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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Formaldehyde over the eastern Mediterranean during MINOS: Comparison of airborne in-situ measurements with 3D-model results" *by* R. Kormann et al.

R. Kormann et al.

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Reply to referee # 2:

We would like to thank the referee for his/her thorough review of our manuscript. We carefully checked his/her comments and made the following changes:

Details about the trajectory model and the trajectory calculations made for the MINOS project can be found in the paper by Traub et al. (Chemical characteristics assigned to trajectory clusters during the MINOS campaign, Atmos. Chem. Phys., 3, 459-468, 2003). Three-dimensional trajectories were calculated with the FLEXTRA trajectory model developed by Stohl et al. (Interpolation errors in wind fields as a function of spatial and temporal resolution and their impact on different types of kinematic trajectories, J. Appl. Meteorol., 34, 2149-2165, 1995). As input data, three dimensional wind fields

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from ECMWF are used with a horizontal resolution of 2°. A higher resolution of 0.5° was used for a nested domain covering the latitude range from 15° to 75° N and the longitude range from 30°W to 70°E, respectively. To determine the airmass origin, 5 day backward trajectories were calculated. The particle positions with respect to latitude, longitude and height above sea level were calculated every 30 min. The temporal resolution along the flight track is one minute. Since the back-trajectory calculations are highly sensitive to the initial conditions with respect to time and space, the deduced airmass origin is not always correct. Nevertheless, the analysis of back-trajectory clusters along the flight path generally provides a good approximation of the airmass origin. This is supported by the good agreement between back-trajectory calculations based on the FLEXPART model, 3D model results (Lawrence et al., An operational global chemical weather forecast system for field campaign support: Predictions and observations of large scale features during INDOEX, MINOS, and CONTRACE, Atmos. Chem. Phys., 3, 267-289, 2003) and additional back-trajectories provided by the KNMI, DeBilt, The Netherlands (Scheeren et al., The impact of monsoon outflow from India and Southeast Asia in the upper troposphere over the eastern Mediterranean, Atmos. Chem. Phys. Discuss., 3, 2285-2330, 2003). Both trajectory models and the 3D-model indicate easterly advection at 200 hPa on August 3rd. Along with enhanced HCHO levels, significantly higher mixing ratios of biomass burning tracers e.g. CO (102 vs 74 ppbv), C2H2 (186 vs 44 pptv), CH3CN (168 vs 126 pptv) or CH3Cl (675 vs 576 pptv) were observed in airmasses of South Asian origin compared to those of North-American/North-Atlantic origin (Scheeren et al., 2003). Since the Mediterranean basin is under the direct influence of the descending branch of the Hadley circulation during the summer month, cloud free conditions prevail in this area during the summer month, so that deep convection can be widely excluded as a source of enhanced HCHO in the UT. As discussed by Lelieveld et al. (Global air pollution crossroads over the Mediterranean, Science, 298, 794-799, 2002) the chemical composition of the troposphere over the Eastern Mediterranean is strongly influenced by pollution advection, while local emissions can be neglected. Any measurement-model-comparison there-

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fore has to take into account the different (mainly altitude dependent) history of the airmasses, which affects the concentrations of HCHO precursors as well as HCHO production and destruction rates. Therefore, we compared the HCHO measurements to 3D model results even if the horizontal resolution of the model is insufficient to resolve small scale processes like local shallow convection or island emissions. This is especially important for the interpretation of the vertical profiles, where strongest gradients are observed, while horizontal variations of the HCHO mixing ratios were much smaller.

Technical remark: An improved version of figure 4 will be provided for the final revised version of the manuscript.

Interactive comment on Atmos. Chem. Phys. Discuss., 3, 1303, 2003.