

Interactive comment on “Turbulent transport of energy across a forest and a semi-arid shrubland” by Tirtha Banerjee et al.

G. Bohrer (Referee)

bohrer.17@osu.edu

Received and published: 9 May 2017

P4L7 - Prognostic models predict the result in a future timestep (relative to the timestamp of observations they ingest). I think you mean here “diagnostically”. P4L9 – I think you somewhat misrepresent the meaning of prognostic and diagnostic models. The difference between the two is that diagnostic model does not include a time evolution. Neither of your terms requires time evolution. Please remove the terms “prognostic” and “diagnostic”. I think the best terms to use here will be “directly” and “indirectly”. Also see <https://earthscience.stackexchange.com/questions/924/model-types-robust-diagnostic-versus-prognostic> for a good explanation.

P4 where did eq. 4 come from (it is not in Banerjee et al 2016)? And how come it does not include the roughness length?

C1

P4L20 I recommend making this a numbered equation (the new eq 5), as this is a key component of your calculation, and you don't want to make the reader fish it out of the inline.

P4L26 Can you show the results of this regression (perhaps in an appendix)? What was its R^2 ? As you can use a whole range of r values to calculate epsilon, how did you actually do it? Picked a particular r ? using the average with all possible r values (given your observation timestep and wind speed) within the 0.2-2 m range? Please add an equation stating the exact and complete formulation of epsilon the way you actually calculated it.

Figure 2 – I assume you mean the half-hourly means (or is it the hourly? Daily?) Please state it in the caption.

P5L6 (and in the description of all other figures) in “thicker” and “thinner” lines, I assume you mean “black” and “red” lines?

P7L3-6 this entire section (and similar sections that follow each of your figures) belongs in the figure caption and not in the text. You should move this to the captions of figs 2 and 3, and start section 3.1 stating: “Our observations show that the desert is associated with higher wind speed ... (Fig. 2) ...”. I have the exact same problem with the first few lines of section 3.2. Also, P10L7-11 should be removed (it is already in the caption). These are just examples, the same problem exists in many other places.

P7L9 I totally do not agree that the increase of $u\overline{w}$ over the desert after 24th August “can be attributed to mesoscale motions appearing over the region”. I think that this is a very simple and direct result of the change in tower height. I do not accept your claim (P6L11-12) that “However, the raising of the mast should not have affected the measurement of turbulent fluxes since it was done within the constant flux layer” - Obviously, and as clearly expressed in your observations - it did.

P8L6 “however, after 24th August, the levels of $w'w'$...” Similarly, it is rather easy to

C2

claim that it is due to changing the tower height. As the vertical profiles of $w'w'$ are different between the desert and forest (due to roughness length differences), the observed differences between $w'w'$ are a function of observation height. Apparently at 15 m above the desert and 19 m above the forest are high enough to be at the “constant flux layer”, the vertical profiles of TKE ($u'u' + w'w'$) converge. However, when you observed at lower elevation, and apparently below the constant flux layer, your data show clear differences in $w'w'$. As currently stated, without explicitly reminding the reader about the elevation change at that exact date, this statement is highly misleading, especially as it is immediately followed by “Thus. . .” (next sentence, L7).

Further in the same point: P9L14 “Although the effect of the large scale structure after 24th August seems to dampen the [dissipation] over the desert while its effects on the [dissipation] over the forest are not very conspicuous.” Here, again, it is rather clear to me that you record less TKE dissipation when you are further from the ground and above the roughness sub-layer.

One strong argument for observed changes after Aug 24 being tower-height effects rather than change of forcing is that you only observe changes in the desert after the 24th, while the forest observation keep a rather consistent dynamics. You only changed the height of the desert tower, however, a change of forcing should be apparent over both forest and desert.

Fig 4 – what is “full TKE production”? You did not define such term, and if it is the e from eq 1, your data does not allow calculating it. I guess it is the sum of the mechanical and shear production terms. Please state it explicitly and do not call it “full TKE”.

ALL figures - Please list in the caption the exact same symbols you used on the figures' y axes, so it is easier to understand what they are, and which is which. Currently you either ignore the symbols (e.g. fig 4), or provide a different version of the symbols on the caption than what is listed on the axes (e.g. fig 7 top 3 panels).

P9L7 remove “also”. You already say “and”

C3

P9L12 “huge” is a very subjective term. Perhaps “significant” (if you tested it) or “large” or simply “a” difference (can you calculate and state the % difference?)

Fig 5 – Explain what are the blue lines, and in the caption or on the figures (as in fig 6) provide the regression statistics (R^2 , significance P) for the trend lines (blue?) that you are plotting.

Fig 6 Provide also the significance P.

P13L4 I do not understand why a larger integral eddy time scale over the desert is an indicator of “the transport by secondary circulations above the desert.” I think it is indicative of buoyant production of turbulence, which generates larger eddies than shear production.

P14 – Please combine eq 8-10 to a single equation that relates σ_{u/u^*} to α . It is easy to see that eq 10 is totally redundant (you are re-assigning a fixed number), and neither eq 8 or 9 are too complicated to allow direct substitution (B1 is a simple additive term in eq 8).

P14L11 How do you determine that “The data over the desert is found to be ill conditioned to compute α ”? I think it'll be more accurate to say that this empirical formulation was originally derived for forests (using data from forest flux towers) and therefore, the values of A_1 and C_k for the desert are unknown.

Fig 8 – draw a dashed line for $\alpha=1$ (but, as you can see below, I rather you removed this figure altogether)

Section 3.5 – I totally do not understand what you learn from the VLSM analysis (shown in bottom panel fig 8). During the entire section, you explain how to calculate α , and provide excuses for not calculating it over the desert, and not being unable to use it to show sea breezes and other obvious large scale circulation patterns. The only actual informative statement you make about VLSM is that “there are a number of large peaks of $\alpha > 1$ after 24th August which confirms the presence of VLSM and

C4

supports the interpretations of previous findings in this manuscript". I need to point out that there is presence of large peaks also before 8/24. In fact, larger (Aug 15 is the largest peak) and more (especially if you bundle up the adjacent peaks on the morning of Aug 27) peaks are present before you changed the tower height. Later, in the conclusions section (bullet point 4) you state that "The VLSMs are found to enhance turbulence fluxes and the nonlocal motions for both the forest and the desert. Although its main effect is to enhance the secondary circulations already existing over the desert transporting energy towards the forest." How do you reach this conclusion? Did you measure the correlation between alpha and turbulent fluxes? Can you prove that it enhances the mesoscale circulation already existing? This is purely speculative. If the reason for section 3.5 and conclusion point 4 is to provide justification for all the false claims about the effect of changing the tower height – than it doesn't work. It totally doesn't make a strong case to convince me that there was not effect of tower height. However, I do not understand the insistence on this entire point. Your conclusions do not rely in any way on the tower height and all the things you show about imbalance are valid before and after Aug 24, so why get yourself into this problem. Simply point out the places where the tower height may have influenced the observations, and further point out that the imbalance and other observations from which you draw conclusions about mesoscale circulations and TKE advection are showing similar patterns regardless of the tower height. I will be happy if you remove this section and the 4th point of the conclusions.

Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2017-159, 2017.