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Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "Sea surface wind speed estimation from space-based lidar measurements" *by* Y. Hu et al.

**Y. Hu et al.**

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Response to Reviewer #4:

The authors want to thank reviewers for the amount of effort into an in-depth review of manuscript and providing needed suggestions. We fully agree with all the comments and suggestions the reviewer made and made the corrections as the reviewer suggested. 1. Reference Wu (1972) is replaced by Wu (1990), following reviewer’s suggestion. 2. tan (theta) in the imbedded equation is changed as tan(theta_x) as reviewer suggested. 3. To clarify the ambiguity in the off-nadir angle and wave slope, we have changed the sentence to “For a lidar/ radar system pointing at off-nadir angle $\theta_ {\rm L}) $, the specular reflection returns back to the lidar receiver if the wave slope tan$\theta$ equals tan$\theta_ {\rm L}) $. Thus the incident area at the surface is the unit laser/receiver area divided by cos$\theta $. 4. Re-



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moved the $\theta$ from the specular reflectance equation, a bug detected by the reviewer. 5. Reference added, as suggested by reviewer. 6. We added a few sentences, but did not go deep into those radiometer studies: “With collocated ocean surface wind and sunglint satellite radiometer measurements, recent studies concur with Cox-Munk relation at moderate wind speeds while issues related to wind direction, low wind and high wind exist Ebuchi and Kibu, 2002; Breon and Henriot, 2006; Li et al., 2007). The nadir-pointing lidar is not sensitive to the wind direction related issues found in the sunglint measurements. Studying wind and slope variance relation using combined wind/lidar measurements can avoid uncertainty associated-cloud/aerosol contaminaiton (Flamant et al., 1998).” 7. To define the cleanness, we added: “The cleanness is defined by 15-shot average lidar integrated atmospheric backscatter at both 532nm and 1064nm.” 8. A couple of sentences are added: “The 15% depolarization is based on limited Monte Carlo simulation using the Full Stokes Monte Carlo model (Hu et al. 2001) with simplified optical properties of foam and whitecaps. A more sophisticated correction algorithm based on realistic foam and whitecaps simulation is in progress.” 9. To put more quantitative measure into this, we changed the sentence into: “For wind speed larger than 12 m/s, the correlation between AMSR-E wind speed and CALIPSO lidar backscatter increased from 0.36 to 0.69 after this whitecap correction (lower panel). 10. We added sentence: “The best fit is performed on the entire month's worth of clear sky ocean surface lidar backscatter data, weighted by the uncertainties in 1064nm aerosol extinction optical depth.” 11. We added the reference and the sentence: “Using ocean surface backscatter for space based lidar calibration was first performed by Ice, Cloud and land Elevation Satellite (ICESat) (Lancaster et al., 2005).” 12. We changed the sentence into: “This small bias is probably due tothe uncertainty of CALIPSO's lidar calibration using molecules as targets and the impact of the transient response of the CALIPSO photomultiplier tubes (PMT) (Hu et al., 2007a; Hu et al., 2007b; McGill et al., 2007). 13. The revewer is correct. We removed that sentence. 14. A few sentences are added here: “Daytime



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wind speed can be slightly less accurate due to larger uncertainties in calibrations and aerosol corrections as a result of smaller SNR of aerosol backscatter. The day/night SNR difference of ocean surface backscatter is small because the SNRs for both clear day/night are in the hundreds and CALIPSO nadir track is away from sunglint.” 15. We added an error bar. We will work on improving the assessment of the uncertainty. At this moment, we only have the rms of the data points, but we do not have a realistic assessment of other error sources such as lidar calibration, AMSR wind speed, aerosol and whitecap correction. 16. We added the sentence in the figure caption: Multiplying the total lidar backscatter (co-polarization+cross-polarization) by the factor 1-7.66$\delta $ removes the cross-polarization component plus the whitecaps part of the co-polarization component (assuming the whitecaps has a 15% depolarization). 17. We added the sentence in the caption: Here "clean" means that atmospheric (aerosol) backscatter is low. And similar sentences are added in the main text.

We also corrected the technical errors pointed out by the revewer.

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Interactive comment on Atmos. Chem. Phys. Discuss., 8, 2771, 2008.