The authors present novel offshore LLJ research off the coast of California in regions relevant to wind energy. This research includes not only observational LLJ characterization, but also various model comparisons. Overall, observations capture LLJ events occurring only a few percent over the observational campaign but note that the vertical extent of these observations will undercount LLJ events. The models tend to underestimate the number of LLJ events but overestimate the duration. Models do a good job of capturing the hourly timing, but struggle on a seasonal basis. Other LLJ characteristics have positive/negative biases depending on the location and model used.

Overall, I believe this research to be a great addition to the offshore wind energy literature, and I recommend this article to be *accepted with minor revisions*, which are listed below.

We are so grateful for your support of our work and for the helpful suggestions for improvement! We have incorporated your recommendations as follows.

Major comments

- I feel the paper ends abruptly and that no proper conclusion is given. It would be beneficial for the paper to include, at the very least, future directions this research could/should go to help offshore low-level jet characterization.

  We agree that the paper ended on a lackluster note. We have revised the final paragraph as follows per your and another reviewer's helpful recommendations: "Coastal and offshore measurement campaigns, while challenging to execute, provide valuable data collections to support the evaluation of potential wind energy generation in an offshore setting. The increasing number of such deployments is advantageous for understanding the characteristics of meteorological influences, such as LLJs, on the wind profile in unique locations. For example, recent measurement campaigns yielded locationally-driven diversity in the time of year for most frequent LLJ occurrence, namely May in the Baltic Sea (Hallgren et al., 2020), April – November in the New York Bight (McCabe and Freedman, 2023), and January at Morro Bay. Offshore observations are also needed for highlighting research areas for wind modelling improvement, such as the studies of Hallgren et al. (2020) and this work in noting the limitations of ERA5 representation of LLJs in distinct environments. The breadth of wind profile characteristics revealed by such measurement campaigns encourages similar analyses in new areas of offshore wind development interest. Subsequent DOE lidar buoy deployments include the waters off Hawaii and the U.S. Atlantic coast. Additionally, we look forward to expansion in the understanding of offshore LLJ occurrence and features, particularly in vertical extent, as floating lidar technology continues to advance. We hope this work encourages increased offshore wind observational campaigns to support validation and improvements for modelling of atmospheric phenomena like LLJs." (Lines 459-471)

Minor comments

- Line 45: It is stated that the California coastal LLJ is well-studied, yet only two references are included. The first reference, Parish 2000, is repeatedly mentioned and referenced from this point on. To the authors knowledge, are these the only two studies to investigate LLJs along the California coast? If so, I would recommend rewording this sentence to tamper down the claim that the California coastal LLJ is well-studied.

  Thank you for pointing this out. We were remiss in capturing the literature on the California summertime LLJ and have provided a more complete set of citations to the sentence: “The summertime California coastal LLJ is well-studied and occurs due to the pressure gradient between the North Pacific High and southwestern U.S. thermal low (Burk and Thompson, 1996; Holt, 1996; Parish 2000; Pomeroy and Parish, 2001; Ström and Tjernström, 2004; Liu et al., 2023).” (Lines 50-52)

  Burk, S. D. and Thompson, W. T.: The Summertime Low-Level Jet and Marine Boundary Layer Structure along the California Coast, Monthly Weather Review, 124(4), 668-686, https://doi.org/10.1175/1520-0493(1996)124%3C0668:TSLLJA%3E2.0.CO;2, 1996.

  Holt, T. R.: Mesoscale forcing of a boundary layer jet along the California coast, Journal of Geophysical Research: Atmospheres, 101(D2), 4235-4254, https://doi.org/10.1029/95JD03231, 1996.

  Liu, Y., Gaudet, B., Krishnamurthy, R., Tai, S. L., Berg, L. K., Bodini, N., and Rybchuk, A.: Identifying meteorological drivers for errors in modelled winds along the Northern California Coast, Monthly Weather Review, https://doi.org/10.1175/MWR-D-23-0030.1, 2023.

  Parish, T. R.: Forcing of the Summertime Low-Level Jet along the California Coast, Journal of Applied Meteorology and Climatology, 39(12) 2421-2433, https://doi.org/10.1175/1520-0450(2000)039%3C2421:FOTSLL%3E2.0.CO;2, 2000.

  Pomeroy, K. R. and Parish, T. R.: A Case Study of the Interaction of the Summertime Coastal Jet with the California Topography, Monthly Weather Review, 129(3), 530-539, https://doi.org/10.1175/1520-0493(2001)129%3C0530:ACSOTI%3E2.0.CO;2, 2001.

  Ström, L. and Tjernström, M.: Variability in the summertime coastal marine atmospheric boundary-layer off California, USA, Quarterly Journal of the Royal Meteorological Society, 130(597), 423-448, https://doi.org/10.1256/qj.03.12, 2004.

- Lines 88-89: Do the phrases “in 1100 m of water” and “in 625 m of water” refer to the depth of the ocean floor to the sea-level surface? This reads weird to me.

  Thank you for this suggestion to improve the clarity. We have switched the wording to “in a depth of 1100 m of water” and “in a depth of 625 m of water.” (Lines 99-102)

- Section 2.1: What is the temporal resolution of the lidars and ultrasonic anemometers, and was any temporal averaging done? I understand the specifics are in Severy et al. (2021) and Krishnamurthy et al. (2023), but I feel at the very least basic temporal resolution of these instruments should be discussed.

  We agree. The temporal resolution in the original draft was not mentioned until the results section, and it is far more helpful to add this information to the data discussion. We have added the following sentence to Section 2.1: "The temporal resolutions of the lidar and near-surface measurements utilised in this analysis are 10-minute averages." (Line 120)

  Additionally, the discussion of ERA5 in Section 2.3 was supplemented with temporal information as follows: "ERA5 provides extensive temporal coverage from 1950 through present time at 1-hour temporal resolution (Hersbach et al., 2020)." (Line 163)

  The discussion of CA20-Ext and NOW-23 in Section 2.3 had already made note of their temporal resolutions in the original draft, so this wording remains unchanged: "CA20-Ext and NOW-23 include 61 vertical layers and, as CA20 extensions to evaluate the PBL schemes, output wind estimates at 10 m and every 20 m between 20 m and 200 m a.s.l. at 5-minute temporal resolution and 2-km horizontal resolution." (Lines 156-158)

- Section 2.2: What is the advantage of using the TOGA COARE algorithm, compared, say, to alternative algorithms? I feel a little more discussion is warranted here.

  Thank you for this suggestion. We have added the following discussion to Section 2.2: "To compute the traditional measure of surface layer stability, *z/L*, heat and momentum turbulent fluxes are needed, but measurements of these fluxes are not available to us. The developers of the COARE series of parameterizations provide iterative algorithms that relate these fluxes to measured mean state thermodynamic and wind fields in a self-consistent manner that is also consistent with Monin-Obukhov similarity theory. The COARE parameterizations are specifically adapted to the ocean environment, for which the wave state must either be provided or parameterized as a function of wind speed so that the turbulent momentum flux may be determined. Multiple marine observational datasets of momentum flux have been used by the COARE developers over the years to determine and refine these relationships for general global applications." (Lines 136-143)

- Section 2.4: While I am aware that quantifying LLJs are an unsettled topic of discussion in our field, I would be remiss not to request Debnath et al. (2021) to be included in this section. While Debnath et al. (2021) leverages Kalverla et al.

(2019)'s work, the Debnath paper has been used extensively in LLJ discussions in the U.S.

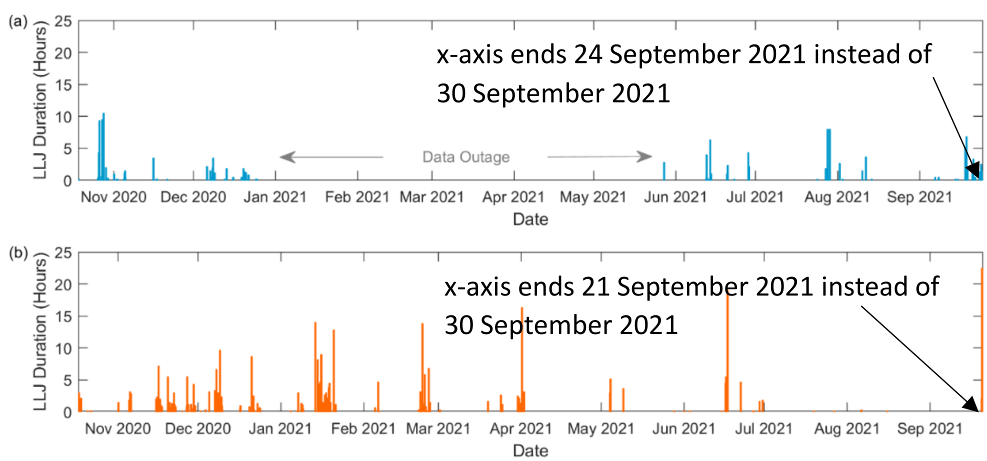
Thank you! The Debnath paper has been added to Section 2.4 as follows: "Debnath et al. (2021) consider a wind profile to be an LLJ if the wind speed gradient between the bottom of the profile and the jet core exceeds a threshold shear value of 0.035 s^{-1} and the wind speed fall-off above the core is at least 1.5 m s^{-1} and 10% of the core speed." (Lines 180-182)

- Lines 163-164: I appreciate the mention of the limitation of the observations in capturing the true extent of LLJ events.

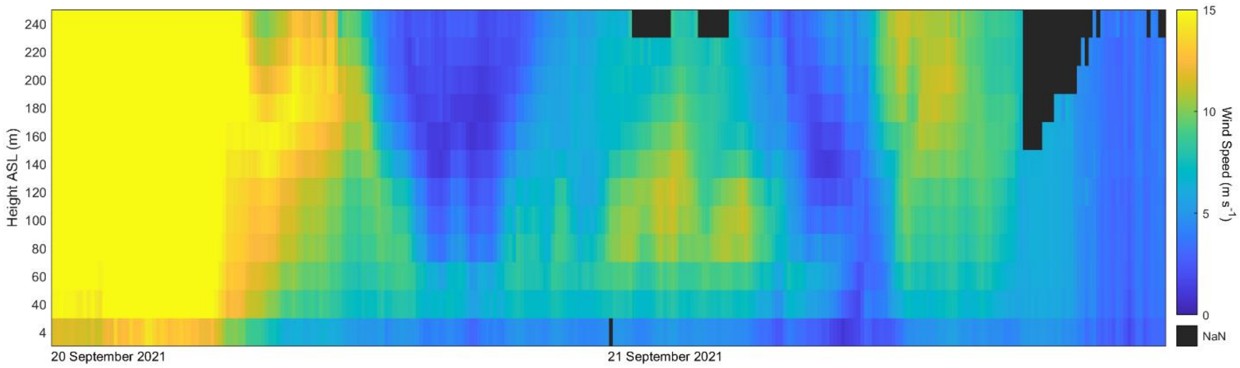
  Thank you!

- Figure 2b: It is interesting that the longest LLJ occurrence at Morro Bay occurs at the end of the period. I assume this is by chance, no?

  We are so glad you pointed this out, because while the longest LLJ at Morro Bay is real (see the heatmap below), the temporal extent of Figure 2b (now Figure 4b) ends prematurely (see annotated graphic below), making it seem like this LLJ is occurring at the end of the analysis period. The long LLJ begins on 20 September 2021 11:40 and ends 21 September 2021 10:00. Also shown in the heatmap is a shorter duration LLJ ranging from 20 September 2021 8:20 to 10:20. We realized that the analysis had truncated the last LLJ in each timeseries and have fixed the graphic so that the temporal extent reaches the end of the analysis period on 30 September 2021, on which another, shorter LLJ occurred which was cut off in the original figure and analysis. The truncation of the last LLJ in the duration analyses was also corrected in the model comparison analysis in Section 4.1. Thank you!



Original Figure 2. Duration in hours of observed LLJs during the (a) Humboldt and (b) Morro Bay lidar buoy deployments.



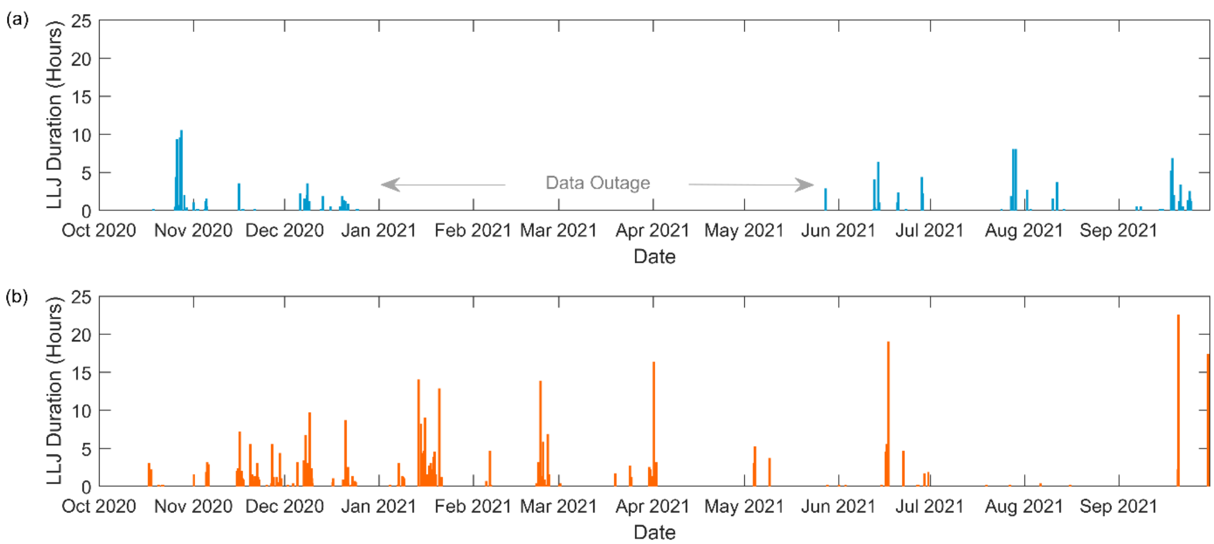


Figure 4. Duration in hours of observed LLJs during the (a) Humboldt and (b) Morro Bay lidar buoy deployments.

- Line 242: When it is said that the data are resampled at the top of the hour, does this mean that only top of the hour observations are taken, or some mathematical operation is done (hourly average)?

  Only the top of the hour observations are taken. The sentence has been modified as follows to provide clarity: "In order to compare the performance of LLJ representation in wind models, the lidar buoy observations and model wind data are resampled to include only the top of the hour output to temporally align with the ERA5, which has the coarsest temporal resolution (hourly)." (Lines 280-282)

- Figure 11: Neat way to visually compare LLJ core height differences!

  Thank you!

- Lines 352-353: Is that duration time correct? 10:00 to 14:10 UTC is not 14.2 hours. Am I missing something here?

  Thank you for catching this typo! The sentence has been modified to read 4.2 hours instead of 14.2 hours. (Line 404)

- Line 513: The paper for this reference has been officially published and should be updated accordingly.

  Thank you, we have updated the reference with the published DOI.

References

(Debnath et al., 2021)

Debnath, M., Doubrawa, P., Optis, M., Hawbecker, P., and Bodini, N.: Extreme wind shear events in US offshore wind energy areas and the role of induced stratification, Wind Energy Science, 6, 1043–1059, https://doi.org/10.5194/wes-6-1043-2021, 2021.