Nitrogen Trifluoride Global Emissions and Emission Factors Estimated from Atmospheric Observations

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Nitrogen trifluoride (NF_3), an anthropogenic greenhouse gas with a 100-yr Global Warming Potential (GWP) of over 16,000, has an increasing atmospheric abundance due to its emission from a growing number of manufacturing processes and an expanding end-use market. We present an updated historical record for atmospheric NF_3 based on a new and rigorous calibration (SIO-2012 scale), and show the latest analyses using our automated analytical method (an adapted Medusa GC-MS), including *in situ* measurements at La Jolla, California (32.87° N, 117.25° W).

We used a 2D atmospheric chemical transport model and inverse method together with our atmospheric data to optimally calculate global emissions over the last three decades. CO_2-equivalent NF_3 emissions (based on a 100-yr GWP) in 2011 totaled around 20 Mt, which equates to ~0.06% of global CO_2 emissions due to fossil fuel combustion and cement production. Our results suggest that the global emission factor has recently stabilized after many years of efficiency gains. Longer-term market trends for NF_3 are difficult to predict, however, production is expected to continue rising significantly in the foreseeable future. Given our latest findings, we expect a similar relative rise in both production and emissions over the coming years. This would lead to an accelerating rise in atmospheric NF_3 and a significant increase in the contribution of NF_3 to total radiative forcing. Although the emission factors we calculate are higher than "bottom-up" estimates from industry, from a climate perspective NF_3 continues to be preferred to C_2F_6 as source of fluorine plasma in industrial processes.

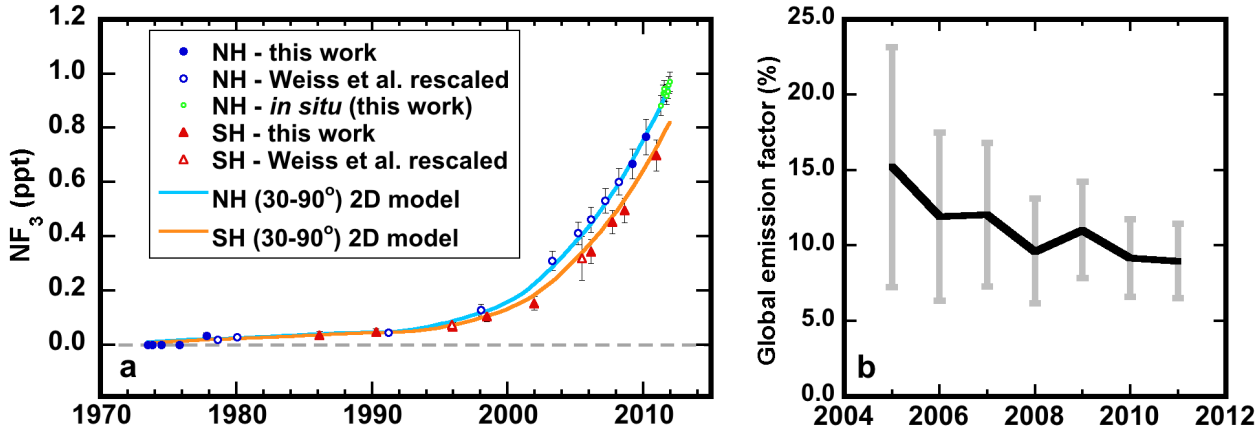

Figure 1. a) Nitrogen trifluoride abundances given in ppt (parts-per-trillion, dry air mole fraction) from Northern Hemisphere (NH) and Southern Hemisphere (SH) archived air sample measurements and *in situ* analyses at La Jolla, California in 2011. b) Emissions calculated from the atmospheric measurements were compared with industry production figures to estimate the global emission factor over recent years. Error bars represent a 1-σ uncertainty from the model-inversion emissions calculation. Uncertainties in the production figures were not available and are not included here.