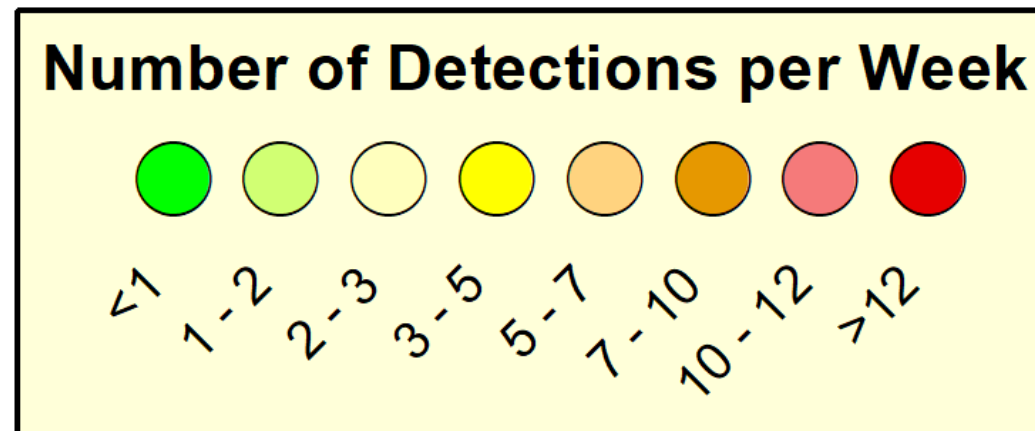


Impact of Civilian Nuclear Emissions

Harry Miley and Paul Eslinger

Pacific Northwest National Laboratory



Xenon Backgrounds

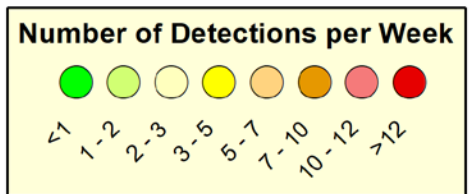
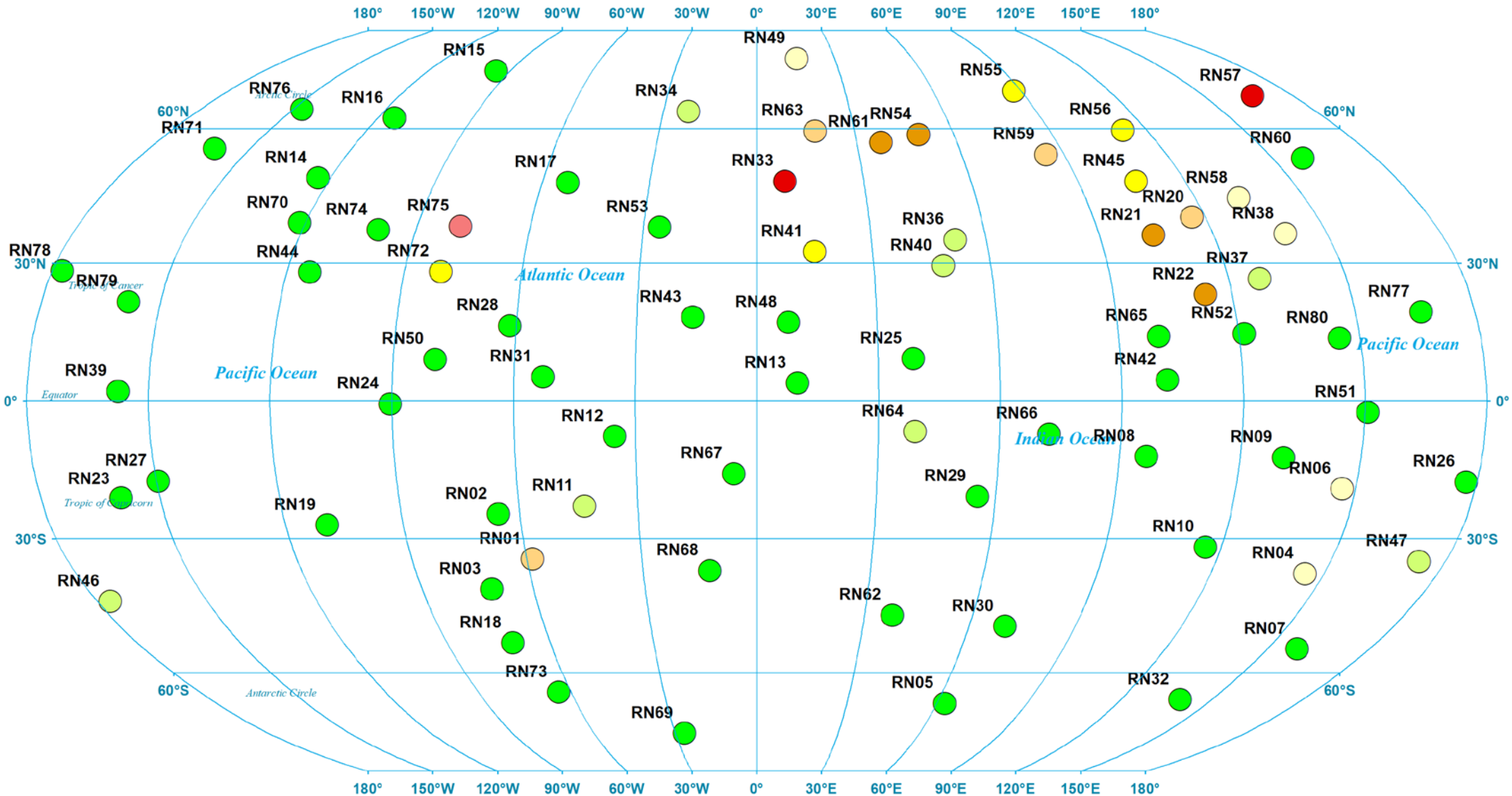
- Goal
 - Estimate the xenon background and variability for the 79 IMS RN stations
 - From nuclear power plants (NPP) and from medical isotope production (MIP)
- Approach
 - Rates of leakage from scientific literature
 - Two years of forward calculations from all known locations
 - Assume the same xenon monitoring system at each place (SAUNA)



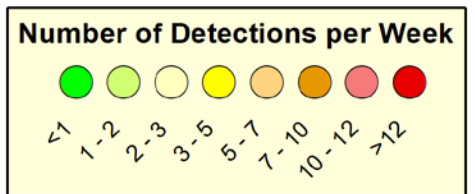
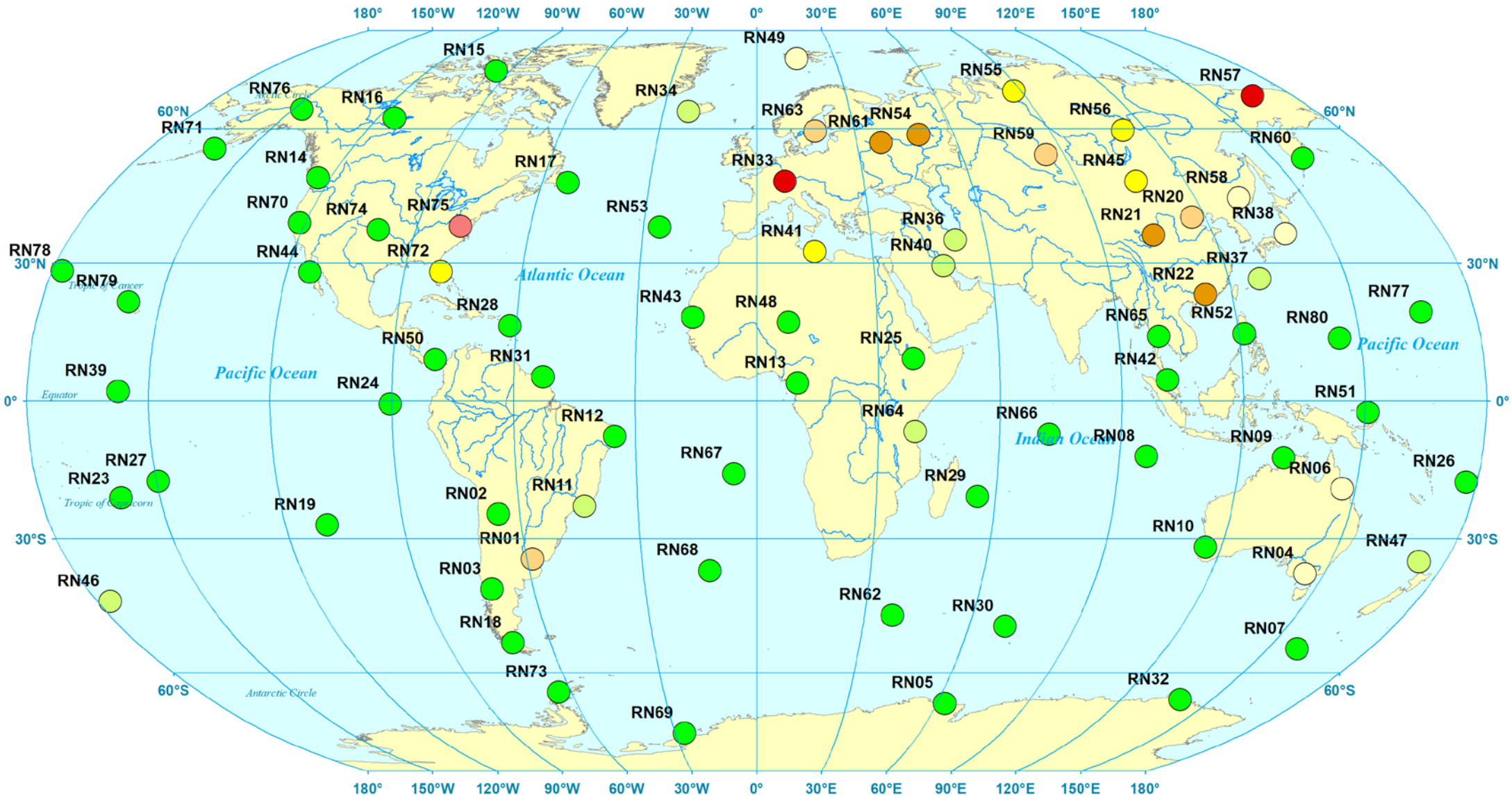
D1

Year	Month	Day	Hour	Decimal Date	Excel date	ARP01	ARP02	ARP03	AUP04	AUP05	AUP06	AUP07	AUP08	AUP09	AUP10	BRP11	BRP12	CMP13	CAP14	CAP15	CAP16	CAP17	CLP18	CLP19
2015	1	1	0	2015.00274	1/1/2015 0:00	0.0147173														3.515E-05				
2015	1	1	12	2015.00411	1/1/2015 12:00	25.8288														0.0001907				
2015	1	2	0	2015.00548	1/2/2015 0:00	7.928E-06								0.0173184						9.715E-05			0.0014417	
2015	1	2	12	2015.00685	1/2/2015 12:00	4.42624			0.31042					0.66606									0.0339737	
2015	1	3	0	2015.00822	1/3/2015 0:00	0	1.325E-05		0.316383					0.628907									0.0199196	
2015	1	3	12	2015.00959	1/3/2015 12:00	47.0987			0.0023417				0.0136056	0.325141									0.0131859	
2015	1	4	0	2015.01096	1/4/2015 0:00	0.0005337						0.190578		0.25628									0.0397849	0.0015823
2015	1	4	12	2015.01233	1/4/2015 12:00	7.59269						0.0022507		0.0072532				0.00047						
2015	1	5	0	2015.0137	1/5/2015 0:00	0.0036057	4.676E-06	0.0056099				0.116884		0.050787		0.0029062		0.0032742						0.0012278
2015	1	5	12	2015.01507	1/5/2015 12:00	0.141758	5.666E-05					0.0017541		0.0549284		0.002337								0.0023123
2015	1	6	0	2015.01644	1/6/2015 0:00	0.0262003																		0.0006816
2015	1	6	12	2015.01781	1/6/2015 12:00	0.24741	0.0001																	0.0612239
2015	1	7	0	2015.01918	1/7/2015 0:00	0.0225529	0.00015																	0.0021254
2015	1	7	12	2015.02055	1/7/2015 12:00	3.1827	0.0001																	0.0002388
2015	1	8	0	2015.02192	1/8/2015 0:00	2.04837	9.834E-05																	
2015	1	8	12	2015.02329	1/8/2015 12:00	0.236997																		
2015	1	9	0	2015.02466	1/9/2015 0:00	0.0325563																	6.712E-05	0.0011641
2015	1	9	12	2015.02603	1/9/2015 12:00	1.21504																		0.0436652
2015	1	10	0	2015.0274	1/10/2015 0:00	2.884E-05																		0.0013062
2015	1	10	12	2015.02877	1/10/2015 12:00	5.08754																		7.732E-05
2015	1	11	0	2015.03014	1/11/2015 0:00	0.0073435																		0.0092553
2015	1	11	12	2015.03151	1/11/2015 12:00	0.282893																		0.0005764
2015	1	12	0	2015.03288	1/12/2015 0:00	0.035257																		0.0003461
2015	1	12	12	2015.03425	1/12/2015 12:00	6.11232																		0.0061932
2015	1	13	0	2015.03562	1/13/2015 0:00	0.0007482																		0.133881
2015	1	13	12	2015.03699	1/13/2015 12:00	0.226169																		0.0003495
2015	1	13	12	2015.03699	1/13/2015 12:00	0.226169																		0.0003495
2015	1	13	12	2015.03699	1/13/2015 12:00	0.226169																		0.0231224
2015	1	14	0	2015.03836	1/14/2015 0:00	0.103276																		0.0875496
2015	1	14	12	2015.03973	1/14/2015 12:00	17.0934																		0.0036856
2015	1	15	0	2015.0411	1/15/2015 0:00	0.115259																		0.0002969
2015	1	15	12	2015.04247	1/15/2015 12:00	0.0697942																		0.0002206
2015	1	16	0	2015.04384	1/16/2015 0:00	0.0710877																		0.0005878
2015	1	16	12	2015.04521	1/16/2015 12:00	0.226223																		0.0036634
2015	1	17	0	2015.04658	1/17/2015 0:00	0.027353																		0.0070932
2015	1	17	12	2015.04795	1/17/2015 12:00	5.75333																		0.0001189
2015	1	18	0	2015.04932	1/18/2015 0:00	0.0134296																		0.169763
2015	1	18	12	2015.05068	1/18/2015 12:00	5.913E-06																		0.0114764
2015	1	19	0	2015.05205	1/19/2015 0:00	0.0096642																		0.0001013
2015	1	19	12	2015.05342	1/19/2015 12:00	0.558096																		0.0160863
2015	1	20	0	2015.05479	1/20/2015 0:00	0.0521797																		0.0004093
2015	1	20	12	2015.05616	1/20/2015 12:00	0.702324																		0.0079374
2015	1	21	0	2015.05753	1/21/2015 0:00	1.051E-05	4.169E-05	1.394E-06	13.7505															0.0021933

Tabulated detections at each station, each day for two years, with a median and 95th percentile level.



Number of Modeled ^{133}Xe Concentrations from Combined MIPF and NPP Releases per Week that Exceed a Detection Limit of 0.2 mBq/m^3 in 12-hour Samples



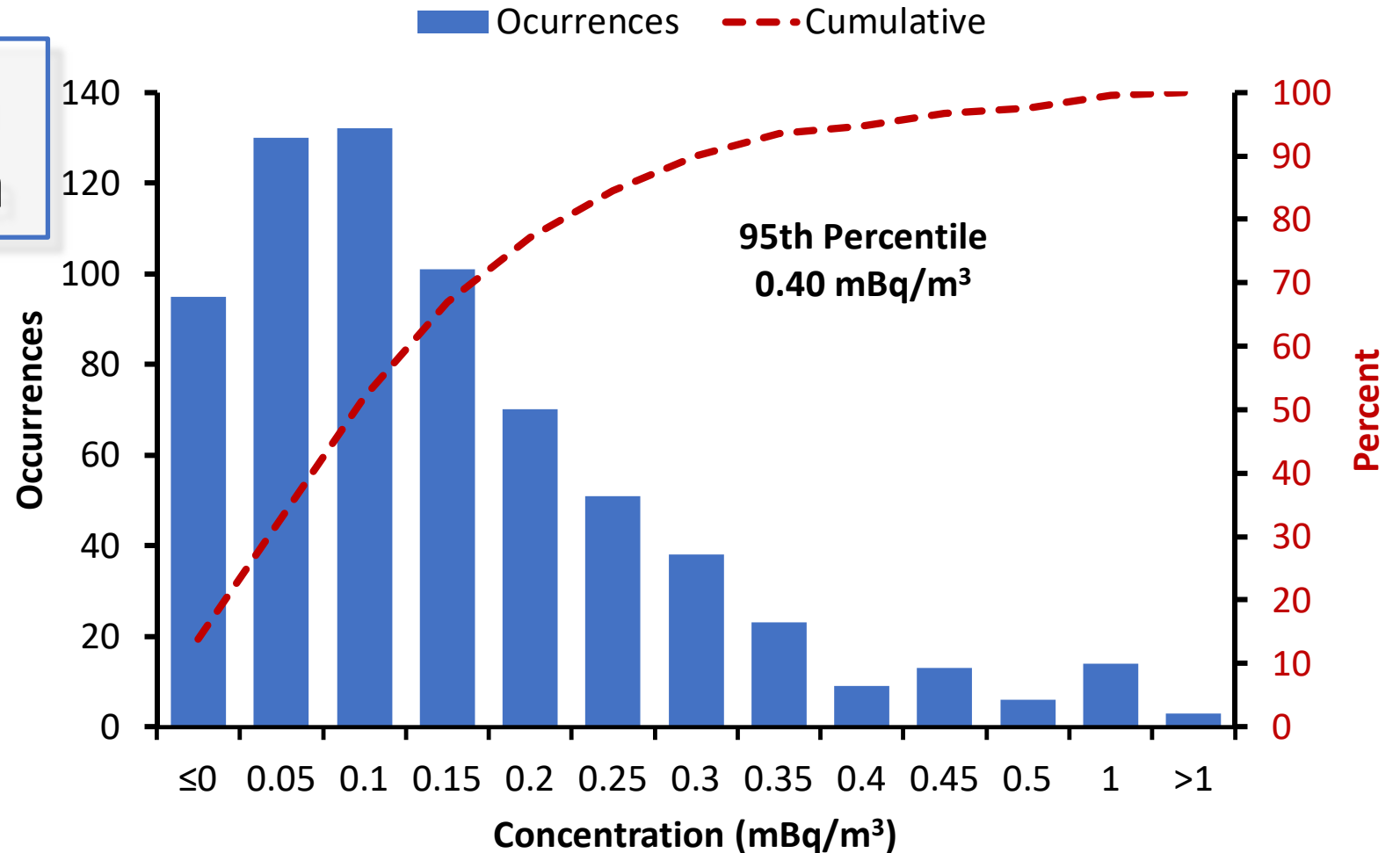
Number of Modeled ¹³³Xe Concentrations from Combined MIPF and NPP Releases per Week that Exceed a Detection Limit of 0.2 mBq/m³ in 12-hour Samples

Why is 95th percentile so important?

-- Or --

What is an anomaly?

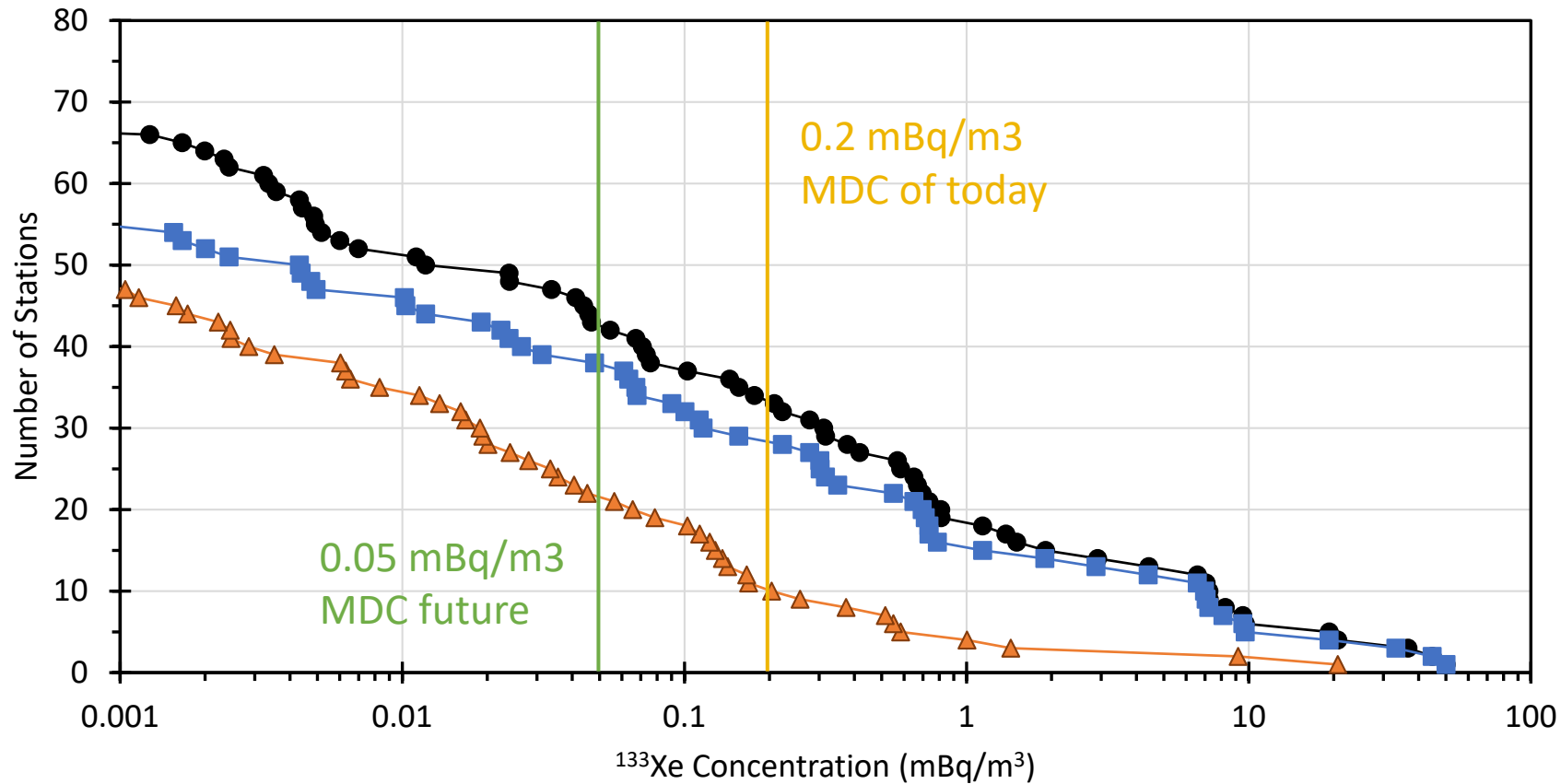
JPX38 Takasaki, Japan
One year of ^{133}Xe data



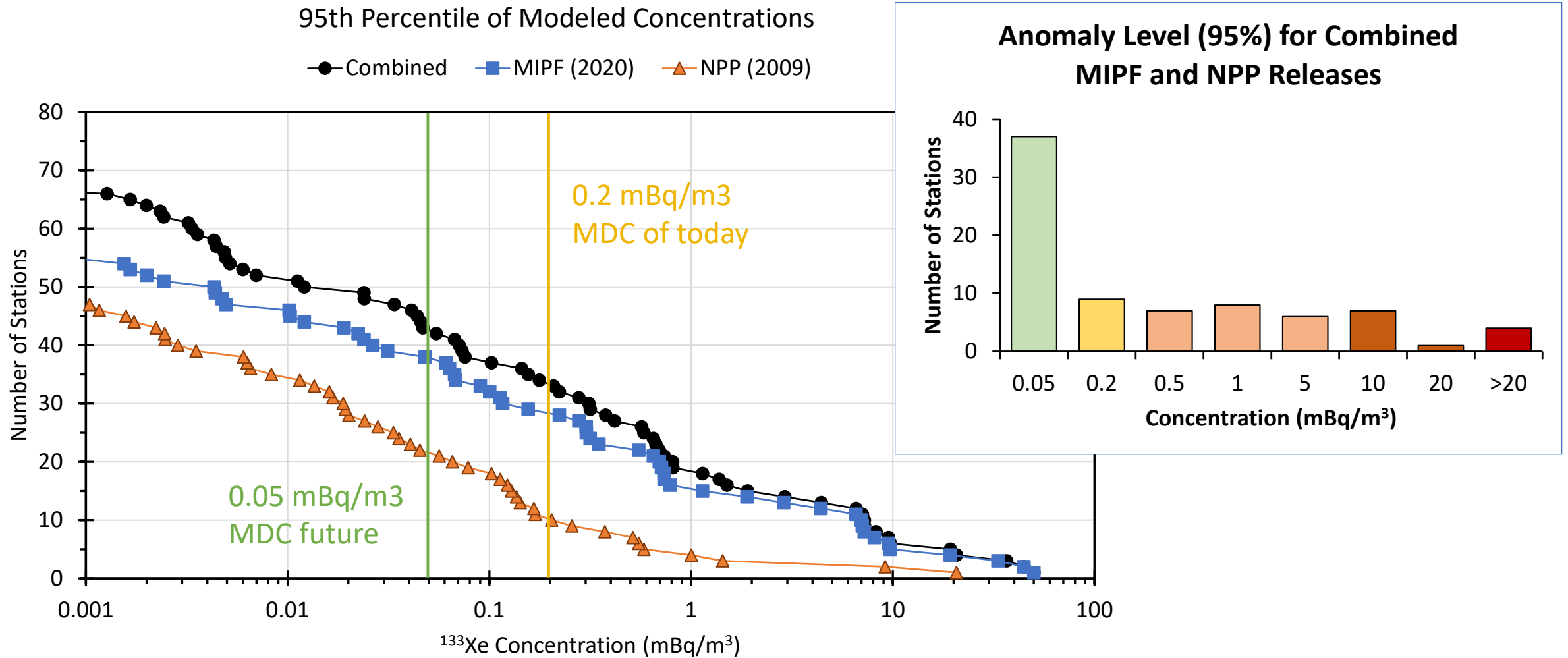
How much xenon is needed for an anomaly?

95th Percentile of Modeled Concentrations

● Combined ■ MIPF (2020) ▲ NPP (2009)



How much xenon is needed for an anomaly?



Summary/Conclusions

- We tested an approach to examine the challenges at IMS station locations.
- Today we have a clearer picture of where NPP emissions are important, and where the greatest background challenges are.
- In future work we can consider adjustments to improve data collection and analysis.

