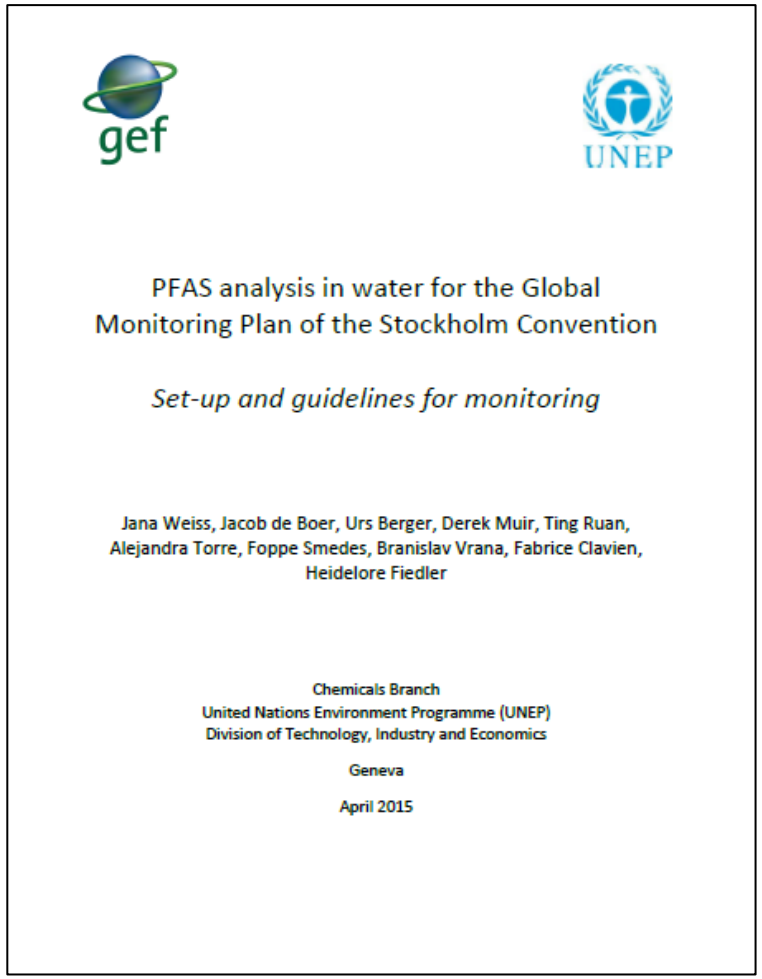
PFAS in Water by Expert Laboratory

Heidelore Fiedler
Örebro University
School of Science and Technology, MTM Research Centre
SE-702 18 Örebro, Sweden
E-mail: heidelore.fiedler@oru.se

Core matrix ”water” – for PFAS only

- Water is a new core matrix and was not included in UNEP/GEF GMP1 projects;
- The guideline states: active sampling, 4-times per year, at mouth of river or estuaries;
- Analytes: PFOS; amended by PFOA (through listing at COP-9 in 2019) and PFHxS (through recommendation by POPRC in 2019);
- PFOS separated into linear and branched isomers (L-PFOS and br-PFOS); to follow EPA methods 533 and 537.1

UNEP guidance documents



PFAS analysis in water for the Global Monitoring Plan of the Stockholm Convention

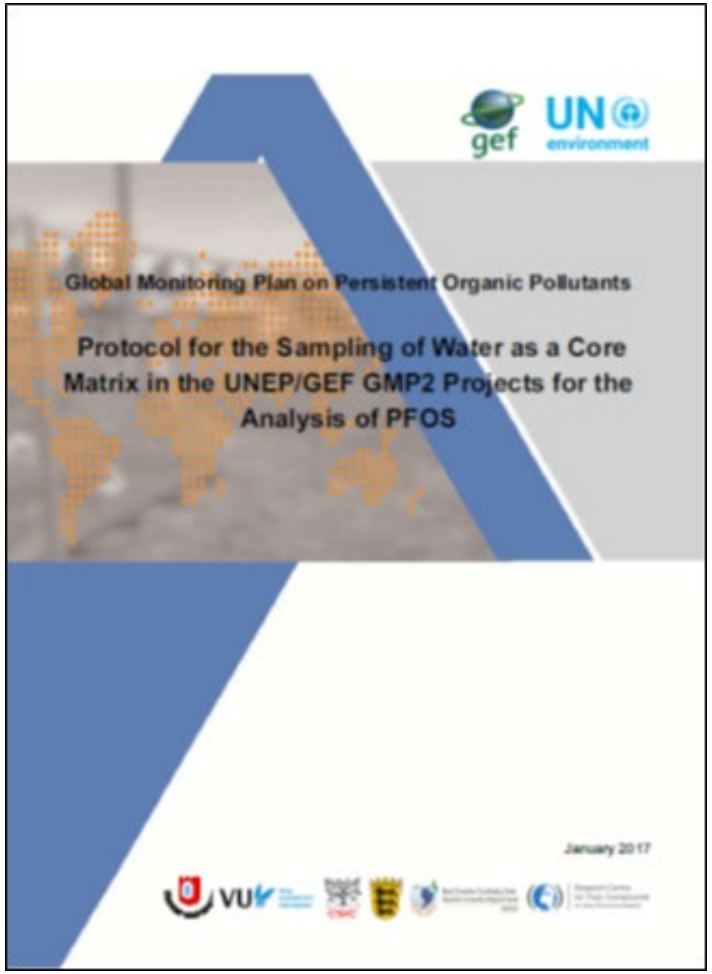
Set-up and guidelines for monitoring

Jana Weiss, Jacob de Boer, Urs Berger, Derek Muir, Ting Ruan, Alejandra Torre, Foppe Smedes, Branislav Vrana, Fabrice Clavien, Heidelore Fiedler

Chemicals Branch
United Nations Environment Programme (UNEP)
Division of Technology, Industry and Economics

Geneva

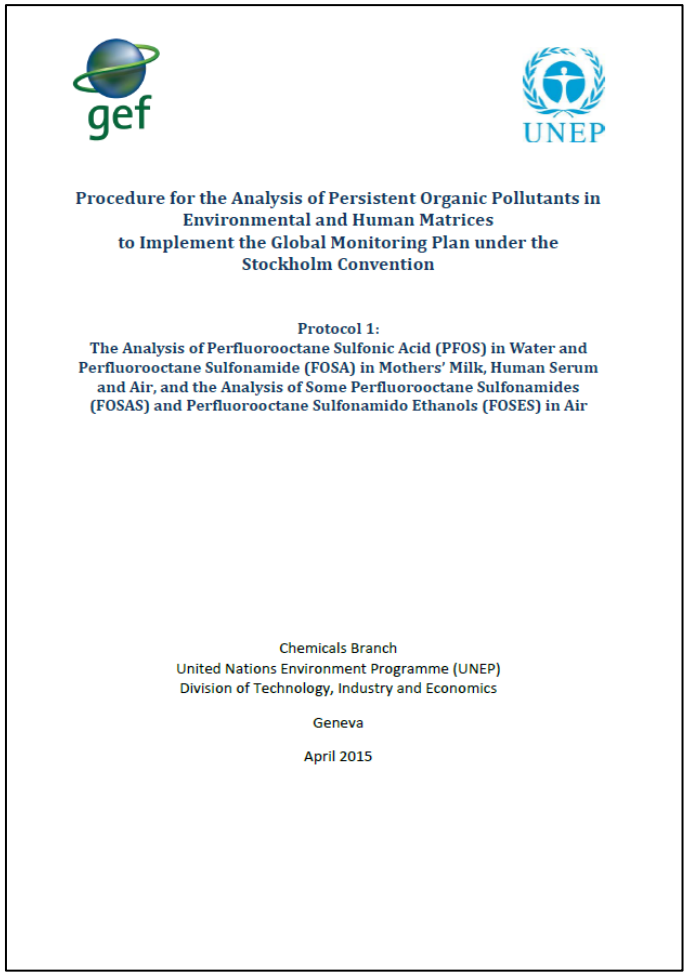
April 2015



Global Monitoring Plan on Persistent Organic Pollutants

Protocol for the Sampling of Water as a Core Matrix in the UNEP/GEF GMP2 Projects for the Analysis of PFOS

January 2017



Procedure for the Analysis of Persistent Organic Pollutants in Environmental and Human Matrices to Implement the Global Monitoring Plan under the Stockholm Convention

Protocol 1:
The Analysis of Perfluorooctane Sulfonic Acid (PFOS) in Water and Perfluorooctane Sulfonamide (FOSA) in Mothers' Milk, Human Serum and Air, and the Analysis of Some Perfluorooctane Sulfonamides (FOSAS) and Perfluorooctane Sulfonamido Ethanols (FOSES) in Air

Chemicals Branch
United Nations Environment Programme (UNEP)
Division of Technology, Industry and Economics

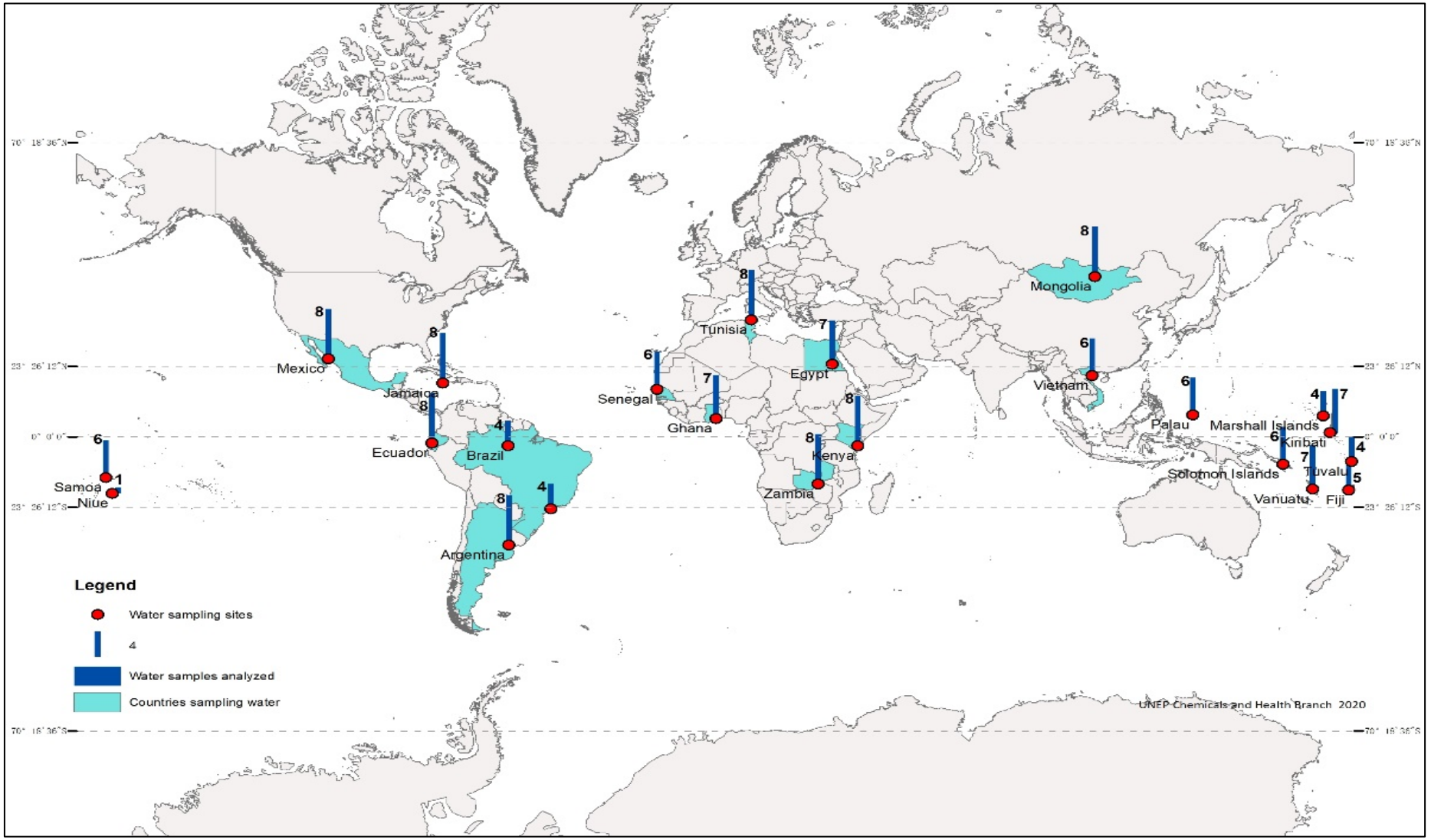
Geneva

April 2015

Results PFAS in water

1. Across all projects

Number of water samples analyzed for PFAS



Summary (n=144)

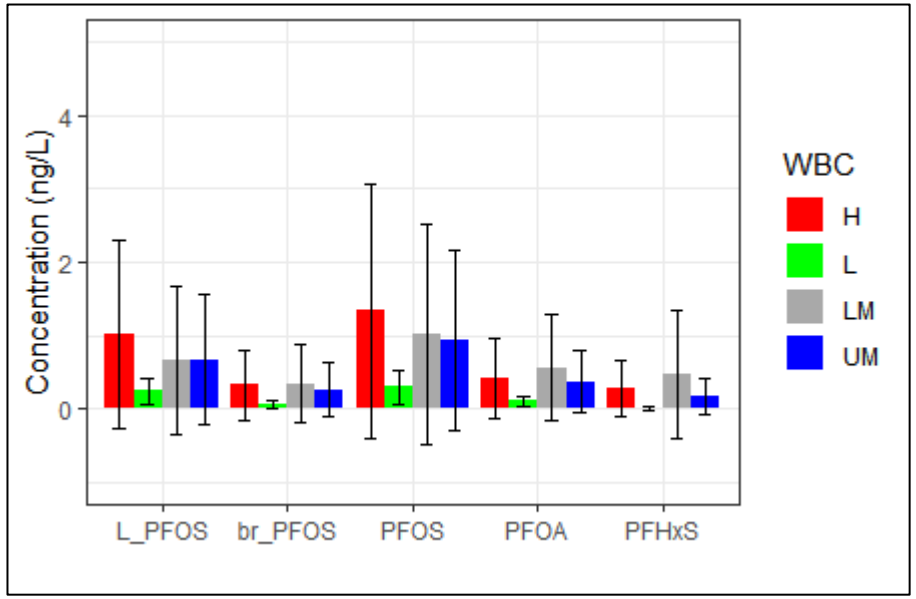
Distribution of sample origin and characteristics of the countries submitting water samples
Concentrations in ng/L

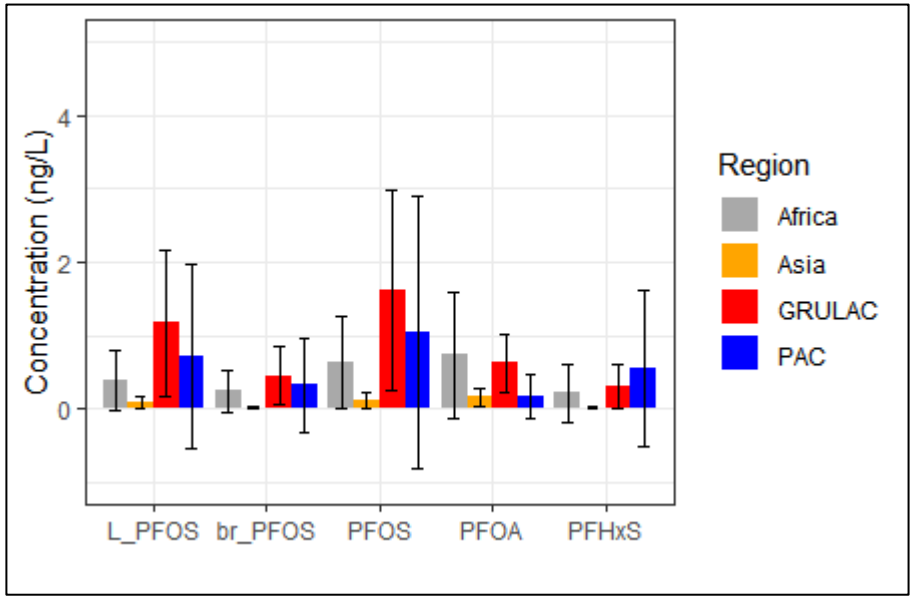
	Africa (N=44)	Asia (N=14)	GRULAC (N=40)	PAC (N=46)	Overall (N=144)
PFOS					
Mean (SD)	0.637 (0.637)	0.107 (0.111)	1.61 (1.35)	1.04 (1.85)	0.985 (1.39)
Median [Min, Max]	0.446 [0, 2.64]	0.0688 [0, 0.441]	1.35 [0.0443, 5.32]	0.0688 [0, 6.23]	0.370 [0, 6.23]
PFOA					
Mean (SD)	0.732 (0.854)	0.166 (0.118)	0.621 (0.396)	0.161 (0.302)	0.464 (0.599)
Median [Min, Max]	0.377 [0.0521, 4.02]	0.132 [0, 0.459]	0.551 [0.0506, 1.44]	0.0526 [0, 1.51]	0.225 [0, 4.02]
PFHxS					
Mean (SD)	0.217 (0.403)	0.0132 (0.0189)	0.305 (0.295)	0.552 (1.05)	0.329 (0.670)
Median [Min, Max]	0.0570 [0, 1.63]	0 [0, 0.0474]	0.166 [0, 0.952]	0.0129 [0, 3.51]	0.0550 [0, 3.51]

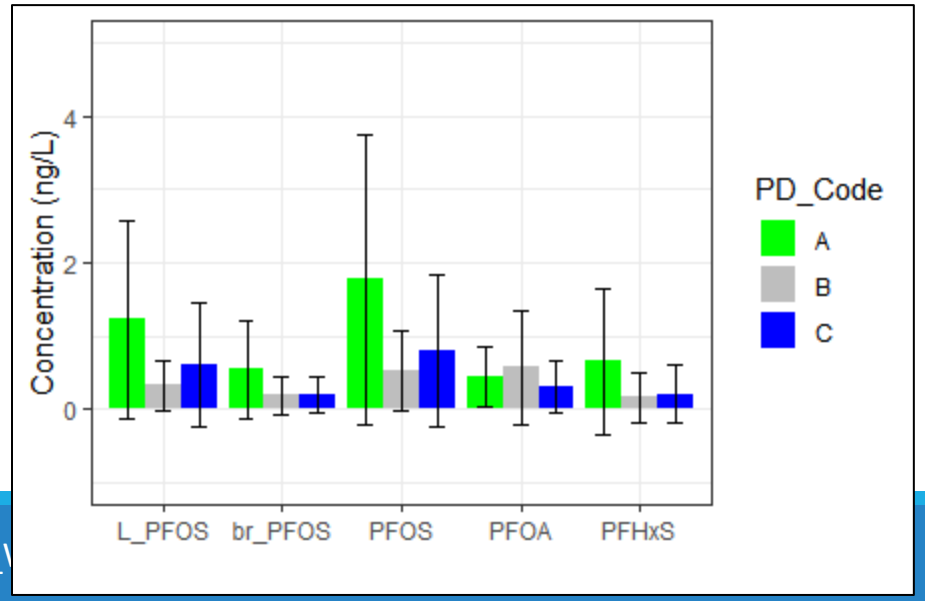
	Africa (N=44)	Asia (N=14)	GRULAC (N=40)	PAC (N=46)	Overall (N=144)
Region					
Africa	44 (100%)	0 (0%)	0 (0%)	0 (0%)	44 (30.6%)
Asia	0 (0%)	14 (100%)	0 (0%)	0 (0%)	14 (9.7%)
GRULAC	0 (0%)	0 (0%)	40 (100%)	0 (0%)	40 (27.8%)
PAC	0 (0%)	0 (0%)	0 (0%)	46 (100%)	46 (31.9%)
Year					
Y2017	24 (54.5%)	6 (42.9%)	20 (50.0%)	14 (30.4%)	64 (44.4%)
Y2018	20 (45.5%)	7 (50.0%)	20 (50.0%)	27 (58.7%)	74 (51.4%)
Y2019	0 (0%)	1 (7.1%)	0 (0%)	5 (10.9%)	6 (4.2%)
WBC					
L	4 (9.1%)	0 (0%)	0 (0%)	0 (0%)	4 (2.8%)
LM	40 (90.9%)	14 (100%)	0 (0%)	20 (43.5%)	74 (51.4%)
H	0 (0%)	0 (0%)	4 (10.0%)	6 (13.0%)	10 (6.9%)
UM	0 (0%)	0 (0%)	36 (90.0%)	20 (43.5%)	56 (38.9%)
PD_Code					
A	8 (18.2%)	8 (57.1%)	16 (40.0%)	14 (30.4%)	46 (31.9%)
B	29 (65.9%)	0 (0%)	16 (40.0%)	17 (37.0%)	62 (43.1%)
C	7 (15.9%)	6 (42.9%)	8 (20.0%)	15 (32.6%)	36 (25.0%)

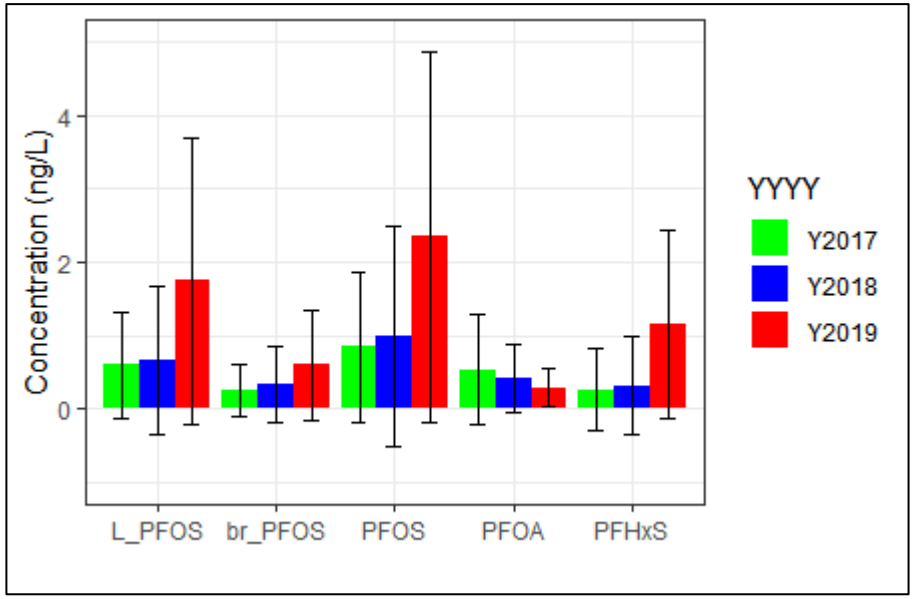
Statistical summary of results for PFOS, PFOA and PFHxS according to project region

Mean values and SD (n=144)



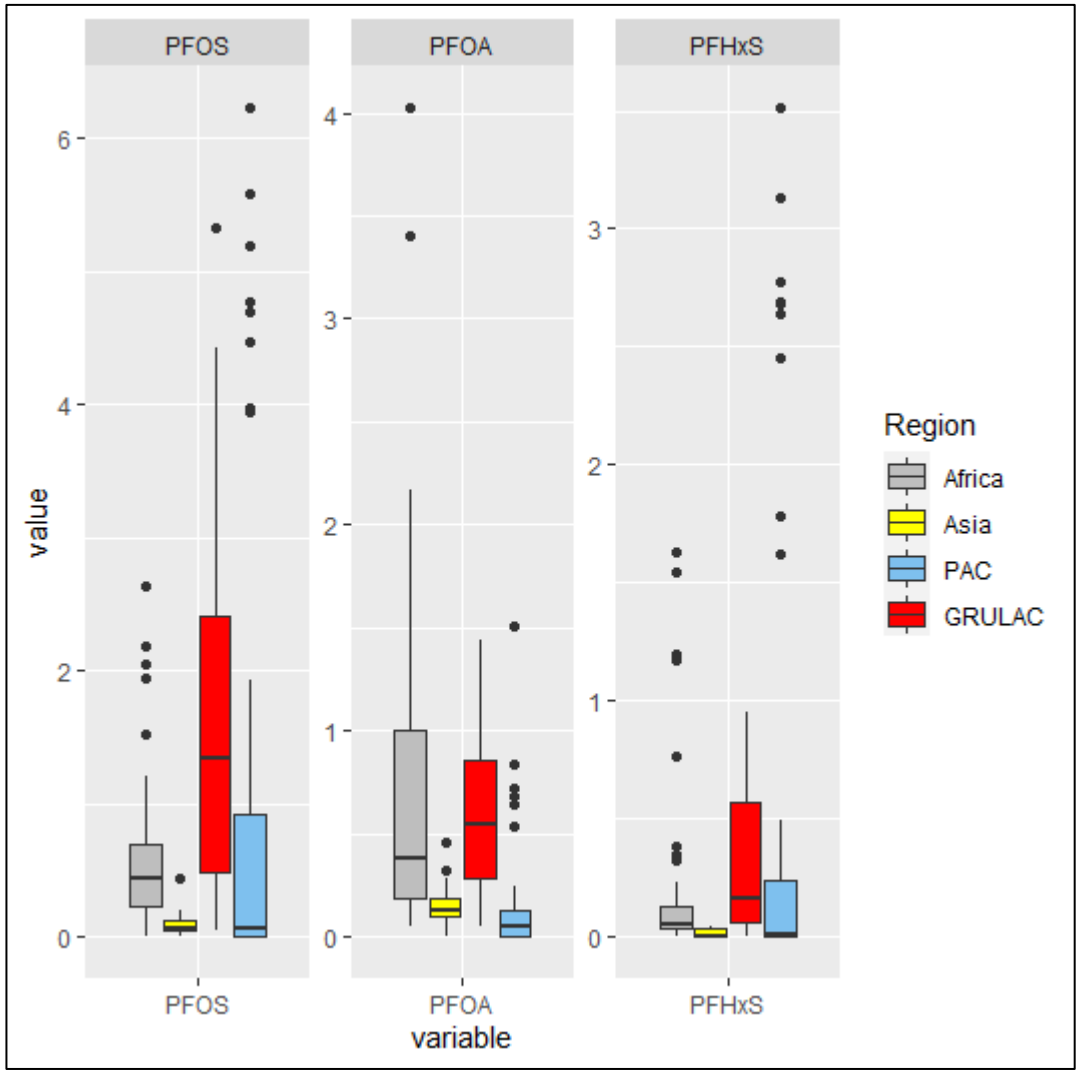


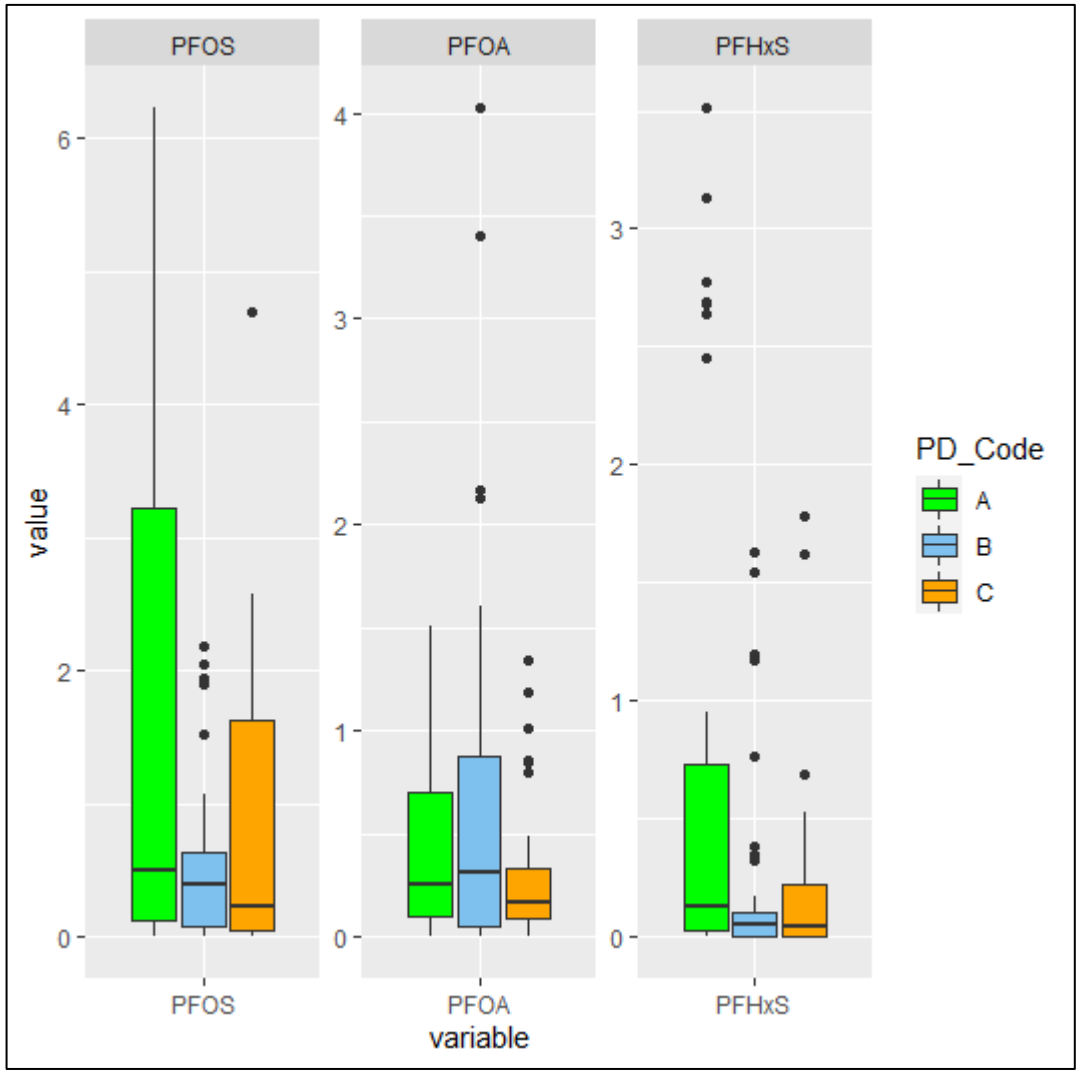




PD_Code: Population density code using World Bank indicator; WBC = World Bank classification of income

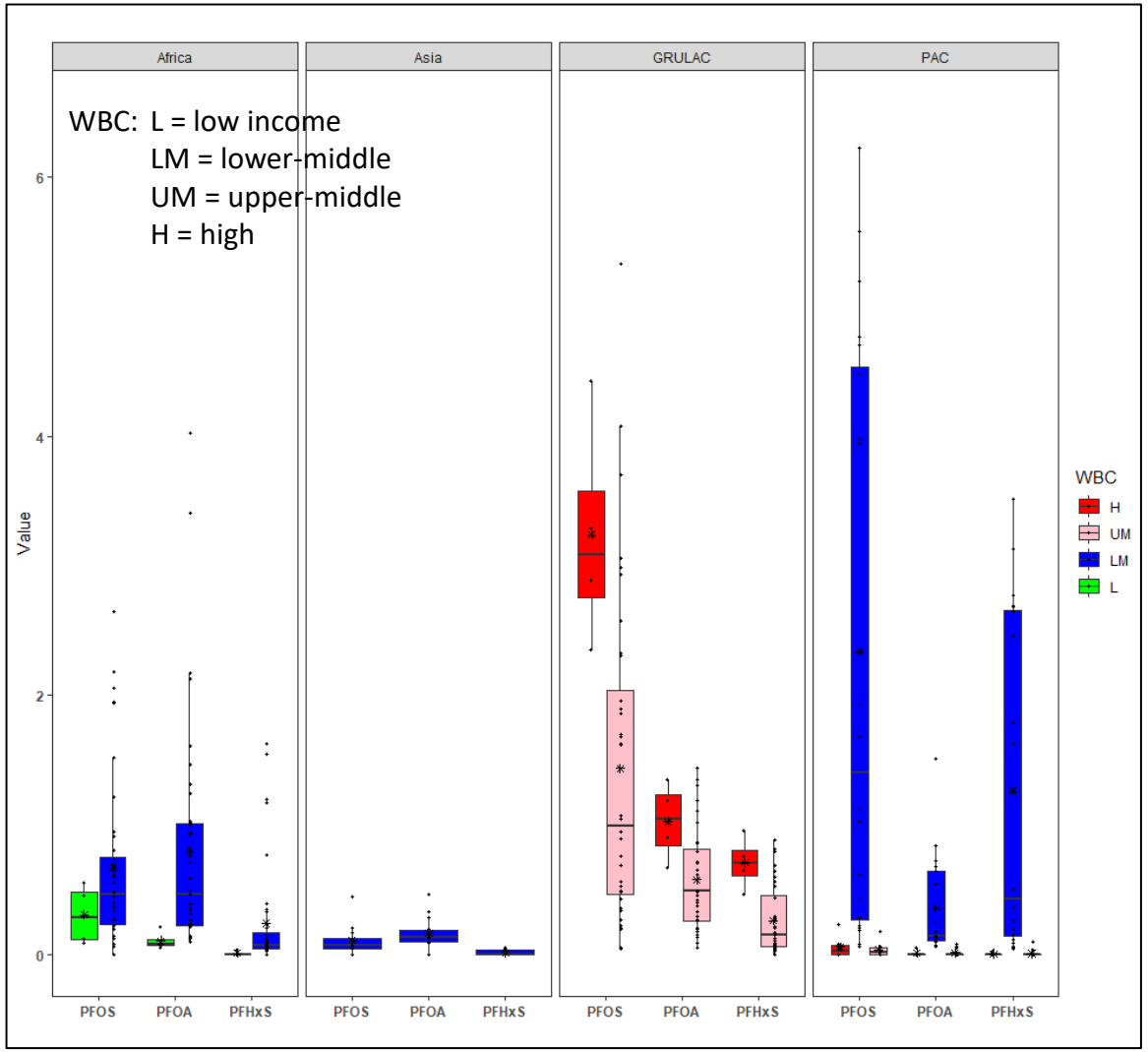
Overview PFAS per Region and PopDensity

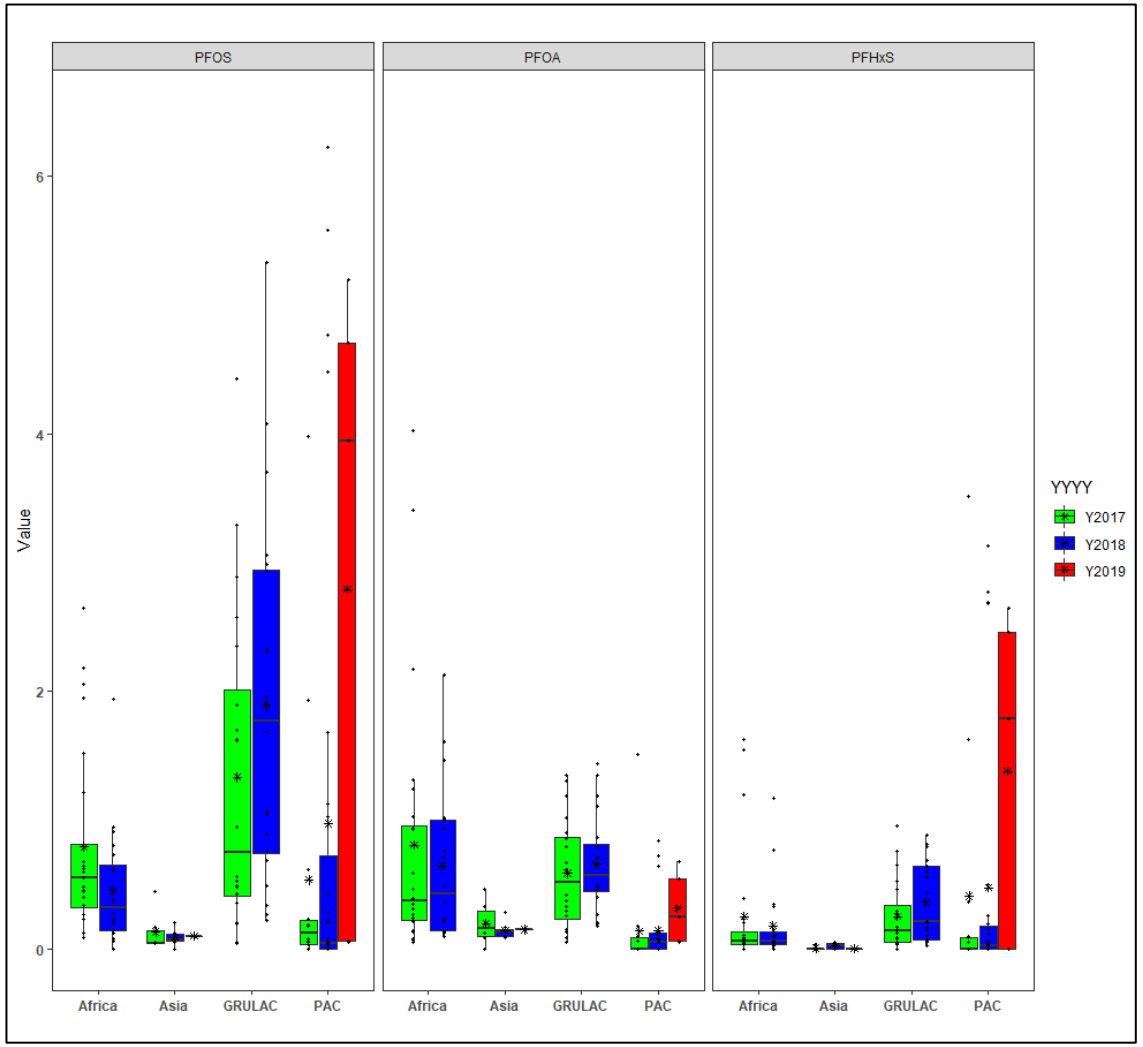




Values in ng/L

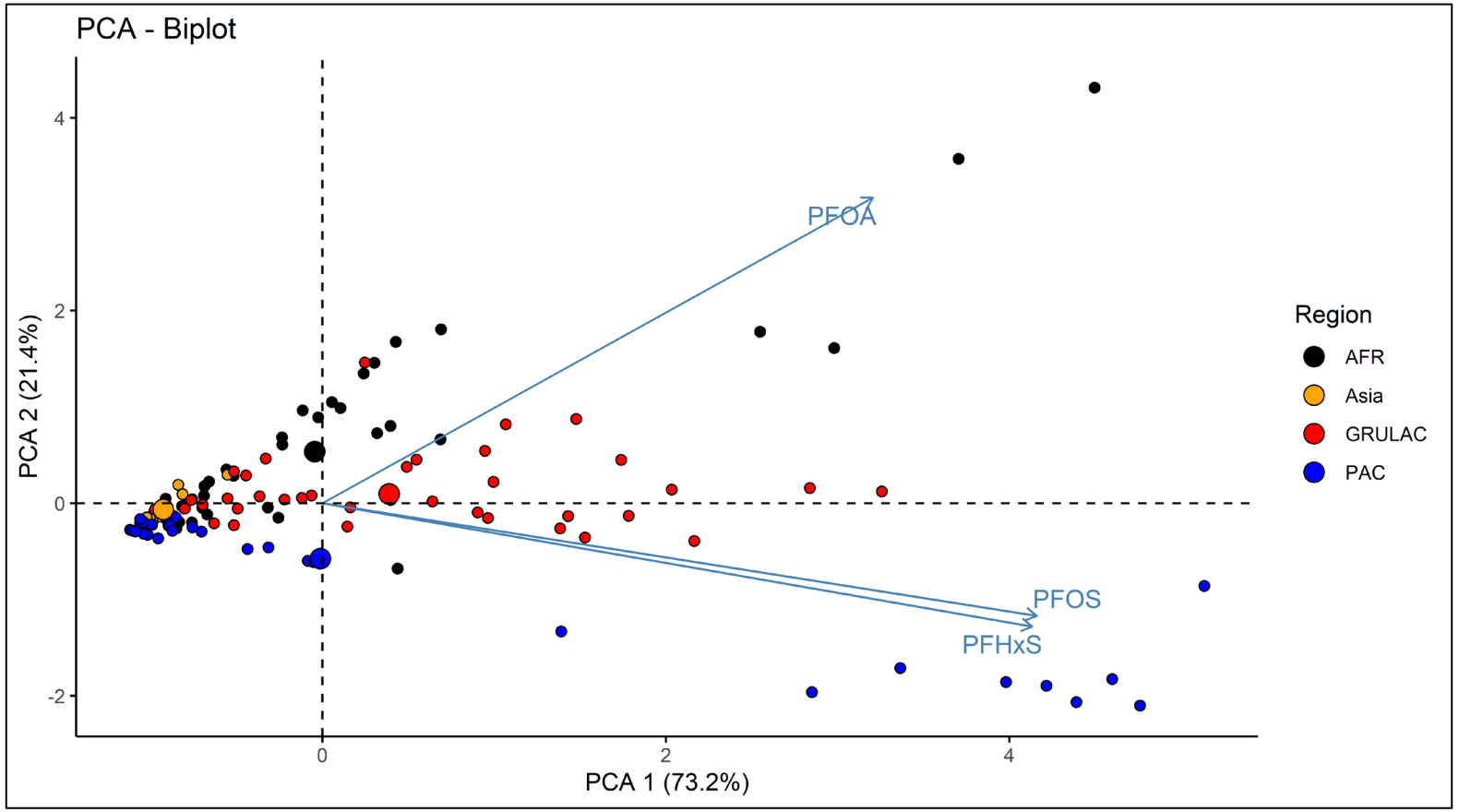
Overview according to income and year

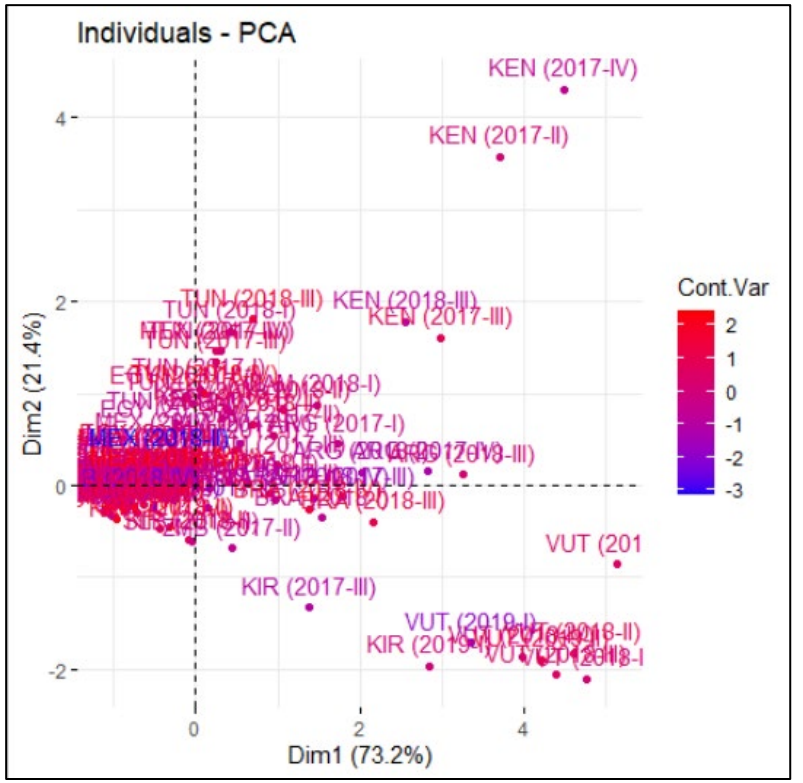


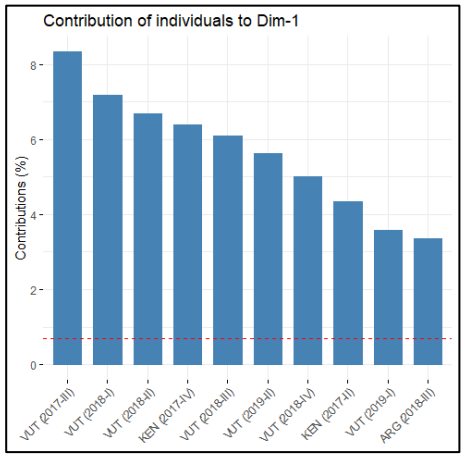


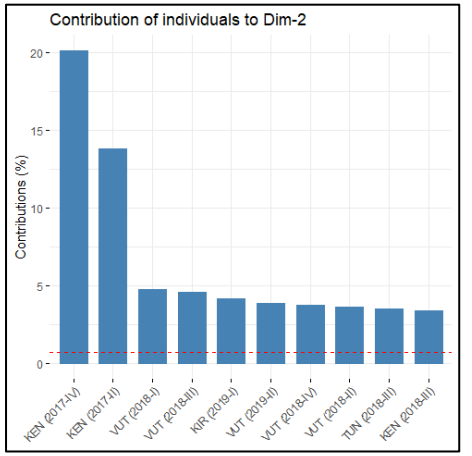
Values in ng/L

PCA biplot for region (n=144)





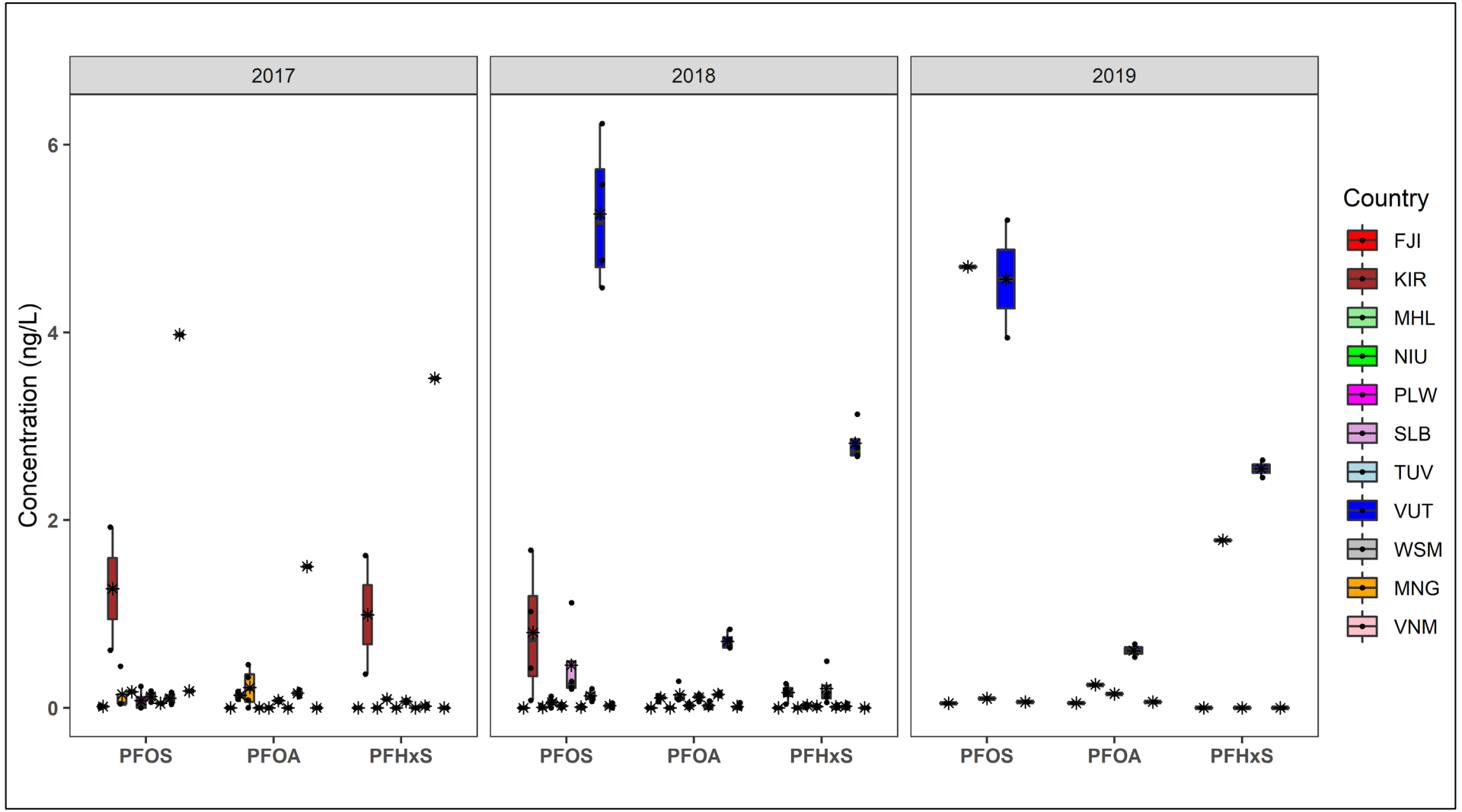




Results

2. Asia-Pacific Region

Overview on concentrations per country



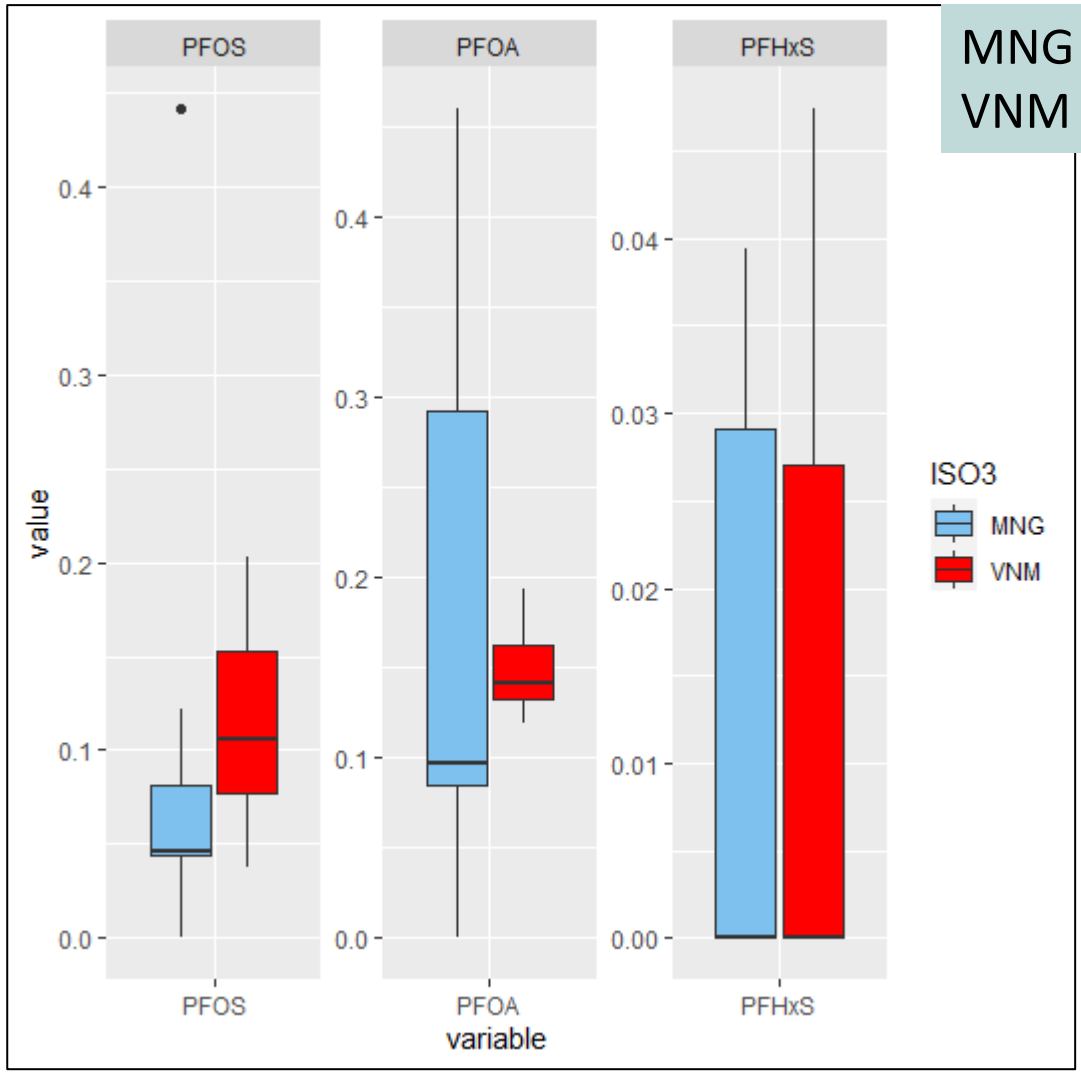
Asia-Pacific region:

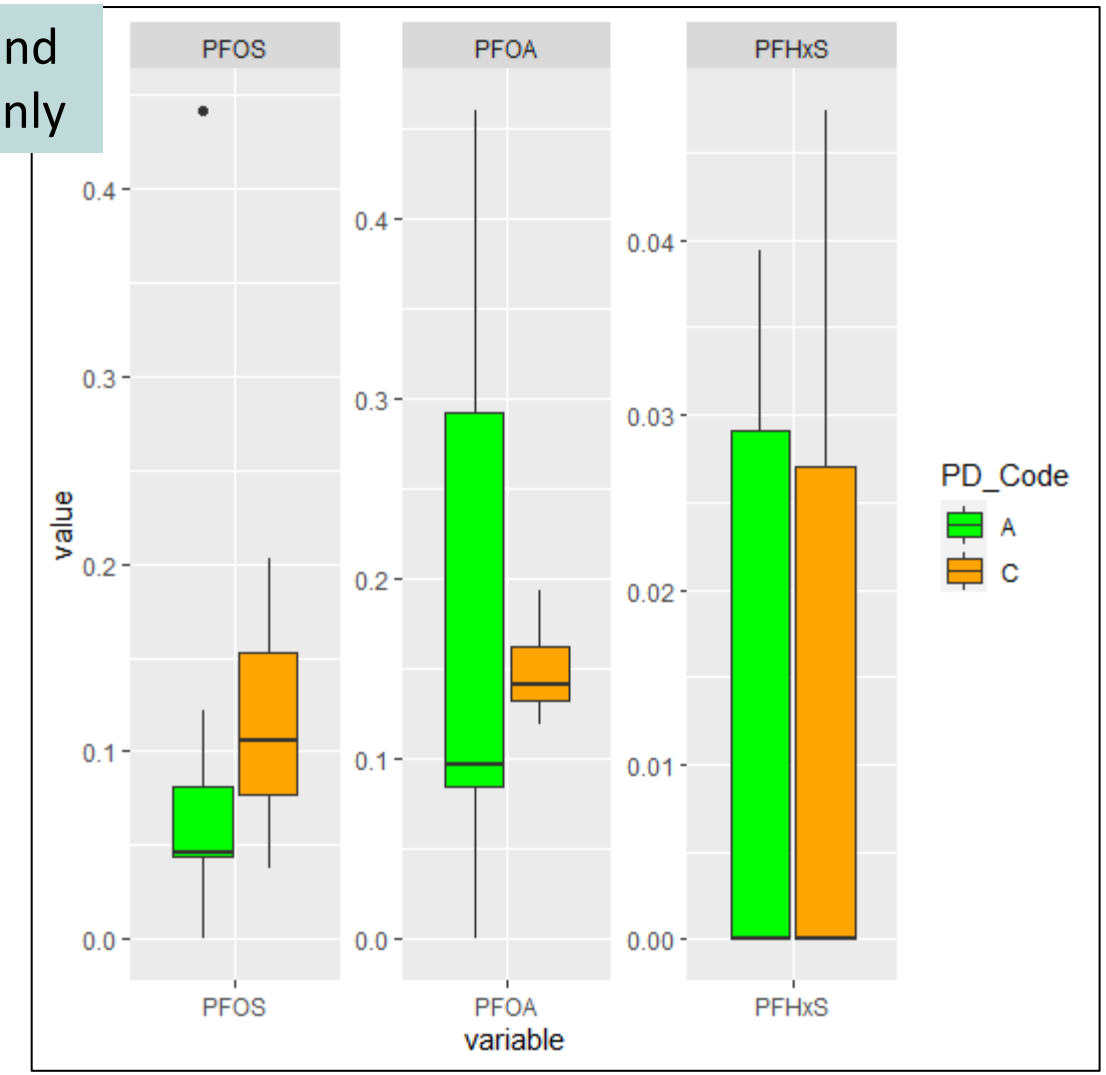
- 2 from Asia project
- 9 from PAC project

Values in ng/L

Concentrations of 3 PFAS in Asia project countries

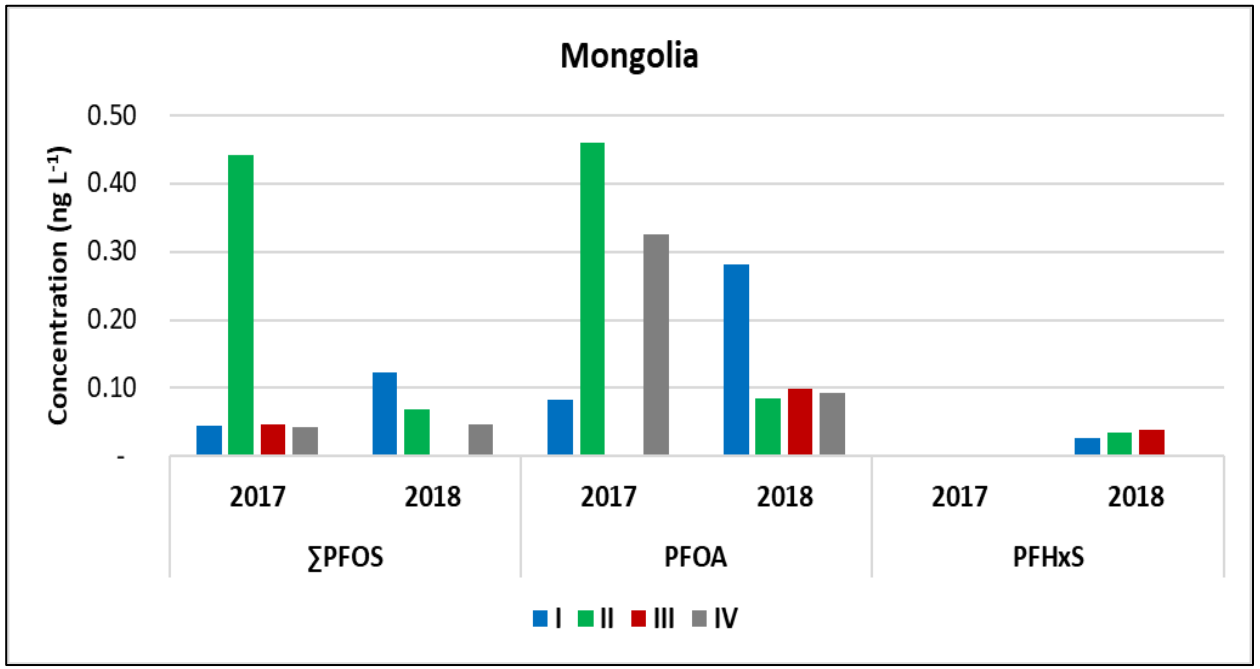
MNG and VNM only

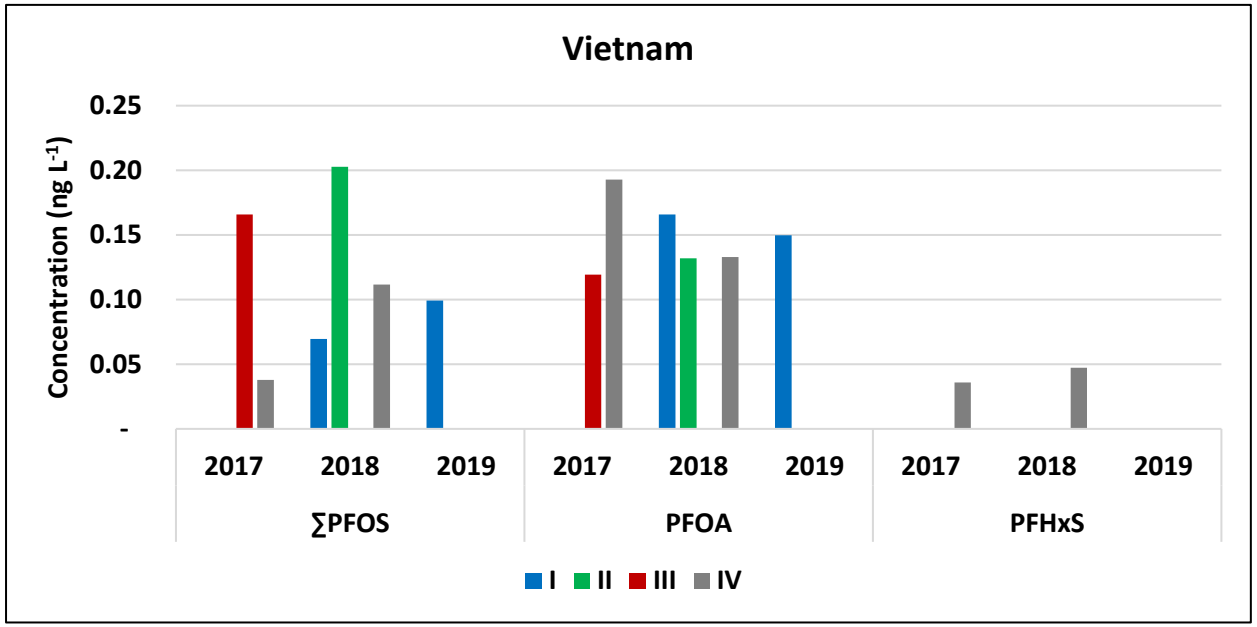




Values in ng/L

PFAS in surface water Asia





Season codes (sampling date): I = March 31, II = June 30; III = Sep 30; IV = Dec 31

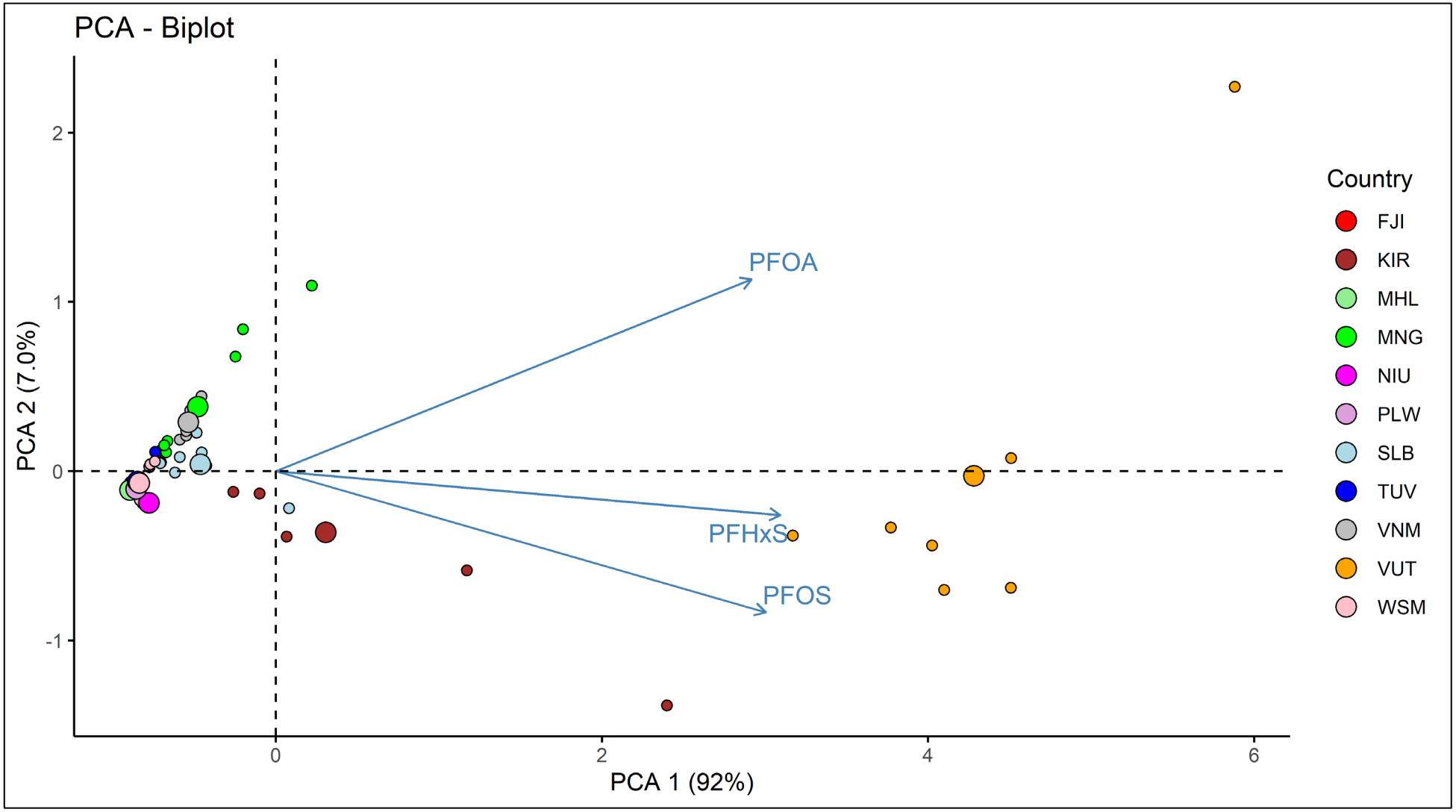
Mean values for PFAS in surface water
Asia-Pacific region

n=60

Concentrations in ng/L

Year/Country	#Results	Average SPFOS	Average PFOA	Average PFHxS
2017	**20**	**0.49**	**0.31**	**0.82**
FJI	2	0.03	<LOQ	<LOQ
KIR	2	1.27	0.13	0.99
MNG	4	0.14	0.29	<LOQ
NIU	1	0.17	<LOQ	0.09
PLW	4	0.15	<LOQ	<LOQ
SLB	2	0.12	0.08	0.07
TUV	1	0.05	<LOQ	<LOQ
VNM	2	0.10	0.16	0.04
VUT	1	3.98	1.51	3.51
WSM	1	0.18	<LOQ	<LOQ
2018	**34**	**1.17**	**0.22**	**0.72**
FJI	2	<LOQ	<LOQ	<LOQ
KIR	4	0.80	0.11	0.16
MHL	4	0.03	<LOQ	<LOQ
MNG	4	0.08	0.14	0.03
PLW	2	0.04	0.05	0.03
SLB	4	0.46	0.11	0.20
TUV	3	0.03	0.07	0.03
VNM	3	0.13	0.14	0.05
VUT	4	5.26	0.71	2.82
WSM	4	0.04	0.05	<LOQ
2019	**6**	**2.34**	**0.29**	**2.29**
FJI	1	0.05	0.05	<LOQ
KIR	1	4.70	0.25	1.79
VNM	1	0.10	0.15	<LOQ
VUT	2	4.57	0.61	2.55
WSM	1	0.06	0.06	<LOQ
Grand Total	**60**	**1.07**	**0.26**	**0.91**

PCA biplot for Asia-Pacific countries



Acknowledgment:

- This work was funded through a grant from UN Environment (funds from the Global Environment Facility – GEF) “Supporting implementation of the Global Monitoring Plan on POPs” to Örebro University;
- Thanks to Dr. Leo W.Y. Yeung for PFASs QA/QC, Siamak Sobhanei, Mohammad Sadia, and Abeer Baabish for PFAS lab work;
- Thanks to all national teams for providing the samples.

Thank you !