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Inter-annual variability of CO and CH4 observations interpreted by a global Lagrangian transport model

Stephan Henne, Dominik Brunner, Jörg Klausen, and Brigitte Buchmann
Empa, Materials Science and Technology, Air Pollution/Environmental Technology, Dübendorf, Switzerland
(stephan.henne@empa.ch)

A Lagrangian particle dispersion model (based on FLEXPART, Version 8.0) was set up to simulate global CO and CH4 concentrations. Three million particles were constantly advected forward in time and allowed to pick up emissions during surface contact. Concentrations in the model were driven by 8-daily emission fields that reflect variability in biomass burning. Degradation of CO and CH4 (and CO production from CH4) was taken into accounting using monthly resolved OH fields and pressure and temperature dependent reaction rates. Next to the less diffusive character of the Lagrangina context, the benefit of this approach is the potential to analyse concentration contributions not only by source regions and source category (as could be done in the Eulerian context as well) but also by age of an air mass. This age is given by the transport time from a certain source region.

Here we analyse a multi-year run of the model (2001-2007) and discuss inter-annual variability of CO and CH4 as observed within the WMO/GAW programme. In total 60 and 69 observational data sets of CO and CH4, respectively, were analysed. Monthly receptor concentrations at the sites' location were extracted from the model. Changes and anomalies in source region contributions at these sites were revealed and exceptional transport pathways highlighted. In the Lagrangian context it is necessary to sum contributions of individual particles over a certain period of time to derive a robust concentration estimate at a given location in space. The temporal resolution of receptor concentrations is therefore limited by the number of particles passing through a receptor volume. We demonstrate the ability of our model setup to realistically simulated concentration variability at receptor sites on a day-to-day basis. This capacity is further proven by the identification of previously studied inter-continental transport events with duration of one to two days.