Answer to reviewer # 1

"The EUREC⁴A turbulence dataset derived from the SAFIRE ATR 42 aircraft"

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The authors would like to thank the anonymous reviewer for his/her suggestions and relevant remarks, which helped us to improve the manuscript. The original text from the review is written in black below, our reply in blue and the proposed modifications of the manuscript in red.

Summary Comment -

This paper describes the derived/processed turbulence parameters computed from the high-rate (~25 Hz) dataset collected the SAFIRE ATR 42 aircraft during EUREC 4 A. The manuscript is well-written and easy to follow. The data set are accessible as described. A perusal of the data files indicates the data appear to be complete and follow the description as laid out in the manuscript. The data set is suitable for publication with ESSD as I see potential for future use of the data set for a range of atmospheric scientists. For these reasons, I recommend publication once the authors address a few comments below.

Specific Comment -

1. I think the manuscript would benefit from a bit more additional information in the introduction or in section 2. Specifically, one to two paragraphs describing the data set would have helped me as I read through the manuscript. Little information about the data set itself was provided until Section 7—I think a bit more information upfront about a general description would be useful. The very specific information could still be retained later in the manuscript (Section 7).

We understand this point, and the need to very shortly describe the dataset, before it is fully detailed in sections 6 and 7. As suggested, a general description of the dataset has been added in the end of the introduction, before the outline. Since the description is included here before the details about the data-processing, we find appropriate to remain concise. The complete information on the data set is given in section 7. The following clarifications have been added in the text:

"This paper describes the EUREC4A dataset containing the turbulent fluctuations and turbulent moments associated with the high frequency measurements of temperature, moisture and wind from the SAFIRE ATR 42 aircraft, computed over horizontal stabilized legs."

2. The authors provide a very good, detailed description of the handling of the humidity data/measurements. In a revised version, the authors should include more information on the handling of the temperature measurements. I view this as the one major lacking component of the manuscript/data handling description. The Rosemount (Total temperature) housing is notoriously susceptible to wetting of the element—the authors point to this, but don't really discuss what impacts wetting has their measurements nor how they identify wetting in the data set. No information is provided about the fine-wire, not even a reference is provided for this sensor. Some description of the sensor itself should be provided—is it housed? Fully open to the free-stream? If the latter, how is the sensor protected against radiative effects? How is the recovery factor (of the element and the housing) determined and accounted for?

It is true that the description of the temperature was short in the manuscript, and that more details should be given.

The Rosemount probe wetting is actually not easily detectable, among other aspects like salting and some other technical issues, more intrinsic to the sensor itself, and which manifested as some spurious noise, and numerous spikes for some flights. Those, however, did not significantly impact the slow rate (1 Hz) of the temperature measurement. We think that the sensor itself had some unexpected issues during EUREC4A, mostly independent of the presence of droplets.

The fine wire sensor used in EUREC4A is an home-made sensor, analyzed in Baehr et al. 2002. However, there is no specific reference related to this sensor, other than this internal report. The two platinum fine wires are housed in a tubular antenna from SFIM company (model T4113). They are directly exposed to the stream, but protected from radiation, which consequently should not have a significant impact.
We considered this measurement as non-absolute, and used it only for the study of temperature fluctuations. We calibrated the fine wire with the raw impact temperature of the Rosemount probe temperature as a reference, with one calibration per flight. The regression slope was very close to 1 (1.07 in average, with a standard deviation of 1.2% over the 11 flights concerned). The most significant variability was found on the offset (coordinate at origine of the regression line), which varied between -4.6 and -1.9 °C , with a standard deviation of 2.6 °C. This variation may be explained by the fine wire resistance varying with time due to oxydation. From this calibration, and due to the incertitude of the housing features and recovery factor, we applied the same recovery factor of the Rosemount (0.98), to retrieve the static temperature from the impact temperature. Those results were similar to those found in the analysis of Baehr et al. 2002 on the same type of fine wire, and same antenna.

We added those details about the sensor in section 3:
"During EUREC4A, temperature was also measured using two fine wires (Baehr et al. 2002) that were housed in a tubular antenna. The two platinum fine wires are housed in a tubular antenna from SFIM company (model T4113). They are more directly exposed to the stream, but protected from radiation, which consequently should not have a significant impact."

A clarification about the Rosemount probe behaviour has been added:
"Those were not easily explained, but supposed to be inherent to the sensor itself. Rarely, a large noise could also appear locally in the presence of cloud droplets."

And also more discussion in section 5 about the fine wire:
"The two fine wires were installed starting at flight RF09, and calibrated with the Rosemount probe at 1Hz for each flight. Both fine wires were consistent together, but one showed some noise that the other did not show at all. We consider only the latter here. We considered this measurement as non-absolute, and used it only for the study of temperature fluctuations. We calibrated the fine wire with the raw impact temperature of the Rosemount probe temperature as a reference, with one calibration per flight. The regression slope was very close to 1 (1.07 in average, with a standard deviation of 1.2\% over the 11 flights concerned). The most significant variability was found on the offset (coordinate at origin of the regression line), which varied between -4.6 and -1.9 $^\circ$C , with a standard deviation of 2.6 $^\circ$C. This variation may be explained by the fine wire resistance varying with time due to oxidation. From this calibration, and due to the incertitude of

the housing features and recovery factor, we applied the same recovery factor of the Rosemount (0.98), to retrieve the static temperature from the impact temperature. Those results were similar to those found in the analysis of Baehr et al. (2002) on the same type of fine wire, and same antenna."

references:

- Baehr C., Méquignon A., Piguet B., 2002: Une première approche du capteur de température à fils fins sur le Merlin IV. Rapport interne, Météo-France/CNRM/GMEI/TRAMM.

Technical/Minor Comments-

1. Line 7 (abstract) delete 'a fast rate' and simply replace with '25 Hz'

The correction has been made.

2. Line 45 'Section 2 describes…'

The correction has been made.

3. Figure 1 – in caption, note that R-pattern is shown in red and L-pattern is shown in blue. Remove reference to S-Pattern. The last sentence in the figure description does not make sense to me...I'm not sure what the authors are trying to convey.

Thank you for your recommendations. The last sentence regarding the surface leg has been removed for simplification and clarification.

4. Table 1 – The authors should provide some description about the shorthand being used—it took me a while to figure out that, for example, R strati (1830 m) + 2R cb (680m – 740 m) referred to "1 R pattern in stratiform clouds at 1830 m and 2 R patterns at cloud base, one at 680 m and the other at 740 m" --- I still don't know what L flower is?

We agree with Reviewer 1 that Table 1 was not sufficiently explicit. To avoid confusion, the notations 'strati', 'top' and 'flower' have been merged into a single notation, 'strati', because in all of those cases, the leg was performed in the anvil of the cloud. In order to clarify this point, the following sentence has been added in the caption of Table 1:

"The flight altitude is indicated between brackets and the notation 'cb', 'strati' and 'surf' refer to cloud base, stratiform layer and surface, respectively."

5. Line 87-88 – Inertial navigation unit (Xsea model)? Is this a manufacturer and model number? I've never heard of that and didn't find anything with a quick internet search.

The INS system is AIRINS (model 6005214) from Ixblue company. The followig clarification has been made:

"The ground velocity is measured with inertial navigation unit (AIRINS, model 6005214 from Ixblue company)."

6. Line 126 – Krypton

The correction has been made.

7. Line 142 – KH20 showed 'a very good behavior.' -- What do you mean by this? It tracked well with other measures? Authors need to be more descriptive here.

We understand that the expression 'a very good behavior' can seem vague here, especially prior to the analysis which follows and more precisely explains what we consider as a "good behaviour". The performances of the KH20 were progressively improved during the campaign thanks to the

feedbacks and evaluations done after each flight. Therefore, the paragraph in Section 3 'Aircraft in situ instrumentation' about the KH20 issues, has been modified to clarify this point:
"The KH20 also showed issues during this first phase, partly due to the particular conditions of the marine environment encountered during EUREC4A, which make it very challenging to measure air moisture at fine scale. The drastic change of water vapour content from above the inversion (where relative humidity can be as dry as a few percent) to below cloud base (where relative humidity is generally higher than 80%), was a challenge and the spacing between the emitter and the receiver of the KH20 sensor has been adjusted. In the subcloud layer patterns, the sea salt loading of the KH20 sensor generated a significant loss of signal dynamics. An assiduous cleaning of the optics at the beginning of each flight allowed to limit this loss of signal. Regarding the KH20 behaviour, many technical issues have been gradually solved and several improvements have been made following the feedbacks at the end of each flight. Thus, the KH20 performances have been significantly improved by the second phase of the campaign (flights RF09 to RF19). The calibration of moisture fluctuations, choice of reference slow measurement and the relative performances of the KH20 and Licor are discussed further in Section 4."

Also, at the beginning of Section 4, the expression "during which the KH20 showed a very good behaviour" has been replaced by:
"[…] during which the KH20 showed a very good behaviour, in terms of time response, and of consistency with other moisture sensors".

8. Line 268 – orthogonal? (not orthonormed...)
The correction has been made.