REPLY TO REVIEWERS' LETTER

We thank the reviewers for their very useful feedback on our initially submitted manuscript. Clarifications to the individual comments are provided in the following sections. We also revised our manuscript as per their comments and suggestions and major changes (only) which were implemented are highlighted in red in the manuscript.

REVIEWER 1:

The paper is in like with the journal scope. It is clear and well presented. The steps forward the state of art are properly described as the results as well. We minor comments are highlighted on pdf file.

R1C1: page 3 Introduction: line 2....different components. Please, add an example.
ANS: *We have added in the sentence "(lithosphere hydrosphere, the biosphere and atmosphere)".*

R1C2: page 11 session 4 , line 16: .....Roughness values above 2.00 were rare.... Please give an example or be more specific.
ANS: *We indeed meant to write "above 1.0", which is an even more strict criterion. We added some example as well, as requested. So, the sentence is now "Roughness values above 1.0 were rare (eg. for* $\overline{H_{daily}}$ *were vegetation height and surface soil moisture availability and for* $\overline{Trad_{daily}}$ *were aspect, fractional vegetation cover, vegetation height and surface moisture availability)."*

R1C3:page 13 session 4.2.1 line 10.... also important... ->relevant
ANS: *Change implemented, as suggested.*

R1C4: We recommend the paper for publication. Regards
ANS: *Thank you for your time in considering our work for publication; we are pleased with your decision.*

REVIEWER 2:

The authors present a detailed parameter sensitivity analysis of the SimSphere SVAT model. This study extends on previous work by looking at modelled surface fluxes and states under different atmospheric conditions. The global sensitivity analysis uses BACCO, an advanced technique that includes the construction of a model emulator and quantification of related uncertainty. In my opinion the manuscript is acceptable with revision, but represents only a minor advance over previous studies.
It is stated that the analysis can direct future efforts to reduce the uncertainty (p. 8 line 16). In this sense prior information about a site should be used to reflect knowledge, or lack thereof,

about certain parameters. Instead the entire theoretical range of possible values is taken, except for the latitude, longitude, and atmospheric data (page 11). At a given site, the slope, aspect, and station height should be well known as well. As mentioned in the discussion, it is not surprising that slope and aspect are critical controls on model outputs because of their impact on incident solar radiation.

R2C1: What is presented here is a parameter sensitivity analysis, in the pure sense, over the model's entire possible parameter space – which is interesting and useful, but doesn't provide much guidance on how to reduce uncertainty. In my opinion this would have higher impact if the analysis were to use estimated site-level parameters with realistic observation uncertainties.

ANS: *Knowing which of the model outputs are the most sensitive ones we can reduce uncertainly in the estimation of the outputs of which their sensitivity was examined herein. A sensitivity analysis allows ranking the model inputs in terms of importance and this is important as we can identify which parameter need to be provided more accurately to the model during its parameterisation. If this is done, then the uncertainly in the estimation of the output simulated by the model inputs can be reduced.*

R2C2: ***The analysis builds on previous analysis by looking at a new site. However, the atmospheric sounding is not shown – I think this deserves a figure to visualize how conditions are different from previous studies.***

ANS: *We appreciate the reviewers' comment. We initially didn't include this figure as we validated the atmospheric conditions and were totally different to each other. To ensure this, we selected days that belonged to different seasons apart from different sites located at totally different climates (Mediterranean versus temperate maritime climate). On the basis of this rationale, we thought is not necessary to include a figure that shows how different were the soundings between two different days. Though, since it is thought necessary from the reviewer, we have added this figure now in the revised manuscript (as Figure 2).*

R2C3: ***Also while this analysis shows that previous results generally hold at a new site, the MS represents a small incremental advance over previous work. How do parameter sensitivities vary over a range of soundings? Alternatively, one could compare and contrast the sensitivities between 2 soundings (extremely wet vs. dry).***

ANS: *All the model inputs were varied across their whole range of theoretical variation apart from the sounding information which was replaced in this study by a different one, representative of totally different conditions. This was the only way, we could at least identify, in order to be able to test the models' sensitivity to atmospheric sounding, given that it consisted of profile data of 6 columns in total acquired at several at least 12 heights.*

R2C4: ***Page 11 lines 5-10 Please include a table or specific reference for the ranges of uniform priors, and for the mean and standard deviations of the Gaussian priors.***

ANS: *We have added a table to the paper (Table 1) that shows the requested information. We are happy to add this table here to this manuscript as well if required.*

R2C5: ***Page 11 line 14: Why 11 AM? Is this simply when the sounding is available? Is this late enough in the day to observe midday depression in photosynthesis and related effects on surface fluxes?***

ANS: *We thought it would be very important to see what is the sensitivity of the model outputs to its inputs at this time, as this model is apart from a stand-alone application also used synergistically with remote sensing data to derive regional estimates of energy fluxes and soil moisture. Thus, we chose 11 am as this is the local time close to the overpass of several polar-orbiting satellites (e.g. ASTER, Landsat, MODIS).*

R2C6: Is surface albedo a SimSphere parameter? It seems this would also be quite important but it is not shown.

ANS: *This is a very good point; albedo is one of the model inputs which when the model is initialised it can be either defined with a specific value (if known), or it can be asked from the user this to be computed internally based on other information included in the model parameterisation. In our study, we chose the 2nd option. One of the main reasons in doing so was because we wanted to keep the number of model inputs for GEM SA method implementation to 30, since this the absolute maximum number of inputs that can be used to run this SA method.*