Note from the Production office:
Coloured or marked text in *.pdf manuscript file is not allowed (page 9, Eq 1). Please provide a clean version of *pdf manuscript file (without marked changes, but with black text) for next revision.

Thank you for the comment. We have now provided a clean version of the manuscript PDF with all text, including Equation 1 on page 9, in black and without any marked changes.

Reviewer's comments:

The authors have substantially changed the paper to address the comments raised in review, accounting for each comment in turn. In particular, Section 3.1 is now much more easy to follow, Section 3.7 has the detail it deserves, and the Figures are much better – especially 3 and 4. There are some small clarifications that need to be made just to iron things out, and there is one conceptual issue regarding the definition of the "demographic transition" in terms of aging versus overall population growth. In light of the substantial alterations to address comments, and the very minor changes that need making, I recommend this revision be accepted subject to technical corrections, which do not need further review.

We sincerely thank the reviewer for the thoughtful and constructive feedback throughout the review process. We are very pleased that the revised manuscript is now clearer and that the improvements to Section 3.1, Section 3.7, and Figures 3 and 4 were well received.

We have carefully addressed the remaining minor clarifications and resolved the conceptual issue regarding the definition of the "demographic transition" to ensure accuracy and consistency throughout the manuscript.

We appreciate your recommendation for acceptance with technical corrections and are grateful for your support in bringing this work to publication.

Figure 1: this can be cropped at -40 latitude to remove the white space. Also needs a full stop in the caption.

Thank you for the helpful suggestion. We have now cropped the figure at –40° latitude to remove the excess white space, and we have also added a full stop at the end of the caption as recommended.

Section 2.2: good to have the resolutions, but would also just highlight around L210 that they all have the same 0.5x0.5, to aid the reader.

Thank you for your positive feedback on the scenario selection description. We agree that highlighting the common spatial resolution will help readers, and we have added a sentence around L210 clarifying that all model datasets are at a consistent 0.5° × 0.5° resolution.

We added the following to the manuscript:

All emissions datasets used share a common horizontal resolution of 0.5° latitude by 0.5° longitude, facilitating direct comparison and integration across scenarios.

L262 needs to be “, and ammonium” in the list.

Thank you for pointing this out.

We have added “, and ammonium” to L262 in the manuscript, The sentence now reads: $PM_{2.5}$ was calculated as the sum of individual fine-mode aerosol species, namely BC, primary and secondary organic aerosol (POA, SOA), sulfate (SO_4), dust, sea salt, nitrate (NO_3), and ammonium (NH_4).

L280: need citation for “Natural Earth dataset”

Thank you for your suggestion. We have added a citation, and the revised sentence now reads: “Grid cells were assigned to countries based on whether their center point lies within national boundaries, using a shapefile of administrative boundaries from the Natural Earth dataset (Natural Earth, 2025).”

L332: “ranging from 2.4 μg m-3” to what? (5.9, uniformly, I think? Need to clarify both the range and the distribution ie uniform or other). Also, how many samples? It’s fine to refer to the other paper for more specific details but the key info should be given here, and I think that should include the number of samples.

Thank you for your comment. We have clarified the text to indicate that the counterfactual concentration (TMREL) was held constant at 2.4 μg m^{-3} in this study, rather than distributed across a range. We have also ensured that this is clearly stated in the manuscript (L332).

The revised sentence reads: We assumed a theoretical minimum risk exposure level (TMREL) of 2.4 μg m^{-3}, held constant across all locations and scenarios (Murray et al., 2020).

L351: at the end you have “a grid by age.” which highlights the dependence of the population, but you don’t do the same for the mortality or RR. Maybe for clarity add a new sentence noting which properties each variable depends on.

Thank you for your suggestion. We have added the following after “a grid by age.”: “Each variable is a function of specific dimensions: RR varies with concentration of $PM_{2.5}$, age group, and disease; BM varies with age group and disease; and population varies by age group and location”

L362: “about 25 km” – why is this only “about”? Is the resolution in degrees and this is approx? It’s not too important but worth clarifying.

Thank you for your suggestion. The resolution is 25 km × 25 km, not an approximation. We have therefore removed the word “about” to improve clarity.

The revised sentence now reads: Age distributions at 5-year intervals (adults > 25 years), and <5 years for children were obtained from the SSP database (Riahi et al., 2017) which are then merged with the gridded population data at 25 km by 25 km horizontal resolution under the respective SSP scenarios to obtain the age-specific population (P_a) at each 25 km by 25 km grid.

L407: “For instance, [in] Central Africa”

Thank you for pointing this out. We have added “in” to the sentence, so it now reads “For instance, in Central Africa...” in the revised manuscript.

Figs 3+4: these are much better, but 1) cape verde encroaches on the text – maybe just make the boxes non-transparent 2) I feel the boxes could possibly be rearranged to the sides, to make the figure wider and allow for it to be bigger overall therefore – but if you have played around with it and this is the best configuration then that’s fine.

Thank you very much for your helpful suggestion. We experimented with making the boxes non-transparent; however, this caused them to completely obscure Cape Verde. After careful consideration, we believe that the current configuration represents the best balance between readability and geographic clarity. Thank you for understanding.

Fig 5: much better; caption needs a full stop.

Thank you for your positive feedback on Figure 5. We have added the full stop at the end of the caption as requested.

L605: this is substantially improved and really interesting! However, there’s some confusion around the “demographic transition” and aging. The “demographic transition” is comprised of aging and general population increase, right? But you attribute the demographic transition bar in S13 purely to aging in the text. Really, to explore this effect, you’d have to repeat the analysis with the population increased but the age distribution constant, versus the results where both change, i.e. decompose the demographic transition into aging and population growth. I’m not suggesting you need to do this unless you’re interested in exploring this aspect, but you at least need to resolve this ambiguity by not referring purely to aging as the cause of these deaths. I also think S13 is a key figure and deserves to be in the main text really, unless there’s a limit on figures here. But up to you

Thank you for this insightful comment. We agree that the demographic transition encompasses both aging and overall population growth. In the revised text, we have refrained from attributing the demographic transition effects solely to aging and have instead highlighted the combined influence of both aging and population growth on excess deaths. We acknowledge that fully decomposing these effects by holding one factor constant while varying the other would be valuable, though it is beyond the scope of the current study. We revised sentences in L605 paragraph as follows:

“Aging and population growth are both key aspects of the demographic transition, each contributing to increased excess deaths. Aging increases excess deaths from age-related diseases, even in scenarios with modest population growth. In parallel, overall population growth amplifies excess deaths, particularly in regions with high fertility rates and younger populations, such as Western Africa and Eastern Africa. In Northern Africa, while population growth is projected to be slower, the aging population resulting from demographic shifts is projected to lead to a substantial number of excess deaths, reaching 300,000 under SSP119 and SSP585, and exceeding 200,000 in other scenarios (**Figure 8**). Southern Africa is projected to experience the lowest number of excess deaths attributable to aging and population growth,

except under SSP119 and SSP585, where demographic transition-related excess deaths increase to about 20,000."

Thank you for the helpful suggestion regarding Figure S13. We agree that it presents important results. In response, we have now included this figure in the main manuscript as **Figure 8**,and revised the figure numbers throughout the paper accordingly to reflect this change. Thank you again for your helpful feedback.