Atmos. Chem. Phys. Discuss.,
doi:10.5194/acp-2015-1060-RC1, 2016

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Observing local turbulence and anisotropy during the afternoon transition with an unmanned aerial system – a case study" *by* A. Lampert et al.

Anonymous Referee #1

Received and published: 1 March 2016

Review of "Observing local turbulence and anisotropy during the afternoon transition..." by A. Lampert et al.

The use of unmanned aerial vehicles in the study of meteorology is still novel. To this end, manuscripts such as this one are to be encouraged as the scientific potential of UAVs seems to be large. However, whilst the manuscrpit contains some interesting and tantalizing data, and its methodology is sound, its conclusions are not robust because the dataset is too small. This is clear from a basic statistical viewpoint alone. In addition, the presence of a low-level jet on this occasion leaves the reader asking: what would have happened to the anisotropy ratio if the LLJ had not been there ? If you can so much as answer this question, then the paper will be vastly improved. If the LLJ was

present on all available measurement days, then of course this is important too, and more flight data will in any case boost the statistical base. Fig 10 in particular could be added to and improved. I see from Lothon et al that three other days are potentially available from the M2AV dataset. For this reason, it is probably best to label such a revision as major although it is difficult for me to know how much work is involved.

The conclusions section is also very small, as mentioned below. This should be improved with a larger dataset for a better range of meterological conditions.

A bit of an overhaul of the figures is required too, as described in detail at the bottom of the details below.

Other detailed points:

In general:Stick to either local time or UTC. Do not keep changing from one to the other. But state, both in the abstract and in the main body of the paper, that local time = UTC+2hr.

Abstract. Line 1 "We analyse airborne observations..." Line 1-2 "directions" Line 2 "turbulently-mixed", "stably-stratified" Use local times in the abstract (but state local=UTC+2hr) Line 5. "...anisotropy ratio, defined here as the ratio of the variance of horizontal to vertical wind speed, changes..." Line 7. "...mean value of about 1 to a mean value of 2 about one..." Line 8. "...a mean value of about 8 one hour after sunset."

Introduction. Line 28. "...is described in two distinct consecutive phases:" Lines 33-35. Is this typical ? Do you see it here for the case studied ?

Section 2.1 Line 61. The proximity to the Pyrenees I found initially worry because of effects such as gravity waves on the measurements. Given the wind directions during the measurements, this probably isn't an issue. But I would recommend stating the likelihood, or not, of the effect of the mountains on flow. I see gravity waves are not mentioned in Lothon et al (2014) at all !! Line 65. "...with sides about 3-4km long

were equipped..." Line 69. "ultra-high" Line 70. "...which provide a measure of the boundary layer depth..." Lines 73-75. No need to describe what a sonde measures, this is standard. State what type of sondes were used e.g. RS92. Line 80 "M2AV flight tracks" Line 84. "...partially controlled..."

Section 2.2 Line 108-109 spelling: "temperature" Line 120 "calculated by two different methods" Line 121 "removing the zero offset and a linear detrend of the time..." Lines 125-130 gravity waves might be seen in such data. Is there any evidence for this ? Line 150. Need to define LLJ in the body text (it was defined only in the abstract).

Section 2.3 Line 160. No need to define geostrophic wind, remove words "determined by the...centrifugal force" Line 163. "especially at night" Line 164. "observed LLJ occurrence between 30 and 60 % of all nights" Line 171. "Further, for particular interest for the present study, it creates wind shear..."

Section 3: maybe turn section 3 into Section 2.4 as it's quite small?

Section 4.1 Line 198. What are the typical ascent/descent rates of the UAV ? You can then state the typical SLOPE of the

UAV profiles which will help the reader visualise the horizontal distance covered for a given height change. Line 217. "For Flights 1 and 2" Line 218. "decreases" Line 246. Does it really indicate stability and hence also turbulence ?

Section 4.2 Line 249. Define "Zi" here (you define it on line 299, but it needs to be here).

Section 4.3 Line 290-291. Does this refer to the following day ? Best to make it clear.

Section 5.1 Line 309. "In Fig. 9" Lines 310-314. This is even more reason for adding more flight data to the analysis, as explained in the main comments section above. Statistically, the analysis given is barely acceptable and firm conclusions cannot be drawn. Line 322. "flux reduces to zero..."

Section 5.2 Line 327 and 330. No need to put m s-1 in italics. Lines 345-346. "...leads to a thermodynamic decoupling of the air that is in direct contact with the surface from the atmosphere above." Line 353. Do not use "A" notation; use the phrase anisotropy ratio in full throughout. Line 363. "within the scale of a few km."

Section 6. This section is too short. The use of UAV data for meteorological research is still novel. How can future studies of turbulence and the anisotropy ratio be improved upon in the light of BLLAST ? Would you change the flight patterns or the layout of the ground sites ? Line 368. "radiosondes" Line 371. "...vertical component coincided with the evolution of a LLJ."

Figures. (i) Fig 1. Add on a distance scale of 1km, or perhaps 5 km, whatever seems best ? The UAV flight patterns here are very small. Could you make the present figure Fig 1a and add a Fig 1b to the right showing a zoom-in of the flights in nice detail ?

(ii) You should combine Figures 3 and 4, using potential temperature (Kelvin) on the x-axis. With suitable line styles/point symbols the distinction between radiosonde and M2AV profiles should be clear. Add profile times to the key for the M2AV data.

(iii) You should use "mid-profile times" for all profiles, regardless whether M2AV or radiosonde.

(iv) Fig 8. Use same x-axis as Fig 7. Also add "W", "N", "E", "S" direction labels to the x-axis.

(v) Figs 11, 12, 13. I can't help feeling that your interpolated contour plots are disturbing the real data. Please try using "pixel" plots to show true data only.

(vi) Add annotations showing tge astronomical sunrise and sunset times, as appropriate, to Figs 10-13.

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