IMA-Europe
Dust Monitoring Programme

BIENNIAL REPORT 2024

Nicola Blagrove[1], Antonio D'Errico[1],
Remko Houba[2], Hans Kromhout[1]

November 2024

[1]Institute for Risk Assessment Sciences (IRAS) Utrecht University, Utrecht, NL

[2]Netherlands Expertise Centre for Occupational Respiratory Disorders (NECORD) Utrecht, NL

Universiteit Utrecht
Institute for Risk Assessment Sciences

NKAL
Netherlands Expertise Centre for Occupational Respiratory Disorders

Respirable Crystalline Silica carcinogenicity

- IARC Monograph vol. 68 (1997)
  - There is sufficient evidence in humans for the carcinogenicity of inhaled crystalline silica in the form of quartz or cristobalite from occupational sources
  - There is sufficient evidence in experimental animals for the carcinogenicity of quartz and cristobalite.

- IARC Monograph vol. 100C (2009)
  - Established mechanistic event: Impaired particle clearance leading to macrophage activation and persistent inflammation
  - An increased risk of lung cancer was observed across various industries and processes
  - The Working Group reaffirmed crystalline silica dust as a Group 1 Carcinogen

Developments in exposure limits Respirable Crystalline Silica

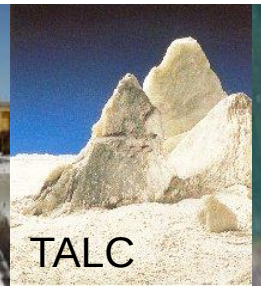
- Europe
  - SCOEL 2003 Occupational Exposure Limit Value OELV **0.100** mg/m^3
  - Health Council of The Netherlands and Nordic Expert Group 2024 Health-Based Calculated Occupational Cancer Risk Value (HBC-OCRV) **0.0363** mg/m^3
- USA
  - ACGIH 2010 Threshold Limit Value (TLV) **0.025** mg/m^3
  - OSHA 2019 Permissible Exposure Level (PEL) **0.050** mg/m^3 with an action level for respirable **0.025** mg/m^3
- Australia
  - WorkSafe 2020 workplace exposure standard (WES) **0.050** mg/m^3
  - WorkSafe 1st July 2024 **ban** on manufacture, supply, processing and installation of engineered stone benchtops, panels and slabs

Developments in exposure limits Respirable Dust

- Germany current limit for respirable dust 1.25 mg/m^3 (BAuA, 2024)
- France, ANSES suggested in 2019 OELV of 0.9 mg/m^3 (ANSES, 20192)
- Ongoing discussion on Poorly Soluble Low Toxicity particles (PSLTs) also called Granular Biopersistent Particles (GBS)
- These exposure were earlier on loosely defined as of low toxicity and having no identified inherent toxicity due to their chemical nature and named “nuisance dusts” or “particles not otherwise classified”

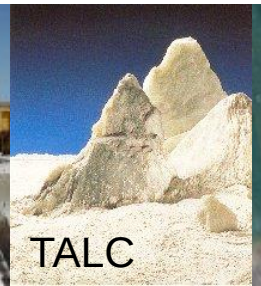
IMA Europe
Industrial Minerals Association

- Took up its responsibility now more than two decades ago
- Set up a Dust Monitoring Programme in 1999/2000
- Transferred the IMA-DMP database to The Netherlands in 2006, where it is coordinated in a collaborative project of NECORD and IRAS



IMA Dust Monitoring Programme
Goals and minerals covered

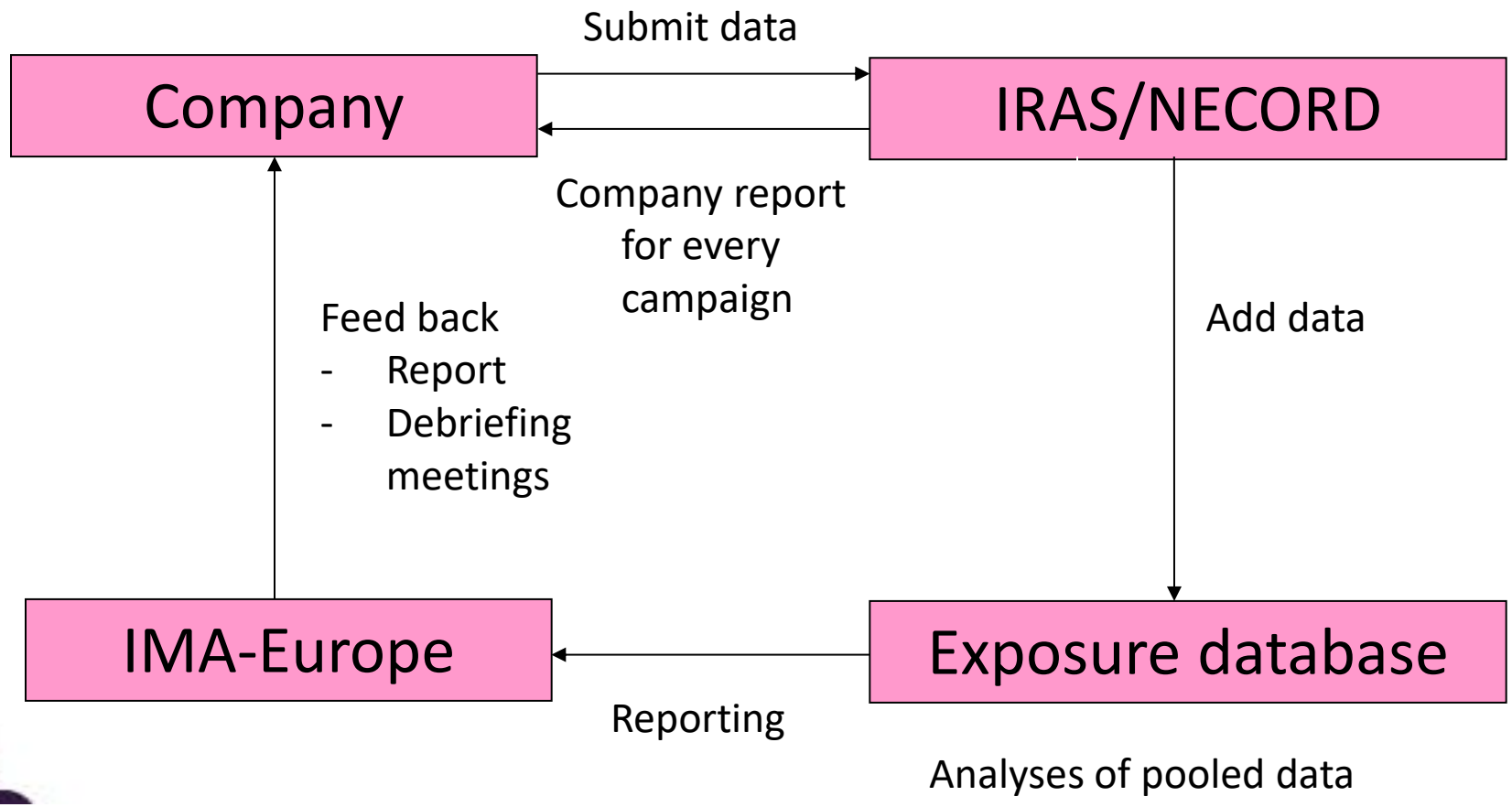
- To have (statistically) reliable exposure data
- To be able to discuss with authorities on new/future exposure limits
- To develop prevention strategies to reduce exposure (develop prevention culture)
- To improve compliance with current exposure limits
  - On industry level
  - On company level
- To be used as a resource for exposure assessment for future epidemiological studies
- To check effectiveness of implemented control measures



Measurement strategy
IMA-DMP Protocol

- Collect 6 dust samples per job function per site and per campaign (include repeats!)
- Personal measurements
- At least respirable dust
- Sampling equipment conform EN481
- Analytical technique either X-ray diffraction or Fourier transform infrared spectroscopy
- Full documentation required alongside the data
- Labs involved should join an interlab round robin

Lines of communication



Reports 2003, 2005, 2006, **2007, 2008, 2009, 2011, 2013, 2015, 2017, 2019, 2022, 2024**

Presentations at conferences IOHA, ISEE, EPICOH, IP, DOHS, X-conferences, AIRMON

Scientific papers:

- Zilaout, Vlaanderen, Houba, Kromhout. Database paper. Int J Hyg Environ Health 2017
- Zilaout, Houba, Kromhout. Trends paper. Occupational and Environmental Medicine 2020
- D'Errico, Houba, Kromhout. New EN689 a better standard to test compliance? Annals of Work Exposures and Health 2022
- Zilaout, Houba, Kromhout. Trends in variability. Annals of Work Exposures and Health 2023
- ***Blagrove-Hall, Houba, Kromhout. Meteorological conditions and exposure. In preparation 2024***

Status of IMA-Dust Monitoring Programme

Campaign	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47		
Report	report 2013			report 2015				report 2017				report 2019				report 2022					report 2024							
company	summer 11	winter 11-12	summer 12	winter 12-13	summer 13	winter 13-14	summer 14	winter 14-15	summer 15	winter 15-16	summer 16	winter 16-17	summer 17	winter 17-18	summer 18	winter 18-19	summer 19	winter 19-20	summer 20	winter 20-21	summer 21	winter 21-22	summer 22	winter 22-23	summer 23	winter 23-24	Total	company
1		108			102			61			62			60			60						60				1399	1
2		31	68	45	64	40	73	18																			580	2
3 Fin			18				24				21			25				20									328	3 Fin
3 NL											10	5															189	3 NL
4																											897	4
5	46			41			35			46			37			32	1		30			23			25	8	646	5
6			236	91	169	435	12		426	6	39	375	55	7	280	144	35	243	144	118	123	3	253	123	232		5552	6
7	28	8	46		30	11	44	19	39	22	25	17															651	7
8	260	173	156	202	218	167	144	168	172	144	155	177	168	162	196	128	203	82	126	84	193	85	89	63	114		8035	8
9																											103	9
10																											18	10
11	111			118	61	47	48		6			7	72		6	76		13	80		96		18		92		1612	11
12	23	28	21	6	10	26	10	6																			1482	12
13	22	150			181			144				25	20	103	43		110	23	24		117	4	87		108		2387	13
14	381	346	358	350	350	218	325		238	275	288	219	180	189	247	198	241	6	208	19	184	19	167	6	149	21	7902	14
15																											5	15
17	67		26	33	36			24	37			37		24	33		31	61			61	49		21	36		931	17
19	98	23	79	5	93	15	99	36	273	213	265	201	306		325		327		317	3	391		255	23	218		4176	19
20	18	16	18	18	17	24	18		18	26	31	24	39		45	48	48		48		6	42	23	25	36	6	820	20
21		120	168		60	95	185		51	139	182	24		198	169			156	47	130	69		179		151		2852	21
22	223	151	200	84	182	52	92	53	165	55	168	92	144	54	163	36	228	85	165	36	152	68	232	99	167		3791	22
23	4	20	17		31	2		38	1					42			48	9			47	1	40	18			466	23
24	30																										72	24
25	11	6	46	14	12		47		18	6	18		24		18		24		18	18	12						459	25
26																				11	69						174	26
33		10	10	4	19								18			18				18							115	33
34	5	12	9	5	15			15	1							18											101	34
36																											67	36
37	87	36			108							42	42		56	58	72	30	54		82						718	37
38	78	215	46	18		51	12			6																	624	38
39		21	70	44	54	35																					224	39
40	4		10	15	15	15	23	13	31	15	43		67		68		67		73		60		49		48		626	40
41		42			108			30				54	120	76	102		116		98		145						891	41
42					54	54	51				78				81	8	44	5	21		30		30				456	42
43						57																					57	43
44													36	36			48		9	12	24		24		24		213	44
45					35	1	36			36	36				72			36			47		36				335	45
Total	1496	1516	1602	1093	2024	1345	1278	625	1476	989	1421	1299	1328	976	1904	764	1703	769	1462	449	1908	294	1542	378	1400	35	49954	
																					Number of data in 2022 report:		44370					
																					Number of new data arrived since:		5584					

Institute for Risk Assessment Sciences

Status of IMA-Dust Monitoring Programme

42	43	44	45	46	47		
report 2024							
summer 21	winter 21-22	summer 22	winter 22-23	summer 23	winter 23-24	Total	company
		60				1399	1
						580	2
						328	3 Fin
						189	3 NL
						897	4
	23			25	8	646	5
123	3	253	123	232		5552	6
						651	7
193	85	89	63	114		8035	8
						103	9
						18	10
96		18		92		1612	11
						1482	12
117	4	87		108		2387	13
184	19	167	6	149	21	7902	14
						5	15
61	49		21	36		931	17
391		255	23	218		4176	19
6	42	23	25	36	6	820	20
69		179		151		2852	21
152	68	232	99	167		3791	22
47	1	40	18			466	23
						72	24
12						459	25
69						174	26
						115	33
						101	34
						67	36
82						718	37
						624	38
						224	39
60		49		48		626	40
145						891	41
30		30				456	42
						57	43
24		24		24		213	44
47		36				335	45
1908	294	1542	378	1400	35	49954	
					Number of data in 2022 report:	44370	
					Number of new data arrived since:	5584	

	Data does not meet some basic criteria (main aspects are availability of worker codes; sampling duration other than full-shift sampling)
	Data that have mixed content (partly good quality data, partly data that does not meet some basic criteria
	Good quality data

Main issues:

- lacking Worker-IDs
- sampling time <4 hrs or >10 hrs

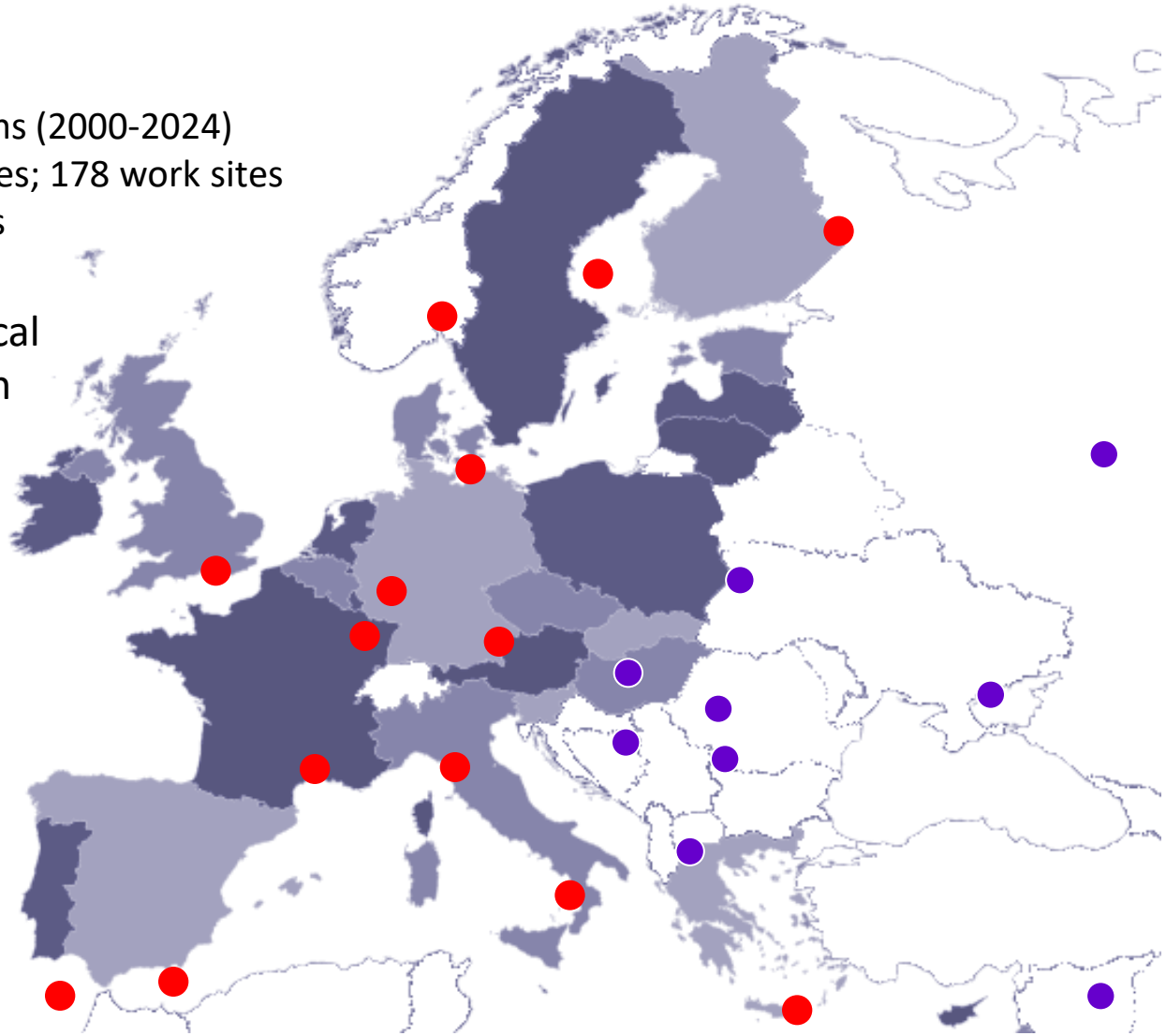
Measurement data in IMA-DMP database
per September 2024

- Total **49,954** measurements (increase of 5,584 measurements (11% up from 44,370)
- 49,785 respirable dust and 44,364 respirable quartz
- Collected prospectively in 47 campaigns over 23.5 years between winter 2000/2001 until winter 2023/2024
- The measurements have been collected at 36 companies in 23 countries among workers employed at 178 sites
- Representative for a total workforce of >> 5,000

Available data per September 2024

47 campaigns (2000-2024)
36 companies; 178 work sites
23 countries

Geographical distribution



Institute for Risk Assessment Sciences

Available data per country

Country	Respirable dust (%)	Respirable quartz (%)
Belgium	2,188 (4.4)	2,056 (4.6)
Denmark	294 (0.6)	294 (0.7)
Finland	1,290 (2.6)	939 (2.1)
France	**8,463 (17)**	**7,106 (16)**
Germany	4,973 (10)	4,914 (11)
Greece	740 (1.5)	246 (0.6)
Italy	**4,751 (9.5)**	**4,215 (9.5)**
Netherlands	3,061 (6.2)	2,062 (4.7)
Norway	1,688 (3.4)	724 (1.6)
Portugal	820 (1.7)	812 (1.8)
Spain	**8,022 (16)**	**7,651 (17)**
Sweden	1,036 (2.1)	1,035 (2.3)
Switzerland	0	84 ((0.2)
United Kingdom	**8,675 (17)**	**8,543 (19)**
Total	**46,001 (92)**	**40,681 (92)**

More recent countries	Respirable dust (%)	Respirable quartz (%)
Austria	184	153
Bosnia	66	18
Czech Republic	419	419
Hungary	39	34
Poland	456	456
Russia	891	891
Slovakia	161	161
Turkey	850	835
Ukraine	718	716
Total	**3,784 (8)**	**3,683 (8)**

No new data in 5 countries
+ Greece only respirable dust

No new measurements for bentonite

Institute for Risk Assessment Sciences

Data types

Type II:	duration 4-10 hours (calculation of probability of exceedance)
Type IIB:	additional criteria ≥6 measurements per cell for compliance testing EN 689:2018
Type III:	N ≥ 5; K ≥ 2; at least one K with repeats (calculation of probability of overexposure)
Type 0:	Data not fulfilling Type IIA criteria

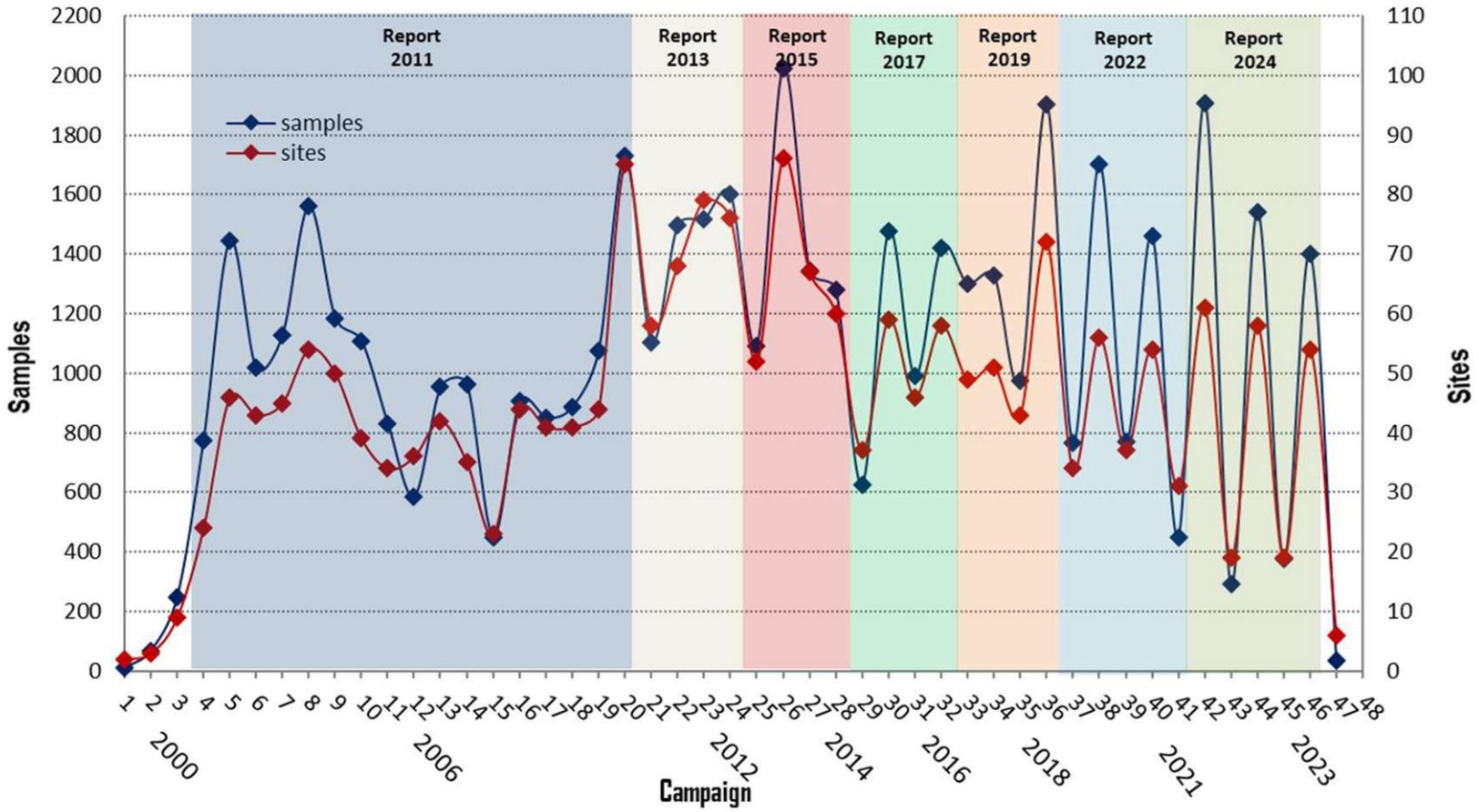
Number of observations
IMA DMP database 2000-2024

Analyte	All data	Type 0 data	Type II data	Type IIB data	Type III data
Respirable dust	**49,785**	5,350 (11%)	44,435 (89%)	35,988 (72%)	26,536 (53%)
Respirable quartz	**44,364**	4,251 (10%)	40,113 (90%)	32,519 (73%)	23,990 (54%)

New data since previous report

- 5,584 respirable dust measurements
- 5,474 respirable quartz measurements
- from 84 sites (down from 95 sites) from 21 companies
- collected in 18 countries
- 90-94% Type II, 80-82% Type IIB and 58-64% Type III

Temporal trends in number of measurements and sites



Institute for Risk Assessment Sciences

13 March 2024

Do meteorological conditions influence measurement strategy and measured concentrations of respirable dust and quartz?

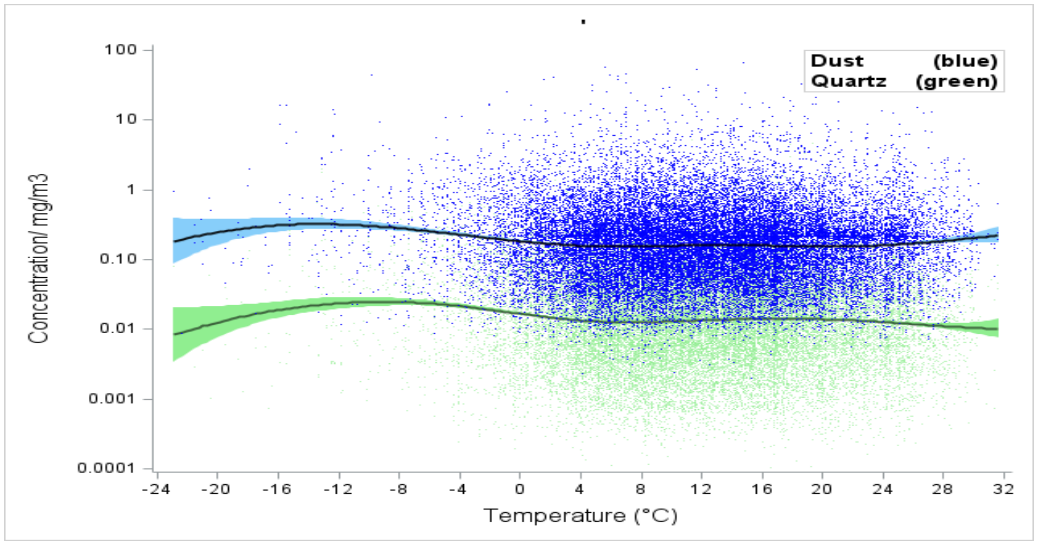
Nicola Blagrove-Hall[1], Remko Houba[2], Alonso Bussalleu[3]
Hans Kromhout[1]

[1]Institute for Risk Assessment Sciences (IRAS) Utrecht University, Utrecht, NL
[2]Netherlands Expertise Centre for Occupational Respiratory Disorders (NECORD) Utrecht, NL
[3]Swiss Tropical and Public Health Institute, Bazel, Switzerland

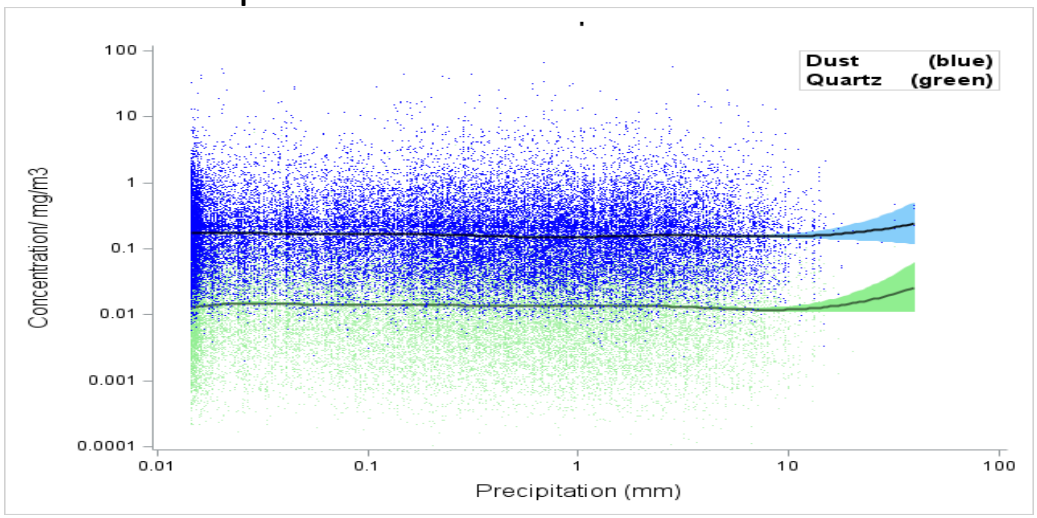
https://www.hsa.ie/eng/your_industry/quarrying/health_surveillance_occupational_disease/dust_including_silica_dust/

Institute for Risk Assessment Sciences

Temperature and Precipitation



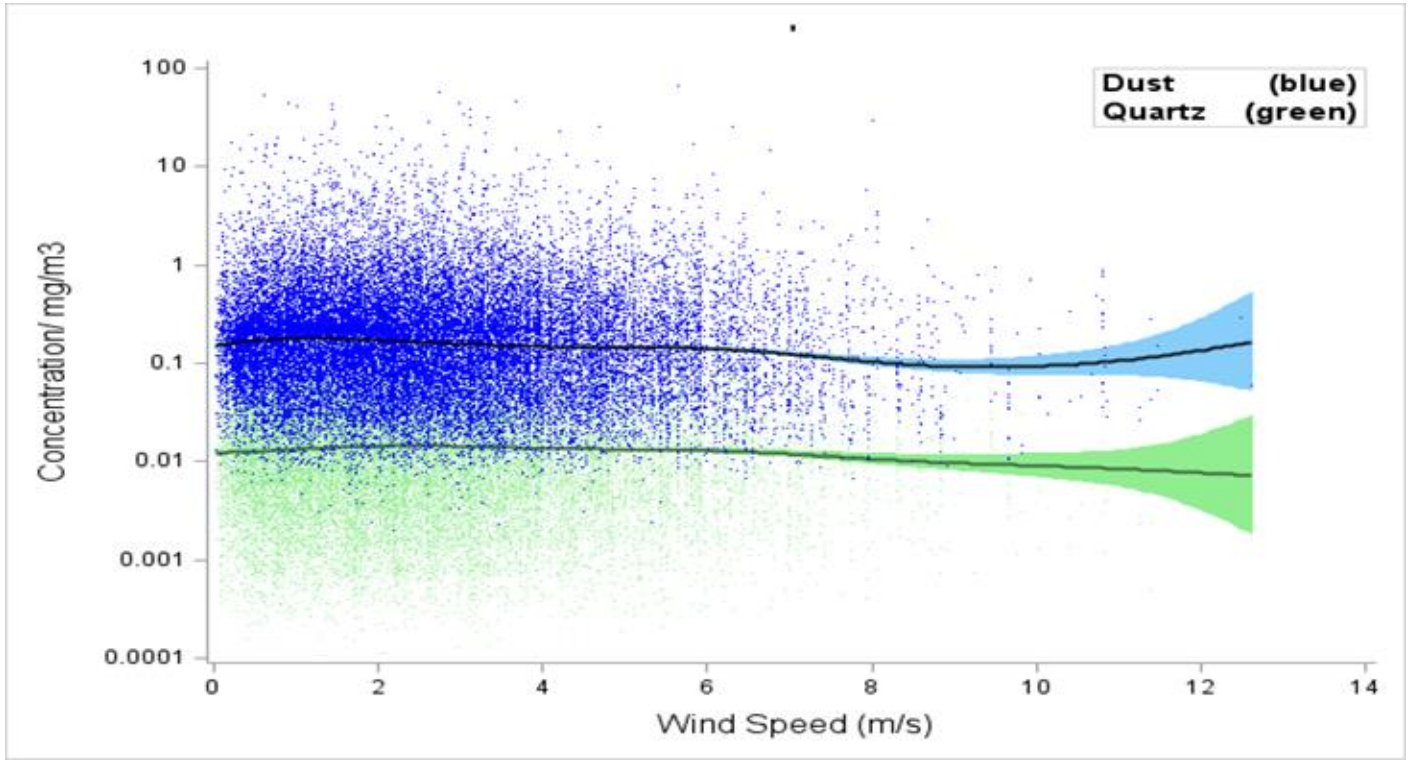
Temperature versus concentration



Precipitation versus concentration

Institute for Risk Assessment Sciences

Windspeed

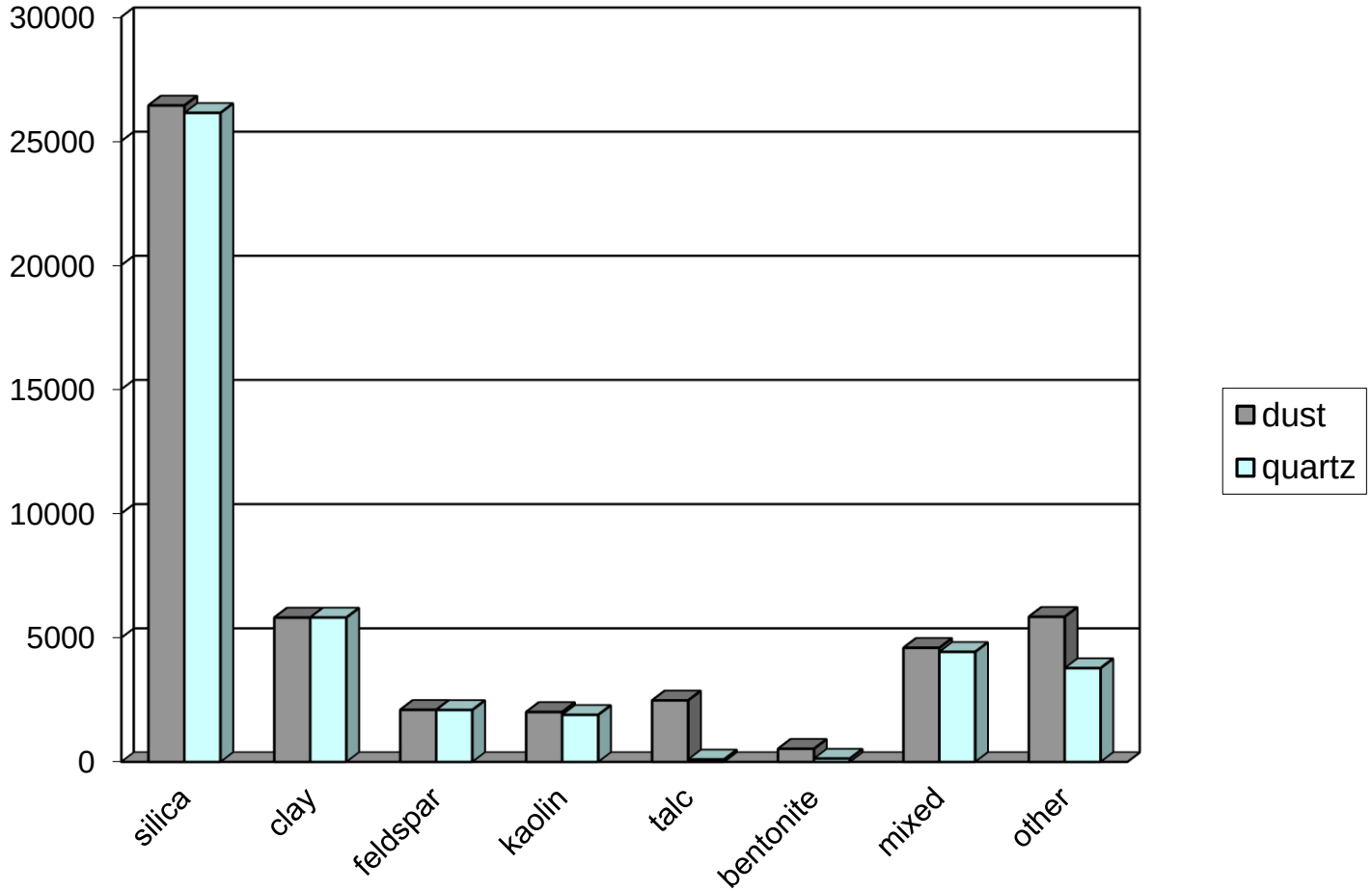


Windspeed versus concentration

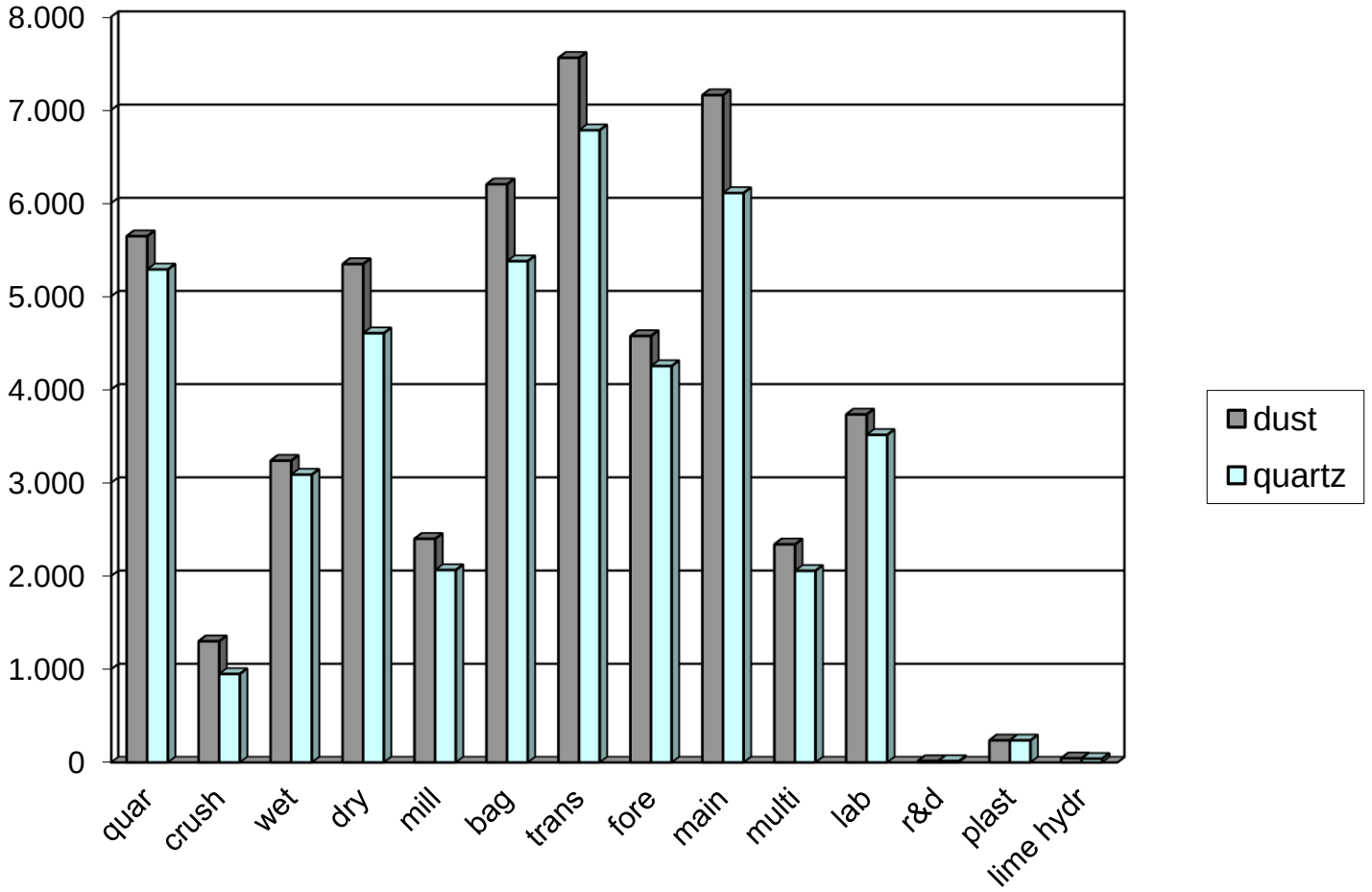
Conclusions

- Meteorological conditions on measurement days were largely similar as on non-measurement days
- Relatively small differences (less than 10%) in dust and quartz concentrations over various temperature, precipitation and wind speed ranges
- Only outdoor meteorological conditions could be linked while most measurements were likely done indoors within IM-DMP
- Based on this study recording outdoor and indoor meteorological data during dust measurements seems warranted

Number of measurements categorized by mineral



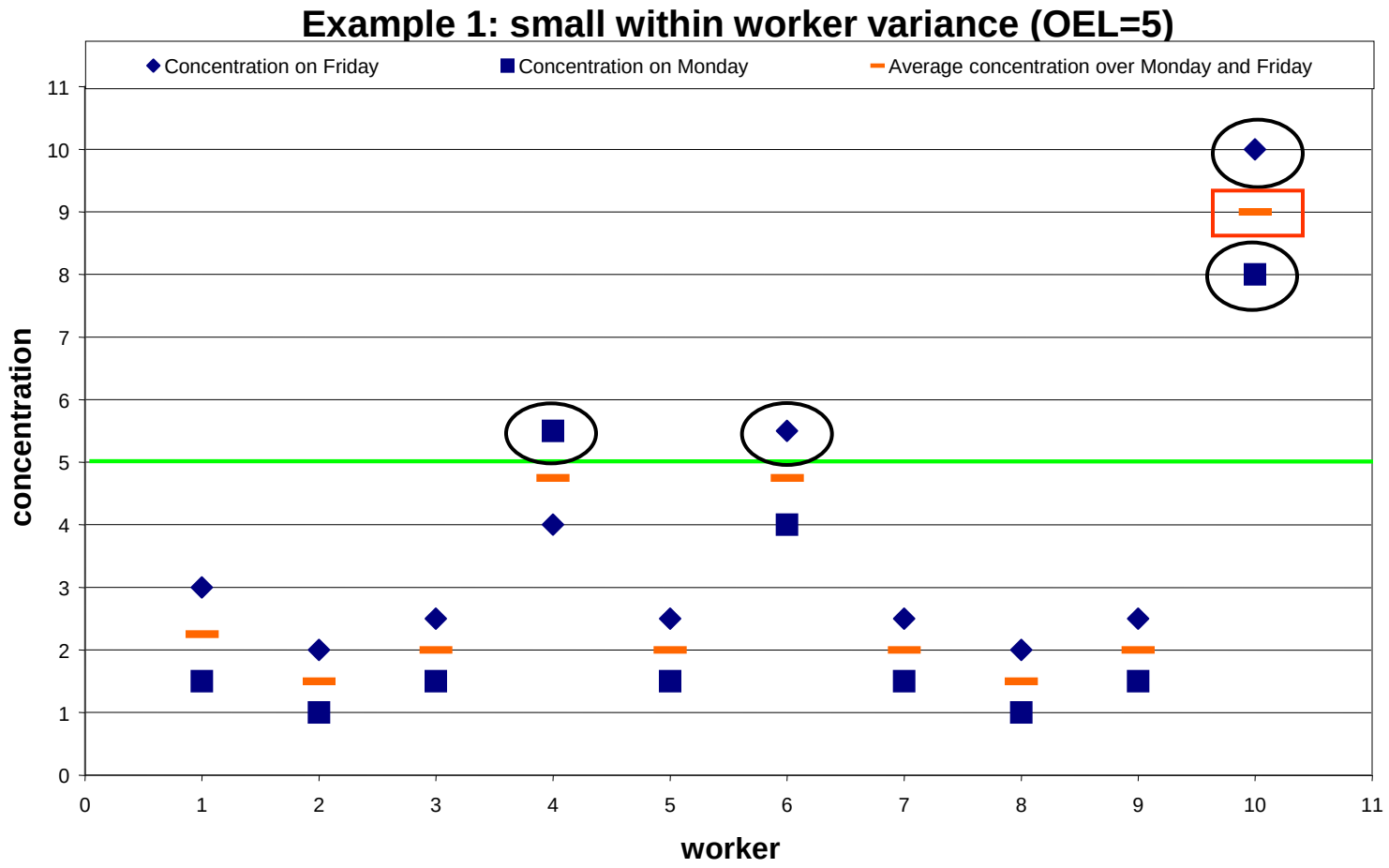
Number of measurements categorized by job title



Judge compliance by estimating Group Exceedance and Overexposure

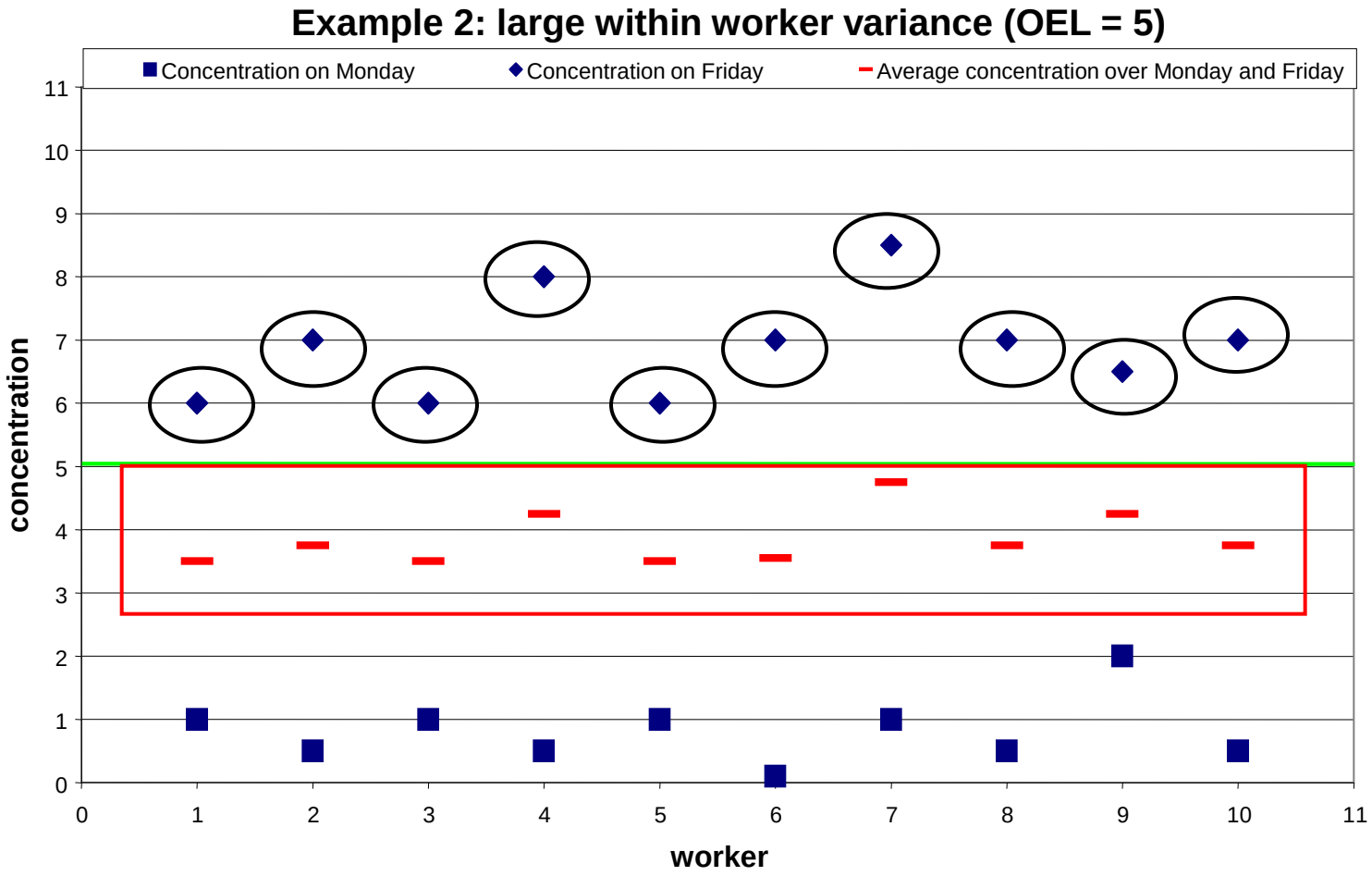
- Group Exceedance:
  - Probability that a single measurement of an individual on a randomly selected day is greater than the OEL (*total variance*)

- Overexposure:
  - Probability that a long-term average exposure of an individual worker exceeds the OEL → (*between-worker variance and within-worker variance*)



4 samples exceed OEL → exceedance = 20%

1 individual's average exposure exceeds OEL → overexposure = 10%

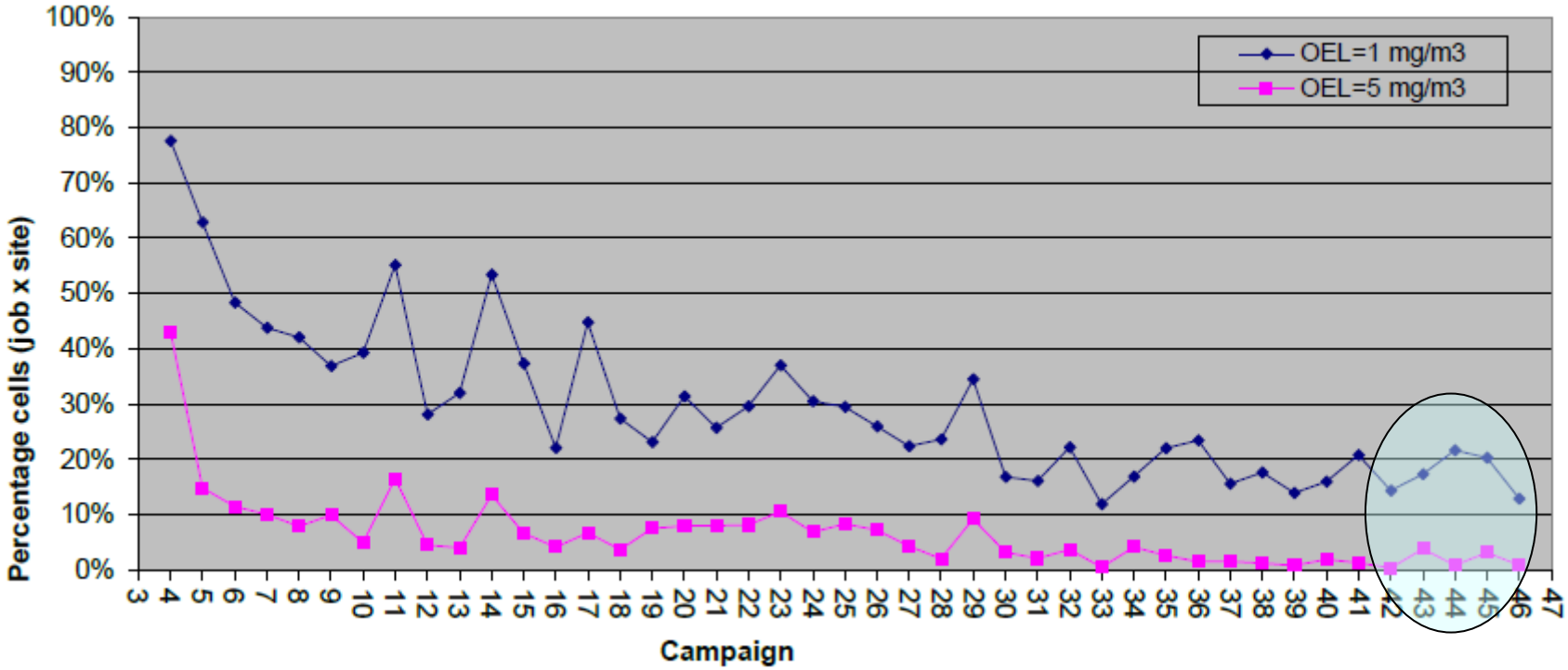


10 samples exceed OEL → exceedance = 50%

0 individual's average exposures exceed OEL → overexposure = 0%

Temporal trend in percentage of cells with probability of exceedance >5%

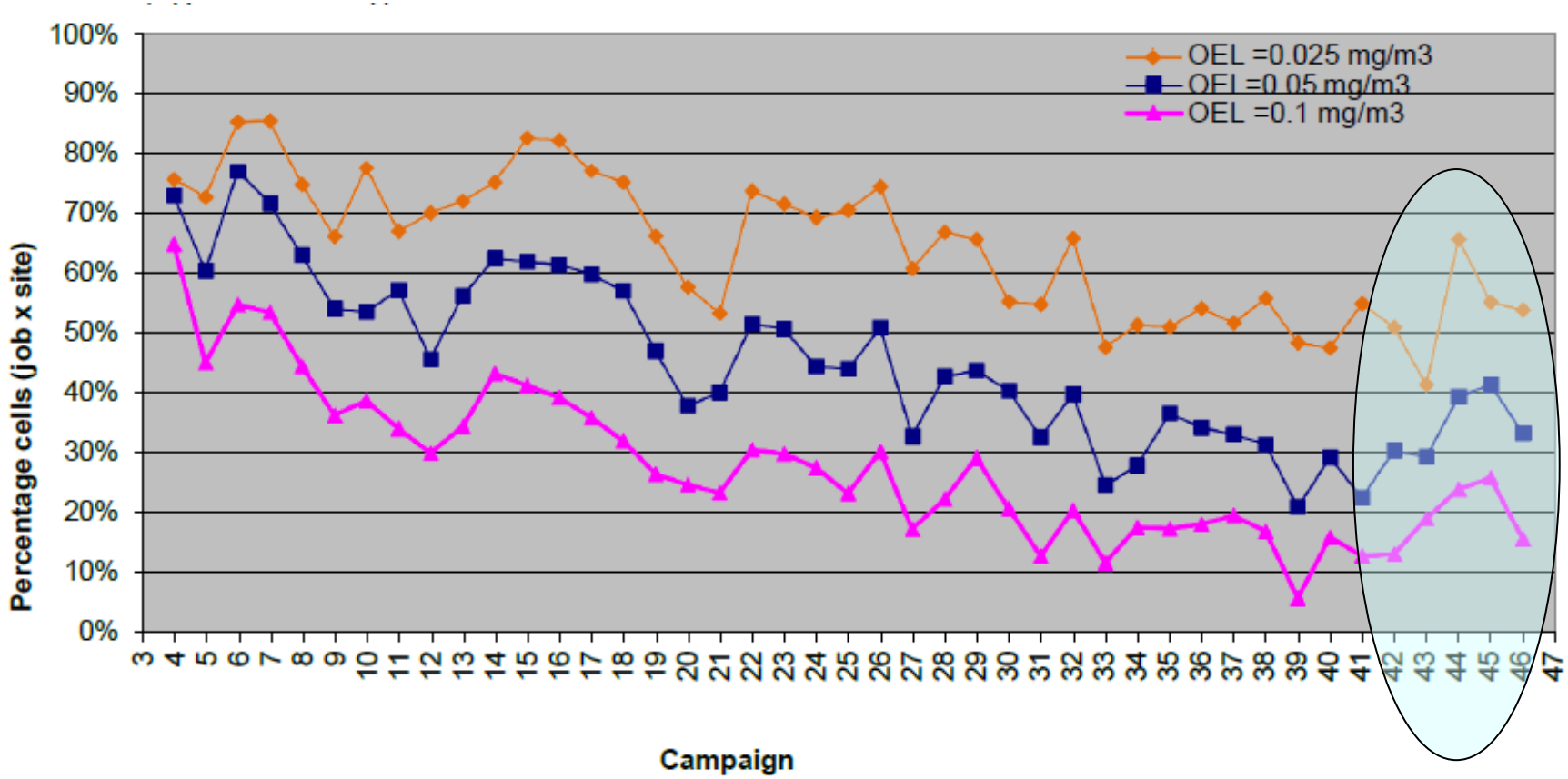
(respirable dust) (Type II)



Institute for Risk Assessment Sciences

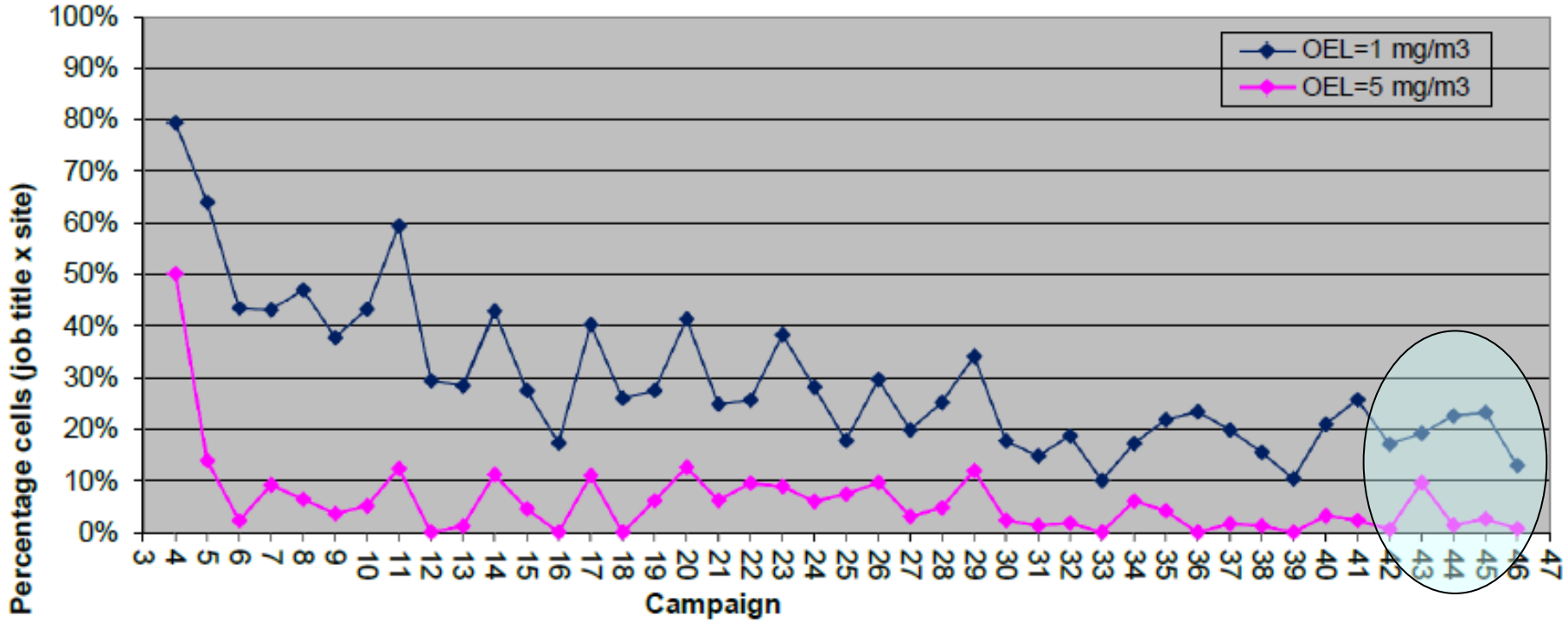
Temporal trend in percentage of cells with probability of exceedance >5%

(respirable quartz) (Type II)



Temporal trend in percentage of cells with probability of overexposure >5%

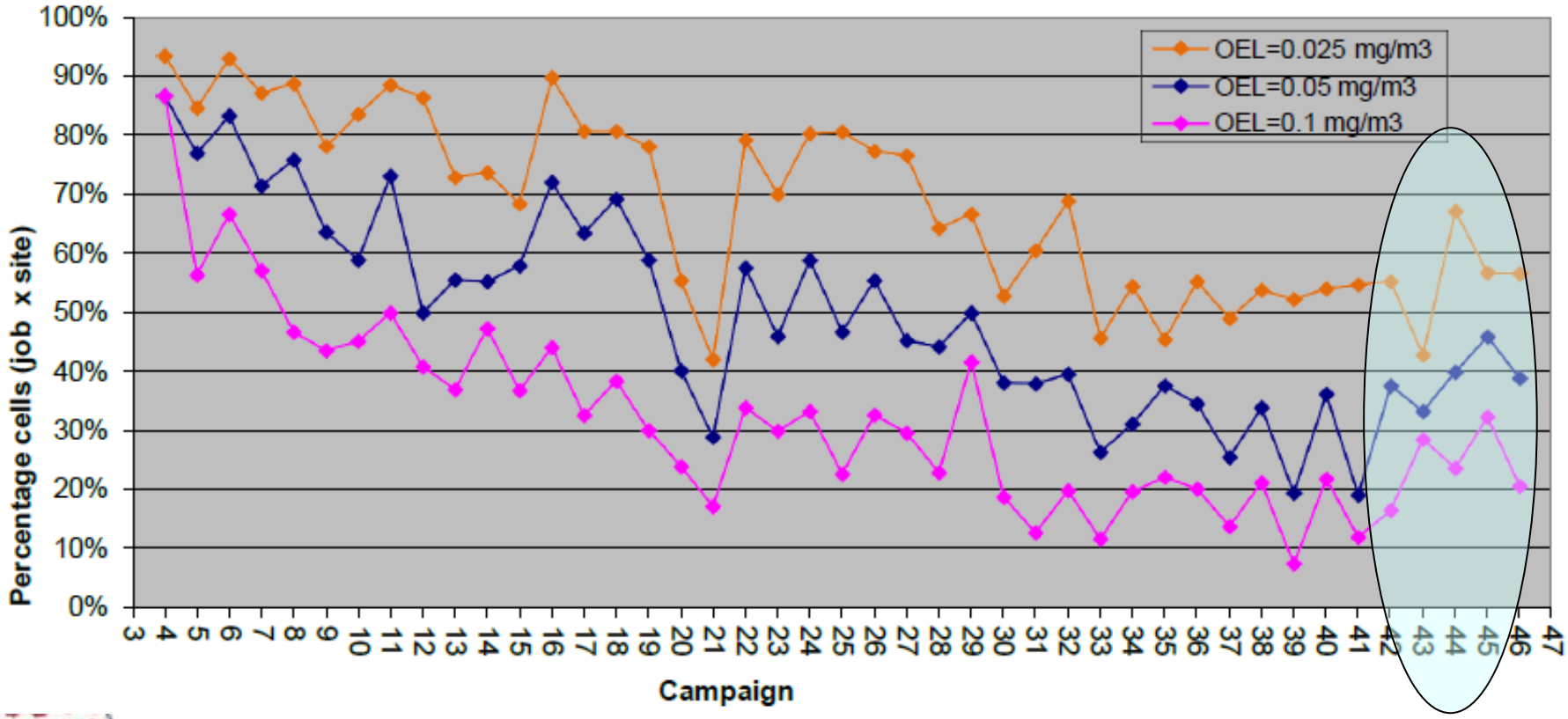
(respirable dust) (Type III)



Institute for Risk Assessment Sciences

Temporal trend in percentage of cells with probability of overexposure >5%

(respirable quartz) (Type III)



Conclusions on exceedance

IMA DMP database (Type II)

- Probability of exceedance >5% for respirable quartz has been considerably higher (26%-64%) than probability of exceedance for respirable dust (6%-28%)

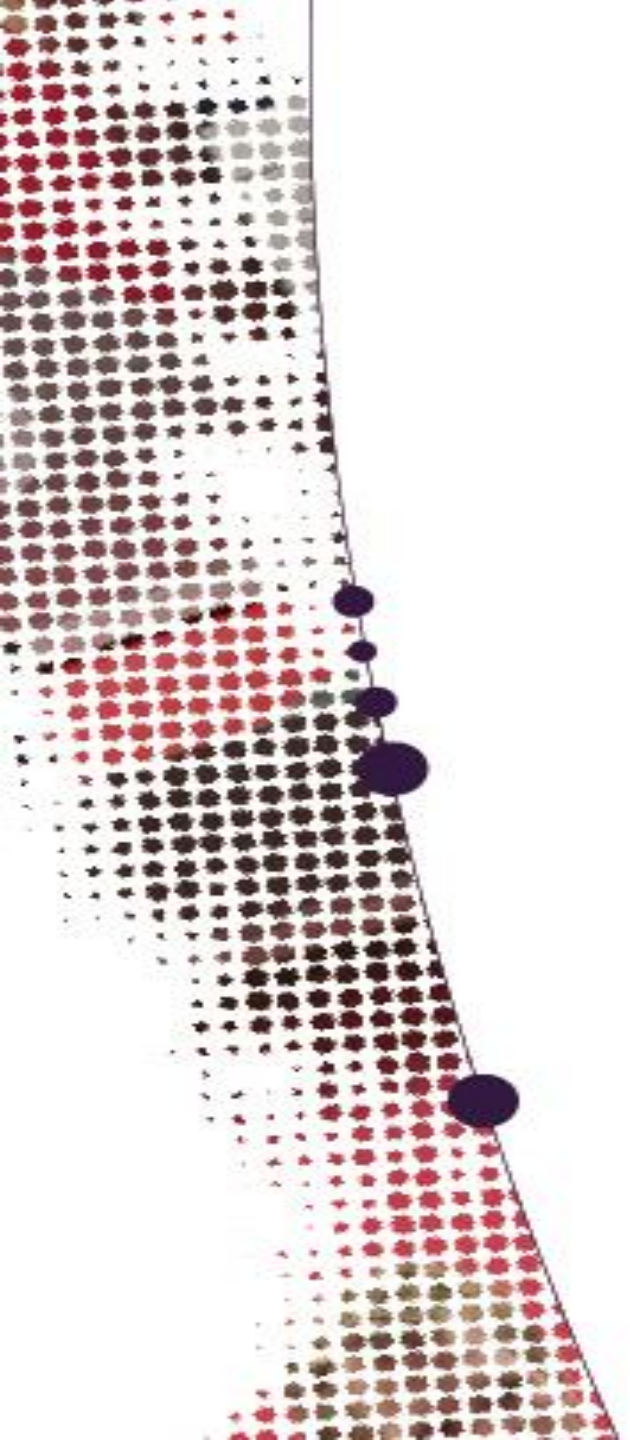
- Clear downward temporal trends have been shown in percentages of cells with exceedance >5% for both respirable dust and respirable quartz

- Currently, trends of >5% exceedance of OELV respirable dust have stabilized (campaigns 42-46). For respirable quartz trends of >5% exceedance of OELV respirable crystalline silica are slightly increasing.

Conclusions on overexposure
IMA DMP database (Type III)

- Considerably lower percentages of cells with overexposure >5% compared to exceedance >5% for both respirable dust (5% and 26% vs. 3 and 17%) and respirable quartz (27% - 65% vs. 18 and 48%)

- The percentage of cells with overexposure >5% is stable for respirable dust but has started to slightly increase for quartz



Hot Spots analysis for quartz

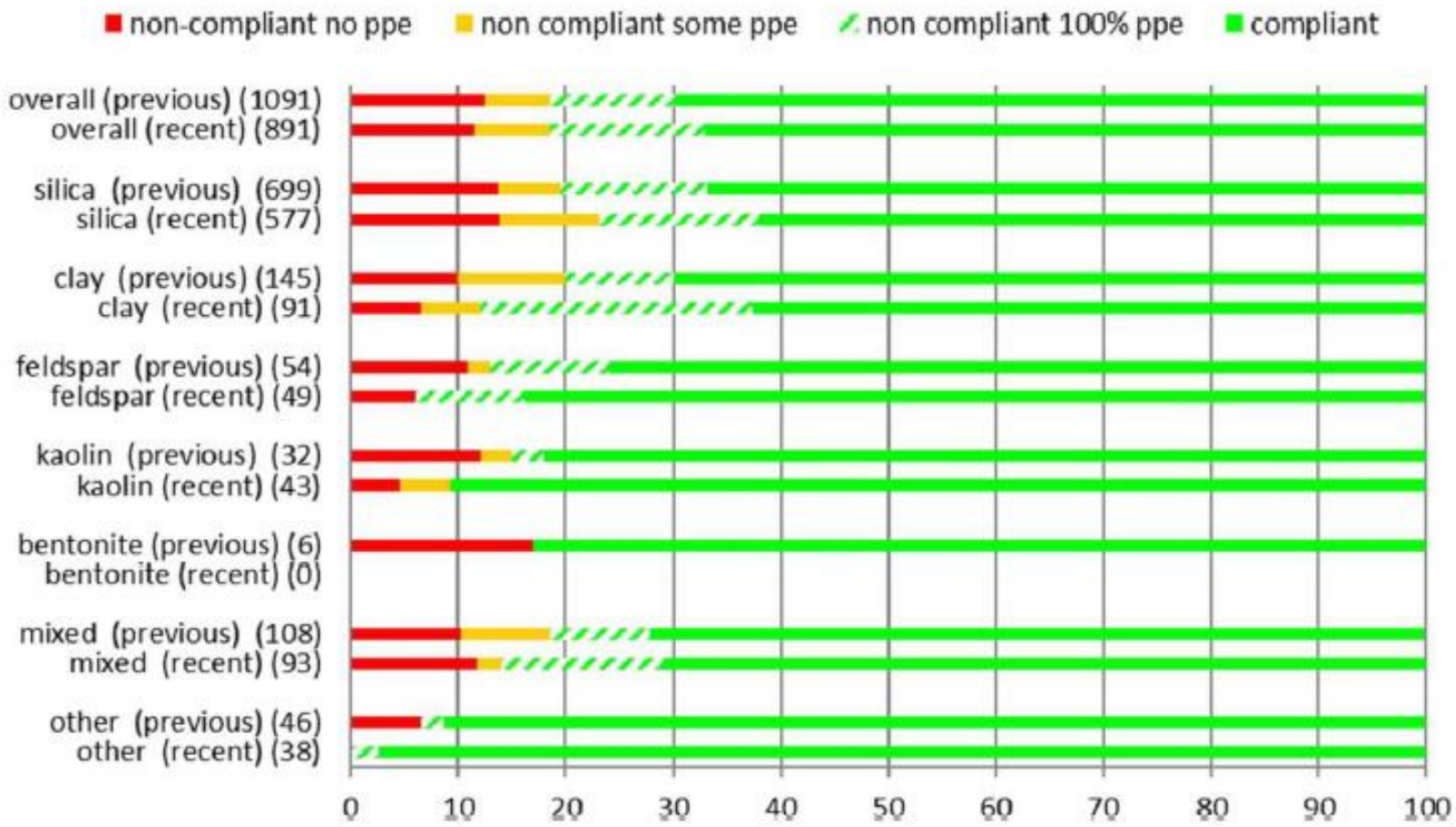
definitions for compliance/non-compliance

- **non-compliant no PPE: exceedance >5% and less than 50% use of personal (respiratory) protective equipment**
- **non-compliant some PPE: exceedance >5% and at least 50% and less than 100% use of personal (respiratory) protective equipment**
- **non-compliant 100% PPE: exceedance >5% and 100% use of personal (respiratory) protective equipment**
- **compliant: exceedance ≤5%**

Change in hot spots by mineral

campaigns 41-46 versus campaigns 35-40

for OEL quartz of 0.05 mg/m^3

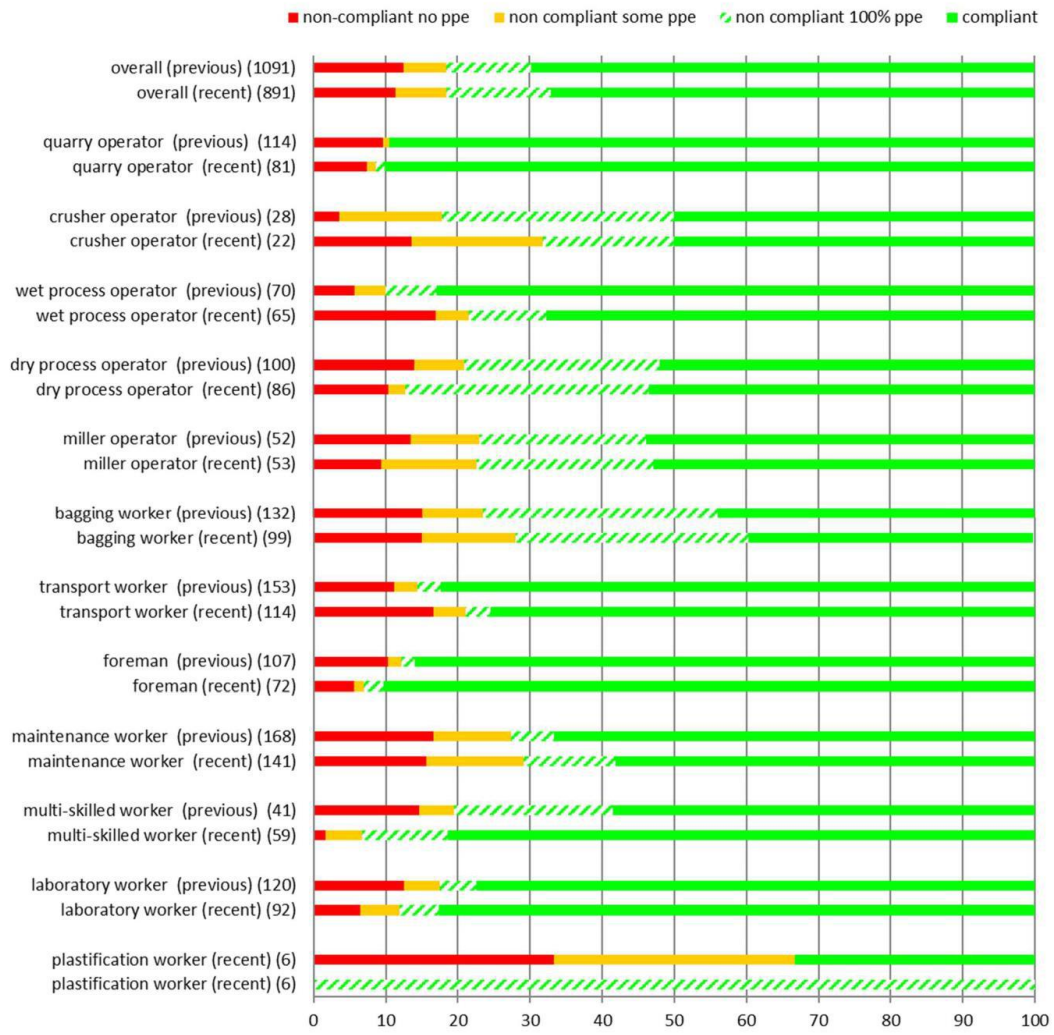


Institute for Risk Assessment Sciences

Change in hot spots by job

campaigns 41-46 versus campaigns 35-40

for OEL quartz of 0.05 mg/m^3



Institute for Risk Assessment Sciences

Hot Spots

campaigns 41-46 versus campaigns 35-40

for OEL quartz of 0.05 mg/m^3

- Overall percentage of compliant cells (67%) has slightly decreased in comparison with ‘previous’ campaigns (70%)
- Percentage of non-compliant cells where no personal protection equipment was used decreased as well from 12% to 11%.
- Decrease in non-compliant hot-spots without use of personal protection equipment for almost all mineral types except for ‘silica’ (no change) and ‘mixed minerals’ (2% increase)
- Percentage non-compliant cells in ‘recent’ campaigns varied from 3% (other minerals’) to 38% (‘silica’)
- Overall increase in use of PPE during measurements (46% in ‘recent campaigns’ versus 40% in ‘previous’ campaigns)

Hot Spots

campaigns 41-46 versus campaigns 35-40 for OEL quartz of 0.05 mg/m^3

- Increase in non-compliant hot-spots without use of personal protection equipment visible for ‘crusher operator’, ‘wet process operator’ and ‘transport worker’. For ‘bagging worker’ it stayed constant at 15%. For other jobs the hot-spots declined

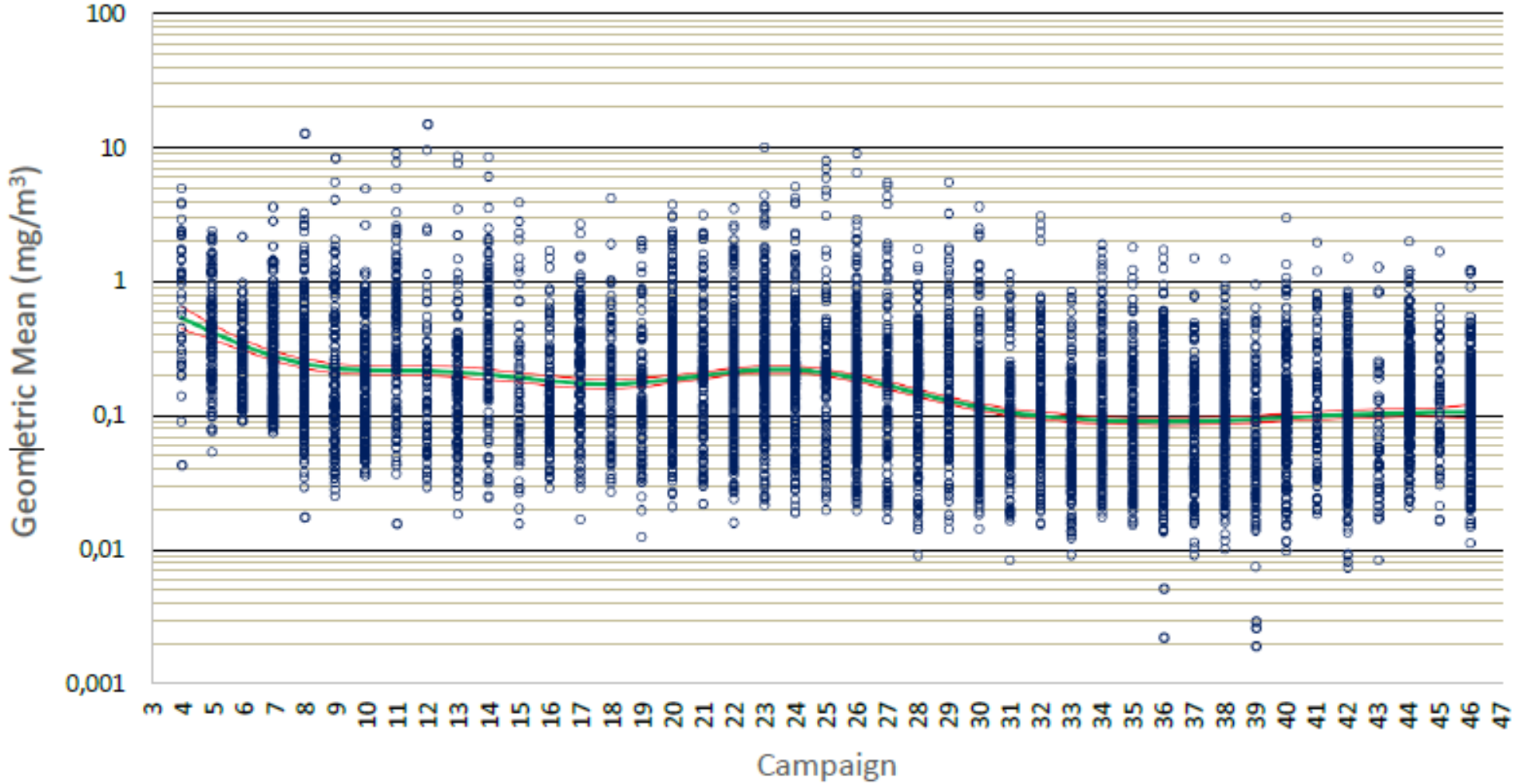
- Percentage of all non-compliant cells across job titles currently varies from 10% (‘quarry operator’ and ‘foreman’) to 100% (‘plastification worker’).

- Jobs ‘plastification worker’, ‘bagging worker’ and ‘crusher operator’ continue to have the most non-compliant cells, while the jobs ‘quarry operator’ and ‘foreman’ were most frequently compliant.

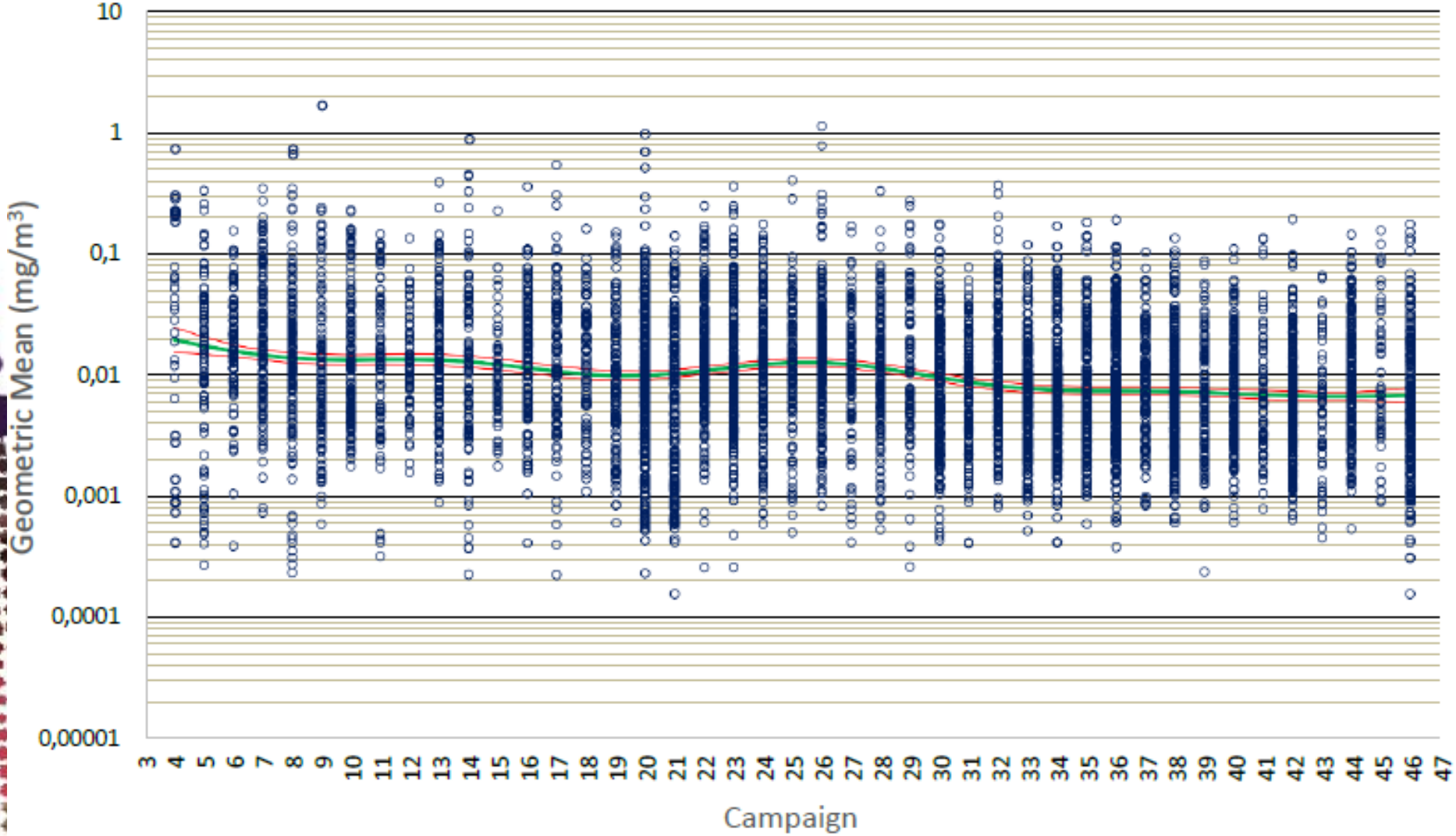
Temporal trends in exposure concentrations (Type II)

- Type II data were analyzed, however Type II data without worker-id could not be analyzed
- Linear mixed effects model considering fixed effects of site and campaign (time trend) and random worker effect
- Overall, by time period, by mineral and by job title

Temporal trends in respirable dust concentration in mg/m^3



Temporal trends in respirable quartz concentration in mg/m^3



Institute for Risk Assessment Sciences

Temporal trends in exposure concentrations by time period (Type II)

	Respirable Dust					Respirable Quartz				
Time period	**N sites**	**N obs.**	**GM Start**	**GM end**	**Trend per Campaign (%)**	**N sites**	**N obs.**	**GM start**	**GM end**	**Trend per Campaign (%)**
s 2002 - s 2023	167	40,885	0.41	0.11	**-3.1*** **	160	37,212	0.013	0.005	**-2.3*** **
s 2002 – w 09/10	84	10,686	0.50	0.18	**-6.6*** **	82	9,236	0.014	0.007	**-3.9*** **
s 2010 – w 12/13	126	7,377	0.23	0.22	-1.1	117	6,630	0.009	0.011	**+4.6*** **
s 2013 – s 2016	110	7,790	0.17	0.12	**-5.9*** **	101	6,877	0.012	0.008	**-6.9*** **
w 16/17 – s 2023	**100**	**15,032**	**0.10**	**0.11**	**+1.2*** **	**96**	**14,469**	**0.007**	**0.006**	**-1.7*** **

Temporal trends in exposure concentrations by mineral (Type II)

Mineral	Respirable dust					Respirable quartz				
	N sites	N obs.	GM 2002	GM 2023	Trend per campaign (%)	N sites	N obs.	GM 2002	GM 2023	Trend per campaign (%)
All	**167**	**40,885**	**0.41**	**0.11**	**-3.1*** **	**160**	**37,212**	**0.013**	**0.005**	**-2.3*** **
Silica	84	21,959	0.26	0.08	-2.7***	82	21,827	0.016	0.007	-1.9***
Clay	21	5,039	0.34	0.08	-3.4***	21	5,035	0.028	0.006	-3.5***
Feldspar	12	1,490	0.28	0.43	+1.0	12	1,454	0.026	0.002	-5.6***
Kaolin	11	1,504	0.54	0.22	-2.2***	11	1,506	0.009	0.004	-2.2**
Talc	8	1,262	0.54	0.20	-2.3***	5	94	0.001	<0.001	-8.4*
Bentonite	4	402	0.22	0.40	+1.5*	3	90	0.009	0.011	+0.5
Mixed minerals	28	3,922	1.21	0.08	-6.3***	28	3,854	0.020	0.006	-2.7***
Other minerals	47	5,307	0.86	0.14	-4.3***	41	3,377	0.011	0.002	-3.7***

Temporal trends in exposure concentrations by job title (Type II)

	Respirable dust					Respirable quartz				
Job	N sites	N obs.	GM 2002	GM 2023	Trend per campaign (%)	N sites	N obs.	GM 2002	GM 2023	Trend per campaign (%)
All	**167**	**40,885**	**0.41**	**0.11**	**-3.1*** **	**160**	**37,212**	**0.013**	**0.005**	**-2.3*** **
Quarry operator	94	4,745	0.25	0.05	-3.8***	84	4,530	0.010	0.003	-3.0***
Crusher operator	29	1,035	0.52	0.20	-2.2***	23	733	0.028	0.006	-4.0***
Wet process operator	60	2,741	0.19	0.08	-2.1***	59	2,650	0.012	0.007	-1.6***
Dry process operator	104	4,288	0.44	0.13	-2.8***	96	3,727	0.018	0.009	-1.8***
Miller operator	39	1,946	0.51	0.11	-3.7***	37	1,744	0.032	0.010	-3.0***
Bagging operator	102	4,970	0.70	0.20	-3.0***	97	4,414	0.027	0.013	-2.0***
Transport worker	119	6,133	0.34	0.07	-3.9***	110	5,685	0.012	0.005	-2.4***
Foreman	101	3,732	0.20	0.05	-3.1***	93	3,483	0.009	0.004	-2.5***
Maintenance worker	121	5,907	0.47	0.16	-2.6***	114	5,229	0.014	0.008	-1.6***
Multi-skilled worker	76	1,863	0.30	0.09	-2.9***	70	1,681	0.020	0.005	-3.8***
Laboratory worker	88	3,251	0.27	0.07	-3.3***	82	3,062	0.013	0.005	-2.4***

Future developments
Discourse and decisions needed

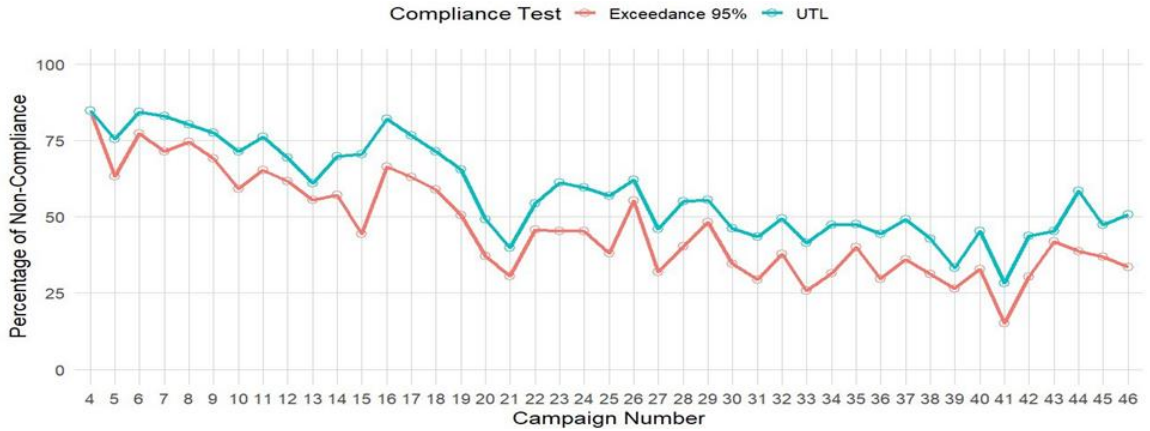
- New EN 689:2018
- Future lowering of EU OELV from 0.100 mg/m^3 to 0.050 mg/m^3 or maybe even 0.025 mg/m^3 respirable crystalline silica
- Monitoring lower concentrations of quartz and limit of detection/quantification
- Lower OELVs for respirable (PSLT/GBS) dust?

Consequence EN 689:2018 and lower OELV? Analysis 4,475 cells (2002-2023)

OELV	Probability of exceedance>5% non-compliance	EN 689:2018 $UTL_{95,70}$ non-compliance
0.100 mg/m^3	1,098 (24%)	1,637 (37%)
0.050 mg/m^3	1,914 (43%)	2,477 (55%)
0.025 mg/m^3	2,858 (64%)	3,295 (74%)

Consequence EN 689:2018 and lower OELV?

15-25% exceedance

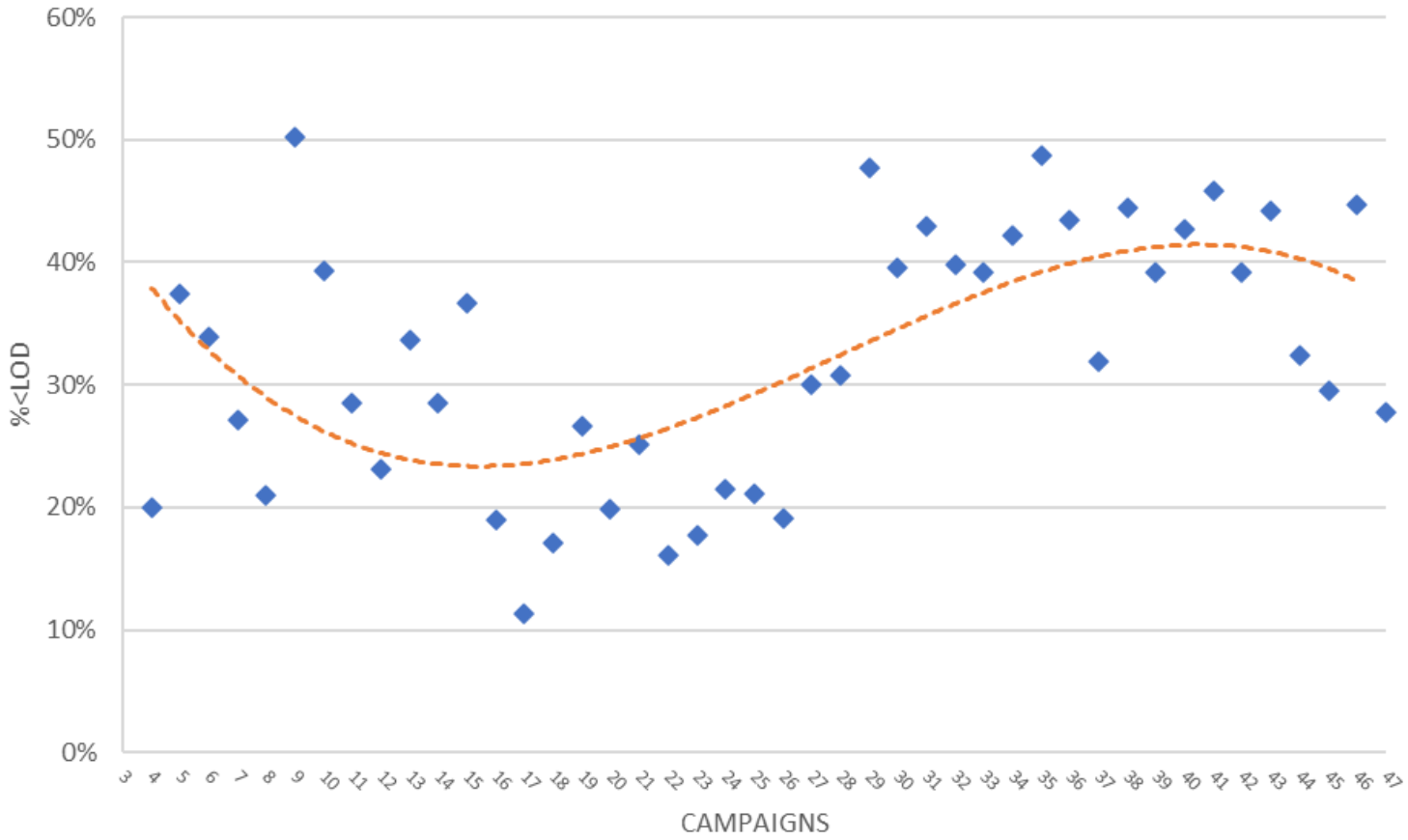


60-70% non-compliance

Consequences of future EU-limit and new EN 689 statistical test ($UTL_{95,70}$)

- Non-compliance will increase substantially with ~30% (OELV 0.050 mg/m^3) or ~50% (OELV 0.025 mg/m^3)
- Back at the levels when IMA-DMP started!
- New sampling and analytical techniques will be needed to be able to monitor lower concentrations of RCS/Quartz

Percentage of quartz measurements below Limit of Detection by campaign



Institute for Risk Assessment Sciences

Enhance participation and adopting EN 689

- Make the requirement of 6 samples per job per campaign less strict
- Allowing minimal 3 samples per job per campaign and preliminary test (EN 689)
- However, as we showed probability of compliance with OELV increases with additional measurements (total ≥ 6) and being able to perform the statistical test with $UTL_{95,70}$ (D'Errico et al., 2022)
- Also, strict registration of unique Worker IDs will become even more necessary to enable pooling of measurements for statistical testing across campaigns!

Overall conclusions (1)

- **Largest multi-company multiple-site coordinated dust monitoring programme in Europe** (and probably the world); serves as good example of how hazardous exposures should be periodically monitored and consequently be controlled

- **Data management and quality control** is at a high level, but some sites have been less consistently reporting worker ID's

- Result is a **unique, very rich and promising database**, that provides excellent insight in (changes in) occupational exposures to respirable dust and quartz within European industrial minerals producing industry

Overall conclusions (2)

- **Statistically significant overall downward trends** in exposure levels for period 2002-2021 both for exposure to respirable dust and quartz of respectively -3.1% and -2.3% per half year; these trends were not constant and have been going and down

- **Number of cells with exceedance and overexposure >5%** for exposure to respirable dust is no longer decreasing during most recent sampling campaigns. For respirable quartz a slight increase in exceedance and overexposure has become visible

Overall conclusions (3)

- Median geometric mean respirable dust and quartz concentrations are now at respectively **0.11 mg/m3** and **0.005 mg/m^3** and have decreased with respectively factor of ~4 and ~3 since start IMA-DMP

- **Hot spot analysis** of exposure to **quartz** shows a slight decrease from **70% to 67% compliant situations** (OEL 0.050 mg/m^3), but at the same time use of PPE during the measurement increased

Overall conclusions (4)

- Identification of recent changes in exposure to **respirable dust** and **respirable quartz** must be **closely monitored and followed-up** and once more shows the **value of IMA-DMP**
- **Protocol needs adaptation** to allow increased participation in the near future
- **IMA-Dust Monitoring Programme** and resulting **database** are **distinctive and without equal** in the field of occupational health and safety

IMA Europe

Thank you for your attention

and very fruitful collaboration

Universiteit Utrecht

Institute for Risk Assessment Sciences

NKAL

Netherlands Expertise Centre for Occupational Respiratory Disorders