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CO emission and export from Asia: an analysis combining complementary satellite measurements (MOPITT, SCIAMACHY and ACE-FTS) with global modeling

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Abstract. This study presents the complementary picture of the pollution outflow provided by several satellite observations of carbon monoxide (CO), based on different observation techniques. This is illustrated by an analysis of the Asian outflow during the spring of 2005, through comparisons with simulations by the LMDz-INCA global chemistry transport model. The CO observations from the MOPITT and SCIAMACHY nadir sounders, which provide vertically integrated information with excellent horizontal sampling, and from the ACE-FTS solar occultation instrument, which has limited spatial coverage but allows the retrieval of vertical profiles, are used. Combining observations from MOPITT (mainly sensitive to the free troposphere) and SCIAMACHY (sensitive to the full column) allows a qualitative evaluation of the boundary layer CO. The model tends to underestimate this residual compared to the observations, suggesting underestimated emissions, especially in eastern Asia. However, a better understanding of the consistency and possible biases between the MOPITT and SCIAMACHY CO is necessary for a quantitative evaluation. Underestimated emissions, and possibly too low lofting and underestimated chemical production in the model, lead to an underestimate of the export to the free troposphere, as highlighted by comparisons with MOPITT and ACE-FTS. Both instruments observe large trans-Pacific transport extending from ~20° N to ~60° N, with high upper tropospheric CO observed by ACE-FTS above the eastern Pacific (with values of up to 300 ppbv around 50° N at 500 hPa and up to ~200 ppbv around 30° N at 300 hPa). The low vertical and horizontal resolutions of the global model do not allow the simulation of the strong enhancements in the observed plumes. However, the transport patterns are well captured, and are mainly attributed to export from eastern Asia, with increasing contributions from South Asia and Indonesia towards the

tropics. Additional measurements of C_2H_2, C_2H_6 and HCN by ACE-FTS provide further information on the plume history. C_2H_2 and C_2H_6 enhancements are well correlated with the CO plumes, indicating common sources and rapid trans-Pacific transport. HCN observations show that the biomass burning contributes mainly at latitudes lower than ~40° N. This study provides a first step towards a full combination of complementary observations, but also highlights the need for a better evaluation of consistency between the datasets in order to allow precise quantitative analyses.

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