Hydrol. Earth Syst. Sci. Discuss., 2, S405–S410, 2005
www.copernicus.org/EGU/hess/hessd/2/S405/
European Geosciences Union

Hydrology and
Earth System
Sciences
Discussions

Interactive comment on "Transpiration of montane *Pinus sylvestris* L. and *Quercus pubescens* Willd. forest stands measured with sap flow sensors in NE Spain" *by* R. Poyatos et al.

R. Poyatos et al.

Received and published: 21 July 2005

The authors greatly appreciate the positive comments on the paper and the recognisition of the importance of the topic. The questions and comments made by the referee A.Granier (original comments in lines beginning with a dash) are now discussed.

-Does the method used for calibrating the transpiration model in Scots pine give the same parameterisation than non-linear multi-variate methods?

We would like to acknowledge that although the technique used for obtaining the upper envelope of transpiration measurements against reference evapotranspiration (quantile regression) has never been used in this kind of models, the idea of a 'boundary-line analysis' (Chambers et al., 1985) has been widely adopted in the parametrisation of multiplicative models of sap flow or canopy conductance (e.g. Lagergren and Lindroth, 2002). Moreover, this method follows a logical process, by which there is a ‘driving force’, that poses an upper limit under optimal conditions (ET0), and a limiting variable (soil moisture) acting as a constraint. An important advantage of using this methodology, is that upper envelopes are obtained in a statistically sound fashion (i.e. the 95th quantile regression), thus reducing the degree of subjectivity in the process. Finally, non-linear regression techniques do not always yield a consistent solution, because of associated problems of multicollinearity between variables.

-E0 is calculated with the Penman-Monteith formula; the fact that non-linear relationships are obtained between Ec and E0 probably results from the canopy conductance.

This is explicitly stated in the paper and dealt with in the model by using a logarithmic relationship between Ec and ET0.

-A model could be proposed by: 1) calculating canopy conductance from sap flow and climate measurements, 2) modelling the canopy conductance variation with climate and soil water deficit, 3) include this model in the Penman-Monteith equation.

Initially, we did use a model of canopy stomatal conductance to model transpiration, however, we finally decided to focus on the performance of a more hydrologically-oriented model, testing the ability to predict the large interannual variation in transpiration from evaporative demand (ET0) and a measure of soil moisture deficit.

-Anyway I would suggest a model calibrated using the 2003 data and validated on the 2004 data

We believe that mixing both datasets would account for a greater range of possible meteorological and soil moisture conditions ().

-Why a transpiration model cannot be built in oak?

The reason why a transpiration model was not built for oak was the lack of sufficient soil moisture data in this plot, because it was not measured continuously during the period presented in this study. We used a linear regression between manual soil moisture

TDR measurements in the oak plot and the continuous ones in the pine plot, but just to illustrate the dynamics of soil moisture. Soil moisture continous monitoring has already been installed in the oak plot, which will make further comparisons between the two species more feasible.

-Soil measured only in the first 30 cm soil depth (probably impossible to install the TDR probes deeper); anyway, this limits the use of soil moisture deficit. As stated in this paper, there is probably water extraction below.

As it is very likely that water extraction by pubescent oak goes below 30 cm, TDR probes have now been installed up to 50 cm, the maximum soil depth at which we could install them. Our opinion is that pubescent oak must rely on deep water resources and there is some evidence indicating so in this species (Valentini et al., 1992). However, we still expect a certain fraction of fine oak roots to be present in the upper soil, ‘sensing’ drought conditions. This is important, as these soil layers might not be so important as water supply, (oaks prefer ‘safer’ water supplies in groundwater, specially when upper soil layers might be intensively exploited by the dense understorey) but as an important part in the drought signalling process (Meinzer, 2002).

-Transpiration in oak plot seem quite low. I am not convinced that the scaling procedure in oak sapflow is correct. The sapwood thickness in Q.pubescens is probably larger than 10 mm.

Sap flow measurements in ring-porous trees have been largely regarded as problematic, and although some precautions have been taken in this work to prevent errors in the direct measurements, by using shorter probes (Clearwater et al., 1999), several uncertainties still remain. We hypothesized that sources of uncertainty from radial variation of sap flow (Cermák et al., 1998) and sensitivity of heat dissipation probes to high sap velocities (Lundblad et al., 2001) could compensate each other. Finally, sapwood area estimates in pubescent oak could also differ from more accurate measurements based on radial patterns of sap flow (Cermák and Nadezhdina, 1998).

The exercise presented in this work follows a widely-used procedure (Bréda and Granier, 1996; Teixeira-Filho et al., 1998), enhanced by taking specific precautions for ring-porous species (Clearwater et al., 1999), but not considering the expected high radial gradients in sap flow (Cermák et al., 1998). This last issue will certainly have an impact on sap flow measurements with single-point probes and is currently dealt with by the authors.

-Note also that in the paper of Bréda and Granier (1996), sessile oak transpiration was compared to Penman PET, not toPenman-Monteith. T/PET ratio is lower using Penman.

We are aware of that, Penman PET is always larger than Penman-Monteith ET0, and thus an even lower ratio would result if we used Penman instead. In our case, though, computed ET0 for the period between days 141 and 289 (end of May to mid October) is only 3 mm higher than Penman PET..

-Why more data points in figure 1a than in figure 1b?

As stated in the figure caption, the data is grouped according to integer values of the independent variable (i.e. inf Fig. 1a, values with DBH=20.1 and DBH=20.5 cm would be grouped in the same integer category). This applies also to Fig. 1b, and the degree of grouping differs between the two independent variables (DBH and Ac)

-The paper by Nadezhdina et al (1992) does not give data in this species.

The reference by Nadezhdina et al. (1992) is not present in this paper. However, there is a reference indeed by Nadezhdina et al. (2002) in:

Page 3. (Introduction) Page 7. Used to illustrate the possible overestimation of total sap flow if decreasing sap flow with depth is not accounted for. It does not mention any species in particular, it is a general statement. Page 13. Refers to measured radial patterns of sap flow in P.sylvestris.

References

Bréda, N. and Granier, A., 1996. Intra- and interannual variations of transpiration, leaf area index and radial growth of a sessile oak stand (Quercus petraea). Annales des Sciences Forestieres, 53: 521-536.

Cermák, J. and Nadezhdina, N., 1998. Sapwood as the scaling parameter-defining according to xylem water content or radial pattern of sap flow? Annales des Sciences Forestieres, 55: 509-521.

Cermak, J., Nadezhdina, N., Raschi, A. and Tognetti, R., 1998. Sap flow in Quercus pubescens and Quercus cerris stands in Itay, 4th International Workshop on Measuring Sap Flow in Intact Plants. IUFRO Publications-Publishing House of the Mendel University, Zidlochovice, Czech Republic, pp. 149.

Clearwater, M.J., Meinzer, F.C., Andrade, J.L., Goldstein, G. and Holbrook, N.M., 1999. Potential erros in measurement of nonuniform sap flow using heat dissipation probes. Tree physiology, 19: 681-687.

Chambers, J.L., T.M.Hinckley, Cox, G.S., Metcalf, C.L. and Aslin, R.G., 1985. Boundary-Line Analysis and Models of Leaf Conductance for Four Oak-Hickory Forest Species. Forest Science, 31(2): 437-450.

Lagergren, F. and Lindroth, A., 2002. Transpiration response to soil moisture in pine and spruce trees in Sweden. Agricultural and Forest Meteorology, 112(2): 67-85.

Lundblad, M., Lagergen, F. and Lindroth, A., 2001. Evaluation of heat balance and heat dissipation methods for sapflow measurements in pine and spruce. Annales des Sciences Forestieres, 58: 625-638.

Meinzer, F.C., 2002. Co-ordination of vapour and liquid phase water transport properties in plants. Plant Cell Environ, 25(2): 265-274. Teixeira-Filho, J., Damesin, C., Rambal, S. and Joffre, R., 1998. Retrieving leaf conductances from sap flows in a mixed mediterranean woodland: a scaling exercise. Annales des Sciences Forestieres, 55: 173-190.

Valentini, R., G.E. Scarascia Mugnozza, G.E. and Ehleringer, J.R., 1992. Hydrogen and carbon isotope ratios of selected species of a Mediterranean macchia ecosystem. Functional Ecology, 6(6): 627-631.

Interactive comment on Hydrology and Earth System Sciences Discussions, 2, 1011, 2005.

Full Screen / Esc

Print Version

Interactive Discussion

Discussion Paper