Atmos. Meas. Tech. Discuss., 3, C2662–C2666, 2011
www.atmos-meas-tech-discuss.net/3/C2662/2011/

Atmospheric Measurement Techniques Discussions

Interactive comment on "Analysis of the application of the optical method to the measurements of the water vapor content in the atmosphere – Part 1: Basic concepts – the measurements of the water vapor content in the atmosphere with the optical method" *by* V. D. Galkin et al.

V. D. Galkin et al.

novikov_victor@mail.ru

Received and published: 9 February 2011

Dear Referee #2!

Thanks for your important and useful comments.

Of course, authors understand that the achievement of high accuracy by optical (photometrical) method is not easy and very multicomponent task. Therefore, it is necessary to discriminate the set of sequential steps in the solution of this task.

At first the high accuracy for photometric measurements of initial signal is needed as for laboratory sources (calibrated lamps), and for natural sources (Sun or stars). Today the millimagnitude accuracy of one measurement is really feasible both for laboratory and majority of natural conditions by means of variation of total exposure time. In our long-time practice of stellar photometric observations at Lindenberg we achieved the accuracy 5 millimagditudes with total exposure time no more than 2 min, even for no so good nights. It may be possible for our task, because only sufficient bright stars (no more than 3 visual magnitude) are used. Certainly, for natural calibrations only good nights with stable atmospheric conditions must be used.

In order to keep high initial accuracy during data processing, up to obtaining the final values of column water vapor content, it is necessary to analyze carefully the following factors: stability of instrumental photometric system, errors at definition of extraterrestrial star magnitudes, determination of time-trend of atmospheric extinction during observations (especially of the aerosol absorption in the boards of water vapor band), etc. Partially (for old observations) it is made by us in (Galkin et al., 2010). We plan to return to this analysis in a separate publication (Analysis of the application of the optical method to the measurements of the water vapor content in the atmosphere – Part 2: Intercomparison with data obtained by other devices and techniques) devoted to the analysis of the data, obtained in Lindenberg by various devices and methods in 1995-2007. Basic methodic details of observation and data processing were described in (Leiterer et al., 1998; Alekseeva et al., 2000; Novikov et al., 2010). The descriptions of different versions of Lindenberg's photometers were presented in publications (will be added to References):

Leiterer, U., and Weller M.: Sunphotometer BAS/ABAS for Atmospheric Research, WMO/TD, No. 222, 21-26, 1988.

Leiterer U., Naebert, A., Naebert, T., Alekseeva, G.: A new star photometer developed for spectral aerosol optical thickness measurements in Lindenberg, Contributions to Atmospheric Physics (Beiträge zur Physik der Atmosphäre), 68, 133-141, 1995.

Alekseeva, G. A.; Bogoroditskaya, N. V.; Mikhel'Son, N. N.; Novikov, V. V.; Olonova, T. P.; Pakhomov, V. P.; Sosnina, M. A.: Version of the optical system of the Pulkovo Stellar Photometer, Journal of Optical Technology, Volume 62, Issue 9, 629-630, 1995

Here we only mention shortly that sun photometers and old versions of star photometers (mentioned above) are equipped by interference filters. The parameters of these filters (including temperature dependences for star photometers) were investigated carefully before every season of observations. Certainly, for star photometers the collimated light beam was used. The sun photometers are thermo-stabilized. Since 2009 we are testing at Lindenberg the new thermo-stabilized star photometer with diffraction grating and CCD-receiver.

The main goal of presented discussion article (Part 1) is analysis of the possibilities for improving the accuracy of calibration integral water vapor contents to $\sim$1%, which will make it possible to use data obtained by optical photometry as an independent reference for other methods. Without solving this problem it is impossible to increase the real accuracy of final data essentially. And the ways of such solving are scheduled.

Unfortunately, today the optical method is not really independent (see pp. 5722-23 in Discussion). And we had to correct our water vapor contents scale, recalculating the parameters c with the use of a large volume of interpolated radiosonde data for every year of photometric observations. Fig. 5 is example. Really, we have radiosonde data with time-step 6 hours and sunphotometer's data every 10 min. Therefore, we are forced to use linear-interpolated data on X-axis. This is not quite correct procedure, and it can be used only for sufficient large volume of data (in our concrete case – 7154 values). Therefore, we can not use little parts of data for separate analysis. The overwhelming majority of points (5857 values, or 82%) are allocated in the basic range of X-axis (1-3), but these points are not separate visually. As the result we have very small uncertainties in C and m0. Also, we must mark the erratum on Fig. 5 in the value "sigma" (must be 0.044833, not 0.188585), and correct version of Fig.5 is attached. In too time it is possible to note some diversions of points from a straight line for small and very major water vapor contents, that testifies to insufficient accuracy of the accepted approximation. Therefore, μ depends on the interval of the water vapor contents, and tends to decrease with an increase of the latter. The parameter c depends on pressure. The height distribution of water vapor in the atmosphere varies within a wide range. The variations in the water vapor distribution affect the effective pressure of water vapor and thereby specify the value of parameter c. To a larger extent, the parameter c depends on the interval of the water vapor content for which the parameter was determined. All these factors should be studied and subsequently included into the processing algorithm, to maintain the accuracy of 0.5 % (already reached in photometric observations) and to decrease the error of calibration of the water vapor content closer to 1 %.

Thanks again, and best regards.

Victor Novikov, corresponding author.

Interactive comment on Atmos. Meas. Tech. Discuss., 3, 5705, 2010.

AMTD

3, C2662–C2666, 2011

Interactive Comment

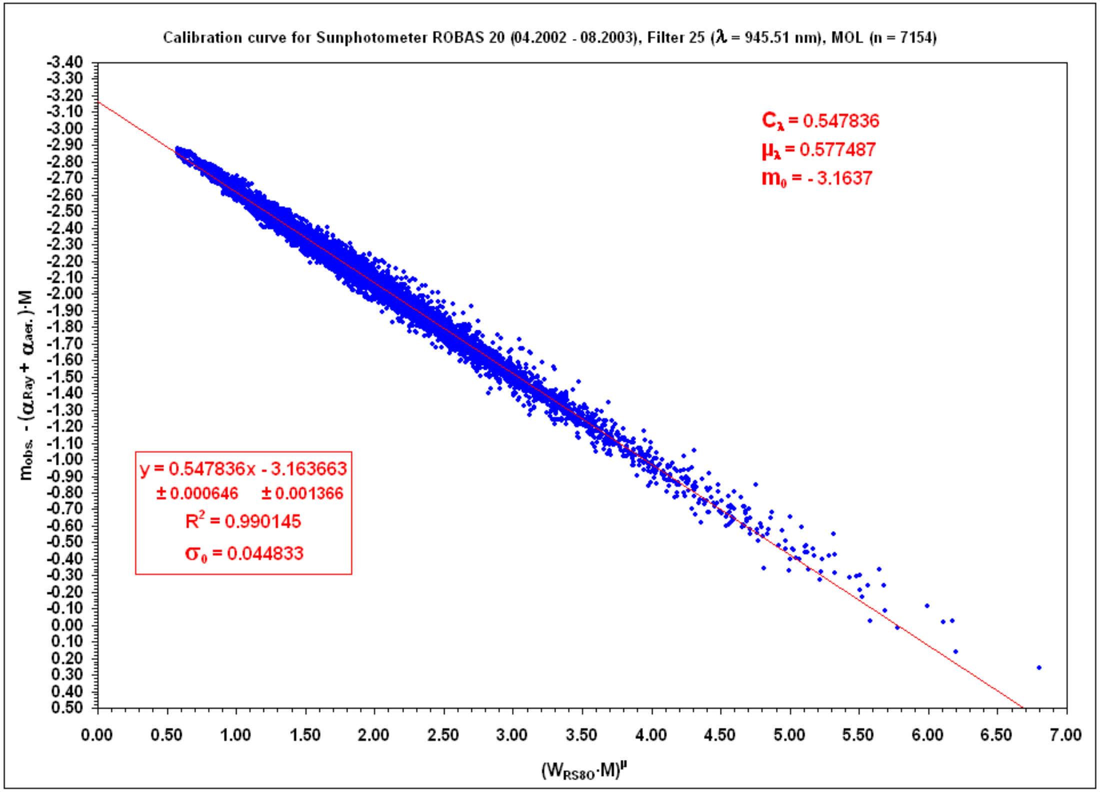

Fig. 1. Fig. 5 (corrected)

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper