Corrigendum: “An Attempt to Retrieve Continuous Water Vapor Profiles in Marine Lower Troposphere Using Shipboard Raman/Mie Lidar System”

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The authors of Katsumata et al. (2020) (hereafter KTN2020) have discovered an error to process the lidar data. The error is on the length of the raw data bin along the ray direction (hereafter “bin length”) at a part of the channels to archive Raman backscattered signals. KTN2020 erroneously set the value as 7.5 meters at all wavelengths in both MR15-04 and MR17-08. The correct bin length is 3.75 meters, for data at 607 and 387 nm (for nitrogen) in MR15-04 and MR17-08, and for data at 660 and 408 nm (for water vapor) in MR17-08. Meanwhile at 660 nm (for water vapor) in MR15-04, correct bin length is 7.5 meters as identical to that in KTN2020. The differences between correct bin length and those in KTN2020 are summarized in Table C1. These errors came by confusing specifications of hardware used before and after 2015 (i.e. before and after adding capability to receive Raman signals). Note that the error was only for the Raman signals, while the other data (at Mie scattering channels) were unaffected.

On the scatter diagrams comparing $q_l$ and radiosonde-observed water vapor mixing ratio $q_r$ (Fig. 2), panels for MR17-08 (Figs. 2b and 2c) show that the data points are better confined along $q_l = q_r$ line than those of KTN2020. The statistical parameters are also improved from those in KTN2020, as in the correlation coefficients ($-0.9$) and the root mean squared differences (RMSD) ($-0.5 \text{ g/kg}$, which corresponds ~3% of $q_r$ (and $q_l$)). In contrast, the results for MR15-04 are not improved as those for MR17-08, with the correlation coefficients of 0.67 and the RMSD is approximately $1.2 \text{ g/kg}$ which corresponds to approximately 7% of $q_r$ (and $q_l$). These differences are probably resulted by the larger number of the raw data bin in a resampled data grid point (with the size of 120 meters and 10 minutes) in the corrected data for MR15-04 than in KTN2020.

On the panels comparing vertical profiles of $q_l$ and $q_r$ (Fig. 3), the data available height range is lower than those in KTN2020 for all panels, by reflecting the correction of the range distance of the raw data. For MR17-08, $q_{355}$ and $q_{408}$ are available up to 0.45 and 0.85 km height, respectively. Below 0.6 km height where MABL generally exists, the RMSD and the quartiles of $q_l - q_r$ are smaller than $0.7 \text{ g/kg}$ which is improved than those in KTN2020. On the other hands for MR15-04, the RMSD and the quartiles of $q_l - q_r$ are generally $\geq 1.0 \text{ g/kg}$, which is comparable to those in KTN2020.

On the case study (Fig. 4), the available height range of $q_{3532}$ and $q_{3535}$ become lower than in KTN2020. However the temporal variation of $q_{3532}$ and $q_{3535}$ (Figs. 4a and 4b) and their correspon-

dence to the other data (Figs. 4c–f) are unchanged from those in KTN2020.

The conclusions of KTN2020 are found to be basically unchanged with the corrected data, while the data-available height range is generally shortened. Reflecting the corrected results, we correct the former part in “5. Summary” as follows:

“In this study, we demonstrated the current capability of the Mirai lidar to estimate the vertical profile of the water vapor mixing ratio for the lower troposphere over the ocean. The signal ratio of Raman water vapor to Raman nitrogen from the lidar is utilized to estimate water vapor mixing ratio ($q_r$) by referring the radiosonde-observed water vapor mixing ratio ($q_l$). Our demonstration involves data from two special observations, “MR15-04” cruise during “Pre-YMC” and “MR17-08” cruise during “YMC-Sumatra”. The obtained $q_r$ by using 355 nm laser (received signal at 387 and 408 nm) are shown to be quantitatively reasonable up to 0.6 km height that covers the MABL, and to be feasible to study meso-scale features of MABL. With the present Mirai lidar system, $q_r$ from 355 nm laser is advantageous to analyze up to higher altitude and better quality than that from 532 nm laser (received signal at 607 and 660 nm).”

The bin length is also described in the Supplement of KTN2020. In the Supplement, we correct the penultimate sentence of the penultimate paragraph (in the middle of the right column in the page ii) as follows:

“The one bin corresponds to 6 m and 3.75 m vertical resolutions for Mie and Raman channels, respectively (except 660 nm channel during MR15-04, which corresponds to 7.5 m).”

References

Katsumata, M., K. Taniguchi, and T. Nishizawa, 2020: An attempt to retrieve continuous water vapor profiles in marine lower troposphere using shipboard Raman/Mie lidar system. SOLA, 16A, 6–11, doi:10.2151/sola.16A-002.

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Table C1. Bin length of data at each channel used in KTN2020 and corrected calculations. Corrected values (different from KTN2020) are written in bold text with underbar.

| Cruise code | MR15-04 | MR17-08 |
|-------------|---------|---------|
| Wave length [nm] | 387 | 408 | 607 | 660 |
| Scattering medium | N2 | H2O | N2 | H2O |
| Correct bin length [m] | 3.75 | (N/A) | 3.75 | 7.50 |
| Bin length as in KTN2020 [m] | 7.50 | (N/A) | 7.50 | 7.50 |

Scattering medium

| Cruise code | MR17-08 |
|-------------|---------|
| Wave length [nm] | 387 | 408 | 607 | 660 |
| Scattering medium | N2 | H2O | N2 | H2O |
| Correct bin length [m] | 3.75 | 3.75 | 3.75 | 3.75 |
| Bin length as in KTN2020 [m] | 7.50 | 7.50 | 7.50 | 7.50 |

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Fig. 2. Scattering plots comparing lidar-derived water vapor mixing ratio $q_l$ (in ordinate) and radiosonde-observed one $q_{rs}$ (in abscissa). (a) $q_{532}$ for MR15-04, (b) $q_{532}$ for MR17-08, and (c) $q_{355}$ for MR17-08, respectively. "points", "RMSD" and "cor" stands for number of data points, root mean square difference, and correlation coefficient, respectively.
Fig. 3. Comparison of the vertical profiles of water vapor mixing ratio. Panels in the left column ((a), (d) and (g)) are for the averaged profile of $q_l$ (red) and $q_{rs}$ at corresponding time (black). Panels in the middle column are for the $q_l - q_{rs}$, as in the average (thick black), average ± standard deviation (gray), median (thick red), and 1st and 3rd quartiles (thin red), respectively. Panels in the right column are number of available pairs of $q_l$ and $q_{rs}$. Top panels are for $q_{ls2}$ in MR15-04, middle panels are for $q_{ls2}$ in MR17-08, and bottom panels are for $q_{ls5}$ in MR17-08.
Fig. 4. Observed time series on 12 December 2017 (in UTC). (a–b) Time-height cross section of lidar-derived water vapor mixing ratio, for (a) $q_{\text{532}}$ and (b) $q_{\text{355}}$. White color indicates the location where data is unavailable (see Section 2.2). (c–e) Surface meteorological parameters obtained by instruments onboard R/V Mirai, for (c) pressure (blue) and temperature (red), (d) rainrate (red), relative humidity (blue) and water vapor mixing ratio (green), and (e) wind speed (black), zonal wind speed (red), meridional wind speed (blue) and wind vector at every hour. (f) time-height cross section of normalized backscatter signal received at 1064 nm.