summary. This manuscript describes the dataset, including instrumentation and network deployment, associated with the FESST@HH experiment designed to study the sub-mesocale structure of convective cold pools. The authors also present some preliminary analysis of a cold pool event, nocturnal urban heat island, and turbulent temperature fluctuations. The manuscript is well-written, dataset well-described, and the topic relevant to the journal. Some comments are suggested for consideration.

* Author replies to reviewer comments are added in green

Bastian Kirsch, University of Hamburg, bastian.kirsch@uni-hamburg.de (on behalf of all co-authors)

Comments

1. The title does not quite represent the manuscript content given that it is not meant to be a detailed analysis of the observed cold pools' sub-mesoscale structure, but rather to describe the dataset and present some preliminary findings on several different topics not only related to cold pools. Re-consideration of the title is suggested.
   We agree and will change the title to "Sub-mesoscale meteorological observations with a dense station network during FESST@HH 2020".
2. L46-48: These statements are not actually correct, re-wording is suggested based on the C3LOUD-Ex reference.
   We will rephrase the statement based on the suggestion of reviewer 2, who was involved in C3LOUD-Ex.
3. L95-99 and Fig 3: The APOLLO sensor is smoother overall than the Ultrasonic measurement, which appears to capture higher magnitudes of variability, and the APOLLO sensor's running mean does not always match the running mean of the Ultrasonic sensor (e.g. near minutes 3-4, 7-7.5, 9-10). What could cause these differences? The corresponding text (e.g. L97) seems to skate over the differences that are seen in Fig 3.
   The APOLLO data shown in Fig. 3 are un-smoothed raw measurements, whereas the ultrasonic sensor data are 1-s averages of the original 20-Hz data. Still, the ultrasonic sensor adapts instantaneously to sub-second scale fluctuations in temperature due to its measurement principle, whereas the response time (or e-folding time constant) of the APOLLO sensor is on the order of seconds. This explains the differences between both sensors, however, the point we want to make is that the APOLLO sensor captures the shape and strength of the temperature drop without any apparent lag with respect to the inertia-free sensor, meaning that its response time is virtually negligible for measuring cold pools. We will modify the sentence for more clarity.
4. Section 3.1: Does the coverage of sites permit study of land-atmosphere interactions for different land classes? This could be another interesting application of the dataset.
   Yes, this idea would fit to the preliminary analyses shown in section 6.3. One caveat is of course the lack of measurements of turbulent fluxes and/or surface properties (temperature, soil moisture), which need to be related to the discussed temperature fluctuations. Measurements of surface temperature and soil moisture were added in a follow-up experiment. We will mention this in the revised version.
5. L247, section 6.1: Can weaker or dissipating cold pools be detected with these data? The criteria of -2K seems somewhat restrictive?

Yes, for more detailed studies this threshold can be adapted, however, the rather conservative threshold of -2 K has proven to be useful to discriminate the spatial cold pool signal from other source of variability within the station network. We will reformulate the respective part to clarify this.

6. L254 “deepened” – Re-wording is suggested here, since the dataset does not contain observations of cold pool depth.
   Thanks, we will do so.
7. L273: How can there be an expected range of propagation velocities without any observations of cold pool depth? Some additional explanation would be helpful in this section.
   We agree that the term “expected range” is misleading in this context. We will rephrase the sentence accordingly.
8. L276-282: The authors could consider dynamic contributions to pressure perturbations in this discussion. The fluctuations in both temperature and pressure for 104PGa shown in Figure 9 are intriguing. Additionally, it is difficult to relate pressure perturbations to the strength of surface-observed cooling because pressure perturbations are also related to the depth of cooling as well as the dynamic contributions. It has been well-known in the literature that pressure perturbations in cold pools are controlled by multiple factors aside from just hydrostatic cooling.
   Yes, this is true. Our wording was not clear enough on this topic. We will specifically mentioning the dynamic effects in the revised version.
9. Figure 10: It would be helpful to indicate the urban and rural stations somehow in panel a, such as by different line styles or thickness.
   We believe that the message of the plot, the systematic difference in diurnal cycle between urban and rural stations, becomes clearer when only highlighting selected locations that are representative for the two regimes. Indeed, we missed to clearly indicate which of the two highlighted stations refer to which regime. We will revise the figure caption accordingly. However, a more detailed analysis of the spectrum between the two extremes is out of scope of this study.