

# Stereo & VG Second meeting

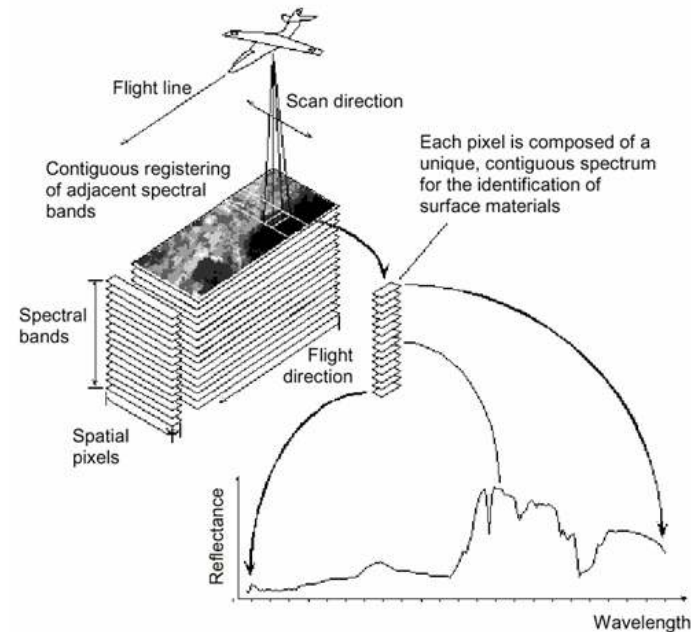
09/05/2003

# Content

- Objectives
- Methodology
- Results

# HyperCrunch: Improve information extraction from hyperspectral datacubes

- Algorithm Development
- Test and validation



The principle of imaging spectroscopy: contiguous spectra are collected in imaging mode

# HyperCrunch - Consortium

- **Vito** = Remote Sensing Centre of Expertise
  - Remote sensing background
- **UA** = Visielab
  - Theoretical, mathematical and physical background
- **KULeuven** = Geomatics and Forest Engineering Group
  - Thematic background (Biophysical interpretation)

# Experimental Test Site

Gorseem (KUL)

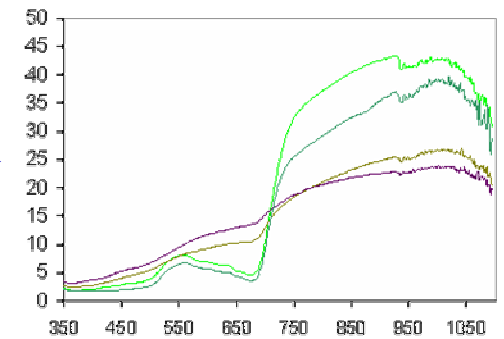


Data Acquisition (Vito+KUL)



ASD

Hyperspectral data set



Stress



CASI



# Methodology

Feature Choice

Feature Selection

Classification

# Methodology

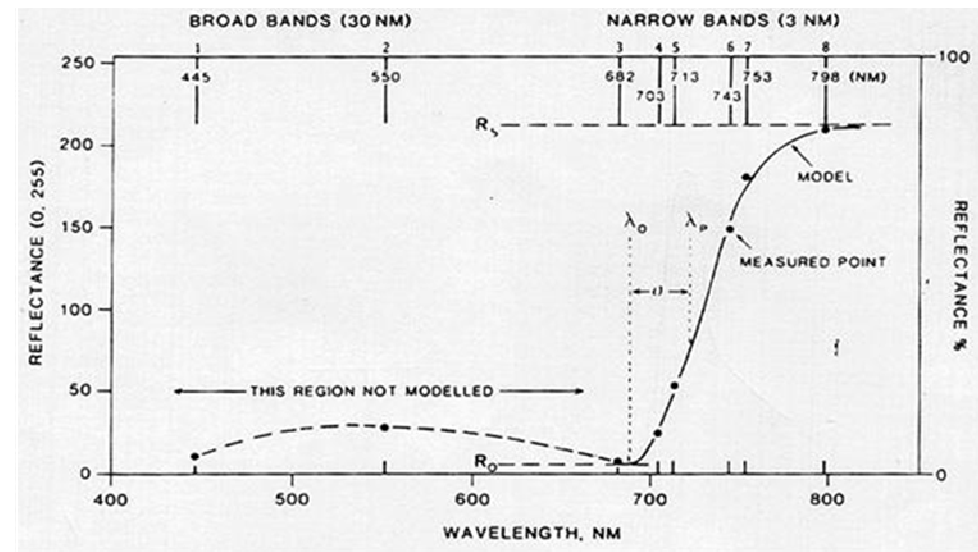
Feature Choice

Feature Selection

Classification

## Classical Features: Stress Indices (Vito)

- $\lambda_0$  : wavelength of the chlorophyll absorption feature at about 680 nm
- $R_0$  : the reflection minimum at  $\lambda_0$
- $R_s$  : the ‘shoulder’ reflectance at about 800 nm
- $\sigma$  : width of the Gaussian
- $\lambda_p$  :  $\lambda_0 + \sigma$  ; wavelength at the inflection point
- $R_{740} / R_{720}$  (Vogelmann et al., 1993)



Inverted Gaussian Model:

$$R(\lambda) = R_s - (R_s - R_0) e^{-\left[ \frac{(\lambda - \lambda_0)^2}{2\sigma^2} \right]}$$

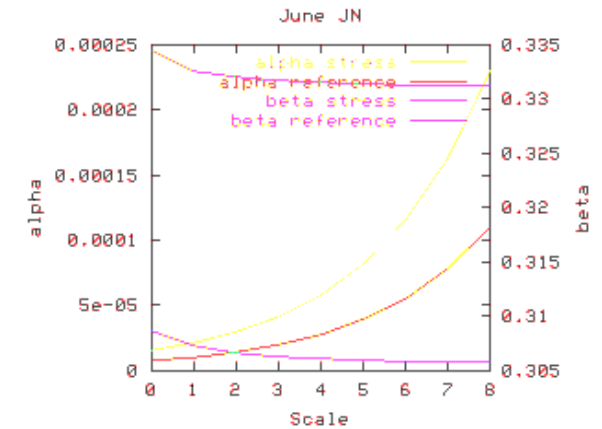
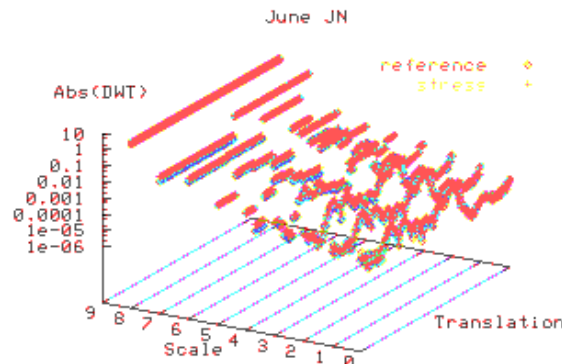
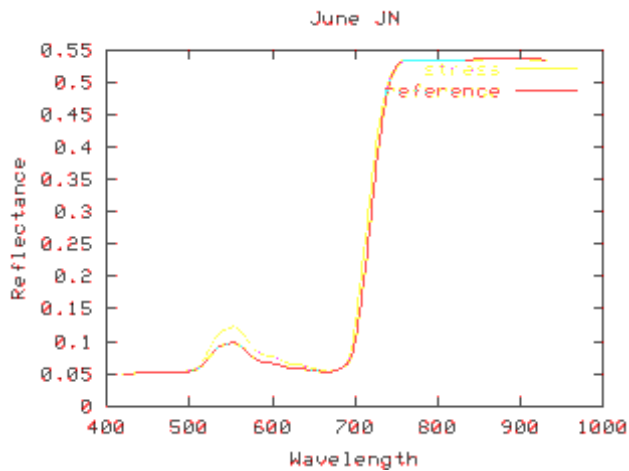
# Methodology

Feature Choice

Feature Selection

Classification

Wavelet Transform Coefficients + Statistical features (Vito and UA)





# Methodology

Feature Choice

Feature Selection

Classification

- Univariate
  - ROC: Receiver Operating Characteristic [literature]
- Multivariate
  - Floating Search
    - Cost function: Fisher's criterion (UA)
    - With Cost function through classification directly (Vito)

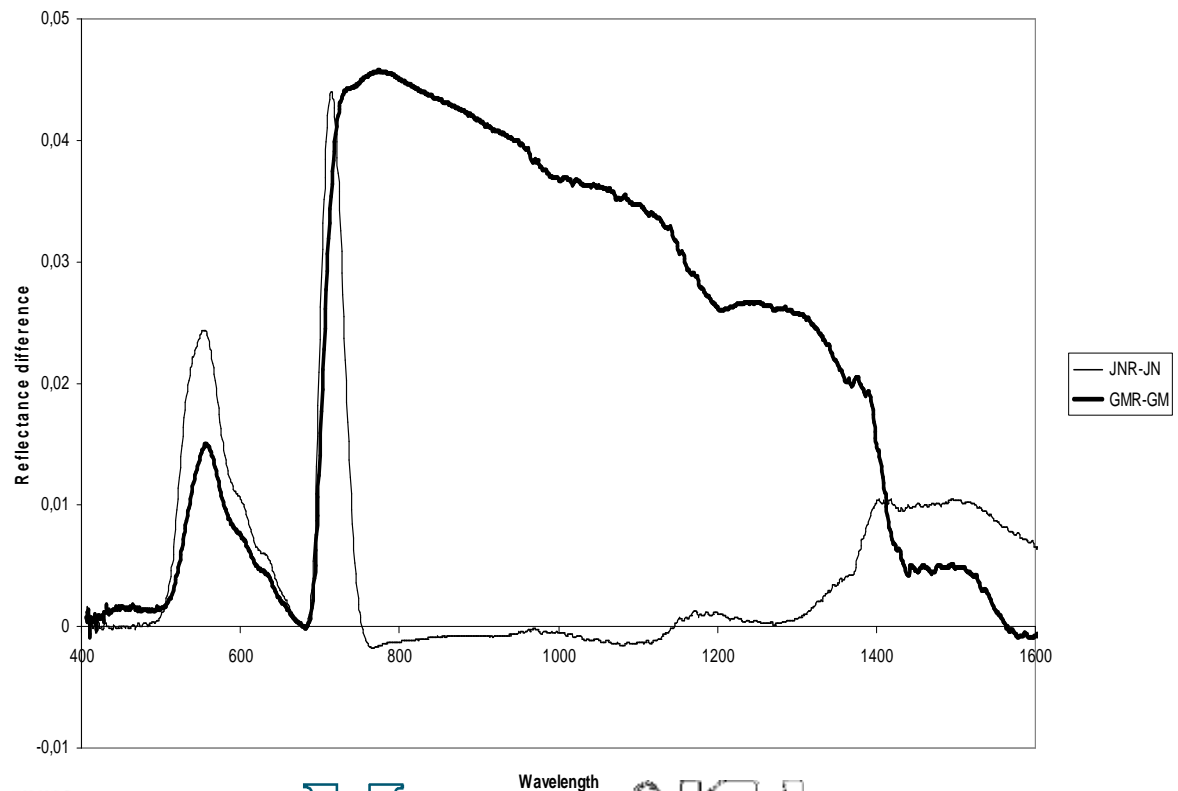
# Methodology

Feature Choice

Feature Selection

Classification

- Concentrate on spectra
- Comparison of spectra of stressed and unstressed leaves: differences in parts of the spectra depending on kind of stress
- Once regions are identified (unique regions for each stress type??) → creating specific indices?!

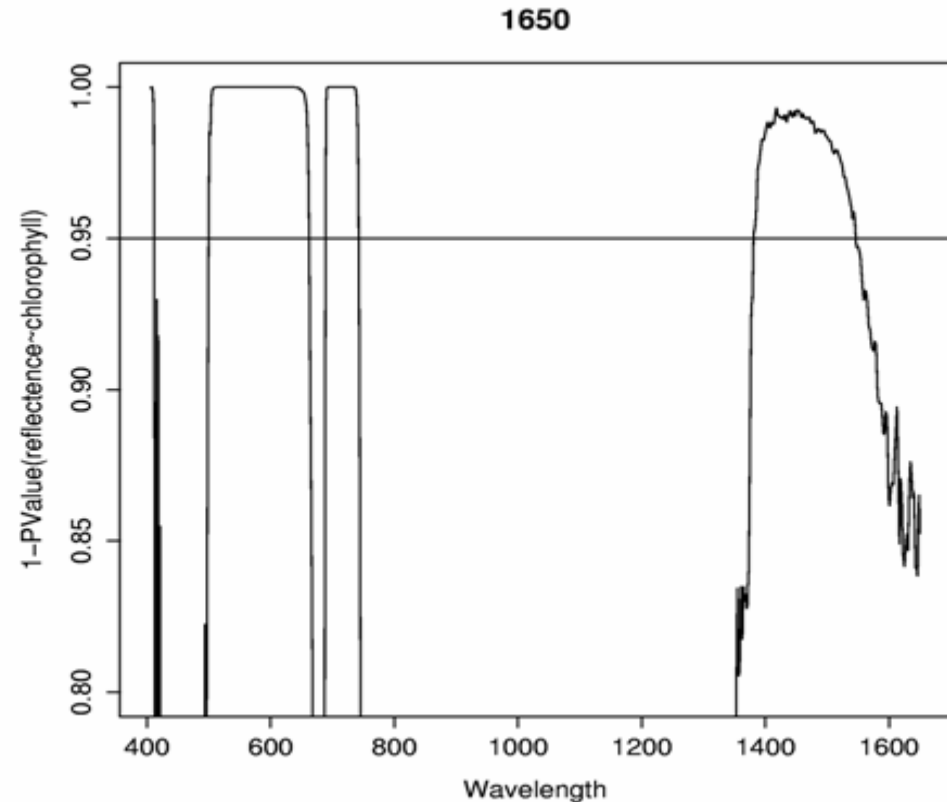
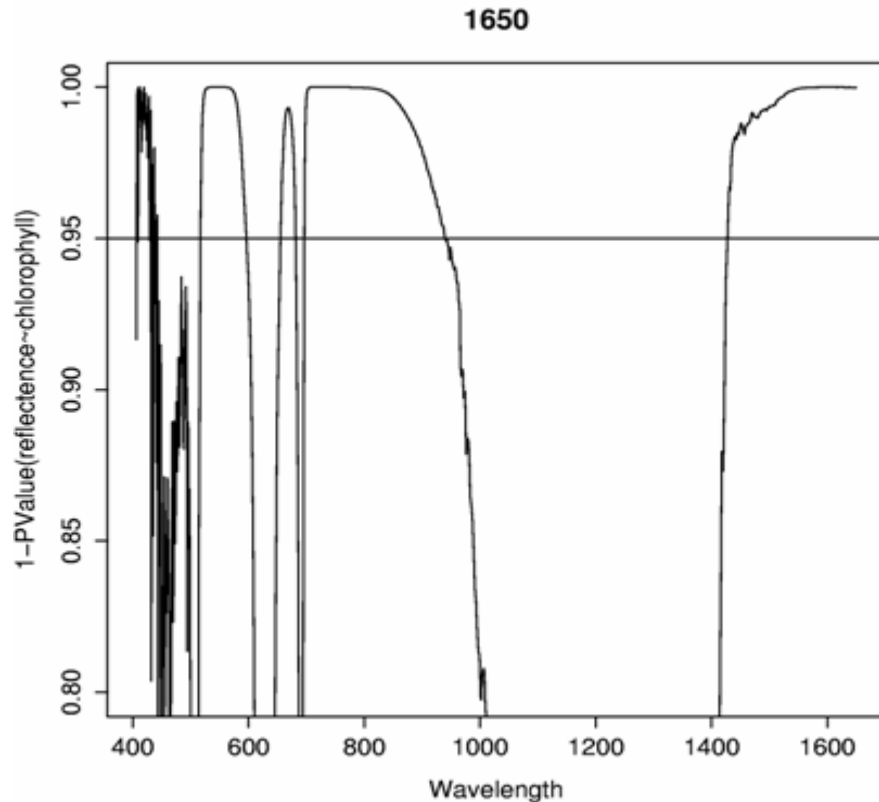


# Methodology

Feature Choice

Feature Selection

Classification

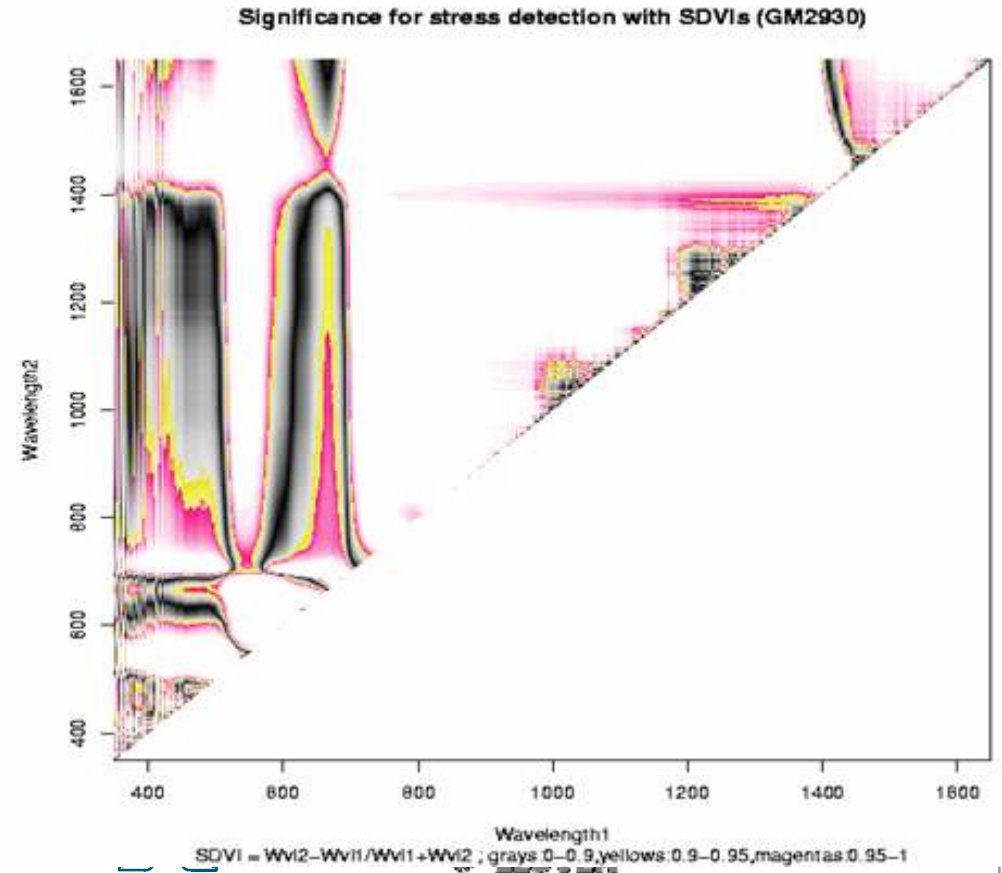
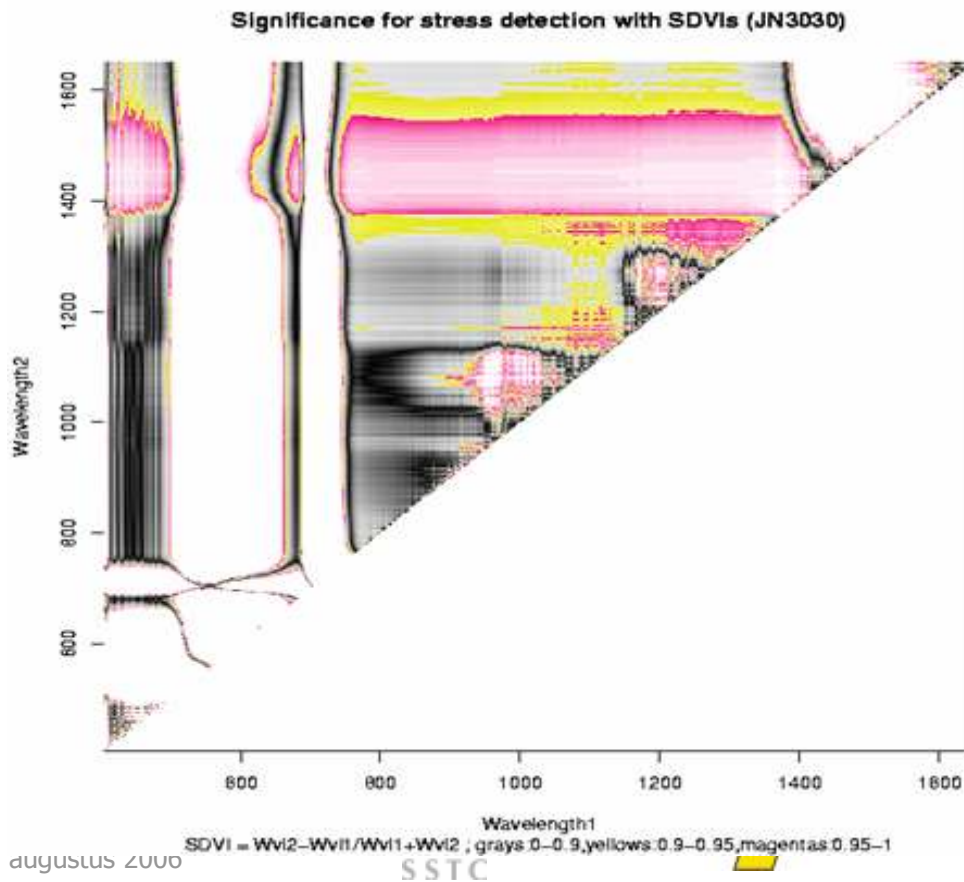


# Methodology

Feature Choice

Feature Selection

Classification



# Methodology

Feature Choice

Feature Selection

Classification

# Classification Results: Leaf-level

Stress factor	Bands	DWT	Stress Indices	RMS
JN June	.95	.98	.93	.92
JN Augustus	.85	.82	.72	.75
JN September	.68	.95	.90	.88
JA June	.90	.90	.69	.83
JA Augustus	.93	.97	.75	.80
JA September	.92	1.00	.67	.50
JV June	.70	.84	.58	.50
JV Augustus	1.00	1.00	.75	.98
JV September	.42	1.00	.67	.67
JF June	.98	.95	.72	.87
JF Augustus	.92	.95	.78	.72
JF September	.97	1.00	.70	.80
GF June	1.00	1.00	.74	.84
GF Augustus	.97	1.00	.93	.97
GF September	.90	.88	.85	.86

# Classification Results: Tree-level

Stress factor	Bands	DWT	Stress Indices	RMS
JN June				
JN Augustus	.92	.96	.96	1.00
JN September	1.00	1.00	.89	1.00
JA June	1.00	1.00	1.00	1.00
JA Augustus				
JA September	1.00	1.00	.94	1.00
JV June	1.00	1.00	.94	.63
JV Augustus				
JV September	.72	.83	.67	.67
JF June				
JF Augustus	.74	1.00	.84	.74
JF September	.78	.94	.78	.72
GF June				
GF Augustus	.79	1.00	.93	.71
GF September	.83	.94	.83	.83

# Chemical analysis leaves

- Leaves put in 100 % acetone solution
- Analysis with spectro-photometer ( $\lambda = 470, 645$  and  $662$  nm)
- Determination of chlorophyll (a and b) and Carotenoids (Lichtenthaler 1987)
- Results were poor!!
- Same leaves
- Portable chlorophyll meter
- More samples



1650

