EGU23-5420, updated on 26 Apr 2024
https://doi.org/10.5194/egusphere-egu23-5420
EGU General Assembly 2023


# A global tracer release experiment to help estimate OH tropospheric concentrations and benchmark chemistry-transport models

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Despite the urgent need for reduction of greenhouse gas concentrations, their emissions remain at high levels worldwide. Atmospheric inverse modelling allows to quantify these emissions by leveraging observations of greenhouse gas mole fractions and chemistry-transport models. However, this technique largely relies on models with an imperfect representation of transport and chemical processes and the resulting errors propagate to emission estimates. Atmospheric scientists can improve their models by comparing simulated processes against available observational data.

One efficient, although challenging, way of acquiring such validation data is to perform a tracer release experiment. It consists of releasing one or multiple decaying tracers into the atmosphere at one or multiple locations in the world, and then observe their time-evolving mixing ratios to understand transport pathways, mixing and decay rates. To the best of our knowledge, tracer release experiments have only been performed at local or regional scales to study transport processes, but never at the global scale. A global tracer release experiment could generate invaluable data against which to compare model outputs. However, modelers must be able to disentangle transport and chemical processes from the data, which requires that the experiment be carefully designed. Subject to this requirement being met, it could help to better quantify and even reduce 1) transport errors by investigating inter- and intra-hemispheric transport and 2) chemistry errors by constraining OH tropospheric concentrations. These data could also help to create a benchmarking methodology to highlight the strengths and weaknesses of the regional and global models that are currently used to quantify greenhouse gas emissions.

Here, we present design considerations for such a global tracer release experiment based on simulations with the 3-D chemistry-transport model ICON-ART. Our first results indicate that releasing several hundred tons of two tracers with different lifetimes as pulses could be sufficient to obtain a good estimate of OH concentrations along the parcel trajectories. This method could be applied at different locations in order to sample a large part of the world and at different times, e.g., to account for seasonal variations in OH concentrations. However, we also show that many parameters influence the results and therefore we enumerate the benefits but also the limits of such an experiment.