EGU21-7980
https://doi.org/10.5194/egusphere-egu21-7980
EGU General Assembly 2021

Atmosphere-based US emission estimates of SF6 for 2007 - 2018

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Sulfur hexafluoride (SF_6) is a potent greenhouse gas (GHG) that is primarily emitted from electrical circuit breakers and heavy-duty gas-insulated switchgears in electric transmission and distribution equipment, magnesium production and processing, and electronics production. It has a 100-year global warming potential of 23500 and an atmospheric lifetime of 850 (580 - 1400) years. Because of its extremely large global warming potential and long atmospheric lifetime, its emissions, while currently small, have an outsized influence on changing climate over the long term. However, current US emissions of SF_6 are uncertain. The US SF_6 consumption that was used to estimate SF_6 emissions in the US EPA national GHG reporting to the UNFCCC has an uncertainty of 30 – 60%, depending on whether to use the US SF_6 supplier reports or user reports. With different inventory methodologies, the national emissions estimates of SF_6 from the EDGAR and US EPA's GHG inventories differ by more than a factor of 4. Here, we will present the first detailed U.S. national and regional emissions of SF_6 that were derived from an inverse analysis of an extensive flask-air sampling network from the US NOAA's Global Greenhouse Gas Reference Network and high-resolution atmospheric transport simulations for 2007 - 2018. We will discuss our atmosphere-based top-down emission estimates in comparison with the existing bottom-up emission inventories, our derived seasonal variation of SF_6 emissions, and associated implications regarding each industry's contribution to emissions and optimal emissions mitigation strategies. Because atmospheric SF_6 measurements are also used to assess atmospheric transport errors assuming no biases in SF_6 emissions reported by the EDGAR inventory, our analysis also has important implications on limitations in such applications.