HESSD

Interactive
comment

Interactive comment on "Lidar-based modelling approaches for estimating solar insolation in heavily forested streams" *by* Jeffrey J. Richardson et al.

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I appreciate very much that the authors provide their data and analysis (as is HESS standard now). While I could easily follow the general setup of the study, I found it difficult to grasp the information residing in the Lidar data set and how it has been used. Since the latter is not included in the repository: Did I understand correctly that the Lidar data was commercially acquired and preprocessed to 1m pixels? So each pixel has values about all point returns, the number of highest hits (canopy) and the number of lowest hits (ground)?

THE LIDAR WAS PRE-PROCESSED BY THE VENDOR INTO 1 M PIXELS CONTAIN-

ING HIGHEST ELEVATION AND GROUND MODEL. THE AUTHORS CREATED AD-
DITIONAL RASTERS USING THE RAW LIDAR POINTS IN ORDER TO DETERMINE
NUMBER OF CANOPY HITS AND GROUND HITS PER 1 M PIXEL

Please be more specific about the calculation methods than naming the Software Ar-
cGIS. I suppose this is an array operation which could be done in R (or any other math
software) too. Which approaches did you employ? What can be understood about the
"10m Buffer around the field points" (L187) and how does it differ to the "shifted square
buffer" (L188f.)?

THESE CALCULATIONS COULD BE PERFORMED IN R OR ANY OTHER SOFT-
WARE BUT IT IS QUITE SIMPLE TO DO IN ARCGIS. THE SPECIFIC OPERA-
TIONS INCLUDED USING THE BUFFER TOOL AND SUMMING THE NUMBER OF
CANOPY AND GROUND POINTS QUANTIFIED IN THE VALUE FIELD OF THE
RASTER USING THE ZONAL STATISTICS TOOL. THE SHIFT CALCULATION WAS
PERFORMED IN THE SAME WAY AFTER USING THE EDITOR TOOL AND MOVE
COMMAND TO SHIFT THE POINTS SOUTH BY 3.42 M. THE FINAL VERSION WILL
BE EDITED TO INCLUDE THIS SPECIFIC INFORMATION.

Did you average within this area for comparison?

WE SUMMED THE VALUES AS DESCRIBED ABOVE.

What are the effects on the performance of the estimates. Especially with regards to
the issue of "registration errors" L277ff. would this mean that a higher resolution could
be more accurate or in other words that the hemispherical photographs suffer from
minor shading effects to become representative at stand scale?

YES, THIS IS VALID CONCLUSION FROM THESE RESULTS.

For a validation of the Lidar-derived solar insolation there is basically the correlation
plot in Fig. 8 comparing it to pyranometer measurements. To me this does not appear
very convincing to support the conclusion. By not allowing for an intercept in your linear

regression model, you define the bias-term to be zero. While this is an understandable desire in comparing two measurements which should give the same results, I do not understand your statement in L298f.

AGREED THAT THIS IS NOT WELL STATED. THE INTENTION WAS TO BE ABLE TO PREDICT INSOLATION WITH A MODEL THAT WOULD ESTIMATE INSOLATION TO BE ZERO IN AREAS WHERE NO CANOPY POINTS WERE PRESENT. THIS WILL BE CLARIFIED IN REVISION

The 16 points appear to overestimate the pyranometer references in most cases. High insolation references are underestimated. With an R^2 of 0.63, I find it rather problematic to speak of accurate: L329f. "a synthetic hemispherical photograph approach accurately predict solar insolation and light transmittance".

I STRUGGLE WITH DESIGNATION A THRESHOLD FOR ACCURACY, BUT AGREE THAT THIS IS NOT VERY PRECISE TO DECLARE THIS ACCURATE WITHOUT A THRESHOLD. WILL REWORD TO SUGGEST THAT IT MAY BE ACCURATE DEPENDING ON APPLICATION.

In this respect, I moreover have difficulties to relate this back to the presented indices which leaves me with a couple of questions about the reason of their introduction in the first place. This confusion might partially stem from the mannifold usage of the term "model" in the manuscript. I would suggest to allow for a more precise terminology to differentiate regression analyses from conversion models, from indices and from spatial map models. From the title I was expecting several modelling approaches using the Lidar data, which I did not find in the manuscript.

REVIEWER 1 HAD A SIMILAR CRITICISM AND WE WILL REVISE TO INDICATE WHAT WE MEAN BY MODEL.

Coming back to the indices (Fig. 6, Tab. 3) I do not find the focus of the study specifically suitable to address these correlations.

YOUR CRITICISM IS NOT SUFFICIENTLY DETAILED FOR ME TO RESPOND IN DETAIL. I WILL SIMPLY SAY THAT THE CORRELATIONS IN MY OPINION ARE SUITABLE AS THE OBJECTIVE OF THE STUDY IS TO EVALUATE THE DIFFERENT METHODS COMPARED TO FIELD DATA.

Contrastingly, the comparison of synthetic and actual hemispherical photograph (Fig. 7) is very compelling but falls in my view a little short in its analysis and evaluation (e.g. applying this for all 16 locations). Since the validation of the "Lidar-based modelling" is rather difficult using the 16 measurements alone, maybe some further reference could be derived from remote sensing products? This could also provide the link to some of the addressed indices?

I'M NOT SURE WHAT SPECIFICALLY YOU ARE PROPOSING. WE ARE PRESENTING THIS WORK TO STAND ALONE AND CANNOT AT THIS TIME EXPAND THE SCOPE.

2 Minor comments: L28f.: why only ecological applications?

THE SCOPE OF THIS STUDY IS FOCUSED ON ECOLOGICAL APPLICATIONS.

L29: do trees really interact (so having feedbacks) with solar radiation?

I WOULD ARGUE THAT TREES INTERACT WITH PHOTONS THROUGH REFLECTION, TRANSMITTANCE, AND ABSORPTION. SHADING IS A COMBINATION OF THESE THREE EFFECTS.

C3 HESSD Interactive comment Printer-friendly version Discussion paper L36: can (solar) energy intercept with something? maybe irradiate a stream?

WILL CHANGE TO IRRADIATE

L37: how does solar irradiation limit options for forest management? I do not understand.

THE REST OF THE PARAGRAPH EXPLAINS THIS, CULMINATION IN THE FINAL

SENTENCE WHICH ANSWERS YOUR QUESTION

L48ff.: is it really necessary to describe the function of a pyranometer (at this broad level of detail)?

I DON'T THINK IT DETRACTS FROM THE PAPER. SINCE THIS IS A HYDROLOGY JOURNAL I WANT THE TECHNICAL INFORMATION TO BE WELL EXPLAINED.

L53: I do not see the difference between the time references of a direct state measurement and the photograph

IT IS IN THE DIRECT VS INDIRECT MEASUREMENT. THE DIRECT MEASUREMENT IS DEPENDENT ON THE ANGLE OF THE SUN WHILE THE INDIRECT MEASUREMENT IS NOT

L56: Depending on the type of pyranometer, diffuse radiation is directly measured too.

THIS IS REFERRING TO HEMISPHERICAL PHOTOGRAPHS

L67: Start new paragraph with "Airborne lidar..." ?

I SEE HOW IT COULD BE GOOD TO START A NEW PARAGRAPH THERE BUT THAT WOULD LEAD TO TWO VERY SHORT PARAGRAPHS AND PREFER IT AS IS.

L113f.: very confusing. please rephrase.

I'M NOT SURE WHAT IS CONFUSING. THE CITATION TO THE ORIGINAL PAPER IS ALSO THERE TO HELP READERS IF THEY ARE CONFUSED.

Fig 1: I would prefer all four Lidar models/maps instead of the grey box, which I assume to be the total Lidar dataset footprint. If you find my suggestion feasible, maybe a map of a satellite RS derived index could also be a reference here. A colourbar would be nice.

IT WOULD BE DIFFICULT TO FIT ALL FOUR MAPS IN THIS FIGURE WITHOUT MAKING THEM EXTREMELY SMALL. THE GREY FOOTPRINT AND EXPLANATION

OF THE COLORING IS IN THE CAPTION.

L200f.: What happened to the longitudinal profiles? Were they processed?

YES, THOSE ARE IN FIGURE 9.

L215: See general comment. Which exactly are THE models? do you refer to the different indices? the calculus to derive them? a model to generate the synthetic hemispherical what are the assumptions behind the comparison approach? What is the observation reference deemed as closest to the true value?

SEE COMMENT ABOVE. WILL REVISE TO MAKE THIS MORE CLEAR.

L257: model performance? in reference to what? Is a R2 to each other really a good measure?

AGREED. IT IS A POINT THAT REVIEWER 1 ALSO BROUGHT UP AND WILL BE EDITED TO REMOVE SATISFACTORY AND CLARIFY THAT R2 IS THE METHOD OF EVALUATION AND DISCUSS THE LIMITS OF THE USE OF THAT STATISTIC.

C4 HESSD Interactive comment Printer-friendly version Discussion paper L277ff.: I do not understand why this should not be desirable... actually, i find the results in fig 7 quite convincing and the sensitivity ght be quite an interesting feature. Pls. see my general comment on this, too.

IT IS UNDESIRABLE BECAUSE IT MAKES IT DIFFICULT TO EVALUATE THE AC-CURACY OF THE MODELS. THIS WILL HOPEFULLY BE MORE CLEAR WHEN THE MODEL LANGUAGE IS REVISED.

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