Modeling of Lightning Flashes in Thunderstorm Front by Constructive Production of Fractal Time Series

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Abstract. Using the tools of structural-synthesizing modeling, a set of constructors was developed. Implementing parametric multi-character constructors allows to form fractal sequences of characters. Constructor-converter from the character string to time series creates fractal time series, which determine the location, magnitude and decay rate of lightning discharges. Model video images of lightnings in the thunderstorm front are formed in accordance with the implementation of the constructor-assembler. All constructors are developed on the basis of the generalized constructor that was previously presented and repeatedly tested. The model adequacy of the model is confirmed by comparing the video image of the model with the image, what was obtained by NASA satellite. This approach can be the basis for solving the dynamic problems on lightning protection of engineering constructions and civil objects, and development of strategy of aircraft behavior in order to mitigate the risks of lightning strokes in the conditions of movement in the thunderstorm front.

Keywords: L-system · Constrictive-synthesizing modeling · Fractal · Lightning activity · Lightning flash · Thunderstorm front · Time series

1 Introduction

Standard monitoring and forecasting of hazardous thunderstorm phenomena are carried out in all countries on the basis of a unified program and regulatory documents. Such monitoring includes:

- regular monitoring of qualitative and quantitative indicators of the atmospheric thunderstorm state;
- collection, processing and storage of observations of thunderstorm phenomena;
- creation and maintenance of observational databases.

It becomes possible to conduct modeling experiments in order to develop adequate quantitative predictive models of lightning activity of thunderstorm fronts.

The study of patterns of spatial distribution of thunderstorms is the relevant and practically important problem for solving both the essential tasks of atmospheric

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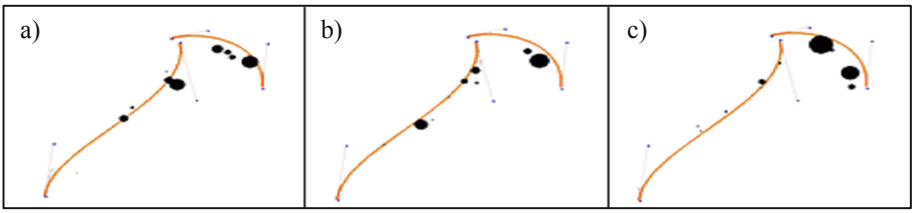

Fig. 5. Video frames of lightning flashes by improved model

4 Conclusions

Usage of modeling in the formation of lightning discharges based on the constructive-synthesizing approach allows obtaining the realistic description of the thunderstorm front lightning activity. This approach can be the basis for solving the dynamic problem on lightning protection of engineering constructions and civil objects, and development of strategy of aircraft behavior in order to mitigate the risks of lightning strokes in the conditions of movement in the thunderstorm front.

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