Document Title

Summary of the fate and behaviour in the environment for fluopicolide

Part 3

Data Requirement(s)

Regulation (EC) No 1107/2009 & Regulation (EU) No 283/2013

Document MCA

Section 7: Fate and behaviour in the environment

According to the Guidance Document SANCO/10181/2013 for applicants on preparing dossiers for the approval of a chemical active substance

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[1] It is suggested that applicants adopt a similar approach to showing revisions and version history as outlined in SANCO/10180/2013 Chapter 4, 'How to revise an Assessment Report'.

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CA 7.5 Monitoring data

No monitoring data were evaluated during the initial EU review of fluopicolide. Two new assessments and 14 published peer reviewed papers are included as new data not yet reviewed.

Two comprehensive assessments of public data have been conducted. The assessment in KCA 7.5/01 describes the collection process of public monitoring data (from regional and national environment agencies) for European countries for fluopicolide and M-01 (BAM, 2,6 dichlorobenzamide) covering soil, groundwater, surface water, drinking water, sediment and air. Monitoring of fluopicolide and M-01 has not been recorded or documented in soil or drinking water. The scope of the assessment in KCA 7.5/02 was to collect groundwater residue data of fluopicolide, M-01 and dichlobenil derived from public monitoring across representative EU Member States. The data were assessed spatially and temporally in order to differentiate whether M-01 residues are related to leaching following historical applications of dichlobenil or more recent applications of fluopicolide.

The 14 peer reviewed publications distribute as follows:

Five published peer reviewed publications provide additional information on M-01 residues in groundwater in France (KCA 7.5/03 and KCA 7.5/07), France and England (KCA 7.5/04), the Republic of Ireland (KCA 7.5/05 and KCA 7.5/06).

Two published peer reviewed publications provide additional information on fluopicolide residues in surface water in France (KCA 7.5/08) and Switzerland (KCA 7.5/09), a further four publications provide information on M-01 residues in surface water in Switzerland (KCA 7.5/10), Denmark (KCA 7.5/11), Luxembourg (KCA 7.5/12) and Sweden (KCA 7.5/13). The Luxembourgian publication has additional information on M-01 residues in drinking water (tap and bottled).

Finally, a published peer reviewed publication provides additional information on M-01 residues in Norwegian drinking water in 1999 and 2000.

In addition, an assessment of the potential impact of drinking water treatment processes, considering both the exposure aspects and transformational chemistry, will be prepared for fluopicolide. The final report was not available in time to be included in this dossier. As agreed with the RMS, an updated dossier will be submitted by the notifier which will include the final report and its summary.

Overview of Results

Concentrations of fluopicolide and its metabolite M-01 (BAM, 2,6-dichlorobenzamide) arising from public monitoring datasets have been collected from regional and national environment agencies as well as published peer reviewed publications from literature searches. This data collection and analysis is comprehensive considering a range of environmental compartments and for a number of these compartments evaluates a very large dataset that allows firm conclusions to be drawn.

Throughout the documents in this chapter the metabolite M-01 is referred to as either BAM or 2,6-dichlorobenzamide. This metabolite is common to both fluopicolide (FLC) and the herbicide dichlobenil (DCB). Dichlobenil was first marketed in the 1960s and its authorization expired between 1997 to 2013. In contrast, fluopicolide authorisations started between 2005 and 2011 in most EU Member States. The consequence is that residue detections of M-01 (BAM, 2,6-dichlorobenzamide) in groundwater cannot readily be attributed to fluopicolide usage but are mainly attributable to dichlobenil. This is particularly relevant for Denmark and Norway, the only Member States in which fluopicolide was never registered for use. Denmark holds a large groundwater monitoring dataset on M-01 (BAM, 2,6-dichlorobenzamide) and any detections can unequivocally be attributed to historic dichlobenil usage. Where M-01 (BAM, 2,6-dichlorobenzamide) groundwater data cannot clearly be attributed to dichlobenil, they are typically low and below 10 µg/L.

The reports and publications assessed cover country, regional, provincial, and even specific locations or fields. Similarly, they cover a range of temporal scales ranging from a single sampling occasion to multi-monthly and annual sampling schemes.

Table 7.5- 1: Summary of minimum reported rates of compliance with regulatory acceptable concentrations (RAC) for measured concentrations of fluopicolide (FLC) and M-01 (AE C653711, BAM, 2,6-dichlorobenzamide) in each environmental compartment

Compartment	Fluopicolide			M-01 (BAM, 2,6-dichlorobenzamide)		
	Dataset Size	RAC [A] / Threshold (µg/L)	Compliance (%)	Dataset Size	RAC [A] / Threshold (µg/L)	Compliance (%)
Soil	No data [B]	1.77 mg/kg	-	No data [B]	0.92 mg/kg	-
Groundwater	Medium	0.1	99.9	Large	10.0 [C]	> 99.9 [D]
Surface water	Medium	3.6	>99.9	Large	1800	100
Drinking water	No data [B]	0.1	100	No data [B]	67-350 [E]	100
Sediment	No data	198 µg/kg	-	Small	NA	-
Air	Very small	NA	-	Very small	NA	-

NA Not applicable/available

[A] Regulatory acceptable concentration

[B] No soil or drinking water monitoring data in public databases was recorded. Two publications reported analysis of drinking water for M-01 (BAM, 2,6-dichlobenzamide). See footnote to Table 7.5- 2.

[C] Arbitrary general concentration threshold for non-relevant metabolites

[D] 10 of 13 exceedances identified as either related to historic dichlobenil applications or related to exceptional environmental conditions.

[E] Life-time WHO health based safe drinking water limit for all consumer groups – see document N4.

The rates of compliance with different RACs and thresholds are provided in Figure 7.5- 1 and maximum reported concentrations in each compartment are summarised in Table 7.5- 2. The rates of compliance with key RACs and thresholds for both fluopicolide and M-01 are high (≥ 99.9 % of samples) and in some cases absolute (100 %) with little or no exceedances reported.

Table 7.5- 2: Summary of reported maximum concentrations of fluopicolide (FLC) and M-01 (AE C653711, BAM, 2,6--dichlorobenzamide) in each environmental compartment

Compartment	Maximum concentration (µg/L, unless stated)	
	Fluopicolide	M-01 (BAM, 2,6-dichlorobenzamide)
Soil	No data	No data
Groundwater	1.3 (0.73) [A]	18.86 (10.57) [A]
Surface water	19	8
Drinking water	No data	No data [B]
Sediment	No data	23 µg/kg
Air	<0.006 ng/m³	<0.006 ng/m³

[A] The maximum concentrations in groundwater reported in public monitoring databases for fluopicolide and M-01 (BAM, 2,6-dichlorobenzamide) are provided above. The values in parenthesis are the maximum concentrations after elucidation of false positives (e.g due to hydraulic short-cuts) or values most likely related to historic dichlobenil usage are removed. Full details of this elucidation are provided in KCA 7.5/02, M-686676-01-1.

[B] No drinking water monitoring data in public databases was recorded. In the literature search two publications were found which reported analysis of drinking water for M-01 (BAM, 2,6-dichlobenzamide). KCA 7.5/12, M-597682-01-1 reports BAM detected in Luxembourgian tap water (maximum 0.096 µg/L, n =34) and in bottled water (maximum 0.014 µg/L, n = 25) in 2008 to 2009. KCA 7.5/14, M-532496-01-1 reports BAM detected in Norwegian drinking water wells (maximum 0.39 µg/L, n=6) in 1999 and 2000 resulting from historic dichlobenil applications.

Maximum concentrations that exceed RACs or maximum allowable concentration are reported in Table 7.5- 2. However, in large datasets comprising many hundreds of thousands of analytical results a small number of anomalous values are likely and may occur at several points during the sampling, storage and analytical process. A transparent and precautionary data analysis approach retained and contextualised these values (KCA 7.5/01, M-686397-02-1 and KCA 7.5/02, M-686676-01-1), for example, by determining the percentile of the RAC in the distribution of concentration values to demonstrate this is much higher than the 99th percentile value. These observations are supported by publications which generally demonstrate lower concentrations.

Conclusions

The data presented in Point CA 7.5 demonstrate that fluopicolide usage does not pose a risk for either biota and ecosystems or to human health via drinking water. Safe use is demonstrated for the overwhelming majority of environments in Europe following the use of fluopicolide products according to the label.

A matrix summarizing these documents is presented below in Table 7.5- 3 for each sub-chapter.

Table 7.5- 3: List of all monitoring studies and literature articles summarized

Test item	Report reference	Author, Year	Relevant subchapter					
			A. Soil	B.1 Groundwater	B.2 Surface water	B.3 Drinking water	C. Sediment	D. Air
Applicant Assessments								
Fluopicolide & M-01	KCA 7.5/01 M-686397-02-1	[redacted] 2020	A	▨	▨	A	▨	▨
Fluopicolide, Dichlobenil & M-01	KCA 7.5/02 M-686676-01-1	[redacted] 020		▨				
Relevant Literature Articles								
M-01	KCA 7.5/03 M-597785-01-1	Lopez, B. *et al.*, 2015		▨				
M-01	KCA 7.5/04 M-597786-01-1	Lapworth, D. *et al.*, 2015		▨				
M-01	KCA 7.5/05 M-597919-01-1	McManus, S. *et al.*, 2014		▨				
M-01	KCA 7.5/06 M-681589-01-1	McManus, S. *et al.*, 2017		▨				
M-01	KCA 7.5/07 M-681600-01-1	Pinasseau, L. *et al.*, 2019		▨				
Fluopicolide	KCA 7.5/08 M-589687-01-1	Gulkowska, A. *et al.*, 2014			▨			
Fluopicolide	KCA 7.5/09 M-589692-01-1	Lefrancq, M. *et al.*, 2017			▨			
M-01	KCA 7.5/10 M-529707-01-1	Moschet, C. *et al.*, 2015			▨			
M-01	KCA 7.5/11 M-557391-01-1	McKnight, U. *et al.*, 2015			▨			
M-01	KCA 7.5/12 M-597682-01-1	Bohn, T. *et al.*, 2011			▨	▨		
M-01	KCA 7.5/13 M-642713-01-1	Ahrens, L. *et al.*, 2018			▨			
M-01	KCA 7.5/14 [B] M-532496-01-1	Kvaerner, J. *et al.*, 2014				B		

[A] No public monitoring data are available in soil or drinking water for fluopicolide or M-01

[B] KCA 7.5/14, M-532496-01-1 reports BAM detected in Norwegian drinking water wells (maximum 0.39 µg/L, n =6) in 1999 and 2000 resulting from historic dichlobenil applications. Information is included for completeness only as residues are not due to fluopicolide applications.

Data Point:	KCA 7.5/01
Report Author:	[redacted]
Report Year:	2020
Report Title:	Fluopicolide (FLC) and its metabolite 2,6-dichlorobenzamide (BAM): public environmental monitoring data (groundwater, surface water, soil, air and sediment)
Report No:	EnSa-20-0476
Document No:	M-686397-02-1
Guideline(s) followed in study:	None
Deviations from current test guideline:	Not applicable
Previous evaluation:	No, not previously submitted
GLP/Officially recognised testing facilities:	No, not conducted under GLP/Officially recognised testing facilities
Acceptability/Reliability:	Yes

Executive Summary

Searches for public monitoring data were performed to provide an overview of residue concentrations of fluopicolide (FLC, parent) and 2,6-dichlorobenzamide (M-01, BAM, metabolite) in the environmental compartments of groundwater, surface water, soil, air and sediment in the frame of the EU approval renewal of fluopicolide according to EU Regulations 1107/2009 and 844/2012. The search was predominantly based on internet sources identifying databases and reports which are publicly accessible e.g. from the national Environmental Agencies of EU Member States.

The data search used the key words "fluopicolide" as well as "2,6-dichlorobenzamide" and "BAM". If applicable, the time period searched for was from 1995 to present (April 2020). Available monitoring data was analysed for potential exceedance of regulatory thresholds appropriate for the compartment and the results summarised. Results of the search indicate that monitoring information is not generally available to the public in all Member States. Information is also not necessarily available at national level, while it is in some cases only available at some state, regional or province level.

Metabolite M-01 "BAM" is a common metabolite of the two active substances FLC and dichlobenil. Dichlobenil is a former active substance no longer registered in the EU which entered the market in the 1960s and authorizations expired in the period 1997 to 2013. In contrast, FLC authorizations commenced between 2006-2011 in most EU Member States. The consequence of this is that residue detections of BAM may not be readily attributable to the use of FLC but are mainly attributable to dichlobenil. This is particularly relevant for Denmark being the only Member State in which FLC was never registered for use. Denmark holds a large groundwater monitoring dataset on BAM and any detections can unequivocally be attributed to historic dichlobenil usage.

Key Regulatory Acceptable Concentrations (RACs) are considered for surface water (3.6 µg/L for FLC, 1.8 mg/L for BAM). For groundwater, a value of 0.1 µg/L applies for FLC. As part of the EFSA conclusion (2009) for FLC, BAM is classified as a non-relevant metabolite. The conclusion was derived from application of the guidance document assessing the relevance of metabolites in groundwater (EU Sanco/221/2000 rev. 10 Feb 2003) which is the current guidance document, and this considered as still valid today. In this guidance document an arbitrary general non-specific limit value of 10 µg/L was selected (for chlorinated aliphatic hydrocarbons) and therefore for the purpose of this project the same concentration threshold of 10 µg/L was selected for BAM. The life-time WHO health based safe drinking water limit for all consumer groups ranges from 67-350 µg/L – see document N4.

The results from the groundwater monitoring data search indicate that FLC concentrations above the regulatory trigger of 0.1 µg/L are rare (14 samples; 0.10% of 13,573 analyses) with a maximum concentration of 0.73 µg/L. For BAM, the monitoring data amount is much larger (293,108 analyses) but BAM concentrations above 10 µg/L are proportionally also rare (32 samples, 0.011% of the analyses). Moreover, excluding the BAM data for Denmark, where this metabolite cannot originate from FLC usage, there are only 9 samples that exceed the 10 µg/L concentration threshold which relates to an exceedance rate of 0.0044% for a total of 205,018 samples.

The results from the surface water monitoring data search indicate that FLC concentrations above the Tier 1-RAC-SW (3.6 µg/L) are rare (5 samples, 0.022% of 22,592 analyses) and the highest value was 19 µg/L. The results from the surface water monitoring data search for BAM show that no residue concentrations above the Tier 1-RAC-SW (1.8 mg/L) were measured (0 samples of 179,028 analyses) and the highest value was 8 µg/L.

For the air compartment, analyses with FLC or BAM concentrations above the LOQ were found but no residue concentration above 0.006 ng/m^3 was reported.

For the sediment compartment, results from the monitoring data search were only found for BAM, indicating that residue concentrations above LOQ were rare (2 samples, 0.15% of 1,350 analyses) and did not exceed 23 µg/kg dry matter.

It cannot be discounted that some of the detections identified are erroneous; given they originate from non-GLP monitoring networks and programmes of unknown quality.

Monitoring of FLC and BAM has not been recorded nor documented in soil or drinking water.

Overall it can be concluded from assessment of readily available public monitoring datasets that fluopicolide (FLC) and 2,6-dichlorobenzamide (BAM) do not pose a concern for the investigated environmental compartments.

I. Materials and Methods

This evaluation includes the following Member States: Austria, Czech Republic, Denmark, France, Germany, Greece, Italy, the Netherlands, Sweden, Slovenia, Spain, Switzerland, United Kingdom, and also includes 'supra national' i.e. EU and river basin databases, for which Public Monitoring Programs and their data were found accessible via a link on the internet. Overall, the search includes results of public monitoring from between the years 1995 and 2019. Evaluation of these data should be undertaken with caution as they are collected from monitoring points of unknown quality and to unknown quality standards and experience from using these data suggests that they contain false positive findings.

Searches were performed in a list of databases or national information portals (Table 7.5- 4). The parent FLC as well as the metabolite M-01 BAM were subject of this overview of monitoring results. The search was conducted with "fluopicolide" as well as "2,6-dichlorobenzamide" and "BAM" as key words. This would also cover national spellings of the analyte, e.g. "fluopikolid", "2,6-dichlorobenzamide", "2,6-dichlorobenzamid", "2,6-Dichlorbenzamide", "2,6-dichloorbenzamide", "BAM" etc...

If applicable, the time period for which monitoring results were searched, was from 1995 to today (April 2020). Where monitoring data was found, this was analysed for exceedance of regulatory thresholds appropriate for the compartment and the results were summarised.

Table 7.5- 4: Searching results for Austria, Czech Republic, Denmark, France, Germany, Greece, Italy, Netherlands, Spain, Sweden, Switzerland, United Kingdom and also includes 'supra national' i.e. EU or river basin data sources

Country	Data Source/Organisation	Monitoring Data available [Yes/No]
Europe	NORMAN - EMPODAT Database - Network of reference laboratories, research centres and related organisations for monitoring of emerging environmental substances	Please see comment below*
	Danube River Basin Water Quality Database	Yes
Austria	Federal Ministry for Sustainability and Tourism – Water Database	Yes
	Annual National Reports on water quality	Yes
Czech Republic	IS Arrow – Assessment and Reference reports of water monitoring	Yes
Denmark[a)]	Geological Survey of Denmark and Greenland – Groundwater analyses	Yes
	Danish Pesticide Leaching Assessment Programme	No monitoring data reported**
France	Naïades – National Surface Water Quality Data Portal	Yes
	ADES – National Groundwater Quality Portal	Yes
Germany	Sachsen Environment Agency – Surface water/Groundwater Quality Portal	Yes
	Rheinland Pfalz – State Office for the Environment, Water Management and Trade Inspection	No monitoring data reported**
	Baden-Württemberg – State Institute for the Environment, Measurements and Nature Conservation	No monitoring data reported**
	Elbe River Basin – Data Information System	No monitoring data reported**
	LAWA - Working Group on water issues of the Federal States and the Federal Government	No monitoring data reported**
	Rheinland Pfalz GeoPortal Wasser	No monitoring data reported**
	Schleswig-Holstein - Landesamt für Landwirtschaft, Umwelt und Ländliche Räume	No monitoring data reported**
Greece	Ypeka – Ministry of Environment and Energy	No monitoring data reported**
Italy	Italian National Institute for Environmental Protection and Research (ISPRA) – Pesticide Portal and annual national reports	Yes
Netherlands	Groundwater Atlas for pesticides in The Netherlands[b)]	Yes
	Water Quality Data portal of the Netherlands – groundwater and surface water data	Yes
	Ground Water Quality Report	Yes
Slovenia	Slovenia Environment Agency	Yes

Country	**Data Source/Organisation**	**Monitoring Data available [Yes/No]**
Spain	Confederación hidrográfica del Ebro, Web de Consulta de datos de Calidad de Aguas Superficiales	No monitoring data reported**
	Demarcación Hidrográfica de las Cuencas Mediterráneas Andaluzas; Consejería de Medio Ambiente y Ordenación del Territorio, Junta de Andalucía	No monitoring data reported**
	Confederación hidrográfica del Guadalquivir; Consulta de datos de calidad de aguas superficiales	No monitoring data reported**
	Confederación hidrográfica del Júcar; Descarga de datos y Cartografía	No monitoring data reported**
	Confederación hidrográfica del Segura; Redes de control de las masas de agua superficiales	No monitoring data reported**
Sweden	Swedish University of Agricultural Sciences – Pesticide Database	Yes
Switzerland	NAQUA – Report: Plant protection products and their degradation products in groundwater 2007 - 2017	Yes
United Kingdom	England Environment Agency - Water quality archive	No monitoring data reported**
	Drinking Water Inspectorate of England and Wales – Chief Inspector Annual Reports	No monitoring data reported**
	Pesticide Monitoring Bulletin	Yes

* In the NORMAN database, the data of the national/regional databases is repeated. Therefore, the results are displayed only for the national/regional data.

** Search was conducted, but using English key words neither references in monitoring databases nor monitoring reports could be found.

[a] In Denmark, FLC was never registered for use. As a consequence, the residue detections of BAM cannot derive from FLC usage and can be excluded.

[b] The data from this database is used here only as indicative since the quality check from authorities is still on-going. The database will be "ready" for use in 2021.

II. Results and Discussion

The parent fluopicolide (FLC) was moderately quantified (less than 11% of the analyses showed residue levels above LOQ) in groundwater and surface water samples retrievable from readily available public monitoring databases spanning 2010 – 2019 for 8 Member States, namely Austria, Czech Republic, France, Germany, Italy, the Netherlands, Sweden and the UK. In the cases where it was quantified with residue levels above LOQ, there were only sparse findings above the applied thresholds. A few records relating to concentrations in air were also found and were below the LOQ, except for Sweden.

The metabolite M-01 2,6-dichlorobenzamide (BAM) was also moderately quantified (less than 9% of the analyses showed residue levels above LOQ) in groundwater and surface water samples retrievable from readily available public monitoring databases spanning 1995 – 2019 for 10 Member States, namely Austria, Czech Republic, Denmark, France, Germany, Italy, the Netherlands, Slovenia, Sweden and Switzerland and the Danube database. There were only sparse findings above the applied thresholds. A few records relating to concentrations in air and sediment were also found and were below the LOQ, except for Sweden and France.

Groundwater

For FLC, a total of 13,573 groundwater analyses were investigated (Table 7.5- 5), of which 590 analyses quantified FLC (with residue levels above LOQ), including 14 analyses which suggest exceedance of the regulatory threshold of 0.1 µg/L (0.10% of samples). These exceedances were found in analyses from France, Germany and Italy where they represent 0.011%, 0.068% and 0.58% of all analyses, respectively. The maximum concentration was reported as 0.73 µg/L (in Italy).

For M-01 BAM, a total of 205,018 groundwater analyses were investigated (excluding Denmark and Switzerland, Table 7.5- 5), of which 11,112 analyses quantified BAM (with residue levels above LOQ), including at least 9 analyses (for reports from Austria and the Netherlands no conclusion can be drawn) which suggest exceedance of the threshold of 10 µg/L (0.0044% of samples). These exceedances were found in analyses from Austria, France and the Netherlands. The maximum concentration was reported as 18.86 µg/L (in France).

Table 7.5- 5: Summary of public monitoring results for fluopicolide (FLC) and M-01 / 2,6-dichlorobenzamide (BAM) in groundwater

Fluopicolide (FLC)						
Country	**Data Source/ Organisation**	**Monitoring Period**	**Samples**	**Quantifications* (≥LOQ)**	**≥0.1 µg/L**	**≥0.1 µg/L (%)**
Austria	Federal Ministry for Sustainability and Tourism – Water Database	2019	482	482	0	0.0
Czech Republic	IS Arrow – Assessment and Reference reports of water monitoring	2019	407	1	0	0.0
France	ADES – National Groundwater Quality Portal	2016 – 2019	8,734	31	1	0.011
Germany	Sachsen Environmental Agency	2012 – 2018	1,477	5	1	0.068
Italy	Italian National Institute for Environmental Protection and Research (ISPRA) Pesticide Portal	2013 - 2016	2,065	70	12	0.58
Netherlands	Groundwater Atlas for Pesticides**	2011 - 2016	185	0	0	0.0
	Groundwater Quality Report 2017	2015-2016	161	1	0	0.0
Sweden	Swedish University of Agricultural Sciences – Pesticide Database	2015	62	0	0	0.0

M-01 2,6-dichlorobenzamide (BAM)

Country	Data Source/ Organisation	Monitoring Period	Samples	Quantifications* (≥LOQ)	≥10µg/L	≥10µg/L (%)
Austria	Federal Ministry for Sustainability and Tourism – Water Database	2014-2019	33,305^{A}	994	2	0.006
	Annual reports on water quality	2013-2016	18,020	572	-^{5}	-^{5}
Czech Republic	IS Arrow – Assessment and Reference reports of water monitoring	2017-2019	3,663	43	0^{5}	0.0^{5}
Denmark***	Geological Survey of Denmark and Greenland – Groundwater Data analyses	1995-2020	88,090**	12,411	23	0.026
France	ADES – National Groundwater Quality Portal	2000 – 2019	124,025	7,294	3	0.0024
Germany	Sachsen Environmental Agency	2006 – 2018	3,161	-^{C}	0	0.0
Italy	Italian National Institute for Environmental Protection and Research (ISPRA) – Pesticide Portal	2011 - 2016	9,480	360	0	0.0
Netherlands	Groundwater Atlas for Pesticides and Water Quality Data portal of the Netherlands – groundwater^{D}	1995 - 2019	8,681	1,708	4	0.046
	Groundwater Quality Report 2017	2015-2016	978	134	-^{E}	-^{E}
Slovenia	Slovenia Environment Agency	2007-2018	2,979	4	0	0.0
Sweden	Swedish University of Agricultural Sciences – Pesticide Database	2004 – 2015	726	3	0	0.0
Switzerland	NAQUA – Report: Plant protection products and their degradation products in groundwater 2007 - 2017	2002-2003	32^{B}	17	0^{E}	0.0^{E}

* Quantifications represent the number of analyses with residue levels amounted for neither "zero" and nor "<LOQ". The value of the LOQ is depending on analytical method and therefore variable (LOQ values ranged from 0.005 to 0.02 µg/L for FLC and from 0.01 to 0.1 µg/L for BAM and in some databases LOQ value was not specified, please see chapter 4.2 for details).

** The data from this database is used here only as indicative since the quality check from authorities is still on-going.

*** FLC was never authorised for usage in Denmark, the recorded BAM detections must derive for Dichlobenil. Therefore, this dataset is excluded from evaluation and is presented only as indicative.

[A] In Austria, a total of 97,252 entries could be found in the database, but only 33,305 analyses contain residue data.

[B] In Switzerland, in the reports 2014 and 2017 the number of sampling points is given instead of number of samples, and therefore the results are not included in the statistics.

[C] In Germany, LOQ was unspecified, however the residue levels ranged from 0.05 µg/L to 2 µg/L and were all below 10 µg/L.

[D] In Netherlands, for BAM, since some data were identical between these two databases, both datasets were compiled for BAM, and replicates were removed. Additionally, the data from the Groundwater Atlas database is used here only as indicative since the quality check from authorities is still on-going.

[E] In the reports from Austria, Italy, Netherlands, Switzerland and Czech Republic, groundwater data were only compared to 0.1 µg/L, therefore no statistics are possible, however the maximum value reported in Switzerland, Italy and Czech Republic is always below 10 µg/L.

Surface water

For FLC, a total of 22,592 samples of surface water analyses were investigated (excluding United Kingdom, Table 7.5- 6), of which 2,460 analyses quantified FLC (with residue levels above LOQ), including 5 analyses which indicate exceedance of the regulatory acceptable concentration (Tier 1-RAC-SW) of 3.6 µg/L (0.022% of samples). All these 5 exceedances were found in analyses from the Netherlands. The maximum reported surface water concentration was reported as 19 µg/L (in the Netherlands).

For M-01 BAM, a total of 179,028 samples of surface water analyses were investigated (Table 7.5- 6), of which 14,728 analyses quantified M-01 BAM (with residue levels above LOQ), with no exceedance of the regulatory acceptable concentration (Tier 1-RAC-SW) of 1.8 mg/L. The maximum reported surface water concentration was from the Netherlands, reported as 8 µg/L.

Table 7.5- 6: Summary of public monitoring results for fluopicolide (FLC) and M-01 2,6-dichlorobenzamide (BAM) in surface water

Fluopicolide (FLC)						
Country	**Data Source/ Organisation**	**Monitoring Period**	**Samples**	**Quantifications* (≥LOQ)**	**>RAC****	**>RAC** (%)**
Austria	Annual reports on water quality	2013-2015	313	5	0	0.0
Czech Republic	IS Arrow – Assessment and Reference reports of water monitoring	2017-2019	2,369	72	0[5]	0.0[5]
France	Naïades – National Surface Water Quality Data Portal	2015 - 2018	1,520	38	0	0.0
Germany	Sachsen Environmental Agency	2012 – 2019	8,693	-[1]	0	0.0
Italy	Italian National Institute for Environmental Protection and Research (ISPRA) – Pesticide Portal incl. annual reports	2013 - 2016	4,787	510	0[5]	0.0[5]
Netherlands	Water quality Data Portal	2010-2017	4,383	1,835	5	0.11
Sweden	Swedish University of Agricultural Sciences Pesticide Database	2015-2018	527	125	0	0.0
United Kingdom	Pesticide Monitoring Bulletin	2014 – 2018	-[2]	1,227	0	0.0
M-01 2,6-dichlorobenzamide (BAM)						
Country	**Data Source/ Organisation**	**Monitoring Period**	**Samples**	**Quantifications* (≥LOQ)**	**>RAC****	**>RAC** (%)**
Europe***	Danubis - The ICPDR Information System	2013	22	0	0	0.0
Austria	Federal Ministry for Sustainability and Tourism – Water Database	2007 - 2008	22	11	0	0.0
Czech Republic	IS Arrow – Assessment and Reference reports of water monitoring	2017-2019	3,838	294	0[5]	0.0[5]
France	Naïades – National Surface Water Quality Data Portal	1999 - 2018	137,304	9,276	0	0.0
Germany	Sachsen Environmental Agency	2012 – 2019	7,753	28	0	0.0
Italy	Italian National Institute for Environmental Protection and Research (ISPRA) – Pesticide Portal incl. annual reports	2011 - 2016	11,525	404	0[5]	0.0[5]

Netherlands	Water quality Data Portal	1996 - 2017	15,324[4]	3,979	0	0.0
Slovenia	Slovenia Environment Agency	2015 - 2019	1,046	0	0	0.0
Sweden	Swedish University of Agricultural Sciences Pesticide Database	2002-2018	2,093	741	0	0.0

* Quantifications represent the number of analyses with residue levels amounted to neither "zero" and nor "<LOQ". The value of the LOQ is depending on analytical method and therefore variable (LOQ values ranged from 0.002 to 0.02 µg/L for FLC and from 0.002 to 0.086 µg/L for BAM, in some databases LOQ value was not specified, please see chapter 4.2 for details).

** RAC value for FLC: 3.6 µg/L; for BAM: 1.8 mg/L

*** Includes countries Austria, Bulgaria, Croatia, Hungary, Serbia, Romania

[1] In Germany, LOQ was not specified, however the residue levels ranged from 0 µg/L to 1.4 µg/L and were all below the RAC of 3.6 µg/L.

[2] In the UK, only "positive findings" (analyses with residue levels above LOQ) are presented in the reports but the total number of samples analyzed is unclear and therefore results are not included in the statistics.

[3] In Austria, a total of 22 entries could be found in the database, but only 11 analyses contain residue data.

[4] In Netherlands, a total of 15,418 entries could be found in the database, but only 15,324 analyses contain residue data.

[5] In the reports from Italy and Czech Republic, surface water data were only compared to 0.1 µg/L, however the maximum value reported in Italy and Czech Republic is always below 3.6 µg/L for FLC and 1.8 mg/L for BAM.

Air

For FLC and M-01 BAM, Sweden reported 25 analyses of air for each analyte (see Table 7.5- 7) but in none was a finding above 0.006 ng/m^3 reported.

Table 7.5- 7: Summary of public monitoring results for fluopicolide (FLC) and M-01 2,6-dichlorobenzamide (BAM) in air

Fluopicolide (FLC)					
Country	**Data Source/ Organisation**	**Monitoring Period**	**Samples**	**Quantifications* (≥LOQ)**	**Quantifications* (≥LOQ, %)**
Sweden	Swedish University of Agricultural Sciences – Regional Pesticide Database	2016 - 2017	25	1	4.0
2,6-dichlorobenzamide (BAM)					
Country	**Data Source/ Organisation**	**Monitoring Period**	**Samples**	**Quantifications* (≥LOQ)**	**Quantifications* (≥LOQ, %)**
Sweden	Swedish University of Agricultural Sciences – Regional Pesticide Database	2016 - 2017	25	5	20.0

* Quantifications represent the number of analyses with residue levels amounted to neither "zero" and nor "<LOQ". The value of the LOQ is depending on the analytical method and therefore variable (LOQ values ranged from 0.002 to 0.003 ng/m^3 for FLC and from 0.0007 to 0.026 ng/m^3 for BAM).

Sediment

No sediment data were identified for FLC.

For M-01 BAM, France reported 1,350 analyses of sediments (Table 7.5- 8) of which two analyses quantified M-01 BAM at levels above LOQ. The maximum reported sediment concentration is reported as 23 µg/kg dry matter.

Table 7.5- 8: Summary of public monitoring results for M-01 2,6-dichlorobenzamide (BAM) in sediment

2,6-dichlorobenzamide (BAM)					
Country	**Data Source/ Organisation**	**Monitoring Period**	**Samples**	**Quantifications* (≥LOQ)**	**Quantifications* (≥LOQ, %)**
France	Naïades – Données sur la qualité des eaux de surface French database for surface water	2003 - 2018	1,350	2 2	0.15

* Quantifications represent the number of analyses with residue levels amounted to neither "zero" and nor "<LOQ". The value of the LOQ is depending on the analytical method and therefore variable (LOQ values ranged from 4 to 50 µg/kg dry matter).

Drinking water

Monitoring of FLC and M-01 BAM is not documented for drinking water.

Soil

No soil monitoring data reporting concentrations on a mass basis (e.g. mg/kg) were identified for FLC and M-01 BAM.

Groundwater and surface water detailed results for across the EU and thereafter for individual countries are presented in alphabetical order in Table 7.5-9.

Table 7.5- 9: Groundwater and surface water detailed results for trans-EU and individual countries

Country	Source	Monitoring period	Relevant Compartment	
			Groundwater	Surface water
EU	NORMAN - EMPODAT	2002-2018	The database contains monitoring data for FLC and BAM compiled from national/regional databases already consulted. No new data was identified. For clarity, the results from the national/regional databases, which contain additional data, are presented in the corresponding country/region.	
	Danube River Basin Water Quality Database	2013	Not applicable	**Parent** The database does not contain monitoring data for FLC for this compartment. **2,6-dichlorobenzamide (BAM)** <u>2013</u>: 22 analyses **All analyses <LOD** (LOD 0 µg/L, LOQ 0.01 µg/L)
Austria	Federal Ministry for Sustainability and Tourism – Water Database	1995-2019	**Parent** <u>2019</u>: 482 analyses 1 analysis > LOD (LOD: 0.015 µg/L) **All analyses <0.1 µg/L** **2,6-dichlorobenzamide (BAM)** <u>2014-2019</u>: 97,241 analyses, including 63,936 analyses without any information on residue level (empty cell) 33,305 analyses <LOQ (LOQ: 0.00376-0.05 µg/L, LOD unspecified) 994 analyses > LOQ (LOQ 0.00376-0.05 µg/L) Range: 0.016-12 µg/L **2 analyses >10 µg/L** **Maximum residue level 12 µg/L**	**Parent** The database does not contain monitoring data for FLC for this compartment. **2,6-dichlorobenzamide (BAM)** <u>2007-2008</u>: 22 analyses, including 11 analyses without any information on residue level (empty cell) 10 analyses < LOD (LOD: 0.025 - 0.043 µg/L**)** 2 analyses > LOD (LOD: 0.025 - 0.043 µg/L**)** **All analyses <LOQ** (LOQ: 0.086 µg/L)

Country	Source	Monitoring period	Relevant Compartment	
			Groundwater	Surface water
	Annual national reports on water quality	1997-2016	**Parent** The reports do not contain monitoring data for FLC for this compartment. **2,6-dichlorobenzamide (BAM)** 2013-2016: 18,020 analyses 572 analyses > LOQ (with residue, LOD/LOQ unspecified) 6 analyses > 3 µg/L ("limit for not-relevant metabolite") **No indication about analyses above 10 µg/L**	**Parent** 2013-2015: 313 analyses 5 analyses > LOQ (with residue, LOD/LOQ unspecified) Maximum residue level 0.45 µg/L **All analyses < 3.6 µg/L** (Tier 1-RAC-SW of FLC) **2,6-dichlorobenzamide (BAM)** The reports do not contain monitoring data for BAM for this compartment.
Czech Republic	IS Arrow – Assessment and Reference reports of water monitoring	2015-2019	**Parent** 2019: 407 analyses 1 analysis > LOQ (LOQ: 0.01 µg/L) Maximum residue level 0.021 µg/L **All analyses <0.1 µg/L** **2,6-dichlorobenzamide (BAM)** 2017-2019: 3,663 analyses 43 analyses > LOQ (LOQ: 0.01 µg/L) Maximum residue level 0.384 µg/L **All analyses <10 µg/L**	**Parent** 2017-2019: 2,369 analyses 72 analyses > LOQ (LOQ: 0.01 µg/L) Maximum residue level 0.28 µg/L **All analyses <3.6 µg/L** (Tier 1-RAC-SW of FLC) (**2,6-dichlorobenzamide (BAM)** 2017-2019: 3,838 analyses 294 analyses > LOQ (LOQ: 0.01-0.02 µg/L) Maximum residue level 0.24 µg/L **All analyses < 1.8 mg/L** (Tier 1-RAC-SW of BAM)

Country	Source	Monitoring period	Relevant Compartment	
			Groundwater	**Surface water**
Denmark	Geological Survey of Denmark and Greenland – Groundwater analyses	1995-2020	**Parent** The database does not contain monitoring data for FLC for this compartment. **2,6-dichlorobenzamide (BAM)** <u>1995-2020</u>: 88,090 analyses 65,414 analyses < LOQ (LOQ: 0.005-0.51 µg/L; LOD: 0.008-0.1 µg/L) 12,411 analyses > LOQ Range: 0-260 µg/L **23 analyses >10 µg/L** **Maximum residue level 260 µg/L** **NOTE: FLC was never authorised for usage in Denmark, the recorded BAM detections must derive for Dichlobenil. Therefore, this dataset is excluded from evaluation and is presented only as indicative.**	Not applicable
	Danish Pesticide Leaching Assessment Programme	1999-2015	The report does not contain monitoring data for FLC or BAM for this compartment.	The report does not contain monitoring data for FLC or BAM for this compartment.

Country	Source	Monitoring period	Relevant Compartment	
			Groundwater	**Surface water**
France	ADES – National Groundwater Quality Portal Naïades – National Surface Water Quality Data Portal (including sediments)	1996–2019	**Parent** 2016-2019: 8,734 analyses 8,703 analyses <LOQ including 1,735 analyses < LOD (LOQ: 0 - 0.1 µg/L, LOD: 0 - 0.5 µg/L) 31 analyses > LOQ Range: 0.007-0.193 µg/L **1 analysis >0.1 µg/L** **Maximum concentration 0.193 µg/L** **2,6-dichlorobenzamide (BAM)** 2000-2019: 124,025 analyses including 1,494 analyses at zero residue level 115,237 analyses <LOQ including 58,922 analyses < LOD (LOQ: 0 - 0.1 µg/L, LOD: 0 - 0.5 µg/L) 7,294 analyses > LOQ Range: 0.03-18.86 µg/L **3 analyses >10 µg/L** **Maximum residue level 18.86 µg/L**	**Parent** 2015-2018: 1,520 analyses 38 analyses > LOQ (LOQ: 0.005-0.04 µg/L; LOD: 0.003-0.014 µg/L) Range: 0.02-0.514 µg/L **All analyses <3.6 µg/L** (Tier 1-RAC-SW of FLC) **2,6-dichlorobenzamide (BAM)** 1999-2018: 137,304 analyses 128,028 analyses < LOQ including 136 analyses < LOD (LOQ: 0.02-0.2 µg/L; LOD: 0.00067-0.2 µg/L) 9,276 analyses > LOQ Range: 0.002-1.9 µg/L **All analyses < 1.8 mg/L** (Tier 1-RAC-SW of BAM)
Germany	Sachsen Environmental Agency	1995-2019	**Parent** 2012-2018: 1,477 analyses including 1,472 analyses at zero residue level (LOD/LOQ unspecified) Range: 0.025-0.12 µg/L **1 analysis >0.1 µg/L** **Maximum residue level: 0.12 µg/L** **2,6-dichlorobenzamide (BAM)** 2006-2018: 3,161 analyses including 3,117 analyses at zero residue level (LOD/LOQ unspecified) Range: 0.05-2.0 µg/L **All analyses <10 µg/L**	**Parent** 2012-2019: 8,693 analyses including 8,612 analyses at zero residue level (LOD/LOQ unspecified) Range: 0.025-1.4 µg/L **All analyses < 3.6 µg/L** (Tier 1-RAC-SW of FLC) **2,6-dichlorobenzamide (BAM)** 2012-2019: 7,753 analyses including 7,502 analyses at zero residue level 28 analyses > LOQ (LOQ: 0.05 µg/L) Range: 0.051-1.4 µg/L **All analyses < 1.8 mg/L** (Tier 1-RAC-SW of BAM)

Country	Source	Monitoring period	Relevant Compartment	
			Groundwater	Surface water
	Rheinland Pfalz - State Office for the Environment, Water Management and Trade Inspection	Varies	The reports do not contain monitoring data for FLC or BAM for this compartment.	The reports do not contain monitoring data for FLC or BAM for this compartment.
	Baden-Württemberg - State Institute for the Environment, Measurements and Nature Conservation	2006-2018	The reports do not contain monitoring data for FLC or BAM for this compartment.	Not applicable
	Elbe River Basin - Data Information System	1995-2019	Not applicable	The database does not contain monitoring data for FLC or BAM for this compartment.
	LAWA - Working Group on water issues of the Federal States and the Federal Government	2003-2019	The database does not contain monitoring data for FLC or BAM for this compartment.	The database does not contain monitoring data for FLC or BAM for this compartment.
	Rheinland-Pfalz GeoPortal Wasser	1995-2017	Not applicable	The database does not contain monitoring data for FLC or BAM for this compartment.
	Schleswig-Holstein - Landesamt für Landwirtschaft, Umwelt und Ländliche Räume	2015-2017	Not applicable	The database does not contain monitoring data for FLC or BAM for this compartment.
	Ypeka – Ministry of Environment and Energy	Not specified	The database does not contain monitoring data for FLC or BAM for this compartment.	The database does not contain monitoring data for FLC or BAM for this compartment.

Italy	Italian National Institute for Environmental Protection and Research (ISPRA) – Pesticide Portal National Statistical Data (2013 – 2016) National Annual Reports 2011-2012	2011-2016	**Parent** 2013: 236 analyses 8 analyses >LOQ (LOQ 0.005 µg/L) Maximum residue level 0.034 µg/L **All analyses <0.1 µg/L** 2014: 379 analyses 3 analyses >LOQ (LOQ 0.005 µg/L) Maximum residue level 0.021 µg/L **All analyses <0.1 µg/L** 2015: 464 analyses 2 analyses >LOQ (LOQ 0.005 µg/L) Maximum residue level 0.007 µg/L **All analyses <0.1 µg/L** 2016: 986 analyses 57 analyses >LOQ (LOQ 0.02 µg/L) **12 analyses > 0.1 µg/L** **Maximum residue level 0.73 µg/L** **2,6-dichlorobenzamide (BAM)** 2011: 1,321 analyses 65 analyses >LOQ (LOQ of 0.05 µg/L) Maximum residue level 0.76 µg/L **All analyses <10 µg/L** 2012: 1,840 analyses 75 analyses >LOQ (LOQ of 0.02 µg/L) Maximum residue level 1.2 µg/L **All analyses <10 µg/L** 2013: 1,669 analyses 75 analyses >LOQ (LOQ of 0.02 µg/L) Maximum residue level 1.27 µg/L **All analyses <10 µg/L** 2014: 1,566 analyses 88 analyses >LOQ (LOQ of 0.02 µg/L) Maximum residue level 0.63 µg/L **All analyses <10 µg/L** 2015: 1,711 analyses 135 analyses >LOQ (LOQ of 0.02 µg/L)	Since the database displays the same results as the reports for 2013 - 2016, the two source types will not be distinguished here for these years: **Parent** 2013: 188 analyses 37 analyses >LOQ (LOQ 0.005 µg/L) Maximum residue level 0.854 µg/L **All analyses <3.6 µg/L** (Tier 1-RAC-SW of FLC) 2014: 1,095 analyses 128 analyses >LOQ (LOQ 0.005 µg/L) Maximum residue level 0.41 µg/L **All analyses <3.6 µg/L** (Tier 1-RAC-SW of FLC) 2015: 1,510 analyses 160 analyses >LOQ (LOQ 0.005 µg/L) Maximum residue level 0.009 µg/L **All analyses <3.6 µg/L** (Tier 1-RAC-SW of FLC) 2016: 1,994 analyses 185 analyses >LOQ (LOQ 0.005 µg/L) Maximum residue level 0.274 µg/L **All analyses <3.6 µg/L** (Tier 1-RAC-SW of FLC) **2,6-dichlorobenzamide (BAM)** 2011: 1,443 analyses 5 analyses >LOQ (LOQ 0.05 µg/L) Maximum residue level 0.47 µg/L **All analyses < 1.8 mg/L** (Tier 1-RAC-SW of BAM) 2012: 2,087 analyses 61 analyses >LOQ (LOQ 0.02 µg/L) Maximum residue level 0.52 µg/L **All analyses < 1.8 mg/L** (Tier 1-RAC-SW of BAM) 2013: 1,663 analyses 47 analyses >LOQ (LOQ 0.02 µg/L) Maximum residue level 0.23 µg/L **All analyses < 1.8 mg/L** (Tier 1-RAC-SW of BAM) 2014: 2,117 analyses 106 analyses >LOQ (LOQ 0.02 µg/L) Maximum residue level 0.26 µg/L

Country	Source	Monitoring period	Relevant Compartment	
			Groundwater	Surface water
			Maximum residue level 0.03 µg/L **All analyses <10 µg/L** 2016: 1,373 analyses 86 analyses >LOQ (LOQ of 0.02 µg/L) Maximum residue level 1.12 µg/L **All analyses <10 µg/L**	**All analyses < 1.8 mg/L** (Tier 1-RAC-SW of BAM) 2015: 2,006 analyses 105 analyses >LOQ (LOQ 0.02 µg/L) Maximum residue level 0.02 µg/L **All analyses < 1.8 mg/L** (Tier 1-RAC-SW of BAM) 2016: 2,209 analyses 80 analyses >LOQ (LOQ 0.02 µg/L) Maximum residue level 0.24 µg/L **All analyses < 1.8 mg/L** (Tier 1-RAC-SW of BAM)
Netherlands	Water Quality Data Portal – surface water	1995-2017	Not applicable	**Parent** 2010-2017: 4,383 analyses 2,548 analyses < 0.001-0.1 µg/L (LOD/LOQ unspecified) 1,835 analyses > 0.001-0.1 µg/L (LOD/LOQ unspecified) Range 0.001-19 µg/L **5 analyses > 3.6 µg/L** (Tier 1-RAC-SW of FLC) **Maximum residue level 19 µg/L** **2,6-dichlorobenzamide (BAM)** 1996-2017: 15,418 analyses including 94 analyses without any information on residue level (empty cell) and 1 analysis at zero residue level 11,344 analyses < 0.002-0.5 µg/L (LOD/LOQ unspecified) 3,979 analyses > 0.002-0.5 µg/L (LOD/LOQ unspecified) Range: 0.014-1.4 µg/L **All analyses < 1.8 mg/L** (Tier 1-RAC-SW of BAM)

Country	Source	Monitoring period	Relevant Compartment	
			Groundwater	Surface water
	Water Quality Data Portal –groundwater Groundwater Atlas for Pesticides	1995-2019	**Parent** 2011-2016: 185 analyses **All analyses < LOQ** (LOQ 0.01 µg/L) **2,6-dichlorobenzamide (BAM)**[a)] 1995-2019: 8,681 analyses 1,708 analyses > LOQ (LOQ 0.01 - 0.1 µg/L) Range: 0.01-18 µg/L **4 analyses > 10 µg/L** **Maximum residue level 18 µg/L**	Not applicable
	Ground water Quality – Report 2017	2015-2016	**Parent** 2015-2016: 161 analyses 1 analysis >LOQ (LOQ unspecified) **All analyses < 0.1 µg/L** **2,6-dichlorobenzamide (BAM)** 2015-2016: 978 analyses 134 analyses > LOQ (LOQ/LOD unspecified) 74 analyses > 0.1 µg/L **No indication about analyses above 10 µg/L**	Not applicable
Slovenia	Slovenia Environment Agency	2007-2019	**Parent** The database does not contain monitoring data for FLC for this compartment. **2,6-dichlorobenzamide (BAM)** 2007 - 2019: 2,979 analyses 4 analyses > LOQ (LOQ 0.006-0.06 µg/L) Range: 0.022-0.091 µg/L **All analyses ≤10 µg/L**	**Parent** The database does not contain monitoring data for FLC for this compartment. **2,6-dichlorobenzamide (BAM)** 2015 - 2018: 1,046 analyses **All analyses <LOQ** (LOQ 0.02-0.05 µg/L; LOD 0.01 µg/L)

Country	Source	Monitoring period	Relevant Compartment	
			Groundwater	**Surface water**
Spain	Directiva Marco del Agua – Calidad - Junta de Andalucía Web de Consulta de datos de Calidad de Aguas Superficiales – Ebro Confederación hidrográfica del Segura, O.A. Ríos hormonados - Amplia presencia de plaguicidas disruptores endocrinos en los ríos españoles	Junta de Andalucía: 1995-2019 Ebro: 2002-2019 Segura: 2008-2017 Report Rios de hormonados: 2012 + 2016	Not applicable	These reports / databases do not contain monitoring data for FLC or BAM for this compartment.
Sweden	Swedish University of Agricultural Sciences –Pesticide Database	2002-2018	**Parent** <u>2015</u>: 62 analyses All analyses at zero residue level (LOQ 0.01 µg/L, LOD 0.002 µg/L) **All analyses <LOQ** **2,6-dichlorobenzamide (BAM)** <u>2004 - 2015</u>: 726 analyses including 723 analyses at zero residue level 3 analyses with residues above zero (LOQ 0.01 - 0.02 µg/L, LOD 0.002 - 0.02 µg/L) Range: 0.01—0.019 µg/L **All analyses <10 µg/L**	**Parent** <u>2015-2018</u>: 527 analyses including 402 analyses at zero residue level 125 analyses with residues above zero (LOQ 0.002 - 0.01 µg/L, LOD 0.001 - 0.005 µg/L) Range: 0.002-0.24 µg/L **All analyses < 3.6 µg/L** (Tier 1-RAC-SW of FLC) **2,6-dichlorobenzamide (BAM)** <u>2002 - 2018</u>: 2,093 analyses including 1352 analyses at zero residue level 741 analyses with residues above zero (LOQ 0.01 - 0.04 µg/L, LOD 0.002 - 0.03 µg/L) Range 0.01-0.47 µg/L **All analyses <1.8 mg/L** (Tier 1-RAC-SW of BAM)

Country	Source	Monitoring period	Relevant Compartment	
			Groundwater	**Surface water**
Switzerland	NAQUA – Report: Plant protection products and their degradation products in groundwater 2007 - 2017	Not specified	**ParentNo** The report does not contain monitoring data for FLC for this compartment. **2,6-dichlorobenzamide (BAM)** 2002 – 2003: 32 analyses 17 analyses >LOQ (LOQ of 0.005 µg/L) Maximum residue level 0.047 µg/L **All analyses < 10 µg/L** 2014: 529 measuring points 109 measuring points >LOQ (LOQ unspecified) 82 measuring points > 0.01 µg/L 10 measuring points > 0.1 µg/L 2 measuring points > 0.5 µg/L 1 measuring point > 1 µg/L **No information about analyses above 10 µg/L** 2017: 525 measuring points 97 measuring points >LOQ (LOQ unspecified) 64 measuring points > 0.01 µg/L 3 measuring points > 0.1 µg/L 0 measuring point > 1 µg/L **All analyses < 10 µg/L**	Not applicable
United Kingdom	England Environment Agency - Water quality data archive	2000-2019	Not applicable	These reports do not contain monitoring data for FLC or BAM for this compartment.
	Drinking Water Inspectorate of England and Wales – Chief Inspectors Annual Reports	1995-2018	Not applicable	These reports do not contain monitoring data for FLC or BAM for this compartment.

Country	Source	Monitoring period	Relevant Compartment	
			Groundwater	Surface water
	Pesticide Monitoring Bulletin	2014	Not applicable	**Parent** 1,227 analyses with residue (LOQ 0.01 µg/L, total number of samples analysed unspecified) 1 analysis > 0.1µg/L Maximum residue level 0.14 µg/L **All analyses < 3.6 µg/L** (Tier 1-RAC-SW of FLC) **2,6-dichlorobenzamide (BAM)** These reports do not contain monitoring data for BAM for this compartment.

a): for BAM, since some data were identical between these two databases, both datasets were compiled for BAM, and replicates were removed. Additionally, the data from the Groundwater Atlas database is used here only as indicative since the quality check from authorities is still on-going

III. Conclusion

The groundwater monitoring data search indicates that fluopicolide (FLC, parent) concentrations above the regulatory trigger of 0.1 µg/L are rare (14 samples; 0.10% of 13,573 analyses) with the highest value of 0.73 µg/L. For M-01 2,6-dichlorobenzamide (BAM), the monitoring data amount is much larger (293,108 analyses) but M-01 BAM concentrations above the threshold of 10 µg/L are proportionally also rare (32 samples, 0.011% of the analyses). Moreover, excluding the BAM data for Denmark, where this metabolite cannot originate from FLC usage, there are only 9 samples that exceed the concentration threshold which relates to an exceedance rate of 0.0044% of 205,018 analyses.

The surface water monitoring data search indicate that FLC concentrations above the Tier 1-RAC-SW (3.6 µg/L) are exceedingly rare (5 samples, 0.022% of 22,592 analyses), with the highest value of 19 µg/L. The results from the surface water monitoring data search for BAM show that no residue concentrations above the Tier 1-RAC-SW (1.8 mg/L) were measured (0 samples of 179,028 analyses) and are at most 8 µg/L.

For the air compartment, FLC concentrations and BAM above the LOQ were found but no residue concentration above 0.006 ng/m^3 was reported.

For the sediment compartment results from the monitoring data search were only found for BAM, indicate that residue concentrations above LOQ were rare (2 samples, 0.15% of 1,350 analyses) and did not exceed 23 µg/kg dry matter.

It cannot be discounted that some of the detections identified are erroneous; given they originate from large non-GLP monitoring networks and programmes of unknown quality.

FLC and M-01 BAM monitoring is not documented in soil or drinking water.

Overall it can be concluded from assessment of readily available public monitoring datasets that fluopicolide (FLC) and M-01 2,6-dichlorobenzamide (BAM) do not pose a concern for the environment for the following compartments - surface water, groundwater, drinking water, soil, air and sediment.

Assessment and conclusion by applicant:

This study is reliable and provides information on the exposure values for fluopicolide and the metabolite M-01 (BAM) in surface water, groundwater, drinking water, soil, air and sediment and shows no concerns in any of these compartments.

A) Soil

No public monitoring data or peer reviewed published data is available in soil for fluopicolide or M-01.

B) Water

B.1 Groundwater

Fluopicolide

Data Point:	KCA 7.5/02
Report Author:	[redacted]
Report Year:	2020
Report Title:	Dichlobenil (DCB), fluopicolide (FLC) and their common metabolite 2,6-dichlorobenzamide (BAM): Assessment of groundwater public monitoring data from 8 EU member state countries
Report No:	CEA.2028
Document No:	M-686676-01-1
Guideline(s) followed in study:	None
Deviations from current test guideline:	No. Not applicable
Previous evaluation:	No, not previously submitted
GLP/Officially recognised testing facilities:	No, not conducted under GLP/Officially recognised testing facilities
Acceptability/Reliability:	Yes

Executive Summary:

Fluopicolide (FLC) is a foliar applied fungicide used at relatively low application rates on a range of vegetable crops, potatoes and vines. Recently, it has also been used as a seed treatment in oil seed rape at very low application rates. Dichlobenil (DCB) is a soil applied herbicide that was used to control weeds on a variety of woody crops, grassland non-cropped areas and vineyards at very high application rates. Both FLC and DCB form a common soil metabolite, namely 2,6-dichlorobenzamide (M-01, BAM), which is known to potentially leach to groundwater and has been intensively monitored in many countries for many years.

FLC and DCB have different expiry/authorisation dates with only a small overlap where both a.s. were registered for use. DCB is an 'old' compound which entered the market in the 1960s and authorisations expired during the period 1997 to 2012 in the countries considered in this report. In contrast FLC foliar authorisations commenced between 2006-2011 in most EU Member States, with the first seed treatment authorisations granted in 2018. In addition, there is also a difference in target crops between DCB and FLC, although some overlaps occur.

The scope of this study was to collect groundwater residue data derived from public monitoring across several EU Member States (MS) and to assess these spatially and temporally with the aim to discriminate whether M-01 BAM residues are related to leaching following historical applications of DCB or more recent applications of FLC.

The assessment of the groundwater public monitoring data concluded that there is no apparent risk to groundwater related to FLC usage. The detection rates of FLC are very low across all target Member States and the elucidation of exceedances shows that most of these are likely to be false positive findings or are related to exceptional environmental conditions.

For the non-relevant metabolite M-01 BAM, there is clear evidence that a significant proportion of the M-01 BAM detections are the legacy of historic DCB applications. These DCB linked M-01 BAM detections occur even several years after the expiry of the DCB usage authorisation. From the monitoring data, the possibility that some M-01 BAM detections are related to leaching following FLC usage cannot be excluded, but the data indicate that these are typically low in concentrations and are below the threshold of 10 µg/L for non-relevant metabolites. These conclusions are consistent with the much lower net effective application rates of FLC and its degradation / metabolism which results in less M-01 BAM entering the environment. Out of 210,000 M-01 BAM analyses across the target Member States there were only 13 exceedances of the 10 µg/L groundwater concentration threshold of which 10 were identified to be related to historic DCB applications or are related to exceptional environmental conditions.

I. Materials and Methods

Groundwater residue data for DCB, FLC and M-01 BAM from public monitoring were collected, from EU countries which are most prominent in terms of FLC use. In total 8 EU countries were selected for this exercise which represent in the order of 94% and 95% of FLC sales for the main target crops potatoes and vines, respectively. These countries are: Austria, Belgium, France, Germany, Italy, Netherlands, Poland and UK. From these countries, there are large groundwater monitoring data sets available, with more than 420,000 analytical results for the three analytes FLC, DCB and M-01 BAM, covering a time period from 1989-2019. No data could be included from Poland and the UK. The authorities in Poland confirmed that the three analytes are not part of the national groundwater monitoring programme, and for the UK only data for DCB exist. Although, FLC was never registered for use in Denmark there is a comprehensive dataset for DCB and BAM, and the data from Denmark was therefore included in this assessment as it forms a valuable baseline in terms of historical and ongoing BAM detections in groundwater without the use of FLC.

The registrations of DCB and FLC were evaluated in terms of authorisation dates for each country and the crops for which the products containing the a.s. were authorised for usage. An assessment of the application rates and uses was undertaken in order to compare the possibility for leaching of M-01 BAM associated with DCB and FLC applications.

The groundwater residue data were subsequently processed and assessed temporally and spatially to determine (a) the concentration ranges and detection rates over time in which the analytes were detected in groundwater, (b) whether there are trends in residue concentrations that can be related to the expiry of DCB and/or the authorisation of FLC, and (c) whether there is a spatial correlation between M-01 BAM detections and the occurrence of FLC target crops and/or FLC usage data.

In addition, FLC and M-01 BAM detections above the regulatory threshold for groundwater (0.1 µg/L for FLC and 10 µg/L for the non-relevant metabolite M-01 BAM) were subject to a desk-based elucidation. The aim of the elucidation was to investigate whether these detections were likely to derive from leaching following compliant uses of FLC or are related to historic DCB applications or other circumstances. The elucidation of DCB exceedances was not part of the scope of this study.

II. Results and Discussion

Information on DCB and FLC registrations

The temporal overlap between uses associated with DCB and FLC was assessed by comparing the authorisation expiry date for DCB, extracted from national product registration databases, with the first date of authorisation for FLC, provided by Bayer, for each of the target Member States (Table 7.5- 10). In addition, the potential for a spatial overlap between the uses associated with DCB and FLC was assessed by comparing the crops for which products containing these a.s. were registered.

While these data may be incomplete, they suggest that in most Member States there is little temporal overlap between the authorisation expiry date for DCB and the first date of authorisation for FLC. However, the authorisation expiry date for DCB may not be the date after which DCB usage ceased. An approximately one-year period may need to be added, during which remaining DCB containing products stocks would have been "used up". DCB has a long use history of about 40-50 years and entered the EU market in the 1960s. Its authorisation expired in the EU successively and DCB is no longer registered in any EU Member States. For the target Member States the DCB authorisation expired between 1997 (Denmark) and 2012 (UK).

Similarly, the available product registration data suggest that there is limited overlap between crops for which DCB and FLC products were registered. DCB containing products were registered for use with woody crops including top-fruit, small fruit, vines, ornamentals and forestry. They were also used as a total herbicide on in the amenity and industrial sectors e.g. to treat pathways and railway tracks. In contrast, FLC containing products are registered for use on potatoes, vegetables, vines, cane fruit and herbs. Aside from the uses targeting vines there is little overlap in the target crops. Recently, FLC is also used as a seed treatment in oil seed rape but at very low application rates with the first registrations granted in 2018.

In summary, the registration data suggest that there is only a limited temporal overlap between DCB and FLC authorisation. In terms of common target crops, there seems to be an overlap for vines, however the non-agricultural uses of DCB may make it difficult to discount spatial overlap between DCB and FLC uses in other crops.

A general overview of the registered uses of DCB and FLC in the target Member States is provided in Table 7.5- 10, with overlapping uses marked in bold.

Table 7.5- 10: Authorisation expiry date for DCB, first date of authorisation for FLC and authorised crops

Member State	DCB authorisation expiry date	DCB registered crops	FLC first authorisation date	FLC registered crops
AT	N/R - assume Mar 2010	N/R	Nov 2011	potatoes, vegetables, hops, cane fruit, vines
BE	Apr 2010	woody crops including berries, orchards, ornamental. Until Nov 2007 also for uncultivated and paved land	May 2008	potatoes, vegetables
DE	Aug 2004, suspended in Mar 2001*	water bodies, meadows and pastures, garnet berry, blackcurrant, stone fruit, **vines**, ornamental trees, railway tracks, coniferous wood and hardwood, ways and places with woody plants and tree nurseries with woody plants	Jan 2007	potatoes, vegetables, hops, cane fruit, **vines**

Member State	DCB authorisation expiry date	DCB registered crops	FLC first authorisation date	FLC registered crops
DK	Jul 1997	trees and shrubs, forestry, total herbicide in cultivated areas, non-agricultural use, amenity use, hard surfaces, land adjacent to aquatic areas†	N/A	N/A
FR	Mar 2010	trees and shrubs, cane fruit, **vines**, roses, forestry, non-agricultural use, hard surfaces, aquatic	Feb 2010	potatoes, vegetables, **vines**
IT	Mar 2009	**vines**, olives, apples, ornamentals, amenity use, hard surfaces, land adjacent to aquatic areas	Jul 2008	potatoes, vegetables, herbs, **vines**, flowers
NL	Oct 2008	top fruit (pome), amenity use (excluding hard surfaces), land not intended to bear vegetation	June 2007	potatoes, vegetables, herbs
PL	N/R - assume Mar 2010	top fruit (pome), cane fruit, vines, ornamentals, forestry, amenity use, drainage ditches	Jun 2011	potatoes, vegetables
UK	Sep 2011	top fruit (pome), cane fruit, ornamentals, amenity use, land not intended to bear vegetation, hard surfaces, aquatic, land immediately adjacent to aquatic areas, **potato (post-harvest use)**, **potato (dumps for destruction)**, refuse tip.	Nov 2005	**potatoes**

Overlapping uses are marked in **bold**

N/A – not applicable as not registered in this MS

N/R – no records; N/R – no records assume March 2010 (EC, 2008)

*BVL, 2009

A key difference in the registrations of DCB and FLC is in the approved application rates, although there is limited information on the formerly approved DCB rates for individual countries.

Example DCB rates, compiled from publications, product labels and country authority product registration databases, can be summarised as follows:

- In Denmark, DCB was registered for use at rates around 4-30 kg a.s./ha.
- In France, DCB was registered for use on vines (Casoron G UC) at rates of 100 kg/ha (7.5 kg a.s./ha) and rates on non-crop areas and aquatic environments (Aqua G) were up to 160 kg/ha (12 kg a.s./ha).
- In the Netherlands, DCB rates varied from 30-100 kg/ha (Casoron G and Casoron G4) depending on the target crop, which corresponds to 2-4 kg a.s./ha.
- In Belgium, DCB was last registered in berries, orchards, ornamental trees and hedges at annual application rates between 80-135 kg/ha (Casoron 4GR and Casoron GR) which corresponds to 5.4 kg a.s./ha.
- Germany confirmed product rates for applications in ornamental trees of 4 g/m^2 (2.84 kg a.s./ha) and on railway tracks at 25 g/m^2 (17.75 kg a.s./ha).
- In Italy, DCB rates varied from 75-120 kg/ha (Du-Cason 20 SR) or 16-48 L/ha (Du-Cason Liquid) depending on the crop which corresponds to 8.1 to 20 kg a.s./ha or 2.7-8.2 kg a.s./ha.
- In Poland DCB rates varied from 40 to 100 kg/ha (Casoron 6.75 GR) depending on the target crop which corresponds to 2.7 to 6.75 kg a.s./ha.
- In the UK DCB rates varied from 56 to 225 kg/ha (Casoron G) depending on the target weed and use which corresponds to 3.8 to 15.2 kg a.s./ha.

Apart from the information from Denmark, the DCB rates listed above would typically relate to the last authorisation of DCB containing products when rates would likely have been restricted. It is likely that DCB was authorised at even higher rates in older registrations and would have typically been applied as a granular herbicide directly to the ground with little or no crop interception to reduce the amount of the a.s. reaching the soil.

In contrast, FLC application rates are much lower. Maximum registered annual application rates vary between 133.2 g a.s./ha and 266.4 g a.s./ha for vines and 400 g a.s./ha for potatoes (Table 7.5- 11). In addition, as a fungicide FLC is a foliar application, with applications after BBCH 53 in vines and between BBCHs 20 and 95 in potatoes. Crop interception rates used in regulatory modelling for these BBCH growth stages (EFSA, 2014) are (i) 60% (BBCH20-39), 85% (BBCH40-89) and 50% (BBCH90-99) for potatoes and (ii) 60% (BBCH53-69) and 75% (BBCH71-89) for vines. As such, significant crop interception will occur as part of FLC applications, thus limiting the amount of a.s. reaching the soil where it can be degraded/metabolised to form BAM. Recently, FLC is also used as a seed treatment in oil seed rape but at very low application rates with a maximum of 12 g a.s./ha with the first registrations granted in 2018.

Table 7.5- 11: FLC registration for vines and potatoes for target Member States

Country	Product name®	Target crop	FLC application rate (max.)	Number of applications per year (max)	Max. annual registered rate (g a.s./ha)
AT	Profiler	Vines	44.4 g a.s./kg at 3 kg/ha*	2	266.4
	Infinito	Potatoes	62.5 g a.s./L at 1.6 L/ha*	4	400.0
BE	N/A	Vines	--	--	--
	Infinito	Potatoes	62.5 g a.s./L at 1.6 L/ha	4	400.0
DE	Profiler	Vines	44.4 g a.s./kg at 3 kg/ha*	2	266.4
	Infinito	Potatoes	62.5 g a.s./L at 1.6 L/ha*	4	400.0
FR	Profiler	Vines	44.4 g a.s./kg at 3 kg/ha*	1	133.2
	Infinito/ Kyriel	Potatoes	62.5 g a.s./L at 1.6 L/ha*	4	400.0
IT	R6 ERRESEI ALBIS EASY R6 ERRESEI ALBIS R6 ERRESEI ALBIS ORTO	Vines	44.4 g a.s./kg at 3 kg/ha*	2	266.4
	Volare	Potatoes	62.5 g a.s./L at 1.6 L/ha*	4	400.0
NL	N/A	Vines	--	--	--
	Infinito	Potatoes	62.5 g a.s./L at 1.6 L/ha* or at 1.2 L/ha*	4 or 5	400.0
PL	N/A	Vines	--	--	--
	Infinito	Potatoes	62.5 g a.s./L at 1.6 L/ha*	4	400.0
UK	N/A	Vines	--	--	--
	Infinito	Potatoes	62.5 g a.s./L at 1.6 L/ha* or at 1.2 L/ha*	4 or 5	400.0

N/A = not applicable as not registered for this crop;
*rate for formulated product

In addition, the metabolism of the two parent a.s. in soil is different with the addition of a water molecule to DCB producing up to 110% mass units of BAM for every mass unit of DCB reaching soil. In contrast, the metabolism of FLC results in cleavage of the molecule to produce up to 50% mass units of M-01 BAM for every mass unit of FLC reaching the soil. Therefore, DCB will form about twice as much BAM for any applied mass unit compared to FLC.

In summary:

- DCB application rates were much higher (23-30 times related to kg a.s./ha) than for FLC. In France the application rates (in kg a.s./ha) for DCB usage in vines were even 56 times those registered for FLC;
- As a herbicide DCB was commonly applied as a granular formulation directly to ground with no or little crop interception. In contrast, FLC as a fungicide is applied to foliage with significant crop interception;
- During metabolism, DCB will form about twice as much BAM for any applied mass unit compared to FLC.

Overview of residue detections

Public groundwater monitoring data were requested from the competent authorities in the individual target Member States (Austria, Belgium, France, Germany, Italy, Netherlands, Poland and UK) for the analytes DCB, FLC and M-01 BAM. The authorities in Poland confirmed that the analytes are not part of their national groundwater monitoring program and that no data exist. The UK authority confirmed that only data for DCB exist, but not for FLC or M-01 BAM. The UK data were not included in the further assessment as data on DCB alone will not facilitate an assessment as to whether BAM residues may be related to FLC applications.

Although, FLC was never registered for use in Denmark there is a comprehensive data set for DCB and BAM, and the data from Denmark were therefore included in this assessment as it forms a good baseline in terms of BAM detections in groundwater without the use of FLC.

Following the receipt of the data, they were joined for each country, checked for consistency and quality, before further data analysis. Data were removed for one of the following, principal reasons:

- Data incomplete for a certain year. This applies to data in the last monitoring year. Data were only considered in the assessment if these were available for the full year to facilitate a year on year comparison of detections;
- Duplicates;
- Official data quality flag which states that the quality of the analyses is not validated or the status unknown:
- Data with a LOQ >0.1 µg/L

A total of 155, 7,197 and 8,038 datapoints were eliminated for FLC, DCB and M-01 BAM respectively, representing 2.6% of the originally available data. Most data were removed because they were incomplete for the last year. The available data for each Member State, following check for data consistency and quality, are listed in Table 7.5- 12. In total there are more than 580,000 data points available for an assessment across the selected Member States. The available data for FLC are comparatively low with about 12,000 data points, whereas extensive data sets are available for DCB and M-01 BAM. By far the most data exist for France with almost 250,000 analyses for the three analytes and Denmark with more than 160,000 analyses for DCB and BAM.

Table 7.5- 12: General data availability for FLC, DCB and M-01 BAM for target Member States

Target Member State	FLC	DCB	M-01 BAM
	Number of data points & (time period)*	Number of data points & (time period)*	Number of data points & (time period)*
Denmark	--	69,776 (1994-2019)	92,446 (1994-2019)
France	6,294 (2016-2018)	127,821 (1997-2018)	115,235 (2000-2018)
Belgium	542 (2016-2017)	7,279 (1995-2017)	15,910 (1995-2017)
Netherlands	498 (2011-2016)	8,238 (1989-2016)	7,487 (1989-2016)
Germany	2,152 (2011-2017)	21,562 (1990-2017)	26,862 (1993-2017)
Austria	--[1]	25,498 (1998-2018)	32,780 (2004-2018)
Italy	2,383 (2013-2017)	8,249 (2008-2017)	12,048 (2008-2017)
UK	--	--[2]	--
Poland	--[3]	--[3]	--[3]
Total	**11,869**	**268,423**	**302,768**
Total (excluding DK)	**11,869**	**199,647**	**210,322**

*the time period for which data are available is provided in brackets

[1] FLC data are only available for 2019, these were omitted as assessment was only done up to 2018

[2] 3114 DCB data are available for the UK, these were omitted as DCB data on their own do not allow an assessment on the leaching risk of BAM following FLC applications

[3] Confirmed data not collected by the national authority

The geographical distribution of the available data is shown in Figure 7.5- 1 to Figure 7.5- 3 for the analytes FLC, DCB and M-01 BAM respectively.

For FLC, the distribution of the monitoring data is scattered across individual regions of the selected MSs, with no coherent coverage. The most prominent clusters of monitoring data occur in the east of France, parts of northern Italy, southern and central Germany and in the west along the border region with Belgium and the Netherlands.

The geographical distribution of DCB data in groundwater is extensive. The data cover all of Denmark, the Netherlands, France, Austria, the southern parts of Belgium, large areas of western, southern and northern Germany and individual regions in Italy.

The widest distribution of data across the selected MSs exists for M-01 BAM. The data cover most areas of the selected countries except for Italy where the data clusters predominantly in the northwest of the country. There are also some federal sates in central Germany where M-01 BAM was not monitored in groundwater.

The time series of the number of samples analysed in each year is shown in Figure 7.5- 4 for each of the three analytes. The data for Denmark is excluded in this figure as FLC was not registered in this country and the data were only assessed to provide a baseline for the other MSs in which FLC is registered. The time series exemplifies that the number of groundwater analyses for DCB and BAM markedly increased from the late 1990s to about 2013, when it reached a maximum with more than 20,000 analyses for both DCB and BAM. In the subsequent period the number of available data gradually decreased again for the two analytes but remained at sizable numbers. Monitoring for FLC only started in 2011, at low numbers and the data availability only increased slowly. Most FLC analyses are related to the year 2017, when the sample number was just under 5,000.

Figure 7.5- 1: **Geographical distribution of FLC groundwater residue data for selected Member States**

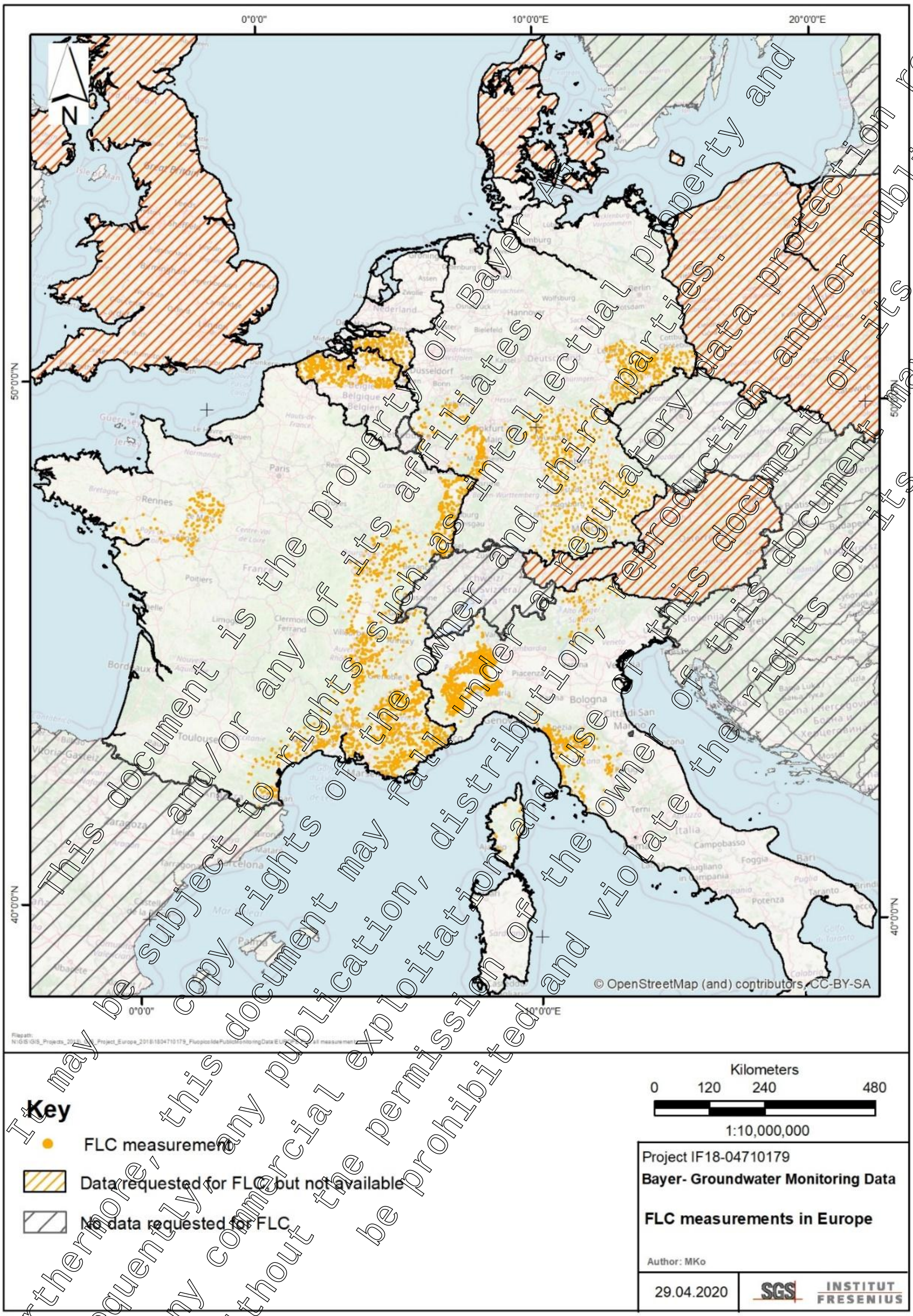


Figure 7.5- 2: Geographical distribution of DCB groundwater residue data for selected Member States

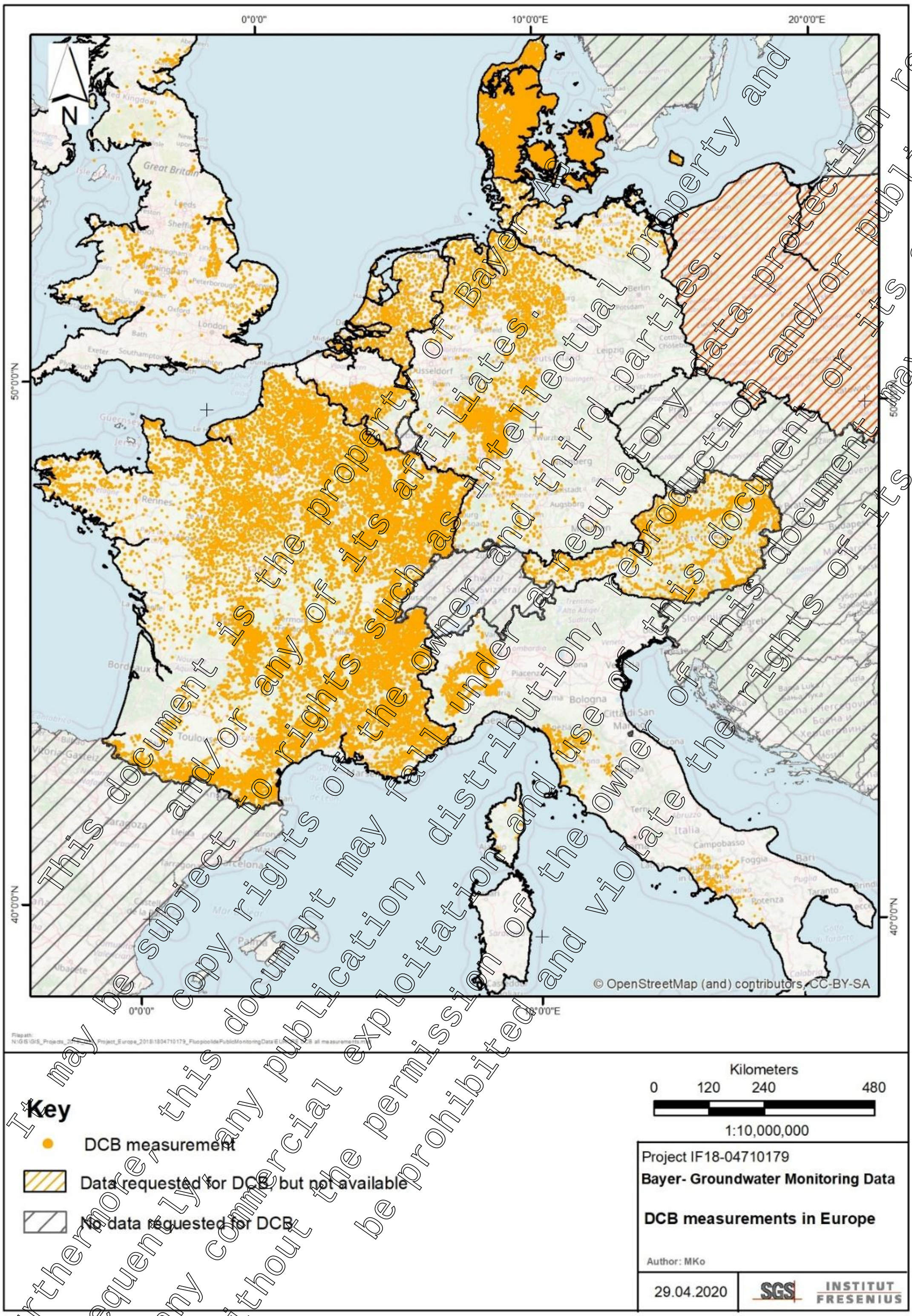


Figure 7.5- 3: Geographical distribution of M-01 BAM groundwater residue data for selected Member States

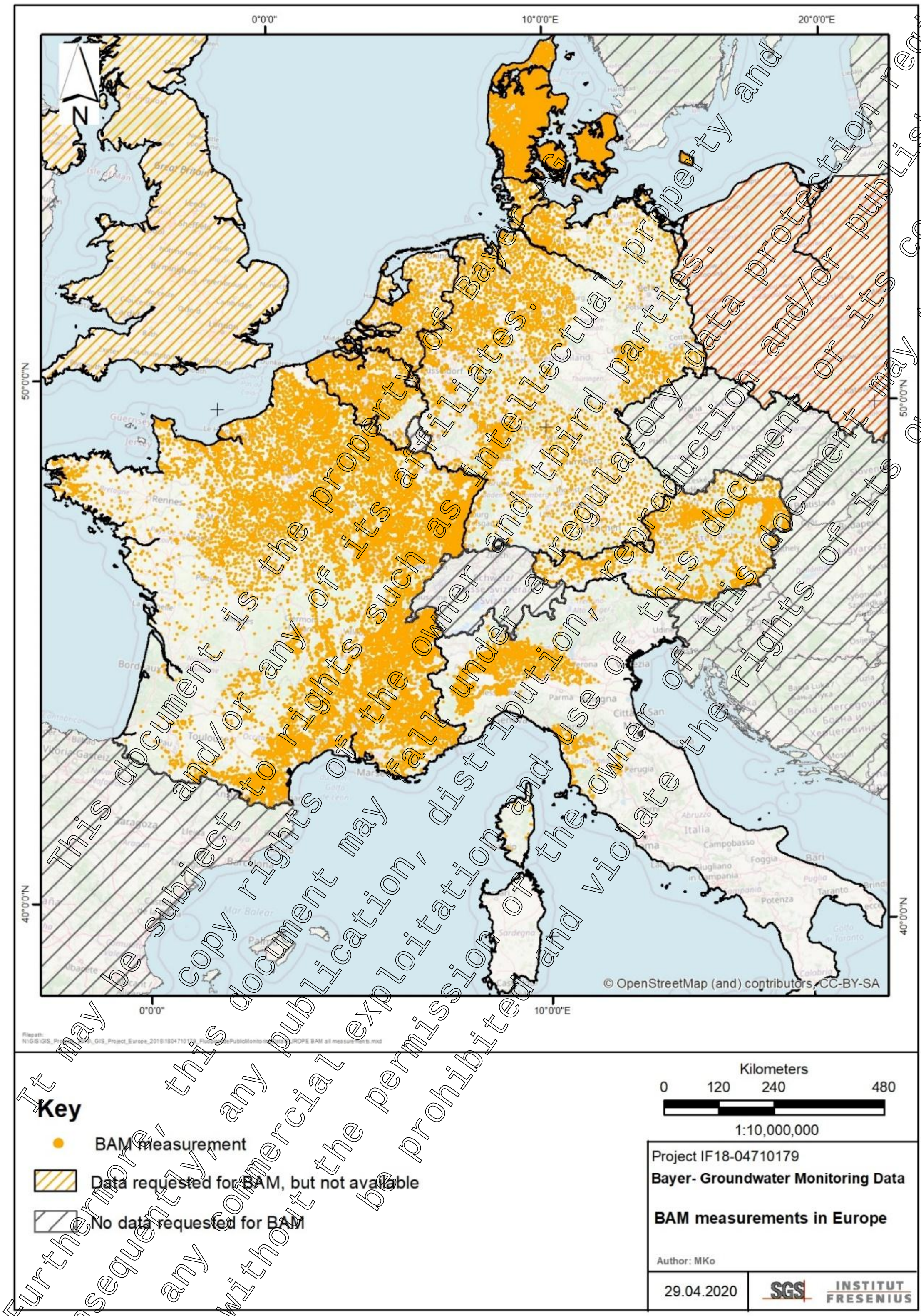
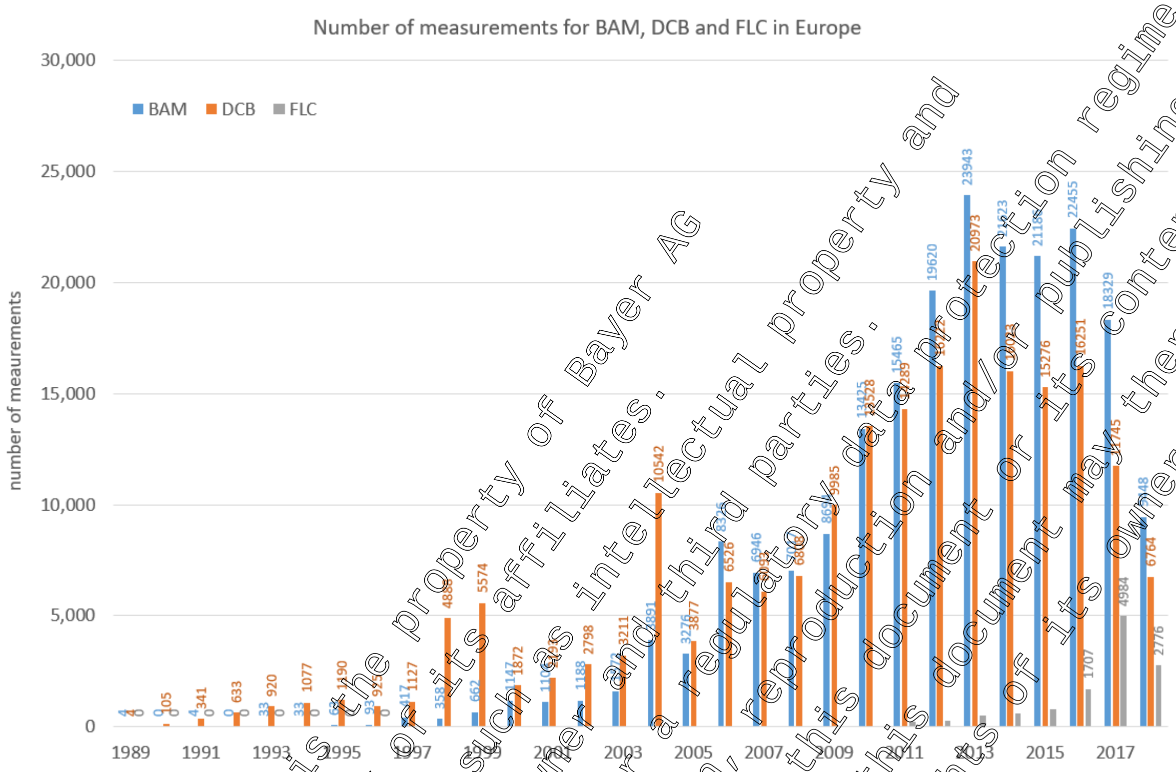


Figure 7.5- 4: Time series of number of residue analyses for FLC, DCB and M-01 BAM for selected Member States in Europe



An overview of the residue detections for the selected MSs is provided in Table 7.5- 13 and details the detection rates in the individual concentration classes for FLC, DCB and M-01 BAM. Also provided are the detection rates aggregated across all target MSs, although it should be noted that these are biased by the much larger number of analyses from France.

Over the years the LOQ for DCB, FLC and M-01 BAM will have decreased due to significant advances in analytical technology. While the achievement of an LOQ of 0.05 to 0.1 µg/L might have been an analytical challenge in the 1990s, it is somewhat routine in modern analysis that LOQs as low as 0.01 µg/L or even 0.002 µg/L can be achieved. To avoid a bias in the temporal assessment of the residue data due to a lower LOQ with time, the lower boundary of the LOQ was fixed to 0.025 µg/L. This means that all residue concentration detected below a value of 0.025 µg/L were set to <LOQ. This allows for a more ready comparison of actual data to those determined 10 or 20 years ago. Data for which the LOQ was >0.025µg/L remained unchanged. This approach is considered valid as the set LOQ is still significantly lower than the regulatory groundwater threshold of 0.1 µg/L for active substances or relevant metabolites.

For the subsequent data analysis, the residue data for all countries were subdivided into the following classes (x):

- <LOQ
- 0.025 µg/L ≤ x < 0.1 µg/L
- 0.1 µg/L ≤ x < 1.0 µg/L
- 1.0 µg/L ≤ x < 10.0 µg/L
- ≥10 µg/L

A subdivision of residue concentration classes higher than 0.1 µg/L are applicable since M-01 BAM derived from FLC was classified as a non-relevant metabolite in the EFSA conclusion, 2009.

For FLC, 99.5-100% (average = 99.86%) of the samples across the target MSs were below the concentration threshold of 0.1 µg/L and for 99.7-99.9% of the samples from FR, BE, NL and DE concentrations were <LOQ (<0.025 µg/L). For IT the concentrations between LOQ and <0.1 µg/L were noticeably higher with 1.3%. The detection rates of FLC ≥0.1 µg/L were 0.02% for FR (n=1), 0.55% (n=3) for BE, 0.00% (n=0) for NL, 0.05% (n=1) for DE and 0.5% (n=12) for IT. Out of the almost 12,000 samples only 17 samples exceeded the groundwater concentration threshold, with most exceedances (n=12) reported from Italy. All FLC exceedances were subject to a desk-based elucidation.

For DCB detection rates were also very low. Apart from the target MSs, DCB detection rates are also provided for Denmark. On average, across the target MSs, 99.99% of all samples showed concentrations <0.1 µg/L, in Denmark the rate is comparable with 99.90%. The detection rates of DCB ≥0.1µg/L were 0.1% (n=69) for DK, 0.00% (n=1) for FR, 0.00% (n=0) for BE, 0.13% (n=11) for NL, 0.01% (n=3) for DE, 0.02% (n=5) for AT and 0.01% (n=1) for IT. Out of the more than 270,000 samples, 90 samples exceeded the groundwater concentration threshold, with most exceedances (n=69) reported from Denmark. The DCB exceedances were not further investigated as part of an elucidation, as DCB usage is not the prime driver for this report.

For the more mobile metabolite M-01 BAM, detection rates >LOQ are much higher than for its parent compounds. M-01 BAM is classified as non-relevant metabolite and as such a concentration threshold of 10 µg/L has been chosen for this report, although lower thresholds may be applicable at a national level. In Demark, FLC was never registered and as such M-01 BAM residues in groundwater can unequivocally be attributed to DCB usage. In Denmark, BAM was detected in concentrations above LOQ (0.025 µg/L) in 18.39% of the samples, in 7.46% of the samples in concentrations ≥0.1 µg/L, and 0.03 % (n=29) of the samples showed concentrations >10 µg/L. Detection rates in the countries in which FLC is registered are considerably lower. Across the target MSs, M-01 BAM was detected in concentrations >LOQ in 5.19% of the samples, 2.31% of the samples had concentrations ≥0.1 µg/L and 0.01% (n=13) of the analyses exceeded the chosen groundwater concentration threshold of 10 µg/L. Across the target MSs, M-01 BAM detection rates ≥0.1µg/L are noticeably higher in BE and in particular in NL. In total, there are only 13 M-01 BAM exceedances of the 10 µg/L concentration threshold: 3 in FR, 4 in BE, 4 in NL, 0 in DE, 2 in AT and 0 in IT. It should be noted that this may include multiple detections at one site and that there only 9 sites for which exceedances are reported. All exceedances were subject to a desk-based elucidation.

Table 7.5- 13: Number of detections, concentration classes and detection rates across selected Member States

A) FLC analyses and detections for target Member States

	Unit	All countries except DK	FR	BE	NL	DE	AT	IT
Data period	--	2011-2018	2016-2018	2016-2017	2011-2016	2011-2017	--	2013-2017
Total analyses	count	11,869	6,294	542	498	2,152	--	2,383
< LOQ (0.025 µg/L)	%	99.42	99.81	98.89	99.80	99.67	--	98.20
LOQ ≤ x < 0.1 µg/L	%	0.44	0.17	0.55	0.20	0.26	--	1.30
0.1 ≤ x < 1.0 µg/L	%	0.13	0.02	0.37	0.00	0.05	--	0.50
1.0 ≤ x < 10.0 µg/L	%	0.01	0.00	0.18	0.00	0.00	--	0.00
≥ 10.0 µg/L	%	0.00	0.00	0.00	0.00	0.00	--	0.00

B) Analyses and detections for Denmark

	Unit	DCB	BAM
Data period	--	1994-2019	1994-2019
Total analyses	count	69,776	92,446
< LOQ (0.025 µg/L)	%	99.66	81.61
LOQ ≤ x < 0.1 µg/L	%	0.24	10.92
0.1 ≤ x < 1.0 µg/L	%	0.09	6.72
1.0 ≤ x < 10.0 µg/L	%	0.01	0.71
≥ 10.0 µg/L	%	0.00	0.03

C) DCB analyses and detections for target Member States

	Unit	All countries except DK	FR	BE	NL	DE	AT	IT
Data period	--	1989-2018	1997-2018	1995-2017	1989-2016	1990-2018	1998-2018	2008-2017
Total analyses	count	201,760	127,821	7,279	8,238	21,562	25,498	8,249
< LOQ (0.025 µg/L)	%	99.91	99.99	100.00	98.17	99.94	99.98	99.98
LOQ ≤ x < 0.1 µg/L	%	0.08	0.01	0.00	1.70	0.04	0.00	0.01
0.1 ≤ x < 1.0 µg/L	%	0.01	0.00	0.00	0.13	0.01	0.02	0.00
1.0 ≤ x < 10.0 µg/L	%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
≥ 10.0 µg/L	%	0.00	0.00	0.00	0.00	0.00	0.00	0.01

D) M-01 BAM analyses and detections for target Member States

	Unit	All countries except DK	FR	BE	NL	DE	AT	IT
Data period	--	1989-2018	2000-2018	1995-2017	1989-2016	1991-2018	2004-2018	2008-2017
Total analyses	count	210,322	115,235	15,910	7,487	26,862	32,780	12,048
< LOQ (0.025 µg/L)	%	94.81	96.63	86,34	80.65	92.50	97.20	95.97
LOQ ≤ x < 0.1 µg/L	%	2.88	1.94	8,30	7.55	3.76	1.98	2.41
0.1 ≤ x < 1.0 µg/L	%	2.09	1.35	4.70	10.07	3.42	0.74	1.59
1.0 ≤ x < 10.0 µg/L	%	0.21	0.09	0.65	1.68	0.32	0.08	0.03
≥ 10.0 µg/L	%	0.01	0.00	0.02	0.05	0.00	0.00	0.00

The spatial distribution of the residue detections for FLC, DCB and M-01 BAM are illustrated in Figure 7.5- 5 to Figure 7.5- 7 in correlation to the main vine and potato cropping areas.

The map for FLC (Figure 7.5- 5) shows how sparse detections are across the target MSs. There is however a noticeable cluster of detections in the northeast of Italy. This cluster is outside the main potato cropping area and only shows a limited correlation to the vine cropping areas. Similarly, sparse is the distribution of DCB detections (Figure 7.5- 6), with only a small cluster of detections in the north of the Netherlands and a much higher density of detections on mainland Denmark.

The figure for the spatial distribution of M-01 BAM (Figure 7.5- 7) illustrates that there are many more detections for this analyte. Clusters of low concentration detections (<1 µg/L) occur particularly in Belgium, Netherlands and in Denmark. Smaller clusters are also apparent in the southwest of Germany. In terms of higher residue concentrations (≥1.0 µg/L) the large number of detections in Denmark stands out. Other clusters occur in the Netherlands and in Germany which appear to have a correlation to potato growing areas. However, it should be noted, that Denmark also has significant potato cropping areas but FLC was never authorised for usage. Despite this, the number of BAM detections in Denmark is much more pronounced than in the Netherlands or northern Germany.

Figure 7.5- 5: **Geographical distribution of FLC groundwater residue detections >LOQ relative to target crops**

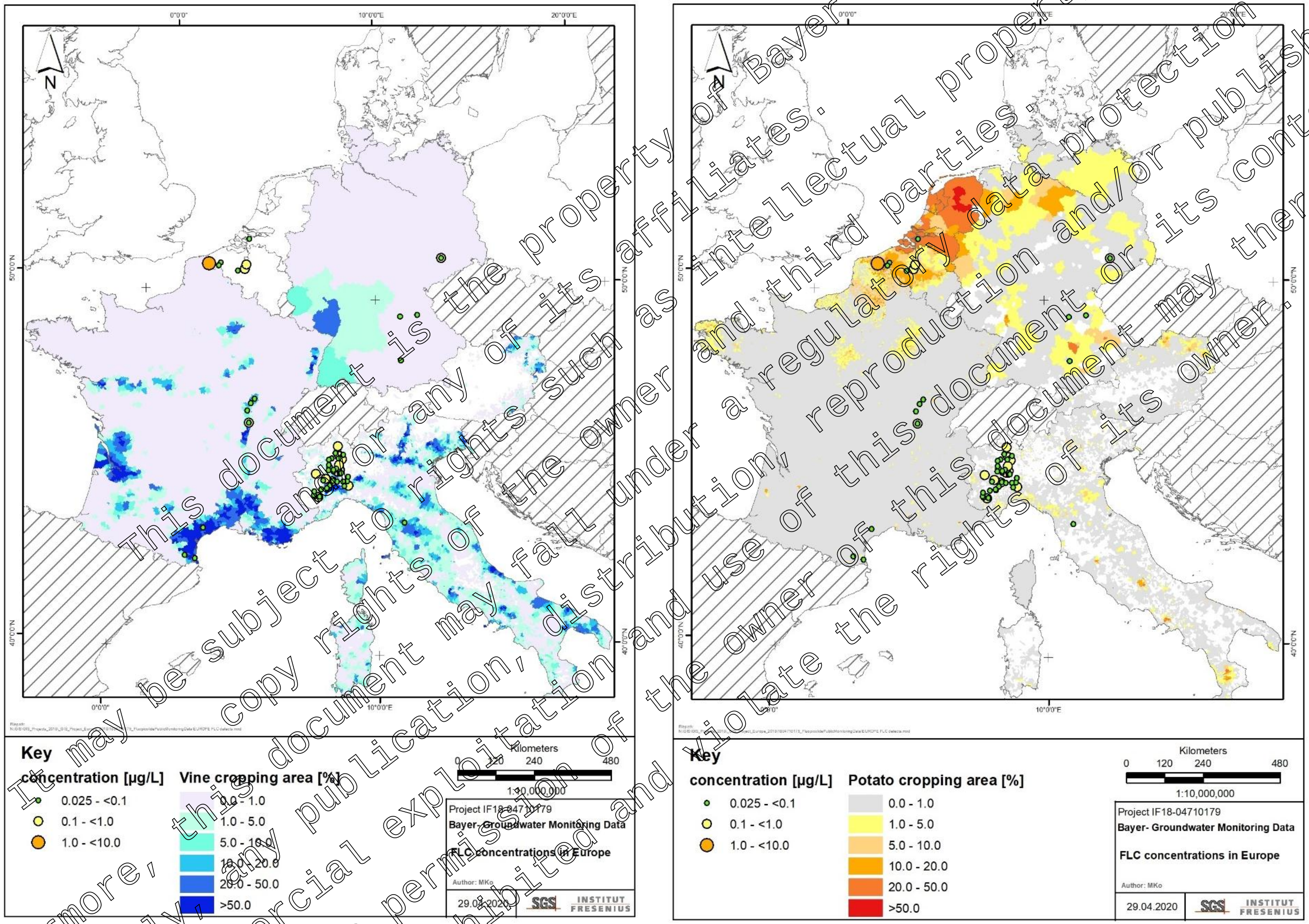


Figure 7.5- 6: Geographical distribution of DCB groundwater residue detections >LOQ relative to target crops

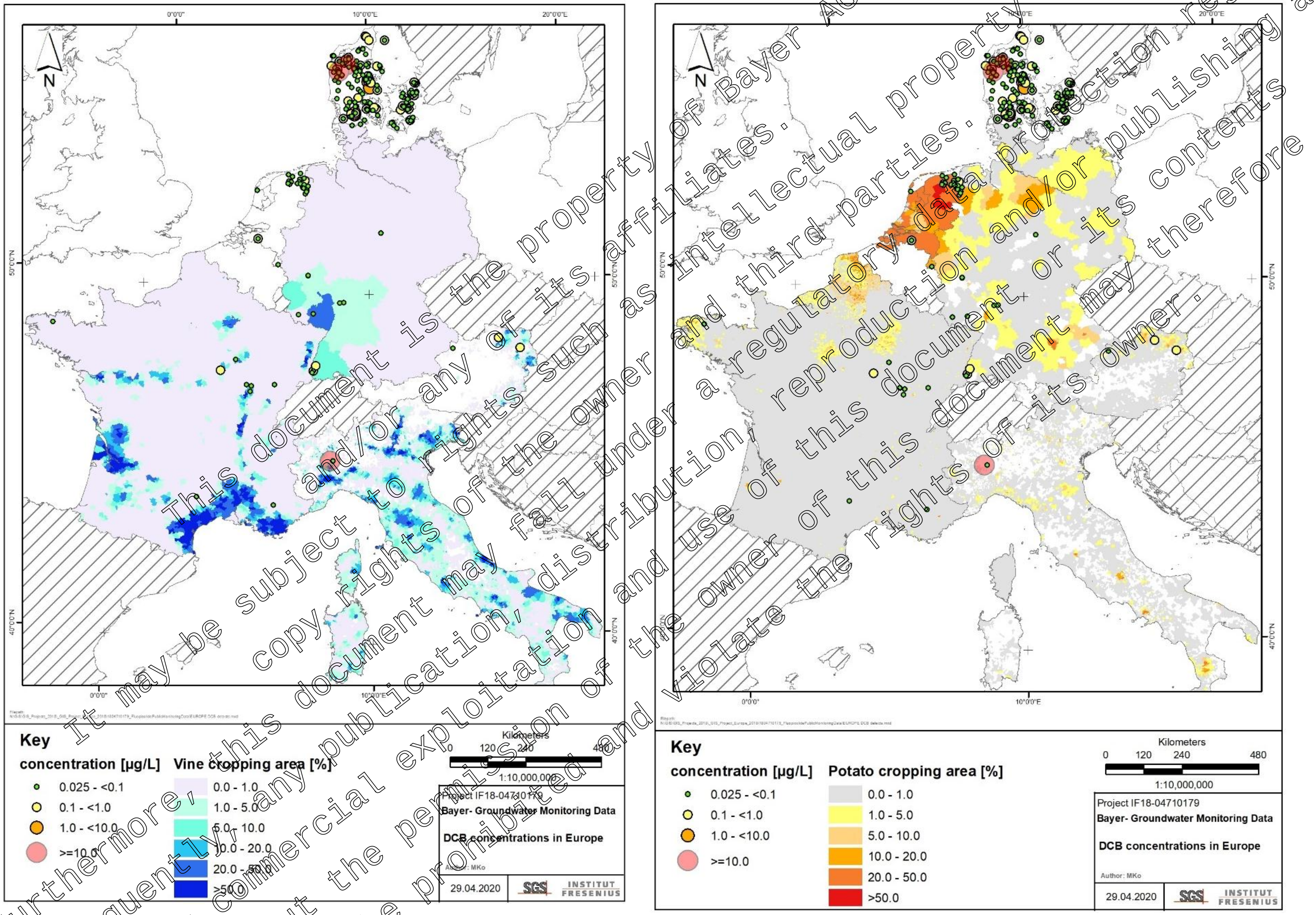
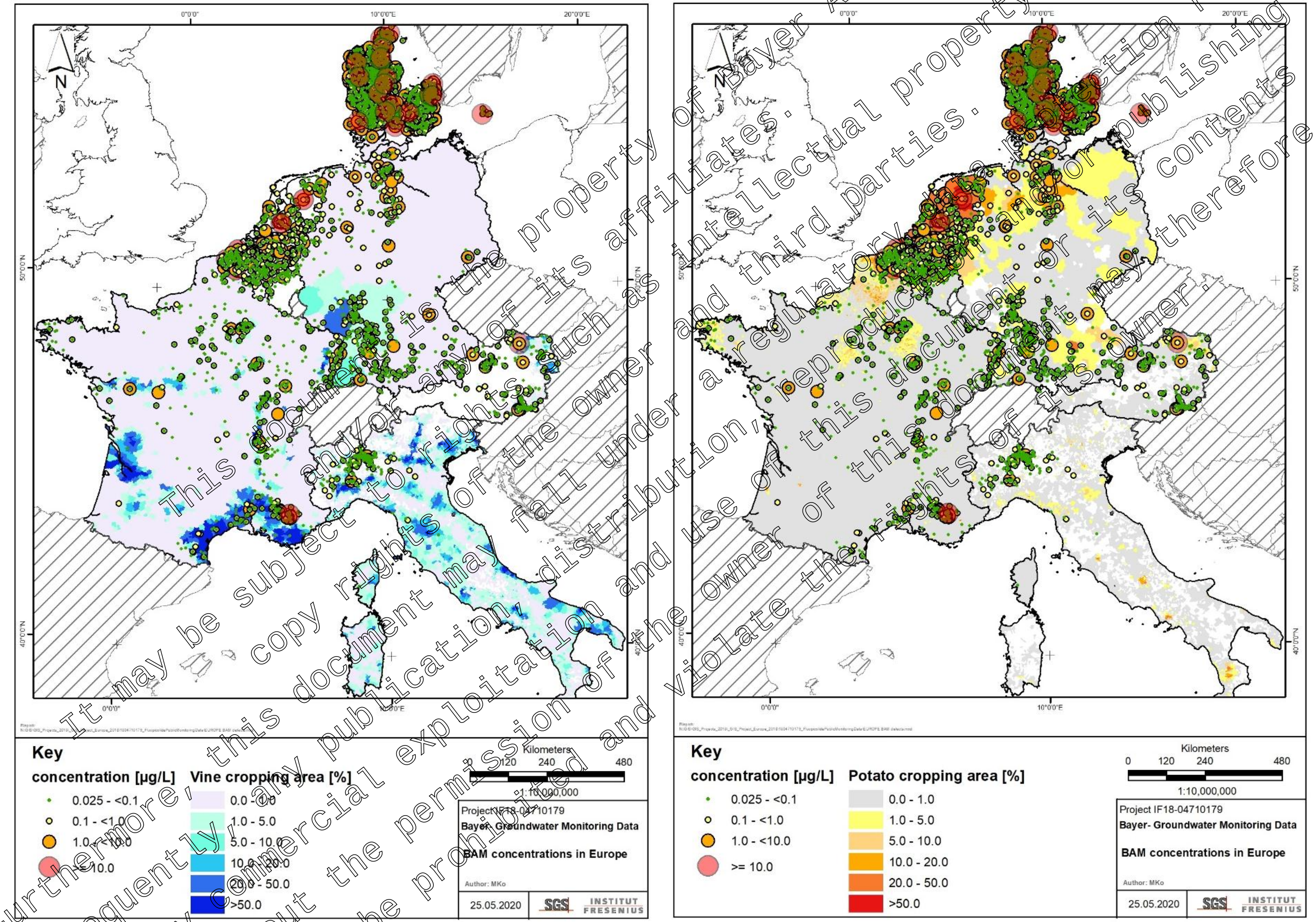


Figure 7.5- 7: Geographical distribution of M-01 BAM groundwater residue detections >LOQ relative to target crops



The detection rates and trends for individual countries will be further discussed below. While reference is made to the study scale maps, graphs and tables already presented, detailed maps, graphs and tables are available within the report:

Denmark

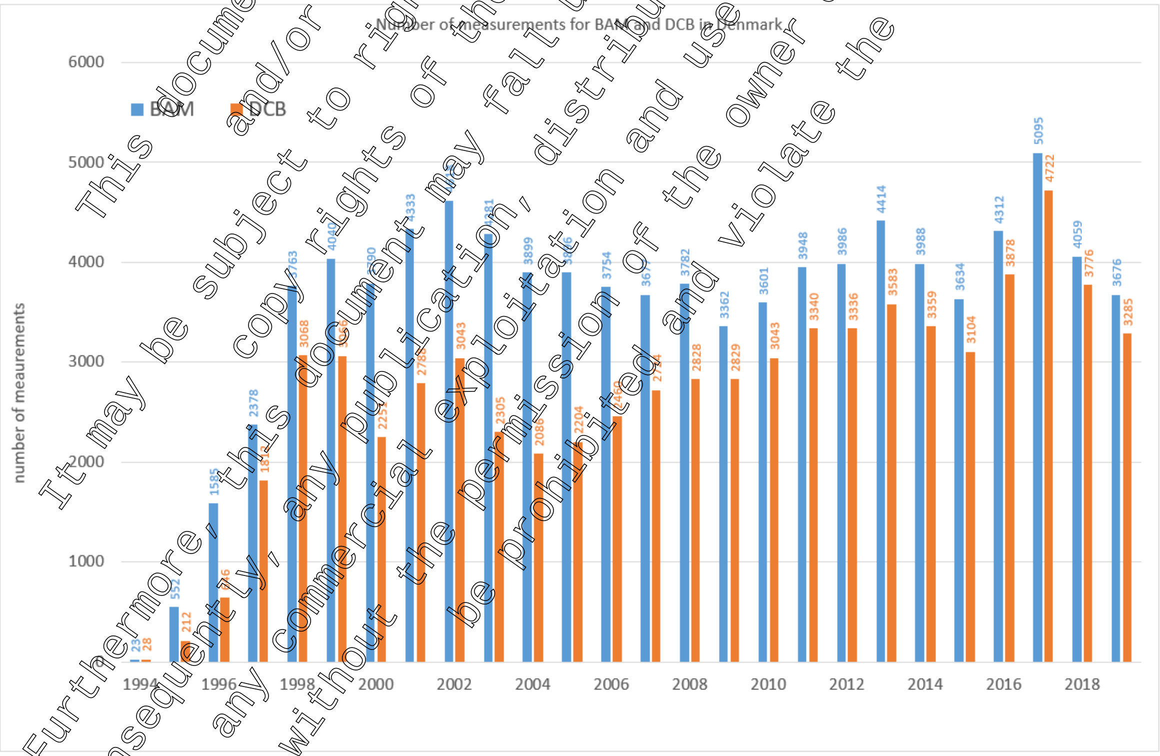
The active substance DCB was registered for use in Denmark in the period between 1965 to 1997. FLC was never authorised in Denmark. The monitoring data therefore provide a valuable baseline in terms of BAM concentrations that may derive following the usage of DCB and ongoing groundwater quality issues that may result.

A general overview of the registered uses of DCB in Denmark is listed in Table 7.5- 10. The application dose of DCB was high at around 4-30 kg a.s./ha. The authorisation for DCB expired in July 1997, although an approximately one-year period for phase-out would be typical, during which the use of remaining DCB containing products would have been allowed.

Following the check for data consistency and quality, a total of more than 162,000 values from groundwater analyses were available for the DCB and BAM covering a common time period 1994-2019 for both analytes (Table 7.5- 12). For both analytes the spatial distribution of the monitoring data is extensive and covers all regions of Denmark.

The time series of the number of samples analysed in each year is shown in Figure 7.5- 8. The number of analyses was low in 1994 with less than 30 data points for each analyte but increased rapidly until the end of the 1990s. From 1997 onwards there are more than 1,000 analyses available for each, DCB and BAM and about 2,000-5,000 analyses for each monitoring year in the period 2000-2019. In general, there are more analyses for BAM but the data coverage for DCB is still excellent.

Figure 7.5- 8: Time series of number of residue analyses for DCB and BAM for Denmark



An overview of the available groundwater residue data for DCB and BAM is provided in Table 7.5-13B in relation to the concentration classes.

For DCB there almost 70,000 analyses available, of which 235 are >LOQ (0.34%), with 69 detections >0.1 µg/L (0.1%). For the more mobile metabolite BAM there are more than 92,000 analyses available of which 16,311 analyses fall within the concentration range of >LOQ to 1 µg/L (17.6%). There are 688 detections >1.0 µg/L (0.74%) of which 29 are above 10 µg/L (0.03%).

DCB detections >LOQ but also >0.1 µg/L occur all over Denmark with no particular cluster. The detections >1 µg/L occur in north-western Denmark and along the eastern coastline of the regions Nordjyland and Syddanmark.

BAM detections were found wide spread across all of Denmark, this accounts for detections >0.1 µg/L but also for the higher concentration classes. There seems to be a particular cluster of elevated BAM concentrations >10 µg/L in the vicinity of the main Danish cities Copenhagen and Aarhus suggesting that the residues derive from historic non-agricultural applications.

France

A general overview of the registered uses of DCB and FLC in France is listed in Table 7.5- 10.

DCB had a long historic registered use in France, mainly in woody crops as well as for applications on hard surfaces and in aquatic environments. The authorisation for DCB use expired in 2010, although an approximately one-year period for phase-out would be typical, during which the use of remaining DCB containing products would have been allowed.

FLC was first registered in France in February 2010 for applications in vines, potatoes and vegetables. As such, there is a negligible temporal overlap between DCB and FLC authorisation. In terms of common target crops, there is only a spatial overlap for use on vines, but the non-agricultural use of DCB may make it difficult to discount spatial overlap between DCB and FLC uses as farmers may have used DCB on non-cropped areas on their farms or associated with other crops.

A comparison between typical application rates and modes for DCB and FLC identified a much higher possibility for leaching of BAM associated with DCB applications.

Following the check for data consistency and quality, a total of almost 250,000 values from groundwater analyses were available for the three analytes covering the time period 1997-2018 (Table 7.5- 12).

The geographical distribution of the available data for the three analytes is shown in Figure 7.5- 1 to Figure 7.5- 3.

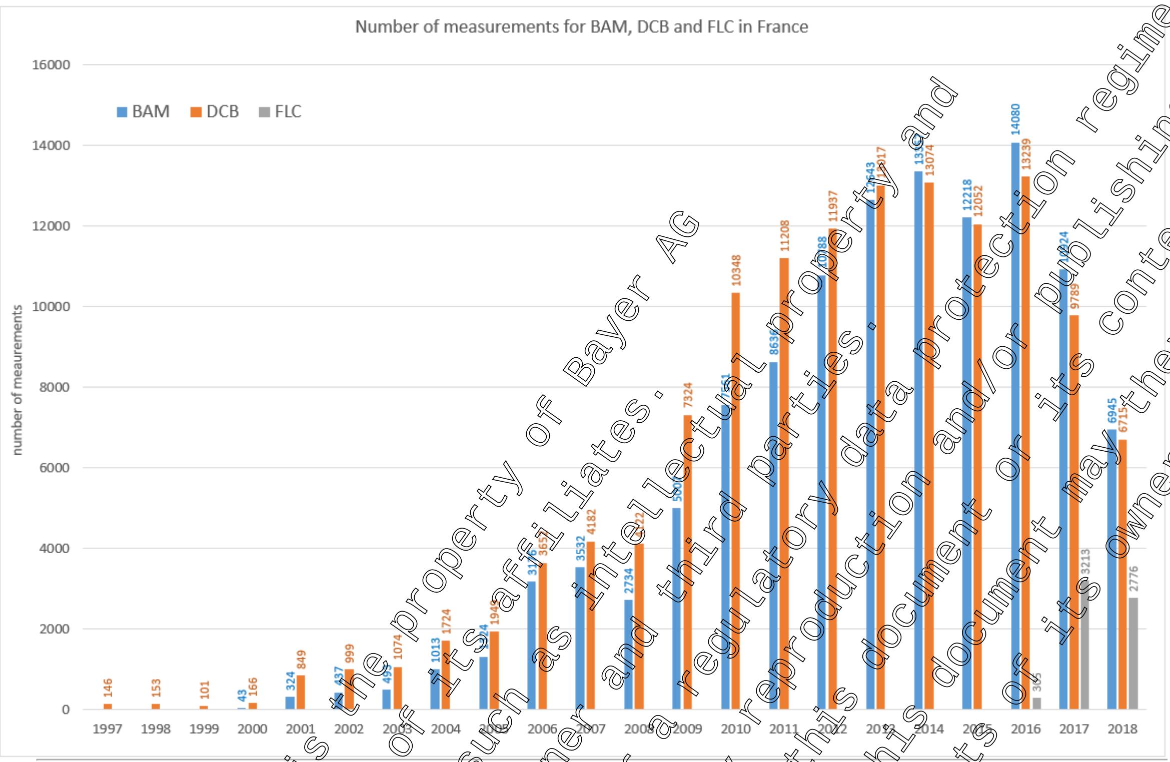
For FLC data are only available for 3 years, covering the time period 2016-2018. The monitoring data coverage across France is heterogeneous. Data are only available for the eastern parts of France and the ‘Pays de la Loire’.

For DCB almost 130,000 data points are available for the time period 1997-2018. There is wide geographical coverage of the monitoring data although it is apparent that there are much less data for the western central and southern parts of France.

For M-01 BAM, there are more than 120,000 data points available for the period 2000-2018. Despite the large number of data, there is a heterogeneous distribution in the geographical distribution of monitoring points, with distinctively fewer monitoring data for the central and western parts of France.

The time series of the number of samples analysed in each year is shown in Figure 7.5- 9 for each of the three analytes. The figure illustrates that there was a sharp increase in the sampling frequency for DCB and M-01 BAM from about 2005 to around 2014. Whereas in 2005 less than 2000 samples were analysed for DCB and M-01 BAM each, this increased to >10,000 samples each in the mid-2010s. The number of analysis for DCB and M-01 BAM decreased again towards 2017 and 2018.

Figure 7.5- 9: Time series of number of residue analyses for FLC, DCB and M-01 BAM for France



An overview of the available groundwater analyses for FLC, DCB and M-01 BAM is provided in Table 7.5- 13A, Table 7.5- 13C and Table 7.5- 13D in relation to the concentration classes.

For FLC there are more than 6000 analyses available of which only 12 are >LOQ (0.19 %), with only 1 detection ≥0.1 µg/L. All detections occurred in the river Rhône and Saône valleys, areas which are also important in terms of vine cropping. The 12 detections >LOQ relate, however, to only 7 sites as repeated detections were encountered at some of the monitoring sites. There were no FLC detections >LOQ in potato growing regions. A desk-based elucidation of the single elevated FLC detection concluded that the FLC detection is most likely due to a FLC application in vines associated with very vulnerable site conditions in a karstic setting, with thin soil coverage and a relatively direct entry of the substances into the subsoil and subsequently into the groundwater.

For DCB there are more than 127,000 analyses with only 9 detections >LOQ (0.007%) of which only 1 detection is ≥0.1 µg/L. Detections >LOQ are scattered in the eastern half of France and appear to have correlation to vine cropping. There are 9 detections >LOQ which relate to 9 monitoring sites. The DCB detection rate is less than 0.01%. Four out of the 9 DCB detections >LOQ fall in the period 2011-2015, indicating that DCB was detected up to 5 years after the authorisation for DCB usage had expired. This is attributed to soil residues that continue to leach and longer leaching times through the unsaturated zone to the groundwater

For M-01 BAM there are in the order of 115,000 analyses available for an assessment of which 3762 analyses fall within the concentration range of >LOQ to 1 µg/L (3.3%). There are 104 detections ≥1.0 µg/L (0.09%) of which 3 are above 10 µg/L. The highest density of detections occurs in the South and East of France in the regions of Provence Alpes and Franche Compte, in the northern central region of Champagne and along the Loire valley in the West of France. In the concentration class 1.0 ≤ x < 10.0 µg/L there were 101 detections (0.09% of samples) which relate to 17 monitoring sites. The 3 detections ≥10 µg/L all relate to 1 monitoring site. Many of the M-01 BAM residues correspond to areas outside the main vine or potato growing regions with no apparent correlation to the density of these two crops. A desk-based elucidation of these detections concluded that the region is known for lavender farming.

The time series of M-01 BAM residues with repeated M-01 BAM detections prior to the authorisation of FLC together with the absence of FLC target crops suggests that the elevated M-01 BAM detections must be related to historic DCB usage, possibly associated with the lavender (woody crop).

Belgium

A general overview of the registered uses of DCB and FLC in Belgium is listed in Table 7.5- 10.

DCB had a long historic registered use in Belgium until April 2010 when the authorisation expired. Until November 2007, DCB was registered for a variety of uses, including the usage on uncultivated and paved land. In the subsequent period, until April 2010, DCB usage was only further authorised for usage in the following crops: berries, orchards, ornamental trees and hedges. For the later uses authorised annual application rates were between 80-135 kg/ha (Casoron 4GR and Casoron GR) which corresponds to 5.2-5.4 kg a.s./ha.

FLC was first registered in Belgium in May 2008 for applications in potatoes and vegetables. As such, there would have been an approximately 2-year temporal overlap between DCB and FLC authorisation. There were no common target crops, but the non-agricultural use of DCB until 2007 may make it difficult to discount spatial overlap between DCB and FLC uses as farmers may have used DCB on non-cropped areas on their farms or associated with other crops.

A comparison between typical application rates and modes for DCB and FLC identified a much higher possibility for leaching of M-01 BAM associated with DCB applications.

Following the check for data consistency and quality, a total of more almost 24,000 values from groundwater analyses were available for the three analytes covering the time period 1995-2017 (Table 7.5- 12).

The geographical distribution of the available data for the three analytes is shown in Figure 7.5- 1 to Figure 7.5- 3.

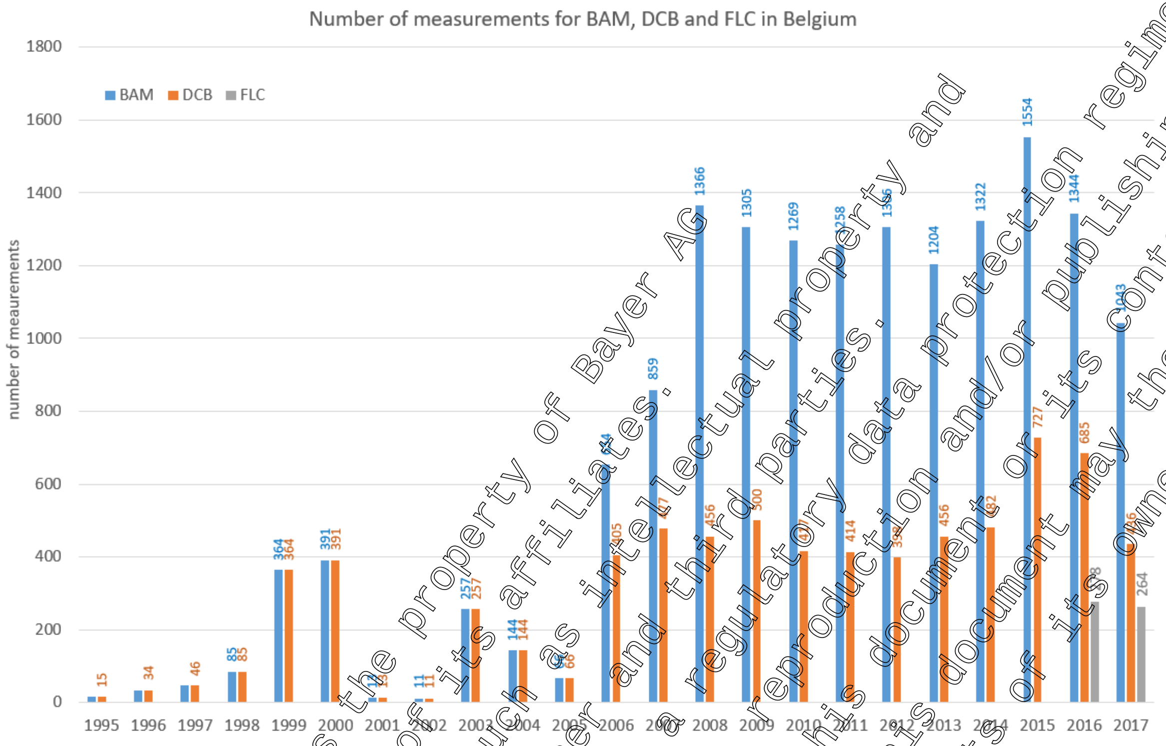
For FLC data are only available for 2016 and 2017 and only for the region of Flanders. The monitoring data are relatively evenly distributed across Flanders, expect for the central eastern part for which there are no data.

For DCB almost 7,300 data points are available for the time period 1995-2017. Data for this analyte only exist for the region of Wallonia, where there is an even coverage but there are no data for the Ardennes, a mountainous area in the east of Belgium with less agriculture and large forest areas.

For M-01 BAM, there are almost 16,000 data points available for the period 1995-2017. Monitoring data are distributed evenly across Belgium, except for the Ardennes region.

The time series of the number of samples analysed in each year is shown in Figure 7.5- 10, for each of the three analytes. The figure illustrates that there are only relatively few data available for the early time period and that there was a sharp increase in the sampling frequency from 2006 onwards, particularly for M-01 BAM. Monitoring for FLC only started in 2016.

Figure 7.5- 10: **Time series of number of residue analyses for FLC, DCB and M-01 BAM for Belgium**



An overview of the available groundwater analyses for FLC, DCB and M-01 BAM is provided in Table 7.5- 13A, Table 7.5- 13C and Table 7.5- 13D in relation to the concentration classes.

For FLC there are only 542 analyses available of which 536 are <LOQ (98.9%). Six detections were >LOQ and 3 >0.1 µg/L. The 3 detections >0.1 µg/L relate to 3 individual sites, 2 of them are located in the centre of Belgium and 1 at the border to France. The 3 detections occur in typical potato growing regions. They were all single detections. The desk-based elucidation concluded that all 3 detections are likely false positives. For 2 sites FLC detection is likely to be related to sample/well contamination and for the other site the well is not ideally suited for residue monitoring (Ground flush installation next to a ditch and agricultural field, at a junction of a farm track).

For DCB there are more than 7,000 analyses, all of which were <LOQ.

For M-01 BAM there are in the order of 16,000 analyses available for an assessment of which 13,736 were <LOQ, 2067 analyses fall within the concentration range of >LOQ to 1.0 µg/L. There are 107 detections >1.0 µg/L of which 4 are above 10 µg/L. The highest density of detections occurs in Flanders and the north-western part of Wallonia and appear to have a correlation to the potato growing areas. There are also M-01 BAM detections in the south-eastern part of Wallonia, outside the main potato growing areas. But these are generally small in concentration, with only few detections in the concentration class of 0.1-1 µg/L. The desk-based elucidation of the 4 sites above 10 µg/L was inconclusive for 3 of the sites, although for one site the analytical result looks suspicious and there may be an indication for an analytical or transcription error. The elevated M-01 BAM detection at the fourth site was found to be related to DCB usage.

Netherlands

A general overview of the registered uses of DCB and FLC in the Netherlands is listed in Table 7.5- 10.

DCB had a long historic registered use in the Netherlands, mainly for top fruit (pome), amenity use (excluding hard surfaces) and land not intended to bear vegetation. The authorisation for DCB expired in the autumn of 2008, although an approximately one-year period for phase-out would be typical, during which the use of remaining DCB containing products would have been allowed.

FLC was first registered in the Netherlands in June 2007 for applications in potatoes, vegetables and herbs. As such, there is an about 1-year temporal overlap between DCB and FLC authorisation. It is unlikely that were significant common target crops, but the non-agricultural use of DCB may make it difficult to discount spatial overlap between DCB and FLC uses as farmers may have used DCB on non-cropped areas on their farms.

A comparison between typical application rates and modes for DCB and FLC identified a much higher possibility for leaching of M-01 BAM associated with DCB applications.

Following the check for data consistency and quality, more than 16,000 values from groundwater analyses were available for the three analytes covering the time period 1989-2016 (Table 7.5- 12).

The geographical distribution of the available data for the three analytes is shown in Figure 7.5- 1 to Figure 7.5- 3.

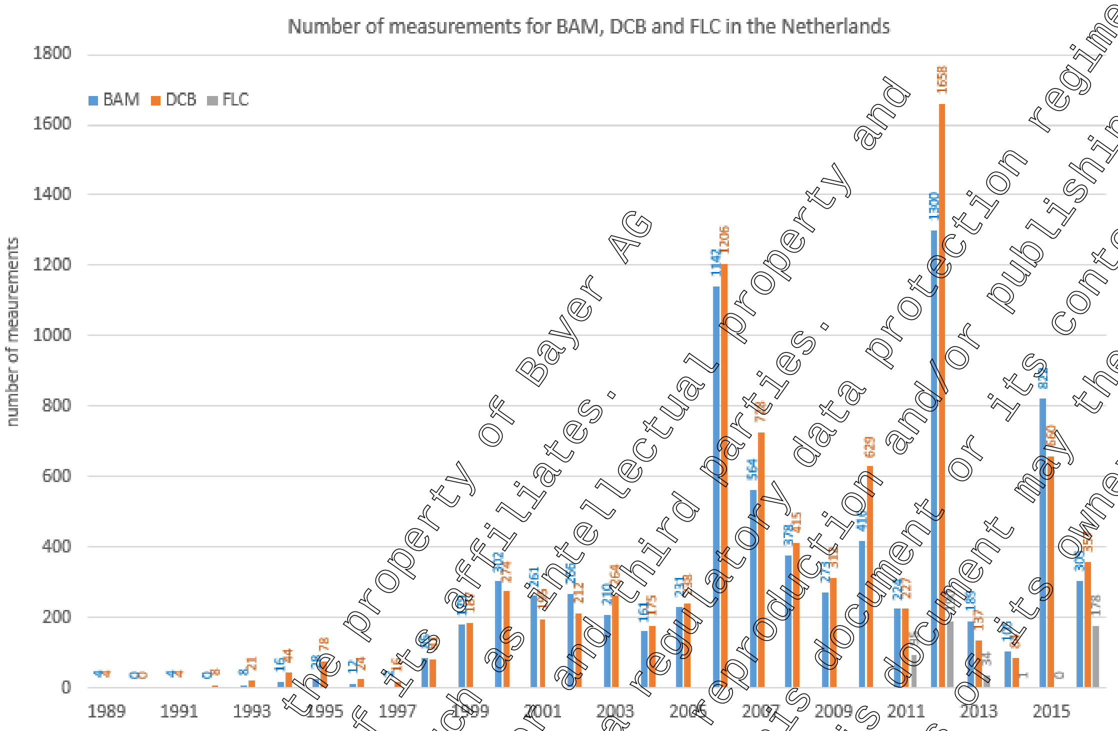
For FLC, there 311 data points with co-ordinates available and only for the provinces in the southern Netherlands, North Brabant and Limburg. The data cover the time period 2011-2016.

For DCB there are almost 4,500 data points available that have co-ordinates, covering the time period 1989-2016. The data are for all provinces of the Netherlands with a relatively even coverage across the country.

For M-01 BAM there are almost 4,000 data points with co-ordinates available for the period 1989-2016. Monitoring data are distributed evenly across all provinces of the Netherlands.

The time series of the number of samples analysed in each year is shown in Figure 7.5- 11 for each of the three analytes. For DCB and M-01 BAM there are only few analyses for the years before 1999. More than 100 analyses for each analyte and year typically exist for the period 1999-2016 with marked increases of analyses in the years 2006 and 2012 when the number of measurements is >1,000 for each analyte. For FLC, data are available for the period 2011-2016 but with only very few measurements for the years 2013 (n=34), 2014 (n=1) and 2015 (n=0).

Figure 7.5- 11: Time series of number of residue analyses for FLC, DCB and M-01 BAM for the Netherlands



An overview of the available groundwater analyses for FLC, DCB and M-01 BAM is provided in Table 7.5- 13A, Table 7.5- 13C and Table 7.5- 13D in relation to the concentration classes.

For FLC there are 498 analyses available of which 497 are <LOQ (99.8%). There is one FLC detection in the concentrations range between LOQ and 0.1 µg/L (in the southwest of the Netherlands) and no exceedances of the 0.1 µg/L groundwater concentration threshold.

For DCB there are more than 8,000 analyses of which 98.2% are <LOQ. There are 140 analyses with detections < 0.1 µg/L and 11 samples which exceed the 0.1 µg/L concentration threshold, but these detections relate to only 2 sites. One in the northeast of the country and the second in the south.

For M-01 BAM there are 7,500 analyses available for an assessment of which 6,083 were <LOQ. 1319 analyses fall within the concentration range of >LOQ to 1.0 µg/L. There are 130 detections ≥1.0 µg/L of which 4 are above 10 µg/L trigger value. Lower M-01 BAM concentrations were detected across all of the Netherlands. Higher concentrations are more frequent in the south of the country, and in a cluster in the central part of the country which seems to relate to the military airport Soesterberg. There are 4 detections with M-01 BAM concentrations ≥10 µg/L which correspond to 3 sites. Two of them occurred in central Netherlands in the city of Zeist, the third relates to a location in the central northern part of the country near Havelterberg. The desk-based elucidation concluded that all 4 detections are most likely related to historic DCB usage.

Germany

A general overview of the registered uses of DCB and FLC in Germany is listed in Table 7.5- 10.

DCB had a long historic registered use in Germany, in orchards, ornamental, vines and other woody crops as well as for applications on grassland, non-cropped areas including railway tracks and water bodies. The authorisation for DCB use expired in 2004 but was already suspended in March 2001. For Germany, confirmed DCB product application rates are 4 g/m^2 (2.84 kg a.s./ha) for ornamental trees and 25 g/m^2 (17.75 kg/ha) on railway tracks (written communication with BVL, 2020).

FLC was first registered in Germany in January 2007 for applications in vines, potatoes and vegetables, but also in hops. There is a 2.5-year gap between the expiry of the DCB registration and the authorisation of FLC. In terms of common target crops, there is only a spatial overlap for use on vines, but the non-agricultural use of DCB may make it difficult to discount spatial overlap between DCB and FLC uses as farmers may have used DCB on non-cropped areas on their farms or associated with other crops.

A comparison between typical application rates and modes for DCB and FLC identified a much higher possibility for leaching of M-01 BAM associated with DCB applications.

Following the check for data consistency and quality, around 50,000 groundwater analyses were available for the three analytes covering the time period 1990-2017 (Table 7.5- 12).

The geographical distribution of the available data for the three analytes is shown in Figure 7.5- 1 to Figure 7.5- 3.

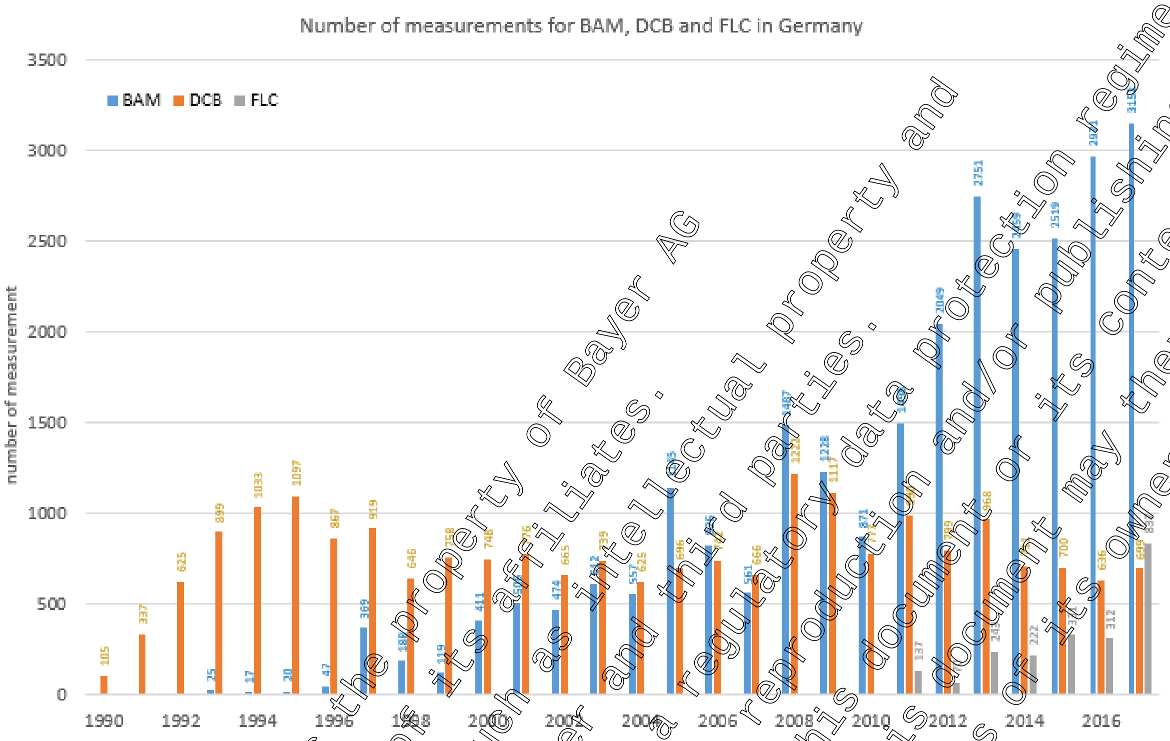
For FLC data are available for 7 years, covering the time period 2011-2017. Because only 3 federal states are monitoring FLC, the distribution of the data points is heterogeneous. The federal state Saxony contributes more than 50% of the available measurements.

For DCB more than 20,000 data points are available for the time period 1990-2017. The focus for DCB measurements was in the west of Germany. Specifically, in the southern parts of Hesse DCB was intensively monitored with more than 14,000 analyses.

For M-01 BAM there are more than 26,000 data points available for the period 1993-2017. M-01 BAM was monitored in many regions across Germany. There is a concentration of data points in the south of Hesse and around the city of Hamburg. There are no M-01 BAM data available for the federal states Saxony-Anhalt and Thuringia.

The time series of the number of samples analysed in each year is shown in Figure 7.5- 12 for each of the three analytes. DCB was the first of the 3 substances to be analysed in Germany, with data starting from 1990. The amount of analyses increased slightly from around 100 to a maximum of 1,200 in 2008. Up to 2017 there were around 600-1,000 analyses per year. Monitoring for FLC started in 2011. There are about 70-330 yearly analyses available for the period 2011-2016 and more than 800 for the year 2017. Monitoring data for M-01 BAM are available from 1993 onwards but with only a few hundred analyses per year up to the year 2000. The monitoring effort increased slightly in the period 2000-2010 and significantly for the period from 2011 onwards. The maximum number of data available are for 2017, with more than 3,000 analyses.

Figure 7.5- 12: Time series of number of residue analyses for FLC, DCB and M-01 BAM for Germany



An overview of the available groundwater analyses for FLC, DCB and M-01 BAM is provided in Table 7.5- 13A, Table 7.5- 13C and Table 7.5- 13D in relation to the concentration classes.

FLC is monitored in 3 federal states and has been detected in 7 analyses from 4 sites in Germany. Three of the detections were made in Bavaria and the single concentration >0.1 µg/L relates to a site in Saxony. The monitored detections do not correlate with the typical vine or potato cropping areas. The one groundwater concentration threshold exceedance for FLC was further investigated as part of a desk-based elucidation study but the reason for the exceedance could not be elucidated. In the sample from April 2013, FLC was detected with a concentration of 0.12 µg/L but its metabolite M-01 BAM was not detected. This pattern of parent detection without detections of the more mobile metabolite indicates towards a relatively direct entry pathway via a hydraulic short-cut. Several other a.s. were detected in elevated concentrations with up to 1.6 µg/L at the same sampling event, suggesting that some exceptional event triggered the observed concentrations. Nitrate concentrations are <30 mg/L and do not suggest very vulnerable site conditions which are prone to excessive leaching. Possible explanations for the observed detections are: a) rapid leaching through cracking soils following storm events, or b) an entry of substances into groundwater following handling, mixing and loading of crop sprayers at the nearby farm yard. In any case, the FLC exceedance was a single occurrence related to some exceptional event. The data for this site do not suggest excessive leaching of FLC under normal environmental conditions and following compliant product use.

DCB detections >LOQ mainly occur in the southwest of Germany with a tendency to vine cropping areas but the detections could also relate to urban areas in this region. The 3 analyses with concentrations >0.1 µg/L correspond to 2 sites in the Rhine valley in southern Germany near to the border with France.

In the east of Germany there are only very few M-01 BAM detections, despite the fact that M-01 BAM was also monitored for in most of these federal states. There are three clusters of detections apparent:

1) the southwest of Germany shows the highest number of residue concentrations >LOQ but the number of high concentrations is limited,

2) central northern Germany with a high number of detections >1 µg/L, and

3) a cluster in the central western part of Germany along the border with the Netherlands. There is no obvious correlation of M-01 BAM detections with intensive vine or potato areas, apart from the cluster in central western Germany, which is an area with a high potato cropping density and also known as a significant vegetable producing region.

Austria

A general overview of the registered uses of DCB and FLC in Austria is listed in Table 7.5- 10.

DCB had a long historic registered use in Austria but there are no records readily available on the registered uses or the exact authorisation expiry. Across the EU, DCB was registered for usage as a herbicide mainly in woody crops such as vines, orchards and berries and for weed control in non-cropped (PPDB, access 2020). A similar usage authorisation is anticipated for Austria. The authorisation for DCB use would have certainly expired in 2010, although an approximately one-year period for phase-out would be typical, during which the use of remaining DCB containing products would have been allowed.

FLC was first registered in Austria in November 2011 for applications in potatoes, vegetables, hops, cane fruit and vines. As such, there is an approximately 1.5-year temporal gap between DCB and FLC authorisations. In terms of common target crops, there is only a spatial overlap for use on vines, but the non-agricultural use of DCB may make it difficult to discount spatial overlap between DCB and FLC uses, as farmers may have used DCB on non-cropped areas on their farms or associated with other crops.

A comparison between typical application rates and modes for DCB and FLC identified a much higher possibility for leaching of M-01 BAM associated with DCB applications.

Following the check for data consistency and quality, a total of more than 58,000 results from groundwater analyses were available for DCB and M-01 BAM, covering the time period 1998-2018 (Table 7.5- 12). Even though FLC is registered since November 2011 in Austria, it is only monitored from 2019 in groundwater. As data for 2019 were not considered further, to ensure that only complete years were assessed to allow for a comparison on a year-on-year basis, there were no FLC data available for the assessment.

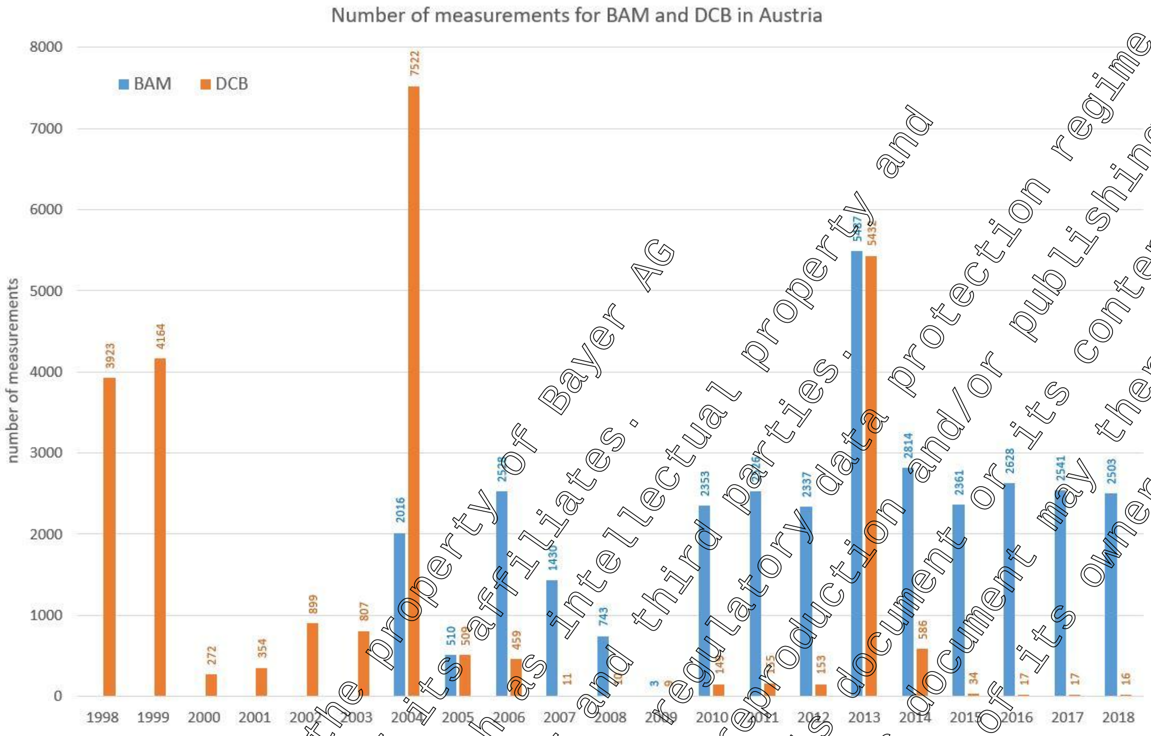
The geographical distribution of the available data for the three analytes is shown in Figure 7.5- 1 to Figure 7.5- 3.

For DCB almost 25,500 data points are available for the time period 1998-2018. There is wide geographical coverage of the monitoring data, although it is apparent that there are less data for the western, central and southern alpine parts of Austria where agriculture is of less importance.

For M-01 BAM there are more than 32,700 data points available for the period 2004-2018. Despite the large number of data, there is a heterogeneous distribution in the geographical distribution of monitoring points. Like for DCB, there are distinctively fewer monitoring data for the western, central and southern alpine parts of Austria.

The time series of the number of samples analysed in each year is shown in Figure 7.5- 13 for each of the 2 analytes. The sampling frequency for DCB was high in the years 1998, 1999, 2004 and 2013 with about 4,000 data points per year and a peak in 2004 with about 7,500 data points. From 2000 onwards a decrease in analyses was recorded, with only 9 data points in 2009 and an average of 150 data points in 2010-2012 and 2014. From 2015 a constant drop of sampling frequency, with only 16 samples in 2018 was recorded. Monitoring for M-01 BAM started in 2004 and has a decrease in sample numbers towards 2009, with only 3 data points in that year. From 2010 to 2018 the sampling frequency was stable with about 2,500 data points per year, except the one peak value in 2013 with 5,500 data points. In general, there are more analyses for M-01 BAM than for DCB.

Figure 7.5- 13: Time series of number of residue analyses for DCB and M-01 BAM for Austria



An overview of the available groundwater analyses for DCB and M-01 BAM is provided in Table 7.5- 13C and Table 7.5- 13D´ in relation to the concentration classes. For FLC there are no data available.

DCB detections >LOQ but also >0.1 µg/L occur in Lower and Upper Austria, with no particular cluster and with no obvious correlation to vine or potatoes cropping. There are 6 detections >LOQ which relate to 3 monitoring sites.

M-01 BAM detections were found widespread across the plain terrains of Austria (Lower and Upper Austria, Burgenland, southern part of Styria, south eastern part of Carinthia and north eastern part of Salzburg). This accounts for detections >0.1 µg/L but also for the higher concentration classes. There seems to be particular clusters of elevated M-01 BAM concentrations in the districts Linz, Linz-Land and the districts Graz and Leibnitz. Many of the M-01 BAM residues correspond to areas outside the main vine or potato growing regions with no apparent correlation to the density of these 2 crops. In the vine cropping areas there was only one M-01 BAM detection ≥1 µg/L and this occurred in 2006, prior to the authorisation of FLC. There were no detections ≥1 µg/L in potato cropping areas. These data imply that M-01 BAM detections ≥1 µg/L are related to historic DCB usage. There is however, one exception, where M-01 BAM residues ≥10 µg/L are related to potato cropping and FLC usage. The groundwater of this monitoring site (ID: PG31300362) was analysed for M-01 BAM residues since 2007 and there were no detections until early 2012. Elevated M-01 BAM detections ≥10 µg/L were detected in April 2012 and in July 2013 with a maximum of 12 µg/L. Subsequently there was a sharp decline in concentrations, and from 2014 onwards concentrations were typically in the order of 1-2 µg/L. Although the monitoring site is outside of main potato cropping areas, aerial pictures show that at this site potato farming is of local importance. The elevated M-01 BAM detections ≥10 µg/L cannot unambiguously be elucidated. It is likely that the detections are related to FLC usage. However, the timing of the first detection (mid of April 2012) very shortly after a first opportunity for a FLC application, together with the rapid decrease of concentrations in the subsequent monitoring period, suggest that M-01 BAM entered the groundwater relatively directly. This may have happened via hydraulic short cuts or via a point source during handling, mixing or loading of spray broth. It is concluded that the elevated M-01 BAM detections at this site are not related to excessive leaching under normal environmental conditions following good agricultural practice.

Italy

A general overview of the registered uses of DCB and FLC in Italy is listed in Table 7.5- 10.

DCB was used since 1970´s in Italy, in vines, olives, apples, ornamentals, amenity use, hard surfaces, land adjacent to aquatic areas and was in wide spread use until 1980, when it was partially replaced by glyphosate in agriculture and other uses. DCB was used mainly to control weeds in industrial areas, car parks, railways and motorway sides. The authorisation for DCB use expired in March 2009, although an approximately one-year period for phase-out would be typical, during which the use of remaining DCB containing products would have been allowed.

FLC was first registered in Italy in July 2008 for applications in vines, potatoes, vegetables, herbs and flowers. As such, there is a negligible temporal overlap between DCB and FLC authorisation. In terms of common target crops, there is a spatial overlap for use on vines, but the non-agricultural use of DCB may make it difficult to discount spatial overlap between DCB and FLC uses as farmers may have used DCB on non-cropped areas on their farms or associated with other crops.

A comparison between typical application rates and modes for DCB and FLC identified a much higher possibility for leaching of M-01 BAM associated with DCB applications.

After completion of the data consistency check, a total of almost 23,000 values from groundwater analyses were available for the three analytes covering the time period 2008-2017 (Table 7.5- 12).

The geographical distribution of the available data for the three analytes is shown in Figure 7.5- 1 to Figure 7.5- 3.

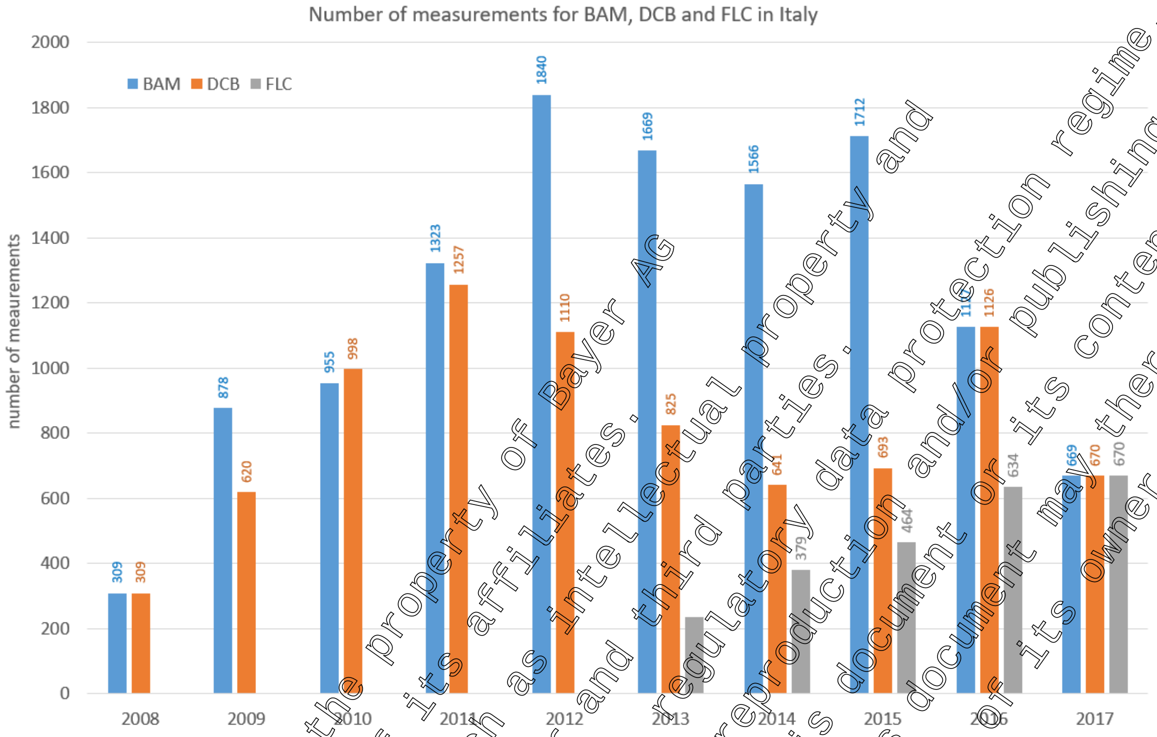
For FLC data are only available for 4 years, covering the time period 2013-2017. The monitoring data cover northern and north-western Italy (Tuscany, Piedmont and Trentino-Alto-Adige/South Tyrol regions).

For DCB almost 8,300 data points are available for the time period 2008-2017. Monitoring data are only available for the regions Piedmont, Tuscany and Campania.

For M-01 BAM GW there are more than 12,000 data points available for the period 2008-2017, located in Tuscany, Piedmont, Lombardy and Trentino-Alto-Adige/South Tyrol regions.

The time series of the number of samples analysed in each year is shown in Figure 7.5- 14 for each of the three analytes. The figure illustrates that there was a sharp increase in the sampling frequency from 2008-2011 for DCB and from 2008-2012 for M-01 BAM. DCB and M-01 BAM were the first 2 of the 3 substances analysed in Italy in 2008. The amount of analyses slightly increased from around 310 to a maximum of 1,257 in 2011 for DCB and 1,840 for M-01 BAM in 2012. From 2011 a decrease in sampling frequency for DCB to an average of 700 analyses yearly can be recorded. In the period 2012-2015, the number of M-01 BAM analyses stayed at a high level, with an average of 1,600 measurements and decreased subsequently to 670 measurements in 2017. The FLC monitoring started in 2013 with only 220 samples, which increased to 670 samples in 2017.

Figure 7.5- 14: Time series of number of residue analyses for FLC, DCB and M-01 BAM for Italy



An overview of the available groundwater analyses for FLC, DCB and M-01 BAM is provided in Table 7.5- 13A, Table 7.5- 13C and Table 7.5- 13D in relation to the concentration classes.

For FLC there are almost 2,400 analyses available of which 43 are >LOQ (1.8%), with 12 analyses exceeding the regulatory groundwater concentration threshold of 0.1 µg/L. All FLC detections occurred in the Piedmont region, an area where vine cropping is only of significance in the southern part, in the provinces Cuneo and Asti. The 43 detections >LOQ relate to 42 sites as repeated detections were encountered at one of the monitoring sites. The 12 elevated FLC exceedances relate to 11 sites. The elucidation concluded that the detections at 10 of the sites are likely to be false positive findings, possibly related to sample contamination or an analytical error. Most of the samples that show detections were sampled in October 2016 and are single detections with FLC concentrations <LOQ in subsequent samplings. Several of these findings occurred in deep and confined aquifers and there were no detections of M-01 BAM residues. The circumstantial evidence suggest that the findings are false positives. There is no obvious correlation to potato growing regions

For DCB there are almost 8,250 analyses with only 2 detections (0.02%) >LOQ. One is <0.1 µg/L, the other ≥10 µg/L.

For M-01 BAM there are in the order of 12,000 analyses available for an assessment of which 491 analyses are >LOQ (4.0%). The highest density of detections was found in the province Monza and Brianza. There were no detections ≥10 µg/L. In the concentration class 0.75 ≤ x < 1.0 µg/L there were 6 detections (0.05%) which relate to 4 monitoring sites. The 4 detections in the class 1.0 ≤ x < 10.0 µg/L relate to 3 monitoring sites and that all of these detections were observed outside the main vine and potato cropping areas, which implies that these these detections are related to historic DCB usage.

Spatial and temporal assessment of residue data

The residue analyses for each analyte were categorised according to their concentrations classes and assessed for temporal trends.

The data for Denmark set a baseline, as FLC was never registered in this country. The time series for DCB detections is shown in Figure 7.5- 15. In Denmark the authorisation for DCB usage expired in July 1997. Although the parent detection rates are generally low, (166 detections >LOQ, out of 69,776 samples) the time series illustrates that DCB was found in groundwater persistently even more than 20 years after its registration expiry. Detection rates were in the order of 1-2% in 1996 and 1997 and declined to <1% in the following monitoring period. Taking the year 2017 as an example, 20 years after the expiry of DCB usage in Denmark, the detection rate was still in the order of 0.5%, corresponding to 15 samples with detections >LOQ, and a further 6 samples with concentrations >0.1 µg/L.

For BAM, residue concentrations in groundwater remained even more persistent (Figure 7.5- 16). In the late 1990s, shortly after the expiry of DCB usage, detection rates >LOQ were in the order of 20% and the detection rates in the concentration class >0.1 µg/L were around 10%. In the subsequent monitoring period detection rates declined only very slowly, and in 2017 there were still 15% of the samples with concentrations >LOQ and about 7% (n=350) of the samples with concentrations >0.1µg/L.

The data for Denmark clearly show that DCB and BAM residues are still detected in groundwater long (>20 years) after the expiry of the DCB registration. The reason for this is residual DCB concentrations in soil following very high use rates which still degrade to form BAM coupled with the percolation times through the unsaturated zone.

Figure 7.5- 15: Time series of DCB residue detections categorised by residue classes for Denmark

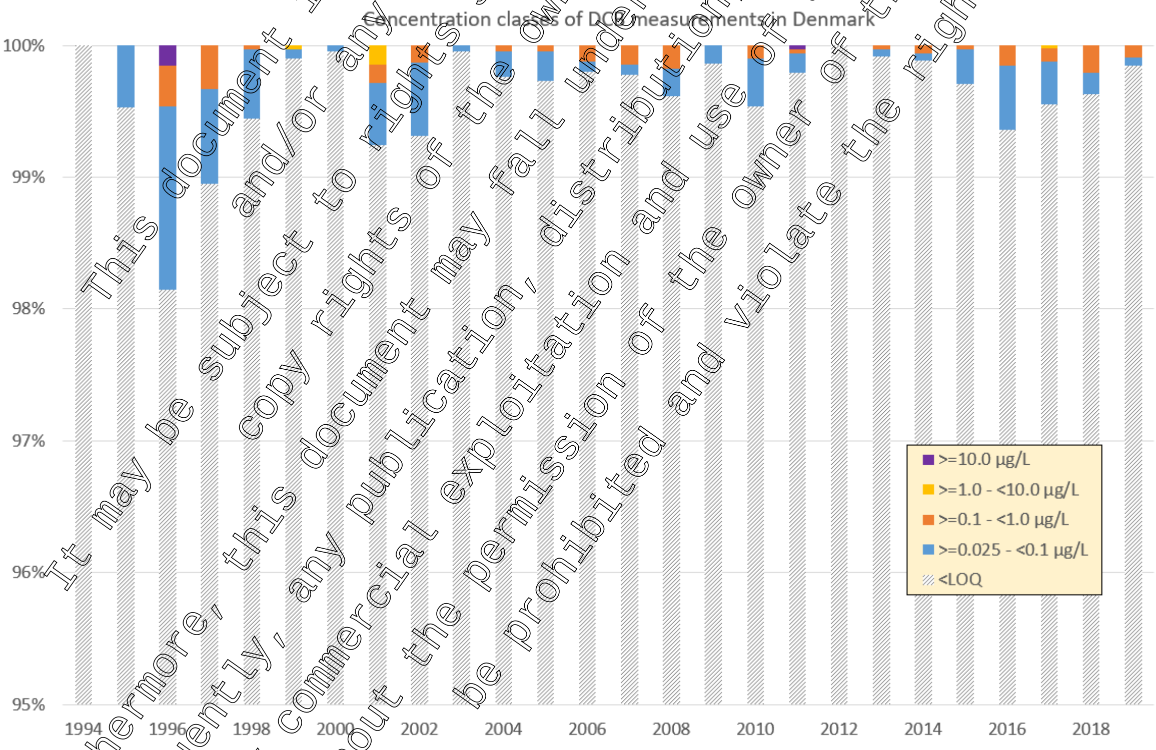
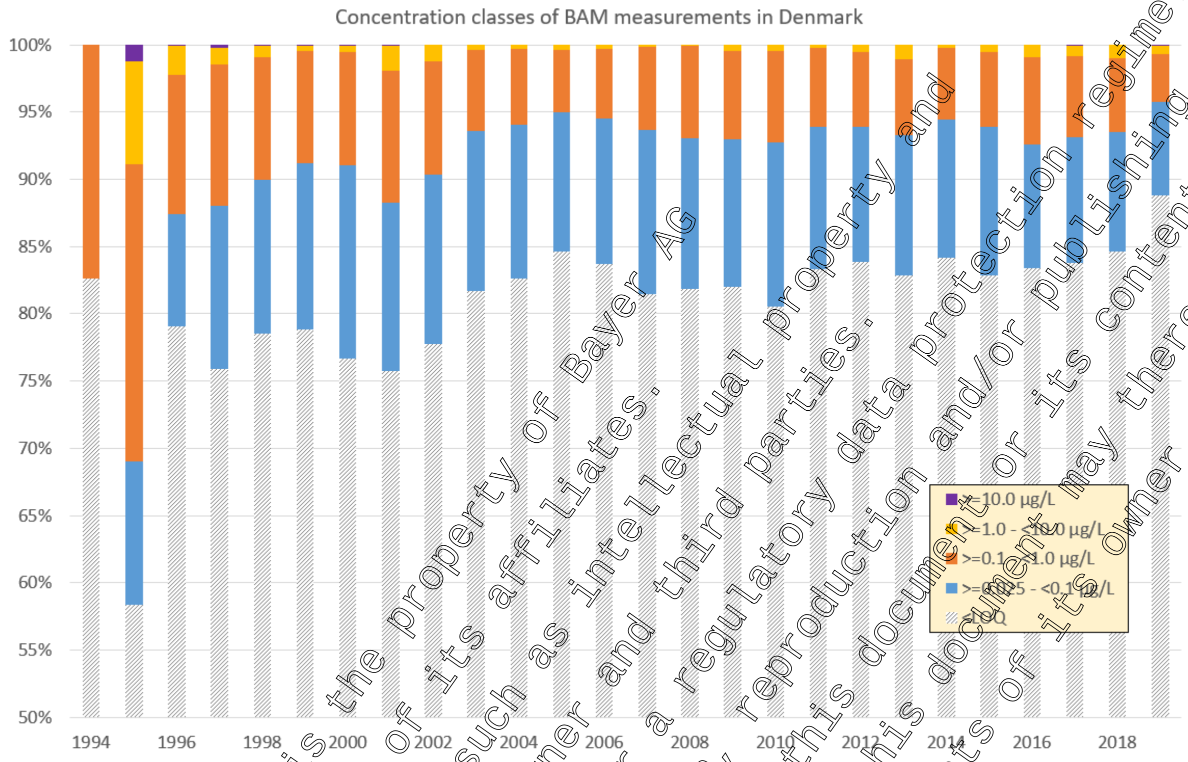


Figure 7.5- 16: **Time series of BAM residue detections categorised by residue classes for Denmark**



The temporal trends of groundwater detections of FLC, DCB and M-01 BAM based on the aggregated data from the six selected target MSs is discussed below.

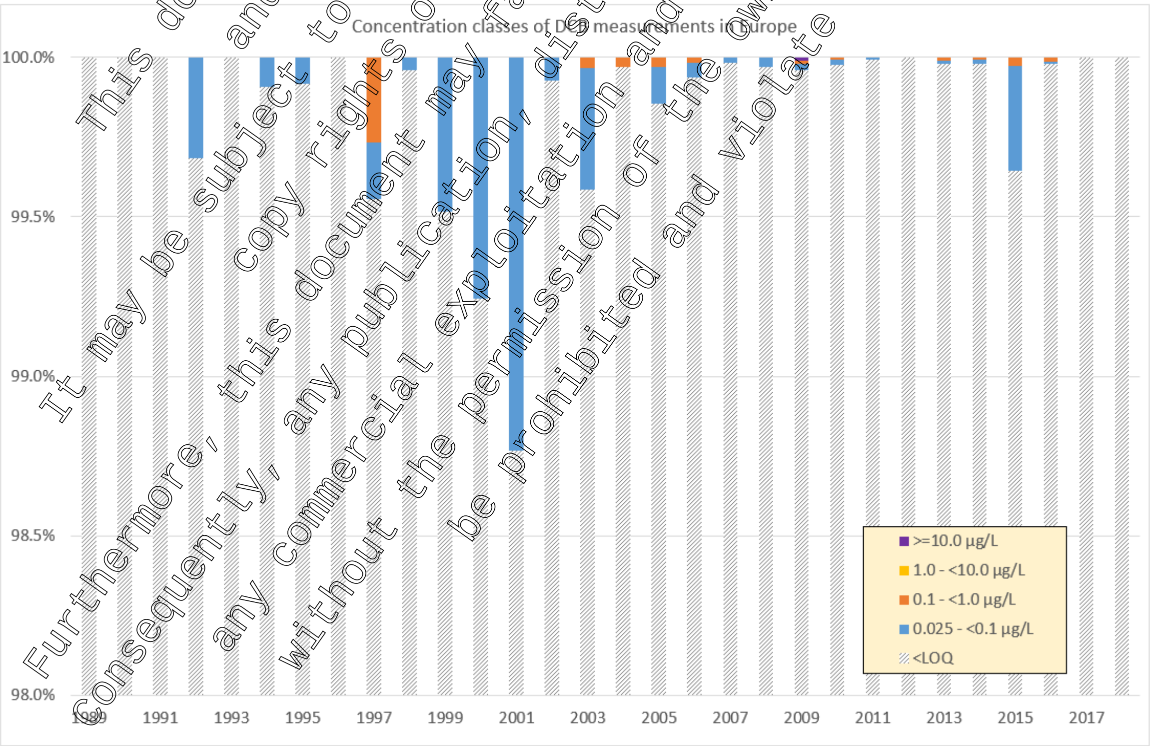
For FLC, the data are listed in Table 7.5- 14. FLC was first registered in the target MSs, for which residue data are available, between 2007 (Germany and the Netherlands) and 2010 (France). The number of detections were low in the period 2011-2015 with only 3 detections >LOQ in this 5-year period. The detection numbers increased markedly in 2016 and 2017 with 45 detections >LOQ in 2016 and 14 in 2017. This is strongly biased by the data from Italy, where 41 detections >LOQ were reported for 2016, of which 11 detections were ≥0.1 µg/L. The detections above the 0.1 µg/L threshold were subject to a desk-based elucidation which concluded that many the reported concentrations are most likely false positive detections.

Table 7.5- 14: Number of residue detections and sites for FLC in selected MS categorised by residue classes

Year	Total		< LOQ µg/L		0.025 ≤ x < 0.1 µg/L		0.1 ≤ x < 1.0 µg/L		1.0 ≤ x < 10.0 µg/L	
	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites
2011	232	155	232	155	0	0	0	0	0	0
2012	260	226	260	226	0	0	0	0	0	0
2013	513	438	511	436	1	1	1	1	0	0
2014	602	428	602	428	0	0	0	0	0	0
2015	795	577	794	576	1	1	0	0	0	0
2016	1707	1435	1662	1400	32	32	12	12	1	1
2017	4984	2853	4970	2848	12	10	2	2	0	0
2018	2776	1066	2769	1066	6	6	1	1	0	0
Total	**11869**	**4154**	**11800**	**4147**	**52**	**46**	**16**	**15**	**1**	**1**

The time series for DCB detections over the monitoring period is illustrated in Figure 7.5- 17. In the target MSs the registration for DCB usage expired between 2004 (Germany) and 2010 (France, Belgium). The residue detection rates are generally low and vary between 0-1.5%. The temporal trend may be biased by the total number of analyses which increased significantly over time. Nevertheless, the data show that DCB detections were still recorded in the period following the expiry of the registration. In 2015, DCB was detected in groundwater on 53 occasions (0.35%).

Figure 7.5- 17: Time series of DCB residue detections categorised by residue classes for selected MS



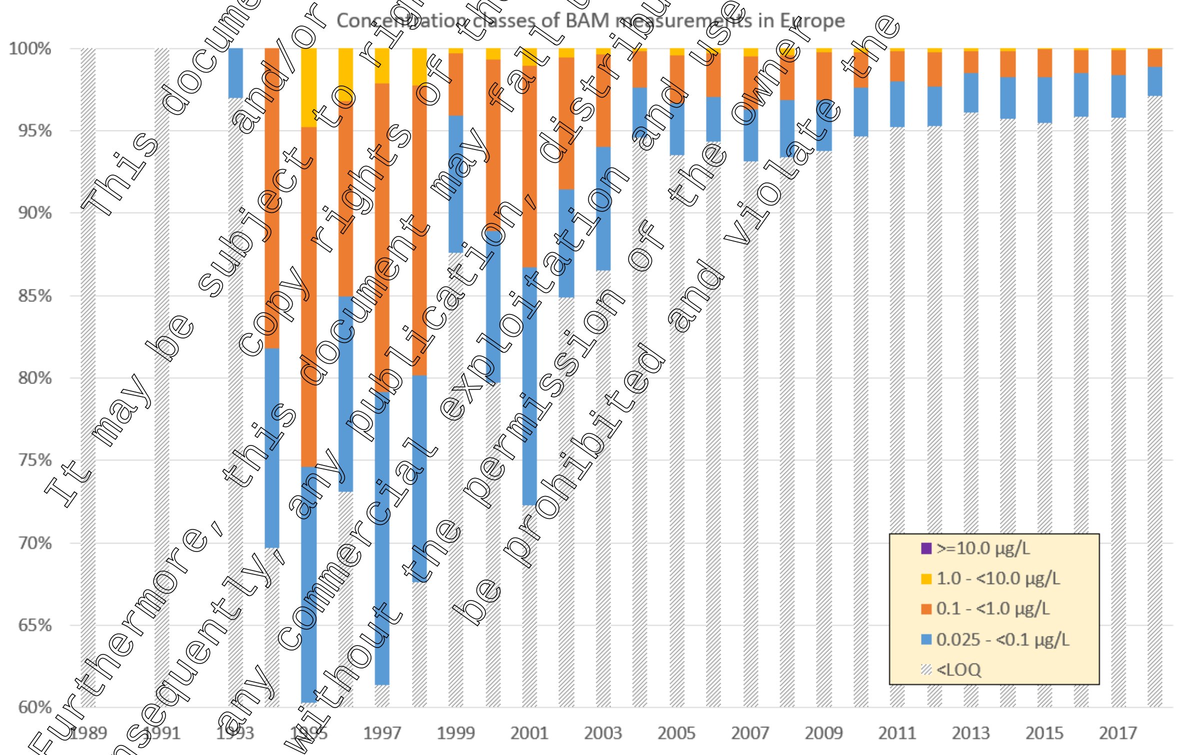
The temporal trend of M-01 BAM detections is shown in Figure 7.5- 18 for the target MSs. M-01 BAM detection rates show a significantly decreasing trend from the mid-1990s to about 2003. During this period DCB was still registered in all target MSs and the strong decline in detection rates is more likely related to the increase in number of analyses that are available for each year and a more widespread monitoring away from known problem sites. For instance, in 1995 there are only the results for 63 M-01 BAM analyses available. From 2004 onwards there were more than 3,000 analyses for each monitoring year and in the period 2013-2016 more than 20,000.

From the mid-2000s onwards, M-01 BAM detection rates decreased slowly over time from about 7% in 2007 to 2.5% in 2018. This decrease relates particularly to the higher concentration residue classes between 0.1-1.0 µg/L and 1-10 µg/L.

In comparison to Denmark, the aggregated BAM data across all MSs show considerably lower detection rates. For the period post 2010, following the expiry of DCB authorisation in all target MSs, detection rates were in the order of 2.5-5% with a slightly decreasing trend. In the same time period, BAM detection rates in Denmark were 12-17%, although DCB usage was already banned for almost 15 years. It should however be noted, that the aggregated MSs data are biased by the much larger sample numbers from France. When looking at individual countries, M-01 BAM detection rates appear to have a bimodal distribution. In France, Germany, Austria and Italy the detection rates post 2010 are in the range of 2-7%, whereas in Belgium and the Netherlands the detection rates are in the range of 13-20%.

For the target MSs it may be concluded that M-01 BAM residues in the period post 2010 cannot readily be linked to FLC usage. Instead, a significant proportion of M-01 BAM detections in this period are most likely caused by leaching related to the legacy of DCB usage. This is based on the conclusions that can be drawn from the Danish data and the fact that there are still numerous DCB detections in the target MSs after 2010.

Figure 7.5- 18: Time series of M-01 BAM residue detections categorised by residue classes for selected MS



The spatial and temporal trends from the country assessments are as follows:

Denmark

Denmark - Temporal assessment of residue data

The number of residue analyses for each monitoring year are categorised according to residue concentration classes in Table 7.5- 15 and Table 7.5- 16 for DCB and BAM respectively. These tables also include the number of sites that fall into each residue concentration class.

Table 7.5- 15: Number of residue detections and sites for DCB categorised by residue classes for Denmark

Year	**Total**		**< LOQ (0.025 µg/L)**		**0.025 ≤ x < 0.1 µg/L**		**0.1 ≤ x < 1.0 µg/L**		**1.0 ≤ x < 10.0 µg/L**		**≥ 10.0 µg/L**	
	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites
1994	28	28	28	28	0	--	0	--	0	--	0	--
1995	212	188	211	187	1	1	0	--	0	--	0	--
1996	646	561	634	553	9	7	2	2	0	--	1	1
1997	1812	1535	1793	1526	13	10	6	5	0	--	0	--
1998	3068	2466	3051	2455	16	16	1	1	0	--	0	--
1999	3066	2474	3063	2473	2	2	0	--	1	1	0	--
2000	2251	1777	2250	1777	1	1	0	--	0	--	0	--
2001	2788	2108	2767	2098	13	12	4	4	4	2	0	--
2002	3043	2250	3022	2237	17	14	4	3	0	--	0	--
2003	2305	1775	2304	1774	1	1	0	--	0	--	0	--
2004	2086	1609	2081	1606	4	4	1	1	0	--	0	--
2005	2204	1765	2198	1760	5	5	1	1	0	--	0	--
2006	2460	1979	2455	1975	2	2	3	3	0	--	0	--
2007	2724	2165	2718	2162	2	2	4	2	0	--	0	--
2008	2828	2432	2817	2422	6	6	5	4	0	--	0	--
2009	2829	2471	2825	2468	4	3	0	--	0	--	0	--
2010	3043	2597	3029	2587	11	9	3	2	0	--	0	--
2011	3340	2883	3333	2879	5	5	1	1	0	--	1	1
2012	3336	2843	3336	2843	0	--	0	--	0	--	0	--
2013	3583	3113	3580	3110	2	2	1	1	0	--	0	--
2014	3359	2788	3355	2786	2	2	2	2	0	--	0	--
2015	3104	2676	3095	2669	8	8	1	1	0	--	0	--
2016	3878	3371	3853	3354	19	17	6	6	0	--	0	--
2017	4722	3926	4701	3912	15	14	5	4	1	1	0	--
2018	3776	3266	3762	3252	6	6	8	8	0	--	0	--
2019	3285	2890	3280	2885	2	2	3	3	0	--	0	--
Total	**69776**	**18677**	**69541**	**18586**	**166**	**135**	**61**	**47**	**6**	**4**	**2**	**2**

The sum of the number of sites in each class does not necessarily match the total number of sites in each year. This is because one site may have been sampled several times in a particular year, and because the resulting residue concentrations vary within the year, one individual site may fall into more than one residue class. Similarly, the sum of the number of sites in each residue class and each year will not add up to the total number of sites in this residue class. This is because the same sites may have had residue concentrations in this class over more than one year.

Table 7.5- 16: Number of residue detections and sites for BAM categorised by residue classes for Denmark

Year	Total		< LOQ (0.025 µg/L)		0.025 ≤ x < 0.1 µg/L		0.1 ≤ x < 1.0 µg/L		1.0 ≤ x < 10.0 µg/L		≥ 10.0 µg/L	
	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites
1994	23	23	19	19	0	--	4	4	0	--	0	--
1995	552	366	322	243	59	49	122	89	42	20	7	6
1996	1585	1226	1253	1034	132	107	164	124	35	23	1	1
1997	2378	1789	1805	1470	289	195	250	172	29	21	5	5
1998	3763	2755	2956	2310	428	309	345	236	31	27	3	3
1999	4040	2897	3186	2448	499	328	335	236	18	15	2	2
2000	3790	2738	2907	2259	544	354	318	225	19	17	2	2
2001	4333	3144	3283	2547	541	378	425	290	82	58	2	2
2002	4618	3309	3591	2721	581	397	390	280	56	43	0	--
2003	4281	3092	3496	2658	511	350	257	179	17	17	0	--
2004	3899	2882	3220	2499	446	301	222	154	10	10	1	1
2005	3896	2999	3296	2633	404	306	180	130	16	15	0	--
2006	3754	2915	3143	2541	405	297	194	144	12	12	0	--
2007	3677	2826	2996	2403	447	333	229	147	5	5	0	--
2008	3782	3056	3095	2620	424	322	259	182	4	4	0	--
2009	3362	2805	2757	2425	368	277	222	155	15	12	0	--
2010	3601	2883	2900	2442	441	330	244	167	16	14	0	--
2011	3948	3238	3289	2822	419	308	230	161	10	10	0	--
2012	3986	3188	3344	2784	399	290	221	153	21	18	1	1
2013	4414	3555	3656	3064	461	323	249	184	47	38	1	1
2014	3988	3174	3357	2765	410	309	211	146	10	8	0	--
2015	3634	2993	3011	2582	402	306	202	145	19	19	0	--
2016	4312	3573	3597	3071	395	298	279	224	41	35	0	--
2017	5095	4103	4270	3486	475	384	308	266	40	39	2	1
2018	4059	3422	3434	2947	361	301	223	185	41	38	0	--
2019	3676	3089	3264	2772	255	217	132	112	23	23	2	2
Total	**92446**	**20519**	**75447**	**17797**	**10096**	**2833**	**6215**	**2193**	**659**	**381**	**29**	**24**

The sum of the number of sites in each class does not necessarily match the total number of sites in each year. This is because one site may have been sampled several times in a particular year, and because the resulting residue concentrations vary within the year, one individual site may fall into more than one residue class. Similarly, the sum of the number of sites in each residue class and each year will not add up to the total number of sites in this residue class. This is because the same sites may have had residue concentrations in this class over more than one year.

DCB detection rates ≥LOQ range from 0% to 1.9% and were highest in the years 1996 and 1997. However, this may be a bias of the data density, as there are relatively fewer residue results available for these years, particularly for the year 1996. DCB detection rates are generally low, typically in the order of 0.2-0.7%. Detection rates ≥0.1 µg/L range from 0.0-0.5% and are on average 0.1%. It is however striking that even though the DCB authorisation expired in 1997 the detection rate of DCB in groundwater does not decline nor is there a clear trend towards decreasing concentration classes over time. Detections of DCB in concentrations ≥0.1 µg/L were still observed in recent years, some 20 years after the expiry of the usage authorisation for this a.s..

BAM detection rates ≥LOQ typically range from 15-25% with the exception for the year 1995 when the detection rate was 41%. The latter is likely to be a bias due to the relatively smaller number of analyses in this year. Detection rates ≥0.1 µg/L show a slightly decreasing trend in the late 1990s following the expiry of the DCB authorisation but remain relatively stable at 4-7% from 2003 onwards. Over the monitoring period there were 29 BAM detections ≥10 µg/L most of which occurred until 2001, but there were occasional further detections also in the later monitoring period (compare to Table 7.5- 16). In 2019 two BAM detections ≥10 µg/L were made, 22 years after the expiry of the DCB authorisation.

Denmark - Spatial assessment of BAM residues pre and post FLC registration

The geographical distribution of DCB and BAM residue data was assessed in relation to the time period pre and post DCB authorisation. Three time periods were chosen for this, 1) 1994-1997 representing the time period when DCB was still authorised for usage, 2) 1998-2009 covering the first 12 years following the expiry DCB authorisation, and 3) 2010-2019 as a later time period post authorisation.

For DCB there were 9 detections ≥0.1 µg/L in the monitoring period to the end of the DCB authorisation in 1997, but this also included one detection >10 µg/L. All detections occurred in the regions of Nordjyland and Syddanmark. In comparison to the later monitoring period there are fewer detections in this early monitoring period. The likely reason for this is the shorter monitoring time period covering only 4 years and that monitoring was not yet as intensive as in the subsequent time period. In later monitoring period further DCB detection ≥0.1 µg/L were observed. The detections are not related to particular sites or areas of Denmark, instead the locations where elevated DCB concentrations were found change over time.

BAM detections show that there is no obvious geographical pattern to the distribution of BAM detections over time. All areas of Denmark are affected by BAM detections, also by higher concentrations of ≥1 µg/L or even ≥10 µg/L. In the first monitoring period to 1997 there are fewer detections, but this is simply because the data are for a shorter time period and monitoring for BAM was not yet as extensive. The elevated BAM concentrations are not restricted to certain areas, instead the groundwater across all of Denmark is affected. Similar to DCB there is no general pattern whereby high concentrations are detected persistently at certain locations over the monitoring period, instead the locations where BAM concentrations >10µg/L were found change over time.

In summary the DCB and BAM residue data for Denmark show no particular relation to certain sites or regions over the monitoring period. Detections of high residue concentrations change over time. It is however remarkable that DCB, and BAM in particular, are detected wide spread across Denmark even decades after the expiry of DCB.

France

France - Temporal assessment of residue data

The number of residue analyses for each monitoring year are categorised according to residue concentration classes in Table 7.5- 17 to Table 7.5- 19 for FLC, DCB, and M-01 BAM respectively. These tables also include the number of sites that fall into each residue concentration class.

Table 7.5- 17: Number of residue detections and sites for FLC in France categorised by residue classes

Year	Total		< LOQ		0.025 ≤ x < 0.1 µg/L		0.1 ≤ x < 1.0 µg/L	
	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites
2016	305	155	305	155	0	--	0	--
2017	3213	1488	3208	1488	5	4	0	--
2018	2776	1066	2769	1066	6	6	1	1
Total	**6294**	**1752**	**6282**	**1752**	**11**	**7**	**1**	**1**

The sum of the number of sites in each class does not necessarily match the total number of sites in each year. This is because one site may have been sampled several times in a particular year, and because the resulting residue concentrations vary within the year, one individual site may fall into more than one residue class. Similarly, the sum of the number of sites in each residue class and each year will not add up to the total number of sites in this residue class. This is because the same sites may have had residue concentrations in this class over more than one year.

Table 7.5- 18: Number of residue detections and sites for DCB in France categorised by residue classes

Year	Total		< LOQ		0.025 ≤ x < 0.1 µg/L		0.1 ≤ x < 1.0 µg/L	
	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites
1996	1	1	1	1	0	--	0	--
1997	146	78	146	78	0	--	0	--
1998	153	95	153	95	0	--	0	--
1999	101	58	101	58	0	--	0	--
2000	166	108	166	108	0	--	0	--
2001	849	444	849	444	0	--	0	--
2002	999	418	999	418	0	--	0	--
2003	1074	423	1074	423	0	--	0	--
2004	1724	953	1723	953	0	--	1	1
2005	1949	1082	1947	1081	2	2	0	--
2006	3652	1956	3652	1956	0	--	0	--
2007	4182	2291	4182	2291	0	--	0	--
2008	4122	1938	4122	1938	0	--	0	--
2009	7324	4517	7323	4517	1	1	0	--
2010	10348	5451	10347	5450	1	1	0	--
2011	11208	5512	11207	5511	1	1	0	--
2012	11937	6364	11937	6364	0	--	0	--
2013	13017	7522	13016	7521	1	1	0	--
2014	13074	7330	13074	7330	0	--	0	--
2015	12052	7614	12050	7613	2	2	0	--
2016	13239	7484	13239	7484	0	--	0	--
2017	9789	6548	9789	6548	0	--	0	--
2018	6715	3570	6715	3570	0	--	0	--
Total	**127821**	**21928**	**127812**	**21927**	**8**	**8**	**1**	**1**

The sum of the number of sites in each class does not necessarily match the total number of sites in each year. This is because one site may have been sampled several times in a particular year, and because the resulting residue concentrations vary within the year, one individual site may fall into more than one residue class. Similarly, the sum of the number of sites in each residue class and each year will not add up to the total number of sites in this residue class. This is because the same sites may have had residue concentrations in this class over more than one year.

Table 7.5- 19: Number of residue detections and sites for M-01 BAM in France categorised by residue classes

Year	Total		< LOQ		0.025 ≤ x < 0.1 µg/L		0.1 ≤ x < 1.0 µg/L		1.0 ≤ x < 10.0 µg/L		≥ 10.0 µg/L	
	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites
2000	43	15	38	12	2	2	3	2	0	--	0	--
2001	324	143	314	142	5	3	2	2	3	1	0	--
2002	437	173	431	173	2	2	0	--	4	1	0	--
2003	493	239	483	235	5	5	1	1	4	1	0	--
2004	1013	538	999	536	4	2	8	5	2	1	0	--
2005	1324	614	1274	606	25	14	22	10	3	1	0	--
2006	3176	1734	3097	1711	25	17	46	24	8	3	0	--
2007	3532	1802	3400	1760	53	29	68	34	11	6	0	--
2008	2734	1321	2602	1281	69	42	59	28	4	2	0	--
2009	5007	3054	4766	2977	115	64	121	51	5	2	0	--
2010	7561	4095	7295	4002	140	94	116	56	10	3	0	--
2011	8636	4404	8279	4301	216	116	131	68	10	4	0	--
2012	10788	5354	10399	5252	206	126	175	80	8	3	0	--
2013	12643	7144	12287	7021	213	129	132	63	10	5	1	1
2014	13357	7501	12927	7358	254	151	166	73	8	5	2	1
2015	12218	7856	11887	7727	203	120	127	55	1	1	0	--
2016	14080	7936	13650	7794	297	173	131	70	2	2	0	--
2017	10924	7366	10516	7229	257	140	147	65	4	3	0	--
2018	6945	3897	6705	3804	141	92	95	42	4	1	0	--
Total	**115235**	**19735**	**111349**	**19599**	**2232**	**506**	**1550**	**219**	**101**	**17**	**3**	**1**

The sum of the number of sites in each class does not necessarily match the total number of sites in each year. This is because one site may have been sampled several times in a particular year, and because the resulting residue concentrations vary within the year, one individual site may fall into more than one residue class. Similarly, the sum of the number of sites in each residue class and each year will not add up to the total number of sites in this residue class. This is because the same sites may have had residue concentrations in this class over more than one year.

For FLC the rate of detections >LOQ is in the order of 0.2% for the monitoring years 2017 and 2018. The number of detections is too small to derive a statistically meaningful population to assess whether there may be potential trends in the detection frequency over time. The same accounts for DCB where the detection rate is even lower. For DCB it is however worth noting that some detections were still observed in the year 2015, 5 years after the authorisation for DCB use expired. Half of the detections (n=4) occurred in the period post 2010, after the DCB authorisation had expired.

Due to the small number of FLC and DCB detections, no further temporal assessment was performed for the two analytes.

For M-01 BAM there are more detections >LOQ which enables an assessment of detection rates and concentration classes over time. A summary of the residue data for each monitoring year is provided in Table 7.5- 19.

The M-01 BAM detection rate >LOQ is typically in the order of 2-5% of the total number of analyses in any one year. The detection rate is however much higher in the year 2000 which is attributed to the relatively low number of analyses in this first monitoring year, which distorts the statistics. Detection rates increased in the first monitoring decade and reached a maximum of about 5% in the years 2008 and 2009 just before the expiry of the DCB authorisation. In the period 2010-2018 there is an overall declining trend in M-01 BAM detections although a slight increase in detection rates is indicated for the years 2017 and 2018.

More important are the detection trends for the higher concentration classes. Detection rates in the concentration class 0.1 ≤ x < 1.0 µg/L peaked in 2008 and 2009 when they were just over 2%. In the subsequent period this concentration class shows a generally decreasing trend. Detection rates were in the order of 1.4% in the monitoring years 2017 and 2018. This detection rate is even lower, in the order of 1%, when the detections are related to the number of monitoring sites rather than the total number of detections (compare to Table 7.5- 19). For instance, in the years 2017 and 2018 there were 147 and 95 detections in this concentration class respectively. These detections relate to 65 sites in 2017 and 42 sites in 2018.

The most obvious trend is observed in the concentration class 1.0 < x < 10 µg/L. In the early 2000s the detection rate in this class was in the order of 1% which decreased in subsequent years. In the period post 2010, after the expiry of DCB authorisation, the detection rate was mostly <0.1 % and the detections related to only very few sites (maximum of 10 sites) across France. Detections ≥10 µg/L were only observed 3 times over the entire monitoring period. The detections occurred in 2013 and 2014. All detections in this class relate to one monitoring site and are the legacy of DCB usage.

The M-01 BAM residue time series data are further assessed by discriminating them against the occurrence of the main FLC target crops, namely, vines and potatoes. To facilitate this, annual residue data were processed in GIS to correlate them to land use data.

The number of M-01 BAM detections in the higher concentration class (≥1 µg/L) are listed in Table 7.5- 20, categorised per year and dominant cropping areas. In the monitoring period there were 104 BAM detections (≥1 µg/L) of which 44 occurred prior to the authorisation of FLC in 2010. As such, 81% (n=84) of all detections ≥1 µg/L were observed in areas with 'no' (<1%) vines or potato cropping, the remaining 19% (n=20) derived from vine cropping areas. There were no detections ≥1 µg/L in potato cropping areas.

The 20 M-01 BAM detections ≥1 µg/L in vines areas, occurred at only 6 sites across France. In vine areas there is a generally declining trend in M-01 BAM detections in this concentration class from 2013 onwards and there was only 1 detection ≥1 µg/L since 2015.

In summary, most M-01 BAM detections ≥1 µg/L (81%) were observed outside the main FLC target crops areas and are almost certainly related to DCB usage. These DCB related detections still occur in 2018, 7 years after the expiry of the DCB authorisation. Given that DCB was also extensively used in vines it is expected that the legacy of this usage is also observed in vine cultivation areas. In vine cropping areas there are only very few detections ≥1 µg/L and there is a declining trend in this concentration class. It is therefore likely that these detections derive from historic DCB applications and not from FLC. There are no detections ≥1 µg/L in potato cropping areas.

Table 7.5- 20: Number of residue detections and sites ≥1.0 µg/L for M-01 BAM in France categorised by cropping density

Year	Detections ≥1.0 µg/L							
	Total		Vines and potatoes cropping area <1%		Vines cropping area >1%		Potato cropping area >1%	
	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites
2000	0	0	0	0	0	0	0	0
2001	3	1	3	1	0	0	0	0
2002	4	1	4	1	0	0	0	0
2003	4	1	4	1	0	0	0	0
2004	2	1	2	1	0	0	0	0
2005	3	1	3	1	0	0	0	0
2006	8	3	5	2	3	1	0	0
2007	11	6	8	4	3	2	0	0
2008	4	2	4	2	0	0	0	0
2009	5	2	5	2	0	0	0	0
2010	10	3	8	2	2	1	0	0
2011	10	4	7	3	3	1	0	0
2012	8	3	5	2	3	1	0	0
2013	11	6	8	3	3	3	0	0
2014	10	6	8	5	2	1	0	0
2015	1	1	1	1	0	0	0	0
2016	2	2	1	1	1	1	0	0
2017	4	3	4	3	0	0	0	0
2018	4	1	4	1	0	0	0	0
Total	**104**	**17**	**84**	**12**	**20**	**6**	**0**	**0**

Note: The sum of sites may not add up to the total number of sites over all monitoring years. The reason for this is that detections at particular sites may occur in more than one year.

France - Spatial assessment of M-01 BAM residues pre and post FLC registration

The geographical distribution of M-01 BAM residue data was assessed in relation to the time period pre and post FLC authorisation. The M-01 BAM residue data up to the end of 2009 and the data for 2010-2018 were plotted in relation to the main vines and potatoes cropping areas. This assessment is only indicative as remaining DCB containing products will have probably been used until 2011 (authorisation expiry date plus 1 year to use up old stocks). In addition, the time dependent assessment in the previous chapter has clearly shown that a significant proportion of M-01 BAM residues in the period post 2010 are likely attributable to historic DCB usage.

The spatial distribution of M-01 BAM detections pre and post 2010 show that significantly more M-01 BAM detections at low concentrations (<1 µg/L) are observed in the period post 2010. There is no obvious correlation of M-01 BAM detections to intensive vine or potato cropping areas and many detections are even located in areas which are not related to any vine or potato cropping (e.g. Paris region). The higher number of M-01 BAM detections post 2010 is therefore most likely due to the increase in M-01 BAM sampling points in this later monitoring period (compare with Table 7.5- 19). There is a shift in locations with M-01 BAM residue concentrations >1µg/L in the period post 2010 but this shift is again not towards regions of intensive vine or potato cultivation in which FLC containing products could potentially have been used.

The M-01 BAM residue detections post FLC authorisation are further plotted in relation to the FLC product usage and show that there is no clear correlation between the spatial occurrence of M-01 BAM residues and the intensity of FLC usage. Many of the detections are located in areas where there is very limited or 'no' FLC product usage (1-5%) and clusters of M-01 BAM detections seem to be unrelated to higher FLC usage.

Belgium

Belgium - Temporal assessment of residue data

The number of residue analyses for each monitoring year are categorised according to residue concentration classes Table 7.5- 21 and Table 7.5- 22for FLC and M-01 BAM, respectively. The data for DCB are not further tabulated as there were no detections >LOQ for this analyte.

For FLC the rate of detections >LOQ is in the order of 0.1% for the monitoring years 2016 and 2017. The number of detections is too small to derive a statistically meaningful population, to assess whether there may be potential trends in the detection frequency over time. Due to the small number of FLC monitoring data and detections, no further temporal assessment was performed for this analyte.

Table 7.5- 21: Number of residue detections and sites for FLC in Belgium categorised by residue classes

Year	Total		<LOQ		0.025 ≤ x < 0.1 µg/L		0.1 ≤ x < 1.0 µg/L		1.0 ≤ x < 10.0 µg/L	
	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites
2016	278	237	275	234	1	1	1	1	1	1
2017	264	238	261	235	2	2	1	1	0	--
Total	**542**	**296**	**536**	**292**	**3**	**3**	**2**	**2**	**1**	**1**

The sum of the number of sites in each class does not necessarily match the total number of sites in each year. This is because one site may have been sampled several times in a particular year, and because the resulting residue concentrations vary within the year, one individual site may fall into more than one residue class. Similarly, the sum of the number of sites in each residue class and each year will not add up to the total number of sites in this residue class. This is because the same sites may have had residue concentrations in this class over more than one year.

For M-01 BAM there are more detections >LOQ which enables an assessment of detection rates and concentration classes over time. The M-01 BAM detection rate >LOQ is typically in the order of 12-25% of the total number of analyses in any one year. In the year 2005 the detection rate >LOQ was 29% but the total number of analyses in this year was relatively small (n=66) which may distort the statistics. Detection rates are relatively stable at about 12-15% for the monitoring period 2006-2017. Also, in the higher concentration classes there seems to be no significant trend. M-01 BAM detections ≥0.1 µg/L were in the order of 5% in the period 2006-2007 before the authorisation of FLC and are similar, in the order of 4-7%, in the period 2008-2017 after the authorisation of FLC. M-01 BAM concentrations in the concentration class ≤1 ≤ x < 10 µg/L occurred at exceedance rates in the order of 1% in the period after the FLC authorisation in 2008 and there is a slight increase in detections in this concentration class until 2014. M-01 BAM was detected in concentrations ≥10 µg/L in the years 2006 (n=1), 2012 (n=2) and 2016 (n=1).

Table 7.5- 22: Number of residue detections and sites for M-01 BAM in Belgium categorised by residue classes

Year	Total		< LOQ		0.025 ≤ x < 0.1 µg/L		0.1 ≤ x < 1.0 µg/L		1.0 ≤ x < 10.0 µg/L		≥ 10.0 µg/L	
	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites
1995	15	15	15	15	0	--	0	--	0	--	0	--
1996	34	14	34	14	0	--	0	--	0	--	0	--
1997	46	35	46	35	0	--	0	--	0	--	0	--
1998	85	73	85	73	0	--	0	--	0	--	0	--
1999	364	83	364	83	0	--	0	--	0	--	0	--
2000	391	87	391	87	0	--	0	--	0	--	0	--
2001	13	12	13	12	0	--	0	--	0	--	0	--
2002	11	9	11	9	0	--	0	--	0	--	0	--
2003	257	77	192	71	40	13	25	7	0	--	0	--
2004	144	78	108	60	25	17	11	5	0	--	0	--
2005	66	47	45	37	12	8	9	5	0	--	0	--
2006	654	382	548	352	75	27	29	9	1	1	1	1
2007	859	453	740	420	72	28	46	16	1	1	0	--
2008	1366	620	1195	573	113	54	52	25	6	4	0	--
2009	1305	672	1140	596	105	65	52	35	8	5	0	--
2010	1269	666	1069	577	129	89	60	41	11	8	0	--
2011	1258	645	1101	563	88	60	59	40	10	7	0	--
2012	1306	678	1137	612	79	65	73	55	15	13	2	2
2013	1204	650	1032	562	101	83	55	41	16	12	0	--
2014	1322	634	1122	545	111	78	70	51	19	11	0	--
2015	1554	676	1330	588	133	78	85	55	6	4	0	--
2016	1344	648	1127	562	141	81	72	48	3	3	1	1
2017	1043	542	891	474	96	59	49	35	7	5	0	--
Total	**15910**	**906**	**13736**	**877**	**1320**	**262**	**747**	**151**	**103**	**27**	**4**	**4**

The sum of the number of sites in each class does not necessarily match the total number of sites in each year. This is because one site may have been sampled several times in a particular year, and because the resulting residue concentrations vary within the year, one individual site may fall into more than one residue class. Similarly, the sum of the number of sites in each residue class and each year will not add up to the total number of sites in this residue class. This is because the same sites may have had residue concentrations in this class over more than one year.

Note: For the period to 2005 data for BAM only exist for the Wallonia region. From 2006 onwards BAM data are for Wallonia and Flanders.

The M-01 BAM residue time series data are further assessed by discriminating them against the occurrence of potatoes, the main FLC target crop. For this, annual residue data were processed in GIS to correlate them to land use data.

All M-01 BAM detections ≥1 µg/L occur in potato cropping areas, although this is due to the fact that most of the land in Belgium has some potato crops in its rotation. In the monitoring period there were 107 M-01 BAM detections ≥1 µg/L of which 104 (97%) occurred from 2008 onwards, after the authorisation of FLC. The number of M-01 BAM detections ≥1 µg/L increases up to 2014, when there were 19 detections in this class. It decreased again in 2015-2017 with only 4-7 detections in each year.

The number of M-01 BAM detections ≥1 µg/L are listed in Table 7.5- 23, categorised per year and subdivided in further concentration classes. By far most detections (n=80) fall into a concentration range of 1-3 µg/L and a further 19 detection were between 3-6 µg/L. This demonstrates that most of the higher BAM concentrations in potato areas are still well below the 10 µg/L GW concentration threshold.

Table 7.5- 23: M-01 BAM concentrations ≥1.0 µg/L

Year	≥1.0 µg/L		1.0 ≤ x < 3.0 µg/L		3.0 ≤ x < 6.0 µg/L		6.0 ≤ x < 10.0 µg/L		≥10.0 µg/L	
	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites
1995	0	--	0	--	0	--	0	--	0	--
1996	0	--	0	--	0	--	0	--	0	--
1997	0	--	0	--	0	--	0	--	0	--
1998	0	--	0	--	0	--	0	--	0	--
1999	0	--	0	--	0	--	0	--	0	--
2000	0	--	0	--	0	--	0	--	0	--
2001	0	--	0	--	0	--	0	--	0	--
2002	0	--	0	--	0	--	0	--	0	--
2003	0	--	0	--	0	--	0	--	0	--
2004	0	--	0	--	0	--	0	--	0	--
2005	0	--	0	--	0	--	0	--	0	--
2006	2	1	1	1	0	--	0	--	1	1
2007	1	1	1	1	0	--	0	--	0	--
2008	6	4	4	3	1	1	1	1	0	--
2009	8	5	4	4	4	1	0	--	0	--
2010	11	8	10	8	0	--	1	1	0	--
2011	10	7	10	7	0	--	0	--	0	--
2012	17	14	10	8	3	3	2	2	2	2
2013	16	12	14	10	2	2	0	--	0	--
2014	19	11	14	9	5	4	0	--	0	--
2015	6	4	5	4	1	1	0	--	0	--
2016	4	4	3	3	0	--	0	--	1	1
2017	7	5	4	4	3	2	0	--	0	--
Total	**107**	**27**	**80**	**23**	**19**	**11**	**4**	**4**	**4**	**4**

Note: The sum of sites may not add up to the total number of sites over all monitoring years. The reason for this is that detections at particular sites may have been observed in more than one year.

Belgium - Spatial assessment of M-01 BAM residues pre and post FLC registration

The geographical distribution of M-01 BAM residue data was assessed in relation to the time period pre and post FLC authorisation. The M-01 BAM residue data up to the end of 2007 and the data for 2008-2017 were plotted in relation to the main potatoes cropping areas. This assessment is provided here for completeness but has significant limitations which make a meaningful interpretation difficult:

1- There are fewer M-01 BAM data for the monitoring period to the end of 2007, representing only 18% of all M-01 BAM analyses;
2- M-01 BAM monitoring in Flanders only started in 2006, so the data for this region is strongly underrepresented in a spatial assessment to the end of 2007 (period pre FLC authorisation);
3- DCB was authorised to 2010 and DCB containing products will have probably been used until 2011 (1 year to use up old stocks). Therefore, there will be a temporal overlap of 4 years when DCB and FLC containing products were authorised for usage. In addition, there will be a proportion of M-01 BAM residues in the period post 2010 which are likely attributable to historic DCB usage.

For the period before 2007 there are only few M-01 BAM detections >0.1 µg/L. These detections are predominantly distributed in the central and north-western part of Belgium, in areas that are typical for potato cropping. The few detections ≥1 µg/L and the single detection ≥10 µg/L are also located in these typical potato regions. There are no M-01 BAM detections in the central northern part of Belgium, but this is attributed to the circumstance that in this time period there was only limited monitoring in this area.

In the period post 2008 there are significantly more M-01 BAM detections ≥0.1 µg/L but also ≥1 µg/L. This is unsurprising given the significantly higher data density for this period. Monitoring mainly focused on the central and western parts of Belgium, which are also the main agricultural areas of Belgium. It is therefore to be expected that M-01 BAM data show some correlation to the potato cropping areas. There are no clear clusters of M-01 BAM residues, nor is there a distinct correlation of M-01 BAM residues to regions of higher potato cropping density. Most M-01 BAM detections >1 µg/L seem to occur in the north-western part of Belgium and on the region around Brussels in the central part of Belgium, but M-01 BAM detections were also observed in these areas in the period prior to the FLC authorisation.

The locations of M-01 BAM detections in relation to the FLC usage indicates that there is no conclusive correlation between M-01 BAM detections ≥1 µg/L and the potato area that was treated with FLC. In the northwest of Belgium there are several M-01 BAM detections in this residue class that correspond to higher FLC usage but there are also several M-01 BAM detections in the area around Brussels where the FLC usage was lower. The FLC usage is high in the southern central region of Belgium that borders to France, but there is only one M-01 BAM detection ≥1 µg/L in this region.

It must be concluded that the spatial assessment of M-01 BAM detections in relation to the authorisation timing of FLC is inconclusive and yields no reliable information as to whether M-01 BAM detections are related FLC usage in potato cropping areas or are related to historic DCB applications. The reasons for this are the uneven distribution of the available data across the monitoring period, the temporal overlap of FLC and DCB authorisation, and the low resolution of the land use and FLC usage data.

Netherlands

Netherlands - Temporal assessment of residue data

The number of residue analyses for each monitoring year are categorised according to residue concentration classes in Table 7.5- 24 to Table 7.5- 26 for FLC, DCB, and M-01 BAM respectively. These tables also include the number of sites that fall into each residue concentration class.

For FLC the rate of detections >LOQ is in the order of 0.2%, corresponding to only one detection above the LOQ. The number of detections is too small to derive a statistically meaningful population to assess whether there may be potential trends in the detection frequency over time.

Table 7.5- 24: Number of residue detections and sites for FLC in the Netherlands categorised by residue classes

Year	Total		< LOQ		$0.025 \le x < 0.1$ µg/L		$0.1 \le x < 1.0$ µg/L	
	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites
2011	95	19	95	19	0	--	0	--
2012	190	157	190	157	0	--	0	--
2013	34	8	34	8	0	--	0	--
2014	1	1	1	1	0	--	0	--
2015	0	--	0	--	0	--	0	--
2016	178	169	177	169	1	1	0	--
Total	**498**	**206**	**497**	**206**	**1**	**1**	**0**	

The sum of the number of sites in each class does not necessarily match the total number of sites in each year. This is because one site may have been sampled several times in a particular year, and because the resulting residue concentrations vary within the year, one individual site may fall into more than one residue class. Similarly, the sum of the number of sites in each residue class and each year will not add up to the total number of sites in this residue class. This is because the same sites may have had residue concentrations in this class over more than one year.

For DCB there were 151 detections above the LOQ corresponding to 1.8% of all samples analysed for DCB. This is noticeably higher than for other countries that are assessed as part of this report. The detections occurred across the entire monitoring period but the highest detection rate of 7.7% (n=51) was observed in 2015, 7 years after the authorisation for DCB use expired. This clearly shows that there are residual soil residues of DCB which continue to leach, even several years after the withdrawal of its authorisation.

For BAM there are more detections >LOQ which enables a more detailed assessment of detection rates and concentration classes over time. A summary of the residue data for each monitoring year is provided in Table 7.5- 26. M-01 BAM detection rates in the 1990s were very high up to 75%. But this is considered an artefact as the number of M-01 BAM analyses was below 100 in each year and in several years there were even less than 10 samples analysed. There are more data available for the monitoring period 2000-2016 but nevertheless M-01 BAM detection rates are still very variable and in the order of 10-40%. In this period the highest detection rates occurred up to 2004, when M-01 BAM was found in concentrations >LOQ in about 40% of the samples analysed. The detection rates following the expiry of the DCB usage authorisation in 2008 were 14-20%. These M-01 BAM detection rates are higher than for most other countries that were considered in this report and more comparable to those reported from Denmark. Also, the higher concentration classes do not show a continuous decline in detection rates, and M-01 BAM detections >1µg/L are still detected at rates of 1-3% with no apparent trend in the period 2010-2016.

Table 7.5- 25: Number of residue detections and sites for DCB in the Netherlands categorised by residue classes

Year	Total		< LOQ		0.025 ≤ x < 0.1 µg/L		0.1 ≤ x < 1.0 µg/L	
	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites
1989	4	1	4	1	0	--	0	--
1990	0	--	0	--	0	--	0	--
1991	4	1	4	1	0	--	0	--
1992	8	4	8	4	0	--	0	--
1993	21	8	21	8	0	--	0	--
1994	44	15	44	15	0	--	0	--
1995	78	32	77	31	1	1	0	--
1996	24	8	24	8	0	--	0	--
1997	16	7	16	7	0	--	0	--
1998	81	61	81	61	0	--	0	--
1999	187	85	160	75	27	12	0	--
2000	274	146	260	144	14	2	0	--
2001	195	91	168	81	27	12	0	--
2002	212	116	210	114	2	2	0	--
2003	264	125	252	118	12	11	0	--
2004	175	65	175	65	0	--	0	--
2005	238	94	235	94	2	1	1	1
2006	1206	836	1202	834	3	2	1	1
2007	728	491	727	490	1	1	0	--
2008	415	255	415	255	0	--	0	--
2009	312	123	311	123	0	--	1	1
2010	629	518	627	518	1	1	1	1
2011	227	124	227	124	0	--	0	--
2012	1658	1371	1658	1371	0	--	0	--
2013	137	100	137	100	0	--	0	--
2014	84	47	81	46	2	2	1	1
2015	660	563	609	518	47	46	4	1
2016	357	316	354	315	1	1	2	1
Total	**8238**	**2515**	**8087**	**2501**	**140**	**68**	**11**	**3**

The sum of the number of sites in each class does not necessarily match the total number of sites in each year. This is because one site may have been sampled several times in a particular year, and because the resulting residue concentrations vary within the year, one individual site may fall into more than one residue class. Similarly, the sum of the number of sites in each residue class and each year will not add up to the total number of sites in this residue class. This is because the same sites may have had residue concentrations in this class over more than one year.

For the Netherlands a further spatial assessment, in which M-01 BAM residues are correlated to individual areas of potato crop land use, as done for the other countries, would not yield further results as potato cropping is prominent across most of the Netherlands. In addition, co-ordinates are not available for all analyses. There are also no regional FLC sales data available which could support a further analysis.

In the absence of a further data analysis the reason for the M-01 BAM detections in recent years cannot unequivocally be resolved. However, the high number of DCB detections made in the period following the expiry of the DCB usage authorisation shows that residual soil residues are present and it is considered likely that many of the observed M-01 BAM residues are related to historic DCB applications, similar to the observations made in Denmark and in the other target MSs.

Table 7.5- 26: Number of residue detections and sites for M-01 BAM in the Netherlands categorised by residue classes

Year	Total		< LOQ µg/L		0.025 ≤ x < 0.1 µg/L		0.1 ≤ x < 1.0 µg/L		1.0 ≤ x < 10.0 µg/L		≥ 10.0 µg/L	
	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites
1989	4	1	4	1	0	--	0	--	0	--	0	--
1990	0	--	0	--	0	--	0	--	0	--	0	--
1991	4	1	4	1	0	--	0	--	0	--	0	--
1992	0	--	0	--	0	--	0	--	0	--	0	--
1993	8	2	7	2	1	1	0	--	0	--	0	--
1994	16	4	11	3	1	1	4	3	0	--	0	--
1995	28	4	11	2	7	2	10	4	0	--	0	--
1996	12	2	3	1	2	1	7	3	0	--	0	--
1997	2	1	2	1	0	--	0	--	0	--	0	--
1998	85	64	60	49	8	7	14	12	3	3	0	--
1999	179	80	137	64	31	16	9	7	2	2	0	--
2000	302	152	233	130	33	19	34	28	2	2	0	--
2001	261	103	151	71	65	32	41	25	4	4	0	--
2002	266	119	170	96	25	18	69	35	2	2	0	--
2003	210	96	125	62	40	33	43	29	2	2	0	--
2004	161	51	99	40	30	12	30	20	2	2	0	--
2005	231	90	197	75	11	11	17	16	6	5	0	--
2006	1142	485	1037	455	19	11	76	43	10	9	0	--
2007	564	346	422	286	42	33	79	54	20	16	1	1
2008	378	205	291	177	28	23	44	32	13	8	2	1
2009	273	99	236	86	9	8	20	14	8	5	0	--
2010	416	259	331	216	27	24	52	44	5	5	1	1
2011	224	112	193	99	13	10	14	12	4	4	0	--
2012	1300	604	1133	542	63	48	87	65	17	13	0	--
2013	189	137	161	119	8	8	15	13	5	4	0	--
2014	105	47	89	39	5	5	9	7	2	2	0	--
2015	822	495	690	421	77	63	48	46	7	7	0	--
2016	305	238	241	198	20	20	32	29	12	9	0	--
Total	**7487**	**1493**	**6038**	**1390**	**565**	**242**	**754**	**222**	**126**	**53**	**4**	**3**

The sum of the number of sites in each class does not necessarily match the total number of sites in each year. This is because one site may have been sampled several times in a particular year, and because the resulting residue concentrations vary within the year, one individual site may fall into more than one residue class. Similarly, the sum of the number of sites in each residue class and each year will not add up to the total number of sites in this residue class. This is because the same sites may have had residue concentrations in this class over more than one year.

Netherlands - Spatial assessment of M-01 BAM residues pre and post FLC registration

The geographical distribution of M-01 BAM residue data was assessed in relation to the time period pre and post FLC authorisation. The M-01 BAM residue data up to the end of 2006 and the data for 2007-2016 were plotted.

This has large limitations given that DCB was registered for use until 2008 and leaching of M-01 BAM residues due to historical DCB application will have occurred in the later monitoring period. In addition, not all M-01 BAM detections could be displayed, as co-ordinates are not available for all data. Nevertheless, in the northern and central part of the Netherlands, most of the residue concentrations >0.1 µg/L and in particular >1 µg/L that are reported for the period post 2007, occur in areas where there were previous (pre 2007) M-01 BAM detections. The cluster in central Netherlands seems to correlate to the military airbase Soesterberg. There are many detections in the regions with few potatoes (<5%). It can therefore be concluded that most of these detections are likely related to historic DCB applications.

The picture is different for the southern part of the country. There are several M-01 BAM detections >1µg/L in the period post 2007 which were not observed previously. The reason for this is that intensive M-01 BAM monitoring in this region only started in 2007 and it is unknown whether similar detections would have already occurred prior to the FLC authorisation in 2007.

Germany

Germany - Temporal assessment of residue data

The number of residue analyses for each monitoring year are categorised according to residue concentration classes in Table 7.5-48 Table 7.5- 29 for FLC, DCB, and M-01 BAM respectively. These tables also include the number of sites that fall into each residue concentration class.

For FLC the rate of detections >LOQ is in the order of 0.3% for the monitoring years 2011-2017. The number of detections is too small to derive a statistically meaningful population to assess whether there may be potential trends in the detection frequency over time. It is however worth noting that 5 of the 7 FLC detections >LOQ were observed in 2017. These detections were made at 4 different sites.

For DCB the detection rate is even lower, and no further temporal assessment of detection was undertaken. It should be noted that some detections were still observed in the year 2008, 4 years after the authorisation for DCB use expired.

Table 7.5- 27: Number of residue detections and sites for FLC in Germany categorised by residue classes

Year	Total		< LOQ µg/L		0.025 ≤ x < 0.1 µg/L		0.1 ≤ x < 1.0 µg/L	
	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites
2011	137	136	137	136	0	--	0	--
2012	70	69	70	69	0	--	0	--
2013	243	242	242	241	0	--	1	1
2014	222	222	222	222	0	--	0	--
2015	331	331	330	330	1	1	0	--
2016	312	307	312	307	0	--	0	--
2017	837	726	832	724	5	4	0	--
Total	**2152**	**978**	**2145**	**977**	**6**	**4**	**1**	**1**

The sum of the number of sites in each class does not necessarily match the total number of sites in each year. This is because one site may have been sampled several times in a particular year, and because the resulting residue concentrations vary within the year, one individual site may fall into more than one residue class. Similarly, the sum of the number of sites in each residue class and each year will not add up to the total number of sites in this residue class. This is because the same sites may have had residue concentrations in this class over more than one year.

For BAM there are more detections >LOQ which enables an assessment of detection rates and concentration classes over time. A summary of the residue data for each monitoring year is provided in Table 7.5- 29.

Table 7.5- 28: Number of residue detections and sites for DCB in Germany categorised by residue classes

Year	Total		< LOQ		0.025 ≤ x < 0.1 µg/L		0.1 ≤ x < 1.0 µg/L	
	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites
1990	105	101	105	101	0	--	0	--
1991	337	335	337	335	0	--	0	--
1992	625	617	623	615	2	2	0	--
1993	899	873	899	873	0	--	0	--
1994	1033	1010	1032	1010	1	1	0	--
1995	1097	1027	1097	1027	0	--	0	--
1996	867	816	867	816	0	--	0	--
1997	919	769	914	767	2	2	3	2
1998	646	601	644	599	2	2	0	--
1999	758	715	758	715	0	--	0	--
2000	748	668	748	668	0	--	0	--
2001	776	691	776	691	0	--	0	--
2002	665	596	665	596	0	--	0	--
2003	739	606	739	606	0	--	0	--
2004	625	542	625	542	0	--	0	--
2005	696	562	696	562	0	--	0	--
2006	742	627	742	627	0	--	0	--
2007	666	637	666	637	0	--	0	--
2008	1222	1150	1220	1149	2	2	0	--
2009	1117	1037	1117	1037	0	--	0	--
2010	777	720	777	720	0	--	0	--
2011	990	936	990	936	0	--	0	--
2012	799	783	799	783	0	--	0	--
2013	968	938	968	938	0	--	0	--
2014	711	691	711	691	0	--	0	--
2015	700	674	700	674	0	--	0	--
2016	636	606	636	606	0	--	0	--
2017	699	692	699	692	0	--	0	--
Total	**21562**	**4860**	**21550**	**4858**	**9**	**9**	**3**	**2**

The sum of the number of sites in each class does not necessarily match the total number of sites in each year. This is because one site may have been sampled several times in a particular year, and because the resulting residue concentrations vary within the year, one individual site may fall into more than one residue class. Similarly, the sum of the number of sites in each residue class and each year will not add up to the total number of sites in this residue class. This is because the same sites may have had residue concentrations in this class over more than one year.

The M-01 BAM detection rate >LOQ has a wide range from 3% to 48% over the monitoring period from 1993-2017. The detection rates were significantly higher across all residue concentration classes in the early monitoring period to about 2002. In this period, detection rates were typically in the order of 17-48%. The significant decrease in detection rates in the early 2000s is probably due to a data bias with smaller sample numbers and data only being available for some federal states. In the period 2003-2006, before the authorisation of FLC detection rates were in the order 5-9%. From 2007 to 2017 the detection rates were relatively stable at about 4-7%. A similar trend is observed in the higher residue concentration classes, particularly for the detections ≥1 µg/L. Detection rates in the latter concentration class were in the order of 2-15% in the period pre 2000, whereas they were <0.5% in the subsequent monitoring period. The total number of detections >1 µg/L in any one year has not significantly changed over time, but the number of analyses has increased, resulting in lower detection rates.

Table 7.5- 29: Number of residue detections and sites for M-01 BAM in Germany categorised by residue classes

Year	Total		< LOQ µg/L		0.025 ≤ x < 0.1 µg/L		0.1 ≤ x < 1.0 µg/L		1.0 ≤ x < 10.0 µg/L		≥ 10.0 µg/L	
	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites
1993	25	25	25	25	0	--	0	--	0	--	0	--
1994	17	17	12	12	3	3	2	2	0	--	0	--
1995	20	19	12	12	2	2	3	3	3	2	0	--
1996	47	44	31	30	9	9	4	4	3	2	0	--
1997	369	297	208	202	74	59	78	46	9	5	0	--
1998	188	176	97	95	37	36	49	44	5	5	0	--
1999	119	98	79	58	24	24	16	16	0	--	0	--
2000	411	314	252	205	71	69	82	49	6	3	0	--
2001	506	395	320	275	89	82	92	53	5	3	0	--
2002	474	318	396	285	51	41	26	16	1	1	0	--
2003	612	427	560	399	33	24	19	12	0	--	0	--
2004	557	391	519	372	28	20	10	8	0	--	0	--
2005	1145	946	1044	856	54	51	42	39	5	5	0	--
2006	826	690	789	664	19	14	14	11	4	4	0	--
2007	561	515	517	479	22	22	19	15	3	3	0	--
2008	1487	1427	1445	1388	16	16	22	21	4	4	0	--
2009	1228	1152	1174	1104	22	22	30	25	2	2	0	--
2010	871	817	810	759	26	26	32	31	3	3	0	--
2011	1498	1411	1415	1336	40	40	42	39	1	1	0	--
2012	2049	1975	1963	1894	37	36	46	45	3	3	0	--
2013	2751	2519	2603	2392	76	73	64	57	8	8	0	--
2014	2459	2338	2327	2228	72	65	58	54	2	2	0	--
2015	2519	2404	2412	2305	51	51	53	51	3	3	0	--
2016	2971	2736	2839	2617	68	66	56	50	8	8	0	--
2017	3152	2921	2998	2784	87	82	60	56	7	7	0	--
Total	**26862**	**5709**	**24847**	**5573**	**1011**	**434**	**919**	**251**	**85**	**30**	**0**	**--**

The sum of the number of sites in each class does not necessarily match the total number of sites in each year. This is because one site may have been sampled several times in a particular year, and because the resulting residue concentrations vary within the year, one individual site may fall into more than one residue class. Similarly, the sum of the number of sites in each residue class and each year will not add up to the total number of sites in this residue class. This is because the same sites may have had residue concentrations in this class over more than one year.

The M-01 BAM residue time series data are further assessed by discriminating them against the occurrence of the main FLC target crops, namely, vines and potatoes. For this, annual residue data were processed in GIS to correlate them to land use data (data in vines from 2015 and for potatoes from 2016).

The number of M-01 BAM detections in the higher concentration class (≥1 µg/L) are listed in Table 7.5- 30 categorised per year and dominant cropping areas.

In the monitoring period there were 85 M-01 BAM detections (≥1 µg/L) of which 41 occurred prior to the authorisation of FLC in 2007. 51% (n=43) of all detections ≥1 µg/L were observed in areas with 'no' (<1%) vines or potato cropping. Of these 43 detections, 84% (n=36) occurred in the period post 2004, following the expiry of the DCB authorisation, clearly showing that M-01 BAM residues are likely to derive from DCB applications long after the expiry of its registration. Adding up, all M-01 BAM detections prior to 2007 and all M-01 BAM detections in the 'no' vine/potato regions for the period 2007-2017 there are 71 detections ≥1 µg/L (84%) which are most likely related to historic DCB applications. In the vine cropping areas, a total of 27 detections ≥1 µg/L were made, of which only 1 relates to the period post 2007, following the FLC authorisation in Germany. In the potato regions there were 25 detections ≥1 µg/L of which 13 were made post 2007. The data suggest an increase in detection rates in potato areas in recent years. In terms of absolute concentrations 11 of the detections showed concentrations <2 µg/L, the other 2 detections were at concentrations of 2.9 µg/L and 3.7 µg/L.

In summary, most M-01 BAM detections ≥1 µg/L (84%) were observed outside the main FLC target crops areas or occurred prior to the authorisation of FLC. These detections are almost certainly related to DCB usage. These DCB related detections still occurred in 2017, 13 years after the expiry of the DCB authorisation. Given that DCB was also extensively used in vines it is expected that the legacy of this usage is also observed in vine cultivation areas. In vine cropping areas there is a strong declining trend in detections ≥ 1 µg/L and there was only one detection in this class in the period following the FLC registration. It is therefore likely that this detection also derives from historic DCB applications and not from FLC. In potato areas some detections ≥1 µg/L were made in recent years. These detections were typically at concentrations <2 µg/L; the highest recorded concentration was 3.7 µg/L. If these concentrations were related to FLC applications, the observed concentrations would still be significantly below the 10 µg/L concentration threshold for non-relevant metabolites.

Table 7.5- 30: Number of residue detections and sites ≥1.0 µg/L for M-01 BAM in Germany categorised by cropping density

Year	Detections ≥1.0 µg/L							
	Total		Vines and potatoes cropping area <1%		Vines cropping area >1%		Potato cropping area >1%	
	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites
1993	0	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0	0
1995	3	2	0	0	3	2	0	0
1996	3	2	0	0	3	2	0	0
1997	9	5	2	1	7*	4	4*	2
1998	5	5	1	1	4*	4	2*	2
1999	0	0	0	0	0	0	0	0
2000	6	3	2	1	4*	2	2*	1
2001	5	3	2	1	3*	2	1*	1
2002	1	1	0	0	1*	1	1*	1
2003	0	0	0	0	0	0	0	0
2004	0	0	0	0	0	0	0	0
2005	5	5	3	3	1	1	1	1
2006	4	4	3	3	0	0	1	1
2007	3	3	3	3	0	0	0	0
2008	4	4	4	4	0	0	0	0
2009	2	2	2	2	0	0	0	0
2010	3	3	2	2	1	1	0	0
2011	1	1	1	1	0	0	0	0
2012	3	3	3	3	0	0	0	0
2013	8	7	5	5	0	0	3	2
2014	2	2	1	1	0	0	1	1
2015	3	3	1	1	0	0	2	2
2016	8	8	4	4	0	0	4	4
2017	7	7	4	4	0	0	3	3
Total	**85**	**30**	**43**	**12**	**27***	**7**	**25***	**14**

Note: The sum of sites may not add up to the total number of sites over all monitoring years. The reason for this is that detections at particular sites may have been observed in more than one year.

*some detections are double counted as they fall in areas which have vine and potato usage. For this reason, the total number of analyses do not add up to the sum of detections made in the individual cropping areas

Germany – Spatial assessment of M-01 BAM residues pre and post FLC registration

The geographical distribution of M-01 BAM residue data was assessed in relation to the time period pre and post FLC authorisation. The M-01 BAM residue data up to the end of 2006 and the data for 2007-2017 were plotted in relation to the main vines and potatoes cropping areas. Any M-01 BAM detections to the end of 2006 can unambiguously be attributed to DCB usage. For the data from 2007-2017 this is less obvious. Although only FLC was authorised in this period, the time dependent assessment in the previous chapter has clearly shown that a significant proportion of M-01 BAM residues in the period post 2006 are likely attributable to historic DCB usage.

For the period prior to the FLC authorisation there is a cluster of detection in the southwest of Germany in the federal states Baden-Wuerttemberg, Bavaria and Hesse, with only a few detections in the remainder of the country. This is due to the data availability as about ¾ of the available data derive from these 3 federal states.

The spatial assessment of detections shows no apparent correlation to the main vine cropping areas, particularly for the later monitoring period from 2007-2017. This indicates that the M-01 BAM detections are not systematically related to FLC usage in vine areas.

A similar assessment of detections in relation to potato cropping areas suggests, that detections have an increased spatial density in the potato cropping areas in the Kleeve region along the Dutch border in central Germany, and in Lower Saxony in central northern Germany, south of Hamburg. Whether these areas already showed M-01 BAM detections prior to the FLC authorisation cannot be determined as there are no data for the earlier period. Apart from these 2 regions, there is no obvious correlation between BAM detections and the main potato cropping areas.

Spatial comparison of M-01 BAM detections to FLC product use, show the product use data has a relatively low resolution which limits the conclusions that can be draw from this assessment. It is however worth noting that in the area of highest FLC usage in vines, there are only very few M-01 BAM detections. Similarly, there is a relatively high FLC usage in Bavaria for both, vines and potatoes, with M-01 BAM detections mainly occurring in the low concentration classes. The only region where there may be a correlation between product use and detections is in Lower Saxony, south of Hamburg, where there is a cluster of M-01 BAM detections in some of the main potato cropping areas, which is accompanied by high FLC product usage.

Austria

Austria - Temporal assessment of residue data

The number of residue analyses for each monitoring year are categorised according to residue concentration classes in Table 7.5- 31 and Table 7.5- 32 for DCB and M-01 BAM respectively. These tables also include the number of sites that fall into each residue concentration class.

Table 7.5- 31: Number of residue detections and sites for DCB in Austria categorised by residue classes

Year	Total		< LOQ		0.025 ≤ x < 0.1 µg/L		0.1 ≤ x < 1.0 µg/L	
	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites
1998	3923	2005	3923	2005	0	--	0	--
1999	4164	2004	4164	2004	0	--	0	--
2000	272	168	272	168	0	--	0	--
2001	354	214	354	214	0	--	0	--
2002	899	389	899	389	0	--	0	--
2003	807	334	806	334	0	--	1	1
2004	7522	1981	7520	1981	0	--	2	1
2005	509	169	509	169	0	--	0	--
2006	459	172	459	172	0	--	0	--
2007	11	4	11	4	0	--	0	--
2008	10	4	10	4	0	--	0	--
2009	9	3	9	3	0	--	0	--
2010	149	149	149	149	0	--	0	--
2011	155	155	155	155	0	--	0	--
2012	153	153	153	153	0	--	0	--
2013	5432	1970	5429	1970	1	1	2	1
2014	586	520	586	520	0	--	0	--
2015	34	34	34	34	0	--	0	--
2016	17	17	17	17	0	--	0	--
2017	17	17	17	17	0	--	0	--
2018	16	16	16	16	0	--	0	--
Total	**25498**	**2522**	**25492**	**2522**	**1**	**1**	**5**	**2**

The sum of the number of sites in each class does not necessarily match the total number of sites in each year. This is because one site may have been sampled several times in a particular year, and because the resulting residue concentrations vary within the year, one individual site may fall into more than one residue class. Similarly, the sum of the number of sites in each residue class and each year will not add up to the total number of sites in this residue class. This is because the same sites may have had residue concentrations in this class over more than one year.

For DCB the rate of detections >LOQ is in the order of 0.02% for the monitoring years 1998-2018. The number of detections is too small to derive a statistically meaningful population to assess whether there may be potential trends in the detection frequency over time. Due to the small number of DCB detections, no further time dependent assessment was performed for the analyte.

For M-01 BAM detection rates ≥LOQ typically range from 1-6% with the exception for the year 2009 when the detection rate was 33%. This is due to the relatively small number of analyses in this year. Detection rates in the concentration class 0.1 < x < 1.0 µg/L peaked in 2006 when they were just over

2%. In the subsequent monitoring period, the detection rates in this class were in the order of 0.5-1%. The detection rate in the concentration class 1.0 < x < 10 µg/L was in the order of 0.2% in the early 2000s, which decreased in subsequent years, with the exception of 2009, where due to the small number of analyses the detection rate was 33%. In the period post 2010, after the expiry of DCB authorisation, the detection rate was mostly <0.1% and the detections related to only very few sites. Over the monitoring period there were only 2 M-01 BAM detections ≥10 µg/L which occurred in 2012 and 2013, both at one site. A summary of the residue data for each monitoring year is provided in Table 7.5- 32.

Table 7.5- 32: Number of residue detections and sites for M-01 BAM in Austria categorised by residue classes

Year	Total		< LOQ		0.025 ≤ x < 0.1 µg/L		0.1 ≤ x < 1.0 µg/L		1.0 ≤ x < 10.0 µg/L		≥ 10.0 µg/L	
	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites
2004	2016	1227	1956	1203	31	26	26	19	3	2	0	--
2005	510	169	503	166	2	2	4	1	1	1	0	--
2006	2528	968	2381	941	89	63	54	35	4	3	0	--
2007	1430	735	1388	717	30	22	11	7	1	1	0	--
2008	743	691	717	673	17	15	8	7	1	1	0	--
2009	3	3	1	1	0	--	1	1	1	1	0	--
2010	2353	1931	2294	1909	45	23	13	9	1	1	0	--
2011	2526	1941	2463	1916	46	21	16	10	1	1	0	--
2012	2337	1922	2279	1902	46	21	10	8	1	1	1	1
2013	5487	1970	5325	1937	125	68	33	19	3	2	1	1
2014	2814	1952	2732	1919	57	46	22	14	3	2	0	--
2015	2361	1952	2296	1919	51	39	13	13	1	1	0	--
2016	2628	1936	2559	1910	57	38	10	7	2	2	0	--
2017	2541	1938	2499	1916	28	20	13	9	1	1	0	--
2018	2503	1916	2470	1899	24	17	8	7	1	1	0	--
Total	**32780**	**2318**	**31863**	**2311**	**648**	**158**	**242**	**81**	**25**	**6**	**2**	**1**

The sum of the number of sites in each class does not necessarily match the total number of sites in each year. This is because one site may have been sampled several times in a particular year, and because the resulting residue concentrations vary within the year, one individual site may fall into more than one residue class. Similarly, the sum of the number of sites in each residue class and each year will not add up to the total number of sites in this residue class. This is because the same sites may have had residue concentrations in this class over more than one year.

The M-01 BAM residue time series data are further assessed by discriminating them against the occurrence of the main FLC target crops, namely vines and potatoes. For this, annual residue data were processed in GIS to correlate them to land use data.

The number of M-01 BAM detections in the higher concentration class (≥1 µg/L) are listed in Table 7.5- 33 categorised per year and dominant cropping areas. There were 27 detections ≥1 µg/L in the monitoring period. Almost all of these detections are outside the vine and potato cropping areas. This is in part attributed to the fact that about 80% of the analyses relate to the 'no' vine/potato cropping areas. In the vine cropping areas there was only one M-01 BAM detection ≥1 µg/L and this occurred in 2006, prior to the authorisation of FLC. There were no detections ≥1 µg/L in potato cropping areas. These data imply that M-01 BAM detections ≥1 µg/L are related to historic DCB usage.

There is however, one exception, where M-01 BAM residues ≥10 µg/L are related to potato cropping and FLC usage. This site is outside the main potato cropping areas (<1%) but potato growing seems to be of local importance. The elevated M-01 BAM concentrations at this site were further addressed as part of the desk-based elucidation. It is likely that the detections are related to FLC usage. However, the timing of the first detection (mid of April 2012) very shortly after a first opportunity for a FLC application, together with the rapid decrease of concentrations in the subsequent monitoring period, suggest that M-01 BAM entered the groundwater relatively directly. This may have happened via hydraulic short cuts or via a point source during handling, mixing or loading of spray broth. It is concluded that the elevated M-01 BAM detections at this site are not related to excessive leaching under normal environmental conditions following good agricultural practice.

Table 7.5- 33: Number of residue detections and sites ≥1.0 µg/L for M-01 BAM in Austria categorised by cropping density

Year	Detections ≥1.0 µg/L							
	Total		Vines and potatoes cropping area ≤1%		Vines cropping area >1%		Potato cropping area >1%	
	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites
2004	3	2	3	2	0	0	0	0
2005	1	1	1	1	0	0	0	0
2006	4	3	3	2	1	1	0	0
2007	1	1	1	1	0	0	0	0
2008	1	1	1	1	0	0	0	0
2009	1	1	1	1	0	0	0	0
2010	1	1	1	1	0	0	0	0
2011	1	1	1	1	0	0	0	0
2012	2	1	2	1	0	0	0	0
2013	4	2	4	2	0	0	0	0
2014	3	2	3	2	0	0	0	0
2015	1	1	1	1	0	0	0	0
2016	2	2	2	2	0	0	0	0
2017	1	1	1	1	0	0	0	0
2018	1	1	1	1	0	0	0	0
Total	**27**	**6**	**26**	**5**	**1**	**1**	**0**	**0**

Austria - Spatial assessment of M-01 BAM residues pre and post FLC registration

The geographical distribution of M-01 BAM residue data was assessed in relation to the time period pre and post FLC authorisation. The M-01 BAM residue data up to the end of 2011 (authorisation expiry date plus 1 year to use up old stocks) and the data for 2012-2018 were plotted in relation to the main vines and potatoes cropping areas.

For the period before 2011, M-01 BAM detections >0.1 µg/L are predominantly distributed in Upper and Lower Austria and in the Burgenland, generally with no obvious correlation to vine and potato cropping. The exception is the Mur valley in the south of Austria, where the detections can be correlated with vine cropping. The few detections >1 µg/L show no obvious correlation to vine or potato cropping areas.

The geographical distribution of M-01 BAM detections in the period post 2012 is comparable to that prior to the FLC authorisation. There is again no obvious pattern, which suggests that clusters of M-01

BAM detections would correlate to intensive vine or potato cropping areas. There is one site with M-01 BAM detections ≥10 µg/L, located in the northeast of Austria. The detections occurred in 2012 and 2013. The site is located in an area with 'no' vine cropping, but aerial pictures show that at this site potato farming is of local importance.

Italy

Italy - Temporal assessment of residue data

The number of residue analyses for each monitoring year are categorised according to residue concentration classes in Table 7.5- 34 to Table 7.5- 36 for FLC, DCB, and M-01 BAM respectively. These tables also include the number of sites that fall into each residue concentration class.

For FLC the rate of detections >LOQ is 1.8% for the monitoring years 2013-2017. Almost all detections were made in 2016.

Due to the small number of FLC and DCB detections, no further temporal assessment was performed for the 2 analytes.

Table 7.5- 34: Number of residue detections and sites for FLC in Italy categorised by residue classes

Year	Total		< LOQ		0.025 ≤ x < 0.1 µg/L		0.1 ≤ x < 1.0 µg/L	
	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites
2013	236	188	235	187	1	1	0	--
2014	379	205	379	205	0	--	0	--
2015	464	246	464	246	0	--	0	--
2016	634	567	593	535	30	30	11	11
2017	670	401	669	401	0	--	1	1
Total	**2383**	**922**	**2340**	**920**	**31**	**31**	**12**	**11**

The sum of the number of sites in each class does not necessarily match the total number of sites in each year. This is because one site may have been sampled several times in a particular year, and because the resulting residue concentrations vary within the year, one individual site may fall into more than one residue class. Similarly, the sum of the number of sites in each residue class and each year will not add up to the total number of sites in this residue class. This is because the same sites may have had residue concentrations in this class over more than one year.

Table 7.5- 35: Number of residue detections and sites for DCB in Italy categorised by residue classes

Year	Total		< LOQ		0.025 ≤ x < 0.1 µg/L		0.1 ≤ x < 1.0 µg/L		1.0 ≤ x < 10.0 µg/L		≥ 10.0 µg/L	
	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites
2008	309	309	309	309	0	--	0	--	0	--	0	--
2009	620	324	618	324	1	1	0	--	0	--	1	1
2010	998	542	998	542	0	--	0	--	0	--	0	--
2011	1257	644	1257	644	0	--	0	--	0	--	0	--
2012	1110	585	1110	585	0	--	0	--	0	--	0	--
2013	825	576	825	576	0	--	0	--	0	--	0	--
2014	641	333	641	333	0	--	0	--	0	--	0	--
2015	693	340	693	340	0	--	0	--	0	--	0	--
2016	1126	579	1126	579	0	--	0	--	0	--	0	--
2017	670	401	670	401	0	--	0	--	0	--	0	--
Total	**8249**	**1085**	**8247**	**1085**	**1**	**1**	**0**	**0**	**0**	**0**	**1**	**1**

The sum of the number of sites in each class does not necessarily match the total number of sites in each year. This is because one site may have been sampled several times in a particular year, and because the resulting residue concentrations vary within the year, one individual site may fall into more than one residue class. Similarly, the sum of the number of sites in each residue class and each year will not add up to the total number of sites in this residue class. This is because the same sites may have had residue concentrations in this class over more than one year.

For M-01 BAM there are more detections >LOQ which enables an assessment of detection rates and concentration classes over time. A summary of the residue data for each monitoring year is provided in Table 7.5- 36. Detection rates >LOQ typically range from 2-6%. Detection rates in the concentration class 0.1 < x < 0.75 µg/L peaked in 2009 with almost 3%. In the subsequent monitoring period, the detection rates in this class were in order of 0.5-2%. The detection rate in the concentration class 0.75 < x < 1.0 µg/L was in the order of 0.2%. From 2008-2013 a constant decrease in detection rates in the concentration class 1.0 < x < 10 µg/L can be recorded (same number of detections, n=1, but increasing total number of samples) and after 2013 there are no detections recorded in this class. The detection rate was in order 0.1-0.3%. Detections ≥10 µg/L were not recorded during the entire monitoring period.

Table 7.5- 36: Number of residue detections and sites for M-01 BAM in Italy categorised by residue classes

Year	Total		< LOQ		0.025 ≤ x < 0.1 µg/L		0.1 ≤ x < 1.0 µg/L		0.75 ≤ x < 1.0 µg/L		1.0 ≤ x < 10.0 µg/L	
	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites	No. of analyses	No. of sites
2008	309	309	302	302	3	3	3	3	0	--	1	1
2009	878	460	835	446	19	15	24	18	0	--	0	--
2010	955	514	908	494	26	20	20	11	0	--	1	1
2011	1323	716	1270	694	27	19	26	16	1	1	0	--
2012	1840	954	1786	940	33	27	20	16	2	2	1	1
2013	1669	1013	1603	992	44	35	21	14	1	1	1	1
2014	1566	805	1494	792	46	45	26	19	0	--	0	--
2015	1712	762	1609	732	68	38	35	19	2	1	0	--
2016	1127	580	1105	573	16	14	6	6	0	--	0	--
2017	669	401	651	395	8	8	10	6	0	--	0	--
Total	**12048**	**1678**	**11563**	**1647**	**290**	**145**	**191**	**69**	**6**	**4**	**4**	**3**

The sum of the number of sites in each class does not necessarily match the total number of sites in each year. This is because one site may have been sampled several times in a particular year, and because the resulting residue concentrations vary within the year, one individual site may fall into more than one residue class. Similarly, the sum of the number of sites in each residue class and each year will not add up to the total number of sites in this residue class. This is because the same sites may have had residue concentrations in this class over more than one year.
Concentration class ≥10.0 µg/L is omitted, because there are no detections for this class.

The M-01 BAM residue time series data are further assessed by discriminating them against the occurrence of the main FLC target crops, namely, vines and potatoes. For this, annual residue data were processed in GIS to correlate them to land use data.

The geographical distribution of M-01 BAM detections in relation to the FLC product use data shows that most detections are made outside the main vine and potatoes areas and therefore in regions of no/very limited FLC usage. This again confirms that there may be only a very weak link between M-01 BAM detections and FLC usage and that most M-01 BAM detections are related to historic DCB usage.

Italy - Spatial assessment of M-01 BAM residues pre and post FLC registration

Spatially most M-01 BAM residues correspond to areas outside the main vine or potato growing regions with no apparent correlation to the density of these 2 crops. Instead clusters of M-01 BAM detections correlate to the city areas of Milan and further southwest to the area of Alessandria.

III. Conclusion

The assessment of the groundwater public monitoring data concluded that there is no apparent risk to groundwater related to FLC usage. The detection rates of FLC are very low across all target Member States and the elucidation of exceedances shows that most of these are likely to be false positive findings or are related to exceptional environmental conditions.

For the non-relevant metabolite M-01 BAM, there is clear evidence that a significant proportion of the M-01 BAM detections are the legacy of historic DCB applications. These DCB linked M-01 BAM detections occur even several years after the expiry of the DCB usage authorisation. From the monitoring data, the possibility that some M-01 BAM detections are related to leaching following FLC usage cannot be excluded, but the data indicate that these are typically low in concentrations and are below the threshold of 10 µg/L for non-relevant metabolites. These conclusions are consistent with the much lower net effective application rates of FLC and its degradation / metabolism which results in less M-01 BAM entering the environment. Out of 210,000 M-01 BAM analyses across the target Member States there were only 13 exceedances of the 10 µg/L groundwater concentration threshold of which 10 were identified to be related to historic DCB applications or are related to exceptional environmental conditions.

Assessment and conclusion by applicant:

This review of groundwater public monitoring data is reliable and shows no concerns for fluopicolide or the metabolite M-01 (BAM).

M-01 (AE C653711, BAM)

The public monitoring data assessments KCA 7.5/01 and KCA 7.5/02 include data on the metabolite M-01. In addition, five published peer reviewed publications provide additional information on M-01 residues in groundwater in France (KCA 7.5/03 and KCA 7.5/07), France and England (KCA 7.5/04), the Republic of Ireland (KCA 7.5/05 and KCA 7.5/06).

Data Point:	KCA 7.5/03
Report Author:	Lopez, B.; Ollivier, P.; Togola, A.; Baran, N.; Ghestem, J.
Report Year:	2015
Report Title:	Screening of French groundwater for regulated and emerging contaminants
Report No:	M-597785-01-1
Document No:	M-597785-01-1
Guideline(s) followed in study:	--
Deviations from current test guideline:	No. Not applicable
Previous evaluation:	No, not previously submitted
GLP/Officially recognised testing facilities:	not applicable
Acceptability/Reliability:	Yes

Executive Summary:

Nationwide screening of 411 compounds including 2,6-dichlorobenzamide (BAM) was done at 494 groundwater sites throughout France during two sampling campaigns in the spring and autumn of 2011.

The quantification frequency for 2,6-dichlorobenzamide (BAM) for the total dataset ($QF_{overall}$) was 2.9% with 0.7% of samples exceeding a concentration of 0.1 µg/L for BAM. The maximum concentration of BAM was 0.42 µg/L and the mean concentration in positive samples (i.e. samples above the analytical LOQ) was 0.0936 µg/L. Most results for BAM were below the analytical LOQ of 0.02 µg/L.

7. Materials and Methods

The French Ministry of Ecology and the French National Agency for Water and Aquatic Environments initiated a national reconnaissance study of emerging (or poorly monitored) contaminants of different origins (411 in total) such as pharmaceutical products, industrial compounds, pesticides and personal care products. One hundred and thirty one pharmaceutical products (37 antibiotics, 17 steroids and hormones, 6 non-prescription drugs, 5 biocides and 66 other prescription drugs), 143 industrial compounds (36 PCBs, dioxins and furans, 25 dyes, 13 perfluorinated compounds, 11 flame retardants, 10 plasticizers and 48 other industrial compounds), 103 pesticides and their transformation products (48 herbicides, 29 fungicides and 26 insecticides), and 34 other emerging pollutants (13 lifestyle products, 10 cosmetics, 4 disinfection by-products, 4 toxins and 3 organotins) were sought in the groundwater samples, including the pesticide metabolite 2,6-dichlorobenzamide (BAM).

Samples were collected at 494 groundwater sites (springs, wells, and boreholes) throughout France during two campaigns in the spring (485 sites) and the autumn (475 sites) of 2011.

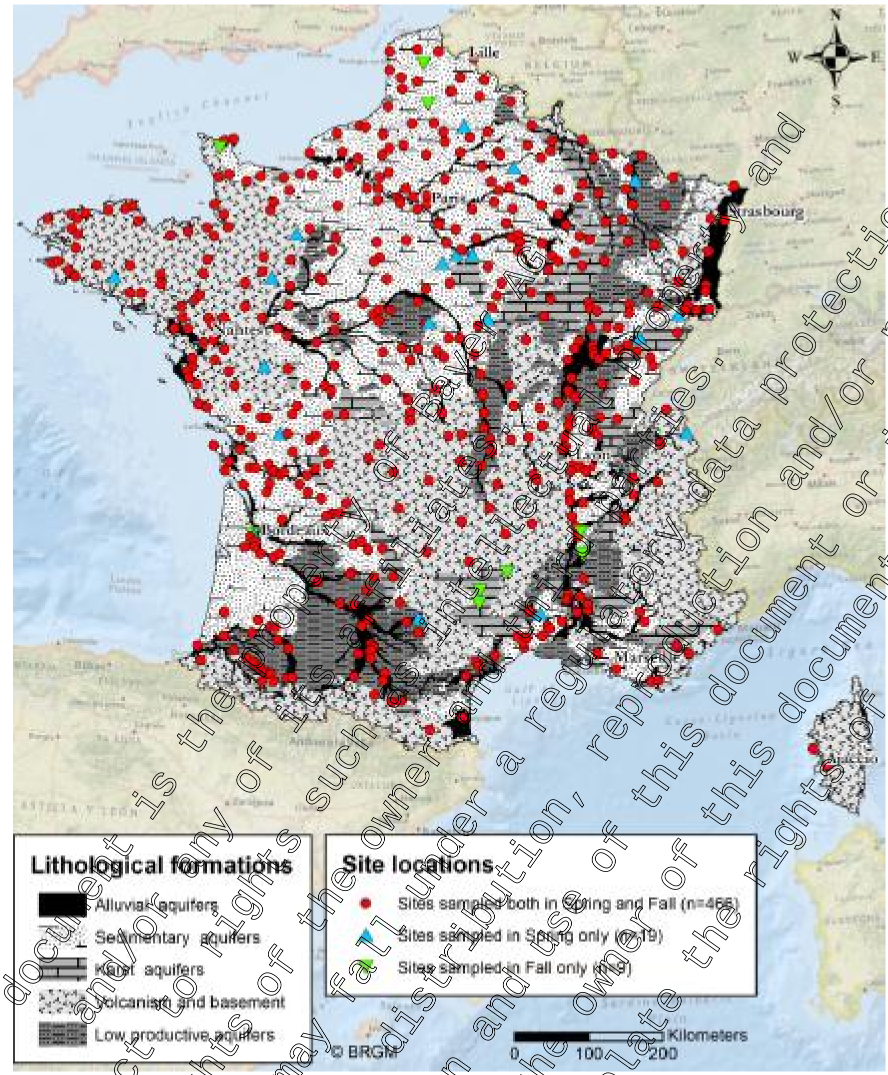
Table 7.5- 37: Characteristics of selected sampling sites

Hydrogeological contexts	Sedimentary formations	Alluvial aquifers	Basement formations	Low production aquifers	Volcanic & mountain aquifers	Total sites
Land uses						
Agricultural	146	34	34	10	1	225
Urban and agricultural	68	38	19	1	2	128
Urban and industrial	35	45	2	1	0	83
Natural	21	8	19	2	8	58
Total	270	125	74	14	11	494

The sites included a variety of lithological and hydrogeological conditions, anthropogenic pressures, urban, mixed, and natural or semi-natural environments and a variety of uses such as drinking water, irrigation and industrial water. The proportion of different environments sampled was representative at a national level: 55% of the groundwater was collected from sedimentary formations, 25% from alluvial aquifers, 15% from basement formations, 3% from low production aquifers, and 2% from volcanic and mountain aquifers. The land surrounding the sampled sites was classified according to principal land use as agricultural, urban-agricultural, urban-industrial, or natural. A breakdown of the characteristics of the selected sampling sites is given below.

The locations of the sampling sites are shown in Figure 7.5- 19.

Figure 7.5- 19: Locations and lithological formations of sampling sites



Groundwater samples were analysed for 2,6-dichlorobenzamide (BAM) by LC-MS/MS after solid phase extraction.

II. Results and Discussion

The concentrations of BAM in French groundwater are given in Table 7.5- 38.

The maximum concentration of BAM was 0.42 µg/L and the mean concentration in positive samples (i.e. samples above the analytical LOQ) was 0.0936 µg/L. Most results for BAM were below the analytical LOQ of 0.02 µg/L (1036 out of 1067 samples tested). The quantification frequency (QF, as %) was calculated as the number of results reported above the LOQ (ie only positive samples) divided by the total number of samples. The quantification frequency for 2,6-dichlorobenzamide (BAM) for the total dataset ($QF_{overall}$) was 2.9%, for samples collected in the spring of 2011 (QF_{spring}) was 1.9% and for samples collected in the autumn of 2011 (QF_{fall}) was 3.8%. 0.7% of samples exceeded a threshold of 0.1 µg/L for BAM ($FE_{0.1 µg/L}$). As discussed below this threshold is not mandatory for metabolites which meet certain criteria, but has been used in the publication to assess all pesticides and their transformation products.

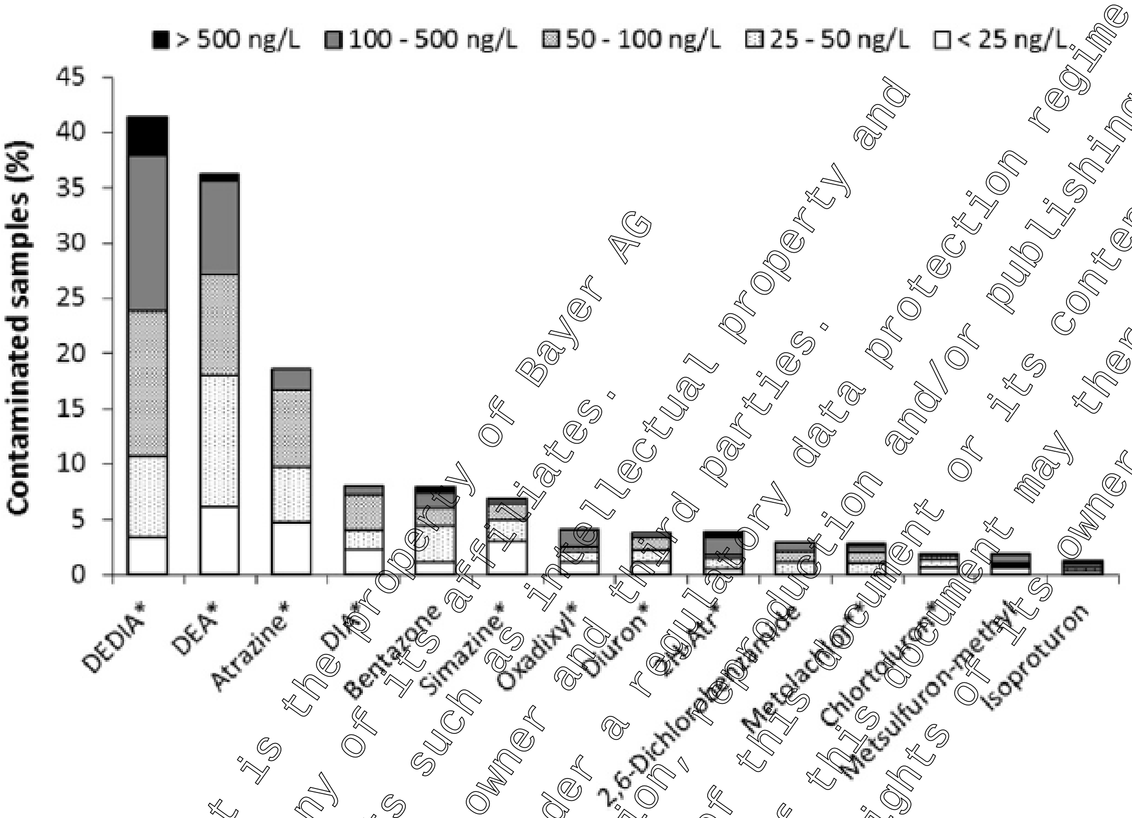
Table 7.5- 38: Summary of analytical results for 2,6-dichlorobenzamide (BAM) quantified in French groundwater

	LOQ (ng/L)	n samples	$QF_{overall}$ (%)	QF_{spring} (%)	QF_{fall} (%)	$FE_{0.1µg/L}$ (%)	C_{max} (ng/L)	MEC95 (ng/L)	C_{mean} detects (ng/L)
2,6-dichlorobenzamide (BAM)	20	1067	2.9	1.9	3.8	0.7	420	343	93.6

LOQ = Limit of quantification
n samples = number of samples
$QF_{overall}$ = Quantification Frequency for samples in both campaigns (%)
QF_{spring} = Quantification Frequency for the spring campaign samples (%)
QF_{fall} = Quantification Frequency for the autumn campaign samples (%)
$FE_{0.1µg/L}$ = Frequency of exceeding the 0.1 µg/L TTC value for the "overall" samples (%)
C_{max} = Concentration maximum (ng/L)
MEC95 = 95th percentile of maximum concentration of ECs per site (ng/L)
C_{mean}detects = Concentration mean in positive samples (ng/L)

Fourteen pesticides and their metabolites were quantified with a QF >1% (Figure 7.5- 20) including 2,6-dichlorobenzamide (BAM). Agricultural use of some compounds detected has been forbidden in France for a number of years (atrazine, simazine, oxadixyl, diuron and metolachlor) indicating the time course for transfer of water and pesticides throughout soil, unsaturated and saturated zones that may take years or decades. This also applies to 2,6-dichlorobenzamide, which is a metabolite of dichlobenil (withdrawn in 2010), itself a transformation product of chlorthiamid (withdrawn in 2004), and of fluopicolide whose use is permitted in France.

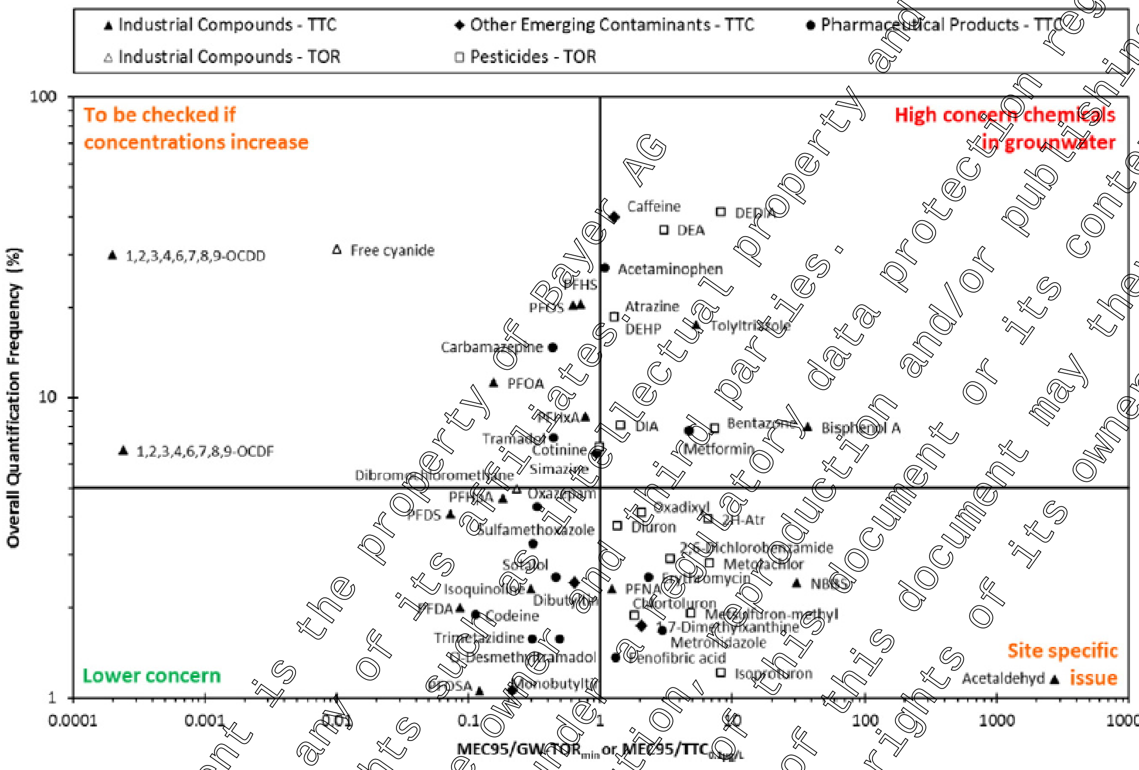
Figure 7.5- 20: Frequency of quantification and levels of pesticides quantified in more than 1% of overall samples



*Withdrawn or transformation product of a withdrawn parent molecule; **S-metolachlor isomer approved only.

The occurrence of chemicals was plotted in Figure 7.5- 21 as a graph with occurrence (QF) plotted against groundwater quality indicator (C_{mean}detected/GW-TOR or MEC95/GW-TOR). The groundwater threshold of regulation (GW-TOR) value used for BAM was 0.1 µg/L (or 100 ng/L). [It should be noted as a metabolite without biological activity which meets the criteria for non-relevance in groundwater this threshold is not applicable.]

Figure 7.5- 21: Matrix of occurrence in groundwater (%) against ratio MEC95/GW-TOR$_{min}$ (95th percentile of maximum concentration of ECs per site/lowest groundwater threshold of regulation value) for regulated compounds (symbols in white) or MEC95/TTC$_{0.1µg/L}$ for unregulated compounds (symbols in black)



III. Conclusion

Two large screening programmes of French groundwater were conducted in the spring and autumn of 2011. Data were collected from a total of 494 groundwater sites. 2,6-dichlorbenzamide (BAM) was detected at an overall detection frequency of 2.9% at a mean concentration in positive samples (i.e. samples above the analytical LOQ) of 0.0936 µg/L. The maximum concentration of BAM detected was 0.42 µg/L

<u>Assessment and conclusion by applicant:</u>

This publication provides information on the exposure values for the metabolite M-01 (BAM) in French groundwater in 2011 and shows no concerns.

Data Point:	KCA 7.5/04
Report Author:	Lapworth, D. J.; Baran, N.; Stuart, M. E.; Manamsa, K.; Talbot, J.
Report Year:	2015
Report Title:	Persistent and emerging micro-organic contaminants in Chalk groundwater of England and France
Report No:	M-597786-01-1
Document No:	M-597786-01-1
Guideline(s) followed in study:	--
Deviations from current test guideline:	No. Not applicable
Previous evaluation:	No, not previously submitted
GLP/Officially recognised testing facilities:	not applicable
Acceptability/Reliability:	Yes

Executive Summary:

This study presents results from a reconnaissance survey of microorganic contaminants in Chalk groundwater, including pharmaceuticals, personal care products and pesticides and their transformation products, conducted across the major Chalk aquifers of England and France. Data from a total of 345 sites collected during 2011 were included in this study to provide a representative baseline assessment of microorganic contaminants occurrence in groundwater. A suite of 42 compounds were analysed for at each site including industrial compounds (16), pesticides and their metabolites (14) and pharmaceuticals, personal care and lifestyle products (12).

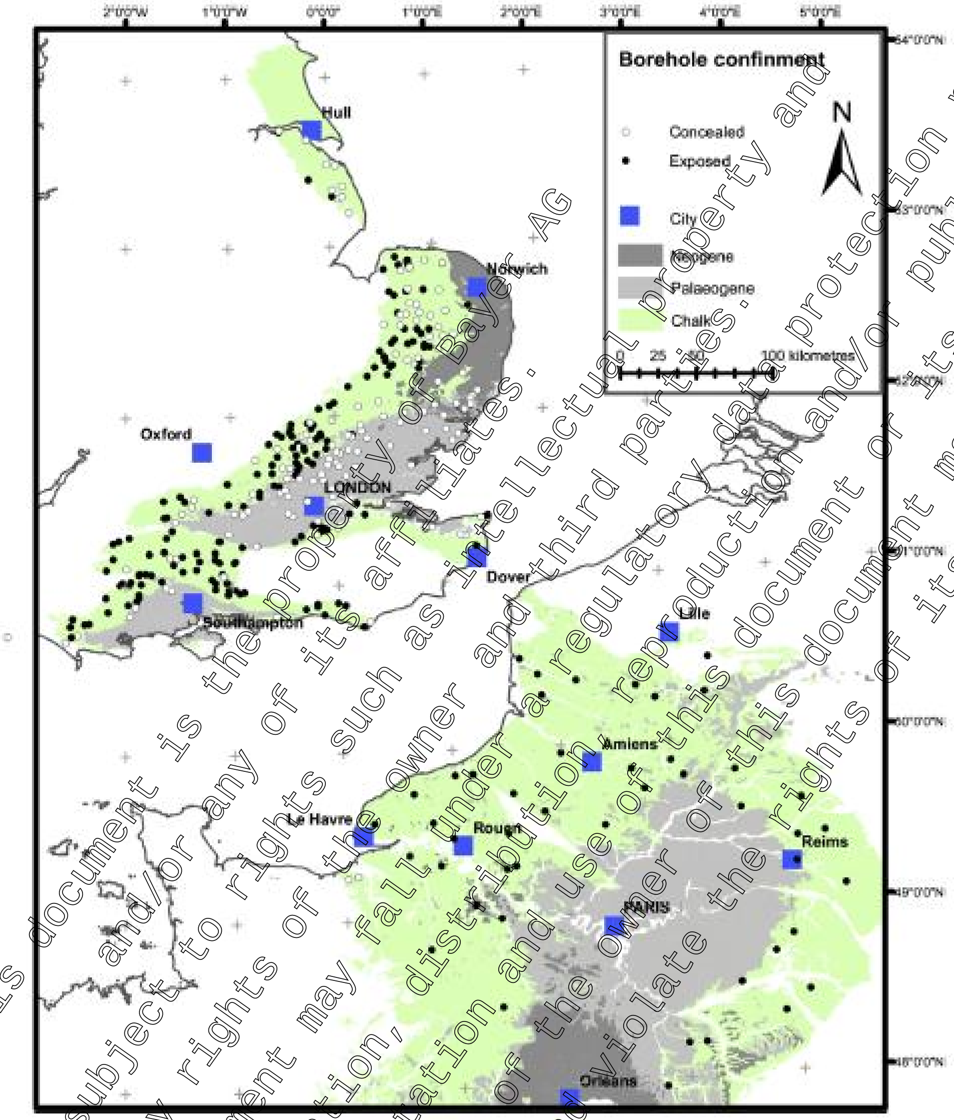
2,6-dichlorbenzamide (BAM) was detected in English and French groundwater with an overall detection frequency of 6.1%. The maximum concentration of BAM in England was 10 µg/L (although the 97.5 percentile was 0.15 µg/L) and in France was 0.11 µg/L. The mean concentration in England (n=300) was 0.1 µg/L and in France (n=45) was 0.04 µg/L.

I. Materials and Methods

The purpose of this study was to evaluate the occurrence of a broad range of organic contaminants (16 industrial compounds, 14 pesticides and their metabolites and 12 pharmaceuticals and personal care compounds) including BAM (2,6 dichlorobenzamide) in untreated groundwater from two large areas in North West Europe, the Chalk of England and the Chalk of North West France. Data from numerous sampling sites was analysed. The nature of the Chalk means that this aquifer can be very vulnerable to rapid migration of contaminants.

45 sites in France and 300 sites in England of the Chalk outcrop were sampled during 2011. The outline of the Chalk outcrop and the sample network is shown in Figure 7.5- 22.

Figure 7.5- 22: Map of Southern England and northern France showing Chalk outcrop, Palaeogene cover and sample sites used in the study.



Filled symbols are sites that are on exposed Chalk outcrop, unfilled symbols are sites that are either confined or covered with >10 m of impermeable superficial cover.
Selected major cities are show with square symbols.

Groundwater samples from England were analysed using a multi-residue GC/MS method. Groundwater samples collected in France were analysed by LC-MS/MS after solid phase extraction or by GC/MS.

II. Results and Discussion

The minimum, mean and maximum concentrations of BAM in English and French Chalk groundwater are given in Table 7.5- 39. The maximum concentration of BAM (10 µg/L) was one of the highest concentrations detected in Chalk groundwater. Overall BAM was one of the most frequently detected compounds related to pesticides detected in England with a detection frequency of 6.3%.

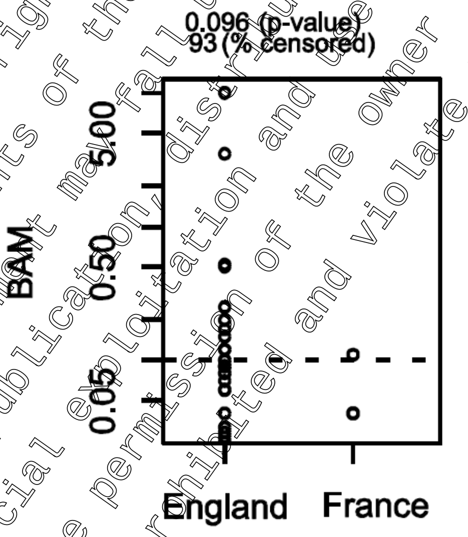
Table 7.5- 39: Concentration and frequency of 2,6-dichlorobenzamide (BAM) detections

Substance	**All**	**English Chalk (n=300)**						
	Detection %	**Detection %**	**Min µg/L**	**Mean µg/L**	**Max µg/L**	**Percentile**		
						90	**95**	**97.5**
2,6-dichlorobenzamide (BAM)	6.1	6.3	<0.03	0.1	10		0.08	0.15

Substance	**French Chalk (n=45)**						
	Detection %	**Min µg/L**	**Mean µg/L**	**Max µg/L**	**Percentile**		
					90	**95**	**97.5**
2,6-dichlorobenzamide (BAM)	4.4	<0.03	0.04	0.11	-	-	0.04

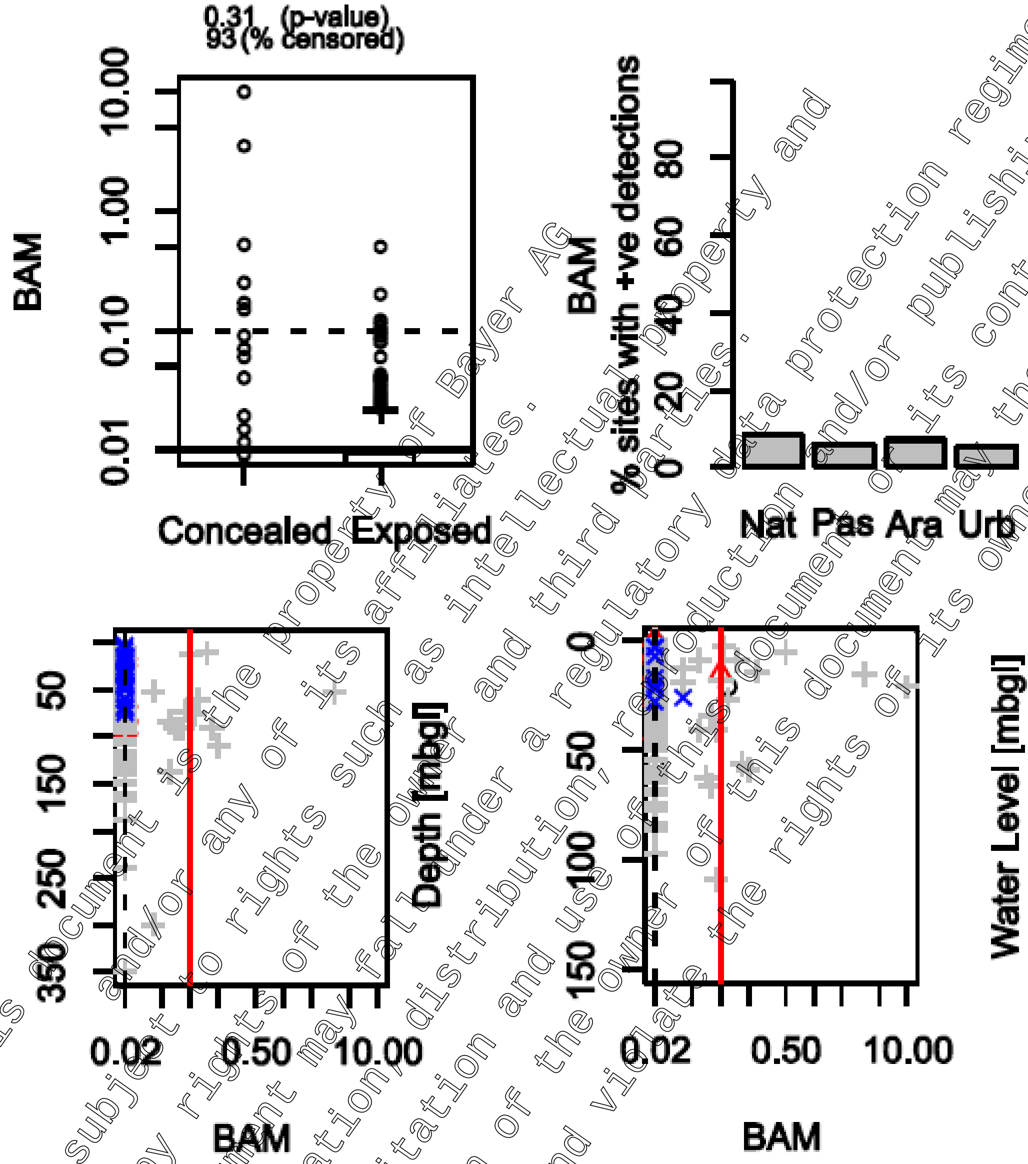
A comparison of BAM concentrations (in µg/L) in Chalk in France and England is presented in Figure 7.5- 23.

Figure 7.5- 23: Comparison of BAM concentrations (in µg/L) in Chalk in France and England



A comparison of BAM concentrations (in µg/L) in exposed and concealed chalk sites, by land use category, by well depth and by water level is presented in Figure 7.5- 24.

Figure 7.5- 24: Comparison of BAM concentrations (in µg/L) in by other covariates



III. Conclusion

A large monitoring survey of the major Chalk aquifers of England and France was conducted in 2011. Data from a total of 345 sites was collected. 2,6-dichlorbenzamide (BAM) was detected in vulnerable chalk groundwaters at a mean concentration of 0.1 µg/L in England (n=300) and 0.04 µg/L in France (n=45). The maximum concentration of BAM in England was 10 µg/L (although the 97.5 percentile was 0.15 µg/L) and in France was 0.11 µg/L.

Assessment and conclusion by applicant:

This publication provides information on the exposure values for the metabolite M-01 (BAM) in English and French groundwater in 2011 and shows no concerns.

Data Point:	KCA 7.5/05
Report Author:	McManus, S.; Moloney, M.; Richards, K. G.; Coxon, C. E.; Danaher, M.
Report Year:	2014
Report Title:	Determination and occurrence of phenoxyacetic acid herbicides and their transformation products in groundwater using ultra high performance liquid chromatography coupled to tandem mass spectrometry
Report No:	M-597919-01-1
Document No:	M-597919-01-1
Guideline(s) followed in study:	--
Deviations from current test guideline:	No. Not applicable
Previous evaluation:	No, not previously submitted
GLP/Officially recognised testing facilities:	not applicable
Acceptability/Reliability:	Yes

Executive Summary:

An analytical method was developed and validated for 18 compounds in groundwater including 2,6-dichlorobenzamide (BAM). Water samples were analysed using an efficient ultra-high-performance liquid chromatography (UHPLC) method prior to detection by tandem mass spectrometry (MS/MS). The limit of detection (LOD) of the method for BAM was 0.0006 µg/L. The method was validated with recoveries ranging between 88 and 105% for BAM at spiked concentrations of 0.02, 0.04 and 0.06 µg/L.

The method was successfully applied to 42 groundwater samples collected across several locations in Ireland in March 2012 to reveal that that some transformation products were detected just as often as their parent active ingredients (a.i.) in groundwater. However, the compound BAM was not detected at concentrations > LOD (0.0006 µg/L) in the groundwater samples.

I. Materials and Methods

This paper describes the development of a method to analysed for a number of herbicides and metabolites in groundwater including 2,6-dichlorobenzamide (BAM). 42 groundwater samples collected in March 2012 from seven locations across Ireland were analysed using the method.

Descriptions of groundwater samples are summarised in Table 7.5- 40. The same locations were used in a separate publication (see M-681589-01-1).

Table 7.5- 40: Description of groundwater samples collected from seven sites across Ireland in March 2012

Site name	No. samples analysed	No. reps	Sample date	pH	Redox (mV)	Conductivity (µS/cm @25°C)	Turbidity (NTU)	Temp. (°C)
KWDg	2	2	13 March	7.2	189	595	0	8.4
KWDa	2	2	21 March	7.9	113	470	0	10.2
I/KWDa	7	2	13 March	7.9	180	406	128	9.6
FyWDa	3	2	14 March	6.1	164	127	167	9.5
FvPDa	9	2	14 March	7.3	-40	263	194	9.8
FmWDa1 [a]	10	2	21 March	7.1	117	220	28	9.7
FmWDa2 [a]	9	2	20 March	6.5	120	196	53	10.6

Values are averaged across all samples collected at that site on each day

Groundwater samples were acidified with 2 mM HCl, extracted by Bond Elut ENV SPE cartridges and eluted with acetone. The acetone was evaporated under nitrogen at 40 °C to dryness and concentrated extracts resuspended in acetonitrile/water (50:50, v/v), prior to filtering through 0.2 µm membrane. BAM was analysed by UHPLC-MS/MS by monitoring the transitions m/z 190.0 →109.0 and m/z 190.0 →144.9 with detection by electrospray in positive ionisation mode. The compound was stable in raw groundwater samples over 42 days.

The method was validated at concentrations of 0.02, 0.04 and 0.06 µg/L in ultra-pure water.

Table 7.5- 41: Validation results for 2,6-dichlorobenzamide (BAM)

Substance	Validation level (µg/L)						LOQ (µg/L)	LOD (µg/L)
	Accuracy (%)			Precision (% RSD)				
	0.02	0.04	0.06	0.02	0.04	0.06		
2,6-dichlorobenzamide (BAM)	95	105	88	18	12	22	0.0009	0.0006

Validation results tested at three concentrations: 0.02, 0.04 and 0.06 µg/L
Accuracy and precision were determined from six replicates

The stability of raw groundwater samples over time was assessed by spiking 500 mL of groundwater to achieve a concentration of 0.1 µg/L. Samples were stored in the dark at 4 °C and analysed every seven days over a 42 day period. BAM was stable in raw groundwater samples throughout the test.

II. Results and Discussion

The minimum, maximum, median and average concentrations of BAM detected in groundwater are given in Table 7.5- 42.

Table 7.5- 42: Concentration of 2,6-dichlorobenzamide (BAM) detected in groundwater samples collected from seven sites in Republic of Ireland in March 2012

Substance	Minimum (µg/L)	Maximum (µg/L)	Median (µg/L)	Average (µg/L)
2,6-dichlorobenzamide (BAM)	<LOD	<LOD	0	-

III. Conclusion

Groundwater samples from seven agricultural sites in the Republic of Ireland were monitored in March 2012 for a number of pesticides and their metabolites. The compound 2,6-dichlorobenzamide (BAM) was not detected at concentrations > LOD (0.0006 µg/L) in the 42 groundwater samples.

Assessment and conclusion by applicant:

This publication provides information on the exposure values for the metabolite M-01 (BAM) in Irish groundwater in 2012 and shows no concerns.

Data Point:	KCA 7.5/06
Report Author:	Mcmanus, S. L.; Coxon, C. E.; Mellander, P. E.; Danaher, M.; Richards, K. G.
Report Year:	2017
Report Title:	Hydrogeological characteristics influencing the occurrence of pesticides and pesticide metabolites in groundwater across the Republic of Ireland
Report No:	M-681589-01-1
Document No:	M-681589-01-1
Guideline(s) followed in study:	--
Deviations from current test guideline:	none
Previous evaluation:	No, not previously submitted
GLP/Officially recognised testing facilities:	not applicable
Acceptability/Reliability:	Yes

Executive Summary:

Groundwater pesticide occurrence was investigated at seven agricultural sites in different hydrogeological settings to identify where pesticide occurrence dominated in temperate maritime climatic conditions. In Ireland, six cereal dominated sites in the South East and one grassland site in the West were investigated. Soil and subsoils varied from acid brown earths with high permeability to clay and silt rich tills with lower permeability. Over a 2-year monitoring period, 730 samples were collected from a network of dedicated wells and springs across the seven sites. Piezometers were installed in intergranular, fissured and karstic type aquifers to target shallow, transition and deeper groundwaters. Several springs were also sampled and the network included a confined aquifer. Groundwater was analyzed for nine pesticide active ingredients and eight metabolites.

BAM was not detected at the grassland site at concentration > LOD (0.0006 µg/L) but was detected at the remaining six sites at concentrations up to 1.35 µg/L. The total number of samples found to contain BAM at concentration > LOD was 31 out of a total of 730 samples. The average concentration of BAM in groundwater samples was 0.01 µg/L.

I. Materials and Methods

The objective of this study was to evaluate the occurrence of pesticides and their metabolites in groundwater in a range of sites, representing the main arable regions across the Republic of Ireland. Sites were chosen for their contrasting hydrogeological characteristics.

Two sites were sampled by groundwater fed springs (KWDg and KWDa). Piezometers were installed between 2008 and 2009 at the remaining sites between 2008 and 2009. The wells installed aimed to target three groundwater depths:

1. Shallow: within subsoil (i.e. Quaternary deposits), approximately 5 m below ground level
2. Interface: the interface between subsoil and bedrock, approximately 10 m below ground level
3. Bedrock: within bedrock, approximately 20 m below ground level.

The characteristics of the seven sites are summarised in Table 7.5- 43.

Table 7.5- 43: Characteristics of the seven sites

Site name	Dominant land use	Principal soil association	Soil drainage class	Quaternary deposit (subsoil)	Aquifer type (code)	Monitoring point ([b])
KWDg	Grassland	Rendzina	Deep well drained mineral	Bedrock at or near the surface	Karstified limestone dominated by conduit flow (Rkc)	Spring (1)
KWDa	Spring barley	Minimal grey brown podzolic	Deep well drained mineral	Bedrock at or near the surface	Karstified limestone dominated by diffuse flow (Rkd)	Spring (2)
I/KWDa	Spring barley	Grey brown podzolic	Shallow well drained mineral	Gravels derived from limestones	Gravel underlain by karstified limestone dominated by diffuse flow (Rg and Rkd)	Piezometers (5)
FvWDa	Spring barley	Acid brown earth	Deep well drained mineral	Bedrock at or near the surface	Fractured volcanic bedrock (Rf)	Piezometers (2)
FvPDa	Spring barley and pasture	Gley	Deep poorly drained mineral	Irish Sea Till derived from limestone	Fractured volcanic bedrock (Rf)	Piezometers (9)
FmWDa1 [a]	Spring barley	Acid brown earth	Deep well drained mineral	Till derived from Lower Palaeozoic sandstones and shales	Fractured Ordovician metasediments (Ll)	Piezometers (9)
FmWDa2 [a]	Spring barley	Acid brown earth	Deep well drained mineral	Till derived from Lower Palaeozoic sandstones and shales	Fractured Ordovician metasediments (Ll)	Piezometers (9)

[a] There were two fields monitored and labelled FmWDa: Site 1 and Site 2 which have slightly contrasting soil conditions

[b] Number available to sample in parenthesis

The location of the seven sites are shown in Figure 7.5- 25. Groundwater samples were collected monthly between March 2010 and March 2012. Samples were taken using a bladder pump lined with Teflon. Water properties such as pH, turbidity, dissolved oxygen, specific conductivity, temperature and redox were recorded every 30 seconds. Groundwater was collected into a 500 mL amber glass bottle and stored under chilled conditions (between 1 and 4 °C) prior to analysis. In total 730 samples were collected across the seven sites.

Figure 7.5- 25: Location of seven sites across Ireland sampled monthly between March 2010 to March 2012

Groundwater samples were analysed for a number of pesticides and their metabolites including BAM (2,6 dichlorobenzamide). Water samples were acidified with formic acid 95% v/v and extracted using Bond Elut ENV prior to analysis using ultra high-performance liquid chromatography (UHPLC) tandem mass spectrometry (MS/MS).

II. Results and Discussion

The average and maximum concentrations of BAM detected in groundwater are given in Table 7.5- 44.

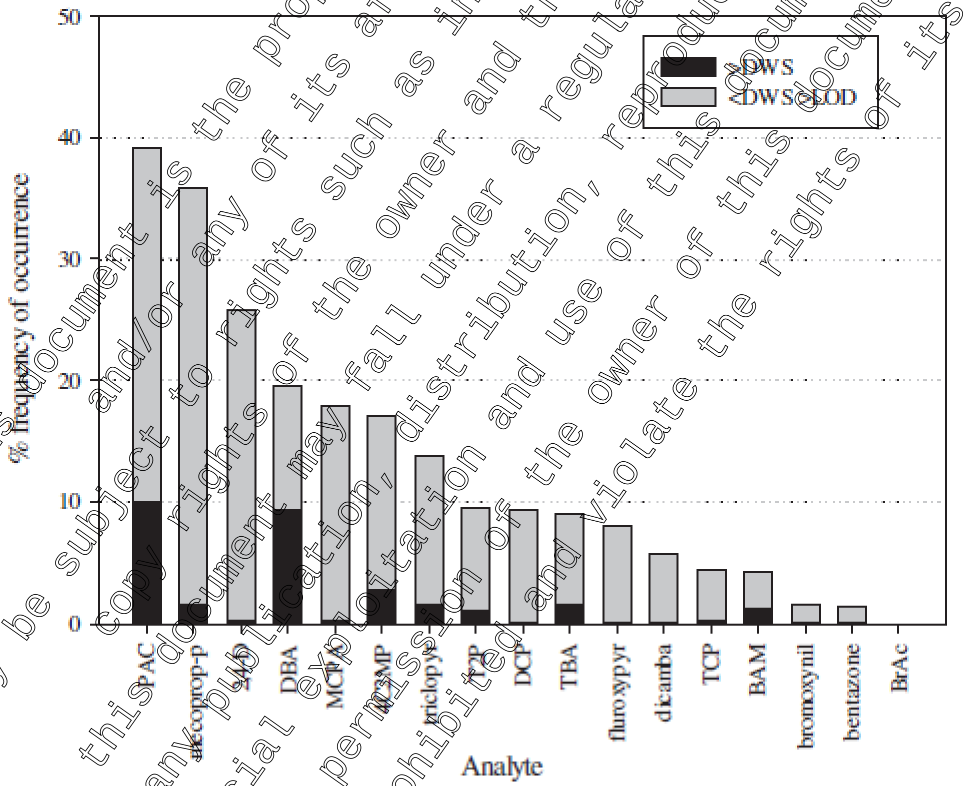
Table 7.5- 44: Concentration of 2,6-dichlorobenzamide (BAM) detected in groundwater samples collected from seven sites in Republic of Ireland between April 2010 and March 2012

Substance	LOD (µg/L)	LOQ (µg/L)	Total no. positive detections > LOD	Total no. samples analysed	Maximum observed conc. (µg/L)	Average conc. (µg/L)
2,6-dichlorobenzamide (BAM)	0.0006	0.0009	31	730	1.35	0.01

LOD = limit of detection, LOQ = limit of quantitation
The average concentration was calculated by giving non-detects a zero value

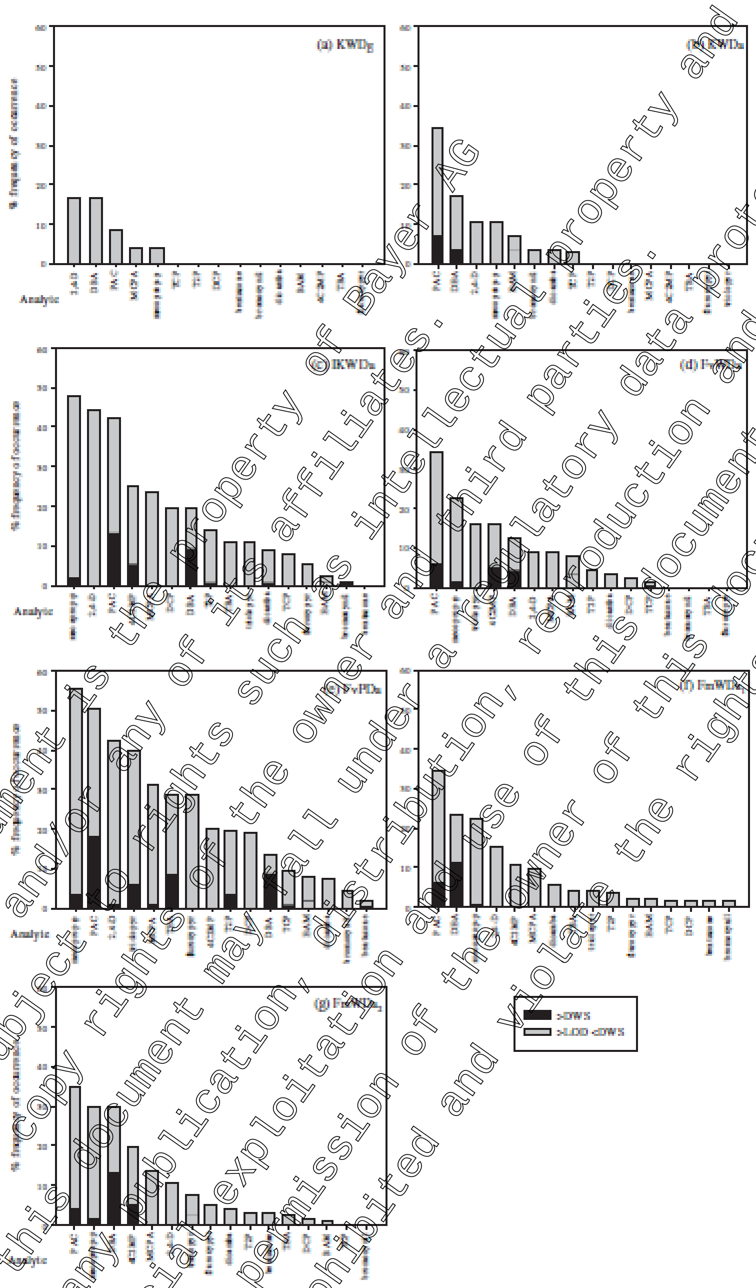
Of the 17 compounds analysed for BAM was ranked as the fourteenth most frequent detected across the seven sites (see Figure 7.5- 26). In general more pesticide metabolites were present in Irish groundwaters than parent active ingredients.

Figure 7.5- 26: Percentage frequency of detection for all seven sites sampled monthly from March 2010 to March 2012 differentiating concentrations above the limit of detection (LOD) and the drinking water standard (DWS) of 0.1 µg/L



Over the 2-year sampling campaign, the percentage of samples > LOD but < 0.1 µg/L was lowest at KWDg and highest at FvPDa (Figure 7.5- 27). BAM was not detected at Site KWDg (Figure 7.5- 27a) at > LOD (0.0006 µg/L) but was detected at the remaining six sites (Figure 7.5- 27b to g).

Figure 7.5- 27: Percentage frequency of detection for samples collected between March 2010 to March 2012 at each site investigated. (Concentrations are differentiated as being above the limit of detection (LOD) and the drinking water standard (DWS) for individual pesticides (0.1 µg/L)



a) karst well-drained grassland, (b) karst well-drained arable, (c) intergranular/karstwell-drained arable, (d) fractured volcanic well-drained arable (e) fractured volcanic poorly-drained arable, (f) fractured metasediments well-drained arable site 1, and (g) fractured metasediments well-drained arable site 2.

Table 7.5- 45: Percentage of detects > LOD for 2,6-dichlorobenzamide (BAM) analysed between April 2010 and March 2012 per sampling type and sampling depth.

Substance	Springs	0-5 m below ground level	5.1-10 m below ground level	10.1-17 m below ground level	Artesian well
2,6-dichlorobenzamide (BAM)	2	2	3	5	3

III. Conclusion

Irish groundwaters at seven agricultural sites were monitored between April 2010 and March 2012 for a number of pesticides and their metabolites.

The average concentration of 2,6-dichlorobenzamide (BAM) detected was 0.01 µg/L, with a maximum concentration of 1.35 µg/L. BAM was detected at concentrations > LOD (0,0006 µg/L) in 31 out of 730 groundwater samples.

Assessment and conclusion by applicant:

This publication provides information on the exposure values for the metabolite M-01 (BAM) in Irish groundwater in 2010 to 2012 and shows no concerns.

Data Point:	KCA 7.5/07
Report Author:	Pinasseau, L.; Wiest, L.; Volatier, L.; Fones, G. R.; Mills, G. A.; Mermillod-Blondin, F.; Vulliet, E.
Report Year:	2019
Report Title:	Calibration and field application of an innovative passive sampler for monitoring groundwater quality
Report No:	M-681600-01-1
Document No:	M-681600-01-1
Guideline(s) followed in study:	--
Deviations from current test guideline:	none
Previous evaluation:	No, not previously submitted
GLP/Officially recognised testing facilities:	not applicable
Acceptability/Reliability:	Yes

Executive Summary:

The performance of polystyrene divinylbenzene (SDB-XC) Empore™ disk-based passive sampler specially adapted to groundwater monitoring was evaluated. The sampler was calibrated in the laboratory using conditions that corresponded to groundwater (i.e. matrix medium, water temperature, flow rate and water flow across the disks). The retention and elution performance for sixteen semi-polar and polar pollutants on the sampler was evaluated. Overall mean recoveries were 76.8 % for BAM. Sampler uptake kinetics were measured over fourteen days at three concentrations (10, 100 and 500 ng/L) and the sampling rate (R_S) calculated for four compounds. There was no influence of concentration of the test analyte on the uptake profile; with mean R_S varying between 0.018 ± 0.007 L day^{-1} and 0.047 ± 0.001 L day−1. Passive samplers were deployed in twelve characterized groundwater wells near Lyon (France). BAM was found with a maximum time-weighted concentration of 14 ng/L.

I. Materials and Methods

Urban groundwater aquifers at 6 sites in the eastern metropolitan area of Lyon, France were sampled for a total of 16 polar and polar pesticides and pharmaceuticals including BAM (2,6 dichlorobenzamide). At 12 groundwater wells (2 per site) a specially designed rig containing nine individual polystyrene divinylbenzene (SDB-XC) Empore™ EDs (47mm diameter, 12 µm particle size, 0.5mm thick) was deployed for ten days between 26 October and 5 November 2018.

The passive samplers were adapted to groundwater monitoring by eliminating the polyethersulfone (PES) limiting diffusion membrane as is normal in the conventional Chemcatcher® passive sampler. Groundwater flow rates are low and so there is no need to slow the sampling process. Fouling issues are much more uncommon, so the protection needed in surface water sampling is not needed. This adaptation decreased the analytical detection limits as diffusional uptakes of analytes into the ED increased.

Passive ED samplers were extracted individually with acetone/MeOH (50/50; v/v). Extracts from three EDs were pooled, evaporated to dryness and reconstituted in 500 µL of water/MeOH (95/5; v/v) and diluted 30 times prior to analysis by LC-MS/MS.

Details of the analytical method and its performance are provided below. The product ions (m/z) 173.0 and 109.0 were monitored for 2,6-dichlorobenzamide and sulfamethoxazole-D_4 was used as an internal standard.

Table 7.5- 46: Details of HPLC-MS/MS

Substance	Rt	Instrument detection limit	Instrument quantification limit	RSD (n = 3)
	(min)	(ng/L)	(ng/L)	(%)
2,6-dichlorobenzamide (BAM)	3.1	5.2	17.4	6

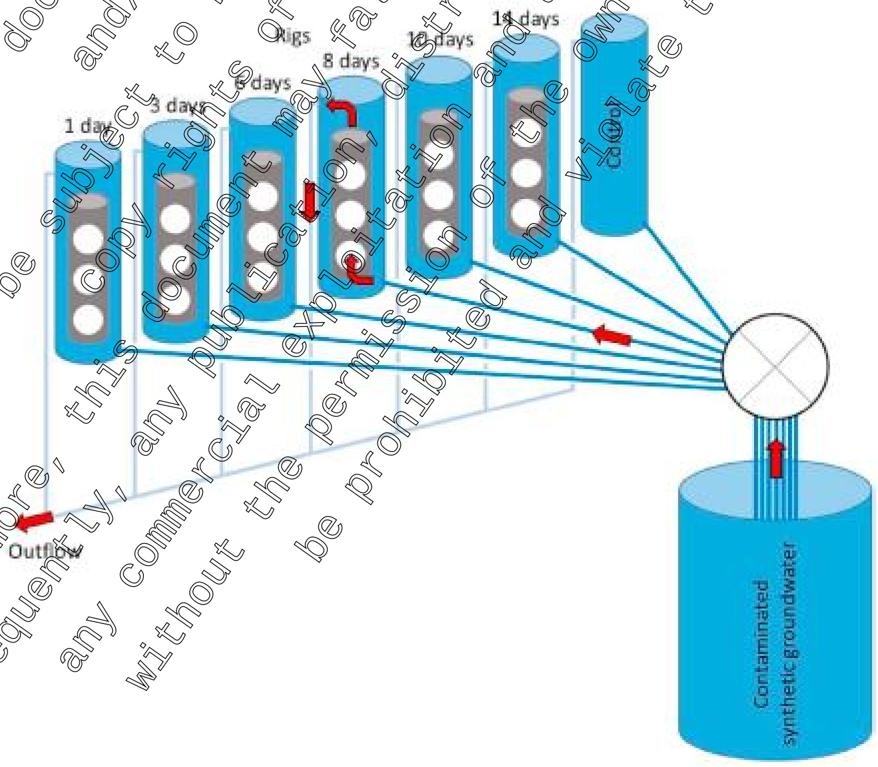
The performance of the passive samplers was assessed by filtering 30 mL of synthetic groundwater spiked at concentrations of 10, 100 and 500 ng/L with each substance. Each test was conducted in triplicate. For BAM the recovery increased with concentration (see Table 7.5- 47).

Table 7.5- 47: Log D_{ow} and mean percentage recovery for BAM from the SDB-XC disc at three concentrations

Substance	Log D_{ow}	Mean recoveries (%)			Overall mean recoveries (%)
	(pH 7.4)	10 ng/L	100 ng/L	500 ng/L	
2,6-dichlorobenzamide (BAM)	2.03	60.5 ± 0.7	78.8 ± 0.3	91.3 ± 1.7	76.8 ± 15.5

Experiments on the uptake rates of four pollutants were performed under environmental conditions found in groundwater. Passive SDB-XC samplers contained within sealable columns (24 cm high, 10 cm diameter, 1.9 L volume) were expose to a constant concentration of atrazine, hexazinone, metolachlor and sulfamethoxazole dissolved in synthetic groundwater at concentrations of 10, 00 and 500 ng/L.

Figure 7.5- 28: Experimental set up for uptake experiments onto the SDB-XC discs



Uptake experiments were conducted in the dark at a temperature of 16 °C to mimic groundwater temperatures. A flow rate of 5.9 mL min^{-1} was applied in each column to obtain a Darcy velocity of 1.08 m day^{-1} in the experimental system, a flow rate considered representative of the aquifer of Eastern Lyon. A set of seven columns was used: one column control (without rig) and one column for each of the six exposure times (1, 3, 6, 8, 10 and 14 days). The experiment was performed at three test concentrations: 10, 100 and 500 ng/L.

The uptake of chemicals by a passive sampler follows first-order kinetics. Between the start of exposure and the half-life to equilibrium, the uptake of an analyte is linear and can be described using the following equation:

$$M_S(t) = C_W R_S t$$

where

$M_S(t)$ is the mass (ng) of analyte accumulated in the sampler after exposure time t (day),

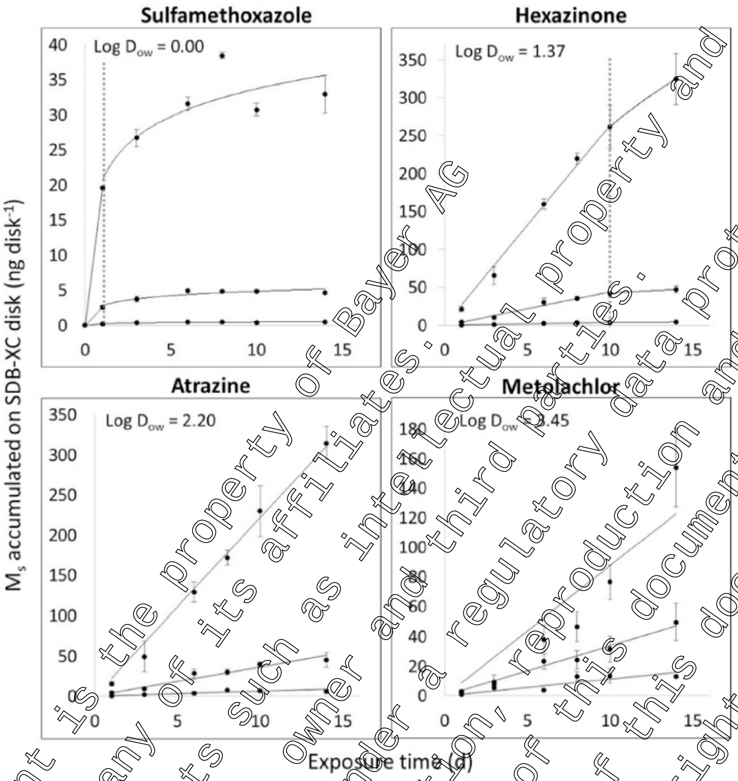
C_W is the concentration (ng/L of an analyte in the groundwater

and R_S is the sampling rate (L day^{-1}) and represents the volume of water extracted by a sampler per unit of time.

During a calibration experiment, R_S can be determined from the slope of the regression between the mass of analyte accumulated against the time of exposure. Once R_S is known, C_W, which corresponds to the TWA concentration in the field, can be calculated.

The sampling rate (R_S) of hexazinone was determined experimentally at three concentrations; 10, 100 and 500 ng/L (see Figure 7.5- 29). The mean R_S for hexazinone was 0.047 ± 0.001 L day^{-1}. On the basis of similarities in their retention time on a reversed-phase chromatographic column, log D_{ow} and chemical structures, the hexazinone value was applied to BAM to determine TWA concentrations (C_W) in the field trial. It was assumed compounds with similar physico-chemical properties would exhibit similar uptake behaviour on the samplers during the field trial.

Figure 7.5- 29: Analyte uptake on SDB-XC Empore™ disks for atrazine, hexazinone, metolachlor and sulfamethoxazole over 14 days at three concentrations (10, 100 and 500 ng/L, n=3).



The dotted lines show the limit of the linear uptake sampling time window

II. Results and Discussion

After retrieval of the twelve deployment rigs (six sites, with two groundwater sampling points per site) the passive samples were extracted and the concentration of each substance in groundwater (C_W) determined. The median, minimum and maximum time weighted average concentrations of BAM in groundwater are given in Table 7.5- 48.

Table 7.5- 48: Concentration of 2,6-dichlorobenzamide (BAM) in groundwater samples collected from urban aquifers in Lyon, France

Substance	Detection Frequency (%)		Median C_w	Minimum C_w	Maximum C_w	MQL
	Global	> MQL	(ng/L)	(ng/L)	(ng/L)	(ng/L)
2,6-dichlorobenzamide (BAM)	92	92	3.5	0.5	17	*

MQL = method quantification limit
* C_w values were calculated when S/N ratio > 10

III. Conclusion

Field trials were undertaken using twelve groundwater wells located in urban sites in Lyon, France. At each well a specially designed rig containing nine passive SDB-XC samplers was deployed between 26 October and 5 November 2018. Over a 10 day period in late 2108 the concentrations of 2,6-dichlorobenzamide (BAM) reported ranged from 0.5 to 17 ng/L.

Assessment and conclusion by applicant:

This publication provides information on the exposure values for the metabolite M-01 (BAM) in French groundwater in 2018 and shows no concerns.

B.2 Surface Water

Fluopicolide

The public monitoring data assessment KCA 7.5/01 included surface water monitoring data for fluopicolide. In addition, two published peer reviewed publications provide additional information on fluopicolide residues in surface water in France (KCA 7.5/08) and Switzerland (KCA 7.5/09).

Data Point:	KCA 7.5/08
Report Author:	Gulkowska, A.; Buerge, I. J.; Poiger, T.
Report Year:	2014
Report Title:	Online solid phase extraction LC-MS/MS method for the analysis of succinate dehydrogenase inhibitor fungicides and its applicability to surface water samples
Report No:	M-589687-01-1
Document No:	M-589687-01-1
Guideline(s) followed in study:	not applicable
Deviations from current test guideline:	none
Previous evaluation:	No, not previously submitted
GLP/Officially recognised testing facilities:	No, not conducted under GLP/Officially recognised testing facilities
Acceptability/Reliability:	Yes

Executive Summary:

A sensitive and selective analytical method, based on online solid phase extraction coupled to LC-MS/MS, was developed and validated to detect traces of fungicides in surface water and wastewater. The list of target analytes included 8 succinate dehydrogenase inhibitors (bixafen, boscalid, fluopyram, flutolanil, fluxapyroxad, isopyrazam, penflufen, and penthiopyrad), and 2 other fungicides with different modes of action, fenpyrazamine and fluopicolide. Detection and quantification limits in various matrixes were 0.1 - 2 and 0.5 - 10 ng/L, respectively. The applicability of the method was demonstrated in a study on the occurrence of fungicides in the River Glatt, Switzerland, that drains a catchment area of 419 km^2 with a substantial proportion of agricultural land. Of the studied compounds only boscalid and fluopicolide were detected in flow-proportional weekly composite samples, generally at low concentrations up to 15 and 5 ng/L, respectively. While fluopicolide was detected in only 30 percent of the samples above the LOD of 0.5 ng/L, boscalid was detected in all samples analysed between March and October 2012.

I. Materials and Methods

Surface water samples were collected from several lakes in the Swiss Midland region. Grab samples were taken at the outflow of the lakes at 0 – 1 m depth in June 2012. A 24-h composite effluent sample was taken from a wastewater treatment plant of Horgen, Switzerland following sand filtration. "Fossil" groundwater from a public fountain (Aqui) in Zurich, Switzerland was used as blank samples to study potential contamination from reagents and the experimental procedure as well as cross contamination between samples. Purified water was used for recovery experiments and preparation of calibration standards. A sampling campaign was performed at the river Glatt, Switzerland, during March – October 2012 to monitor the presence of the pesticides and the seasonality of their occurrence in the river. Thirty-three flow-proportional weekly composite samples were taken from an automatic water sampling station installed ≈ 400 m upstream from the mouth of river Glatt, where it flows into river Rhine (coordinates 47° 34′ 25″ N/08° 28′ 33″ E). The catchment area of 419 km^2 is characterized by intensive agricultural production (45 %), mainly arable land and grassland, followed by urban areas (26 %), and forests (24 %). All water samples were collected into glass bottles and stored at 4 °C in the dark.

The samples were concentrated by an online SPE procedure which involved three main steps: sample loading, pre-concentration, and elution using a column switching technique. A 2-mL PEEK loop was over-filled with 2.1 mL of sample via an auto sampler syringe. The sample was transferred from the loop to the SPE cartridge (two stacked Gemini-NX C18 cartridge pre columns, 4 × 3.0 mm i.d., 5 µm; Phenomenex, Torrance, CA) with purified water at a flow rate of 1 mL/min, providing enrichment of the analytes as well as clean-up of the samples from highly polar components. After valve switching, the enriched analytes were eluted backwards directly on to a Gemini NX C18 column (150 × 2.0 mm i.d, 5 µm; Phenomenex) equipped with a guard column filled with the same stationary phase (4 × 3 mm i.d.). The mobile phase consisted of 1 mM ammonium acetate in water (eluent A) and methanol (eluent B). Gradient elution at a flow rate of 0.2 mL/min was done in two steps with a fast initial increase from 5 to 50 % B within 2 min, followed by a slower linear increase to 95 % B within 21 min. Initial conditions were re-established within 0.1 min, and the column was equilibrated for 8.9 min prior to the next analysis, yielding a total run time of 32 min.

Detection of fungicides was accomplished using an API 4000 triple quadrupole tandem mass spectrometer equipped with a Turbo Ion Spray source. The most specific or most intense product ion of each target analyte was used for quantification, and a secondary product ion was used as a qualifier ion for confirmation. Together with the retention times, they were used to ensure correct peak assignment. The use of an isotopically labelled internal standard for each substance would be favourable for trace analysis to correct for the loss of analyte during sample preparation and for matrix effects. However, no such labelled standards were available for the fungicides tested in this study and, therefore, penflufen was selected as the most suitable surrogate standard. Penflufen has a medium retention time (21.2 min; range of all analytes = 17.0 – 24.3 min) and its chemical structure resembles most other fungicides investigated. Furthermore, penflufen has not been authorized in Europe very long and is therefore not expected to appear in natural waters. The concentration of each compound was calculated by comparing the peak area ratios of the analytes and penflufen to the corresponding ratios in the calibration standards. Calibration curves were constructed from two sets of 11 standards spiked in purified water (concentrations, 0.1 – 1,500 ng/L), acquired at the beginning and at the end of a measurement series, and obtained by a weighted (1/x) linear least squares regression.

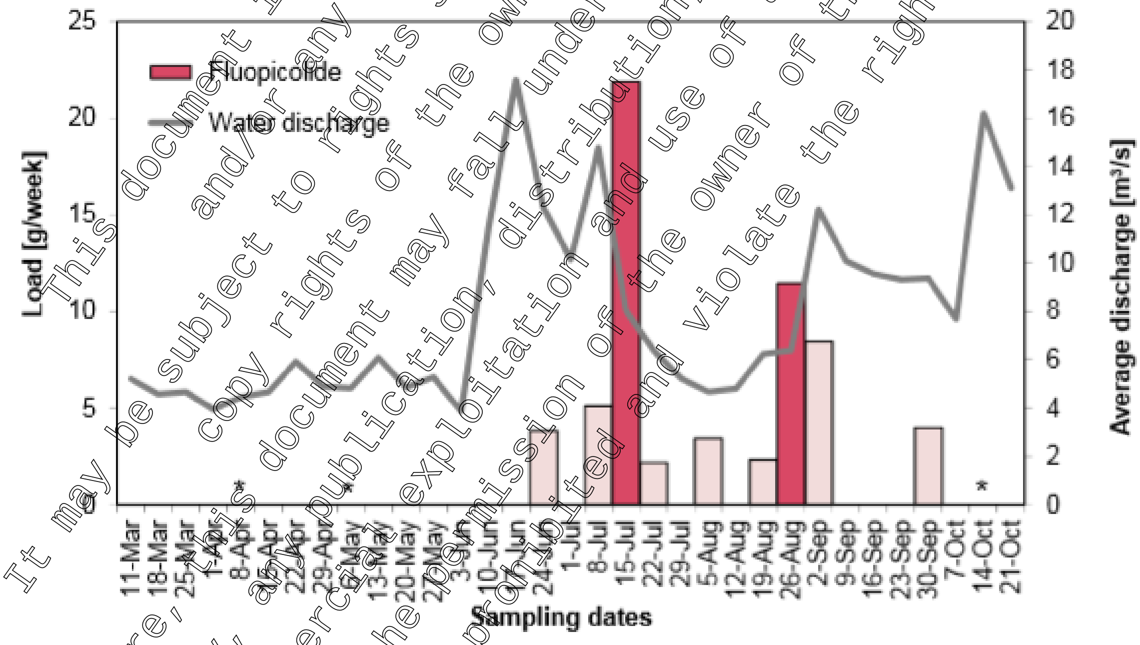
Three different water matrices were used for validation of the method: purified water, surface water from Swiss Midland lakes, and treated wastewater. The following parameters were determined: limits of detection (LOD) and quantification (LOQ), linearity, precision, and accuracy. The LODs were determined on the basis of the lowest calibration standard where the peak in the quantifier ion trace reached a signal-to-noise ratio of ≥3. The lowest concentration levels for which the quantifier signal-to-noise ratio was ≥10, was set as LOQ.

II. Results and Discussion

The method was used to monitor samples from the river Glatt, Switzerland from March – October 2012. At the time when analyses were conducted, only plant protection products containing boscalid, fluopicolide, and bixafen were commercially available on the Swiss market. Boscalid and fluopicolide were found in low, but detectable concentrations in the range of 0.5 – 15 ng/L, with boscalid being detected in all samples collected. Fluopicolide was detected in 30% of the collected samples above the LOD of 0.5 ng/L. The third compound, bixafen, was not detected at all. Only a small number of samples contained concentrations above the respective LOQs. The maximum concentrations were 15 and 4.5 ng/L for boscalid and fluopicolide,

Weekly fungicide loads were also calculated from the measured discharge of the river and the fungicide concentrations in the flow-proportional weekly composite samples. The loads ranged between <2 and 22 g for fluopicolide Figure 7.5- 30. There was no clear correlation between weekly concentrations of fungicides and water discharge. This maybe, in part, due to the fact that the river originates at Lake Greifensee that contributes a significant portion of water in the river downstream. The maximum water concentrations typically coincided with fungicide treatments in the River Glatt catchment area. For example, the occurrence of fluopicolide (approved for use on potato fields with up to four applications per culture) mirrored the potato growing season, which falls within May – September. Typically, fungicide applications are ceased 3 weeks before harvest. This is reflected by lower fluopicolide detections in October.

Figure 7.5- 30 **Weekly loads of fluopicolide in the River Glatt, Switzerland, in 2012 calculated from the measured discharge and the fungicide concentration measured in flow proportional weekly composite samples**



Dark coloured bars indicate loads calculated based on samples with concentrations above LOQ, light coloured bars indicate loads calculated based on samples with concentrations below LOQ but above LOD (* - no sample available)

III. Conclusion

In the monitoring programme fluopicolide was detected in 30% of the collected samples above the LOD of 0.5 ng/L between March and October 2012. Fluopicolide was detected in flow-proportional weekly composite samples, generally at low concentrations up to 5 ng/L.

Assessment and conclusion by applicant: This publication provides information on the exposure values for fluopicolide in Swiss surface water in 2012 and shows no concerns.

Data Point:	KCA 7.5/09
Report Author:	Lefrancq, M.; Jadas-Hecart, A.; La Jeunesse, I.; Landry, D.; Payraudeau, S.
Report Year:	2017
Report Title:	High frequency monitoring of pesticides in runoff water to improve understanding of their transport and environmental impacts
Report No:	M-589692-01-1
Document No:	M-589692-01-1
Guideline(s) followed in study:	--
Deviations from current test guideline:	none
Previous evaluation:	No, not previously submitted
GLP/Officially recognised testing facilities:	not applicable
Acceptability/Reliability:	Yes

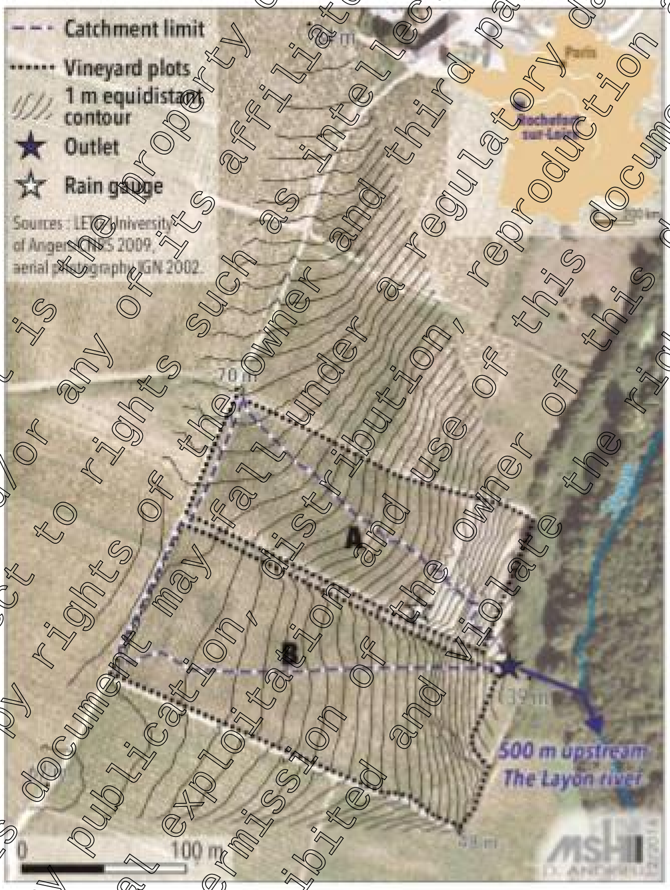
Executive Summary:

Rainfall-induced peaks in pesticide concentrations can occur rapidly. Low frequency sampling may therefore largely underestimate maximum pesticide concentrations and fluxes. Detailed storm-based sampling of pesticide concentrations in runoff water to better predict pesticide sources, transport pathways and toxicity within the headwater catchments is lacking. High frequency monitoring (2 minute) of seven pesticides (dimetomorph, fluopicolide, glyphosate, iprovalicarb, tebuconazole, tetraconazole and triadimenol) and one degradation product (AMPA) were assessed for 20 runoff events from 2009 to 2012 at the outlet of a vineyard catchment in the Layon catchment in France. The maximum pesticide concentrations were 387 µg L^{-1}. Samples from all of the runoff events exceeded the legal limit of 0.1 µg L^{-1} for at least one pesticide (European directive 2013/39/EC). High resolution sampling used to detect the peak pesticide levels revealed that Toxic Units (TU) for algae, invertebrates and fish often exceeded the European Uniform principles (25 percent). The point and average (time or discharge-weighted) concentrations indicated up to a 30 - or 4 - fold underestimation of the TU obtained when measuring the maximum concentrations, respectively. This highlights the important role of sampling methods for assessing peak exposure.

I. Materials and Methods

The 2.2 ha catchment was located in Rochefort sur Loire in the West of France, 47°19″19.47″N; 0°38″21.39″W). The outlet of the catchment was located 37 m from an influent of the Layon River that is itself 500 m downstream and is characterised by three different gradients: (i) The upper catchment had 0 – 5% slopes (51% of the total catchment area); (ii) The middle catchment had 5 – 15% slopes (40%); and (iii) The lower catchment had >15% slopes (9%), including agricultural terraces. Soil characteristics for the catchment were as follows: sand: 42.3%; silt: 36.1%; clay: 19.5%; OM: 2.1%; pH: 7.1; CEC: 10.4 meq 100 g^{-1}; CaCO$_3$: 0.1%. Vineyards cover 89% of the catchment and were divided into two fields managed by two farmers (subscripts A and B Figure 7.5- 31). These fields were separated by a grassed strip that had been reinforced with stones near the catchment outlet to limit erosion. Vines were planted perpendicular to the slope. Grass covered the vineyard plots along every two vine rows (1.4 m separated).

Figure 7.5- 31 The study catchment with the experimental setup Rochefort sur Loire



31 commercial products with 21 different active ingredients were applied to the vineyard during 2009, 2010, 2011 and 2012. The study focussed on 7 pesticides (dimetomorph (DIM), fluopicolide (FLU) **this summary will focus on the results for fluopicolide**, glyphosate (GLY), iprovalicarbe (IPR), tebuconazole (TEB), tetraconazole (TET) and triadimenol (TRI)) and one degradation product (AMPA). The 7 pesticides were mostly applied between March and July. TEB and TRI were generally applied to the upstream section of plot A, while FLU, IPR and TET were only applied to plot B (Figure 7.5- 30).

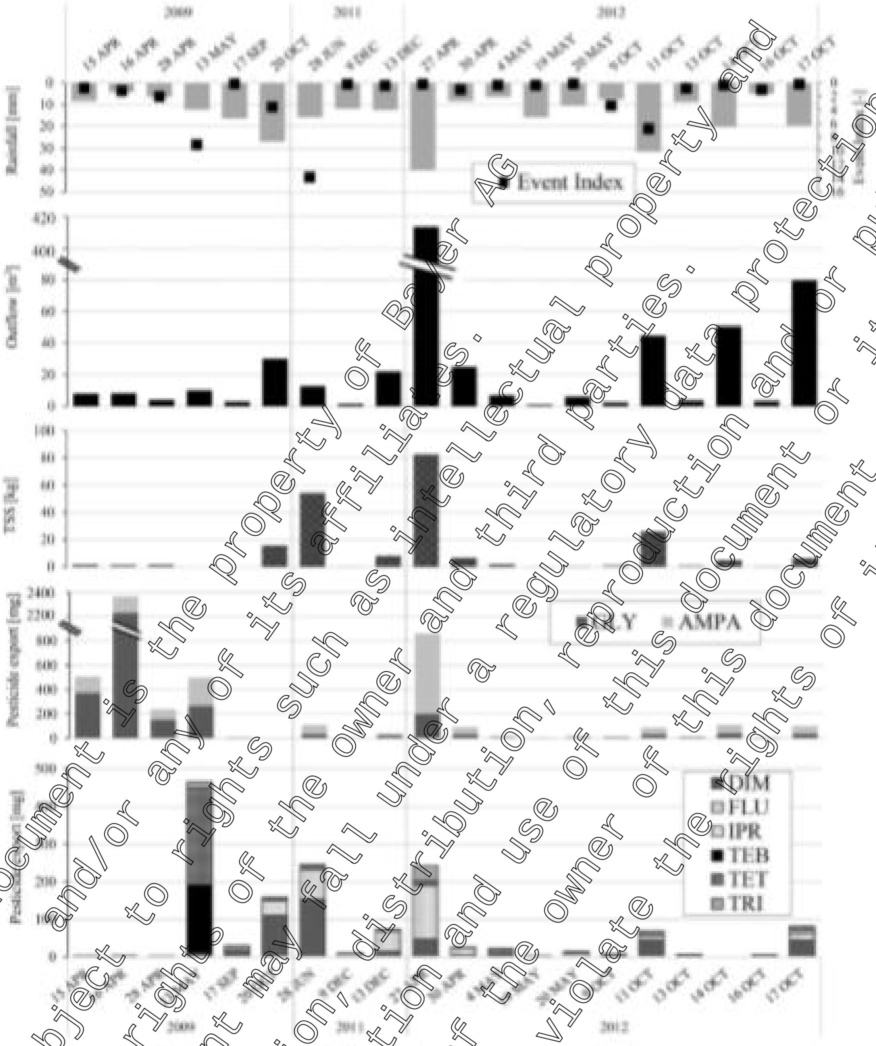
Water discharge was measured at the catchment outlet every 30 s using a bubbler flow module with a 5 mm precision combined with a Venturi channel. As soon as the water level increased above 2 cm, 500 mL of water were sampled every 2 minutes using an automatic sampler containing 24 polyethylene flasks of 500 mL. Water samples were then collected and placed on ice for transportation to the laboratory.

Samples were filtered through a 0.45 µm regenerated cellulose filter to measure the total suspended solid concentration (TSS). Raw and filtered samples were kept at −18°C in the dark prior to chemical analysis. GLY and AMPA samples were analysed after filtering (0.45µm), this step being required for the derivatization of both compounds prior to their analysis by HPLC with fluorescence detection. Other compounds were analysed in raw water in order to not underestimate the runoff export via the particulate phase (>0.45µm). After spiking with surrogate standards chlorpyriphos-d_{10} and diuron-d_6, water samples (500 mL) were successively liquid–liquid extracted at 3 pHs (<2, 7 and >12) using a mixture of dichloromethane: ethyl acetate 80:20. The extracts were combined, dehydrated and evaporated to <1 mL under vacuum. The concentrated extract was transferred into a vial and adjusted accurately to 1 mL with ethyl acetate. An aliquot of this extract was solvent exchanged with a mixture of water:methanol (50:50 with 0.1% acetic acid). Analysis was performed by liquid chromatography/electrospray ionisation tandem mass spectrometry (LC/ESI-MS-MS). The remainder of the ethyl acetate extract was analysed by gas chromatography/ion trap tandem mass spectrometry GC/IT-MS-MS. The pesticide quantification limit within the water samples was 0.05 µgL^{-1}. Recovery rates ranged between 86 and 96%.

II. Results and Discussion

Twenty rainfall-runoff events occurring between 2009 and 2012 were studied. Each event yielded >1m^3 total discharge at the outlet of the catchment. These events represented a wide range of rainfall intensities and durations, runoff percentages and volumes Figure 7.5- 32. Maximum pesticide concentrations reached 13, 8, 386.9, 47, 3, 81, 68 and 4.2 µgL^{-1} for DIM, FLU, GLY, AMPA, IPR, TEB, TET and TRI, respectively. These concentrations are more than one order of magnitude higher than reported in French vineyards with grab or integrated sampling and a similar order of magnitude for short time interval sampling. Maximum exported loads for a single event reached 154, 142, 2229, 660, 39, 185, 255 and 39 mg, for DIM, FLU, GLY, AMPA, IPR, TEB, TET and TRI respectively.

Figure 7.5- 32 **Rainfall, outflow, total suspended solids (TSS) and pesticide and degradation product loads (GLY, AMPA, DIM, FLU, IPR, TEB, TET, TRI) for 20 run off events in a vineyard catchment**



III. Conclusion

Rainfall-induced maximum concentrations of fluopicolide from a catchment located in Rochefort sur Loire in the West of France, taken during 2009, 2010, 2011 and 2012 reached 8 µg/L (concentration in surface runoff prior to entering a surface water body). The maximum exported load of fluopicolide for a single event reached 142 mg.

Assessment and conclusion by applicant:

This publication provides information on the exposure values for fluopicolide in French surface water in 2009 to 2012 and shows no concerns.

M-01 (AE C653711, BAM)

The public monitoring data assessment KCA 7.5/01 included surface water monitoring data for M-01. A further four publications provide information on M-01 residues in surface water in Switzerland (KCA 7.5/10), Denmark (KCA 7.5/11), Luxembourg (KCA 7.5/12) and Sweden (KCA 7.5/13). The Luxembourgian publication has additional information on M-01 residues in drinking water (tap and bottled).

Data Point:	KCA 7.5/10
Report Author:	Moschet, C.; Vermeirssen, E. L. M.; Singer, H.; Stamm, C.; Hollender, J.
Report Year:	2015
Report Title:	Evaluation of in-situ calibration of Chemcatcher passive samplers for 322 micropollutants in agricultural and urban affected rivers
Report No:	M-529707-01-1
Document No:	M-529707-01-1
Guideline(s) followed in study:	--
Deviations from current test guideline:	none
Previous evaluation:	No, not previously submitted
GLP/Officially recognised testing facilities:	not applicable
Acceptability/Reliability:	Yes

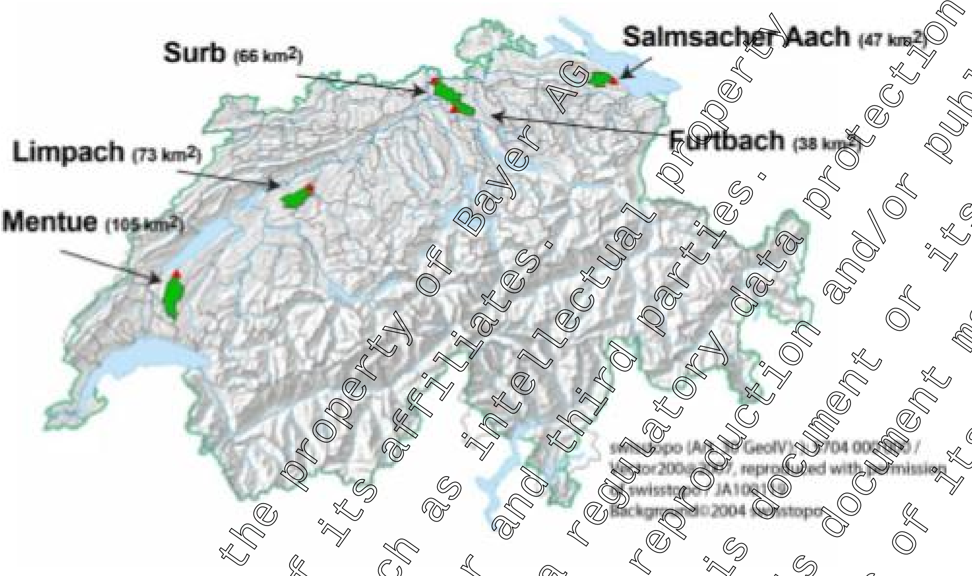
Executive Summary:

In a large field study, the in-situ calibration of the Chemcatcher passive sampler - styrenedivinylbenzene (SDB) covered by a polyether sulfone (PES) membrane - was evaluated for 322 polar organic micropollutants which included 2,6-dichlorobenzamide (BAM). Five rivers with different agricultural and urban influences were monitored from March to July 2012 with two methods i) two-week time proportional composite water samples and ii) two-week passive sampler deployment. All substances - from different substance classes with logKow -3 to 5, and neutral, anionic, cationic, and zwitterionic species - were analysed by liquid chromatography high-resolution tandem mass spectrometry. This study showed that SDB passive samplers are well-suited for the qualitative screening of polar micropollutants because the number of detected substances was similar (204 for SDB samples vs. 207 for composite water samples), limits of quantification were comparable (median: 1.3 ng/L vs. 1.6 ng/L), and the handling in the field and lab. is fast and easy. Substances with moderately fluctuating river concentrations such as pharmaceuticals showed much better correlations than substances with highly fluctuating concentrations such as pesticides. 2,6-dichlorobenzamide (BAM) was detected in 44 samples at between 7.5 and 48 ng/L.

I. Materials and Methods

The study investigated five medium-sized Swiss rivers (Furtbach, Limpach, Mentue, Salmsacher Aach, Surb with catchment sizes between 38 - 105 km^2 between March and July 2012 (see Figure 7.5- 33).

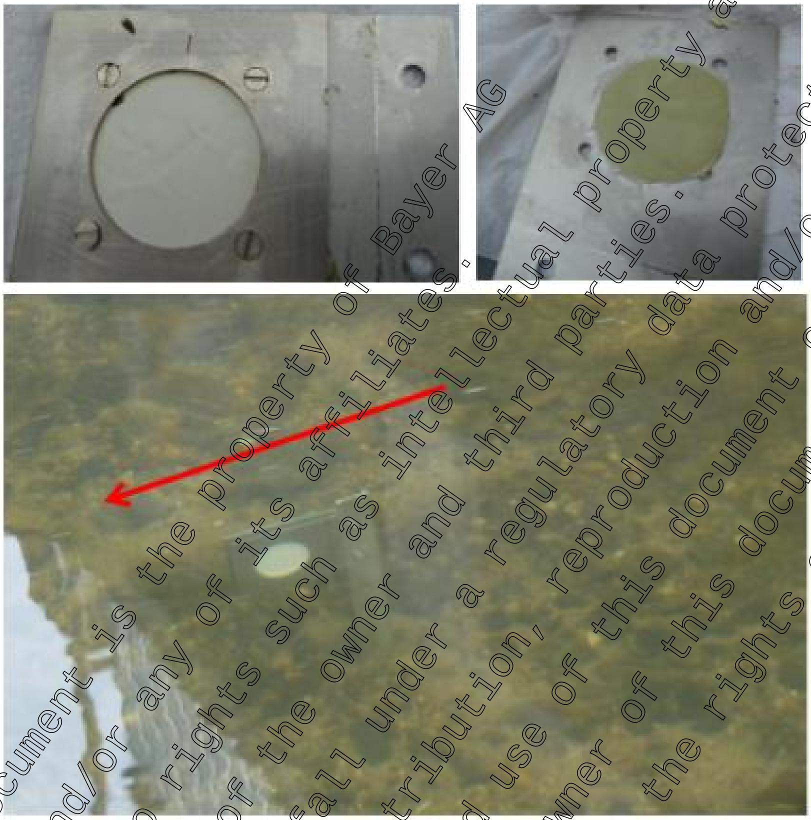
Figure 7.5- 33 **Catchments (green) and sampling locations (red) of the five investigated rivers**



The rivers had comparable sizes and were influenced by intense but varying agricultural and/or urban land use. In each catchment, from mid-March to mid-July 2012, nine two-week composite water samples were taken and nine Chemcatchers® (SDB-RPS disks covered by PES membranes) were deployed for two weeks. Composite water samples were taken time-proportionally by automatic sampling devices (Isco samplers), using a 60 min sub-sampling interval.

Conditioned SDB passive samplers were deployed at the same locations during approximately the same time intervals by attaching two disks to an iron rod (see Figure 7.5- 34). Both SDB disks were recovered after two weeks and each put in 6 mL of acetone. The samples were cooled on-site at 4 °C, transported to the lab, and stored at -20 °C until analysis.

Figure 7.5- 34 **Top left: prepared and conditioned passive sampler (SDB-RPS disk covered by a PES membrane). Top right: recovered SDB-RPS disk (PES membrane already removed). Bottom: deployed passive sampler in the river (iron rod was hammered roughly 30 cm into the riverbed). The red arrow indicates the flow direction.**



One litre of the composite water samples were extracted by solid phase extraction (SPE) concentrated on a multi-layer cartridge containing Oasis HLB, Strata XAW, Strata XCW, and Isolute ENVþ then evaporated to 0.1 mL under nitrogen stream and re-dissolved in nanopure water. The Empore™ SDB-RPS disks were initially extracted in acetone they had been stored in then in methanol. The combined fractions were concentrated by evaporation and re-dissolved in nanopure water. Extracts from both the composite water samples and SDB disks were quantified by LC-HR-MS/MS with electrospray ionization (ESI).

II. Results and Discussion

From the 322 investigated substances, 207 were detected at least once in a composite water sample and 204 were detected at least once on an SDB passive sampler. The range of substances detected was very similar in both sampling types (181 overlapping substances), but not identical. On the one hand, 23 substances had no detection in the composite water sample but at least one detection on the SDB passive sampler. 2,6-dichlorobenzamide (BAM) was one of the substances investigated and was detected in 44 samples at between 7.5 and 48 ng/L (see Table 7.5- 49).

Table 7.5- 49: Quantitative results for 2,6- dichlorobenzamide

Compound name	Substance class [a]	LOQw (ng/L)	LOQ SDB (ng/SDB)[b]	No. of detection in water	No. of detection in SDB	Minimal concentration (ng/L)[c]	Maximal concentration (ng/L) [c]
2,6-dichlorobenzamide (BAM)	PE-TP	5	0.5	44	44	7.5	48

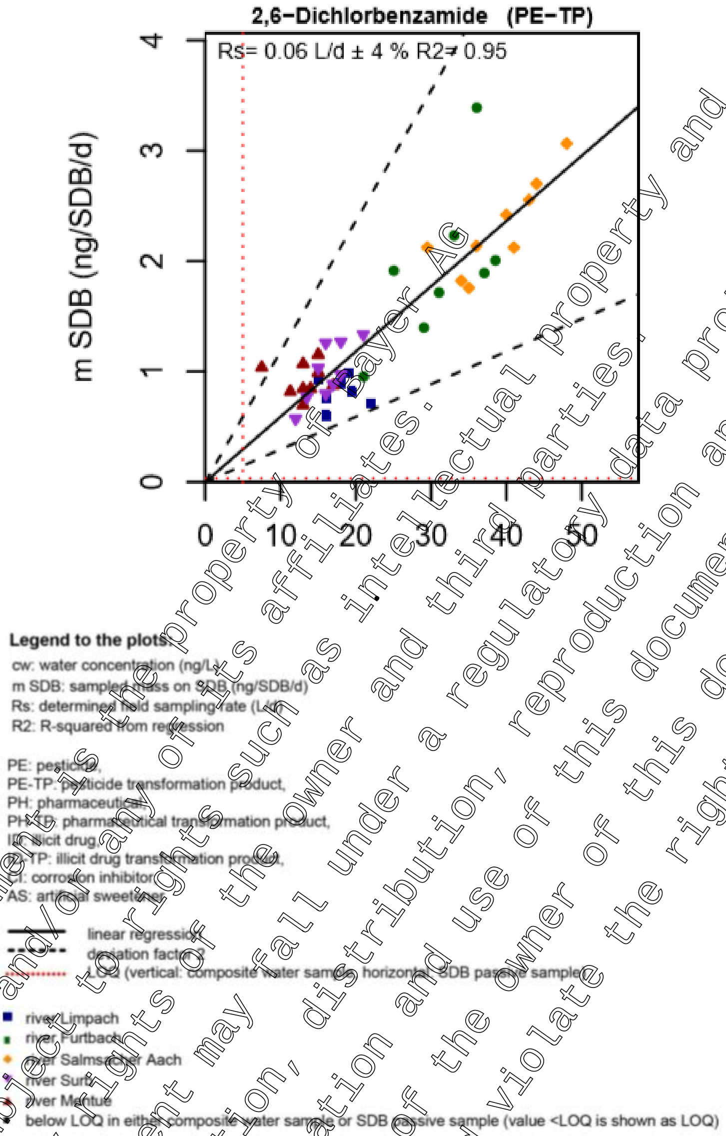
[a] Substance class: PE-TP: pesticide transformation product,

[b] Only substances detected in at least 10 water samples were quantitatively evaluated in the passive samples,

[c] From the measurement of composite water samples

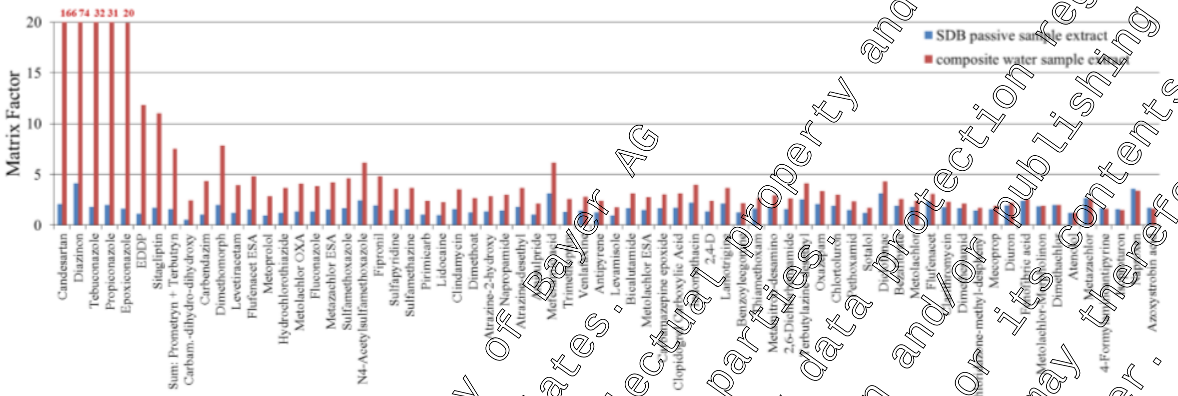
Quantitative correlation was established for 114 of the substances, a regression between water concentration from the composite water samples (ng/L) and sampled mass on SDB disks (ng/d) was calculated (see Fig. 1). For the majority of the substances (88 out of 114), either a good or fair correlation was found (R2 > 0.9 or R2 between 0.75 and 0.9 respectively. The correlation for 2,6 dichlorobenzamide is shown in Figure 7.5- 35.

Figure 7.5- 35 **Correlation for water concentration and sampled mass on SDB**



This study showed that SDB passive samplers are well-suited for the qualitative screening of polar micropollutants because the number of detected substances was similar (204 for SDB samples vs. 207 for composite water samples), limits of quantification were comparable (median: 1.3 ng/L vs. 1.6 ng/L), and the handling in the field and lab. is fast and easy. The results for 2,6 dichlorobenzamide is shown in Figure 7.5- 36.

Figure 7.5- 36 **Comparison between matrix factor in the SDB passive sample extracts (blue) and in composite water sample extracts (red). Matrix factors were calculated by comparing the peak area of each substance in a calibration standard (in nanopure water) with the peak area in a spiked environmental sample**



III. Conclusion

This large field study investigating 322 substances confirmed that the Chemcatcher passive sampler (SDB-RPS disks covered by a PES membrane) are suitable for the qualitative screening of polar micropollutants in river waters. 2,6-dichlorobenzamide (BAM) was one of the substances investigated and was detected in 44 samples at between 7.5 and 48 ng/L.

<u>Assessment and conclusion by applicant:</u>

This publication provides information on the exposure values for the metabolite M-01 (BAM) in Swiss surface water in 2012 and shows no concerns.

Data Point:	KCA 7.5/11
Report Author:	Mcknight, U.; Rasmussen, J.; Kronvang, B.; Binning, P.; Bjerg, P.
Report Year:	2015
Report Title:	Sources, occurrence and predicted aquatic impact of legacy and contemporary pesticides in streams
Report No:	M-557391-01-1
Document No:	M-557391-01-1
Guideline(s) followed in study:	not applicable
Deviations from current test guideline:	--
Previous evaluation:	
GLP/Officially recognised testing facilities:	No, not conducted under GLP/Officially recognised testing facilities
Acceptability/Reliability:	

Executive Summary:

Current findings of pesticides in surface and groundwater were linked to historical pesticide usage, focusing on the potential contribution of legacy pesticides to the predicted ecotoxicological impact on benthic macroinvertebrates in headwater streams. Results suggest that groundwater, in addition to precipitation and surface runoff, is an important source of pesticides (particularly legacy herbicides) entering surface water.

A large number of pesticides and selected metabolites including 2,6-dichlorobenzamide (BAM) were determined in samples collected from headwater streams in four catchments located in Sjaelland, Denmark. Sampling was conducted predominantly in May to June from 2010 to 2012 during the main pesticide application period in Denmark. 2,6-Dichlorobenzamide (BAM) was analysed for in water samples in 2010 and 2011. Sediment samples were analysed for selected compounds in 2011 and 2012 but did not include BAM.

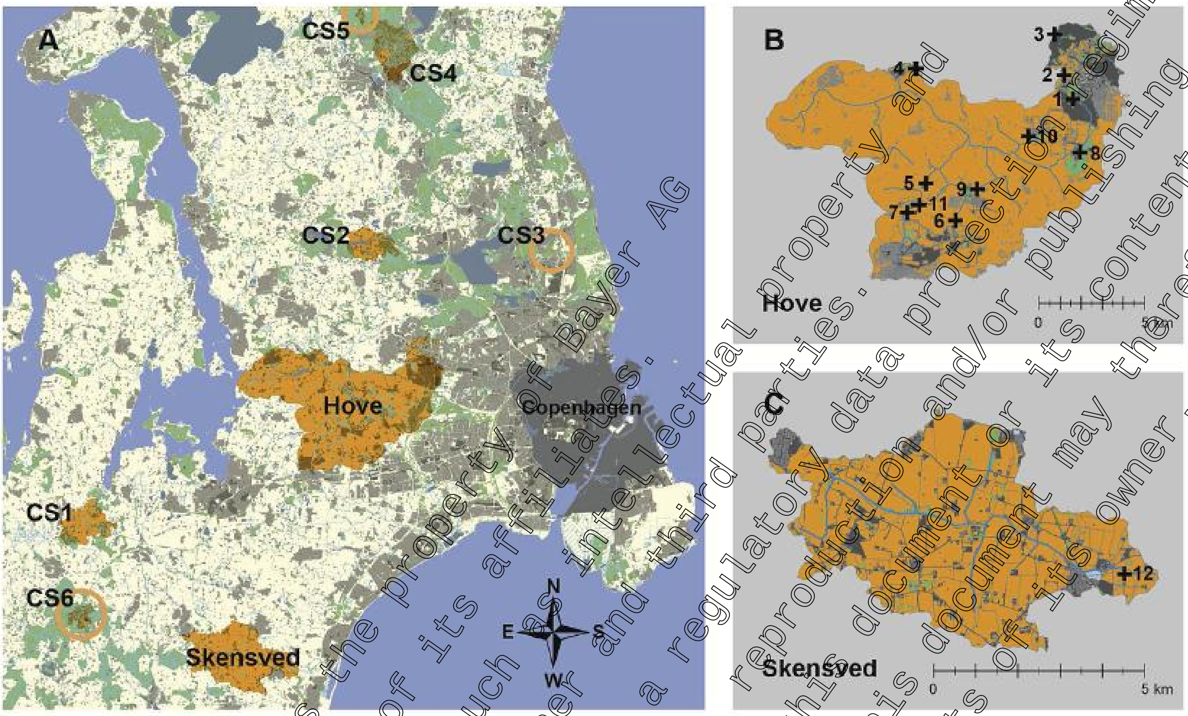
BAM was one of the most prevalent compounds detected in the water samples. Maximum concentrations of BAM were 0.19 ug/L in storm-flow water samples, 1.7 ug/L in base-flow water samples and 2.1 ug/L in groundwater. The median concentration was 0.14 ug/L in storm-flow and 0.036 ug/L in groundwater.

I. Materials and Methods

The main objective of this work was to link current findings of pesticides in Danish streams and groundwater to the history of pesticide usage, focusing on whether legacy pesticides contributed to the overall predicted toxicity impacting aquatic benthic macroinvertebrates. Five decades of agricultural application data were used in combination with measured stream concentrations for a number of pesticides found in 14 Danish headwater streams. The publication evaluates whether groundwater, in addition to precipitation and surface runoff, is possible source of pesticides (particularly legacy herbicides) entering surface water.

A large number of pesticides and selected metabolites including 2,6-dichlorobenzamide (BAM) were determined in the dissolved water phase (and for some compounds, but not BAM, also in the sediment-bound phase) of samples collected from headwater streams in four catchments located in Sjaelland, Denmark (Figure 7.5- 37). Two streams were chosen as control sites, representing least disturbed (sub)catchments with > 90% forested or natural lands (CS1-2; Figure 7.5- 37). Eleven streams were chosen in the Hove catchment (Figure 7.5- 37B), where agriculture represents 80% of the catchment land use. One stream was located in the Skensved catchment (Figure 7.5- 37C), where agriculture represents ca. 99% of the total land use. Tile drains, triggered by stormflow events and wet seasons, were present in agricultural fields in both catchments.

Figure 7.5- 37: Location of the study catchments (A) on Sjaelland, Denmark, including the position of the six least disturbed control catchments (labelled CS1-6); the (B) Hove and (C) Skensved catchments together with their respective stream networks.



In (a), green and gray areas indicate natural and urban areas, respectively. In (B) and (C), green, orange, light gray and dark gray areas indicate natural areas, cultivated lands, uncultivated lands and residential settlements, respectively. Black crosses indicate sampling locations within each catchment. Note that streams CS1-2 were actively sampled during this field campaign; all other control catchments was taken from the NOVANA database

Sampling to capture surface runoff and flow through tile drains during heavy precipitation events was conducted in May to June from 2010 to 2012 resulting in 8 storm-flow event samples. One grab sample was additionally collected at each site in August 2010 after a period with little to no precipitation and restrictions on the application of pesticides (close to harvest), representing base-flow conditions.

Surface water samples collected in May to June 2010 and May-June 2011 were analysed for 2,6-dichlorobenzamide (BAM) by LC-MS/MS after solid phase extraction. Suspended sediment and bed sediments were not analysed for BAM.

In total, 42 pesticides and their metabolites, intermediates, potential impurities or isomers were detected at least once.

II. Results and Discussion

An overview of the concentrations of 2,6-dichlorobenzamide (BAM) detected in the storm-flow, base-flow and groundwater are given in Table 7.5- 50. Maximum concentrations of BAM were 0.19 ug/L in storm-flow water samples, 1.7 ug/L in base-flow water samples and 2.1 ug/L in groundwater.

The median concentration of BAM was 0.14 ug/L in storm-flow events (n=8) and 0.036 ug/L in groundwater extraction well from the Hove catchment (n=63).

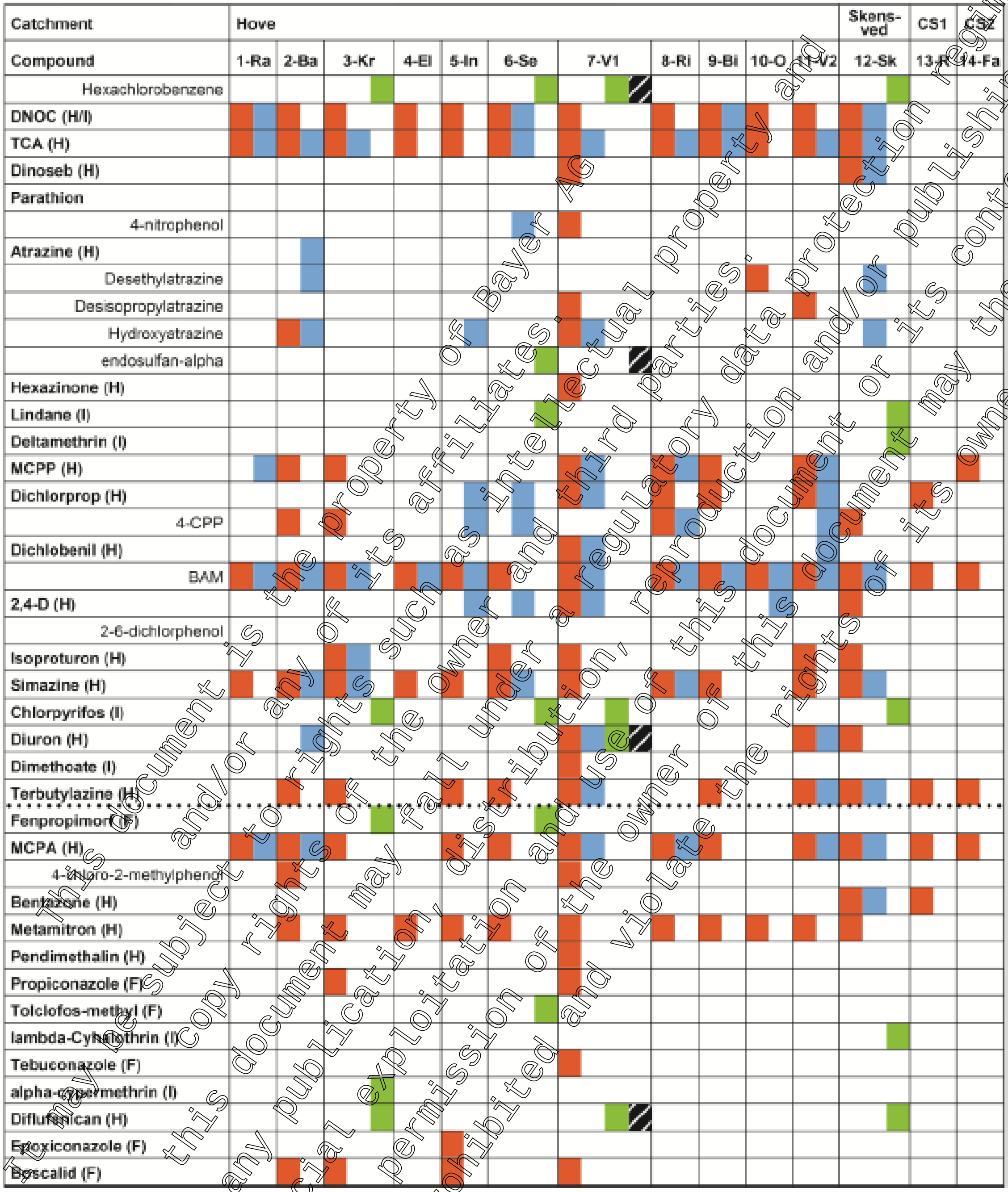
Table 7.5- 50: Overview for maximum and median pesticide concentrations of 2,6-dichlorobenzamide (BAM) detected in the storm-flow, base-flow and groundwater (Hove catchment only).

Compound	**Maximum concentration detected (µg/L)**			**Median concentration detected (µg/L)**	
	Storm-flow	**Base-flow**	**Groundwater**	**Storm-flow**	**Groundwater**
2,6-dichlorobenzamide (BAM)	0.19	1.7	**2.1**	0.14	0.036

Note that median equals maximum for base-flow as this was only sampled once.
The maximum concentration detected per pathway is highlighted in bold.

The number of compounds found per stream site ranged from 5 to 24 for storm-flow samples, and from 1 to 10 for base-flow samples (Figure 7.5- 38). It was evident from this overview which compounds were most widespread (found in multiple streams) as well as which stream locations were the most impacted (most compounds present per site). 2,6-dichlorobenzamide (BAM) was one of the most prevalent compounds detected in the water samples. BAM was also one of the compounds detected in the control (least disturbed) sites during storm-flow events. The findings are reported to be due to use of dichlobenil which was typically associated with urban applications and not with agricultural use, resulting in BAM being a common contaminant in Danish aquifers.

Figure 7.5- 38: Incidence of detection of pesticides (justified left) and their respective degradation products and/or impurities (justified right) including 2,6-dichlorobenzamide (BAM), with each column showing one of the 14 streams sampled.



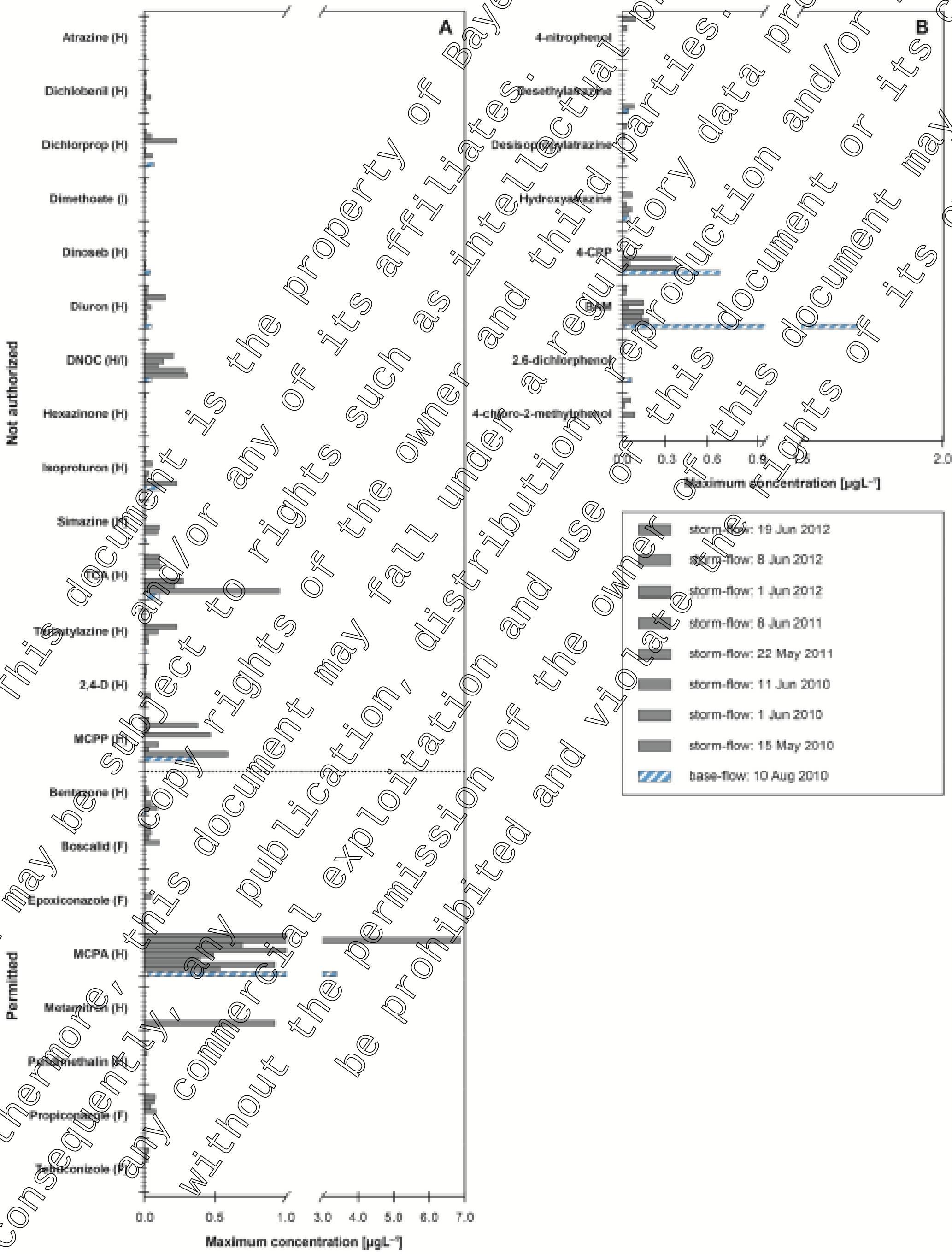
Catchment	Hove											Skens-ved	CS1	CS2
Compound	1-Ra	2-Ba	3-Kr	4-El	5-In	6-Se	7-V1	8-Ri	9-Bi	10-O	11-V2	12-Sk	13-R	14-Fa
Hexachlorobenzene			🟩			🟩	🟩▨					🟩		
DNOC (H/I)	🟧🟦	🟧	🟧	🟧	🟧	🟧🟦	🟧	🟧	🟧🟦	🟧	🟧	🟧🟦		
TCA (H)	🟧🟦	🟧🟦	🟧🟦	🟧	🟧	🟧🟦	🟧🟦	🟧🟦	🟧🟦	🟧	🟧🟦	🟧🟦		
Dinoseb (H)												🟧🟦		
Parathion														
4-nitrophenol						🟦	🟧							
Atrazine (H)		🟦												
Desethylatrazine		🟦								🟧		🟦		
Desisopropylatrazine							🟧				🟧			
Hydroxyatrazine		🟧🟦			🟦		🟧🟦					🟦		
endosulfan-alpha						🟩	▨							
Hexazinone (H)							🟧							
Lindane (I)						🟩						🟩		
Deltamethrin (I)												🟩		
MCPP (H)	🟦	🟧	🟧				🟧🟦	🟧🟦	🟧		🟧🟦			🟧
Dichlorprop (H)					🟦	🟦	🟧🟦	🟧	🟧		🟧🟦		🟧	
4-CPP		🟧	🟧		🟦	🟦		🟧🟦			🟦	🟧		
Dichlobenil (H)							🟧🟦				🟦			
BAM	🟧🟦	🟧🟦	🟧🟦	🟧🟦	🟧🟦	🟧	🟧🟦	🟧🟦	🟧🟦	🟧🟦	🟧🟦	🟧🟦	🟧	🟧
2,4-D (H)					🟦	🟦	🟧🟦			🟦		🟧		
2-6-dichlorphenol														
Isoproturon (H)			🟧🟦			🟧	🟧				🟧	🟧		
Simazine (H)	🟧	🟦	🟧🟦	🟧	🟧	🟧🟦	🟧	🟧🟦	🟧			🟧🟦		
Chlorpyrifos (I)			🟩			🟩	🟩					🟩		
Diuron (H)		🟦					🟧🟦🟩▨				🟧🟦	🟧		
Dimethoate (I)							🟧							
Terbutylazine (H)		🟧	🟧		🟧	🟧	🟧🟦		🟧		🟧🟦	🟧🟦	🟧	🟧
Fenpropimorf (F)			🟩			🟩								
MCPA (H)	🟧🟦	🟧🟦	🟧		🟧	🟧	🟧🟦	🟧🟦	🟧		🟧🟦	🟧🟦	🟧	🟧
4-chloro-2-methylphenol		🟧					🟧							
Bentazone (H)												🟧🟦	🟧	
Metamitron (H)		🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧		
Pendimethalin (H)							🟧							
Propiconazole (F)			🟧				🟧							
Tolclofos-methyl (F)						🟩								
lambda-Cyhalothrin (I)												🟩		
Tebuconazole (F)							🟧							
alpha-cypermethrin (I)			🟩											
Diflufenican (H)			🟩				🟩▨					🟩		
Epoxiconazole (F)					🟧									
Boscalid (F)		🟧	🟧		🟧		🟧							

Each cell can be populated with up to four colours, representing the different paths: orange squares indicate storm flow samples; blue indicates base-flow; green indicates suspended sediment (SPS); black-striped squares indicate bed sediment (BS).
SPS samples were collected at four sites: 3-Kr, 6-Se, 7-V1, 12-Sk;
BS samples were only collected at 7-V1.
Stream sites 13 and 14 are least disturbed controls (labelled as catchments CS1 and CS2).
Note that pesticides listed below the dotted black line indicate pesticides that are still permitted for use in Denmark

Figure 7.5- 39 separates the storm-flow and baseflow water samples for pesticides (Figure 7.5- 39A) and detected metabolites and impurities (Figure 7.5- 39B). It is proposed that groundwater, in addition to precipitation and surface runoff, is possible source of pesticides (particularly legacy herbicides) entering surface water. Almost all pesticides (17 from 22 detected) not authorized for use in Denmark,

and some metabolites including 2,6-dichlorobenzamide (BAM), were detected during base-flow conditions when groundwater discharge is expected to be the most dominant source of inflow to the streams. Maximum storm-flow and base-flow concentrations were detected at the same stream for compounds such as BAM (Site 5-In) indicating the importance of groundwater inflow to the stream for these compounds in addition to the inflow via surface run-off and tile-drains during storm-flow events. For BAM, the highest detected concentration was in the groundwater, with comparable concentrations in the base-flow (Table 7.5- 50).

Figure 7.5- 39: Overview of dissolved-phase (A) pesticides and (B) metabolites and/or impurities, identified either during the base-flow event (blue-striped bars) or during a storm-flow event (gray-scale bars)



Note the dotted black line that marks the transition from not authorized to permitted status according to Danish legislation.

Further details of the groundwater survey of the Hove catchment are provided in Table 7.5- 51. In total 63 wells were sampled, and 457 samples were analysed. 2,6-dichlorobenzamide (BAM) was detected in 59 wells (out of 60 wells in which pesticides were detected) of which 20 wells exceeded the detection limit of 0.02 µg/L and 13 wells exceeded a concentration of 0.1 µg/L. The maximum concentration of BAM detected in the survey was 2.1 µg/L.

Table 7.5- 51: Maximum concentration for 2,6-dichlorobenzamide (BAM) detected in 63 groundwater extraction wells within the Hove catchment

Compound	Detection limit (µg/L)	No. wells with detections (from 60)	Max conc. > DL& < DK MCL (µg/L)	No. wells > DL & < DK MCL (from 39)	Max. conc. > DK MCL (µg/L)	No. wells > DK MCL (from 14)	No. samples analysed
2,6-dichlorobenzamide (BAM)	0.01	59	0.094	20	2.1	13	457

DL = Detection limit
DK MCL = Danish maximum concentration limit (Danish drinking water limit of 0.1 µg/L)

III. Conclusion

In a survey conducted in Danish headwater streams in four catchments located in Sjaelland, Denmark between 2010 and 2012, 2,6-dichlorobenzamide (BAM) was one of the most prevalent compounds detected. The maximum concentrations of 2,6-dichlorobenzamide (BAM) detected in the storm-flow water samples, base-flow water samples and groundwater were 0.19 ug/L, 1.7 ug/L and 2.1 ug/L in groundwater. The median concentration of BAM was 0.14 ug/L in storm-flow events and 0.036 ug/L in groundwater.

Assessment and conclusion by applicant:

This publication provides information on the exposure values for the metabolite M-01 (BAM) in Danish surface water in 2010 to 2012 and shows no concerns.

Data Point:	KCA 7.5/12
Report Author:	Bohn, T.; Cocco, E.; Gourdol, L.; Guignard, C.; Hoffmann, L.
Report Year:	2011
Report Title:	Determination of atrazine and degradation products in Luxembourgish drinking water: origin and fate of potential endocrine-disrupting pesticides
Report No:	M-597682-01-1
Document No:	M-597682-01-1
Guideline(s) followed in study:	not applicable
Deviations from current test guideline:	none
Previous evaluation:	No, not previously submitted
GLP/Officially recognised testing facilities:	No, not conducted under GLP/Officially recognised testing facilities
Acceptability/Reliability:	Yes

Executive Summary:

The aim of this investigation was to study concentrations of s-triazine herbicides and their major degradation products in drinking water, including spring water, tap water and bottled water in Luxembourg. In addition, the monitoring included analysis for 2,6-dichlorobenzamide (BAM). Spring water (2007/2008/2009, n = 69/69/69), tap water (2008/2009, n = 19/26), and bottled water (2007/2008/2009, n = 5/13/7) were sampled at locations in Luxembourg and investigated for pesticides by LC-ESI-MS/MS.

2,6-dichlorobenzamide (BAM) was detected in 58 out of 69 samples of spring water (79.9% analyses) collected from summer 2007 to spring 2009. In 51 out of approximately 700 samples, concentrations slightly exceeded 0.1 ug/L. The maximum concentration of BAM in spring waters was 0.346 µg/L and the mean concentration was 0.03 µg/L. BAM was detected in tap water at concentration ranging from 0 to 0.096 µg/L collected from spring 2008 and spring 2009. BAM was detected in 4 out of 25 samples of bottled water at average concentration of 0.002 µg/L (range 0 to 0.014 µg/L).

I. Materials and Methods

The aim of this study was to investigate pesticide contamination of individual spring water locations in Luxembourg and to determine concentrations in finished drinking water (tap water) and bottled water in Luxembourg. A total of 19 pesticides and their degradation products were analysed for with the main targets s-triazine herbicides and their major degradation products. The work included analysis of 2,6-dichlorobenzamide (BAM).

Spring water was monitored between summer 2007 and spring 2009. 69 springs from the major sandstone aquifer in Luxembourg located in the Luxembourg City area were monitored in ten collection campaigns (July/August 2007, November 2007; January 2008, March 2008, May 2008, June/July 2008, September 2008, October/November 2008, January 2009, March 2009).

Tap water (34 samples) from 28 different locations were analysed in spring 2008 and spring 2009. Tap water was collected from private households mainly in southern Luxembourg. 15 villages or cities, each with one to five sampling locations were tested.

Various bottled waters (25 samples in total, 15 from Luxembourg) were obtained in summer 2007, 2008 and 2009. A total of 10 brands were investigated including both sparkling (n=4) and still water (n=21).

The locations of the springs are shown in Figure 7.5- 40 and tap water sampling sites in Figure 7.5- 41.

Figure 7.5- 40: **Locations of spring water (n=69, circles) included for pesticide analyses from Luxembourg City between summer 2007 and spring 2009. All spring water locations used for drinking water supply in Luxembourg City were included.**

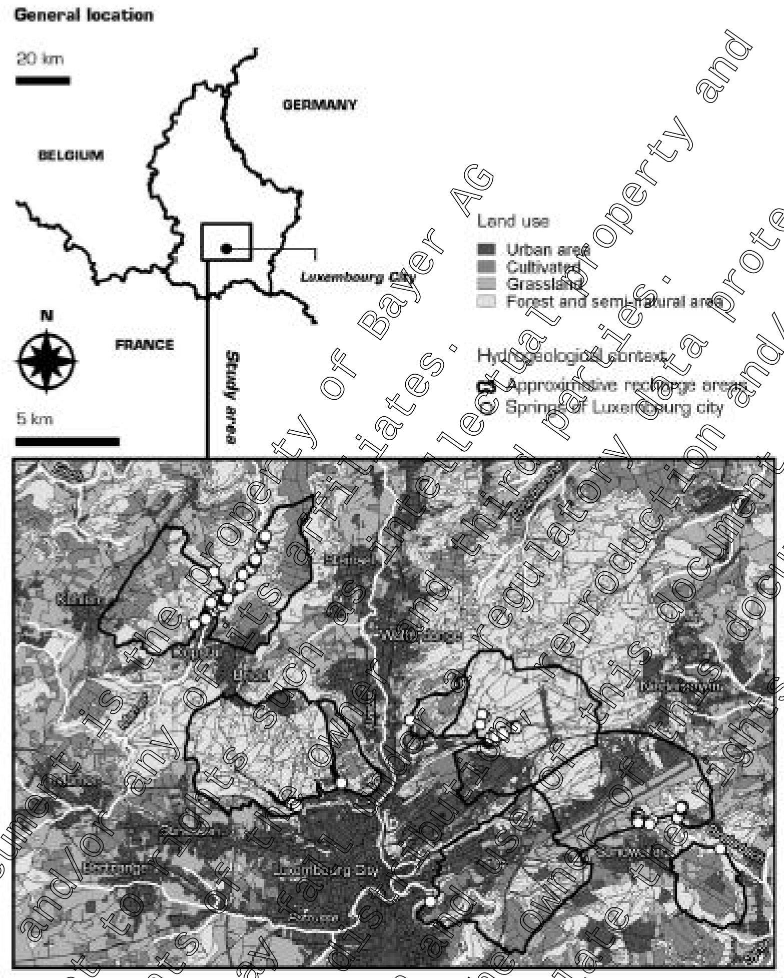
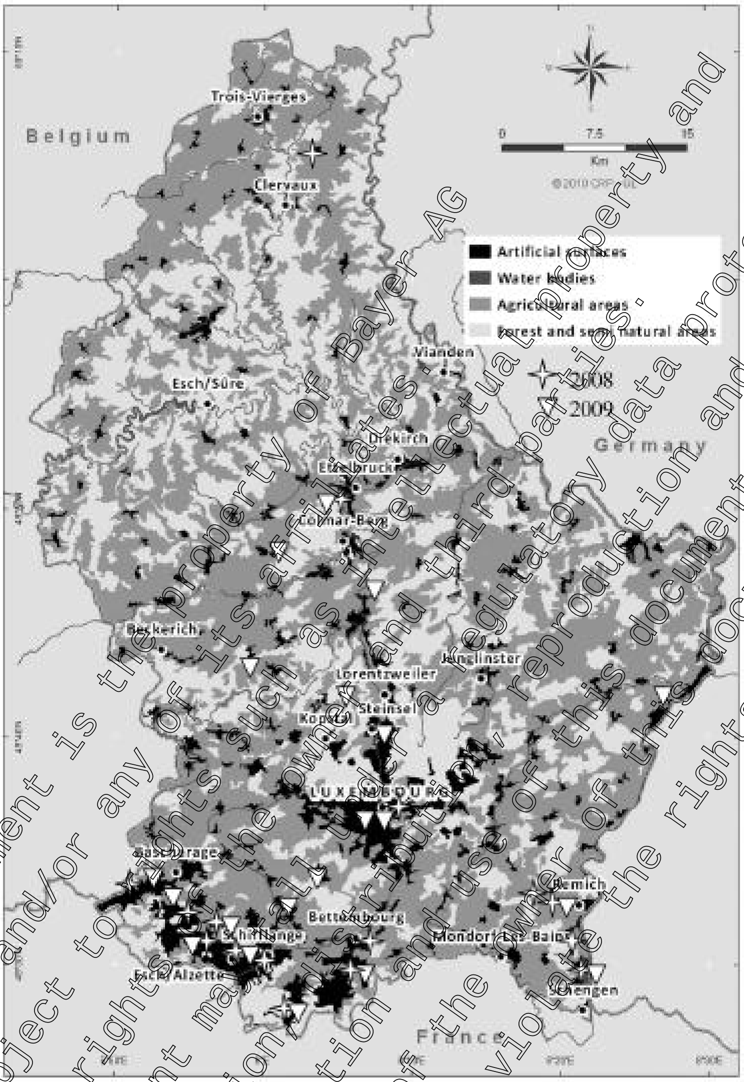


Figure 7.5- 41: Locations of tap water sampling (n=28) for the determination of pesticides in 2008 (stars) and 2009 (triangles) in Luxembourg.



Water samples were analysed by HPLC-MS/MS using electrospray ionization in positive mode after solid phase extraction for 19 pesticides and their degradation products. Details of the analytical conditions for 2,6-dichlorobenzamide (BAM) are listed below.

Table 7.5- 52: Summary of analytical conditions for 2,6-dichlorobenzamide (BAM) quantified by LC/MS/MS in positive mode

	Retention time (minutes)	Parent ion (m/z)	Declustering potential (V)	Transition 1 Collision energy (V)	Transition 2 Collision energy (V)
2,6-dichlorobenzamide (BAM)	3.30	190.0	44	109.0 (50)	172.9 (23)

II. Results and Discussion

The concentrations of 2,6-dichlorobenzamide (BAM) in Luxembourg spring water are given in Table 7.5- 53. It was the most common compound detected in spring water, detectable in the majority of springs (79.9% of analyses). The maximum concentration of BAM was 0.346 µg/L and the mean concentration was 0.03 µg/L. BAM was found in 51 spring water samples (out of approximately 700) at concentrations above 0.1 µg/L. However, it is stated such concentrations were only found in few individual springs, which were usually not consumed unpooled. Once water from various sources is pooled concentrations of BAM were predicted to be more likely below 0.1 µg/L.

Table 7.5- 53: Summary of analytical results for 2,6-dichlorobenzamide (BAM) quantified in Luxembourg spring water (n=69) between summer 2007 and spring 2009.

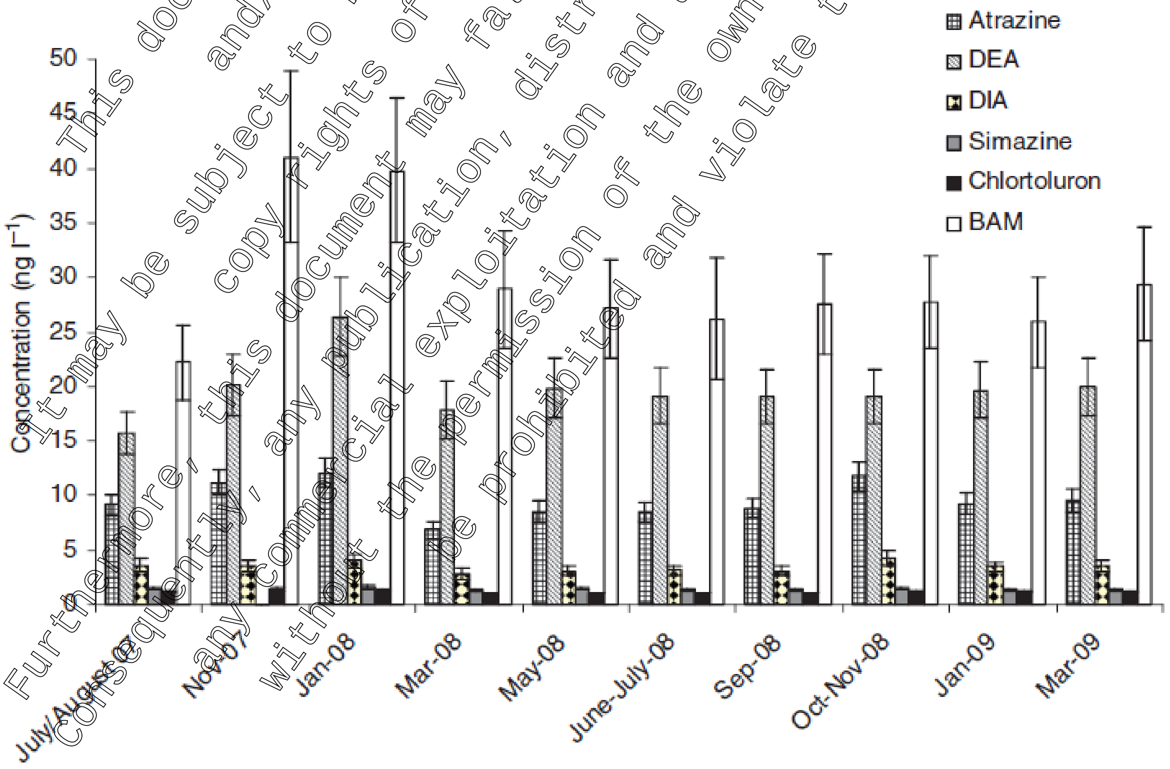
	Locations* with detectable concentration (n)	Analyses with detectable concentrations (%)	Minimum concentration (ng/L)	Maximum concentration (ng/L)	Mean concentration (ng/L)
2,6-dichlorobenzamide (BAM)	58	79.9	0	346	30

* Number of locations with at least one finding above the limit of detection (1 ng/L)

The range of land usage varied from 1.7 to 38.8 cropland (average=16.1%), and from 3.2% to 26.6% (mean=15.4%) for urban usage. A high correlation between BAM and urban land use was found (R=0.81, *p*<0.05) which suggests that exposure may not have been from agricultural use. Dichlobenil, one of the parent compounds of BAM, is reported to have been used mainly for lawns and gardens in Luxembourg.

The results of the 10 different collection campaigns over the two year period are shown in Figure 7.5-42.

Figure 7.5- 42: Concentrations of major herbicides and degradation products detected in spring water from Luxembourg City (n=69) between summer 2007 and spring 2009.



Values are the mean ±SE. BAM, 2,6 dichlorobenzamide; DEA, desethylatrazine; DIA, deisopropylatrazine

Tap water was collected at a number of locations (n=15 villages or cities, each with one to five sampling locations) in Luxembourg. 2,6-Dichlorobenzamide (BAM) was one of the few compounds detected in tap water at concentrations ranging from 0 to 0.096 µg/L, with a mean concentration of 0.013 µg/L. At five of the 15 locations no BAM was detected.

Seven Luxembourgish bottled water varieties from two major areas were investigated. In addition, three French brands commonly sold in Luxembourg were investigated (Table 7.5- 54). BAM was detected in four out of 25 samples (all originating from Luxembourg), with average concentrations of 0.002 µg/L (range 0 to 0.014 µg/L).

Table 7.5- 54: Levels of 2,6-dichlorobenzamide (BAM) in bottled water sold in Luxembourg during spring 2008 and spring 2009

Number	Origin	n	Type	2,6-dichlorobenzamide (BAM, ng/L)
1	Luxembourg, north (Canton Echternach)	1	Sparkling	Not detected
2	Luxembourg, north (Canton Echternach)	3	Weakly sparkling	Not detected
3	Luxembourg, north (Canton Echternach)	3	Non-sparkling	11.9 ± 2.4
4	Luxembourg, west (Canton Redingen	4	Non-sparkling	3.3 ± 3.7
5	Luxembourg, west (Canton Redingen	1	Non-sparkling	Not detected
6	Luxembourg, west (Canton Redingen	1	Non-sparkling	Not detected
7	Luxembourg, west (Canton Redingen	2	Non-sparkling	Not detected
8	France (Haute-Savoie)	3	Non-sparkling	Not detected
9	France (Alsace-Lorraine)	2	Non-sparkling	Not detected
10	France (Auvergne)	5	Non-sparkling	0.1 ± 0.1

III. Conclusion

A survey of spring waters, finished drinking water (tap water) and bottled water in Luxembourg was conducted between summer 2007 and spring 2009. Data was collected from a total of 69 spring waters in ten collection campaigns (approximately 700 samples), 34 tap water samples and 25 samples of bottled water.

2,6-Dichlorobenzamide (BAM) was found in 51 spring water samples at concentrations above 0.1 µg/L. The maximum concentration of BAM was 0.346 µg/L and the mean concentration was 0.03 µg/L. It was one of the few compounds detected in tap water at concentrations ranging from 0 to 0.096 µg/L, with a mean concentration of 0.013 µg/L. BAM was detected in four samples of bottle water with average concentrations of 0.002 µg/L (range 0 to 0.014 µg/L).

<u>Assessment and conclusion by applicant:</u>

This publication provides information on the exposure values for the metabolite M-01 (BAM) in Luxembourg spring waters, finished drinking water (tap water) and bottled water in 2007 to 2009 and shows no concerns.

Data Point:	KCA 7.5/13
Report Author:	Ahrens, L.; Daneshvar, A.; Lau, A. E.; Kreuger, J.
Report Year:	2018
Report Title:	Concentrations, fluxes and field calibration of passive water samplers for pesticides and hazard-based risk assessment
Report No:	M-642713-01-1
Document No:	M-642713-01-1
Guideline(s) followed in study:	--
Deviations from current test guideline:	none
Previous evaluation:	No, not previously submitted
GLP/Officially recognised testing facilities:	not applicable
Acceptability/Reliability:	Yes

Executive Summary:

The performance of three passive sampler types; Chemcatcher® C18, polar organic chemical integrative sampler-hydrophilic–lipophilic balance (POCIS-HLB) and silicone rubber (SR) based on polydimethylsiloxane (PDMS) was evaluated at two sampling locations in southern Sweden over a period of 6 weeks and compared to time-proportional composite active sampling. Analysis for 124 pesticides including 2,6-dichlorobenzamide (BAM) was performed.

In total 90 pesticides were detected in surface water, 52 using active sampling and 32, 58, and 69 using the passive samplers Chemcatcher® C18, POCIS-HLB and SR, respectively. No concentrations of 2,6-dichlorobenzamide (BAM) were detected by passive sampler Chemcatcher® C18 at either site over the six week period (LOD 14 ng/L). The compound was detected at both sites at mean concentrations of 14 and 35 ng/L using active sampling, 6.9 and 2.9 ng/L using passive POCIS-HLB samplers and 40 and 8.6 ng/L using passive SR samplers. The corresponding maximum concentration were 21 and 78 ng/L using active sampling, 11 and 4.4 ng/L using passive POCIS-HLB samplers and 74 and 13 ng/L using passive SR samplers.

In the 6 week monitoring programme 2,6-dichlorobenzamide was one of the most frequently detected compounds in the two surface water streams in 2013 with detection frequencies of 100% by active sampling and two out of three passive sampling methods.

I. Materials and Methods

Fresh water samples were collected between 8 July to 19 August 2013 from two monitoring stations included in the Swedish national pesticide monitoring programme using three different passive samplers; Chemcatcher® C18; polar organic chemical integrative sampler-hydrophilic–lipophilic balance (POCIS-HLB) and silicone rubber (SR) based on polydimethylsiloxane. Active sampling, that is, time-proportional composite active samples (subsamples taken every ~90 minutes) were collected every week during the exposure period of the passive samplers. At site 2 the passive samplers were deployed 1 km further downstream of the active sampling point because of low water concentrations at the active sampling site.

The aim of the work was to compare the performance of the three passive samplers compared to active sampling and to compare *in situ* sampling rates (R_S) and passive sampler-water partition coefficients (K_{PW}) with those obtained under laboratory conditions.

Some details of the sampling sites are given below.

Table 7.5- 55: Details of the sampling sites

Parameter	Site 1	Site 2
Catchment area	14 km^2	8 km^2
Agricultural activities	85%	92%
Average annual water flow	15540 m^3	5744 m^3
Median flow during the sampling period	2900 m^{3}d^{-1}	92 m^{3}d^{-1}

Six passive samplers of each type were deployed at each site for 7 days in total covering a period of six weeks (8 July to 19 August 2013). 2 x 4 additional samplers of each type were deployed in duplicate for 7, 14, 28 and 42 days at Site 1.

In total 124 pesticides were analysed for using a variety of methods. 2,6-dichlorobenzamide (BAM) was analysed by liquid chromatography– tandem mass spectrometry (LC–MS/MS). For this method the SR strips were extracted with methanol by Soxhlet extraction for 19h, the POCIS-HLB was extracted with methanol by solid-phase extraction (SPE) and the Chemcatcher® C18 was sonicated with ethyl acetate. Extracts were concentrated under nitrogen and redissolved in acetonitrile prior to analysis by LC-MS/MS using electrospray ionisation in positive-ion mode (ESI(+)).

The LODs for the various methods were 2 ng/L for the active sampling method (see Table 7.5- 56) and 14, 0.034 and 1.2 ng/L for the Chemcatcher® C18, POCIS-HLB and SR passive samplers (see Table 7.5- 57).

Table 7.5- 56: Details of the active sampling method

Substance	Method	LOD (ng/L)	LOQ (ng/L)	Recovery (%)
2,6-dichlorobenzamide (BAM)	LC-ESI(+)-MS/MS	2.0	10	94

Table 7.5- 57: Calculated limit of detection (LOD) for passive sampler methods

Substance	Chemcatcher® C18 (ng/L)	POCIS-HLB (ng/L)	SR (ng/L)
2,6-dichlorobenzamide (BAM)	14	0.034	1.2

II. Results and Discussion

52 out of 124 pesticides analysed for were detected using active sampling at site 1 and site 2 over a period of six weeks, while 32, 58, and 69 individual pesticides were detected using the passive samplers Chemcatcher® C18, POCIS-HLB and SR, respectively. No concentrations of 2,6-dichlorobenzamide (BAM) were detected by passive sampler Chemcatcher® C18 at either site over the six week period (LOD 14 ng/L). The compound was detected at both sites at mean concentrations of 14 and 35 ng/L using active sampling, 6.9 and 2.9 ng/L using passive POCIS-HLB samplers and 40 and 8.6 ng/L using passive SR samplers. The corresponding maximum concentration were 21 and 78 ng/L using active sampling, 11 and 4.4 ng/L using passive POCIS-HLB samplers and 74 and 13 ng/L using passive SR samplers.

Table 7.5- 58: Concentration of 2,6-dichlorobenzamide (BAM) in samples collected over 6 week sampling period (8 July to 19 August 2013)

	Concentration of 2,6-dichlorobenzamide (BAM) (ng/L)							
	Site 1				Site 2			
Method	Active sampling	Chemcatcher® C18	POCIS-HLB	SR	Active sampling	Chemcatcher® C18	POCIS-HLB	SR
DF	100%	-	100%	100%	100%	-	100%	100%
Mean	14	-	6.9	40	35	-	2.9	8.6
Median	11	-	5.6	38	22	-	2.8	8.6
Min	7.0	-	4.0	15	11	-	1.4	4.9
Max	21	-	11	74	78	-	4.4	13

DF = Detection frequency

Laboratory sampling rates (R_S) in L/day and sampler-water partitioning coefficients (K_{PW}) are summarised for 2,6-dichlorobenzamide (BAM) in Table 7.5- 59. *In situ* R_S and K_{PW} were estimated for BAM with two of the three passive sampling methods, POCIS-HLB and SR, although the values should be treated with caution as the systems were not at equilibrium (see Table 7.5- 60).

Table 7.5- 59: Laboratory sampling rates (R_S, L/day) and sampler-water partitioning coefficients (K_{PW}, L/ kg) applied for the calculation of TWA concentrations

Substance	**SR**		**POCIS-HLB**		**Chemcatcher® C18**	
	R_S (L/day)	**log K_{PW} (L/kg)**	**R_S (L/day)**	**log K_{PW} (L/kg)**	**R_S (L/day)**	**log K_{PW} (L/kg)**
2,6-dichlorobenzamide (BAM)	0.005	-0.3 *	0.17	3.8	0.005	0.7

* Pesticide concentration not equilibrated in the passive sampler, values should be handled as estimates

Table 7.5- 60: *In situ* sampling rates (R_S, L/day) and sampler-water partitioning coefficients (K_{PW}, L/ kg)

Substance	**SR**		**POCIS-HLB**		**Chemcatcher® C18**	
	R_S (L/day)	**log K_{PW} (L/kg)**	**R_S (L/day)**	**log K_{PW} (L/kg)**	**R_S (L/day)**	**log K_{PW} (L/kg)**
2,6-dichlorobenzamide (BAM)	0.011	1.1 *	0.046	3.6 *	NA	NA

* Pesticide concentration not equilibrated in the passive sampler, values should be handled as estimates
NA = not accumulated in passive sampler but detected in water phase

III. Conclusion

In the monitoring programme 2,6-dichlorobenzamide (BAM) was one of the most frequently detected compounds in the two surface water streams with detection frequencies of 100% by active sampling and two out of three passive sampling methods, POCIS-HLB and SR. No concentrations of 2,6-dichlorobenzamide (BAM) were reported for the passive sampler Chemcatcher® C18. Over a 6 week period in the summer of 2013 the concentrations of 2,6-dichlorobenzamide (BAM) reported ranged from 1.4 to 78 ng/L.

<u>Assessment and conclusion by applicant:</u> This publication provides information on the exposure values for the metabolite M-01 (BAM) in Swedish surface water in 2013 and shows no concerns.

B.3 Drinking Water

No public monitoring data or peer reviewed published data is available in drinking water for fluopicolide.

No public monitoring data is available in drinking water for M-01. Two peer reviewed publications reported analysis of drinking water for M-01. KCA 7.5/12 is summarised earlier as the publication describes analysis of surface water and drinking water. KCA 7.5/14 provides information on M-01 residues in Norwegian drinking water between 1999 and 2000 due to historic dichlobenil applications.

Data Point:	KCA 7.5/14
Report Author:	Kvaerner, J.; Eklo, O. M.; Solbakken, E.; Solberg, I.; Sorknes, S.
Report Year:	2014
Report Title:	An integrated approach for assessing influence of agricultural activities on pesticides in a shallow aquifer in south-eastern Norway
Report No:	M-532496-01-1
Document No:	M-532496-01-1
Guideline(s) followed in study:	--
Deviations from current test guideline:	none
Previous evaluation:	No, not previously submitted
GLP/Officially recognised testing facilities:	not applicable
Acceptability/Reliability:	Yes

Executive Summary:

This work examined the effect of agricultural activity on pesticide occurrence in groundwater in an area with fluvial sand deposits with a top layer of sandy silt and silt, intensive potato and cereal cultivation, and drinking water withdrawal for households from local wells in south-eastern Norway. Information about local agricultural practice and wash sites for pesticide spray equipment, soil and deeper deposit properties, hydrogeology. and groundwater flow, simulated pesticide leaching, and groundwater well pesticides and NO_3-content was used to examine extensions and causes of pesticide groundwater pollution. Pesticides occurred in a majority of sampled wells; 8 pesticides and metabolites were detected in groundwater samples. This summary focuses on the results for 2,6-dichlorobenzamide (BAM) a metabolite of dichlobenil which was detected in six samples at between 0.04 and 0.39 µg/L. As fluopicolide has never been registered in Norway, the residues of M-01 can be attributed to use of dichlobenil.

I. Materials and Methods It

The study area is located along the eastern side of the river Glomma in Gruein south-eastern Norway (see Figure 7.5- 43).

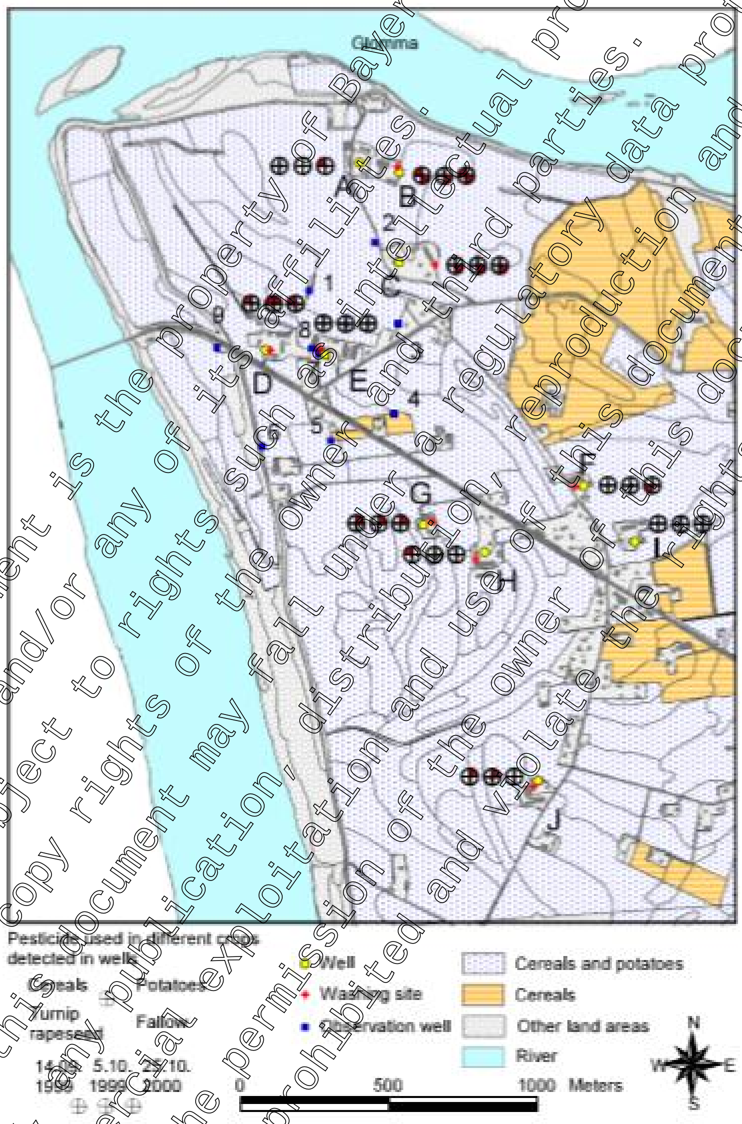
Figure 7.5- 43: Location of study area

The climate in the area is characterized by precipitation surplus, and monthly mean temperatures are below zero in November, December, January, February and March. Annual mean air temperature and precipitation in the normal period 1961–1990 at the nearest meteorological station Vinger were 3.3 °C and 664 mm, respectively. The study area is situated in a deep basin filled with sediments. In an early stage of the ice retreat after the last glaciation epoch the basin was a narrow fjord. Later the basin became a lake. The basin has been filled up with sediments brought in with river Glomma. The upper part of the basin is characterized by thick fluvial sediments, consisting of layers of sand with a 0.4 – 1.8 m thick top layer of floodplain deposits with sandy silt and silt filled with sediments.

Spatial distribution of crops, location and use of washing sites for pesticide spraying equipment, and location of drinking water wells were provided by the local agricultural administration in Grue Kommune. The soils were surveyed by the Norwegian Forest and Landscape Institute according to the Soil Survey Staff (1993) guidelines. Groundwater levels were measured in nine observation wells (Fig. 2). The water level of river Glomma at Grue was measured at selected moments of time and later estimated from data from Glommen and Laagen Brukseierforening's gauge station at Norsfoss.

Groundwater samples were collected from ten selected drinking water wells (see Figure 7.5- 44) within the study area at three occasions: June 14, 1999, October 06, 1999 and May 25, 2000. The water samples were analysed for contents of 59 different pesticides and pesticide metabolites with GC or GC-MS which included the dichlobenil metabolite BAM (2,6-dichlor**o**benzamid**e**). Except the pesticides isoproturon, diquat and glyphosate, which were analysed only in the samples collected in June 1999, all samples were analysed for all pesticides and metabolites.

Figure 7.5- 44: **Area use, locations of observation wells with groundwater level measurements (1–9), sampled drinking water wells (A–J), washing sites and overview of findings of pesticides used in different crops.**



Average groundwater levels were estimated by steady state simulations with the modelling software Feflow 6.1 using average values for the water level in Glomma and average annual recharge as hydrological model input. To provide a spatial overview of the thickness of the unsaturated zone, contours for the simulated average groundwater level were combined with Lidar based data for terrain altitudes in a map using the software Arcview GIS 3.2. Simulations of groundwater flow around a washing site for spraying equipment were performed with the model codes Visual Modflow and Mod Path (Waterloo Hydrogeologic Inc, 2001).

The aquifer parameters used in groundwater modelling were based on results from field investigations carried out by Norges Geotekniske Institutt (1968) and von der Lippe (1998). Model simulations of pesticide leaching were performed with the model MACRO_DB version 2.0, running version 4.3 of MACRO (Jarvis et al., 1997). Soil input data for the modelling were based on the performed soil survey of the area and the soil at a base at Norwegian Forest and Landscape Institute. In the modelling, the soil profiles were extended down to a depth of 4.2 m.

Mean concentrations of pesticides in leachates were calculated for a 10-year simulation period. Pesticide concentrations were calculated without any dilution from groundwater. By simulating pesticide leaching to a depth of 4.2 m, representing the bottom of the unsaturated zone and recharging groundwater, comparison of simulated pesticide concentrations with actual concentrations in groundwater from wells in the uppermost groundwater zone was feasible. Risk maps showing the spatial distribution of potential pesticide leaching were made by coupling results from MACRO_DB simulations.

II. Results and Discussion

Pesticides were found in groundwater samples in eight of the ten sampled drinking water wells, and concentrations of single pesticides above 0.1µg/L occurred in six of ten wells. Considering average values for the three sampling times, concentrations of individual pesticides above 0.1µg/L occurred in four of ten wells. Eight different pesticides or pesticide metabolites were found in the groundwater samples, six herbicides (metribuzin, bentazon, MCPA, 2,4D, propachlor, the dichlobenil metabolite BAM (2,6-dichlorobenzamide), the fungicide metalaxyl and the mancozeb metabolite ethylenethiourea (ETU)). 2,6-dichlorobenzamide (BAM) was detected in six samples at between 0.04 and 0.39 µg/L in two of the wells over the sampling period (see Table 7.5- 49).

Table 7.5- 61: Quantitative results for 2,6- dichlorobenzamide (BAM) metabolite of dichlobenil

Well	Sampling date	Concentration (µg/L)
B	June 14 1999	0.06
	October 6 1999	0.04
	May 25 2000	0.15
C	June 14 1999	0.15
	October 6 1999	0.09
	May 25 2000	0.39

III. Conclusion

Pesticides were found in groundwater samples in eight of the ten sampled drinking water wells, and concentrations of single pesticides above 0.1µg/L occurred in six of ten wells. 2,6-dichlorobenzamide (BAM) was detected in six samples at between 0.04 and 0.39 µg/L. As fluopicolide has never been registered in Norway, the residues of M-01 are attributed to use of dichlobenil.

Assessment and conclusion by applicant:

This publication provides information on the exposure values for the metabolite M-01 (BAM) in Norwegian drinking water in 1999 to 2000. Fluopicolide has never been registered in Norway and so these residues of M-01 are attributed to use of dichlobenil.

C) Sediment

No public monitoring data or peer reviewed published data is available in sediment for fluopicolide.

The public monitoring data assessment KCA 7.5/01 summarised earlier includes a small amount of sediment data on the metabolite M-01. No peer reviewed published data in sediment is available for M-01 residues.

D) Air

The public monitoring data assessment KCA 7.5/01 summarised earlier includes a very small amount of air data on fluopicolide and M-01. No peer reviewed published data is available for fluopicolide or M-01.

E) Drinking Water Treatment

No public monitoring data or peer reviewed published data is available on drinking water treatment for fluopicolide or M-01.

An assessment of the potential impact of drinking water treatment, considering both the exposure aspects and transformation chemistry, will prepared for fluopicolide. The final report was not available was not available in time to be included in this dossier. As agreed with the RMS, an updated dossier will be submitted by the notifier which will include the final report and its OECD summary.