Afvanding og planteproduktion

Vækst, ressource udnyttelse og udbytter i korn, under forskellige og fluktuerende grundvandsstand

PhD
cand.agro
Kasper Jakob Steensgaard Jensen

UNIVERSITY OF COPENHAGEN

Foto: Kasper Jensen Seggelund September 2016 2018

Foto: Kasper Jensen Igelsø Juni 2018

Foto: Kasper Jensen Lolland 22. Februar 2018

Foto: Kasper Jensen Lolland 22. Februar 2018

INDLAND

Støjberg erkender fejlbehandling i sag om syge udlændinge
KL. 11.48

LIVE-TV Erkend
KL. 11.45

Overset klimapr undergrund kar al den regn

Forskere mener, at stigende grunc klimaproblem.

Den samlede nedbør på landsplan endte i 2017 på 849 millimeter, og det gør året til det tiende vådeste, som DMI har registreret, siden de landsdækkende målinger begyndte i 1874.

2018 KL. 18.07

Hold øje med din kælder: Stigende grundvand er »en pæn stor udfordring«

Højere grundvand giver udfordringer for kælderejere, og her betaler det sig at være opmærksom, lyder rådet fra Bolius.

P FOR ABONNENTER

Haver og marker er dyngvåde efter lange perioder med masser af regnvejr, og grundvandet er flere steder i landet steget med en til to meter.

Er du uheldig, så har det allerede resulteret i våde strømpesokker, når du er trådt ned i dit kælderrum, og hvis ikke så kan du risikere det i

ALT DU BEH MORGEN
Tilmeld dig vores og lad os give dig med et håndpluk væsentlig

LÆS

Toppen af isbjerget!

Udbytte effekt af dræning

Udbytte (kg tørstof/ha)

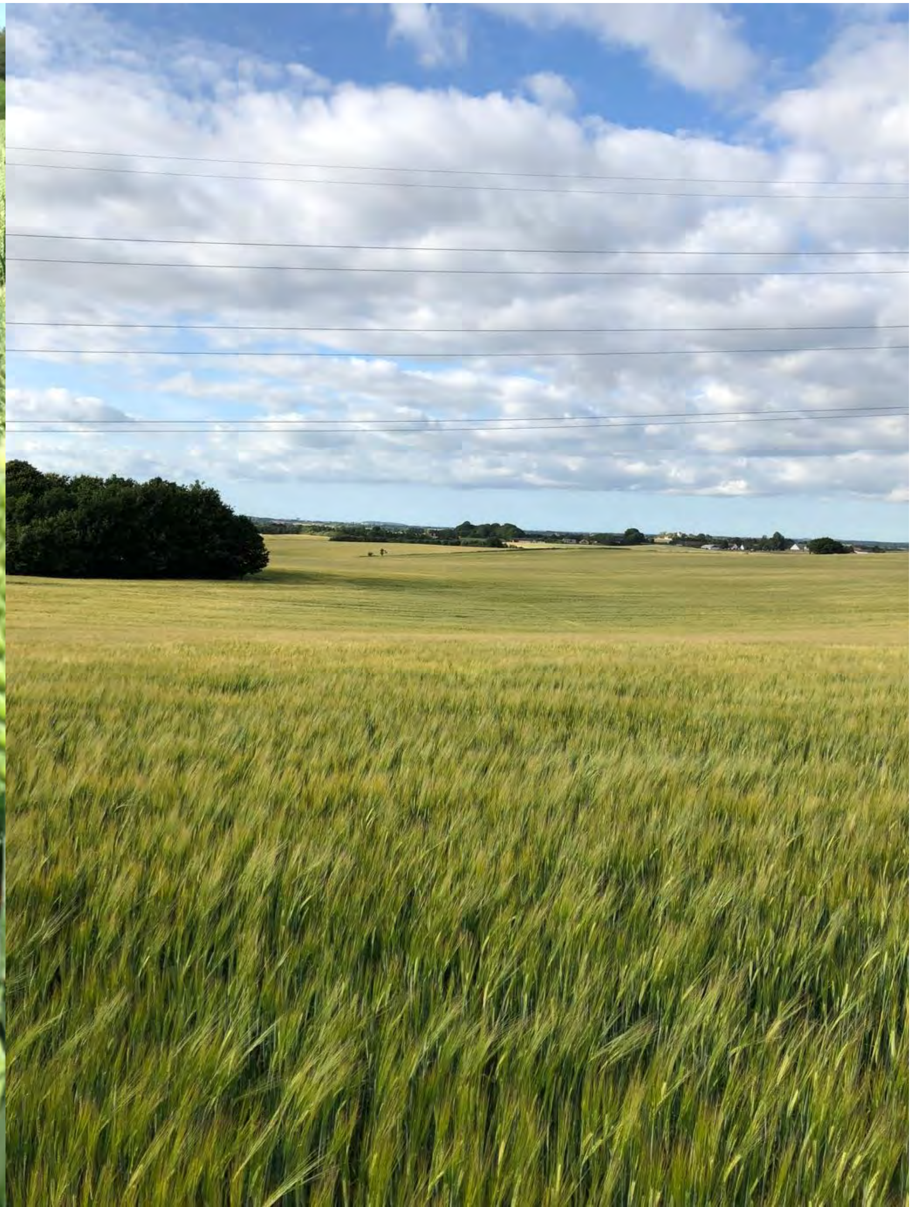
Afgrøde	År	N tildel.	Bedre drænede	Dårligere drænede	Udbytte tab	LSD
Drændybde			120-95cm	65-60cm		
Vårbyg	2012	111	6652	5596	16%	534
Vinterhvede	2013	174	7230	6523	10%	392
Vinterhvede	2014	175	7654	6452	16%	438
Vårbyg	2015	70	6008	4664	22%	697
		140	6598	5486	17%	697
Vinterhvede	2016	90	6108	4173	31%	538
		180	7622	5838	23%	538
Vinterhvede	2017	90	7111	5208	27%	756
		180	7760	6038	22%	756
Vårbyg	2018	70	3204 *	2477 *	23%	442
		140	3237 *	3050 *	6%	442

* Kernevægt incl vand

KU Kasper Jensen 2018

Di

Ingen visuel effekt, alt ånder fred og ro



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KU Kasper Jensen 2018

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Soil gas exchange

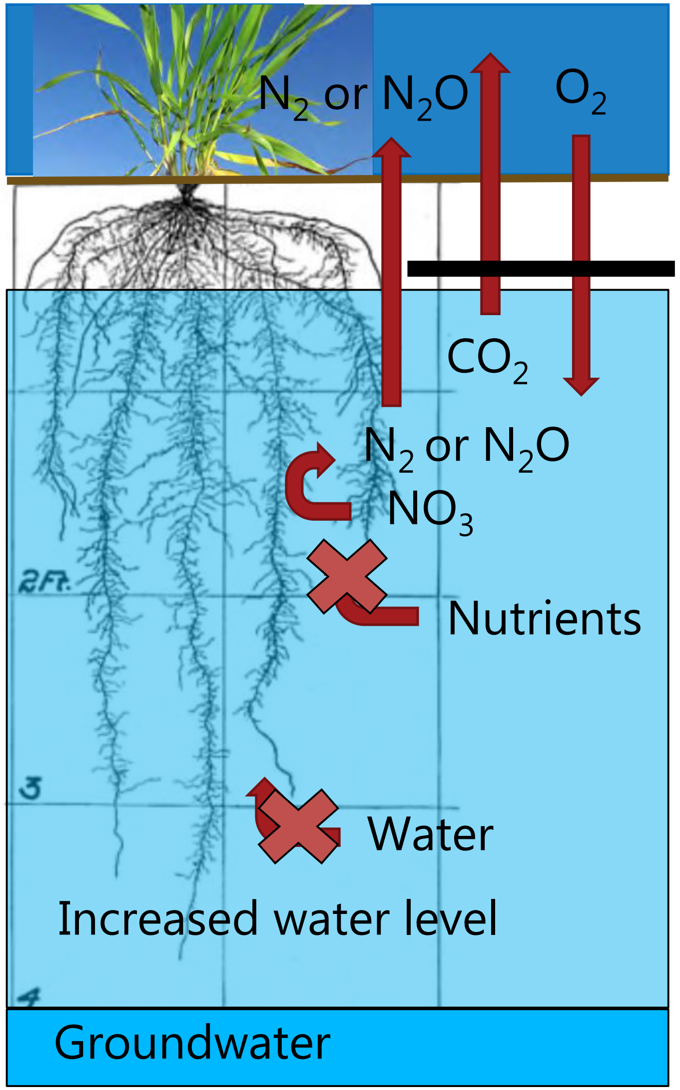
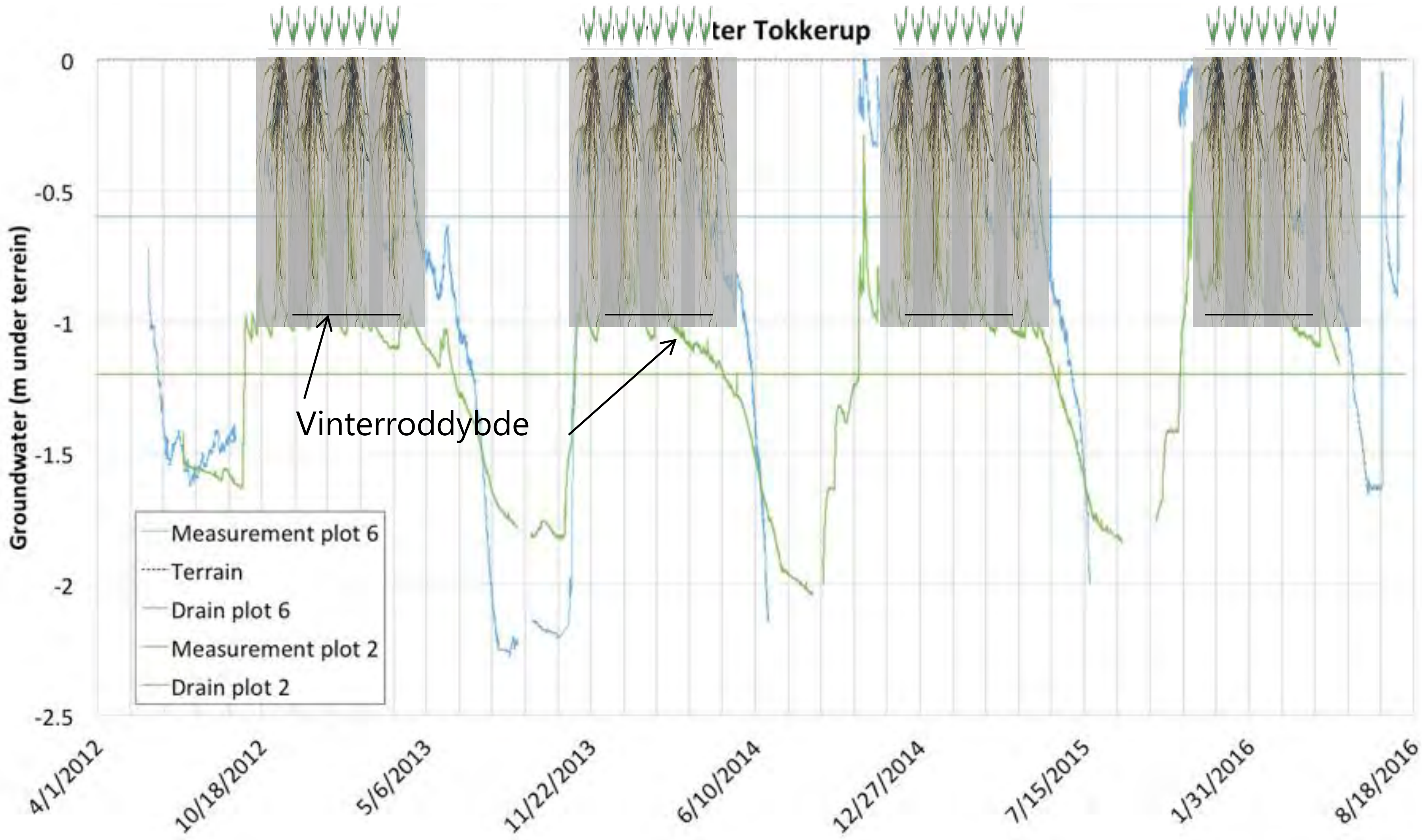


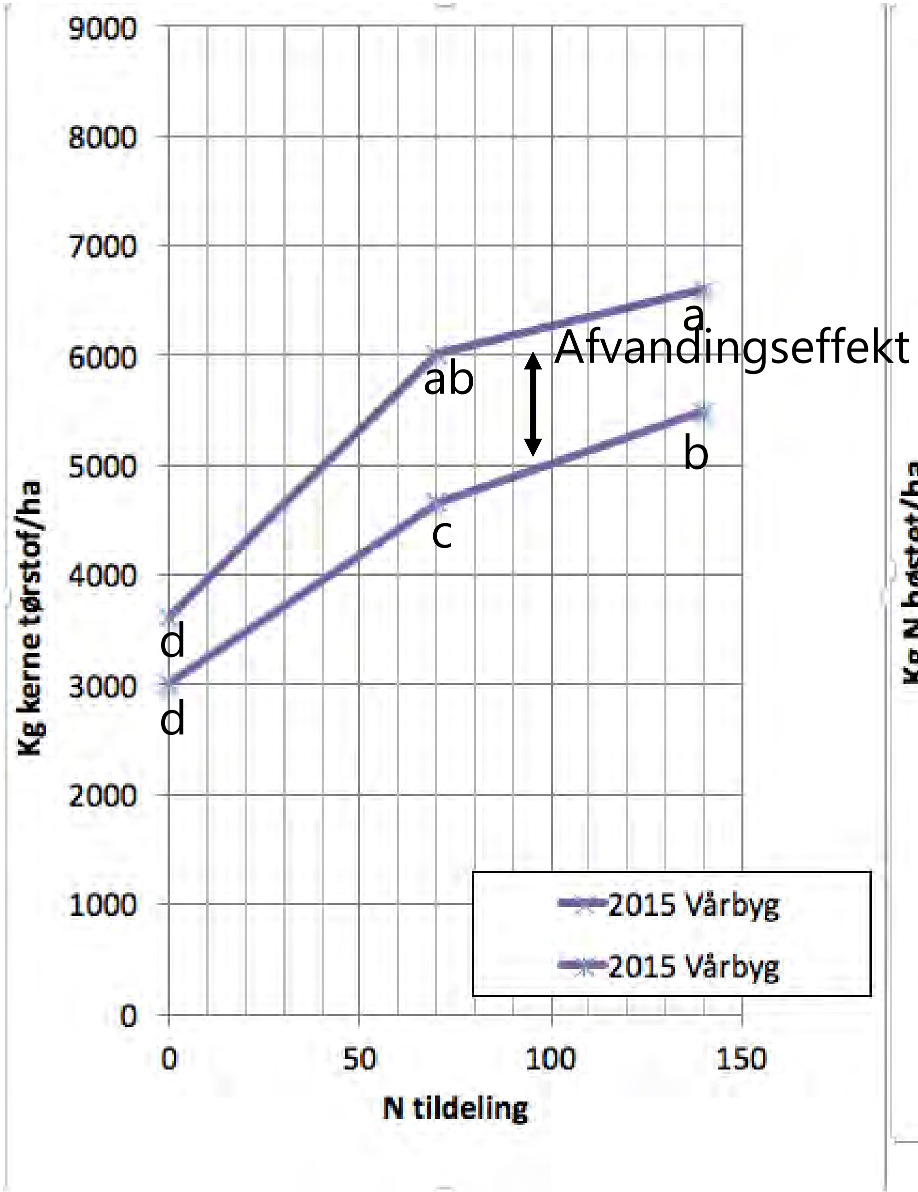
Figure: Kasper Jensen KU 2019 (Winter wheat root system: Weaver (1927))

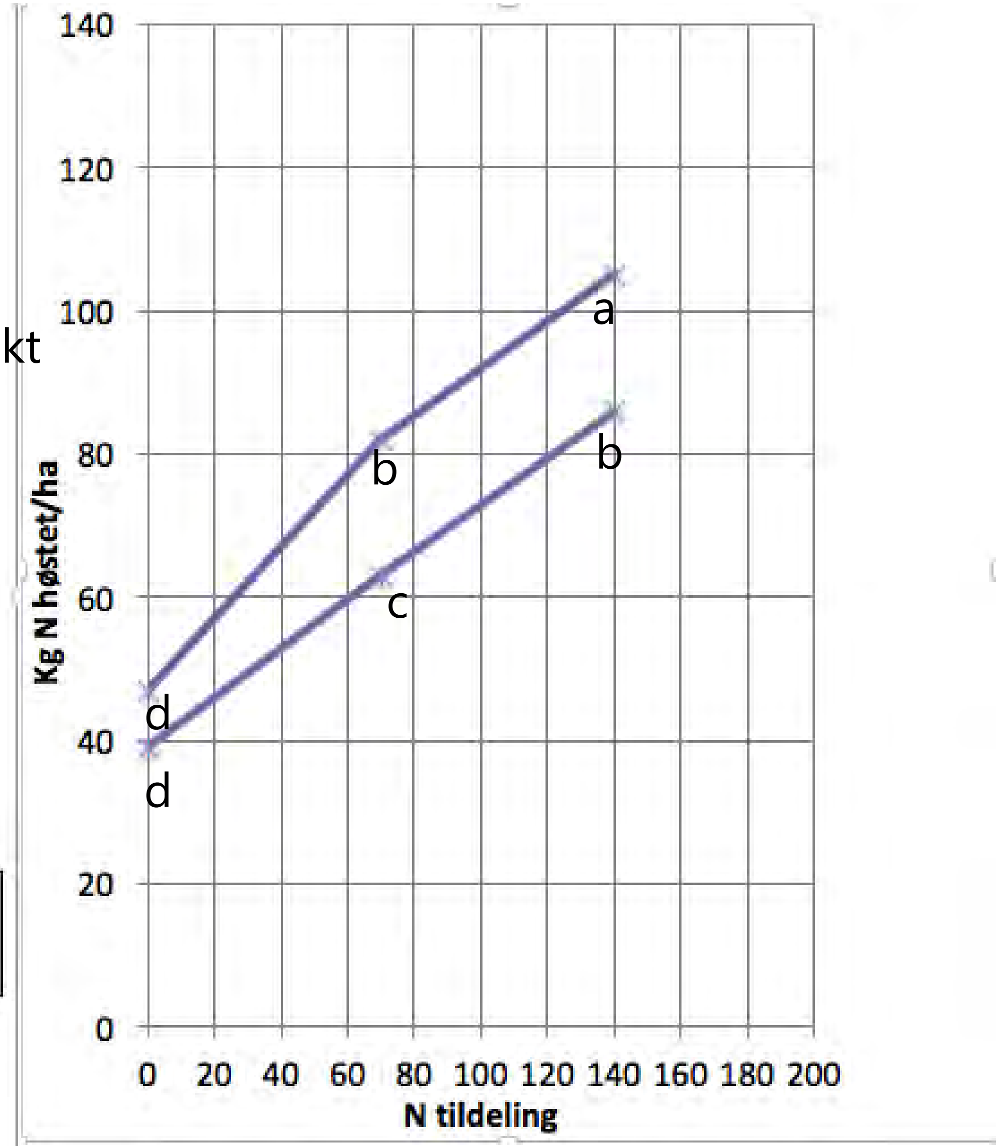
Målt grundvandsstand



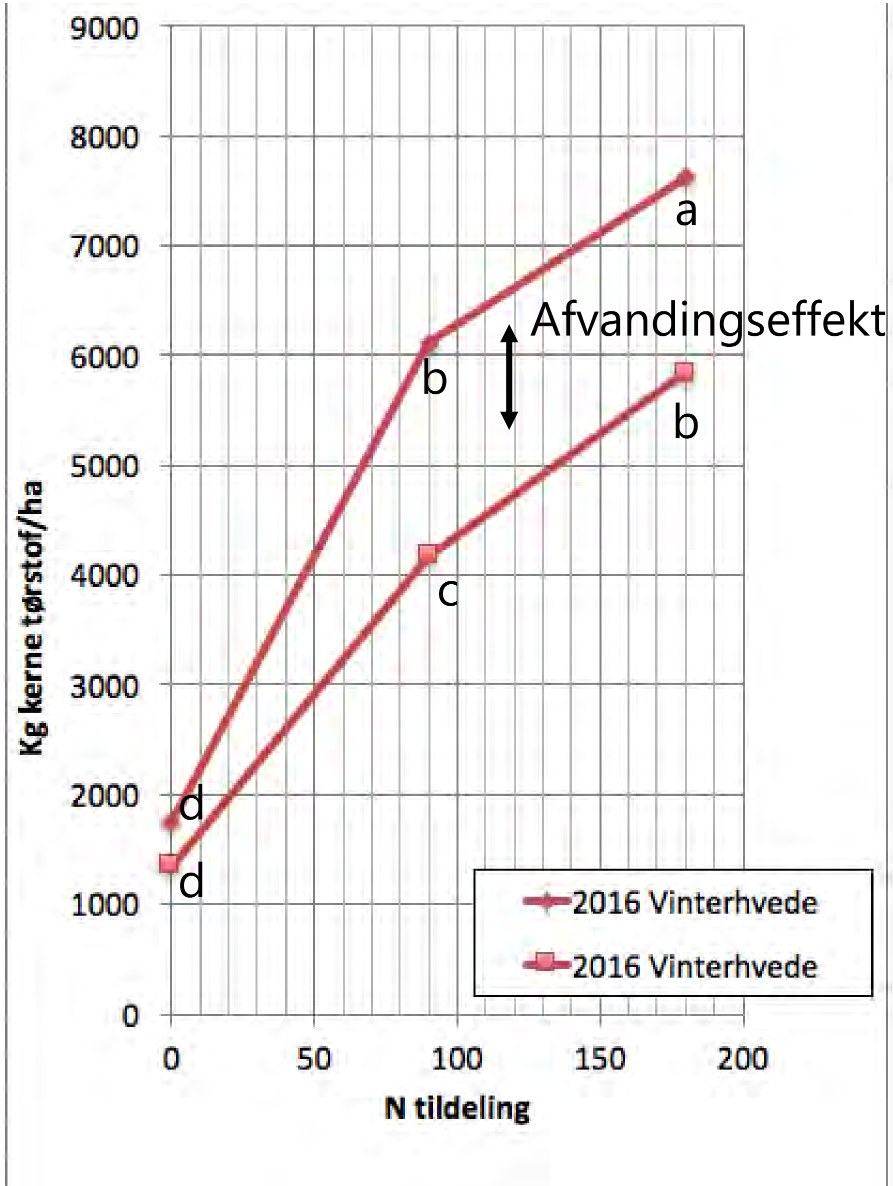
KU Kasper Jensen 2018

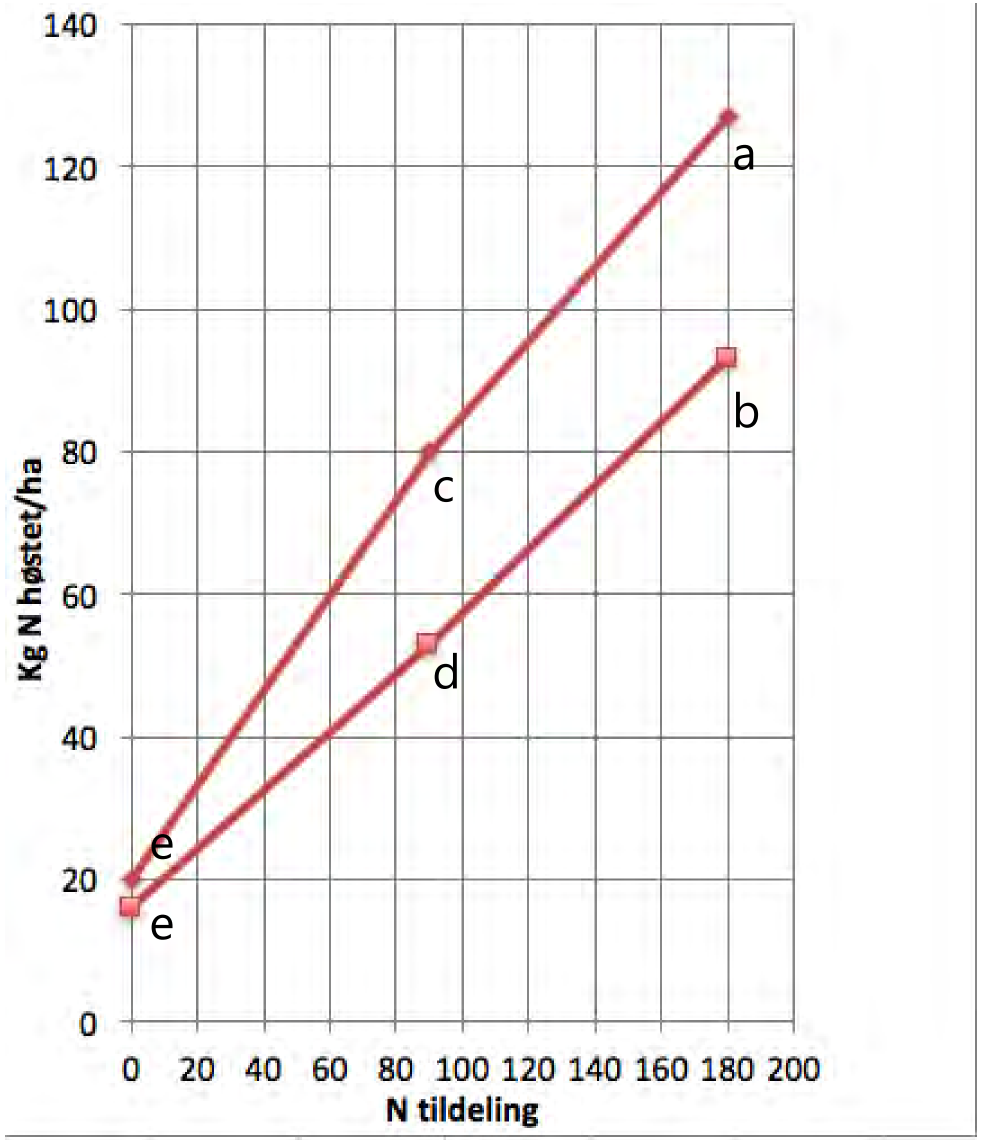
2015 Kvælstoftilgængelighed og denitrifikation



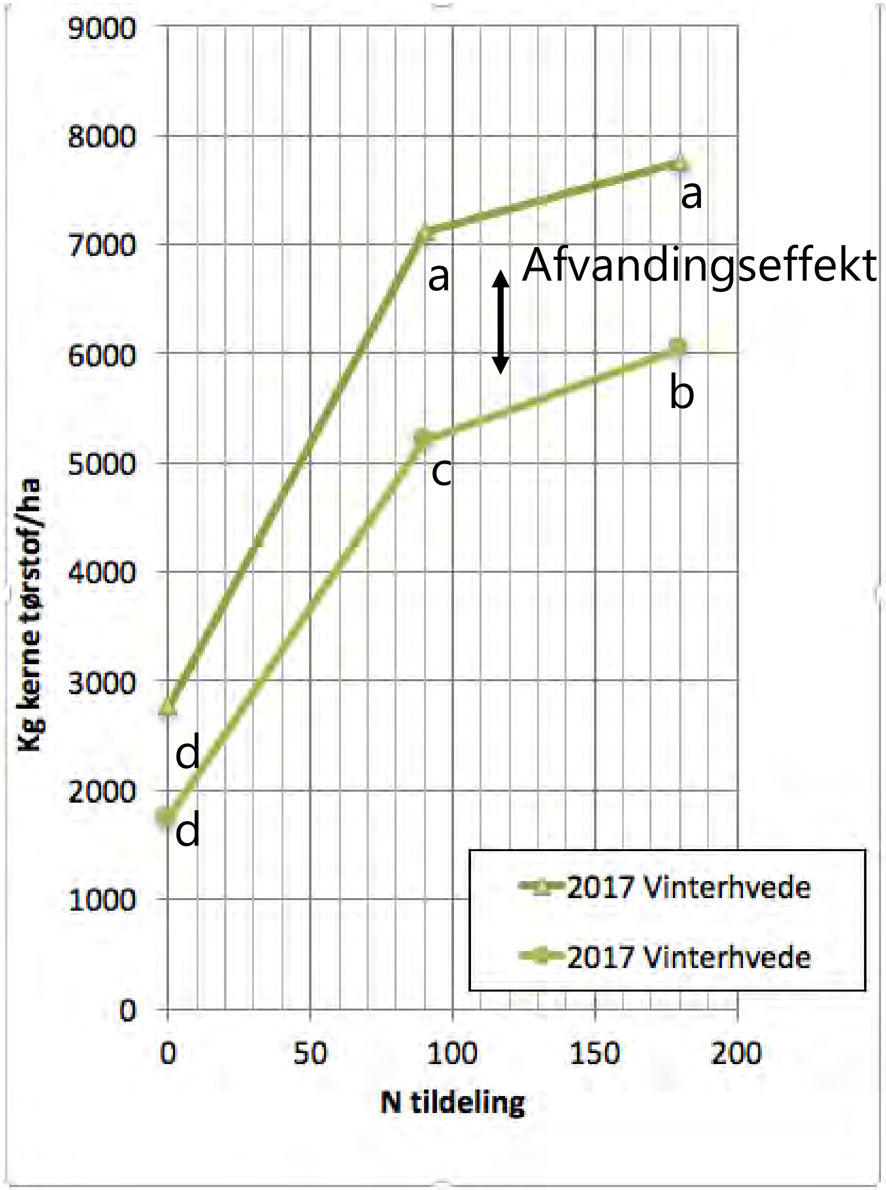


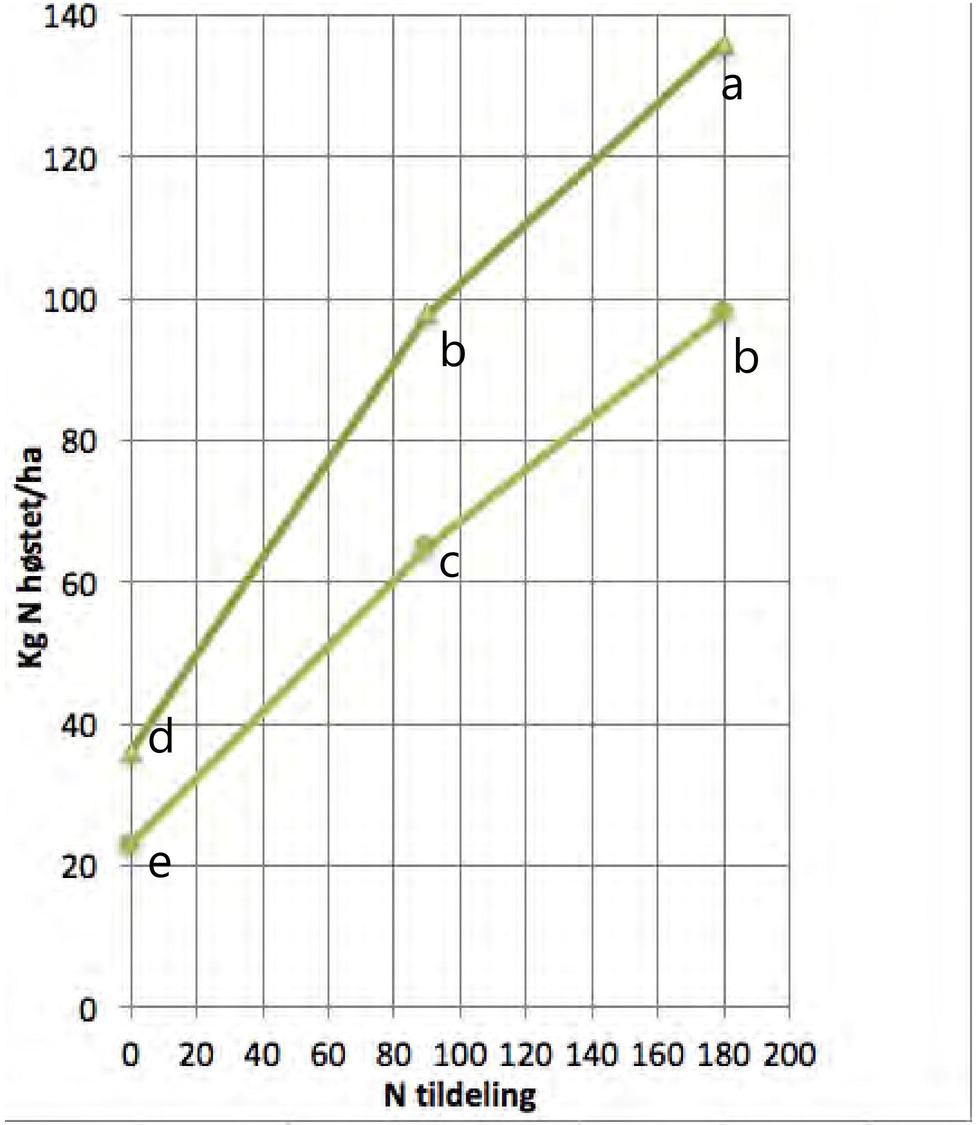
2016 Kvælstoftilgængelighed og denitrifikation



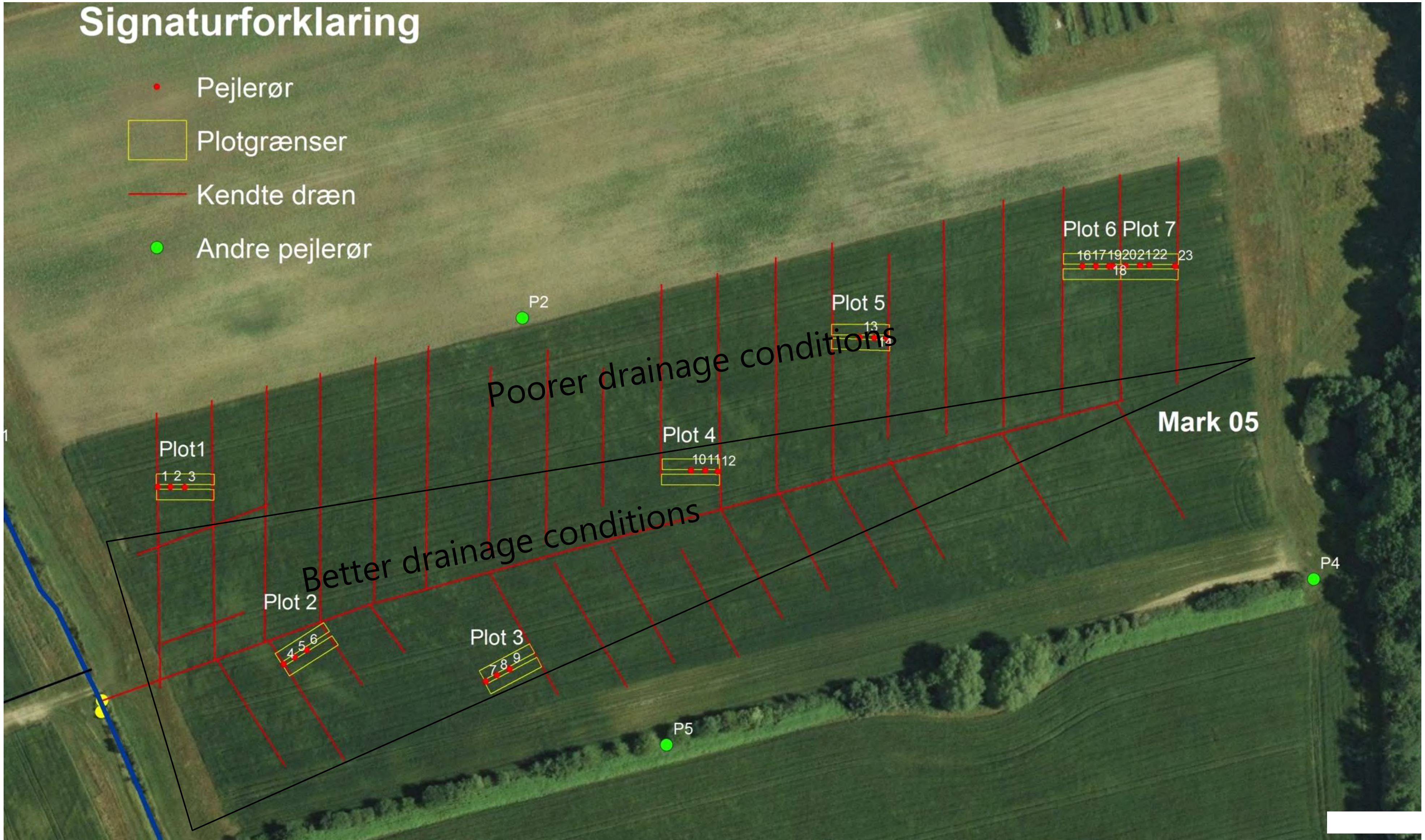


2017 Kvælstoftilgængelighed og denitrifikation





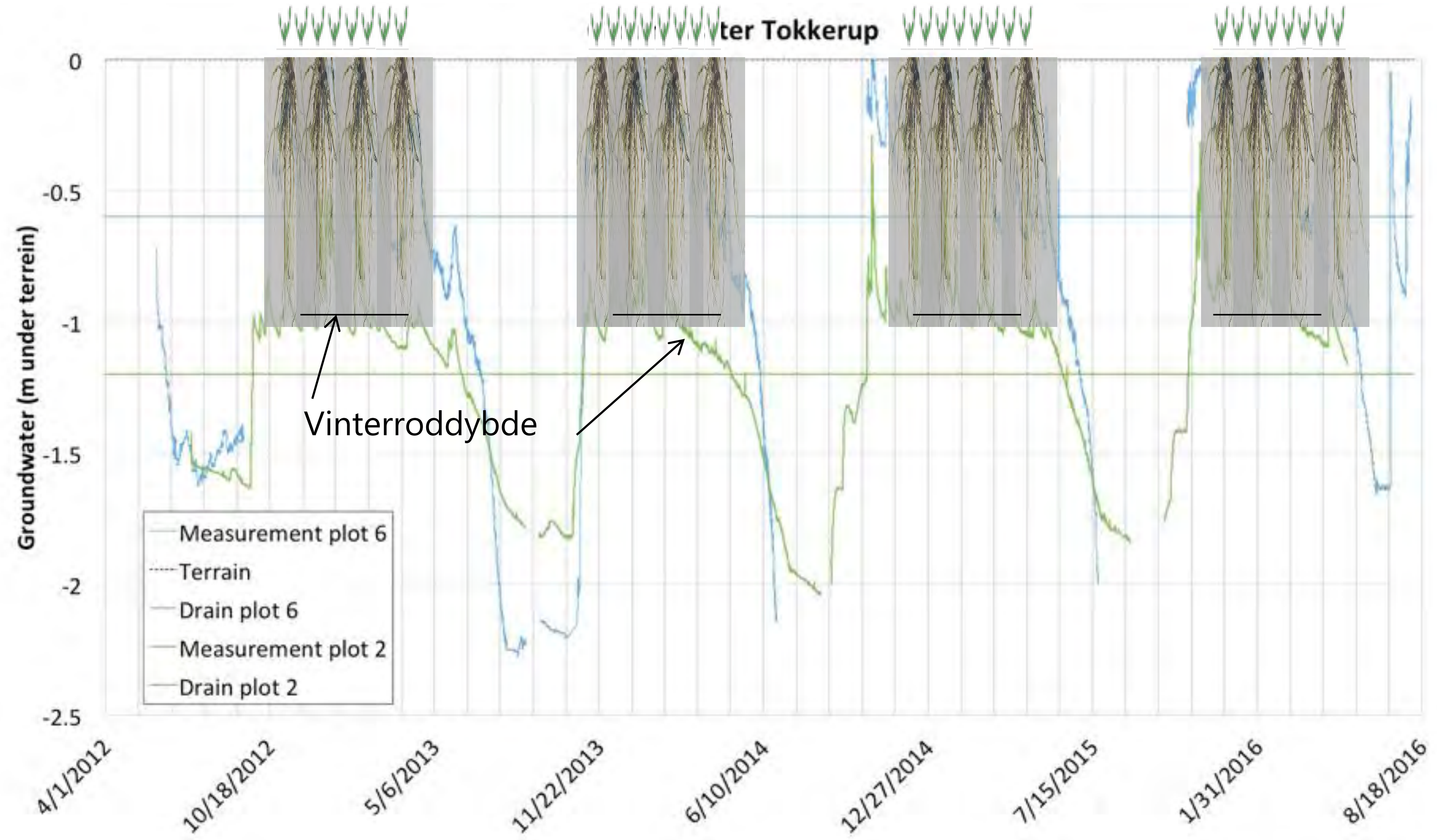
Detail system tile-drained



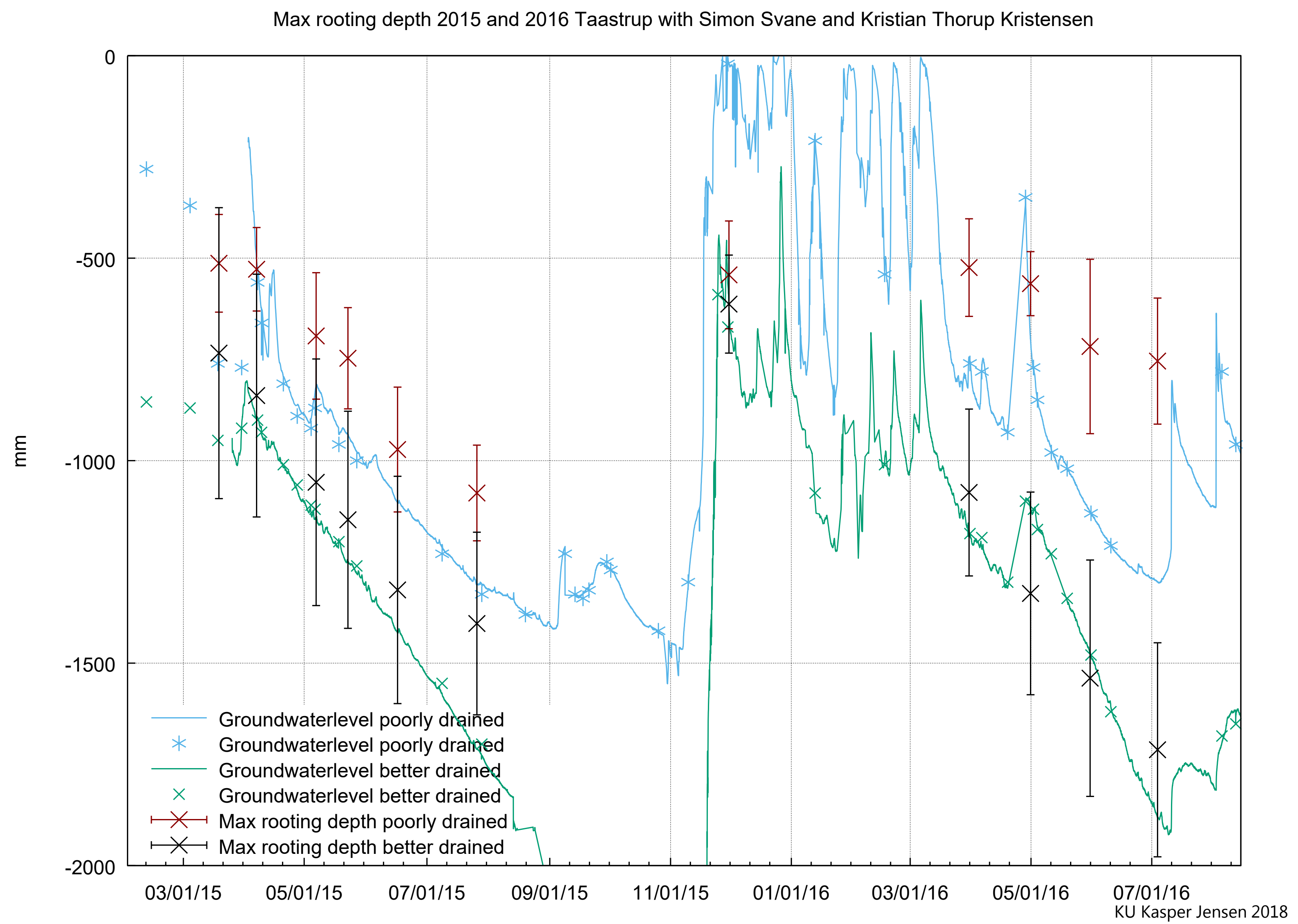
Nitrogen and denitrification an important factor?

Billede fra Miljøportalen, Hvede 2002

Rod påvirkning, højtliggende grundvand



Max roddybde vinterhvede 2015 og 2016



Mikroklima og jordtemperatur


Photo of the trial field in spring

Soil surface energy balance

$$R_n = G + H + \lambda E$$

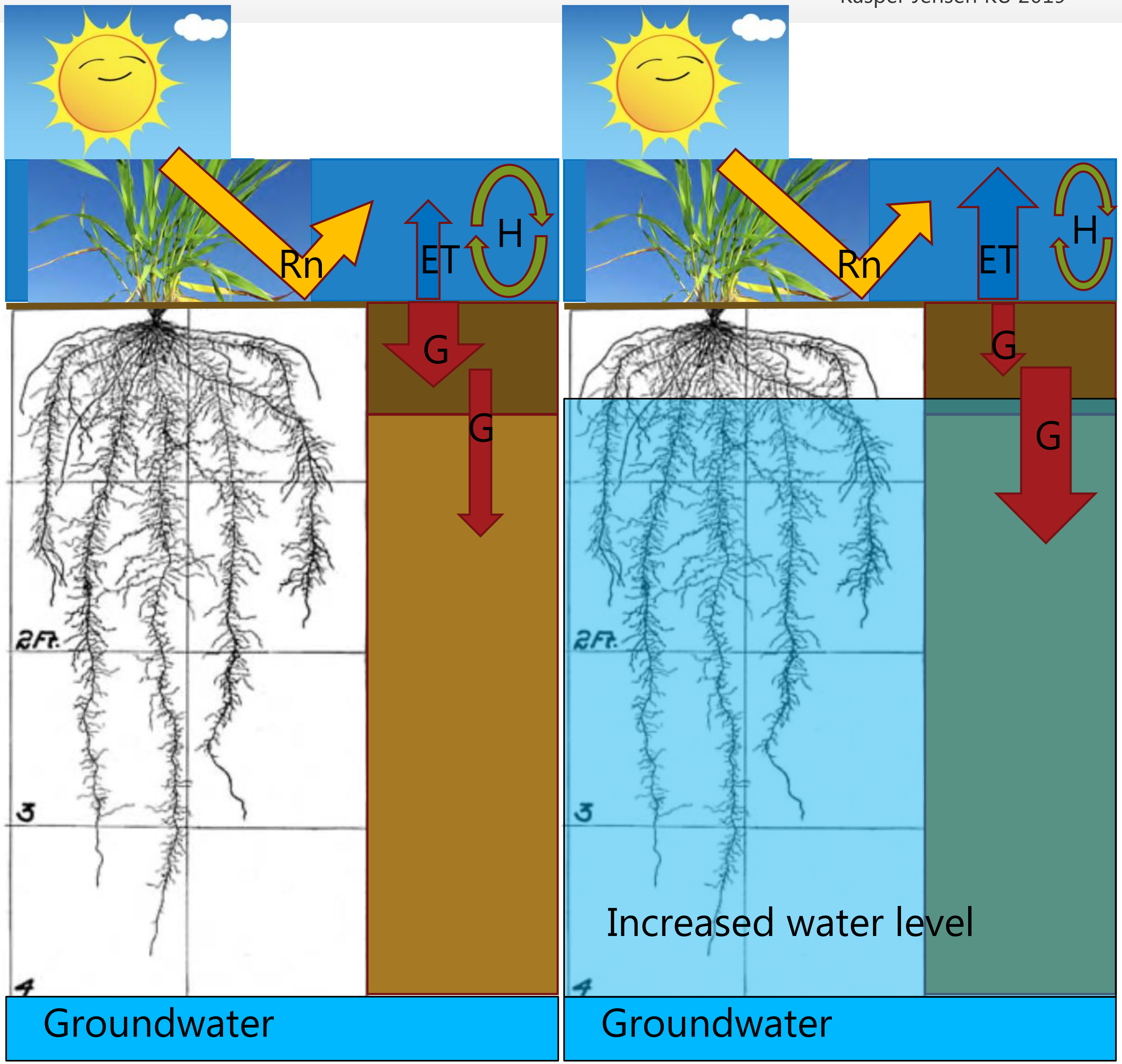
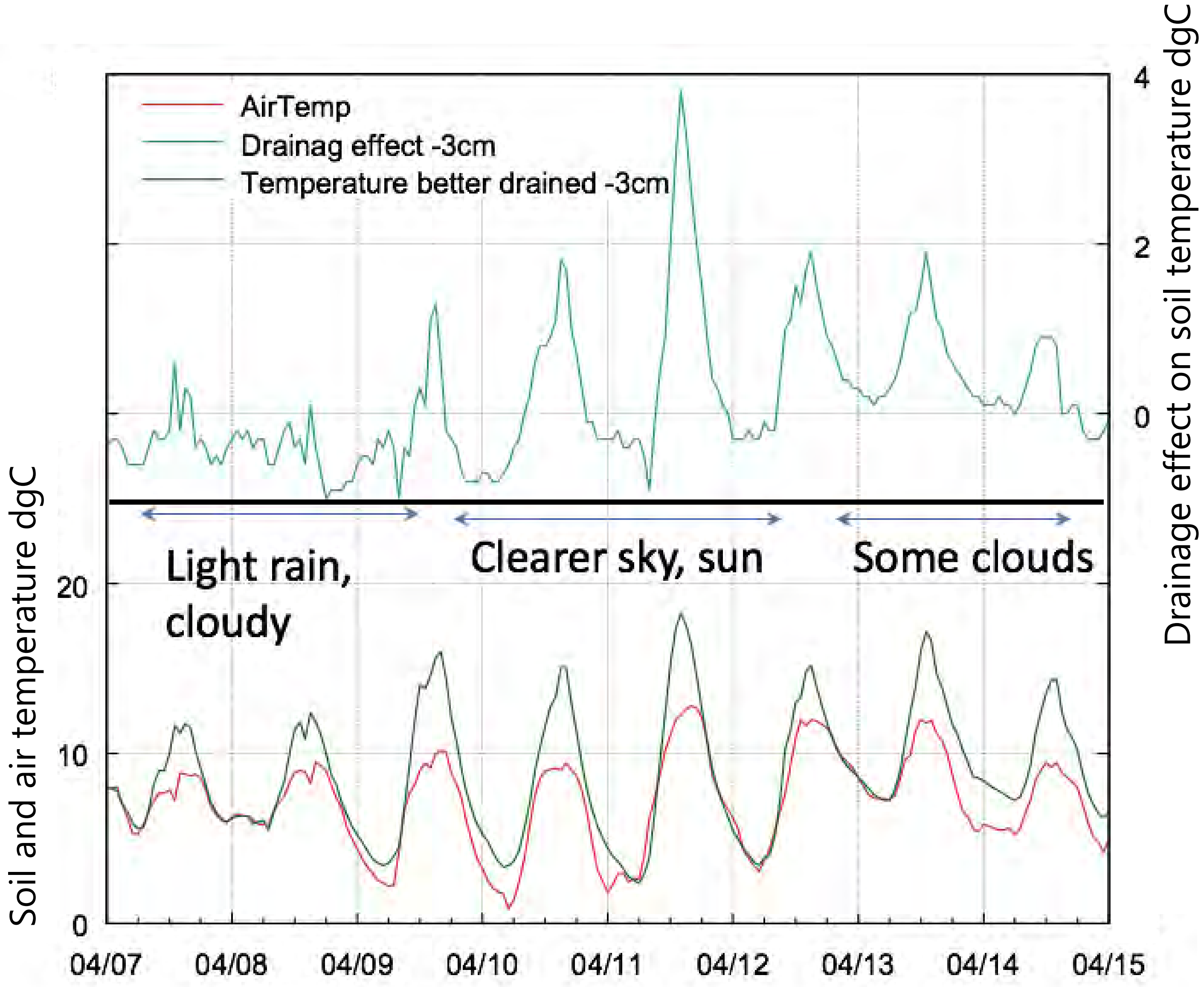


Figure: Kasper Jensen KU 2019 (Winter wheat root system: Weaver (1927))

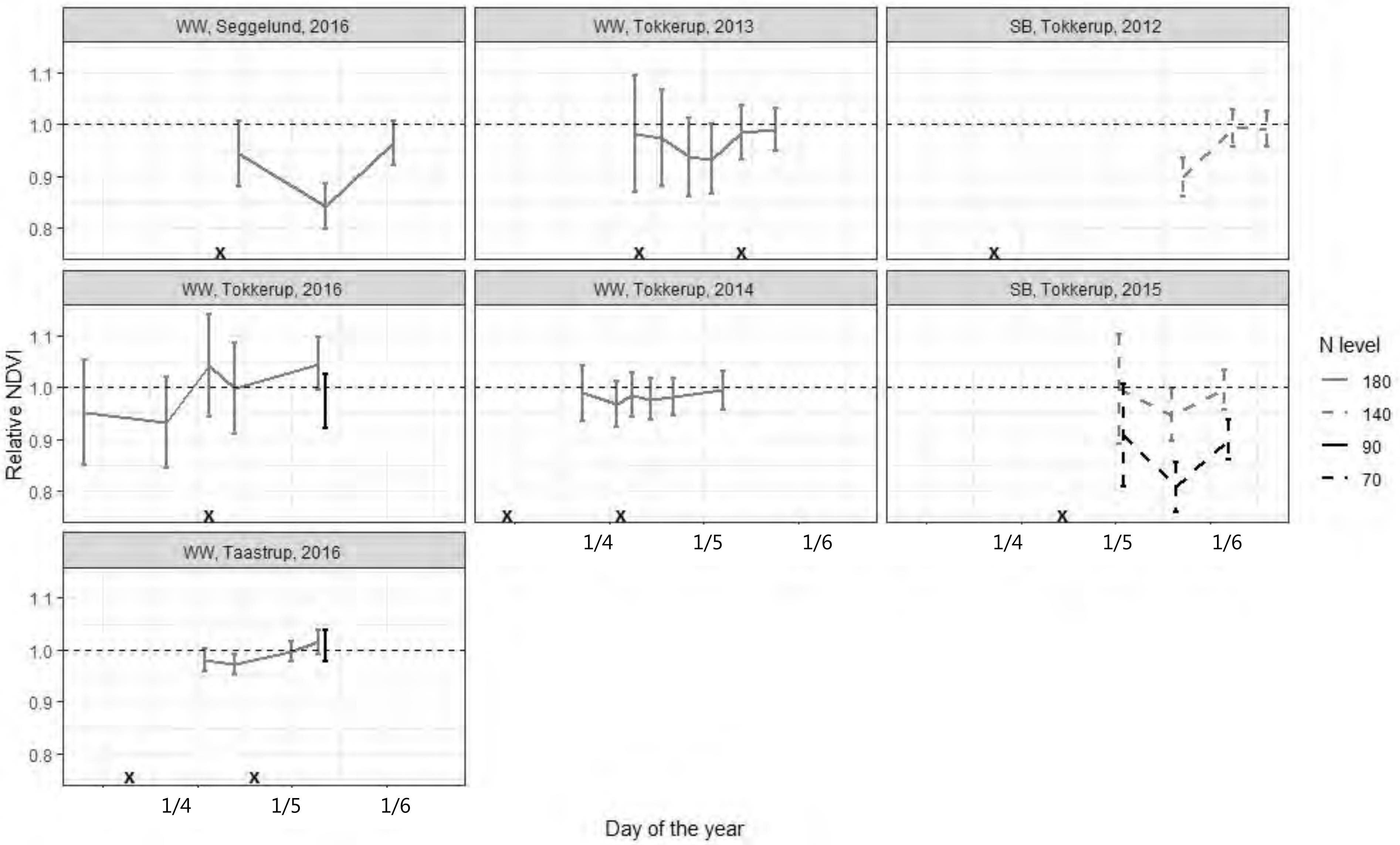
Weather dependent soil temperature effect



Field soil temperature -3cm April 2015 - May 2017	
Avg.Drainage effect on daily max soil temperature	
March	1.3
April	1.1
May	0.9

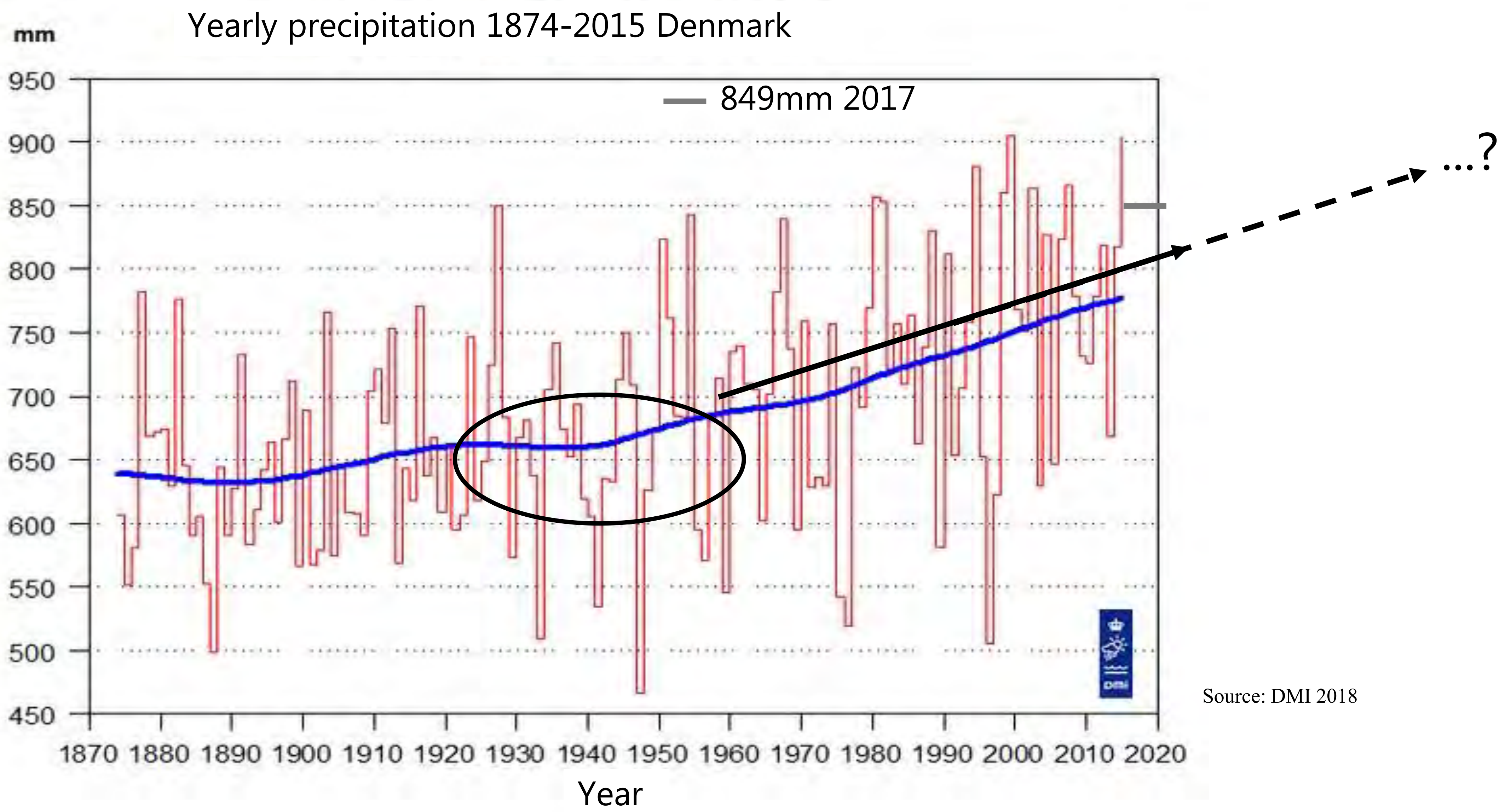
Tåstrup 2016

Crop growth development



Perspectives

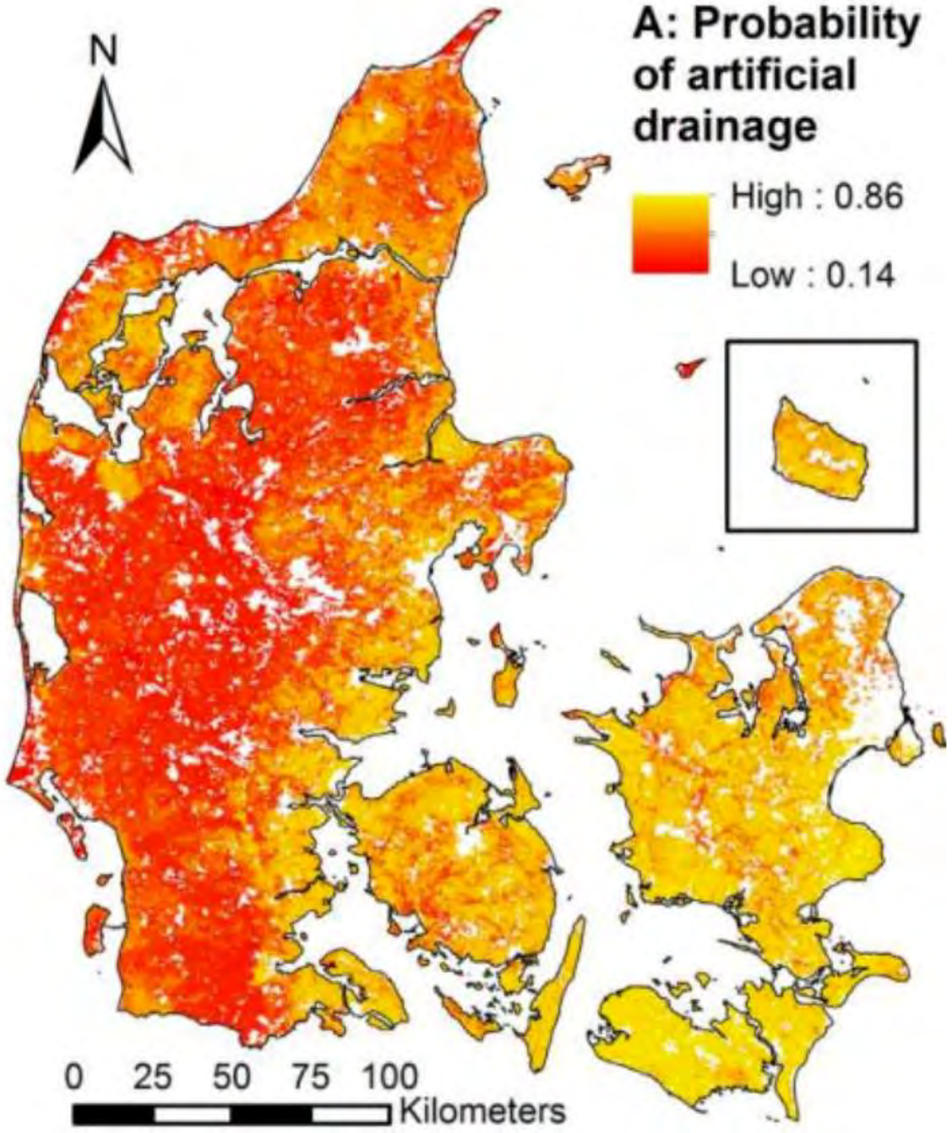
Climate change mitigation



Source: DMI 2018

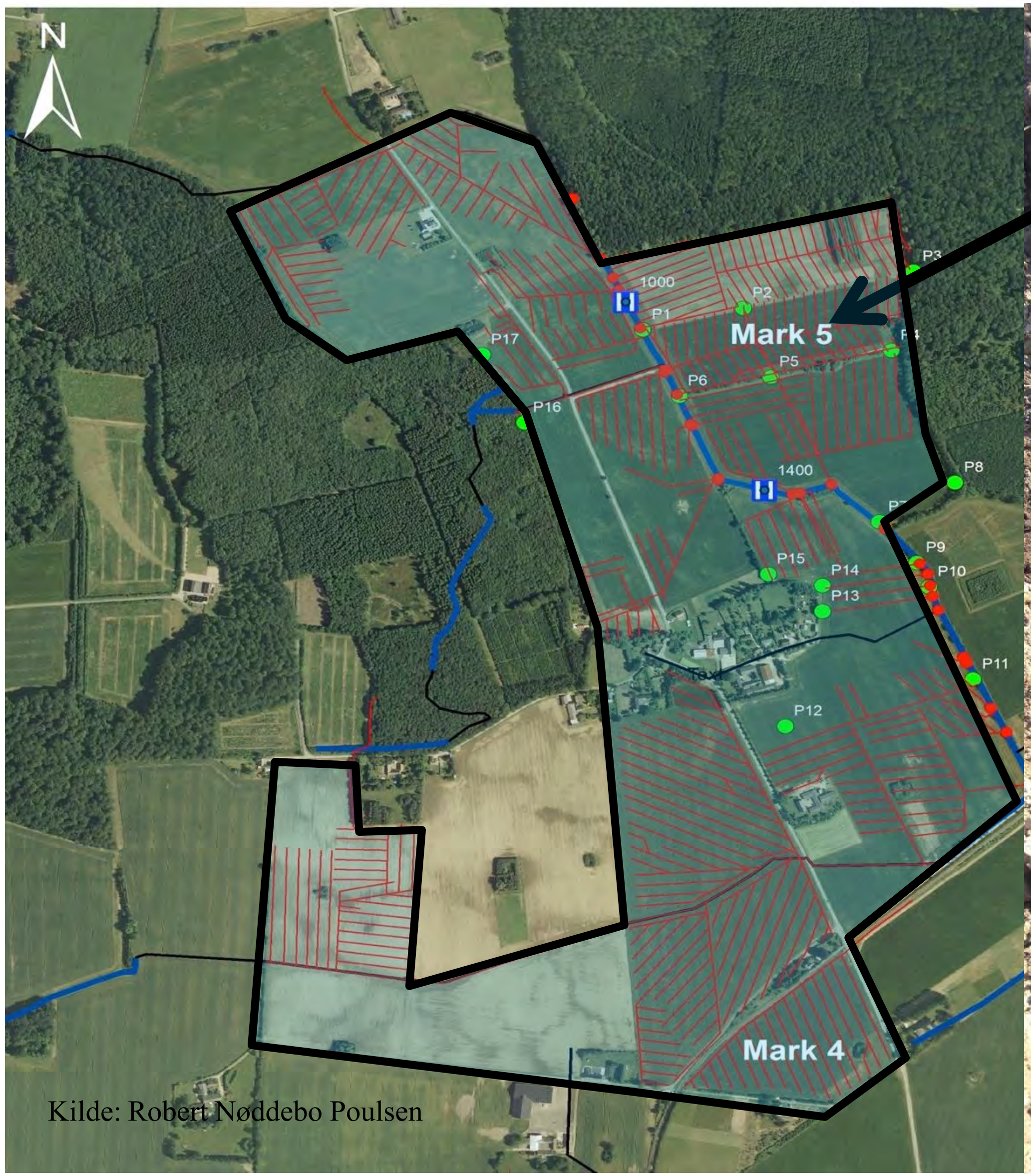
Potential proportion of area with drainage need I DK

50% of the agricultural area in DK have a drainage demand

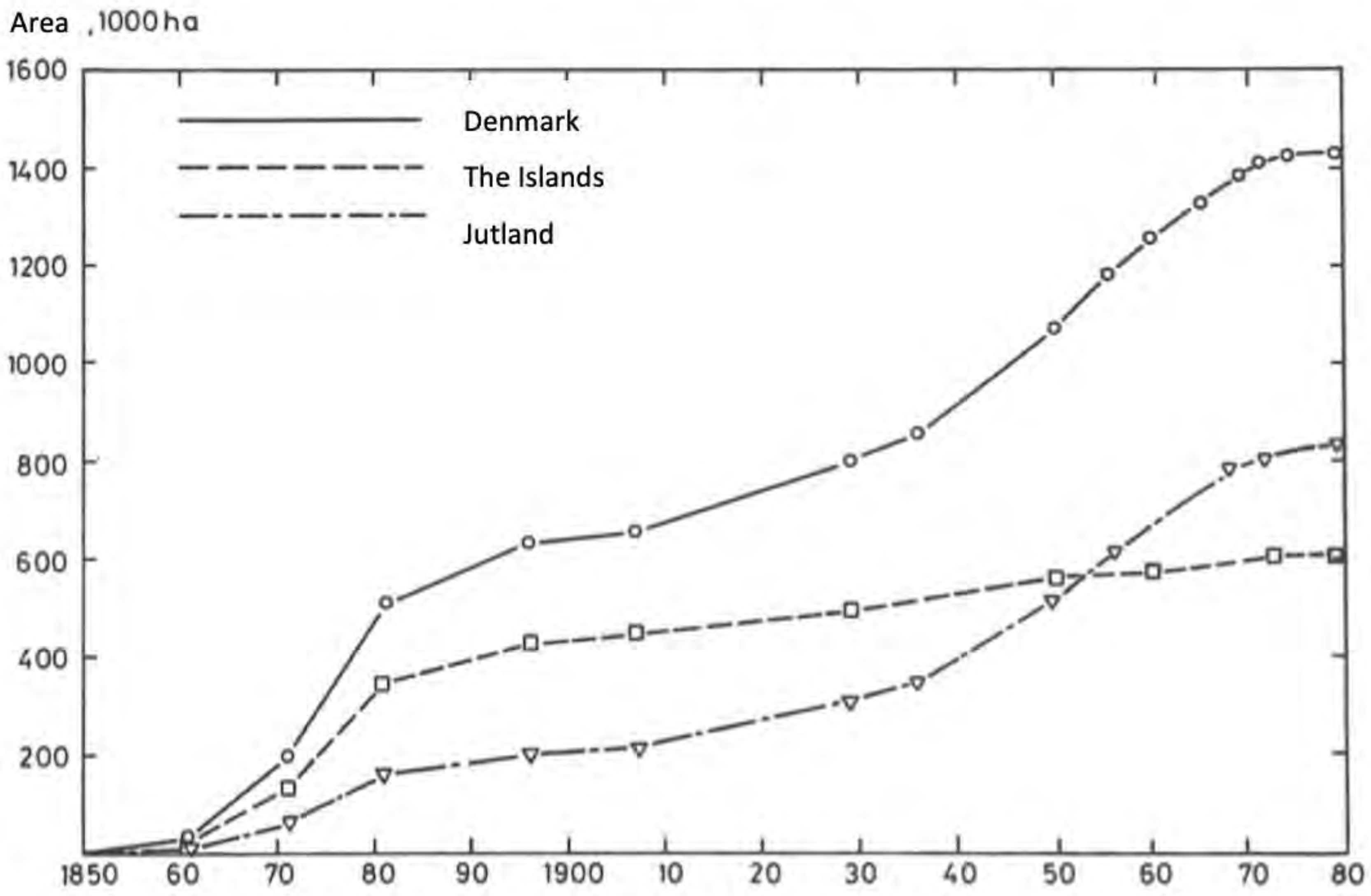


from (Møller et al., 2018)

Detailafvanding, omfang, vedligehold og dimensionering

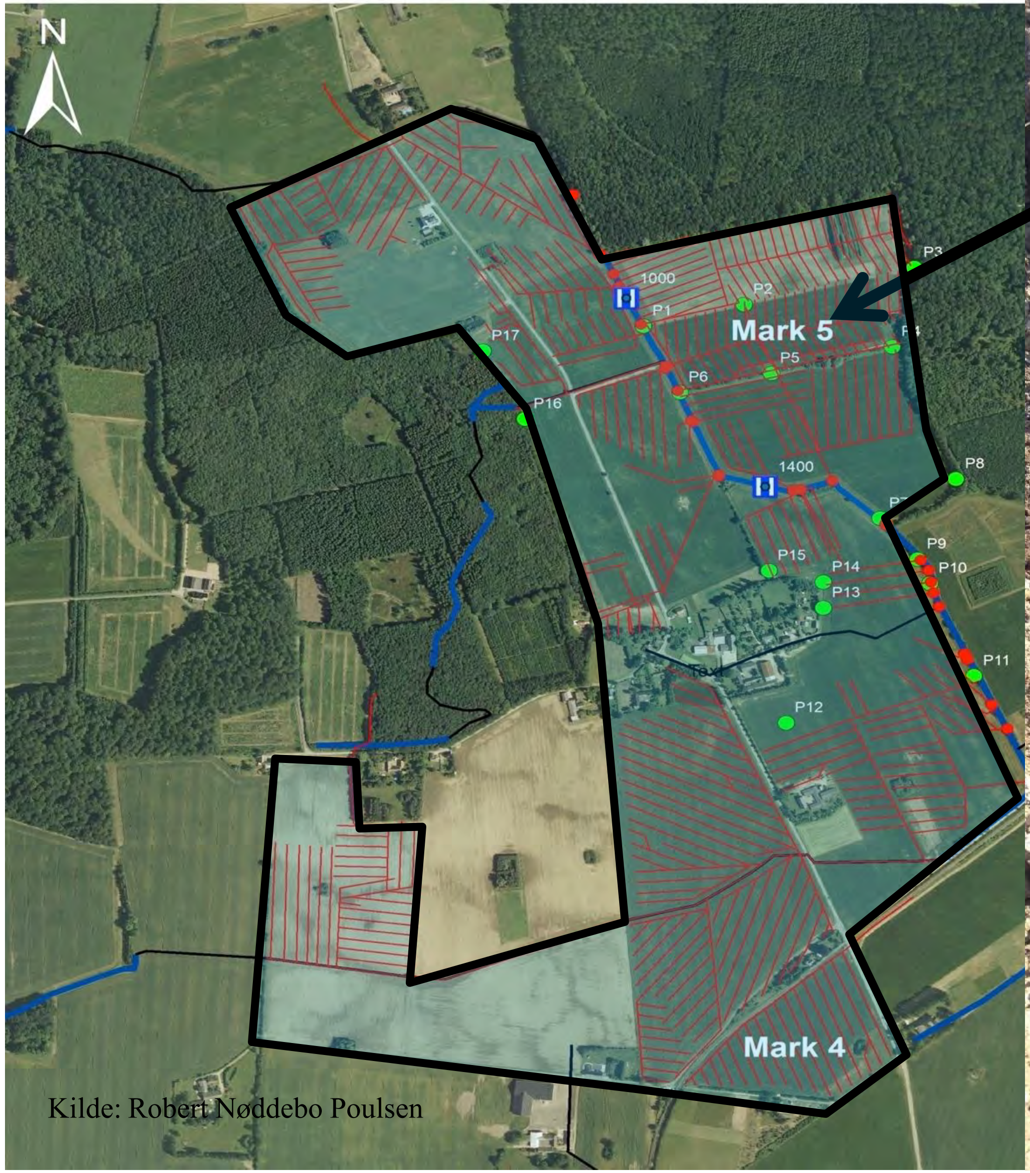


History of drainage



Tile drained agricultural area Denmark 1850-1980 ref. Aslyng (1980)

Detailafvanding, omfang, vedligehold og dimensionering



Kilde: Robert Nøddebo Poulsen

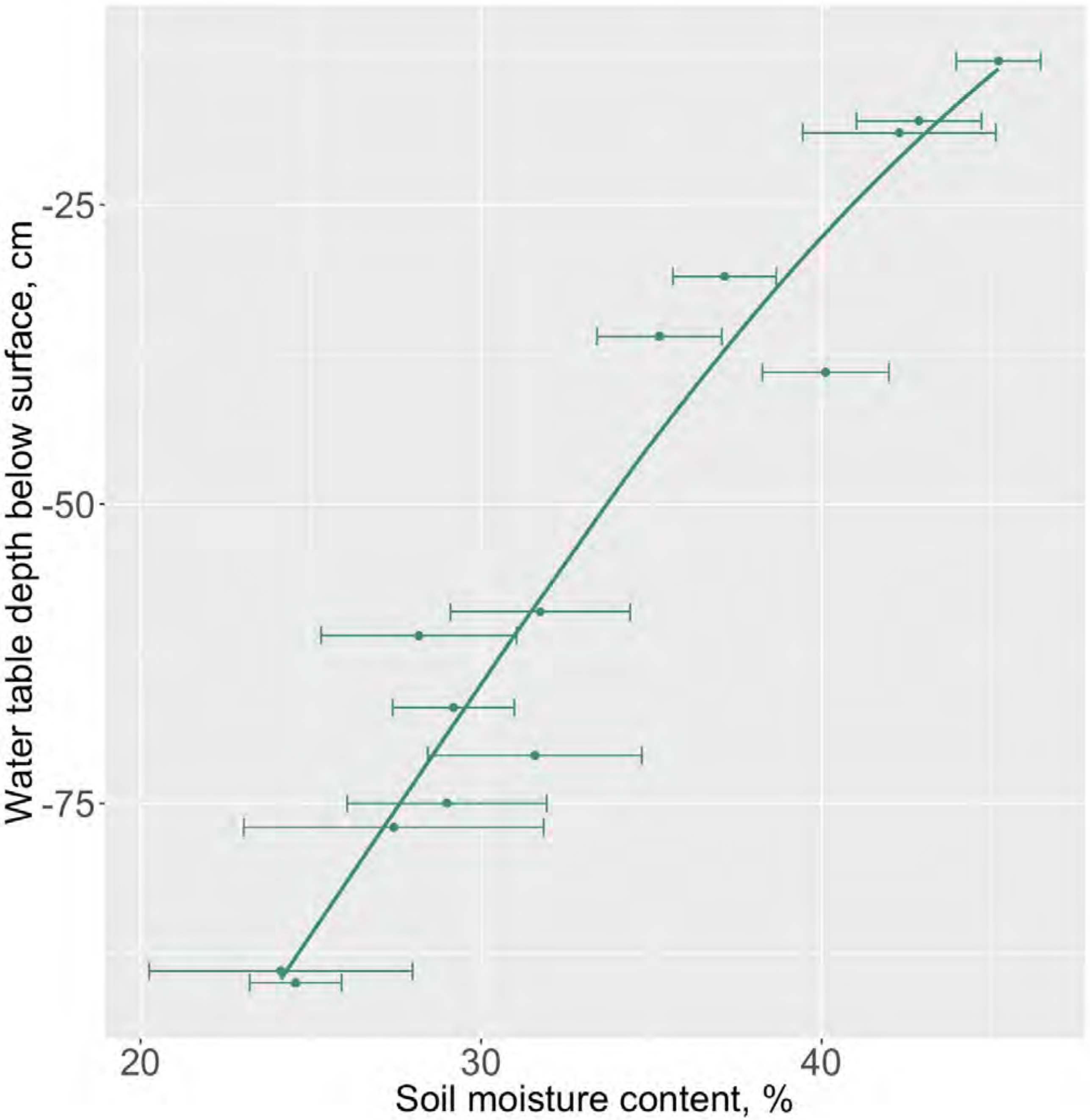
Water management

Water management

Uniform soil water conditions

Issues of poorly drained spots in the field

Dræn dybde


-25
-50
-75
Water table depth below surface, cm
20
30
40
Soil moisture content, %

Wat


Kasper Jensen KU 2019
Ortofoto, 2018 forår
Ortofoto forår 2018
www.miljøgis.dk
100 m
ETRS89 ØST / Nord
674780.8 ,6170315.6
WGS84 Bredde / Længde
55° 38.8330' N ,11° 46.6542' E

The project has been supported by:

CARLSEN-LANGES LEGATSTIFTELSE

DLF SEEDS & SCIENCE

Landbrugets Hudefond

Hofmansgave anno 1784

Foreningen Plan Danmark

Innovationsfonden

Future Cropping er støttet af Innovationsfonden

VIDENCENTRET FOR LANDBRUG

Østlige Øers Landboforeninger

Naturerhverv.dk

Ministeriet for Fødevarer, Landbrug og Fiskeri

Den Europæiske Landbrugsfond for Udvikling af Landdistrikterne

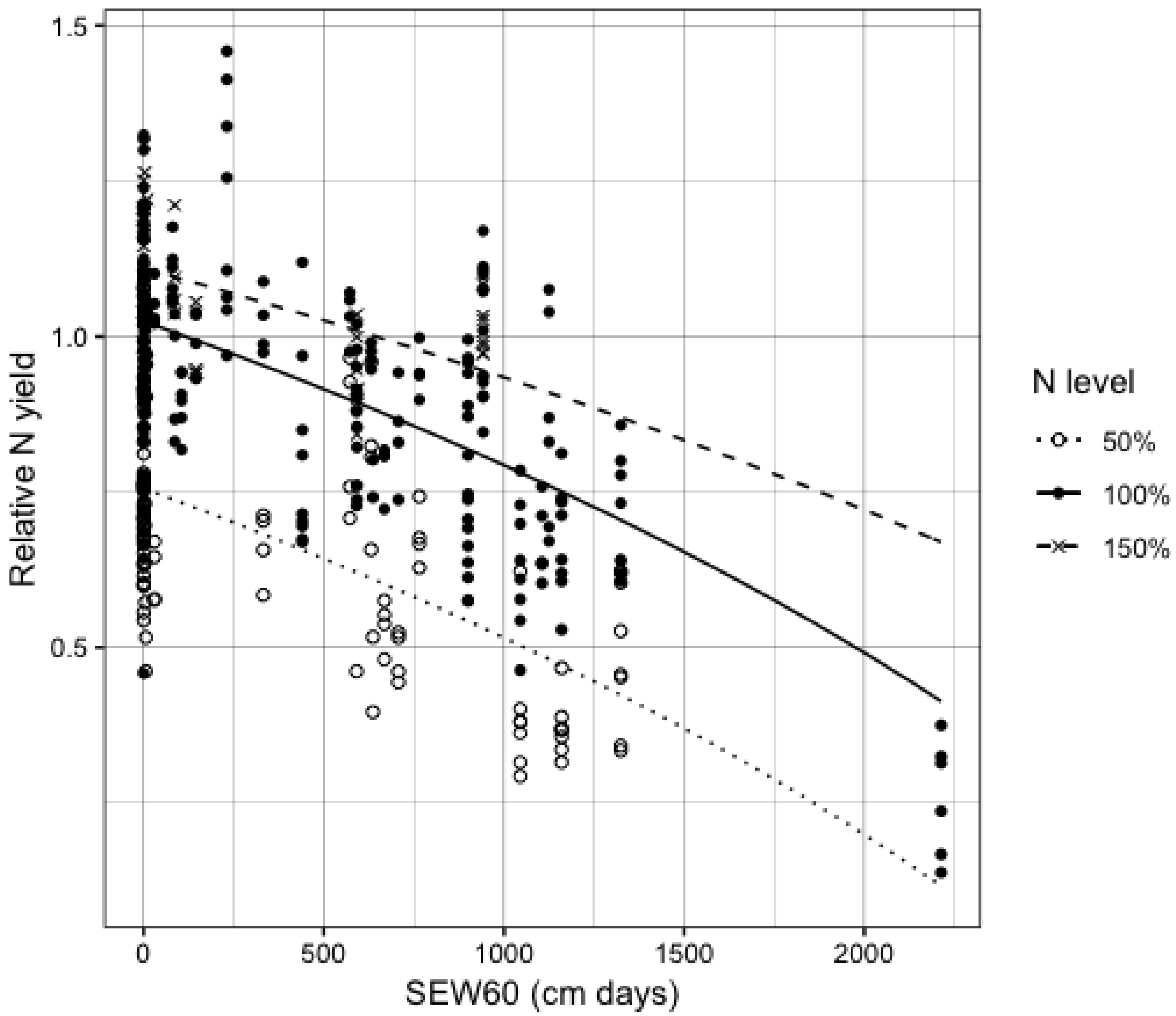
Danmark og EU investerer i landdistrikterne.

Se "European Agricultural Fund for Rural Development" (EAFRD)

Tokkerupgaard I/S

Promilleafgiftsfonden for landbrug

Poor resource utilization on poorly drained soils



Relative N yield = log (-5.75e-04*SEW_{60} +2.79)

At normal N application level (100% eq. WW, 180 and SB, 140 kgN/ha)

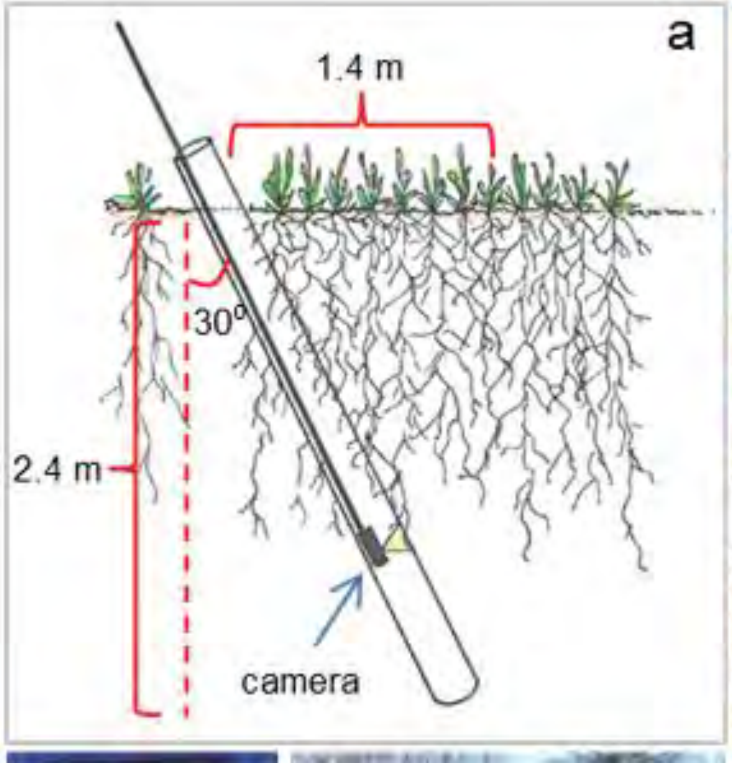
Figure 1 Relative N yield in grains related to SEW_{60}. Data covers winter wheat (WW) and spring barley (SB) for all years and for all

Conclusions:

- Consistent yield reductions of up to 25% across 11 trial site years.
- Yield of dry matter (DM yield) and nitrogen uptake in grains (N yield) were related to SEW_{60}
- There was no significant interaction between SEW_{60} and nitrogen application level with respect to yields.
- The drainage conditions had a clear effect on soil temperature
- Simulated energy fluxes could explain some of the observed daily temperature variations in the soil surface layer.

Environmental impact of N in fields studies

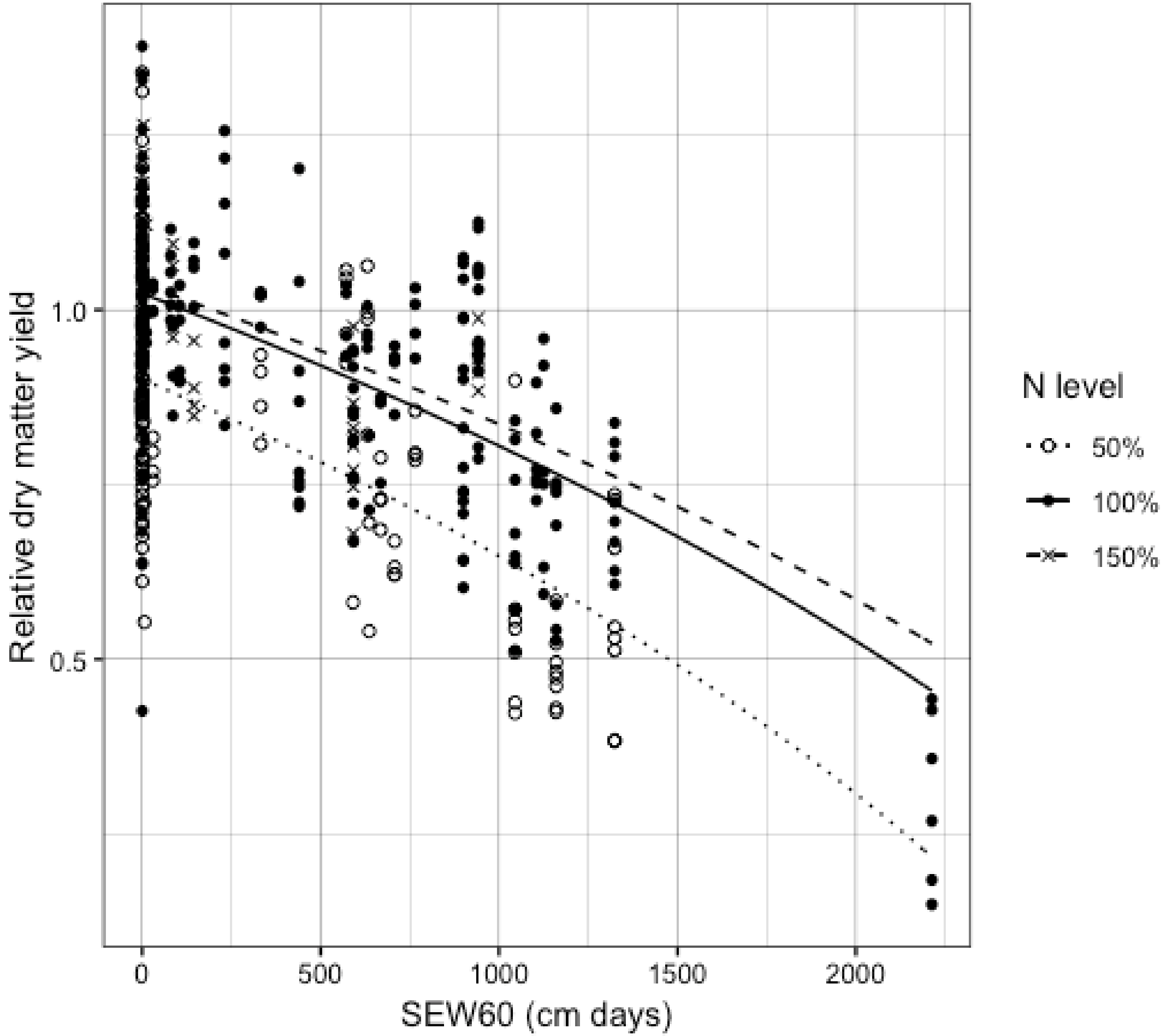
Root environment



en KU (2015)

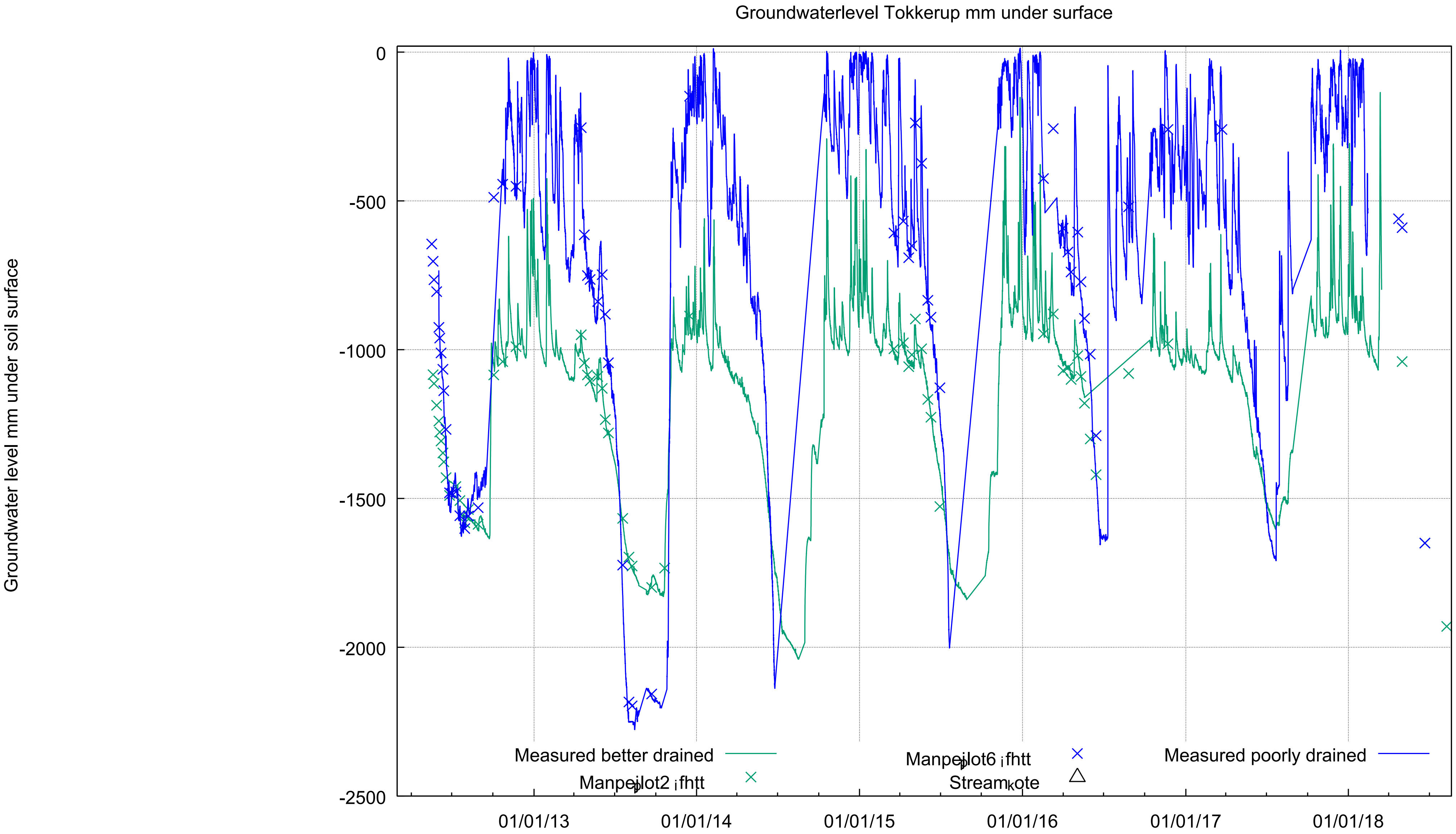
Soil temperature as basis for application of new research

Drainage Yield Response (grain drymatter)



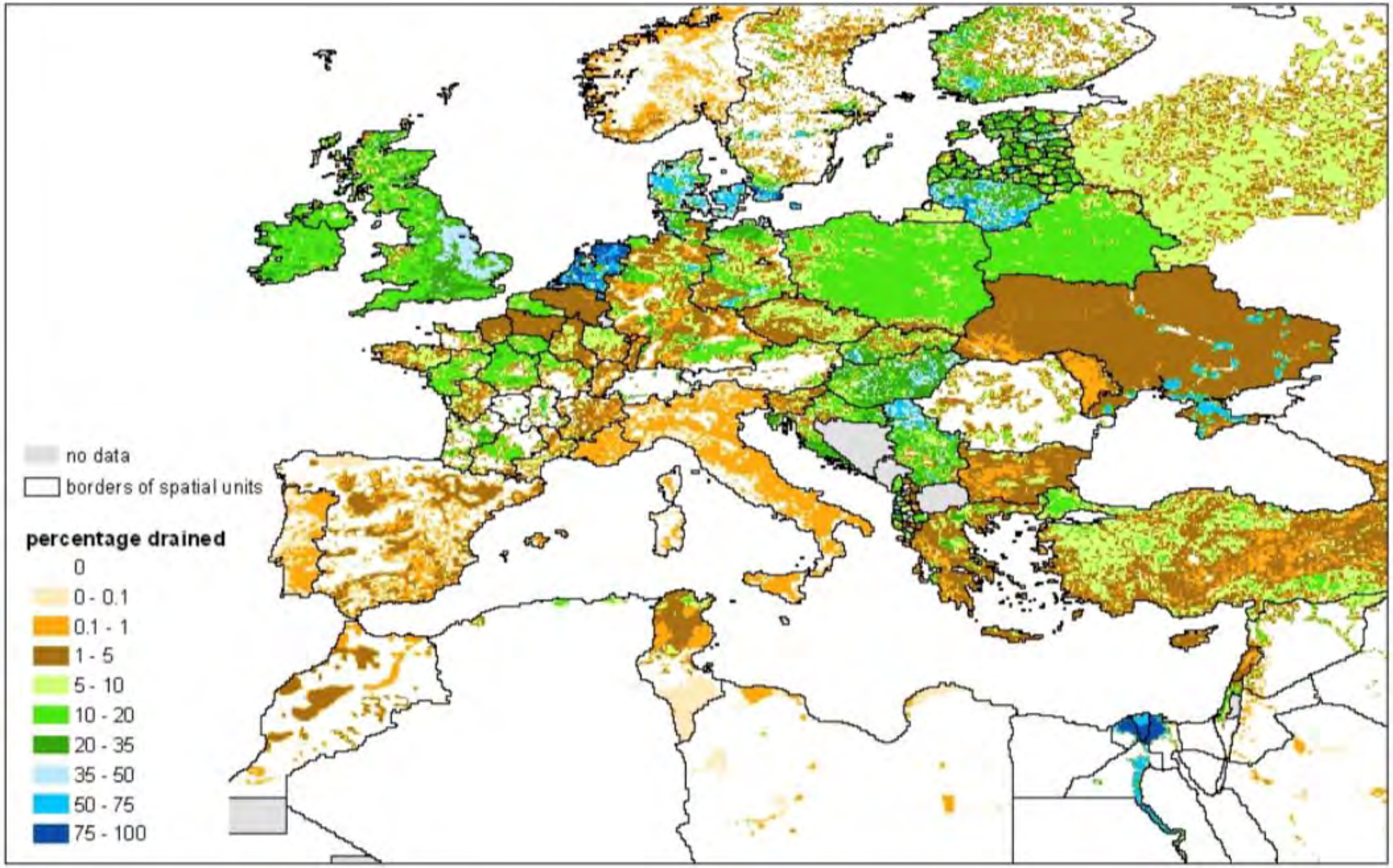
$$\text{Relative DM yield} = \log(-5.45e\text{-}04 \cdot SEW_{60} + 2.78)$$

At normal N application level (100% eq. WW, 180 and SB, 140 kgN/ha)



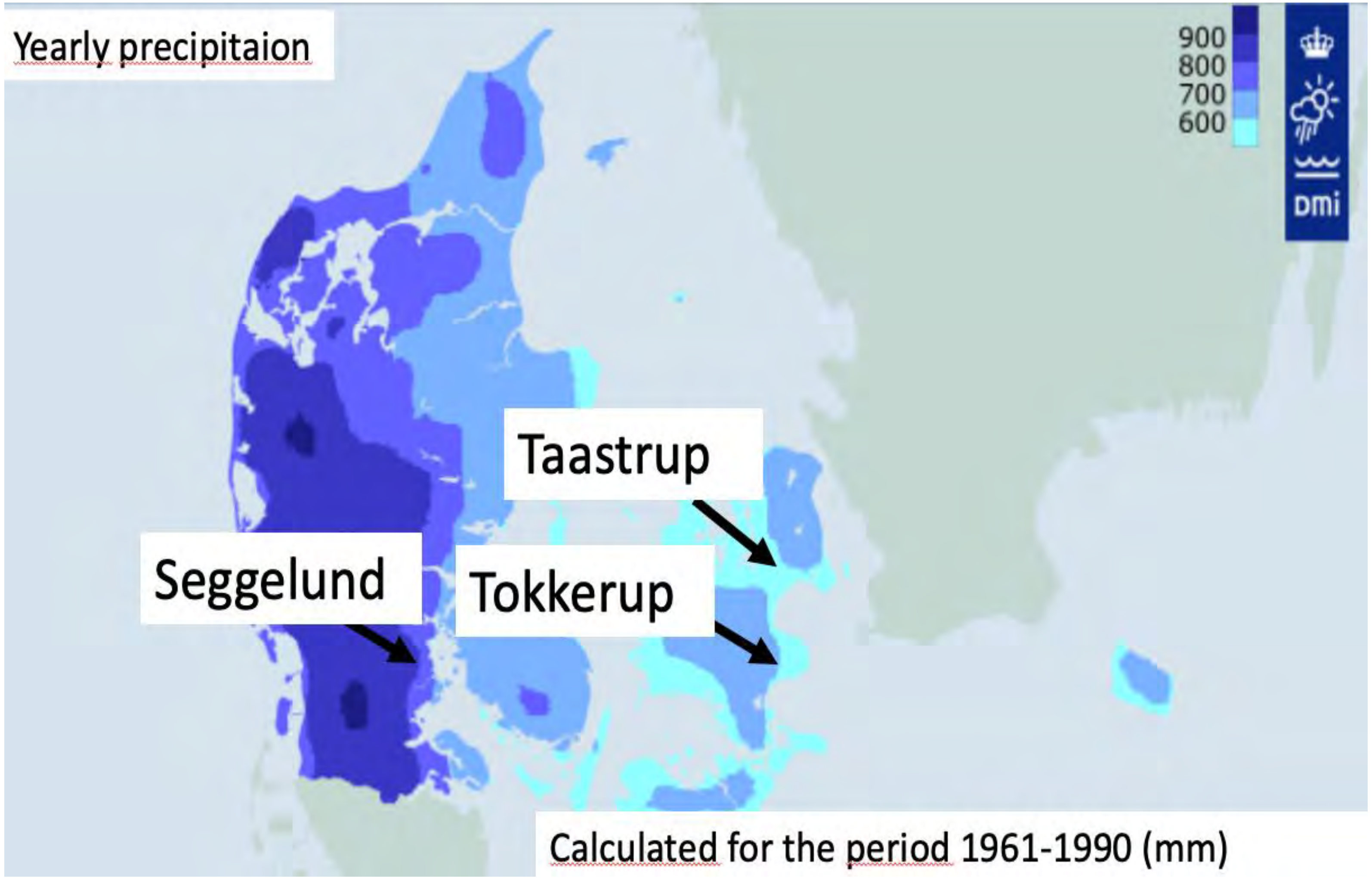
Groundwaterlevel Tokkerup mm under surface
Groundwater level mm under soil surface
0
-500
-1000
-1500
-2000
-2500
01/01/13
01/01/14
01/01/15
01/01/16
01/01/17
01/01/18
Measured better drained
Manpejlot2 ¡fhtt
Manpejlot6 ¡fhtt
Streamkote
Measured poorly drained

Proportion of drained areas

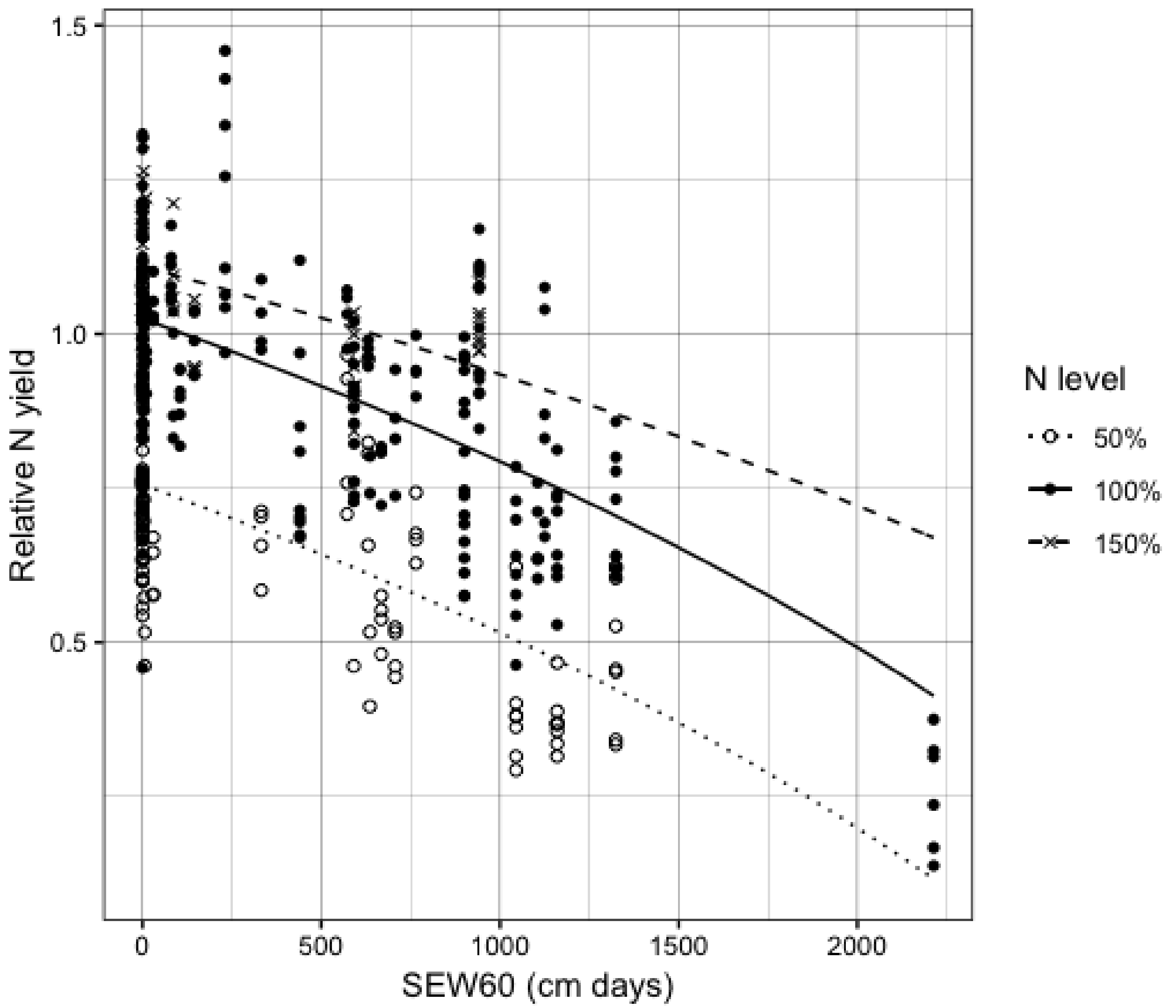


Artifical drained agricultural areas in Europe (Feick et al., 2005)

Different locations and climate



Drainage Yield Response (grain N content)



Relative N yield = log (-5.75e-04*SEW_{60} +2.79)

At normal N application level (100% eq. WW, 180 and SB, 140 kgN/ha)

Figure 1 Relative N yield in grains related to SEW_{60}. Data covers winter wheat (WW) and spring barley (SB) for all years and for all

Draiange trials

TABLE 1. YIELD OF CROPS (IN PERCENT) AT VARYING WATER TABLE DEPTHS AT LOCATIONS OTHER THAN RALEIGH, N.C.

Crop	Number of experi-ments	Water table depth, cm							
		15	30	40-50	60	80-90	120	150	240
Wheat[1]	6			58	77	89	95	100*	
Barley[1]	5			58	80	89	95	100*	
Oats[1]	3			49	74	85	95	100*	
Ladino[2a]	1	100*	97	[illegible]					
Ladino[2b]	1	100*	99	92					
Orchardgrass[2a]	1	28	100*	93					
Orchardgrass[2b]	1	100*	70	92					
Fescue[2a]	1	51	100*	87					
Fescue[2b]	1	100*	50	72					
Alfalfa[3a]	1				100*		97		96
Alfalfa[3b]	1				100*		92		86
Corn[4a,b]	1	45	55	67	70	100*			
Corn[4c]	1	80	100*	96	83	93			
Peas[1]	4			50	90	100*	100*	100*	
Beans[1]	3			79	84	90	94	100*	
Tomato[4a,b,c]	3	9	28	47	60	100*			
Snap beans[4a]	1	71	78	80	94	100*			
Snap beans[4b]	1	100*	83	89	94	92			
Snap beans[4c]	1	28	43	100*	78	75			
Sugar beets[1]	2			71	84	92	97	100*	
Potatoes[1]	1			90	100*	95	92	96	
Horsebeans[5]	1			75	82	95	100*	100*	
Colza[5]	2			77	93	94	100*	98	

[1] van Hoorn (34)—clay, combination watering.
[2a] Gilbert and Chamblee (7)—silt loam, combination watering.
[2b] Gilbert and Chamblee (7)—silt loam, no surface watering.
[3a] Tovey (31)—clay loam, loam, sandy loam, combination watering.
[3b] Tovey (31)—clay loam, loam, sandy loam, no surface watering.
[4a] Goins et al. (8)—silty clay loam, combination watering.
[4b] Goins et al. (8)—loam, combination watering.
[4c] Goins et al. (8)—loamy fine sand, combination watering.
[5] Hooghoudt (15)—clay, combination watering.
* Maximum yield.

Williamson and Kriz (1970)

Det danske hedeselskab, Kvorning 1927-1934 sandy loam

Undrianed index 100	Oat	Wheat	Barley	Turnip	Fodder beets	Clover grass
Drained	121	155	175	133	222	139

Source: (Aslyng 1980)

British studies in the 80ties

Belford, R.K., 1981. Response of winter wheat to prolonged waterlogging under outdoor conditions. The Journal of Agricultural Science 97, 557–568. https://doi.org/10.1017/S0021859600036881

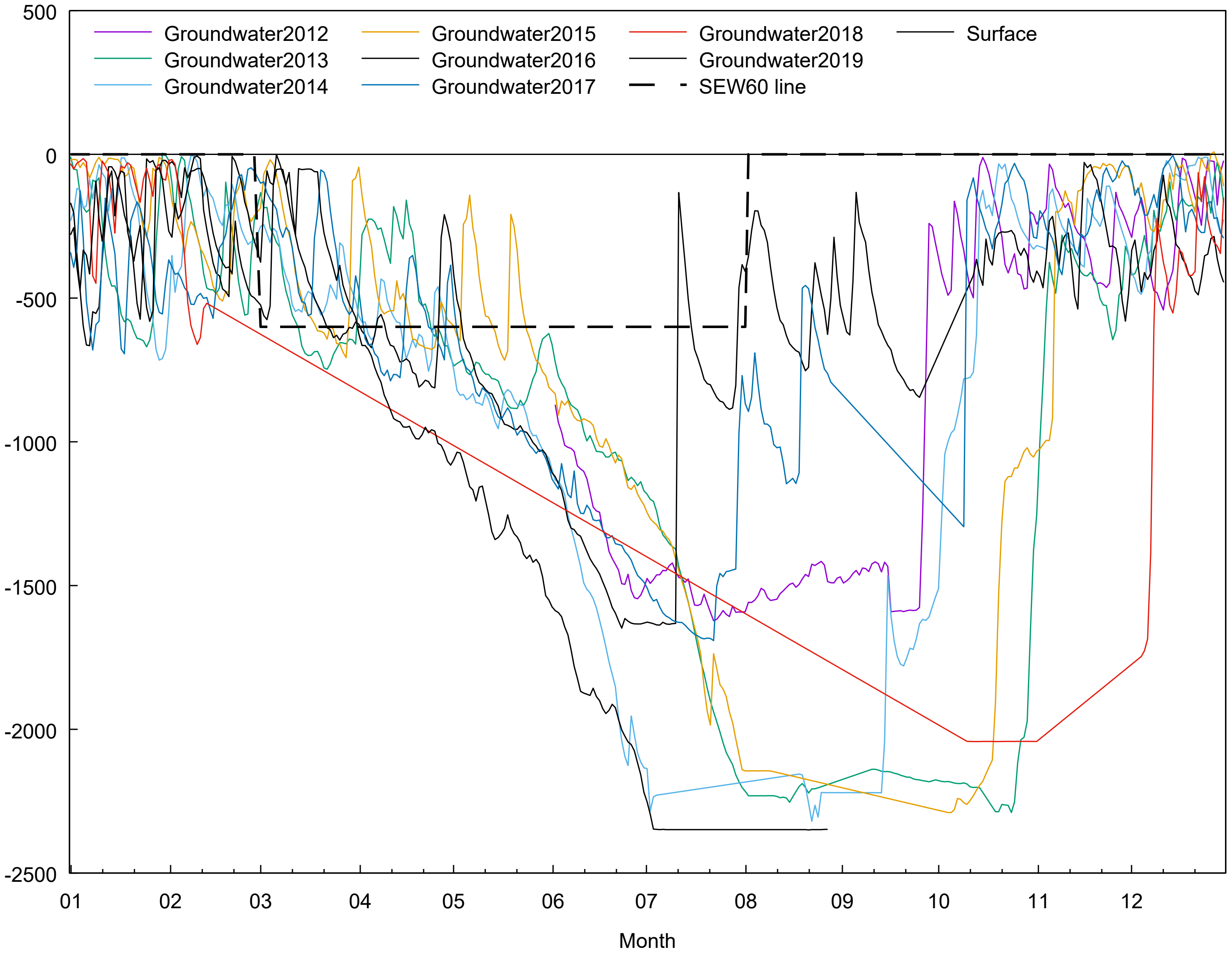
Belford, R.K., Cannell, R.Q., Thomson, R.J., 1985. Effects of single and multiple waterloggings on the growth and yield of winter wheat on a clay soil. Journal of the Science of Food and Agriculture 36, 142–156. https://doi.org/10.1002/jsfa.2740360304

Cannell, R.Q., Belford, R.K., Gales, K., Dennis, C.W., Prew, R.D., 1980. Effects of waterlogging at different stages of development on the growth and yield of winter wheat. Journal of the Science of Food and Agriculture 31, 117–132. https://doi.org/10.1002/jsfa.2740310203

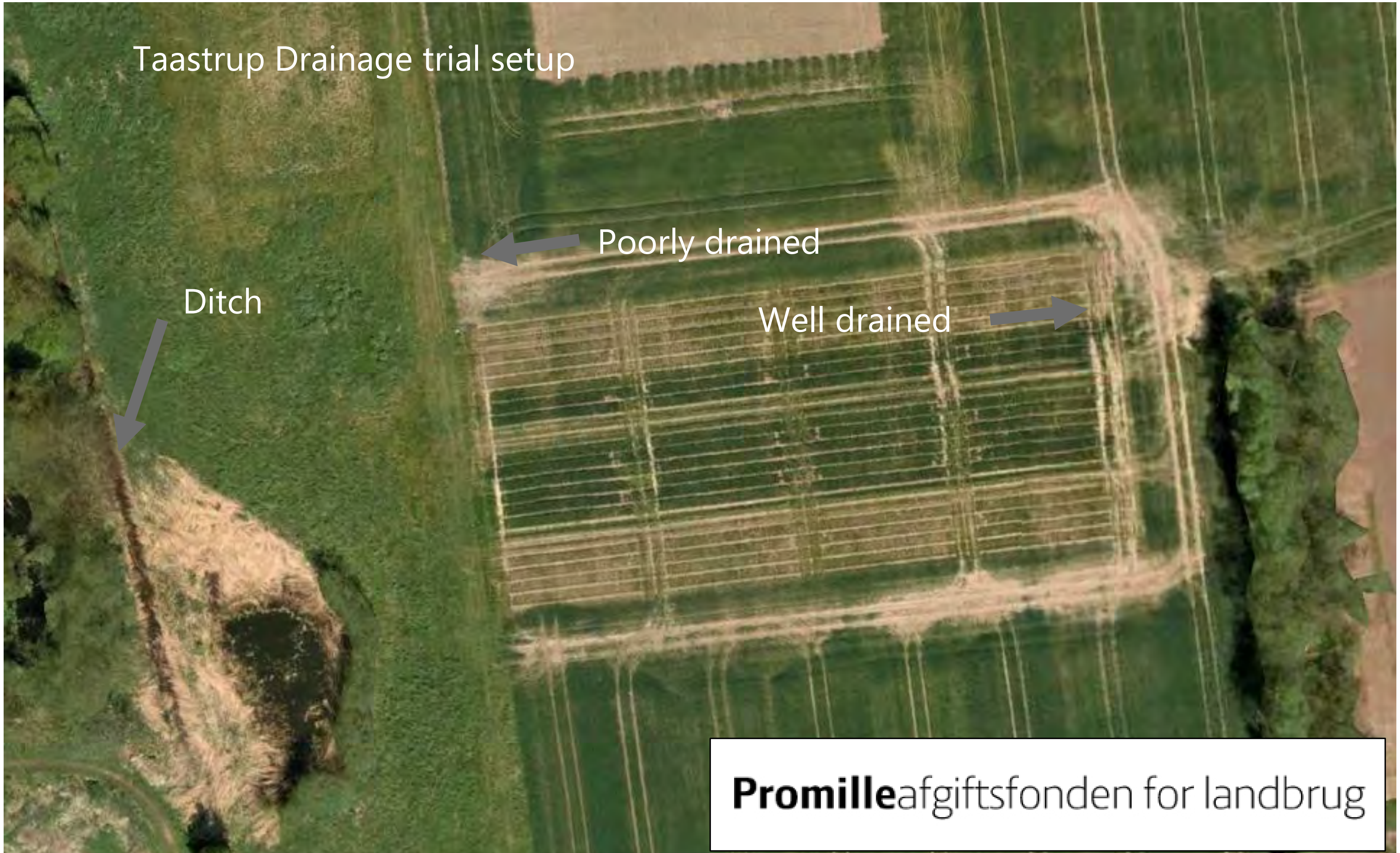
Cannell, R.Q., Belford, R.K., Gales, K., Thomson, R.J., Webster, C.P., 1984. Effects of waterlogging and drought on winter wheat and winter barley grown on a clay and a sandy loam soil: I. Crop growth and yield. Plant and Soil 80, 53–66. https://doi.org/10.1007/BF02232939

Cannell, R.Q., Christian, D.G., Henderson, F.K.G., 1986. A study of mole drainage with simplified cultivation for autumn-sown crops on a clay soil. 4. A comparison of direct drilling and mouldboard ploughing on drained and undrained land on root and shoot growth, nutrient uptake and yield. Soil and Tillage Research 7, 251–272. https://doi.org/10.1016/0167-1987(86)90468-X

SEW$_{60}$ line

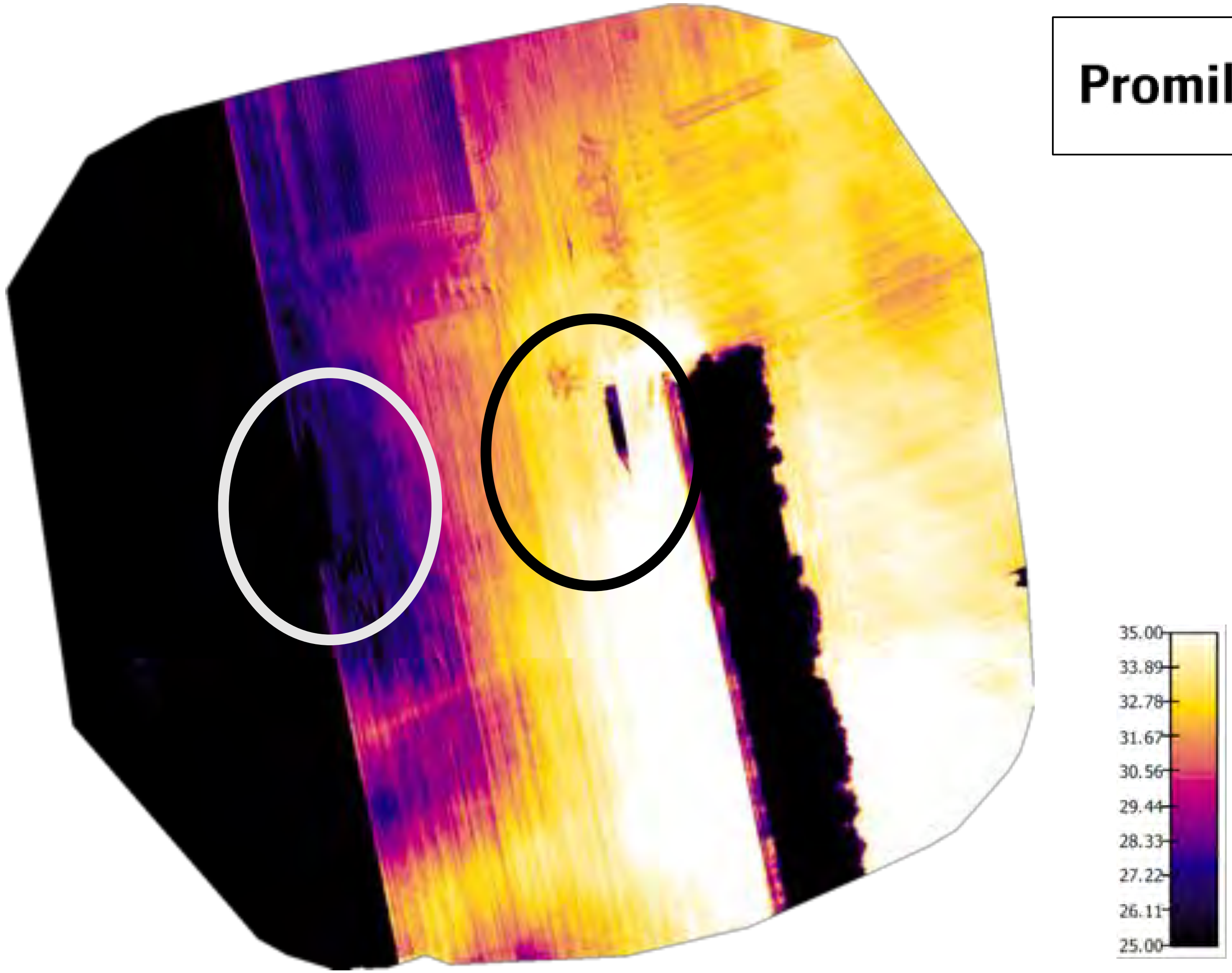

Groundwater2012
Groundwater2013
Groundwater2014
Groundwater2015
Groundwater2016
Groundwater2017
Groundwater2018
Groundwater2019
SEW60 line
Surface
500
0
-500
-1000
-1500
-2000
-2500
01
02
03
04
05
06
07
08
09
10
11
12
Month

Mapping of Temperature effects on soil surface



Temperature effects on soil surface

15/4-2018
Tåstrup after
tillage

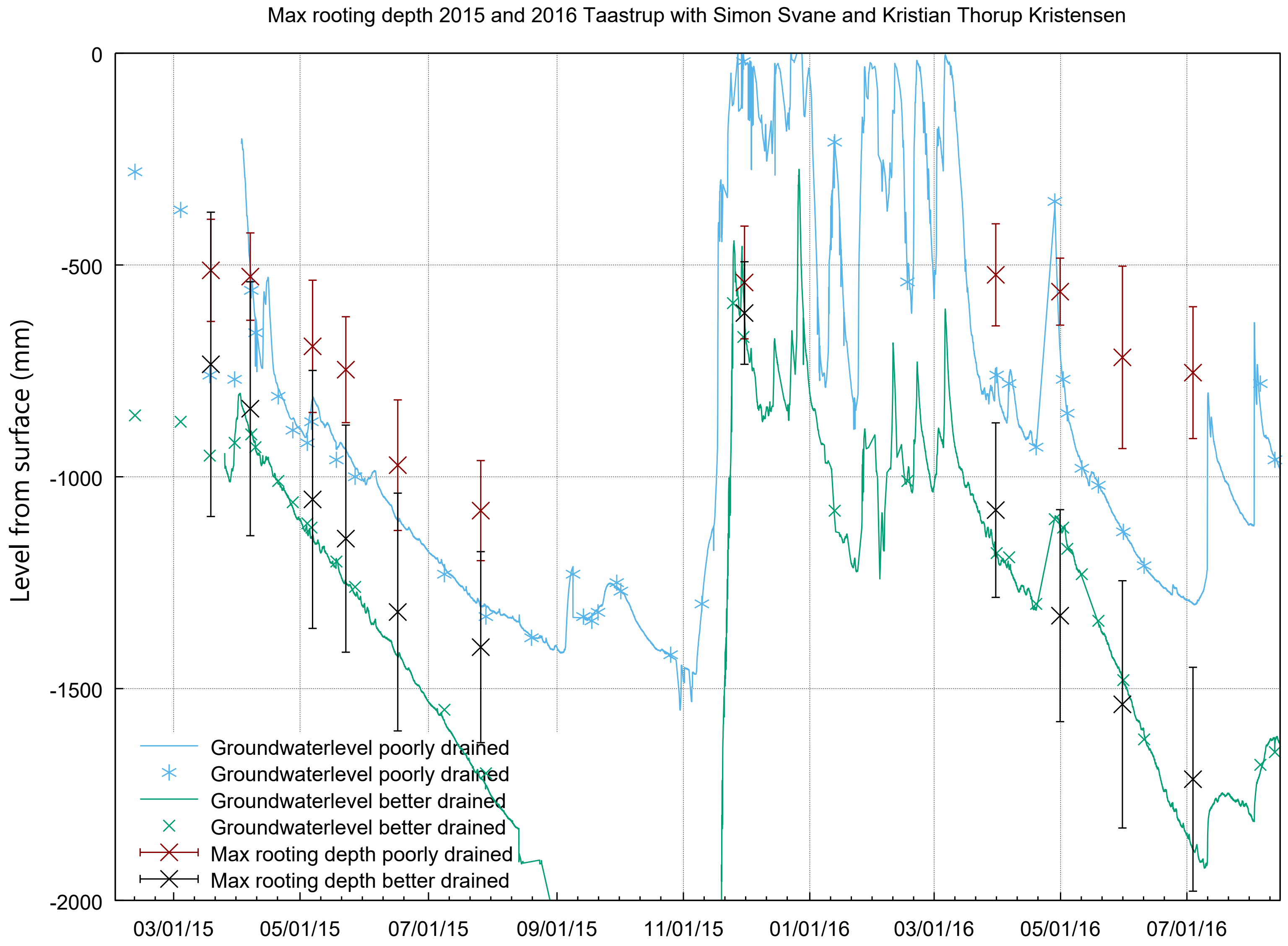


Project financed by:

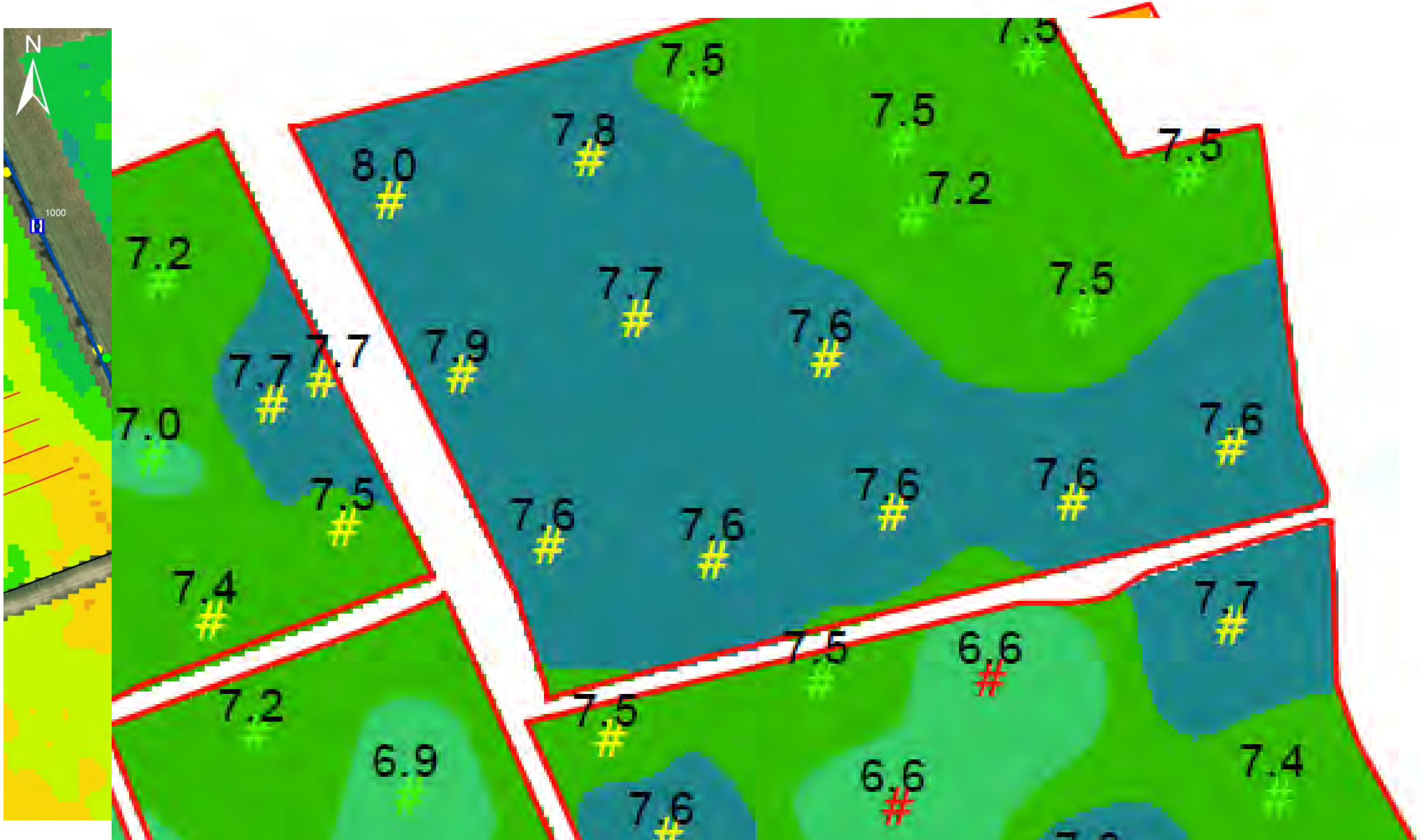
Promilleafgiftsfonden for landbrug

Figure: Jesper Svendsgaard KU

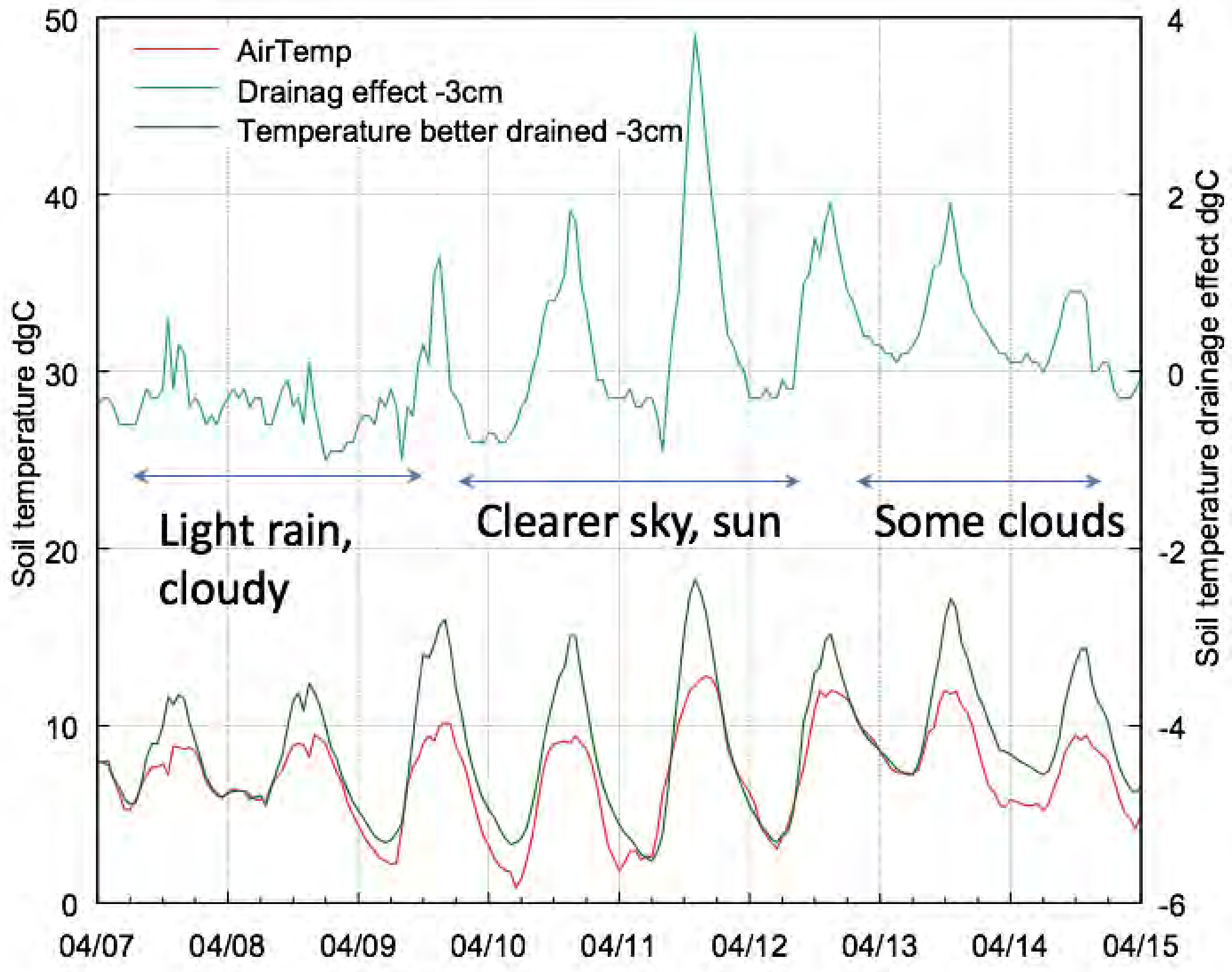
Drainage effect on maximum rooting depth



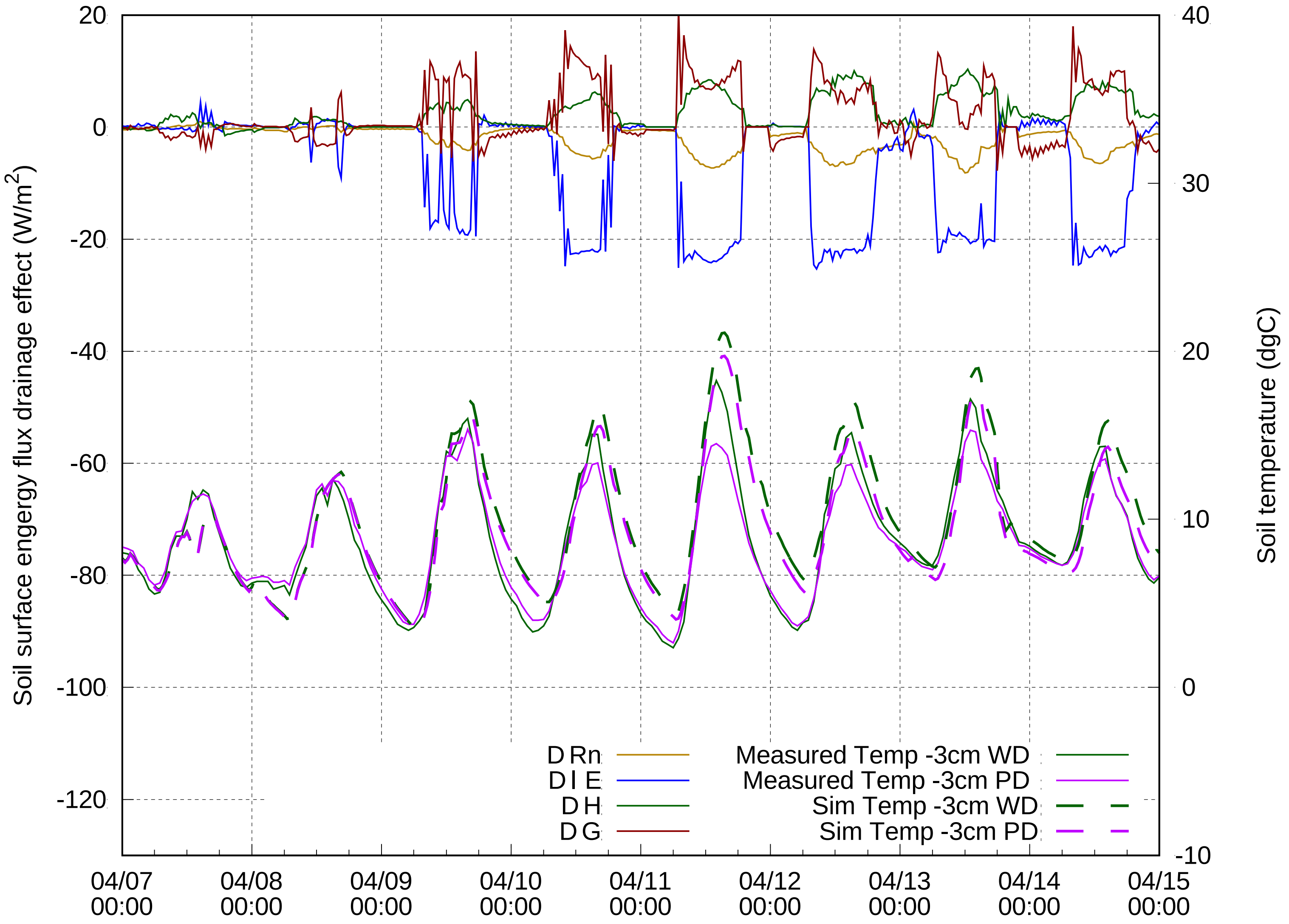
Soil variation



Weather dependent soil temperature effect



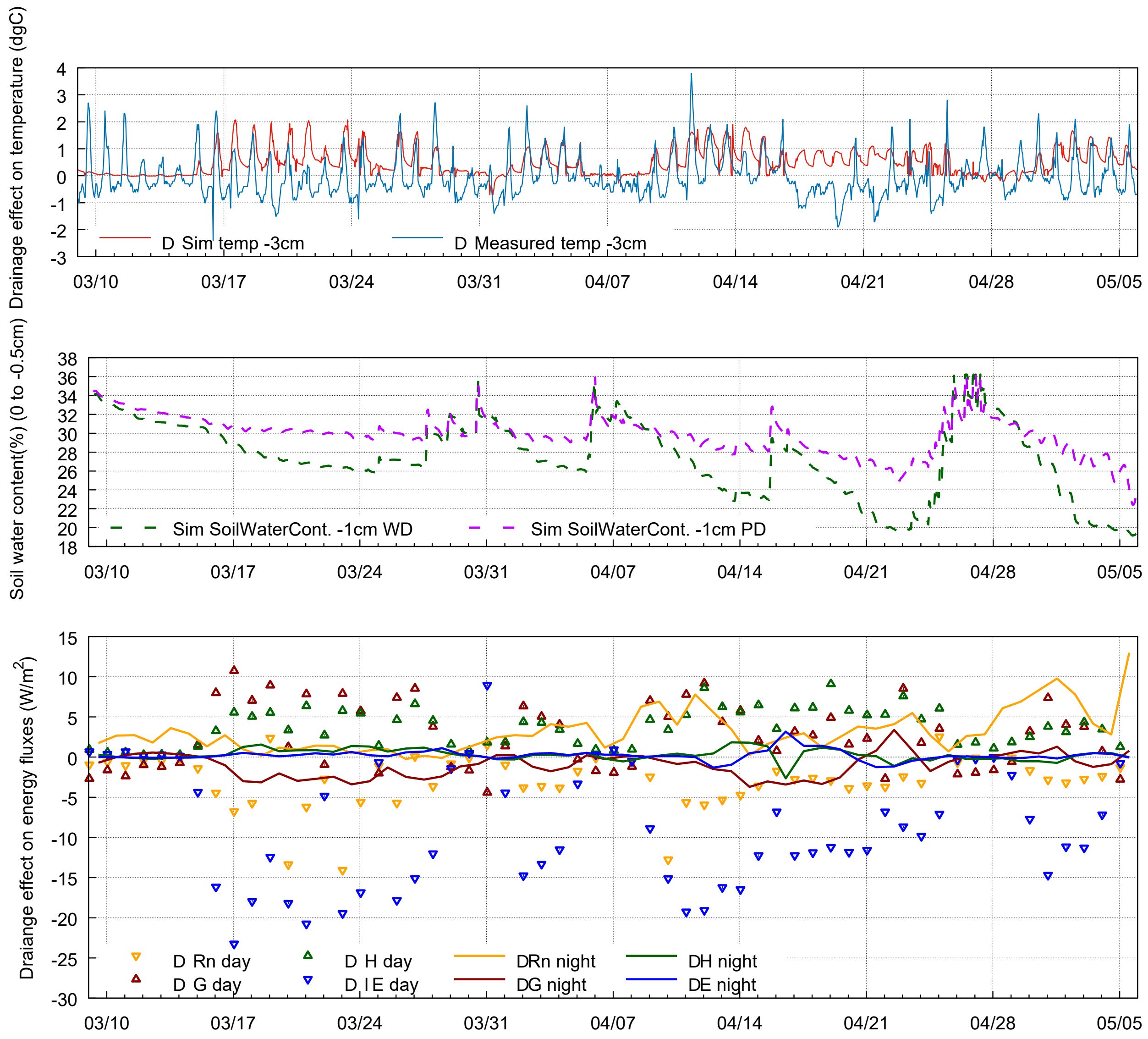
Energy fluxes



Energy flux, absolute values

Billedet kan ikke vises.

Perspektives



Rn effect of drainage

DAISY parameters	Reflectance		Emissivity
pF	PAR %	NIR %	
0			0.975
1	2.5	11	
1.65			0.968
2	4.0	17	
3	5.0	22	
4	6.5	27	
5	9.0	31	0.947
6	11.0	34	
7			0.94

Soil temperatures in deeper layers

Billedet kan ikke vises.

Crop cover development

Soil water potential measured and modelled

Billedet kan ikke vises.

Field soil temperature April 2015 to May 2017

	Air T	Air T	Air T	Diff SoilT and airT	Diff SoilT and airT	Diff SoilT and airT	STDE	STDE	STDE	Soil temp	Soil temp	Soil temp
	avr	avr max daily	avr min daily	avr	avr max daily	avr min daily	avr	avr max daily	avr min daily	avr	avr	avr
Soil depth				3cm	3cm	3cm	3cm	3cm	3cm	20 cm	40 cm	70 cm
Jan	0.6	2.5	-1.6	0.2	-0.9	1.6	-0.3	0.1	-0.8	1.5	2.3	3.4
Feb	2.2	4.0	0.2	0.1	-0.1	0.9	-0.1	0.6	-0.6	2.6	2.9	3.5
Mar	4.0	7.1	1.2	1.0	2.5	0.8	-0.1	1.3	-1.1	4.9	4.6	4.8
Apr	7.0	10.4	3.5	1.5	4.0	0.9	-0.1	1.1	-1.0	8.5	7.6	8.1
May	11.8	15.6	7.3	1.2	1.4	2.3	0.1	0.9	-0.6	12.4	12.2	10.9
Jun	15.0	18.4	10.9	1.1	0.7	2.6	0.1	0.5	-0.3	15.5	16.1	13.9
Jul	16.8	20.2	12.8	1.0	0.5	2.5	0.0	0.4	-0.5	17.3	16.8	15.9
Aug	17.2	21.1	12.8	0.3	0.1	1.7	-0.1	0.6	-0.6	17.3	16.5	16.3
Sep	15.1	18.5	11.5	-0.3	2.1	2.0	-0.1	1.1	-0.8	15.4	15.0	15.3
Oct	9.3	11.5	7.0	-0.6	0.1	-0.3	-0.6	0.5	-1.2	9.9	10.5	11.3
Nov	5.8	7.9	3.4	-0.3	-1.0	0.6	-0.6	0.1	-1.3	5.9	6.7	7.7
Dec	5.6	7.4	3.5	-1.0	-1.4	-0.4	-0.2	0.5	-0.9	5.0	5.4	6.1

Dykkede dræn øger risikoen for sedimentation