Author Response to Reviewer #1

We thank Reviewer #1 for their constructive comments. Please find below our responses to each point raised.

General comments:

We thoroughly reviewed and corrected incorrect internal references (figures and sections), and improved the English language throughout the paper.

1. Section 1.1 – Broaden context beyond internal work

We added a citation to the IAEA report "Considerations in the Development of a Protection Strategy for a Nuclear or Radiological Emergency" (2021) to broaden the contextual background beyond our own institute's previous studies.

2. Line 35 – Missing reference for pX code

We added two references for the pX code in Section 1.1 to clarify its origin and documentation.

3. Line 55 – Typo: double "both"

Corrected.

4. Section 1.2 – Incorrect section references

We fixed all references to later sections and ensured that the reference to Section 5 is correct and relevant.

5. Table 1 – Clarify parameter ranges

We added explanations in the text and in the table caption for each parameter range. For example, we clarified that 0–100 m for release height is consistent with typical nuclear accident scenarios and excludes extreme or implausible configurations. We also provided references to justify these ranges.

6. Line 120 – Improve Kriging description

We revised Section 3.2 to improve the explanation of Kriging. While we chose not to enter into too much technical detail, we added references to Rasmussen and Williams (2006), Roustant et al. (2012), and Girard et al. (2016) for readers seeking more information.

7. Equation line 126 – Improve mathematical notation

We corrected the notation to $\forall i \in \{1, \ldots, N\}$ and ensured consistency between left- and right-hand sides. The explanation now matches the equation.

8. Section 3.2 – Add BFGS reference and explanation

We ultimately decided not to mention BFGS to avoid unnecessary detail at that point in the manuscript.

9. Line 143 – Specify range values

We added a sentence in Section 3.3 to explain that dose values vary by up to a factor of 10^5 depending on distance.

10. Line 145–148 – Justify AAM dimension choice

We added Figure (figure 1) and an accompanying paragraph in Section 3.3 to explain how the number of AAM coordinates was selected.

11. Line 149 – Typo

Removed "Once these emulators built."

12. Line 157 – Missing closing parenthesis

Corrected.

13. Lines 160–162 – Figure reference and description

We clarified the reference to Figure 4 and expanded its caption.

14. Figure 7 caption – Inconsistencies with text

We corrected the figure (previously incorrect due to file mix-up) and aligned the caption and text.

15. Line 188–189 – Case 3 and 4 descriptions swapped

Corrected.

16. Line 221 – Improve Figure 9 and Table 3 explanations

We expanded the captions and added explanatory paragraphs at the end of Section 4.2 to help interpret both elements.

17. Line 240 – Typo

"allow" was replaced with "allows".

18. Section 5 – Too succinct

We significantly expanded Section 5 to better explain the objectives and results. We illustrated practical applications and cited the CONFIDENCE project to emphasize the relevance for operational use.

19. Line 243 – Typo

Corrected.

Author Response to Reviewer #2

We thank Reviewer #2 for the constructive and detailed feedback. Please find below our point-by-point responses.

Major Comments

1. Regarding the use of AAM:

(a) More context on the method has been introduced in Section 1.2. However, we intentionally kept Section 3.1 concise to avoid going too deep into technical details. We provide relevant references for readers who wish to explore further.

(b) Section 1.2 was significantly expanded to clarify what we mean by "non-linear structures". In particular, we now explicitly contrast the linear subspace assumption of PCA with the curved manifold approximation used in AAM.

(c) Section 1.2 also includes a reference to Girard et al. (2020), which compares AAM and PCA for reconstructing radiological dispersion maps — a case very similar to our own.

2. Regarding the construction of the emulator:

(a) We now include Figure~**??**, which shows the evolution of reconstruction error as a function of AAM dimension. The discussion is expanded in Section 3.3.

(b) Yes, the emulators are fit independently for each coordinate. This is now clarified in Section 3.3.

3. Regarding the validation metrics:

(a) We clarified in the text and caption that Figure 7 shows FMS results computed on the test set. We also corrected the figure, which was previously showing the wrong version due to a file mix-up. The caption of Figure 4 has also been improved for consistency.

(b) We did not modify the manuscript on this point, as the FMS is a well-established metric in the radioactive dispersion modeling community. A reference to its use in the CONFIDENCE project has been added to support this.

(c) The SMSE of some scores is strongly degraded due to a single outlier that is poorly reconstructed and falls outside the axes limits of Figure 5. To mitigate this, we added the 95% quantile of the relative absolute error in Table 2, providing a more robust alternative metric that is less sensitive to extreme values.

(d) To clarify Figure 9, we expanded its caption and improved the caption of Table 3. Additional explanation was added at the end of Section 4.2 to help interpret both the figure and the table.

Minor Comments

1. We modified the abstract and Section 2 to clarify that scalar-only emulators are common in radioactive dispersion but not a limitation of emulators in general. The sentence around line 53 was removed for consistency.

2. We chose not to cite Cartwright et al. (2023) to keep the focus on directly relevant literature and avoid overloading the manuscript with peripheral references.

3. We chose not to cite the other suggested reference, as we have not read it in detail and preferred to reference sources that were directly used and understood in our work.

4. We expanded the caption of Figure 6 for clarity.

Typographical Comments

1. Parenthetic citations have been reformatted according to GMD style.
2. The stray parenthesis at line 35 has been removed.
3. "sets of map" corrected to "sets of maps".
4. Table 1 units have been harmonized.

Response to Community Comments

Response to Juan Antonio Añel (CEC1): Thank you for the reminder. The code DOI is now correctly included in the codedataavailability section of the revised manuscript.

We hope that the revised manuscript addresses all concerns raised. We thank the reviewers and the community for their constructive comments.