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Hydrology and Earth System Sciences Discussions

Interactive comment on "Estimation of forest structure metrics relevant to hydrologic modeling using coordinate transformation of airborne laser scanning data" *by* A. Varhola et al.

Anonymous Referee #4

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General comments:

The paper presents a new method to transform the Cartesian coordinates of Airborne Laser Scanning (ALS) data into a polar projection. The purpose of this is to generate synthetic images similar to upwards-looking hemispherical photographs taken at ground level. The rationale is that hydrologic models use input variables derived from measures of the vegetation structure and density from hemispherical photographs. The paper describes how to estimate the same measures from the transformed ALS data and validates the estimated values versus values obtained from hemispherical pho-

tographs.

My main response is that transforming ALS data coordinates to mimic hemispherical photographs is the wrong way to go. In my opinion, a much better way to make use of the ALS data would be to adapt the hydrologic models to use three-dimensional vegetation structure information. I would suggest developing methods for three-dimensional analysis of the ALS data and adapting the hydrologic models for this input.

From my understanding, hemispherical photographs are used because they have been the only feasible way to obtain information about vegetation structure. However, the information obtained from hemispherical photographs is two-dimensional (coverage projected along polar axes) and does not fully describe the three-dimensional structure.

A better description of the three-dimensional structure would be possible from ground-based laser scanning. Airborne laser scanning does not measure all surfaces in the understory below the dominant tree layer, which means that it contains less information than ground-based laser scanning. However, the transformation described in this paper does not improve this. The transformation actually reduces the amount of information in the laser scanning data. Three-dimensional analysis of laser scanning data should be able to provide three-dimensional vegetation structure that can be used as input to adapted hydrologic models.

Having said that, the paper is well written and of high technical quality. If the principle of the coordinate transformation is considered sound, the methods are well developed and probably useful in realistic applications. The methods require hemispherical photographs taken in a number of sampling points as reference data but no manual field measurements of vegetation structure, which is a great advantage. The transformed ALS variables were useful for estimation of the gap fraction as derived from hemispherical photographs. The results can be used to derive input to existing hydrologic models.

Detailed comments:

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Page 5538 line 5: Why did you not measure the GPS position of the point where you took the hemispherical photographs? The positioning error could cause problems due to local variations in vegetation structure.

Page 5538 line 22: What was the pixel size of the DEM? If the area of each pixel was 5 m2, the pixel side was approximately 2.2 m which is rather big.

Page 5538 line 25: A plot size of 50 x 50 m is very big; I would suggest using smaller sub-plots and calculating averages and variation for the sub-plots within one plot to better describe the vegetation structure, or working with representations of individual tree crowns.

Page 5539 line 4: The single highest ALS return is likely to be an outlier, which is not representative of the whole plot. I would suggest using for example the 95th or 99th percentile.

Page 5539 line 14: How does 234 relate to the total number of sampling points? If I understand correctly, the total number of sampling points was 7 x 36 = 252. Is that true and how many did you exclude?

Page 5539 line 19: Why did you collect the ALS data in the winter? The varying snow depth causes an uncertainty in the ALS data.

Page 5544-5545: The chapter Regression modeling contains several steps and to me it is unclear if, for example, page 5544 line 22-25 were done before equations 1-2 were fitted or at the same time as page 5545 line 19-25. The chapter could be made more clear by dividing it into bullet points or similar.

Page 5545 line 5: What you call split-sampling average seems to be the same as leave-one-out cross-validation, which is a more well-known statistical term.

Page 5547 line 5: You indicate that a point density of 5-8 m-2 is too low to identify individual trees. In many other papers, individual trees are identified with a point density of around 7 m-2. Additionally, chapter 2.2 says that the effective density was 4.8 m-2.

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Interactive Comment

How did you get the density 5-8 m-2?

Page 5554 line 19: Any kind of area-based metrics can be calculated from ALS data with user-defined spacing and sub-pixel specific locations. It is just a matter of defining the size and position of the area where the metrics should be calculated.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 5531, 2012.

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