Technologies for Disaster Risk Planning, Assessment and Adaptation: case studies in flood adaptation and evacuation modelling

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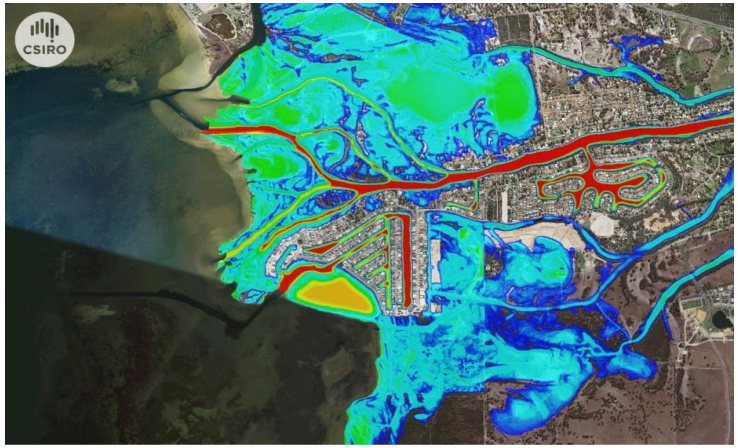
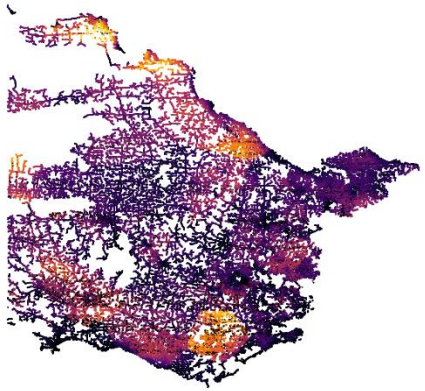
2.9 HOURS


CSIRO




1.1m sea level rise
storm surge
2:15 / 2:44
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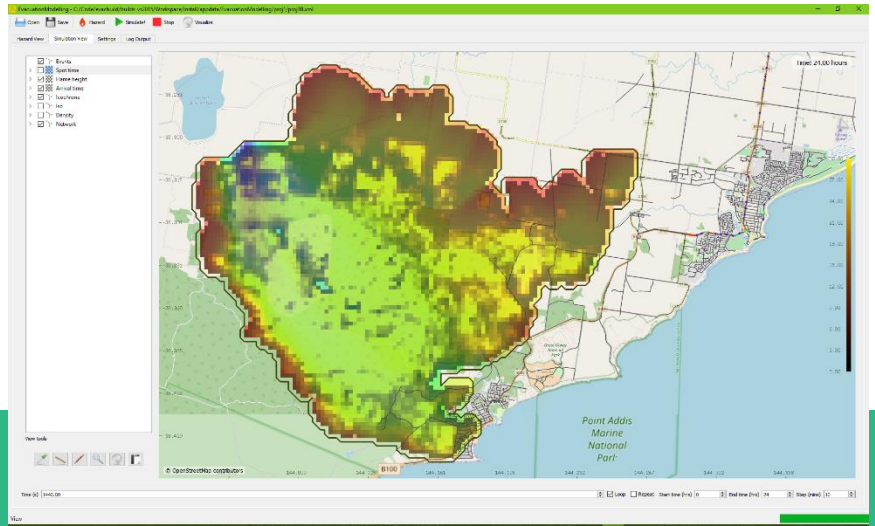
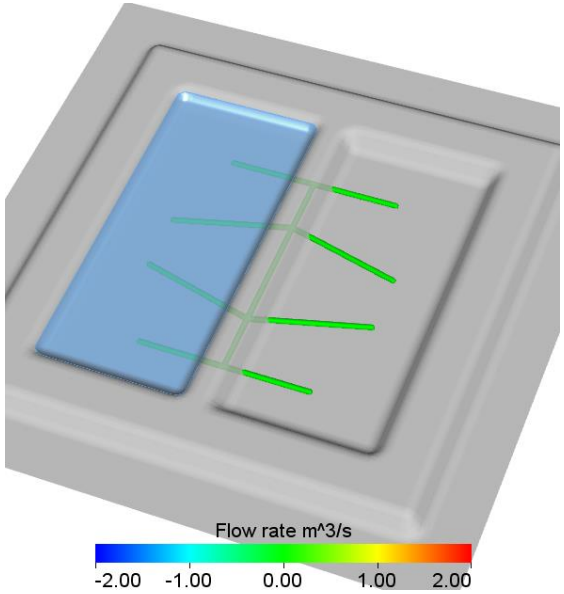

Point Addis
Marine
National
Park

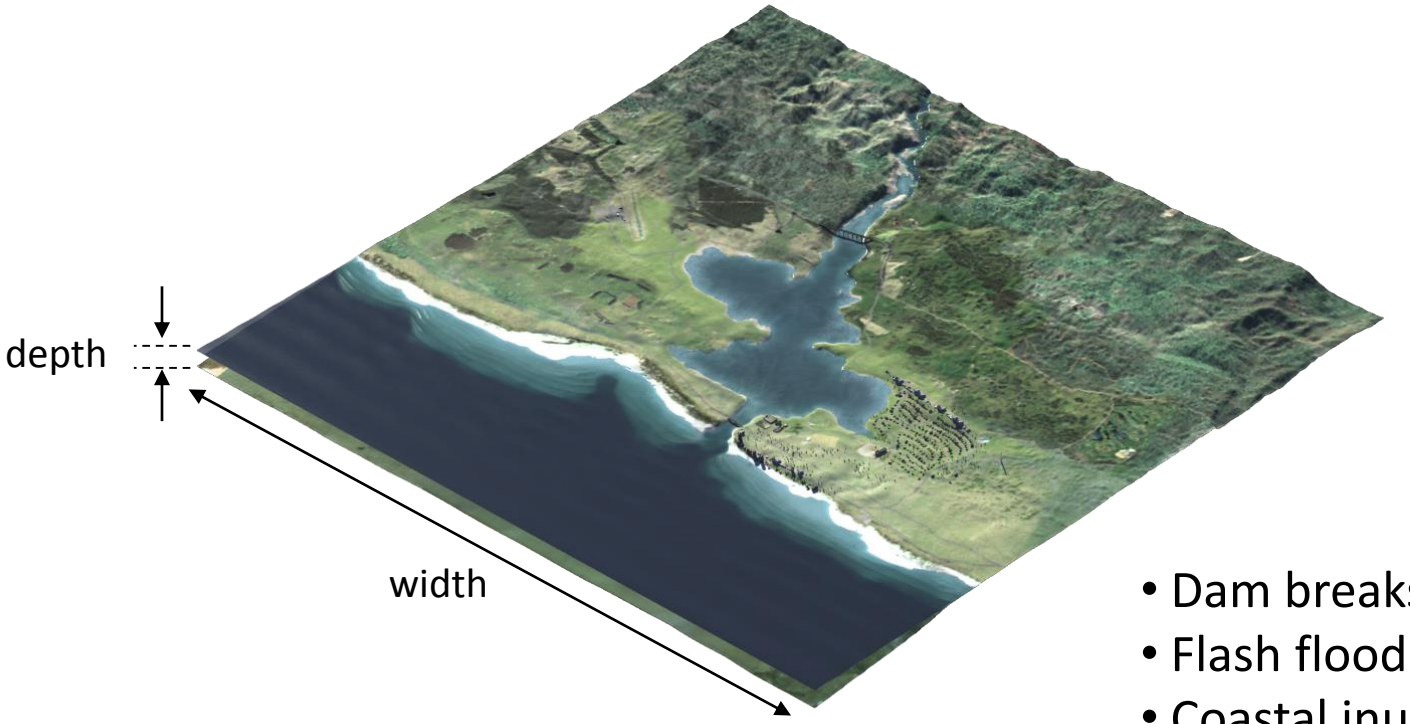
C-FAST Summary of capabilities

- Integrated hydrodynamic/hydraulic flood modelling
  - Modular & flexible
  - Very fast - GPU accelerated code
- Capable of investigating storm surge, extreme rainfall, catchment flooding, sea level rise
- Able to study adaptation options in an integrated manner
- Able to include additional processes such as “salinity”, “sedimentation”, “infiltration” into the inundation modelling
- Potential to carry out integrated investigation of effect of groundwater flows (conceptual modelling)



Swift Hydrodynamic Model

- Water depth << width
- 2D formulation
- Predicts water height, momentum
- Shallow water finite volume model

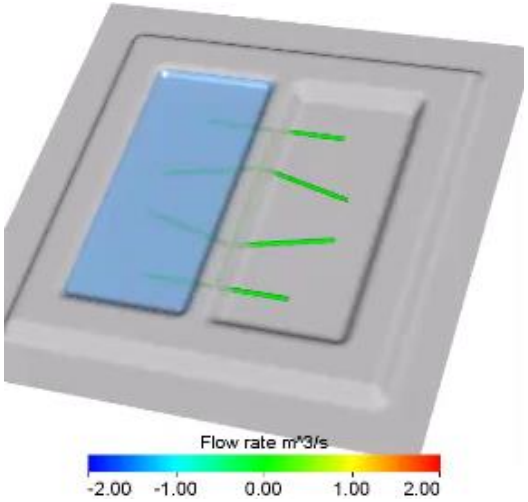


- Dam breaks
- Flash flooding
- Coastal inundation

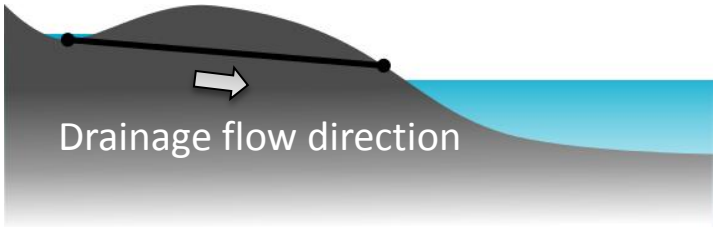
Hydraulic Model

- Pressure head-based pipe network model
- Assume sound speed >> gravity wave speed

- Pipe network both helps and hinders flooding:



Normal conditions:



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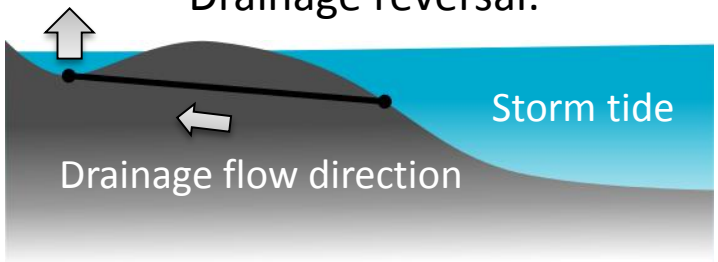
Drainage reversal:



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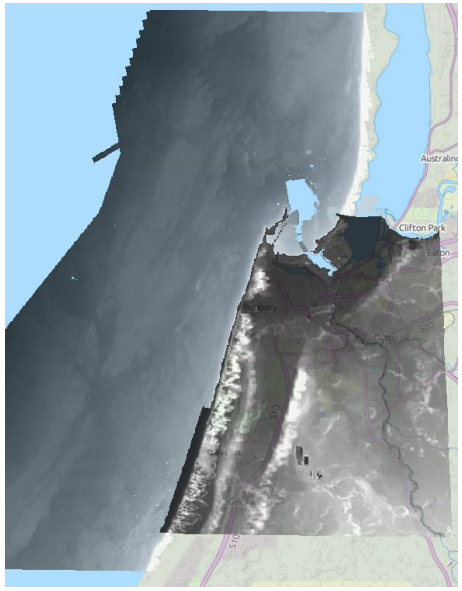
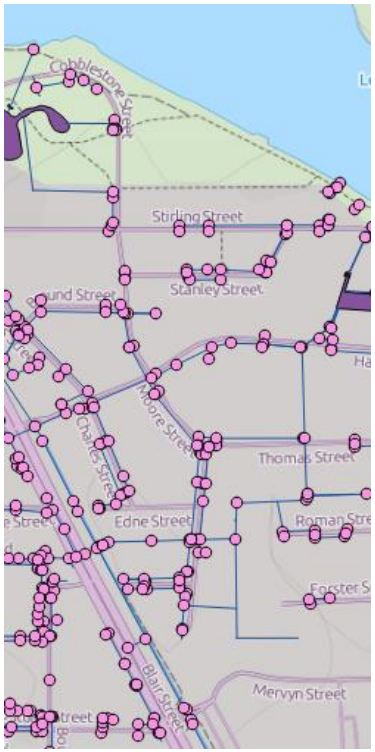
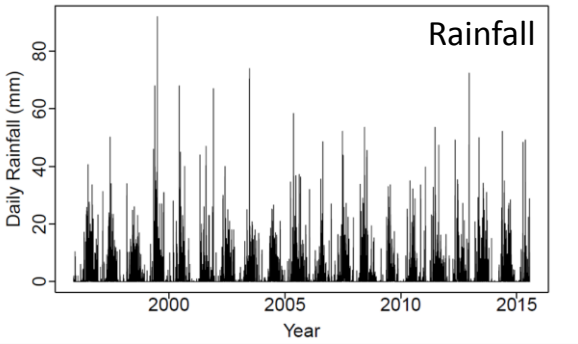
Inputs

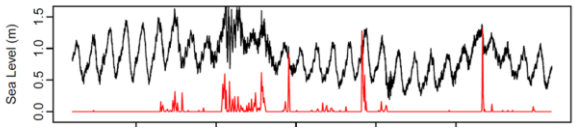


Lidar, bathymetry, land usage
+ DEM from erosion modelling for future scenarios



Pipe networks, pumps, Retention/detention systems





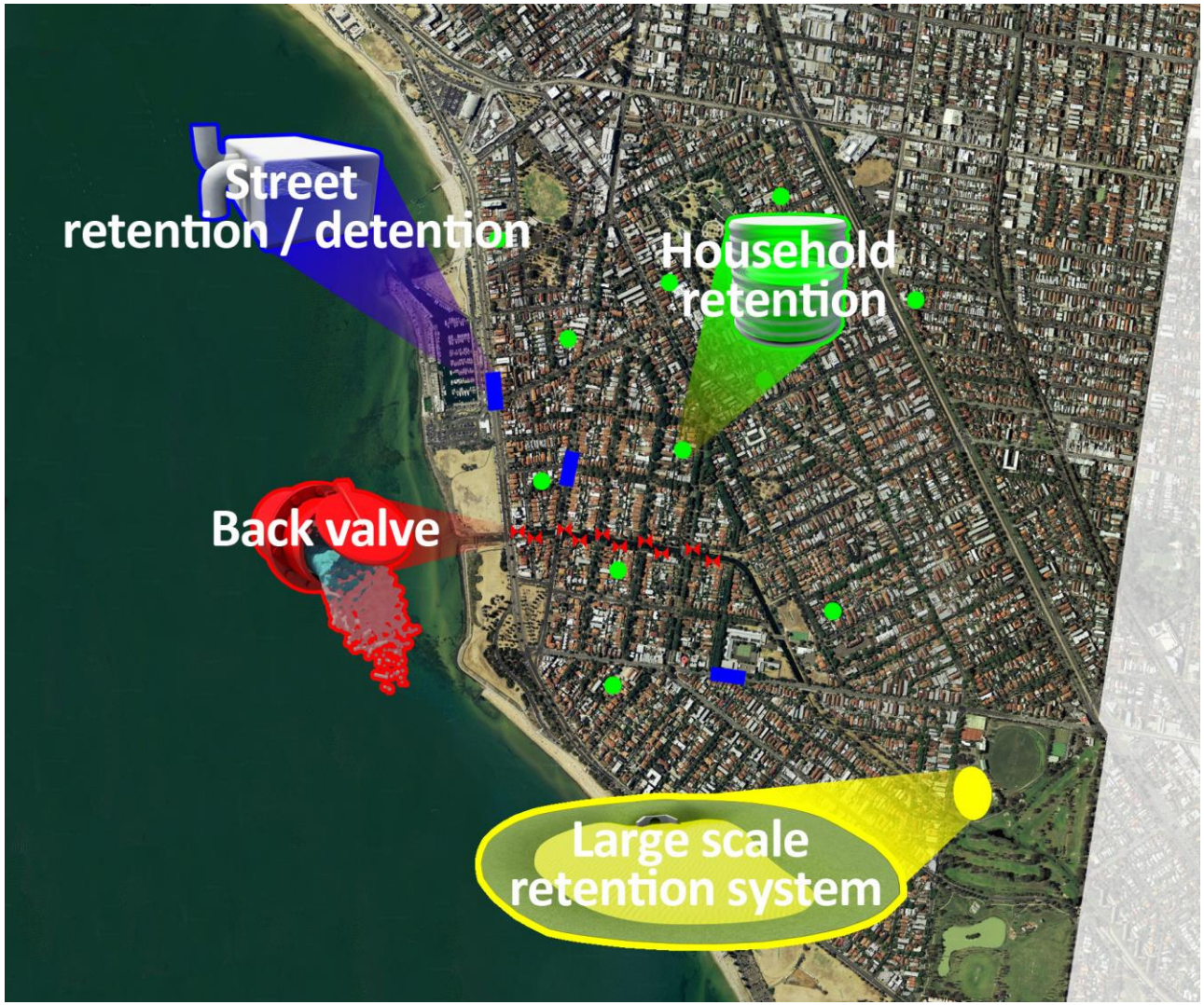
Joint probability analysis

Statistical extreme tide & rainfall scenarios

C-FAST Application

: *Adaptation Analysis*

Adaptation options evaluated



Elwood

Model inputs

Case	Sea level (above 2014 AHD)
1	0.0 m
2	0.4 m
3	0.8 m
4	1.1 m

- City wide terrain and bathymetry (LiDAR)
- Hydraulic and Hydrological (eg. drainage network)
- Storm surge with a peak of 1.3 m
- 1 in a 100 ARI rainfall for 3 hrs (also 1 in 5 and 1 in 10 ARI)
- Total simulation time = 24 hrs
- Rainfall starts at peak storm surge

City of Port Phillip

Urban drainage network

- Extensive urban drainage network (~13k pipes)
- Model effects of 1.3 m storm surge
- Flow reversal back up the drainage network is critical feature to model for CoPP

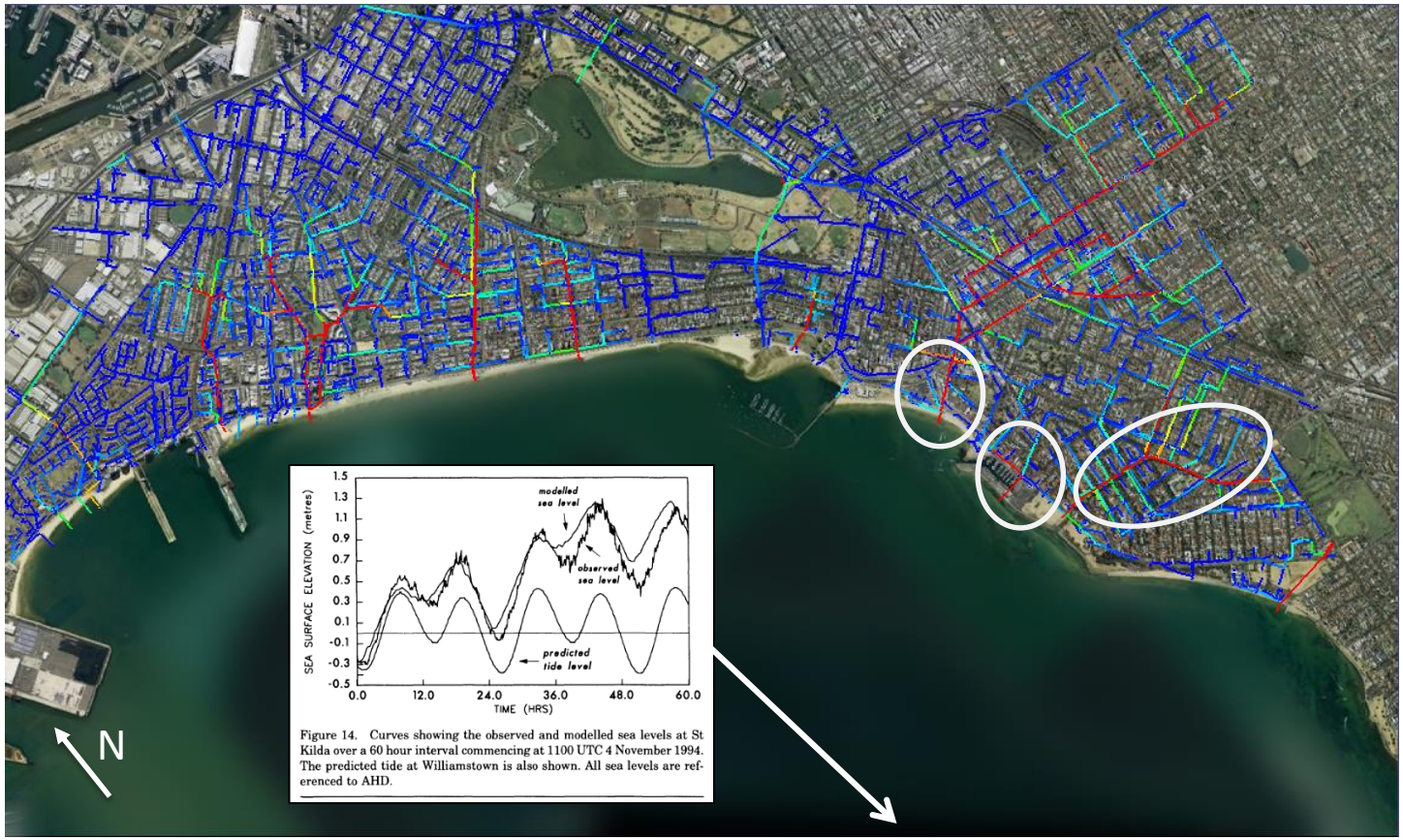


Figure 14. Curves showing the observed and modelled sea levels at St Kilda over a 60 hour interval commencing at 1100 UTC 4 November 1994. The predicted tide at Williamstown is also shown. All sea levels are referenced to AHD.

City of Port Phillip

Adaption summary – present day

2hours 24hours

Retention time

- **Focus area** – Elwood canal
- **Outcome -** Flooding at intersection of Barkly and Meredith street completely stopped

City of Port Phillip

Adaption summary – SLR 0.4 m

2hours 24hours

Retention time

- **Focus area** – Elwood canal
- **Outcome** – Significant flooding around Elwood canal (> 2 hrs) stopped with only nuisance flooding remaining in some locations

City of Port Phillip

Adaption summary – SLR 0.8 m

2hours 24hours

Retention time

- **Focus area** – Elwood canal
- **Outcome** – Adaptation not effective for SLR of 0.8 m and beyond

C-FAST Application

: *Saline intrusion*

Applications

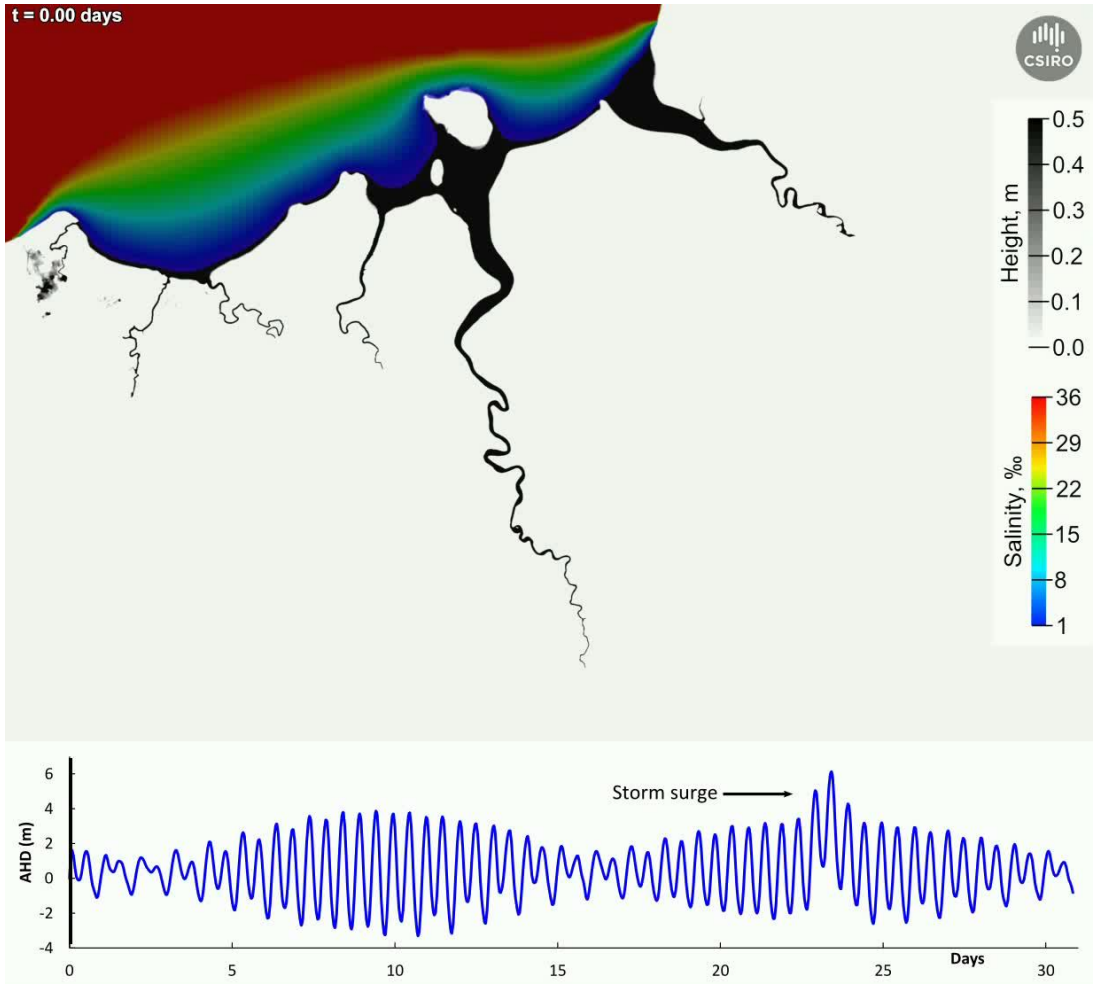
Kakadu (NT) Saline Inundation

Rainfall processor

Evapo-transpiration processor

Advection-diffusion processor

Wave generator processor



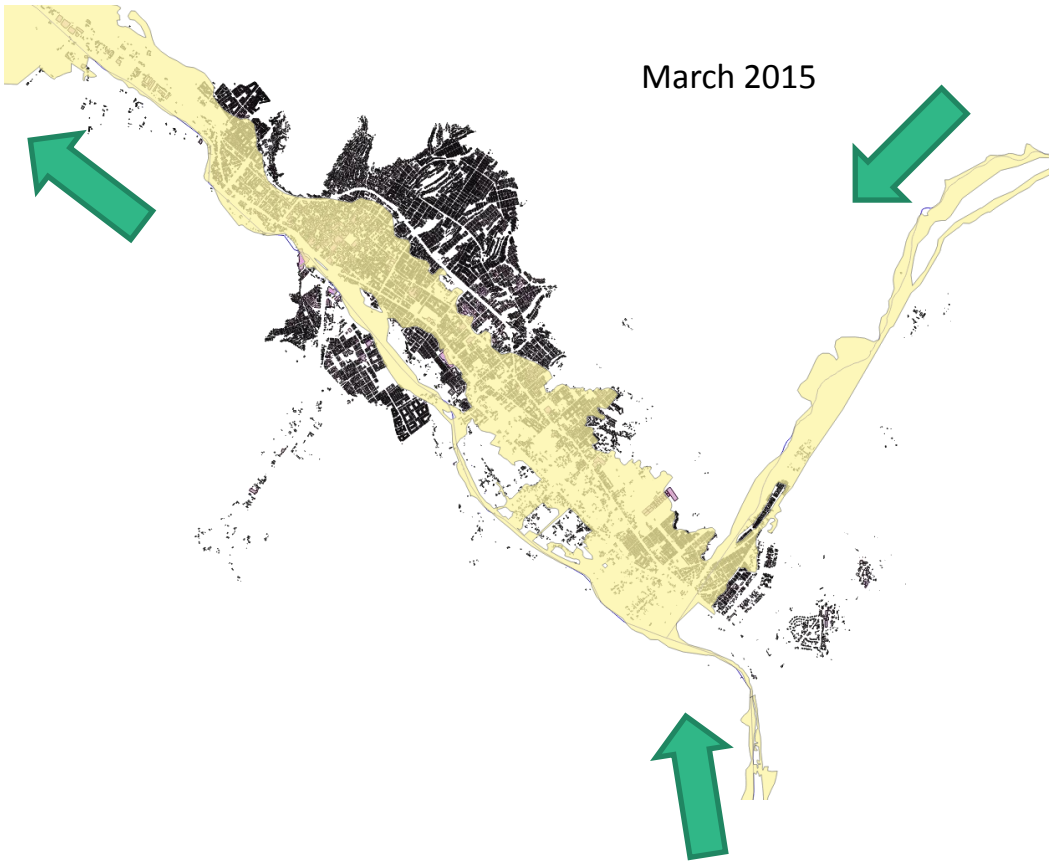
C-FAST Application

: *Copiapo (Chile) flood modelling including sedimentation*

Copiapo Flooding 2015

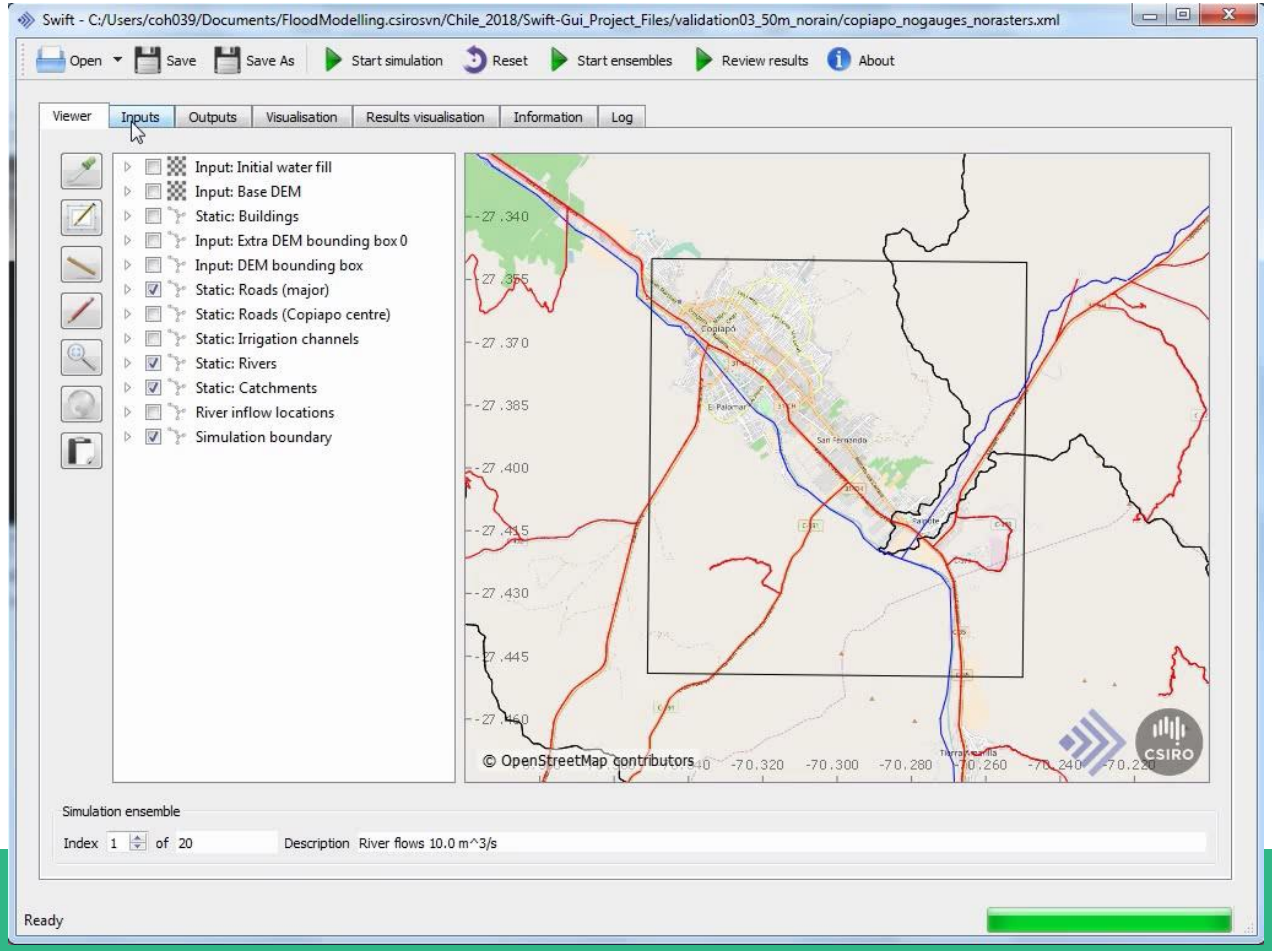
- Extreme rainfall led to:
  - Flash flooding
  - Significant sediment pick-up and mudflows
  - Debris flows

- March 2015 flooding disaster [Source DGA]
  - 31 people died
  - 16 missing
  - Approximately 2,000 homes destroyed
  - 35,000 people affected



Key Software Capabilities

- Ability to assess effectiveness of adaptation scenarios
- Ability to assess effectiveness of evacuation locations
- Inclusion of sedimentation and debris pick-up effects

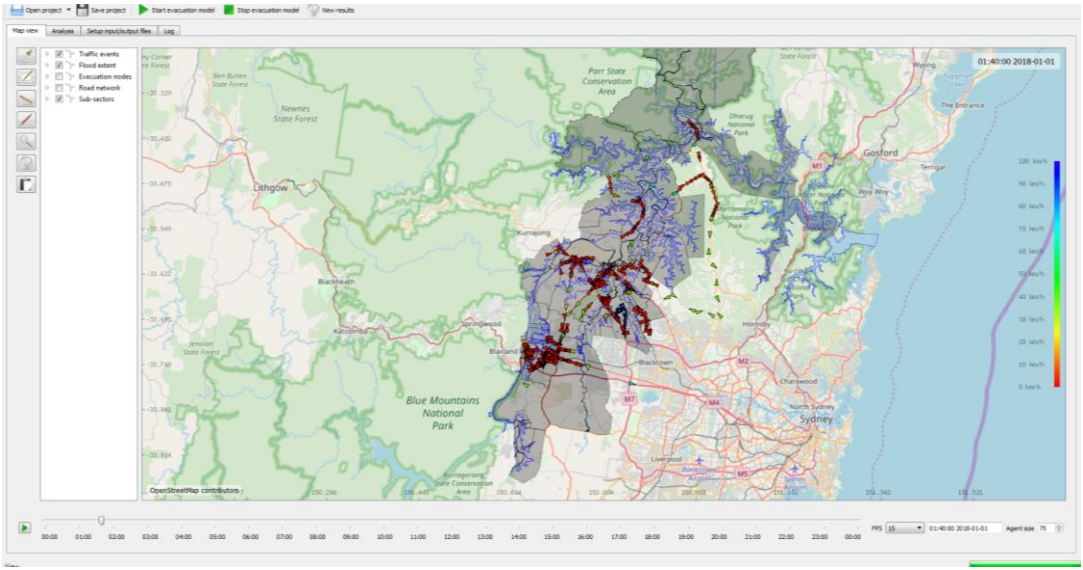


Flood Evacuation

Evacuation Decision Support System

Key Features:

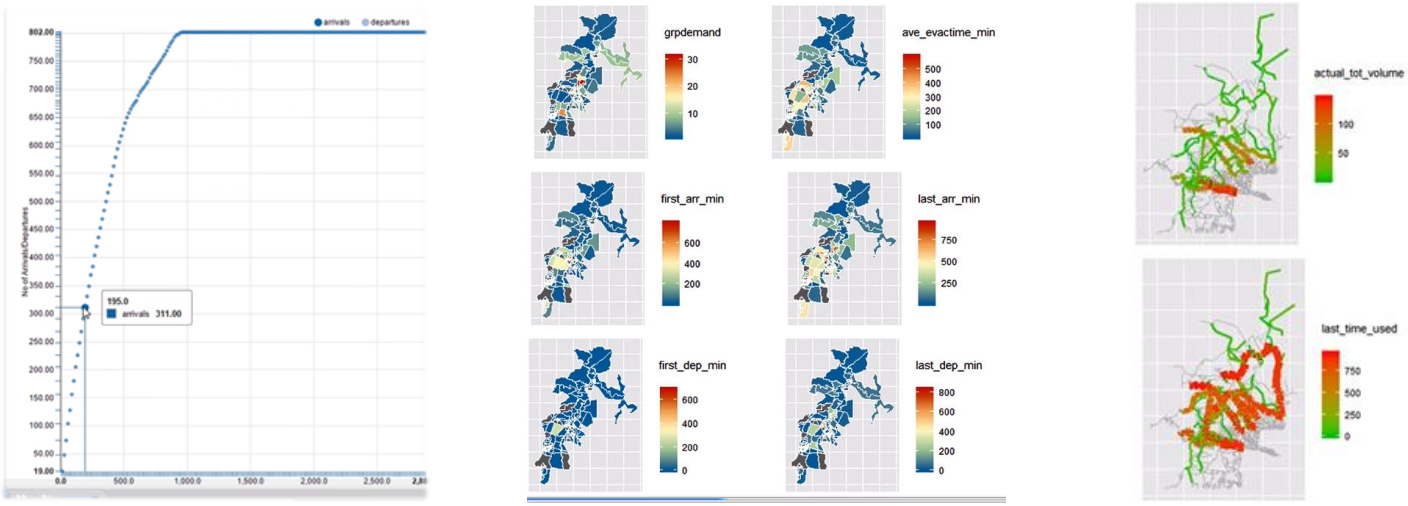
- Decision tool for the evaluation and scenario analysis of evacuation policies, strategies and resource allocation
- Capability to address planning, response, and recovery stages
- Seamlessly integrates with platform technologies: *Swift* and *Spark* (Flood and Fire Modelling)
- Capability can also be used for other forms of emergencies including terrorist threats, building fires etc.



Example shows a flood evacuation scenario with vehicles represented by arrows. The colours represent vehicle speed with red zero (significant vehicle congestion) and blue indicating 100 km/h. The Decision Support System shown here is fully configurable for any region globally.

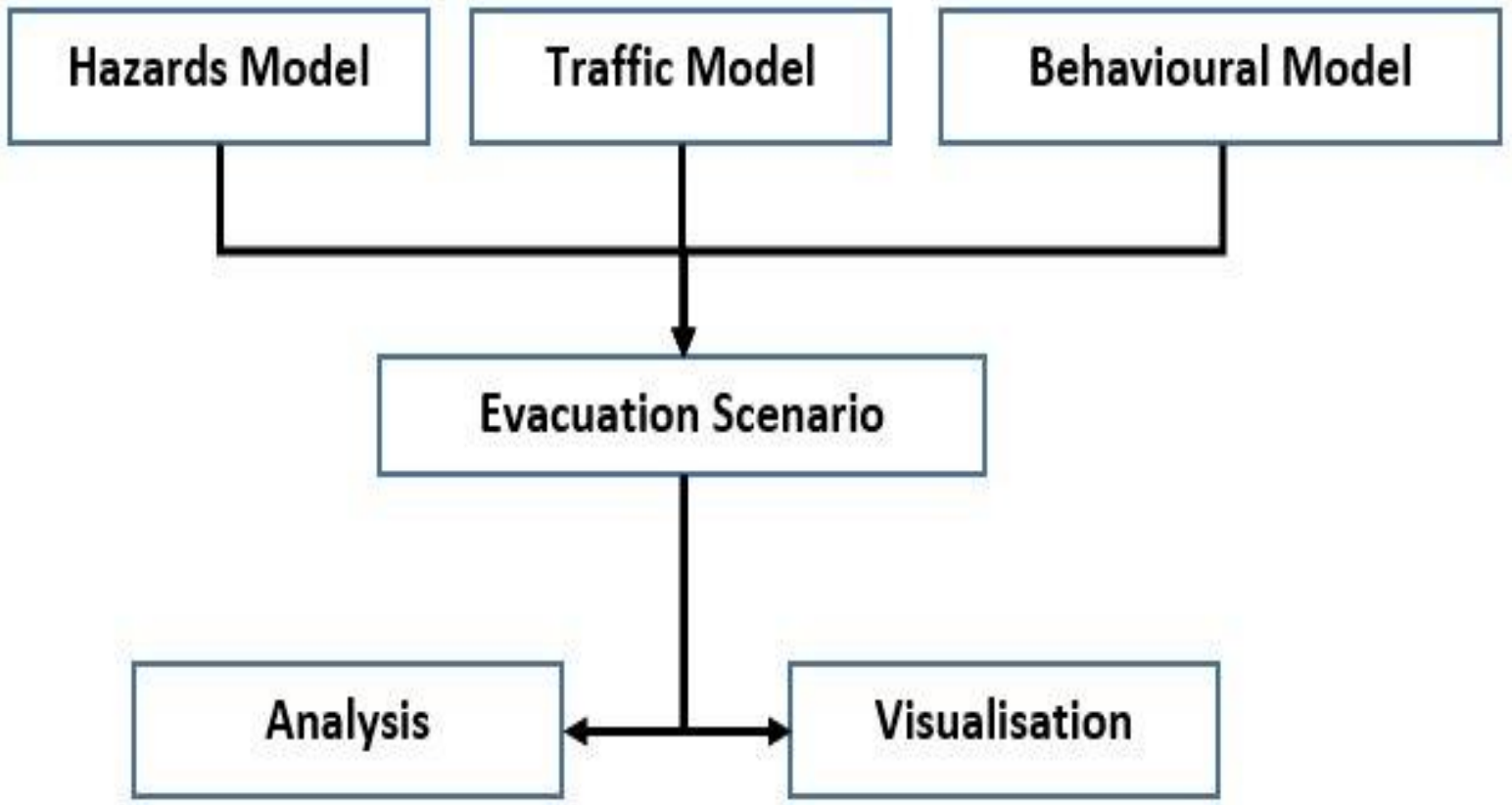
Evacuation Decision Support System

A range of analysis options are supported including heat maps, link maps and charts. There is also the ability to export the datasets to applications such as Tableau or Power BI for further analysis if required.

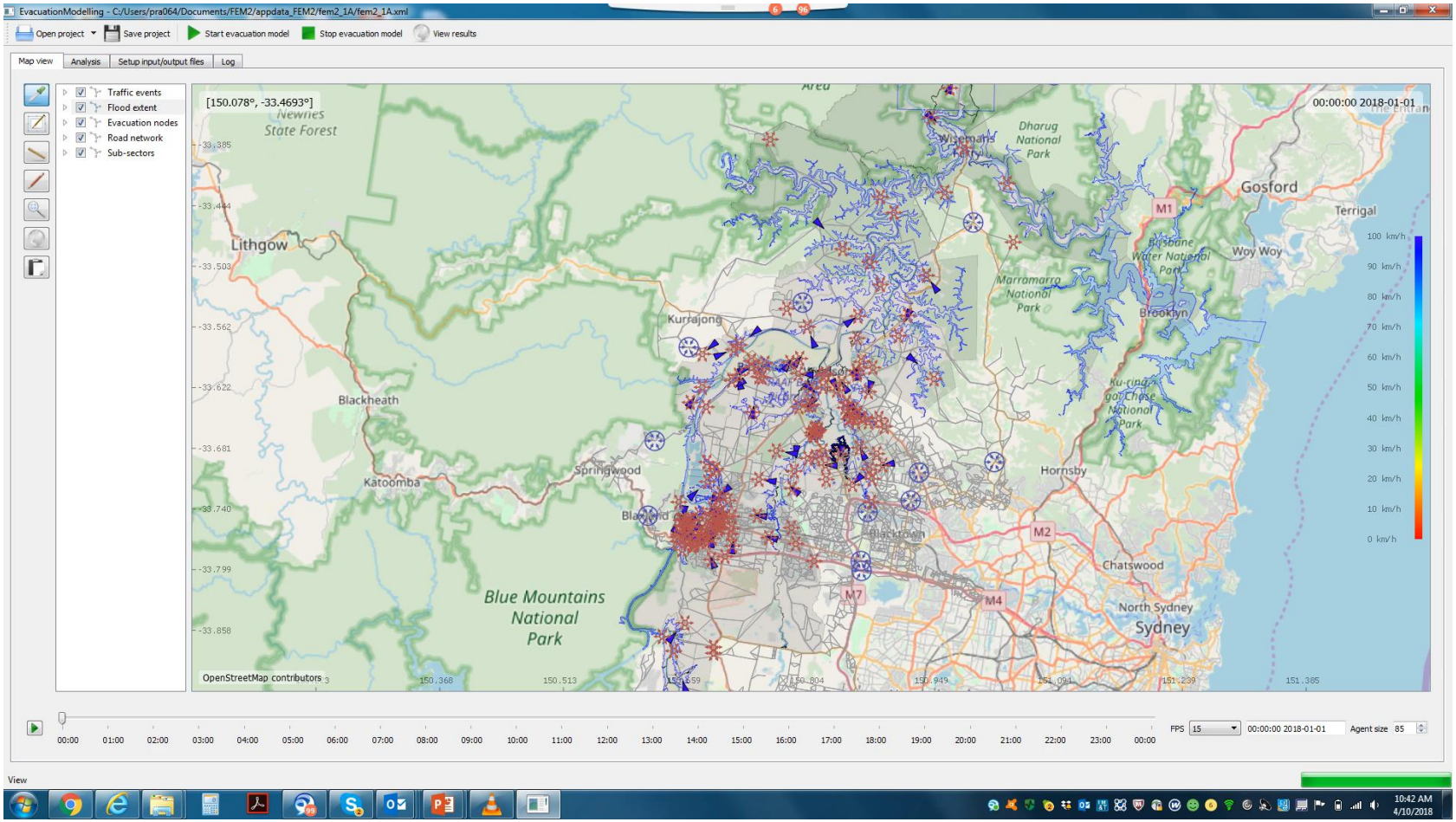


Three types of analysis supported in the Dashboard, (a) xy charts (b) heat maps and (c) link maps, other options can be easily added into the DSS as necessary

Components of the Evacuation Model



Evacuation Modelling Demonstration



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Thank you

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