

The potential impact of urban growth simulation on the long-term planning of our cities

4th Biennial Conference



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Why Urban Growth Simulation?

Unabated urbanisation

Quest for sustainable development

“Making cities sustainable is one of the most important missions of current generations. The planet requires that we move with haste towards sustainability and because of the population concentrated in cities and the opportunities to gain efficiencies, cities are the most important arena for intervention.”

Maurice Strong



What makes a city sustainable?

- Reduced carbon footprint
 - Reduce resource consumption
 - Recycling
 - Increase use of renewable energy
- Smart and compact cities

Smart and Compact cities

Smart cities

“Urban performance currently depends not only on the city’s historical city centre and hard infrastructure, but increasingly on the availability and quality of information technology, knowledge communication, social and environmental capital.”

Danish Architecture Centre



Compact cities and Smart Growth

- Growth considered smart if sprawl is curtailed
- First urban growth boundary introduced in Kentucky in 1958
- Mass transit, bicycle and pedestrian oriented

Sprawling cities...



Common causes

- Single-use zoning, low densities, strip malls, fast food chains all promote automobile dependency

The evils of sprawl

- Traffic and accidents, increased infrastructure and personal transportation costs (more important to low-income groups)

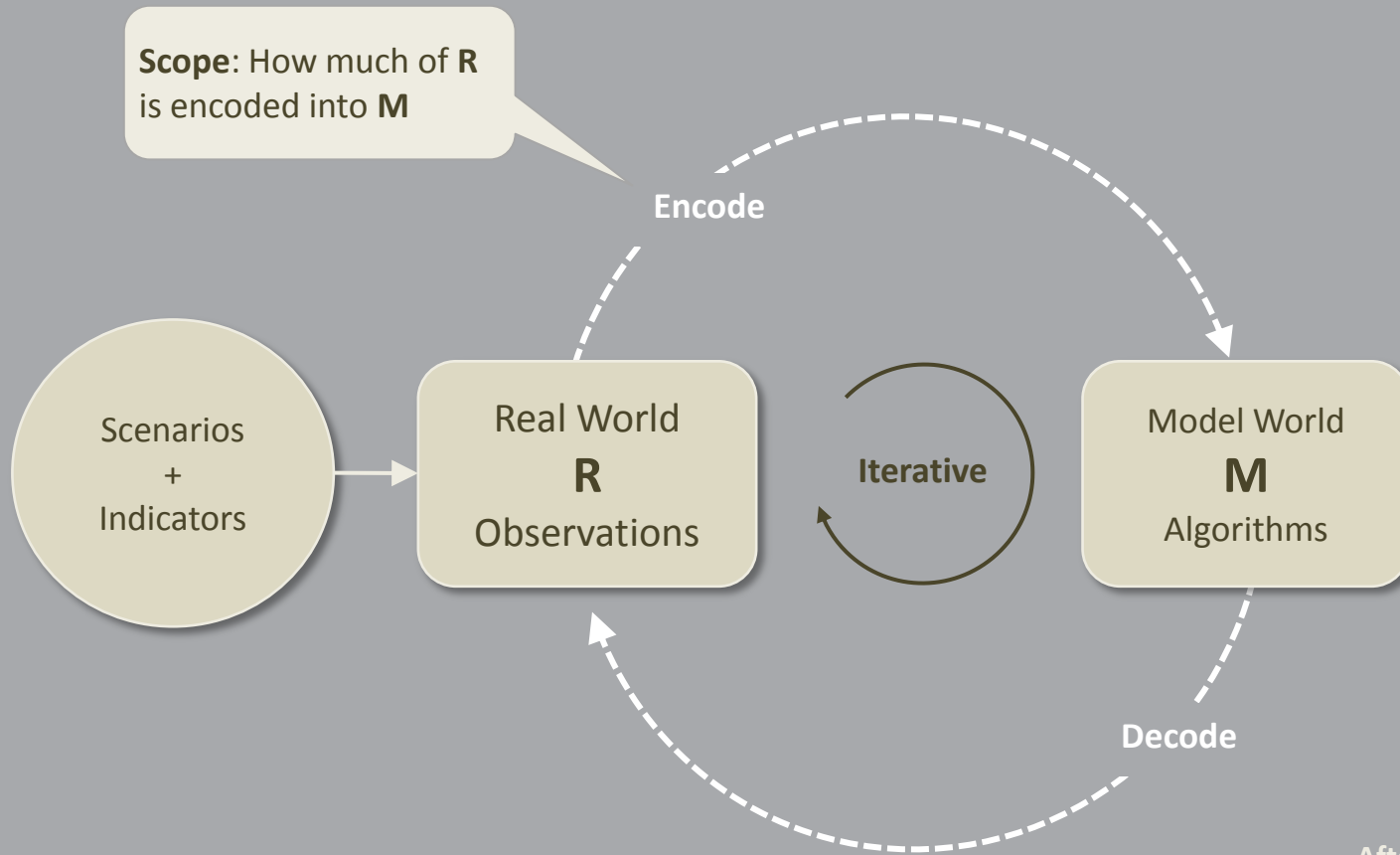
How can sprawl be arrested?

- Mass transit, mixed-use and high-density zoning, developer contributions, etc.

Urban Growth Simulation

provides a risk free means of assessing the likely future outcome of major policy and investment decisions that affect everybody in city

Simulating different scenarios



After Casti, 1994

The model system



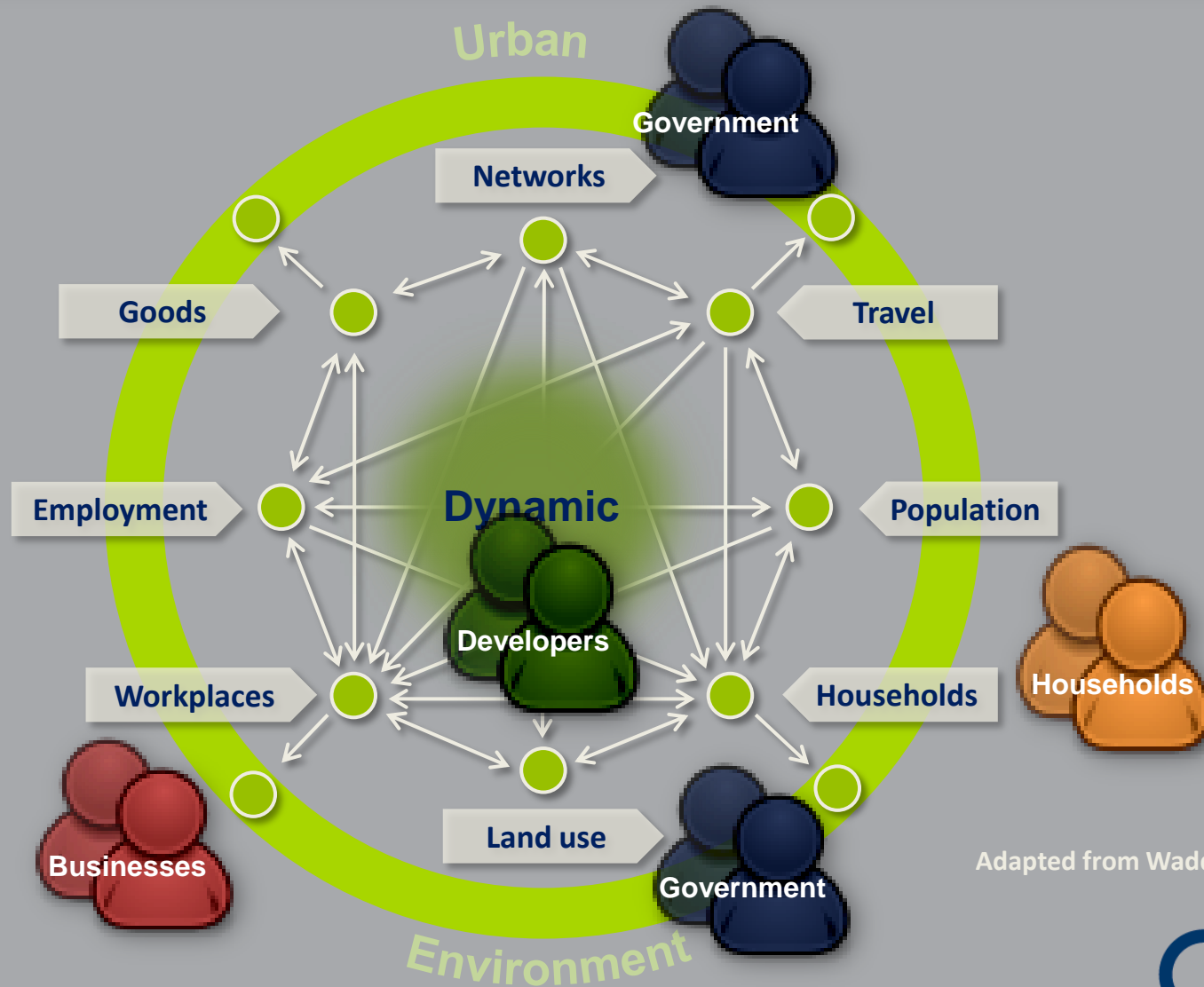
UrbanSim (Open Source)

- Based on discrete choice theory: Simulates the choices made by various agents
 - For example the probability of a household agent characterised by attributes such as age, income, size, children and cars choosing a particular house characterised by price, location, etc.
 - Sub-models allow for different behaviour of different income groups

MATSim (Open Source)

- Based on queue theory: Simulates autonomous agents executing and optimising their daily trip plans

What part of **R** is encoded into **M**?



Adapted from Waddell, 2005

Can this technology work in SA?

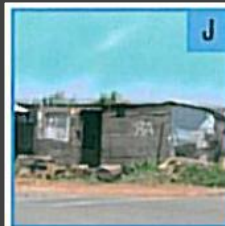


**B****6M: Dish and Decoder Set**

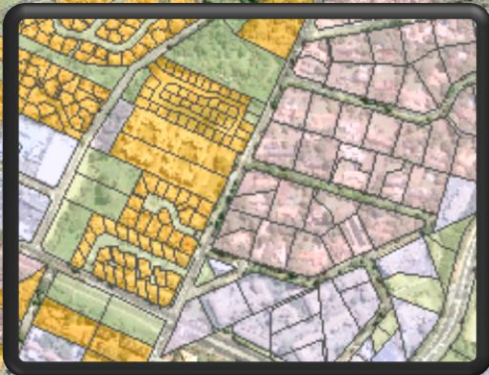
Safe and secure, the Dish and Decoder Set family lives the typical first-world, middle-class, suburban life-style. Dish and Decoder Set neighbourhoods are leafy and well established, if somewhat nondescript. Home-

**A****1M: Upper Crust**

They are the elite of South African society – anointed through wealth and achievement. The Upper Crust live lives of distinction in pampered luxury, with little concern about cost – for them, quality is not negotiable. They know and

**J****28M: eKaya**

Informal settlements are nothing new in South Africa – eKaya clusters are proof of this. They are, however, different from newer informal settlements, being older, with the majority older than a decade and, often quite far from

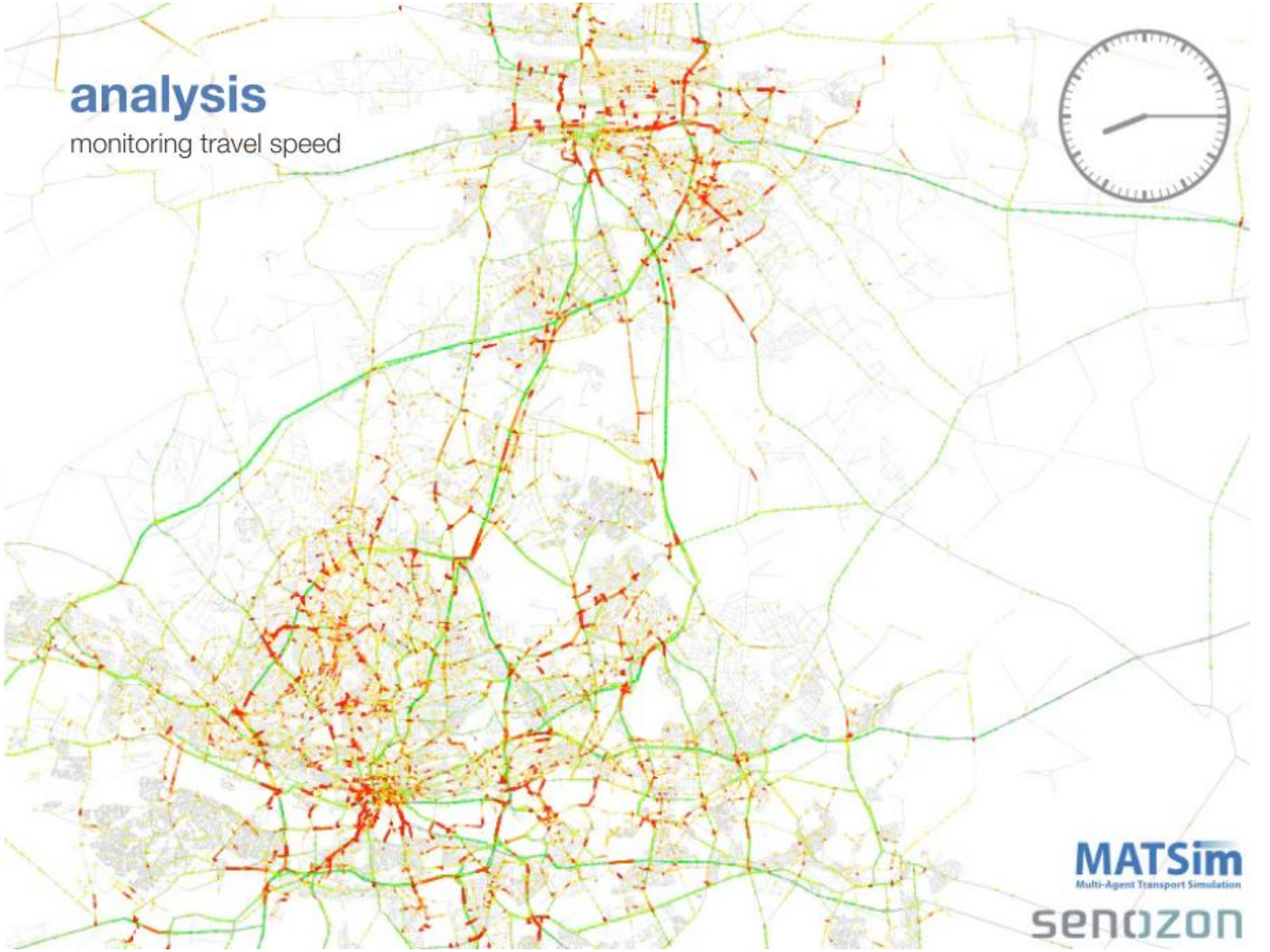


Which cities participated?

- Successfully applied in eThekweni, Nelson Mandela Bay and City of Johannesburg
 - Funded by DST since 2009 (see stepsa.org). Upgraded in 2012 to 'National Initiative'
- Gauteng Integrated Transport Modelling Centre
 - Uptake demonstrated by Gauteng Department of Roads and Transport contracting CSIR and UP to develop in-house capability based on UrbanSim/MATSim (to serve long term planning requirements of province as well as municipalities)

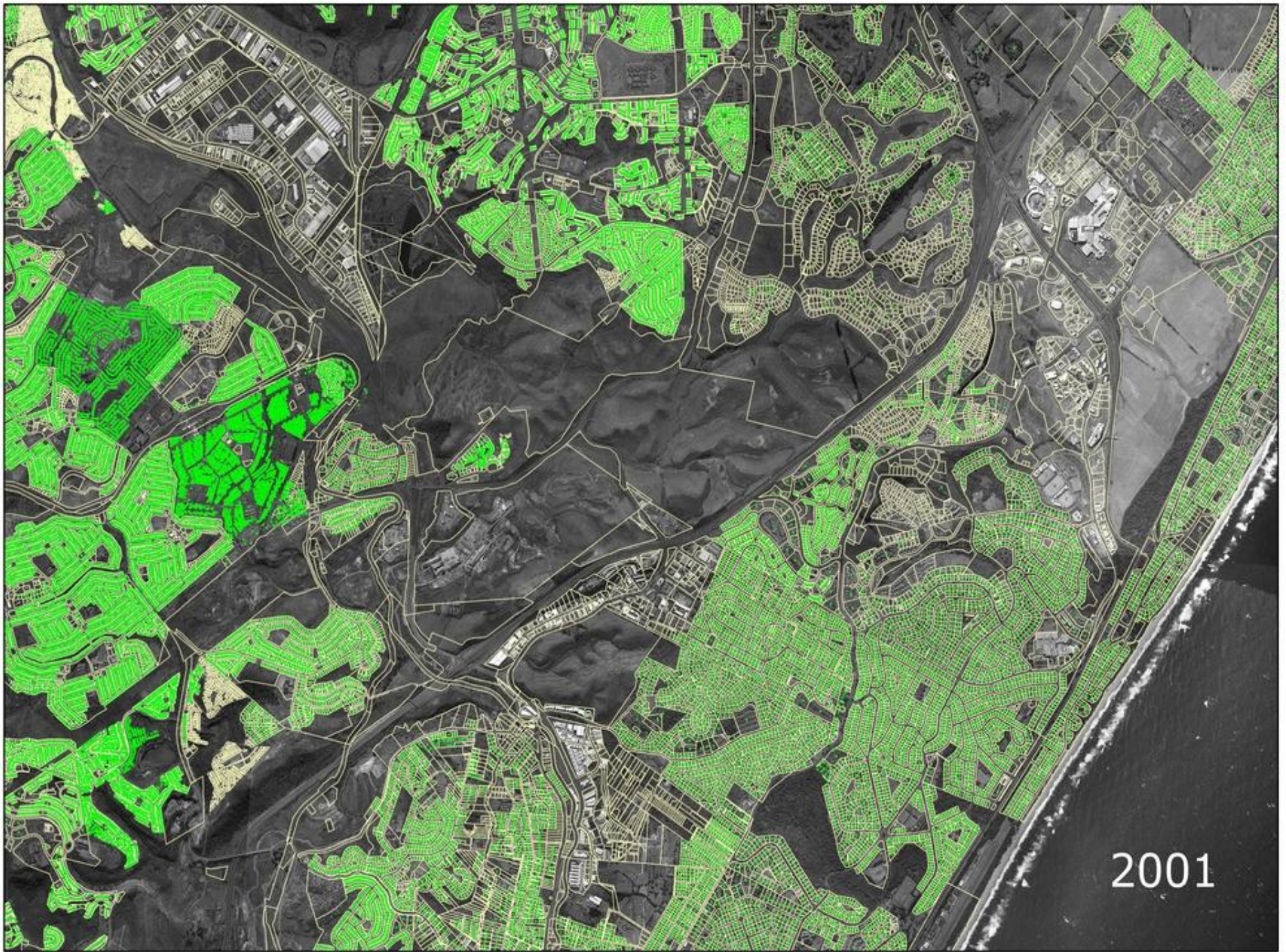
analysis

monitoring travel speed

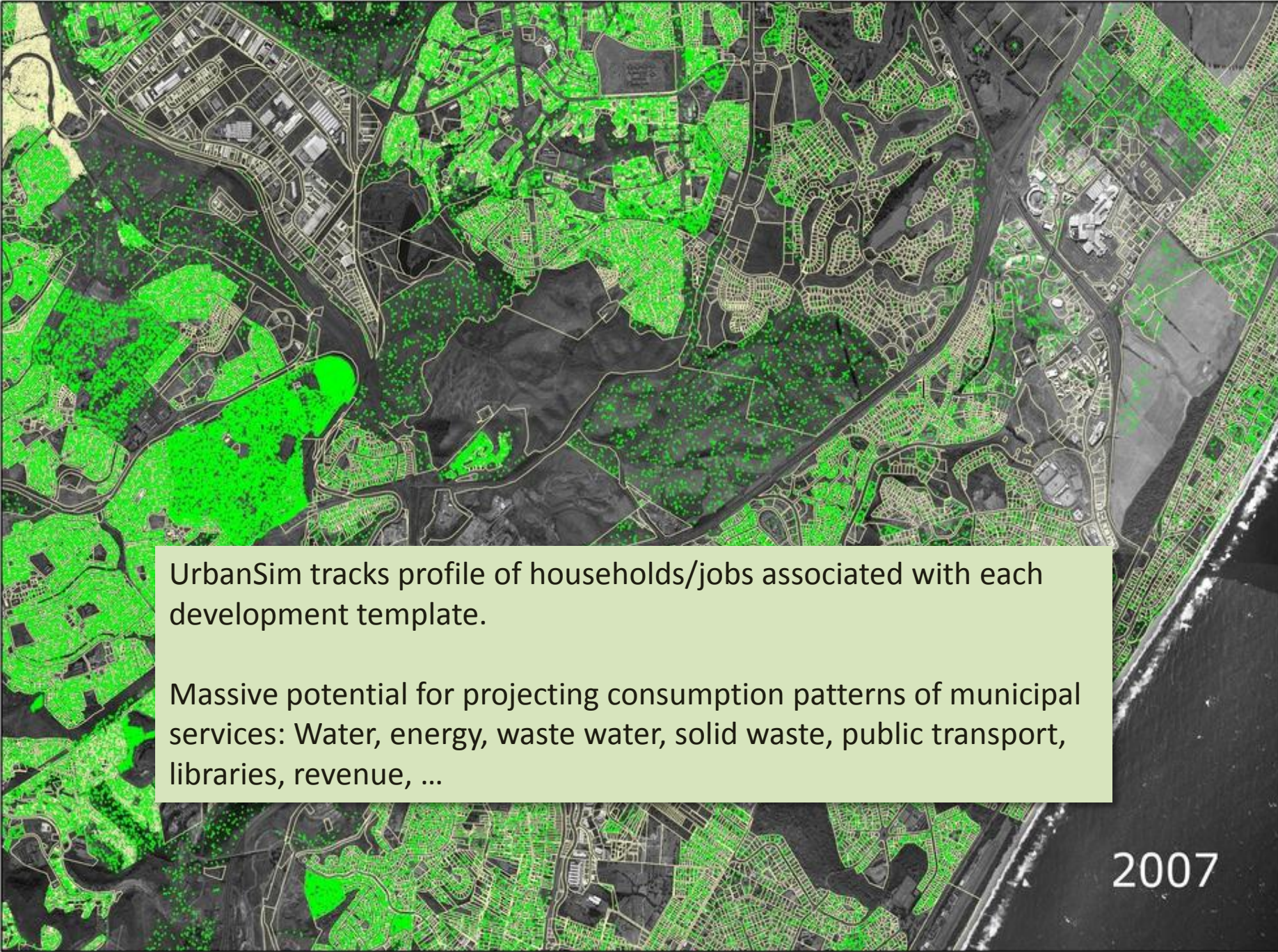


MATSim
Multi-Agent Transport Simulation

senozon



2001

An aerial photograph of a city, likely Seattle, with a dense network of streets and buildings. Overlaid on the image are numerous bright green patches of varying sizes and shapes, representing different development templates or land use zones. The green areas are scattered throughout the urban landscape, following major roads and clusters of buildings. The background is a grayscale aerial view, providing a clear contrast for the green overlays.

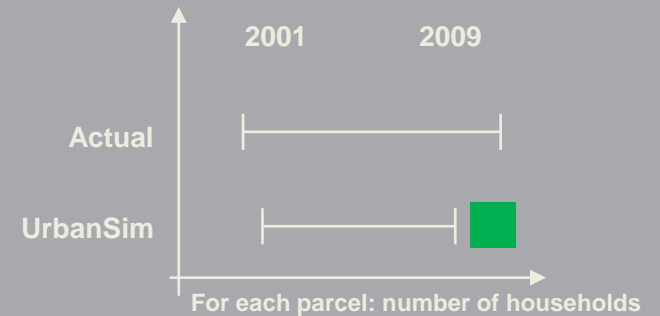
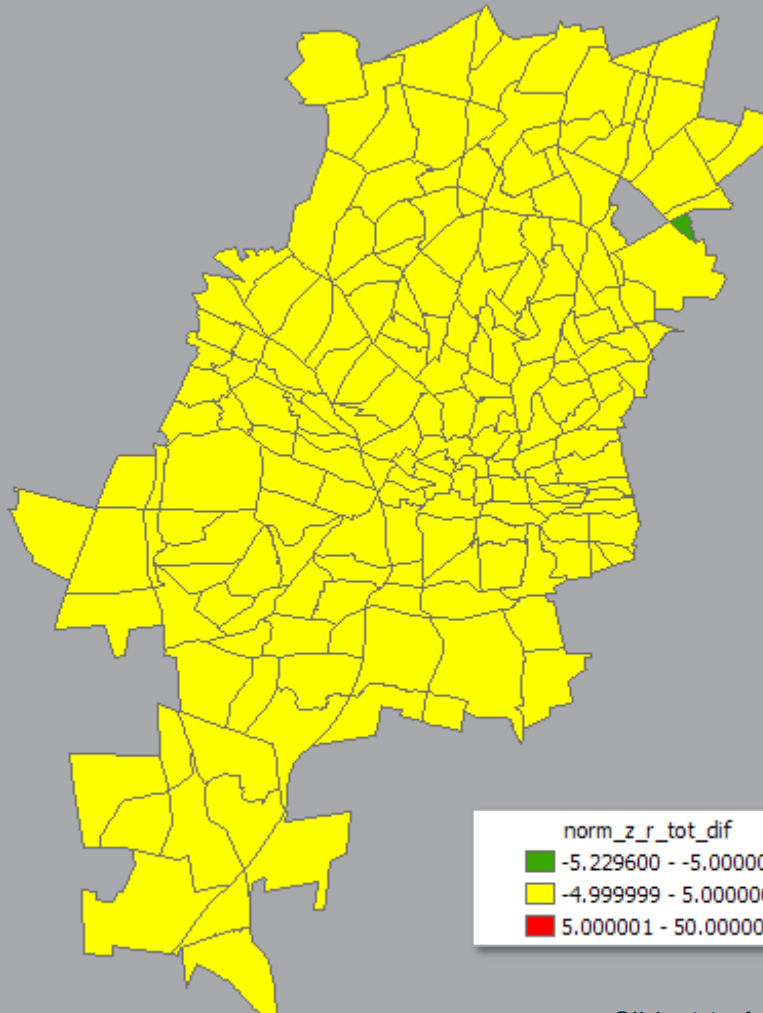
UrbanSim tracks profile of households/jobs associated with each development template.

Massive potential for projecting consumption patterns of municipal services: Water, energy, waste water, solid waste, public transport, libraries, revenue, ...

2007

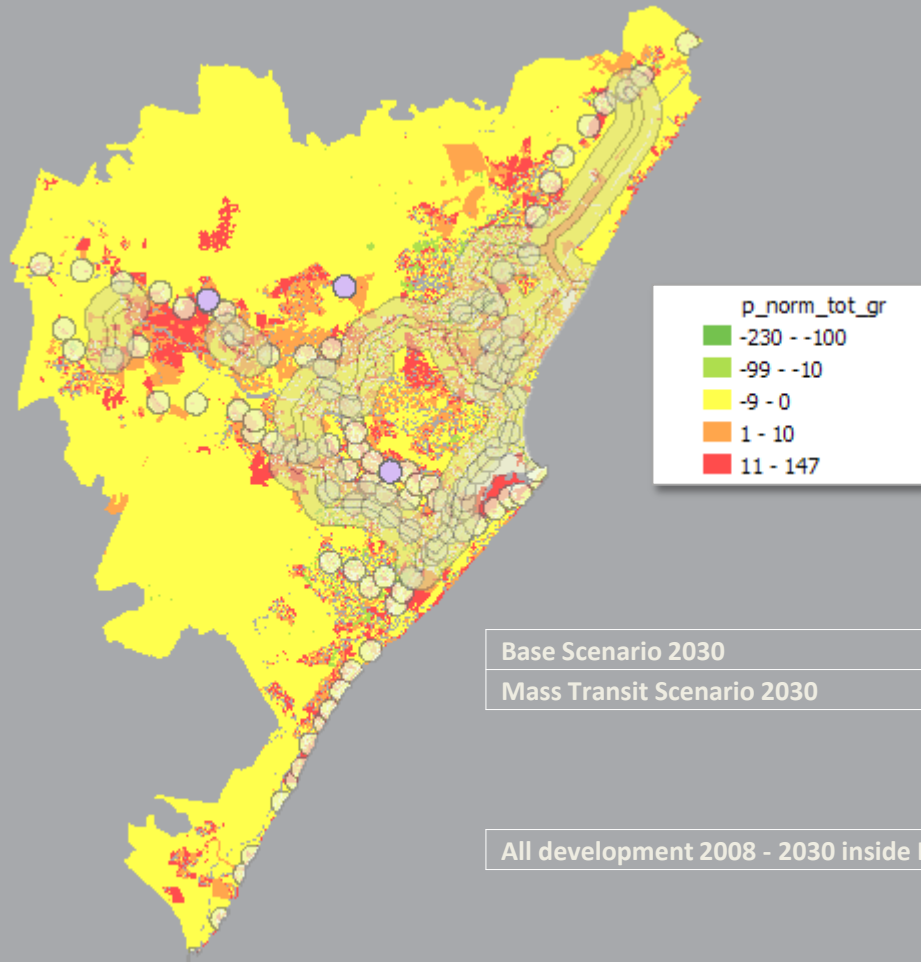
Validation (example from City of Johannesburg)

Growth aggregated to Traffic Analysis Zones



hu / ha

eThekweni Mass Transit Scenario: 2001 - 2030



	Households	Area (ha)	Gross density (hu/ha)
Base Scenario 2030	555 779	63 192	8.8
Mass Transit Scenario 2030	595 238	63 192	9.4

	Households	Area (ha)	Gross density (hu/ha)
All development 2008 - 2030 inside HPPTN	742 778	63 192	11.8

Impact on broader society



Worldwide, mass transit is heavily subsidised

- Except in cities with high population densities, for example Hong Kong, where both bus and rail transit are operated by private sector (5 – 10 more dense than Johannesburg)
- It seems unlikely that required densities will be achieved in SA

Long term implications affecting everybody

- SA subsidies constrained by small tax base
- Failure will result in long-term tax burden for higher income households
- Not affordable by lowest income households anyway
- Unlikely to reduce car dependency or achieve meaningful transition to smart/compact cities
- Densification alone simply increases local congestion

What will turn the tide then?



Fundamental rethink

- Mixed use zoning
- Scalable transit solutions
- A lot of help from Information and Communication Technology

UrbanSim/MATSim is the first fully integrated land use / transportation simulation platform in South Africa and it has already opened debates about alternative solutions that were not previously open for debate

Thank you

