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Hydrology and Earth System Sciences Discussions

Interactive comment on "On the importance of including vegetation dynamics in Budyko's hydrological model" *by* R. J. Donohue et al.

Anonymous Referee #1

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General comments: This is a useful and well-written paper. The conclusion of the paper relates to the importance of vegetation in influencing hydrology, particularly at smaller scales of time and space. This conclusion should not really come as a surprise to hydrologists and is definitely not new to plant scientists, but it is a message that is central to the 'new' discipline of ecohydrology, and this message is very well presented in this paper.

The following comments refer to section 4 where the role of vegetation is discussed:

The authors state that three vegetation characteristics - leaf area, photosynthetic rate and rooting depth - are particularly important in determining evapotranspiration P1530 L3). They are however not all three important for all three components (Et, Ei and Es).

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Although this is implicit in the following paragraphs it would be worthwile to explicitly state that Et is affected by all three vegetation characteristics whereas Ei and Es are only affected by leaf area index.

It is also worthwile to point out that rooting depth influences Et not directly but only through effects on the other two characteristics, leaf area and photosynthetic rate (greater water availability sustains more lush vegetation operating at full photosynthetic capacity). At this point too the authors might refer back to section 2.1 where the relationship between rooting depth and water availability (Sw) is formally explained, and clarify that the same rooting depth in different soil types has different implications for water availability (this may even be of importance in the context of the land use changes discussed by the authors, where soil moisture retention may be affected by the land use change, e.g. through loss of organic matter after clearing for agriculture).

Strictly speaking it is incorrect to state that photosynthetic rate is a characteristic that determines transpiration. Transpiration is determined by leaf conductance, and both correlate with photosynthesis. Equation 17 is correct but not very helpful because it basically states that E=A/(A/E). There are no errors in this section on photosynthesis but it is not clear where this is leading to. Do the authors suggest that measurement of photosynthesis is a promising option for the estimation of transpiration? This would be the case if water use efficiency were easily predictable, or constant, and if photosynthesis were easier to measure than transpiration, but as far as I know this is not the case.

On P1531 the authors discuss relationships between photosynthesis and other leaf traits like leaf lifespan and thickness, but not relationships with leaf area index. Elsewhere (P1535) the authors discuss the relationship between leaf area index and rooting depth. Given the emphasis on the three vegetation characteristics determining the hydrological functioning of the vegetation, it would be good to discuss possible relationships between leaf area index and photosynthetic rates.

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Specific comments: P1526 L12: replace “Ě on Fu” by “Ě of Fu”. P1531 L22: “ Ě support plants with higher Ag than resource poor sites Ě”. This would be best replaced by “ Ě support vegetation with higher Ag than resource poor sites Ě” There is more than one effect here: more plants, denser foliage, and higher rates of photosynthesis per unit leaf area. P1531 L23: the literature referred to discusses photosynthesis per unit leaf area (at the single leaf level), not per unit ground area (at the vegetation level) as defined in the paper. This confuses the discussion. P1532 L13: Mention greater catchment area alongside increased time period. P1536: Mention the limitation of remotely-sensing L at high leaf area index levels (although possibly the implications for hydrology are not so large).

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 3, 1517, 2006.