Comment on hess-2021-131
Anonymous Referee #1

The paper by Li et al. proposes using a four-dimensional variational assimilation method (PODeN4DVar) with soil moisture (SM) and leaf area index (LAI) observations for calculating the evapotranspiration (ET) and gross primary production (GPP). The paper is rich in content but there are a lot of confusions. Therefore, major revisions are required before proceeding with your paper.

As you said, the spatial scale mismatch between the ground observed footprint size and satellite-derived footprint size were the vital factors affecting assimilation performance. The spatial resolution of assimilated GLASS LAI data is 5 km, and thus the resolution of ET and GPP estimates is 5 km. The spatial footprint of EC measurement of ET and GPP is at most about 100-500 m. Hence, there is a mismatch between the footprint of model estimates (5 km) and field EC measurements (100 m). Larger spatial representation mismatches can lead to completely wrong conclusions, especially on heterogeneous surfaces. Perhaps you discussed it in the manuscript, but such uncertainty will strongly change the result.

Lines 47: Maybe it should be "GLASS LAI"?

Lines 73: "ENKF" or "EnKF", please unify.

Lines 74: There have been many applications of four-dimensional variational method (4DVar).

Lines 165: What does this equation mean? What are the constraints of SM on ET?

Lines 170, 179, 180: Confusing expression! Do you assimilate ET in the manuscript?

Lines 187: The flow chart of the LPJ-VSJA assimilation program is complicated and needs to be simplified. What are "section 3.1.1" and "section 3.2" in the Figure 1?
RMSD and ubRMSD have similar meanings, maybe you only need to keep one.

Observation errors should be defined based on the errors of instruments measuring LAI. Why did you choose arbitrary values for LAI observation errors?

"(R, RMSD, BIAS,)" remove the comma.

What is the time step and spatial resolution of the model running?

I can't find ubRMSD in the Taylor diagram of Figure 10.

Please add the reference about Liu et al. (2018). You should add the download URL about Heihe data.


You should add download URLs for LAI, SM, and other remote sensing data.

The spatial resolution of MODIS ET is 1km, and the spatial resolution of GLASS ET is 5km. To be consistent, have you resampled?

You should mention Figure 3 in the description.

The unit format is not uniform, you need to double check. "g C/m²/mon" or "g C m⁻² mon⁻¹", please unify. The x-axis in Figure 3 and 6 is confusing, or you can express it in years.

Over cropland, the data assimilation scheme tends to generally underestimate GPP. What is the reason for the underestimation?

"Fig.4", Full name or abbreviation? please check carefully!

There are a lot of up-scaled ET and GPP products (Jung et al., 2009, 2020) that can be used for regional validation.


The X-axis label is the same as the y-axis label in the Taylor chart.

The full name should be used the first time you use it (NSD).

In column A, GPP is low in the tropics and high in arid regions?

The TC method has been used to quantify uncertainties of gridded datasets. The TC method can only calculate uncertainty based on three (ET/GPP) products. How did you calculate the five (ET/GPP) products?

"Except for MODIS, GLASS, and LPJ-DGVM (0–60 mm month⁻¹), the σ of other
products was generally between 0-20 mm month$^{-1}$. This is hard to see in Figure 14.