

Comment on amt-2021-247

Anonymous Referee #1

Referee comment on "Validation of the Aeolus Level-2B wind product over Northern Canada and the Arctic" by Chih-Chun Chou et al., Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2021-247-RC1>, 2021

General comments

The authors compare Aeolus winds with Ka-radar and radiosonde winds in Northern Canada in periods of the early phase during the first laser nominal flight model (FM-A; 2018-09 to 2018-10), the early phase during the second flight laser (FM-B; 2019-08 to 2019-09), and the mid-FM-B periods (2019-12 to 2020-01). They also compare Aeolus wind fields with ECCO-background and ERA5 reanalysis wind fields over the whole Arctic (poleward of 70°N). Since direct wind observations are especially sparse in the Arctic, the topic is interesting and has important implication in evaluating the quality of Aeolus winds over the Arctic. However, the following major issues need to be improved.

- In order to use Aeolus wind data in numerical weather prediction models and to improve the data quality in newer processor versions, the systematic and random errors of Aeolus winds must be understood. As the purpose of this study is to evaluate the quality of Aeolus wind products over Northern Canada and the Arctic in comparison with several available observational products, the systematic and random errors of Rayleigh-clear and Mie-cloudy winds over these regions should be evaluated. Although the authors evaluated the random errors using Figs. 9–11, they did not evaluate the systematic errors.
- My recommendation concerns bringing the findings of the paper into perspective with what is known from other literature, e.g., Belova et al. (2021), which conducts the validation of Aeolus HLOS winds against ground-based radar measurements in the Antarctica and northern Sweden.
- During the mid-FM-B period (1 December 2019 to 31 January 2020), Aeolus L2B near real-time baseline products '2B07' were used. Please check https://aeolus-ds.eo.esa.int/oads/access/collection/L1B_L2_Products/tree.
- The total number of measurements (N) and number of profiles (p) are important in calculating adjusted r-squared in Figs. 3, 4, and 5. Please give N and p of each site and period.
- Figure 3d shows the scatter plot between Aeolus Rayleigh wind and Ka-band radar at Iqaluit. The number of comparison pairs is only 11. In my opinion, the sample size is

too small. I suggest that the authors must perform the significance test.

- What do you want to discuss using the HLOS winds projected onto the east-west and north-south directions in Figs. 7 and 8? What conclusions should the reader make from Figs. 7 and 8? In my opinion, the projected winds are not related to validation of Aeolus HLOS winds. The authors do not mention results obtained from Figs. 7 and 8 in Sect. 4. Please add some further explanations on that.
- Figs. 10 and 11 show spatial distributions of RMSD of Aeolus and ECCC-B vertical HLOS wind profiles. Figs. 10 and 11 are the most important result of the paper. The spatial distributions of RMSD show remarkable radial patterns. How do the authors explain these patterns? Are these patterns due to interpolation of RMSD data to the grid points? The authors were not careful to ensure that the graphics all use similar color scales. Please use the same color scales for Figs. 10a–d and Figs. 11a–d. Similarly, please use the same color scales for Figs. 10e–h and Figs. 11e–h.
- Lines 446–447: Why no significant improvement is seen here? The estimated HLOS errors of the 2B10 data are decreased compared to the 2B06 data (Figs. S2 and S3). I cannot understand the authors' explanation "because we have implemented a weekly updated dynamic bias correction to the near real time data". Please add some further explanations on that.

Specific comments

- Lines 23–24: "scattering from the solar background" should be revised to "the solar background radiation" or "the solar background noise".
- Line 28: "all cases" should be revised to "all three periods".
- Line 28: "20%" should be revised to "5 to 40%".
- Lines 68–69: Please clarify what is meant by "new technologies" and "cost-effective alternatives to atmospheric monitoring".
- Lines 78–80: "Section 3.1 describes the comparison during the early FM-A period (15 September to 16 October 2018) to ground-based measurements in Canada's North, including the Iqaluit supersite and radiosonde stations over the Northern Canada." However, I can see the comparison results during the early FM-B and mid-FM-B periods in Fig. 5. Please correct.
- Line 82: "1 December to 31 January 2020" should be revised to "1 December 2019 to 31 January 2020".
- Line 107: An Aeolus observation can be regarded as an averaged value of a 90 km line for the Rayleigh winds and Mie winds until 5 March 2019, and as an averaged value of a 10 km line for the Mie winds after 5 March 2019 (Martin et al. 2021). Please correct.
- Lines 115–116: In my opinion, the phrase "winter 2020" is a bit misleading. I would advise to avoid this phrase and rather use "winter 2019–20".
- Line 127: Please give the values of the thresholds for L2B estimated HLOS errors of Rayleigh-clear winds and Mie-cloudy winds.
- Line 139: "ECCC-B background" should be revised to "ECCC-B".
- Lines 186–189 and 207–211: The authors downloaded the radiosonde data from <http://weather.uwyo.edu/upperair/sounding.html>. The vertical resolution of the radiosonde data is coarse than 15 m. The information of the geographical location and time at each level is not included in the radiosonde data. Is the balloon drift taken into account? Please give detailed data matching procedures between Aeolus and radiosonde.
- Line 217: "overpasses Asia around 06 and 18 UTC" is error and needs to be corrected.
- Figure 2: Please add y-axis title. Why are there two Rayleigh winds at the same altitude above 5 km in Fig. 2b. Similarly, why are there two Mie winds at about 8 km in Fig. 2a.

Is this consistent with the temporal criterion described in lines 214-215. Why are the maximum altitudes of HLOS wind profile obtained from ECCO-B 15 km (20 km) in Fig. 2a (2b)? "at Iqaluit" should be added in the caption.

- Figure 3 and Line 249: Is "frequency distributions in percentage" correct? What are the color shading areas in the scatter plots (Figs. 3a-d)?
- Line 270: Is "The ERA5 shows somewhat slightly lower correlation" correct?
- Figure 4: Figure 4 is exactly the same as Fig. 3. Please correct.
- Figure 5: Why did the adjusted r-squared of Mie winds decrease with time? The authors should mention the decrease and discuss the reasons.
- Line 321: "The reprocessed data has improved estimated errors and RMSD" should be revised to "The reprocessed data has improved estimated errors and RMSD over the excluded region".
- Figure 6: Please add y-axis titles. "Aeolus L2B estimated error" should be revised to "Aeolus L2B estimated error of Rayleigh winds".
- Line 335: "free troposphere (2-8 km)" should be revised to "free troposphere (T, 2-8 km)".
- Line 336: "stratosphere (altitude greater than16 km)" should be revised to "stratosphere (S, altitude greater than16 km)".
- Figure 7: Please add y-axis titles. Fig. 7. Figures. 7b and 7d do not use the same horizontal axis scale as Figs. 7f and 7h. Please correct. "70N" should be revised to "70°N". "each level" should be revised to "each atmospheric layer".
- Figure 8: Please add y-axis titles.
- Figure 9: Please add (a), (b), (c), (d), (e), and (f) to the image.
- Line 392: What do you mean with "more structure"? Please add some further explanations on that.
- Line 433: "observation errors" should be revised to "estimated errors of Rayleigh winds".

Technical corrections

- British or European English: For example, you use "16 October 2018" and "October 16th 2018".
- Line 268: Fig. -> Figs.
- Line 345: Fig. -> Figs.
- Line 427: Fig. -> Figs.
- Line 428: Fig. -> Figs.
- Line 445: Fig. -> Figs.
- Line 469: Fig. -> Figs.