INTRODUCTION

Several studies (Williams et al., 1999; Lang et al., 2000; Sooob et al., 2004, etc.) established a relation between lightning characteristics and severe events such as tornado and large hail. The limited number of studies concerning lightning activity of thunderstorms developed over Bulgaria showed that there is a significant difference between lightning characteristics in thunderstorms producing hail, heavy rain and weak rain. The present work is directed to study if there are peculiarities in lightning characteristics during the lifetime of different types of severe hail producing thunderstorms developed over Bulgaria.

III. RESULTS

The highest lightning activity (flash rate and multiplicity) is observed during the lifetime of the evolved from a multi-cell into a supercell MСC thunderstorm. The mean and maximum values of FR in MCC and SC are remarkably lower than in MCC.

<table>
<thead>
<tr>
<th>Flash rate per 4 minutes</th>
<th>Multiplicity</th>
</tr>
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<tbody>
<tr>
<td>Positive mean max</td>
<td>Negative mean max</td>
</tr>
<tr>
<td>MC</td>
<td>1.2</td>
</tr>
<tr>
<td>SC</td>
<td>2.1</td>
</tr>
<tr>
<td>MSC</td>
<td>11.2</td>
</tr>
</tbody>
</table>

* There is a positive time lag between the jumps of both flash rate (Fig. 1) and multiplicity of negative strokes (Fig. 2) and large hail falls in the three analysed thunderstorms.

* The jump of FR in MCC and MSC is accompanied by a sharp increase of H45 and H54. During the large hail falls, the FR decreases in MCC and SC but reaches maximum values in MCC (Fig. 1).

* The maximum values of multiplicity of negative flashes in the three storms are before the falling large hail on the ground (Fig. 2). The highest value of 16 is registered in MCC while maximum values in MC and SC are 6 and 7, respectively.

* A correlation between H45 and FR averaged in 1 km bins is established.

Based on the assumption that the radar volume fraction for grappled cloud with the volume of reflectivity 45 dBZ, one can speculate that these results are consistent with the non-inductive charging mechanisms (Saunders, 1993).

IV. CONCLUSION

The main results are:

* There is a positive time lag between the jumps of both multiplicity and flash rate and large hail falls in the three analysed thunderstorms.

* Significant numbers of positive strokes are detected in both supercell SC and MSC. The highest percentage of positive strokes is observed during the period of large hail falls on the ground.

* The highest lightning activity (flash rate and multiplicity) is observed during the lifetime of the evolved from a multi-cell into a supercell MCC thunderstorm. The mean and maximum values of FR and multiplicity of negative strokes in MCC and SC are remarkably lower than in MCC.

The present study reveals that most of the lightning signatures in the studied severe thunderstorms developed over Bulgaria are similar to those in other geographical regions. The established jump in the flash rate before large hail falls is in accordance with the results reported by Sooob et al. (2004), Kane (2001), and Williams et al. (1999). The detected significant numbers of positive strokes in both supercells correspond to the results obtained by other authors (e.g. MacGorman and Burgess, 1994; Stolarski, 1994; Carey and Rutledge, 1998; Lang et al., 2004; Wams et al., 2006) and according to MacGorman and Burgess (1996) this can be explained by the structure of supercell storms. One can speculate that the significant difference in flash rate in MCC, SC and MCC thunderstorms support the conclusion by Fehr et al. (2005) that the convective organization plays a crucial role in the lightning development.

To answer the question if there is a relationship between an extremely high flash rate in MSC (FR per 4 min) and the presence large hail (greater than 6 cm), more hail producing thunderstorm developed over Bulgaria have to be analyzed.

V. ACKNOWLEDGMENTS

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