We would like to thank the reviewer for his reading and his comments. We have written our replies to the comments in blue.
Please also note we have deleted the reference *Cowie, H.: AIM-HEALTH: Effectiveness of agricultural interventions to minimise the health impacts of air pollution, NIHR, in press, 2025*. While the study (Cowie et al) is accepted for publication, it still has not been published yet and there is no doi for the citation.

We have also amended the text in the manuscript and provided more results, shown as new figures in the supplement.

This manuscript presents different ammonia emission scenarios' impact on PM2.5 mitigation through both a chemical-transport model and a dispersion model. A major revision is recommended before acceptance.

Major comments:
Please add a paragraph to summarize ammonia emission sectors in the UK, e.g., the percentage of NH3 emissions from housed dairy, pigs, and poultry. Are there any noticeable industrial and vehicle NH3 emissions near the selected farms?
Concerning the NH_3 emissions sectors we have added the following sentence in bold:
"Indeed, the most recent figure from the UK National Atmospheric Emissions Inventory (NAEI) shows that agriculture accounted for nearly 87% of total ammonia emissions in 2023 (NAEI, 2025). **Direct soil emissions account for 52.7% of total NH_3 emissions, followed by cattle at 25.9%, waste at 9.5%, other livestock at 4.8%, poultry at 3.7%, and combustion and production processes at 3.4%."**

For the 2nd part of the question, ammonia mainly comes from agriculture in our studied local modelling which is the farm itself. There is no major roads or industries near the farms and so NH_3 emissions from vehicles wouldn't be a significant source.
Thus, we have had the information (in bold) in the following sentence:
"Each farm, **situated in a different region of the UK (Fig. 1), away from major roads and industrial areas,** had a 15km-by-15km points grid centred at the farm with a 100m resolution."

The changes in emissions between different uptake scenarios are relatively small - low2030 is 8.5% and medium2030 is 9.3%. It is redundant to have 3 scenarios with such small emission differences.
One of the main novel aspects is developing realistic scenarios based on input from a range of stakeholders etc. In other words, rather than looking at a certain percentage reduction in NH_3, these estimates are grounded in specialist input from farmers, academia, and advisers.
Thus, despite unrealistic large reductions, the focus of the study was to assess the impact of realistic implementation of measures (even with small total emission reduction) on pollution.

We have added this sentence in Section 2.1:
"The overall aim was to assess realistic implementation of specific mitigation measures."

What is the temporal resolution of the model? Ammonia emissions in winter are much lower than in summer. Wintertime NH3 control is likely to be more effective than summertime. Please comment on the seasonality of ammonia emissions and PM2.5 compositions instead of using the annual mean.
Concerning the temporal resolution of the model we have added the following information (in bold) in Section 2.2.1: "The CMAQ model, calculating the pollutants' concentrations and depositions **at an hourly resolution**, …"

To detail the seasonality in NH_3 emissions and changes in $PM_{2.5}$ concentrations, we have added this following information:

- Section 2.2.2:

"It is noteworthy that the UK NH_3 emissions are mainly dominated by the February-April period as shown in Figure S1 and in Hellsten et al. (2007). Marais et al. (2021) reported an additional July peak associated with dairy cattle farming, based on satellite observations, alongside the spring peak. In contrast, the Emissions Database for Global Atmospheric Research (EDGAR) applies a uniform temporal profile for agricultural NH_3 emissions in the UK in its latest inventory version (EDGARv8.1: https://edgar.jrc.ec.europa.eu/dataset_ap81#p1m, last access on 02.11.2025)."

- Section 3.1.2:

"It is also worth noting that the impact of the mitigation measures, even limited, varies by months, showing a larger relative change in May-July (only up to -3.4%) in the example of the high2030 scenario in Figure S5. These months do not correspond to the maximum in the emitted NH_3 in the modelling as shown in Figure S1. This suggests also an impact of the atmospheric chemistry in the change in $PM_{2.5}$ concentrations."

- Conclusions:

"Although the study primarily addresses annual estimates, further investigations at finer temporal resolutions (e.g., daily, monthly) could yield deeper insights into exposure impacts."

The new figures are:

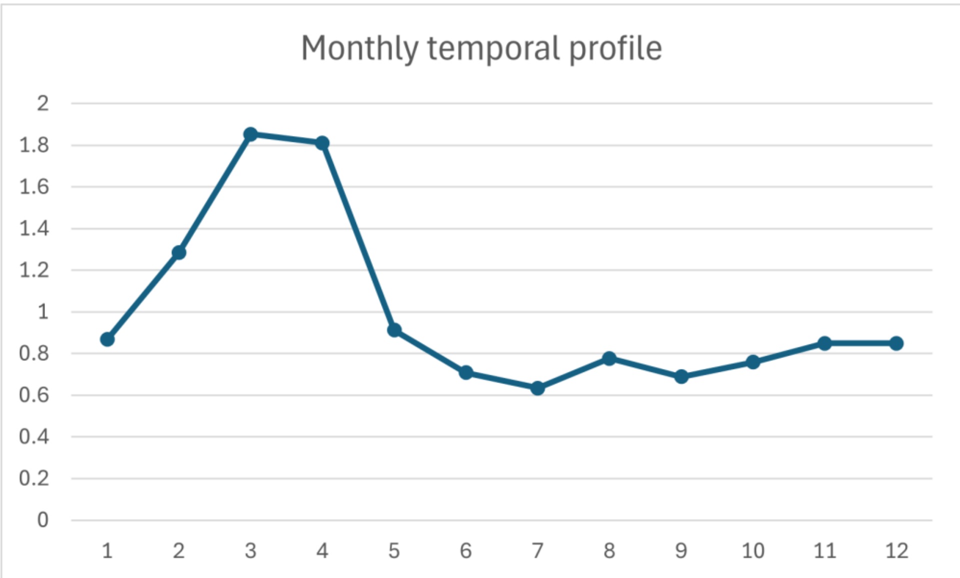

Figure S1. Monthly temporal profile for NH_3 emissions in agriculture sector in the UK.

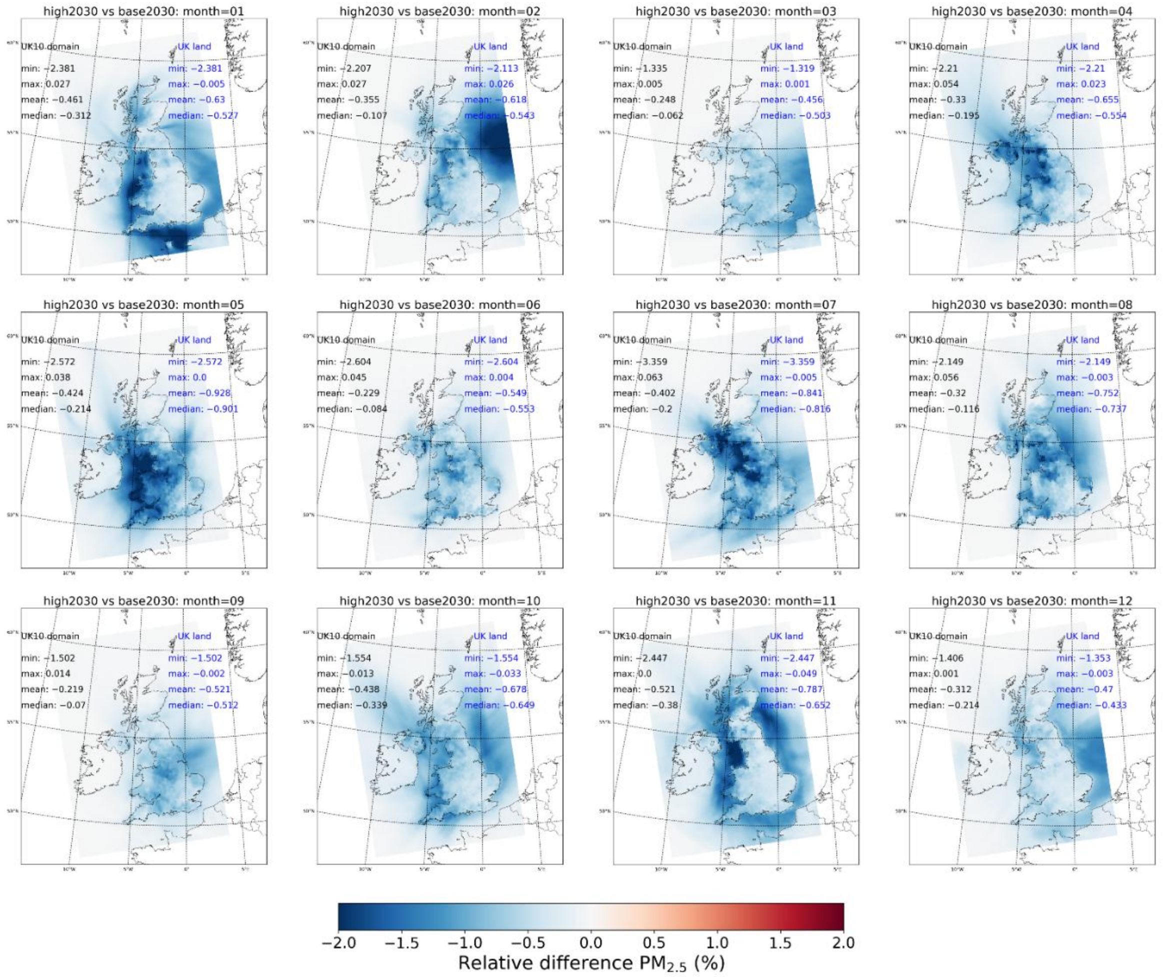

Figure S5. Relative difference of the $PM_{2.5}$ concentration with high2030 scenario compared to base2030 for each month. The minimum, maximum, mean, and median relative difference values in the whole UK10 domain (in black) and for the UK land grid cells (blue) are provided. The relative difference is calculated as follow: ((high2030-base2030)/base2030) × 100%.

And references:

- Hellsten, S., Dragosits, U., Place, C.J. et al. Modelling Seasonal Dynamics from Temporal Variation in Agricultural Practices in the UK Ammonia Emission Inventory. Water Air Soil Pollut: Focus **7**, 3–13, https://doi.org/10.1007/s11267-006-9087-5, 2007.
- Marais, E. A., Pandey, A. K., Van Damme, M., Clarisse, L., Coheur, P.-F., Shephard, M. W., UK ammonia emissions estimated with satellite observations and GEOS-Chem, Journal of Geophysical Research: Atmospheres, 126, e2021JD035237. https://doi.org/10.1029/2021JD035237, 2021.

What is the interannual variability between 2019 and 2030? Are there any warming trends during the studied time period? If so, please comment on the impact on ammonia volatilization. Also, please comment on the contribution from transport and deposition changes.

The study has focused on the changes in future emissions and not on a change on meteorology, so no climate projection has been calculated and used.

The following sentence in lines 190-191 in the original manuscript mentioned this point: “The future scenarios solely focused on change in emissions and no climate projection has been undertaken.”

Thus, there is no analysis on the impact of meteorology on the volatilization.

We have added this sentence to clarify this point:

“Consequently, there is no analysis on changes in meteorological conditions.”

Concerning the question on transport and deposition, we did not undertake a source apportionment study and the complementary study already focused on nitrogen deposition. There is already this sentence in lines 366-368 (beginning of Section 3.1.2):
"Reductions in NH_3 emissions are effective at reducing NH_3 concentrations and its deposition at a regional scale (10 km × 10 km) as shown in Pommier et al. (2025) (e.g. up to 22% reduction in the high2030 scenario) but considerably less effective at reducing ammonium (NH_4) since the UK is characterized by an NH_3-rich chemical domain"

Are NOx emissions underestimated? Any sensitivity test with NOx emissions?
The evaluation of the NO_2 concentrations modelled by CMAQ show a good agreement with the observations downloaded from the UK AIR platform as shown below, highlighting a good estimate in NO_x emissions. However, no sensitivity simulation on NOx emissions was undertaken.

We have added this sentence and figure:
"In addition, the analysis on NO_2 concentrations highlights a good estimate in NO_x emissions since a reasonable underestimation is found (~25.3%, 4.3 µg/m^3), with a good correlation (0.71) and IOA (0.78) (Figure S4)."

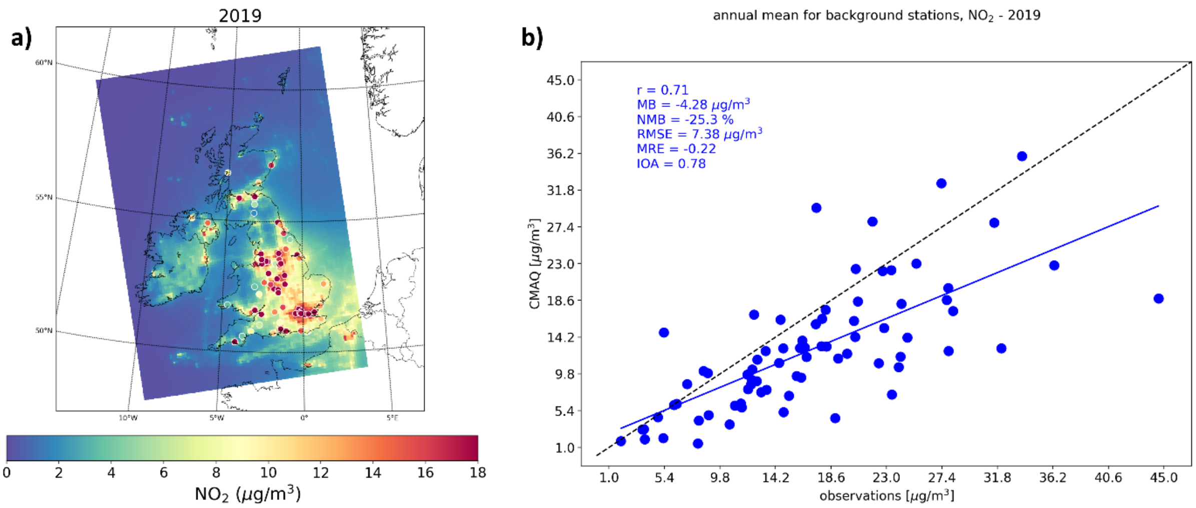

Figure S4. Spatial distribution of annual mean NO_2 concentrations in µg/m^3 calculated by CMAQ at 10 km resolution in 2019. The measured concentrations at the monitoring stations are shown with the coloured circles. b) Comparison between these annual measured concentrations with the modelled values in 2019. Only the background stations with a data capture higher than 75% are used. Insert values are the Pearson correlation coefficient (R), the mean bias (MB), the normalized mean bias (NMB), the mean relative error (MRE), the root-mean-square error (RMSE), and the index of agreement (IOA). The blue line represents the linear fit and dashed black line is the 1:1 slope.

Please clarify how meteorological differences between 2019 and 2030 are taken into consideration for the decay distance comparison.
As mentioned in our reply to a previous comment, no change in meteorology has been applied in this study.

Additionally, I suggest including a figure to display the concentration maps generated by the dispersion model for Farm 3.
The following sentence (in bold) and figure have been added:
"It is worth noting that the mitigation scenario solely impacts the distance of spread of the pollutants for the farm three, while the distances where the 50% of NH_3 and primary $PM_{2.5}$ concentrations are dispersed; and the distances where 10% of their maximum concentrations are found are identical for the other farms (Figs. 5b & c). **However, as illustrated in Figure S6, farm three did not contribute to $PM_{2.5}$, and the NH_3 concentration remained highly localized around the farm.**"

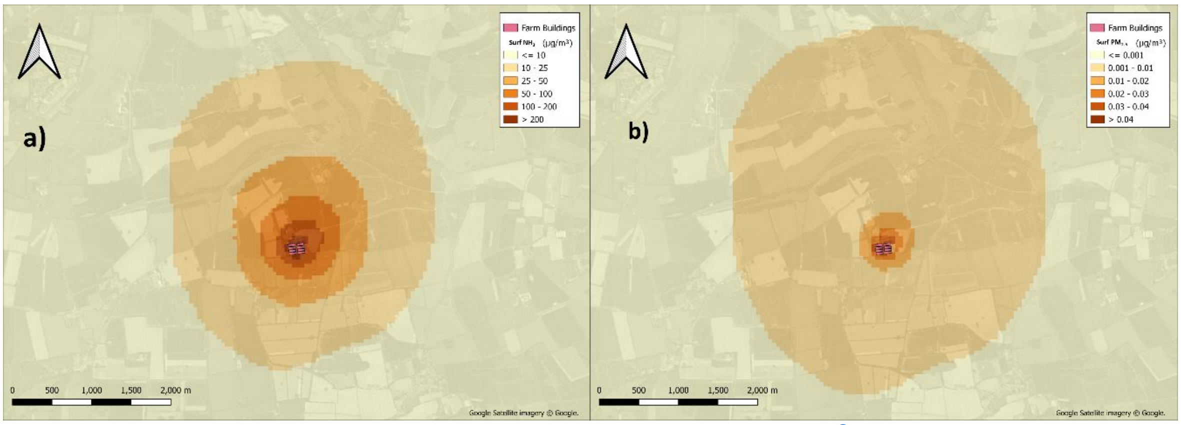

Figure S6. Distribution of NH_3 (a) and $PM_{2.5}$ (b) surface concentrations in µg/m^3 at farm three for the basse2030 scenario.

Minor comments:
Tabel S1: no SO42-?
Yes, it is correct. Thank you for spotting this mistake.
SO4 has been forgotten in this table and now added.