Point-to-point responses to reviewer #3, 12-Aug-2021

Authors: We thank reviewer3 for carefully reading our manuscript and evaluating it as 'excellent and good'. Please find our point-to-point responses to your suggestions below printed in blue.

Specific comments

S1. Were there any rain events during the campaign? It would be useful to discuss/mention if there are effects of rain or variability in relative humidity in the accuracy of the different measurements.

→ CT: Good point, thanks for bringing this up. We included a discussion of the effects of liquid precipitation in three sections of the manuscript:

i) Caption of Figure 3 now reads: "Power failures occurred periodically due to electrical isolation issues heating the fiber optic cables sometimes co-occurring with rain events"

ii) Section 2, ln 97-100, we added: "The number of days with significant precipitation ($\geq$ 1~mm) was 5, 3, and 8 for the three phases, respectively. Significant rains primarily affected the data availability of the active-heating FODS elements during phase 2 as the moisture sometimes led to electric short-circuiting between the FODS cables and grass cover, which resulted in power loss due to the false-current protection."

iii) Section 4, ln 437-424, we added: "Liquid water intercepted by the FODS cables during significant rain events presents a temporary source of uncertainty for FODS wind speed as it affects the term $(T_s - T_f)$ until all water attached to both unheated and heated cables has evaporated. Heated cables dried quicker compared to unheated cables, and drying time was shorter during day than night. The exact drying time was not further evaluated, but was on the order of tens of minutes, during which users are advised to exercise caution when investigating FODS wind speed. High relative humidity without intercepted liquid water present on the FODS cables was not found to have an effect on FODS performance."

S2. Lines 227-229: Could the data from the cable length connecting to the trailer also be useful? Maybe also consider providing these data.

→ CT: Thank you for the suggestion, but the data from these FODS sections cannot be evaluated in any meaningful fashion since cables may be touching the ground, support structures, and/ or be coiled up in tight loops. These sections were excluded in mapping and the data archives for the mentioned reasons, as our focus was on the described FODS elements. We decided to not add this information to the text.

S3. Figure 5: The biases appear to be systematic (positive in 5a, and negative in 5b and 5c). Elaborate why this is case. If the biases are systematic a correction should be possible.

→ CT: Thank you for noting this observation. As already discussed in the text, the bias of the section shown in Fig. 5 is the validation reference section (warm section with largest LAF) not used for calibration. While the biases are systematic for the individual FODS elements (subfigures a, b, c) , a simple correction offsetting the bias applied to the entire section of the specific element did not improve the data certainty. On the contrary, applying the latter led to increased differences between inner and outer array for conditions when spatial temperatures are expected to be very small (e.g. high wind speeds at night, not shown in the manuscript). The main reasons for this is the single-ended configuration in combination with the combined

optical path of the inner and outer FODS array, and location-specific mechanical stress due to holders . Because of the physical configuration, the backscatter from the outer array always must pass through the FODS section of the inner array, making the biases depend on each other with one being positive, the other negative. We already included this explanation in Section 7 (Recommendations for future FODS deployments, ln 540 ff), but amended it. The reported biases are the optimal choice for the intended scientific objectives and a useful 'worst case' estimates. Note that the objectives of LOVE19 was to observe turbulence and submeso-scale motions with time scales much less than the presented 1h averages, and with temperature differences by far exceeding the magnitude of the biases. Hence, the reported biases do not prevent any physical interpretation of the FODS observations. We modified section 7 to now read (ln 555 to 559: "Spatially-dependent biases were found (not shown) even though the biases within the reference validation sections were small, but systematic. The most likely cause for the former was changes in the differential attenuation along the fiber e.g., caused by tension at the fiber holders \citep{VandeGiesen2012}. The systematic biases in the validation reference sections are a result of combining the FODS cables into long optical path, which causes them to depend on one another as the backscatter light must pass through all cable sections. Single-ended calibration cannot account for these changes and artifacts."

S4. Section 7: It could be useful to discuss conditions for longer-term monitoring with FODS.
→ CT: Very good point, we added the following paragraph (ln 573 - 578): "Long-term monitoring intended to collect FODS observations over months and years will benefit from excellent electrical insulation of heated cable sections and temperature-stabilized environments for DTS instruments and reference sections. In environments experiencing large temperature swings, elongation and contraction of FODS cables made of stainless-steel sheaths need to be accounted and planned for in post-field calibration and when evaluating mechanical stresses from support elements. Sections of spare fiber between or within observational FODS elements allow for easier re-splicing after inevitable mechanical breaks without the need to rebuild larger FODS sections. Further recommendations can be found in \citet{Thomas2021_book}."

Technical comments
T1. Line 49: Replace "and" for ";". → CT: We apologize, but we could not find where this replacement was suggested. The sentence reads "This technique relies on the temperature-dependent Raman-backscatter from laser pulses transmitted along a fiber optic cable in order to resolve temperature at a fine spatial (as fine as 0.127 m) and temporal (as fine as 1 s) resolution (Selker et al., 2006; Tyler et al., 2009)." We believe that this sentence structure is correct. Maybe line numbers are different.

T2. Figure 5: I don't see the thin grey lines mentioned in the caption. →CT: This was a remnant text from a previous figure version, we now replaced it with the correct caption of the revised figure. It now reads "The black and blue colors are provided as guidance for selecting lower and higher quality data, respectively."

T3. Line 435: Revise the sentence. → CT: We apologize, but we could not find the sentence to be revised.
Line 435 in the revised submission reads: "The FODS wind direction method is predicated on a similar argument as FODS wind direction."

Line 435 in the revised submission reads: “As a result, we recommend that all future experiments employ a double-ended setup (van de Giesen et al., 2012; des Tombe et al., 2020), but saving raw backscatter stokes and anti-stokes data from both directions separately in a single-ended fashion. “
We believe that both sentences are correct, please advise and direct us to the specific sentence/ flaws. Maybe line numbers are different.