Detection of contaminants in solid matrices and plants

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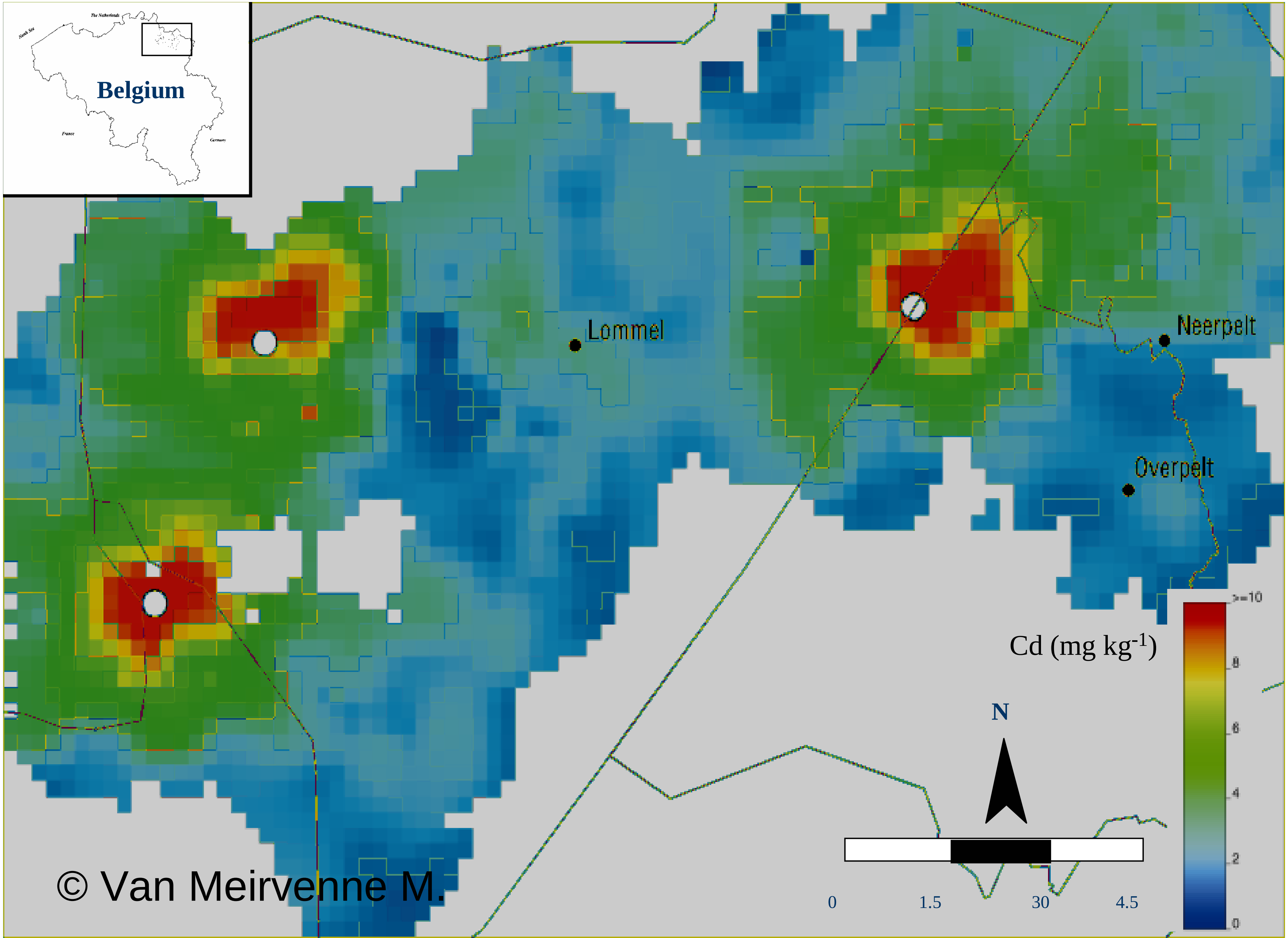
Outline

- Problem and objectives
- Methods
- Results
  - Zinc ash roads
  - Vegetation
- Conclusions

Problem

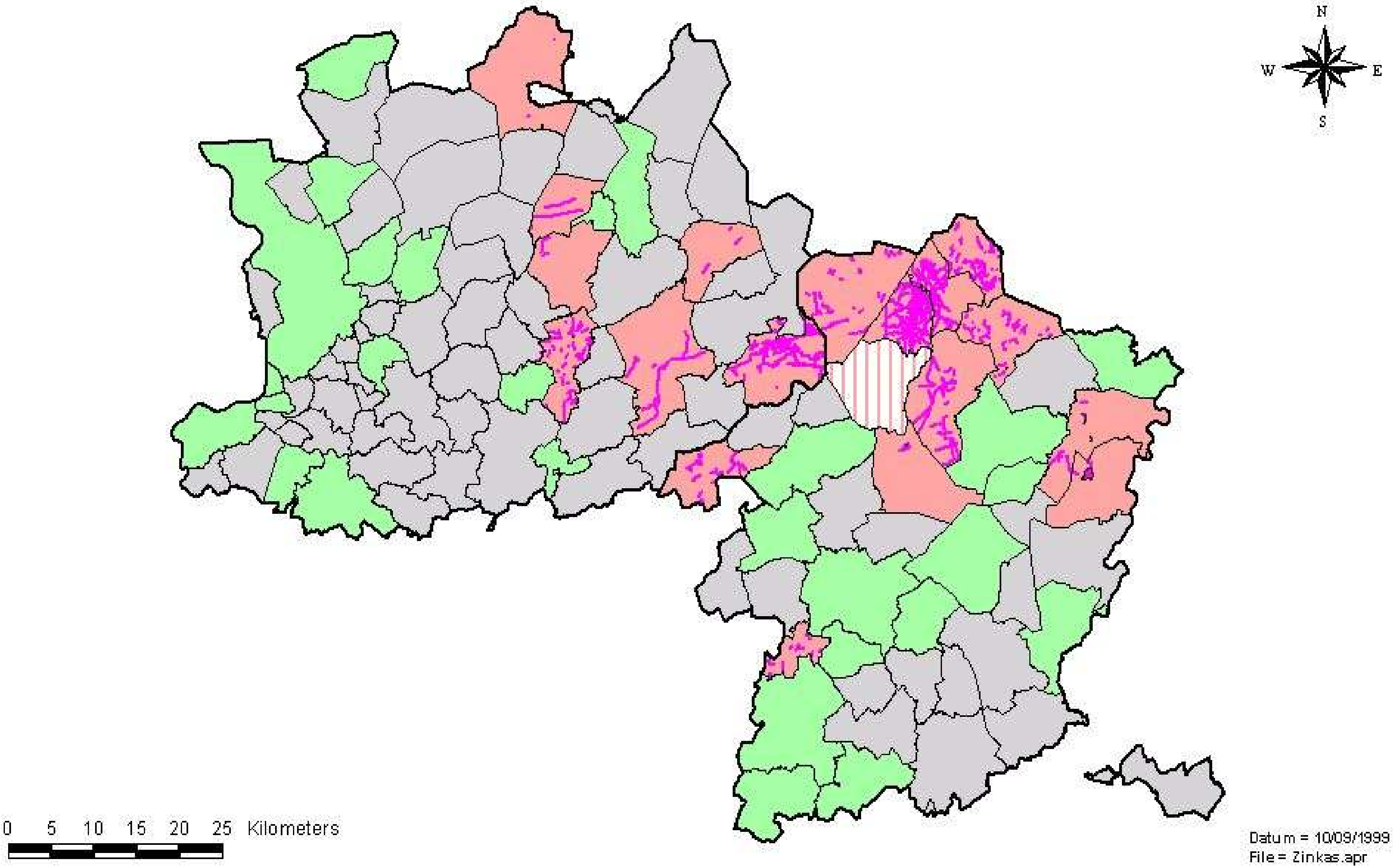
- Heavy metal contamination in the “Kempen”



Belgium
Lommel
Neerpelt
Overpelt
Cd (mg kg-1)
>=10
8
6
4
2
0
N
0
1.5
30
4.5
© Van Meirvenne M.

Problem

- Heavy metal contamination in the “Kempen”
- Zinc ash roads
  - Diffuse geographical occurrence
  - High metal concentrations
    - 6.606 Pb, 40.750 Zn, 1.613 Cu (mg/kg)



ZINKASSENWEGEN IN PROVINCIE ANTWERPEN EN LIMBURG.

- Provincie
- Geen assenwegen
- Locaties niet gespecificeerd
- Locaties gespecificeerd
- Geen antwoord

GRONDSTOFFEN

Problem

- Heavy metal contamination in the “Kempen”
- Zinc ash roads
  - Diffuse geographical occurrence
  - High metal concentrations
    - 6.606 Pb, 40.750 Zn, 1.613 Cu (mg/kg)
- Vegetation
  - Toxic plant concentrations
  - Molecular, biochemical and physiological responses to metal stress occur
  - Large polluted area

Maatheide - Lommel

Vegetative stress

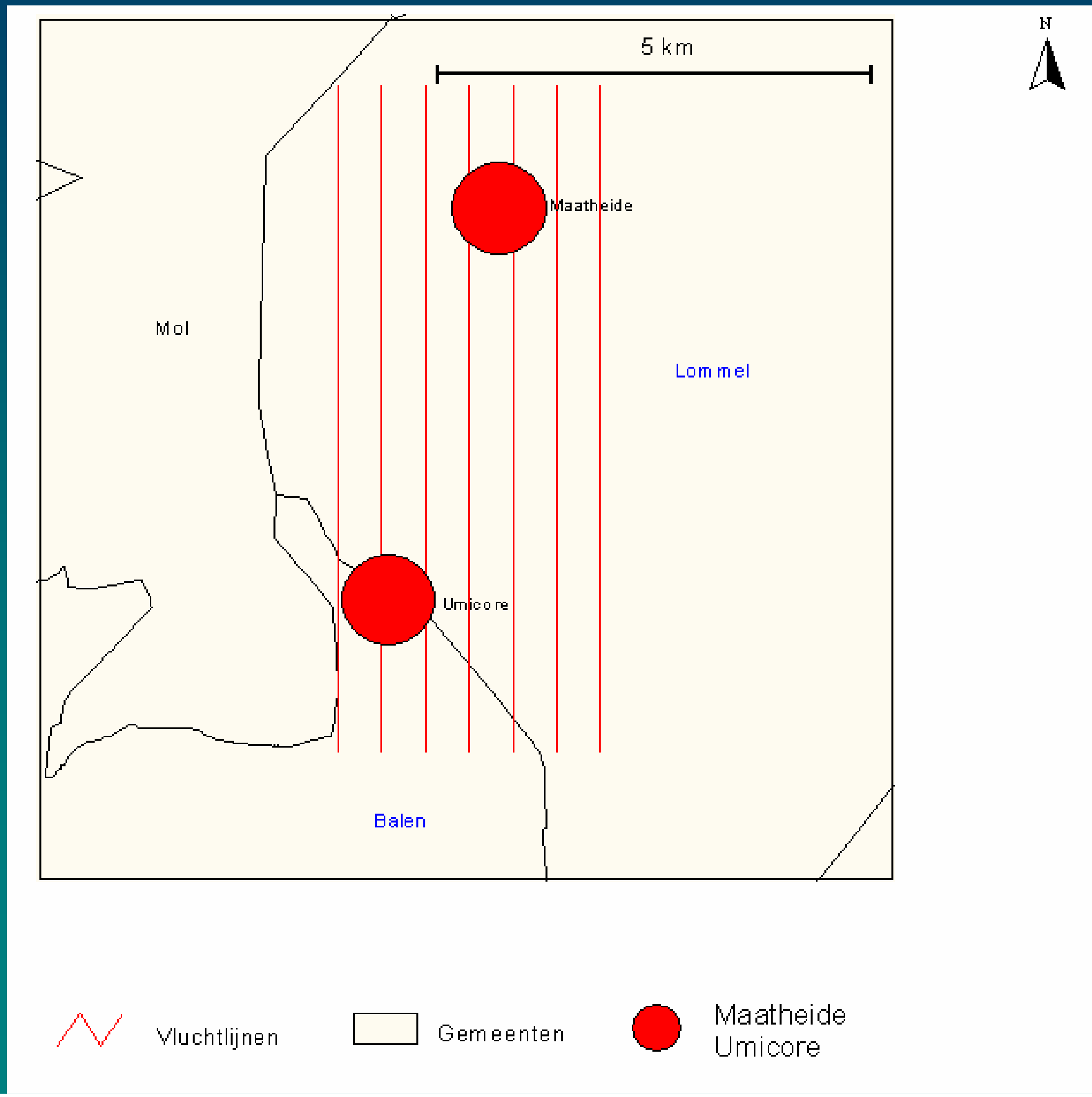
Objectives

- Pilot survey to test the feasibility of (hyper)spectral sensors to:
  - Gain additional information on the presence of zinc ash roads
  - detect metal stress in plants

Methods

- Flight campaign
  - Seven flight-lines Dornier 228
  - CASI2 and SASI sensors
- Ground measurements
  - Ash roads
  - Vegetation
- CASI and SASI image processing

Flight campaign



Ground measurements

- Zinc ash roads
  - Metal concentration in top layer (X-ray fluorescence)
  - Reflectance measurements on 4 ash roads Fieldspec Pro PR (field and lab - dry/wet)

Reflectance of ash roads

Ground measurements

- Vegetation
  - Birch (*Betula pendula*)
    - Five plots, 3-4 individual trees

Birch plots

Ground measurements

- Vegetation
  - Birch (*Betula pendula*)
    - Five plots, 3-4 individual trees
    - Gas exchange (LCA4 gas analyser with PLC), chlorophyl fluorescence (FIS) and reflectance (Li-Cor 1800 and Fieldspec Pro FR)
    - Metal concentrations (AAS)
  - Zinc concentration in 2-y needles of Pine (*Pinus sylvestris*) (AAS)

CASI-SASI image processing

- Zinc ash roads
  - Corrected SASI-data
  - Filtered using semi-interactive smoothing algorithm (Vito)
  - Library of reference spectra of pure zinc and asfalt roads
  - Library mixed with neighboring vegetation pixels : temporary library set
  - Spectral Angle Mapper
  - Low reflectance in SWIR

CASI-SASI image processing

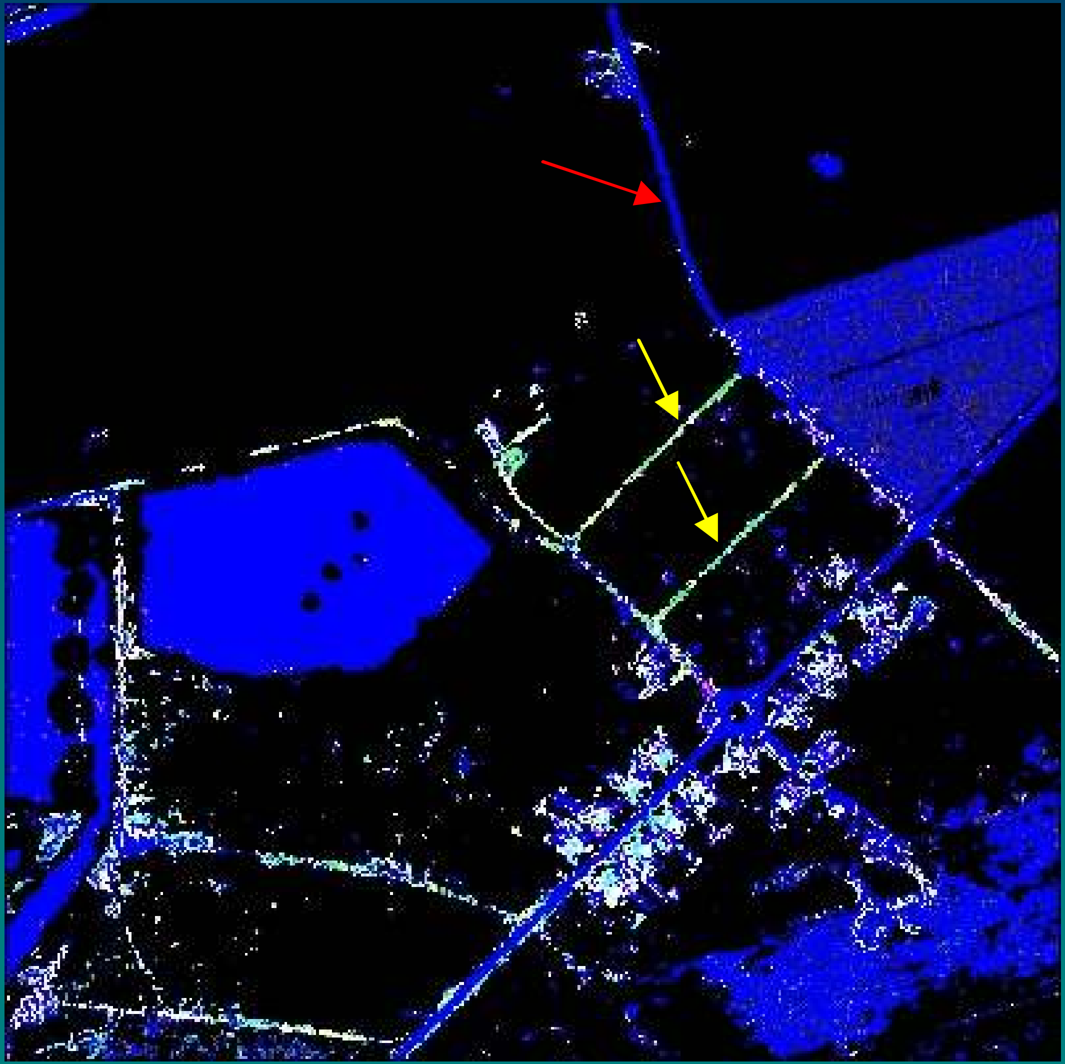
- Vegetation
  - Corrected CASI2 and SASI
  - Smoothing algorithm
  - Selection of regions of interest for pine
  - Spectral Angle Mapper : pine mask
  - Edge Green First derivative Normalized difference (EGFN) calculated for each pixel

Results

- Zinc ash roads
  - Three bands : R (power), G (fraction) and B (spectral angle)
  - Ash roads : green

Zinc ash roads

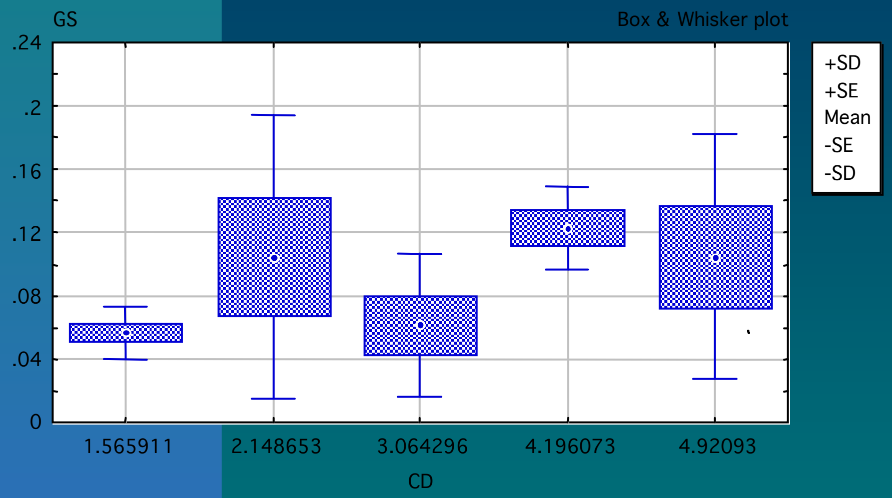
Zinc ash roads

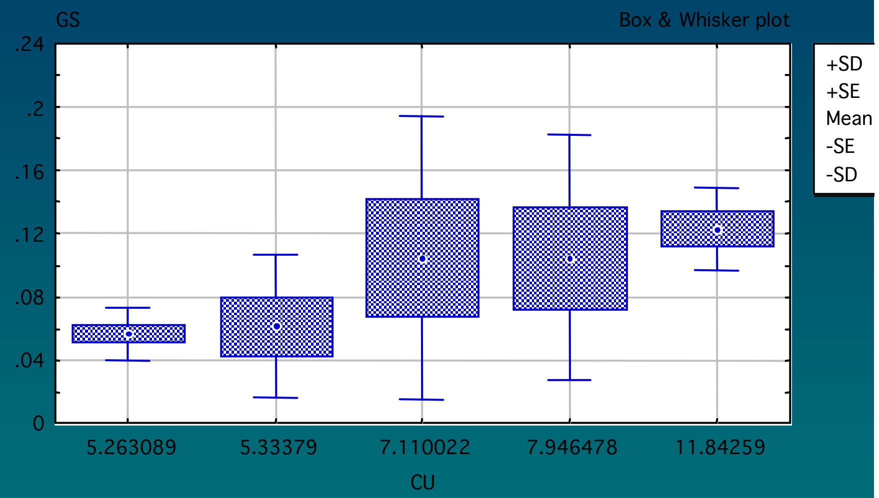


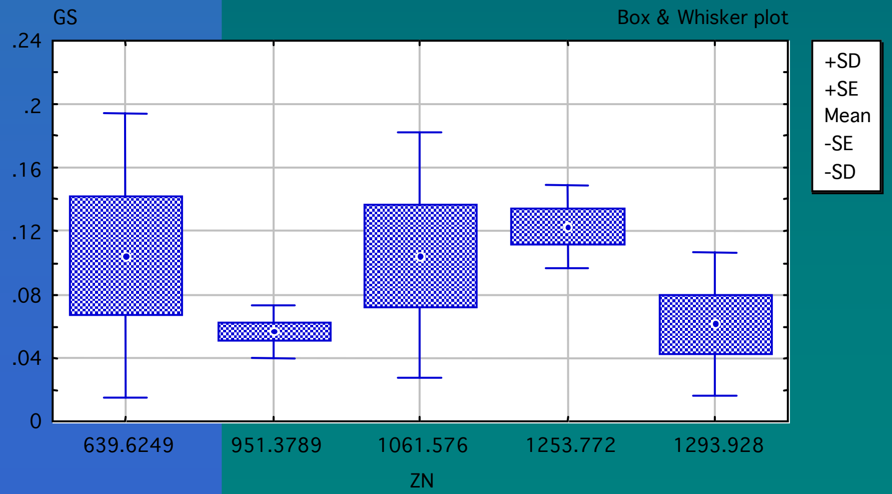
Vegetation

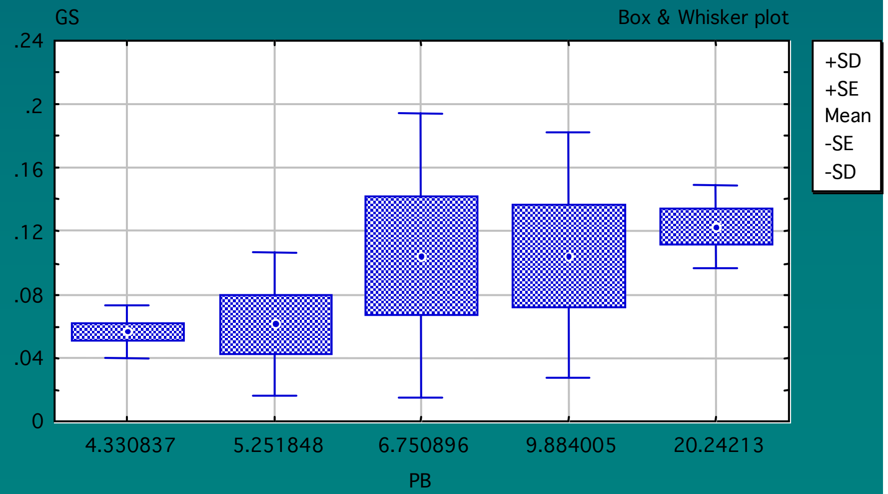
- Metal concentration in Birch leaves
- Gas exchange (gs: stomatal conductance)
- Fluorescence (M: max. Fluor. Int.)
- Reflectance (EGFN)

Gas exchange

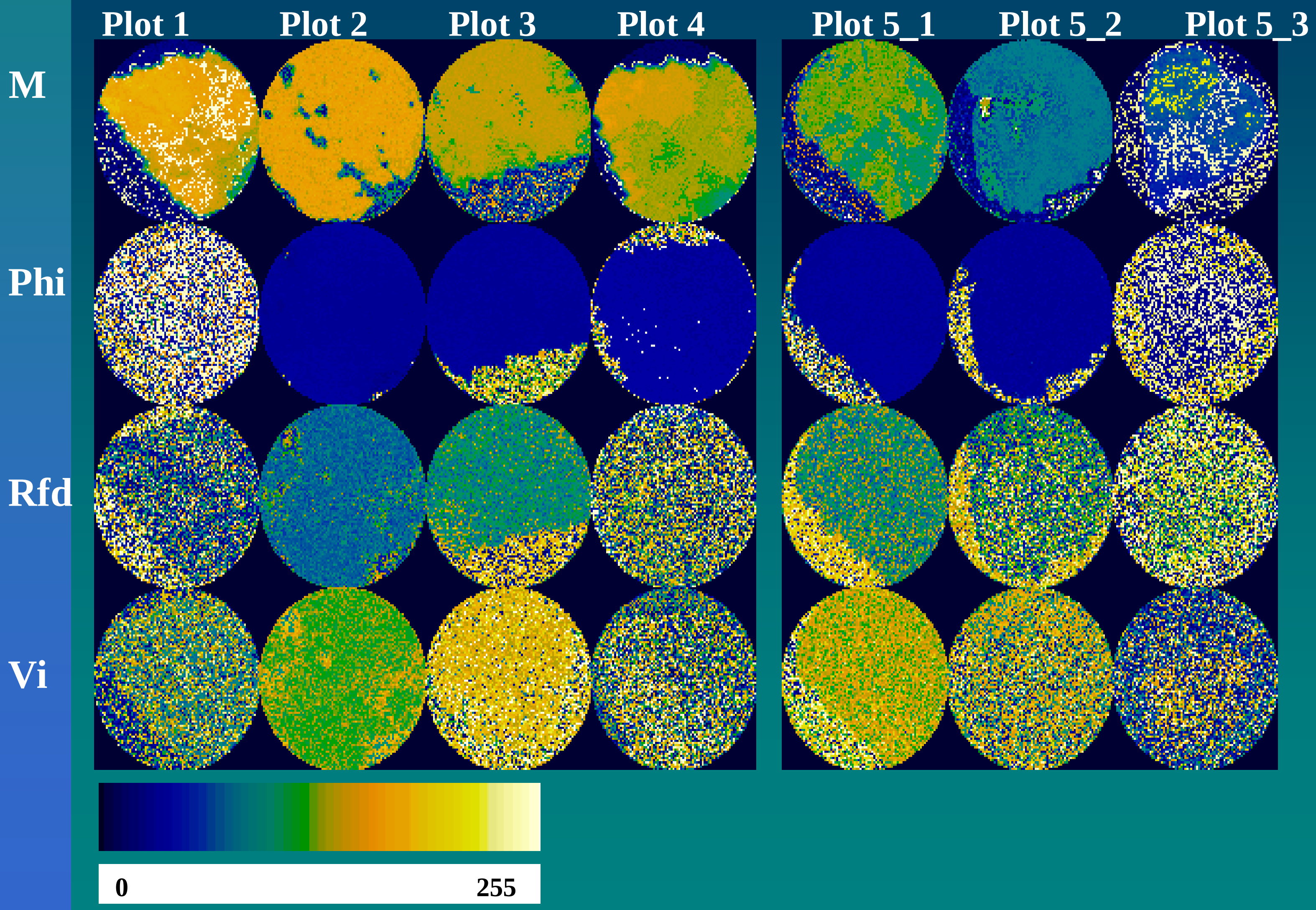




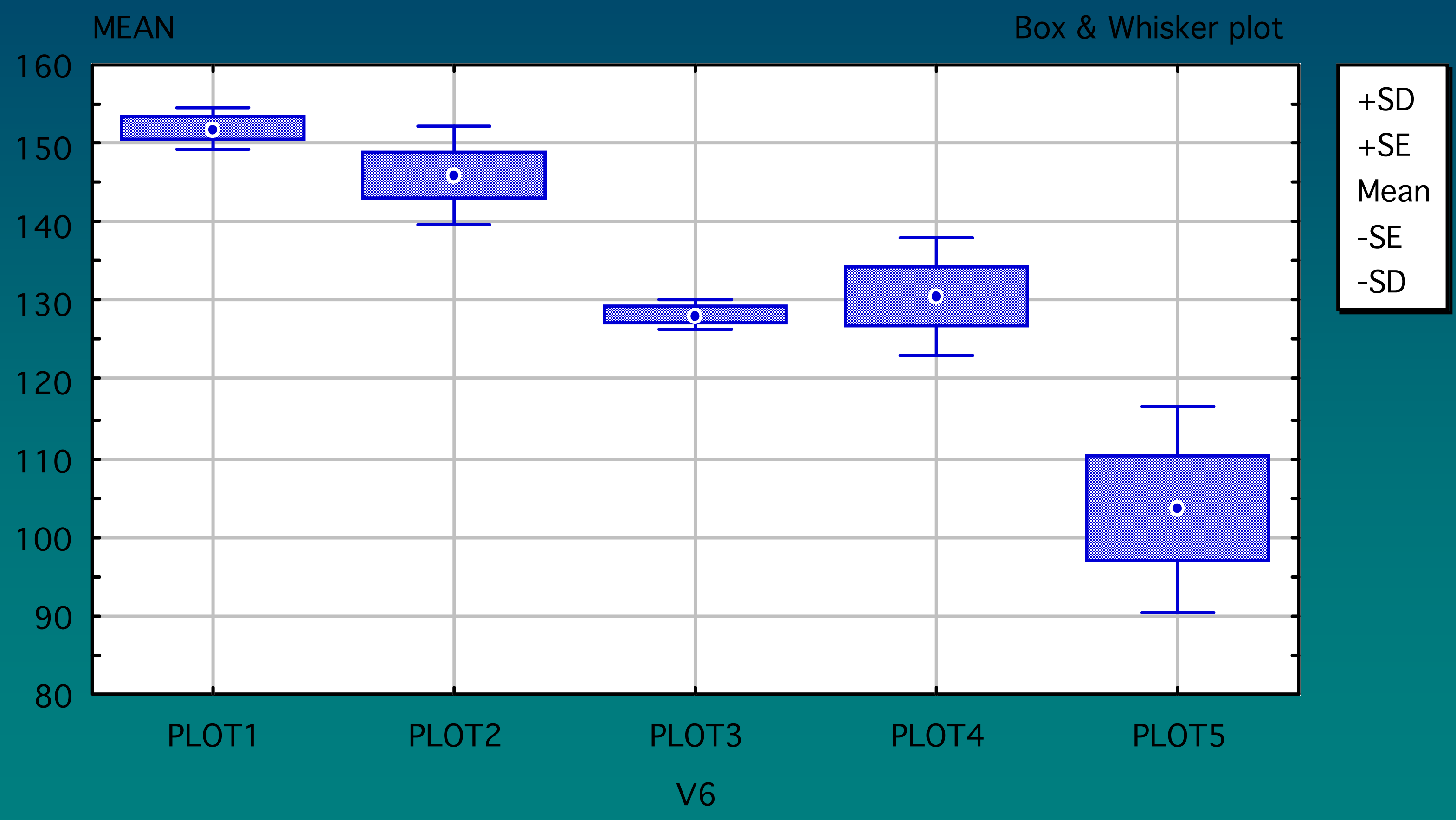




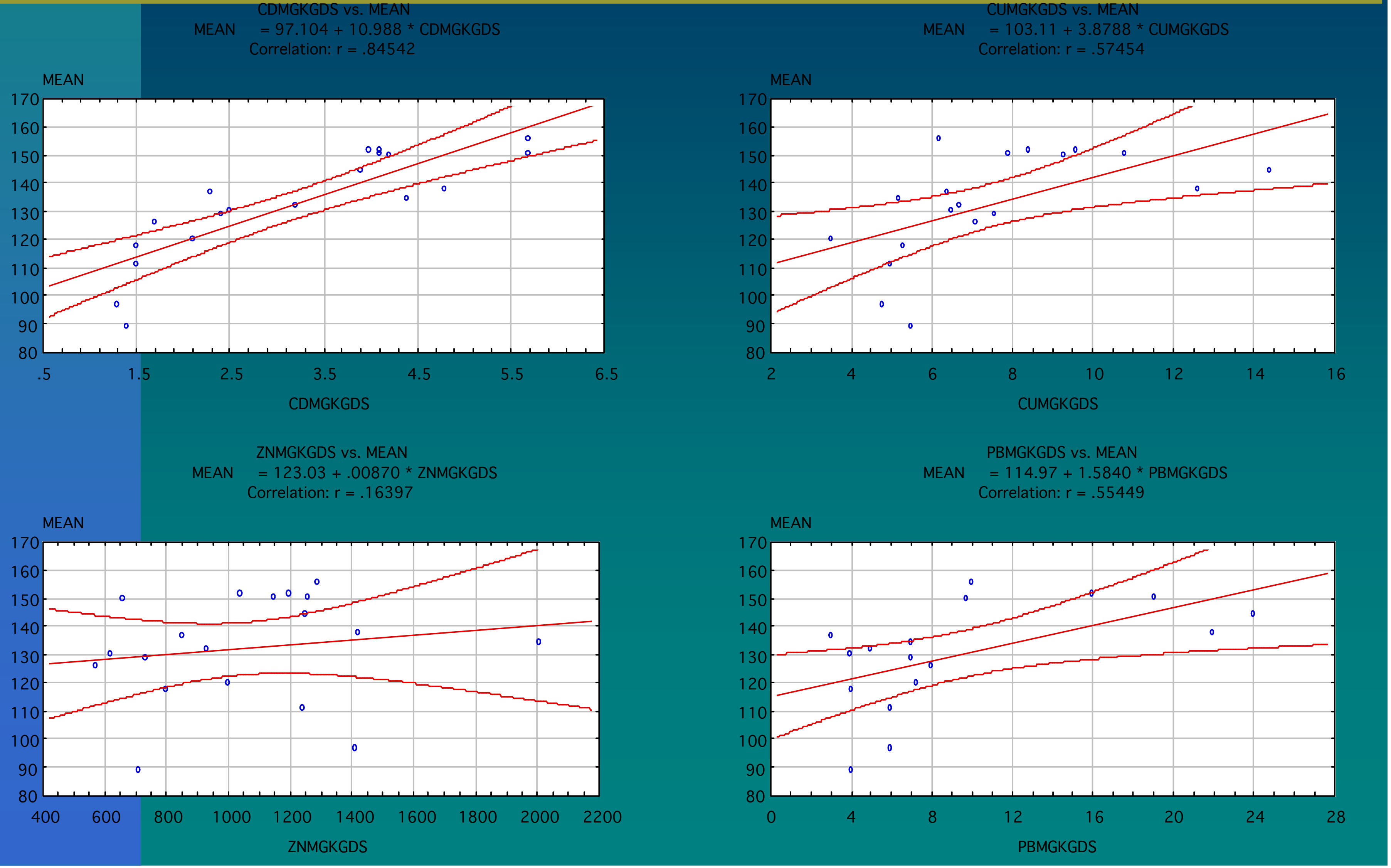
Fluorescence



Fluorescence

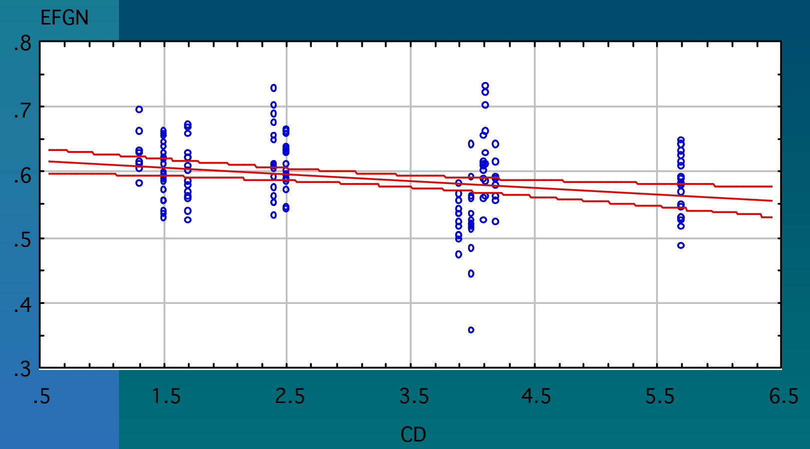


Fluorescence

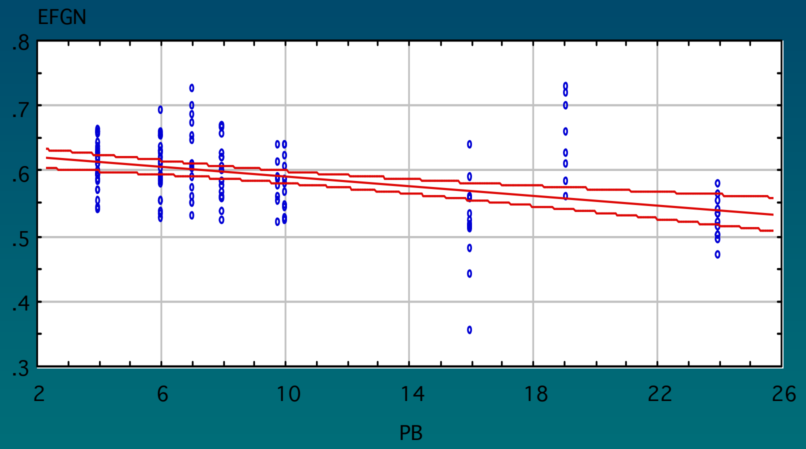


Reflectance

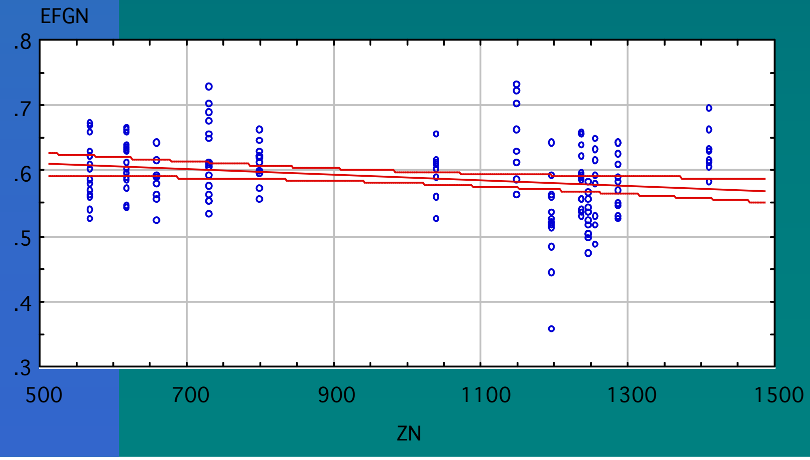
CD vs. EFGN
EFGN = .62331 - .01076 * CD
Correlation: r = -.2685



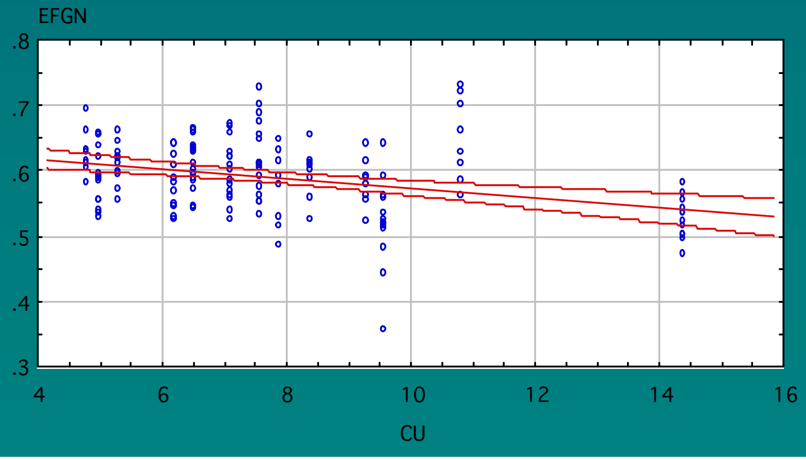
PB vs. EFGN
EFGN = .62682 - .00366 * PB
Correlation: r = -.3810



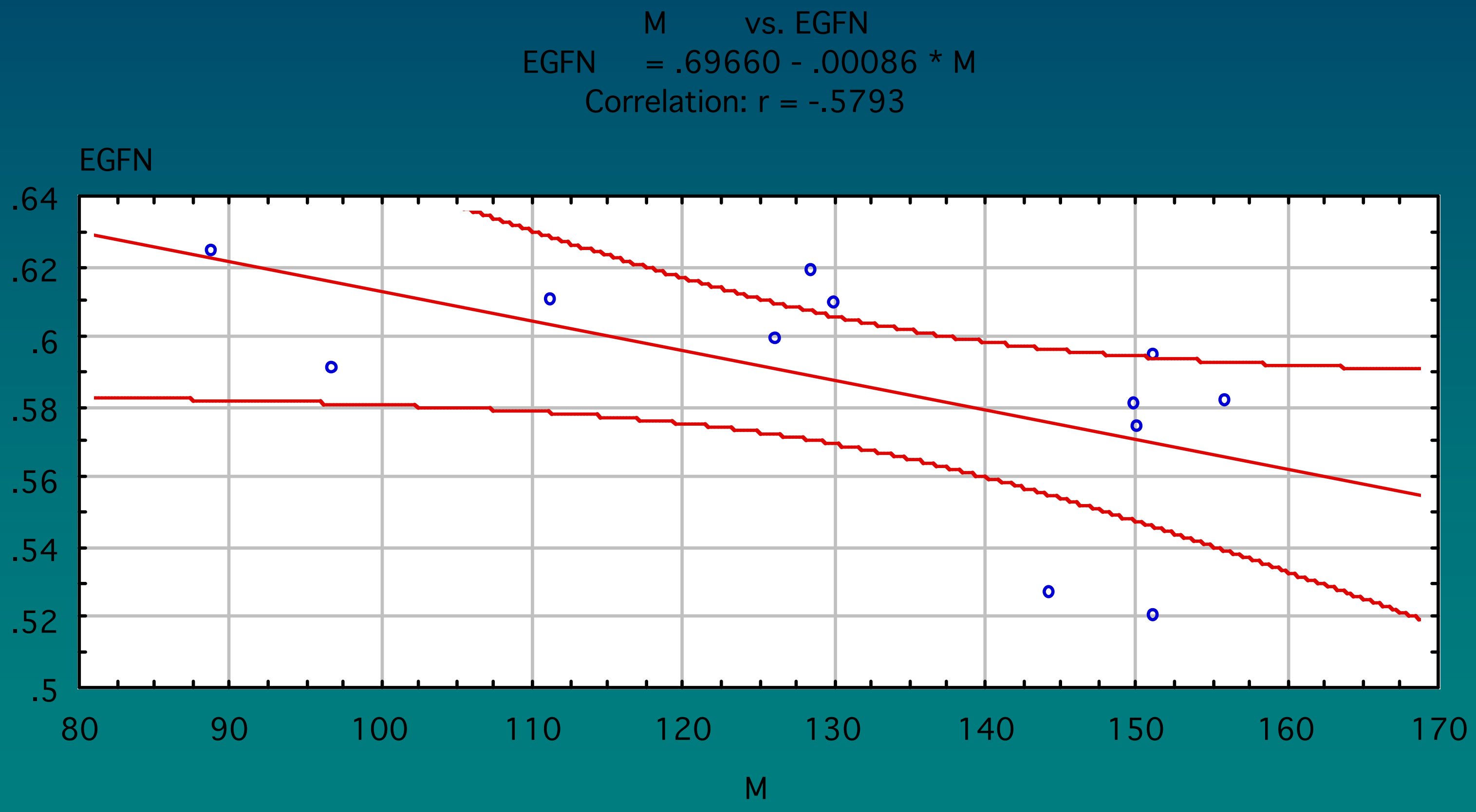
ZN vs. EFGN
EFGN = .63075 - .00006 * ZN
Correlation: r = -.2094



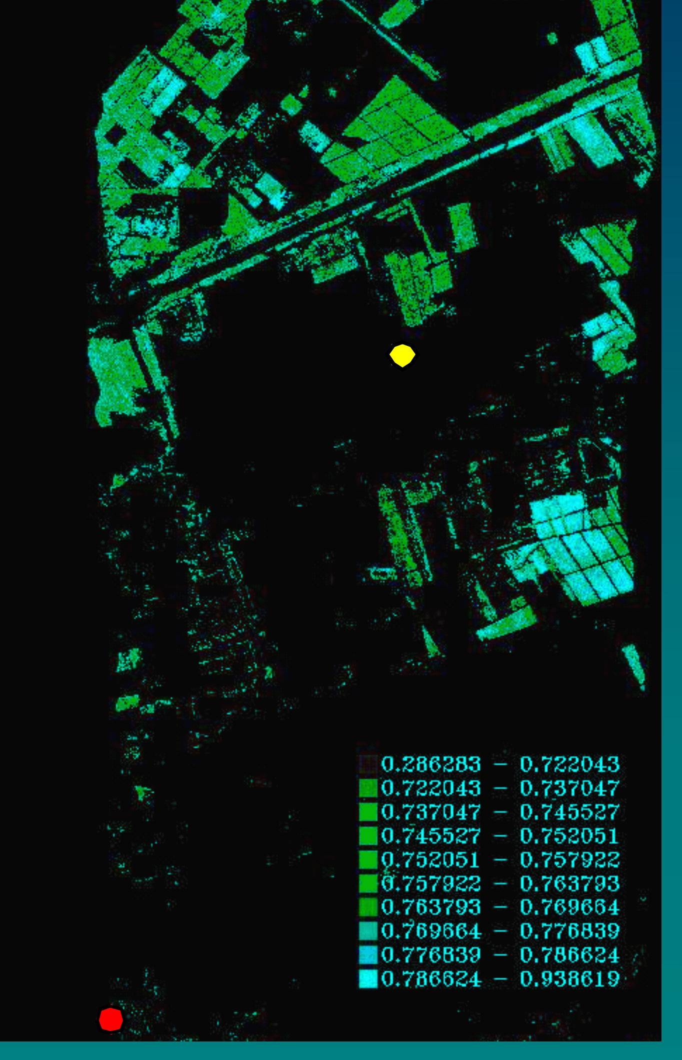
CU vs. EFGN
EFGN = .64967 - .00766 * CU
Correlation: r = -.3417



Different sensitivity of stress indicators



EGFN vegetation stress map



Conclusions

Zinc ash roads

- Distinct zinc ash roads are classified as such
- Misclassification of some roads in respect to the metal concentrations
- No correlation between zinc concentrations in samples and reflectance spectra

Conclusions

Vegetation

- Stress indicators have different sensitivity and robustness
- Relation between aerial reflectance and internal metal concentrations remain unclear
- Further analysis and tests will be needed to verify the aerial stress image

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