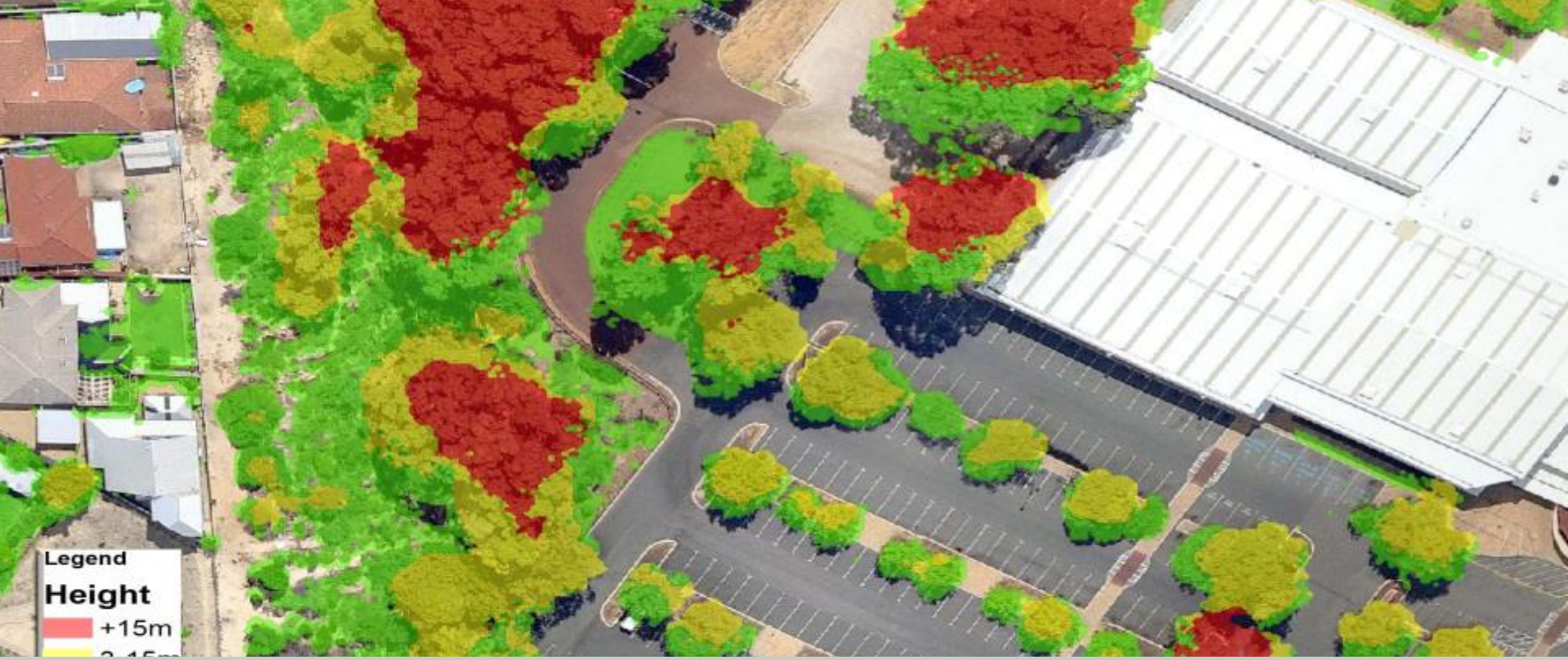


Accurate diagnosis, precision monitoring and sustainable management of urban forests

ArborCarbon

Warwick, UK | 21 September 2015

Paul Barber

Director | ArborCarbon

Adjunct Associate Professor | Murdoch University

A clear message

On 20 September 2015 the newly appointed Australian Prime Minister Malcolm Turnbull stated:

> *"**Liveable, vibrant** cities are absolutely critical to our **prosperity**"*
>
> *"We often overlook the fact, that liveable cities.. efficient, productive cities..the **environment of cities**, are **economic assets**"*
>
> *"…because the **most capital in the world** today is not financial capital….it is **human capital**"*
>
> *"Infrastructure should be assessed **objectively** and **rationally** on its merits. There is no place for ideology."*

A new minister appointed within the Ministry of the Environment…

> ***Minister for Cities and the Built Environment***

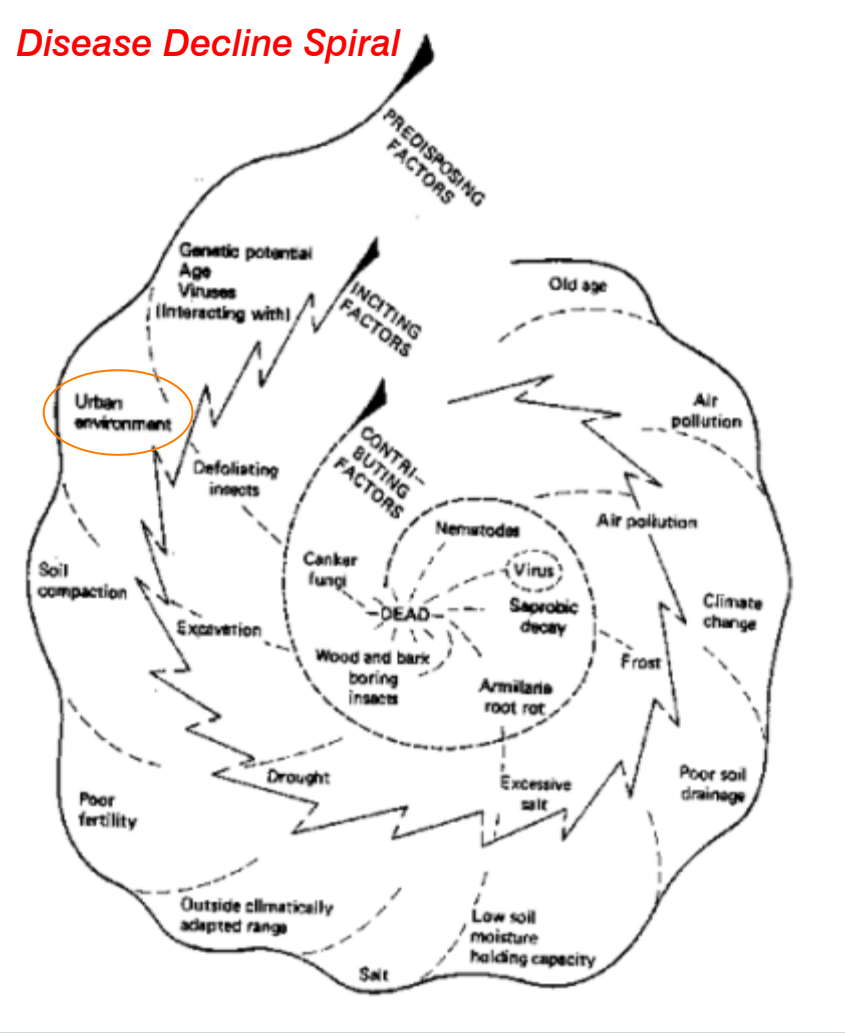
In my opinion…**healthy, vibrant green assets** are critical to the success of this initiative

Arbor Carbon

Accurate diagnosis of urban tree health disorders

- *To have healthy, vibrant green assets we must protect what exists and not simply replace*
- *Health diagnosis of urban trees often difficult*
  - *Urban trees present different challenges to plantation or forest trees (forest pathologist)*
  - *No formal qualification required*
  - *Pathology experience beneficial*
  - *Misdiagnosis by Arborists is common*
    - *Often very limited training in pest & disease diagnosis*
    - *Very diverse field with a wide array of disorders & hosts*
    - *Diagnosis of the symptom easy – how about the cause?*

Accurate diagnosis of urban tree health disorders



Manion 1991

Predisposing Factors

- *Poor nursery stock*
- *Poor planting technique*
- *Suboptimal soil volume / quality*
- *Off-site planting*

Inciting Factors

- *Poor pruning*
- *Mechanical / Construction*
- *Extreme weather events*
- *Pathogens/Pests*
- *Chemical damage*
- *Prolonged Water stress*
- *Prolonged Heat stress*
- *Sunburn!*

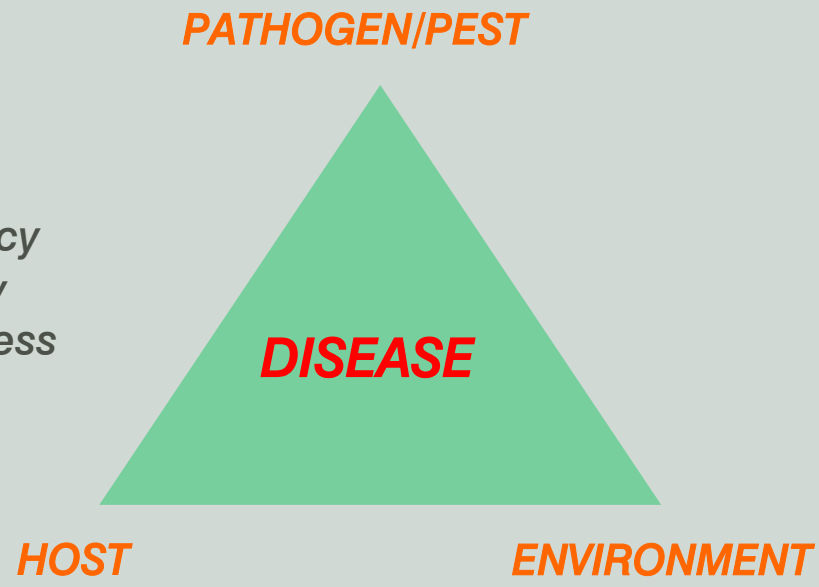
Contributing Factors

- *Phellinus / Armillaria*
- *Phytophthora*
- *Stem-borers / Bark Beetles*

ArborCarbon

Accurate diagnosis of urban tree health disorders

Pathogen
- Presence
- Pathogenicity
- Adaptability
- Dispersal efficiency
- Survival efficiency
- Reproductive fitness



Environment
- Temperature
- Rainfall (duration/intensity)
- Leaf wetness period
- Soil temperature
- Frost
- Soil water content
- Soil fertility
- Wind
- Fire history
- Air pollution
- Chemicals
- Grade change

Host
- Susceptibility
- Growth stage and form
- Structural integrity/wounding
- Population density and structure
- General health/vigour

Accurate diagnosis of urban tree health disorders

Mechanical / Construction damage

Herbicide damage

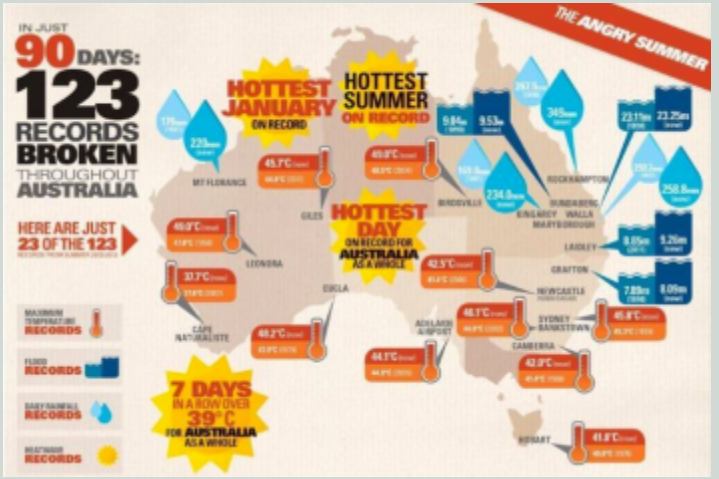
Poor stock

ArborCarbon

Accurate diagnosis of urban tree health disorders

Nutrient deficiencies/toxicities

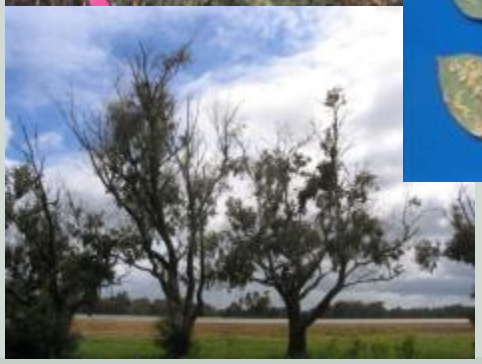
Extreme Weather



Arbor Carbon

Accurate diagnosis of urban tree health disorders

Insect Pests



Pathogens

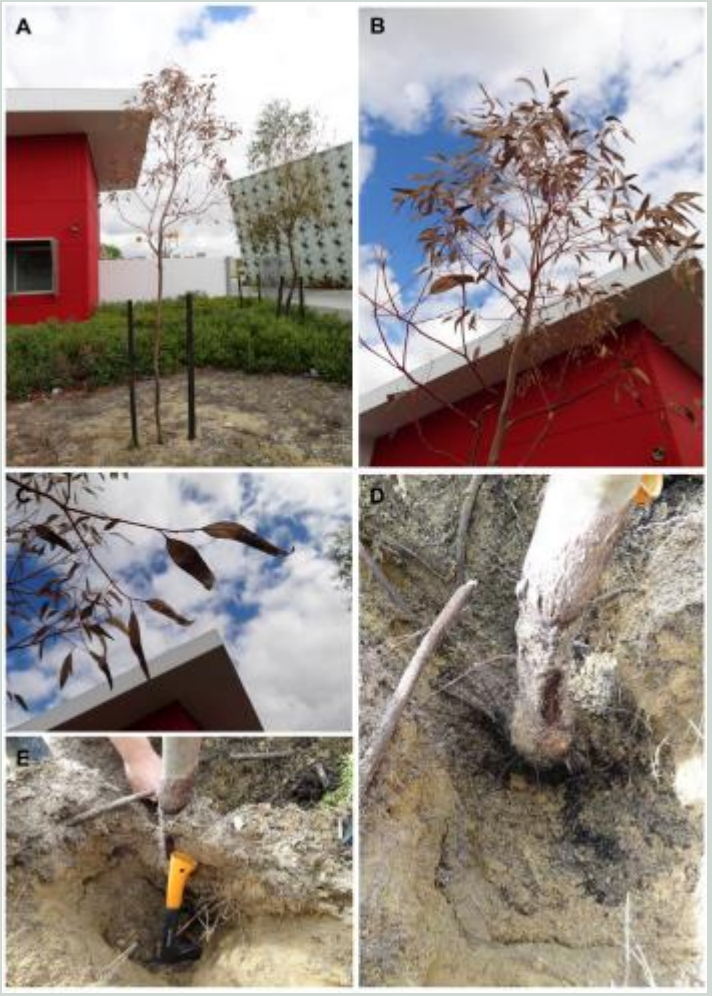
Ophiostoma eucalyptigena
Barber & Crous
Persoonia (2015) 37192-193

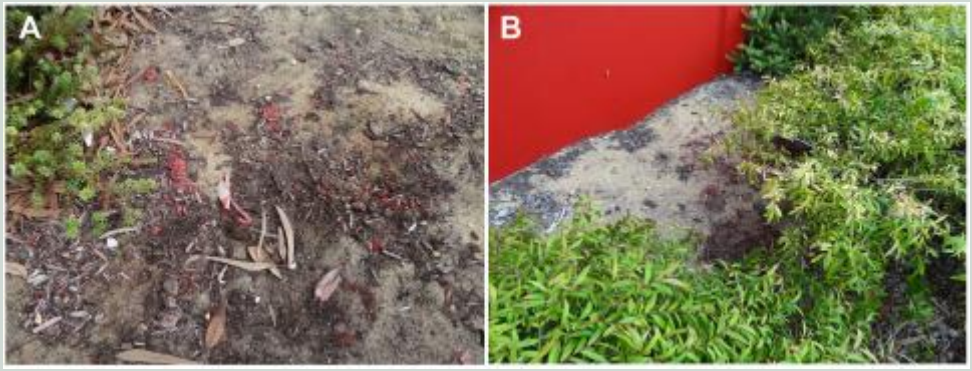
Barber, Paap et al. 2013 A diverse range of *Phytophthora* species are associated with dying urban trees in an Australian capital city. UFUG 12: 569-575.

ArborCarbon

Accurate diagnosis of urban tree health disorders

Case Studies – 2012 – Death of groundcovers and newly planted advanced trees in school





ArborCarbon

Accurate diagnosis of urban tree health disorders

Case Studies – Declining Boab Kings Park & Dead Marri in Golf Course

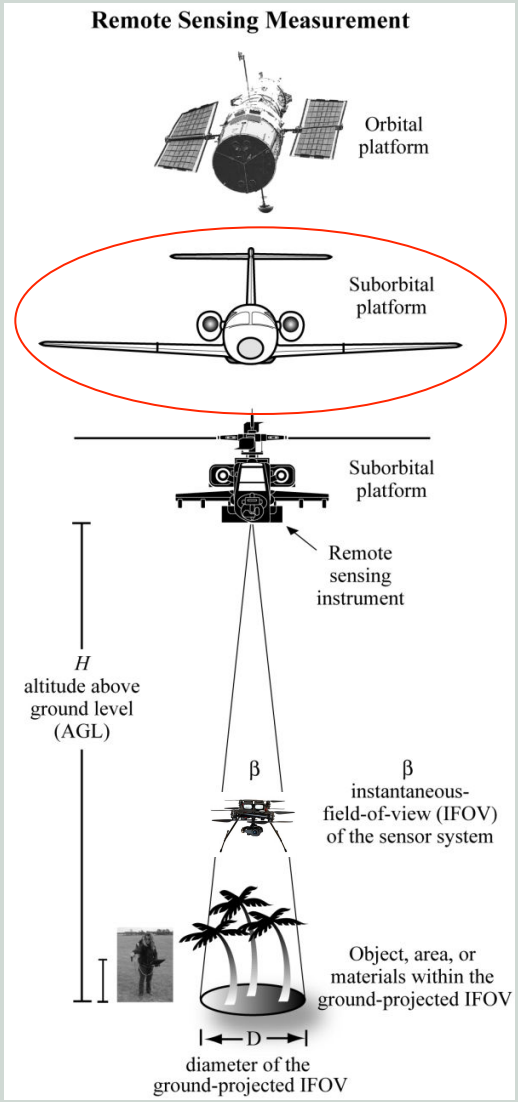
Graphium jumulu Barber & Crous
Persoonia (2015) 37: 190-191

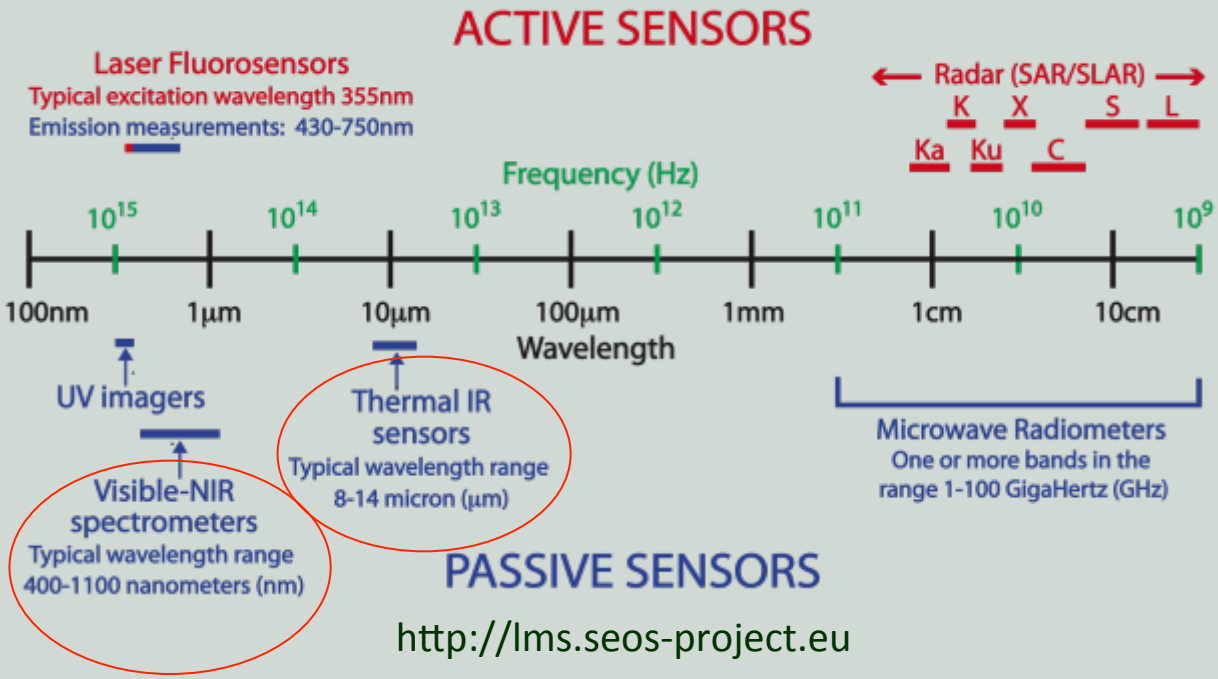
ArborCarbon

Precise monitoring of the urban forest

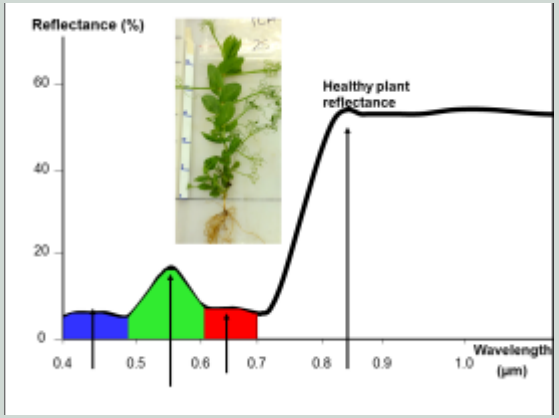
- *Why do we need to monitor?*
  - *To set targets must know what we have*
    - *Baseline*
    - *Increase canopy cover by xx %*
    - *Species diversity = resilience*
    - *Maintain/improve health and growth*
  - *Outcome*
    - *less inputs = less $$ = lower carbon footprint*
    - *More funds to allocate to maintaining health*
      - *proactive approach V reactive approach*
  - *i-tree canopy approach has some limitations*
    - *Relies upon dated google earth imagery, inaccuracies when differentiation between canopy and non-canopy, dead and living grass grouped, no condition/health information*
    - *Models have limitations*

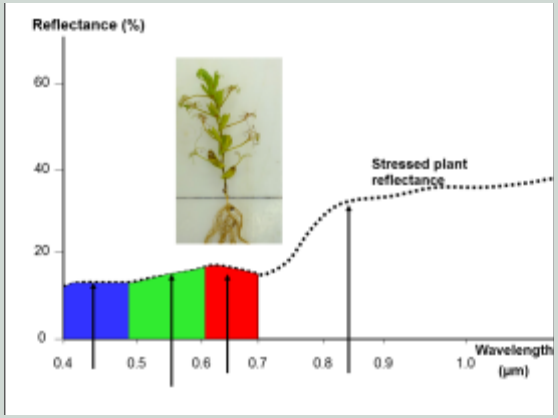
Precise monitoring of the urban forest





http://lms.seos-project.eu



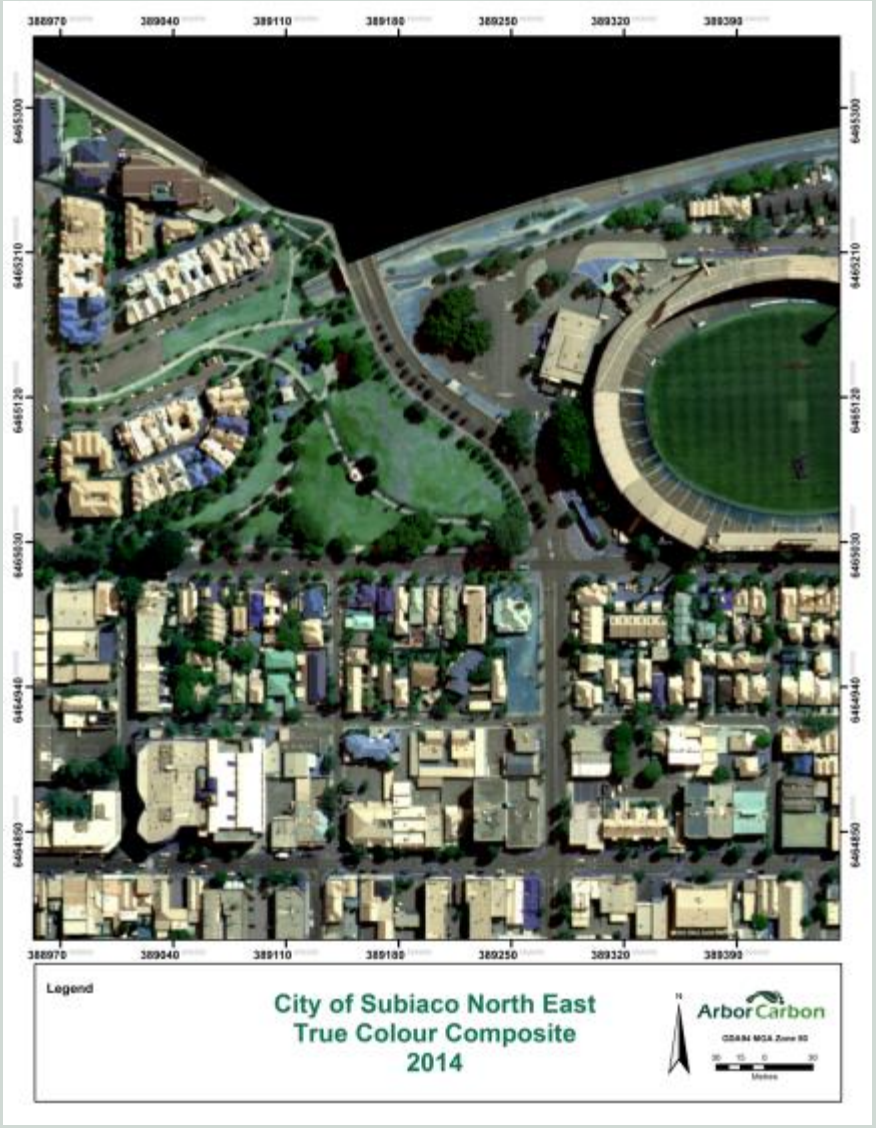


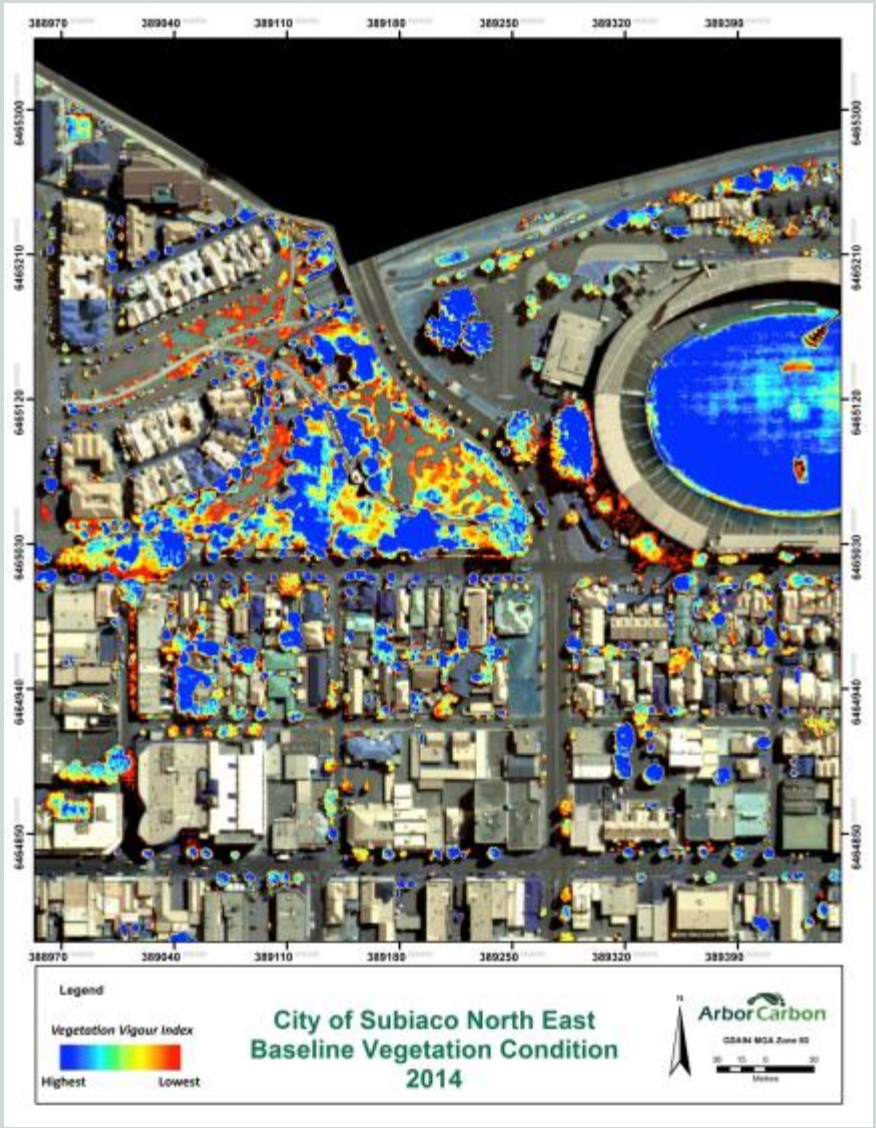
Lim et al. DOI: 10.5772/8319

Source: Felipe Burgos

ArborCarbon

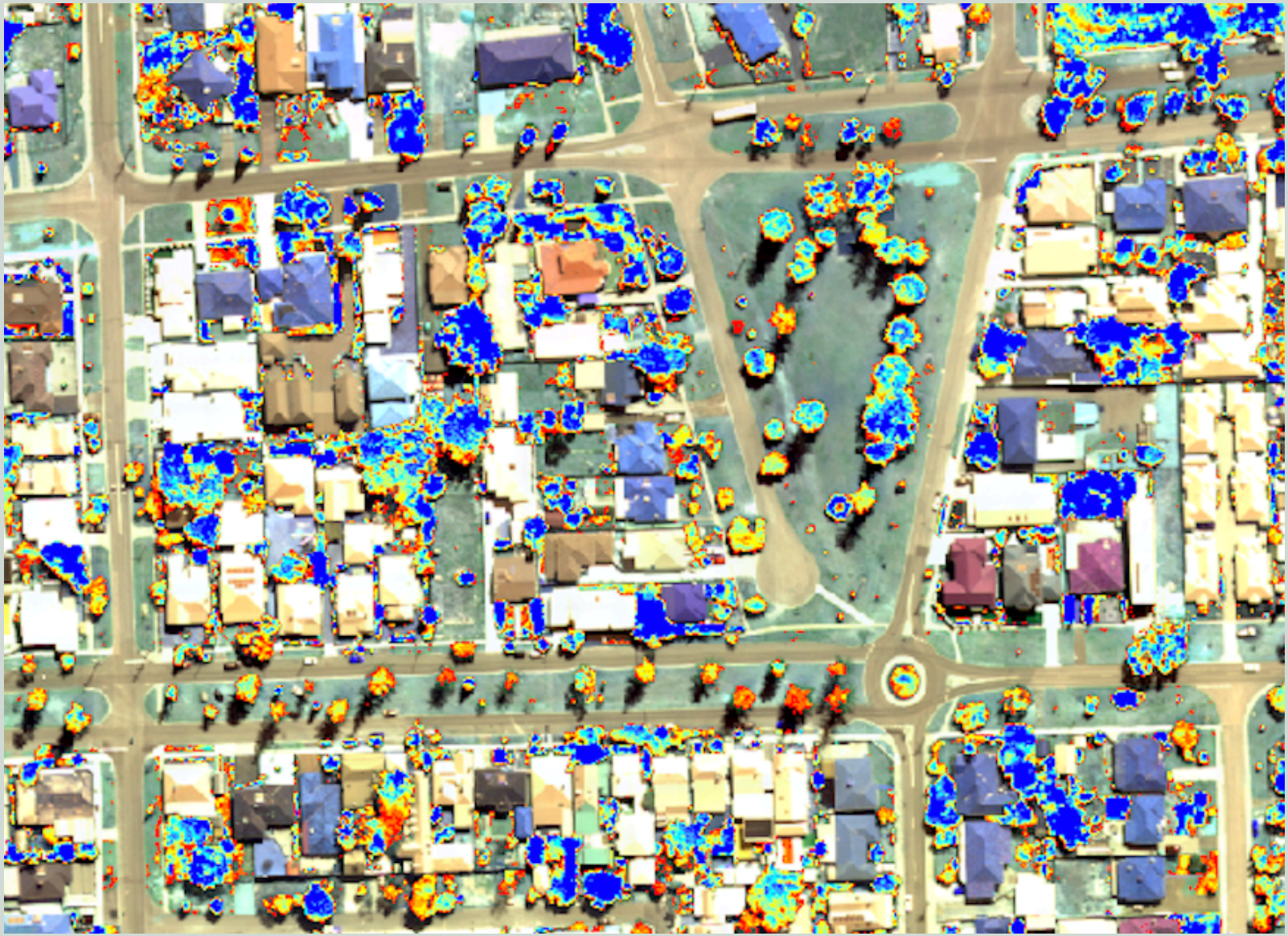
Precise monitoring of the urban forest





ArborCarbon

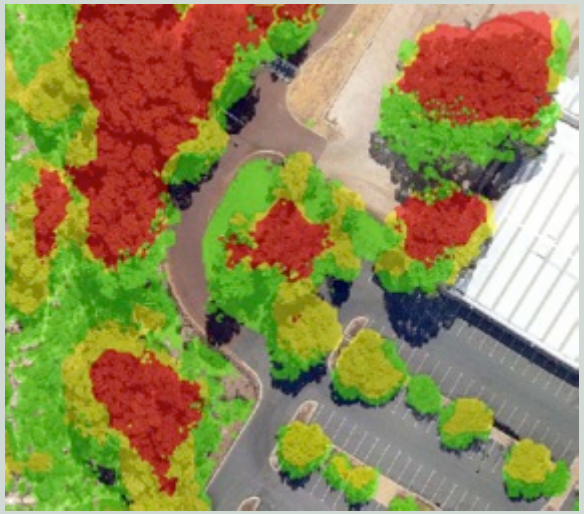
Precise monitoring of the urban forest



ArborCarbon

Precise monitoring of the urban forest

- *Red line indicates landscape view as seen above*

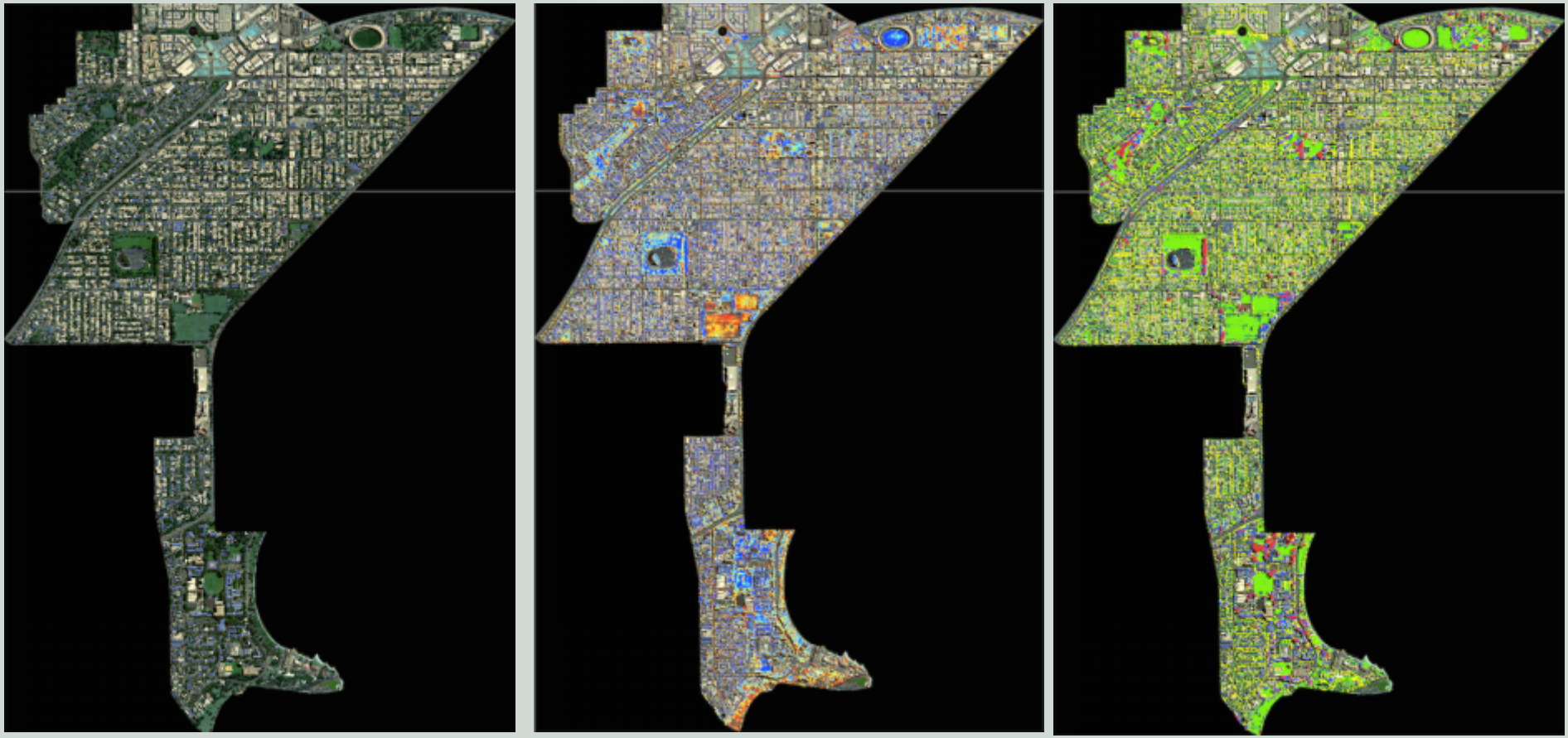


ArborCarbon

Precise monitoring of the urban forest

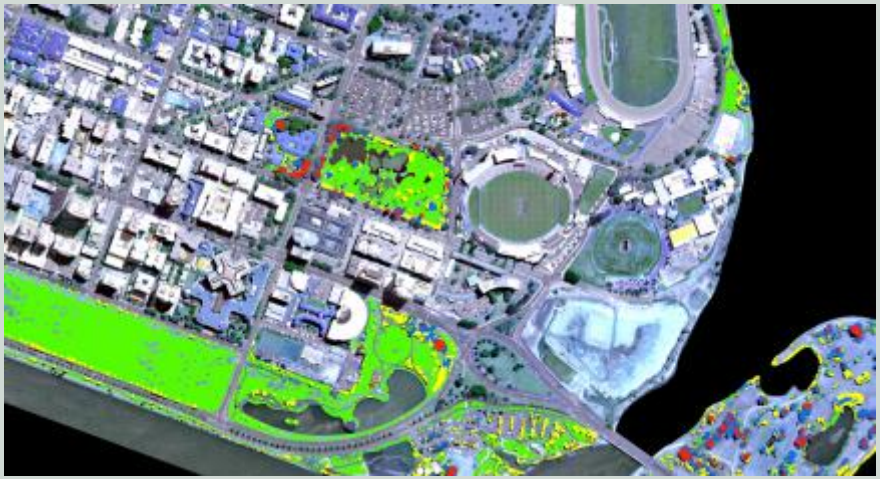
ArborCarbon

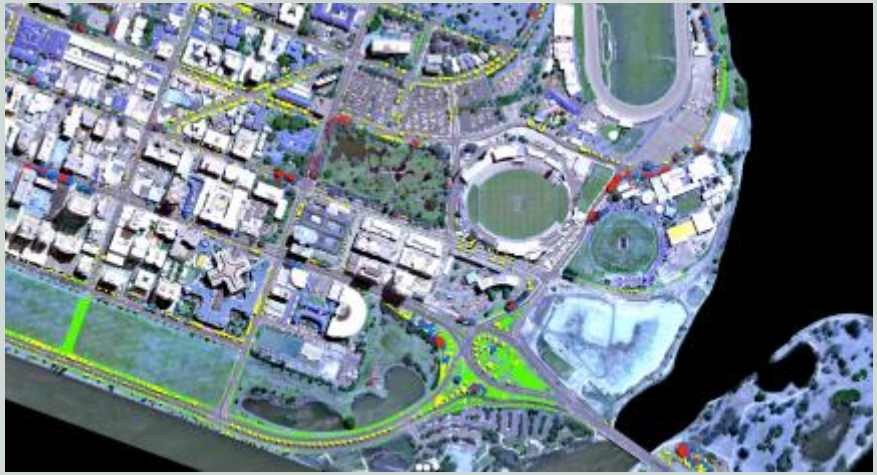
Precise monitoring of the urban forest

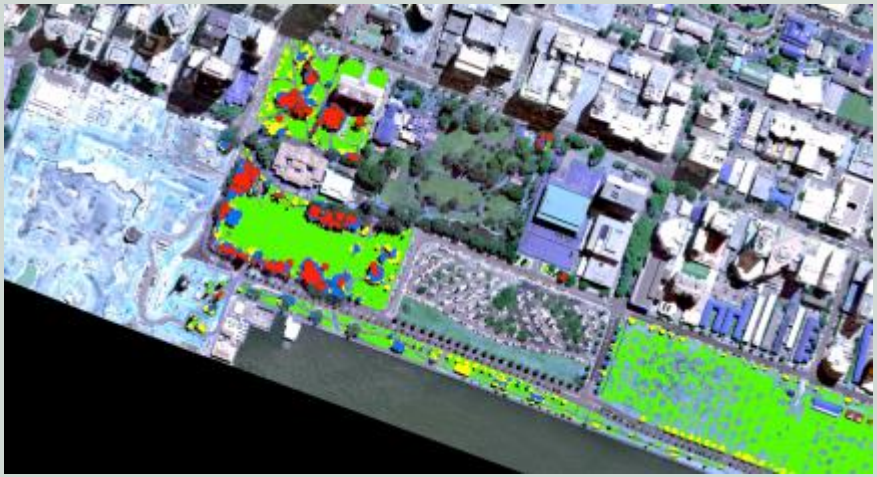


ArborCarbon

Precise monitoring of the urban forest

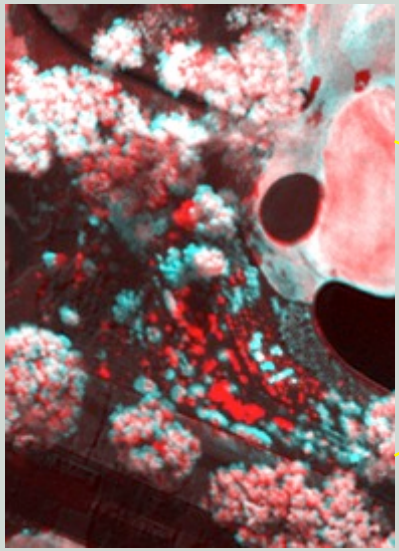




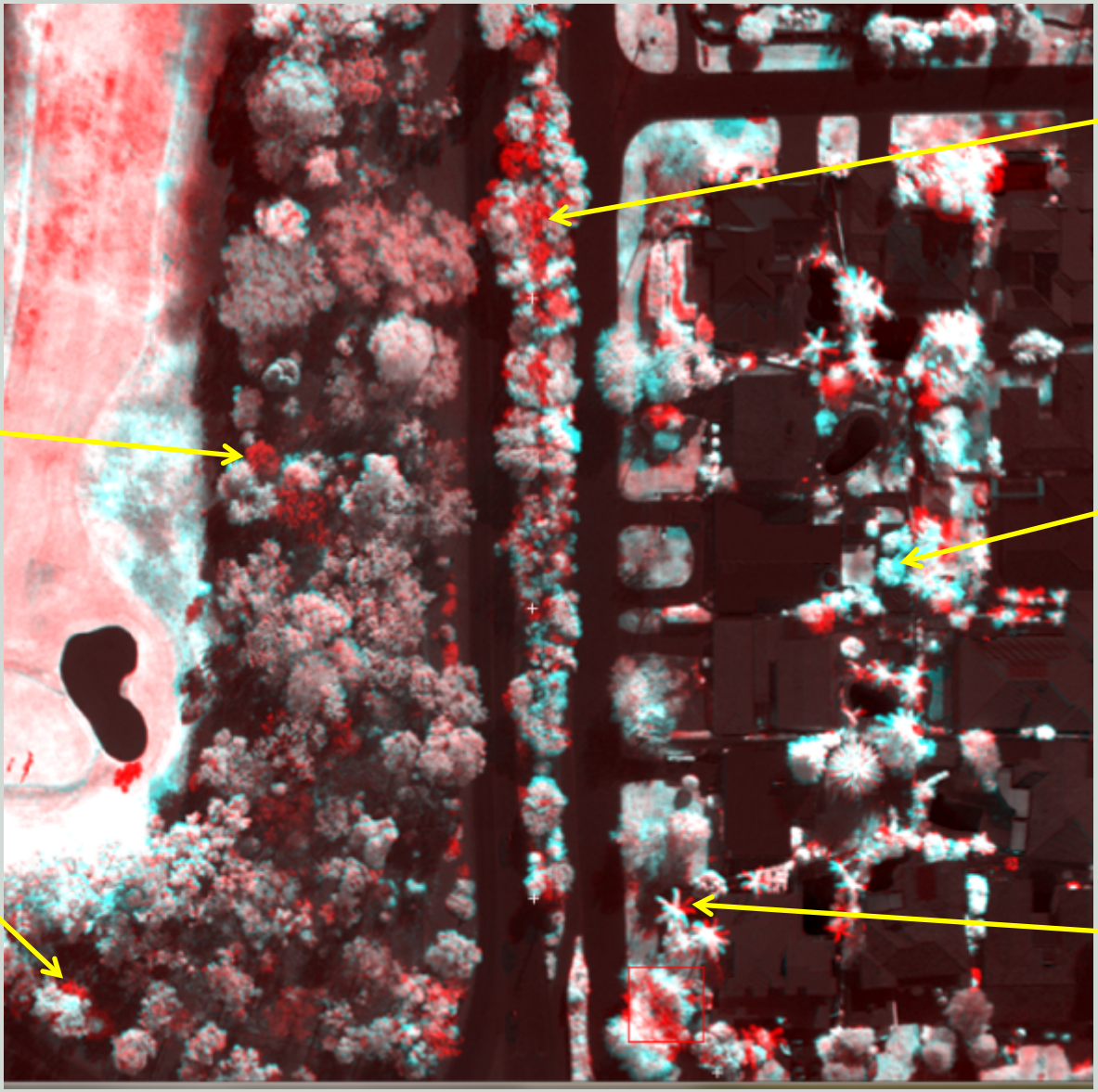


ArborCarbon

Precise monitoring of the urban forest



Precise monitoring of the urban forest

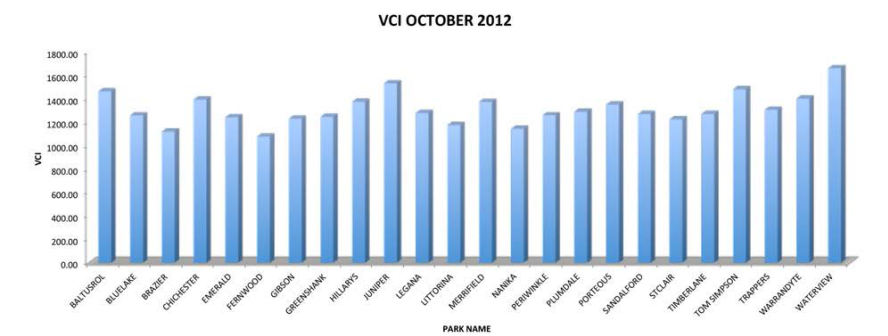


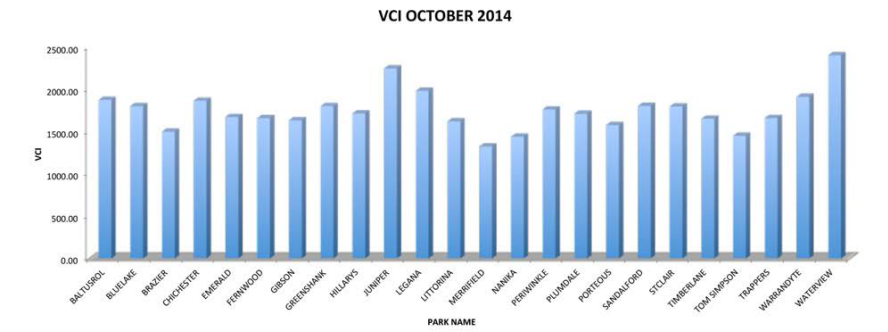
ArborCarbon

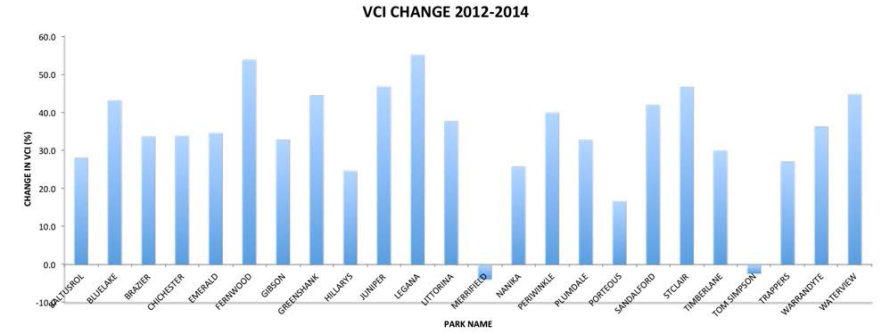
Precise monitoring of the urban forest

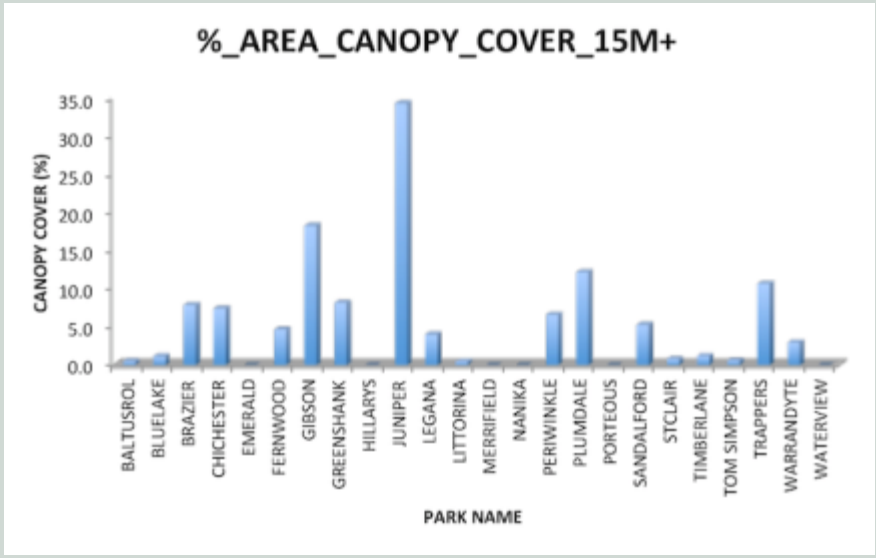
ArborCarbon

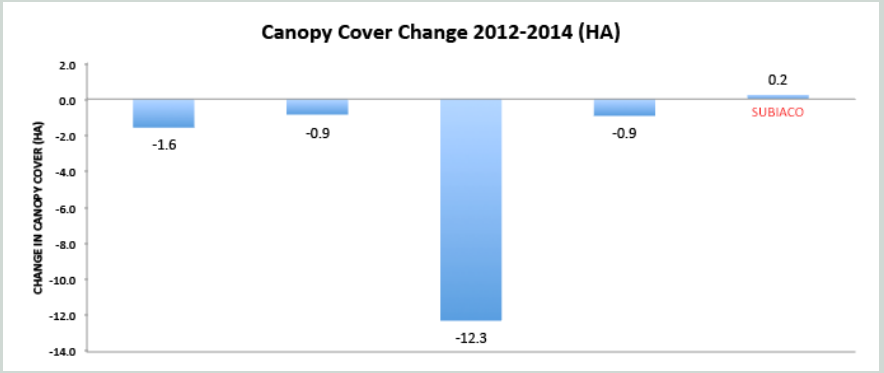
Precise monitoring of the urban forest





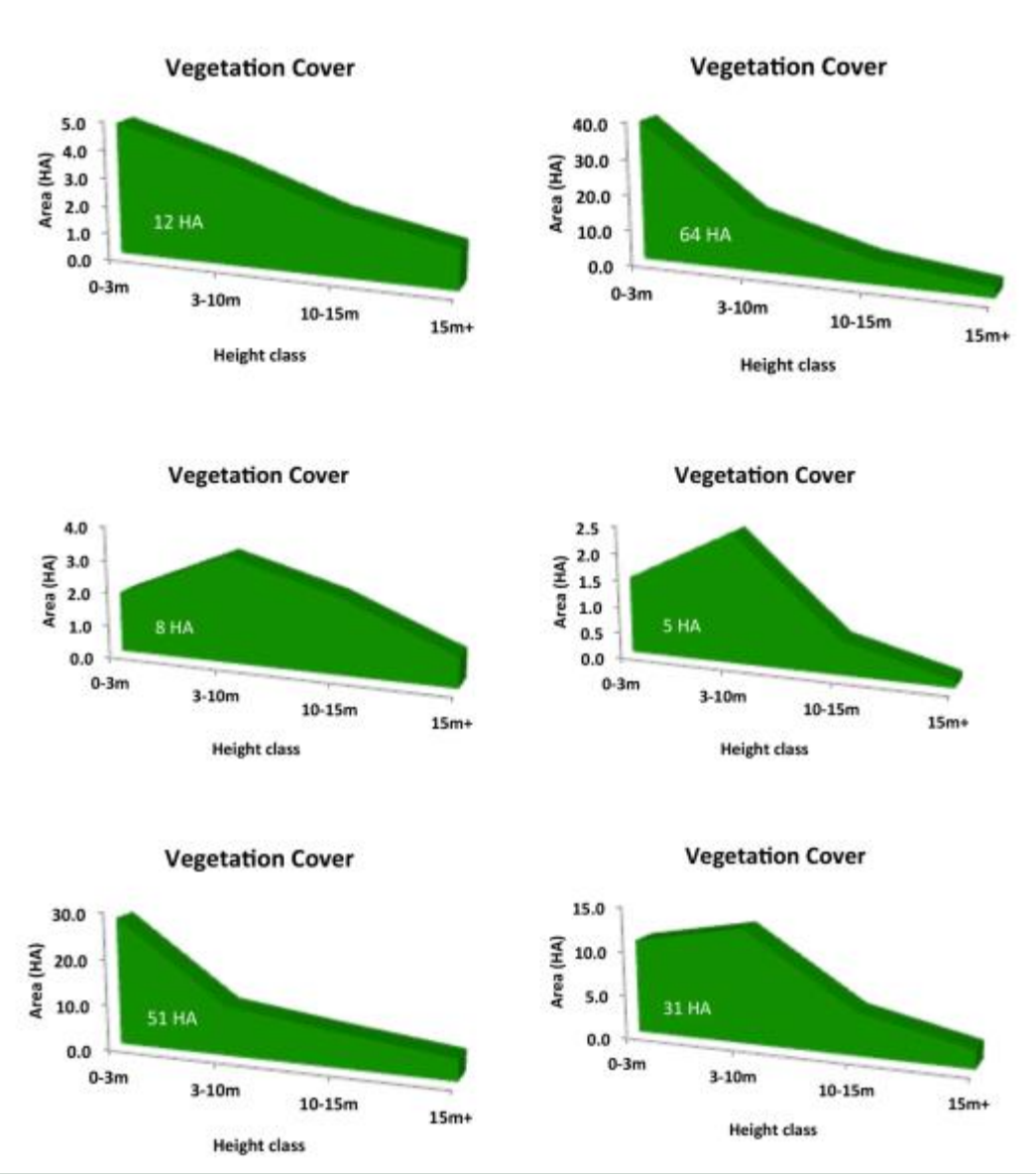






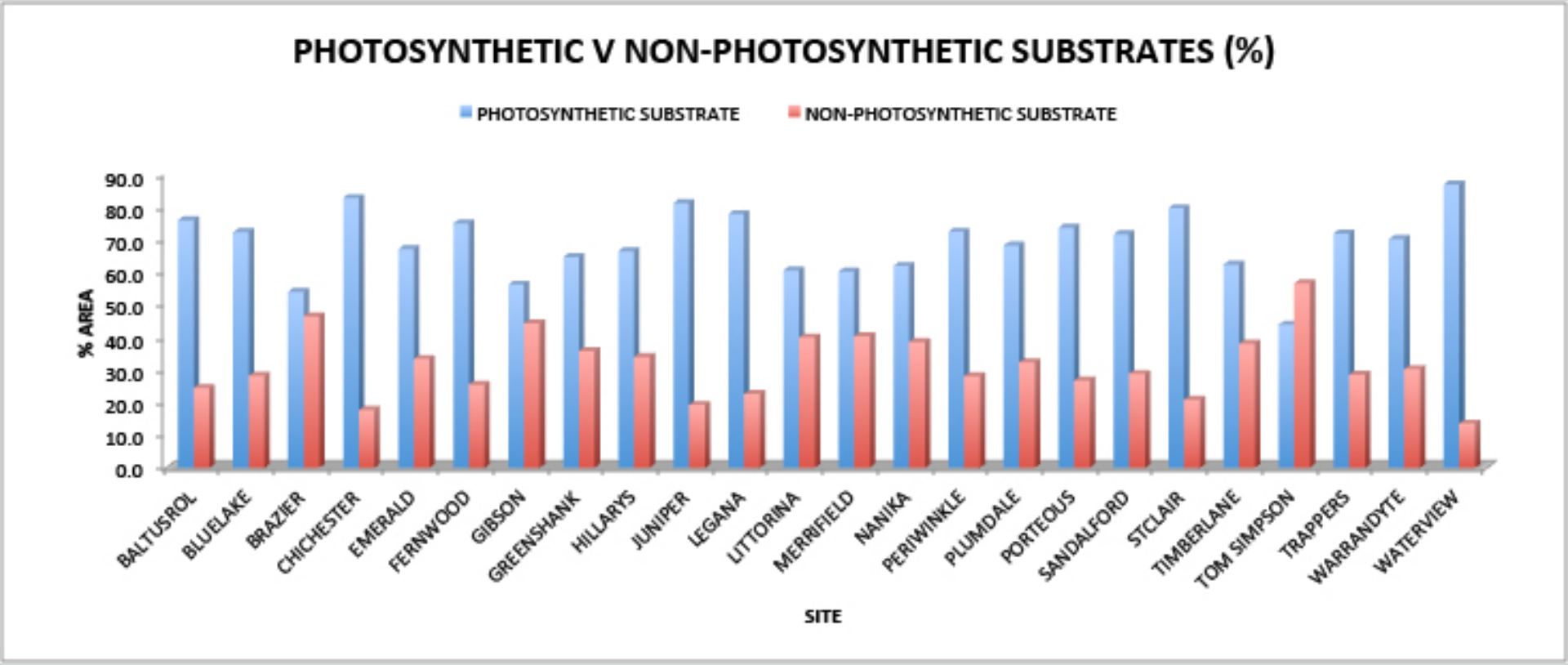
ArborCarbon

Precise monitoring of the urban forest



ArborCarbon

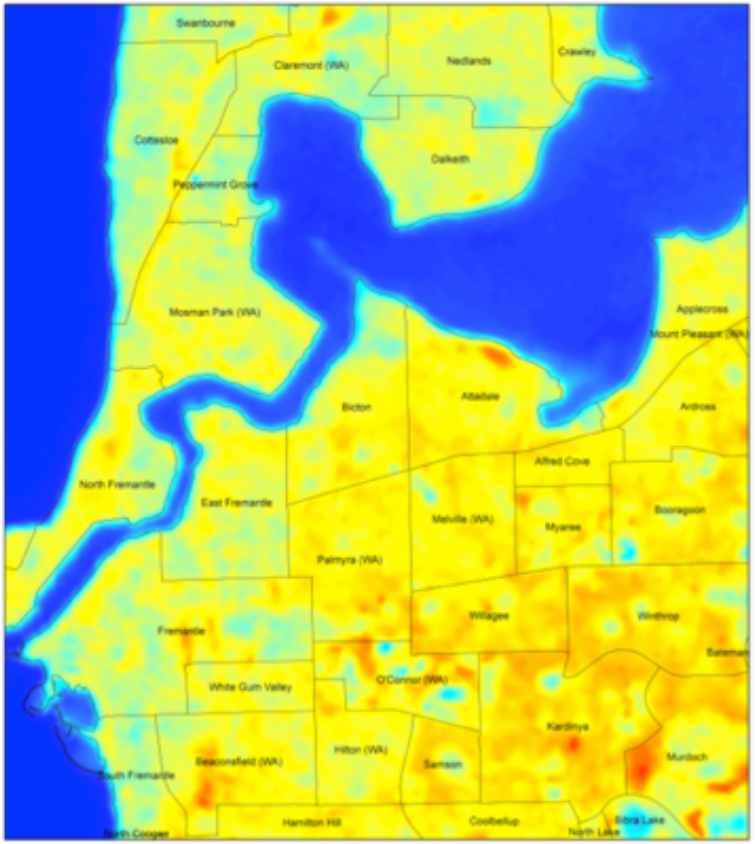
Precise monitoring of the urban forest

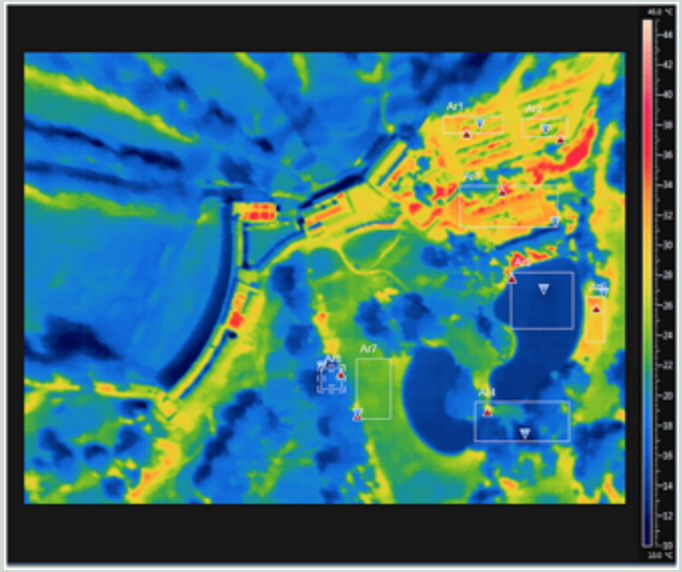


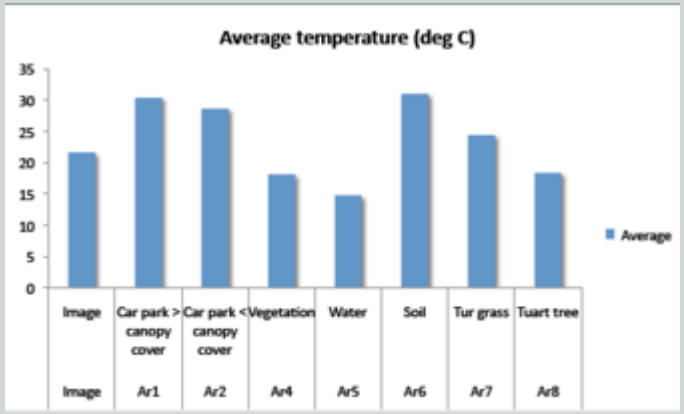
ArborCarbon

Precise monitoring of the urban forest

- *We know temperatures of impervious layers > soil > turf > trees > shadows*
- ***INCREASE CANOPY COVER AND SHADE – up to 6 degree difference***

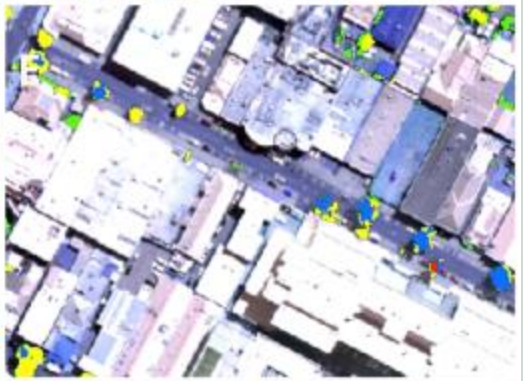


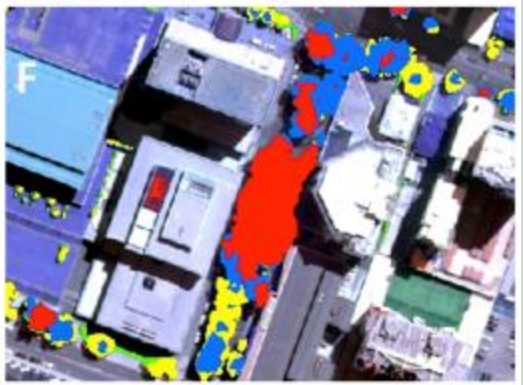




Arbor Carbon

Precise monitoring of the urban forest



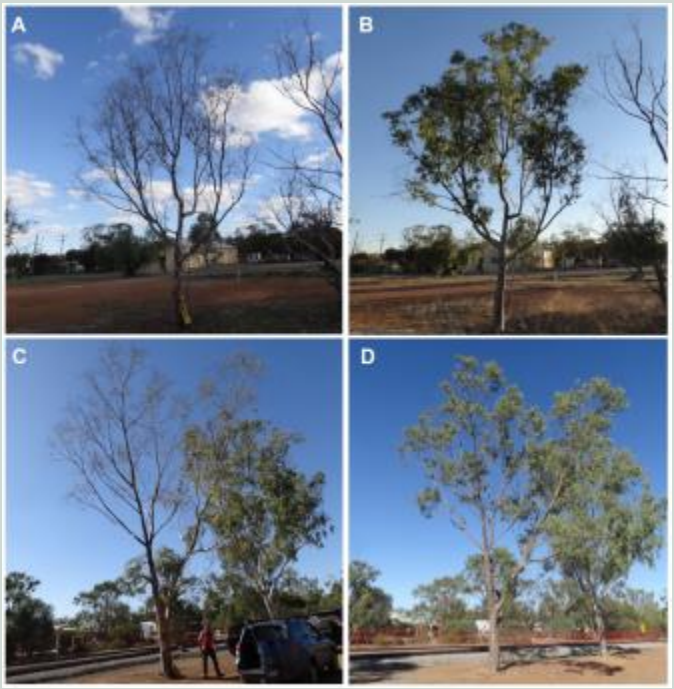


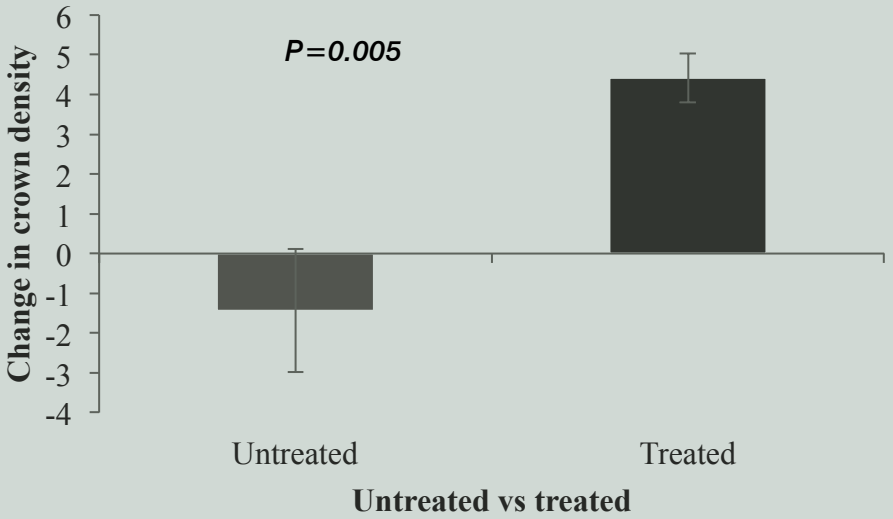
ArborCarbon

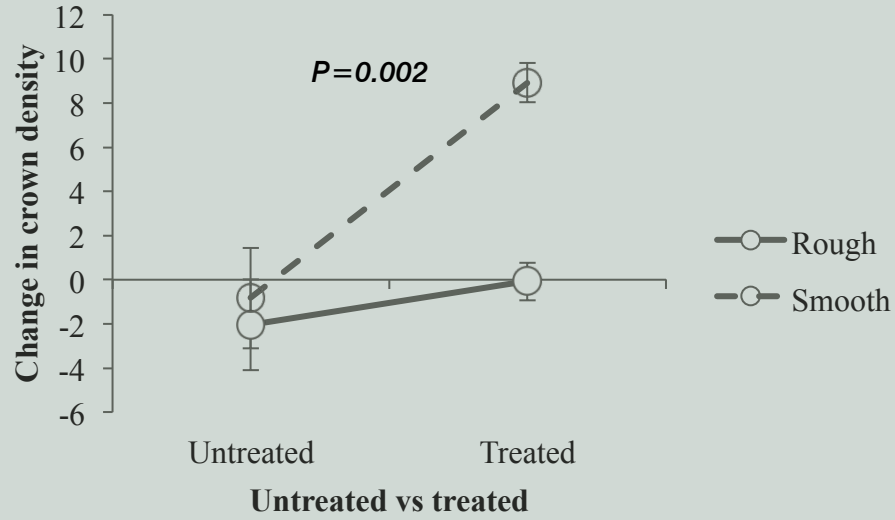
Sustainable management of the urban forest

ArborCarbon

Sustainable management of the urban forest

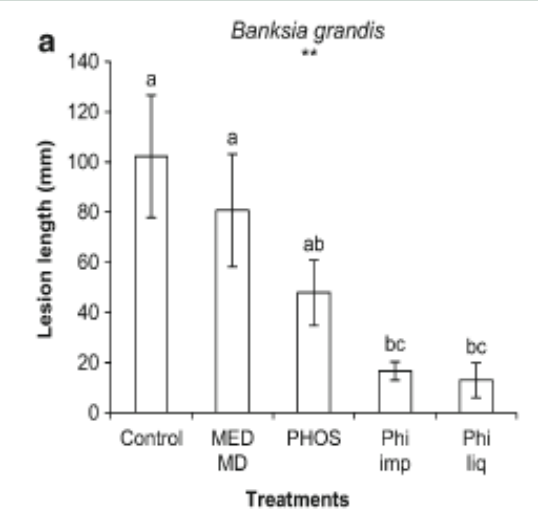


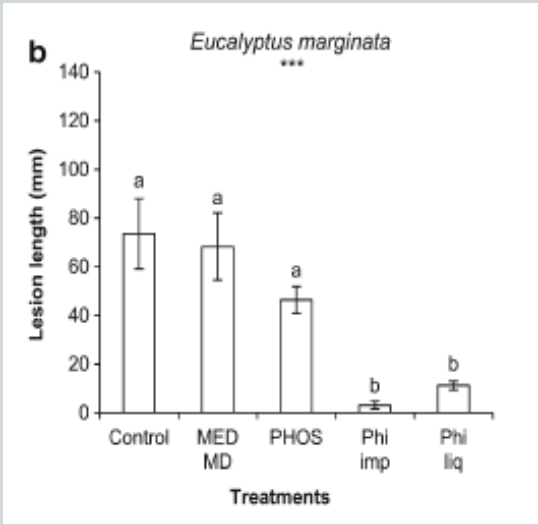




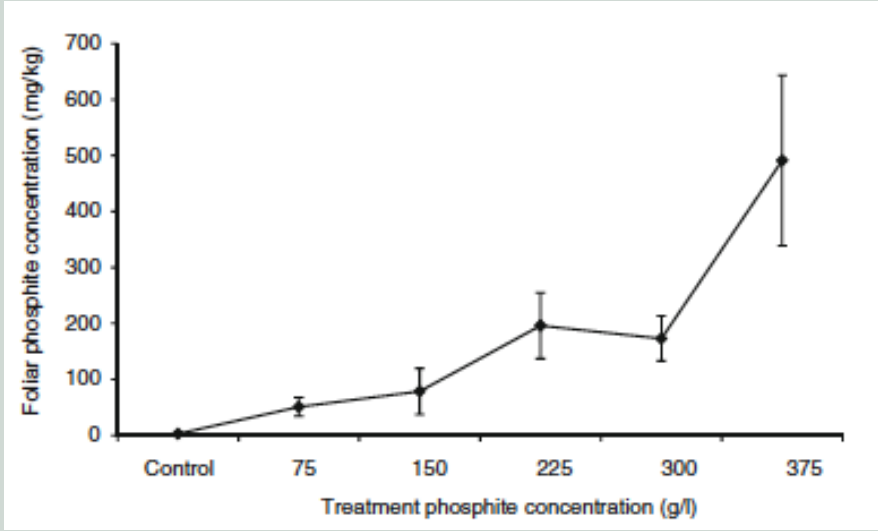
ArborCarbon

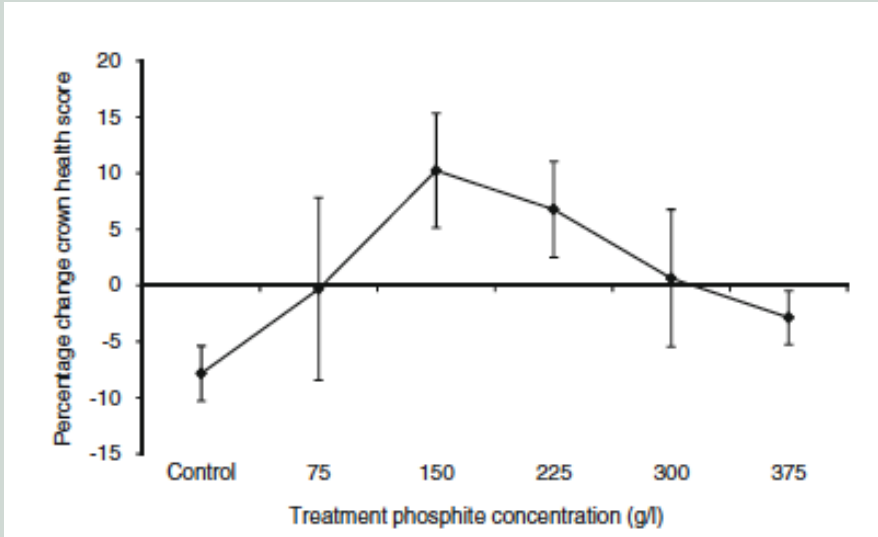
Sustainable management of the urban forest





*** P<0.01 *** P< 0.001*
Scott, Barber & Hardy 2015
APP 44: 431-446





Scott et al. 2013 DOI 10.1007/s13313-013-0243-x

ArborCarbon

Sustainable management of the urban forest

Healthy plants – soil amendments

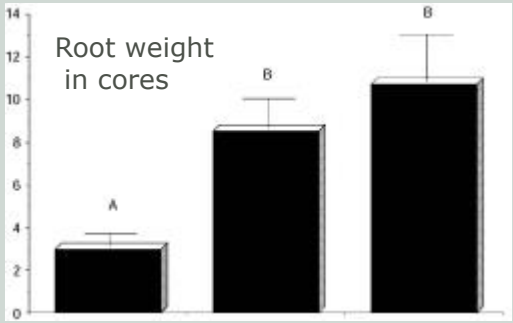
Mycorrhizal fungi & soil bacteria

Improved Nutrition

Left: - P - AMF, Centre: - P + AMF, Right + P - AMF

Left uninoculated control; other 3 treatments are different ECM fungi. All treatments have the same fertilizer rate.

Nursery stock of Shorea – the yellow plant has no ECM



Amaranthus & Jiracek 2001 Fraxinus americana roots respond to subsurface feeding of mycorrhizal inoculum and N fertiliser JSF 14:93-102

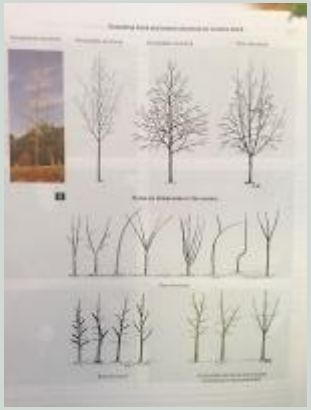
*Cai, Barber et al. 2010. **Soil bacterial functional diversity** is associated with the decline of Eucalyptus gomphocephala. For. Ecol. Man. 260: 1047-1057.*

*Ishaq, Barber et al. 2012. Seedling **mycorrhizal type** and **soil chemistry** are related to **canopy condition** of Eucalyptus gomphocephala. Mycorrhiza 23: 359-371.*

ArborCarbon

Sustainable management of the urban forest

Let's not forget the many other factors….



Source: Gilman 2012

Final message….critically consider whether your approach is truly sustainable in every way…be open to new ideas and always look to innovate and improve.

ArborCarbon

Thank you

Email: p.barber@arborcarbon.com.au

Web: arborcarbon.com.au

Barber, P.A. 2015. Precision Urban Forest Management. ISA Conference 2015 Orlando

Crous, P.W. et al. 2015: Fungal Planet description sheets: 320-370. Persoonia 34: 167-266.

Scott, P., Barber, P., Hardy, G. 2015 Novel phosphite and nutrient application to control *Phytophthora cinnamomi* disease. Australasian Plant Pathology 44: 431-436

Barber, P.A., Paap, T., Burgess, T.I., Dunstan, W., Hardy, G.E.StJ. (2013) A diverse range of *Phytophthora* species are associated with dying urban trees in an Australian capital city. *Urban Forestry & Urban Greening* 12: 569-575.

Evans, B., Stone, C., Barber, P. (2013) Linking a decade of forest decline in the southwest of Western Australia to bioclimatic change. *Australian Forestry* DOI: 10.1080/00049158.2013.844055

Scott, P.M., Dell, B., Shearer, B.L, Barber, P.A. Hardy, G.E.StJ. (2013) Phosphite and nutrient applications as explorative tools to identify possible factors associated with *Eucalyptus gomphocephala* decline in southwestern Australia. *Australasian Plant Pathology* DOI 10.1007/s13313-013-0243-x

Ishaq, L., Barber, P.A., Hardy, G.E.StJ., Calver, M., Dell, B. (2013) Seedling mycorrhizal type and soil chemistry are related to canopy condition of *Eucalyptus gomphocephala. Mycorrhizae* 0.1007/s00572-012-0476-5.

Barber, P.A. (2013) Restoring the canopy health of declining native trees. *Western Wildlife* 17: 8-10.

Evans, B., Lyons, T., Barber, P., Stone, C., Hardy, G. (2012) Enhancing a eucalypt crown condition indicator driven by high spatial and spectral resolution remote sensing imagery. *Journal of Applied Remote Sensing* 6: 1-15.

Evans, B., Lyons, T.J., Barber, P.A., Stone, C., Hardy, G. (2012) Dieback classification modeling using high resolution digital multi spectral imagery and in situ assessments of crown condition. *Remote Sensing Letters* 3: 541-550.

Barber, P.A. and Hardy, G.E.StJ. (2012) Restoring the canopy health of native urban bushland and parkland trees. *Australasian Plant Conservation* 21: 23-24.

Scott P.M., Shearer, B.L,, Barber, P.A. and Hardy, G.E.StJ. (2012) Relationship between the crown health, fine root and ectomycorrhizae density of declining *Eucalyptus gomphocephala*. *Australasian Plant Pathology* DOI 10.1007/s13313-012-0152-4.

Barber, P.A. (2012) The complexity of diagnosing and managing tree decline. ISA International Conference, Parramatta, 7 July.

Cai, Y.F., Barber, P., Dell, B., O'Brien, P., Williams, N., Bowen, B., Hardy, G. 2010. Soil bacterial functional diversity is associated with the decline of Eucalyptus gomphocephala. Forest Ecology and Management 260: 1047-1057.

ArborCarbon