Response to Referee #2:

General comments

The paper by Lovejoy et al., entitled "The Scaling Linear Macroweather model (SLIM): using scaling to forecast global scale macroweather from months to decades", gives an important original contribution to long-term stochastic modeling of climate variables, taking into consideration the existence of memory in the climate system; the approach is validated in this paper for the temperature but it has the potential to be applied also for modeling other climate variables. The paper is well written, it offers a well structured reading and an adequate illustration of results. It gives a good review of fundamental background principles, namely of statistical physics, while also providing detailed explanations on the proposed approach and model. I therefore recommend its publication in the Journal. However, there are some issues about this manuscript that still require further attention from the authors, therefore revision is required, i.e. the manuscript should be subject to technical corrections. I ask the authors to take into consideration some of the comments listed below while revising their paper; the list of corrections is not exhaustive, but I will point out the main required actions which I hope are useful to the authors, to further improving the readability of the manuscript. Below, I refer to the web version of the paper, regarding page and line numbering.

Specific comments

In my opinion, the relevancy of the analysis and modeling approach, in addition to the complexity inherent to this study area, justifies the somewhat lengthy paper, for full comprehension of the material. Results discussed in this manuscript are sufficient to support the interpretations and conclusions. However, I look forward to seeing soon publications reporting on further developments and applications of this work, that can complementary support the methodology proposed and allow for a better assessment of the potential of this model in climate forecasting, namely by confrontation of results with other approaches currently used.

Technical corrections

Section 1:
Page 491, line 24: please, clarify what is meant by "the same basic picture"; it could be linked to different previous sentences, in my view.
Au: OK, more information was added.

Page 492, line 18: please, be more specific on the meaning of "convenient physics notation";

Au: OK, clarified.

line 19: delete “usual”

Au: OK.
Page 492: make sure that all variables are defined in the text for eqs. 1, 2 and 3.

Au: Thanks, several were added.

Page 493, line 15: for clarity, substitute “OU” by “Ohrenstein-Uhlenbeck”
Au: OK.

Section 2:
Page 497, eq. 8: Please revise. Use format as elsewhere for the derivative and check that all variables are correctly in the equation.
Au: OK.

Page 498, line 1: in “usual gamma function”, skip “usual”. T(t) should be defined earlier in the text.

Au: OK.

Page 499, eq. 11: For consistency, please write the exponent H-1/2 as in e.g. eqs. 9 and 10: -(1/2-H). Define range of H values.

Au: OK.

Page 499, eq. 13: A new variable u is included. Please define.

Au: OK.

Page 501, eq. 21: Please revise/correct. The constant before the second integral should be deleted).
Au: OK.

Page 501, line 6: In the beginning of this line, the reference Mandelbrot and Van Ness (1968) seems to be misplaced;

Au: OK.

line 7: “can be eliminated”

Au: OK.

Page 502, line 9: for eq. 23, the interval for H’, 0<H’<1, could also be added.

Au: OK.

Page 502, eq. 25: the interval for H, -1<H<0, could better be added.

Au: OK.

Parameter λ could be defined elsewhere (not included in the equation).

Au: OK, we added it to the text.

Page 503. Line 1: revise limits of H;

Au: H<0 is enough here, but sentence improved.

line 8: please, clarify "the large λ formula"; eq. 27,

Au: OK.

better to give limits for H.
Au: Actually the formula is fine (valid for all H).

Page 504, 505: Section 2.3.2: the headings of subparts on Anomalies, Differences and Haar fluctuations should rather have font different from the headings of level 3, parent heading (maybe use italics, or different font size), to avoid confusion.
Au: OK.

Page 507, eq. 40: typo, delete the minus sign at the end of equation.
Au: OK.

Page 508, eq. 41: typo, delete the minus sign at the end of equation; define limits for τ.

Au: OK.

Page 508, line 14: note sign error in equation.
Au: OK.

Page 510, line 5: maybe better refer to "innovations" instead of "record"
Au: OK.

Page 510, line 18: suggestion: use "ocean temperature" instead of "ocean data".

Au: OK.

Page 510, eq. 50 and page 511, eq. 51: please, check the arguments for F_H.
Au: OK.

Section 3
Check references to tables 1 and 2, not all are correct.

Au: OK.

Page 516, line 18: "… multiproxies (fig. 4c)."

Au: OK.

Section 4
Page 517, line 13: a comma is missing in subscript of M.
Au: OK.

Page 518, Section 4.2. The heading for this section is "results". This is most unexpected, especially because one can identify section 4, as a whole, to report results (although not explicitly stated in the heading of main section 4). Therefore, please, revise the heading of section 4.2.

Au: OK.

Page 520, line after eq. 56, please check text between brackets.
Au: OK.

Figures:
In some figures, the authors opted by preparing longer than usual captions, but in my view these contribute to a more prompt understanding of the different figures, so I hope the journal sees no inconvenient and keeps the captions as proposed.

Au: Yes, we agree.

Axis titles: in some figures the axis labels are missing or cannot be read clearly. Please, revise and include units where applicable. In particular, check Figures 3, 8, 9. For consistency, use units K in Fig. 2.
Au: OK.

Figures composed by different panels: the panels are identified in the caption of the figures (e.g. a-e, Fig. 1) but not in the panels themselves. The readability of all such

figures should be guarantee by their adequate sizing during production of the final printed version of the paper.
Caption Fig. 1d, line 16: replace τ by t in "… with forecast horizon = t = resolution ….",
Caption Fig. 2, line 7 and 8: check respectively Table 2, not Table 1a; and delete "below".
Caption Fig. 3: line 1 - temperature "anomalies" could be indicated; line 7- add (c, bottom left); line 7 – in "The residues of the above", please clarify the meaning of "above".
Caption Fig. 4b, line 4: Clarify that the NASA GISS surface temperature series is anomaly data; line 16: correct "become".
Captions Fig. 5 to 8: there are some typos that need attention.

Au: All done:

Equations:
Symbols, variables: Some symbols and variables used in several equations are not all defined in the text. Also, in some equations the range of pertinent variables are not always defined. This requires attention and revision.

Au: Thank you, many additional definitions and limts were added.

There is not consistency, throughout the text and particularly in equations, in relation to making explicit the dependency of some functions on given variables. Please, revise.
Reference to equations in the text: Please check that the correct equations are identified; in particular, from equation 37 onwards.
Some symbols are not in italic when in the text, please revise.

Au: thank you, all done.

Other comments:
Abbreviations in the text: Throughout the text, please check that all used abbreviations are defined/explained the first time they appear in the text.
Gripenberg and Norros is a few places cited as Gripenberg and Norris. Please, correct.

Au: Thank you, fixed.

References:
Citation of references in the text: please, follow journal guidelines, there are several discrepancies. For example, line 12, page 491: (…) following Hasselmann (1976), (…).
Reference list: please, check references, which should be formatted respecting the journal guidelines. There are a few typos and discrepancies.
Au: the references have been improved.