

Ozone measurements with standard reference photometers in Germany - a success story with metrological traceability

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Summary

UBA and PTB have been working together for more than 20 years to ensure the metrological traceability of ground-level ozone measurements in Germany. The ozone measurements are carried out using an UV absorption process with Standard Reference Photometers (SRP). UBA and PTB have brought their respective SRPs together at an UBA site. The quality assurance of ozone measurements in Germany is therefore unique in the world. The German ozone standard is compared with all metrology institutes worldwide through UBA's participation in the international Key Comparison BIPM.QM-K1. The Degrees of equivalence D_i of UBA at the ozone nominal amount fractions 80 and 420 nmol/mol are 0.03 and -0.03 nmol/mol with an uncertainty $U(D_i)$ of 1.13 and 4.45 nmol/mol.

Methods



Figure 1: SRP 29 (UBA) and SRP 19 (PTB) at the UBA laboratory in Langen

Ozone calibrations at UBA

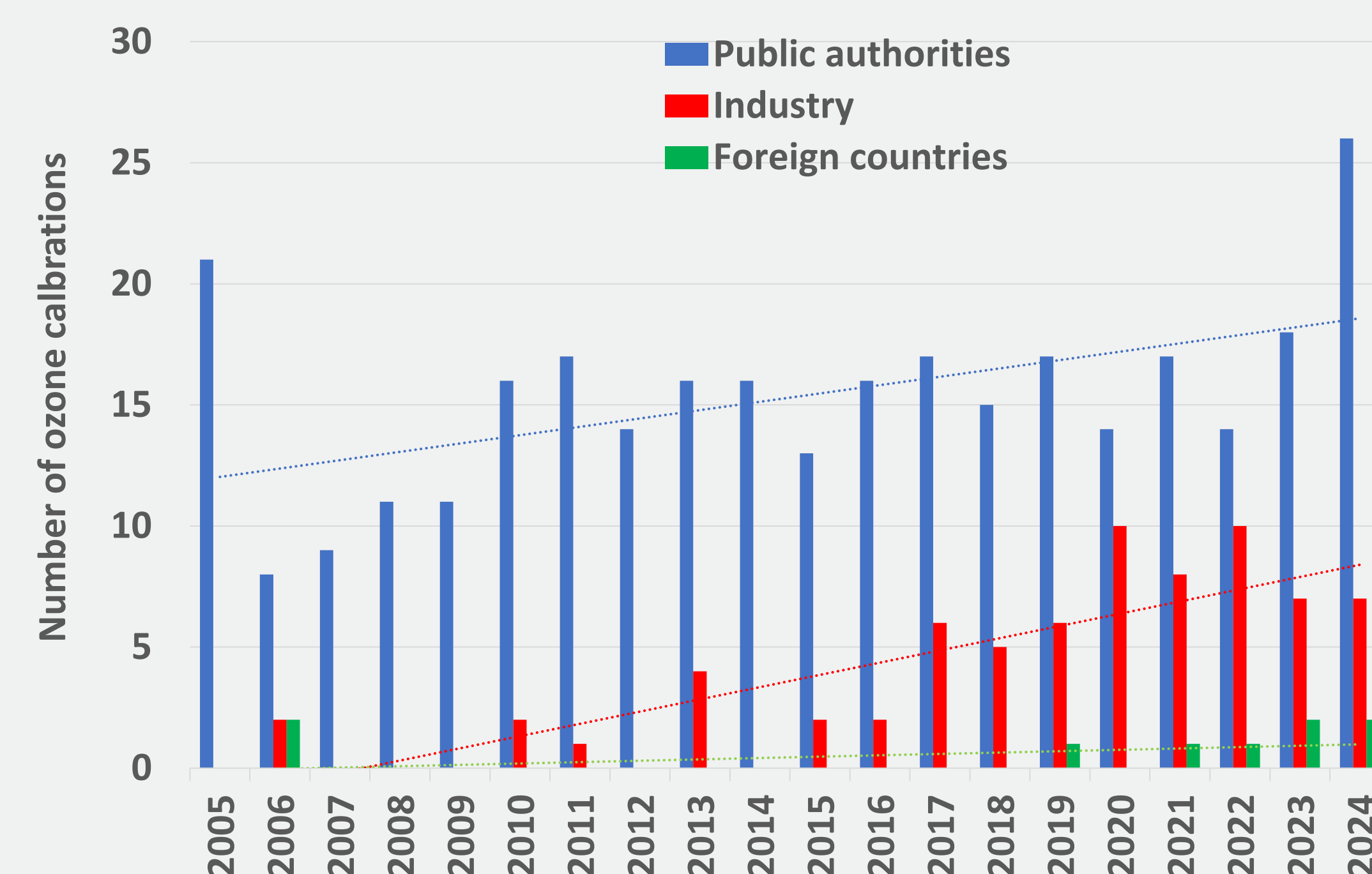


Figure 4: Development of ozone calibrations at UBA

Results

In addition to participating in BIPM.QM-K1 and routinely reviewing the physical parameters of the SRPs, Germany conducts regular comparative measurements of two SRPs. Data from more than 20 years are now available for this comparison between SRP 19 and SRP 29 (Fig. 3). The red ellipse displays the decreasing uncertainty because of the new O_3 absorption cross section CCQM.O3.2019.

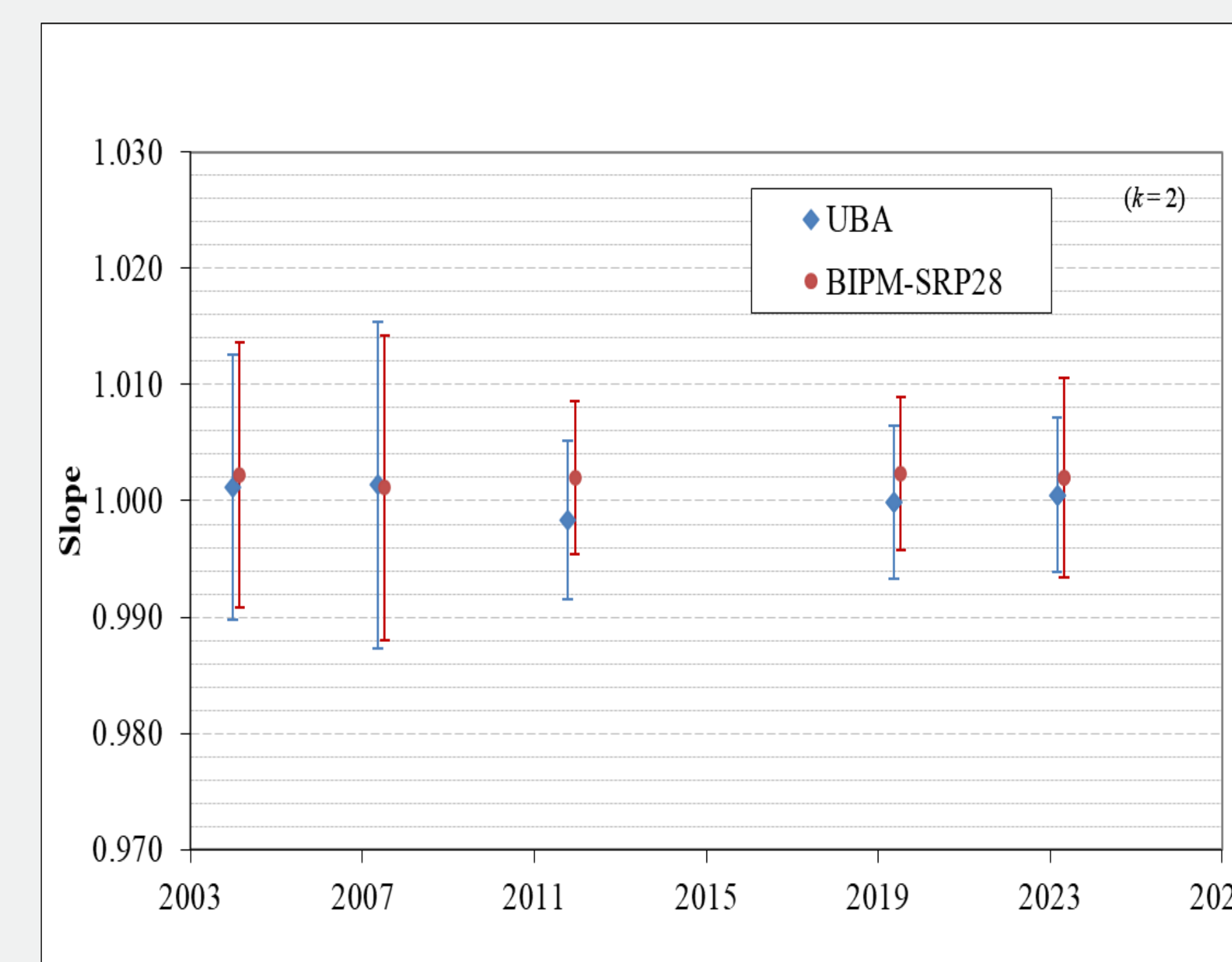


Figure 2: Results of BIPM.QM-K1 between BIPM and UBA (Source: Viallon et al., 2025)

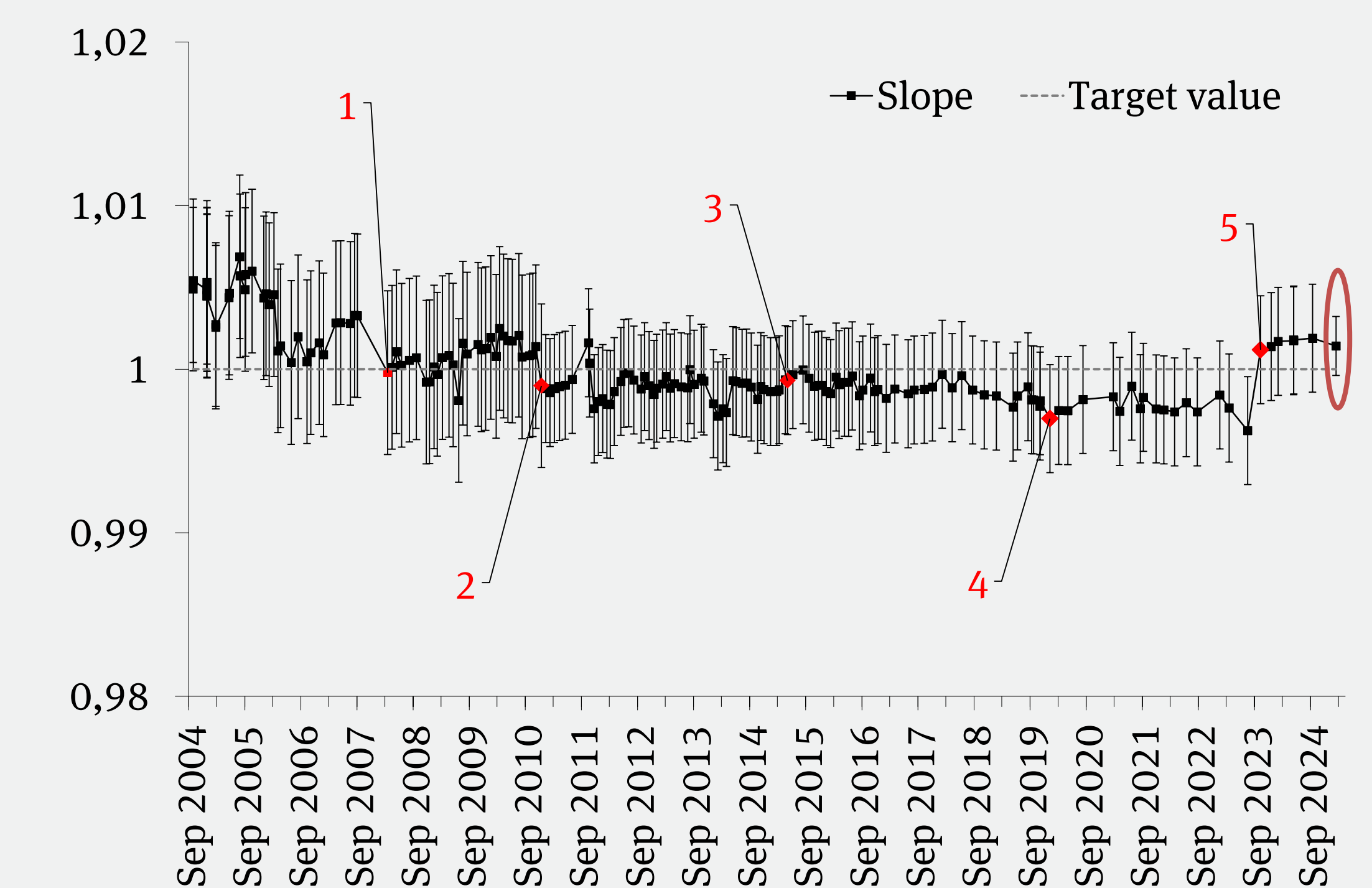


Figure 3: Quality control chart SRP 29 versus SRP 19, linear regression (slope)
1 Upgrade of SRP 29,
2 Upgrade of SRP 19,
3 Backfitting of central zero air supply,
4 Change of generator lamp SRP 29,
5 last upgrade SRP 29/SRP 19

References

- NISTIR 6963 (R. J. Pour; A. M. Bass; J. E. Norris; T. J. Buckley) "Standard Reference Photometer for the Assay of Ozone in Calibration Atmospheres"; Feb. 2003
- Hodges, J. T. et al., "Recommendation of a consensus value of the ozone absorption cross-section at 253.65 nm based on a literature review", METROLOGIA, 2019, doi: 10.1088/1681-7575/ab0bdd.
- Viallon, J. et al., "Final report, ongoing key comparison BIPM.QM-K1, ozone at ambient level, comparison with UBA, July 2023", METROLOGIA, 2025, doi: 10.1088/0026-1394/62/1A/08011.

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