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Thunderstorm Potential prediction - thunderstorm quantification issue.

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1. Introduction

What is essential to obtain an effective thunderstorm prediction is, firstly, to operate self-learning algorithms, secondly, to posses skills to quantify the strength of convection and thunderstorm severity, and, finally, to organize an end-user oriented warning system. The prediction system, http://awiacja.imgw.pl/index.php?product=burze , is fed by the SYNOP (code WW) data and the PERUN data. Till now, the PERUN data was used only to confirm or deny the thunderstorm evidence, but not to quantify their strength. However, it appears that for tornado incidents previous thunderstorm severity scale is not adequate to teaching the prediction system about these extreme cases. Thus, it becomes the most important issue for further forecasting. The SAFIR/PERUN network system provides lighting information in six categories: cloud-to-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). 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 $\pi(15\text{ km})^2$ area (what is equivalent to significant enhancement) within 10 minute interval.

2. Action & Result

The review of the polish press reports and investigation of the SKYWARN POLSKA http://lowcyburz.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] $\geq$ 1 (more or even) giving correlation R≈0.85 reads:

$$[F]=a \times (b\times\text{ICs}+c\times\text{ICi})^{1/2} + d \text{ under condition Rs}>1 \text{ \& ICs}>70 \text{ [NoF]}$$

where: a=0.047, b=0.7, c=0.3, d=0.22

and ICs, ICi are measured in [NoF/ π15kmˆ2•10min.]

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

$$[F]=a \times (b\times\text{ICs}+c\times\text{Rs}+\text{d}\times(\text{ICs}\times\text{Rs})^{1/2})^{1/2}$$

where: a=0.088, b=0.624, c=0.112, d=0.264

3. Some statistics

Mean values of enhanced NoF for aggregated cells - all vs. severe:

Is ICs ICi ICe Rs Ss

42.7 69.5 161.5 63.7 58.1 29.2 <= all aggregated cells

180.2 233.6 498.3 227.3 286.4 159.1 <= severe cells

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 9^{th} European Conference on Applied Climatology, ód, Poland, 10-15 September 2012. Abstracts vol. **9**, EMS2012–81.

http://meetingorganizer.copernicus.org/EMS2012/EMS2012-81.pdf

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