We thank the reviewer for his/her comments on our paper. To guide the review process we have copied the reviewer comments *in black italics*. Our responses are in regular blue font. We have responded to all the referee comments and made alterations to our paper (**in bold text**).

Scientific comment by S.Y. Wang

We thank S. Y. Wang for his constructive comments to our work.

C1.1 *1. Cloud vs wet-aerosol? The present work incorporates detailed understandings about glyoxal processes on deliquesced aerosols, but somehow "did not consider uptake and possible chemical reactions of glyoxal in cloud droplets" (Page 26717, Line 14-15). Fu et al (2008) estimated the glyoxal SOA formation in cloud mainly. 3D model provides unique opportunity to test the relative importance of cloud droplets vs deliquesced aerosols. I wonder any specific reasons that cloud processing is not considered in this work?*

We agree with S. Y. Wang that this would be a good testbed for the relative importance of these processes. The amount of work that already went into implementing the in-aerosol SOA formation was considerable, and adding in-cloud formation was out of scope of this work. A description of in-cloud formation in a regional model is more complex than in a global model, as the underlying processes (resolved vs. parameterized clouds, transport within cloud water, convective displacement) are represented in more detail. Our variant of WRF-chem (MOZART gas-phase chemistry + MOSAIC aerosols) does not include all of the couplings necessary between chemistry and clouds / rain in general (e.g. an aqueous-phase chemistry mechanism with state-of-the-art organic chemistry, or a physically based washout scheme for gases) that allowed adding another process. We are currently working on resolving this issue, but substantial additional work is required. In addition the CalNex period had low cloudiness and precipitation, such that the impact of cloud processing of glyoxal was expected to be limited.

C1.2 *2. Fig 5: AMS measures sub-micron aerosols. How about modeled? Is it the sum of all size bins?*

No, to compare with AMS data the modeled aerosol size distribution is convolved with the transmission function of the AMS (see e.g. Knote et al., 2011, Appendix B for a method description). We have also added a sentence and reference in section 3 (p 17, l 27ff):

Measurements of aerosol chemical composition by the aerosol mass

spectrometer (AMS) were available at all 4 supersites and in Fig. 5 we show a comparison against our model results. For this comparison the modeled size distribution is convolved with the AMS transmission function (see Knote et al. (2011) for a method description). While nitrate concentrations [...]"

C1.3 *3. Fig 8: The authors stated "direct anthropogenic emissions of glyoxal are included..." how does this compare with other secondary sources as shown in this figure? It would be great if the primary source could be included into the figure as well. Similarly, glyoxal loss due to interact with aerosols could be included into the sink panel.*

We have estimated the contribution of direct emissions of glyoxal to be < 0.1% of the secondary production rates, and hence decided not to include it into the budget panel. We have added a sentence to the figure caption to mention this:

[...] over the simulation period in the lowest model level (pies), and its vertical variability (barplot). Direct emissions of glyoxal were found to be minor (< 0.1%) and are not included in the plots.

We further mention this in section 2.3 (p 9, l 17-19):

The MOZART mechanism describes the formation of glyoxal in the gas phase. Direct anthropogenic emissions of glyoxal are included according to the CARB emissions inventory, but were found to be negligible (< 0.1 % contribution to average surface glyoxal production) , which is consistent with earlier findings based on ambient time-series analysis in Mexico City (Volkamer et al., 2005).

We did not include the aerosol sink in the photochemical budget panel (Figure 8) because we would have different amounts for each parameterization / sensitivity study conducted. However, the reader can infer the effect of the aerosol sink on glyoxal concentrations from Figure 14, which we consider sufficient to address this point. Another sentence has been added to section 2.3 (p 9, l 20ff) to guide the reader (see also our response R1.8):

[...] partitioning into aerosols. A detailed description of the aerosol sink for glyoxal follows in section 2.3.2, and the reader is invited to consult Figure 14 showing the effect of this sink on gas-phase glyoxal concentrations. A constant dry deposition velocity [...]

Additional references used in the responses

Knote, C., Brunner, D., Vogel, H., Allan, J., Asmi, A., Äijälä, M., Carbone, S., van der Gon, H. D., Jimenez, J. L., Kiendler-Scharr, A., Mohr, C., Poulain, L., Prévôt, A. S. H., Swietlicki, E., and Vogel, B.: Towards an online-coupled chemistry-climate model: evaluation of trace gases and aerosols in COSMO-ART, Geosci. Model Dev., 4, 1077-1102, doi:10.5194/gmd-4-1077-2011, 2011.