

Simulerede transporttidsfordelinger for indtag med pesticidmålinger

Lars Trolborg (ltr@geus.dk)

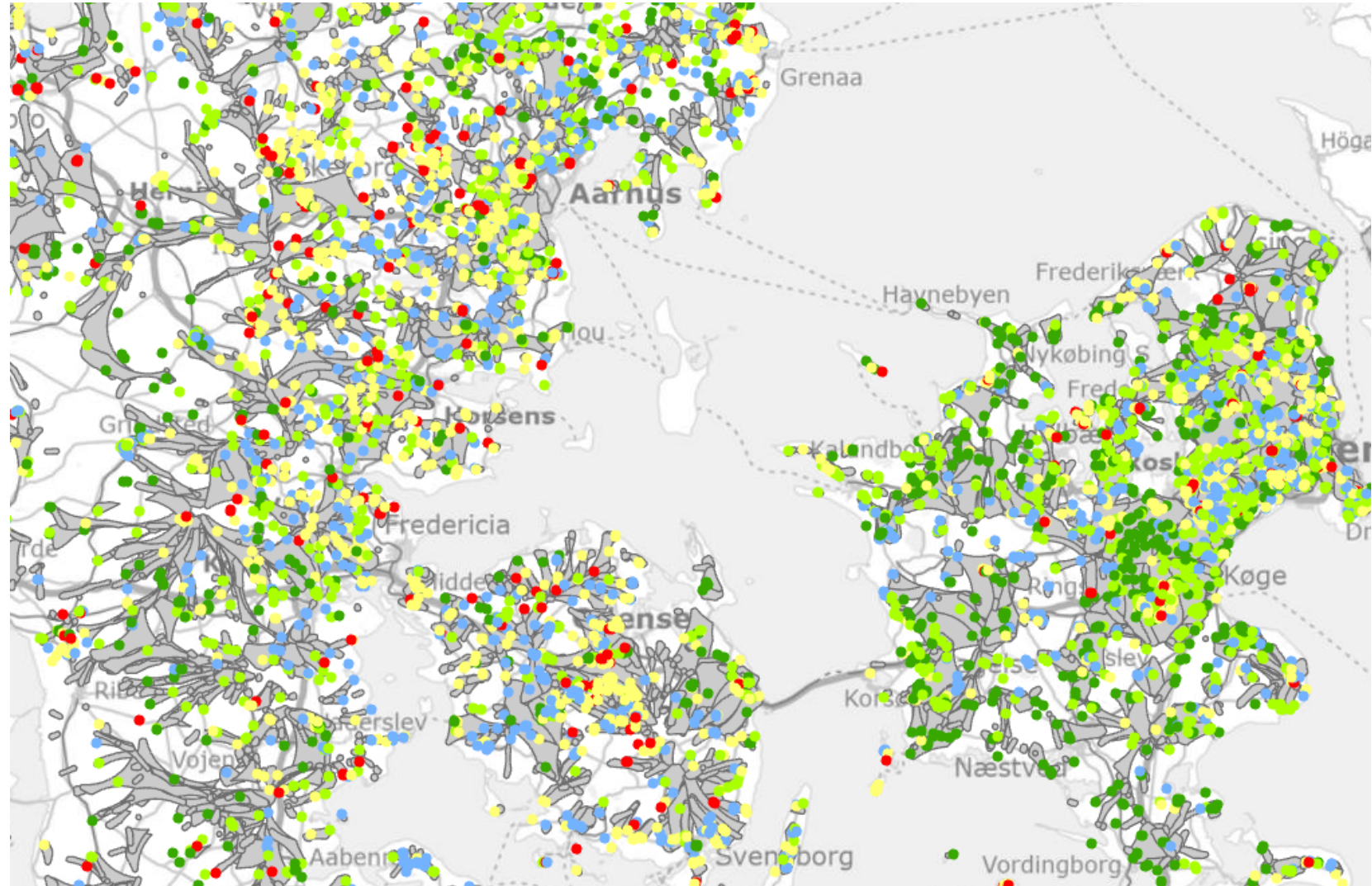
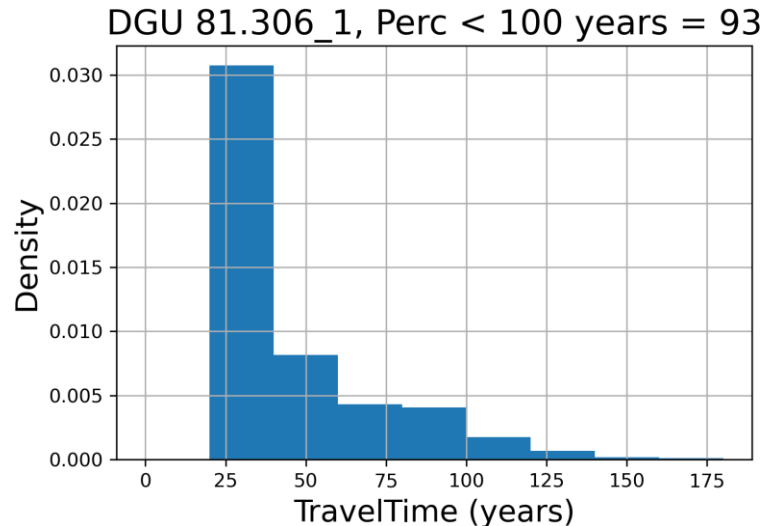
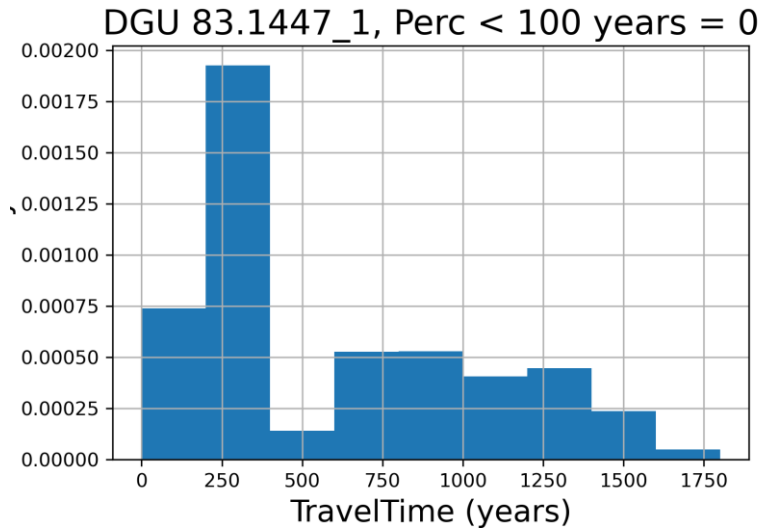
Hydrologiske afdeling

De Nationale Geologiske Undersøgelser for Danmark og Grønland

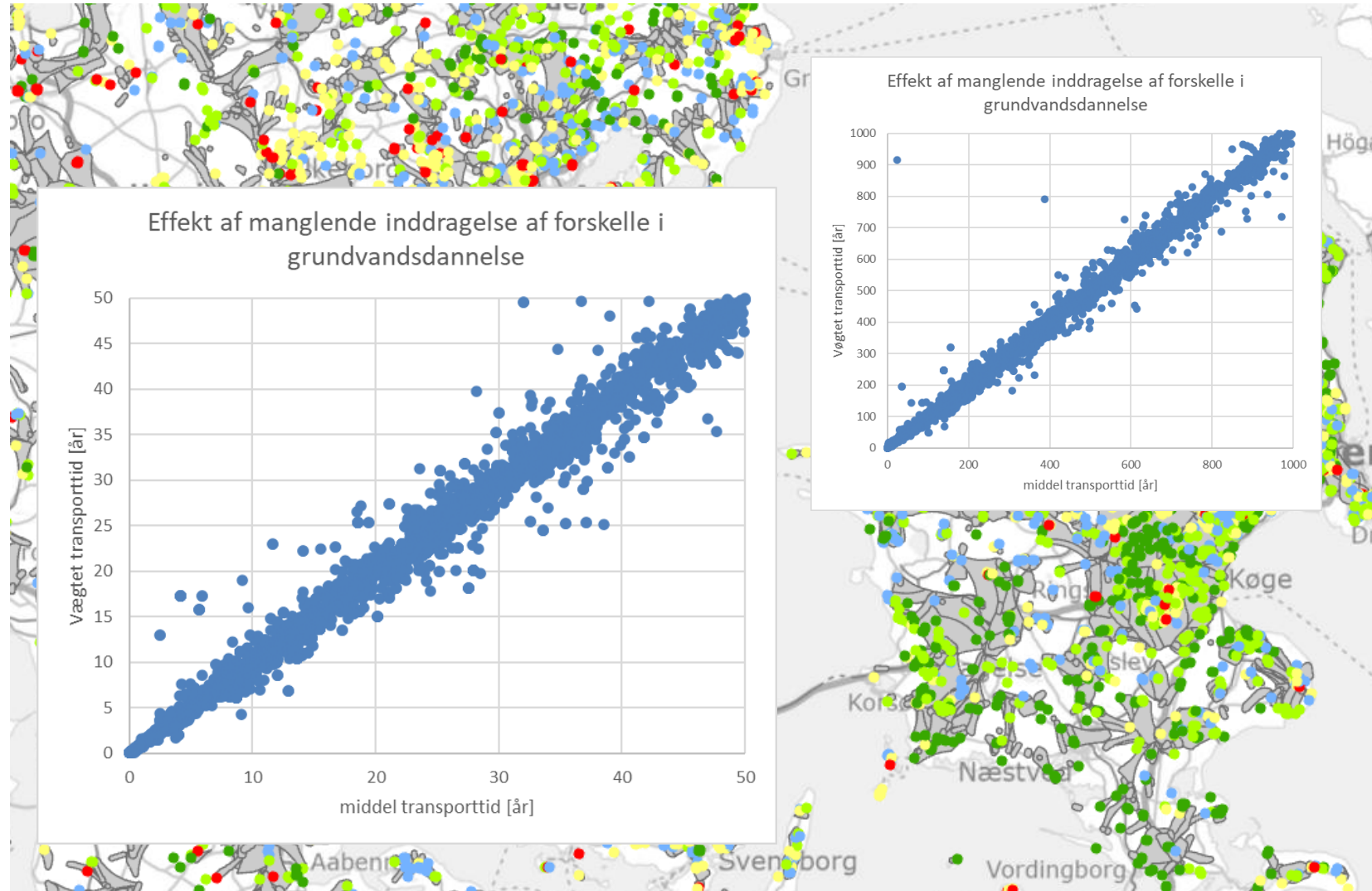
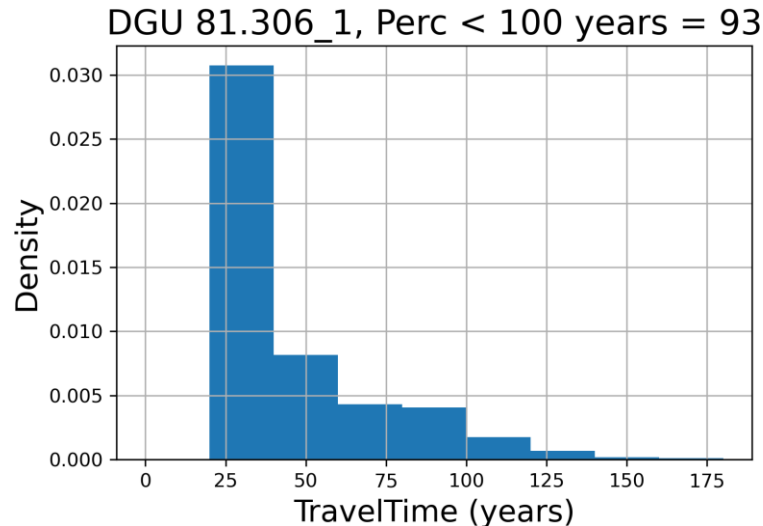
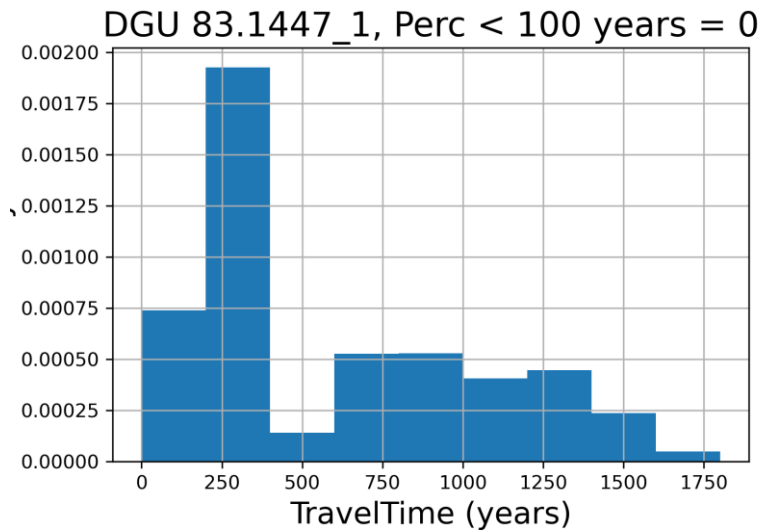


G E U S

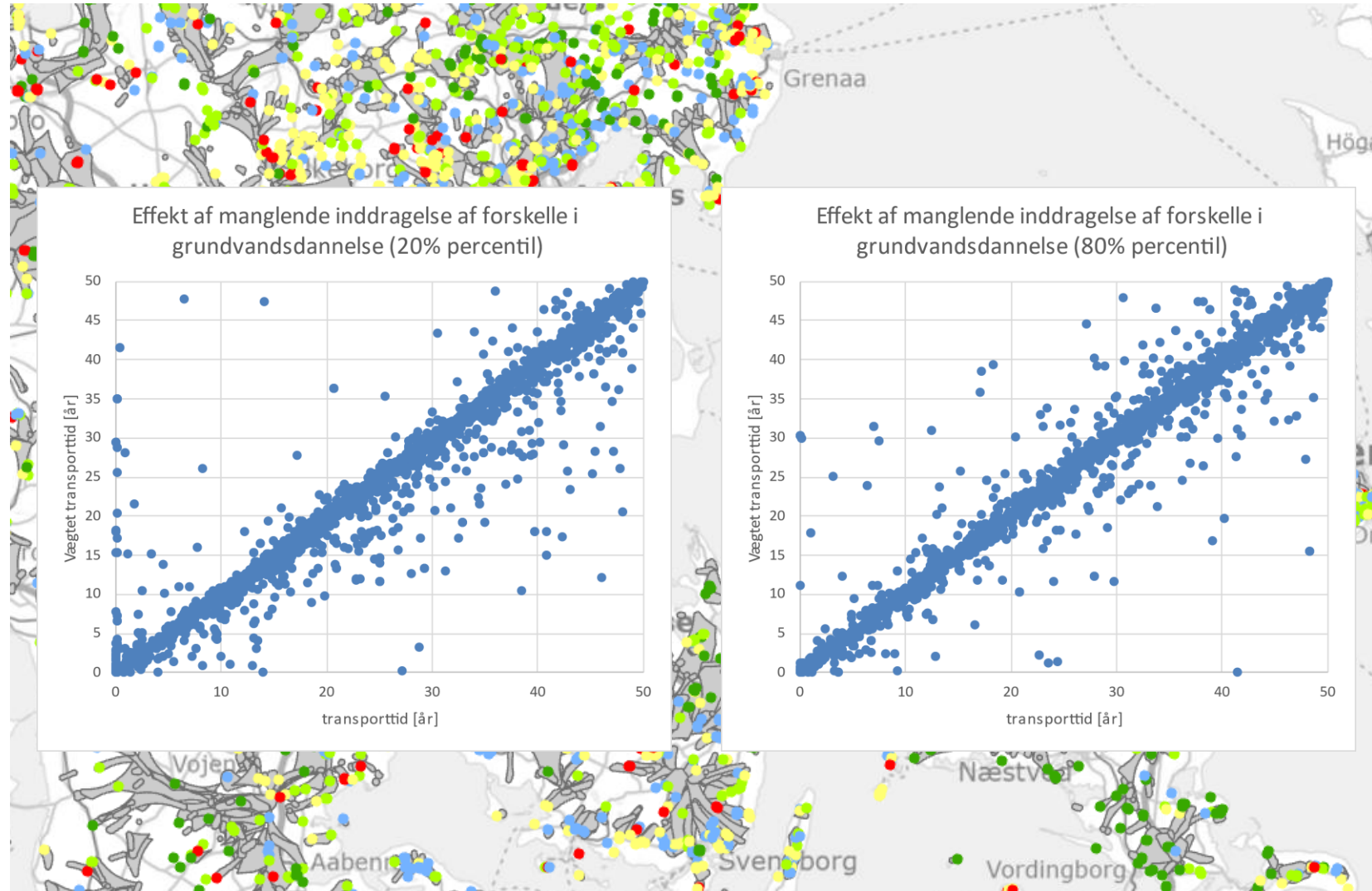
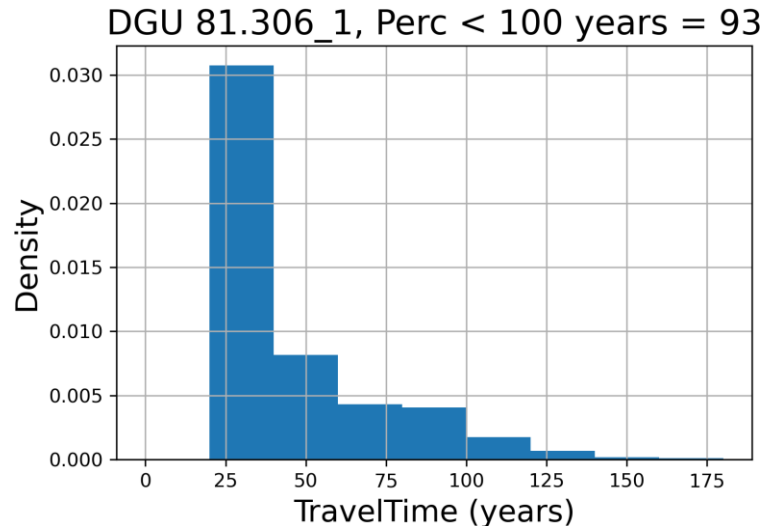
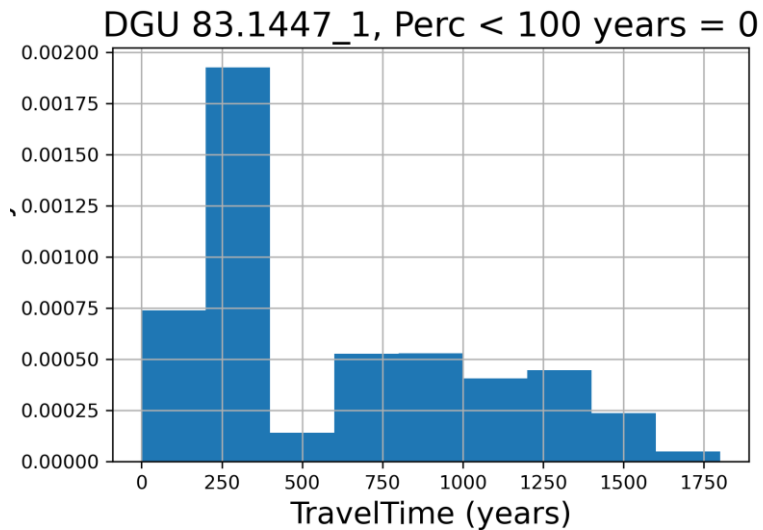
Simulerede 100års oplande samt transporttids- fordelinger og beskrivende statistik for godt 18.300 indtag som er testet for pesticider



Simulerede 100års oplande samt transporttids- fordelinger og beskrivende statistik for godt 18.300 indtag som er testet for pesticider



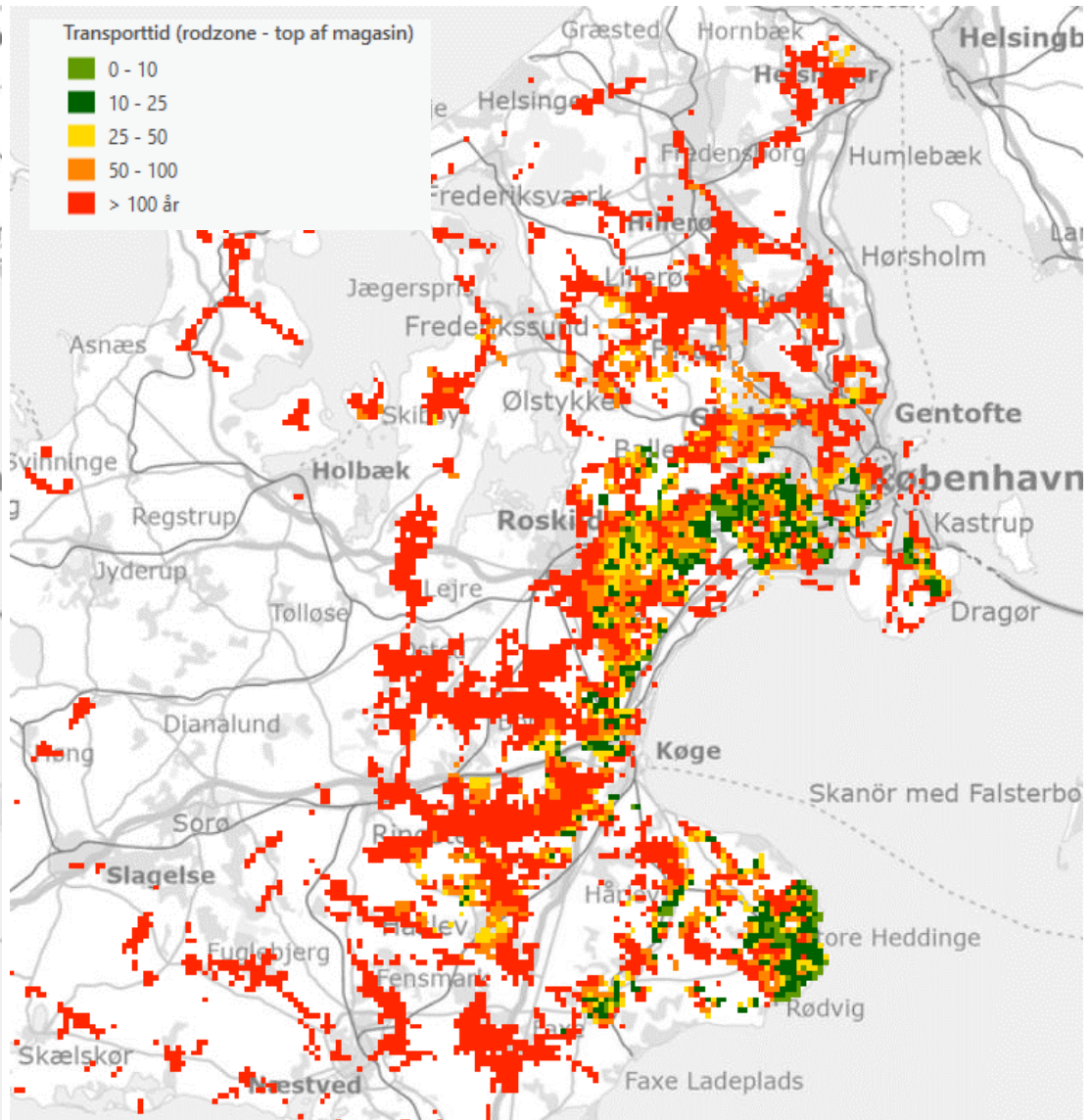
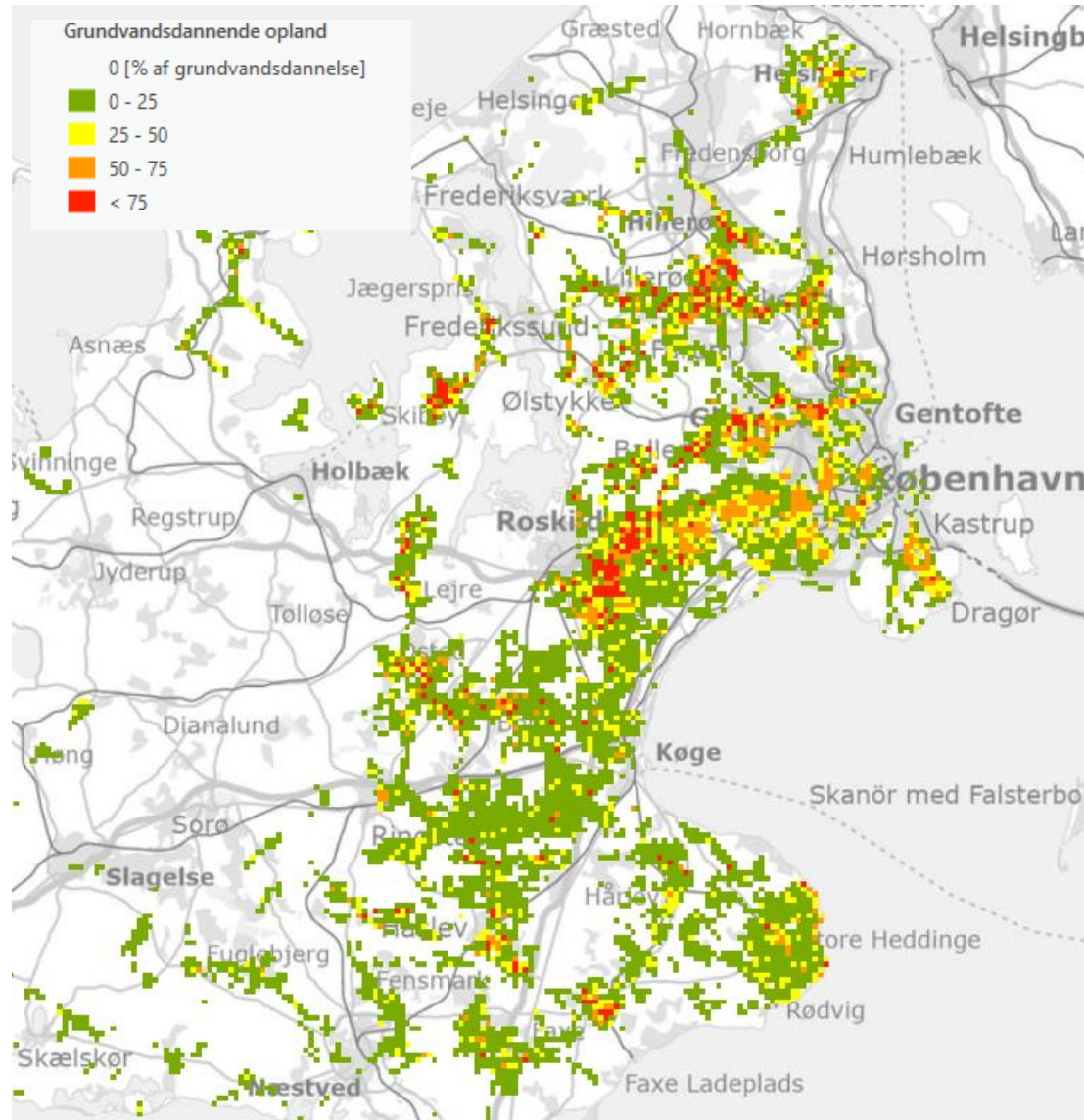
Simulerede 100års oplande samt transporttids- fordelinger og beskrivende statistik for godt 18.300 indtag som er testet for pesticider



Simulerede 100års oplande samt transporttids- fordelinger og beskrivende statistik for godt 18.300 indtag som er testet for pesticider



Og simulerede oplande og transporttider til alle grundvandsforekomster

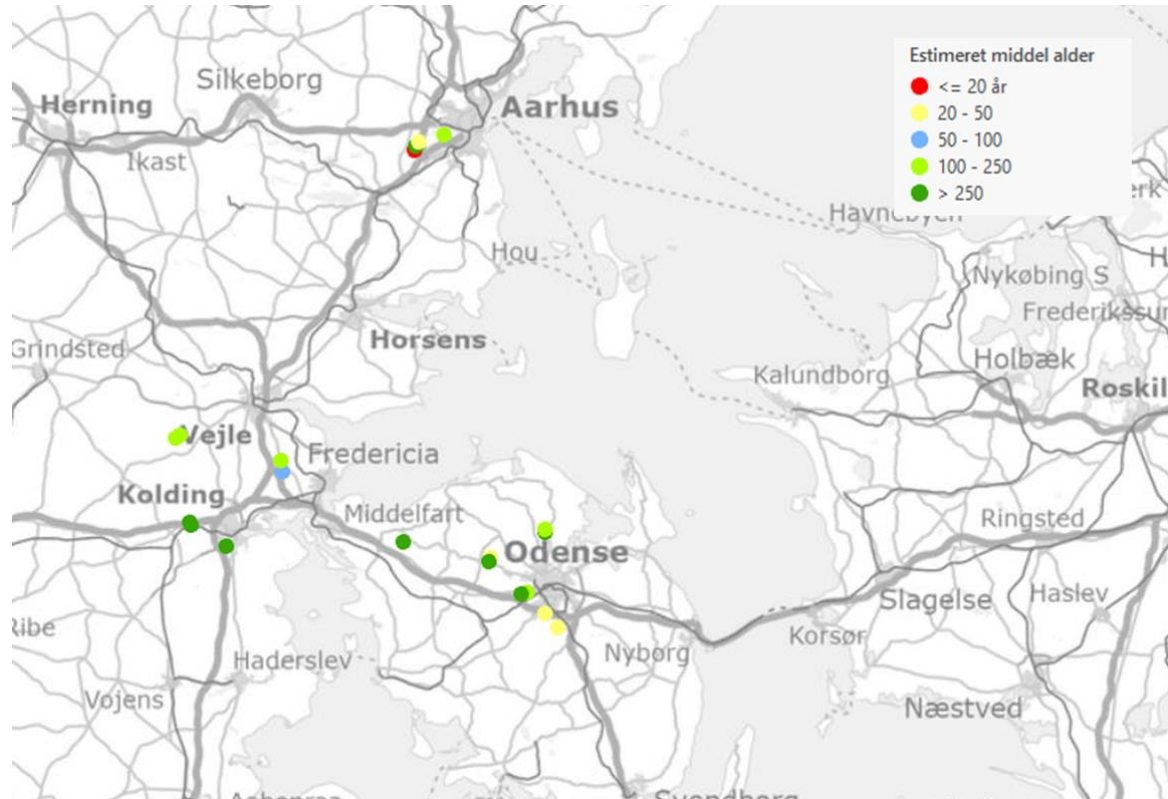


GEUS

Aldersdateringer - beregningsmetoder

Study Unit	Study Area	Sample ID	Sample Date	LPM name	Free Model Parameters	Tracers Modeled	Total mean age, years	Total mean age error, years	Reported Total mean age, years	Reported Total mean age error, years	Reported fraction modern	Reported Susceptibility index
Aarhus Vand	Aabo	88.1942	21-08-2019	DM	Mean Age, Model Parm 1	3H, 3He(trit), 85Kr, 39Ar	16	1	16,5	1,23	100%	28%
Aarhus Vand	Aabo	88.1979-2	21-08-2019	BMM-DM-DM	Mean Age, Model Parm 1, Fraction	3H, 3He(trit), 85Kr, 39Ar	296	46	296	45,8	73%	17%
Aarhus Vand	Aabo	88.1979-1	21-08-2019	BMM-DM-DM	Mean Age, Fraction	3H, 3He(trit), 85Kr, 39Ar	260	24	260	24,4	76%	18%
VCS	Lindved (V7)	146.492	17-06-2019	DM	Mean Age, Model Parm 1	3H, 3He(trit), 85Kr, 39Ar, 14C	33	0	33	0,34	100%	22%
VCS	Trøstrup (4)	136.218	18-06-2019	DM	Mean Age, Model Parm 1	3H, 3He(trit), 85Kr, 39Ar, 14C	28	0	28,3	0,31	100%	23%
VCS (UB)	Lunde (LU253)	136.907	19-06-2019	BMM-DM-DM	Fraction, 2nd Mean Age	3H, 3He(trit), 85Kr, 14C	126	72	126 (61.2 - 265)	72 (4.79 - 104)	43%	18%
VCS (UB)	Lunde (LU 251)	136.891	19-06-2019	BMM-DM-DM	Fraction, 2nd Mean Age	3H, 3He(trit), 85Kr, 14C	391	78	391 (78.3 - 466)	77.6 (14.3 - 77.6)	11%	9%
VCS	Trøstrup (3)	136.285	18-06-2019	BMM-DM-DM	Fraction, 2nd Mean Age	3H, 3He(trit), 85Kr, 14C	436	69	436 (79 - 468)	68.8 (12.9 - 75.3)	22%	10%
VCS	Bolbro	145.2740	18-06-2019	BMM-DM-DM	Mean Age, Fraction, 2nd Mean Age	3H, 3He(trit), 85Kr, 39Ar, 14C	192	47	192	46,9	52%	16%
VCS/GEUS	Bolbro	145.3083t	19-06-2019	BMM-DM-DM	Mean Age, Fraction, 2nd Mean Age	3H, 3He(trit), 85Kr, 39Ar, 14C	198	139	198	139	19%	14%
VCS/GEUS	Bolbro	145.3083m	18-06-2019	BMM-DM-DM	Mean Age, Fraction, 2nd Mean Age	3H, 3He(trit), 85Kr, 39Ar, 14C	471	116	471	116	15%	9%
VCS/GEUS	Bolbro	145.3083b	19-06-2019	BMM-DM-DM	Fraction, 2nd Mean Age	3H, 85Kr, 39Ar, 14C	593	102	593 (577 - 648)	102 (97.9 - 123)	7%	7%
VCS	Lindved	146.490	17-06-2019	DM	Mean Age	39Ar, 14C	422	32	422	32,1	0%	7%
VCS (GEUS)	Dalum (D4)	145.717	19-06-2019	DM	Mean Age	3He(trit), 85Kr, 14C	29	0	29	0,39	100%	23%
TREFOR	Follerup	125.788	22-07-2019	BMM-DM-DM	Mean Age, Fraction, 2nd Mean Age	3H, 85Kr, 39Ar	66	2636	65,8	2640	35%	20%
TREFOR	Follerup	125.1713	22-07-2019	BMM-DM-DM	Fraction, 2nd Mean Age	3H, 85Kr, 39Ar	177	66	177 (175 - 178)	66.1 (60.7 - 66.7)	8%	12%
Aarhus Vand	Stautrup	89.1421-2	23-07-2019	DM	Mean Age	85Kr, 39Ar	186	70	186	69,5	0%	10%
Aarhus Vand	Aabo	88.1580	23-07-2019	BMM-DM-DM	Mean Age, Fraction	3H, 3He(trit), 85Kr	228	18	228	17,7	59%	16%
Aarhus Vand	Aabo	88.969	23-07-2019	DM	Mean Age, Model Parm 1	3H, 3He(trit), 85Kr	32	3	32,1	3,32	100%	22%
Aarhus Vand	Stautrup	89.1421-1	24-07-2019	DM	Mean Age	3H, 39Ar	2000	3476	2000	3480	0%	3%
TREFOR	Soendre Vejle	116.153	24-07-2019	BMM-DM-DM	Mean Age, Fraction, 2nd Mean Age	3H, 3He(trit), 85Kr, 39Ar	967	6889	967	6890	52%	10%
TREFOR	Toerskin	124.357	24-07-2019	BMM-DM-DM	Mean Age, Fraction, 2nd Mean Age	3H, 3He(trit), 85Kr, 39Ar	180	74	180	74,4	29%	14%
TREFOR	Trudsbro	133.1784	20-08-2019	BMM-DM-DM	Mean Age, Fraction, 2nd Mean Age	3H, 85Kr, 39Ar	329	119	329	119	10%	10%
TREFOR	Trudsbro	133.1461	20-08-2019	BMM-DM-DM	Mean Age, Fraction	3H, 3He(trit), 85Kr	471	181	471	181	6%	8%
TREFOR	Toerskin	124.1019	24-07-2019	DM	Mean Age	3H, 39Ar	206	27	206	26,6	0%	10%
TREFOR	Brenderup	135.1883	25-07-2019	BMM-DM-DM	Fraction, 2nd Mean Age	3H, 39Ar	331	1170	331 (330 - 331)	170 (1170 - 1170)	0%	8%
TREFOR	Soendre Kolding	133.1718	25-07-2019	BMM-DM-DM	Fraction, 2nd Mean Age	3H, 39Ar	504	445	504 (501 - 507)	445 (442 - 448)	1%	7%
TREFOR	Soendre Kolding	133.1107	25-07-2019	BMM-DM-DM	Fraction, 2nd Mean Age	3H, 39Ar	266	96	266 (264 - 267)	96.4 (95.3 - 97.9)	2%	10%

Aldersdateringer - beregningsmetoder

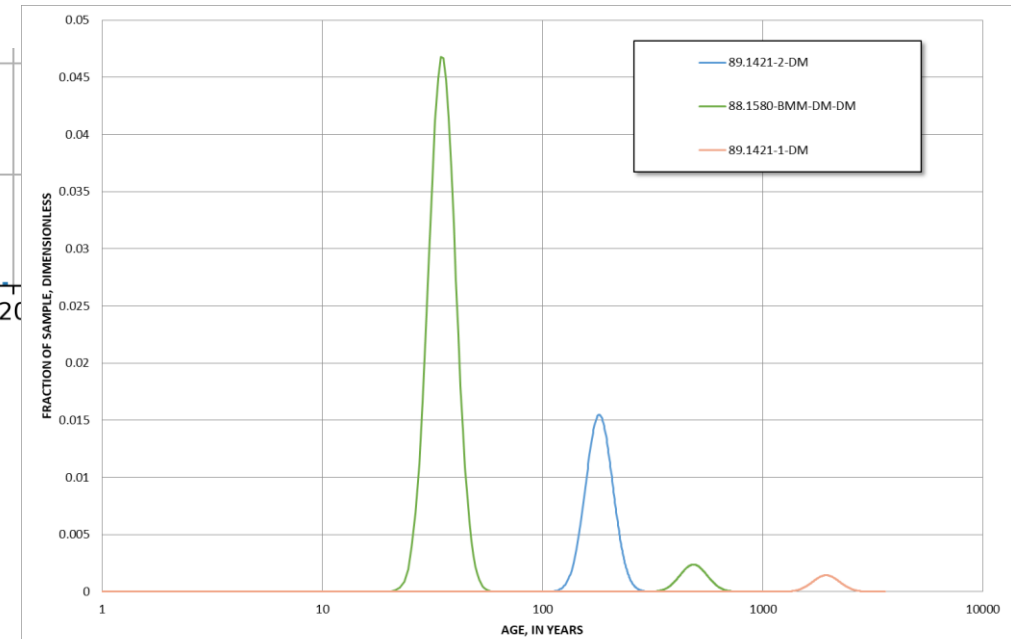
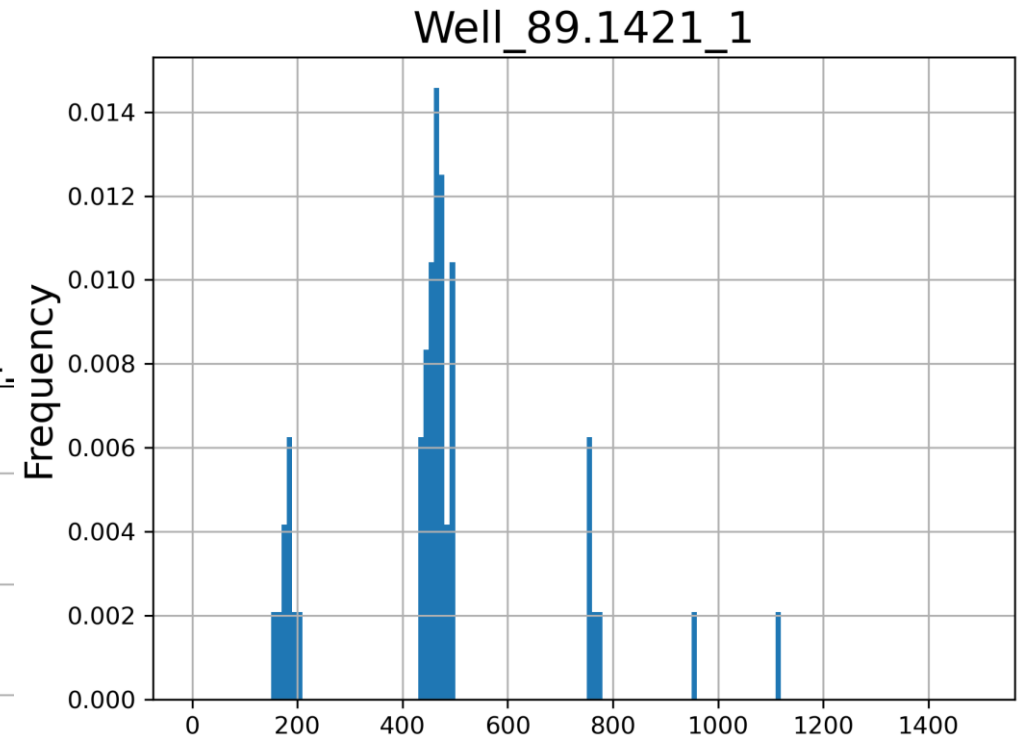
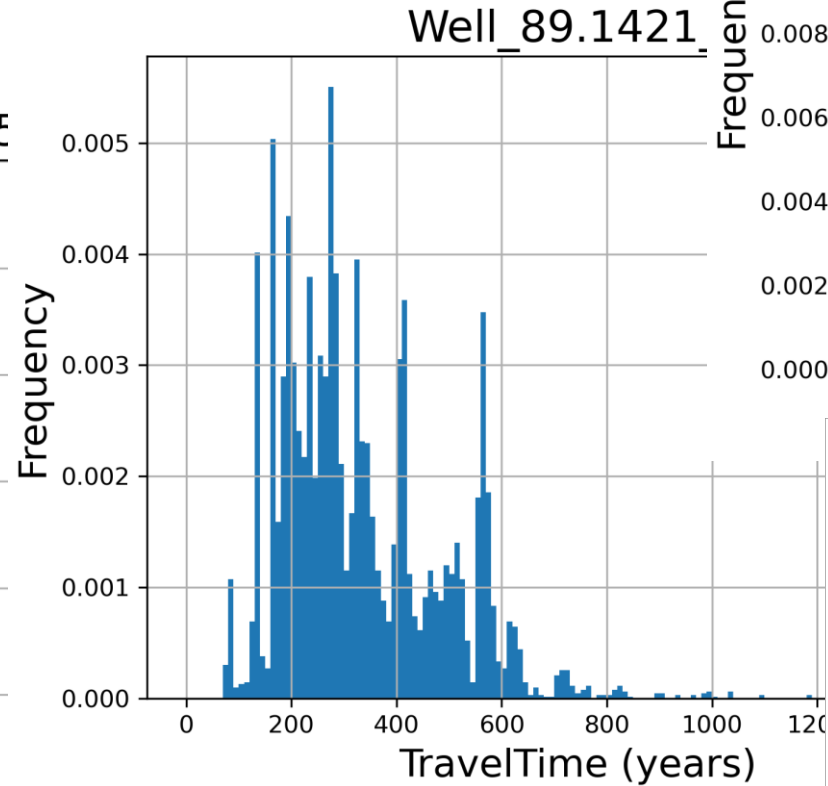
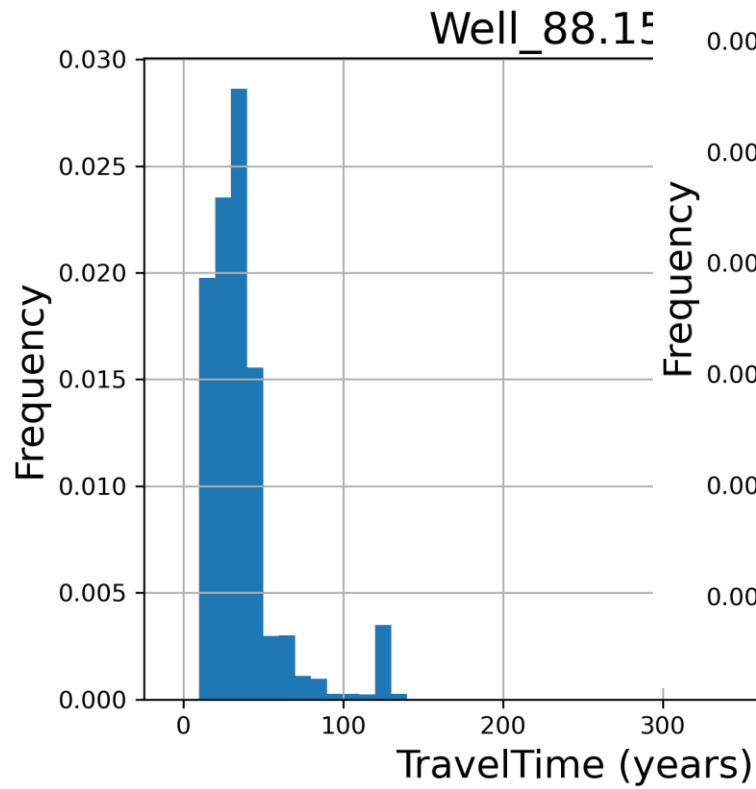


					Total mean age, years	Total mean age error, years	Reported Total mean age, years	Reported Total mean age error, years	Reported fraction modern	Reported Susceptibi lity index
Tracers Modeled										
3H, 3He(trit), 85Kr, 39Ar					16	1	16,5	1,23	100%	28%
3H, 3He(trit), 85Kr, 39Ar					296	46	296	45,8	73%	17%
3H, 3He(trit), 85Kr, 39Ar					260	24	260	24,4	76%	18%
3H, 3He(trit), 85Kr, 39Ar, 14C					33	0	33	0,34	100%	22%
3H, 3He(trit), 85Kr, 39Ar, 14C					28	0	28,3	0,31	100%	23%
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3H, 3He(trit), 85Kr, 39Ar, 14C					198	139	198	139	19%	14%
3H, 3He(trit), 85Kr, 39Ar, 14C					471	116	471	116	15%	9%
3H, 85Kr, 39Ar, 14C					593	102	593 (577 - 648)	102 (97.9 - 123)	7%	7%
39Ar, 14C					422	32	422	32,1	0%	7%
3He(trit), 85Kr, 14C					29	0	29	0,39	100%	23%
3H, 85Kr, 39Ar					66	2636	65,8	2640	35%	20%
3H, 85Kr, 39Ar					177	66	177 (175 - 178)	66.1 (60.7 - 66.7)	8%	12%
85Kr, 39Ar					186	70	186	69,5	0%	10%
3H, 3He(trit), 85Kr					228	18	228	17,7	59%	16%
3H, 3He(trit), 85Kr					32	3	32,1	3,32	100%	22%
3H, 39Ar					2000	3476	2000	3480	0%	3%
3H, 3He(trit), 85Kr, 39Ar					967	6889	967	6890	52%	10%
3H, 3He(trit), 85Kr, 39Ar					180	74	180	74,4	29%	14%
3H, 85Kr, 39Ar					329	119	329	119	10%	10%
3H, 3He(trit), 85Kr					471	181	471	181	6%	8%
3H, 39Ar					206	27	206	26,6	0%	10%
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3H, 39Ar					504	445	504 (501 - 507)	445 (442 - 448)	1%	7%
3H, 39Ar					266	96	266 (264 - 267)	96.4 (95.3 - 97.9)	2%	10%

Aarhus Vand	Stautrup	89.1421-1	24-07-2019	DM	Mean Age
TREFOR	Soendre Vejle	116.153	24-07-2019	BMM-DM-DM	Mean Age, Fraction, 2nd Mean Age
TREFOR	Toerskin	124.357	24-07-2019	BMM-DM-DM	Mean Age, Fraction, 2nd Mean Age
TREFOR	Trudsbro	133.1784	20-08-2019	BMM-DM-DM	Mean Age, Fraction, 2nd Mean Age
TREFOR	Trudsbro	133.1461	20-08-2019	BMM-DM-DM	Mean Age, Fraction
TREFOR	Toerskin	124.1019	24-07-2019	DM	Mean Age
TREFOR	Brenderup	135.1883	25-07-2019	BMM-DM-DM	Fraction, 2nd Mean Age
TREFOR	Soendre Kolding	133.1718	25-07-2019	BMM-DM-DM	Fraction, 2nd Mean Age
TREFOR	Soendre Kolding	133.1107	25-07-2019	BMM-DM-DM	Fraction, 2nd Mean Age

TracerLPM

DK-model2019



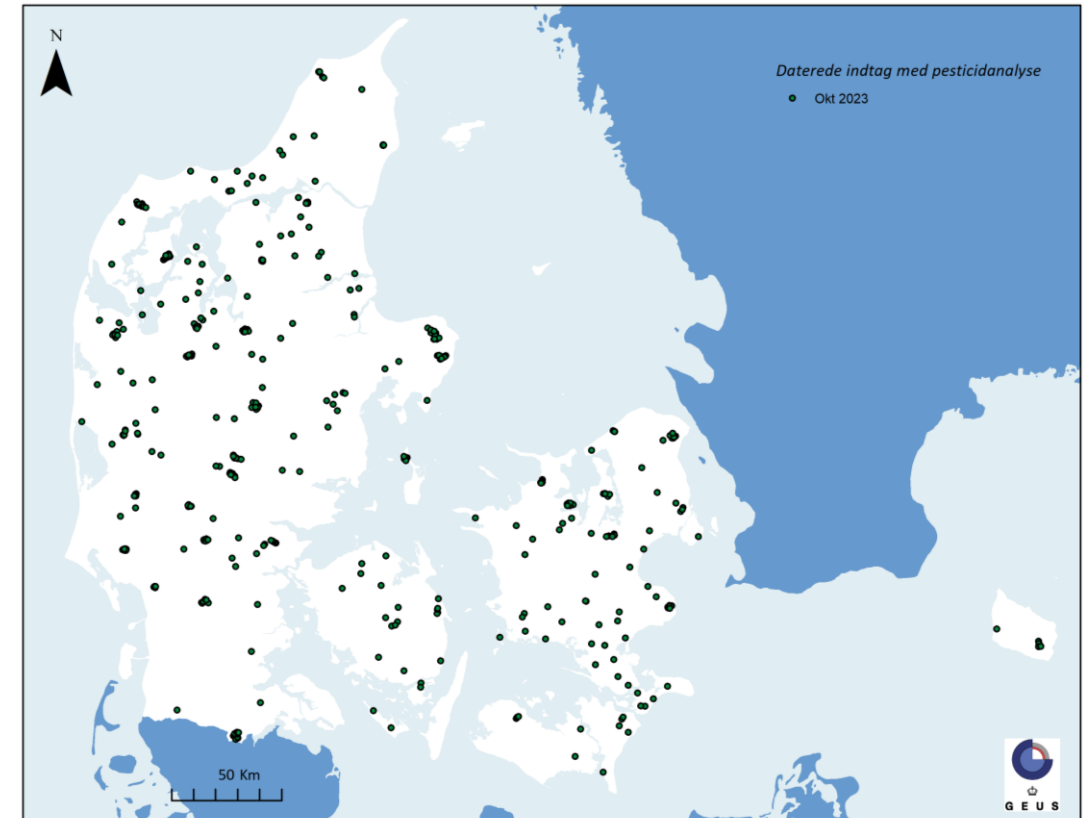
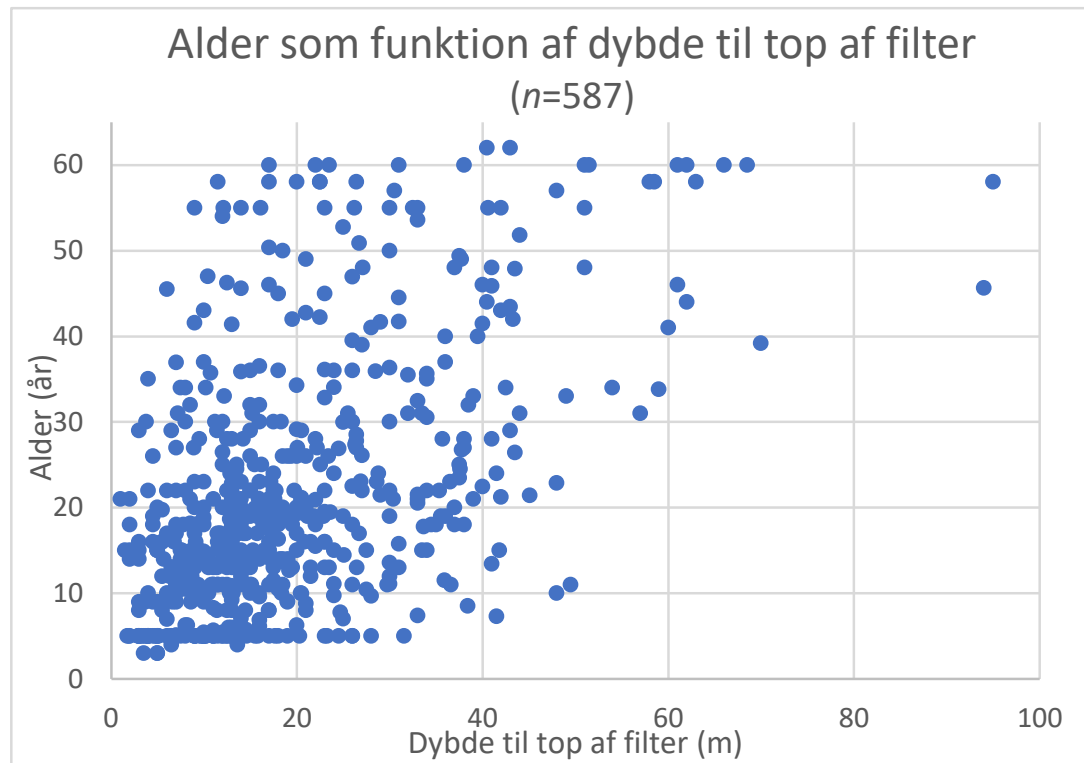
Pesticidfund i GRUMO relateret til datering

Der findes ca. **1200** "aktive" GRUMO-indtag.

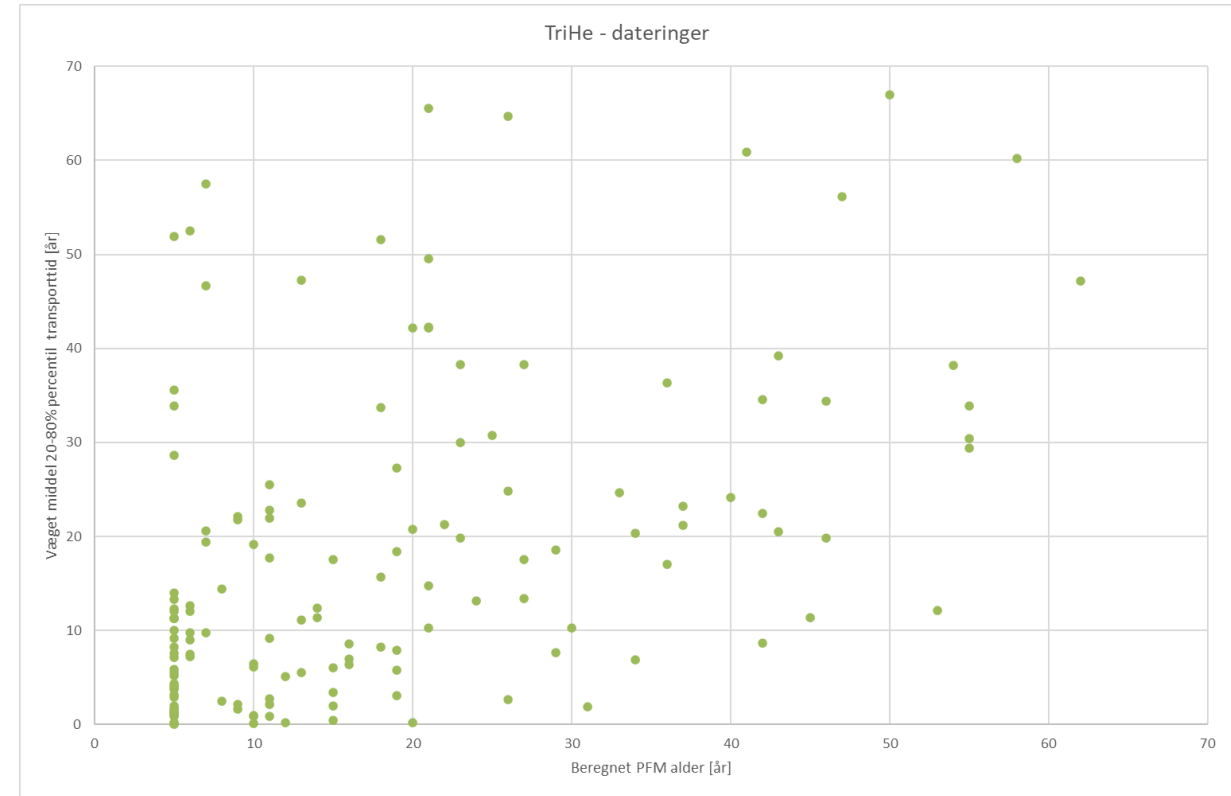
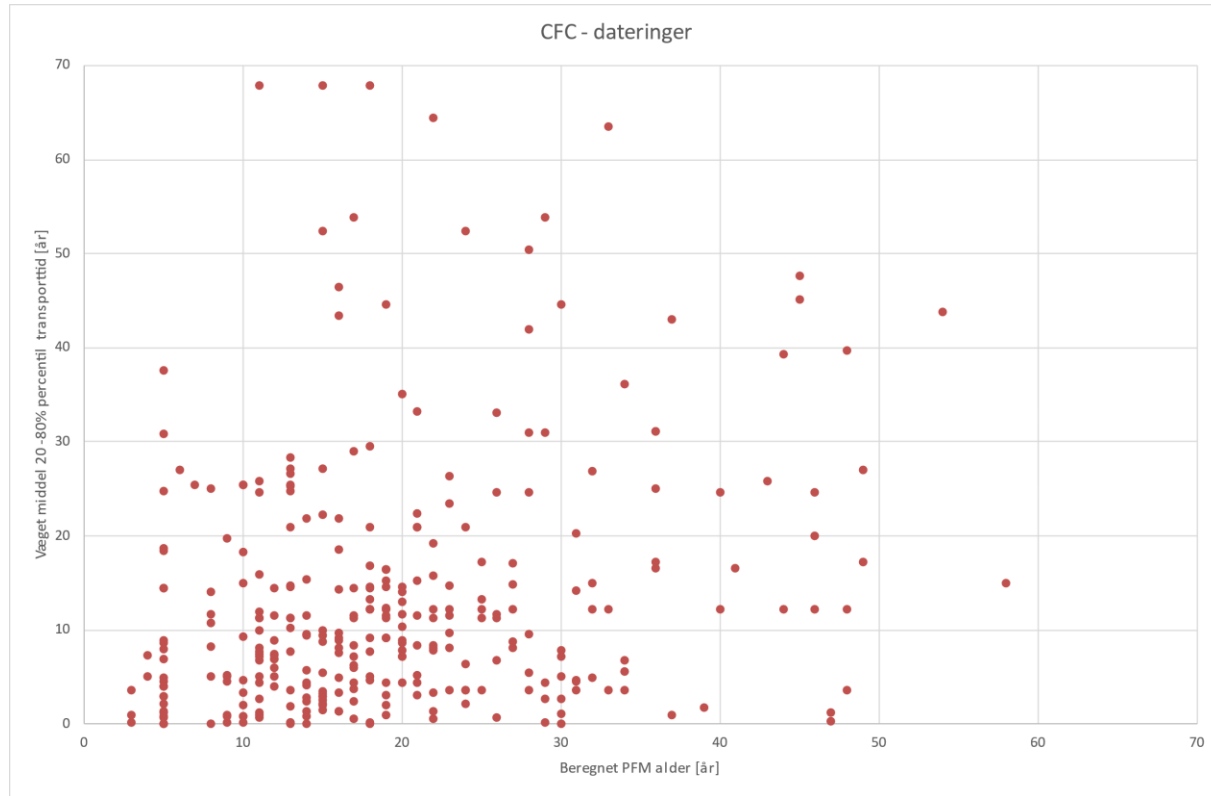
I **697** af disse er der brugbare grundvandsdateringer (CFC eller Tri-He).

587 af disse har pesticidanalyser, med konc. for *N,N*-DMS i **146**, af 1,2,4-triazol i **146** og af DPC i **171**

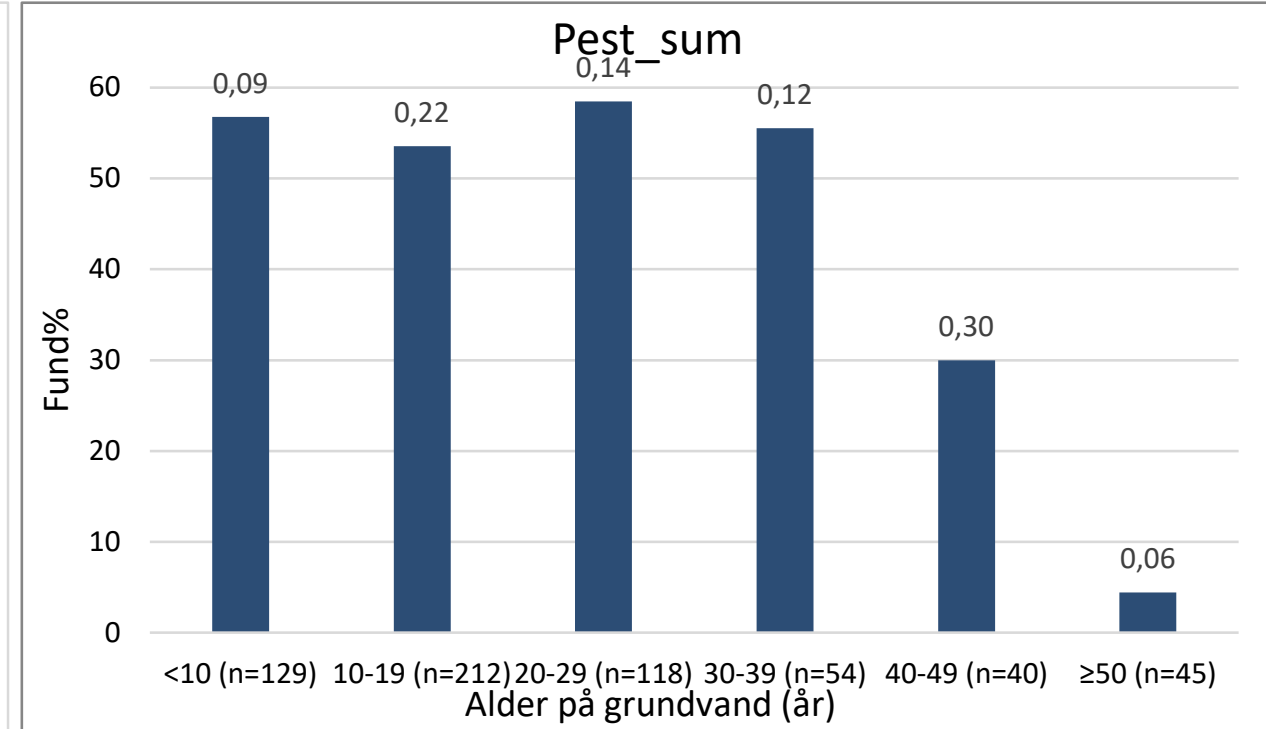
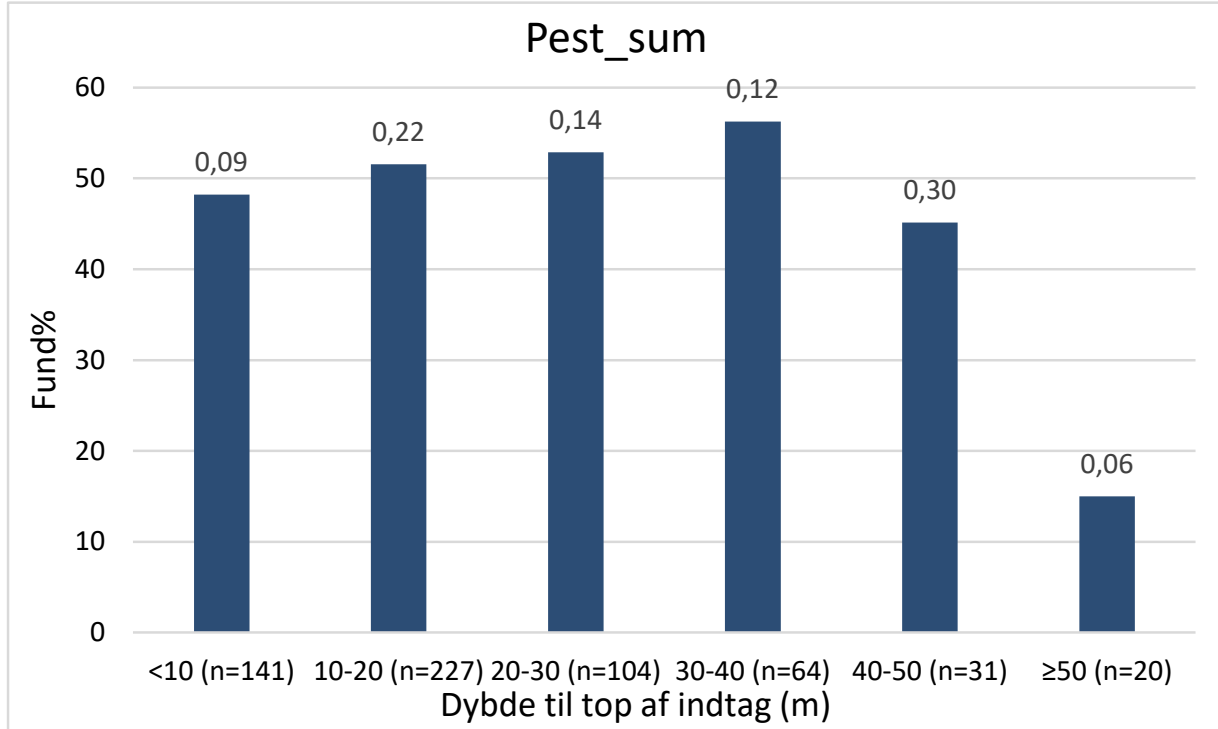
Overrepræsentation af iltholdigt grundvand!



Simulerede transporttider relateret til GRUMO aldersbestemmelser



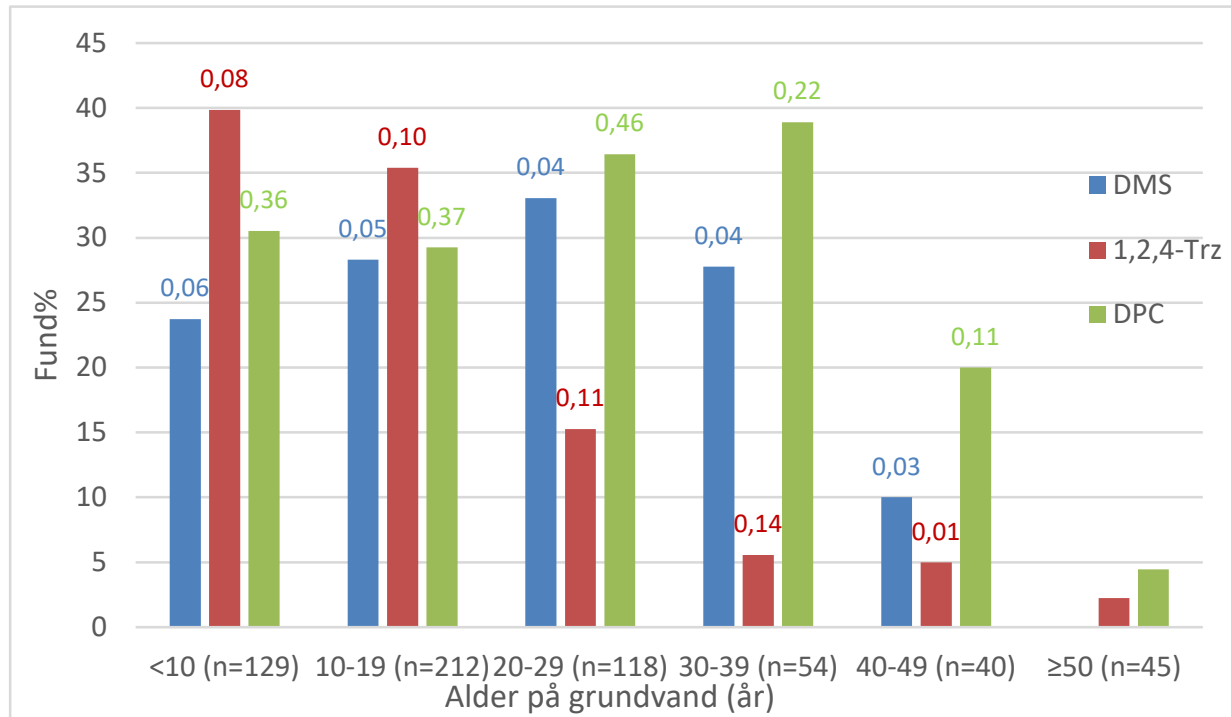
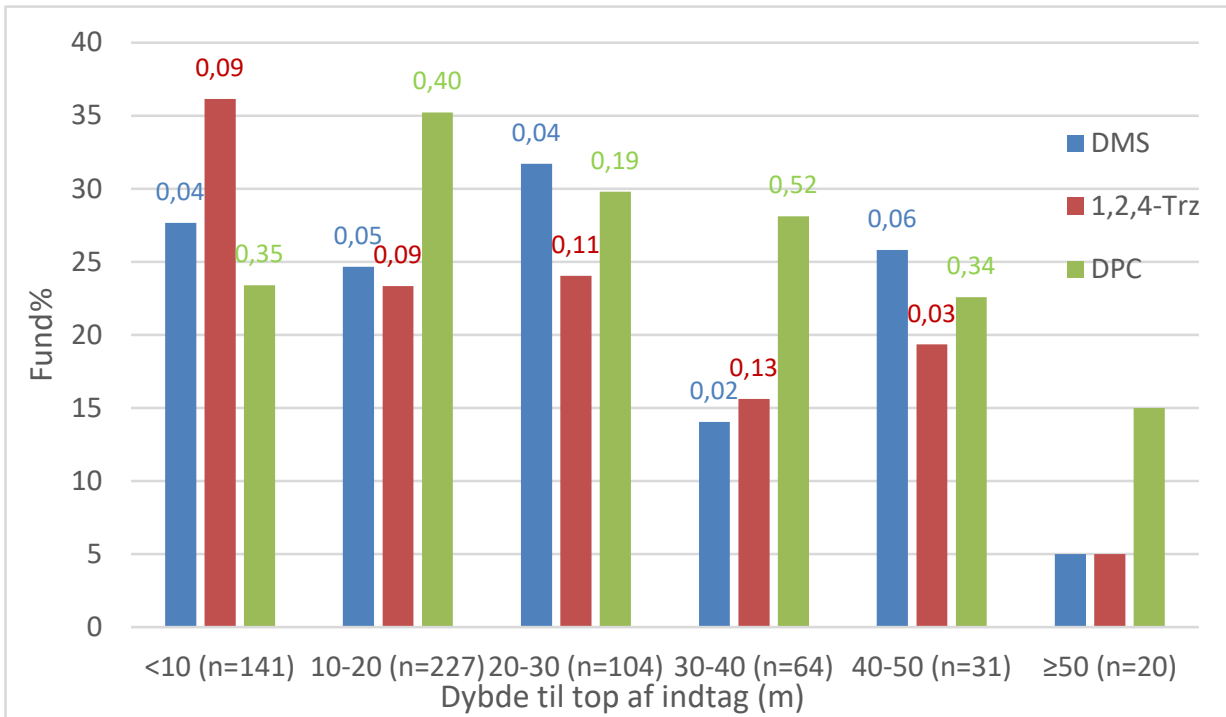
Pesticider som gruppe



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De tre hyppigste pesticider

Anvendt ca.
10*-50 år siden
0-60 år siden
25-55 år siden



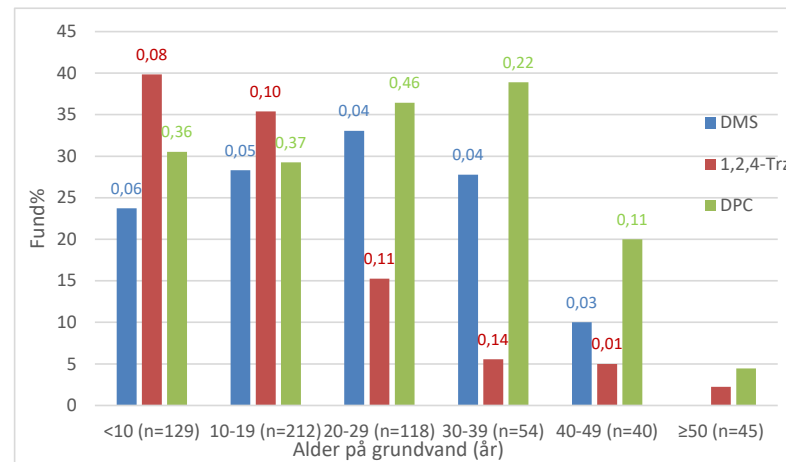
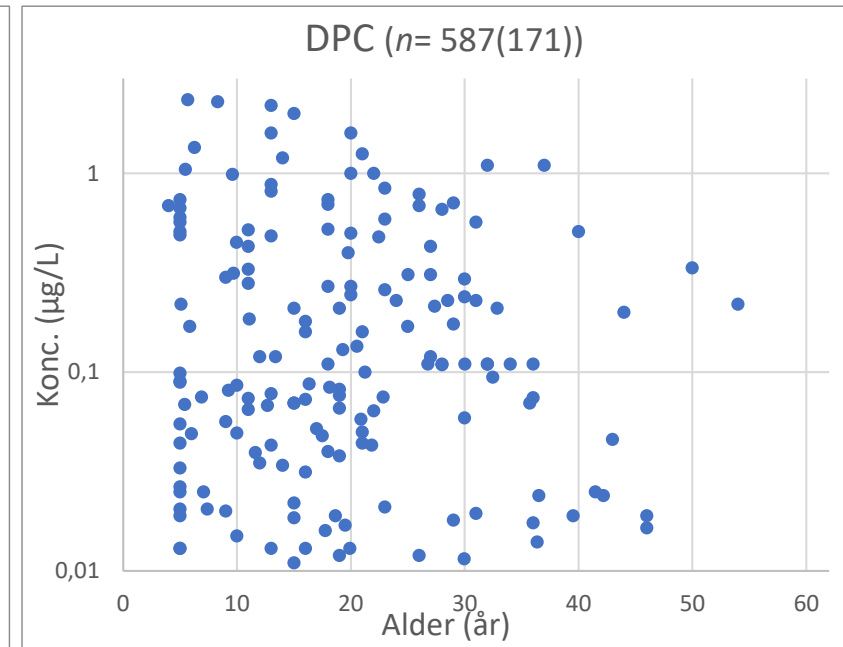
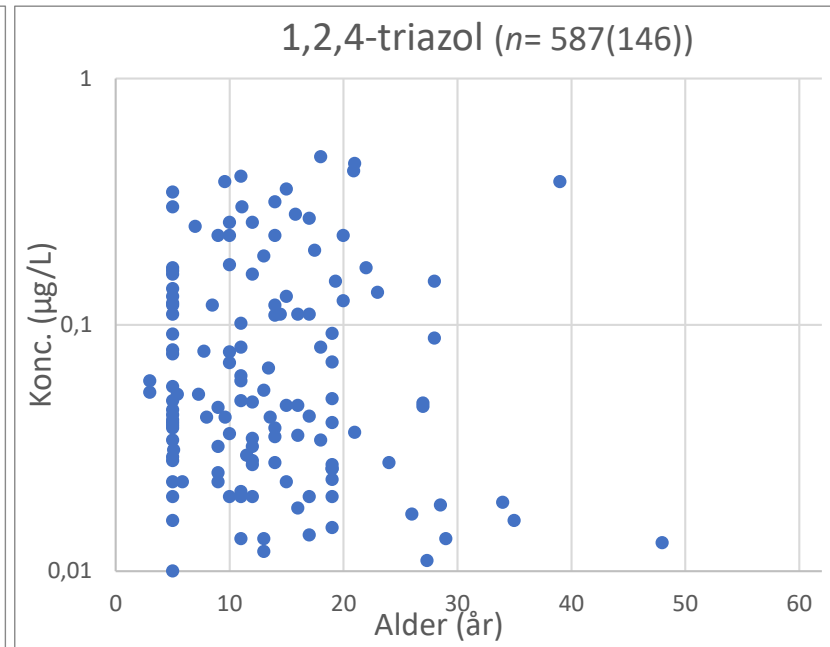
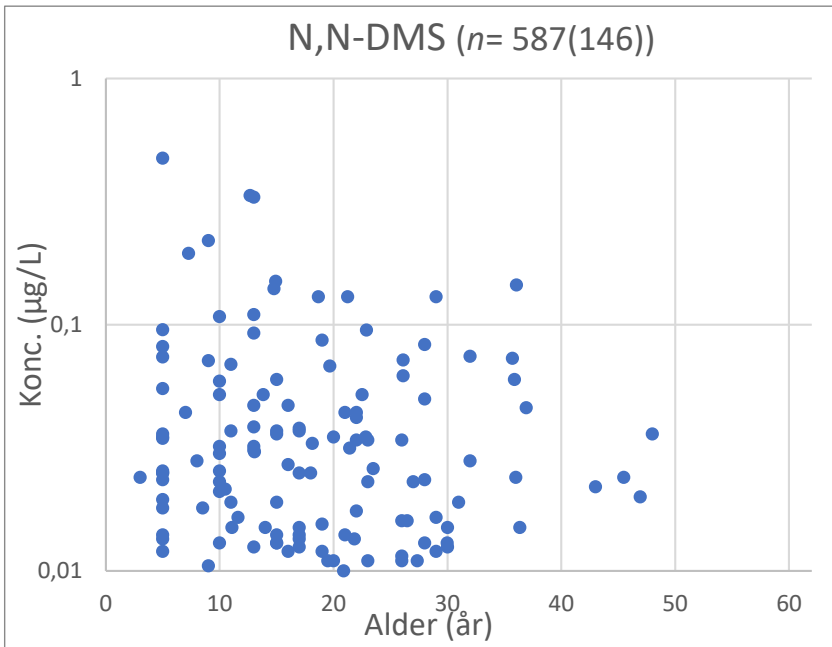
For DMS anes en effekt af stop for de hyppigste moderstoffer for 10-20 år siden, som ikke ses ved at bruge dybde.

For 1,2,4-trz er der meget lille sandsynlighed for forekomst i vand ældre end 30 år, mens hvis der bruges dybde gælder dette først ved >50 m til top af indtag.



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Koncentration vs alder



Konklusion

- Enkelt tracere giver kun begrænsede muligheder for at vurdere aldre, gavn af multiple tracere og multiple målinger
- Direkte sammenligning mellem simulerede aldersfordelinger og tracer beregnede aldre for GRUMO indtag viser meget ringe overensstemmelse
 - Det er ikke muligt at teste om de simulerede aldersfordelinger er forkerte
 - Der er ikke nogen klar relation mellem dybde og udfordringer med alders simuleringer vs datering
- Småskala heterogenitet spiller umiddelbart en stor rolle, både for pesticid fund og for aldersdateringer

