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Hydrology and Earth System Sciences Discussions

Interactive comment on "Modeling and measurement of two-layer-canopy interception losses in a subtropical mixed forest of central-south China" *by* G. Zhang et al.

G. Zhang et al.

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Answer to Anonymous Referee # 1

We highly appreciate the detailed comments of the referee # 1, who raised some interesting points. The suggestions are quite helpful for us and we shall incorporate them in the revised paper. As below, on behalf of my co-authors, I would like to clarify some of the points raised by the referee. (Here, we give only the titles of the figures, which were listed in the revised manuscript.)

There are two main comments on this paper.
1. The presentation of the sampling design and data is poor. It is impossible to judge how well throughfall is measured (no error bars or uncertainty analysis is given). A dis-

cussion on 2% difference between a model and observations is meaningless when the errors in through fall easily approach higher values than 2%. I strongly urge the authors to show the variability between plots and gauges and estimate the errors involved.

Response: We thank the Reviewer for his/her valuable suggestions on the measurements in our present study.
For the large events (precipitation >10 mm) in the Shaoshan forest stand, throughfall accounted for higher than 85% of the incident precipitation, and ranged from 74.1±1.5% to 93.4±2.1% (Figure 6 in the revised manuscript). The proportion of incident partitioned into throughfall for smaller events (precipitation <10 mm) increased in a linear fashion from 14.1±1.1% for events ranged from 0.4 to 2.0 mm to 74.8±3.3% from events ranged from 3.4 to 9.4 mm.
The statistical difference of the throughfall depths between the gauges was averaged to be 7.2±3.4 % and ranged from 3.5±2.7 % to 18.6±4.1%. The variability of throughfall between the measured 10 plots was estimated at 12.7±3.5%, ranging from 5.6±3.2 % to 20.8±6.4 %.
The throughfall coefficients of variability (CV) were shown in Figure 7 in the revised manuscript. The coefficient of variability of throughfall for all events averaged 11.2±2.4% and ranged from 6.8±1.1% to 81.3±3.7%. The CV of sub-throughfall for all events were estimated to be 5.5±3.7% and ranged from 2.1±1.7% to 10.7±4.6%. The CV values for small events were generally much larger than that for large events. The CV values for ∼90% of events, especially for the event precipitation higher than 10 mm, were less than 25%.

Figure 6. Throughfall as a percentage of incident precipitation in the study site during the observe year of 2003.
Figure 7. Throughfall coefficients of variation (CV) (%) as a function of the throughfall (% of incident precipitation).

2. There is no real rationale given for the use of a complete cover Gash model for the top canopy and the reduced cover for the below canopy, other than the somewhat

vaguely formulated lines at the beginning of page 1998. In fact given the canopy covers of 82 and 92% (1999-line 5) I would have expected the reverse. In any case given this high canopy cover, I would have liked to see the application of the original Gash model compared to the reduced cover application. This discussion gains in importance if my first comment is taken into account. If these two issues are addressed, I would recommend publication, as this data is certainly relevant and needs to be published.

Response: There was a mistake in the expression of the canopy coverage for each layer in our original text. The projected top-canopy coverage of the stand is about82The original Gash model described by Gash (1979) demonstrated that the evaporation of rainfall intercepted by forest canopies can be estimated form the forest structure, the mean evaporation and rainfall rates, and the rainfall pattern. Although the model has been used with some success over various different forests, the model has the weakness in application in sparse forest (Lankreijer et al., 1993; Gash et al., 1995).
The original Gash model tends in theory to overestimate the interception loss from sparse forests as they assume that the evaporation area (canopy and trunks) extends to the whole plot area, whereas the actual evaporating area (canopy and trunks) is much reduced in these types of forests (Teklehaimonot and Jarvis, 1991). With regard to the sparse forest, the revised Gash model (Gash et al. 1995) can give more accurate estimates of canopy interception loss than the original one.
In our study, the top-canopy coverage is 82%, but the sub-canopy is relatively sparse compared with that of top-canopy, with the coverage of 41%. Therefore, we use the original Gash model to estimate the canopy interception loss in the top-canopy and use the revised Gash model to predict the loss in the sub-canopy. The predicted results estimated by using the different Gash models have been discussed in the original text, but we shall improve the statement in the revised manuscript by taking the Reviewer's comments into consideration.

Some minor comments of Referee:
1. Page 2000 line 4. Have the authors any idea about the representative of the open

field observations of meteorology? There may be significant errors involved in applying open field meteorology to estimate above canopy evaporation. This may also explain the relatively high values of evaporation obtained. In fact, as explained in the original Gash (or Gash and Morton) derivation one can use observation to derive an empirical value of E-bar. It would be nice to see what the observation suggest for E-bar (even given the limits to applying this “tric”).

Response: (1) The weather station was established adjacent to the throughfall plots within the studied forest stand. Considering the representativity of measurements, the open field was constructed with in the forest, which was not in the open field away from the studied site.
(2) Error in the field determination of interception losses was estimated assuming that (a) a random error of 5% in incident event measurement throughout the study year (Gash et al. 1995), giving a total error of 61.3 mm for top-canopy and 51.2 mm for sub-canopy, (b) an error of 11.2% for throughfall and 5.5% for sub-throughfall, estimated on the basis of its spatial variability, and giving a total error of 19.5 mm for throughfall and 10.0 mm for sub-throughfall, and (c) an error of 20% in stemflow (see Gash et al. 1995) giving a total error of 1.1 mm. The quadratic sum of these errors gives a total error of 64.3 mm, i.e. 5.2% of rainfall or 37.0% of the top-canopy interception losses, and a total error of 52.1 mm, i.e. 5.0% of rainfall or 28.6% of the sub-canopy interception losses. Note that his error translates to error in the estimation of canopy parameters, notably S (Gash and Morton, 1978; Lloyd et al. 1988).

2. In Table 3 I do not understand how canopy capacity scaled with cover can be higher than the original. Has there been a reversion of the two values.

Response: The method of scaling the canopy capacity by the canopy cover is obtained from Valente et al. (1997). The canopy coverage (c) (0.82 for top-canopy and 0.41 for sub-canopy) is less than 1.0, so the scaled canopy capacity is higher than the original one.

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3. In table 2 it would be better to have a free throughfall coefficient for the original Gash model as, even though in practice these two are used interchangeably, the original Gash model knows no canopy cover.

Response: We are in agreement with the comment on free throughfall coefficient mentioned by the Reviewer.

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