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Using atmospheric observations to identify point sources of halogenated trace gases

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Measurement-based emission estimates derived from atmospheric observations provide an independent and important approach for identifying emission sources, quantifying emissions and verifying reported inventories. This is particularly relevant for halogenated gases, which due to their role as ozone depleting substances and potent greenhouse gases are regulated under various international and national frameworks. Here, we present two studies highlighting the urgency and the challenges of the measurement-based emission estimates of sulfur hexafluoride (SF_6) and fluoroform (HFC-23) with a particular focus on the influence of point sources.

SF_6 and HFC-23 are two of the most potent greenhouse gases with a GWP_{100} of approximately 24,000 and 14,700, respectively. Previous studies consistently showed a dominant emission source in southern Germany contributing to a large share of European SF_6 emissions. Meixner et al., 2025 analysed emission estimates based on 22 European measurement sites revealing an underestimated SF_6 emission point source in southern Germany in contrast to the national inventory reports.

Recent studies highlighted major challenges in quantifying HFC-23 emissions (Adam et al., 2024; Rust et al., 2024). We investigate the effects of intermittency in emissions and explore different possibilities based on a priori assumptions about specific emission sources. Forward calculations from these potential emission sources are used to derive expected time series at observational sites. These are compared to observations from different European stations situated in the regions influenced by the potential point sources. We present different approaches based on European atmospheric measurements combined with multiple model approaches, including ICON-ART, FLEXPART and NAME.

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