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Retrieval of the middle atmosphere temperature profile from ground-based microwave sounding data using synchronous measurements of tropospheric water vapour

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Thermal structure of middle atmosphere is a key factor in dynamics and photochemical balance. Presently it is obtained almost exclusively by remote sensing techniques. Satellite based microwave and infra-red radiometric sounding techniques are the most popular as they provide whole globe coverage. The cost of global coverage is low time resolution considering certain small geographic region. Ground based microwave sounding, on the contrary, may provide the high time resolution in a spatial point of interest. Studying of fast local atmospheric processes is an example of an application where the latter is preferable. Rescently ground based microwave sounding of the middle atmosphere temperature profile was realised for the first time (see [1], [2]). However our preliminary investigation has shown that inadequate knowledge of water vapour distribution in the troposphere may in some cases ruin the retrieval procedure rendering the results heavily biased. To overcome this drawback, a development of the method has been proposed: new receiver was incorporated into the radiometry complex, and new version of retrieval procedure was implemented. The development consists in binding together measurements of stratospheric thermal structure and tropospheric water vapour distributions. Both measurements are retrieved from microwave radiometric data: spectrum of atmospheric self-radiation is measured in (52.5-53.5) GHz and (22-31.4) GHz bands.
In this report the improved retrieval procedure is described. It realizes Bayesian approach to treatment of ill-posed problems. The several versions on the algorithm using different parameterizations of the profiles and various prior constrains are presented. The work of the algorithm on simulated and real data is demonstrated. The real data was collected by radiometry complex installed in IAP RAS (Russia, Nizhniy Novgorod 56°20′N 44°00′E).

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