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***Interactive comment on* “Data assimilation in atmospheric chemistry models: current status and future prospects for coupled chemistry meteorology models” by M. Bocquet et al.**

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This paper presents a large review of data assimilation in atmospheric chemistry models with a special focus on coupled chemistry meteorology models (CCMM). First the author proposes a review of assimilation methods used/developed for chemical data applications. A very complete review of chemical data assimilation studies is presented. Also a very interesting review of available chemical observations is given by the authors. Moreover, authors present specific case studies to illustrate the state of data assimilation science for atmospheric chemistry. The paper is in general clear and well written and it is probably a review that will serve the community of atmospheric

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chemistry and more specifically the community of chemical weather prediction. I m then favorable to the publication of this paper but i have the feeling that the paper could be more “efficient” and clear with some minor modifications. Hereafter, i make few remarks that, I hope, could help to improve the paper.

Page 32255 – Line 18: At the end of the section 3.1, you are presenting the results of a study where SCHIAMACHY observations have been assimilated. This study is probably very interesting but it seems that, contrary to the other examples of the section, the results are not related to a publication. The consequence is that the readers do not have the possibility to understand/evaluate the results. Maybe, the corresponding publication is missing but under this form it is like you were presenting results almost without description of the model, the assimilation, the case study, the set-up of the assimilation experiment, the nature of the observation used. In this state, i would recommend you to skip this section and the corresponding figure.

Reply: The two paragraphs referring to this data assimilation study and the associated figures have been deleted.

Page 32275 – Line 9: The case studies presented within section 5 are more documented than the case study mentioned above. Nevertheless, the interest to have such examples in the paper is not obvious. Maybe these case studies (at least one or two) should be used to illustrate a paragraph more focused on CCMM. Indeed, It is not clear from the paper what are the applications/processes that could be targeted with the use of data assimilation in CCMM. The example of the use of CCN to improve aerosol is relatively unexpected but very interesting and I think we would like to have a more exhaustive list of the domain that could benefit assimilation in CCMM. Which of these potential applications could be expected in a very near future when considering current available observations ?

Reply: We feel that it is important to show some examples of data assimilation in atmospheric chemistry models, as those illustrate some of the associated advantages and

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limitations. We debated whether the case studies could be incorporated into Section 3. However, we decided to keep them as a separate section because they not only provide illustrations of the data assimilation methods, but also exemplify the use of observational data sets (ground-level and satellite data), which have been described in Section 4.

It is difficult to anticipate which indirect effects of data assimilation would benefit various model variables via meteorology/chemistry interactions and, therefore, it does not seem feasible to develop an exhaustive list of such potential benefits at this point. Nevertheless, we added a sentence in the conclusion pointing out such potential benefits and giving as examples the improvement in aerosol concentrations following CCN data assimilation and the potential improvement in meteorology (thermal structure and circulation) following AOD data assimilation during dust storms.

A last remark, you mention that CCMM are costly in term of time calculation which combined with assimilation is even more critical. Is there a tendency to have simplified chemistry compared to off-line CTM ?

Reply: CCMM typically use the same gas-phase chemical kinetic mechanisms as CTM. There are some versions of CCMM that use simplified representations of aerosol processes (in terms of particle size resolution and/or chemical composition); however, some CCMM use fairly detailed representations of both particle size resolution and chemical composition.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 32233, 2014.

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