Improving the nowcasting of hazardous weather phenomena by assimilation the lightning-seeking network data

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INTRODUCTION

This study presents results of the nowcasting system preparation of thunderstorms, hail and squalls using the lightning-seeking network.

The forecasting technique is based on the direct numerical simulation of convective cloud electrification in the points with lightning observation.

MAIN GOALS

1. Sensitivity analysis of the electrification model and the critical value of the electric field intensity to the distribution of hydrometeors in convective clouds.
2. Application of lightning-seeking networks data in the forecast of severe convection using the cloud electrification model.

CUMULONIMBUS ELECTRIFICATION MODEL DESCRIPTION

Cb electrification model is a set of equations describing the processes of the generation and separation of electric charges in convective clouds. The input data (air temperature, wind speed, fractions of liquid and solid cloud particles) for the electrification model are obtained by the mesoscale model WRF-ARW.

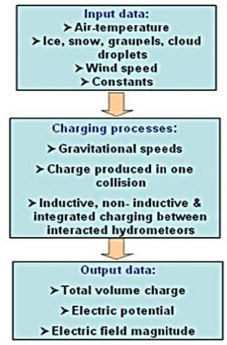

Fig 1. General scheme of the Cb electrification model

SIMULATION RESULTS OF INTENSIVE CONVECTION EVENT OVER 13-14 OF JULY, 2016




According to the Fig. 2 zones of convection (thunderstorms, rains and presipitations) are predicted more realistically with distribution described in Thompson parametrization and the threshold for lightning initiation of the electric field intensity sat to 260 kV/m. For the case of threshold of 250 kV/m there are much more zones of false alarms of predicted convection.

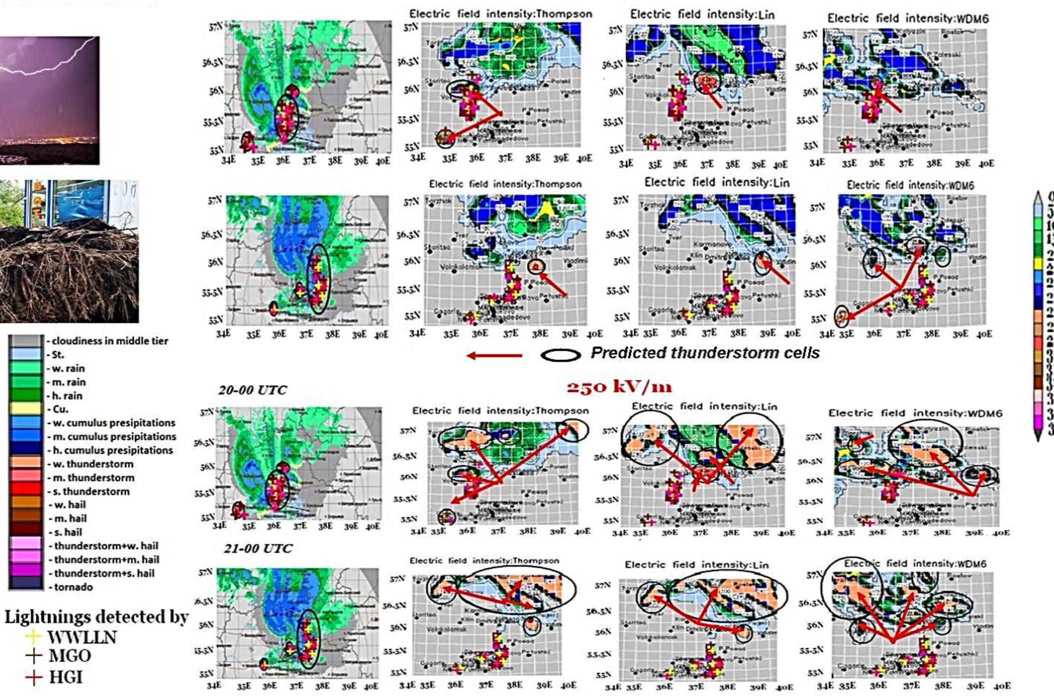

Fig.2. MCC according to DMRL-S radar maps and simulated electric field intensity (kV/m) at 20-00 UTC and 21-00 UTC 13.07.2016 over Moscow region with set two thresholds for lightning initiation.

VALIDATION

Fig. 3. Coverage of the territory of Russia by lightning–seeking network data

Lightning-seeking networks mainly cover only the European Part of Russia.

Parameter	WWLLN	HGI	MGO	TOA
Date/ time/location	+	+	+	+
Diapasons	3-30 kHz	1kHz-118 MHz	1-100kHz	1,5 kHz-1 GHz
Polarity & current amplitude (kA)	-	+	-	+
Lightning type	-	+	-	+
Lightning discharge energy (J)	+	-	-	-
Time error mistake	+	-	-	-

TOA has more parameters in lightning output data and more wide range of diapason detection.

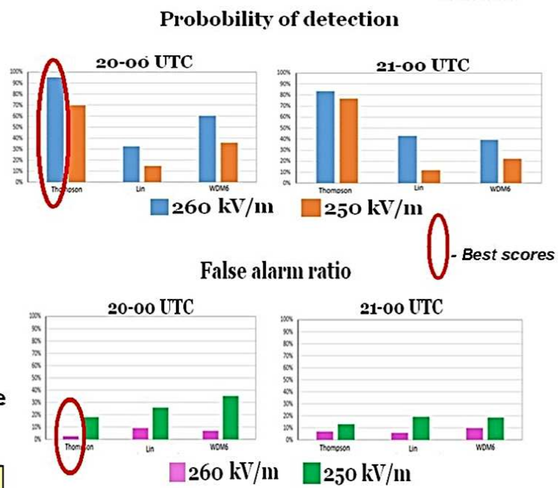

Fig. 4. Comparison of predicted thunderstorms with lightning-seeking data

The highest score of probability of detection and the lowest false alarm ratio are found for the cloud particles distribution described in Thompson parametrization and using the critical value of the electric field intensity set to 260 kV/m.

CONCLUSIONS

1. Electrification model of Cb is ready for the lightning-seeking data assimilation problem within the task of the nowcasting of severe weather.
2. Lightning data from all available lightning-seeking networks are gathering to our data base.
3. Studies of the quality lightning data analysis has been started.

FUTURE WORK

The next step of investigation will be analysis of effect proxy data in points of lighting observation.

ACKNOWLEDGEMENTS

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