MS-No.: egusphere-2024-2431

Title: Observation based temperature and freshwater noise over the Atlantic Ocean

Authors: Amber A. Boot and Henk A. Dijkstra

Point-by-point reply to reviewer #1

November 22, 2024

We thank the reviewer for their careful reading and for the useful comments on the manuscript.

Overview

The authors have successfully addressed my initial concerns with the manuscript and I do not have any strong objections to it in its current state, aside from a few corrections and suggestions which I will outline below.

Minor comments:

1. *Comparison of distributions: The authors mention having tested more than 10 different distributions, where the NIG model performed the best. It would be interesting to know how these were compared, and I think it would benefit the paper to include an overview or a table summarizing their performance. If this comparison is outside the main focus of the paper, then perhaps it could find its way to the appendix.*

   Author's reply:
   We have used Taylor diagrams to assess the goodness of fit.

   Changes in manuscript:
   We have included an additional figure in the Appendix with the Taylor diagrams.

2. *Model comparison metrics: The authors have provided additional figures which show that the NIG model provides a significantly better fit compared to a Gaussian model for most clusters. However, this is somewhat expected, as the NIG model is more flexible. It would be useful to*

include some metrics that assess fit while accounting for the number of model parameters, such as AIC or BIC.

Author's reply:
We have determined the AIC and BIC values for the fits. For the $E-P$ noise, the NIG fit is a better fit compared to a Gaussian fit for 98% and 87% of the grid points for the AIC and BIC metrics, respectively. For the T_{2m} noise this is 62% and 35%, respectively. This nicely supports the other tests carried out.

Changes in manuscript:
The additional results have been added, and two subpanels have been added to Figure A16.

3. *Manuscript length: The manuscript is somewhat lengthy and it would be beneficial to shorten it slightly, if possible.*

   Author's reply:
   We have considered this, but we believe that all the text is relevant to support and show the results.

   Changes in manuscript:
   No changes made.

Specific comments

1. *Figures A4 and A5 are not referred to or discussed in the main text.*

   Author's reply:
   Figures A4 and A5 are referred to in lines 110 - 111.

   Changes in manuscript:
   No changes necessary.

2. *Lines 205-211 regarding the Anderson-Darling test. I would suggest cleaning up the language a bit. The paragraph is a bit long and unclear.*

Author's reply:
Suggestion followed.

Changes in manuscript:
The text has been clarified.

3. *Line 213: "The model fails to provide good statistics" is somewhat vague. Please clarify what is meant by this.*

   Author's reply:
   What we mean is that the model does not capture the skewness and excess kurtosis well.

   Changes in manuscript:
   The text has been clarified.

4. *Line 163-164: The phrase "using replacement" should be changed to "with replacement".*

   Author's reply:
   Suggestion followed.

   Changes in manuscript:
   The text has been changed accordingly.

5. *Line 179: "is set-up very similar but more stochastic than. . . " should be changed to "is set up very similarly, but are more stochastic than. . . ".*

   Author's reply:
   Suggestion followed.

   Changes in manuscript:
   The text has been changed accordingly.

6. *Line: 179: Please be more precise by what is meant by "More stochastic"?*

Author's reply:
What is meant with that is that the total number of possible realizations to sample from is larger.

Changes in manuscript:
We have reworded this sentence in the text.

7. *"timescale" and "time scale" used inconsistently.*

   Author's reply:
   We have made sure it is now used consistently.

   Changes in manuscript:
   Time scale has been changed to timescale.

8. *Line 203-204: Consider replacing "fail this test" with "do not pass", and reword "8 grid points fail (out of. . .)" to "8 grid points do not (out of. . .)".*

   Author's reply:
   Suggestion followed.

   Changes in manuscript:
   The text has been changed accordingly.

9. *Line 204: The nested parentheses could be simplified by dropping the inner set.*

   Author's reply:
   Suggestion followed.

   Changes in manuscript:
   The text has been changed accordingly.

10. *Line 205-206: The word "test" is used very frequently (four times) in a single sentence. I suggest a slight rewording to reduce repetition.*

Author's reply:
Suggestion followed.

Changes in manuscript:
The text has been rewritten.

11. *The NIG abbreviation is introduced in line 193, after the PC(NIG) model has been introduced. I would suggest introducing this earlier, for example in line 169 where the NIG distribution is first mentioned.*

Author's reply:
Suggestion followed.

Changes in manuscript:
The text has been changed accordingly.

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Title: Observation based temperature and freshwater noise over the Atlantic Ocean

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Point-by-point reply to reviewer #2

November 22, 2024

We thank the reviewer for their careful reading and for the useful comments on the manuscript.

Overview

The authors have responded thoroughly to the concerns I raised in the original manuscript. I have a few minor comments on the revised draft; when these have been addressed it is my recommendation that the manuscript be accepted for publication.

1. *K-means clustering is based on a distance metric. In the description of the clustering analysis, please indicate how (if at all) the standard deviation, skewness and kurtosis are standardized before the clustering is calculated, in order to avoid combining dimensionally inhomogeneous variables and dominance of the distance by variables with larger dynamical ranges.*

   Author's reply:
   The standard deviation, skewness and kurtosis were standardized before the analysis.

   Changes in manuscript:
   This has been clarified in the text.

2. *L120: Please cite a reference describing the relationship between skewness and kurtosis for a system with multiplicative noise.*

Author's reply:
Suggestion followed.

Changes in manuscript:
Sardeshmuhk and Sura (2009) has been added.

3. *L217: I believe it is more appropriate to say that such grid points have variability that is "not statistically distinguishable from Gaussian", rather than saying that they "are likely Gaussian". The authors may consider revising the text accordingly.*

   Author's reply:
   Suggestion followed.

   Changes in manuscript:
   The text has been changed accordingly.

4. *L271-272: Please provide a reference to the distance correlation metric, as this is not commonly used in atmosphere/ocean science.*

   Author's reply:
   Suggestion followed.

   Changes in manuscript:
   Szekely et al. (2007) has been added as a reference.

5. *I am not surprised that the authors find weak dependence between the PC modes. Nevertheless,the fact that the original non-Gaussian fields can be reconstructed with the actual observed PC time series (not the sampled versions used in the surrogate models) indicates to me that such dependence must be present, even if it is subtle and difficult to model statistically. The sum in such reconstructions is also subject to the Central Limit Theorem. I recommend that a note to this effect be included in the revised manuscript.*

   Author's reply:
   Suggestion followed.

Changes in manuscript:
A comment has been added in the discussion.