

Interlaboratory reproducibility of PFAS measurements in water: Insights from 8 years of PTS

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INTRODUCTION

Per- and polyfluoroalkyl substances (PFAS) are a class of more than 10 000 synthetic chemicals. They are widely used in industry due to their physicochemical properties (hydrophobic and lipophobic behavior) and their exceptional **resistance** to degradation. This resistance makes them highly persistent in the environment.

Since the late 1990s, PFAS have drawn

global attention from the scientific and regulatory community and the public, because of the growing evidence of their **potential health effects**. After more than half a century of production, some PFAS, such as PFOS and PFOA, have been listed under the international Stockholm Convention on Persistent Organic Pollutants, which aims to restrict or eliminate their use.

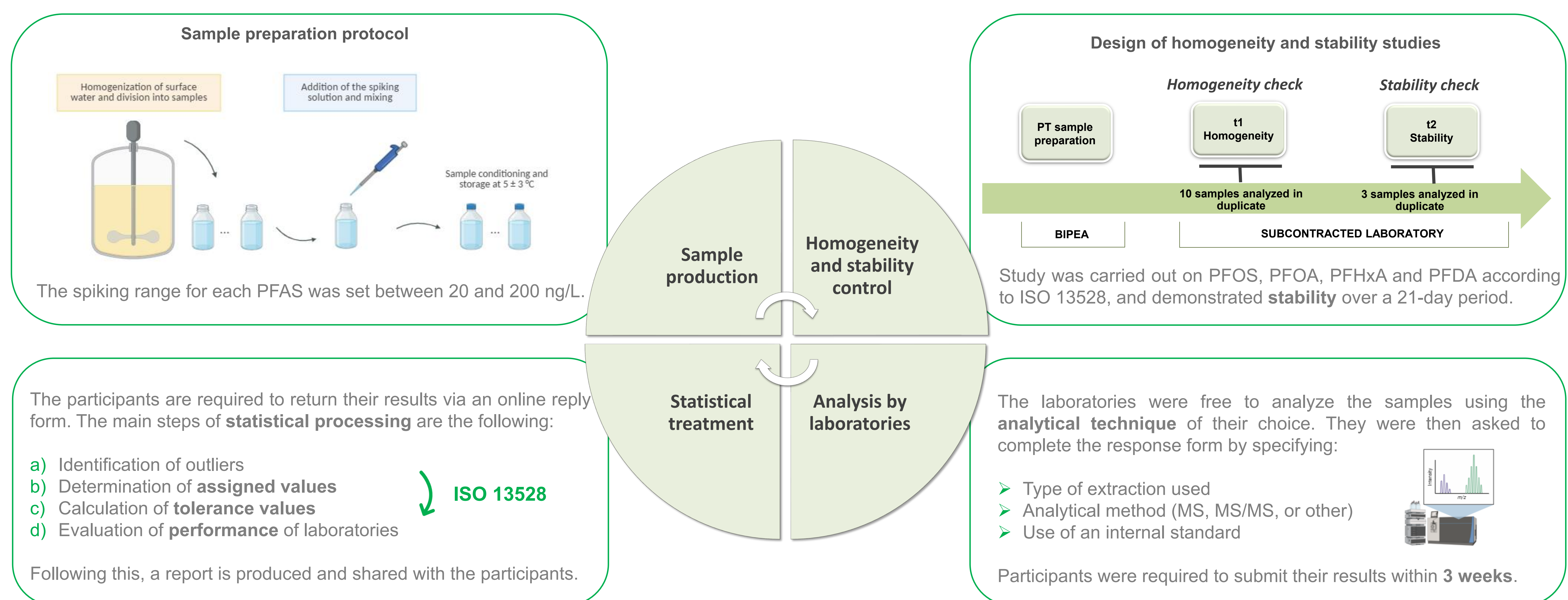
Despite significant analytical progress, the reliable determination of PFAS remains a

major challenge, due to issues such as cross-contamination, limited availability of suitable standards, matrix effects, and variability between instruments. As analytical techniques continue to evolve and diversify, interlaboratory studies provide valuable insight into current **analytical performance and variability**.

Since 2017, BIPEA (Bureau Interprofessionnel d'Études Analytiques) has been running a proficiency testing scheme (PTS) dedicated to

the quantification of PFAS in waters, in accordance with ISO 17043 [1] requirements. The statistical evaluation of participant results is performed following the principles and calculation methods described in ISO 13528 [2]. This PTS provides an independent assessment of the **analytical performance** of laboratories to meet the requirements of ISO 17025 [3] and produces data that offer insights into **PFAS determination in surface waters**.

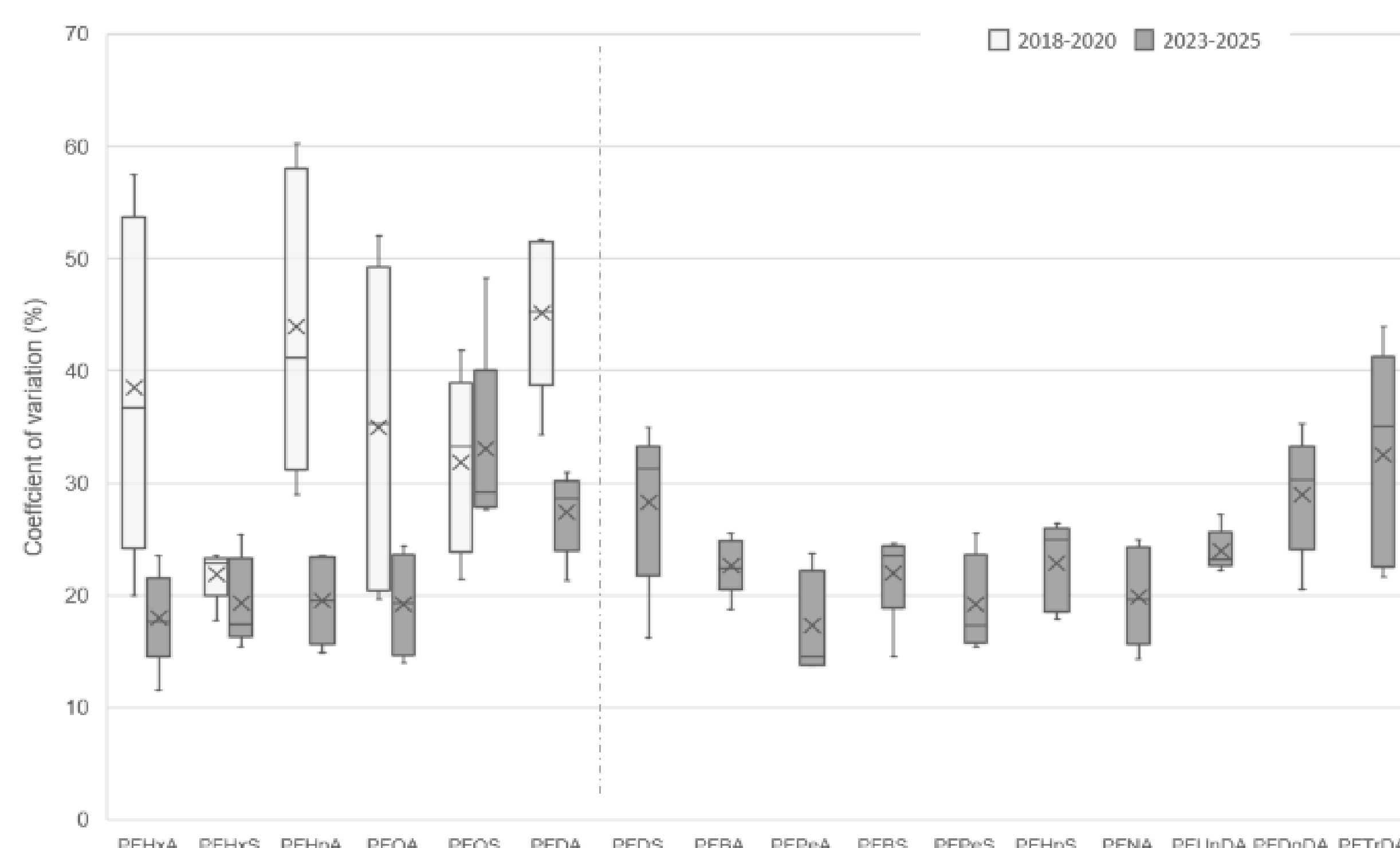
METHODOLOGY



RESULTS and DISCUSSION

In this study, we analyzed PFAS results submitted by laboratories participating in BIPEA proficiency tests on **surface waters**. Two periods were compared:

- Initial period** : December 2018 – December 2020 (5 tests – light grey)
- Recent period** : December 2023 – December 2025 (5 tests – dark grey)



Six PFAS were monitored throughout all rounds, while ten additional PFAS were introduced from 2023 onward. The average number of participating laboratories per PFAS is shown in **Table 1**.

PFAS	Early period (2018-2020)	Recent period (2023-2025)	PFAS	Recent period (2023-2025)
PFHxA	13	25	PFDS	23
PFHxS	14	25	PFBA	23
PFHpA	14	25	PFPeA	21
PFOA	14	25	PFBS	24
PFOS	14	25	PFPeS	21
PFDA	13	23	PFHpS	24
			PFNA	24
			PFUnDA	24
			PFDoDA	23
			PFTtDA	22

Table 1 - Laboratory participation per PFAS

To assess the interlaboratory variability observed across the test periods studied, the **robust coefficient of variation (CV)** was used. It is calculated as follows:

$$CV(\%) = \frac{s(x_{pt})}{x_{pt}} \times 100$$

- $s(x_{pt})$: robust standard deviation
- x_{pt} : assigned value estimated from participants' results, using the robust algorithm A [2]

Figure 1 shows boxplots of the coefficients of variation obtained from BIPEA interlaboratory proficiency tests for 16 PFAS, comparing the 2 periods. Several key observations emerge from this:

- Higher interlaboratory variability in 2018-2020** for long-monitored PFAS (typically 20-50% CV)
- Marked decrease in 2023-2025**, indicating better analytical control and greater harmonization of laboratory practices
- Comparable variability for recently added PFAS**, indicating the extension of methodological improvements
- Persistently high variability for PFOS**, which remains the compound with the greatest interlaboratory dispersion
- Interlaboratory variability decreased** even with higher participation, highlighting the robustness of the testing procedures
- Consistent CVs** across PFAS (except PFOS) at around 20%

CONCLUSION

Overall, the results of this study show a continual and significant **reduction in inter-laboratory variability** for the quantitation of PFAS in surface water, reflecting enhanced methodological consistency and harmonization across laboratories. Despite these advances, measurement variability remains compound-dependent, which indicates the persistence of specific **analytical challenges**. These results clearly illustrate the key role of PTS as a reference tool for monitoring the analytical performance of laboratories and contribute to reinforcing confidence in the **reliability of PFAS measurements in water**.

In a context of expanding regulations, with the progressive inclusion of new PFAS such as TFA and precursors (e.g., 6:2 FTAB or 6:2 FTSA), **inter-laboratory proficiency tests remain essential**, both for established PFAS and for emerging compounds, to ensure ongoing documentation of the **analytical performance of laboratories**.

REFERENCES

- ISO/IEC 17043 (2023)** : Conformity assessment - General requirements for the competence of proficiency testing providers
- ISO 13528 (2022)** : Statistical methods for use in proficiency testing by interlaboratory comparison
- ISO/IEC 17025 (2017)** : General requirements for the competence of testing and calibration laboratories