

The authors evaluate the WRF-GHG model for CO₂ and CH₄ over central Amazonia in January 2023, using tower measurements (ATTO/INSTANT) and aircraft data (HALO campaign of the CAFE-Brazil campaign) for validation. The configuration incorporated nested 18-km and 6-km domains, MapBiomass land cover, regionally calibrated VPRM biospheric flux module (VPRM-cal) and three wetland CH₄ configurations – the online Kaplan model, CAMS-Inversion fluxes and the WetCHARTs ensemble. The authors find that meteorological uncertainty, particularly convection and vertical mixing, dominates the model-observation mismatch. These limitations arising from the study are nothing new in the context of GHG modeling. However, the study conducted useful experiments in Amazon, which brought interesting results, but the main message still needs refining. The release of WRF-GHG-Prepy as an open preprocessing framework is a useful contribution.

General comments:

1. The conclusion that meteorological uncertainty dominates the model-observation discrepancies is plausible and well argued qualitatively, but no experiment is carried out to prove it. A modest sensitivity runs, for example, perturbing wetland flux magnitude while holding meteorology fixed or having the same flux but different parameterization scheme.
2. In result or conclusion manuscript reports: VPRM-cal substantially improves simulated CO₂ concentrations, but it does not adequately discuss whether this improvement results from a more realistic representation of biospheric fluxes or from compensation for known transport biases (e.g., overestimated PBL depth and wind speed). Authors should discuss the possibility of error compensation.
3. The abstract section needs to be rewritten to better highlight the main results of this study. Right now, 30% of the abstract is filled with general information. One recommendation is to emphasize the statistics showing how well the study's observations were reproduced by the WRF-GHG model. Also, highlight the limitation like possibility of error compensation.
4. The manuscript reports that background accounts for ~95% of simulated CH₄ at ATTO, yet all metrics are computed on total mole fractions. Skill statistics therefore largely reflect the quality of the prescribed CAMS fields rather than the model's regional transport or the wetland inventories. I strongly encourage evaluating the background tracer against the above-boundary-layer aircraft legs.

Specific points:

Line 70: “A secondary objective is to evaluate and refine the WRF-GHG model configuration for application in regional modelling over tropical regions, including e.g. downscaling of future climate scenarios, which will be addressed in subsequent work” - Not clear because it is not discussed it at a later stage. Also, the next sentences need a logical connection, right now they highlight separate ideas.

Line 170: “For this study, daily emission factors were applied to represent diurnal variations in CO₂ and CH₄ emissions.” -Which emission factor dataset is used here?

Line 190: “The full set of VPRM parameters also includes T_{min}, T_{max}, T_{opt}, and T_{low}, which are drawn from the literature to avoid numerical instabilities” which literature needs citation?

Line 341: “VPRM-Cal resulting in improved representation of temporal variability in CO₂ concentrations” More discussion on which specific calibrated parameters (e.g., λ_0 , PAR₀, α , or β) are primarily responsible for the observed improvements or how the calibration modifies the representation of different vegetation classes would strengthen the interpretation of the results.

Line 375: Many statements are made without proper justification or clear explanation. Like “possibly caused by limitations in the representation of canopy conductance, soil respiration dynamics, or carbon allocation under Amazonian conditions.”

Grammatical mistakes:

The manuscript contains several grammatical and typographical errors that affect readability. A few examples are listed below.

Line 45: “proper representation ... are important” → “proper representation ... is important”

Line 63: “including online process-based...” → “including an online process-based...”

Line 105: “from end of November ... until end of January” → “from the end ... until the end...”

Line 111: “traces gases” → “trace gases”

Line 135: “intital” → “initial”

Line 277: “session 5.2.2” → “Section 5.2.2”

Line 291: “patterns ... reveals” → “patterns ... reveal”

Line 297: “parameterizations operates” → “parameterizations operate”

Line 381: “VRPM-default” → “VPRM-default”

Line 401: “along the day” → “throughout the day”

Line 434: “boundary-layer” → “boundary-layer mixing”??

Line 442: “winds flow from different direction” → “winds flow from different directions”

Line 449: “does not means” → “does not mean”

Figure 7 captions: “The Blue rectangle correspond” → “The blue rectangle corresponds”

Line 462: “as function of” → “as a function of”