We sincerely thank the Editor, Associate Editor and Reviewers for handling and taking the time to read and review our manuscript. We greatly appreciate the reviewer's insightful and constructive remarks. They have helped us improve both the scientific rigor and the readability of the manuscript. Below we address each comment in turn. Line numbers refer to the clean revised version unless otherwise indicated.

Land surface water-energy-carbon fluxes are key for understanding Earth's climate system. However, high-resolution data on water-energy-carbon fluxes at finer temporal scales remain limited. This study produced a new data that estimates these exchanges hourly during 2000-2020 by using STEMMUS-SCOPE model, field measurements, and machine learning with satellite and meteorological data. I believe this dataset could provide valuable insights into diurnal variability and finer-scale land-air processes. I recommend that this paper be accepted for publication after addressing the following comments.

Comment 1: 1. Note that estimating the water-energy-carbon fluxes at regional to global scales depend on interpolation processes. The authors applied the optimal interpolation to merge Rn, LE, and H from STEMMUS-SCOPE simulations with eddy covariance observations. Can the authors provide a reason or explanation to why this interpolation is reasonable or why this method can reduce the interpolation errors in the best possible way?

Response 1: Thank you for this insightful comment. We agree that fusing in-situ measurements with model simulations requires a principled and robust approach. In this study, Optimal Interpolation is a variance based data assimilation approach, to combine Rn, LE, and H from STEMMUS-SCOPE simulations and eddy covariance observations at flux tower sites. Optimal Interpolation assumes that both model outputs and observations contain errors characterized by their error variances and covariances. The method provides the best linear unbiased estimate (BLUE) of the target variables by minimizing the expected mean-square error, which is mathematically equivalent to a weighted least squares solution::

$$x = \frac{var_{model}}{var_{obs} + var_{model}} * x_{obs} + \frac{var_{obs}}{var_{obs} + var_{model}} * x_{model}$$

In this formulation, daily variances for each data source were calculated based on 48 half-hourly values. The idea is to assign greater weight to the source that shows less fluctuation within a day, reflecting more stable data quality. This approach is especially beneficial in handling periods where eddy covariance observations may be less reliable. For instance, in situations such as nighttime periods or rainfall events where eddy covariance data tend to be noisy or unreliable, the STEMMUS-SCOPE simulations which is physically constrained receives more weight.

We have revised the description of section 3.4 Optimal Interpolation with the above explanation (Line 151-161). We observed that this simple and computationally efficient scheme can preserve diurnal variability while smoothing extreme outliers. The fused fluxes generated via optimal interpolation were exclusively at flux tower locations to enhance the quality of the training data for Random Forest model. The Random Forest model, driven by satellite and meteorological inputs, was then used to generate the global gridded fluxes.

Comment 2: 2. Section 3.5: The authors said that they used three commonly used statistical evaluation metrics. What's the third one, except for RMSE and r?

Response 2: Thanks for noticing this. This was a typo, should be two instead of three. We have changed "three" to "two" in line 164.

Comment 3: 3. The authors should acknowledge the limitations and biases in the STEMMUS-SCOPE simulations in the Discussion Section.

Response 3: We thank the reviewer for this valuable comment. In fact, we have acknowledged and discussed the limitations and biases of the STEMMUS-SCOPE simulations in the Discussion Section 5.1 (lines 319-328). We elaborated on the model performance and its varying accuracy across variables and vegetation types. We have now revised the paragraph slightly to more explicitly frame it as a discussion of model limitations and biases to improve clarity (lines 317-319).

In addition, we have now added a concluding sentence in lines 328-329 to this paragraph to explicitly emphasize the limitations in model applicability: "These results suggest that while STEMMUS-SCOPE performs reliably under certain vegetation conditions, its applicability may be limited in ecosystems with high heterogeneity or lacking comprehensive observational data."

Specific comments:

Comment 4: 1. line 12: "First the integrated STEMMUS-SCOPE model" ---> "First, …" Suggested to separate by a comma. Similarly, line 15 ---> "Next, …"

Response 4: Thanks for your suggestion. We have added comma in line 12 and 15.

Comment 5: 2. line 124: What does "Method ML" mean?

Response 5: Thanks for pointing this out. We have changed "Method ML" to "Machine Learning Method".