Developing an Integrated Transportation Infrastructure Decision Support Platform:

Big & Open Data Visualization

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MEET THE TEAM

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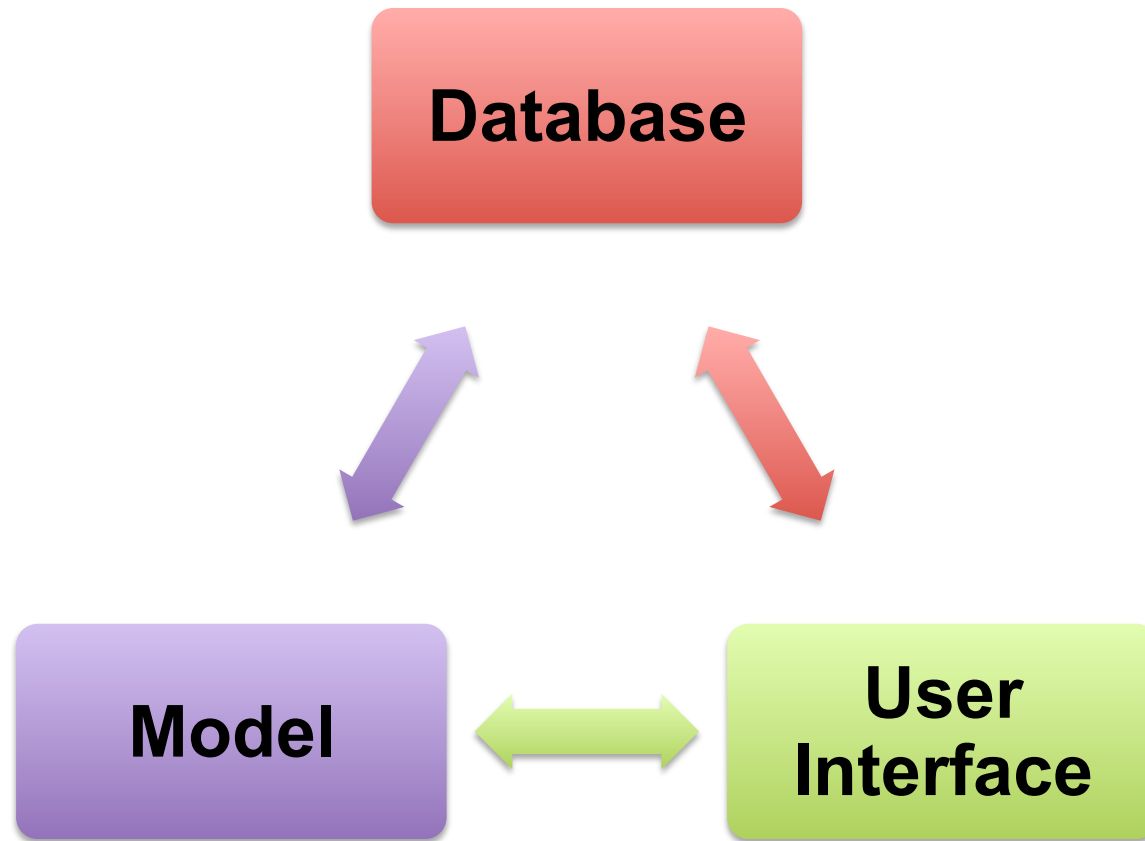# What is a Decision Support System (DSS)?

DSS is a computer-based system that supports decision-making; usually aimed at less well-structured and underspecified problems that upper level managers typically face.

DSS attempts to combine the use of models and analytical techniques with traditional or advanced data access; focuses on features which make them easy to use by non-expert people in an interactive mode.

Source: Sprague (1980)

Fundamental Components of a DSS

Current State-of-the-Art

Existing transportation models/decision support systems are mostly disconnected.

There is no fully integrated *unifying tool* for planning, operations, and management analyses.

Current major focus is on integration of supply and demand models (e.g. ABM-DTA integration).

Examples: POLARIS, MATSim, CMAP ABM-DTA integrated model, etc.

Vision: *Full Integration*

A fully integrated system goes beyond supply and demand models only. It integrates with **real-time data**, take advantage of **big data** and existing **ICT technologies**, and provide a fully **connected modeling environment**.

Developing a fully integrated decision support platform @ITS MONASH, Australia

Integrated understanding of multimodal traffic, land use, urban form, transportation planning needs, public health, safety, welfare, social interactions, demographics and communities.

What's special about our DSS?

- Developing a unifying tool with operational, planning, and management applications in many areas.

- Offline/online **data integration**, communication with a **network of sensors**, and utilization of advanced **ICT technologies**.

- Applying advanced **vizualisation**, **optimization** and **computational techniques** to tackle issues of tomorrow's transportation systems.

- The goal is to assist in better management of complex integrated transportation and urban infrastructure systems in **Victoria, Australia** (*as a starting point*).

Schematic Illustration of our DSS
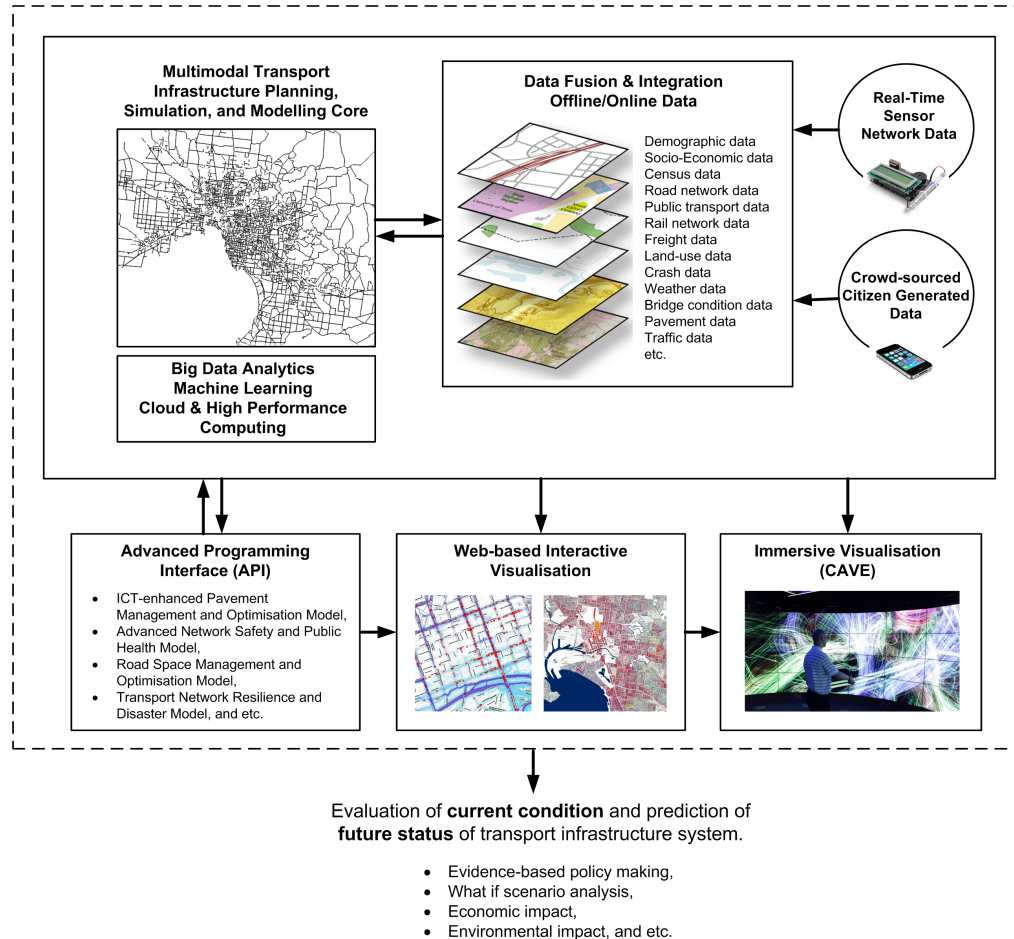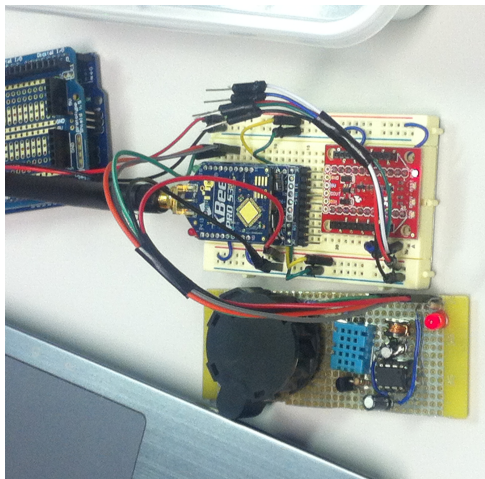
Real-Time Sensor Network Data
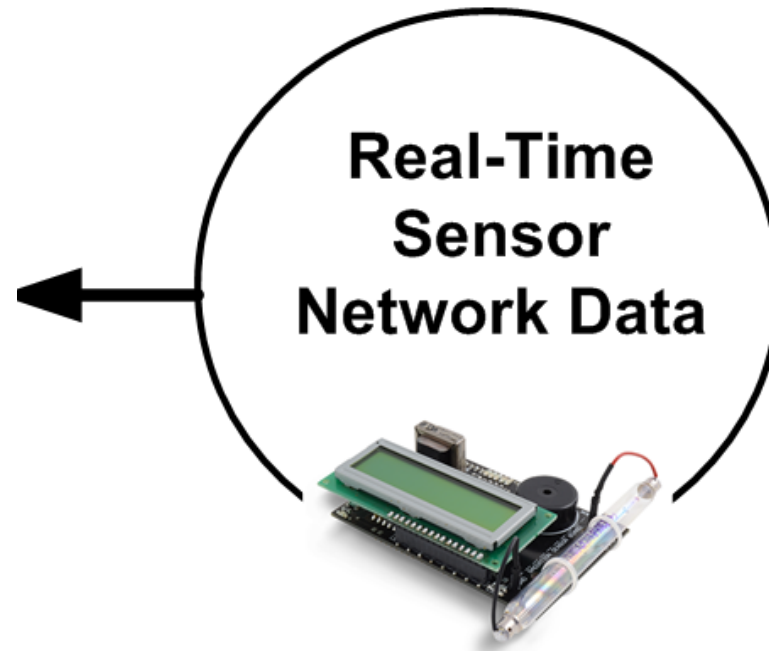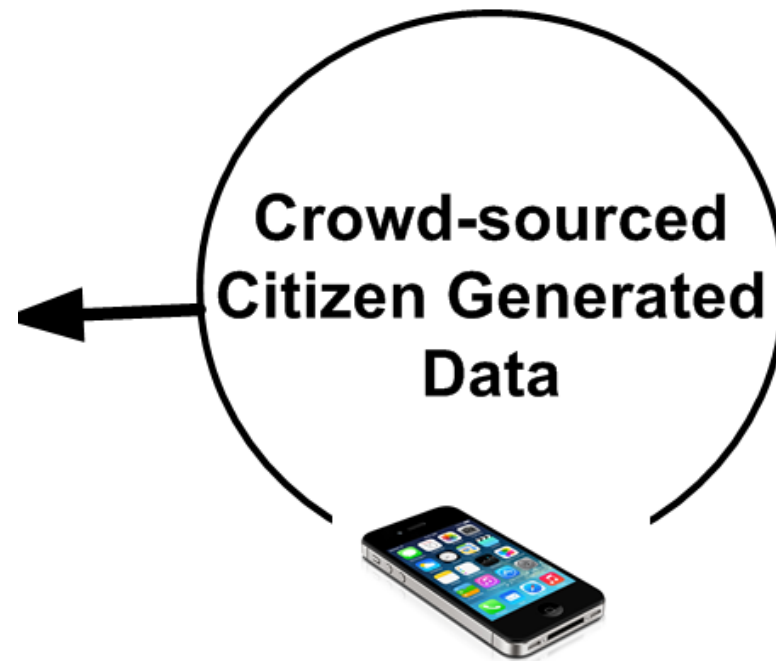
Bushfire is a big issue in Australia.

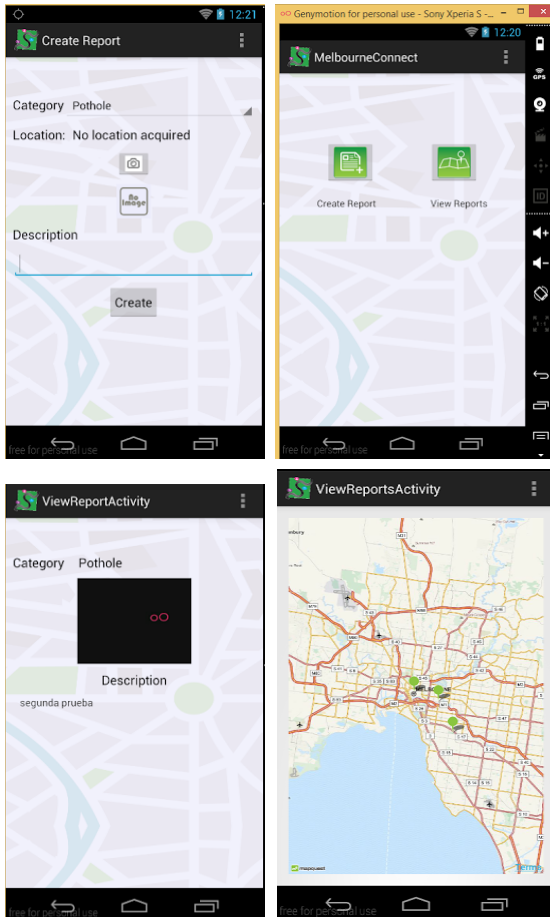**Australian National Bushfire Monitoring System**
http://sentinel.ga.gov.au/

A network of sensors (for fire detection) are developed to collect and transmit data to the platform wirelessly.

Crowd-Sourced Data

Crowd-sourced Citizen Generated Data
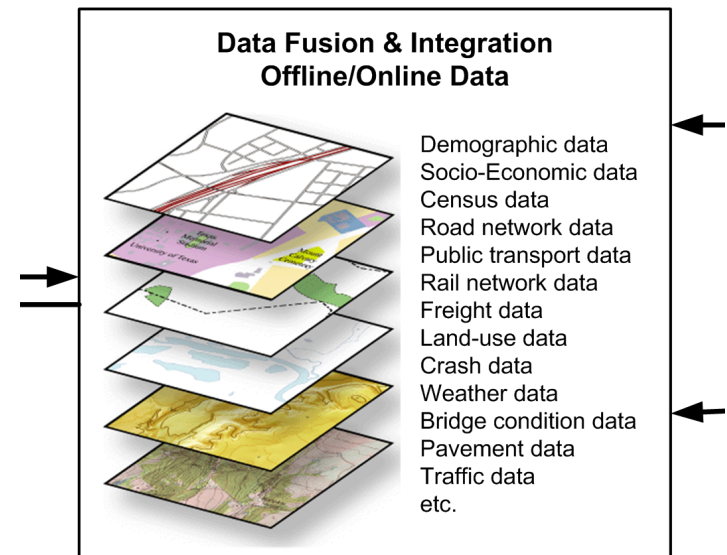
Mobile App: "Victoria Connect"

- We've developed a mobile app which allows citizens to report various types of "*usually un-reported*" data.

- Crowd-sourced data are combined with authoritative data.

- Integrated data are visualized and shared publicly with citizens.

- Integrated data are used in optimizing transportation network operations and planning.

Cloud Data Integration

- Developing an online integrated database in a government-funded cloud (NECTAR). (ongoing)

- Developing online visualizations, accessing data from the cloud in real-time. (ongoing)

- Cloud computing. (future)

Data Fusion & Integration
Offline/Online Data

Demographic data
Socio-Economic data
Census data
Road network data
Public transport data
Rail network data
Freight data
Land-use data
Crash data
Weather data
Bridge condition data
Pavement data
Traffic data
etc.

How does our database look like now?

No user interface yet.
We're working on the back end.
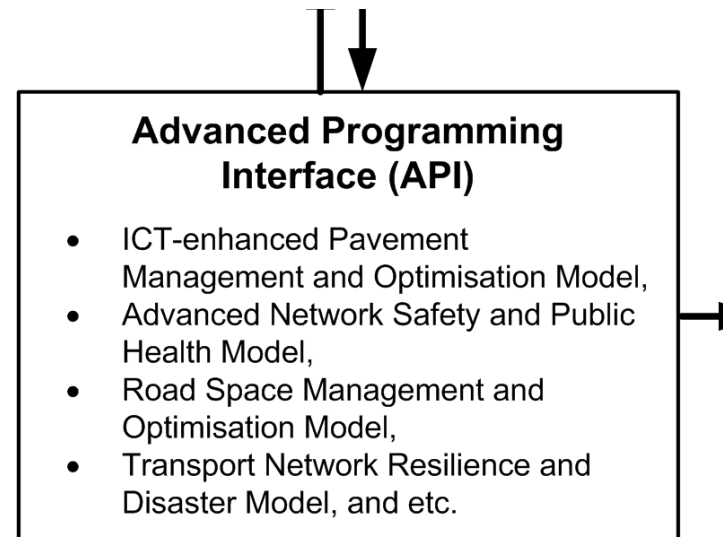
Network Simulation and Modeling Core

Multimodal Transport Infrastructure Planning, Simulation, and Modelling Core

- Developing a multimodal DTA model of Melbourne metropolitan area. (ongoing)

- Auto-calibration using various traffic counts and travel time data sources. (ongoing)

- Dynamic OD estimation. (ongoing)

- Integration with an ABM. (future)

Connected Modeling Environment

- Crash frequency prediction (ongoing)

- Network reliability and resilience; critical link identification (ongoing)

- Land use model (future)

- Public health model (future)

- and many more …

Advanced Programming Interface (API)

- ICT-enhanced Pavement Management and Optimisation Model,
- Advanced Network Safety and Public Health Model,
- Road Space Management and Optimisation Model,
- Transport Network Resilience and Disaster Model, and etc.

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Interactive Visualization
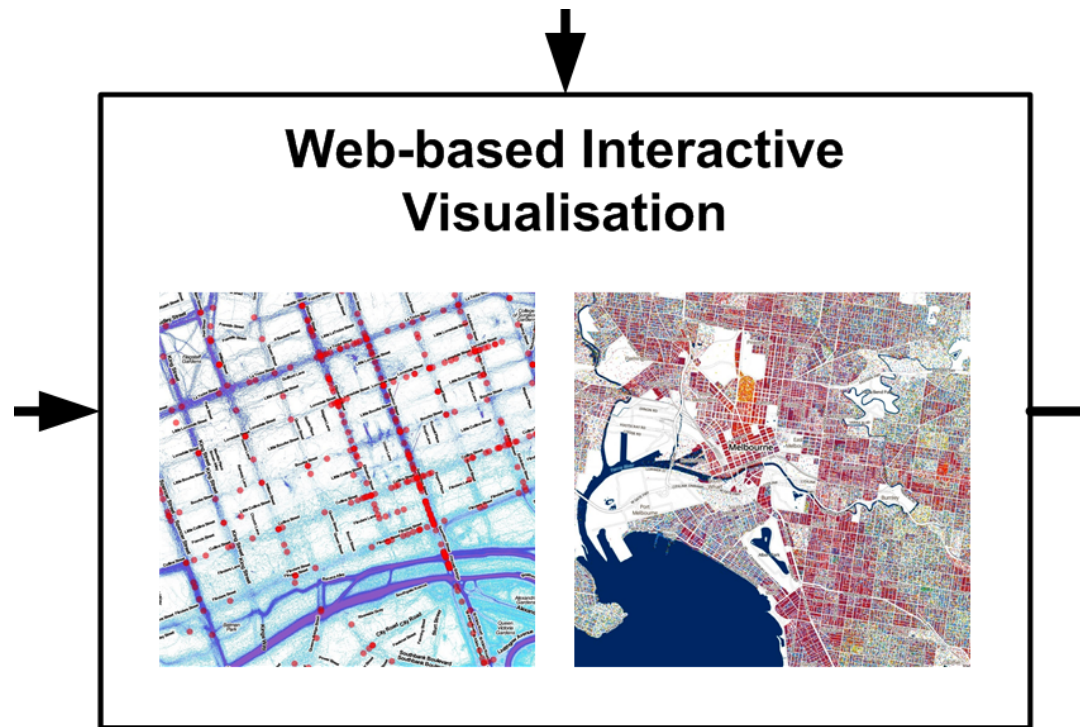
Visualizing Population Growth
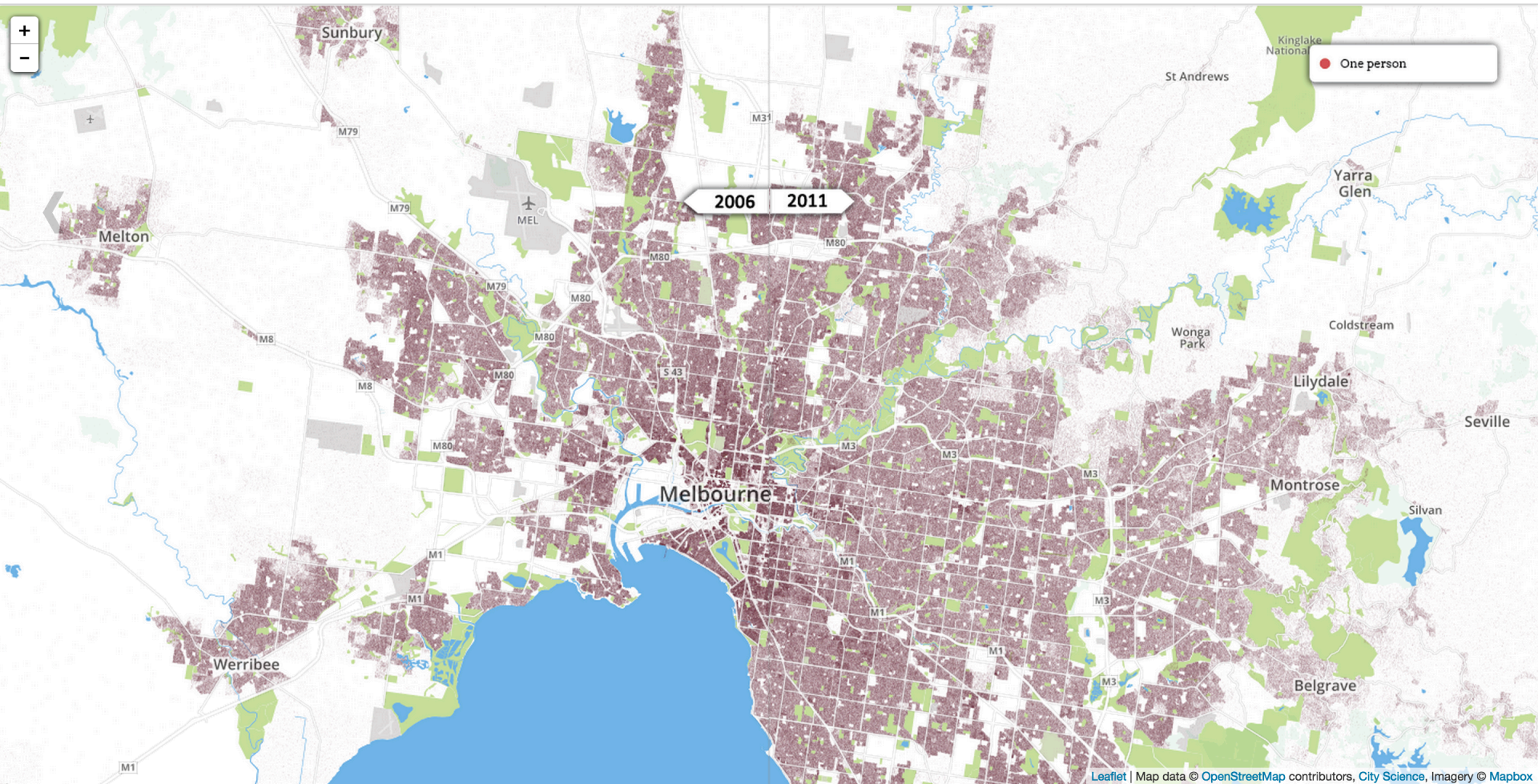
Visualizing Ethnicity Distribution

2011 Melbourne Ethnicity Dot Map

1 dot = 1 person

- Show all ethnic groups
- Australia & New Zealand
- West Europe
- East Europe
- Asia
- Middle East, India, and Africa
- Indigenous
- Other

Interested to see how Chicago and Washington D.C. look like?
Washington D.C. http://4.bp.blogspot.com/-_6KwMllWucl/U8CEx39ydAI/AAAAAAAAI3U/MDUydp7Zk1g/s1600/DC.png
Chicago http://www.wired.com/images_blogs/design/2013/08/chicago.jpg

Visualizing Age Distribution

2011 Melbourne Age Dot Map

1 dot = 1 person

Show all age groups
- 0 - 19
- 20 - 34
- 35 - 64
- 65 and over

Developed by Xianghui Hong and Meead Saberi
Monash City Science Research Group
Data Source: ABS Census 2011

Map data contributors Monash City Science, © Mapbox © OpenStreetMap **Improve this map**
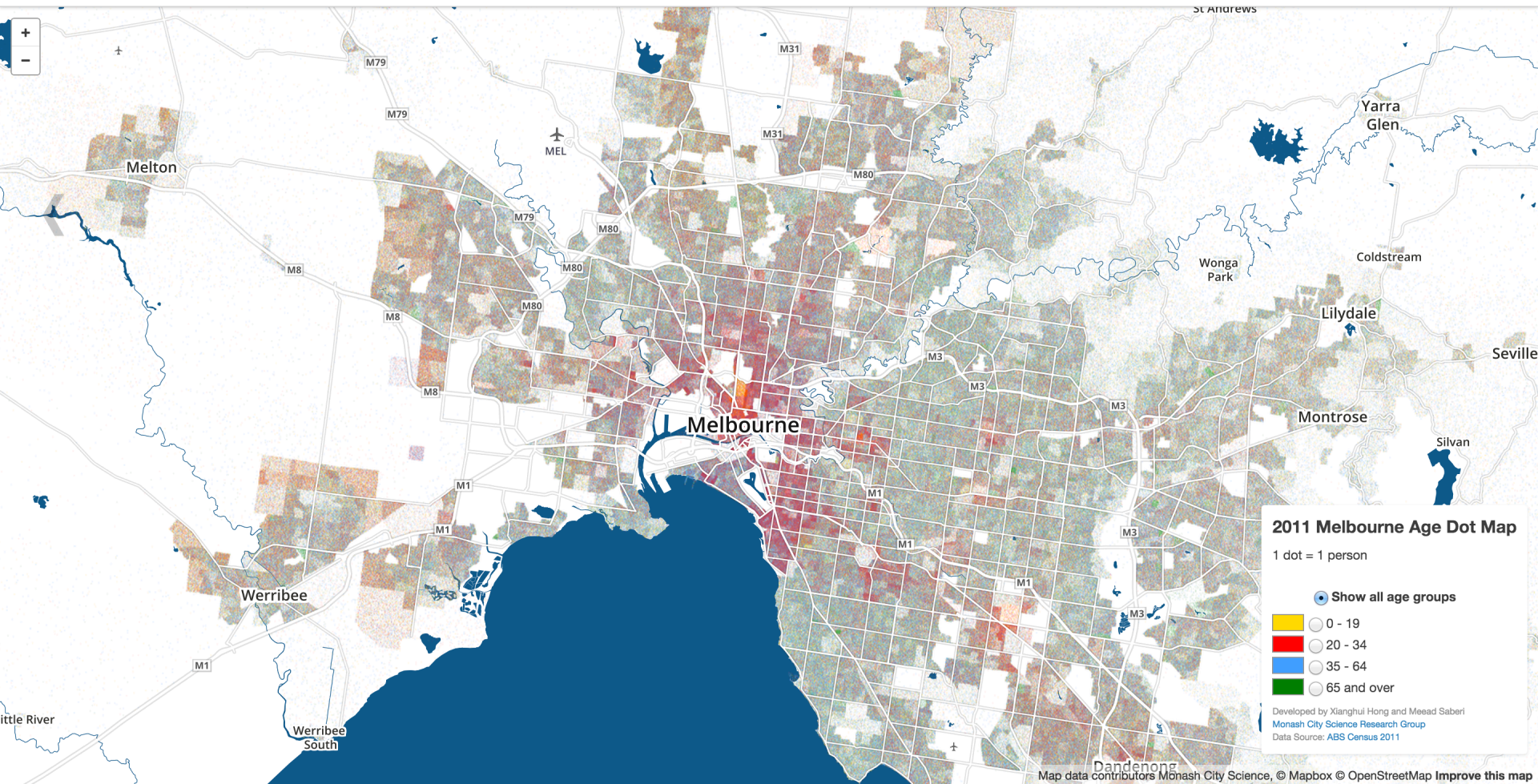
Visualizing Bicycles Crashes

Melbourne Bike Crash Map

5 years' worth of bike crashes
from 1/7/2008 to 1/7/2013

Time Window

00:00 - 23:59

- All crashes
- Fatal crashes
- Serious injury crashes
- Other crashes

Developed by Julian Li and Meead Saberi
City Science at Monash University
http://monash.edu/research/city-science/
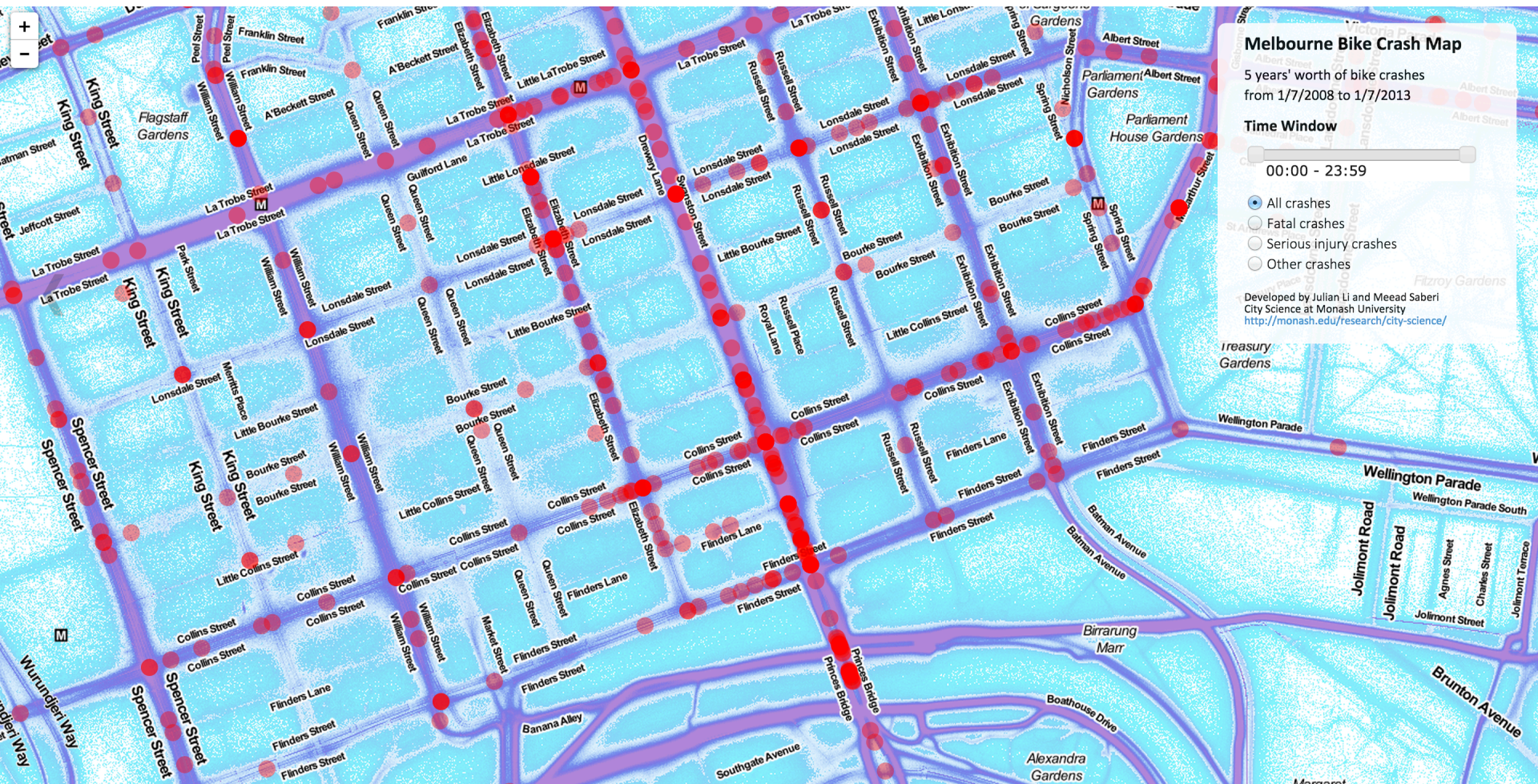
Visualizing Housing Density

2011 Melbourne
Dwelling Density

(dwelling/sq.km)

	0
	1-540
	541-1230
	1231-2090
	2091-4160
	4161-7830
	7831-31168

Developed by Xianghui Hong and Meead Saberi
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Data Source: ABS Census 2011

Map data contributors Monash City Science, © Mapbox © OpenStreetMap **Improve this map**
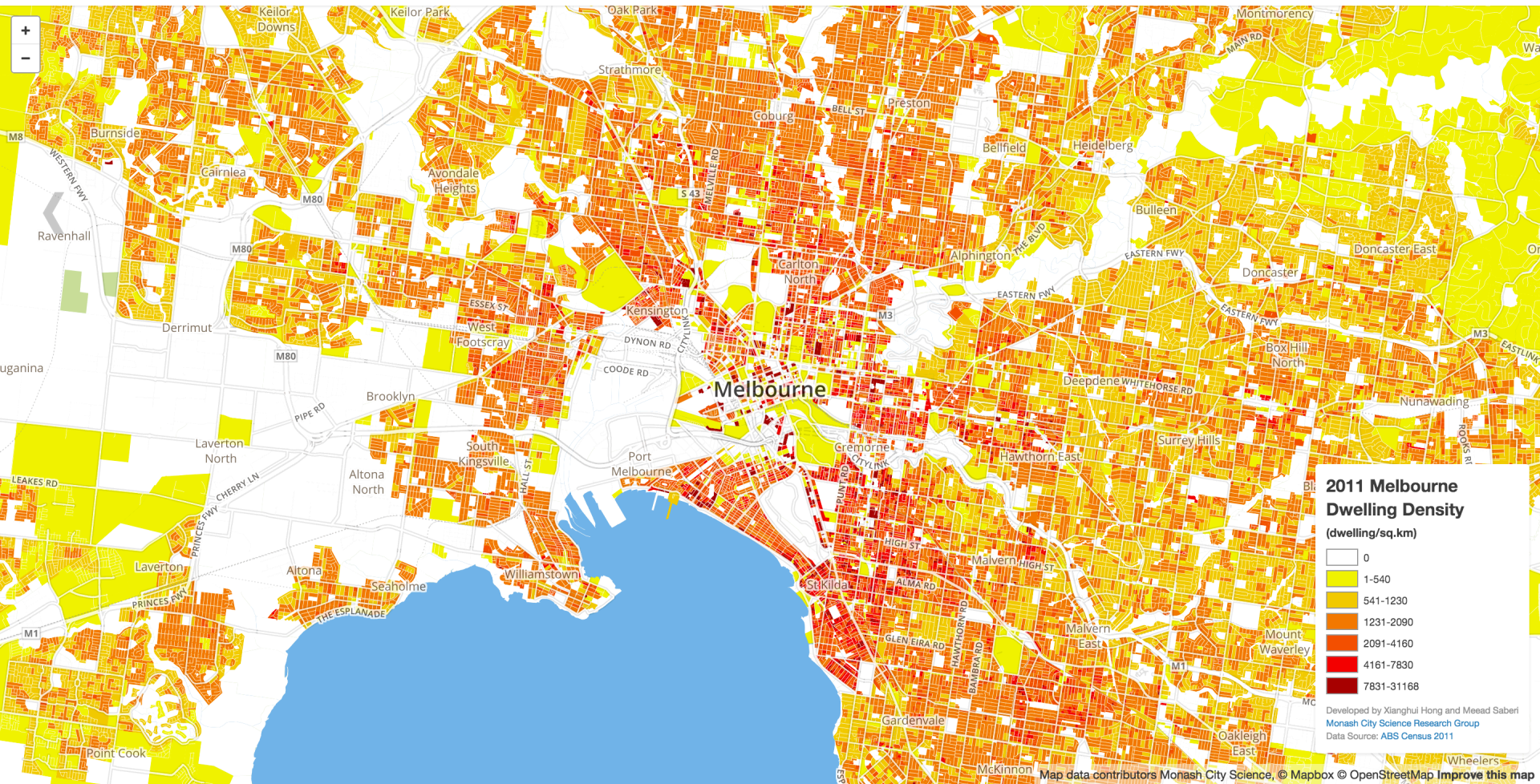
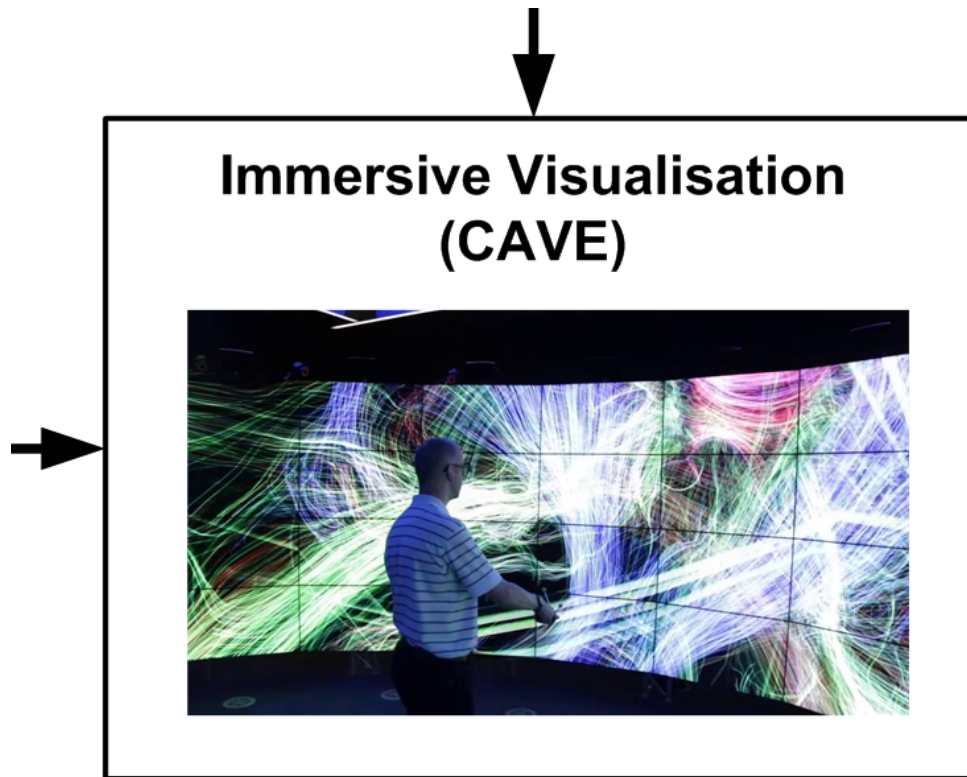# 3D Immersive Visualization

Immersive Visualisation
(CAVE)

CAVE2

What do we get out of the DSS?

Evaluation of **current condition** and prediction of **future status** of transport infrastructure system:

- Evidence-based policy making
- What if scenario analysis
- Economic impact
- Environmental impact, etc.

A second look at the bigger picture

Evaluation of **current condition** and prediction of **future status** of transport infrastructure system.

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- What if scenario analysis,
- Economic impact,
- Environmental impact, and etc.
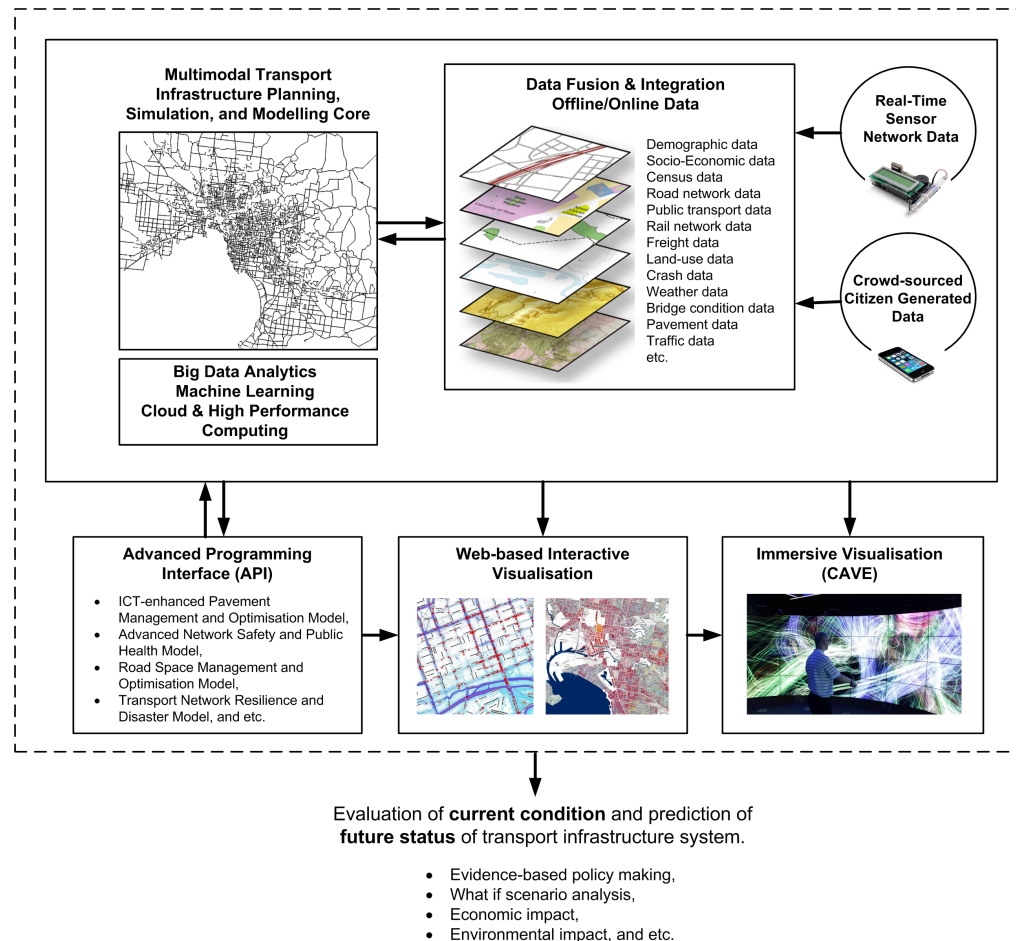
Where we are today?

We've already developed the backbone of the DSS.

- ✓ **Wireless fire detection sensors** are developed and tested.
- ✓ **Mobile app** is developed and tested.
- ✓ **Cloud** instance is set up. We're developing the database.
- ✓ **DTA model** of Melbourne is being developed.
- ✓ A few data **visualizations** are developed. More are coming.
- ✓ The network display at **CAVE2** is set up.

QUESTIONS

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