

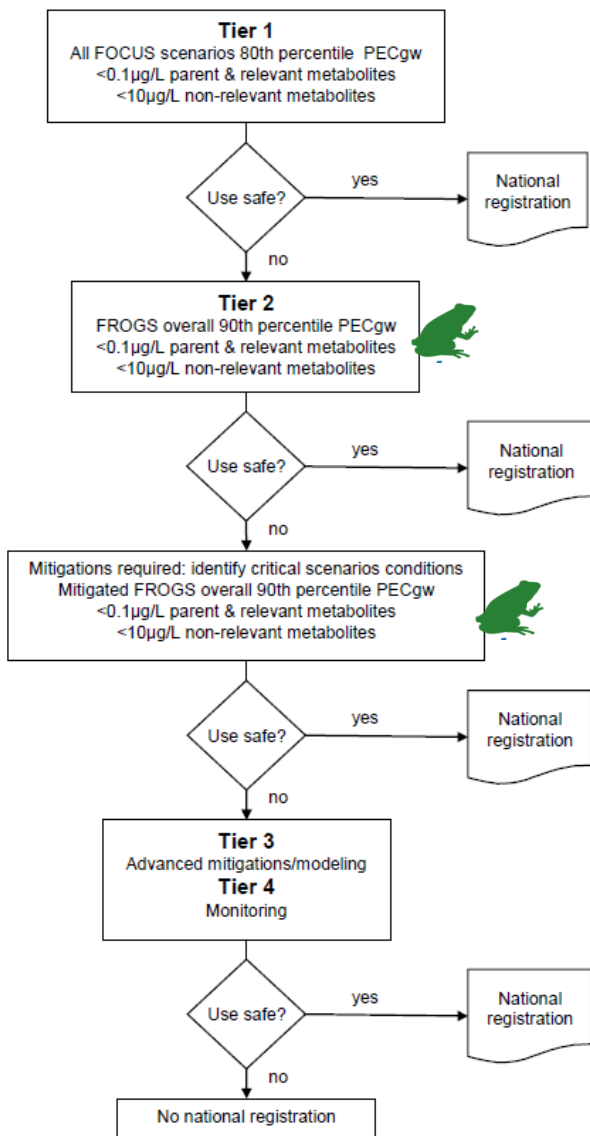


3. IMPLEMENTATION WITHIN THE FRENCH EVALUATION SCHEME

**FROGS (French Refinement Of Groundwater Scenarios)
UIPP Training**

Paris, 16 November 2011

UIPP Environmental Methodology Working Group



- **FROGS is to be used as a Tier 2 model, when Tier 1 fails (one or more FOCUS scenario failing)**
- **Protection goal consistent with FOCUS approach : 90th percentile (combination of 80th spatial and 80th temporal percentiles)**
- **Enables causal analysis of PECgw exceedances thereby allowing identification and proposal of mitigation measures**
- **Fits perfectly within zonal approach (1107/2009) → national addendum**



**80th temporal percentile PEC_{gw} at bottom of profile
(Scenario: AU x Soil(Crop), FOCUS Pearl 3.3.3)**

• $PEC_{gw} = \frac{\sum^{\text{over rotation}} \text{mass leached}}{\sum^{\text{over rotation}} \text{water percolation}}$

Order scenarios by PEC_{gw} (ascending)
Calculate areal probability (cumulative area / total area)
Select 80th areal percentile PEC_{gw}

Represents overall 90th percentile PEC_{gw}
In analogy to FOCUS GW

Area (Scenario)



Output Files prepared by FROGS:

[Frogs Summary.txt](#): Detailed summary of inputs and results of each Scenario

[FROGS Cumulative Areal distribution - Test1.txt](#): Sorted concentrations and cumulative area (in kha and normalized); one file per substance

[FROGS Cumulative Areal distribution - Test1.png](#): Graph of cumulative areal distribution, including the final PEC_{gw} value

Output summary (*.txt)

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**** Output generated with FROGS v2.2.2.2
**** Main crop
Sugar beet (SBEET)

**** Compounds
SubC MET-C
MolMas * 200 150 (q.mol-1) Molar mass [10]100000
OptDT50 * Input Input Option for DT50: Input or Calculate
DT50Ref * 20 100 (d) Half-life time [1]1e6
TemRefTra * 20 20 (C) Temperature at which DT50 is measured [5]30
ExpLiqTra * 0.7 0.7 (-) Exponent for the effect of liquid [0]5
OptCntLiqTraRef * opt. opt. OptimumConditions (opt.) or NonOptimumConditions (non-opt.)
CntLiqTraRef * 1 1 (k.k.q-1) Lq. content at which DT50 is measured [0]1
MolEntTra * 65.4 65.4 (kJ.mol-1) Molar activation energy [0]2001
OptCofFre * pH-independent pH-independent pH-dependent, pH-independent, UserDefined
ConLiqRef * 1 1 (mq.L-1) Reference conc. in liquid phase [0.1]-
ExpFre * 0.9 0.9 (-) Freundlich sorption exponent [0.1]1.3
KomEq * 100 30 (L.kq-1) Coef. eq. sorption on org. matter [0]1e9
KomEqAcid * 374.7 374.7 (L.kq-1) Coef. for eq. sorption on om - acid [0]1e9
KomEqBase * 7.46 7.46 (L.kq-1) Coef. for eq. sorption on om - base [0]1e9
pKa * 4.6 4.6 (-) Coef. for influence of pH on sorption [0]14
pHCorrection 0 0 (-) pH correction [-2]1
KSoEq * 1 1 (L.kq-1) Coef. for equilibrium sorption [0]1e9
MolEntSor * 0 0 (kJ.mol-1)
TemRefSor * 20 20 (C)
PreVapRef * 1E-10 1E-10 (Pa) Saturated vapour pressure [0]2e5
TemRefVap * 20 20 (C) measured at [0]40
MolEntVap * 95 95 (kJ.mol-1) Molar enthalpy of vaporisation [-200]200
SibWatRef * 50 90 (mq.L-1) Solubility in water [1e-9]1e6
TemRefSib * 20 20 (C) measured at [0]40
MolEntSib * 27 27 (kJ.mol-1) Molar enthalpy of dissolution [-200]200
CofDesRat * 0 0 (d-1) Desorption rate coefficient [0]0.5
FacSorNeqEq * 0 0 (-) CofFreNeq/CofFreEq [0]-
FacUp * 0.5 0.5 (-) Coefficient for uptake by plant [0]10
OptDspCrp * Lumped Lumped Lumped or Specified
DT50DspCrp * 1000000 1000000 (d) Half-life at crop surface [1]1e6
DT50PenCrp * - - (d) Half-life due to penetration [1]1e6
DT50VolCrp * - - (d) Half-life due to volatilization [1]1e6
DT50TraCrp * - - (d) Half-life due to transformation [1]1e6
FacWasCrp * 0.0001 0.0001 (m-1) Wash-off factor [1e-6]0.1
CofDiWatRef * 4.3E-05 4.3E-05 (m2.d-1) Reference diff. coeff. in water [10e-5]3e-4
CofDiAirRef * 0.43 0.43 (m2.d-1) Reference diff. coeff. in air [0.1]3
TemRefDif * 20 20 (C) Diff. coeff measured at temperature [10]30

#NAME?
0.71 SubC -> MET-C

**** Application scheme "subc sugarbeet"
Crop Soil load Type
(kq/ha)
SBEET 0.35 relative Emergence 0 days
SBEET 0.35 relative Emergence 5 days
SBEET 0.35 relative Emergence 10 days

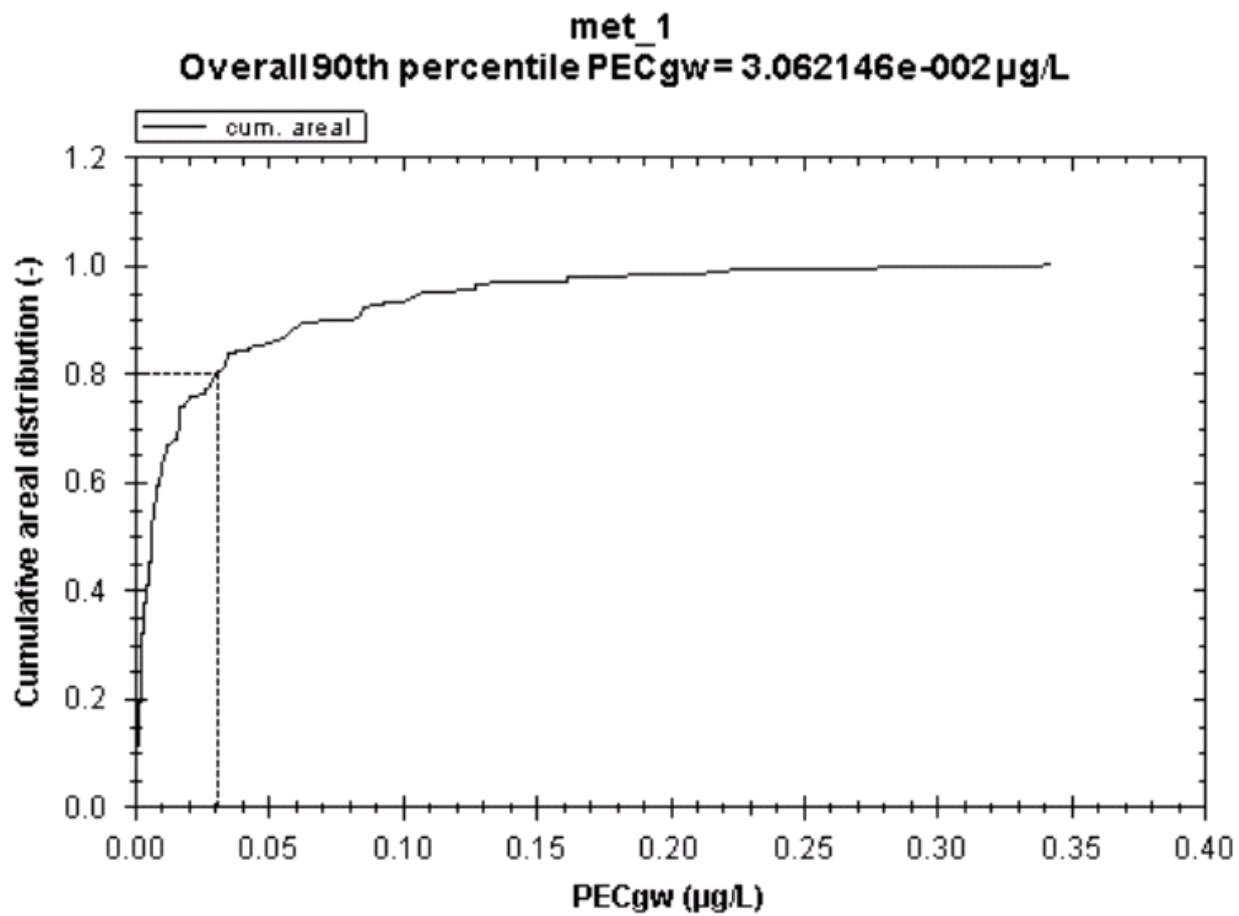
**** Results
* "Error" in the comment column may denote a run with failing hydrology
* For details see Chapter 5.4 of FROGS final report.
RUNID AUID AU SID Soil Area (kha) Rotation SUBID Substance 80th percent Year Comment
1 1 4 Bordure No 1 Luvisol 3>8 571 SBEET-w/w 2 SubC 3.82E-08 2038
1 1 4 Bordure No 1 Luvisol 3>8 571 SBEET-w/w 3 MET-C 9.4398196 2035
2 2 5 Alsace - Sur 1 Luvisol 3>8 6 SBEET-MA 2 SubC 1.05E-09 1990
2 2 5 Alsace - Sur 1 Luvisol 3>8 6 SBEET-MA 3 MET-C 7.4652243 1993
3 3 6 Plaine norm 1 Luvisol 3>8 61 SBEET-w/w 2 SubC 6.07E-14 2020
3 3 6 Plaine norm 1 Luvisol 3>8 61 SBEET-w/w 3 MET-C 5.8464209 1996
4 4 9 Picardie - Ni 1 Luvisol 3>8 570 SBEET-w/w 2 SubC 7.73E-11 1993
  
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Areal PECgw distribution (*.txt)

RUNID	80th percentile	Cumulative Area (kha)	Cumulative Area normalized
3	6.07E-14	61	0.008861127
7	3.63E-13	472	0.06856479
11	1.20E-12	803	0.1166473
8	2.79E-12	1145	0.1663277
64	6.50E-12	1148	0.1667635
15	1.44E-11	1186	0.1722836
6	1.54E-11	1218	0.176932
68	2.26E-11	1235	0.1794015
25	4.73E-11	1703	0.2473852
9	5.22E-11	1800	0.2614759
18	6.15E-11	1846	0.268158
19	7.49E-11	1965	0.2854445
4	7.73E-11	2535	0.3682452
72	1.59E-10	2551	0.3705694
5	1.69E-10	2557	0.371441
69	2.00E-10	2561	0.3720221
27	2.66E-10	2579	0.3746368
41	2.68E-10	2582	0.3750726
67	3.07E-10	2611	0.3792853
20	5.27E-10	2824	0.4102266
44	1.03E-09	2854	0.4145845
2	1.05E-09	2860	0.4154561
45	1.08E-09	2907	0.4222836
21	1.18E-09	2977	0.4324521
23	1.21E-09	3159	0.4588902
12	1.95E-09	3248	0.4718187
26	1.97E-09	3259	0.4734166
65	2.79E-09	3364	0.4886694
70	3.09E-09	3372	0.4898315
66	3.22E-09	3379	0.4908483
17	3.91E-09	3705	0.5382046
16	6.44E-09	3718	0.5400929
46	8.93E-09	3747	0.5443056
49	9.04E-09	3842	0.5581058
63	1.07E-08	3845	0.5585415
38	1.44E-08	3916	0.5688553
14	1.61E-08	4103	0.5960197

Cumulative aerial distribution (*.png)



Input data




	Dummy C	Dummy C metabolite
DT50 (days)	20	100
ffM (-)	-	0.71
Kom/Koc (L/kg)	100 / 172	30 / 52
1/n (-)	0.9	0.9
MW (g/mol)	200	150
Crop uptake factor (-)	0.5	0.5
Transformation E_A (kJ/mol)	65.4	65.4

○ Application of 350 g/ha on sugar beet at emergence

FOCUS results (80th annual percentile)

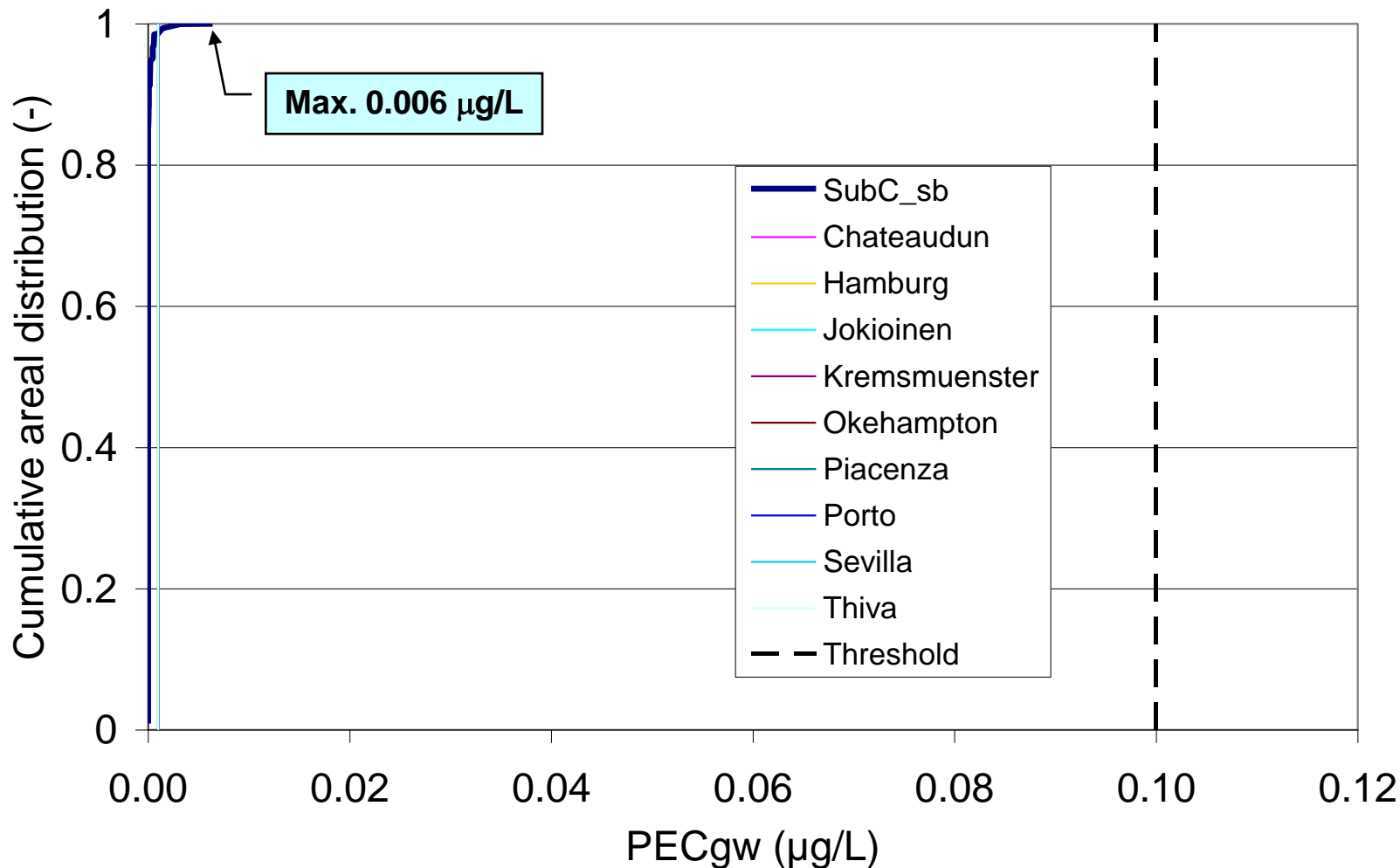


FOCUS scenario	PECgw (µg/L)	
	Substance C	Metabolite Sub_C
Châteaudun	<0.001	10.082
Hamburg	<0.001	11.514
Jokioinen	<0.001	9.088
Kremsmünster	<0.001	8.582
Okehampton	<0.001	8.924
Piacenza	0.001	8.485
Porto	<0.001	1.365
Sevilla	<0.001	5.346
Thiva	<0.001	6.793

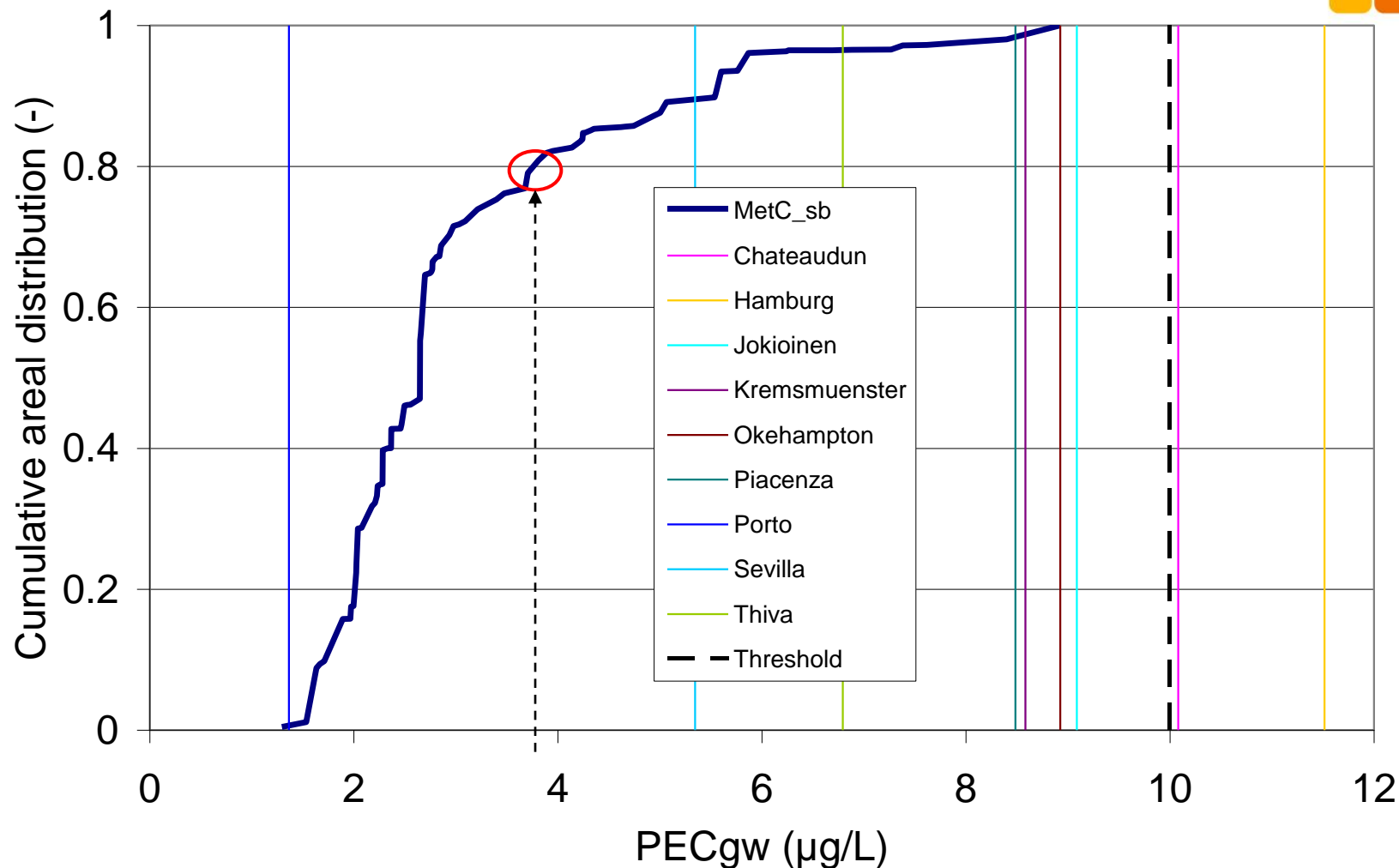
→ Concentrations > 10 µg/L calculated for the metabolite
(2 scenarios) → unacceptable risk for groundwater →
Tier 2 is necessary 



Results FROGS Substance C

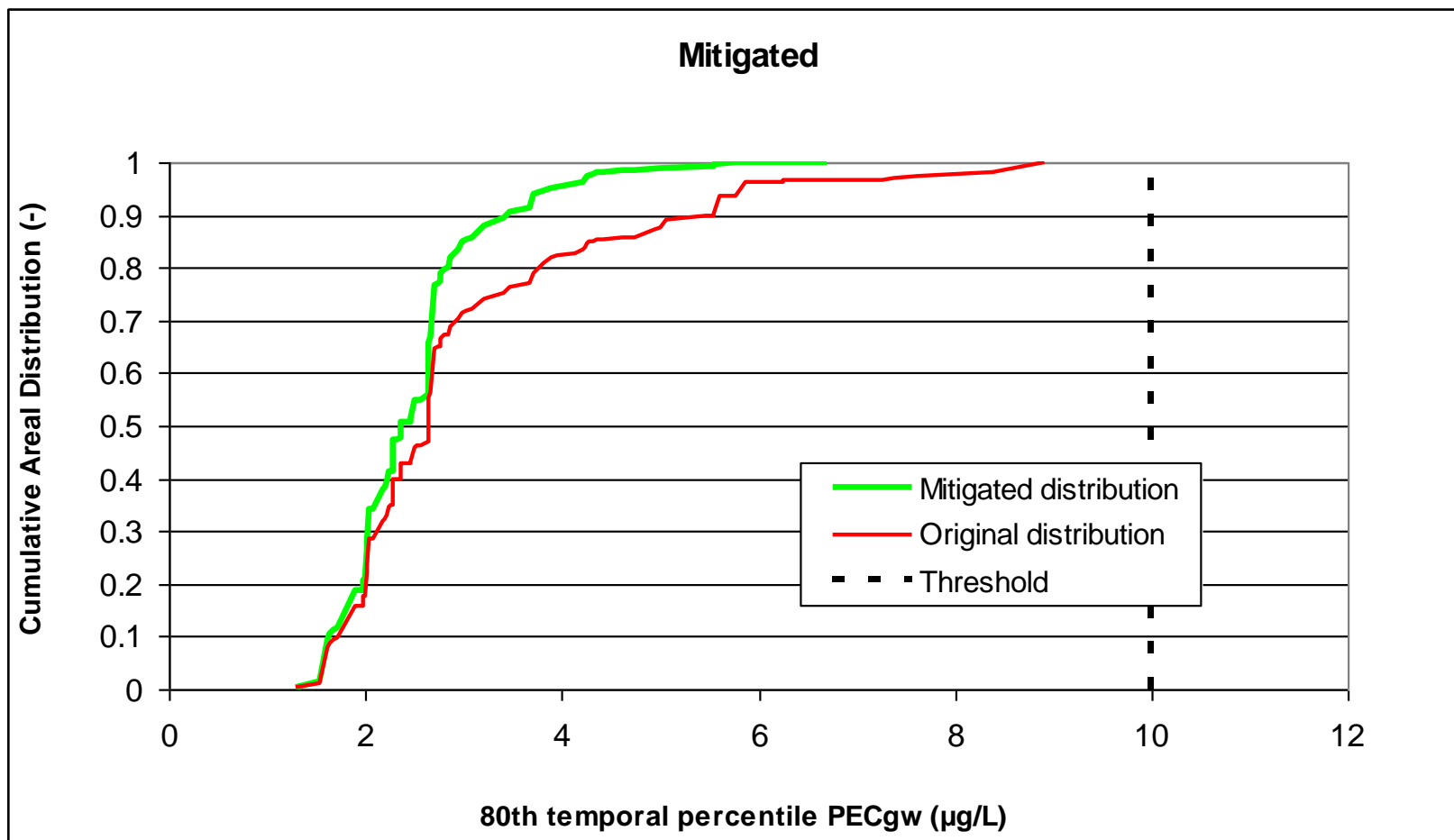


Results FROGS Metabolite C



80th percentile is < 10 µg/L → risk acceptable, no further mitigation required

For more complex cases, mitigation measures are possible
Restriction to soils for which available water content (AWC) within the profile is > 100 mm





Thank you very much for your kind attention