Study on the effect of asymmetric pulsed laser spectrum on wind bias observed by the Na lidar at Tromsø

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We have been continuing wintertime wind/temperature lidar observations of the MLT region (upper mesosphere and lower thermosphere) since October 2012 at Tromsø (69.6N, 19.2E), Norway [Nozawa *et al*., 2014]. With the highly advanced lidar technique, wind velocity in the range of 80-115 km can be measured by detecting the frequency difference between the laser and the returned photon frequency in an accuracy of ~1 MHz [Kawahara *et al*., 2017]. The observed nightly-averaged vertical wind velocities seem large systematic wind bias of ~12 m/s, although it is expected be 0 m/s. One possible reason we haven't consider is the asymmetry of the pulsed laser spectrum. The asymmetry may lead the false wind velocities even though the peak frequency is targeted one. Calculations are made using asymmetric spectrums to compare wind/temperature calibration curve. One example is shown in Figure 1 using a spectrum of a FWHM is 50 MHz and the center of mass is -3.5 MHz from the peak. Green and red lines represent the calibration curves using the broadened asymmetric spectrum described above and a line spectrum. The same data plot can be converted to the wind about -2 m/s which corresponds to -3.5 MHz. In the presentation, we discuss the difference between wind velocities as well as temperature difference.

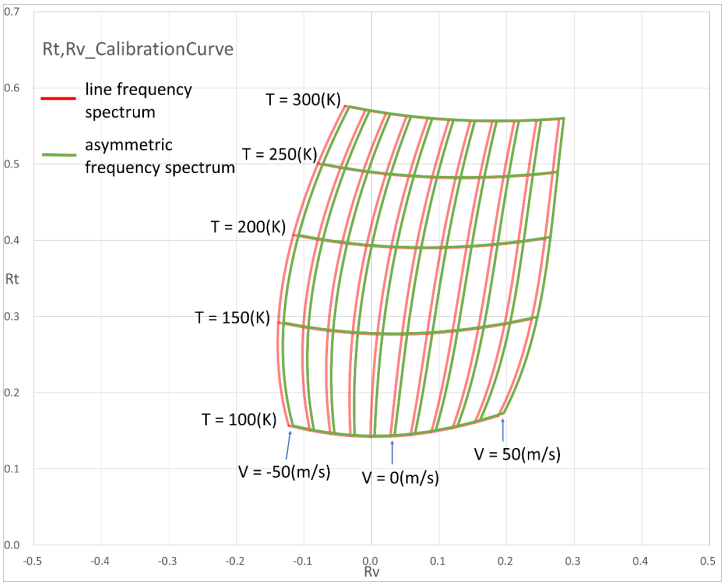

Figure 1. Calculated calibration curves using a broadened asymmetric pulsed laser spectrum and line spectrum.

References

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