Can the Danish regulatory modelling approach assess the leaching risk of pesticides and their metabolites as monitored *via* the Danish Pesticide Leaching Assessment Programme?

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Second workshop on pesticide fate in soil and water in the northern zone – Challenges for pesticide risk assessment

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Introduction

- Aim to compare PEC_{GW} from regulatory models with observed leaching of pesticides (and / or their degradation products) to groundwater
- Objectives:
  - Is the conservative Danish approach protective of the leaching risk?
  - Do the present regulatory model scenarios, required by Denmark, adequately assess the leaching risk?

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Groundwater in Denmark

- Particular interest in groundwater
- 100% of drinking water supply comes from groundwater
- 60% of Denmark is intensively farmed
- Groundwater is only aerated before sending to the consumer – no purification step

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Danish Modelling Framework

Danish Ministry of the Environment
Environmental Protection Agency

Framework for the Assessment of Plant Protection Products

Department of Pesticides and Gene Technology
Danish Environmental Protection Agency

May 2011
Revised February 2013
Revised April 2014
Revised May 2016

Version 1.4

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Key aspects of Danish modelling approach

- Using FOCUS Hamburg scenario (Pelmo) or the national Karup and Langvad scenarios (Macro)
- Different rules for selection of endpoints when compared to core EU modelling
- Different crop interception classes
- Relevancy arguments not accepted for metabolites in Denmark

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Summary of DK selection criteria

Input Parameters			
	DT_{50}	K_{FOC}	1/n
Core EU	Geometric mean	Arithmetic mean[1]	Arithmetic mean
Denmark	80th percentile	20th percentile	80th percentile

Output	
Core EU	80th percentile annual average must be <0.1 µg/L (active substance and relevant metabolites)
Denmark	No more than 1 year in 20 can exceed the 0.1 µg/L limit (active substance and all metabolites)

1 – Now changed to geometric mean

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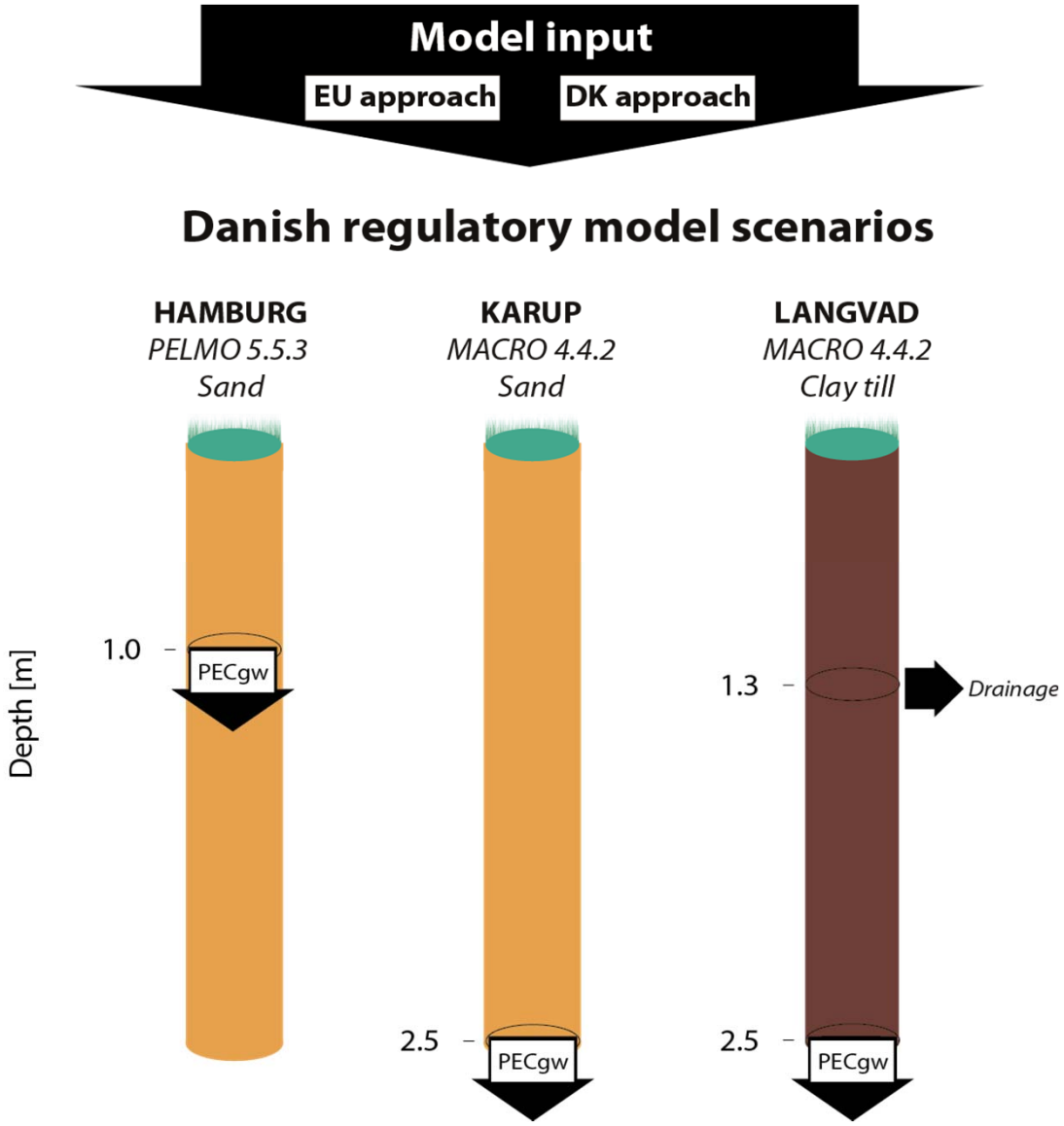
Overview of regulatory modelling scenarios



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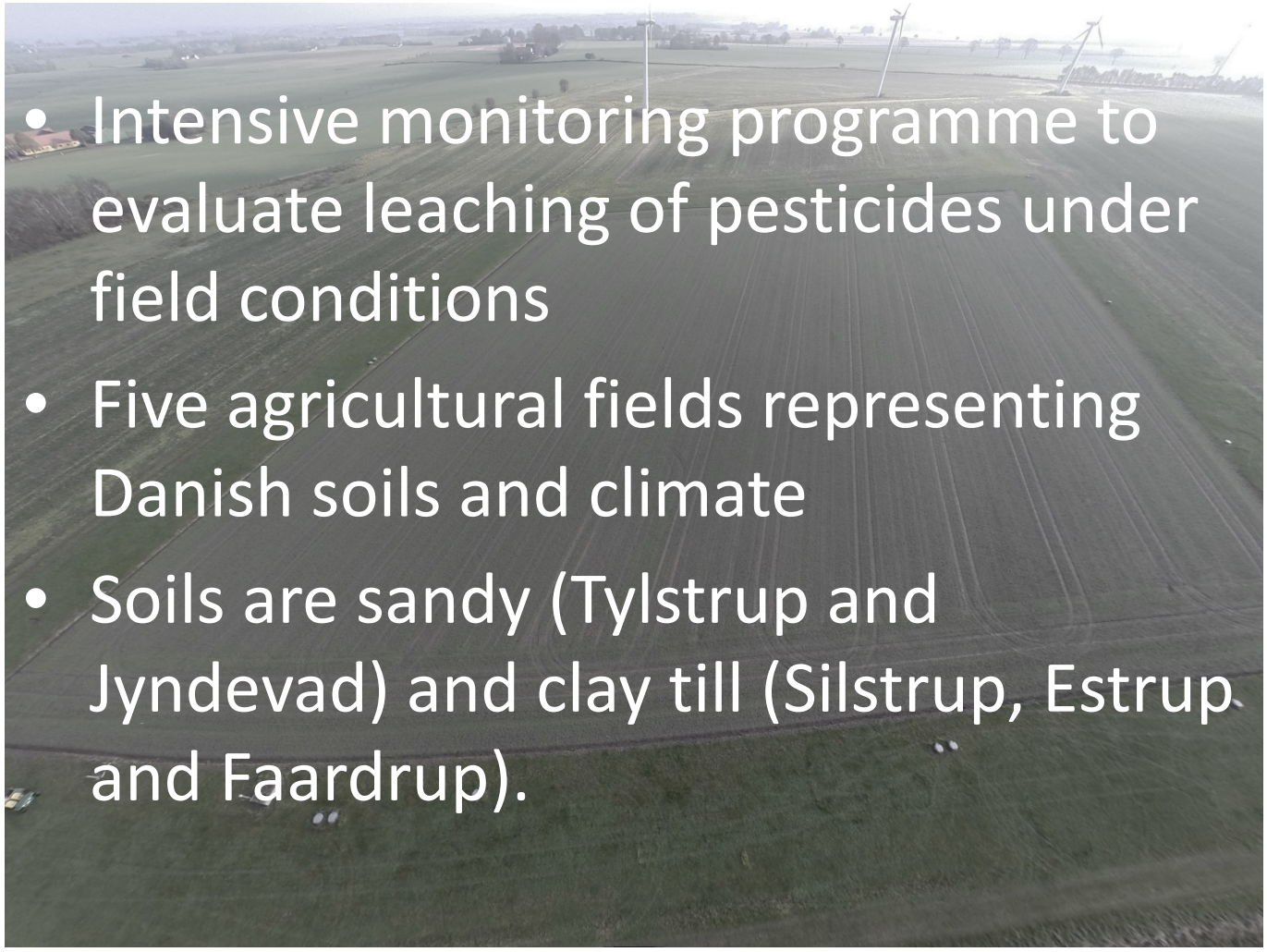
Monitoring programme (PLAP)



- Intensive monitoring programme to evaluate leaching of pesticides under field conditions
- Five agricultural fields representing Danish soils and climate
- Soils are sandy (Tylstrup and Jyndevad) and clay till (Silstrup, Estrup and Faardrup).

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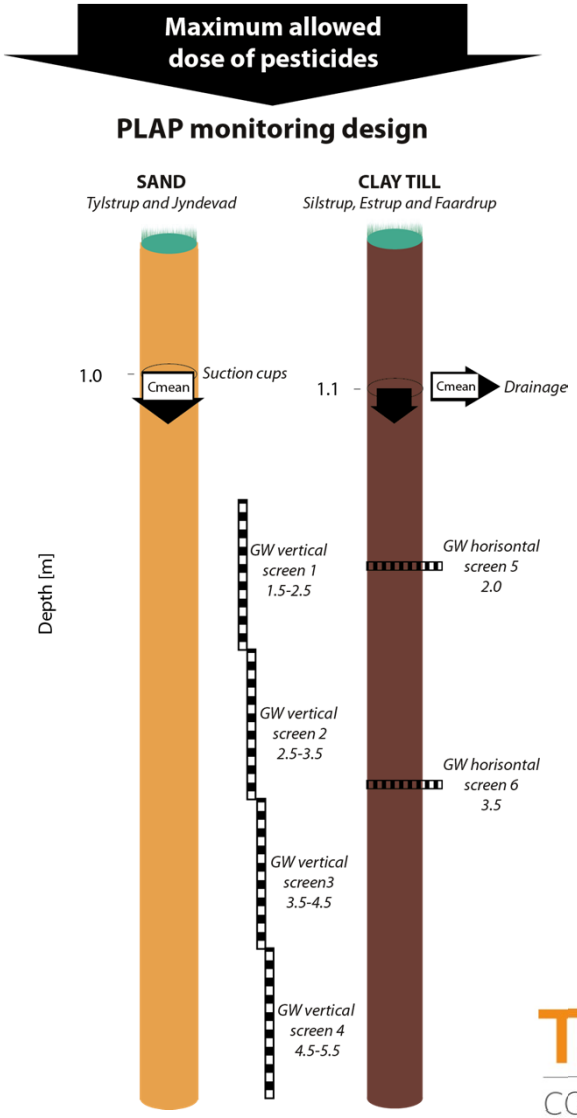
Monitoring programme (PLAP)

Analysis of water sampled:

- at 1 m depth (in suction cups at the sandy fields and tile drainage water in the clay till fields)
- in groundwater monitoring screens (1.5 – 4.5 m depth)



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Selection of substances

- Tiered approach
- The final choice was 13/14 high risk substances (93%), 6/12 low risk substances (50%) and 8/24 no leaching risk substances (33%)
- Metabolites selected if PLAP concentrations > LOD in groundwater between 1999 and 2012

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Substance parameter selection

- Input parameters selected by Danish EPA based on DK and EU guidance
- All parameters “Tier 1” based on laboratory data as listed in the most recent list of endpoints (LoEP)
- DK parameters were generally taken from the most recent Danish evaluations

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Application parameter selection

- Three application dates according to DK evaluation framework
- Application rates and dates based on field use in PLAP and the Danish GAP
- At least one of the application dates is close to the actual application date in PLAP
- Interception rates for modelling based on “new” guidance (EFSA, 2014). Interception rates for DK modelling based on Danish Evaluation Framework (DEPA, 2014)

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Analysis of results

- An overall **R**egulatory view-point
- A **F**ield specific view-point

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Regulatory view-point

- A focus on the ability of the model scenarios to predict leaching potential as detected via the groundwater monitoring in PLAP
- The simulated risk conclusion (based on PEC_{GW} using the EU and DK approach) is compared to the leaching risk conclusion based on PLAP groundwater results

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Field view-point

- A focus on the conceptual understanding behind the regulatory model scenarios and their ability to predict the leaching risk.
- PLAP data at 1 m depth (from drains and/or suction cups) and groundwater **for applications on the specified crop used in the regulatory model scenarios.**

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Results (R-Comparison)

PLAP Conclusions

(200,25,20)	Serious risk of leaching, many detections >0.1 µg/L
(200,25,2)	Limited risk of leaching, few detections >0.1 µg/L
(200,27,0)	Detections ≤0.1 µg/L and ≥LOD
(227,0,0)	All measured concentrations are <LOD
Not Applied Not Measured	Not Applied or Not Measured

Modelling Conclusions (EU)

1.20	>0.1 µg/L
0.08	≤ 0.1 µg/L ≥LOD
<LOD	<LOD

Modelling Conclusions (DK)

0.13	2 or more failures in 20 years (application every year) 4 or more failures in 60 years (application every 3rd year)
0.08	1 or less failures in 20 years 3 or less failures in 60 years (application every 3rd year)
<LOD	No failures

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Example of results (R-Comparison)

	Groundwater monitoring results[1] (May 1999 – June 2013) Combined - All fields	PECgw at 1 m depth Hamburg - PELMO DK/DK approach[2]	DK/EU approach[2]	EU/EU approach[4]	EU/DK approach[5]
BANNED (due to leaching to groundwater)					
Bifenox	(744,7,0)	<LOD	<LOD	<LOD	<LOD
- *Bifenox acid*	(673,7,21)	0.892	0.740	0.189	0.286
Fluazifop-P-butyl (1999 – 2010) old higher app. rate	(232,0,0)	<LOD	<LOD	<LOD	<LOD
- *Fluazifop-P*	(1148,7,1)	0.066	0.023	<LOD	<LOD
- *TFMP*	(131,48,9)	2.105	1.263	0.396	0.613
Ethofumesate (1999 – 2010) old higher app. rate	(1026,36,6)	2.237	0.891	<LOD	0.015
Metalaxyl-M	(374,34,22)	0.019	<LOD	<LOD	<LOD
- *CGA62826*	(330,90,8)	0.763	0.351	0.186	0.454
- *CGA108906*	(73,251,107)	0.282	0.139	0.371	0.812
Metribuzin	(413,1,0)	0.343	0.142	<LOD	<LOD
- *Metribuzin diketo*	(78,145,334)	0.025	<LOD	<LOD	<LOD
- *Metribuzin desamino-diketo*	(295,238,18)	0.309	0.110	<LOD	0.087

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Summary (R-comparison)

Danish EPA conclusion of leaching risk based on PLAP groundwater monitoring results	Regulatory model scenarios	Percentage of compounds where the simulated leaching assessment matches the Danish EPA leaching conclusion[1]	
		DK Approach	EU Approach
		2 or more exceedances[2] >0.1 µg/L	80th percentile PECgw >0.1 µg/L
Failed Serious risk of leaching, many detections > 0.1 µg/L	Hamburg – PELMO	100% (6/6)	67% (4/6)
	Karup – MACRO	100% (6/6)	67% (4/6)
	Langvad – MACRO	100% (6/6)	67% (4/6)
		1 or less exceedances[2] >0.1 µg/L	80th percentile PECgw ≤0.1 µg/L
Passed based on expert judgment Limited risk of leaching, few detections >0.1 µg/L	Hamburg – PELMO	22% (2/9)	100% (9/9)
	Karup – MACRO	22% (2/9)	89% (8/9)
	Langvad – MACRO	22% (2/9)	56% (5/9)
		1 or less exceedances[2] >0.1 µg/L	80th percentile PECgw ≤0.1 µg/L
Passed All detections ≤0.1 µg/L	Hamburg – PELMO	71% (10/14)	93% (13/14)
	Karup – MACRO	71% (10/14)	93% (13/14)
	Langvad – MACRO	57% (8/14)	86% (12/14)

[1] The brackets show the number of compounds where the simulated leaching assessment matches the Danish EPA leaching conclusion and the total number of compounds that are in that category. This considers the behaviour of both the parent substance and metabolites

[2] Number of exceedances per 20 year period appropriate for annual applications. For those substances applied once every three years, the DK approach is considered to fail if there are 4 or more exceedances >0.1 µg/L in a 60 year period.

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Conclusions – R Comparison

- For substances considered to “pass” based on PLAP, the DK approach over-estimates risk compared to the EU approach
- For substances considered to be a “serious leaching risk” based on PLAP, the DK approach performs better than the EU approach (which under-estimates the leaching risk).
- For substances “passed based on expert judgement” based on PLAP the EU approach performs better than the DK approach.

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Presentation of results (F-Comparison)

- Modelling conclusions compared to concentrations in PLAP fields
- Comparisons are crop specific
- Separate comparisons for sandy and clay till soils

Cmean

0.15	>0.1 µg/L
0.05	≤ 0.1 µg/L ≥ LOD
<LOD	< LOD
Not Applied Not Measured	Not Applied or Not Measured

Groundwater

(200,25,2)	Detections >0.1 µg/L
(200,27,0)	Detections ≤0.1 µg/L and ≥LOD
(227,0,0)	All measured concentrations are <LOD
Not Applied Not Measured	Not Applied or Not Measured

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Example of results (F- Comparison)

FRAME	PLAP scenarios				REGULATORY scenarios			
	Groundwater monitoring results[1] *(May 1999 – June 2013)*		*Cmean* at 1m depth *in 1st year after application* [µg/L]		PECgw EU approach *80th percentile* [µg/L]		PECgw DK approach *Number of exceedances >0.1µg/L and 95th percentile* [µg/L]	
Field	**Tylstrup**	**Jyndevad**	**Tylstrup**	**Jyndevad**	**Hamburg**	**Karup**	**Hamburg**	**Karup**
Azoxystrobin	(120,0,0)	Not Applied	<LOD	Not Applied	<LOD	<LOD	0.135	0.136
- *CYPM*	(120,0,0)	Not Applied	<LOD	Not Applied	<LOD	<LOD	2.747	1.952
Bentazone	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Maize	(179,0,0)	(64,1,0)	<LOD	0.24	0.030	0.021	2.085	1.658
Spring barley	(126,0,0)	(146,0,0)	<LOD	0.04	0.027	0.036	1.443	1.696
Peas	Not Applied	(284,0,0)	Not Applied	0.13	0.017	0.021	0.734	1.651
Bifenox	(38,0,0)	(214,2,0)	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
- *Bifenox acid*	(38,0,0)	(170,0,0)	<LOD	<LOD	0.189	0.189	0.892	0.645
Metalaxyl-M	(187,12,0)	(163,20,22)	<LOD	0.02	<LOD	<LOD	0.019	0.016
- *CGA62826*	(184,15,0)	(129,69,8)	0.02	0.19	0.186	0.147	0.763	0.504
- *CGA108906*	(27,131,41)	(41,99,66)	0.12	0.6	0.371	n/a	0.282	n/a
Metribuzin	(336,1,0)	Not Applied	<LOD	Not Applied	<LOD	<LOD	0.343	0.770
- *Metribuzin diketo*	(73,141,315)	Not Applied	0.36	Not Applied	<LOD	<LOD	0.025	0.081
- *Metribuzin desamino diketo*	(289,234,5)	Not Applied	0.97	Not Applied	0.018	n/a	0.309	n/a

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Conclusions – F Comparison

- **Sandy fields** - Hamburg-PELMO and Karup-MACRO underestimate leaching to groundwater. To circumvent this, the application of the DK approach will, compared to the EU approach, provide the best protection of the aquifers below sandy fields.
- **Clay till fields** - the Langvad-MACRO in conjunction with the DK approach successfully predicts the leaching risk for most pesticide and crop combinations. This risk was underestimated when the EU approach was applied.

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Overall Conclusion

- The DK-approach compared to the EU-approach will provide:
  - a better protection of the quality of the Danish groundwater against substances with a high leaching potential.
  - an over-conservative assessment of substances having a low leaching risk.

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Thank you for your attention

The final report is available on the MST.DK website:
http://mst.dk/media/170789/comparison-of-regulatory-modelling-final-report.pdf

Please visit the PLAP-home-page:
http://pesticidvarsling.dk/om_os_uk/uk-forside.html

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