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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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We highly appreciate the detailed comments of the Referee # 2. 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 only give the title of the figures because the figures cannot listed in this LaTex).

1. My major concern is about the quality of the data in combination with a detailed model. There is a debate about the values of the model parameters in combination with the quality of the measurements.

Response: The mentioned papers have been carefully read, and we think the com-

ments on the throughfall data will be valuable to improve over our revised manuscript.

2. If I understand it correctly, measurements of throughfall and rainfall were measured weekly with 16 throughfall collectors. On a yearly basis this error is 2%. However, this error will be must larger if we look to the weekly measurements, due to spatial and temporal variability. If the authors should have hourly measurements (measured for instance with automatic throughfall measurements) they should find that this error will rise to maybe more then 100

Response: (1) In each plot, 16 canopy throughfall collectors were randomly placed under the canopy and 1.0 m above forest ground, and 4 sub-canopy throughfall collectors were placed under the sub-canopy and 0.20 m above the floor. Therefore, there are a total of 160 throughfall collectors and 40 sub-throughfall collectors in the Shaoshan experimental forest.
(2) A throughfall collector samples only the small area where it is placed. In order to take into account the large local variations in throughfall deposition to a forest stand, a sufficiently large number of collectors must be used. Generally, 10 collectors or more are needed for a 30 $\times$ 30 m sampling plot. Less than 10 samplers are usually not sufficient to cover the variability (EMEP/CCC 1996). The procedures of sampling and design in Shaoshan forest stand were taken from the Manual of EMEM (1996) and we consider that the uncertainty in measurements will be much reduced, though there were uncertainties in the throughfall measurements (Vrugt et al. 2003).
(3) The throughfall coefficients of variability (CV) are shown in Figure 7 in the revised manuscript. The coefficient of variability of throughfall for all events averaged 11.2$\pm$2.4% and ranged from 6.8$\pm$1.1% to 81.3$\pm$3.7%. The CV of sub-throughfall for all events were estimated to be 5.5 $\pm$3.7 % and ranged from 2.1$\pm$ 1.7% to 10.7$\pm$4.6%. The CV values for small events were generally much larger than that for large events. The CV values for $\sim$90% of events, especially for the event precipitation higher than 10 mm, were less than 25%.

Figure 7. Throughfall coefficients of variation (CV) (%) as a function of the throughfall

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(% of incident precipitation).

3. Moreover, the results in this paper demonstrate that measured canopy water storage dynamics contain better and more reliable information than measured throughfall dynamics for the calibration of a canopy interception model, thereby increasing the prospects of finding the preferred parameter solutions. Moreover, as only one drying and wetting cycle of the canopy is needed for a reliable model calibration using measured canopy water storage dynamics, these observations are well suited to assess temporal variations in the values of the interception model parameter throughout the year.

Response: To calibrate the two models, several rainfall events were selected throughout the year and were put into an artificial sequence of 10 days in total. The events were selected for relatively extreme rainfall intensities and amounts, for low and high evaporation rates at night and during the day, and for low and high temperatures, and for low and high wind velocities. In parameter optimization, mutual interference between parameters is to be prevented as much as possible.
To test whether one characteristic parameter set can be used throughout the year, the total 10 calibration periods was again split into the five original individual periods. For each period, each parameter was again optimized one at a time. If the trends could be established for parameters, their use would probably improve the performance of the models.
To describe the detailed rainfall and weather data, we selected the two typical events in 15-17 April (wet seasons) and 28-30 October (dry seasons) in the Shaoshan forest, which indicate the wetting and drying cycling of the canopy in the two difference seasons Figure 4 in the revised manuscript.

Figure 4. Detailed half hourly meteorological data for two typical events distributed in 15-17 April (a-e) and 28-30 October (f-j) in 2003 in the Shaoshan forest stand.

4. I found it strange that the author use references to Jetten (1996) and Price and

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Carlyle Moses (2003) but did not include the comments on these papers by Calder and Hall and Keim.

Response: The important references shall be cited in our revised manuscript.

Concluding remark of the Referee:
In my opinion the authors could only use a one parameter model (as in fig 5 and 6). A more detailed model may only be used if the other parameters can be linked to system properties. If the authors are able to cope with the uncertainties in their data and if information is left in their data (or if they have other data, like interception evaporation estimates by for instance eddy correlation), then this manuscript can be concerned for publication.

Response: (1) Figure 5 and 6 in the original text has been analyzed in a one parameter model listed as Figure 8 in the revised manuscript.

Figure 8. Relationship between weekly rainfall and the throughfall and sub-throughfall.

(2) A weather station, which included a cup anemometer (Vector Instruments, Rhyl, UK), a net radiometer (Q6, REBS, Seattle, WA, USA) and a fast platinum resistance thermometer, a LI-6262 closed path infrared gas analyzer (LI-COR, Lincoln, Nebraska), was established for the parameters of wind speed and direction, humidity, radiation and temperature at 5.0 m above the forest canopy, respectively. The two typical events distributed in the wet season and dry season have been described through half hourly data in Figure 4 in the revised manuscript. The weekly averaged data of the measured parameter by eddy correlation were given in Figure 3 in the revised manuscript.

Figure 3. Distributions of weekly precipitation (a), relative humidity (b), averaged air temperature (c), and net radiation (d) in Shaoshan forest during 2003.

Reference:
Calder, I. R. and Hall R. L.: Comment on ‘‘Interception of tropical rain forest: Performance of a canopy water balance model’’ by Jetten V. G., Hydrol. Processes, 11, 225-

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EMEP/CCC (1996) EMEP Manual for Sampling and Chemical Analysis, Norwegian Institute for Air Research, EMEP/CCC-Report 1/95.
Keim R.F.: Comment on "Measuremnt and modeling of growing-season canopy water fluxes in a mature mixed deciduous forest stand, southern Ontario, Canada" by Price A.G. and Carlye-Moses D.E., Agric. Forest Meteorol. 124, 277-279, 2004.
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Interactive comment on Hydrology and Earth System Sciences Discussions, 2, 1995, 2005.