

**Authors' Response to Reviewer 1 of GMDD Manuscript “Operational chemical weather forecasting with the ECCC online Regional Air Quality Deterministic Prediction System version 023 (RAQDPS023) – Part 2: Multi-year prospective and retrospective performance evaluation” by Moran et al. (2026)**

**General comments:**

This manuscript presents the evaluation of the operational chemical weather forecasting system of ECCC, which is described in the Part 1 paper. These continuous presentations will be useful to understand the current modeling performances. The authors conducted a comprehensive analysis of gas, aerosol, and depositions, and discussed them well. As a critical concern, I am confusing the wording “RAQDPS023” throughout the manuscript. It will be better to clearly define “RAQDPS-FW023” and “RAQDPS-OP023” in Abstract (lines 22 and 24) and in Introduction, and then throughout the manuscript. Maybe, the wording “RAQDPS023” in line 22 would be “RAQDPS-FW023”. Although the wording “RAQDPS-OP023” was not introduced, I can see this expression in Table 7, and I feel these clear expressions will be needed to clearly follow the context of this manuscript. In addition to this clarification, I have several specific and technical comments as follows.

Response: We thank the reviewer for their constructive comments. We see their concern about a lack of clarity in the text when one or the other of two very closely related but distinct system versions are being discussed. Their suggestion to follow the example of Table 7 and to refer to these two versions of the RAQDPS023 as the “RAQDPS-OP023” and “RAQDPS-FW023” is a good solution, which we have adopted throughout the revised manuscript and Supplement, beginning with the insertion of the following sentence in the Abstract and a similar sentence in the Introduction.

*“This version of the RAQDPS023, which did not include biomass burning (BB) emissions, is referred to in the text as the RAQDPS-OP023.”*

We have also replaced the word “model” with “RAQDPS-OP023” in a number of places, and we have inserted “RAQDPS-OP023” into the captions for the figures and for Tables 3–6.

We respond below (also in blue font) to the reviewer’s specific comments and technical points.

**Specific comments:**

Lines 1271-1287 and Table 7: From this part, I can see that there was a comparison in operational and forecast for 2021/22; however, we cannot see such comparisons in the following section 4.4 (Fig. 19 and other figures in the supplemental file). Excuse me if I missed this comparison approach, but could you clarify this point?

Response: As described in the companion paper to this manuscript (Moran et al., 2026a), the RAQDPS-OP001, the first version of the ECCC operational AQ forecast system based on the online GEM-MACH chemical weather model, went into service in late 2009 and was followed by a succession of updated versions. However, these earlier forecast systems did not consider biomass burning emissions. RAQDPS-FW015, the first operational version of the RAQDPS that included near-real-time biomass burning emissions, went into service in spring 2016 in tandem with the RAQDPS-OP015. That is, both system versions were operational forecast systems that

were run side by side and whose differences in PM<sub>2.5</sub> predictions could be used to forecast the location and evolution of wildfire smoke plumes by brute-force subtraction (e.g., Pavlovic et al., 2016; Chen et al., 2019). Sections 4.2 and S4.2 and Table 7 (supplemented by Figs. S220–S246) present a side-by-side comparison and performance evaluation of two later operational system versions, the RAQDPS-OP023 and RAQDPS-FW023, for their first year of forecasts in 2021/22.

Section 4.1 and Figs. 19 and S215–S219, which examine performance scores over the full period of deployment of the operational online RAQDPS from 2010 to mid 2022 thus had to consider results for the RAQDPS-OP<sub>nnn</sub>, that is, the system version without biomass burning emissions, in order to cover this entire 13-year period, including the six years from 2010 to 2015 when there was no operational RAQDPS-FW<sub>nnn</sub> system.

Note that Sections 4.3 and S4.3 provide further comparisons of the RAQDPS-OP023 and RAQDPS-FW023 performance in a review of results from an ongoing international multi-model intercomparison with four other peer AQ forecast models.

Line 1404-1457: It would be much better to explicitly mention the reason for the worsened R values in the forecast case.

Response: Unfortunately, we found this comment confusing because the lines referenced by the reviewer correspond mainly to a discussion in Sect. 4.4 about performance scores for the predictions of PM<sub>2.5</sub> chemical components for the 2013-2016 hindcasts, where the focus of the discussion is forecast biases, both positive and negative, for these components. We wonder if the reviewer was referring to the discussion in Sect. 4.2 of differences in performance scores for the RAQDPS-OP023 and RAQDPS-FW023 system versions for the 2021/22 period presented in Table 7. In particular, there were very large differences between the summer and autumn seasonal R scores for the two forecast systems: 0.09 vs. 0.55 in summer 2021 and 0.28 vs. 0.49 in autumn 2021 for the RAQDPS-OP023 vs. RAQDPS-FW023.

The discussion in Sect. 4.2 may not have been as clear as it should have been if there was confusion about the respective roles of the RAQDPS-OP023 and RAQDPS-FW023 system versions (see previous comment and response). The message in Sect. 4.2, though, was not that the seasonal R scores were worse when biomass burning emissions were considered but rather that they were much improved from the very low levels of the RAQDPS-OP023, the system version that did not consider biomass burning emissions. As noted in the response to the other reviewer, these results supported the decision at ECCO to make the system version with biomass burning emissions the standard operational version beginning with the release of the RAQDPS025 in June 2024. We also hope that there will now be greater clarity to the text as a result of the revisions that have been made to the manuscript to refer either to the RAQDPS-OP023 or the RAQDPS-FW023.

#### **Technical points:**

Please confirm a subscript for the chemical species throughout the manuscript.

Response: As described in the companion paper to this paper, the species names for the ADOM-2 gas-phase chemistry mechanism used by the GEM-MACH model are all upper case (e.g., O<sub>3</sub>, NH<sub>3</sub>; Moran et al., 2026, Table 3). However, many of these “model” species correspond to individual chemical species (e.g., O<sub>3</sub>, NH<sub>3</sub>). We have revised the manuscript text and tables to use subscripts in the names of chemical species where there is no confusion. In the case of two ADOM-2 “lumped” VOC species (ETHE, HCHO) for which measurements were available, we retained the

model species name and explained the reason in Section S2.4. However, in order to make this important point more accessible to the reader, we have added the following sentence to Sect. 2.4:

*“For example, one important consideration related to pairing with VOC measurements is that while measurements of both ethene (C<sub>2</sub>H<sub>4</sub>) and formaldehyde (HCHO) are available, the ADOM-2 model VOC species named ETHE and HCHO are both lumped species that include additional VOC species in addition to ethene and formaldehyde. This misalignment must be considered when interpreting evaluation results for these two model species in Sect. 3.3.1 since the measurements are in effect lower bounds on the model predictions rather than direct counterparts.”*

I am wondering about the usage of the supplemental file within this journal or the outer storage (zenodo repository). Could you confirm with the editorial office?

Response: This is an understandable concern, but we have followed the Instructions to Authors from the journal, which state:

*“The overall file size of such a supplement is limited to 50 MB. Larger supplements have to be submitted to a reliable data repository in any case receiving a DOI, cited in your manuscript, and included in your reference list.”*

[see <https://www.geoscientific-model-development.net/submission.html#supplementary>]

In this case the supplemental file was about 110 MB in size, so we made the supplemental file available on zenodo and referenced it as Moran et al. (2026b; <https://doi.org/10.5281/zenodo.16929949>).

Line 1828: Typo “PM3.5”.

Response: Corrected.