

***Interactive comment on* “The influence of model grid resolution on estimation of national scale nitrogen deposition and exceedance of critical levels” by A. J. Dore et al.**

Anonymous Referee #4

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General Comments:

This paper assesses how the spatial scale of a model can influence performance, and is assessed through comparison with selected (point-based) monitoring data and (grid-based) exceedance statistics generated from critical loads maps. I do not think that the study itself is particularly novel, since environmental modellers have been grappling with issues of scale and complexity for many years. Nor do I think the results are particularly exciting or unexpected; one might expect more variance from high resolution inputs (emissions, rainfall) and more localised impacts (deposition hotspots and associated exceedances) as a result.

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However, I believe this paper could make a useful contribution if a) it provided more explicit details on certain aspects of model validation and b) included some discussion of model uncertainties and policy drivers. I suspect that this research was driven by policy requirements yet these receive little mention in the manuscript. The policy maker would presumably be happier with equivalent scale estimates of nitrogen deposition and critical loads in order to inform policy development on source regulation and environmental protection. The scientist (modeller) on the other hand presumably wants to preserve the integrity of his or her model and not give a false impression of accuracy or certainty.

Specific Comments:

I thought the introductory section was reasonably well written though wonder whether it would have been better to include the material on Lagrangian models (in general, not FRAME in specific) earlier- before discussing the influence of model grid resolution. When discussing models in general, or FRAME in particular, it might be worth stating that they tend to be used to provide policy support, hence tend to be used for scenario analysis (forecast, hindcast) and source attribution.

I felt that we were only shown half of the results of validation, with others presented elsewhere, e.g., Hallsworth et al, 2010). Since the paper focusses upon total (wet and dry) oxidised and reduced nitrogen deposition it would have been useful to include some results of NH₃ validation in this paper. Likewise, I wondered why the authors did not compare modelled rainfall amounts and compositions with data from the precipitation composition network?

In discussion of Figure 3 the authors make reference to strong spatial gradients in pollutant concentrations at scales <1km. I would be inclined to include the names of a few models here, e.g., ADMS, AERLINE, etc.

I think the discussion could be usefully extended to reflect on whether the final 'improved' product justified the additional (presumably considerable) run time. There is a

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suggestion that a tiled approach may suffice, with higher resolution outputs generated where pollution gradients change most rapidly. Likewise, I wonder if the authors would like to reflect on whether increasing spatial resolution results in a significant improvement in model performance, or whether more could be gained from addressing key model uncertainties (e.g., ammonia emissions) in more detail.

Technical Corrections:

I believe that the title is incorrect. The study assesses impacts on critical loads not levels.

Model acronyms are not always explained, e.g., OPS. FRAME is mentioned for the first time in full at the top of page 4, but not abbreviated. The abbreviated form is used in the following paragraph.

The description of NH₃ emissions on page 5 seems incomplete. Is the year of the inventory missing here perhaps?

I wondered why you had chosen to anonymise the location of Stanford Park SSSI. Is there merit in including this on Figure 2?

I wondered what the status of the RoTAP was? In the text it is referred to as RoTAP (2010) but in the references RoTAP (2011).

I felt the quality of some of the figures could have been improved to help the reader. Figures 1a and 1b for example would benefit from an inset map indicating the location of Snowdonia relative to the rest of the UK. I presume roads are used to help orientate the reader in the absence of place names? The latter would be better, but perhaps there are no major settlements in this part of North Wales. Line work and labelling for the roads are barely legible. Figure 2 includes a rather precise legend to 3 decimal places. Figure 3 is a little problematic in that you presumably show an area of 3 x 3km² to highlight coarse and fine scale variations in pollutant concentrations. Why not include full squares rather than centre the graphic on the SSSI? Could more be done

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to bring the supporting detail to life – e.g., thicker roads, better labelling, perhaps even other polygons representing built up areas in the immediate neighbourhood.

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