# Optimizing hyperspectral indicators for stress detection in orchards

K. Meuleman, P. Coppin, S. Debacker, W. Debruyn, K. Nackaerts, P.Scheunders, S. Sterckx

- OSTC-project Hypercrunch
- Partners: RUCA (Antwerp)
  VITO (Mol)
- Aim reduction dimensionality hyper-spectral data → provide generic tool for optimal band selection

# Experimental testsites

- Apple orchards (Golden, Jonagold)
- Different stresses:
  - Fungi (scab)
  - Virus (CLS)
  - Nutrient stress (N-stress)
  - Aphids (red apple aphid)
  - Bacteria (Fire blight, pear)
- Three different sample data: June, August, September

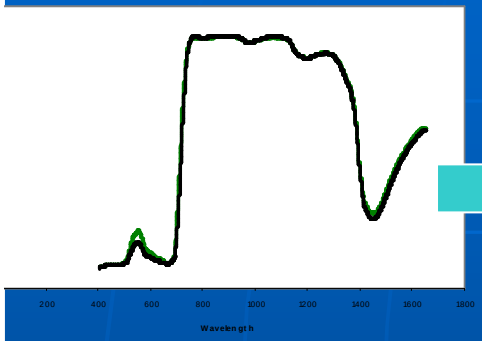
# Measurements

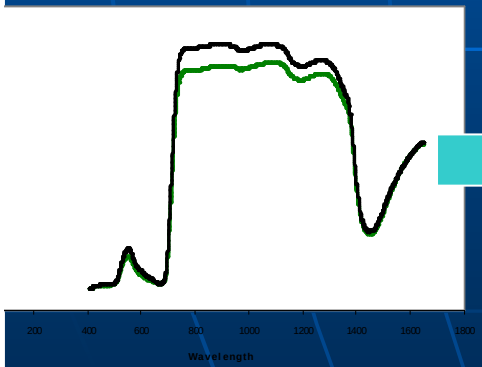
- Leaf measurements:
  - Li-Cor 1800-12S
  - 350 – 1650 nm
- Canopy measurements
  - Cherrypicker → ASD and GER
- CASI-SWIR airborne campaign
  - Pixel resolution: 0,98 m x 2,37 m
  - CASI 96 bands 400-950 nm
  - SWIR 160 bands 850-2500 nm

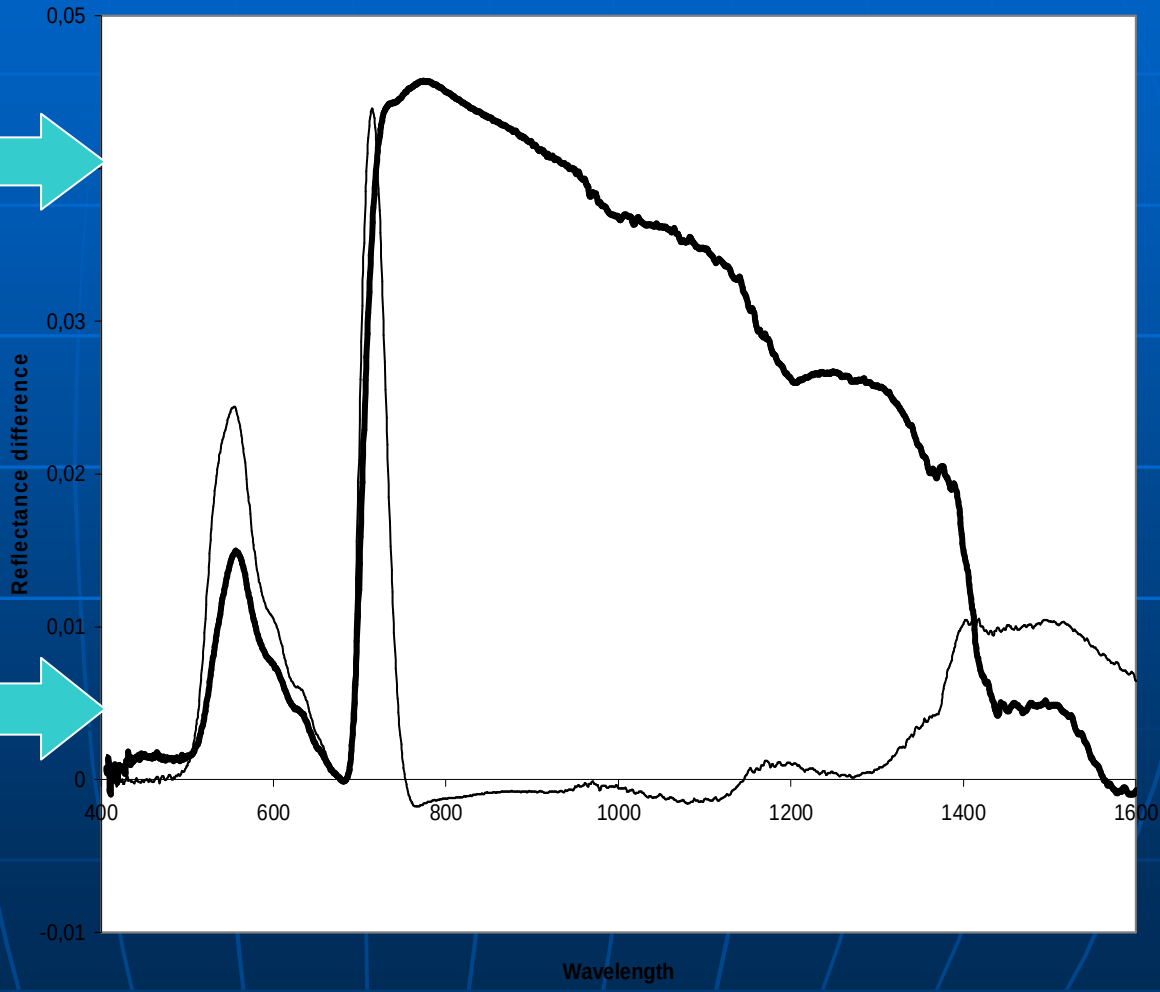
# Data analysis and methodology

- Only on leaf reflectance up to now
- Features are wavelengths
- Explorative analysis: subtraction of mean reflectance values of stressed and unstressed leaves
- Statistical analysis: non-parametric test → logistic regression analysis
  - Single wavelengths
  - Combination of wavelengths e.g. SDVI

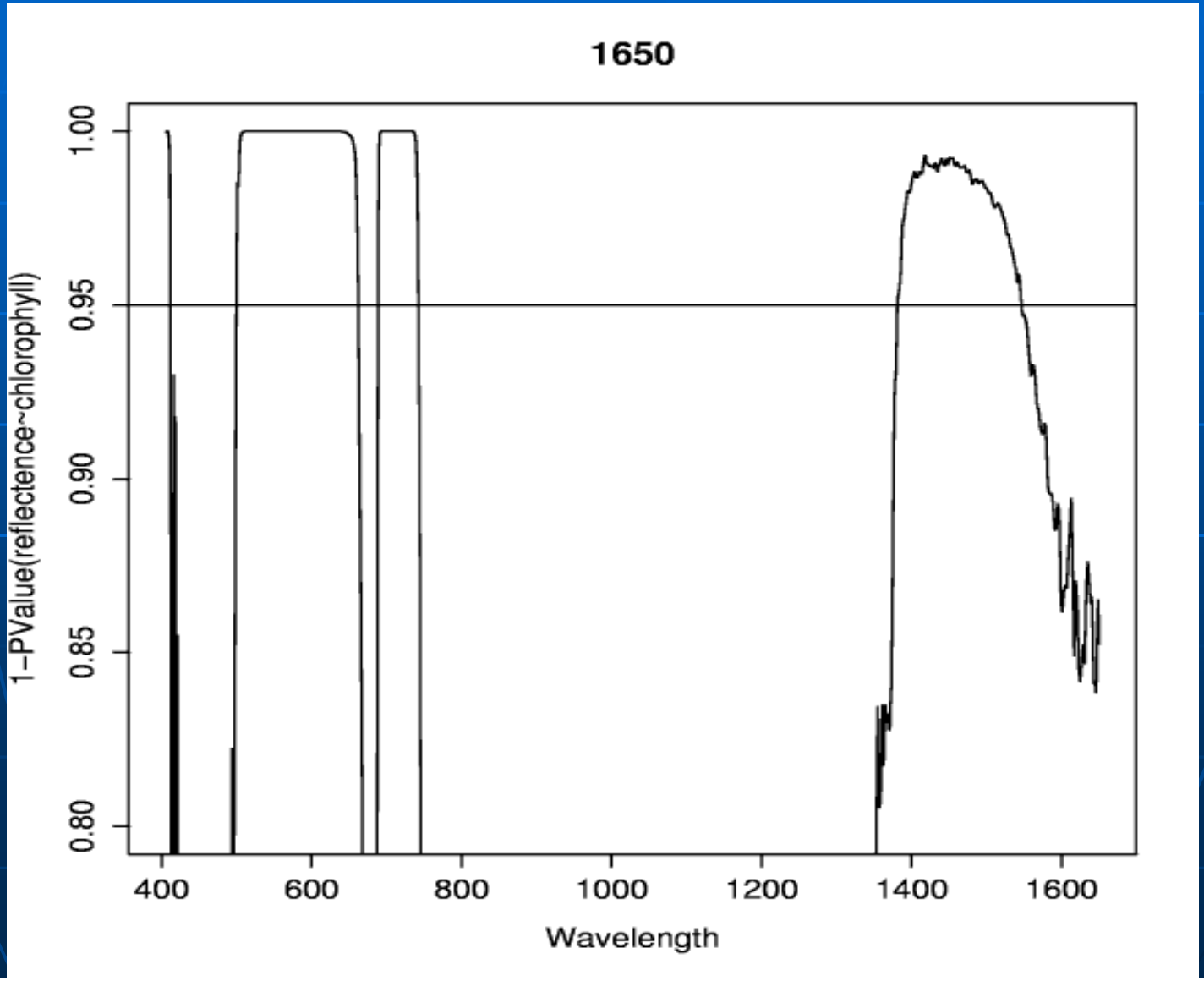
# Results


200
400
600
800
1000
1200
1400
1600
1800
Wavelength

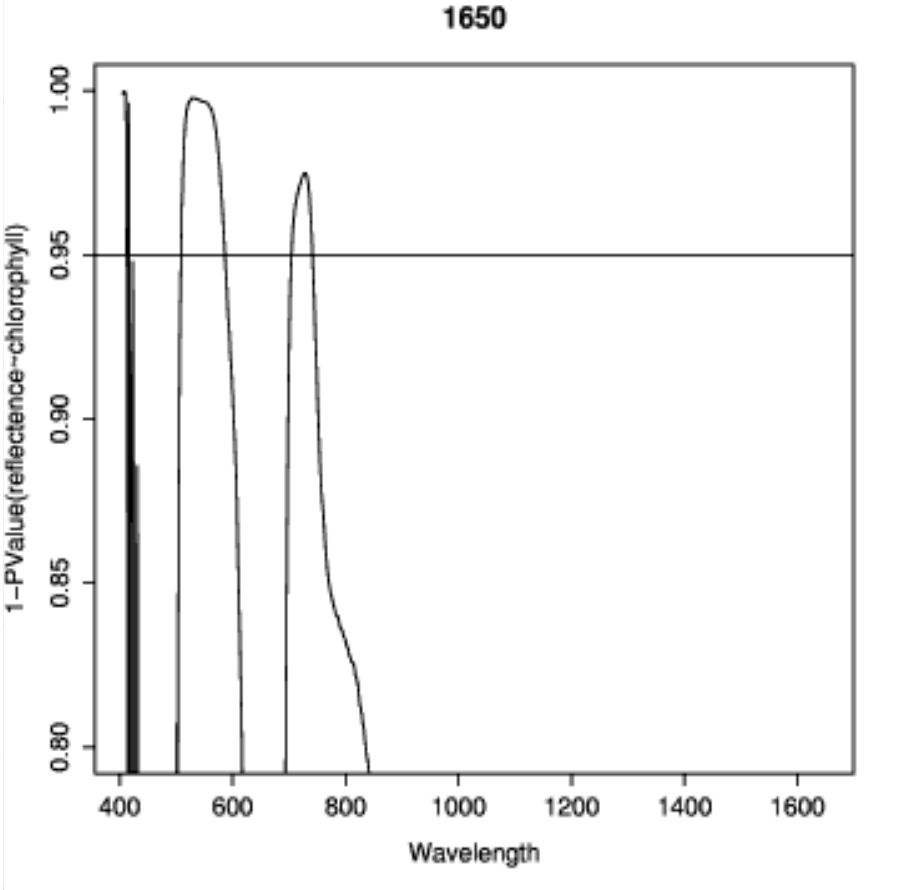

200
400
600
800
1000
1200
1400
1600
1800
Wavelength


0,05
0,03
0,02
0,01
0
-0,01
Reflectance difference
400
600
800
1000
1200
1400
1600
Wavelength
JNR-JN
GMR-GM

# Results


1650
1–PValue(reflectence~chlorophyll)
1.00
0.95
0.90
0.85
0.80
400
600
800
1000
1200
1400
1600
Wavelength

# Results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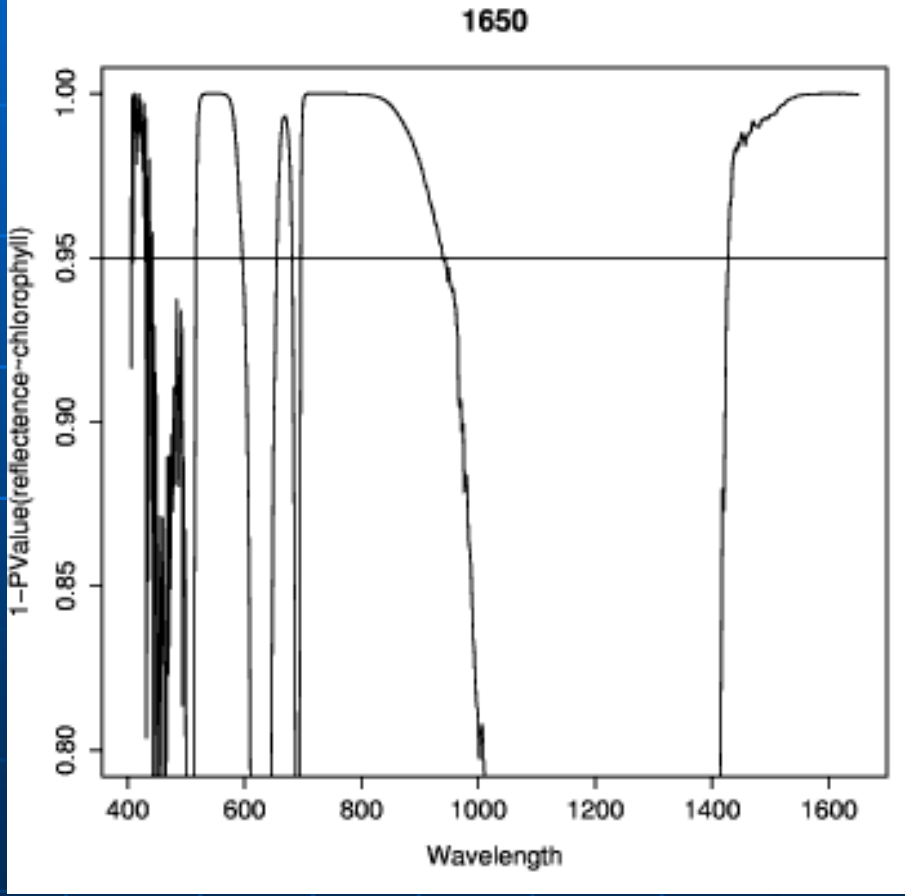
1.00
0.95
0.90
0.85
0.80
400
600
800
1000
1200
1400
1600
Wavelength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0.90
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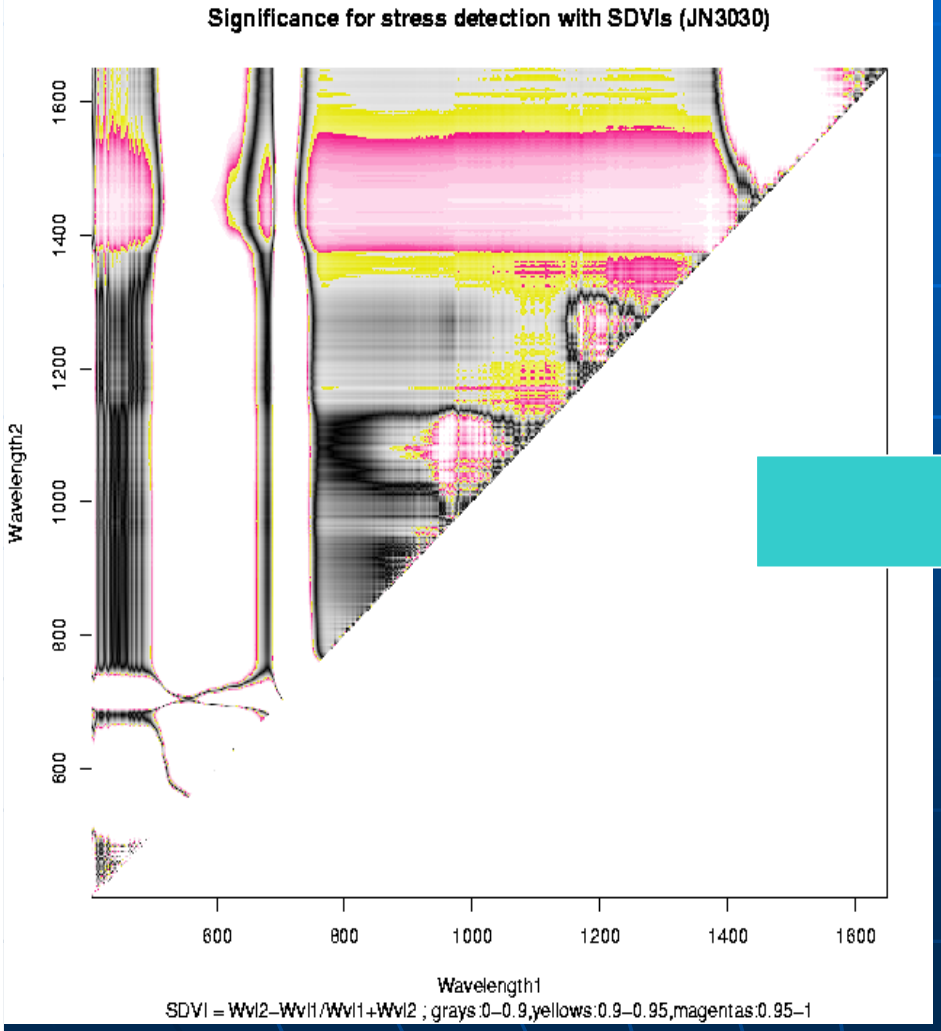
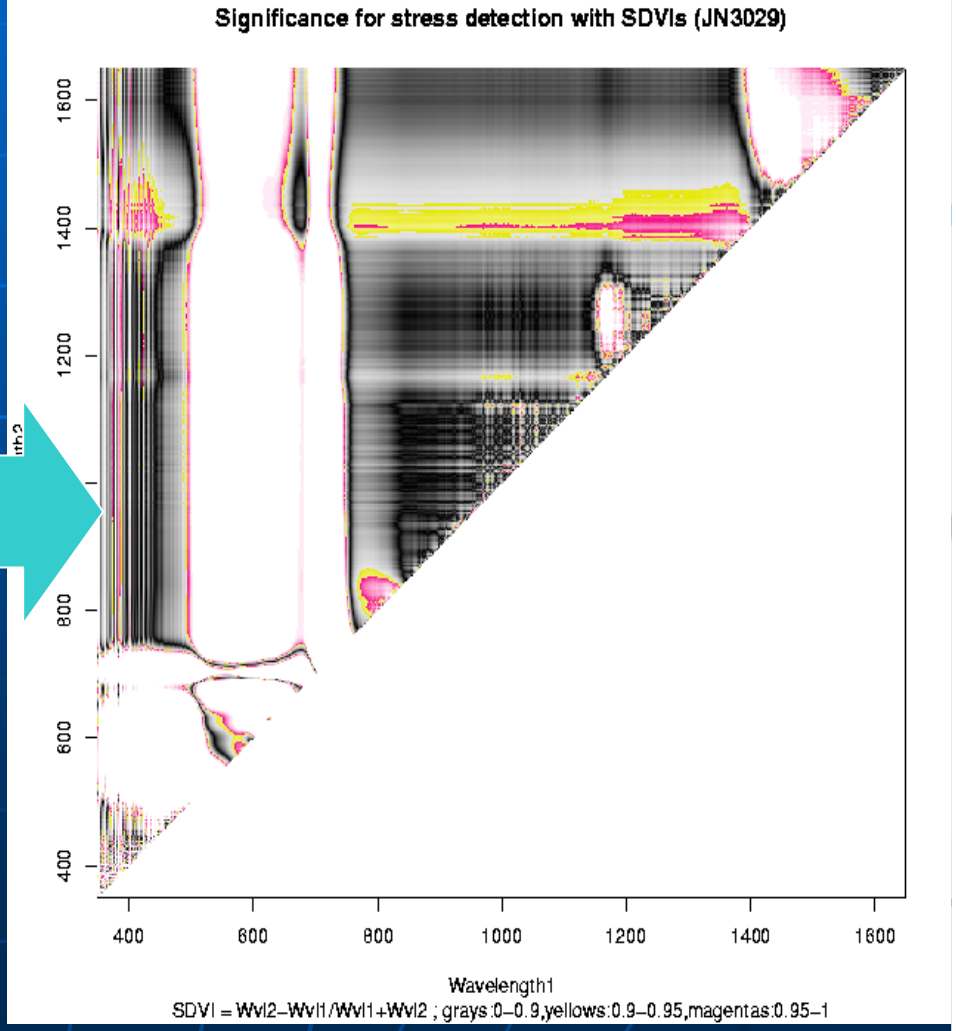
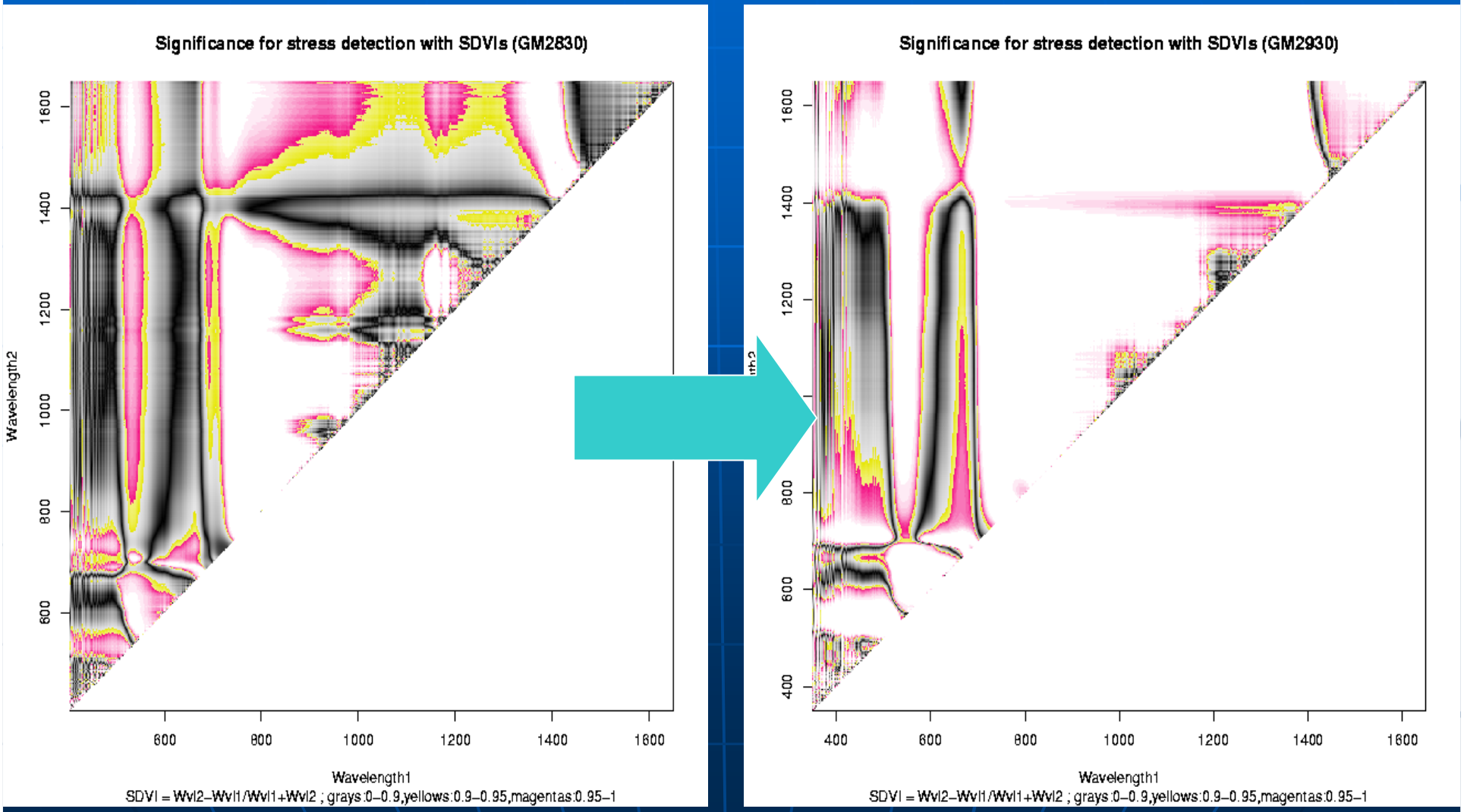
0.80
400
600
800
1000
1200
1400
1600
Wavelength

# Results


Significance for stress detection with SDVIs (JN3030)
Wavelength2
600
800
1000
1200
1400
1600
Wavelength1
SDVI = Wvl2−Wvl1/Wvl1+Wvl2 ; grays:0−0.9,yellows:0.9−0.95,magentas:0.95−1


Significance for stress detection with SDVIs (JN3029)
400
600
800
1000
1200
1400
1600
Wavelength1
SDVI = Wvl2−Wvl1/Wvl1+Wvl2 ; grays:0−0.9,yellows:0.9−0.95,magentas:0.95−1

# Results


Significance for stress detection with SDVIs (GM2830)
Wavelength2
600
800
1000
1200
1400
1600
Wavelength1
SDVI = Wvl2−Wvl1/Wvl1+Wvl2 ; grays:0−0.9,yellows:0.9−0.95,magentas:0.95−1
Significance for stress detection with SDVIs (GM2930)
400
600
800
1000
1200
1400
1600
Wavelength1
SDVI = Wvl2−Wvl1/Wvl1+Wvl2 ; grays:0−0.9,yellows:0.9−0.95,magentas:0.95−1

# Conclusions and future objectives

- Reflectance between stressed and unstressed leaves clearly different
- Spectral regions were specific to a stress or disease → corresponded to biophysical assumptions
- Able to distinguish between different stress types
- Able to predict performance of traditional vegetation indices e.g. SDVI
- Upscaling to tree-level and airborne data