



**MELBOURNE 2030 AND CLIMATE CHANGE :  
THE POTENTIAL IMPACTS ON HUMAN  
THERMAL COMFORT LEVELS**

**Monash University Climate Group  
of the  
School of Geography and Environmental Science**

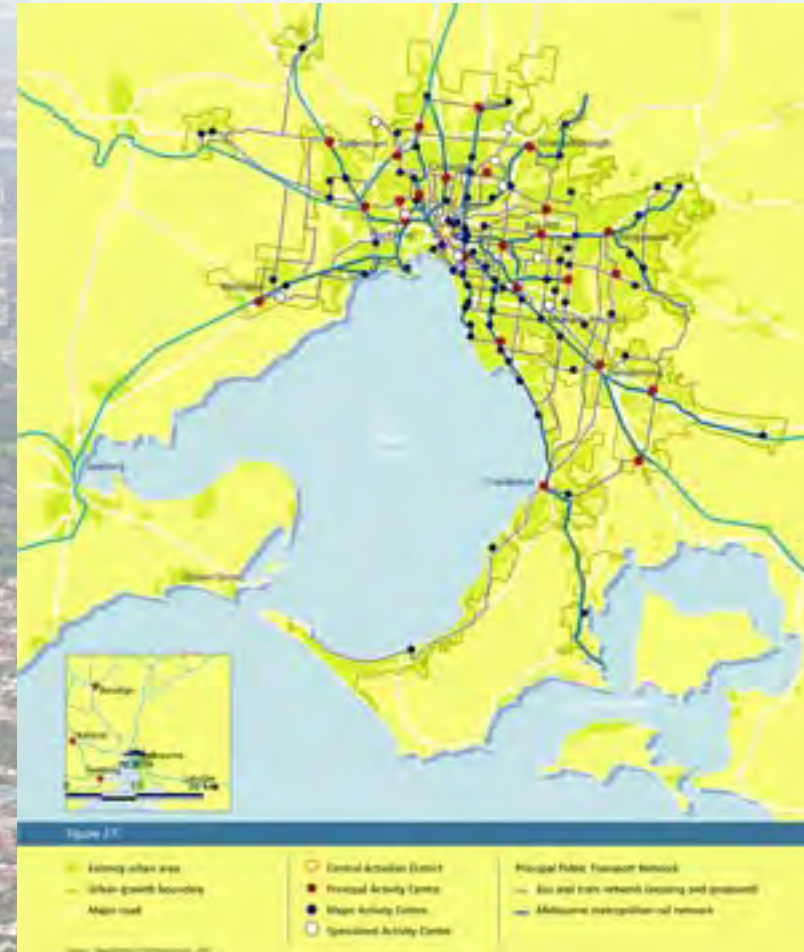
**By  
Nadine D'Argent, Jason Beringer, Nigel Tapper**

# Melbourne planning strategy: *“Melbourne 2030”- planning for sustainable growth”*

**Melbourne’s population will  
grow by up to 1 million  
people within the next 30**

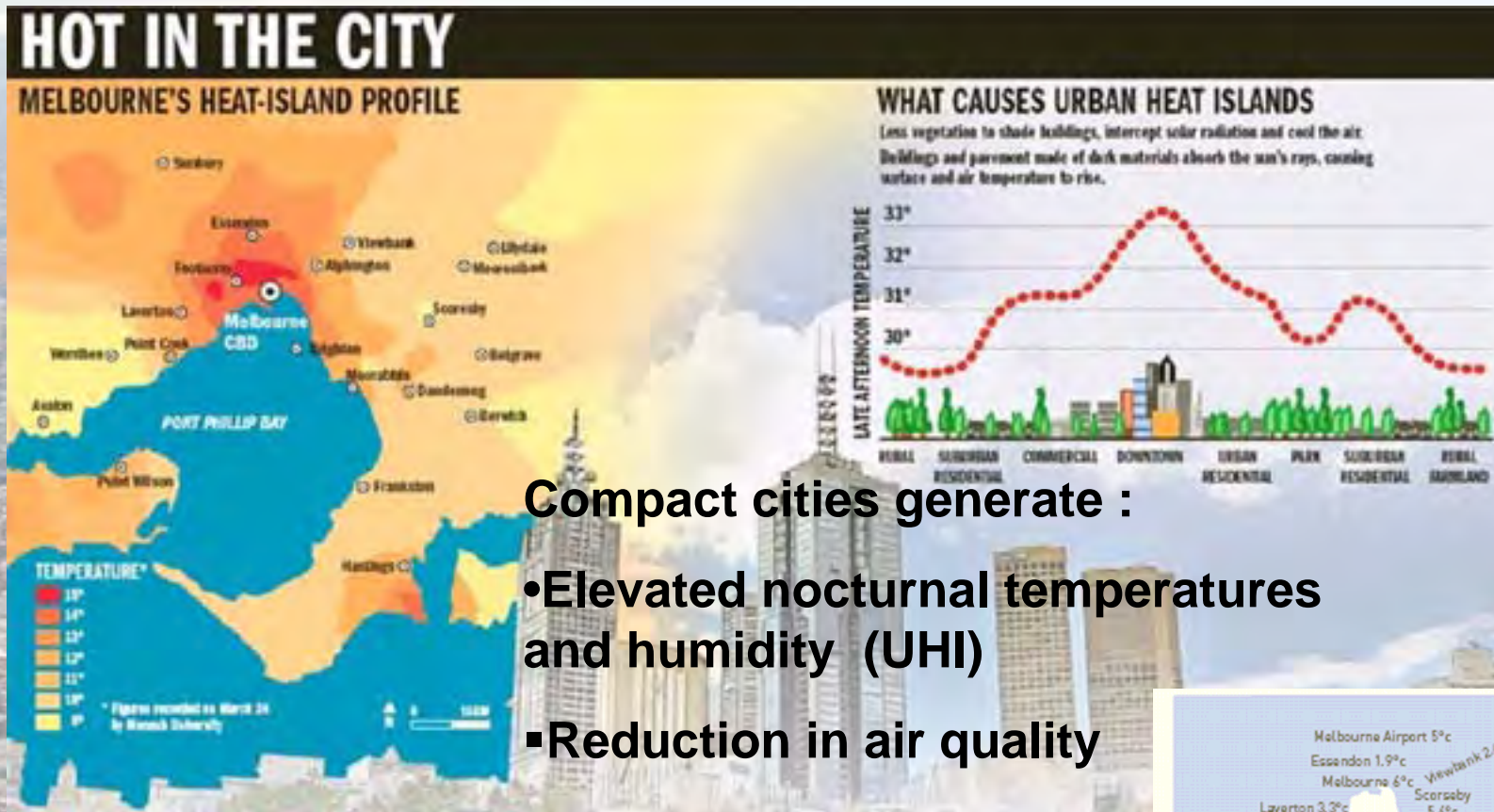
**Growth will be concentrated  
within high density mixed  
used activity centres**

**Establishment of an Urban  
Growth Boundary**



(Source – DSE, 2005)

# The compact city: *Implications for human health*



Compact cities generate :

- Elevated nocturnal temperatures and humidity (UHI)
- Reduction in air quality



(Source – BOM, 2005)

# Aims

The overall objective of this research investigation is to assess whether the change from a present day urban morphology to a proposed *Melbourne 2030* activity centre will increase urban temperatures and impact upon human thermal comfort levels.

Car based orientated urban sprawl centre



Activity Centre



(Source – DSE, 2005)

## **IMPACTS**

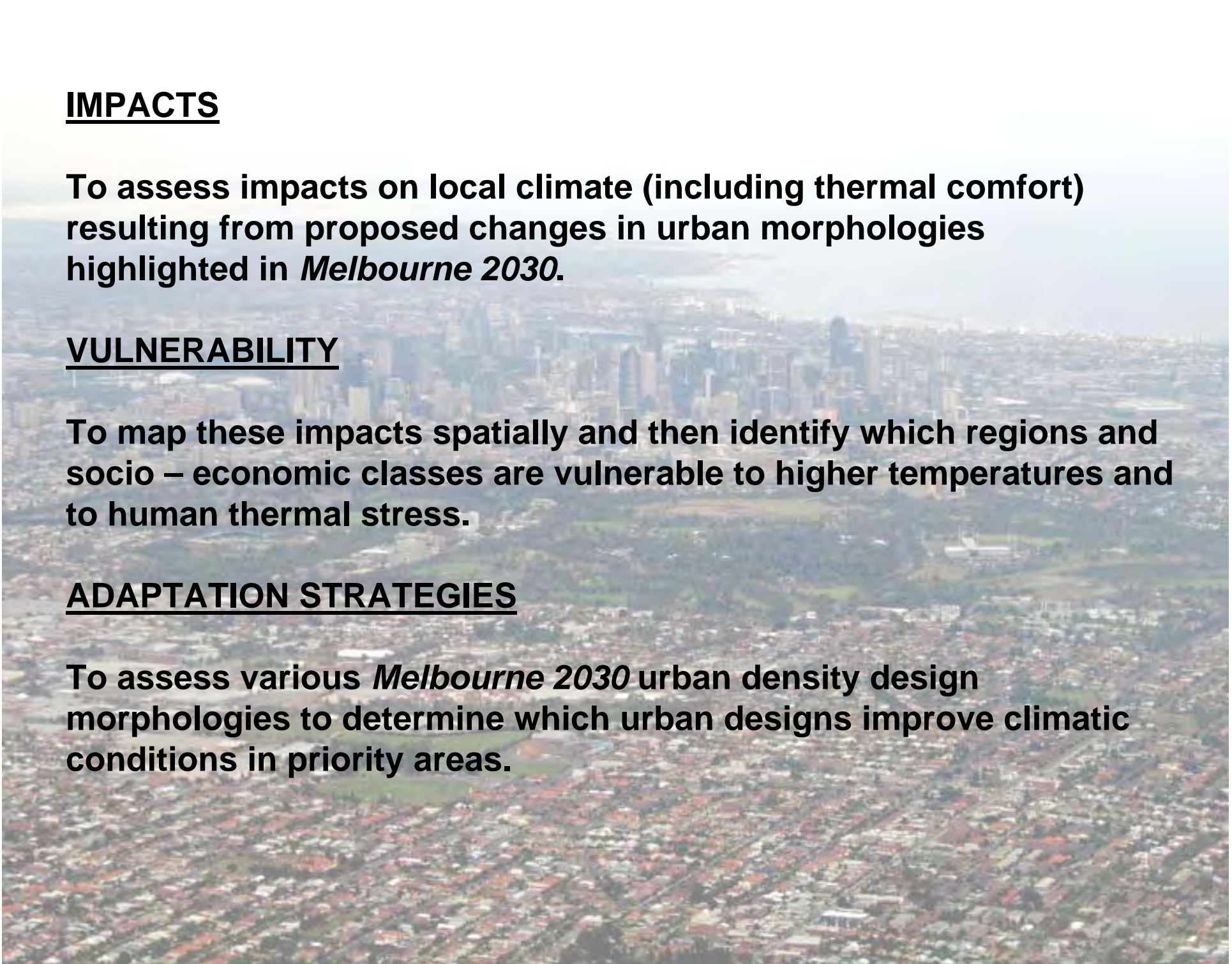
**To assess impacts on local climate (including thermal comfort) resulting from proposed changes in urban morphologies highlighted in *Melbourne 2030*.**

## **VULNERABILITY**

**To map these impacts spatially and then identify which regions and socio – economic classes are vulnerable to higher temperatures and to human thermal stress.**

## **ADAPTATION STRATEGIES**

**To assess various *Melbourne 2030* urban density design morphologies to determine which urban designs improve climatic conditions in priority areas.**



**In order to analyse various urban densities three scenarios have been selected:**

- 1. High – Medium - Low Density Residential Developments**
- 2. Present day urban morphologies and *Melbourne 2030* activity Centres - to represent different urban densities, green spaces, socio economic classes and infrastructure development**
- 3. Climate Change Impacts**





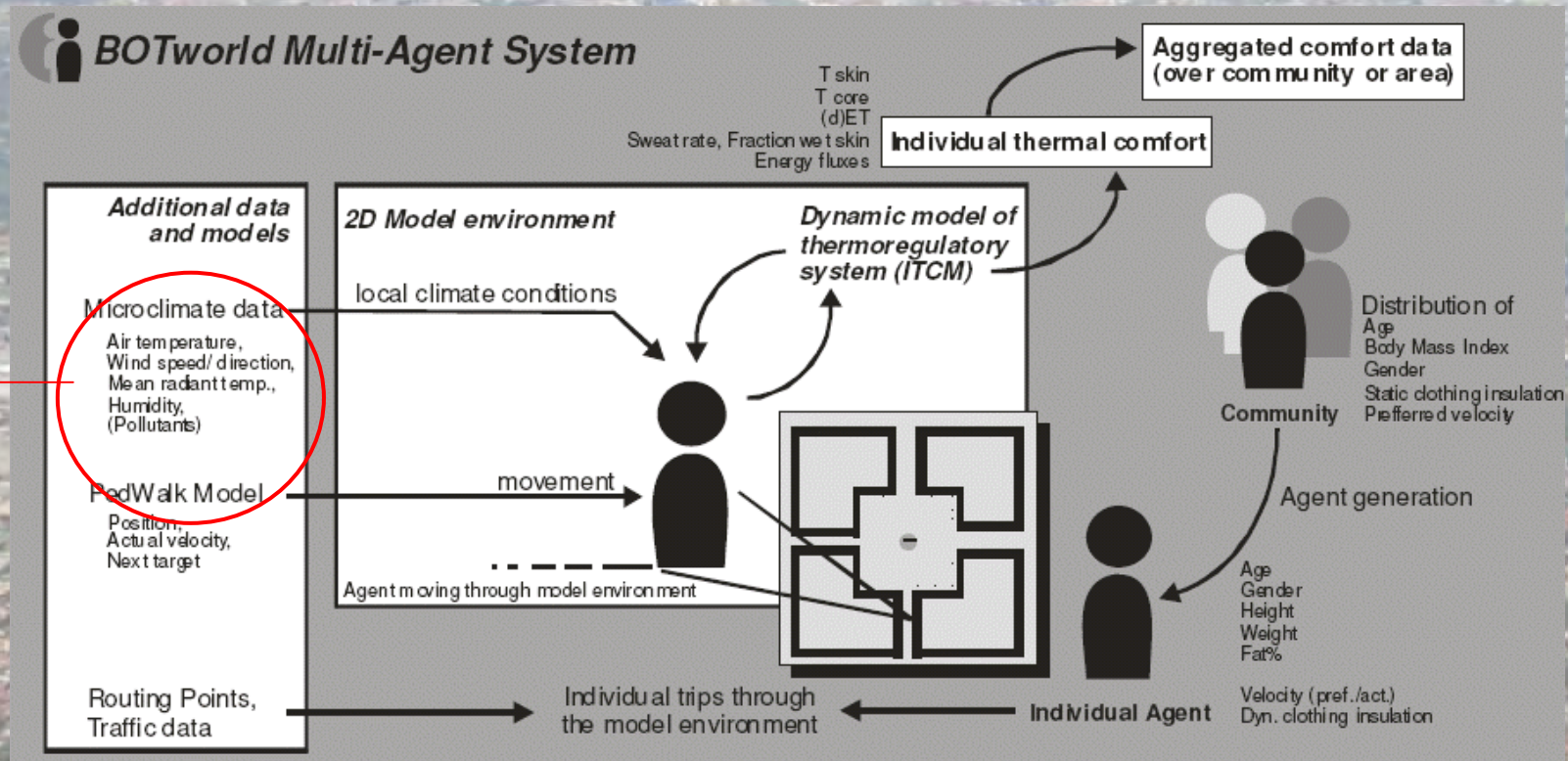


# botWORLD : multi agent modelling system

“climBOT” are virtual pedestrians that move around the urban environment on a user defined path

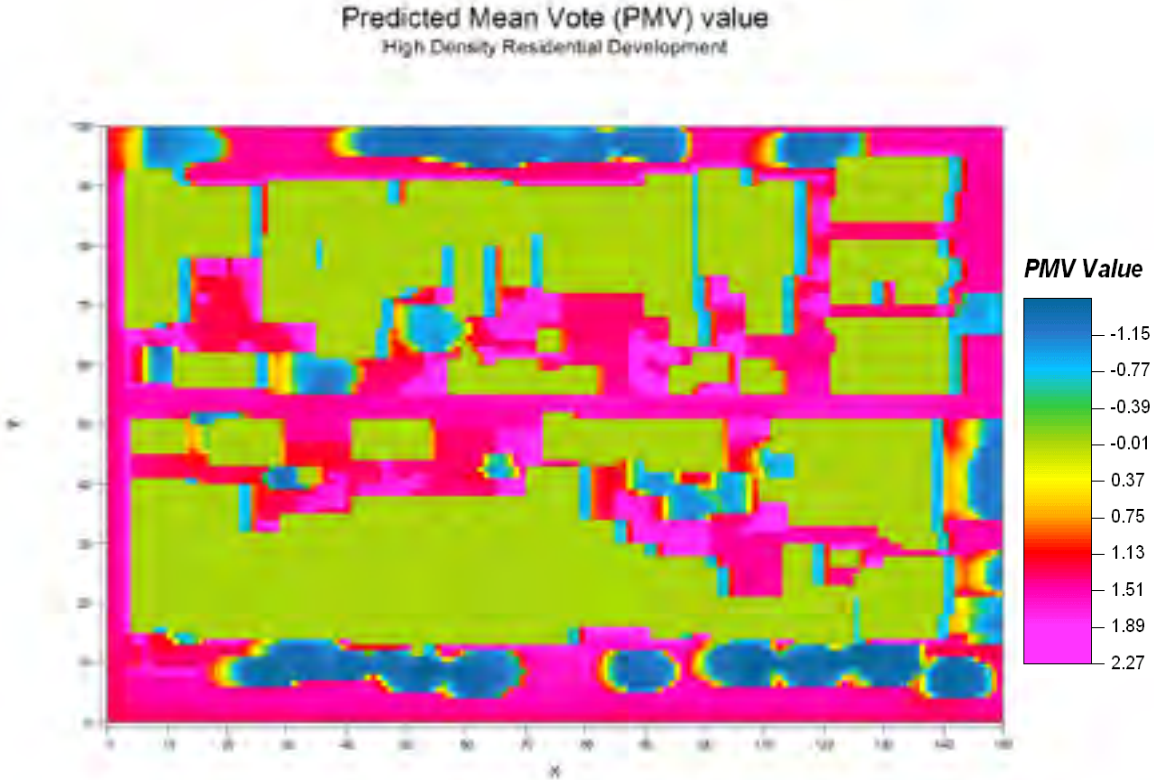
BOTworld uses a complex biometeorological model (ITCM) to simulate the reaction of the human body to the urban design, climatic variables and air quality

ENVI –met  
output results

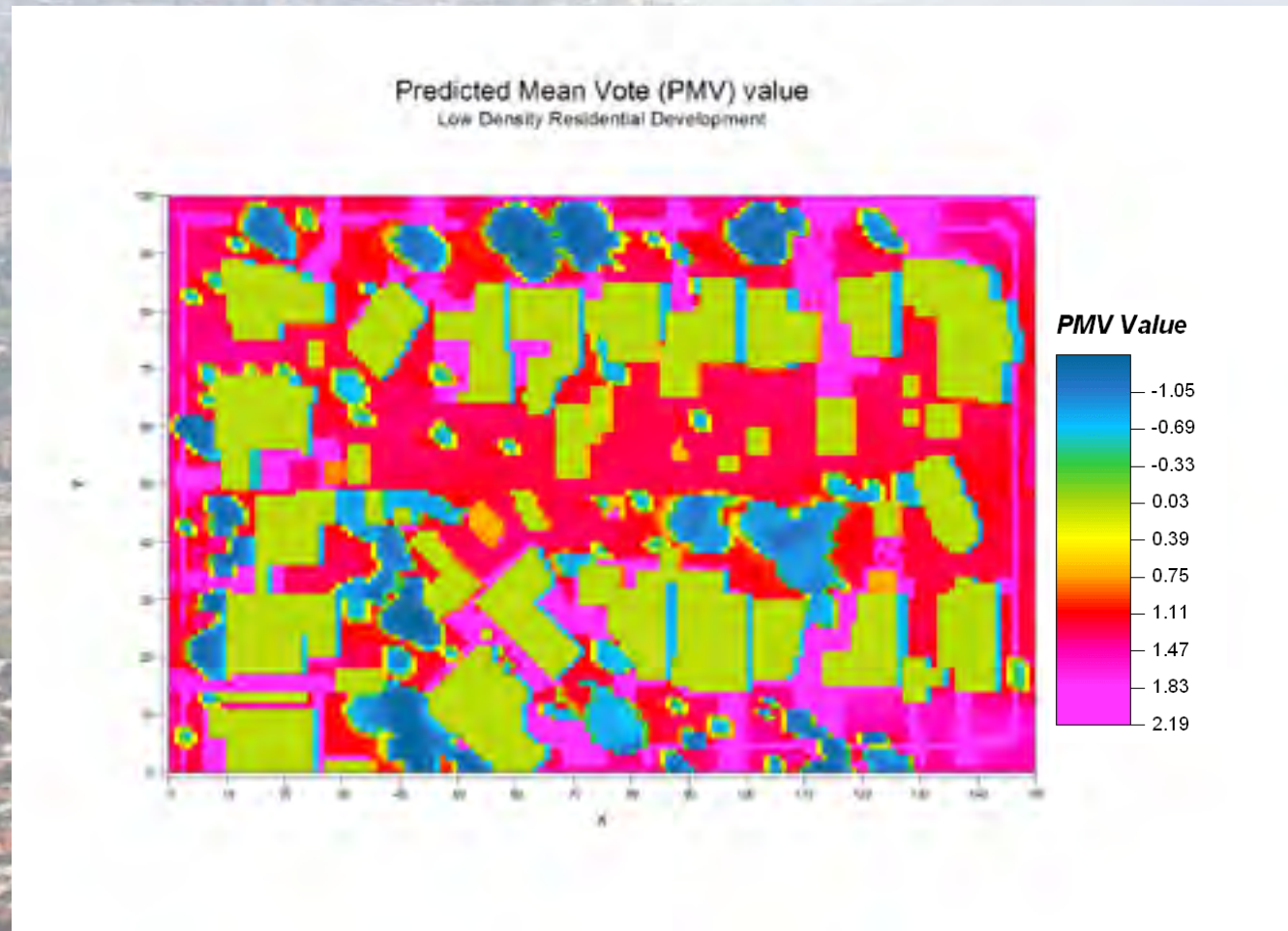


# Preliminary Results : *ENVI - met*

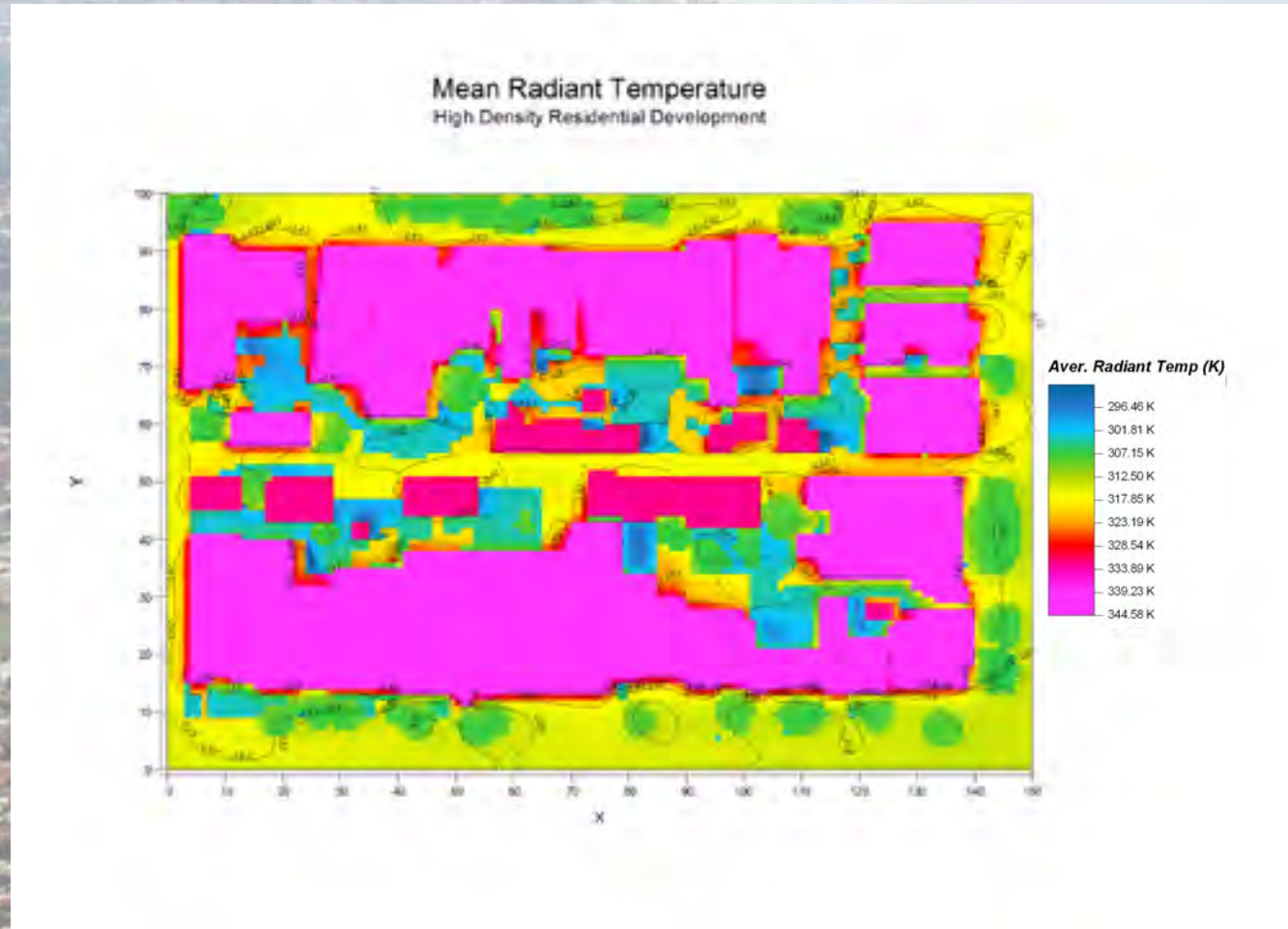
The spatial distribution of the outdoor Predicted Mean Vote Index in a high density residential development is at 2.5 indicating a thermal sensation of strong heat stress



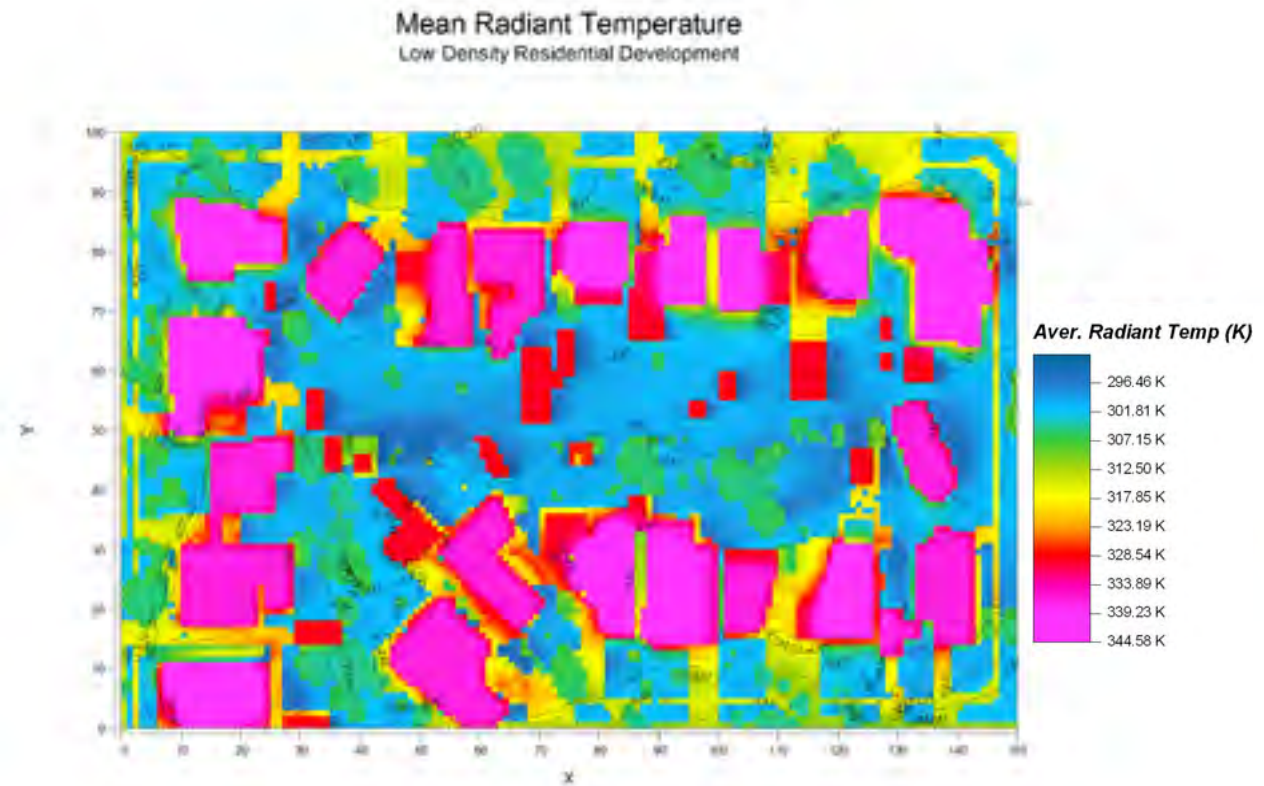
The spatial distribution of the outdoor Predicted Mean Vote Index in a low density residential development is at 1.0 indicating a thermal sensation of slightly warm



The spatial distribution of the Mean Radiant Temperature within a high density residential development demonstrates temperatures in excess of 45°C

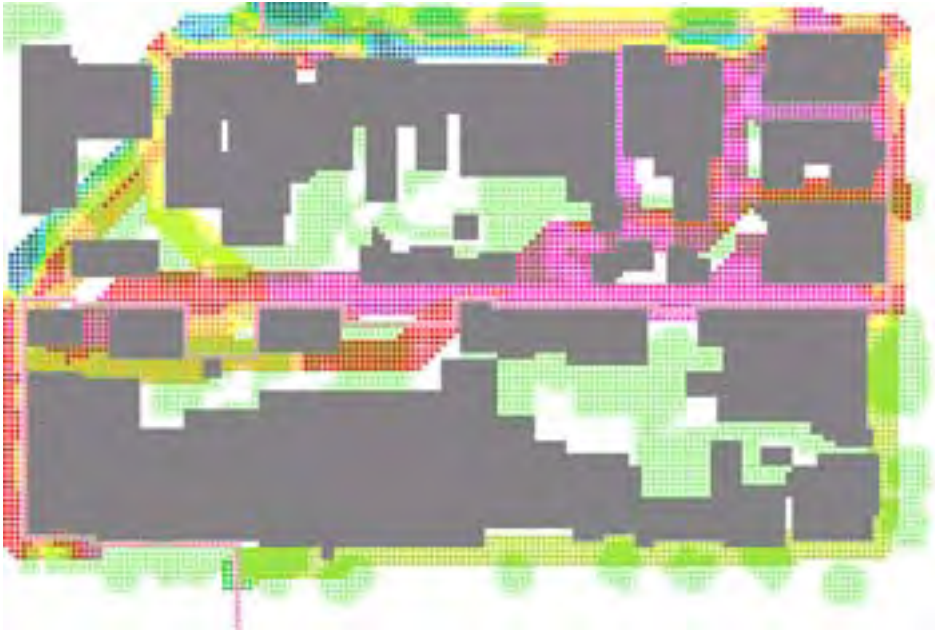
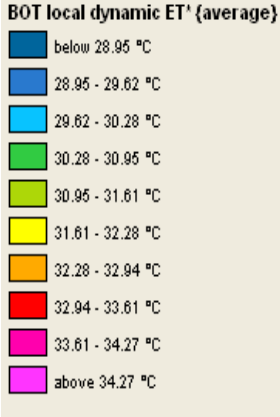
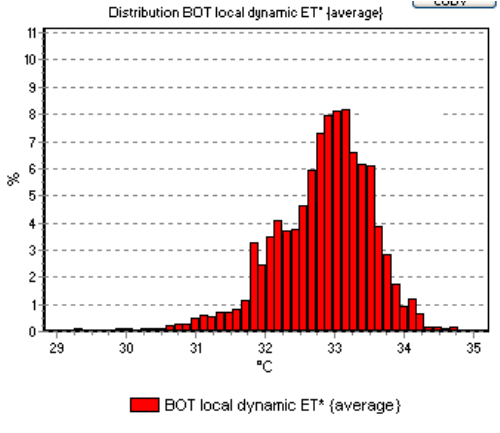


The spatial distribution of the Mean Radiant Temperature within a low density residential development dominated by vegetative surfaces demonstrates temperatures at approximately 35°C





# Spatially aggregated data of the dynamic Effective Temperature measures non steady state effects (dynamic skin and core temperature) and motion



Bot ID #2511

Name: Salvador Bot

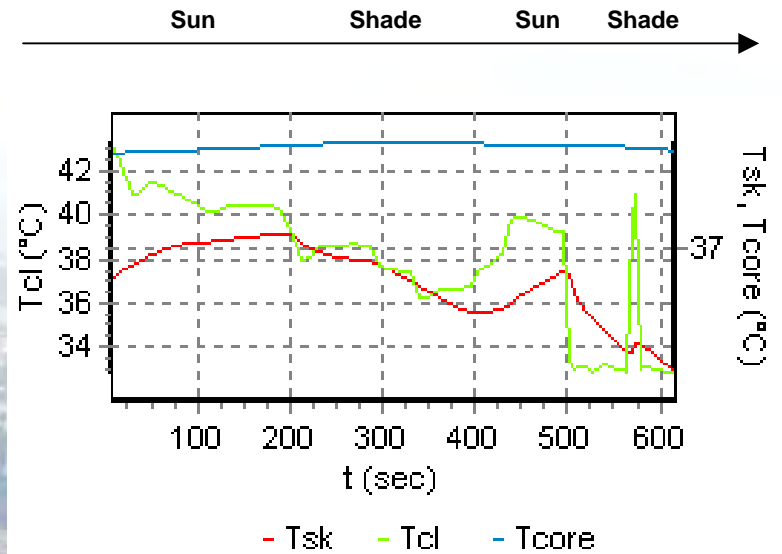
Age: 32 yrs old

Height : 1.69 m

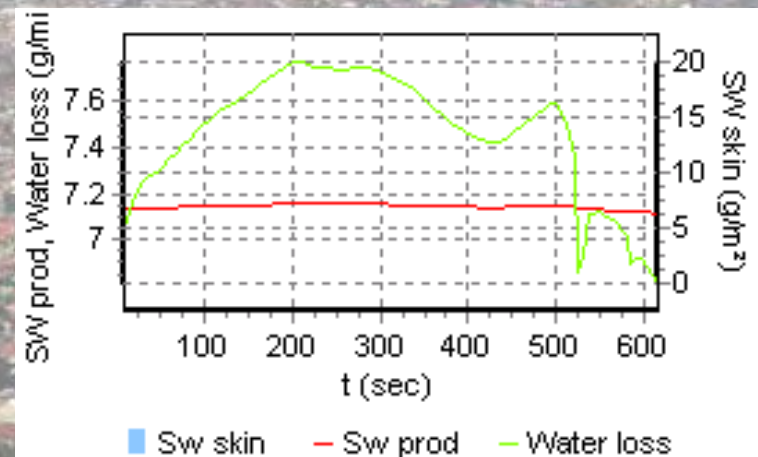
Weight : 65.28 kg



Salvador bot route



**Initial increases in Salvador Bots' skin temperature and sweat production due to high air temperatures and no direct shade**



# Outcomes

- A useful planning adaptation tool to metropolitan Melbourne councils
- Provide metropolitan Melbourne councils with a graphical representation of the potential climatic and bioclimatic information for proposed *Melbourne 2030* activity centres within their municipality

# Future Work

- Model Simulations for present day urban morphologies and Melbourne 2030 activity centres scenario
- Climate change impacts scenario

# References

- Ali-Tourdet F and Mayer H (2007) *Effects of asymmetry, galleries, overhanging facades and vegetation on thermal comfort in urban street canyons*. *Solar Energy* (81): 742 – 754
- Bruse M and Fleer H (1998) *Simulating surface – plant – air interactions inside urban environments with a three dimensional numerical model*. *Environmental modeling and software* (13): 373 -378
- Bruse (2000) *Assessing thermal comfort in urban environments using an integrated dynamic microscale biometeorological model system*, Third Symposium on the Urban Environment, AMS Conference, Davis, CA, USA, 2 pages
- Bruse (2003) *Assessing Urban Microclimate using Multi-Agent Simulations: A new approach to answer an old problem?*. ICUC5, Lodz 1-5- September 2003.
- Bruse M (2002) *Multi agent simulations as a tool for the assessment of urban microclimate and its effects on pedestrian behavior*. Proceedings of the iEMSs Conference 2002, Lugano, 6 pages
- Bruse M (2005) *ITCM – a simple dynamic 2 - node model of the human thermoregulatory system and its application in a multi agent system*. *Annual Meteorology* (41) : 398 - 401
- Bruse M (2007) *BOTworld : exploring your environment: Introducing BOTworld*. [www.botworld.info](http://www.botworld.info).
- Department of Sustainability and Environment (2005) *Melbourne 2030 - Planning for Sustainable Growth*. Department of Sustainability and Environment, Victoria, Australia
- Department of Sustainability and Environment (2007) *Climate Change in Victoria : A summary*. State Government of Victoria.

Thank - you

**If you have any further questions please  
email me,**

**Nadine D'Argent @:**

**[nmdar2@student.monash.edu.au](mailto:nmdar2@student.monash.edu.au)**