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Atmospheric Measurement Techniques
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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 #1

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General comments: This manuscript presents the results of wind measurements by coherent Doppler lidar from a ship in the Yellow Sea. The authors give a description of the algorithm for processing lidar data, which makes it possible to compensate for the measurement error associated with the motion of the ship. The results of joint measurements of height wind profiles by lidar and radiosonde are analyzed. The paper may be of interest to the readers of AMT. However, when describing the experiment and the data processing procedure, excessive attention is paid to secondary issues, and important details are ignored. Sometimes the terminology used by the authors makes it difficult to understand what they mean and how they obtained results presented in the manuscript. Some results raise doubts about their correctness. 1) The authors

assume that the bias of lidar estimate of the wind velocity is associated only with errors in determination of the ship speed and direction and with the pointing angle knowledge errors (Section 3.3). One can agree with this, if lidar estimates of the radial velocity are obtained at a sufficiently high signal-to-noise ratio (SNR, ratio of the signal spectrum peak to the standard deviation of noise component of the spectrum estimate), when the probability (or fraction) of a bad (unreliable) estimate of the radial velocity is practically zero. However, results shown in Fig.9 for heights above 2 km were obtained at SNR = 2 dB when the probability of bad estimate b = 0.3. As shown in Fig.4, true wind speed V = 5 m/s at a height of 2 km. According to the theory (Frehlich, R.G. and Yadlowsky, M.J.: Performance of mean-frequency estimators for Doppler radar and lidar, Journal of Atmospheric and Oceanic Technology 11(5), 1217-1230, 1994), the bias of velocity estimate BIAS = <Vˆ> - V, where <...> is ensemble averaging and Vˆ is the velocity estimate, is determined by the equation: BIAS = -b*V. Therefore at b = 0.3 and V = 5 m/s the bias equals -1.5 m/s. Nevertheless, in Fig. 9(ÑĄ) we see that the bias is about zero at SNR = 2. 2) Fig.9(b) shows the random error of wind velocity. On the other hand, the second term on the right-hand side of Eq.(11) is defined as the random error with zero mean. It is unclear how the result shown in Fig.9(b) was obtained. It is necessary to describe in more detail the procedure for obtaining this result. The results shown in Fig. 4 and Fig. 9 are obtained from the same lidar data (measurements from 15:52 to 16:02 on May 9, 2014)? 3) How can SNR be determined below 2 dB, if in this case with a high degree of probability the peak in the measured spectrum is associated with the noise, but not with the signal?

Specific Comments: 1) Page 3, lines 27-30: The pulse energy depends on the pulse width? If so, what is the pulse energy (and pulse repetition rate) for pulse durations of 100, 200 and 400 ns? 2) In section 2 the following information should be added: a) width of the time window (T) for obtaining the lidar signal power spectrum (T equals probing pulse duration of 200 ns?); b) width of the frequency band (B) within which the radial velocity was estimated from the lidar signal power spectrum (B = 50 MHz?); c) number of laser shots used for the spectral accumulation; d) number of radial velocity estimates (for each range) that were obtained from lidar measurement for 10 minutes and then they were used for obtaining one estimate the wind vector. 3) Add the telescope diameter and beam diameter (1/e**2) to Table 1. 4) Page 8, lines 25-28: "It can been seen that the discrepancies in wind profile above 1 km between the radiosonde and lidar measurement are significant due to the multipath effect at the ship platform and decrease in collocation of the measurement." Another reason for the discrepancy between the results of the measurement of the wind by the lidar and the radiosonde at heights above 1 km is quite possible: the bias of the corrected lidar estimate of the wind due to the low SNR. It would be nice to add high profiles of the SNR in Figures 4 and 5. By the way, using some known procedure of filtration of good (reliable) estimates of the radial velocity obtained from 10-min lidar (4-DBS) measurements, the authors could obtain an unbiased wind speed estimate even in the case when the SNR is about 0 dB (if the percentage of good estimates is not below 20%).

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