Statistical approach to atmospheric profiles retrieval from data of passive remote sensing of atmosphere

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The technique of retrieval of atmospheric parameters vertical profiles from atmosphere remote sensing data is suggested. The technique is based on the statistical (Bayesian) approach to solution of ill-posed inverse problems and aims to construct solution in a form of probability density function (PDF) of sought profile. The main idea of this approach is that finite accuracy of experimental data should ensure finite accuracy of finding a sought profile, thus demanding statistical description of the solution. Sought probability density function is obtained from both noise distribution function that is considered to be known and priory information about retrieved profile (regularization of the problem); necessity of the last is dictated by ill-conditionality of the problem solved. The method of regularization that provides the effective using of physically justified priory information of different types is developed. In this method the regularization is reached by following ways. First, priory restrictions that are imposed on the solution are specified by properties of employing function that approximates the profile. In this report the approximation by means of simplest artificial neural network is used. The number of neurons is a technical parameter that restricts the quantity of monotony sections forming the profile; it can be estimated from priory assumption of vertical structure of the atmosphere. Second, additional priory information is included by applying of special PDF of parameters of the approximating function. We use normal distribution for this purpose; dispersions of different groups of parameters regulate priory restrictions of certain types (profile smoothness, the range of sought quantity variation, and altitudinal localization of the profile). The suggested approach, as shown through model examples, provides more correct regularization in comparing with traditional methods. In particular technique capacity to detect sharp perturbation of the profile that is distinctive to vertical distribution of ozone during the ozone hole formation is demonstrated. Efficiency of suggested technique is demonstrated via retrieval of vertical ozone profile from data of ground-based passive microwave sounding of the atmosphere. The data used is a spectrum of atmospheric radiation temperature measured for frequencies that correspond to one of the ozone self-radiation lines. Ozone profiles over Kola Peninsula (Apatity, 67N) in winter 2002-2003 have been retrieved from frequency spectra recorded within 110 GHz ozone self-radiation line.