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Interactive comment on "Sensitivity analysis of the meteorological pre-processor MPP-FMI 3.0 using algorithmic differentiation" *by* John Backman et al.

Anonymous Referee #2

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The article submitted by Backman et al. introduce an elegant approach to assess the sensitivity of a model in the context of small scale dispersion of air pollutants. It is proposed to use algorithmic differentiation (AD) to assess the sensitivity of the meteorological pre-processor of a dispersion model. The pre-processor evaluates crucial diagnostics to be used in the dispersion model such as the Obukhov lengths or the friction surface velocity. AD allows identifying and quantifying the sensitivity of those parameters to the variables provided in input. The scope, methodology and results are clearly explained. The source code is made available as well as its differentiated form, allowing a satisfactory reproducibility. Therefore, I support publication of this work in GMD provided that the following comments are considered.

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Discussion paper

Comments and questions

The article is limited to the sensitivity of the meteorological pre-processor, and deliberately avoids investigating the dispersion model itself. As such, the relevance of the results is somewhat limited, and the present article should be considered as a methodological proof of concept, which constitutes in itself an important building block, but leaves the reader expecting that the authors will pursue the efforts and include the dispersion model in the approach.

Extending the sensitivity analysis to dispersion modelling will undoubtedly raise the issue of the relative importance of drivers of mixing height in addition to Obukhov length and friction velocity. In the design of the meteorological preprocessor MPP-FMI, the mixing height is computed independently from the Obukhov length. It would be good to recall in Section 2.1 the rationale for this choice, and more specifically the consequences for the findings of the study. Mixing height is at least as important as Obukhov length and friction velocity in driving atmospheric dispersion in the surface layer and the matter should be discussed in more details. This comment regards both the methodological section, but also the results for instance in Section 3.3. on Cross Sensitivity, where the key findings should be put in perspective with the qualitative sensitivity that one might expected regarding mixing height (even if the quantitative sensitivity analysis is left outside of the scope of the paper).

L54: is it possible to assess the sensitivity to internal model parameters rather than input data using the AD approach?

L55: Further background information should be added regarding the fact that Tapenade proposes analytical derivatives for differentiable functions.

L148-150: There are computer programs that deal with non-derivable functions, how are those handled by AD? Isn't that the reason why in Section 3 (L192-194) the outcome of the outlook table is used instead of the (non-derivable) table itself ?

L157: please explain what is meant by “forward” or “reverse”, and why the reverse mode should be favored in some cases (L182)

Technical comments

L40-44: provide the range of spatial scale for application of the mentioned models

L92: two occurrences of “the”

L149: a sequence “of” arithmetic

L185: provide the link for the web interface

L187-189: unclear sentence, rephrase

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