



BIOHYPE: Biomonitoring of urban habitat quality with airborne hyperspectral observations





Our BIOHYPE team

University of Antwerp

- Prof. dr. ir. Roeland SAMSON (coordinator)
- Dr. Frank VEROUSTRAETE (coordinator)
- Ir. Shari VAN WITTENBERGHE (PhD student)



Hasselt University

- Prof. dr. Roland VALCKE (partner)

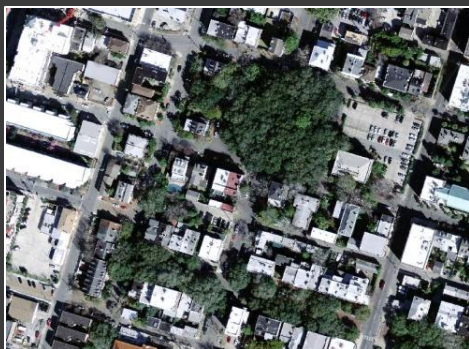


University of Valencia

- Prof. Jose F. MORENO (partner)
- Dr. Jochem VERRELST (PhD Remote Sensing)
- Luis ALONSO (Research technician)



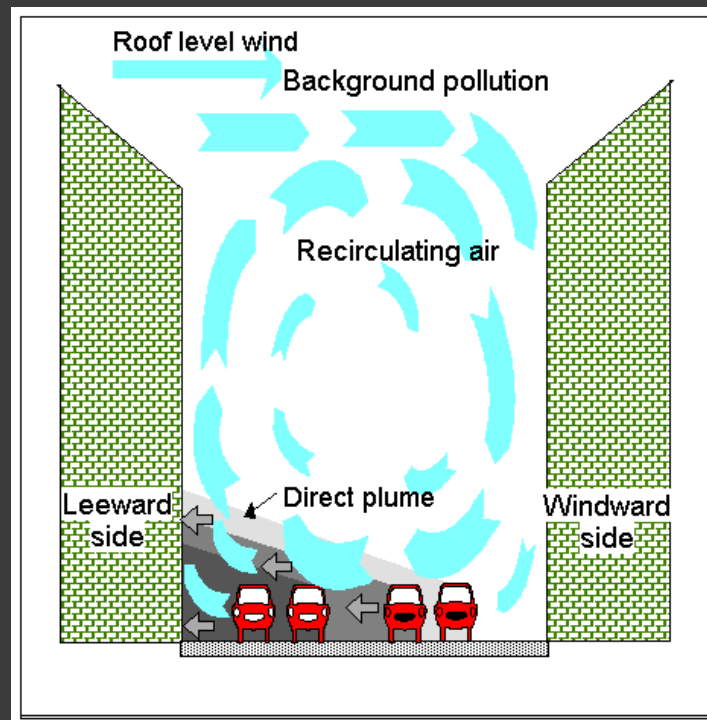
Problem: urban pollution



Harbour and other industries



Traffic



Street canyon effect (www2.dmu.dk)

Objectives

To develop, test and validate a **passive biomonitoring** methodology based on **airborne hyperspectral observations**



- (i) Estimation of spatial distribution overall pollution soil & air
- (ii) Spatial distribution & seasonal evolution sub-leaf level , leaf level & canopy level parameters
- (iii) Compare and validate hyperspectral airborne measurements & ground measurements
- (iv) Describing a protocol for the estimation of urban habitat quality distribution with high spatial resolution

Project overview



2010: Field campaign in Ghent



2011: Field campaign in Valencia

2012: Gap-filling experiments

2013: Setting of protocol Biomonitoring – RS
analyze

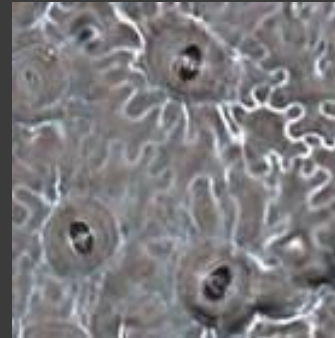


Experimental approach

- Biomonitoring at three tree structural levels:
 1. **Sub-leaf level**
 2. Leaf level
 3. Canopy level



Leaf wettability

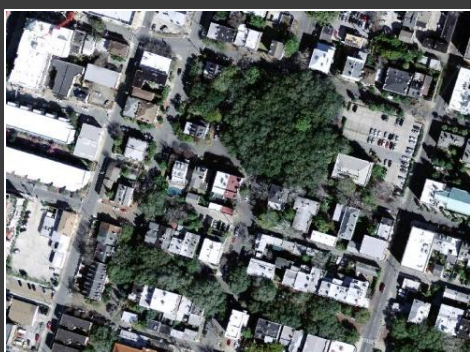


Stomatal characteristics

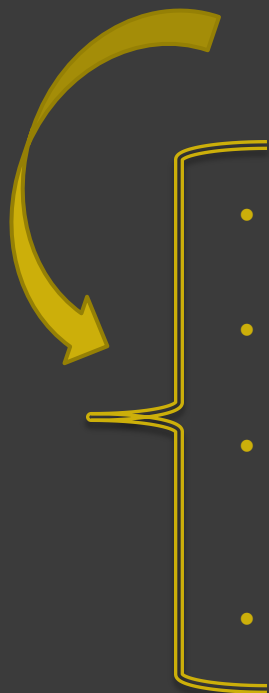


Dark adapted Chl-a fluorescence

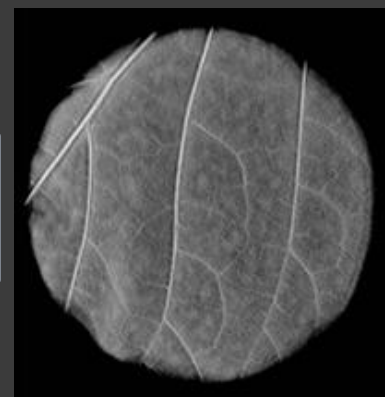
Experimental approach



- Biomonitoring at three tree structural levels:
 1. Sub-leaf level
 - 2. Leaf level**
 3. Canopy level



- Specific leaf area = leaf surface : dry weight
- Chl content
- Light adapted Chl-a fluorescence imaging →
- Leaf reflectance & transmittance



F (650-750)

Experimental approach



- Biomonitoring at three tree structural levels:

1. Sub-leaf level

- 2. Leaf level**

3. Canopy level

- Specific leaf area = leaf surface : dry weight

- Chl content

- Light adapted Chl-a fluorescence imaging

- Leaf reflectance & transmittance

→ Combination of sensors for detecting plant stress

Experimental approach



- Biomonitoring at three tree structural levels:

1. Sub-leaf level
2. Leaf level
3. **Canopy level**



Canopy reflectance

Canopy Chl-fluorescence

→ iFLD method:

improved Fraunhofer Line Depth
(Alonso *et al.*, 2007)

Tree species



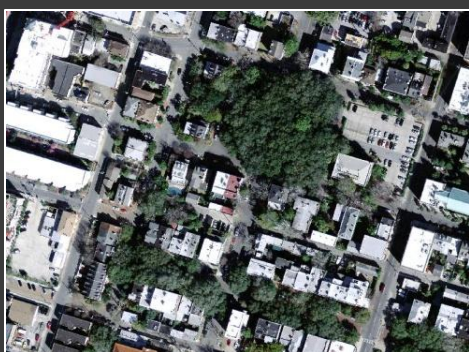
Hornbeam (*Carpinus betulus* L.)

Plane tree (*Platanus x acerifolia*)



Sycamore maple
(*Acer pseudoplatanus* L.)

Norway maple (*Acer platanoides* L.)

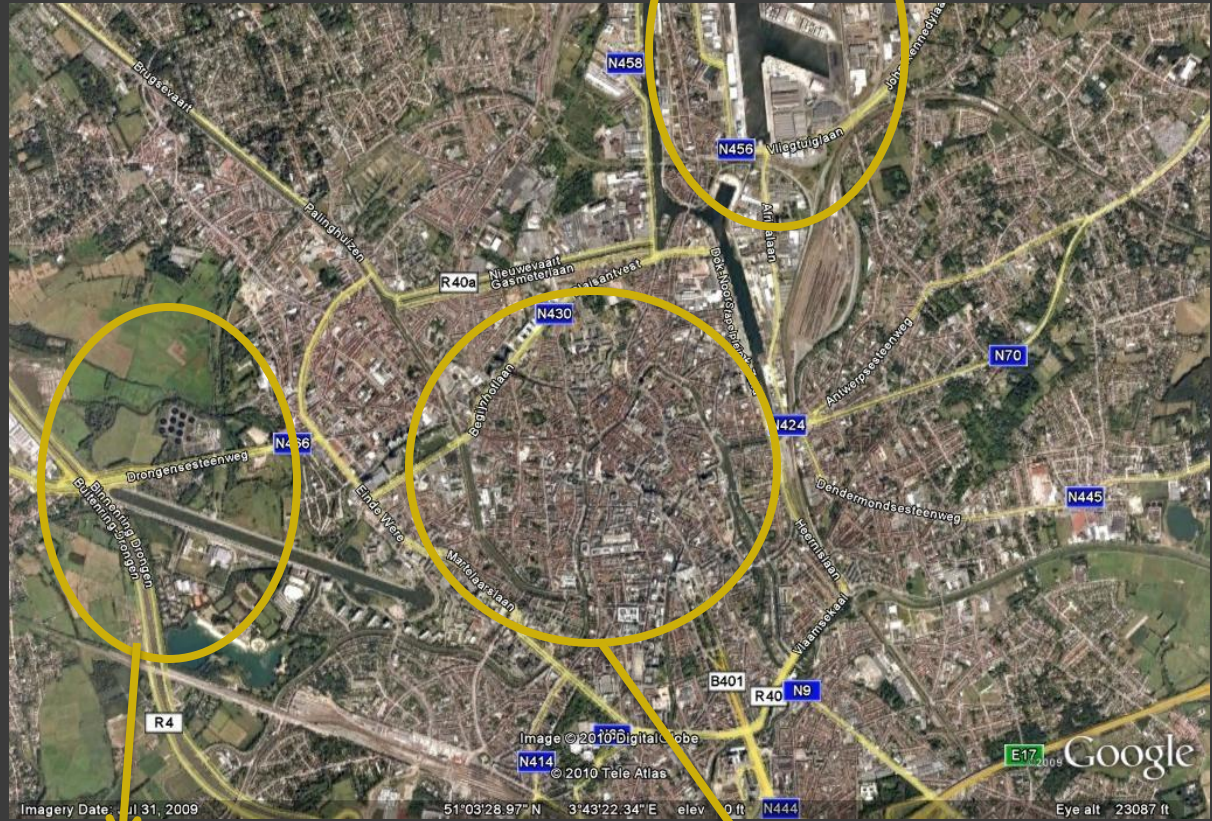




Research area

Ghent

Harbour



Green areas

City centre



Research area

Ghent

City ring



Access roads

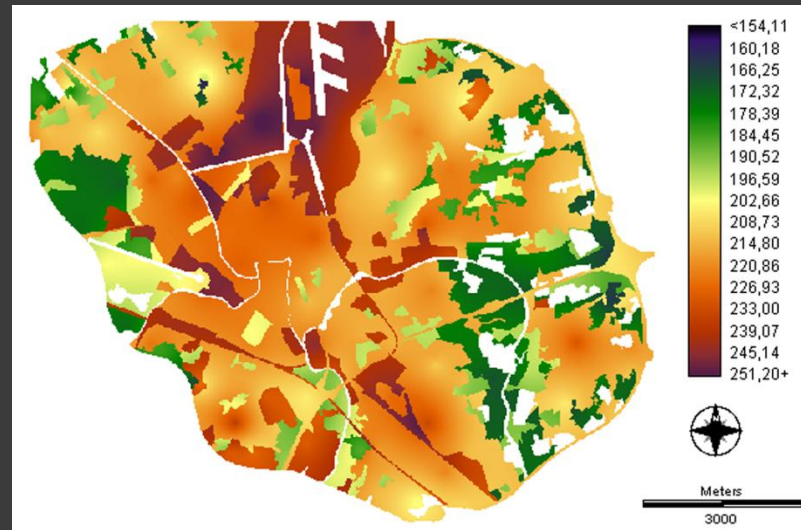
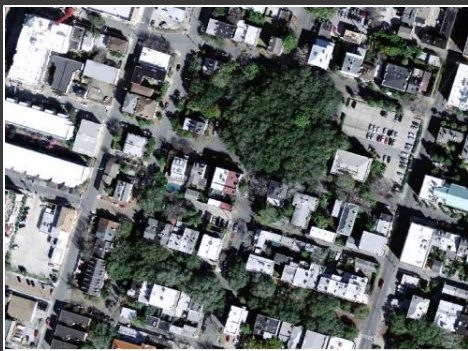


→ Several 'hot spots/areas' for air pollution by traffic in the city centre (data: Lokaal Luchtkwaliteitsplan Gent, 2010-2015)

Urban monitoring – RS analyze

Part I

- Selection of > 50 sampling points per species
- Selection of parameters
- Ground measurements
- **Sub-leaf → Leaf levels**



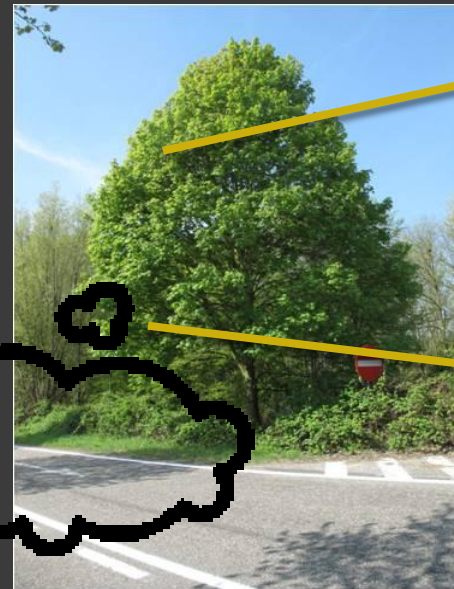
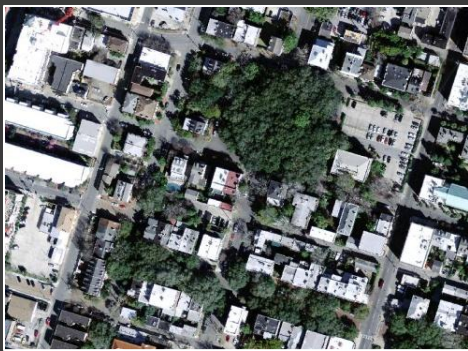
→ To obtain
**spatial
distribution maps**
by geostatistical
analysis

Spatial distribution of abaxial stomatal density (SD, number of stomata per mm^2) in the study area obtained by kriging (SKLM) (Kardel *et al.*, 2010)

Urban monitoring – RS analyze

Part II

- Tree crown measurements in contrasting (pollution) areas
- Sub-leaf → Leaf → Crown levels
- Sampling of outer leaves of free crowns
- Relation between airborne data and ground measurements



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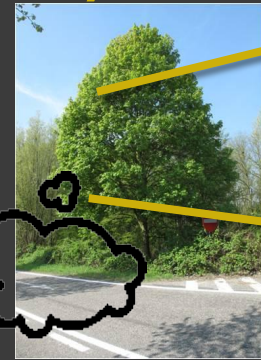
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Urban monitoring – RS analyze

Part II

Tree selection criteria:

- Height and shape of tree crown
- > 3 m crown diameter
- Plane trees which are not (recently) pruned
- At least 3 trees of the same species available
- Not overshadowed
- Access with crane possible
- Preferably more species at the site
- Low pollution impact vs. high pollution impact locations



Urban monitoring – RS analyze

Part II - example

Hornbeam (*Carpinus betulus* L.)



Blaarmeersen
(recreation area)

vs.

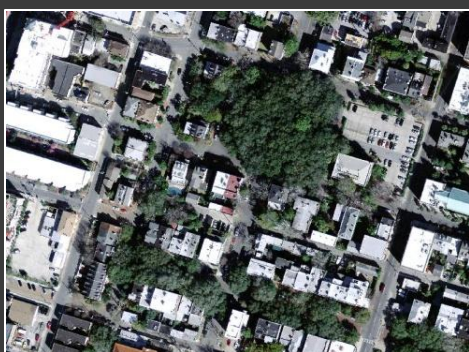


Harbour area of Ghent

Urban monitoring – RS analyze

Part II - example

Norway maple (*Acer platanoides* L.)



Liedermeerspark
(park/nature area)

vs.



De Pintelaan (traffic
road/cross-section)

Urban monitoring – RS analyze

Part III



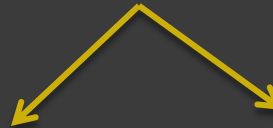
RS data: dependent on sensor



Preprocessing: geometric & atmospheric corrections



Calculation of Vegetation Indices: Chlorophyll indices, PRI, pigment indices



Validation: ASD spectral data measured in the field (Part II)

Statistical approaches: link with non-spectra data e.g. chlorophyll, pollution



www.ua.ac.be/biohype

BIOHYPE

Belgian Earth Observation Day, Chaudfontaine, 6th May 2010

