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Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "A comprehensive investigation on afternoon–evening transition of the atmospheric boundary layer over a tropical rural site" *by* A. Sandeep et al.

**Anonymous Referee #3**

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General Comments:

This paper give an interesting study of the afternoon to evening transitions (AET) over a tropical, rural site. Specifically, the paper seeks to answer three questions: (i) which state variable best identifies the onset of AET, (ii) does the onset of AET exhibit seasonal variability, (iii) does the onset of AET display height dependence? The researchers utilize an extensive, long term data set of both remote and in situ measurements throughout the entire ABL to address the questions. The researchers show that AET begins from the top-down and that there is some seasonal dependence due to high soil-moisture associated with the northeast monsoon. They assert that surface

temperature and wind speed variance are the best signifier of the onset of AET at the surface and that the signal to noise ratio and spectral width are the best signifiers aloft.

This is an interesting study and will be a welcomed addition to the literature. However, I do have several, general concerns that should be addressed before publication. First, the thresholds for the onset of AET in each state variable (Pg 31493) seem somewhat arbitrary. For example, in Fig. 2a-b I feel one could also say that AET is beginning at the surface before it is aloft. This ambiguity may be inevitable but I feel that more explanation is merited. Perhaps a threshold sensitivity analysis could strengthen the authors' argument that the transition is top-down. Also, it'd be interesting to hear the authors hypothesize about any "universal" nature of the thresholds (i.e. would these apply at the mid-latitude sites). Second, the explanation given for the top-down behavior, specifically the ratio of the entrainment to surface flux, is very interesting but also has a large degree of uncertainty. This should be addressed in the paper. Third, some of the subfigures are too small to be easily studied. Finally, the overall readability and English of the paper could use some improvement.

Specific Comments

31484 Ln 14-15: "The T at the surface and SNR aloft identify the signature of transition unambiguously". Judging from Fig. 2, I disagree that it is unambiguous. Perhaps something like, "T at the surface and SNR aloft are the best indicators of transition"

31488 Ln 17-24: I found the general description of the long-term and short-term data sets to be very confusing. Please re-word. Maybe something like, "dataset 1 was collected with a suite of non-continuously operated instruments, spanning a 3 year period. It is being used to examine AET seasonality and height dependence. . . Dataset 2 is comprised of the intensive observations which include the instrumentation of dataset 1 along with a flux tower and radiosondes launched every three hours. Dataset 2 was collected over two, three day campaigns (one during the monsoon and one during the winter)."



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31489 Ln 24: Too bad the 50 m mast housed a single sonic at 8 m. It may or may not be worthwhile clarifying that in the Table 1 caption.

31489 Ln 28-29: Please give a reference for the automated tests that were performed on the tower data. See comment 31499 Ln 22.

31491 Ln 14: I'm not sure I see the increased backscatter in Fig. 1e.

31492 Ln 15: "On 11 May 2010, the temperature (Fig. 2a) starts to decrease monotonically, at the rate of 1–1.5 âŮęC per 1 h, from 16:45 IST (dashed line), 118 min prior to the time of sunset (solid vertical black line). Though the temperature decrement starts little early, but is not consistent and also weak in magnitude". Again, I'm not sure I agree with this. To me, 16:10 looks more appropriate.

31492 Ln 16: "Another surface characteristic showing a significant change during the AET is the mixing ratio (Fig. 2b), which clearly shows a gradual increase from 16:10 IST". I do not think this is clearly shown.

31492 Ln 18: "The temperature gradient (Fig. 2c) also reverses from positive to negative, indicating the reversal of surface sensible heat flux, few minutes after the 5 m level 20 temperature starts to decrease". This isn't necessarily the case. See "Countergradient heat flux observations during the evening transition period" (http://www.atmos-chem-phys.net/14/9077/2014/acp-14-9077-2014.html).

31496 Ln 18-20: The questions the paper seeks to answer are given in the abstract, introduction, discussion and conclusion. Sometimes they are listed as 3 questions and sometimes as 4. While the general idea of the questions is approximately the same, it would help readability if they became more consistent.

31497 Ln 8: "Though Gadanki receives 55 % of the annual rainfall in the southwest monsoon, rising instantaneous soil moisture levels, but the high insolation and temperatures immediately consume the soil moisture for latent heating. On the other hand, this region also gets good amount of rainfall during the cool northeast monsoon (Rao



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et al., 2009). The soil moisture levels, therefore, remain high in this season." Intuitively I agree with this. However, I'm wondering if there is any soil moisture data to help support it.

31497 19: "It is known from the literature that there exists an apparent contradiction between those who think the transition starts in the afternoon at high levels (Angevine, 2008) and others who believe the AET occurs around the sunset and follows a bottom-up evolution. The present study supports the former view, as similar evolution is seen in total and seasonal plots (Figs. 3 and 4)." Again, I'm not fully convinced that this isn't at least partially due to the selected thresholds.

31499 Ln 22: "A stringent data quality check has been performed for the estimation of fluxes (Burba, 2013). These fluxes are evaluated at 30 min resolution." This is more appropriate for section 2.

31500 Ln 4: "In contrast to large eddy simulations (LES) by Canut et al. (2012), who found an increase of the entrainment rate in the late afternoon, the present observations do not show any such increase, rather the entrainment flux remained constant throughout the day on all days" More discussion please. What are the weakness of the LES study vs yours?

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Interactive comment on Atmos. Chem. Phys. Discuss., 14, 31483, 2014.