

Mapping soil pH depth function groups in Denmark

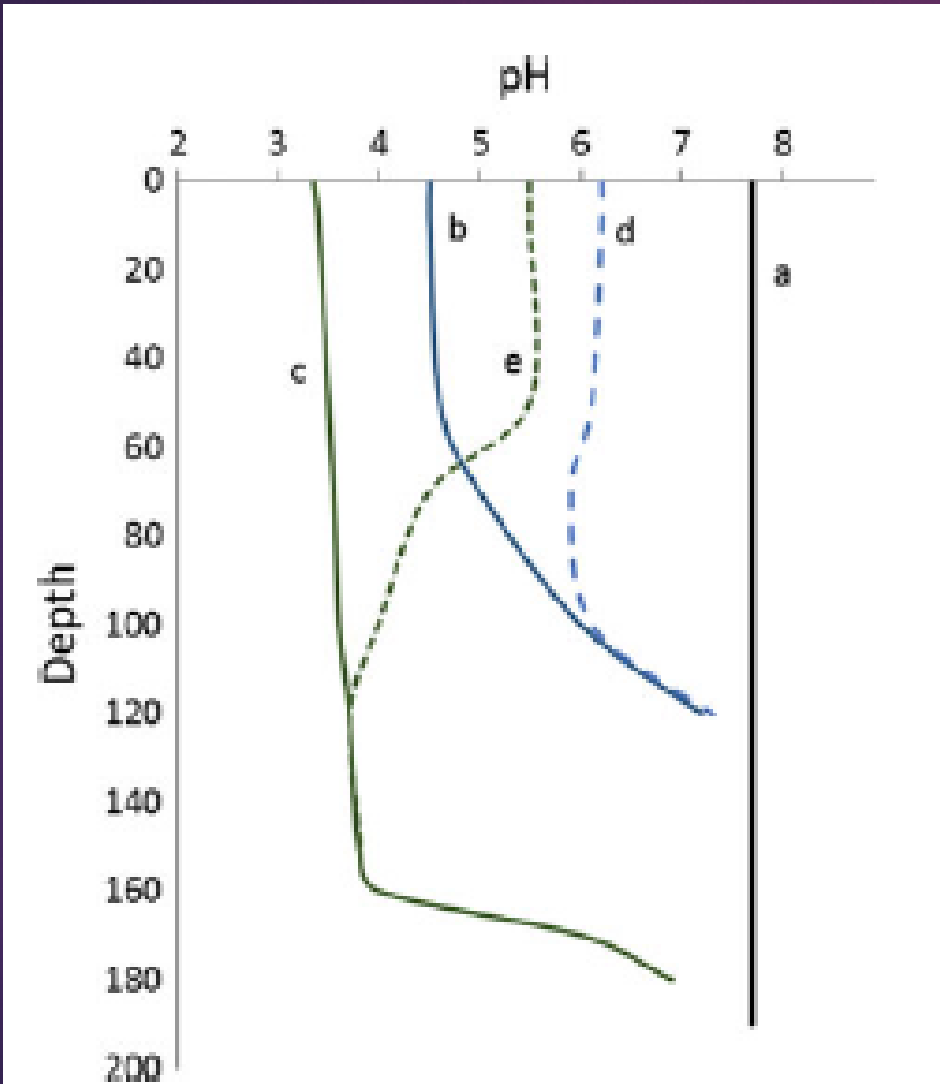
Kabindra Adhikari¹, Budiman Minasny², José Padarian², and
Mogens H. Greve³

¹University of Wisconsin–Madison, Department of Soil Science, Madison, WI 53706, United States

²The University of Sydney, Faculty of Agriculture & Environment, 2006 NSW, Sydney, Australia

³Aarhus University, Department of Agro-ecology, Tjele 8830, Denmark

Pedological & Agricultural impact on Soil pH depth function



Leaching and liming effect on soils developed in lime-rich till in Denmark

- (a) Newly deposited till
- (b) Weakly leached soil
- (c) Strongly leached soil
- (d) Soil (c) limed
- (e) Soil (b) limed

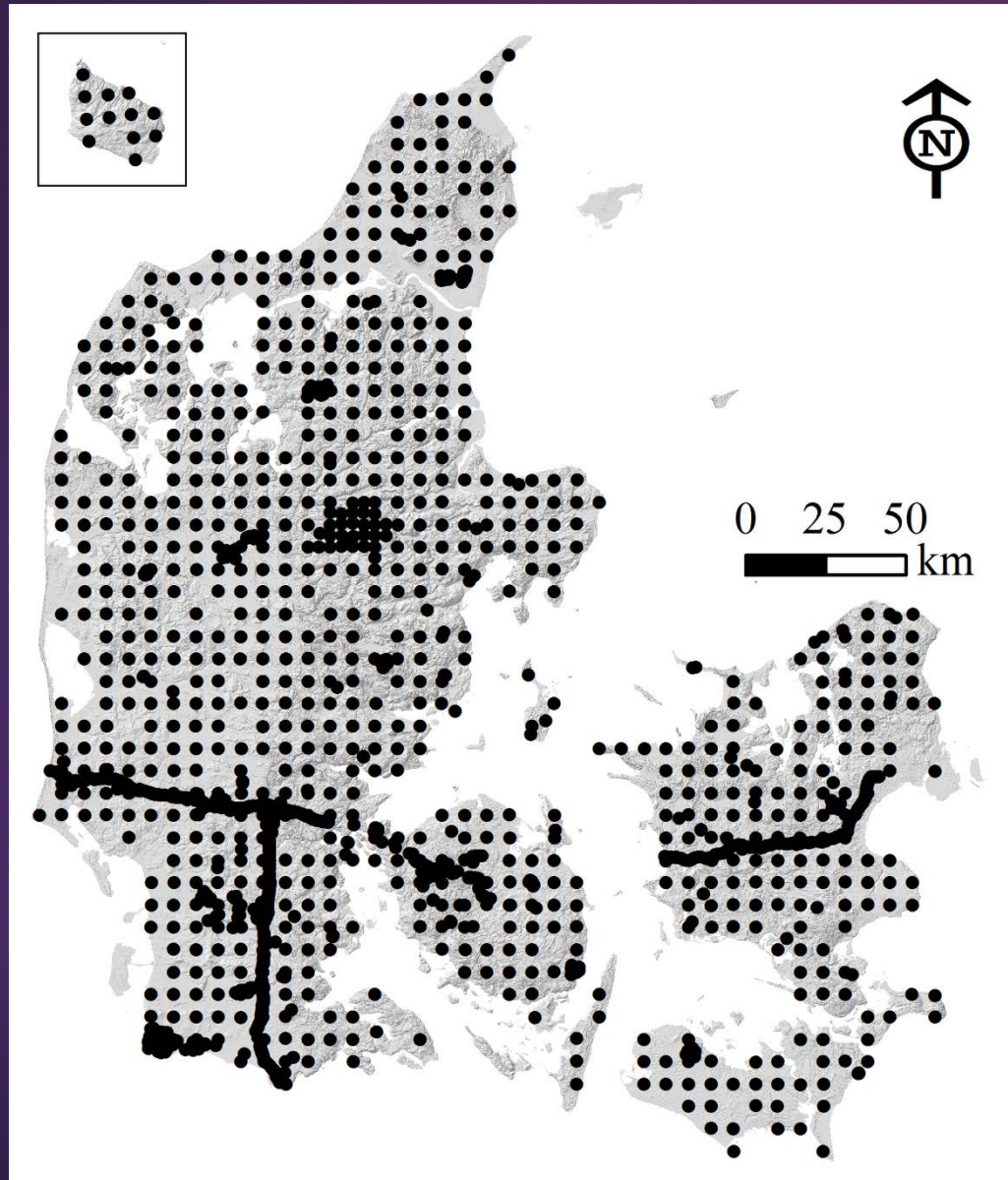
(Madsen and Munk, 1987)

Objectives

1. To model soil pH depth function of Danish soils
2. To predict and map pH distribution at 6 standard depths (0 to 2 m) according to GlobalSoilMap
3. To map pH depth function classes

Soil profile Data

($n = 1934$)



Covariates (30 x 30 m grid)

- DEM derivatives
- Land use
- Soil types
- Geology
- Wetlands
- Landscape types
- Precipitation

Results

Prediction model:
Rule-based Regression Kriging
(*Cubist*)

Model example:

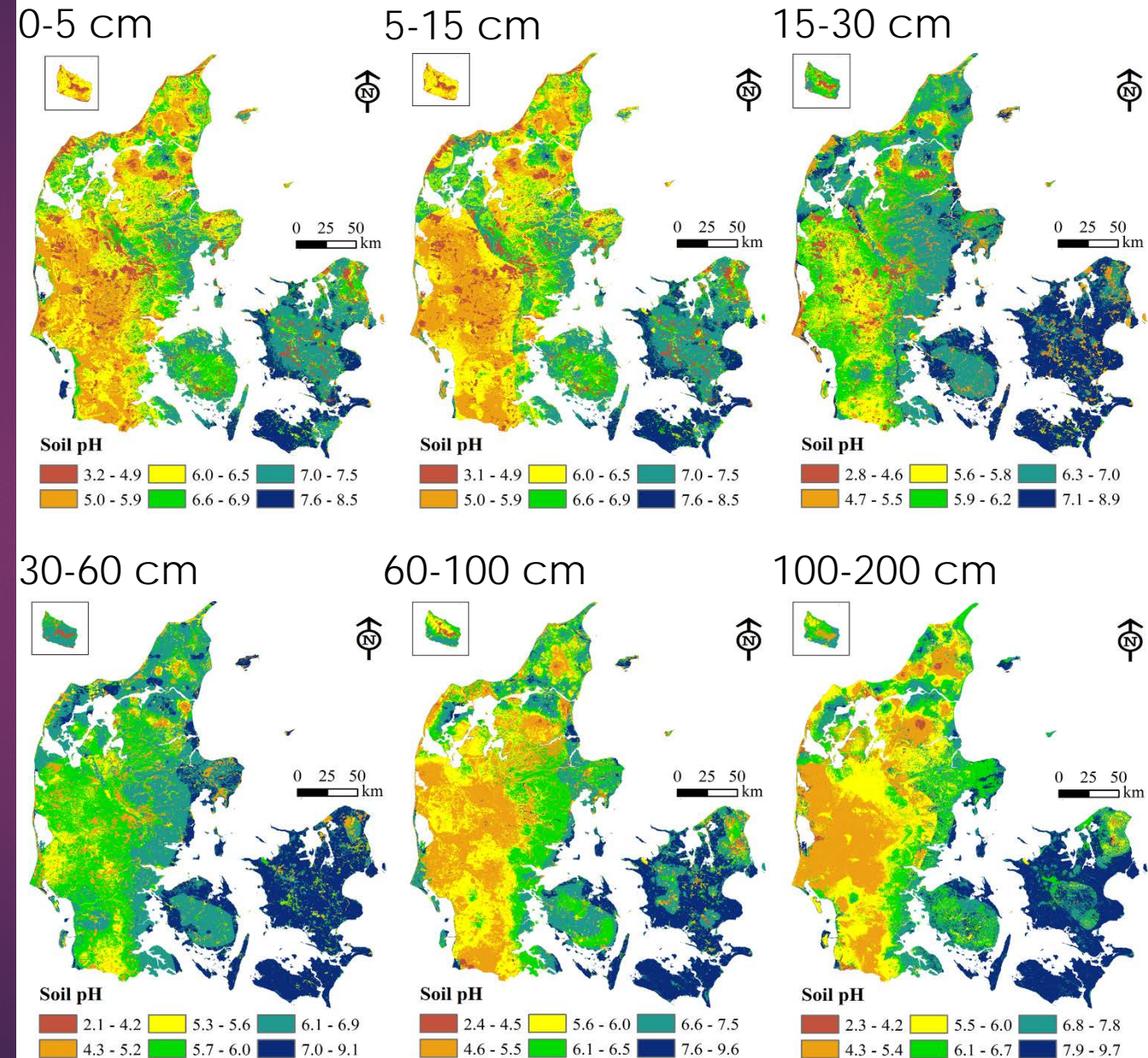
Rule x:
If,

The Condition is "TRUE"

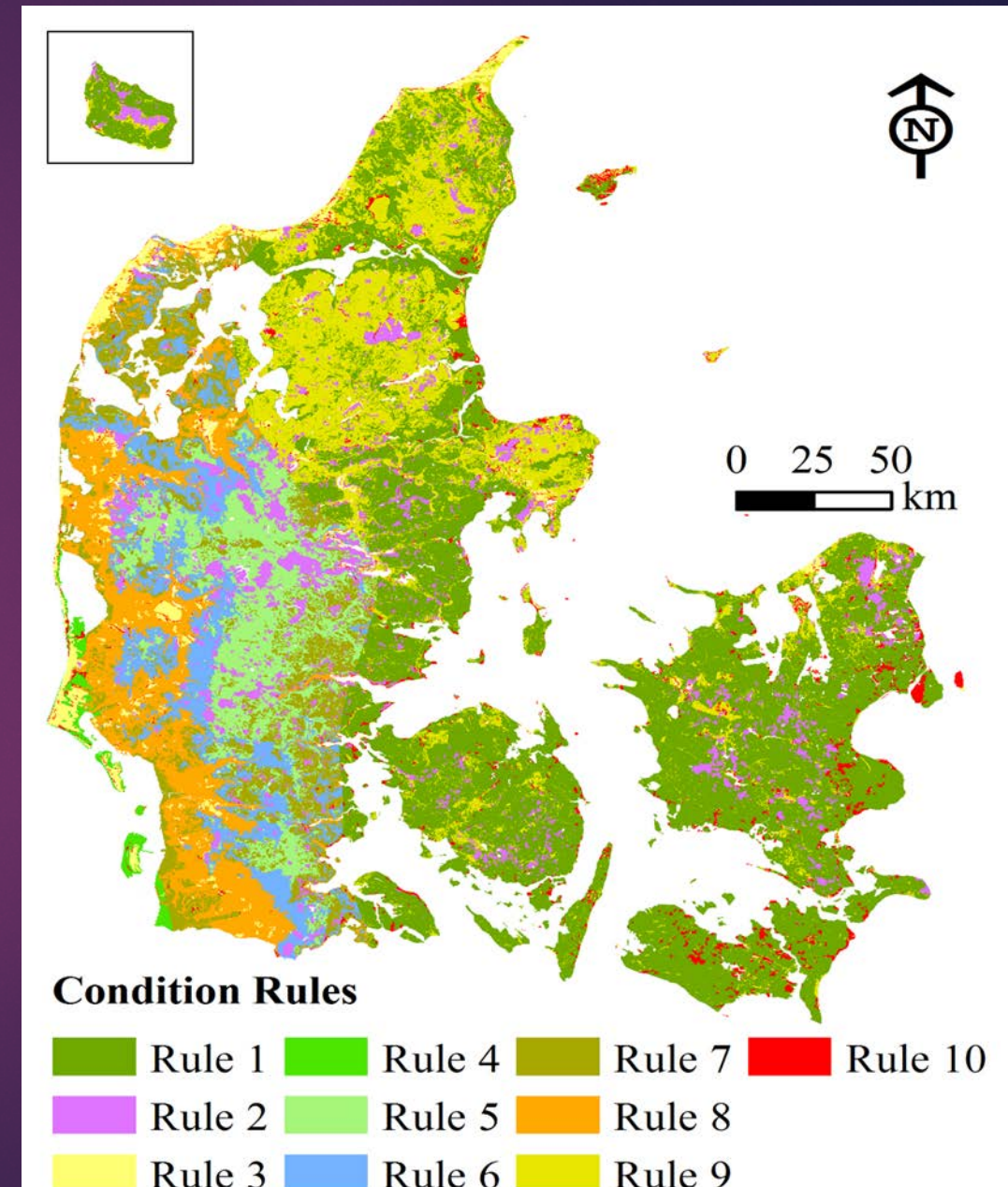
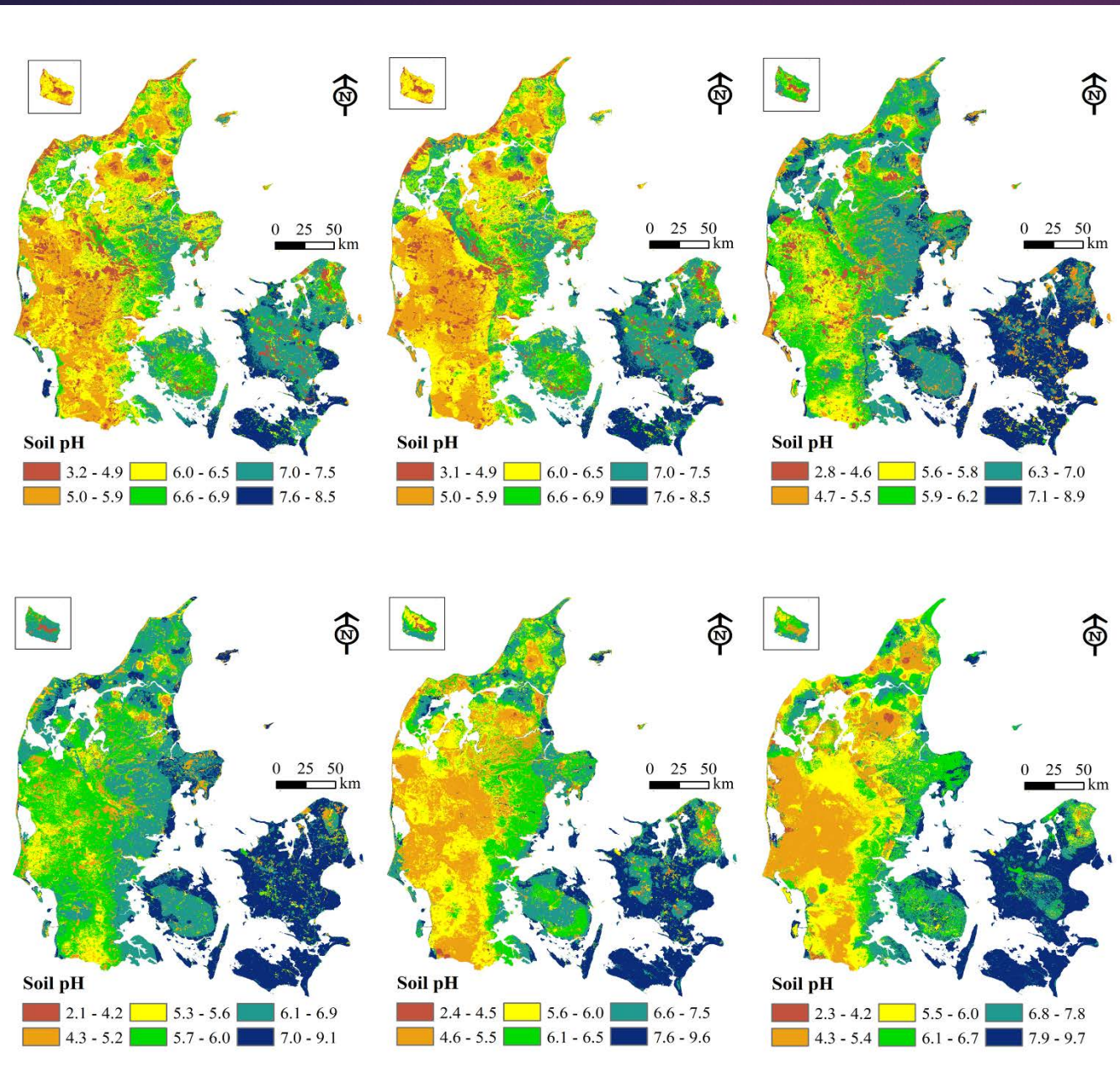
Then,

MLR function for "PREDICITON"

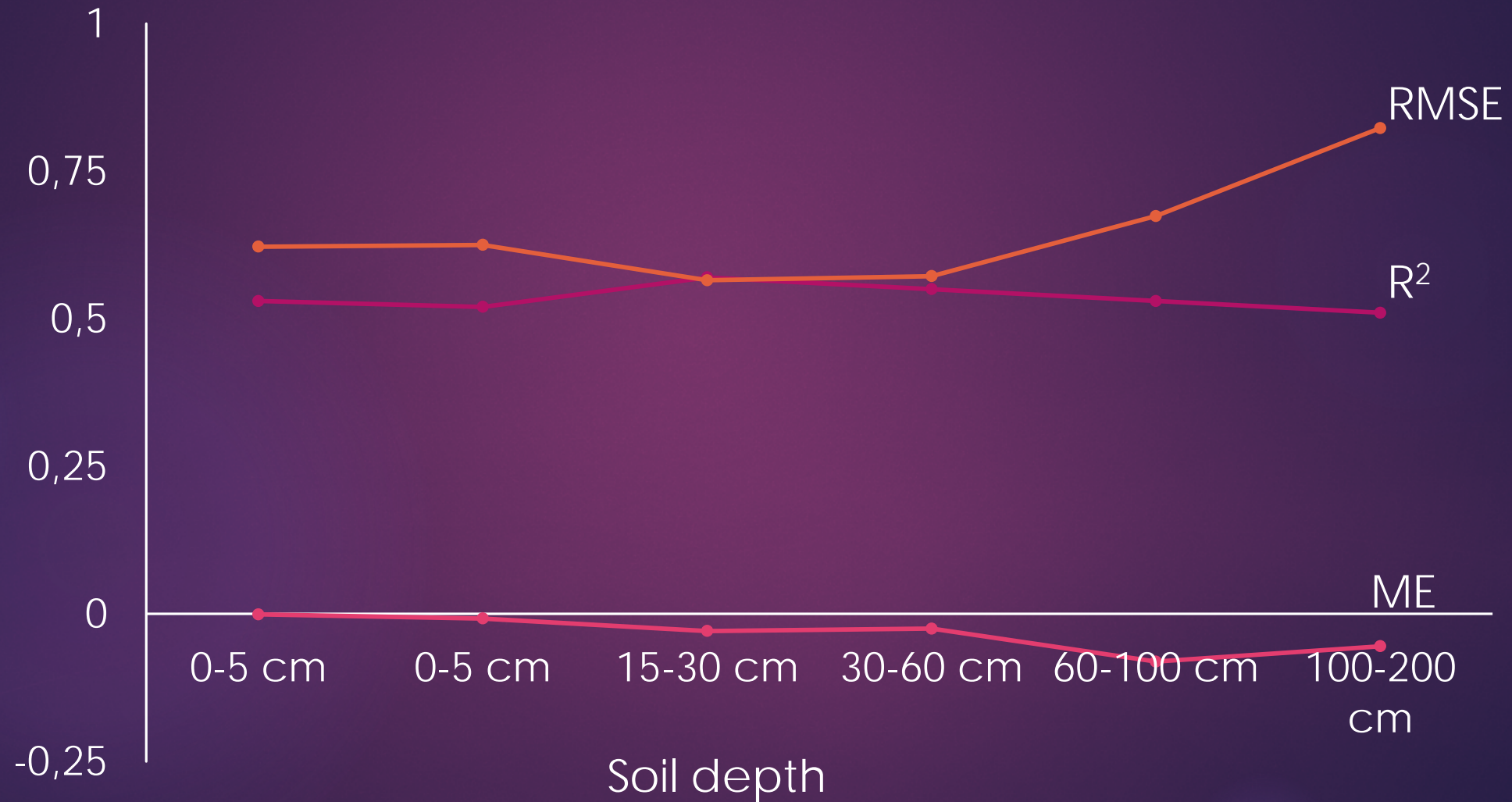
Predicted maps



Prediction Maps

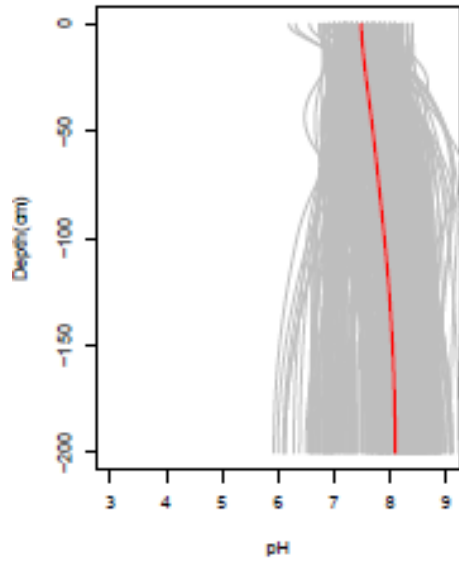


Model performance (on 25 % validation points)

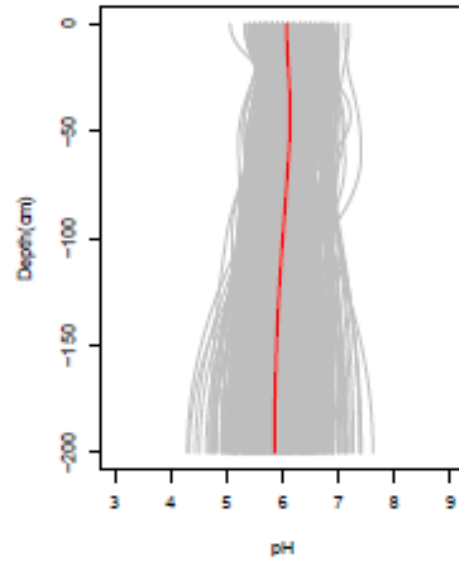


Soil pH depth functions typologies found in the Danish data

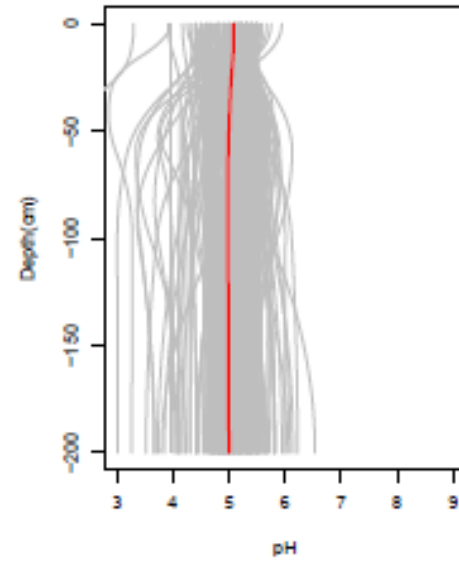
(A) Soil with $\text{pH} > 7$ throughout



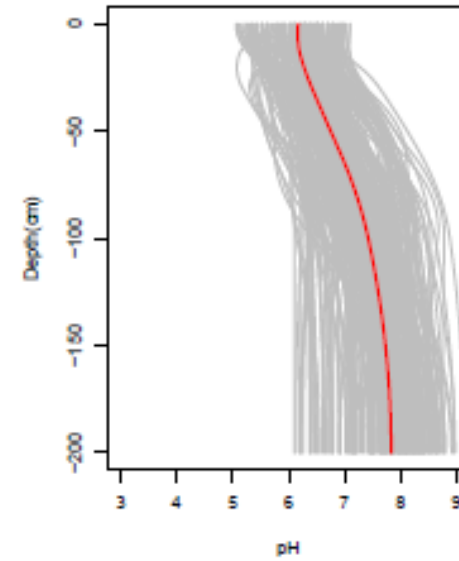
(B) Soil with $5.5 < \text{pH} < 7$



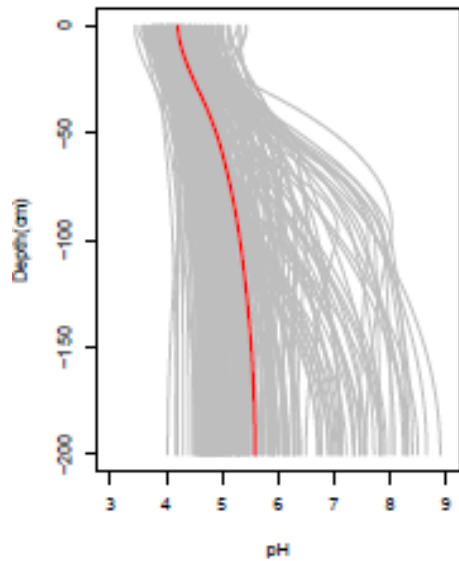
(C) Soil with $\text{pH} \leq 5.5$ throughout



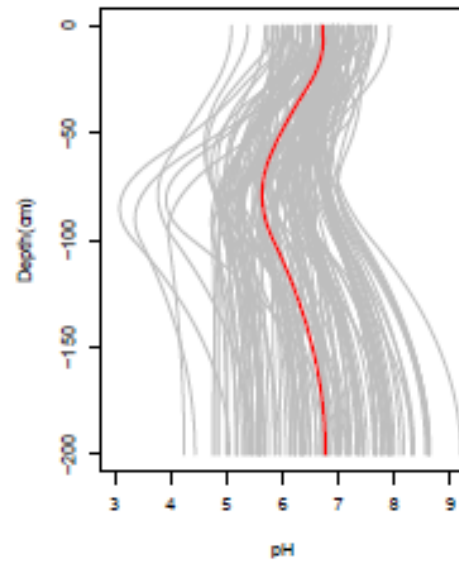
(D) $5.5 < \text{pH} < 7$ on 0-30, and increase with depth mildly leached)



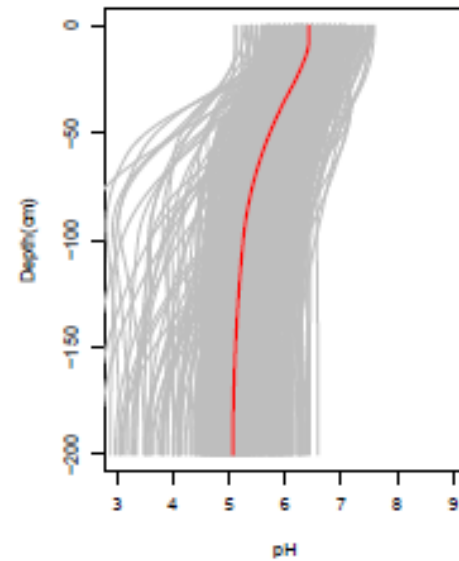
(E) Acid soil with $\text{pH} (\leq 5.5)$ on top and increase with depth (highly leached)



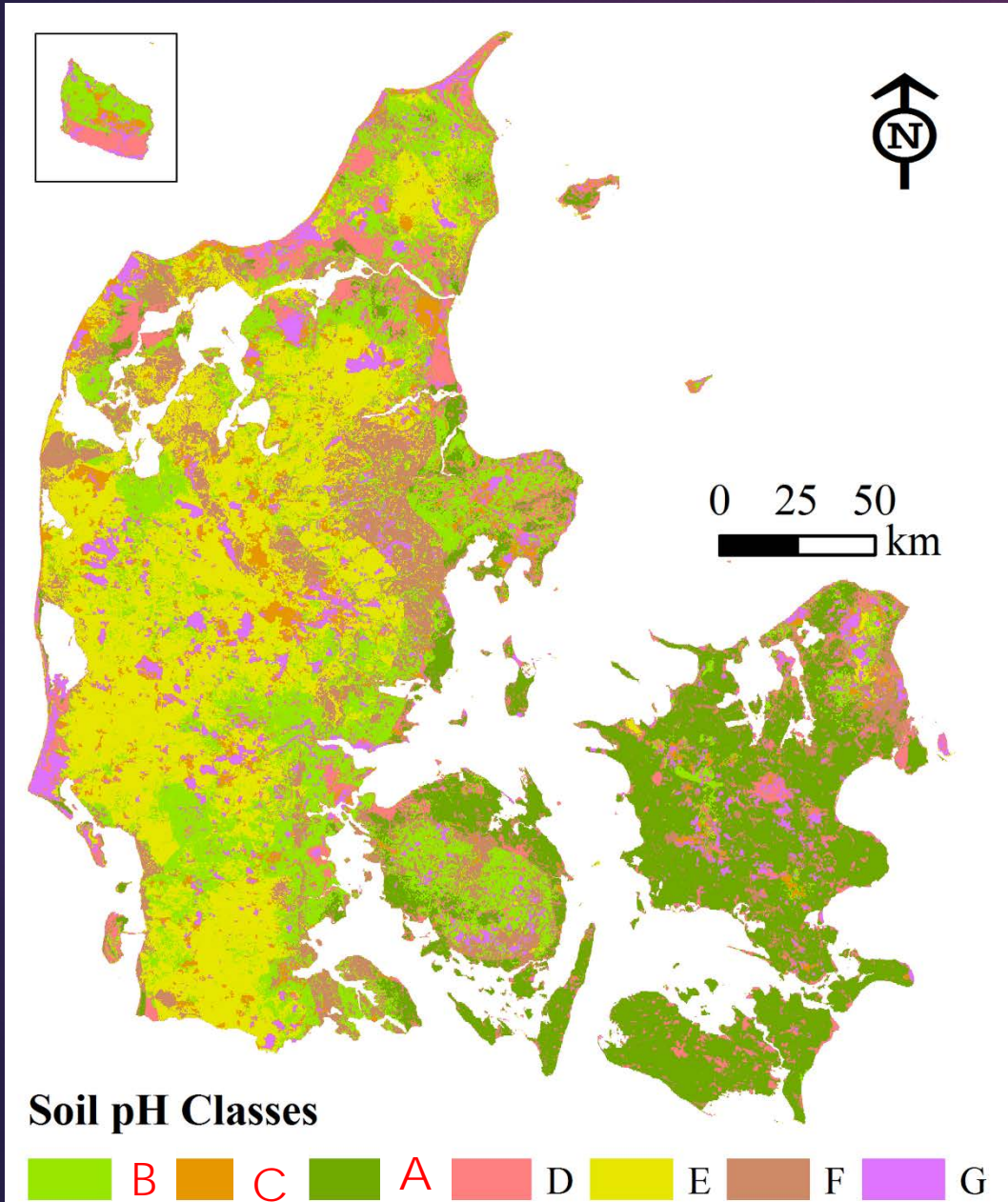
(F) Soil with $5.5 < \text{pH} < 7$ on 0-30 and decrease until 60-100 but increase



(G) Soil with $5.5 < \text{pH} < 7$ on 0-30 and decrease with depth



Soil pH classes map



Legend

(A) Soil with $\text{pH} > 7$ throughout

(B) Soil with $5.5 < \text{pH} < 7$ throughout

(C) Soil with $\text{pH} \leq 5.5$ throughout

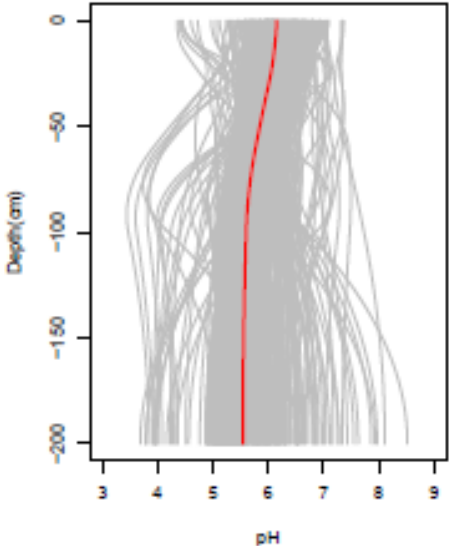
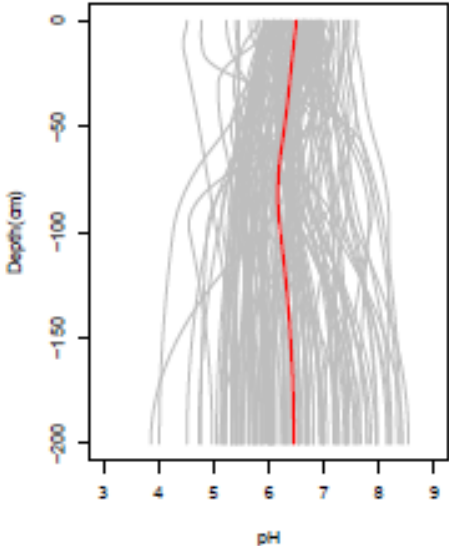
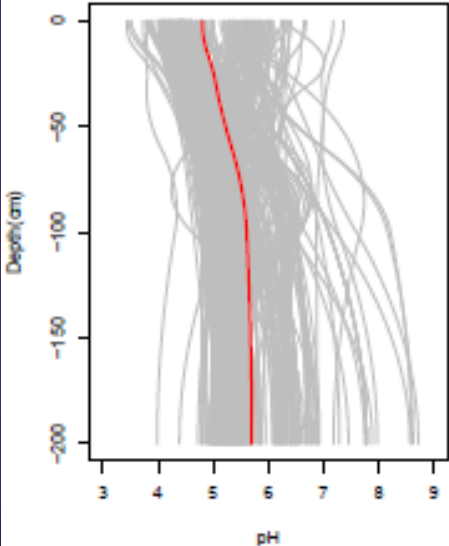
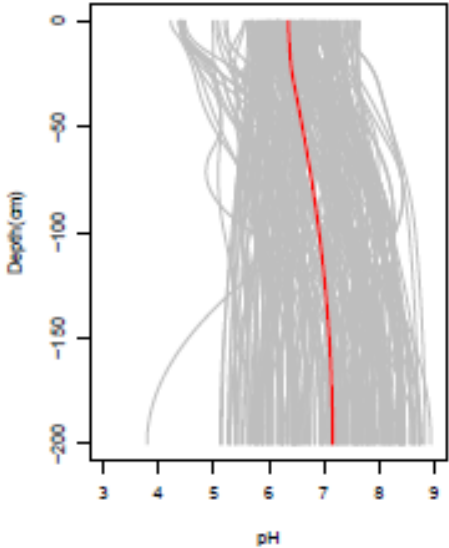
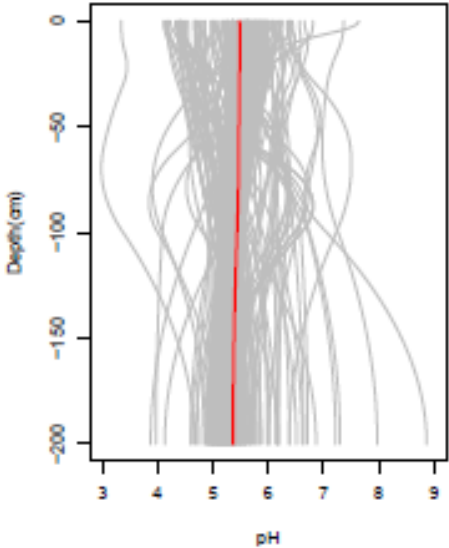
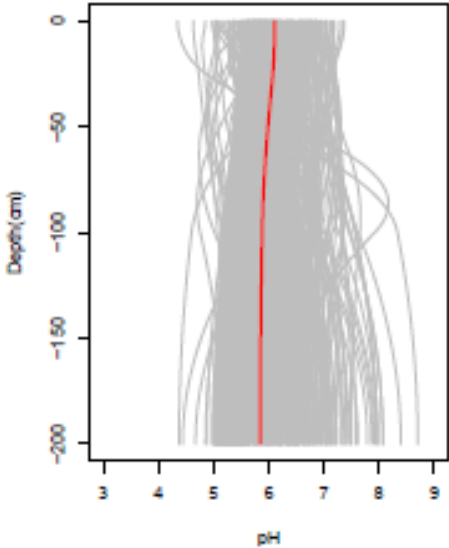
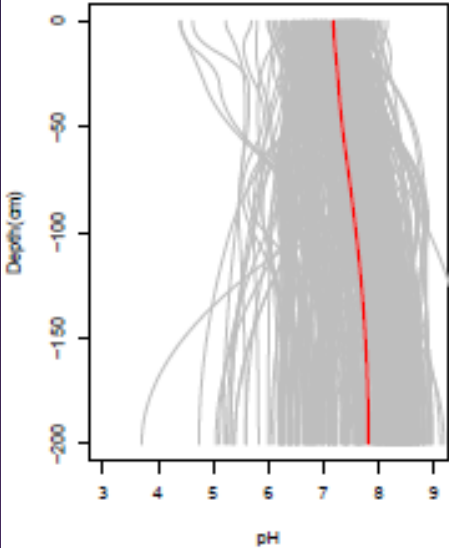
(D) Soil with $5.5 < \text{pH} < 7$ on 0-30, and increase with depth (mildly leached)

(E) Acid soil with $\text{pH} (\leq 5.5)$ on top and increase with depth (highly leached)

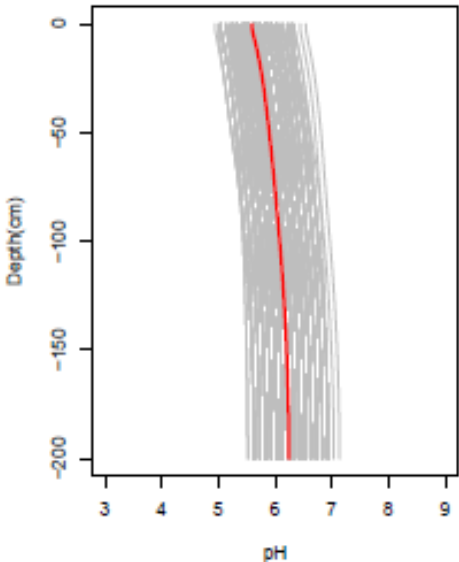
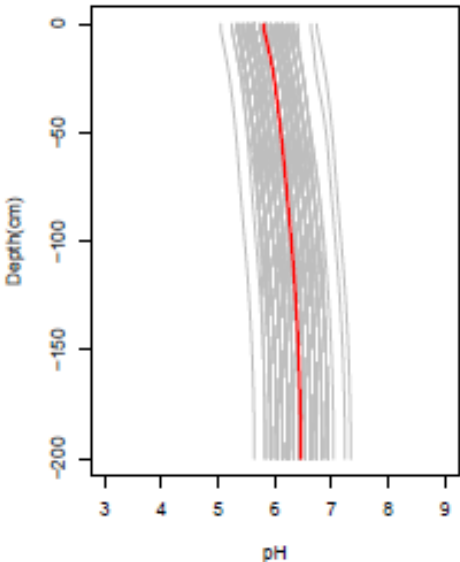
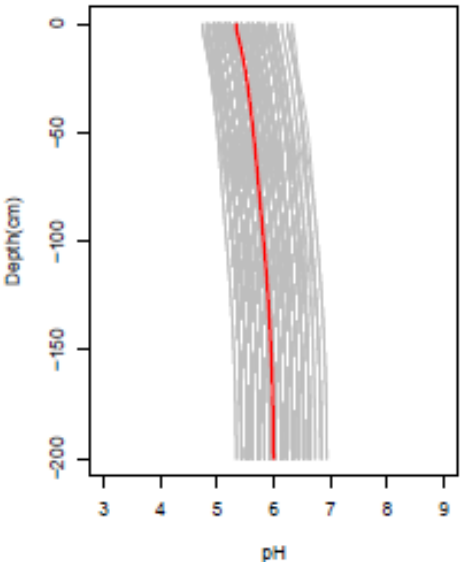
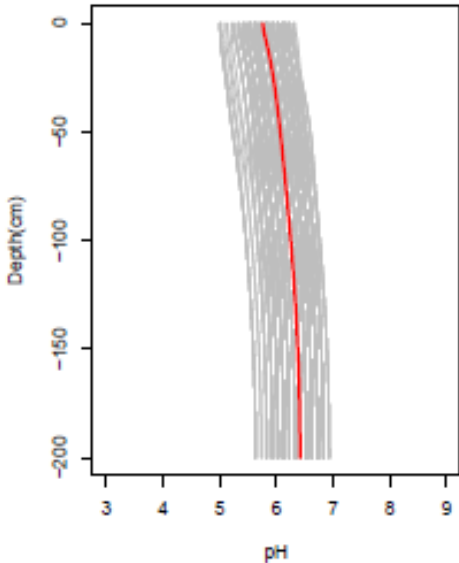
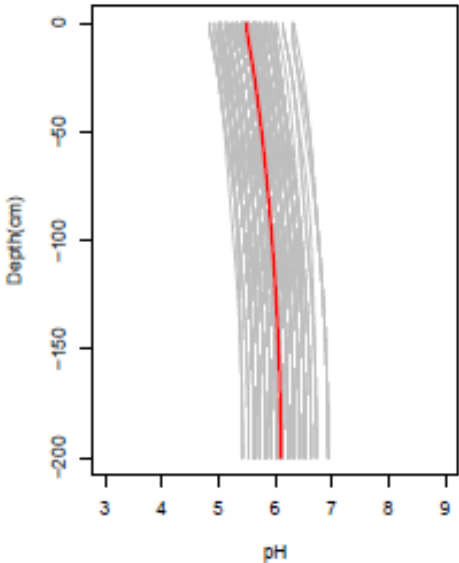
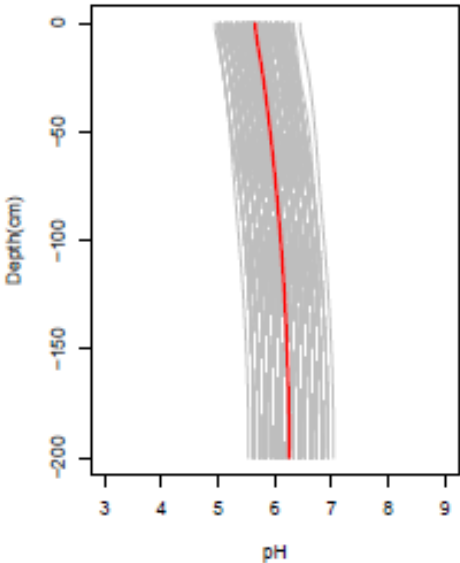
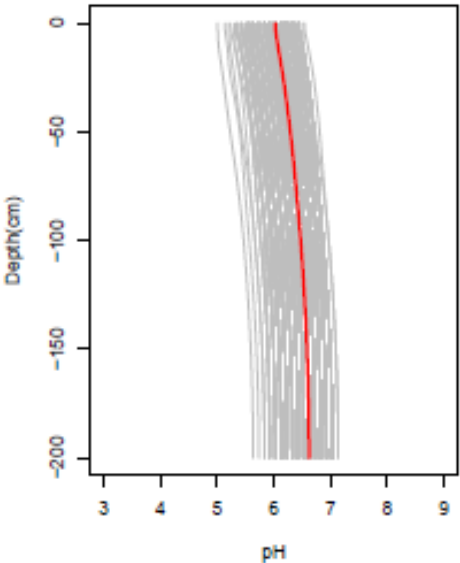
(F) Soil with $5.5 < \text{pH} < 7$ on 0-30 and decrease until 60-100 but increase in 100-200

(G) Soil with $5.5 < \text{pH} < 7$ on 0-30 and decrease with depth

Soil pH depth functions modelled by DSM Cubist



Soil pH depth functions from SoilGrid1k



Comparison with soilgrids1k

Standard soil depths	Mean	Std Dev	Range	Interquartile Range
kabindra_sd1	6.14	0.91	5.18	1.10
kabindra_sd2	6.14	0.91	4.99	1.10
kabindra_sd3	6.16	0.87	4.75	1.04
kabindra_sd4	6.14	0.87	5.54	1.09
kabindra_sd5	6.17	1.00	6.08	1.37
kabindra_sd6	6.24	1.16	7.27	1.78
soilgrids_sd1	5.66	0.37	2.00	0.60
soilgrids_sd2	5.73	0.37	2.00	0.50
soilgrids_sd3	5.83	0.37	2.00	0.50
soilgrids_sd4	5.94	0.37	2.00	0.60
soilgrids_sd5	6.08	0.37	2.00	0.60
soilgrids_sd6	6.26	0.37	2.00	0.60

Conclusions

1. EA splines modelled the depth function of soil pH in Danish soil profiles.
2. Prediction R^2 ranged between 0.51 to 0.57, and RMSE between 0.56 to 0.82.
3. The best predictors were Land use, Precipitation, Soil map, Geology, Slope, and MrVBF.
4. Based on the depth functions, 7 soil pH classes were identified and mapped.