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Assessment of EDGAR emission inventory using carbon monoxide (CO) MOZAIC/IAGOS airborne measurements over Europe

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The main advantage of using airborne data is their ability to collect mole fraction measurements covering most of the troposphere. However, mainly due to the cost of rental aircraft, the number of flights is usually quite limited, with direct consequences on measurement availability. Making use of commercial airliners, the MOZAIC/IAGOS program provides CO mole fraction measurements on a regular basis, avoiding this disadvantage. In this study MOZAIC/IAGOS measurements have been used together with a Lagrangian particle dispersion model (STILT) to evaluate the representativeness of the EDGAR version-4.2 emission inventory at 3 different locations (Frankfurt, Paris and Vienna) for the time frame 2004-2011.

We make use of the concept of the mixed layer, where signals resulting from CO emissions are reasonable well mixed, and lead to an enhancement of CO within the mixed layer. We investigate the CO enhancement relative to values in the free troposphere (specifically at two km above the mixing height), for both the upper and lower half of the mixed layer. The hypothesis is that the CO enhancement in the upper half of the mixed layer is more representative for larger spatial scales, as the vertical distance to the surface and its emission sources is increased compared to that of the lower half. CO enhancements calculated from CO mole fractions modeled by STILT coupled with the emission inventory at 10 km horizontal resolution are compared with the corresponding values from observed CO mole fractions for both the lower and the upper half of the mixed layer. The transport model domain is roughly coincident with the EU territory; simulations show that most of the Lagrangian particles exit the domain to the north and to the west. On these sides of the domain, boundaries are represented by oceans, characterized by small CO vertical gradients. Modeled global CO fields from the MACC project will be used in this study as lateral boundary conditions.

We found that the simulation tends to significantly underestimate the measured CO mole fractions, indicating a low bias of about a factor of two in the inventory-reported CO emissions. In addition, the lower half of the mixed layer usually shows a smaller bias between the observed and modeled CO than does the upper half of the mixed layer. Potential reasons for the discrepancy between simulations and observations will be assessed.