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Key properties for delineating soil management zones

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I. Starting point

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Key soil and topographic properties to delineate potential management classes for precision agriculture in the European loess area

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It was concluded that in the loess area, with complex soil-landscape interactions, pH, EC_a and elevation can be defined as the key properties to delineate potential management classes for precision agriculture.

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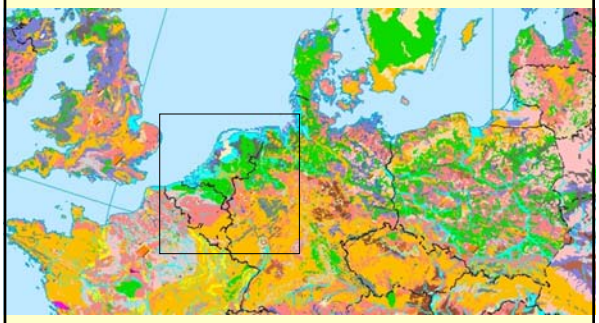
II. The study area



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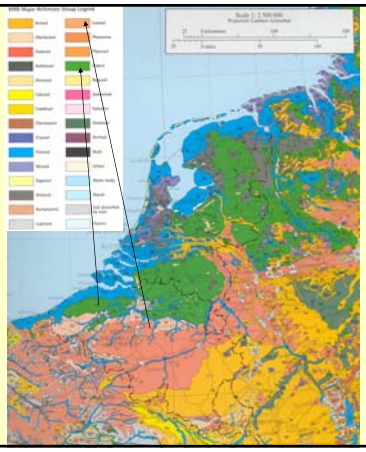

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III. The study field

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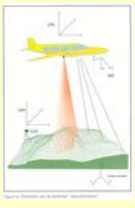
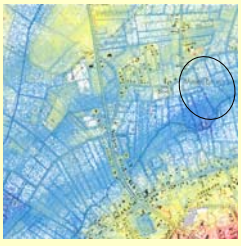
IV. The data set

1. Elevation

Scanned by LIDAR: 0.07 m vertical accuracy.

1 variable: DEM.





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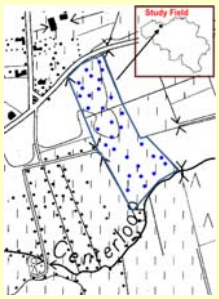
2. Soil samples

30 locations randomly selected out of 100 stratified random samples.

- 2 depths: 0-0.3 m + 0.6-0.9 m.
- 6 variables: top and subsoil OC, sand & pH-KCl.



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3. ECa (EMI-sensor)

EM38-MK2: measured at 2 m inter-line distance.

4 ECa variables: 0.5 and 1 m, both H and V orient.

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4. Gamma ray (The Mole)

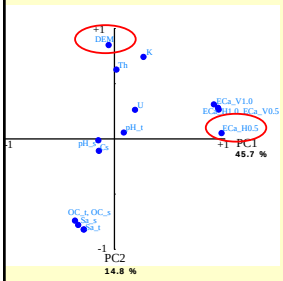
Natural radionuclides in top 30 cm. Measured at 30 locations + along lines over entire field.

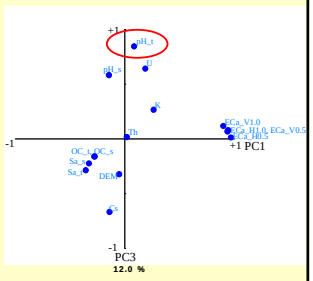
4 variables: ^{40}K, ^{238}U, ^{137}Cs and ^{232}Th.

V. Identification of key properties

30 locations, 15 variables: principal component analysis on correlation matrix.

First 3 PC's covered 72.5 %, variables with largest loadings were selected.





Key properties: ECa, DEM, topsoil pH = same as in loess area !

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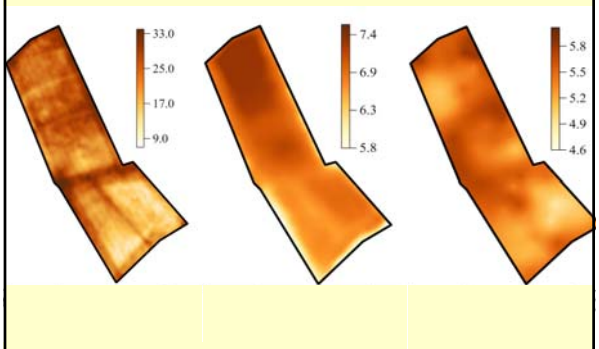
VI. Management zones

1. Maps



$ECa_{H0.5}$ (mS/m) DEM (m a.s.l.) pH

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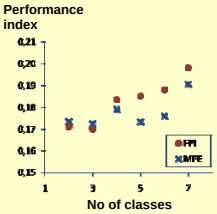
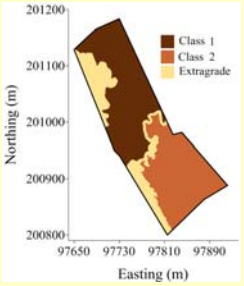
2. Fuzzy *k*-means classification of 3 key properties





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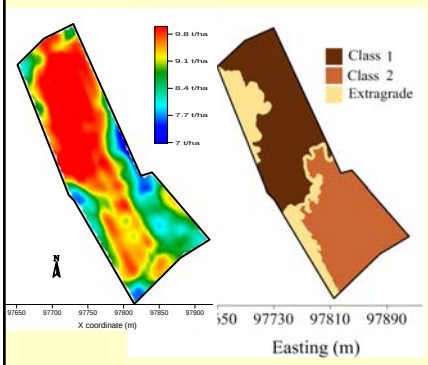
VII. Wheat yield

1. Yield of 2006

Continuous wheat grain recorded with New Holland CX880 combine in summer 2006.

Processing: ref. moisture content (15 %) + data filtering.

2. Yield & management classes



Yield of 2006:

9.9 t/ha (s = 0.54)
8.6 t/ha (s = 0.57)
8.8 t/ha (s = 0.71)

3. Relationship between yield and key properties

Stepwise multiple regression analysis:

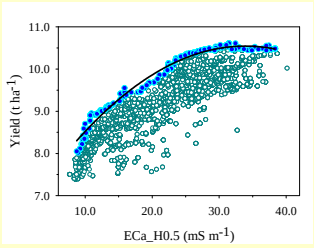
$Yield_{2006} = -0.324 + (0.175*ECa_{H0.5}) + (1.009*DEM) - (0.00217* ECa_{H0.5}^2)$

$R_{adj}^2 = 0.88$

pH did not influence wheat yield of 2006 significantly; ECa was dominant.

4. Boundary line analysis between ECa and yield

Select top 10 % of yield within moving ECa bins of 3 mS/m: locations where ECa is limiting yield.



$Yield_{2006} = 6.537 + (0.232*ECa_{H0.5}) - (0.00331* ECa_{H0.5}^2)$

$R_{adj}^2 = 0.98$

VIII. Conclusions

- Candidate key soil properties for management zone delineation in wind blown sediments of Northern-Europe:

  ECa, elevation and topsoil pH.

- These properties allow to construct relatively stable management zones which produce clear differences in crop yield.

- ECa relates very strongly to wheat yield.