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.

A. Varhola et al.

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Reviewer #2 – Jenny L. Lovell

We greatly appreciate Dr. Lovell's careful attention to our study and positive feedback. The few concerns Dr. Lovell identified are addressed below.

GENERAL COMMENTS

1) "...The validation of the gap fractions against HP shows generally good agreement, but some differences in the nature of the canopy gaps and characterization are noted.

There is no indication of the effect of propagating these differences through a hydrological model. In this sense, it is difficult to assess the success of the method to achieve its goal." REPLY: Our method is unlikely to produce systematically biased estimates of forest structure variables because the residuals from the calibration models are normally distributed and will produce both under- and overestimated outcomes [Table 6, Fig. 4 and 5 (5 and 6 in revised manuscript)]. Additionally, current fully-distributed hydrologic models are intriguingly not adapted to use fully-distributed versions of vegetation metrics, so a follow-up article that we have recently submitted to another journal combines the synthetic ALS hemispherical images generated with our methodology with Landsat spectral indices to analyze the frequency distributions of structural variables at the watershed level. That article contains detailed discussions about the potential effects of inputting fully-distributed versions of vegetation metrics in the models, and is available upon the reviewer's request. This sentence was added in the last paragraph of section 4.4 (Methodological advantages and applicability) to address the reviewer's concern: "The normal distribution of the calibration models' residuals suggest that our method is unlikely to produce systematically biased estimates of forest structure variables, which will benefit fully-distributed hydrologic modeling exercises."

SPECIFIC COMMENTS

2) "In the discussion of figure 3, the authors note some structural differences in between the actual and synthetic hemispherical images. They note that the large continuous gaps in the taller canopies are present in both images, however fail to observe that these are absent in the last two sets of images. In these cases the gaps in the ALS images are discontinuous and the gap size distribution would be quite different for the two methods. Is it possible to comment on the effect this might have in the context of the hydrological models?" REPLY: Our reply to comment 1) above partially addresses this. Because hydrological models are adapted to use bulk versions of forest structure metrics, the actual distribution of canopy gaps within zenith and azimuth compartments in a hemispherical image is of reduced importance. Our calibration models

will incorporate much of the inconsistencies between real and synthetic fisheyes and we have demonstrated that they explain significant portions of the variability. Furthermore, current physically-based and spatially explicit hydrologic models are so poorly parameterized using few vegetation classes with averaged values, that our contribution to improve this is significant despite the uncertainties and reasonable errors of our proposed methodology. In other words, we firstly need to test the effect of inputting fully-distributed versions of the variables in the models before undertaking additional efforts to further articulate or improve the accuracy of our remote-sensing-based approach of obtaining the metrics.

3) "Voxelization of the points is not a difficult task, it would be possible to test the proposition that this would minimize the effect of point density variation." REPLY: The sentence erroneously implying that voxelization is difficult has been removed.

4) "P5554-L12 states that separation of ALS points into ground and non-ground classes is not necessary in this method. This is not strictly true as the methodology states the use of a DEM." REPLY: Agreed; sentence removed.

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