

Response to Reviewer #3:

General Comments and Suggestions:

The work presented here is interesting, and presents an opportunity for researchers to utilize sub-seasonal forecasts from the CFSv2 model. However, this manuscript would benefit from a thorough proofreading, as the authors' writing is difficult to follow throughout much of the paper. Overall, I believe the manuscript can be made more concise and direct, which I believe will improve the readability of the paper. I have noted some specific instances below, but I am sure it is not a comprehensive list of all the improvements that could be made to the manuscript.

Thank you very much for your time and your insightful review. We have carefully revised the manuscript in order to include your comments. We believe that this manuscript is substantially improved as a result of the revision.

On page 2, the authors state that, “: :many extreme events and management decisions fall into sub-seasonal timescales: : :” I suppose I could use some examples. As the paper is currently, “sub-seasonal timescales” are on the order of 3-4 weeks. When I think of extreme events, I think of shorter term events such as flash flooding, tornadoes, extreme hail, wind, etc: : :, or I think of more persistent events such as drought or persistent floods. Many of the examples the authors provide in the second paragraph tend to be on the order of the seasonal timescale as defined by the authors on page 1. It would be beneficial if the authors could state what extreme events they specifically have in mind to be addressed by this research. Some of this is touched on near the end of the Discussion section by the authors, but could be more succinctly stated earlier.

RESPONSE: We added following sentences to this paragraph:

“... For example, flash drought, heat wave, and cold wave are extreme events at sub-seasonal timescale. Sub-seasonal forecast information can be used for developing strategies for proactive natural disaster mitigation, which may be needed during those extreme events. ... In this study, we aim to evaluate forecasting for precipitation and temperature derivatives, or indices that are associated with those extreme events, and decision-making at sub-seasonal timescale.”

At the end of the second paragraph on page 2, the authors state that the, “: :derivitives or indices are directly associated with important events and decision making: : :”. Similar to the previous comment, I do not believe the manuscript currently addresses this point.

RESPONSE: In this study, we aim to evaluate forecasting for precipitation and temperature derivatives or indices that are associated with important events and decision-making at sub-seasonal timescale – in particular the mean, frequency, duration, and intensity of precipitation and temperature at sub-seasonal timescale, such as the number of dry/wet days, number of cold/hot days, etc. We have noted this in the revised manuscript.

Beginning on page 3 and continuing to page 4, the first paragraph of the Data and Methodology section is very confusing. A table comparing the differences between the 9-month, 45-day, and season runs would be beneficial. As it stands now, I believe this section assumes too much of the reader to interpret how NCEP runs the CFSv2 model.

RESPONSE: We added a table and a figure to explain those three hindcast configurations. We have also updated the text in this section to make it more concise and direct.

On page 4, the authors discuss an example and reference a “lead one” forecast. It appears they are referencing the 14-day forecast, but it’s not clear.

RESPONSE: This sentence has been clarified: “Taking the 14-day forecast for WetSpell in January as an example, the first (second) forecast lead time is the number of consecutive rainy days from January 1 to 14 (from January 15 to 28).”

Equation 1 is not clear. The variable E is described as 1/3 the total number of forecasts, T. Why wouldn’t the denominator simply be (T – T/3)? It sounds as if there is more to the variable E than is described.

RESPONSE: The variable E is the expected number of categories forecast correctly just by chance. Since there are three forecast categories in this study, it is described as one third of the total number of forecasts. This has been clarified in the revised manuscript.

With regards to the discussion of Figure 2 that starts near the end of page 6 and continues on to page 7, I am not sure why the authors do not include similar figures for MAM or SON, but do discuss the results. Wouldn’t it be beneficial to include those figures? This comment applies to Figure 4 as well.

RESPONSE: We agree that it would be beneficial to include those figures. The figures for MAM and SON have been added in the revised manuscript as suggested.

Similarly, I’m not sure why the authors stress emphasizing the month of July in Figure 3. The authors state there is some difference in monthly spatial patterns, but without the other months, I do not have the proper context for the figure.

RESPONSE: In the new figure, we have added the month of January as a context for the figure.

With regards to section 3.3, it would be useful to have some sort of table or reference to see what periods of MJO and/or ENSO activity are being analyzed. The number of events considered could be limited enough that the HSS could be somewhat skewed. It would also be helpful if the authors discussed more clearly the impacts of active MJO and ENSO compared to the combined impacts of MJO and ENSO events. I think the authors begin to discuss this in the second paragraph on page 9, but do not offer enough insight on the particular point.

RESPONSE: We have included a table showing the periods of MJO and ENSO events and point out that the limited number of events could somewhat skew the skill score conditioned on ENSO. We also discuss the combined effects of MJO and ENSO compared to the individual effects from either MJO or ENSO, suggesting a potential benefit of using MJO and ENSO information for sub-seasonal forecasts. Please see the details in section 3.3 of the revised manuscript.

The first full paragraph on page 10, describing the role of the BM method is not clear. I would recommend the authors explain this conclusion more clearly, or simply remove the paragraph.

RESPONSE: Thanks for pointing this out. We have simplified this paragraph by removing the sentences for describing the role of the BM method.

On page 11, the authors state that forecast skill could be improved by simply having a larger ensemble. I am not convinced of that; a larger ensemble may not necessarily add useful information. It may be more appropriate to state that a sensitivity study on ensemble size could be performed to see if a larger ensemble does improve forecast skill.

RESPONSE: We agree that a larger ensemble may not necessarily add useful information. We changed the original sentence to:

“Forecast skill could be potentially improved by having a larger ensemble size. A sensitivity study on ensemble size could be performed to assess whether a larger ensemble improves forecast skill.”

Page 1, lines 27-28: I'm not sure what is meant by, “: : : sub-seasonal timescale is beyond the memory of the atmospheric initial conditions: : :”

RESPONSE: It means sub-seasonal timescale is sufficiently long that much of the memory of the atmospheric initial conditions is lost. We have clarified that in the revised manuscript.

Page 5, the NCDC has since been renamed the National Centers for Environmental Information (NCEI)

RESPONSE: It has been revised as suggested.

Page 6, line 26 should read “Figure 2 shows”

RESPONSE: It has been revised as suggested.

There is no legend for Figure 5, so I am unsure which regions match to each particular color.

RESPONSE: We have added a legend as suggested.

Page 8, line 10: “temperally” should be “temporally”

RESPONSE: It has been revised as suggested.

Page 8, line 17: “reasonaly” should be “reasonably”

RESPONSE: It has been revised as suggested.

Page 9, line 23: “depending” should be “dependent”

RESPONSE: It has been revised as suggested

Page 10, line 4, “spatial” and “temporal” should be “spatially” and “temporally”

RESPONSE: It has been revised as suggested.

Page 10, line 5: “to note” should be “noting”

RESPONSE: To address one of the comments raised above, this sentence has been deleted.

Page 10, line 23: There is no Figure 13 included in the manuscript. To this point, referencing a figure in another article (Jones et al. 2011) is a bit confusing. I think I would just note how the results of this study compare to Jones et al., rather than to a specific figure.

RESPONSE: Thanks for pointing this out. Figure 13 is a typo. It has been changed to Figure 12 in the revised manuscript. We agree it is a bit confusing to reference a figure in another article. We have changed that in the revised manuscript as suggested

Page 11, line 8, “highlighted” should be “highlight”

RESPONSE: It has been revised as suggested.

Page 11, line 9, “subseasonal” should be “sub-seasonal”

RESPONSE: It has been revised as suggested throughout the paper.