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Forward modelling of SF_6 with ICON-ART

Maya Harms[1], Katharina Meixner[2], Tanja Schuck[2], Thomas Wagenhäuser[2], Sascha Alber[3], Kieran Stanley[4], Andreas Engel[2], Valentin Bruch[1], Thomas Rösch[1], Martin Steil[1], and Andrea Kaiser-Weiss[1]

[1]German Meteorological Service, Offenbach am Main, Germany
[2]Goethe University Frankfurt, Frankfurt am Main, Germany
[3]Forschungszentrum Jülich, Jülich, Germany
[4]University of Bristol, Bristol, United Kingdom

Sulfur hexafluoride (SF_6) is a highly potent greenhouse gas (GHG). Despite its high global warming potential (GWP), it continues to be produced and used in Germany. The reported emission estimates can be used to calculate expected concentrations at measurements sites. Within the PARIS (Process Attribution of Regional Emissions) project we used the operational numerical weather prediction model ICON (ICOsahedral Nonhydrostatic) and its extension module for aerosol and trace gases (ART) as an Eulerian forward model to calculate the expected mixing concentrations response of Germany's largest point source of SF_6. We compared the modelled concentration peaks that occur when the modelled plume crosses the measurement site of the Taunus observatory (TOB) with the respective observed signals (requiring background subtraction). The 4-year period of 2020-2023 was covered, and the uncertainty of the meteorological transport was estimated using a 20-member ensemble in our limited area model for Europe, which was run with a horizontal grid resolution of 6.5 km and 74 vertical levels.The model predicts well when peaks are measured but weWe found that most observed peaks at TOB are considerably higher than in the model, suggesting that prior emissions estimates were too low.
This indicates that the independent, observation-based emission estimate of our ICON-ART based system is in the range of double-digit tons, which is considerably higher than the self-reported SF_6 emission estimate for this point source, also if the model uncertainties are taken into account.