type	Gradient Based	Weighted MSA	MSA	very sensitive	

Meso Calibration (Initial Results)

Parameter	Traffic Models (3 iterations results)		
Reaction Time (RT)	R^2 Value (Gradient Based Model)	R^2 Value (MSA Model)	R^2 Value (weighted MSA Model)
1.1	0.426		
1.15	0.444	0.4232	0.4197
1.2	0.34		
1.15 (5 iterations)	0.463		

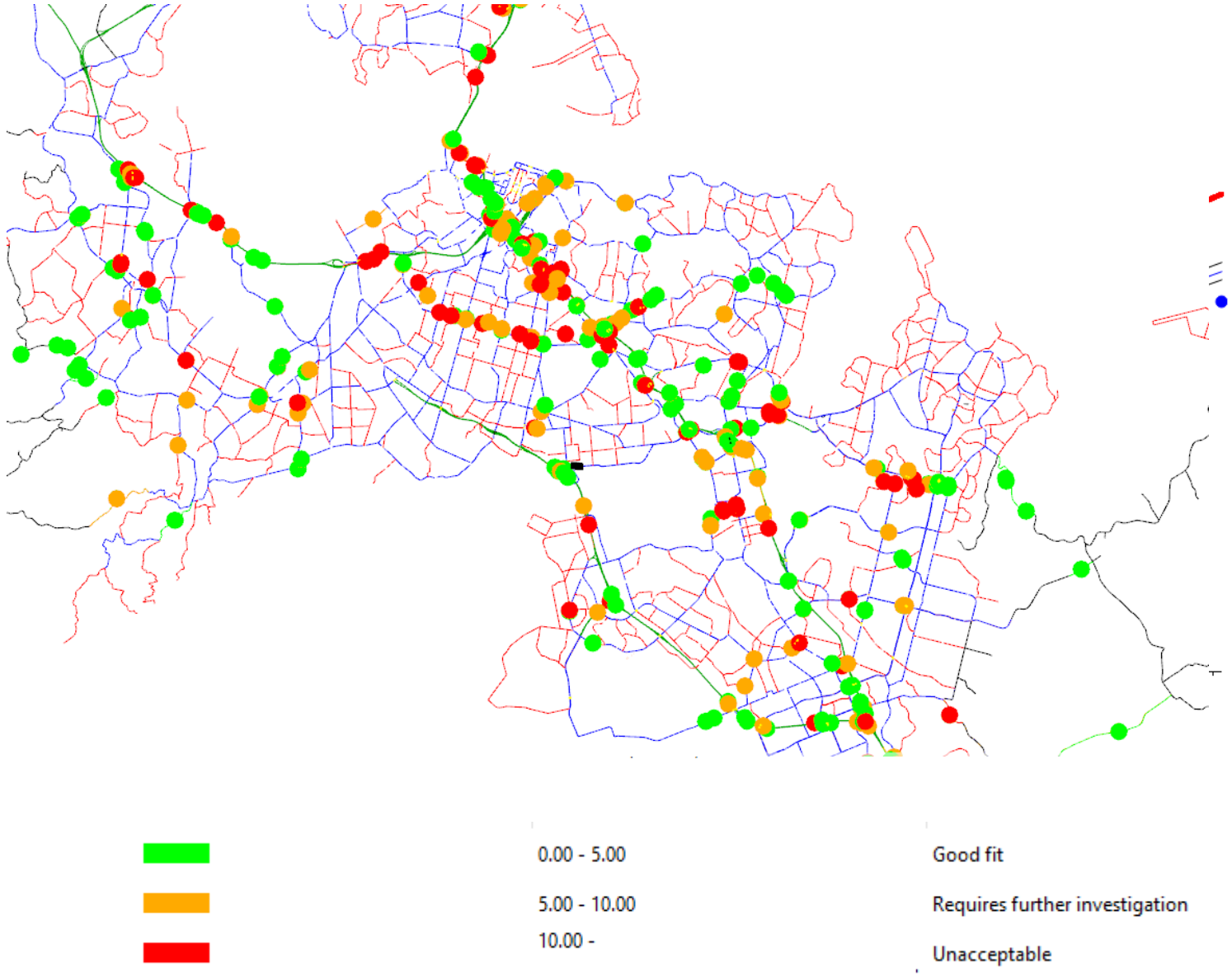
Meso Calibration (Results after Loading Assignment Paths)

Parameter		Traffic Models (5 iterations results)
Path Cost	Assignment Loading method	R^2 Value (Gradient Based Model)
Instantaneous	Start assignment process	0.6719
Experience	Start assignment process	0.6766
Experience	Continuous assignment process	0.6766

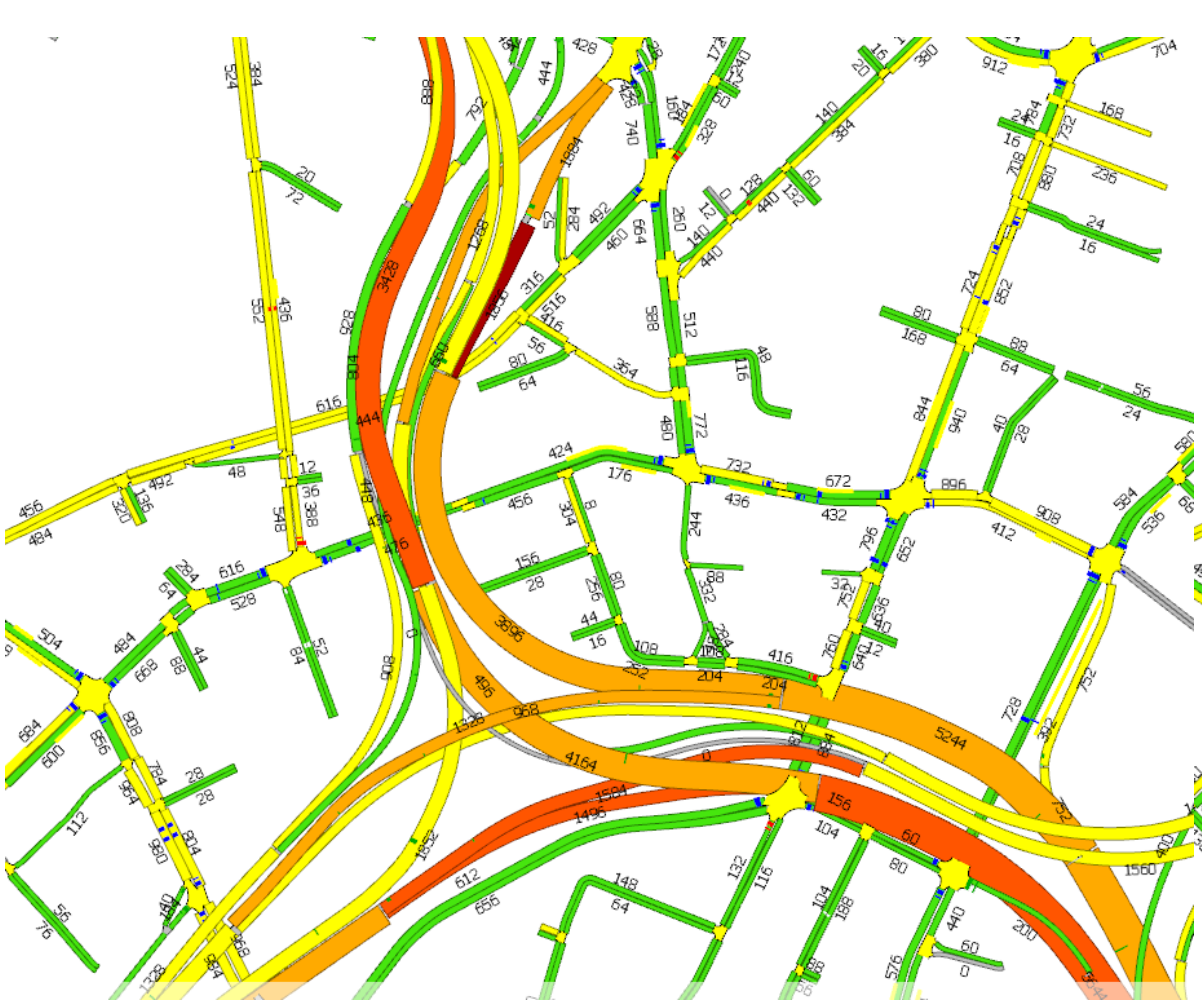
Meso Calibration (Results after Loading Volume Based Actuated Control Plans)

- R^2 = 0.9034
- GEH

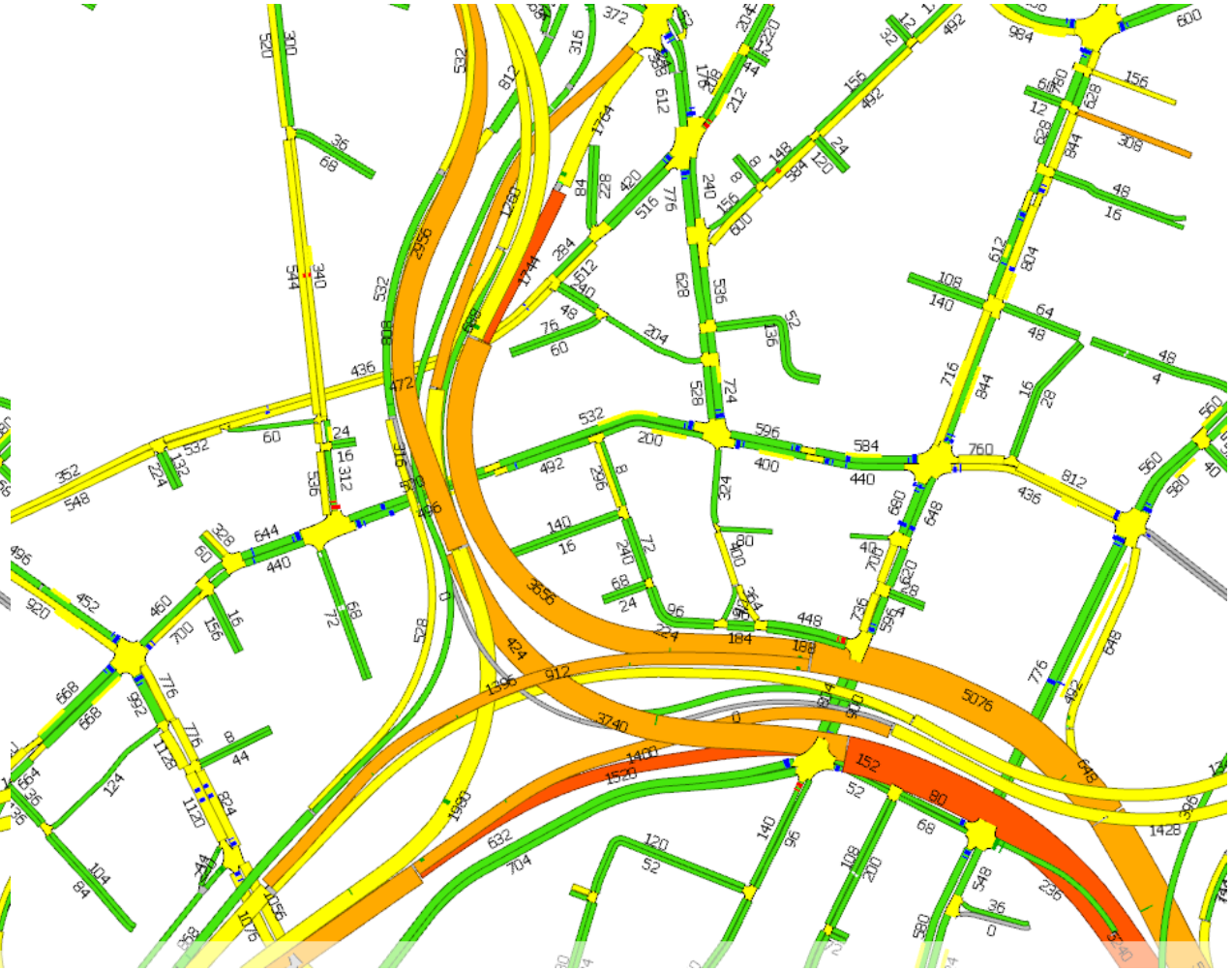
	PM (3 - 7)	GEH Criteria
GEH < 5	49.69 %	>60 %
GEH < 10	77.72 %	>95 %



Meso Calibration (Simulated Flow)

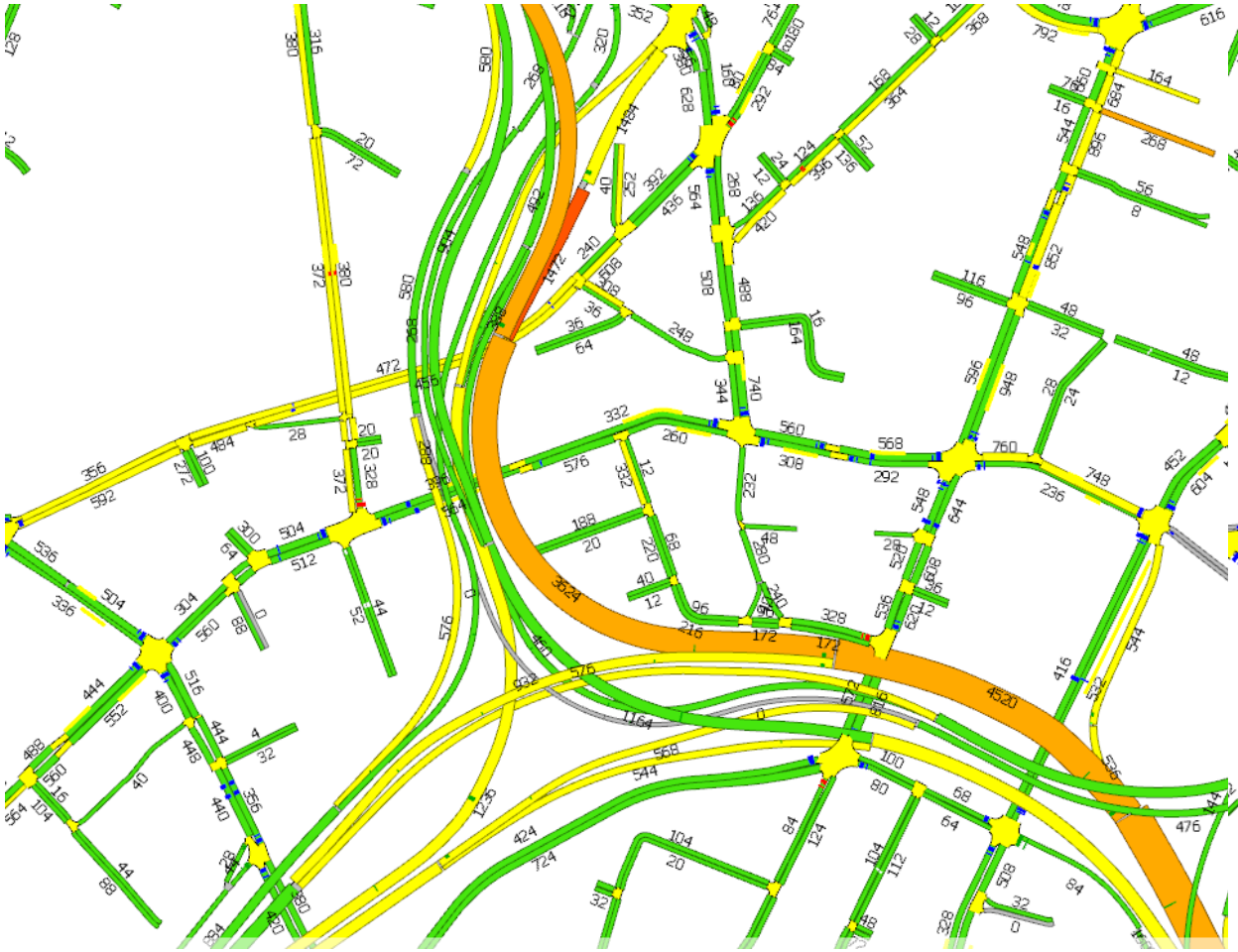


At 4 pm

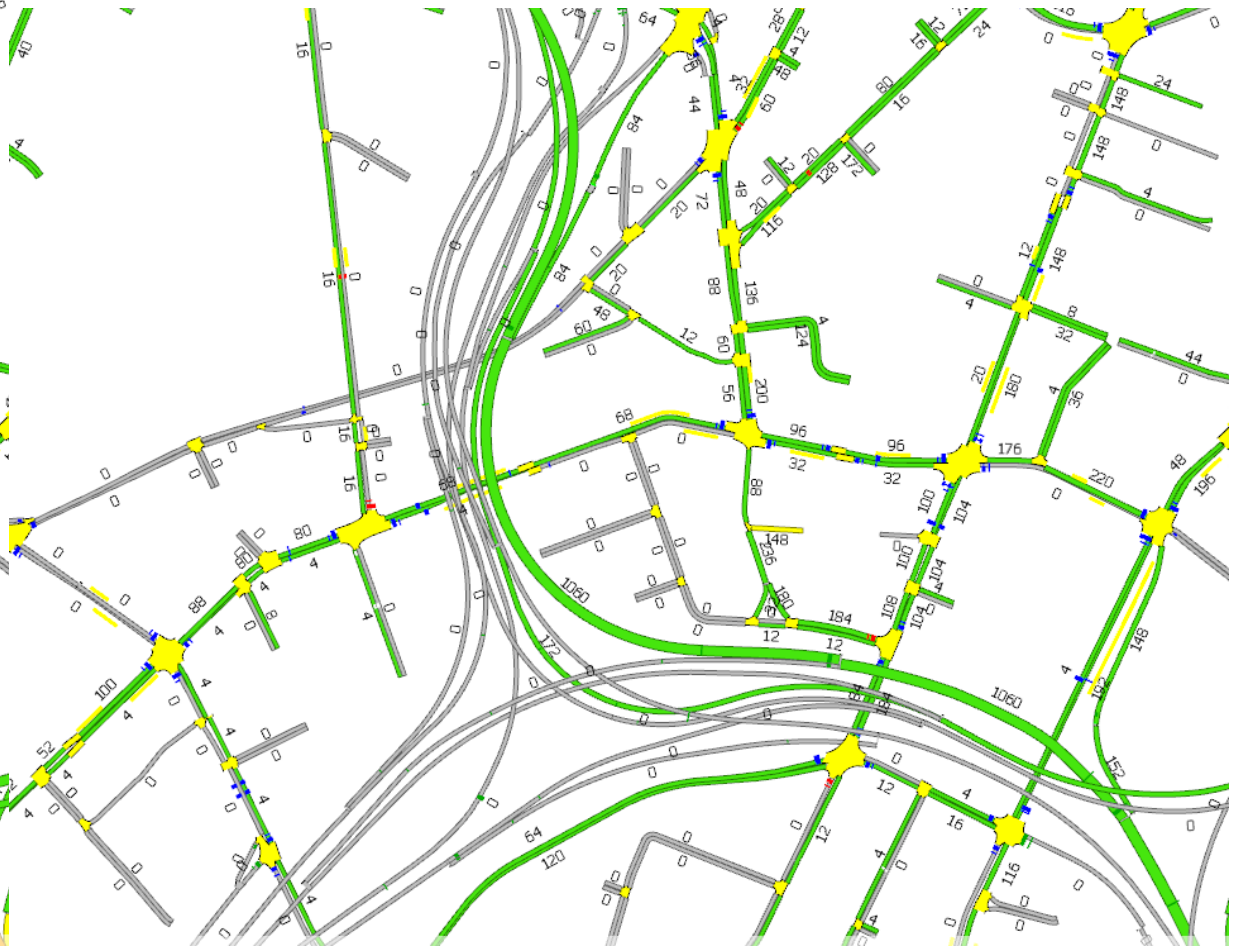


At 5 pm

Meso Calibration (Simulated Flow)



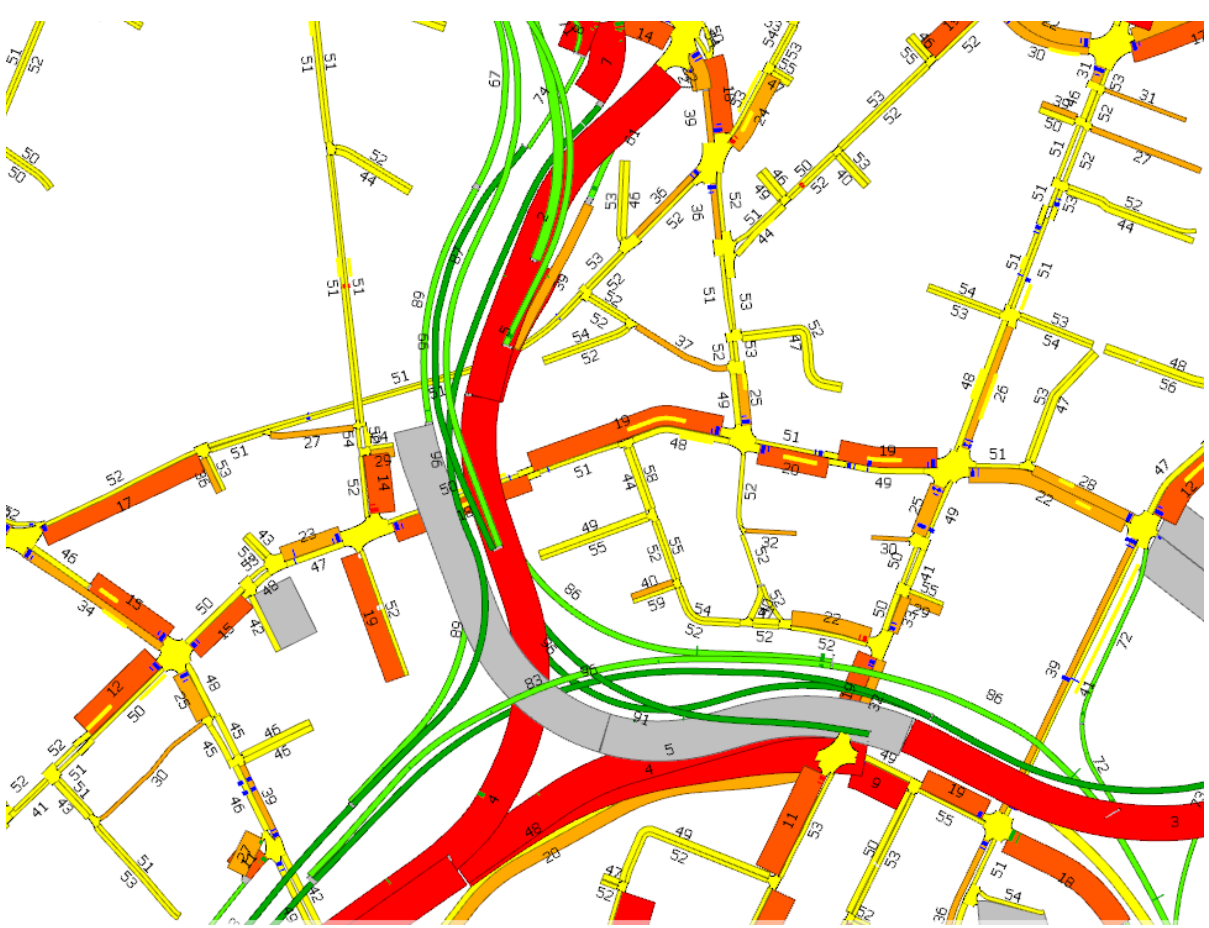
At 6 pm



At 7 pm

Meso Calibration (Simulated Speed)

Meso Calibration (Simulated Speed)



Conclusion and Further Research

- Base Model is calibrated macroscopically with 0.98 R^2 value
- Mesoscopic calibration is in continuation with 0.90 R^2 value and
- GEH < 5: 49.69 % & GEH < 10: 77.72 %
- Individual link analysis is in progress

Thanks

Meso Calibration (Latest Results)

- R^2 = 0.9426
- GEH

	PM (3 - 7)	GEH Criteria
GEH < 5	60.63 %	>60 %
GEH < 10	86.71 %	>95 %