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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Modeling the contributions of global air temperature, synoptic-scale phenomena and soil moisture to near-surface static energy variability using artificial neural networks" *by* Sara C. Pryor et al.

Anonymous Referee #3

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This study examined different statistical models for summertime daily maximum and minimum θe to understand the drivers of historical changes and variability over the eastern USA. The non-linear model considering soil moisture show improved θe estimations over majority of the study region. The authors also argued that SM has played a key role in dictating the presence and intensity of the "warming holes". I think this work will make a valuable contribution to understand the drivers of surface static energy and heat waves, and would recommend publication after some minor revisions. My comments are listed below:

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Discussion paper

1) There major drivers (e.g., global temperature, synoptic-scale indices and SM) were used to develop statistical models for θe. By comparing the statistical models with and without considering the SM (e.g., ANN-HL3-SM vs ANN-HL3), the authors concluded that the SM played a key role in dictating the warming holes. This statement may be misleading. To identify the relative roles of individual drivers, it might be better to develop statistical models by examining different combinations of the drivers (e.g., global temperature and SM, or synoptic-scale indices and SM). It is also possible that the roles of different drivers may vary in different regions. 2) The climate variations in the eastern USA are influenced by different climate modes (e.g., ENSO, NAO, IPO). The aerosol may also play some roles on the warming holes. It is not clear why these modes were not used in this study. 3) For SM index. The 90-day running mean estimate of antecedent SM in 3x3 grid cells were used. Why it is necessary use the 90-day running mean and 3x3 grid cells average? It was found that the SM would influence the climate downstream. Do you think it is possible to improve the model results by averaging the SM over a large region (e.g., 5x5 or 10x10 grid cells)? 4) Page 4, line 15. How were the daily maximum and minimum θe calculated? Did you firstly compute the θe using the hourly T, q, and P, and then derive the maximum and minimum values? 5) Page 5, last sentence. The global T and 15 synoptic-scale PC scores are common to models built for all grid cells, whereas the SM is grid-cell specific. Therefore, it is not a surprise that the SM plays a more important role in the model performance. 6) Table 1. The # of grid cells with r>0.8 & RMSE < 5K were shown. However, it might be better to show the percentage because the number of grid cells depends on the spatial resolution of the dataset used. 7) Figure 2. Would it possible to add the state or continental boundary to the figures?

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