Answer to reviewer # 2

"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.

This is a very interesting and useful dataset addressing the issue of cloud cover in the trade-wind region and its consequent variation in albedo -- among other things. The temperature and humidity content of the air was ably measured by sophisticated sensors of both fast response and slow (stable) response. Considerable care was taken in testing and calibrating the instruments to ensure good absolute accuracy over the frequency range from 0 Hz to 12.5 Hz (25 samples per second). The wind determination over the similar bandwidth was not discussed, resumably because it is already well characterized by SAFIRE.

This is a relevant remark. We did not detail the velocity field determination because the method has been verified in numerous field campaigns and the SAFIRE research team has a robust expertise on this measure. In order to consolidate and clarify this aspect, the following sentence has been added in section 3 :

"The velocity measurement and computation has proved reliable in numerous field campaigns (Lambert and Durand , 1998 ; Saïd et al., 2005, Saïd et al. 2010)".

In Figure 2b some variance appears to be forgone in the method of calibration of the (fast) KH20 using the (0.4 Hz) WVSS2 and the (1Hz) 1011C as (competing) references. The cyan trace (1011C) is visible both above the pink trace on crests and below the pink trace in troughs. That may not be noise. Likewise in the spectra of Figure 6 the KH20 and the Li-Cor separate at about 0.4 Hz, just about the report frequency of the WVSS2. I would trust the Li-Cor at least up to 2 Hz. I recommend checking out complementary filtering as a way to link the WVSS2 at low frequencies to the KH20 at higher frequencies. Assuming the WVSS2 data are available from all of the EUREC 4 A flights, this approach is possible using the existing data.

A critical issue in the study was to determine which slow sensor should be most suitable as a reference for calibrating the fast sensors. As you noticed, in Fig. 2b, the amplitudes of the signal calibrated with the WVSS2 is smaller than with the 1011C, suggesting a loss of variance. This, as you also suggested, is not noise. Figure R1 presents the variance of water vapor mixing ratio computed with the KH20 signal calibrated with the 1011C sensor versus the KH20 signal calibrated with the WVSS2 sensor. The variances computed with the 1011C calibration are indeed higher. Nevertheless, after analysis of several legs, we hypothesized that this is actually an overestimation of the variance, when the fast sensor was calibrated by the 1011C sensor.

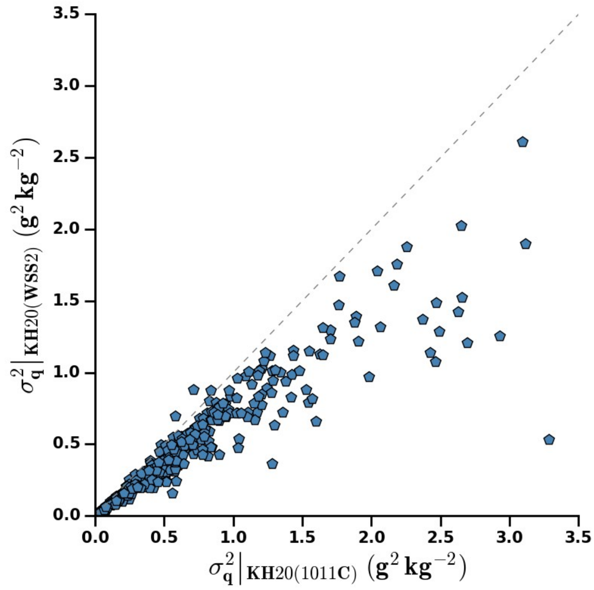

Figure R1 : Variance of water vapor mixing ratio computed with the KH20 signal calibrated with the 1011C sensor versus the KH20 signal calibrated with the WVSS2 sensor. The comparison is done for all flight legs from RF09 to RF19.

It appeared that the sensor was very affected by the particular sampling conditions. The principle of the measurement is to determine the dew point with a chilled-mirror but this approach is not easily compatible with sudden changes in humidity. It can also be contaminated by liquid water when passing through cloud. More details will be available in Etienne et al. 2021, about the Core in situ data measurement of the ATR 42, currently in preparation.

Therefore, a figure has been added (Fig. 3) showing an example of a leg on which the 1011C does not handle abrupt moisture transitions well, resulting in a signal amplitude that is greatly overestimated and does not characterize a physical process. The discussion about this should thus been clearer than in the previous version.

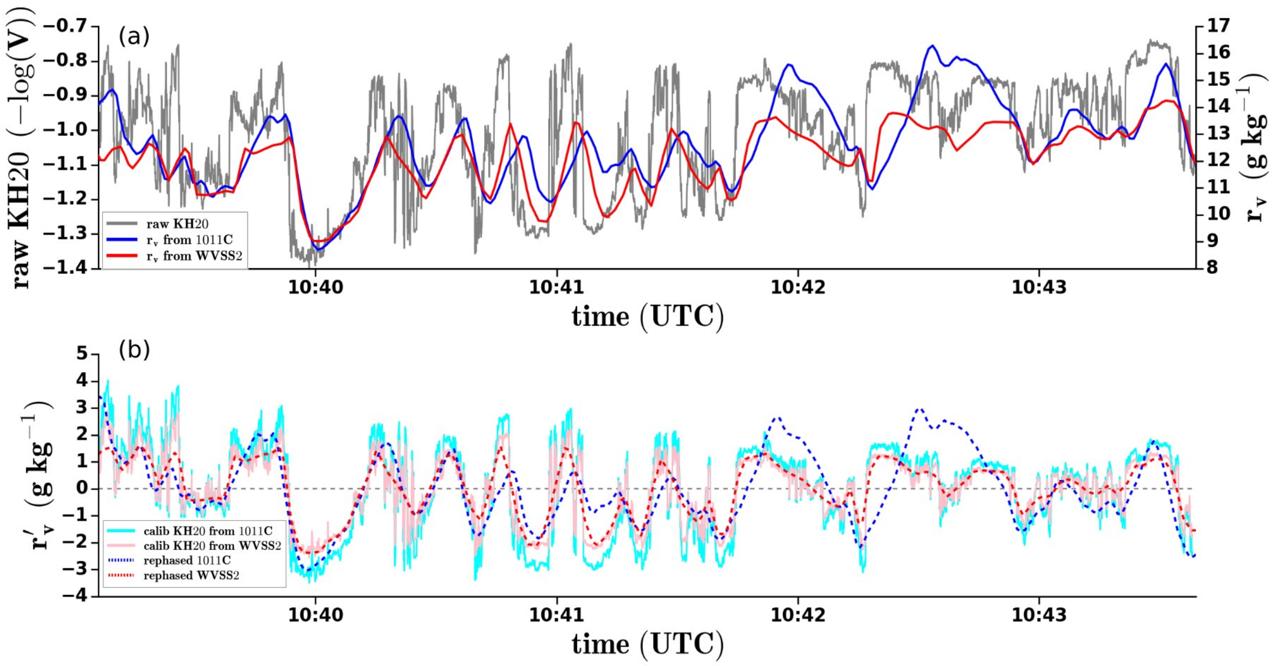

Figure 3 : Same as Fig. 2 or a leg (l1c) flown at z$\sim$600 m on 13 February 2020 (RF19).

The paragraph regarding the justification of the slow sensor choice has been thus modified to better highlight the deficiencies of the 1011C :

«The latter, despite its smaller response time, showed more difficulties in following the large variability of air moisture encountered during EUREC4 A, which added to the challenges of measuring air moisture in an environment with sea salt, clouds or even rain. This phenomenon can be noticed around 10:29:20 UTC in Fig. 2b and more clearly in Fig. 3, where the 1011C signal (dashed blue) shows several exagerated peaks, because it responded too slowly to the increasing and following fast levelling of moisture. This behaviour is explained by its measurement principle, with condensation at the mirror surface, which requires time to recover by drying. This issue resulted in a positive bias of about 27 % in the estimated moisture variance when the KH20 was calibrated with the 1011C hygrometer. This bias is visible in Fig. 2b and even more clearly in Fig. 3b from the difference of fluctuation energy between the two signals.»

We believe that the reviewer's remark about the spectra from Licor and KH20 signals is independent from the first calibration issue adressed before. To support this, we have checked whether the difference in energy density spectrum, bewteen the Licor and the KH20 sensors, was impacted by the choice of the slow reference. As shown in Figure R2, the behaviour of the fast sensor in the inertial domain is independent of the choice of the slow sensor: for both calibrations, the spectra of KH20 and Licor agree together at smaller frequencies, and depart at 0.4 Hz. The only difference that is seen from one calibration to the other is a shift of energy, or variance bias discussed above.

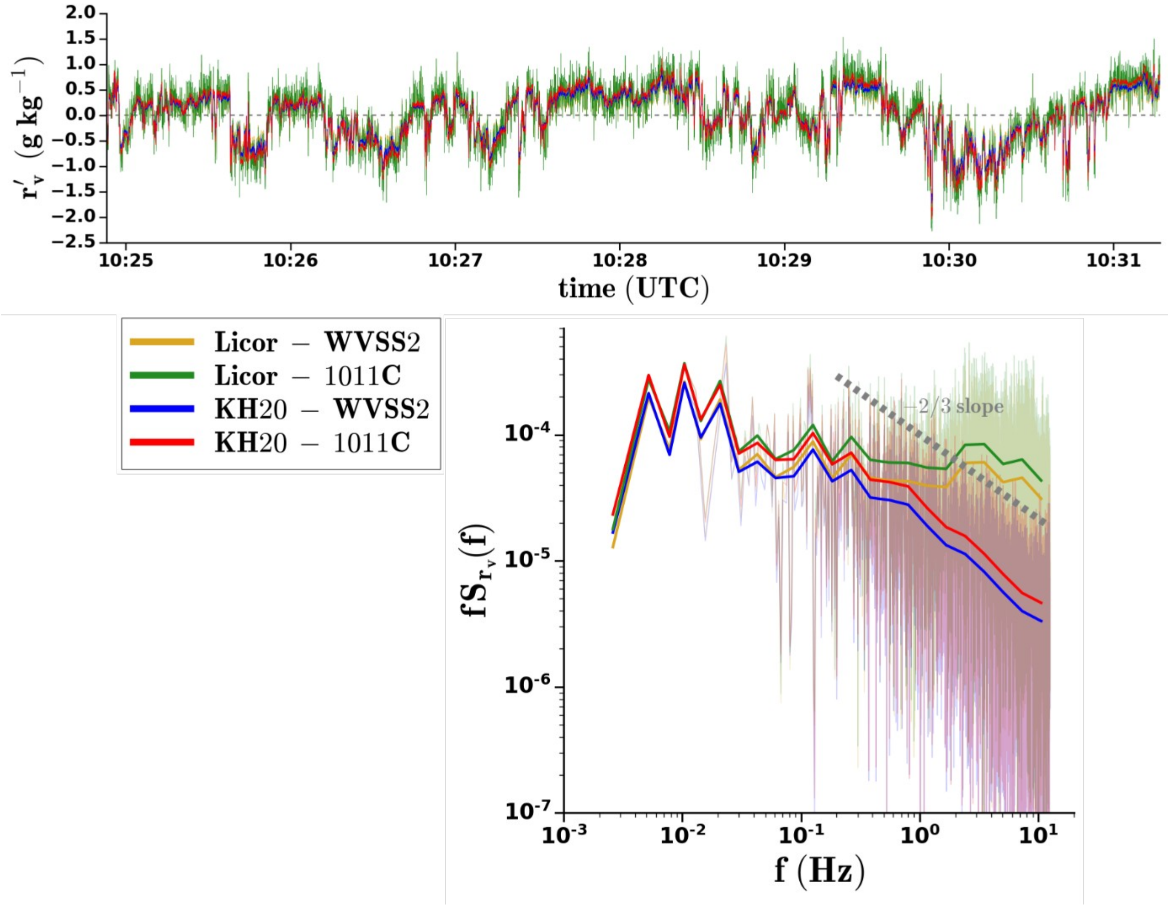

Figure R2 : Comparison of Licor and KH20 spectra calibrated either from the 1011C sensor and the WVSS2 sensor.

As a conclusion, it is possible that we underestimate the variance when using the WVSS2 as a reference instead of the 1011C. But due to the problems on the 1011C, which obviously implied an overestimation of the variance on several legs, we prefered not to correct the variance obtained with the WVSS2 calibration. In any case, this would not change the frequency where Licor and KH20 energy spectra depart from each other.

The data set is fully acceptable as it is, but the opportunity to pick up some additional variance, and hopefully covariance, may be attractive.

The color-coded flag system of figure 5 and Table 4 are very helpful as is the organization into characterized and defined ("stabilized") flight segments 30 km, 60 km, and longest possible (ragged sizes longer than 60 km). Turbulent departures are provided in two modes: detrended over a whole segment or high-pass filtered to pass only departures shorter than about 5 km (the ogive length). This two-tier system looks like a good way to supply turbulent departures for use by other researchers, especially for the strongly heterogeneous segments gathered from cloud base.

Figure 1: Useful to identify "R" as the red pattern and "L" as the blue pattern.
Thank you for your recommendation, which is shared by the other reviewer. The following modification in the figure caption has been made:
"R-pattern is shown in red and L-pattern is shown in blue".

Table 1: Several edits: ShCu, StCu should be expanded in caption. Explain or define "flower clouds", L surf , L flower , L top , R cb , maybe others
In order to clarify the abbreviations related to the cloud cover, the following note has been added at the bottom of Table 1:
"For the description of the cloud cover, the abbreviations are defined as follow Cu : Cumulus, ShCu : Shallow Cumulus, StCu : Stratocumulus and Flower clouds : Circular clumped patterns as introduced by Stevens et al. (2020)".
Also, the Table caption has been completed to properly define the abbreviations in the flight strategy column:
"The flight altitude is indicated between brackets and the "cb", "strati" and "surf"notations refer to "cloud base", "stratiform layer" and "surface", respectively."

Line 85: better to call 4 m the "sample spacing." The word "resolution" is somewhat ambiguous.
The correction has been made.

Line 89: The angles of attack and sideslip are not the Euler angles. The Euler angles (roll, pitch, and yaw) describe the orientation of the aircraft with respect to the earth. The angles of attack and sideslip describe the orientation of the multiport (nose-cone) probe to the oncoming airstream in flight. This appears to be an editing issue rather than a sign of error in the actual calculations. It can be addressed most simply by consulting a team member who has made such calculations.
Thank you for pointing out this mistake. The incorrect mention of the Euler angles has been removed:
"The velocity of the air relative to the aircraft is computed from the measurement of the true air speed magnitude, the attack and side slip angles, according to Lenschow (1986)."

Line 152: subcloud (typographic error)
The correction has been made.

Line 202: Did you mean "lose" instead of "loose"?
Yes, the typing error has been corrected.

Figure 13 Needs editing to make the caption fit with the figure.
We apologize for the wrong figure caption. The following correction has been made:

"Normalized vertical profiles of variance of (a) vertical velocity, (b) horizontal turbulent kinetic energy, (c) temperature and (d) water vapour mixing ratio. Flight numbers are indicated in the top right box. For the water vapour mixing ratio, only the legs with a green or a yellow combined flag have been considered. The normalized altitude z_* is defined by z/LCL, where LCL is the lifting condensation level."

Figure 14 Same: Also include definition of Z* in at least one of these figures
As for your previous remark, we apologize for this missing information The definition of the normalized altitude z* has been added to the captions of the two figures. Also, the caption of Figure 14 has been updated as follow:
"Normalized vertical profiles of (a) the heat flux, (b) the moisture flux, systematic error (c) for the heat flux, (d) for the moisture flux, random error (e) for the heat flux and (f) for the moisture flux. Flight numbers are indicated in the top right box. The normalized altitude z_* is defined by z/LCL, where LCL is the lifting condensation level."

Also, a clarification about the normalization of the profiles has been added :
« The profiles are normalized by the lifting condensation level (LCL), estimated here as the flight altitude of the rectangle at the cloud base minus 50 m.»

Bibliography: F. Saïd, G. Canut, P. Durand, F. Lohou, M. Lothon were not listed as authors of the reference given on line 423.
The correction has been made.