

**On methods of influencing electrical processes in clouds.**  
Mikhailovskii Yu. P., Sinkevich A. A., Abshaev A. M., Toropova M. L.  
Proceedings of MGO. 2021. V. 602. C. 6–22.

Electrical processes in clouds are closely related to microphysics and cloud dynamics and have a significant impact on the dynamics of flows and the formation of precipitation, including hail. Any impact on the clouds leads to a change in all processes. The article presents an overview of physical hypotheses, laboratory and field experiments to investigate the possibility of influencing electrical processes in clouds. It is shown that the effects of an ice-forming reagent are the most theoretically justified and experimentally confirmed. These impacts make it possible to influence the number and size of large ice particles. Which, in turn, determine the intensity of the cloud electrification processes. Works on the possibility of using electrical characteristics to control the effects on precipitation and hail are also considered.

*Keywords:* active influences, clouds, electrical processes, lightning, reagents, precipitation, hail.

Fig. 4. Ref. 53.

**Parameters of convective clouds during the transition to the thunderstorm stage according to the data of three-dimensional numerical simulation.**  
Toropova M. L. Proceedings of MGO. 2021. V. 602. C. 23–41.

The article presents a generalization of numerical experiments on modeling thunderstorm cells for six cases of thunderstorms in different regions of the world: the North Caucasus and the North-West region of the Russian Federation, Beijing (China). During the simulation, the physical processes taken into account were varied. The transition of convective cells to the thunderstorm stage is considered. The characteristic values of the parameters of the convective cell during the transition to the thunderstorm stage were obtained from the data of three-dimensional numerical simulation: the cloud top height, the vertical velocities in the cloud, the maximum radar reflectivity, the water content and ice content of the cloud, the precipitation rate, the volumes of the supercooled part of the cloud above the 0°C isotherm with a radar reflectivity threshold of 35 dBZ, time of the beginning of lightning activity.

*Keywords:* thunder cloud, numerical model, cloud electrification.

Fig. 2. Tab. 4. Ref. 20.

**A mathematical model of a lightning generator based on modern mechanisms of cloud electrification and its inclusion in the current circuit model.** Morozov V. N. Proceedings of MGO. 2021. V. 602. P. 42–67.

Two cloud models are analytically considered: a cylindrical one and a model in a Cartesian coordinate system. The main mechanism of electrification in both models is electrification during collisions of ice crystals with grain / hail particles. Electric fields are calculated in the models and outside. The boundary conditions for the transition from a cloud to a free atmosphere are determined. Key words:

*Keywords:* ice crystals, grains / hail particles, electrification, electric field strength.

Ref. 14.

**Characteristics of cirrus clouds from lidar measurements at Obninsk.** Korshunov V. A., Zubachev D. S. Proceeding of MGO. 2021. V. 602. P. 68–78.

The authors present the results of monitoring the crop formation conditions carried out using the Climate-Soil-Yield simulation system with current and forecast climate change in the Central and North-Western Federal Districts. The climatic risks of large crop failures were estimated for the period 1999—2018. It was found that the largest climatic risks in the territory under consideration, due to lack of moisture, in the Tambov and Lipetsk regions are 12 %. The largest climatic risk caused by soil re-wetting in the Leningrad Region is 37 %. Analysis is provided for efficiency of use of greater heat resources in crops production.

*Keywords:* cirrus clouds, lidar, optical depth of clouds, climatology of cirrus clouds.

Tab. 1. Fig. 4. Ref. 22.

**The efficacy of autonomous pyrotechnic generators of ice-forming aerosol under various conditions.** Shilin A. G. Proceedings of MGO. 2021. V. 602. C.79–91.

This article presents the results of laboratory experiments on testing pyrotechnic generators of ice-forming aerosol performed at the test bench of the horizontal wind tunnel of the Research and Production Association "Typhoon". The following generators were investigated: the head parts of the anti-hail rocket "Alazan-6" and ejectable flares PV-26 under conditions as close as possible to the real flight speed of these generators. The results showed that at a certain ratio of the mass flow rate of the pyrotechnic material of the generator and the speed of the blowing stream, is recorded anomalous functioning of the generator - the ignition of the gas jet outside the generator. In this case, due to the burnout of most of the components of the gas jet, fundamentally change both the composition and the properties of the formed ice-forming aerosol. In particular, there is a decrease in ice-forming activity of this aerosol by one or more orders of magnitude.

Keywords: ice-forming aerosol, ice-forming reagents, pyrotechnic generators, cloud-seeding processes, Alazan-6, anti-hail agents.

Fig. 6. Tab. 2. Ref. 7.

**Influence of soluble iodine compounds on the efficiency of ice-forming aerosol.** A. G. Shilin, B. M. Khuchunaev, A. Kh. Budaev. Proceedings of MGO. 2021. V. 602. C. 92–103.

The results of laboratory studies of changes of the activity of ice-forming aerosols of various chemical composition with time are presented. A hypothesis on the relationship between the change in the ice-forming properties of an aerosol particle and the content of soluble alkali metal and ammonium iodides in its composition is proposed. From the point of view of the authors, the introduction of iodides into the pyrotechnic composition leads to the realization of opposite tendencies: on the one hand, the amount of AgI that has passed into the vapor phase without decomposition during the combustion of the composition increases. The hygroscopicity of the formed aerosol and the likelihood of the immersion mechanism of nucleation increase. On the other hand, an increase in solubility AgI, due to complexation and relaxation of surface defects, possibly decreases the activity of the particle with time. Taking these trends into account will probably make it possible to come to an understanding of the need to develop various formulations of pyrotechnic compositions and aerosol generators: for direct use in the target area of the cloud and for exposure, which assumes a significant time before the aerosol enters the target area.

*Keywords:* ice-forming aerosol, active crystallization centers, ice-forming reagents, active influences, anti-hail agents.

Fig. 5. Tab. 2. Ref. 8.

**Evaluation of the effect of drop deformation of precipitation intensity with help of radar method.** Sozaeva L. T., Zhaboeva M. M. Proceedings of MGO. 2021. V. 602. P. 104–115.

The results of calculations of radar reflectivity and precipitation intensity using the parameters of the gamma distribution of drops received from observations are presented. Calculations were carried out on condition that the drops are spherical, drops have spheroid shape with and without electric field caused by natural thunderstorm activity. Based on the results of calculations, a Z-R relationship was formed. The analysis showed that the drop shape factor does not significantly affect the radar reflectivity in the absence of electric fields. But in the presence of an electric field, the shape factor makes a significant contribution to the radar reflectivity, and therefore, when calculating the intensity of precipitation by the radar reflectivity, it is necessary to make a correction of the drop shape.

*Key words:* backscatter cross sections, variable separation method, hydrometeors, radar methods, hail clouds, Z-R relationship.

Fig. 2. Tab. 2. Ref. 15.

**Analysis of the scheme of impact points in the Krasnodar anti-hail service.** Alita S. L., Borisova N. A. Trudy GGO. 2021. V. 602. P.116–123.

This article is devoted to the analysis of the scheme of placement of points of impact on hail processes in the Krasnodar anti-hail service. For the analysis, the author's methodology, that was earlier used for the analysis of the scheme of placement of impact points in the Stavropol anti-hail service, is also used here. For the analysis, the materials presented in the annual reports of the Krasnodar anti-hail service for the period from 2010 to 2019, were used. As a result, an assessment of the existing scheme of placement of impact points was given and recommendations for its optimization were developed.

*Keywords:* placement scheme, impact point, active impact, protected area, consumption of anti-hail missiles.

Tab. 2. Fig. 2. Ref. 4.

**Analysis of economic efficiency of anti-hail work in the Russian Federation.**

Liev K. B., Kushchev S. A. Proceedings of MGO. 2021. V. 602. P. 124–133.

The paper describes the physical and economic efficiency of anti-hail work over the past five years from 2016-2020. The costs of financing anti-hail services, as well as the rise in prices for anti-hail products, inflation and growth in prices for fuels and lubricants have been analyzed. For this work, the days of passing hail hits were analyzed and the dynamics of the consumption of anti-hail products was shown.

*Keywords:* hail, active influence, damage, hail cells, hail hazard, anti-hail products, economic effect, physical effect.

Fig. 2. Tab. 3. Ref. 5.

**The impact of observed climate change on the agricultural sector of the economy (the case of Pskov, Smolensk and Bryansk regions).** Pigoltcina G. B., Stadnik V. V., Zadvornyykh V. A., Fasolko D. V. Proceedings of MGO. 2021. V. 602. P. 134–166.

Changes in the main agro-climatic indicators of water availability and heat supply of cereal are presented. Quantitative estimates are given for the middle and end of the 21st century for the Russian Federation regions of the bordering on the Republic of Belarus. Adaptation measures for the grain crop production have been formulated.

*Keywords:* agro-climatic indicators, cereal, adaptation

Fig. 18. Tab. 4. Ref. 18.

**Informal memories.** Kiselev A. A. Proceedings of MGO. 2021. V. 602. P. 172–188.

In memory of Igor Leonidovich Karol.

*Keywords:* I. L. Karol, scientific activity, work at the Main Geophysical Observatory.