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Quality assessment of integrated water vapour measurements at the St. Petersburg site, Russia: FTIR vs. MW and GPS techniques

Virolainen Y., Timofeyev Y., Kostsov V., Ionov D., Kalinnikov V., Makarova M., Poberovsky A., Zaitsev N., Imhasin H., Polyakov A., Schneider M., Hase F., Barthlott S., Blumenstock T.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

The cross-comparison of different techniques for atmospheric integrated water vapour (IWV) measurements is the essential part of their quality assessment protocol. We inter-compare the synchronised data sets of IWV values measured by the Bruker 125 HR Fourier-transform infrared spectrometer (FTIR), RPG-HATPRO microwave radiometer (MW), and Novatel ProPak-V3 global navigation satellite system receiver (GPS) at the St. Petersburg site between August 2014 and October 2016. As the result of accurate spatial and temporal matching of different IWV measurements, all three techniques agree well with each other except for small IWV values. We show that GPS and MW data quality depends on the atmospheric conditions; in dry atmosphere (IWV smaller than 6mm), these techniques are less reliable at the St. Petersburg site than the FTIR method. We evaluate the upper bound of statistical measurement errors for clear-sky conditions as 0.29±0.02mm (1.6±0.3%), 0.55±0.02mm (4.7±0.4%), and 0.76±0.04mm (6.3±0.8%) for FTIR, GPS, and MW methods, respectively. We propose the use of FTIR as a reference method under clear-sky conditions since it is reliable on all scales of IWV variability.

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