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Global model simulations of air pollution during the 2003 European heat wave

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Abstract. Three global Chemistry Transport Models – MOZART, MOCAGE, and TM5 – as well as MOZART coupled to the IFS meteorological model including assimilation of ozone (O_3) and carbon monoxide (CO) satellite column retrievals, have been compared to surface measurements and MOZAIC vertical profiles in the troposphere over Western/Central Europe for summer 2003. The models reproduce the meteorological features and enhancement of pollution during the period 2–14 August, but not fully the ozone and CO mixing ratios measured during that episode. Modified normalised mean biases are around −25% (except ~5% for MOCAGE) in the case of ozone and from −80% to −30% for CO in the boundary layer above Frankfurt. The coupling and assimilation of CO columns from MOPITT overcomes some of the deficiencies in the treatment of transport, chemistry and emissions in MOZART, reducing the negative biases to around 20%. The high reactivity and small dry deposition velocities in MOCAGE seem to be responsible for the overestimation of O_3 in this model. Results from sensitivity simulations indicate that an increase of the horizontal resolution to around 1°×1° and potential uncertainties in European anthropogenic emissions or in long-range transport of pollution cannot completely account for the underestimation of CO and O_3 found for most models. A process-oriented TM5 sensitivity simulation where soil wetness was reduced results in a decrease in dry deposition fluxes and a subsequent ozone increase larger than the ozone changes due to the previous sensitivity runs. However this latest simulation still

underestimates ozone during the heat wave and overestimates it outside that period. Most probably, a combination of the mentioned factors together with underrepresented biogenic emissions in the models, uncertainties in the modelling of vertical/horizontal transport processes in the proximity of the boundary layer as well as limitations of the chemistry schemes are responsible for the underestimation of ozone (overestimation in the case of MOCAGE) and CO found in the models during this extreme pollution event.

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