

## ***Interactive comment on “Data assimilation for continuous global assessment of severe conditions over terrestrial surfaces” by Clément Albergel et al.***

### **Anonymous Referee #1**

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#### General comments:

The paper by Albergel et al., describes the application of the LDAS-Monde land data assimilation system (LDAS) to monitor and forecast the impact of extreme events (droughts) on land surface variables, such as surface soil moisture (SSM) and leaf area index (LAI). More specific, the study compares the skill of the open-loop (model only) to that of the analysis (assimilating satellite derived SSM and LAI). This is done globally (to detect anomalies) and at regional scale (using two case studies) for a more comprehensive look at the potential to forecast extreme events. The experiments are validated using different satellite based datasets and also in situ observations. In ad-

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dition the authors look at the potential to include snow in the LDAS-Monde data assimilation system. The paper is well written and organized. Furthermore, the paper demonstrates the challenges and opportunities in setting up a global LDAS. It would have been interesting to see a comparison of analysis vs. open-loop root-zone soil moisture skill (compared to the International Soil Moisture Network), as this could have a longer memory than the surface zone soil moisture, however, this is not crucial for the conclusions of this study. The authors are to be congratulated on setting up a global "near real time" LDAS for monitoring and forecasting of land surface variables and I will recommend that this manuscript is published in HESS after considering the following minor comments:

#### Specific comments:

L107-117: Is it necessary to include such details about the datasets in the introduction?

L180: Please specify what you mean by flow dependency between the prognostic variables and the observations.

L198-200: Difficult to interpret the difference in LAI error when you use a mix of percent and m<sup>2</sup>/m<sup>2</sup>. Please could you clarify this?

L251: Could you please include why you don't consider assimilating surface soil moisture observations from the Soil Moisture and Ocean Salinity (SMOS) and/or from the Soil Moisture Active Passive (SMAP) satellite missions? As these satellites are expected to be more sensitive to surface soil moisture than the C-band observations from ASCAT. Furthermore, as I understand ASCAT data are already assimilated in the production of the ERA5 dataset. Will the LDAS-Monde assimilation not lead to a double counting or usage of the ASCAT data and what are the potential consequences for your analyses results?

L268: Please could you specify the difference between linear rescaling and CDF-matching (if any)? To my understanding linear rescaling is correction of the mean

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and standard deviation, while CDF-matching corrects the whole CDF (i.e., all moments of the probability distribution function), hence linear rescaling is not the same as CDF-matching.

L292-294: Could you please discuss how this short spinup period could affect your results?

L383: Could you please provide more details on how this can explain the differences seen between ISBA and GLEAM?

Technical corrections:

L18: Acronym ERA5 is not defined. What is LDAS\_ERA5? An experiment?

L23: Please remove “successfully”

L25: Evapotranspiration and evapotranspiration, please decide on capital letter or not.

L54: “However its concept is broader” This is a bit unclear, maybe: “The concept of drought is broad and they are generally...”.

L56: This was a bit unclear, maybe: “and they have severe impacts in regions with rain-fed crops and no irrigation”.

L61: Suggestion: “that all drought types...”

L63: Suggestion: “in order to fully understand the...”

L64: Acronym is already defined in the abstract.

L69: Earlier Earth observations now Earth Observations, define acronym earlier.

L73: Please specify what application? Coupling of LSVs with other models of the Earth system? And how is this done?

L75: Please remove “unrestrictedly”

L77: LDAS acronym already defined in the abstract.

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L78: “could lead to...”

L83: “several are NASA lead...”

L84: “Amongst” multiple times? Maybe rephrase to: “Examples of such activities are the Global Land Data Assimilation System (GLDAS) which is run at a global scale. While the...”

L93: “the LDAS-Monde”

L95: Please rephrase. Maybe “Few studies have, however, included...”

L100: “the LDAS-Monde”

L101: ECMWF acronym already defined

L103: This is already specified in the abstract, perhaps remove/rephrase in the abstract to avoid duplication.

L104-106: Acronyms are already defined in the abstract. Maybe cut the definition of the acronyms in the abstract to avoid the abstract to become very technical?

L113: “accessed”

L115: “accessed”

L116: “accessed”

L119: Please remove “severely”

L128: “prospects for future work”

L158: Please specify what kind of parameters.

L159: “The ISBA...”

L161: “bottom”

L167: What is “bale”?

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L184: “.....eight soil layer (1-100 cm) and...”  
L184: “In addition to a control run...”  
L186: “., the initial...”  
L193: “(soil layer 3 to 8, 4 – 100 cm).”  
L204: Replace “and” with a comma.  
L205: Change “precipitations” to “precipitation”  
L209: “is a...”  
L210: Remove “EU-funded” or be more specific.  
L212: Change “dimension” to “resolution”  
L213: Please rephrase to avoid the use of “quite new” and “already evaluated”. Maybe: “Several studies have validated the ERA5 datasets, for example....”  
L214: Remove “former”  
L221: “, also with positive outcomes for ERA5.”  
L226: “this study”? And “, the ERA5....”  
L230: “accessed”  
L231: “...HRES and 31 km in ERA5”.  
L231: “The atmospheric forcing...”  
L232: For HRES this is not a “reanalysis grid”  
L232-234: Please rephrase, what do you mean here?  
L250: “accessed”  
L256: Remove extra spacing

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L256: SWI is already defined.  
L264: “the assimilation”  
L277: Using model or and observed snow dataset?  
L290: “For these regions...”  
L292-294: Please rephrase. Maybe: “The HRES is available at the 0.1x0.1 resolution from April 2016, thus we do a spinup covering April to December 2016 and present results for 2017 to 2018.”  
L295: “used, and initialized...”  
L302: Please change wording.  
L303: Independent from what? The analysis or each other? Please specify  
L304-310: Is defined in the abstract, consider removing this technical information from the abstract.  
L311: Remove “also”  
L314: “and they have been used in previous studies to...”  
L316: “Therefore, the LDAS-Monde ....”  
L327: Nash-Sutcliffe  
L341: open-loop  
L347: Please change “appreciate”  
L348: open-loop  
Figure 4: Perhaps indicate in the figure caption (or in the figure) which observational dataset is being used for comparison e.g., GLEAM for evap etc.  
L356: “averages”

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L364: Please rephrase “healthy behaviour”  
L367: “latitudes”  
L369: Please clarify “decrease in e.g. RMSD values”.  
Figure 5: Please fix the comma in the caption e.g., “Latitudinal plots of score differences (analysis minus open-loop) for Leaf Area Index (LAI), c) correlation ,d) RMSD...” what is the space after correlation?  
L371: “The number...”  
Figure 6: Plot title “Correlation (Analysis – openloop)” to “Correlation (Analysis minus open-loop)”.  
L377: Maybe add “(SIF RMSD N/A)”.  
L387-393: Very long sentence, please rephrase.  
L395: Please remove “latter”  
L396: Please clarify that this is down to the ERA5 forcing and not the snow module in ISBA.  
L397: Spring to spring  
L398: What is it in the snow cover parameterization of ISBA that causes this?  
L400: Please make it more clear that it is the LDAS-Monde snow product that could benefit from this and not data assimilation in general.  
L407: “accessed”  
L409: “The LDAS...”  
L413: Well 1/2 of the metrics are positive and the other 1/2 is negative?  
L428: Please comment why NSE values below -2 were discarded.

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L429: 982 out of how many stations?  
L431: “Panel a)....”  
L437: “These results...”?  
Figure S2 caption: “are available and with a drainage...”  
Figure S2: Do you have any idea why the NSE seems to be better over Europe than for example the United States?  
Figure S3 caption: The analysis is green in the figure, while the text says that it is red.  
L441: “...the SSM analysis.”  
L447: “averaged R values are...”  
L455: Spacing: “(NIC > +3)”  
L455: “in” instead of “by”?  
L460: Please rephrase “significant differences” can also be negative, hence no added value from the analysis.  
Figure 9 caption: Please specify the acronyms and their corresponding color in the figure.  
L471: “...through the whole 2018...”  
L475: “EAFR experiences..”?  
L480: “accessed”  
L481: “is already”?  
L488: “...Murray Darling...” to follow what is used earlier in the text.  
L489: References needed

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L495: Please clarify the title “medium resolutions” what? I assume forecasts.

L501: “years”

L511: Please rephrase “one may appreciate...”

L512: “Almost all months...”?

L518: “high resolutions..” of what? Maybe: “Case studies for assessing the LDAS-Monde high resolution (0.1x0.1) model runs.”

L539: “poorer” to “lower” and please make it clear what you mean by “... that its first day analysis”.

L543: Maybe clarify this by inserting (blue solid line) behind the different model runs. As there is a lot of information from L543 to 546 concerning the different runs.

Figure 14: Please increase the size of this figure, to around the same size as Fig. 15.

L569: “south eastern” in the text and “southeastern” in the Figure 15 caption.

L580: “to force”?

L581: Could you specify what you mean by “fixed configuration”

L581-582: “The ERA5 coarse spatial resolution makes it affordable to run long term and large scale LDAS-Monde experiments”.

L583: “available from 1979...”

L583: Please define and explain ERA5T.

L585: “..long term and near real time...”

L587: “focused”?

L587: Change “weather” to “conditions”?

L592: Small detail, but don't you compare to (1-4 cm) and not (0-1 cm)?

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L599: “...layers and evapotranspiration...”

L607: Change “than if” to “that the...”

L607: “..., however, it suffers from a too early...”

L635: “accessed”

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2019-534>, 2019.