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Atmospheric Measurement Techniques Discussions

Interactive comment on "Shipborne Wind Measurement and Motion-induced Error Correction by Coherent Doppler Lidar over Yellow Sea in 2014" *by* Xiaochun Zhai et al.

Anonymous Referee #3

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Comment on "Shipborne Wind Measurement and Motion-induced Error Correction by Coherent Doppler Lidar over Yellow Sea in 2014", by X. Zhai, S. Wu, B. Liu, X. Song, J. Yin.

This manuscript describes a study that is relevant to Atmospheric Measurement Techniques. The authors describe procedures and measurement performance of a coherent Doppler wind lidar (CDWL) from ship. The manuscript proposes an algorithm to compensate for error of wind measurement due to the motion of the ship and provides contributions for lidar communities using shipborne applications. The manuscript has some issues that need clarification. There are numerous specific comments. A major

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revision of manuscript is needed before it can be accepted for publication.

General comments: (1) Although details of a CDWL WindPrint S4000 are not described in the previous papers, in my opinion, details of the CDWL are not described well. The authors use an AOM for the heterodyne detection and a FPGA for FFT analysis. But there is no information about the sampling frequency and points used for FFT. The information is related to range-resolution for the time-domain, frequency-resolution for the frequency-domain and observable wind speed range. In the manuscript, bandwidth of 50MHz is used for data processing. Do you use a FPGA operating at a sampling frequency of 100MHz? Is it correct? In the previous paper, a AOM of 80MHz is used for the heterodyne detection. Therefore, frequency range of 60-100 MHz at center of 80MHz is detection range to determine LOS wind speed. 20MHz corresponds to be LOS wind speed of 15.5 m/s. $\pm$50 m/s is "speed measurement range" shown in the previous paper. It is not consistent each other. It is puzzled to me. I might be missing something...and if so, please describe technical details and other aspects of the CDWL for better understanding the manuscript. (2) Definition of SNR is given in the manuscript. SNR=0dB means the signal power equals to noise power (NEP). Is it correct? Do you mean that the minus values are bad estimates? Minus values of SNR are shown in Figures 7 and 9. Why? Please describe details and derivation of SNR and search procedure by adding explanation sentences and figure. (3) It is also necessary to describe here the statistical process of these measures. How did you calculate LOS wind speed error and bias? How many radiosondes did you launch? What is the vertical resolution of the radiosonde? How do you interpolate to the CDWL data to for compare with the radiosonde? Ex. vertical resolution of the CDWL is 60m, while the vertical resolution of the radiosonde is 30m. The tow data points measured by the radiosonde are used for comparison with the CDWL. Or, one data averaged using two data points are used for that. Are data in the altitude range between 150m and 4000m used for the statistical comparison show in the Figure 6. A question comes for the difference between number N of 990 shown in Figure 6 and number points (wind speed: 84, 106...65; wind direction: 89,93...88) shown in Table 4. Why are the numbers

used for the wind speeds and wind directions are different? Please add explanation related to spatial and temporal difference between the DBS and the radiosonde measurements. (4) How did you determine misalignment and angle between the ship and laser beam axes? Although explanation sentences using a hard target are descried in the manuscript, technical details and other aspects of this are not described well. More details should be provided.

Specific Comments: P. 2 line 22, “wind speed”. Do you mean “wind vector”? P. 3 line 4, “the CDL”. a CDL P. 3 line 4, “vertical wind”. horizontal wind P. 3 line 11, “In order to . . .the Yellow sea”. What is main purpose of the experimental investigation? Scientific or Engineering? P.3 line 30, “200ns”. Is the number for 150μJ at 10 KHz? P.4 line 2, “a proper”. Do you mean “high”? P.4 line 9, “Yellow Sea”. “the Yellow Sea”. There are the same expressions in the manuscript. Please check in the manuscript P.4 line 13-15, “The inertial navigation system is . . .laser beam”. How did you confirm to keep the constant relative angle? P.4 line 16-17, “Hard target calibration”. How did you conduct out the hard target calibration? Please describe details about it and statistical results (bias and error) P.4 line 19-20, “laser direction”. Do you mean “laser beam direction”? What do you mean “between the ship and...”? Please explain it and show the axes in Figure 2. P.5 line 3, “the transmitting laser path”. Do you mean “laser beam direction”? P.5 line 3, “the transmitting laser”. Do you mean “laser beam direction”? P.5 Eq. 3, (x, y, z) ->(xg, yg, zg) P.5 line 9, “Where” -> “where” P.5 line 10, “Eq. (2)-(3)” -> “Eqs. (2) and (3)” P.5 Eq. 4, (y/x) ->(yg / xg) P.5 Eq. 5, z -> zg P.7 line 3-4, please describe the definition of SNR using a figure. Does the definition of SNR have minus value? P.7 line 16-17, please give observation time to get each LOS wind speed profile. P.7 line 24, How do you determine the wind measurement fluctuation? P.7 line 28, “SNR threshold”. Please add the threshold value. P.8 line 26, “measurement”. “measurements” P.8 line 27, “multipath”. I do not understand it. Please add explanations. P.11 line 1, “shipborne-based”. “ship-based” or “shipborne”. P.11 line 9-10, “assuming that the wind field has a constant horizontal and vertical velocity”. Is the assumption always reasonable? What is the spatial and temporal

scale of wind field when the assumption is reasonable. P.11 line 13, “the lidar pointing angle”. Do you mean the laser beam direction? P.12 line 6-8, “In this case. . .2016).”. Why do you have to use the Hamming window and zero-padding? Please clarify it. What is the difference between with and without Hamming window and zero-padding? P.12 line 16. “Eq.”. “Eqs.” P.12 line 21-23. “8dB.” Why “8dB” ? How do you determine the number? Please add explanation sentences. SNR looks the same value at 1 km as at 1.5 km. But different random errors at the altitudes are shown in the Figure 9. Why? P.12 line 23-25. “At reduced values. . .0 dB.” Please plot results until SNR be 0dB in the Figures 9(a)-9(c). It is important for readers to identify the measurement performance of your CDWL. SNR=0 means the signal power equals to noise power (NEP), which is undetectable a true signal. Random errors would be large. “4 m/s” seems to be small. P.13 line 23-25. “At reduced values. . .0 dB.” Please plot results in the figure until SNR be 0dB. P.14 line 4. “Shipborne wind observation”. This manuscript describes an algorithm to compensate for error of wind measurement due to the motion of the ship, not observation. Please modify explanation sentences to insist on the main purpose of the manuscript. P.14 line 12. “The correlation. . .respectively,”. Please add details such as date, time, altitude range, and so on. P.14 line 19-21. “random error. . .radiosonde data,”. Please add explanation sentence about date, time and altitude.

Reference: P.14 line 12. Please add pages. P.14 line 23. Please add pages: 4675-4692.

Figure and Tables P.19 Figure 4. Label and “(a)” , “(b)”, “(c)” and , “(d)” are small. Please use larger fonts. P.19 Figure 5. Label and “(a)” , “(b)”, “(c)” and , “(d)” are small. Please use larger fonts. P.20 Figures 6. “(a)” and “(b)” are small. Please use larger fonts. P.20 Figures 7. Label and “(a)” , “(b)”, and “(c)” are small. Please add horizontal wind speed. P.20 Figures 7. Label and “(a)” , “(b)”, and “(c)” are small. Please use larger fonts. P.21 Figures 8. “(a)” , “(b)”, and “(c)” are small. Please use larger fonts. P.21 Figures 9. “(a)” , “(b)”, and “(c)” are small. Please use larger fonts.

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