SAR data for agriculture

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Lecture D3Pb3

Crop mapping using polarimetric radar data

In regions where high resolution optical data are not frequently available

Selected radar data

- C-band data (X-band data)
- Polarimetric (or dual polarisation) data to enhance the discrimination
- Multitemporal data to enhance the discrimination

Classification methods

- Preprocessing steps
- Determination of adapted classifiers
- Knowledge-based, supervised ML, unsuppervised.. classification

Knowledge based classifiers

Measurements analysed :

- Amplitude of the HHVV correlation coefficient
- Ratio of powers(between HH, VV, HV)
- Measurements from polarisation synthesis: RR, LL, LR, RR-LL, RR-RL..
- Entropy and alpha

Use of dB (log domain) appropriate because of additive speckle and differences between clusters independent of absolute level

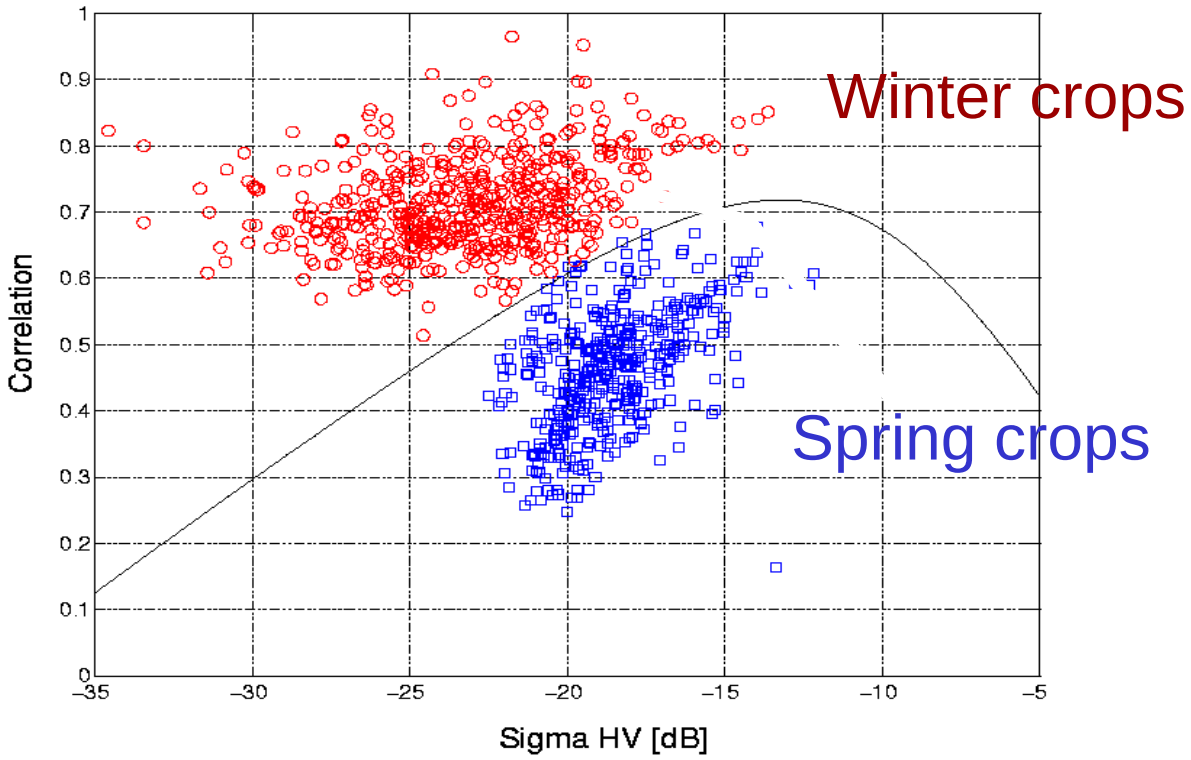
Illustrations

Crop mapping in Flevoland (NL) and Folum (DK) using airborne polarimetric C band SAR

POLSAR ESA project:
- CESBIO
- Technical University Denmark
- Univ of Sheffield

Measurements to separate surface from volume scattering

March-April data:
Separation of winter (surface scattering) and spring (more volume) crops using HHVV correlation and HV



Measurements to separate small stem from broad leaves crops

Ratio (or difference in dB)

RR/LL

HV/VV

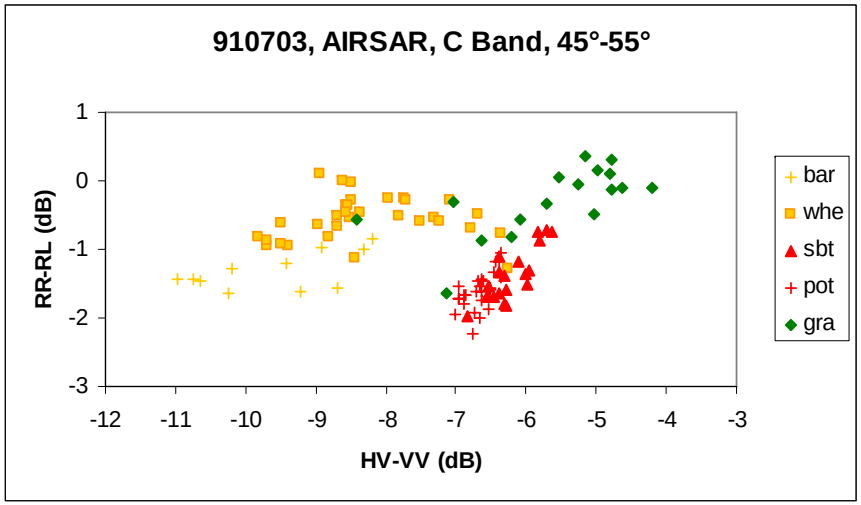


Figure 26.-

Flevoland, July

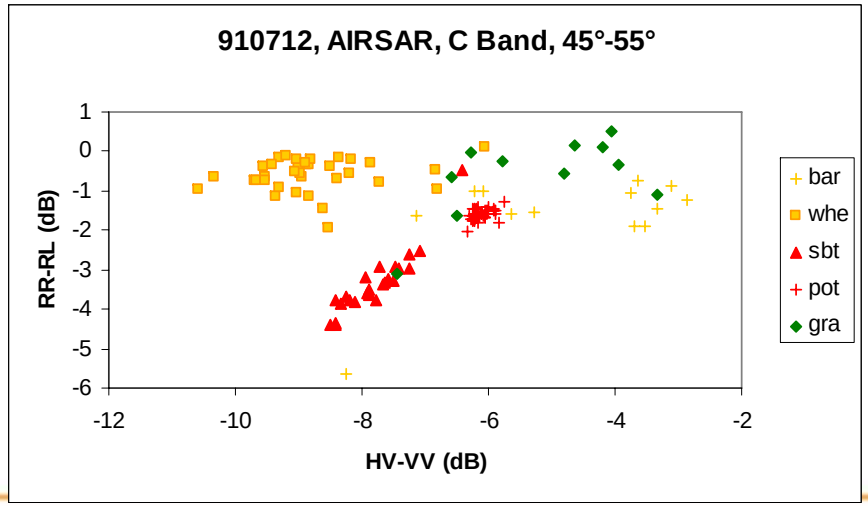


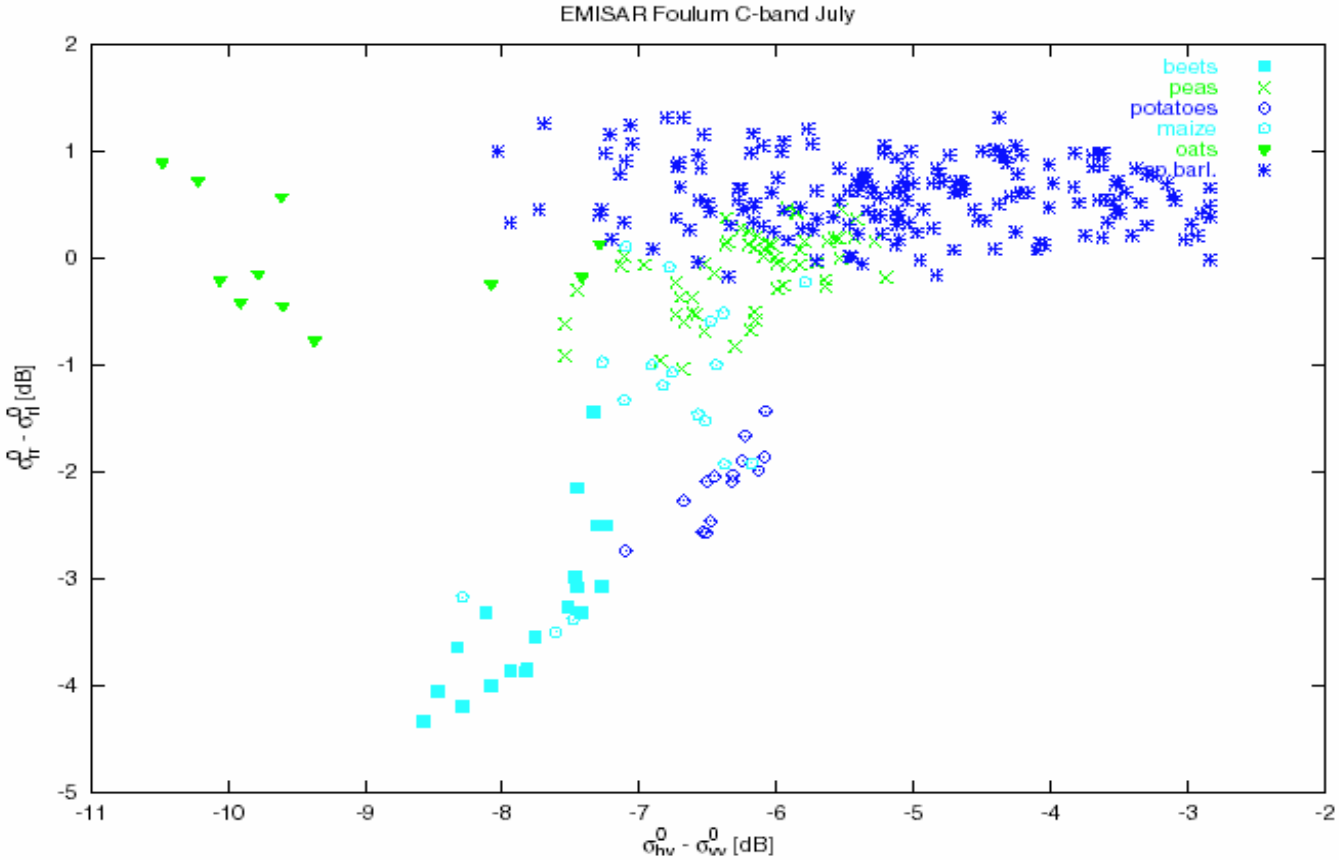
Figure 27.-

Measurements to separate small stem from broad leaves crops

RR-RL
HV-VV
} to separate cylinder from disc scattering

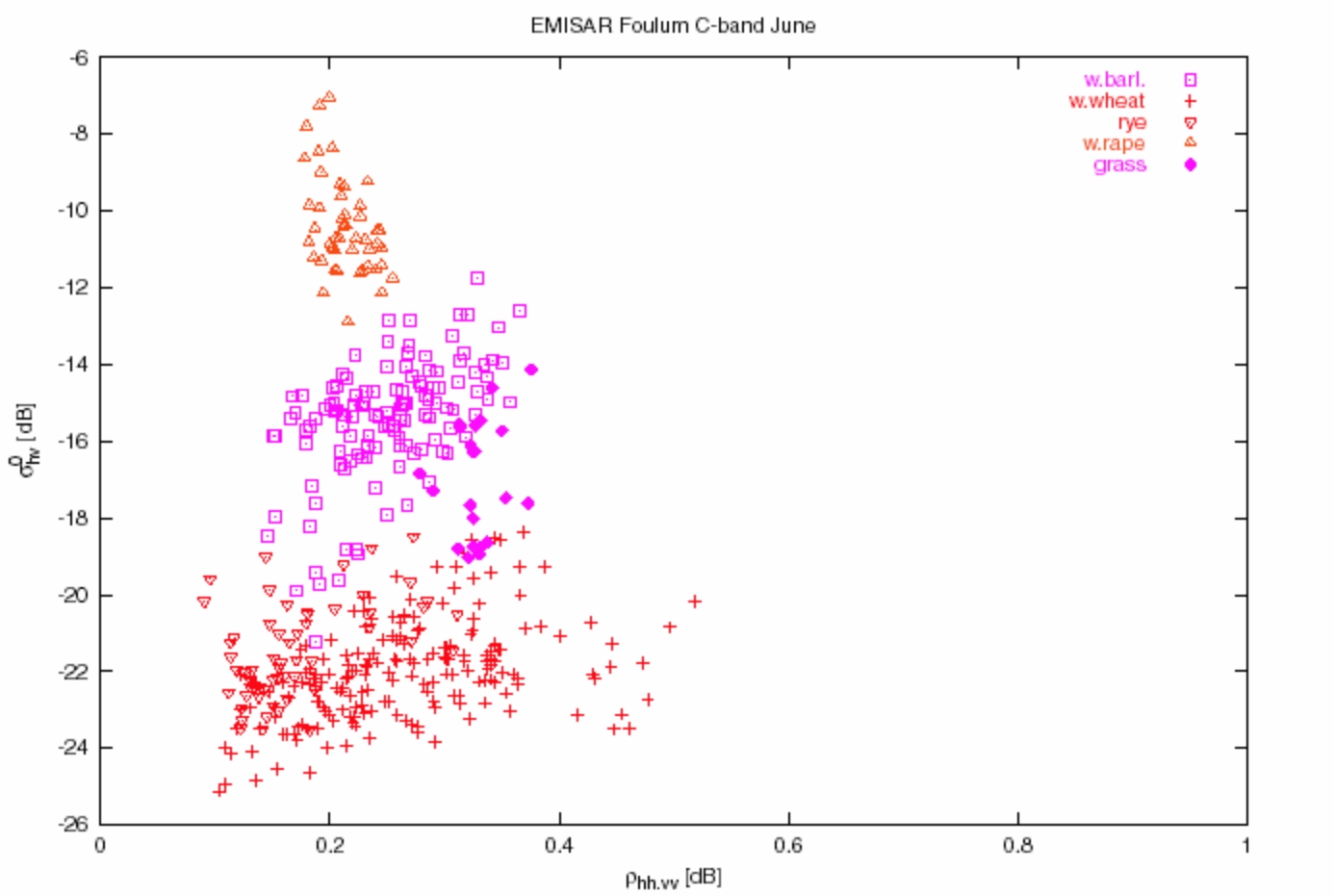
(Ferrazoli et al., 1999)

Foulum, July



Measurements to separate crops with different biomass

HV



Measurements to separate crops with different biomass

HV

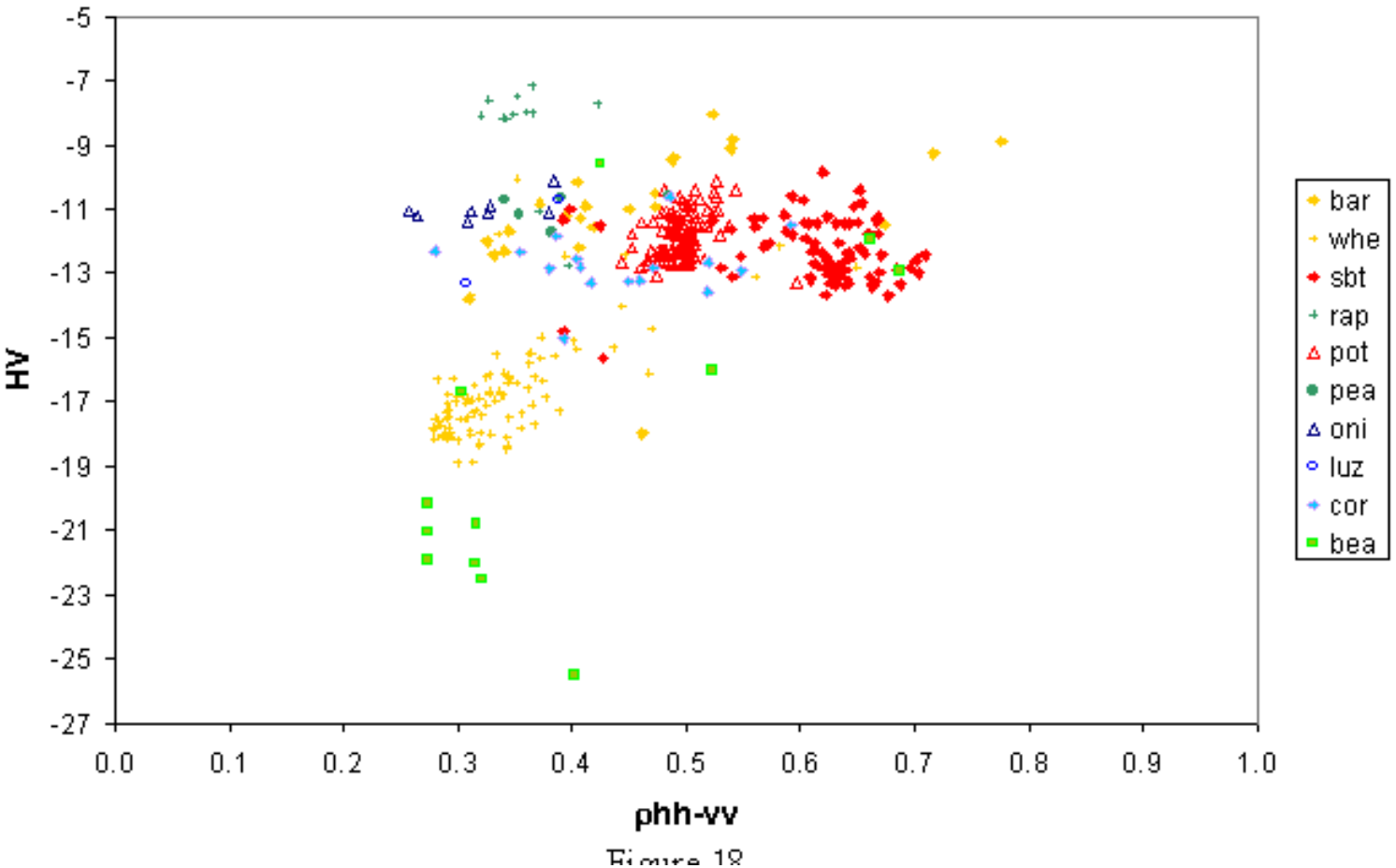
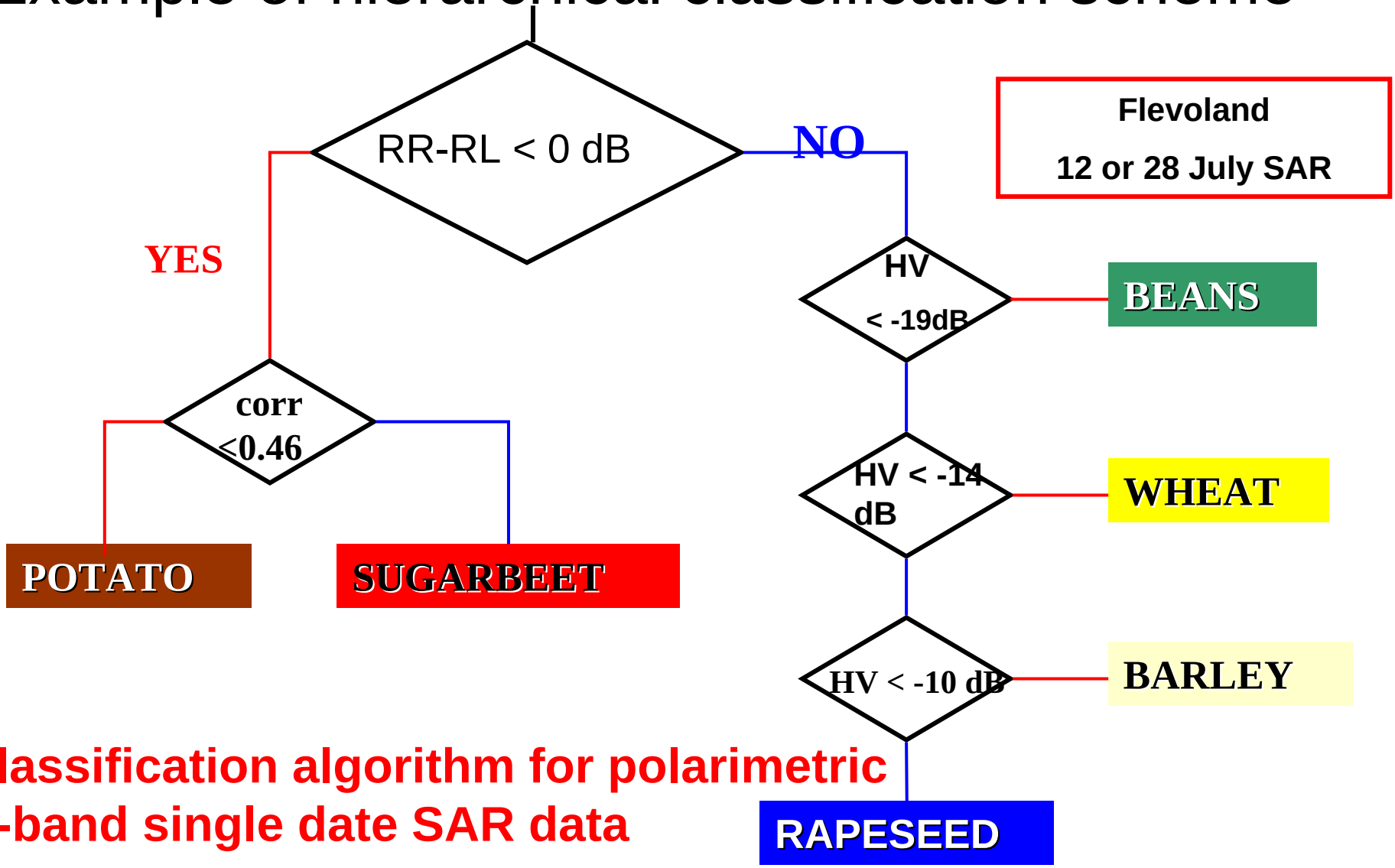


Figure 18

Example of hierarchical classification scheme



Classification algorithm for polarimetric C-band single date SAR data

Broadleaves/small stems classification, July 12

	No of fields	Well classified
Small stems	174	166 (95%)
Broad leaves	217	212 (98%)

Measurements to separate surface from volume scattering

On a single dataset at Foulum, several measurement pairs give good separation winter/spring crop

Best measurement pair:

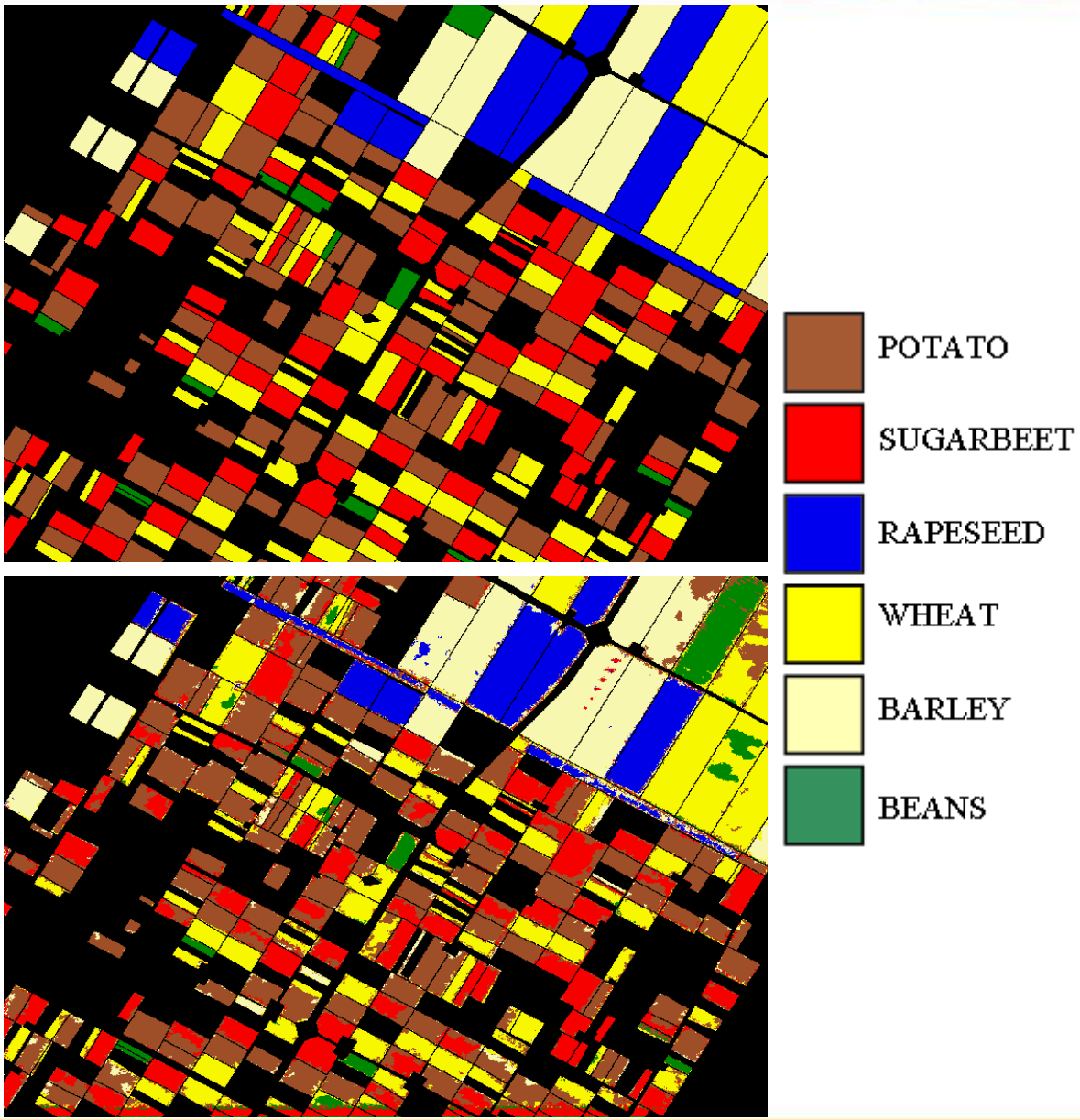
HV: lower for surface scattering

correlation HHVV: higher for surface scattering

Parameter 1	*Parameter 2*	*Spring OK (%)*	*Spring Bad (%)*	*Winter OK (%)*	*Winter Bad (%)*	*Overall (%)*
HV	*VV*	524 (94.2)	32 (5.8)	395 (88.0)	54 (12.0)	92.6
Correlation	*HV*	524 (94.2)	32 (5.8)	432 (96.2)	17 (3.8)	95.1
Entropy	*Alpha*	535 (96.2)	21 (3.8)	413 (92.0)	36 (8.0)	94.2
Entropy	*Correlation*	539 (96.9)	17 (3.1)	392 (87.3)	57 (12.6)	92.6
HV-HH	*HV-VV*	512 (92.0)	44 (8.0)	421 (93.7)	28 (6.3)	92.8
RR-LR	*HV-VV*	506 (91.0)	50 (9.0)	428 (95.3)	21 (4.6)	92.9
HV	*HH*	452 (81.3)	104 (18.7)	424 (94.4)	25 (5.6)	87.1

ISODATA classification of Foulum April data

Crop map



Classification result

Comparison with crop map
= 84%

Physical-based hierarchical classification methods

- **Physical-based analysis could be used to select the best classifiers,**

- **Unsupervised hierarchical classification is possible for robust classifier of broad classes (e.g. for winter/summer,broad /small leaves: to be tested on different datasets),**

- **Combined physical-based and unsupervised classification (ISODATA) is possible.**