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COMPARISON OF RADIOPHYSICAL AND OPTICAL INFRARED GROUND-BASED METHODS FOR MEASURING INTEGRATED CONTENT OF ATMOSPHERIC WATER VAPOR IN ATMOSPHERE

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By virtue of their all-weather capabilities, the radiophysical atmospheric sensing methods allow one, in particular, to perform continuous observations of variations in the atmospheric content of water vapor being the most important natural greenhouse gas. The measurement station of St.Petersburg State University at Peterhof (59.88° N, 29.83° E) runs a number of ground-based instruments to determine total water-vapor content (TWVC) in the atmosphere. During a year period from September 2014 to September 2015, the TWVC was synchronously measured by two radiophysical methods, namely, the microwave and radio-refraction techniques, as well as the optical infrared method. Comparisons show that the average systematic and random discrepancies among the three methods amount to 0.3–0.5 *kg/m*^{2} *(*3–7%*) and* 0.4–0.6 *kg/m*^{2} *(*8–11%*), respectively. The maximum relative differences (up to 20%) among the results of different-type measurements are observed for very small TWVC values (below 5 kg/m*^{2}*). Empirical estimates of the random errors of the methods were 0.5, 0.3, and 0.3 kg/m*^{2} *for the radio-refraction, microwave, and infrared methods, respectively. The results of the TWVC measuring by the radio-refraction and microwave methods are in good agreement and yield greater values than those obtained by the optical method. The obtained discrepancies in the TWVC estimates are small compared with the published results of similar comparisons, which can, in particular, be attributed to the high spatiotemporal matching of various measurements.*

1. INTRODUCTION

Water vapor is the most important natural greenhouse gas in the Earth's atmosphere. Its contribution to the greenhouse effect is extremely variable and can reach 60% under the clear-sky conditions [1]. Water vapor also plays an important role in the water circulation (hydrobiological cycle), atmospheric chemistry, ozone-layer formation, energy transfer in the latent-heat form, etc. [2]. The observed warming should lead to an increase in the water-vapor content and intensify the further climatic variations even more [3]. Papers testifying to the presence of the long-term moisture-content trends at various atmospheric levels have been published in recent years (see, e.g., [4–8]). An important role of water vapor stimulated the development and use of numerous local and remote methods of its measurement. The radio-refraction method for determining the total water-vapor content (TWVC) on the basis of the measurements of radio signals of the Global Navigation Satellite System (GNSS) (see, e.g., [19]) has recently been more widely

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