Peer review of: How do convective cold pools influence the boundary-layer atmosphere near two wind turbines in northern Germany?

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General Comment

The manuscript "How do convective cold pools influence the boundary-layer atmosphere near two wind turbines in northern Germany?**"** addresses a timely and relevant topic which bridges atmospheric sciences with wind energy: convective cold pools (CPs). The downdrafts produced by convective rain have acquired renewed interest in the last 3-4 years, with several observational studies published characterizing composites of CPs from meteorological tower measurements, and from networks of ground-based weather stations. This study by Thayer et al. is the first to my knowledge that focuses on the characteristics of CPs specifically in regards to the effect on wind turbines (in the context of the WiValdi test site), focusing on the heights where the rotor is located. The data is new, the text is very clear, the methods sound, and the figures explicative. I find this work ready to be published, after taking into consideration minor comments, listed below.

Specific Comments

Format: Line – comment

85 – maybe say "Northern Germany" instead of Hamburg, since the two Kirsch studies (2021 and 2024) were conducted in Hamburg and Lindenberg (near Berlin) respectively.

94 – I'm not entirely sure but is there a typo here? Section 2 outlines are observational datasets → Section 2 outlines observational datasets

96 — I would mention that Section 5 also contains estimates of wind power increase.

142 – Would it be possible to make a table with the different instruments, the measurement resolutions, and what they were used for? Just to have a complete picture of the measurement set-up.

160 – What exactly is a positive daily wind anomaly?

170 – Should this say "A theta_v drop of *at least* 1.5 K occurs within 30 minutes of T_0" ?

175 – What does it mean that you prescribe that theta_v must recover at least *somewhat*? In case a person wanted to recreate your detection algorithm, what quantitative criterion would they have to include?

180 – What exactly is t_0 - 30 minutes? The 1-min minute averaged value of a variable at t_0–30 minutes, or the instantaneous value at t_0 - 30 minutes? Or the 30-min averaged value calculated between t_0-30 minutes and t_0?

186 – I would mention/quote here that Kruse et al (2022) linked convective cells to ground-based cold pools.

Table 1 – Maybe highlight "pre-event environment" in the table and specify in the caption. At a first glance, I thought these were the CP temperature drops and was very surprised.

Figure 2 – I do not see the magenta dot indicating WIVALDI in the plots.

Figure 3 – More a comment than a question: did you also look at specific humidity? This is the one feature of a CP that was not in agreement between the Kirsch 2021 and Kruse 2022 studies, with the Kirsch 2021 study showing an increase in moisture, and the Kruse 2022 study showing a decrease in moisture within the CP with respect to the pre-event environment. It would be interesting to see how moist/dry your CPs are since they are located towards a more coastal area like the Netherlands.

245-246 – I'm a little confused. Do you apply your detection algorithm to the temperature time series measured at 100 m and 85 m? Shouldn't you apply it to 2 m with the thresholds you used and check the corresponding temperature data at 100 m and 85 m? If you use the same threshholds at higher altitudes as for T2m, I would also expect that you find a decreased sample size at higher altitudes.

252 – Have you defined "sonic"?

272 – Then the Eddy dissipation rate "epsilon" rises again, right? Is this worth

310 – "averaged vertical profiles up to 1km height": What exactly does this mean? Could you add some words to clarify?

312 – Wouldn't you say that the median wind speed shows a relative increase from the pre CP environment up to about 700–800 m, from the plot?

319 – more-detailed → more detailed?

320 – more-limited → more limited?

320 – when → in which?

323 – "dashed black lines": In what plot?

373 – cut-outhub-height → cut-out hub-height?

Figure 8 – I might have missed this, but why is the sample size always different? Is it due to when the given sensors were active?

400-end (Conclusions) – The conclusions are written very clearly. I would however, like to see a paragraph that puts your WiValdi CPs into the context of the other CP composites measured in similar locations (Kirsch 2021 Hamburg, Kruse 2022 Netherlands, Kirsch 2024 Lindeburg); not only contextualising the detection method. One of course has to take into account that the detection methods are slightly different, since the detection algorithm you used is a bit tweaked with respect to the other Northen European studies, and that the locations are different (more coastal vs more in-land), which are details worth mentioning. Both the Kirsch 2021 and Kruse 2022 studies had measurements at "hub-height" (even if the focus was not on wind power) so there could be interesting comparisons there. This kind of contextualizing could also give an indication on whether the effects of CPs on wind power are expected to be the same everywhere, or completely different based on the location.