Biogeosciences Discuss., 8, C6008–C6013, 2012
www.biogeosciences-discuss.net/8/C6008/2012/


Biogeosciences Discussions



# *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.

**A. J. Dore et al.**

todo@ceh.ac.uk

Received and published: 21 March 2012

Response to Reviewer # 4

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.

The introduction has been re-written and included further references to other models,



Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

including Eulerian models, though the existing structure of the text has been retained. A statement was included on the advantages of forecasting and hindcasting for supporting policy:

"Use of past and future emissions estimates and meteorological data allows atmospheric transport models to calculate both historical and future projected nitrogen deposition (Matejko et al., 2009). For this reason, they are of particular use to policy makers to estimate the influence of measures to control emissions of active nitrogen to the atmosphere."

- 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?

A detailed validation of the model with measurements of NH3 concentrations has been presented by Hallsworth et al, 2010 for both 1 km and 5 km resolution data. We do not wish to repeat this analysis but have added a summary statement of Hallsworth's results:

"A comparison of model correlation with measurements of ammonia concentrations using both 1 km and 5 km resolution data has been undertaken by Hallsworth et al. (2010). This demonstrated an improvement in correlation with measurements and a reduction in model over-estimate of ammonia concentration at semi-natural sites with use of the 1 km resolution model data."

The correlation with measurements of wet deposition has been checked but does not add significantly to the message of the paper on the influence of model grid resolution. The reason for this is that high resolution (1 km) precipitation influences precipitation in upland regions. However almost all the sites in the precipitation chemistry monitoring



BGD

8, C6008–C6013, 2012



network are in lowland regions where wet deposition is relatively insensitive to model grid resolution. A comment to this effect has been added to the text:

"Correlation with measurements of wet deposition of nitrogen was found not to be significantly improved with use of 1 km resolution data. This was attributed to the fact that precipitation is highly spatially variable in upland regions (i.e. Snowdonia) but less sensitive to grid resolution in the lowland areas where the collectors in the precipitation chemistry monitoring network are located."

- 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.

The section has been amended to include reference to local scale dispersion models:

"However, even with 1 km data, strong spatial gradients in air concentrations may occur as a result of the physical limitations of the specified model grid. For focused local scale studies, dedicated local scale dispersion models are preferable (i.e Chaney et al., 2011). Examples of such models, which are commonly applied to simulate dispersion of line and point source emissions in urban and suburban areas at grid resolutions of tens to hundred of metres, include ADMS and AEROMOD (i.e. Carruthers et al., 2011). Despite these considerations, the 1 km resolution simulation of nitrogen deposition data generated with FRAME represents an improved reference national data set for sites where data from local scale dispersion studies is not available."

- 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 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.



BGD

8, C6008–C6013, 2012

A comment has been added on the benefits of the 1km resolution simulation and the increase in run time:

“In conclusion, the 1 km resolution data set provides an improved reference data set for local studies on acidifying and eutrophying effects of nitrogen deposition, in particular when data from specific local dispersion models is absent. High resolution data is of particular importance for upland regions with high precipitation or for Sites of Special Scientific Interest located near to major sources of emissions such as road transport or agriculture. The increase in model simulation time (from 20 minutes for 5km resolution to 12 hours for 1 km resolution) permits multiple emissions scenarios to be undertaken at a 1 km resolution”

and an additional comment on addressing model uncertainties in the context of high resolution simulations has been added to the end of this section:

“Accurate assessment of nitrogen deposition at fine resolution relies on detailed emissions maps of both oxidised and reduced nitrogen. Improvements in information on the spatial distribution of livestock numbers and on agricultural practice and the dependence of emissions on meteorological variables (i.e. temperature, precipitation, wind speed) are necessary to achieve better estimates of nitrogen dry deposition. In upland areas, containing sensitive ecosystems, wet deposition is an important pathway for nitrogen input. Widespread monitoring and accurate modelling and mapping of precipitation in hill regions are required to improve estimates of nitrogen deposition in these regions. Uncertainties in these areas need to be reduced in order to fully benefit from the ability of models to undertake high resolution simulations.”

Technical Corrections:

- I believe that the title is incorrect. The study assesses impacts on critical loads not levels. - The title of the paper was corrected to: “The Influence of Model Grid Resolution on Estimation of National Scale Nitrogen Deposition and Exceedance of Critical Loads”



BGD

8, C6008–C6013, 2012



- 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 FRAME acronym has now been introduced at the beginning of the model introduction. We think that description of acronyms for cited models is less important.

- The description of NH3 emissions on page 5 seems incomplete. Is the year of the inventory missing here perhaps? - The description of the NH3 emissions has been re-written

- I wondered why you had chosen to anonymise the location of Stanford Park SSSI. Is there merit in including this on Figure 2? - There was no intention to anonymise the location of Stanford Park. The national grid co-ordinates have been added to the plot.

- 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).

Final publication of RoTAP has been delayed due to a re-write of the policy makers summary. The citation has been amended to 'RoTAP (2012).'

- 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 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.



BGD

8, C6008–C6013, 2012

Interactive Comment

The plots have been improved, including a map inset to illustrate the location of Snowdonia, improved representation of the roads and revision of the number of decimal places in the legends. Including detail on urban areas would require significantly more work and we think is less important. The aim in figures 3(a) and 3(b) is to show the location of roads as these are the local source of NO2 emissions. The Snowdonia region is remote and mountainous so the location of urban areas and roads is less relevant here. The wet deposition plotted is caused primarily by the long range transport of air pollution.

---

Interactive comment on Biogeosciences Discuss., 8, 12079, 2011.