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# Hyperspectral mapping of riparian wetness gradients

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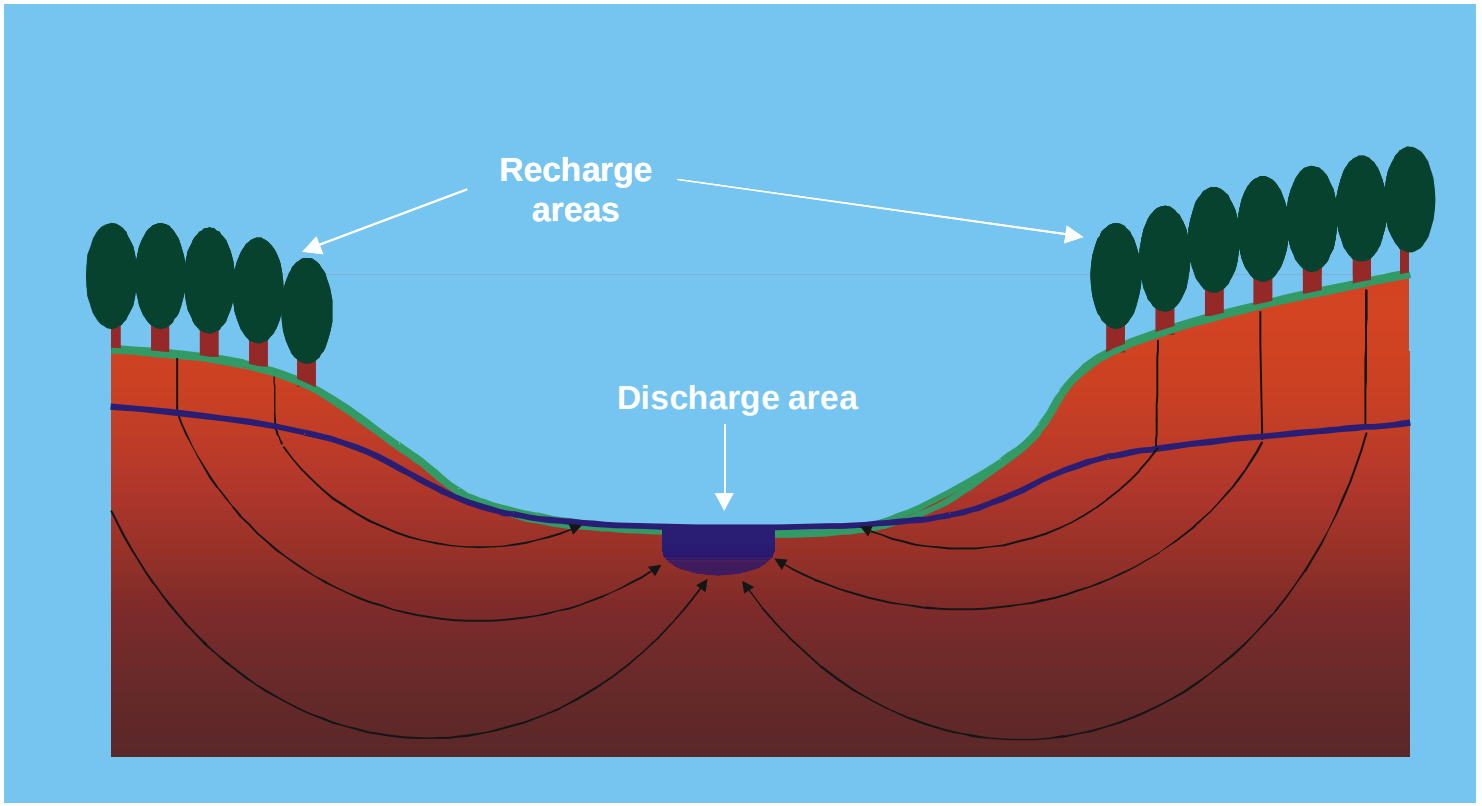
# Outline

- Hydrological groundwater systems & groundwater modeling
- Campaign
- Analysis of hyperspectral dataset
  - Soil moisture
  - Groundwater (depth)
  - Vegetation
- Conclusions

# Hydrological Groundwater Systems

- Natural situation



# Groundwater modeling

- Discharge/infiltration (moisture gradient)
  - complex patterns (interaction of regional groundwater flow, soil, vegetation, topography, …)
- Current method:
  - numerical groundwater models (MODFLOW)
    - groundwater flow and -levels, discharge maps, …
    - input for ecological analysis & models

# Disadvantages

- Data intensive (topography, geology, soil, landuse, meteorological data, …)
- Often a lack of calibration data

There is a direct NEED for repeatable, area covering, mapping posibilities for the determination of wetness gradients and more specially discharge (and infiltration) zones.

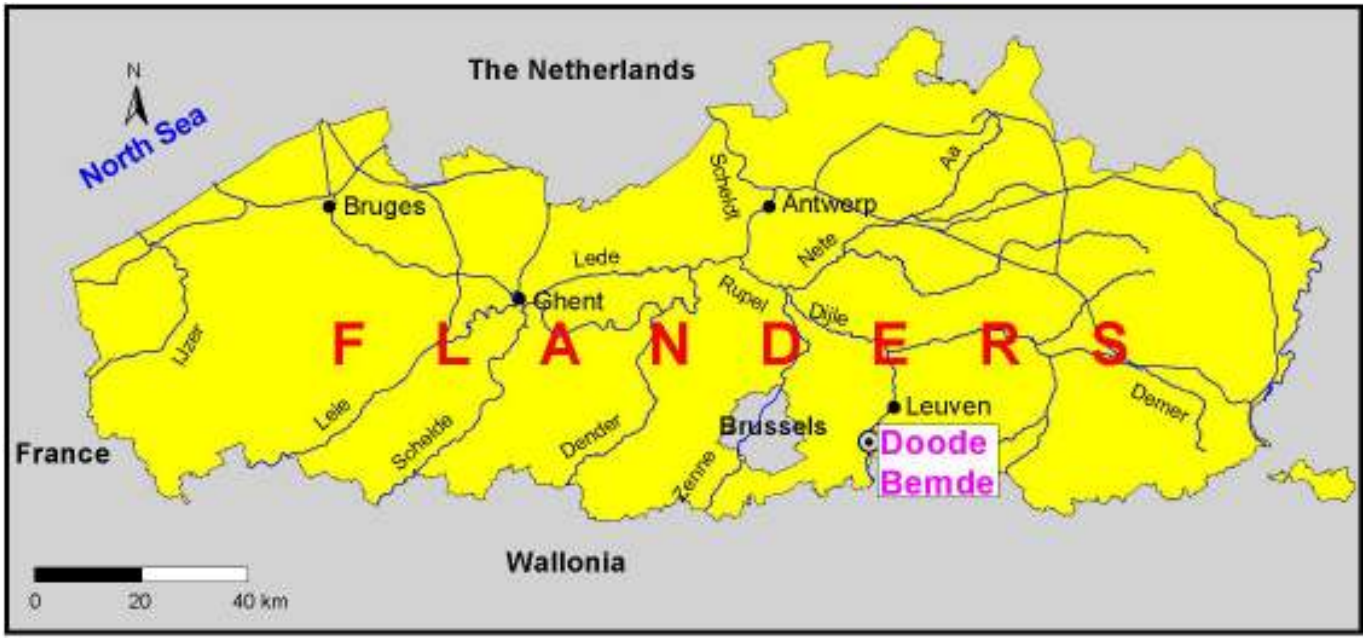
- Could hyperspectral Remote Sensing be an answer or help?

# Set-up campaign

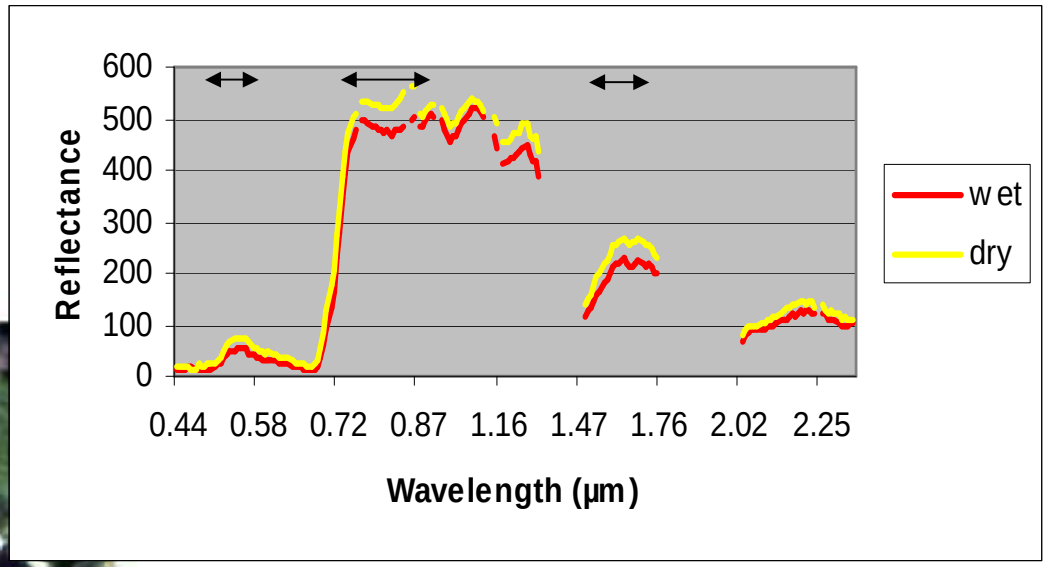
- Airborne hyperspectral campaign
  in combination with,
  Hydrological field campaign
- Aim: analysis and mapping of **wetness gradients** in the ‘Doode Bemde’ riparian wetland.
- Focus:
  (1) Soil moisture
  (2) Groundwater (depth)
  (3) Vegetation (phreatophytes)

# Study area

- Riparian wetland “Doode Bemde”



# Wet versus dry

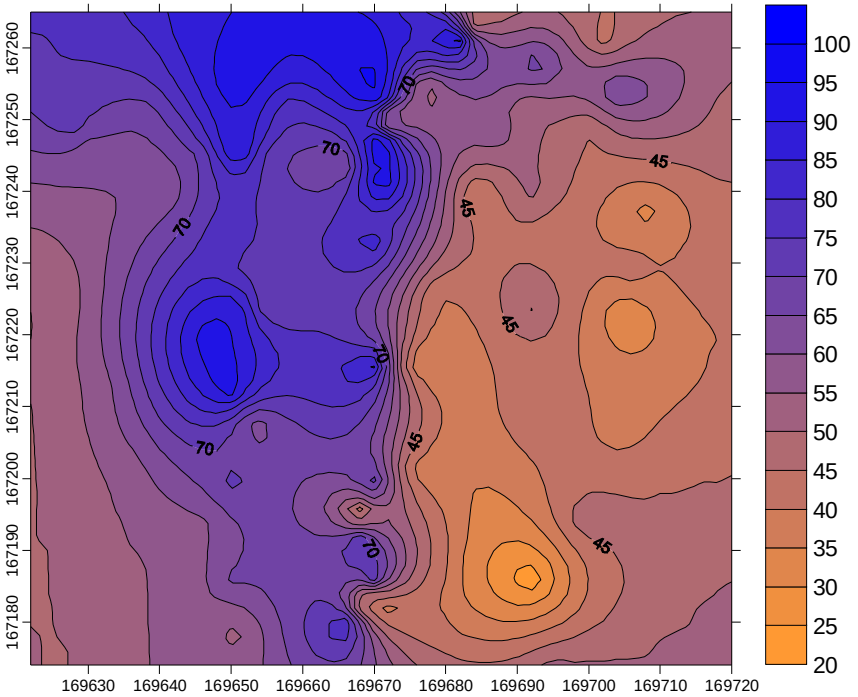

Clear difference between mean spectral signatures of wet and dry vegetation targets

# (1) Soil moisture

- Focussed at 1 parcel (grass field)
- Theta probe

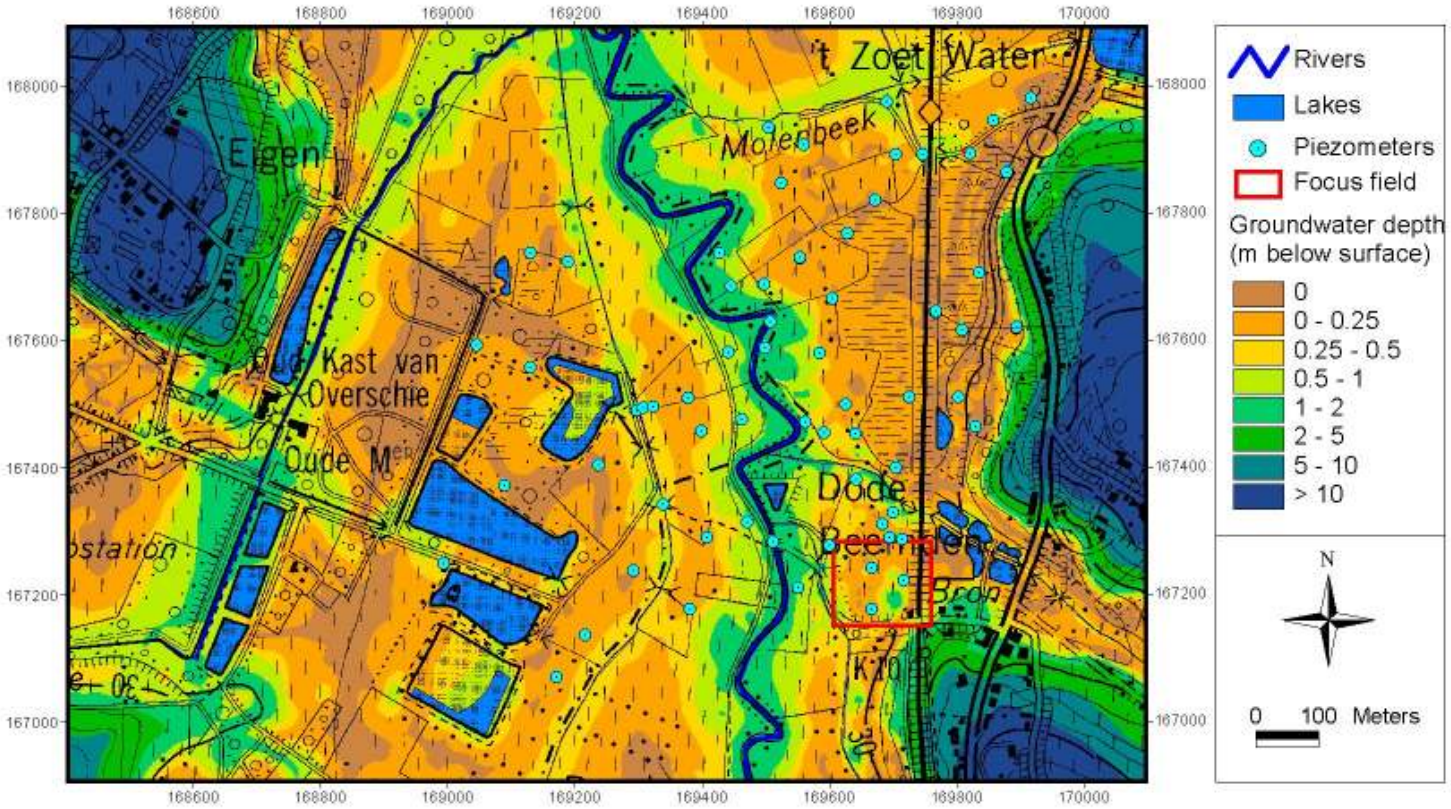
- Measurements at 85 locations

Geostatistically interpolated measured soil moisture.



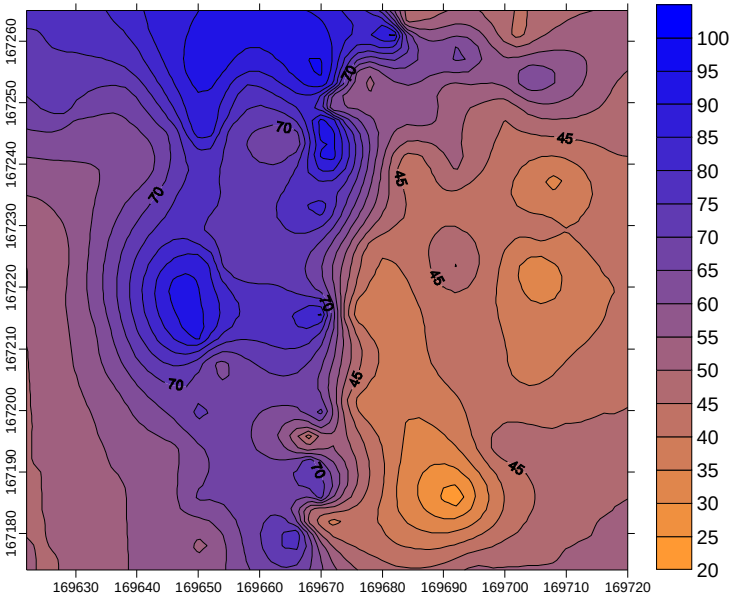
# (2) Groundwater depth

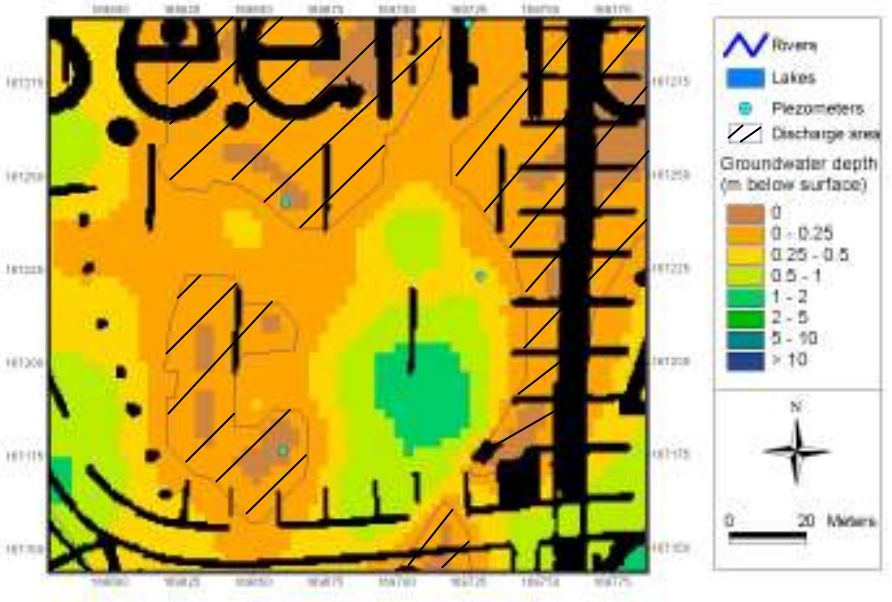
- Detailed groundwatermodel (2.44 x 2.44 m)



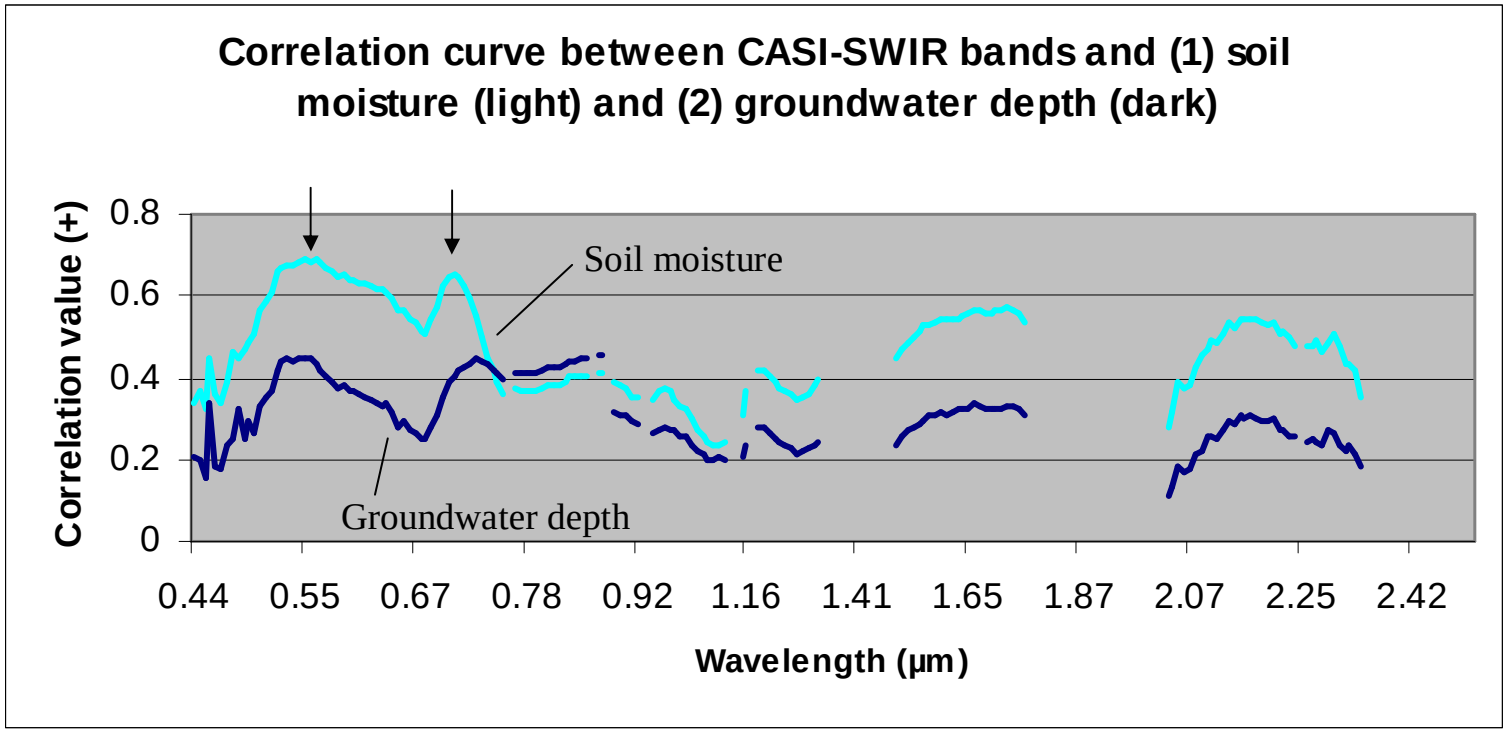
# Soil moisture versus Groundwater depth

- Relatively high correlation between soil moisture distribution and groundwater depth
  => correlation moisture distribution - images ?



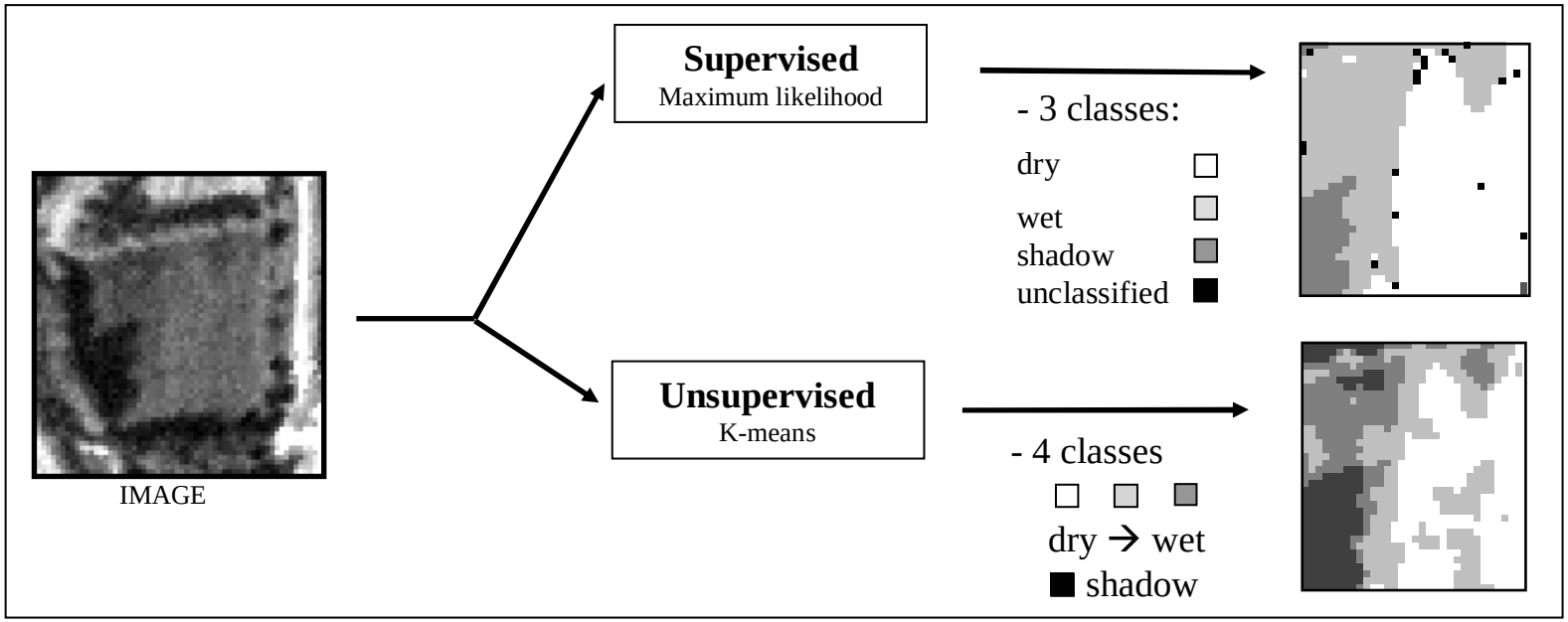
# Measured data versus hyperspectral data (CASI-SWIR)




Sm: Band 26 (0.5690): -0.69 => normalised: -0.73

# Classification

- Goal: mapping of wetness gradients (identification of discharge zones)



# (3) Vegetation

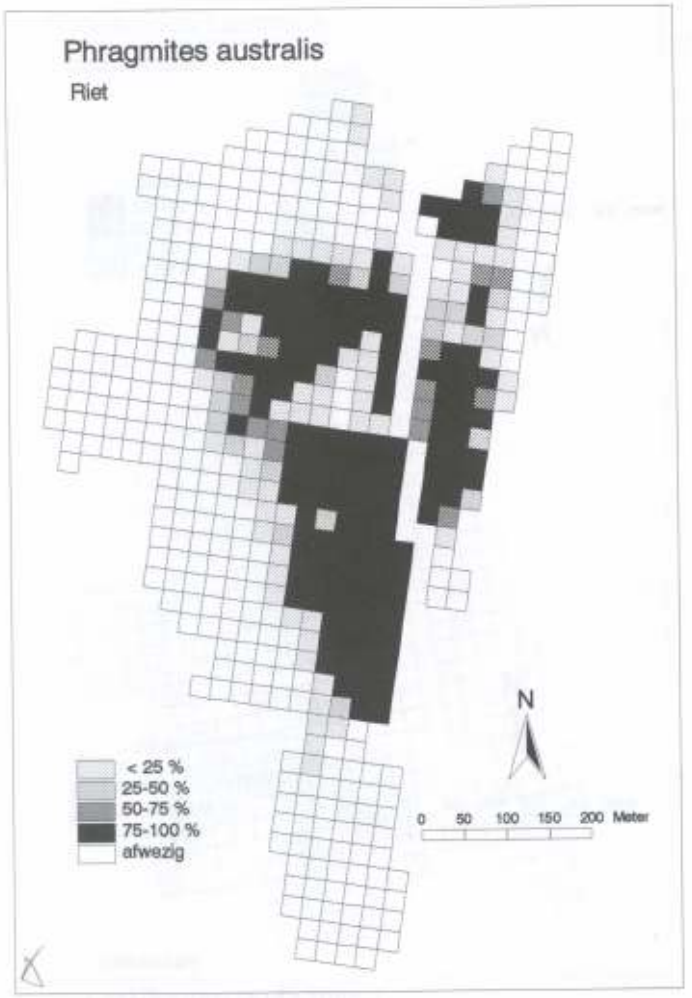
- Vegetation mapping
  => phreatophytes

  (Institute for Nature Conservation)
- Selection species

  (e.g. Phragmites australis)

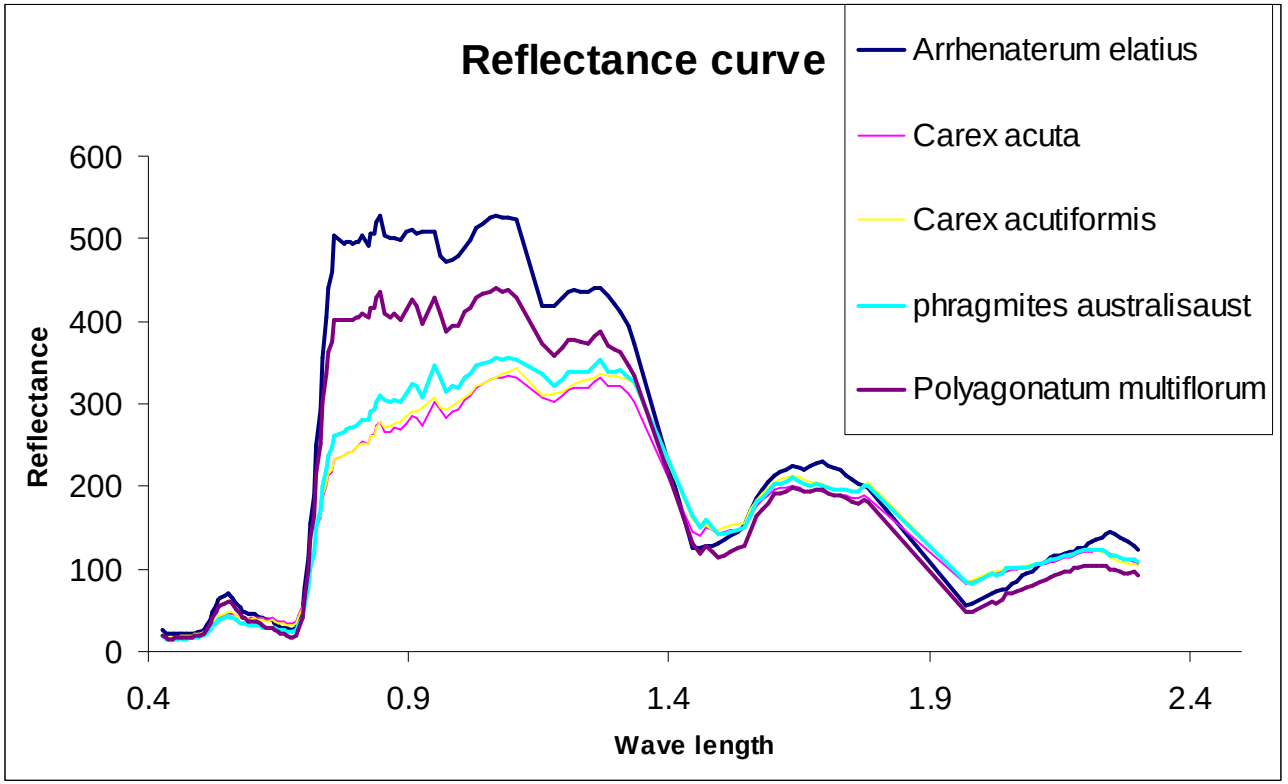
  => define “pure” pixels

  => end-members



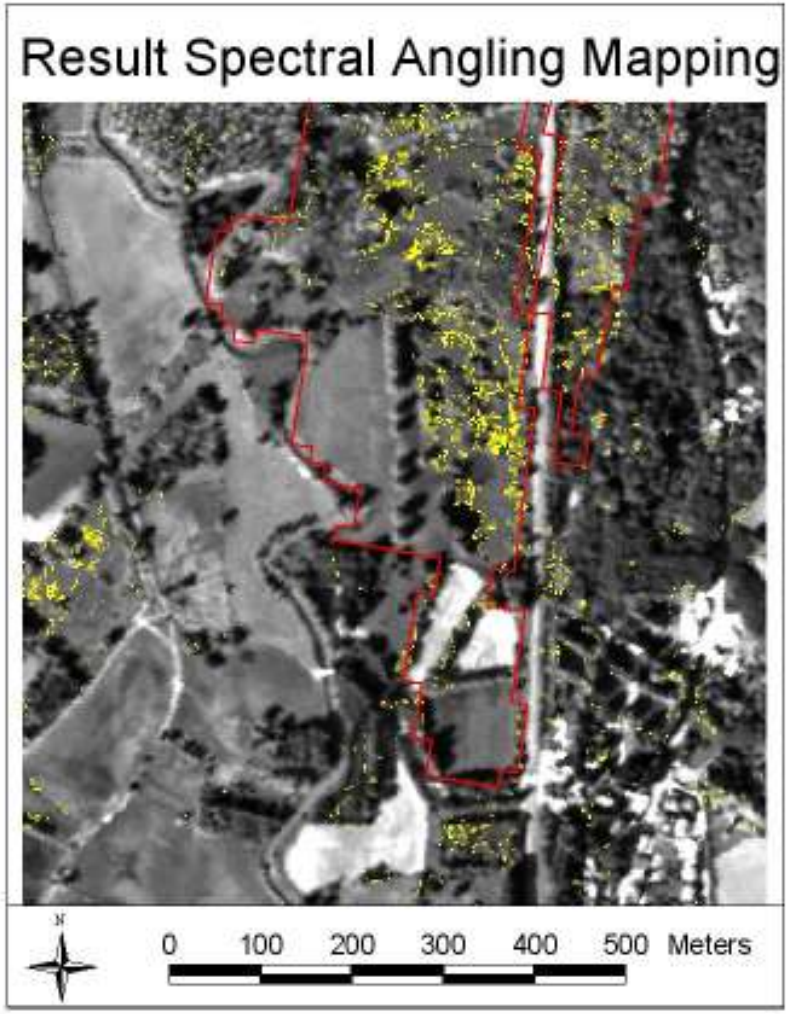
# Phragmites australis (reed)

- Reflectance “pure” pixels

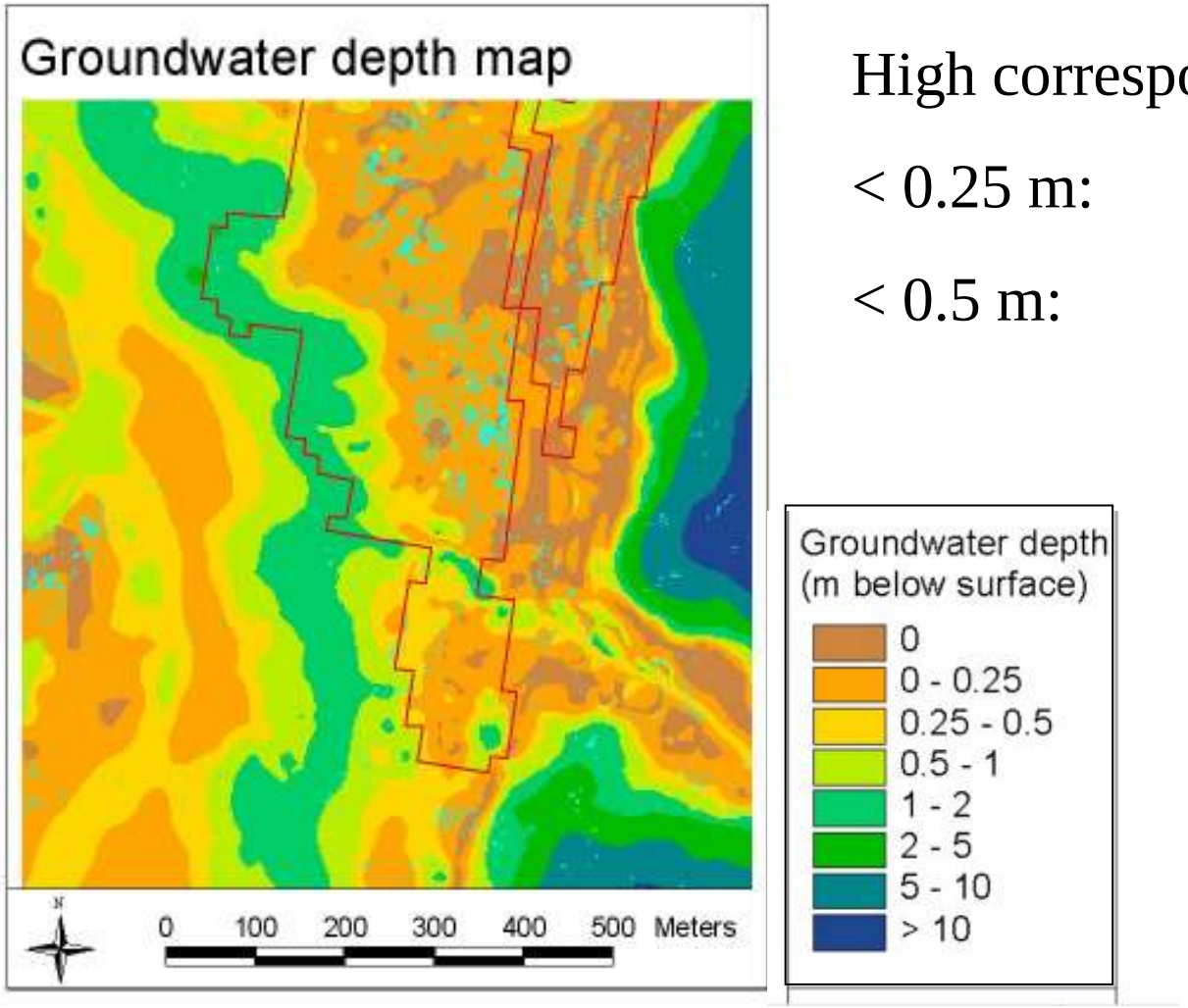


# Classification

- Result classification ‘Phragmites australis’
  - scattered pattern
  - concentration at certain locations



# Link groundwater depth



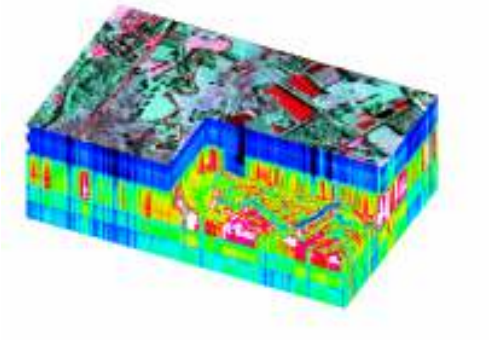

High correspondence

< 0.25 m: 74%

< 0.5 m: 82%

# Hydrological model & hyperspectral dataset

Hyperspectral dataset



- Mapping of **wetness gradients**
- Identification of **zones** with **shallow groundwater**
- Mapping of **phreatophytes**

- **Landcover** map (high resolution!)
- Vegetation abundance

**(1) INPUT**

- **DEM**
- **geology**
- **rivers**
- **recharge**

Hydrological model

results

**(2) CALIBRATION**

# Conclusions

- The CASI-SWIR dataset offers new input and calibration possibilities for improved groundwater modeling.
- Hyperspectral Remote Sensing seems to be useful (in combination with the ‘traditional’ methods) for the analysis and mapping of wetness gradients in valley areas.

# Acknowledgements


- This work is a partial result of the project “Hyperspectral remote sensing of moisture gradients: the influence of infiltration and discharge areas” and is financed by the Belgian Federal Office for Scientific, Technical and Cultural Affairs. With special thanks to the people of the VITO (Flemish Institute for Technological Research) for their help and support before, during and after the campaign.


Thank you very much for your attention!