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Interactive comment on “Application of WRF/Chem-MADRID and WRF/Polyphemus in Europe – Part 1: Model description and evaluation of meteorological predictions” by Y. Zhang et al.

Anonymous Referee #2

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This paper is written as the first part of a study and will be followed by the second part: “Application of WRF/Chem-MADRID and WRF/Polyphemus in Europe, Part II: Evaluation of Chemical Concentrations, Sensitivity Simulations, and Aerosol-Meteorology Interactions” by Y. Zhang et al. (Companion Paper acp-2012-978).

General Comments:

This paper presents results of comprehensive model evaluation and comparison of two 3D air quality modeling systems applied for Europe. This study is really interesting and scientifically sounding. Such comprehensive analyses and evaluation for Europe are novel and done in such a configuration for the fully online coupled WRF-

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Chem model applied for Europe for the first time (at least to my knowledge). Definitely these papers are very interesting for a reader, give new knowledge/experience of on-line meteorology-chemistry models applications for meteorology and air quality and the papers are suitable for publication in ACP.

However, I cannot say that the methodology, simulation design and setup for these two models evaluation and comparative analysis are optimal.

These two ACT models considered are very different in their assumptions, resolutions (e.g. vertical) and compositions, and one of them, WRF/Chem-MADRID, is an online coupled ACT-MetM model (with two-way feedbacks) and the second one, WRF/Polyphemus, is an offline ACT model just using meteo-fields from the WRF model outputs (without feedbacks). So, in such a simulation design it is very difficult to analyze and distinguish differences in models behaviors due to the online vs offline coupling and chemistry feedbacks, and due to differences of the models formulations and setup. Of course, it does not mean that the suggested model setup is not suitable.

This Part I of the paper is focusing on the models description, their setup, simulation design, measurement data and evaluation protocol descriptions, and on the evaluation of meteorological predictions by WRF.

A comprehensive analysis of the WRF meteorological predictions for two seasons with different model resolution runs was done in this part of the paper. I think this Part 1 would be much stronger if the performance statistics for meteorological variables for both WRF and WRF/Chem-MADRID simulations would be analyzed here (in Part 1) in more details for study of the chemistry feedbacks on the meteorology.

Specific comments:

p.3996, lines 20-22: WRF/CMAQ cannot be called an online coupled model as the authors describe, because it uses an interface between WRF and CMAQ, and realize the two-way data exchange not on each time step. It could be conditionally called as

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an 'online access model'.

p.3997, lines 20-22: Zhang (2008) considered mostly US online models, e.g. European models and experience were not analysed in that review. Zhang et al. (2012) gave a nice review of both types of models, but Kukkonen et al. (2011) gave also a comprehensive review of European ACT models.

p.3999, lines 23-25: Authors write: "To minimize differences in model predictions, the same or similar modules are chosen for both model simulations whenever possible". However, the models are different, and the differences between the models include not only the way of coupling and chemistry feedbacks on meteorology. So, it is possible to evaluate them as two different models. In my view it would be very interesting to consider one model (WRF/Chem) with the same grid, but with two setups: one fully online with feedbacks, and other with offline coupling without feedbacks.

In my opinion there are many possibilities to shorten the paper, e.g. (p.4000, lines 23-25) for what reasons in the models description section to specify different options for nucleation, if the nucleation is not taken into account in this work.

p.4009, lines 10-13: Authors write very shortly that: "The meteorological fields generated from online-coupled WRF/Chem-MADRID are slightly different from those generated by WRF, because of the feedbacks between meteorology and chemistry". However, it is important to extend such analysis and comparison of both models runs.

p.4016, lines 20-25: It is not clear was the WRF simulations in this paper done with the coupled UCM or not? If so, it would be good also to extend / include additional analysis of the urban features and parameterization on the meteorological prediction over urban areas with different resolution runs.

Interactive comment on *Atmos. Chem. Phys. Discuss.*, 13, 3993, 2013.

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