

## Evaluation of soil sensor fusion for mapping macronutrients and soil pH. A case study with the Veris MSP

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## Hypothesis

- Combination of soil sensor will improve the prediction of soil parameters
- Put all sensors in one unit and map simultaneously

## Target parameters

- Soil pH
- Total content: C<sub>t</sub>, N<sub>t</sub>, P<sub>t</sub>, K<sub>t</sub>, Mg<sub>t</sub>, Fe<sub>t</sub>, Ca<sub>t</sub>
- Plant available (double-lactate): P-DL, K-DL, Mg-DL

## Commercial multi-sensor: The Veris Mobile Sensor Platform (MSP)

Configuration for quasi-continuous mapping  
„Delux“ version offers 3 types of sensors:

- EC sensor cart
- pH Manager
- vis-NIR spectrophotometer

However, parallel operation is NOT provided by Veris  
-> modification by our working group

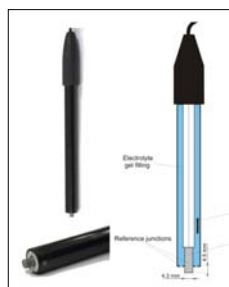
## ECa module

6 coulters, Wenner array for apparent electrical resistivity



Veris 3100

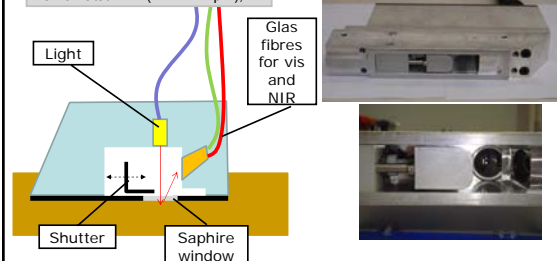
## Veris pH Manager



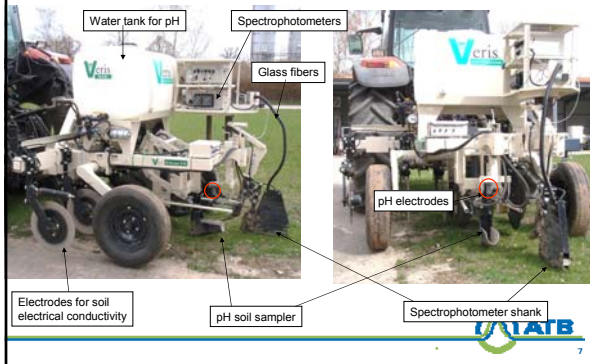
Antimony electrode

## Veris spectrophotometer, shank version

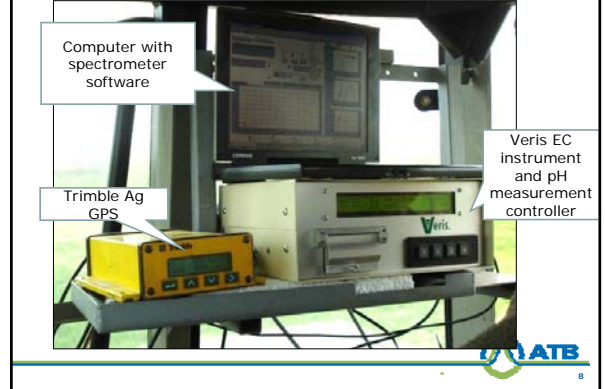
Sensor box:  
OceanOptics vis (0.35 – 1 μm),  
Hamamatsu NIR (1.1 – 2.2 μm),



### Veris MSP: modified system



### Veris MSP: Controllers/instruments



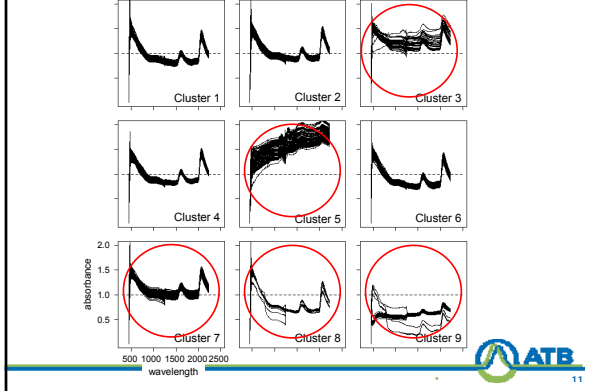
### Veris MSP video 1



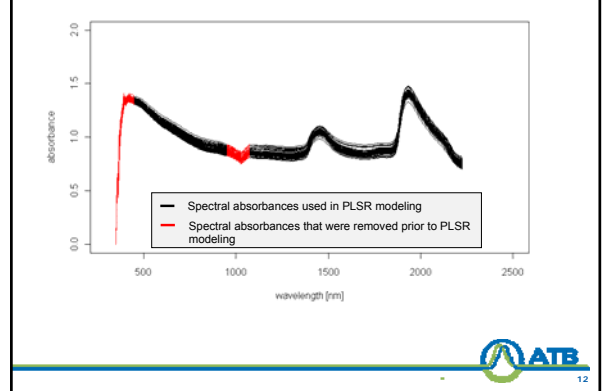
### Veris MSP video 2

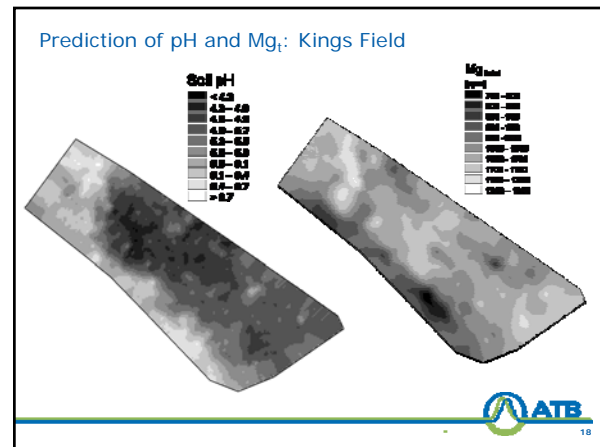
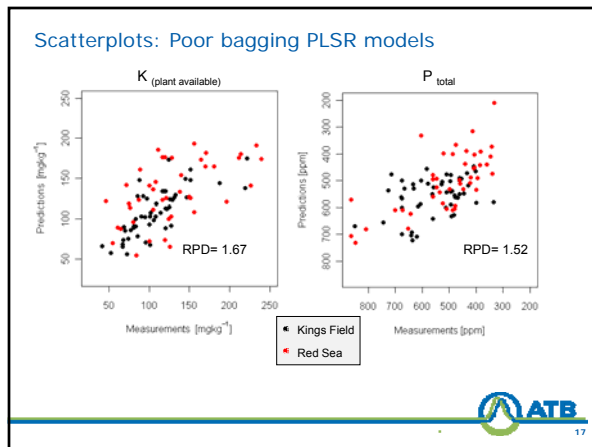
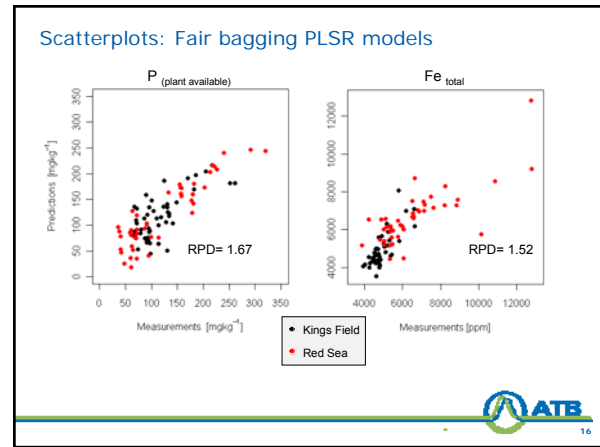
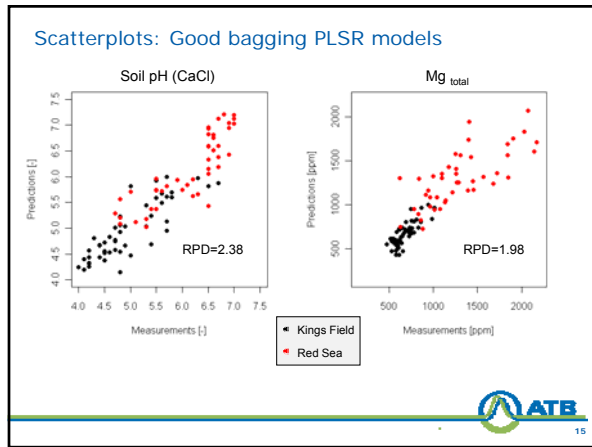
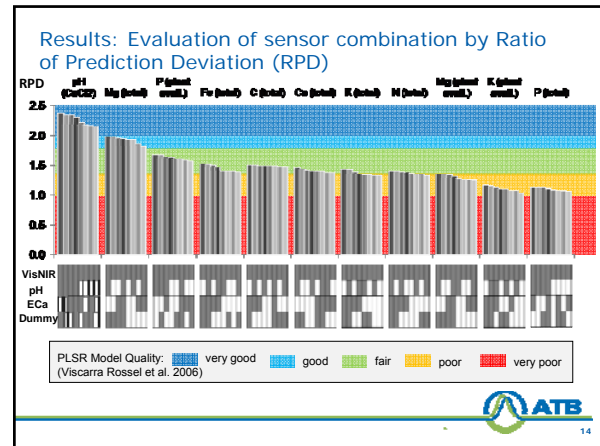
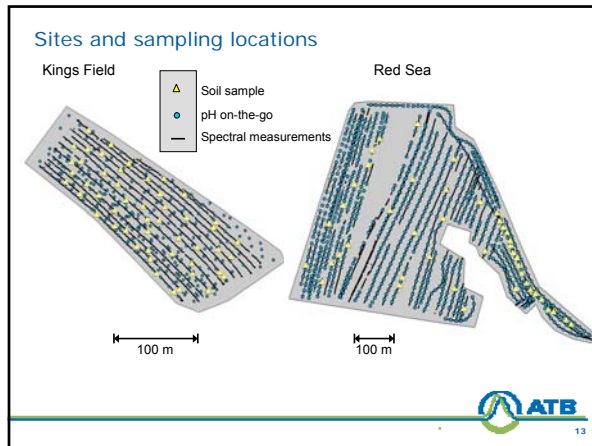


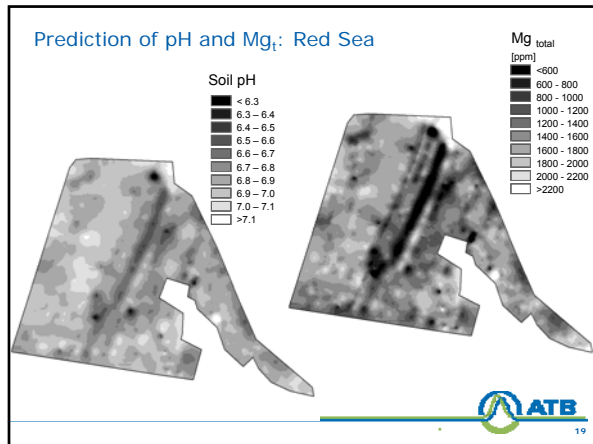
### Pre-treatment of spectra: cluster analysis (k-Means)



### Pre-treatment of spectra: Removal of noisy portions







- ### Discussion
- Calibration was done with field spectra not with lab spectra
  - Limited pre-treatment of data (no derivatives, base-line correction, wavelet transform etc.)
  - Measurement positions do not coincide due to malfunctioning of sensors
  - Variation (spread) of target parameters is important for S/N ratio
  - Simultaneous operation of sensors can cause troubles
    - quality control of diverse signals becomes difficult
    - mutual influences (mechanical, electrical ...)
  - Should pH and ECa readings be weighted against spectra in PLSR?
  - Better calibration with other algorithms (robust PLSR, SVM, ANN ...)?
  - Small sampling support of pH sensor and spectrophotometer
  - Can spatial correlation of errors influence calibration?
- ATB

