

## ***Interactive comment on “An automated system for selective and continuous measurements of vertical Thoron profiles for the determination of transport times near the ground” by D. Plake and I. Trebs***

### **Anonymous Referee #2**

Received and published: 30 January 2013

#### General comments

The authors describe a new measurement system for direct determination of in-canopy (near-surface) transport times and resistances in the field using vertical Thoron profiles. Although the benefits and basic measurement principles of this technique are already well understood, a number of practical issues have limited the accuracy and quality achieved in previous applications. The measurement system described and applied in this study is designed to remove or alleviate many of these issues, and the authors provide an excellent demonstration of its success via a thorough and exhaus-

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tive analysis of systematic and random uncertainties applied to a carefully designed set of field measurements. The resultant conclusions regarding the performance of the new system are highly convincing, and the subsequent comparison of results with common canopy resistance formulae appears to reveal shortcomings in established model parameterisations.

This manuscript represents a substantial contribution to scientific progress within the scope of AMT. The scientific methods used are appropriate, thorough and well discussed. Furthermore, the results are well structured and presented, the number and quality of figures / tables are appropriate, and the conclusions are clear and concise. There are a few minor issues listed below which I believe would improve the manuscript. Once these are addressed, I recommend immediate publication.

#### Specific comments

1. The manuscript is a little too long relative to its content. This is partly due to repetition of descriptions between the system characterisation / determination of uncertainties sections in the Methods (2.4, 2.5 and 2.6), and the corresponding sections in the Results (Sections 3.1 and 3.2) and Discussion (Sections 4.1 and 4.3). Although I don't have any specific suggestions, I do feel that with a bit of effort the manuscript could be shortened and clarified by attention to these sections.

2. The discussion of transport characteristics within the three canopy layers of different depth (Section 3.4, Figure 9) is greatly confused by the insistence on using transport times ( $\tau$ ) which depend critically on the layer depth. The authors should consider presenting the results in Figure 9 as resistances ( $\tau/h$ ) rather than transport times, thereby removing the effects of layer depth differences so that the discussion can focus more clearly upon the physical processes. This will also make the job of comparing results with the model formulations in Section 4.2 easier.

3. Although I understand that this paper is mainly about the technique and its accuracy, I would have liked to see a little more discussion of the possible physical reasons for

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the observed differences in the diurnal variations of transport times (or use resistances, as discussed above) at different heights in Sections 3.4 and 4.2. In Section 4.2, for example, the authors note transport times inside the canopy at night that are smaller than predicted by the Personne et al. (2009) parameterisation. These are attributed to unstable temperature profiles that they observe within the canopy at night. This is an interesting finding in itself, and would benefit from a slightly longer discussion and perhaps a couple of literature references (have others found this?). Also, there was no mention of such physical effects in the discussion of the time series of calculated transport times (or resistances: see above) in Section 3.4.

#### Technical corrections

Listed below are a number of specific minor corrections that I believe would improve the clarity and readability of the manuscript.

P2 L6-8: Rewrite sentence as “The two isotopes . . . and  $^{222}\text{Rn}$  (Radon), are generated in rocks and natural soils, where their respective mother nuclides . . . occur as common radioactive atoms”.

P2 L20: Change “which are sources” to “which act as sources”.

P3 L15-17: Rewrite 2 sentences as: “In contrast, . . . to the ground, where its concentration is determined by the competition of transport and the fast radioactive decay. In contrast, Rn decay can be neglected in this layer because of its longer half-life”.

P3 L19: Change “Tn. . Consistently, Lehmann” to “Tn. Lehmann”

P3 L20: Remove “) to be 28 cm (“

P3 L22: Add “to be 28 cm” between right bracket and full stop.

P4 L12 & L15: Change “instationarities” to “non-stationarities”.

P5 L15: Change “conditions” to “to be monitored”.

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P6 L15: Change “2,5” to “2.5”. Change “4,0” to “4.0”. P 7 L6: Change “pursued with” to “proceeded in”.

P14 L6: After “120 s.”, I suggest adding something along the lines of “Temperature measurements indicated that the reduced transport times in the lower canopy at night may be associated with unstable temperature profiles very near the surface (not shown)”. Are these sonic temperature measurements from the 2D anemometers?

P14 L6-8: So why not report / plot these time series results as resistances? (See Point 2 under “Specific comments” above).

P14 L26: Change “instationarities” to “non-stationarities”.

P16 L12: Change “prize” to “price”.

P16 L14-15: Rewrite sentence as “However, it has to be kept in mind that the analyzer precision is not sufficient for the low  $T_n$  and  $R_n$  concentrations found at the surface at many sites, and higher than a few metres above the surface at all sites”.

P16 L26: Delete “exemplarily”.

P17 L3-4: Rewrite as “...  $K_m(h_c)$  the eddy diffusivity coefficient at  $h_c$  ( $K_m = \kappa \cdot u_{*} \cdot (h_c - d)$ ),  $\kappa$  the von-Kàrmàn constant, ...”.

P17 L11: More detail required as to how LAI was estimated by “canopy harvest”.

P17 L11: Add “ $u_{*}$ ,  $z_0$ ,  $d$ ,  $L$ ,  $\Psi_H$  and  $\Psi_M$  were estimated using standard micrometeorological techniques (REFERENCE)”. Is this correct?

P17 L11: What value was used for  $\alpha_u$ ? (REFERENCE)

P17 L22: Change “measured temperature profiles” to “measured sonic temperature profiles from the 2D anemometers”. Is this correct? (I’m only guessing).

P19 L1: Delete “exemplarily”.

P19 L23: After “total uncertainty” add something like “In other words, when the  $T_n$

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concentration at the upper measurement point is very small, the error in the calculated value of tau is dominated by errors in the upper measurement”.

Figure 3: Add a horizontal line at 0.6m indicating the mean canopy height.

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Interactive comment on Atmos. Meas. Tech. Discuss., 6, 867, 2013.

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