UTILIZATION OF LIGHTNING DATA IN THE CZECH HYDROMETEOROLOGICAL INSTITUTE

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I. INTRODUCTION

The Czech Hydrometeorological Institute (CHMI) utilizes lightning data from the Central European Lightning Detection Network (CELDN) since May 1999 in free experimental mode and since 2002 fully operationally on commercial basis. The CELDN is operated by Siemens AG. It was created by combining LF sensors from German BLIDS network, Austrian ALDIS network and several new sensors installed in Czech Republic, Poland, Slovakia and Hungary. CELDN is primarily targeted on detection of cloud-to-ground (CG) lightning but intra-cloud (IC) lightning detection is also available. CELDN sensors are of the same type but several models that differ in detection efficiency mainly for IC lightning, see Fig. 1. Some of sensors were upgraded during last years.

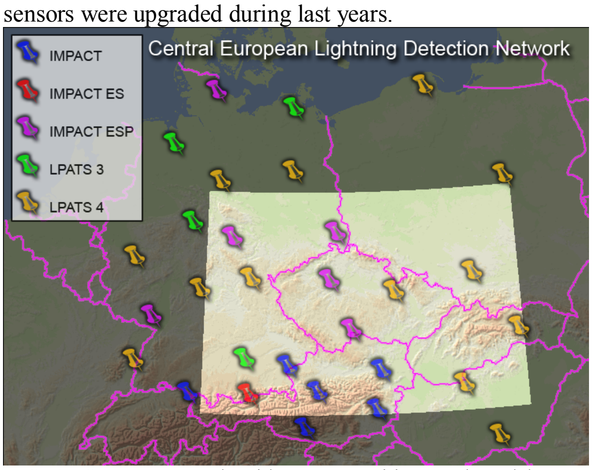

FIG. 1: CELDN network with sensor positions and model as on 24.5.2005, from Euclid webpage. Light area depicts domain of data availability in the CHMI.

II. PRESENTATION OF RESEARCH

In the CHMI, lightning detection is mainly used for nowcasting of severe storms as an important addition to the radar and satellite measurements. Lightning data are operationally combined with other remote sensing data using web-based visualization tool JSMeteoView (Novák, 2007).

Lightning data are also used by some nowcasting systems recently developed in the Czech Republic. Convective cell tracking system CELLTRACK (Kyznarová and Novák, 2009) uses lightning data as an additional indicator of severity of detected cells. Lightning data are also used as one of the predictors in the advective statistical model SAM (Sokol, 2008).

As a time span of available lightning data increases also long-term characteristics are demanded by some users. These long-term characteristics could be also very useful for evaluation of quality of the lightning data. Quality information of the lightning data is helpful during their implementation into nowcasting systems. In most cases the long-term characteristics are calculated for the 2002-2008 period because not all CELDN sensors were available during experimental period 1999-2001 and there were also lots of data dropouts in this experimental phase. Decrease of number of CELDN strokes during experimental phase can be easily seen from fig. 3 where monthly amounts of CG strokes in the Czech Republic are compared with number of strokes detected on synoptic stations. Total of 2 983 971 lightning strokes were detected in the Czech Republic territory in 2002-2008 period. CG strokes comprise 68% (2 042 570) and IC strokes 32% (941 401) of all strokes. Furthermore 81% (1 649 837) of CG strokes were negative and 19% (392 733) were positive.

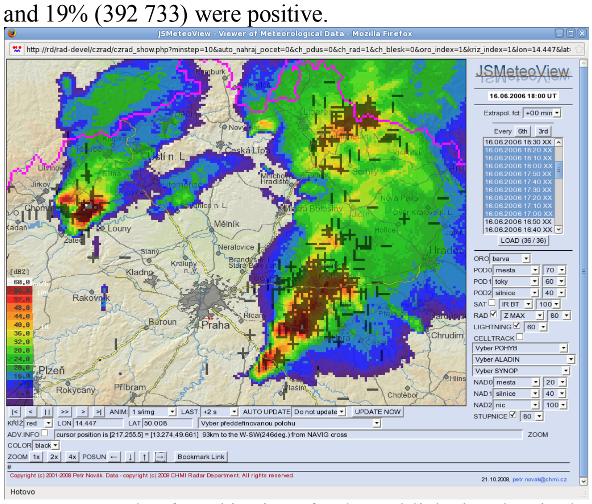

FIG. 2: Example of combination of radar and lightning data in the JSMeteoView application.

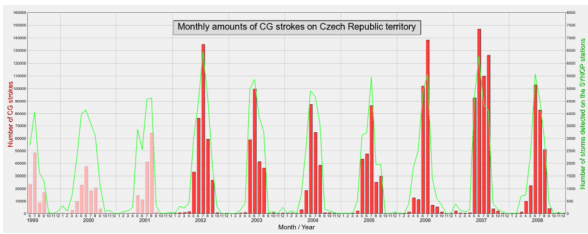

FIG. 3: Monthly amounts of CG strokes and storm records.

Fig. 4 and 5 show monthly and hourly distribution of CG strokes that corresponds well with station observations. On fig. 4, too many days with at least one detected CG stroke indicate that CELDN network produces some small amount of false strokes. Fig. 6 depicts spatial distribution of annual average of CG strokes in 1x1km resolution. Detailed analysis of distribution field showed very well localized local maxima of CG density that correspond to the transmission towers. Small width of these maxima confirms approx. 1km accuracy of lightning localization.

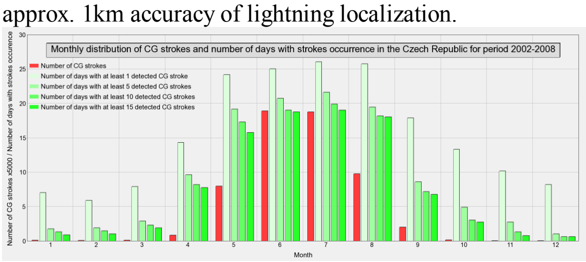

FIG. 4: Monthly distribution of CG strokes and days with detected strokes.

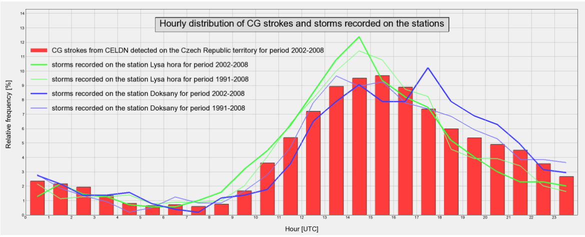

FIG. 5: Hourly distribution of CG strokes and storm recorded on the synoptic stations Doksany and Lysá hora.

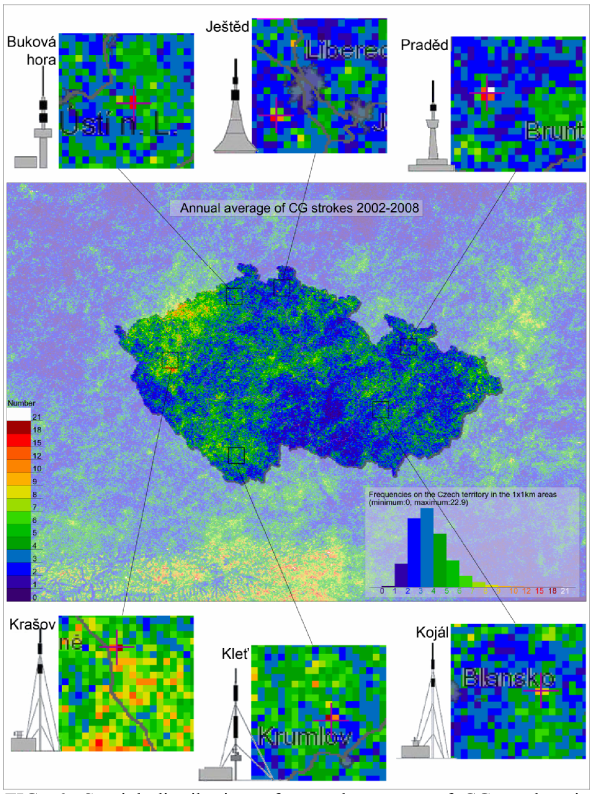

FIG. 6: Spatial distribution of annual average of CG strokes in 1x1km areas. Zooms show detection of increased number of strokes into transmission towers, whose locations are shown by violet crosses.

Fig. 7 shows weak dependency of increasing CG strokes density with higher altitude. Fig. 8 depicts spatial distribution of annual average of days with occurrence of at least 2 CG strokes in 15km vicinity. This combination of limits for number of strokes and vicinity range best corresponds to the number of days with storm observed on the stations. Spatial distributions in fig. 6 and 8 don't fully correspond with station observations. This is probably caused mainly by short time period. Inhomogeneous coverage by the CELDN sensors probably doesn't have significant influence on the CG distribution but has a big impact on the IC distribution (strong decrease of IC strokes density outside the range of IMPACT ESP sensors). This limits usability of IC strokes for the nowcasting systems.

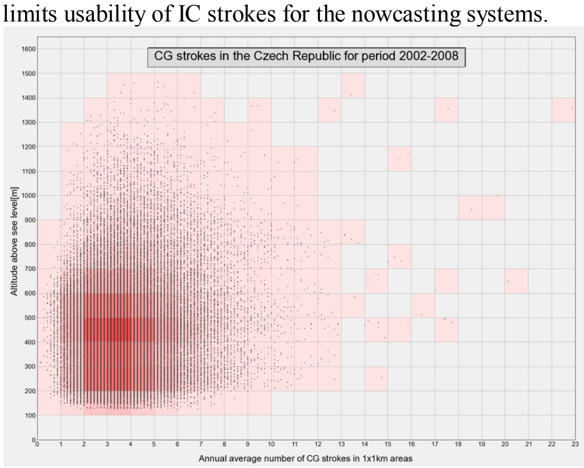

FIG. 7: Dependency of annual average number of CG strokes on altitude. Individual crosses represent value for 1x1km areas in the Czech Republic territory. Intensity of red colour depicts number of crosses in individual intervals.

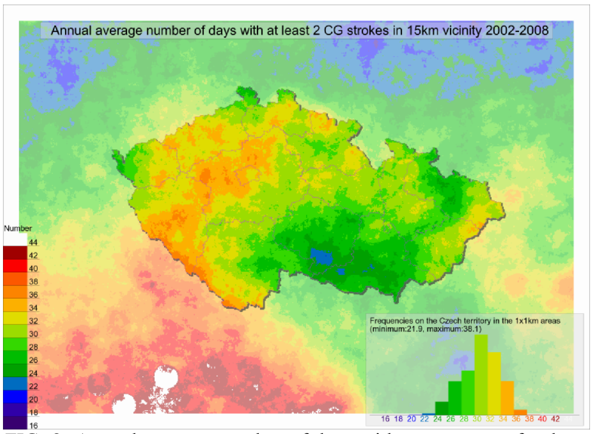

FIG. 8: Annual average number of days with occurrence of at least 2 CG strokes in 15 km vicinity.

III. RESULTS AND CONCLUSIONS

CELDN lightning data are useful additional remote sensing information for convective storms nowcasting and warning. Long-term characteristics of lightning strokes can be useful for development of nowcasting systems.

IV. AKNOWLEDGMENTS

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V. REFERENCES

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