

May 21, 2024

Nonlinear Processes in Geophysics
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Dear Referee 2,

We thank you for taking the time to read our manuscript and for the helpful comments posted. This letter details the changes we made to address the points raised.

We highlight the referee comments in *blue italics*. We provide our replies to the comments and the changes we made to the manuscript. Additionally, we showcase the manuscript additions and alterations in **bold font**.

1. *I advise the authors to change the places where "temperature" is written to "air temperature". And "global radiation" to "global solar radiation".*

We thank the reviewer for pointing this out. We have changed the "temperature" to "air temperature" and "radiation" to "global solar radiation" in Lines 28, 86, 136 and 143-144.

2. *Figure 1 a: The scale and north arrow should be added to the map.*

There is no need to add scale and north arrow since Figure 1a consists of a Robinson-projected map with its corresponding grid, which accounts for representing the varying scale and the non-linear north direction [1].

3. *Description of Fig 1. A typo "radii" needs to be corrected.*

We appreciate the suggestion, but while both radii and radiuses are viable in English [2], we prefer the former.

4. *L115-116: Did you have in situ NDVI measurements to compare MODIS values?*

We did not use in situ NDVI measurements since MODIS data provides extensive coverage and captures canopy-level information, which is particularly relevant for our study focused on forested areas. Acquiring in situ measurements across the forested regions would be logistically challenging and resource-intensive (Instruments such as drones equipped with spectroradiometers or multispectral cameras would be required to obtain canopy-level measurements, and ground-based measurements could be influenced by understorey vegetation, leading to discrepancies with the canopy-focused MODIS data). Furthermore, MODIS Nadir BRDF Adjusted Reflectance (NBAR) data has been validated and is a reliable source for large-scale vegetation analysis [3].

5. *Figure 2: It would be good to show differences in network architectures.*

We appreciate the request to add more clarity in one key figure of the methods section. At the same time, we want to maintain the focus on the research question, which focuses on learning vegetation dynamics. We purposely kept the figure simple to give a quick intuition of the main differences in the models, i.e., the different training concepts. More details are shown in the caption and in the text itself in Sections 2.3 and 2.4. We outline mathematical details in appendices A1 through A4, providing different levels of detail for the interested readers. We have added titles to the figures, clarifying the differences between the backpropagation approach to training and the echo state approach. Figure 1 shows the differences between the old and updated versions of Figure 2. In addition, we have now included references in the introduction of Appendix A, which solely focuses on architecture comparison, for which toy models and benchmark datasets are standard.

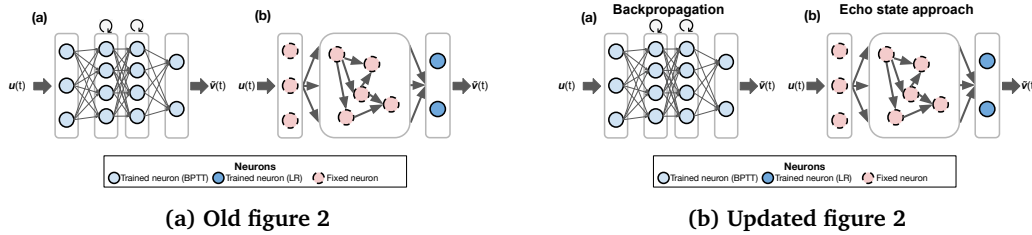


Figure 1: Side-by-side comparison of Figure 2 with updated subtitles.

6. *Section 2.4: What is the ratio between training and testing data?*

Thank you for addressing this. While we mention the training and testing data length in the text, it is only done so once and not in the proper section. Additionally, we do not mention the training and testing ratio. To address this problem, we added the following sentences at the end of Section 2.1:

We split the data for training and testing as follows: years from 2000 to 2013 (inclusive) for training and validation. We use the remaining years, from 2014 to 2020, for testing, resulting in a 67% and 33% training and testing split ratio.

7. *Figure 3e: Please explain the meaning of the red-shaded area here?*

We added the following line to the figure's caption to avoid confusion.

The extreme responses are highlighted by a red shaded area.

8. *Section 2.6.1: Please add a statement indicating at which values these performance indicators work well.*

The metrics indicate improved model performance as they approach zero. However, their true significance is best understood by comparing them with the same metrics from other models. We added a few sentences at the end of subsection 2.6.1, Line 248, to emphasize this context.

Both metrics proposed in this section indicate better model performance as their value approaches zero.

9. *L246: Please use another abbreviation for entropy-complexity. In Line 117, EC stands for "eddy covariance".*

Thanks for pointing out this oversight. We have now removed the use of acronyms for eddy covariance towers.

10. *Figure 5b: The legend should be corrected.*

We have corrected the legend of Figure 5. Figure 2 shows the differences between the old and new legends.

11. *Appendix B: Please add computational resources (GPU, etc.)?*

We thank the reviewer for this query about computational resources used in the paper's experiments. To clarify the setup, we included the following information in Appendix B1:

All the simulations are run on a machine fitted with an NVIDIA RTX A6000 graphics processing unit (GPU) and 504 GB of random access memory (RAM).

12. *Data Availability section: You should add MODIS data source link.*

Our study exclusively used the curated dataset FluxNetEO, which is based on MODIS data, see section 2.1 Lines 115. We believe we provided all the necessary links and citations for

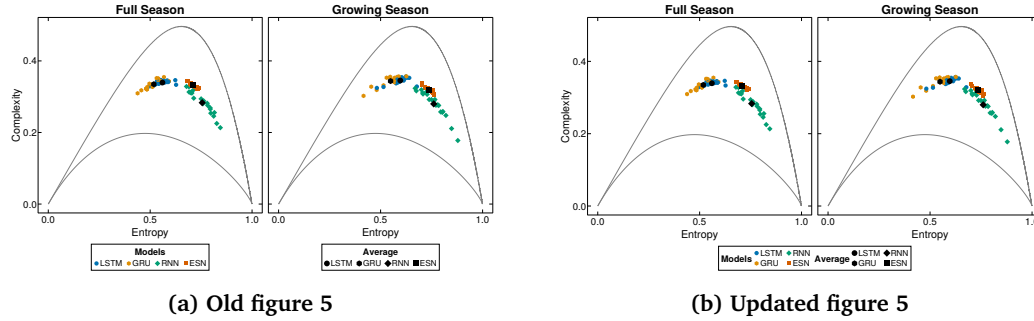


Figure 2: Side-by-side comparison of Figure 5 after the suggested changes.

this study to be reproducible.

We look forward to hearing from you.
Sincerely and on behalf of all authors,

Francesco Martinuzzi

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Center for Scalable Data Analytics and Artificial Intelligence,
Institute for Earth System Science and Remote Sensing, and
Remote Sensing Centre for Earth System Research

References

- [1] John P. Snyder. *Map projections: A working manual*. 1987.
- [2] Radius definition and meaning. <https://www.merriam-webster.com/dictionary/radius>. Accessed: 2024-05-13.
- [3] Crystal Schaaf and Zhuosen Wang. Modis/terra+aqua brdf/albedo nadir brdf adjusted ref daily l3 global - 500m v061. 2021.