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Atmospheric effects of electron and muon components of cosmic rays: Sensitivity theory approach and data of operational satellite monitoring

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The results of a complex approach to the study of sensitivity of spatial distributions of electron and muon components of extensive air showers (EAS), measured by scintillation detectors, to variations in the temperature profile of the atmosphere are presented.
To describe the lateral dependence of the spatial distribution function of electrons in electron-photon cascades, the method of the adjoint equations and also the variational theory of sensitivity developed by the authors were used. Spatial distributions of electron and muon components of EAS, as well as the corresponding differential temperature coefficients, were simulated by the Monte Carlo method.
To assess the effect of variations in the temperature profile of the atmosphere on the lateral distribution of particles measured by scintillation detectors, satellite monitoring of main parameters of the system "atmosphere - underlying surface" was carried out in zones of Yakutsk complex EAS array and TAIGA observatory.
As a result of the studies, coefficients of differential sensitivity of the spatial distribution of electron and muon EAS components to variations in the temperature profile of the atmosphere were obtained for the first time. Corrective functions that relate the energy release in scintillation detectors of various thicknesses with the particles density above the detector at various distances from the shower axis were established.
Based on the obtained data, a method for correcting the EAS detectors readings in view of the temperature effect has been developed. It is shown that changes in the lateral distribution function of the EAS electromagnetic component due to variations in the atmospheric temperature profile in one annual cycle of operation can exceed 10%.

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