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Geoscientific Model Development Discussions

Interactive comment on "Simple Process-Led Algorithms for Simulating Habitats (SPLASH v.1.0): Robust Indices of Radiation, Evapotranspiration and Plant-Available Moisture" *by* Tyler W. Davis et al.

Anonymous Referee #1

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This paper describes a process-based model for some surface flux and other quantity reconstructions, such as radiation, evapotranspiration, and soil moisture, using three daily mean meteorological inputs (i.e., near-surface air temperature, precipitation, and either fraction of bright sunshine hours or fractional cloud cover), latitude, and elevation, in order to overcome data deficiency of plant ecophysiological and biogeophysical studies. The process-based model that is based on theoretical understanding of relevant environmental processes can provide a practical opportunity for understanding specific responses to changes in environmental conditions. For example, the model can be used to estimate the response of paleoenvironmental indicators to the really

different climates from the present a situation that statistical models might make inappropriate extrapolations. Therefore, the manuscript will be really useful for the community to implement paleoclimate and paleoecological analysis.

I realize that this is a consolidated study of separately developed modules in the STASH model, and not a really "new model" paper. Overall, this manuscript is well written and clearly describes the calculation processes. But, the process-based model is greatly simplified; therefore you need to validate whether the model output is reliable or not using the globally or locally observed data. Although I do not know any observed evapotransipiration and plant-available moisture data, we have some monthly-observed radiation data at the surface and top-of-atmosphere (e.g. Clouds and Earth's Radiant Energy System (CERES)). Using the data set, you could validate what extent the simplified process-based model simulates radiation terms.

In the result section (P. 13, L11-), you run the model using a grid data above San Francisco. If you access monthly-observed radiation, evapotranspiration, and soil moisture data there, you can keep the results and then you should add the observed ones into Figure 4. Then, you can discuss the model performance. If not, you should choose other locations where you can access the observed data.

With regard to inputs, do we really need mean daily meteorological variables for the robust approximations of key quantities? If you really need the mean daily data, you should choose any reanalysis data (e.g., ERA-interim daily time data) for the all three meteorological data. I do not understand why you use the mixture of daily and monthly data well. Then, long-term monthly mean values (in equilibrium past climate states, such as mid-Holocene and Last Glacial Maximum) are common for paleoclimate community. Therefore, if you expect the application of the model for paleoclimate studies, you should make a conversion module (i.e., monthly data into quasi-daily data). It is not difficult for you to put the module into the SPLASH code because this kind of model is included BIOME3, BIOME4, and LPJ DGVM. Finally, what do you think if we use quasi-daily data for running the model, it estimates really different output from the one

with regular daily time-step meteorological data?

Other minor comments:

P. 1, L5, what are the exact time scales of "ecologically relevant time scales"? Under your assumption, can we use a traditional climatology (i.e., 30-year average) data?

P. 3, L6, change "air temperature" to "near-surface air temperature" or "air temperature at the height of 2m"

P. 3, L27, one term/character missing for "the analytical integral of the minimum ... over a single day"

P. 5, L25, surface shortwave albedo is constant (0.17) for the model simplification, but is it okay for the energy balance at local? The surface condition including albedo must be different at local. Therefore, the anomaly (actual surface albedo at local minus 0.17) largely impacts on surface net radiation and thus evapotranspiration and soil moisture in some regions, right?

P. 13, L13, although the model requires daily meteorological input (P. 3, L6-7), why do you use monthly cloud fraction data here? Do you think that cloud fraction is less significant for the calculation, compared to the other meteorological variables? I think that the diversity of the forms of clouds and their strong spatial and temporal variability determine the dynamics of the radiation budget to a significant degree.

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