On thunderstorm quantification

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1 Introduction

The SAFIR/PERUN network system provides lighting information in six categories: cloudto-ground (CG) flashes divided into return and subsequent strokes (Rs and Ss), intracloud discharges (IC), where the emission (nodal) points of IC strokes are subdivided into (ICs)tart, (ICi)ntermediate and (ICe)nd points and Isolated emission points (Is). This information is essential for implemented Thunderstorm Potential prediction system http://awiacja.imgw.pl/in dex.php?product=burze, Parfiniewicz, 2012. It occurred that one thunderstorm is not equal to another and special scale to (objectively) quantify (measure) thunderstorm activity is needed so that one can learn the system proper prediction. Operational monitoring of the tornados that were observed over Poland in summer season of 2012 showed that this extreme (Tornado or Downburst - ToD) events are strictly correlated to IC number of flashes [NoF] aggregated in cells over $\pi(15km)^2$ area within 10 minute interval.

2 Action & Result

The review of the polish press reports and investigation of the SKYWARN POLSKA http://lo wcyburz.pl/ archives, including personal contact with A. Surowiecki (the Polish Skywarn representative) led to collecting twenty dates with extreme ToD events. More, A.Surowiecki has been given an eye-witness Fujita value to each event. Now, the statistics over 27887 aggregated cells, filtered in many possible ways has been constructed to fit to expected Fujita [F] values. The best filter for strong ToD events with $[F] \ge 1$ (more or even) giving correlation $R \approx 0.85$ reads:

 $[F] = a \times \sqrt{b \times ICs + c \times ICi} + d$ under condition Rs > 1 & ICs > 70 [NoF]

where: a = 0.047, b = 0.7, c = 0.3, d = 0.22and ICs, ICi are measured in $[NoF/\pi 15km^2 \cdot 10min]$

For less severe events with $0 < [F] \le 2.5$ another indicator-filter which includes CG flashes (Rs > 0) is being recommended:

 $[F] = a \times \sqrt{b \times ICs + c \times Rs} + d \times \sqrt{ICs \times Rs}$ where: a = 0.088, b = 0.624, c = 0.112, d = 0.264.

3 Some statistics

Mean values of NoF for:

Is	ICs	ICi	ICe	Rs	\mathbf{Ss}	
42.7	69.5	161.5	63.7	58.1	29.2	\Leftarrow all aggregated cells
180.2	233.6	498.3	227.3	286.4	159.1	\Leftarrow severe cells

Table 1: Mean values of NoF.

4 Caution

Presented numbers may strongly depend on sensitivity thresholds applied by PERUN producers to the particular application.

References

- Parfiniewicz J., 2012: Concerning Thunderstorm Potential prediction. The European Meteorological Society Annual Meeting and 9th European Conference on Applied Climatology, Łódź, Poland, 10-15 September 2012. Abstracts vol. 9, EMS2012–81.
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