Ship-based lidar measurements for validating ASCAT-derived and ERA5 offshore wind profiles

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Despite all my comments, I still think you present promising work, worth publishing. But you need to be more serious about the feedback. Quite a lot of the comments from the previous review have not been addressed.

The added value of this work is (1) a technique to compare ship based lidar measurements to model values, (2) that we can reliably extrapolate these measurements to heights relevant for wind energy (as long as we avoid areas less than 40 km from the coast and near wind farms, the latter becoming increasingly challenging by the way) and (3) use those to validate weather models that include wind farm effects (wakes/blockage). We can maybe extend this technique to higher resolution satellite (SAR)? This work has added value for wind energy because of 2 and 3.

There are a few things that I think need to be addressed in the paper:

- Uncertainty in the lidar measurements. are the differences that you find with ERA5 and/or modified ASCAT significant? See e.g. page 14: TNO report - DOWA validation against offshore mast and LiDAR measurements | Report | Dutch Offshore Wind Atlas
- Your method is not robust with more/larger WFs (there are no wind farms yet in the Baltic according to https://map.4coffshore.com/offshorewind/, but you expect significant growth). Ship-based lidar measurements may be affected by wind farms (WF), ERA5 definitely does not take WF effects into account and ASCAT is too coarse to measure WF effects (at least in detail: then you need SAR).
- How does your method compare to assimilating ASCAT into the NWP reanalysis like it was done in DOWA (point 1 in Innovations in the DOWA project | DOWA project | Dutch Offshore Wind Atlas)?
- You basically show in your paper that ASCAT and ERA5 should not be used closer than 40 km from the coast (validation results based on ship-based lidar). That is a conclusion that I miss in your paper. As far as I know the ASCAT coastal product is only valid 15 km away from the coast and ERA5 has problems with abrupt changes in surface roughness, such as on the coast. A model (such as ERA5) assumes a grid box average surface roughness for a combination of land and water whereas the wind feels land or water. The larger the grid box size, the larger the problem (ERA5 grid box size 31 km). So basically ASCAT and ERA5 have quality issues near the coast and this is what you find confirmed in your paper.

Comments from earlier review that have not been addressed yet are e.g.: (1) Are there other measurements that you can compare to lidar measurements in harbor (where ASCAT and ERA5 are particularly inaccurate)? (2) Have you considered triple (or quadruple collocation) to assess uncertainties (there are also uncertainties in your lidar measurements! What are they)? (3) Have you considered using other wind climatology's such as NEWA GMD - The Making of the New European Wind Atlas – Part 2: Production and evaluation (copernicus.org)?

Comments more in detail:

- Line 3: typo: observations
- **Line 9/10: The comparison reveals a close agreement between ASCAT and ERA5 beyond 40 km distance from the coast.** Unclear what you mean: close agreement between two different approaches (account for stability)? At 10m height or also extrapolated to hub heights?
- Line 10/11: (Extrapolated) ASCAT tends to **significantly** overestimate the mean wind speed derived from lidar measurements, while ERA5 exhibits a consistent underestimation. I assume the difference between lidar measurement and (Extrapolated)ASCAT/ERA5 is larger than the lidar measurement uncertainty?
- Line 21: **However**, in situ …
- Line 26/27: **Floating lidar systems can be moved to different locations, but generally measure at one location for a certain period of time. With profiling lidar systems installed on cruising ships it is possible to provide reliable wind profile measurements over larger areas.**
- Line 27/30: (can be formulated shorter/clearer): **Before profiling lidar systems on cruising ships can become a generally accepted alternative for offshore met masts and floating lidar, specific challenges have to be overcome such as validation against reference data and quantifying the associated uncertainty (Rubio and Gottschall, 2022). Still, ship based lidar has already been used in different wind energy related studies.** In Wolken-Möhlmann…
- Line 34-38: However, while numerical models have demonstrated good performance in shallow-water offshore regions compared to in situ measurements (Witha et al., 2019b), they often fail to describe the spatial and temporal variability of wind with sufficient accuracy and detail. I suggest an alternative text: **Numerical weather prediction (NWP) models in re-analyses mode** are commonly used … spatial coverage. However, while numerical models have demonstrated good performance in shallow-water offshore regions compared to in situ measurements (Witha et al., 2019b; **Wijnant et al, 2019), they have problems with areas with large changes in surface roughness, such as the coast. The larger the grid box size, the larger the problem because the model assumes a grid box average surface roughness for a larger area (whereas the wind feels land or water, not a combination). Also most re-analyses do not take into account the (changing) effect of wind farms on the atmosphere (except: https://wins50.nl/).**
- Line 38-41: This limitation arises from factors such as the inaccurate parameterization of the model variables or the insufficient temporal and spatial resolution of the models' output data. Furthermore, the lack of in situ measurements in deeper offshore regions hinders the validation of these datasets, leading to increased uncertainties in derived wind statistics for such locations. I suggest an alternative text: **Each NWP model has its own limitations (caused e.g. by grid and domain size and physical modelling and parametrisation choices). This results in uncertainties in wind statistics based on these NWP models and these uncertainties can be quantified when validation measurements (incl. measurement uncertainties) are available. This is however often a problem for hub heights, especially for far-offshore locations with deep water.**
- Line 42-44: To overcome the limitations of in situ measurements and numerical models, satellite remote sensing devices have emerged as a potential alternative for characterizing ocean winds and climate over large areas, capturing the wind

Met opmerkingen [WI(1]: You used industry standard, but industry standard for what? These measurements are only useful for validation of reanalyses which can be used wind resource assessments if the growing effect of wind farms is accounted for.

Met opmerkingen [WI(2]: '… they often fail to describe the spatial and temporal variability of wind with sufficient accuracy and detail' = very general conclusion which I do not agree with. The spatial and temporal variability is pretty well captured in the DOWA/WINS50 re-analyses (see validation section of KNMI Technical report - The Dutch Offshore Wind Atlas (DOWA): description of the dataset | Report | Dutch Offshore Wind Atlas). Witha just used one weather model (WRF).

Met opmerkingen [WI(3R2]: Abbreviate 'Numerical weather prediction models' to NWP models (not numerical models).

Met opmerkingen [WI(4]: KNMI Technical report - The Dutch Offshore Wind Atlas (DOWA): description of the dataset | Report | Dutch Offshore Wind Atlas)

Met opmerkingen [WI(5]: Again a bit over simplified and I do not agree with what you write. I do not think that you can say 'inaccurate parametrisation of model variables'. Choices in NWP models always are a trade-off (optimise which forecast lead-time? Optimise which parameters?).

Met opmerkingen [WI(6]: I would leave this 'model/measurement limitations' out because ASCAT has its own limitations. Basically you have scatterometer data from satellites as additional information in data sparse areas (it is no replacement for models or other measurements).

Note that another way of using ASCAT is data-assimilation in the NWP model, like in DOWA/WINS50 (see TNO report - DOWA validation against ASCAT satellite winds | Report | Dutch Offshore Wind Atlas).

variability with a temporal coverage of over 15 years. I suggest an alternative text: **Scatterometer (wind) measurements from satellites are a welcome additional source of information in these data sparse areas.** Several studies …

- Line 47-53: Fluffy writing: does not make it clearer and there are some mistakes in it. I suggest an alternative text: **The ASCAT coastal product is available since 2007 and provides high quality offshore wind measurements on a 12.5 km grid spacing for locations further than 15 km from the coast. The ASCAT wind speed bias is less than -0.23 ms-1 in coastal areas (15- 50 km from the coast) and -0.29 ms-1 elsewhere (TNO report - DOWA validation against ASCAT satellite winds | Report | Dutch Offshore Wind Atlas). However, ASCAT has its limitations: only available twice a day (around 09:30 and 21:30 UTC) and stability dependent assumptions have to be made to derive turbine height winds from the ASCAT 10m winds.**
- Line 54: The Baltic Sea is an area of great interests for offshore wind development…
- Line 64-71: I suggest that you change sequence of what you write to make it clearer, e.g. **To derive wind profiles from the ASCAT coastal product 10 m measurements, we employ the long-term stability correction approach presented in Kelly and Gryning (2010) and implemented in Badger et al. (2016). For this, we utilize the stability information from ECMWF Reanalysis 5th generation (ERA5)and compare two different collocating methods to evaluate the potential influence of the limited temporal resolution of satellite overpasses in the ASCAT extrapolated profiles. Not only the ASCAT derived wind profiles, but also the wind profiles from ERA5 are then compared to the lidar profiles.**
- Line 75-76: … of the reliability and accuracy of satellite measurements **derived wind statistics** for offshore wind characterization at wind energy relevant heights.
- Line 86: What is the accuracy of your lidar measurements? If you want to compare your measurements to model data, you will have to be able to tell whether the difference that you find is significant (outside the measurement uncertainty). See e.g. TNO report - DOWA validation against offshore mast and LiDAR measurements | Report | Dutch Offshore Wind Atlas
- Line 104-105: the motion (take the s out) effects
- Line 117: fig 2b is the daily cycle the ship (lidar) experiences because it is connected to the location of the ship. It is not how the wind depends on the hour in the day (which is what normally is meant by 'daily cycle'). Maybe use a different name to avoid confusion (wind speed daily cycle plots normally give highest wind speeds during the day), e.g. Wind speed ship daily cycle.
- Line 31: Therefore (?), the ….
- Line 155/156: … available **horizontal grid spacings** of 12.5 km and 25 km
- Line 159: what do you mean by Both of these (?) are implemented (?) at…
- Line 168-170: By applying the IQR outlier detection, the impact of coastal contamination on the wind speed data is minimized, leading to more accurate and reliable results in nearshore areas.
- Line 189: Several methodologies **for vertical extrapolation of satellite measurements** …
- Line 260-264: As observed, considering the stability information from the full campaign results in a better theoretical distribution compared to the collocated approach. Although the difference is minimal at the harbor site, it is more pronounced at the offshore location, where a significant underestimation of unstable stability occurrence is observed. The harbor site presents a rather symmetric distribution

Met opmerkingen [WI(7]: Assume you used that?

Met opmerkingen [WI(8]: Better. Someone might otherwise read this in 10 years time and think ASCAT is available since 2016

Met opmerkingen [WI(9]: That is not the same as resolution!!! Ask Ad Stoffelen KNMI.

Met opmerkingen [WI(10]: If I am correct: please check

Met opmerkingen [WI(11]: You write: 'Lastly, the trustworthiness of satellite retrievals remains a knowledge gap, due
to the lack of available in situ datasets for validation especially in deep water regions'. I left this out because I think it is incorrect: ASCAT has been extensively validated (besides: its quality does not depend on water depth). Ask Ad Stoffelen KNMI.

Met opmerkingen [WI(12]: Apparently not correct for the Baltic where you mention 1-3 times a day?

Met opmerkingen [WI(13]: And yet: you do not mention the effect of wind farms (WF) on the atmosphere. ERA5 is without WF effects, ASCAT is too course, at least for detail (you need SAR for that), but your ship based lidar may measure the effects up to 100 (?) km from a WF. I think you should at least mention WF effects in the paper and tell what the consequences of these WF effects are for your method.

Can you quanlify what you mean with near shore (I assume > 15 km from shore otherwise ASCAT not valid)?

Met opmerkingen [WI(14]: Not the same as resolution

Met opmerkingen [WI(15]: I assume this is part of the ASCAT coastal product? Is nearshore more than 15 km from the coast?

around zero, meaning that both unstable and stable atmospheric conditions are equally represented. However, the offshore site exhibits a higher occurrence of unstable conditions, compared to the stable side of the curve.

- Line 192-193: …. performance at different vertical and horizontal constraints.
- Figure 6. Six locations used for the comparison of the datasets. The approximate distance to the nearest shore is indicated, in km, below of each site. Please add: **Location A is the harbour of Nynäshamn (Sweden) and location D the harbour of Hanko (Finland).**
- Line 241: In this study, the values for the C± constants have been set to 6 and 4 for the stable and unstable portions, respectively.
- Line 307-311: First, the coastal contamination of near shore areas leads to the removal of some ASCAT overpasses for data quality reasons, leading to a reduced number of ASCAT observations in **these** areas. Consequently, the insufficient number of valid wind speed measurements obtained from the collocated approach introduces a biased representation of the prevailing stability conditions during the campaign period.
- Line 313-315 (from previous review): 'pronounced instability in the morning?' Why would ERA5 produce stronger unstable conditions (lower 1/L) in the morning at Nynashamn? What do we know about the water temperature near Nynashamn and how it is modelled by ERA5 (shallower/warmer water between Bedaron and the mainland maybe?)? ERA5 has grid boxes of 31 km2 so model values are probably very land-contaminated in that area: can you make a plot of the ERA5 grid boxes near the harbours? What is the prevailing wind direction? Basically ERA5 and ASCAT are not very good in coastal area: maybe you should take them out of your analyses?
- Line 315-316: This results in a lower wind speed compared to the full campaign approach, as can be derived from Eq. 4.
- Line 316-317: In contrast, the other locations do not exhibit such pronounced daily stability cycles, and therefore, smaller differences are reported between the two approaches.
- Line 317-320: Finally, as mentioned in Section 2.4, the same values of the semi-empirical constant C± are assumed for the entire region, instead of using a site-specific definition of these constants. Therefore, the suitability of the selected values may not be optimal for certain locations, leading to an anomalous theoretical representation of the empirical atmospheric distribution.
- Line 322-323: Add names harbour to fig 7
- Line 322-324: This highlights the robustness of the employed methodology and indicates that the dataset size allows for an accurate characterization of atmospheric stability conditions during the campaign and along the entire ship track.
- Figure 9 basically shows you that ASCAT winds look unrealistic near the coast at 10 and (more so) at 100m. Especially near the Swedish coast where the wind blows predominantly from land to sea, wind near the coast should be lower than further offshore. So this figure proves that you cannot use your method near the coast for 2 reasons: (1) quality of ASCAT, (2) grid size of ERA5 (averages surface roughnesses of land and sea in grid box, therefore wrong for both wind from land and from sea). Small scale effects such as sea breeze and low level jets (you mention these in line 341) don't have a significant effect on your mean values.
- Line 341-342 (fig 9 10m validation): (from previous review) compare to Validation of DOWA ('undisturbed wind' = HARMONIE without WFP) with ASCAT (too coarse to measure wind farm effects) at 10 m height: TNO report - DOWA validation against ASCAT satellite winds | Report | Dutch Offshore Wind Atlas. Because you use ERA5

Met opmerkingen [WI(16]: There are a few things to consider here: (1) at the harbors you have on average 'land behaviour' of stability which means a daily cycle with more stable in the night and more unstable during the day; offshore there is no such daily cycle (stability depends more on the season); (2) I assume that in your collocated harbor graphs you look at around 09:30 UTC and in your collocated offshore graphs at around 21:30 UTC. I assume for the whole measuring campaign you looked at day and night for the period 28 June 2022 to 21 February 2023?

Harbor: in the collocated set (around 09:30 UTC), you would expect unstable to be slightly underrepresented if it is day time, but you see the opposite (more unstable than the theoretical line which is derived for all stability classes). A lot depends on what is really day time off course (in winter well after 07:00). If you take the whole dataset you have apparently a higher percentage stable (?) and a better match with the theoretical line.

Offshore: there is no daily cycle effect on stability here. The only thing that affects stability is that you miss 3 months of the year where the sea is particularly cold (but that is the case for both the collocated and whole dataset). So that probably explains the overestimation of unstable. But why do we only see that for collocated, not for the whole campaign?

Met opmerkingen [WI(17]: What do you mean?

Met opmerkingen [WI(18]: So basically the stability correction has only 2 values for C which are the same for the whole Baltic Sea and all heights, one for stable and one for unstable: correct? Did you consider other values, like the ones from literature? Can you show why these are the best values? Does it not depend on the season which values are …

Met opmerkingen [WI(19]: ASCAT and ERA5 both have problems in coastal areas (see general remarks). So the uncertainty in the wind data that you use in fig 7 is large in these areas (larger than further offshore). Uncertainties in ERA5 are probably larger near the Swedish coast with prevailing W-SW winds. Insufficiënt number of measurements does not necessarily have to lead to a biase …

Met opmerkingen [WI(20]: So what you say is that the wind at 100m height is lower in more unstable conditions? If that is what you mean, it is wrong.

Met opmerkingen [WI(21]: I explained why this is the case for offshore. For the Finnish harbour the prevailing W-SW'ly wind is the reason for a reduced daily stability cycle. Please add the why to your paper.

Met opmerkingen [WI(22]: Bit too vague. Can you tell for what areas the values that you chose for C± (4 stable and 6 unstable) are not so suitable? The coast? Did you test if the differences near the coast get better when you chose different values for C± ?

Met opmerkingen [WI(23]: I think your conclusion should be different. You can conclude that your method works well for offshore, but not near the coast (so not for the entire ship track) because of poor quality ASCAT and ERA5 near the coast (less than 31 km from the coast actually). …

stability info to calculate ASCAT-derived wind speeds at 100m height, the difference you see at 100m should mainly be because of differences at 10m, right?

- Line 342: Figure 10a illustrates the **difference** in wind speed between ASCAT and ERA5 at 10 m and 100 m
- Lines 347-350: This discrepancy in the nearshore areas can be explained by the combination of too high wind speeds retrieved by ASCAT due to coastal contamination and ERA5's inability to properly resolve the coastal atmospheric phenomena and its coarse horizontal resolution that leads to the omission of the flow phenomena variations caused by the small islands present in **these** coastal regions.
- Figure 10 shows you that you should not use your method within about 40 km from the coast (you should expect 31 km because of the grid size of ERA5 and what I explained earlier)
- Line 355-356: Nonetheless, the majority of grid points exhibit wind speed differences below ±1 m s-1. As previously discussed, wind speed differences above this threshold correspond to those **of** near-shore grid points.
- Line 400: what do you mean with the word 'trend 'here? The word trend is used for change in time (e.g. climate change), but this is not what you mean…
- Line 400-403: Notably, the western area of the ship route **(longitude below 18.5 degrees)** exhibits the **largest** errors for both **ASCAT-derived winds (using ERA5) and ERA5 winds**, with maximum differences exceeding 3 m s-1 at all elevation levels. This indicates that wind speed estimation **cannot be done accurately enough in these areas** with **ASCAT and/or ERA5 because (1) poor quality of ASCAT coastal product closer than 15 km from the coast and (2) ERA5 grid box size (surface roughness in land-water grid boxes on the coast problematic).**
- Line 404-405: highlighting the different shear resemble obtained from each of the datasets and their different representation of the wind profiles
- Line 406: (mentioned in previous review: seems like a good idea to write that your results are conform what others have found): Bias ERA5 at hub height 0.5 m/s is also what is found on the North Sea in Characterisation of offshore winds for energy applications — Research@WUR and at Cabauw in Energies | Free Full-Text | Dutch Offshore Wind Atlas Validation against Cabauw Meteomast Wind Measurements (mdpi.com). NEWA comparable to ERA5 (at least on the North Sea). Undisturbed winds in DOWA (2008-2018) and WINS50 (2019-2021) are much better than ERA5 (including correlation) and the domain covers most of the Baltic Sea, but hourly data unfortunately not available for 2022 and 2023 when you have the lidar measurements (Home | Dutch Offshore Wind Atlas; WINS50 - Winds of the North Sea in 2050).
- Line 408-409: ERA5 usually underestimates the wind speed, this is more pronounced at higher elevations and in the eastern part of the ship track. In contrast, ASCAT mainly overestimates compared to the **lidar** (typo) measurements.
- Line 418-419: When comparing the two datasets, ERA5 shows a smaller nRMSE in the majority of the studied region, except in the Eastern area near the harbour in Hanko. What is your explanation for this? Does it have anything to do with time of overpass ASCAT, the location characteristics?
- Line 419-421: When comparing the bias and nRMSE shown by the two datasets, the average absolute bias across the entire region is smaller for ASCAT compared to ERA5 at the three heights considered (see Fig. 13). Differently, as can be observed in Fig. 14, most of the locations reveal a smaller nRMSE for ERA5 than for ASCAT. Bit confusing. I suggest an alternative text: **So for all heights considered the bias (compared to the lidar measurements) of the ASCAT-derived wind speeds is**

Met opmerkingen [WI(24]: Wrong use of the word 'disparity' (nothing unfair about this difference).

Met opmerkingen [WI(25]: It has nothing to do with coastal atmospheric phenomena or flow phenomena variations (do you mean sea breezes?). It has everything to do with 'land roughness contamination' of the roughness in the coastal grid cells

Met opmerkingen [WI(26]: This big difference of 1 m/s in mean values is not the bias, but the max difference, right?

Met opmerkingen [WI(27]: Is it possible to add distance to the nearest coast to fig 13? In this figure we are looking at winds at 60m, 150m and 220 m, so at ASCAT derived winds (with ERA5). The ASCAT coastal product is only valid 15 km or more out of the coast as far as I know…

Met opmerkingen [IW28]: Sentence unclear: shear resemble?

Met opmerkingen [IW29]: If anything: more pronounced in western part of ship track (not eastern) which also makes more sense with prevailing westerly winds (land contamination ERA5 grid surface roughness)

smaller than the bias of the ERA5 wind speeds (fig 13), but for most of the region (except for the eastern part of the region near the Finnish coast) the nRMSE of the ERA5 wind speeds is better (fig 14).

- Line 427-428: The objective of this study has been to evaluate the accuracy of ASCAT-derived wind speed profiles for the characterization of offshore wind resources at turbine operating heights in the Northern Baltic Sea.
- Line 431: … obtained from **a** (typo) novel ship-based lidar campaign
- Line 435: … that machine learning-based techniques for extrapolating satellite winds could surpass the long-term correction method employed herein. Questionable English. I suggest an alternative text: … **that machine learning-based techniques for extrapolating satellite winds could work better than the long-term correction method that was used in this study.**
- Line 436-437: However, the limited amount of data available over the campaign period hinders the implementation of such data-driven approaches.
- Line 441-442: The methodology revealed a remarkable congruence between these two approaches across most of the area examined, thus underscoring the robustness of the methodology.
- Line 443-446: This divergence can be attributed to the limited availability of valid wind speed measurements in the collocated approach, the constraints of considering atmospheric conditions solely during morning and evening hours, and the generic definition of the empirical constants C± required for the calculation of the theoretical stability distributions at each site.
- Discussion: please rewrite given all comments given (running out of time to give detailed comments)
- Line 486-492: Finally, it is imperative to highlight that although the disparities in wind speeds between ASCAT and ERA5 relative to lidar are generally small in far-offshore regions, their cumulative impact over a large-scale wind energy project can still have relevant implications for energy production estimates and financial assessments. Therefore, continued efforts to refine both **satellite based** measurements and numerical models are essential to enhance the accuracy of wind resource assessments for offshore wind energy applications. The diverse characteristics and insights into wind patterns derived from satellite-derived observations, numerical models, and ship-based lidar measurements suggest that an integrative approach, harnessing the collective strengths of these datasets, could yield substantial gains in the accuracy and reliability of offshore wind statistics derivation.

Met opmerkingen [IW30]: Goal wind resource assessments?
As I said before, this work is interesting for wind energy, but only because we can use the ship-based lidar measurements for validation of mesoscale or LES models that include the effect of wind farms. We can then use these models with changed wind farm scenarios to predict the wind resource in the future. Bear in mind that mean values of the wind are not relevant if you want to predict power: you need to look at correlation on a 10 min (or hourly) basis, especially for wind speeds between cut-in and rated (power curve).

Met opmerkingen [WI(31]: Not an ML expert, but is the fact that you have a short campaign really the limiting factor? You have ERA5 and ASCAT measurements for a much longer period, so can you not perform your long-term stability correction? What I do know is that ML cannot reproduce events that have not occurred yet (extremes).

Met opmerkingen [WI(32]: Not convinced this conclusion is justified (see earlier comments).

Met opmerkingen [WI(33]: Rethink this conclusion also based on earlier remarks

Met opmerkingen [WI(34]: The ASCAT measurements extrapolated to 100m with ERA5 are not representative for wind in or near wind farms and therefore do not give accurate wind resource assessments (neither does ERA5 for areas with wind farms or Measure Correlate Predict for areas where the number/size of wind farms is changing). So what we need to do is further develop Numerical Weather Prediction models that include solving the effect of wind farms (for which we need measurements for validation) and run these models for current and future wind farm layouts. ML is a useful tool, but cannot be used to derive extremes in wind climate.
You should also bear in mind that there is no significant trend in the wind climate (apart from at 10m over land) but a strong Inter Annual Variability (IAV). This is the case for the North Sea, but most likely also for the Baltic? Do you know? If there is a strong IAV, then it is important to assess how representative the period you look at is for the wind climate. For the Dutch part of the North Sea (DEEZ) the IAV is 3.5 and 4% for sites in the northern part of the DEEZ and between 4 and 4.5% in the southern part of the DEEZ (Inter-annual wind speed variability on the North Sea | Report | KNMI Projects). Is any information like this available for the Baltic Sea? How representative is 28-6-22 until 21-2-23 for the wind climate in the Baltic Sea? This you can check e.g. with ERA5 data (compare ERA5 28-6-22 - 21-2-23 to ERA January1940-now). So what is the added value of having these 100m wind speeds based on ASCAT? Compared to lidar, the ASCAT derived 100m wind are maybe more accurate than those from ERA5, but only available twice a day. Should we just not assimilate ASCAT in ERA5 and focus more on how useful this ship based lidar technique is to get validation measurements for models including wind farm effects (wakes/blockage)? That is what I like about this work.

Relevant literature you should include (or at least consult):

- Characterisation of offshore winds for energy applications — Research@WUR
- Energies | Free Full-Text | Dutch Offshore Wind Atlas Validation against Cabauw Meteomast Wind Measurements (mdpi.com)
- Comparing available Wind Farm Parametrisations for mesoscale models (Fitch and EWP best): Review of Mesoscale Wind-Farm Parametrizations and Their Applications | Boundary-Layer Meteorology (springer.com)
- Wind farm effects modelled with COSMO-CLM and Fitch WFP: https://wes.copernicus.org/articles/9/697/2024/
- Quadruple collocation: KNMI Technical report - Uncertainty analysis of climatological parameters of the Dutch Offshore Wind Atlas (DOWA) | Report | Dutch Offshore Wind Atlas.
- Validation of HARMONIE+Fitch WFP with e.g. lidar measurements: A One-Year-Long Evaluation of a Wind-Farm Parameterization in HARMONIE-AROME - Stratum - 2022 - Journal of Advances in Modeling Earth Systems - Wiley Online Library
- Wake effects: https://www.researchgate.net/publication/340838550_Long-range_modifications_of_the_wind_field_by_offshore_wind_parks_-_results_of_the_project_WIPAFF
- Internal boundary layer caused by change in surface roughness (coast): An effective parametrization of gust profiles during severe wind conditions - IOPscience