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Earth System Dynamics
Discussions

Interactive comment on "The Standardized Vertical Velocity Anomaly Index (SVVAI): Using Atmospheric Dynamical Anomalies to Simulate and Predict Meteorological Droughts" *by* Zhenchen Liu et al.

Anonymous Referee #2

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This paper introduces a new index (SVVAI) that quantifies the tropospheric vertical velocity, with the application of this index as a meteorological drought diagnostic. The SVVAI is compared to the 3-month Standardised Precipitation Index (SPI3) for six case-study drought events in China. The potential for the SVVAI in drought prediction is also explored for these drought events. The SVVAI is a novel approach to diagnosing drought, with most drought indices based on surface variables rather than atmospheric. Unfortunately, I found the execution of the article to be poor, and recommend rejection.

Major comments

1. The English is not of the required standard. It is frequently a significant challenge to interpret the text, requiring very careful reading. This makes it very difficult to focus on the intended presentation and interpretation of results. I suggest the authors improve the grammar before resubmission.

2. The conclusions for both drought simulation and prediction are hampered by sample size. By selecting only a few case studies, it is difficult to draw overall conclusions about the relative benefits of SPI3 versus SVVAI. For example, how do the two indices compare during (a) other droughts, and (b) on all days (not just droughts)?

Furthermore, the authors' conclusions about the SVVAI being equal or superior to the SPI3 in predictive performance (L316) to be overstated. With only a small sample of events and no use of forecast verification metrics, it is impossible to draw this kind of conclusion.

3. I do not think the authors adequately describe the reasoning behind using the horizontal divergence and vertical velocity as diagnostics of drought. Dynamically, how do we expect these variables to change during drought? Is that seen in the results presented here (e.g. Fig 2). The paper could do more to link the results to dynamical processes. For me this is a "major comment" because it underpins the whole point of the paper.

4. There should be greater discussion of the relative benefits of SVVAI and SPI3. Why would you use SVVAI when you could just use SPI? In what circumstances is it preferable to use SVVAI? Can you draw those conclusions from the results presented here?

For example, Fig 6 implies that SVVAI is only comparable to SPI3 for eastern China, but there is no discussion of this. Does this mean SVVAI is not a useful indicator of meteorological drought for the rest of China?

5. There is too much information presented across all the figures. I think some of the

information should be synthesised. For example, is it really necessary to have 3 similar figures, each with 11 panels (Figs 9, 10, 11)? Surely there are ways of presenting this information more concisely. I also do not advocate simply moving some figures to the supporting information, as that already contains many results.

6. I find the conclusions of the forecasting section to not match the results. As mentioned in point 2, the statements about predictive performance are severely hampered by the sample size of events and lack of forecast verification metrics.

Greater synthesis of the forecast results is needed. For example, for Figs 9, 10 and 11, the authors draw conclusions about model performance by visual inspection of spatial fields. While it is useful to visualise it this way, I do not think it needs to be done 3 times over (this is related to point 5). In fact, the authors already use a measure of pattern correlation (PCC). Could PCC not be used to quantify the similarity of forecast fields to the observation, or between the two models' forecast fields, as a way of presenting results more generally?

Furthermore, I am concerned by the lack of forecast calibration. To be fair, the authors note that the CFSv2 forecasts used in SVVAI prediction are raw (L423-426), and could benefit from calibrating to the ERA-Interim vertical velocity and horizontal divergence data. However, it is not mentioned that the precipitation forecasts are also raw, and hence the SPI3 also require post-processing to indicate operational forecast skill. It is entirely possible (probable, even?) that the biases in the precipitation forecasts are larger than the biases in the atmospheric variables (in fact I think this is what the authors are saying in L83-85). Therefore, the forecast results are presented with the models on an unequal footing, making comparisons very difficult.

Minor comments

1. Figure captions are not detailed enough. For example, what is Figure 7 showing? Why the many different orange and black lines? I assume they are different initialisation dates but please describe what's shown in the figures.

2. L153: What does the "critical proportion" mean? Please explain. Is this where you define "extreme" and "severe" drought processes?

3. Figure 2 caption: "shadow" should be "shading".

4. Figure 4, 7: The y-axis label should surely be something like "Standardized anomaly" rather than SPI3?

5. Section 6: Remind readers which forecast model is used (CFSv2) at the beginning of the section.

6. L316: How do the authors come to the conclusion that SVVAI_ave is equal or superior to SPI3? Please walk the reader through the figure so that they can draw the same conclusions.

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