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Biogeosciences Discussions

Interactive comment on "Atmospheric drivers of storage water use in Scots pine" *by* H. Verbeeck et al.

Anonymous Referee #2

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General comment

This paper provides an interesting and original approach for understanding use of water stored in tree at diurnal and seasonal timescales. The authors made use of data and model in an original way, the paper is mostly well written and well organized, and the length is appropriate. Given the extent of our knowledge, the model is a valid simplification of reality. However, the paper still needs some improvements. Language is sometimes confusing and authors tend to overstate the effects of environmental factors on storage water use. Limitation of the model should be pointed out and discussed. I detail some comments for discussion below.

Specific comments

1/ The paper is written as if storage water use was driven by external meteorological factors (see title for example), while internal physical factors are more important (at least theoretically). Storage water use is not a physiological process influenced directly by external conditions, but mostly a consequence of changes in internal tree water flow and differences in water potential. When soil water availability is low (which is not your case), storage water use is also limited to avoid cavitation, but the exact controlling mechanisms are still under debate. Thus I would advise the authors to be careful with sentences like “radiation is an important factor influencing the use of water from storage compartments” (page 15 line 15-16) or “atmospheric drought is a second important driver of storage water use” (page 16 line 16-17) or “The daily minimum tree water content was clearly determined (correlated?) by daily solar radiation Ĕ” (page 19 line 2). These factors are indirect and influence storage water use through their effects on water flow (transpiration mostly) and water potential. This has to be clearly stated in the paper, before page 18 and conclusions, to avoid confusion.

2/ Following the first specific comment above, I would argue that storage water use is mainly driven by transpiration: when transpiration is high, use of stored water is high and inversely. I would argue that any other meteorological variable affect storage water use through transpiration with no direct effect. Thus I would have preferred more analysis on internal control of storage water use. It’s interesting to see that the paper is organized to discuss what affect storage water use, while I would argue that it should be organized to look at how storage water use influences transpiration. In addition, the authors don’t really analyze data on refilling and night transpiration, while these processes are crucial to understand how tree deals with drought (atmospheric or soil). In addition authors should look at lag effects: how use of stored water and refilling during one day affect transpiration the next day? Is there any such lag effect?

3/ I’m always a little confused with tree water flow model (Figure 1) considering a storage compartment with an individual resistance and an individual capacitance. It seems to me that, in trees, the xylem compartment (with transporting function) and the storage

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compartment (with storage function) are partly confounded and share common properties that are related and highly dynamic (water potential, resistance). In particular, I don't see how stem water potential (or water content) can really vary if flow resistance is constant. However, I agree that electrical analogon and constant resistances are a convenient simplification, but this must be shortly discussed in the paper (see for example Paramaki et al 2001, Holtta et al 2002).

Other comments

1/ Page 6, lines 13-19: description of sap flow measurements is confusing. Please explain better: multi-points sensors are continuously measured? How many per trees? Needles along the radius are really moved?

2/ Model description (pages 8 to 11) should clearly state along the text what are the parameters in equations, and how are they evaluated (measured, calibrated, from literature,Ĕ?). We need a table with parameters values. Equation 4 and 5: How are ψleaf and ψstem evaluated? You have to state that Rx is a calibrated parameter in the text. Equation 6: How are ψstem and ψstorage evaluated? Page 13 line 5: what level of parameter seasonal variability did you find (CV 5%, 10%,Ĕ?)

3/ Page 15 line 9: Obviously your values fall within such a large range found in the literature. Such a statement is no use.

4/ Page 16 line 4: how conductance is so high with low incoming radiation?

5/ Page 16 line 12: I don't see any graph with residuals versus other factors than radiation.

6/ Page 16 line 23: replace "under debate" by "unclear".

Interactive comment on Biogeosciences Discuss., 4, 615, 2007.