

## Response to Authors (2)

The authors have done a fine job addressing my comments and I feel the manuscript may be suitable for publication after addressing several large remaining issues with the text. I'm suggesting further revisions for additional problems with language and brevity.

I would like to thank the authors for a much clearer and better-written manuscript and for addressing our concern about the time-varying soil moisture through further work, and for making a large effort to revise and add to the text for clarity and flow. However, the manuscript is still lacking transitions and sufficient detail, and is still too brief and in many places very confusing to follow. It is still a bit jarring to read and I think the abstract in particular could be more motivating and clear regarding the new science this work has added. The sectioning is over-done, and there are multiple places where you have a single sentence constituting an entire paragraph without any transition between them, an issue I highlighted in my first revision.

For the new sections added, I couldn't take the time once again to heavily edit for language; please do go back over the additional sections to ensure that your sentence structure and word choices are sound. Guide the reader slowly through what you did and motivate it clearly. Some of the word choices and arguments are still awkward and hard to understand. A few that I caught are listed below. Please make appropriate edits throughout. Especially in the results and Discussion, I was really lost.

### Page 1

8 rephrase "Our knowledge of the climate system...governing the evolution of the oceans and atmosphere."

9 "state of the flow" is too vague. Be specific!

12 delete comma after (forecast),

12 delete "Furthermore," and start sentence with The

21 'adjoin model' – unclear on what you mean here

Could you add some more transitional sentences to guide the reader through the subsections in Section 2?

Be careful about extra-short paragraphs that only have one sentence.... Combine where appropriate.

### Page 5

12 as 'a' consequence, not 'the', add 'any one observation may present ....with distant ones'

2.1.1 line 23: what is the 'sensor' – I don't think you have defined this yet...

Once again, the line numbering in this text just changes from 5-30 throughout which made it very difficult to give line-by-line comments.

23-25 the wording of this sentence is a bit confusing. You're trying to say that rain gauges and anemometers take hourly-scale measurements but paleoclimate data contain a time-averaged signal. It reads as if you're saying they're all the same. Revise for clarity.

### Page 6:

3 revise "comprising of a dynamical model" .... 'all which interact with each other'

2.2.1 You need to define the V-S Lite acronym on first use and spell it out in this title. You do that later in the text at the moment and it's out of place. It needs to be here.

24 what is PLF ? Redefine, the reader has forgotten.

Page 7

8: grown = growth

15: change definition of FL acronym to main text, not just in the title.

17: delete 'applied'

18: change to "FL has been applied in ecological ...

22: correspond = corresponds (add s)

Page 8, make line 8 into two sentences. Equation 15. Then, ....

2.4 Page 9

Change to "Experimental Design"

You define VSL here but it should be on the previous page.

16 change model to 'modeling'

Page 10:

10: boundaries THE model requires...

18 why is there a bullet here?

Page 11:

5 'lowest level of the state vector' – this is too much jargon. Do you just mean surface temperature?

12: what is meant by 'shifting of recorded variable?' unclear—revise

Delete Section 2.4.2 and move all of that paragraph to 3 Results.

19: change wording "We focus our analysis on temperature due to the larger error reduction in this field as compared to other variables...."

23: delete parentheses around near surface temperature and add "of near-surface temperatures"

Page 12 typo line 26 "acenso"

Page 13 at the very top here you introduce a PRESCRIBED experiment for the first time. There must be some problem with your LaTeX file here— You meant to have two bullets above, one with SLAB and one with PRESCRIBED, but one got lost....correct above.

Page 14

Do not put a new paragraph between lines 10 and 11.... You're still discussing the same figure.

You've got LaTeX error instances of "DIFdelbegin" and end throughout the text...

17 comma splice. This is also a good example of a long and convoluted sentence that appears throughout that is hard to follow and understand.

20-25 this is a bit of a weak statement regarding optimal network design. We already know that trees at higher latitudes are going to be more sensitive to changes in temperature, so saying that we should measure trees in Alaska instead of South Africa isn't very helpful. We're actually desperate for more terrestrial records from the Southern Hemisphere....I know what you're trying to say here, but you need to make a better argument.

23 contains comma splices

25 change to “This study, where a DA method....”

32 I think you mean to say “constraint on the forecast motivates us to perform our DA experiments in an offline regime”

Page 15

10 delete comma after Prod

25-30 you say that a previous study supports Online .... But then you say “therefore we apply offline” – this doesn’t follow or make sense. Review previous work and then compare it to what you did and say how it’s different. Also, “performs a more realistic temporal variability” makes no sense—rephrase: ‘simulates more realistic ..’ and also, temporal variability of what?

Page 16

Line 3: what system are you referring to?

**Ever since the results section started I have felt lost trying to follow the writing. I also feel the sections are hyper-sectioned....out to four subsections is unnecessary. Just have two paragraphs and introduce them for 3.2.2.1, 3.2.2.2.**

Page 17

3 what is an elbow? Use mathematical language. Inflection point? What is Free run and why is it capitalized?

Your sections just jumped from 3.2.3 to 3.2.1.

Re-label as ‘Time-Varying Soil Moisture’

12 I don’t know what the ‘new set’ is—you have to be specific. New set is the “time-varying soil moisture fields.” Spell it out.

13 I think when you say ‘time evolution....’ Do you mean the time series of global mean temperature? As in, the skill over time vs. the spatial skill? You need to clearly differentiate between these two metrics throughout the text. They are calculated differently and have different implications.

19 “improvement in the error reduction” – don’t you just mean “error reduction” ?

28 rephrase “this methodology can be applied to techniques in Optimal Sensor Placement...”

29 effectiveness, not effectivity (that is not a word)

Page 18

Line 2, “has yet to be investigated”

5: you’re talking about structural biases and how they carry forward using PSMs with GCMs in a DA framework. This is discussed at length in Dee et al., 2016, and you might reference that here.

10: ‘indiscriminant’

17-20 single, long, confusing sentence, single paragraph.

21-35 this section reads as a regurgitation of previous work that is not cohesively linked to what you did and with the writing. I cannot follow this text at all. "enter an offline regime" – don't you just mean "use an offline regime?" I don't understand the argument that you can't get observational constraints for internal variability with annual resolution records. Please clarify this argument dramatically.

4.2 on page 21... you do not effectively review your new results or your new work here at all... What is meant by pollutions? "in the face of" is too colloquial. In this discussion, and the outlook, you need to provide us with a concise summary of what you did, your new findings and how it compares to previous work, outline caveats, and then give suggestions for future work and the importance of yours. At present, it is too disjoint and I think the over-sectioning is a culprit. We don't need multiple sections here. Just "Discussion."