We would like to thank Reviewer#2 for his/her thoughtful comments and constructive suggestions. We reply to these comments individually below. In our response, we are referring to the new manuscript with highlighted changes, in the following just denoted as 'new manuscript'.

Review 2, Anonymous Referee #2

This is a very interesting study that is focused on computing optimal sensor placement and determine optimal quantities of interest to be measured using singular vectors for atmospheric chemical constituents. These developments are applied to an air pollution model.

Major comment(s):

Comment 1: Section 2.2 is ambiguously written. First we see a new equation (10) (note that f is not defined) that does not seem to be connected to the preceding equations. The definitions and the discussion around equations (12)-(15) are not clear. The augmentation of c and the introduction of tilda c in terms of another tilda c not previously defined is confusing. I assume that tilda c is defined in (12), but still. This is the main basis of this work and should be crystal clear.
In Sec. 3.1 we find a new model (16) that fits in (10) but it is somewhat disconnected from (1). Please clarify the mathematical ansatz well.

Response 1: We adjusted Section 2.2 and Section 3.1. Firstly, we added a paragraph to Section 2.2 that defines function f and relates equation (10) to the preceding equations (page 6, lines 161-166 and lines 182-186 in new manuscript). Further, we rewrote the whole paragraph around equations (12)-(15) as well as the equations itself (pages 6-7, lines 182-209 in the new manuscript). In our reformulation, we emphasized the connection to Section 2.1 and simplified our explanations such that they are, as we hope, less complicated presented. In Section 3.1, we rearranged equation (16), such that the connection to equation (10) is more evident and added an explanation in the associated paragraph (page 8, lines 224-229 in the new manuscript). Please note that we followed the recommendation of the journal to utilize the program "latexdiff" to highlight changes. Therefore changes that are made in the "equation environment" are not easy to see. Here, the color red marks deleted terms even though the terms are not crossed.

Minor comments:

Comment 2: I do not understand the implication on page 6268 (l 16-18): "Since the considered [...] correctness" Please clarify.

Response 2: We modified this paragraph to make it easier to understand. the original sentence "Since the considered cases are restricted in terms of considered chemical compounds and selected areas, a comprehensive analysis they allow for a retracing of the results and a confirmation of their correctness.", is replaced by the following sentence: "For the sake of brevity, we concentrate our attention on the following chemical compounds: O_3,

NO, NO$_2$, HCHO, CO, HONO, OH and focus on their influence on selected O$_3$ profiles" (page 1, lines 15-17 in the new manuscript*).*

Comment 3: p 6270 l 10 What is a "chemical weather prediction"?

Response 3: A chemical weather prediction is a forecast that includes both weather prediction and atmospheric chemistry; the former only as preprocessor for driving the chemistry forecast (see, for example, Lawrence, 2005; Kukkonen, 2012 and http://www.iass-potsdam.de/en/research-clusters/sustainable-interactions-atmosphere-siwa/air-pollution-and-climate-change-age-7). In order to make the manuscript easier to understand, we replaced this expression by "chemical transport models" and added Lawrence, 2005 as a reference (page 3, line 1 in the new manuscript).

References:
1. Kukkonen, J., Olsson, T., Schultz, D. M., Baklanov, A., Klein, T., Miranda, A. I., Monteiro, A., Hirtl, M., Tarvainen, V., Boy, M., Peuch, V.-H., Poupkou, A., Kioutsioukis, I., Finardi, S., Sofiev, M., Sokhi, R., Lehtinen, K. E. J., Karatzas, K., San José, R., Astitha, M., Kallos, G., Schaap, M., Reimer, E., Jakobs, H., and Eben, K.: A review of operational, regional-scale, chemical weather forecasting models in Europe, Atmos. Chem. Phys., 12, 1-87, doi:10.5194/acp-12-1-2012, 2012.
2. Lawrence, M.G., O. Hov, M. Beekman, J. Brandt, H. Elbern, H. Eskes, H. Feichter, and M. Takigawa, The Chemical Weather, Environmental Chemistry, 2, 1-3, doi:10.1071/EN05014, 2005.

Comment 4: p 6272, eq 1: If M is not linear it should be defined as a function M(...)

Response 4: We changed this accordingly and denoted M as a function of the initial conditions, so that the right side of the equation reads "$M_{t_I,t_F}[c(t_I)]$", following Liao et al, 2006 (page 4, equation 1 in the new manuscript).

Reference:
1. Liao, W., Sandu, A., Carmichael, G. R., and Chai, T.: Singular vector analysis for atmospheric chemical transport models, Mon. Weather Rev., 134, 2443–2465, 2006.

Comment 5: p6272, l 13-14. There is a repetition of \delta c. The sentence needs to be clarified.

Response 5: We agree that the repetition of \delta c is confusing. In order to clarify the sentence, we omitted the second \delta c (page 4, line 116 in the new manuscript).