

Interactive comment on “Seasonal and inter annual variability of energy exchange above a boreal Scots pine forest” by S. Launiainen

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Received and published: 7 October 2010

The author explores the inter-annual variability of the surface energy budget at one of the longest-run eddy covariance site in Europe near Hyytiälä, Finland. He carefully addresses the possible relevance of storage terms such as sensible and latent heat stored in the canopy air, the above-ground biomass, and the energy consumed by photosynthesis. The energy produced by the decomposition of organic matter and other terms are however neglected, and in particular the phase transition during snow-melt and in winter is excluded. The analysis is restricted to the snow-free period May–October (6446-25).

This paper provides a wealth of interesting and relevant insights into the topic and discusses a whole suite of aspects which help us to understand the underlying mech-

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anisms. However, a clear storyline is lacking and the text is quite lengthy and requires a high level of concentration to read. But it contains relevant information that deserves publication. The author has addressed many of the technical issues that I criticised in the first review step, which in my view already helped to improve the manuscript.

I think after the following minor revisions the paper can be accepted. I realize that many of the points that I criticise below escaped my assessment in the first round, but in particular the figures need a careful revision.

I strongly support your view on the problems associated with u_* filtering expressed on page 6450! Also your approach when to change filters (6447) indicates careful thought on how to carry out your measurements.

FIGURES

In general the font size in most figures is below the minimum size, at least in my printout on A4 paper.

Fig. 3: all alternative y-axes on the right hand side of the panels need a conventional spacing between ticks and at least two ticks must be labeled

Fig. 4: the y-axis labels of the middle and bottom panels, left column have lost the cipher 2 in the exponent; the middle panel to the right has no y-axis label; panel f has its panel label and the associated month (Nov) much lower than any other panel

Fig. 5: why are the midnight values not shown? This graph is somewhat inconsistent. Normally time series averages are plotted at the end of the averaging period, and hence the 0 and 24 hour data points should be the same and there should be no gap between 23:30 and 00:30 hours.

Fig. 6: it would be helpful to have a horizontal line at $\alpha=1$ similar to the one in the Bowen ratio graph. Describe in the caption what the horizontal lines show. Why are the medians for J, F, N and D not shown? Please explain in caption or show them.

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Fig. 7–8: here you mix the scientific notation with negative exponents with the notation of mm/s. Please homogenize and use one variant throughout your manuscript, and be consistent between text, caption and figures.

Fig. 7: Add space in mm s^{-1} in caption.

Fig. 8: are given **as numbers** for each . . . (not as figures)

Fig. 10: if one uses a good magnifying glass one realizes that all regression equations are lacking the intercept although none of the lines is forced through the origin. Reduce the vast empty space between panels and enlarge those instead.

TABLES

It is unclear in Table 1 what the difference between cells showing N/A and those showing empty space is. Be consistent.

TEXT

1. Table 2 referenced on 6455-09 does not show any flux densities as the text suggests, it only shows sums; hence the reference to Table 2 at this place does not seem appropriate (or I did not find out how I could find the extremes of $350\text{--}400 \text{ W m}^{-2}$ in Table 2, there are no extremes to be found there)

2. Interpretation of Bowen ratio (6455-10/11) is not in agreement with your figures: the figures show a minimum in winter (negative values). It appears at several places that you use a sloppy variant of minimum/maximum etc. by ignoring the sign of the numbers you refer to!

3. 6455-14/15: wording is not understandable

4. 6456-16: please double-check; in my understanding equilibrium evaporation according to Priestley and Taylor means $\alpha = 1$, that is, it refers to the state of a saturated atmosphere above a water surface without advection. Priestley and Taylor (1972) do not explicitly use the term “equilibrium evaporation”, they only mention that 1/2 mile

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fetch may not be enough to achieve an equilibrium state. Maybe you have another reference which more clearly defines the correct terminology? They actually name their equation (14) with $\alpha=1.26$ just “potential evaporation” from a horizontally uniform saturated surface.

5. 6456-17 to 19: I do not exactly follow your argumentation why α should exceed 1.26 when sensible heat flux is towards the cooler surface. Priestley and Taylor did not speculate on cold temperature potential evaporation, but if you look at their Figure 2 and extend the H/LE curve to low temperatures this would lead to more positive H/LE (or Bowen ratios); however you argue that it should be negative with negative H and positive LE; this would basically mean that the Priestley and Taylor concept would be invalid for such conditions. I think you realized this inconsistency and hence did not show winter medians in Fig. 6b. This aspect needs a revision to be (a) consistent internally, (b) in agreement with Priestley and Taylor, and (c) defensible.

6. 6459-11 to 15: this is quite confusing wording; it sounds quite obvious that immediately after snowmelt the surface is wet, but how immediate is immediately? I also do not think that anything hindered transpiration rates, there was just no driving force if there is no photosynthesis! Please reword and clarify

7. 6467-09 to 11: γ is not the lapse rate of potential temperature (if it were potential temperature then the dry adiabatic lapse rate would be zero). The value you give is the lapse rate of the absolute temperature, which is consistent with your heat fluxes that also use absolute (and not potential) temperature.

DETAILS

Use the term “parameter” only where a parameter with the meaning of system constant is referred to. If a variable is meant (such as e.g. in line 6442-19) it is better to use the term “variable”. The misuse of the word “parameter” for variables in climatology in my view is a relict of the pre-global change era when people tended to think of climate as an entity with a constant mean state.

Wherever you used the proportional to sign (\sim) you should use the approximate sign (\approx)

Use the word “timescale” if you refer to a timescale (not just “scale”)

6441-01: hyphen lacking in title in "inter-annual"

6443-25: the two references erroneously imply that this is a newer finding (2006), but this is old knowledge and should be reflected by original publications (e.g. those reflected in Larcher’s textbook).

6445-08: was the pine stand really sown or was it planted? In most cases I would assume that seedlings are grown in a tree nursery and then planted, or voluntary re-growth (no active sowing) is used.

6446-22: in particular (without -ly)

6447-25: were taken **into** account using **the** maximum – here I wonder why you did not take the minimum during periods of CO₂ uptake; maybe highest r^2 would be correct?

6448-02: according **to** the

6449-02: taken **into** account

6449-08: were **used**

6449-17: data **from** 1997

6456-22 to 23: unclear wording

6457-20: **degree**

6458-16 to 17: what does “remains more stable over against range” mean?

6460-02: what **was** observed

6460-05: represented **in** detail . . . On **an** annual **timescale**

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6461-16: clarify what you did with the offset – just ignored it or forced the regression through the origin?

6462-05: were **not taken into account**

6463-09: delete “a”

6465-03: has **led to the** development

6468-05: operates **in** the linear

6469-02: did not **find** any

6469-22: There **is a** wealth of

6472-04: magnitude . . . remains **low**

At many places definite or indefinite articles are lacking:

6475-09: “the” missing in title!

6444-20, 6446-25, 6447-01, 6447-04, 6447-25, 6451-12, 6453-10, 6457-13, 6458-27, 6460-07, 6463-08, 6463-17, 6464-16: add “the”

6442-22, 6451-14, 6458-25, 6463-12, 6469-03: add “a”

6465-28: add “an”

Interactive comment on Biogeosciences Discuss., 7, 6441, 2010.

BGD

7, C3190–C3195, 2010

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