Simulation of the multiwavelength satellite lidar for detection of the aerosol concentration inversions in the lower atmosphere

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Airborne laser sensing systems showed their high efficiency for solving some problems of meteorology, ecology, atmospheric and ocean physics. Installation of such systems on satellites and orbital stations enables to significantly expand the capabilities of monitoring, which takes global and regular manner. The matter is real-time monitoring of the spatial field of the main parameters of the atmosphere, including, first of all, cloud fields, vertical structure of aerosol and gas composition of the troposphere, ecologically dangerous emissions of local scale, etc.

Aspects of the technique for laser sensing of the atmosphere from space were analyzed in earlier publications devoted to the spaceborne monitoring. Some projects developed earlier are technically realized to date. First cycles of investigations are carried out by means of the BALKAN Russian spaceborne lidar installed onboard the orbital station “Mir”. The successful experiment on multiwavelength laser sensing of the atmospheric column from onboard the spaceship of the “Shuttle” series was carried out in September 1994. The encouraging results of first lidar spaceborne experiments on the study of cloud fields, profiles of aerosol characteristics and some parameters of the underlying surface stimulate the problem of further involvement of this class of spaceborne lidars into the system of monitoring observations of the Earth. The project of creation of the network of small specialized satellites are realized within the frameworks of the “Etalon” Program of Russian Space Agency. The satellites are equipped with the detectors of different types (electric, magnetic, optical, and other) and are destined for prediction and revealing of the regions of the cataclysms, first of all, earthquakes. As one of predictors of an earthquake is the increase of the number density of the coarse mineral aerosol fraction in the boundary layer of the atmosphere, one of the satellites of the aforementioned network is assumed to be equipped with a multiwavelength lidar operating in the long-term automatic mode. This paper presents the estimates of the signal of the multiwavelength spaceborne lidar destined for revealing the aerosol inversions in the boundary layer of the atmosphere. The estimates are obtained on the basis of solution of the non-stationary transfer equation by the Monte-

Carlo method with the boundary conditions representing the real peculiarities of the detection-transmission system of the lidar. The basis optical model is capable of consideration of aerosol inversions of any origin, natural or anthropogenic. The obtained results enable to judge about the dynamic range of the signal in the prescribed spectral interval for different optical situations. The limit level of the noise is determined both of active origin and caused by the outgoing radiation under different optical-geometric conditions of operation of the lidar.