Long Data Series Analysis- Satellite Climatology of Thunderstorm- Poland Experiences.

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„Estimate storm lifetime and identify intensifying and/or decaying storms via anvil expansion rate and areal coverage trends of cold IRW BTs. Choice of BT **thresholds** used in this analysis should be based **on climatological characteristics of convection over a given region**. Thresholds described in the literature for use with storms over the tropics may not be applicable to mid-latitude regions due to differences in tropopause height."

Work on thunderstorm climatology with use of satellite, lightnings and synoptic data start at IMWM in 2008. Mainly for purposes mentioned above.

based on :

Storms occurrence in Poland – analysis of synoptic stations observations vs. lightning detection system PERUN/SAFIR measurements

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Fot. M. Maciejewski
IMGW Bialystok

A. Previous climatological studies were mainly based on records of visual observations performed at meteorological stations. Detailed and continuous information on lightnings from Perun/Safir lightning detection system are available in Poland for several years.

The goal is to make an attempt to compare and verify storm days occurance in Poland with the use of data from both systems.

B. The study has mainly methodological character.

❑ meteorological observation series on thunderstorms from 52 synoptic stations for the period 2004-2008 - Institute of Meteorology and Water Management (IMGW) network ;

❑ lightning detection measurements from Perun lightning detection system based on Safir/Vaisala technology for the period 2004-2008 - Institute of Meteorology and Water Management (IMGW) network ;

❑ Satellite data from EUMETSAT geostationary Meteosat9 satellite – channel IR 10,8 um - received and processed in IMGW /Krakow branch for 2008;
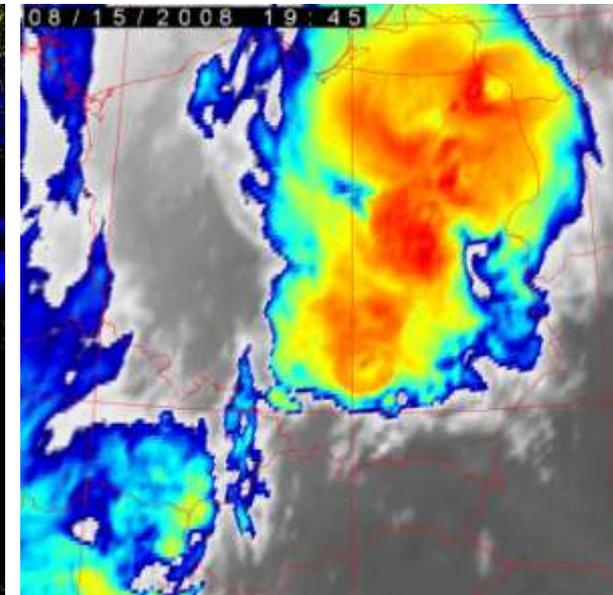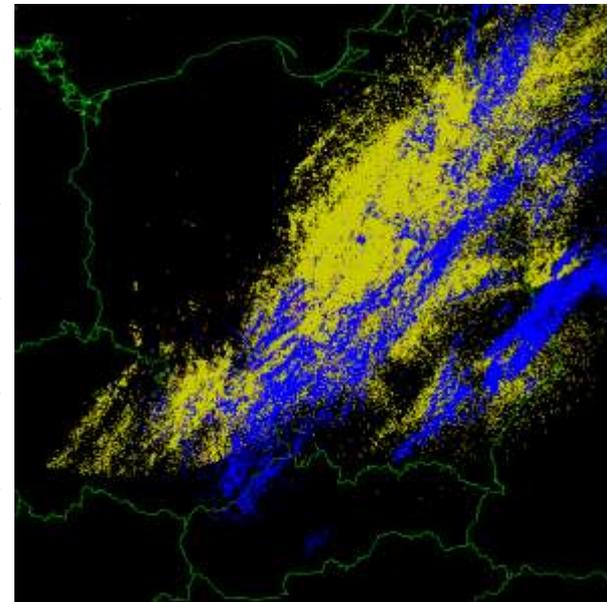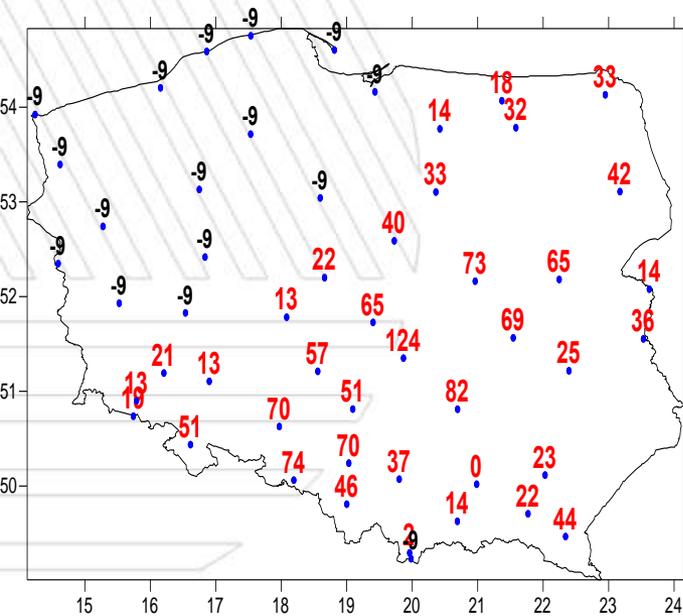
20080815 Thunderstorm occurence,

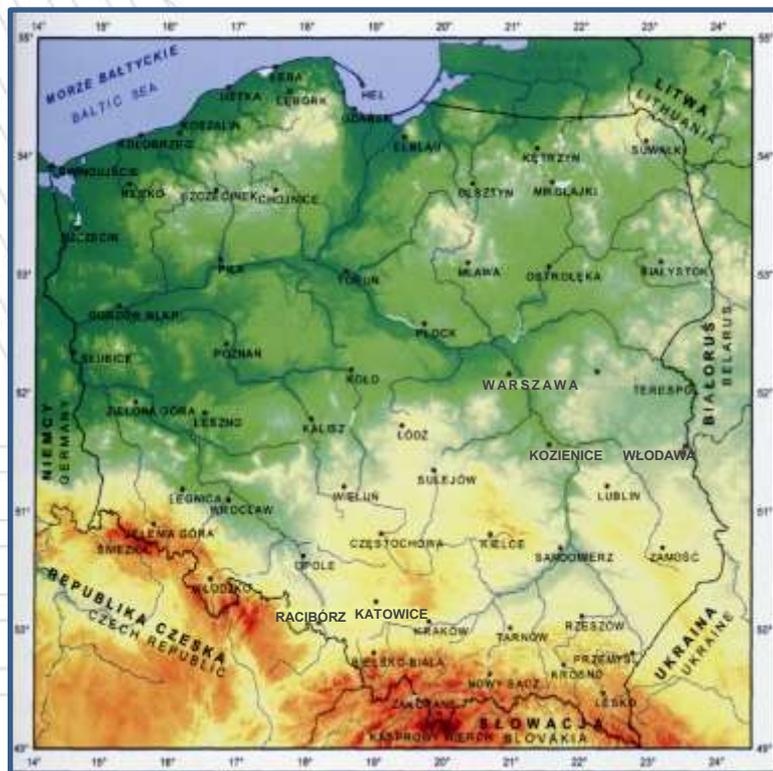Thundermstorm was noted on 36/52 synoptic station – the longest for 12,4 hour was noted in Sulejow

20080815 Perun,/Safir , cumulative - all day,

blue CG-, red CG+, Yellow CC.Amount of all discharges: ~. 242 000, Amount of CG (+and -): ~82000 (58 % montly sum) Source of inf. G.Beblot)

20080815 1945 UTC, MET9 - IR 10.8 M.Setvak palette. Image every 15 minute. Min Cloud top brightness temperature : -68 C.

Day with thunderstorm . Synoptic observations.

❑ **A day with a thunderstorm became a basic, universal index that shows thunderstorm occurrence.**
❑ On synoptic station the thunderstorm is noted when a thunder is heard by observer. The exact time of beginning and duration should be noted .
❑ A day with a thunderstorm was understood as a day (between 00:01 UTC and 24:00 UTC) when at least one thunderstorm occurred;


Location of the synoptic stations with the relief (Ustrnul, 2009)

Local database build on data come from IMGW /CBDH

station	year	month	day	hail	thunderstorm	lighting
690	2004	5	24	-9	-9	0
690	2004	5	25	-9	-9	0
690	2004	5	26	-9	17	0
690	2004	5	27	-9	-9	0
690	2004	5	28	-9	-9	0
690	2004	5	29	-9	-9	0
690	2004	5	30	-9	-9	0
690	2004	5	31	-9	-9	0
690	2004	6	1	-9	-9	0
690	2004	6	2	-9	-9	0
690	2004	6	3	-9	-9	0
690	2004	6	4	-9	26	0
690	2004	6	5	-9	-9	1
690	2004	6	6	-9	11	0
690	2004	6	7	-9	-9	0
690	2004	6	8	-9	22	0
690	2004	6	9	-9	15	0
690	2004	6	10	-9	11	0
690	2004	6	11	-9	-9	0
690	2004	6	12	-9	-9	0
690	2004	6	13	-9	-9	0

-9 / 0 – phenomenon did not occur, 1 – phenomenon occurred,
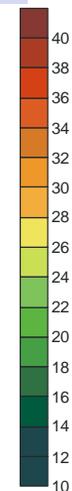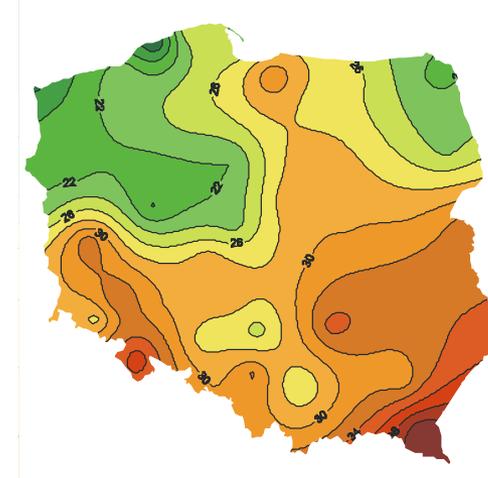22 – thunderstorm / hail lasted 2.2 hour

A day with thunderstorm – universal index. Synoptic observations.
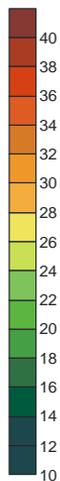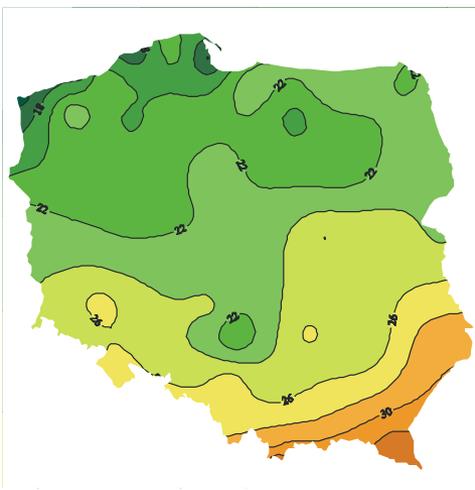
Average number of days with thunderstorm in Poland in the period **1949-1998**
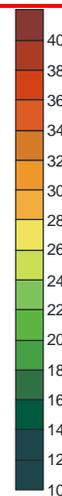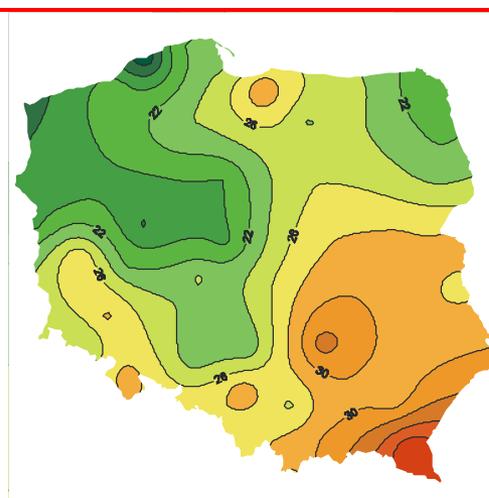
Average number of days with thunderstorm in Poland in the period 2004-2008.

Average number of days **with thunderstorm and / or lighting** in Poland in the period 2004-2008


- Poland averages **24** thunderstorm days per year.

- This number depends on the region. In Tatra Mountains and in the most south-eastern part of Poland more than 30 days with a thunderstorm are observed in a year, which is twice as many as it is at the sea coast -15 days.

- The highest numbers are recorded in the Tatras, where at Mt. Kasprowy Wierch **54** thunderstorm days were recorded in 1963.

- Most of the thunderstorms (96%) occur between April and September, and the incidence peaks in July with an average of 5.6 days.

Polish network of lightning detection and localization. PERUN. Source:www.IMGW.pl

Accuracy of lightning localization (from 0 to 7 km). Thanks to W.Gajda
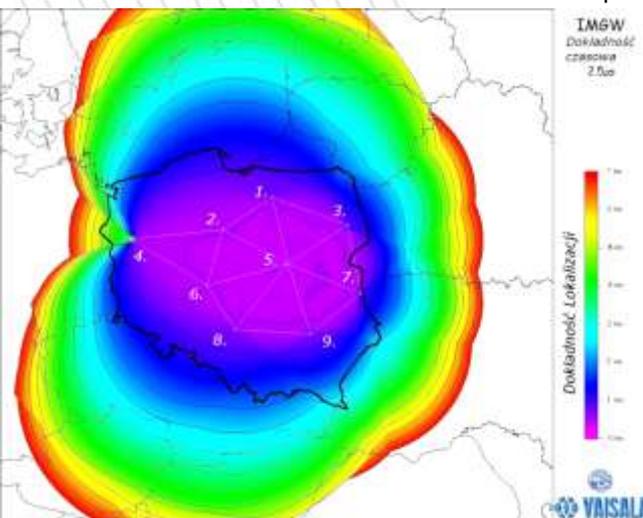
o The PERUN system detects changes in electromagnetic field connected with lightning discharge.

o There is discrimination between Intercloud (IC/CC) and Cloud to Ground (CG) discharges.

o The exact location of discharge is based on three (CG) or two (CC) stations.

Date	Time	System Status	Lightning	Reserved 1	Datation	Latitude	Longitude	Discrimination	Position error	Stroke number	Rise Time	Decay Time	Amplitude	Current	Current error	DS #1	DS #2	DS #3
28/07/2004	16:35:42	10	1	0	3825	509220	281884	4	807	1	36	33	-137	-5851	73	9	5	8
28/07/2004	16:35:48	10	2	0	607	490113	247294	4	495	1	30	23	-53	-2450	79	5	8	7
28/07/2004	16:35:48	10	2	0	7696	532538	265956	4	441	1	54	42	-90	-3563	151	1	4	5
28/07/2004	16:35:51	10	1	0	4459	524571	270944	4	664	1	38	35	-106	-2792	71	9	5	8

IC   Inter cloud discharge
CG   Cloud to Ground discharge
Latitude   In 10-4 degrees
Longitude   In 10-4 degrees
Discrimination   0:isolated point; 1:start; 2:point; 3:end of IC lightning 4: return stroke; 5:subsequent CG lightning
Position error In 10 m
DS #1   First station used for localization (for IC and CG)
DS #2   Second station used for localization (for IC and CG)
DS #3   Third station used for localization (onlyfor CG)

o All discharges **CC + CG** were processed 2004-2008

oPerun data were gridded and apearance or lack of discharge were noted.

o Possible problems
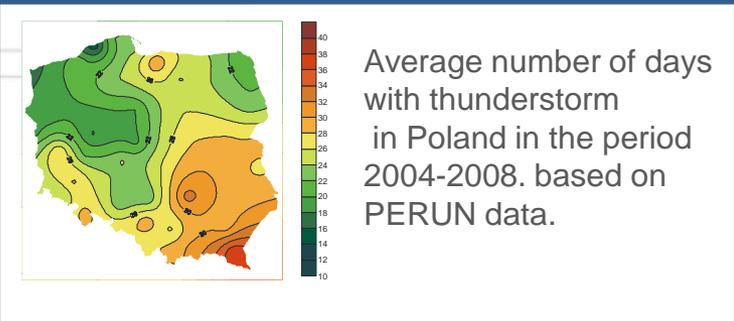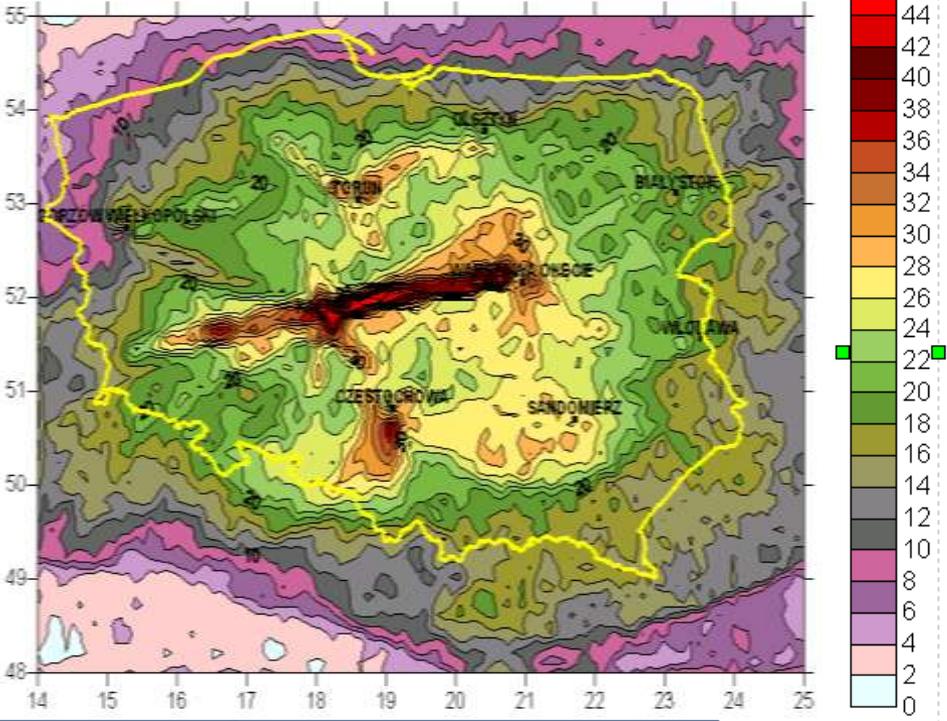
1. Artificial tracks of discharges connected with detection stations(?).

Picture: W.Gajda

2. Lightning on the clear sky

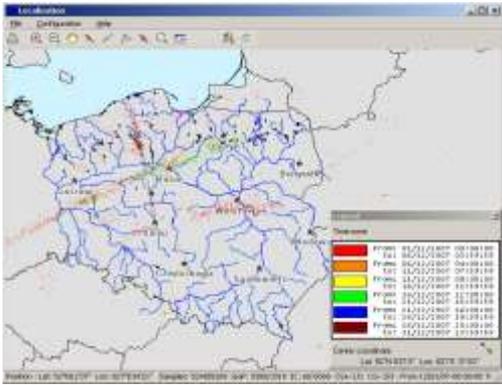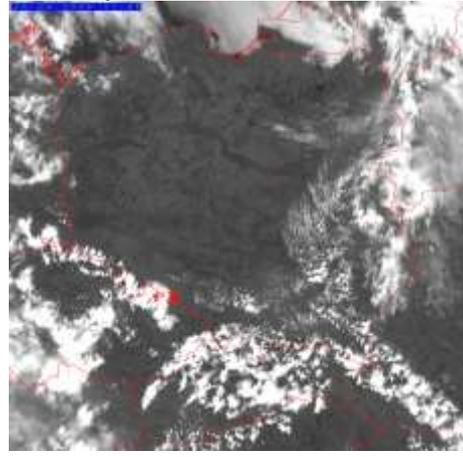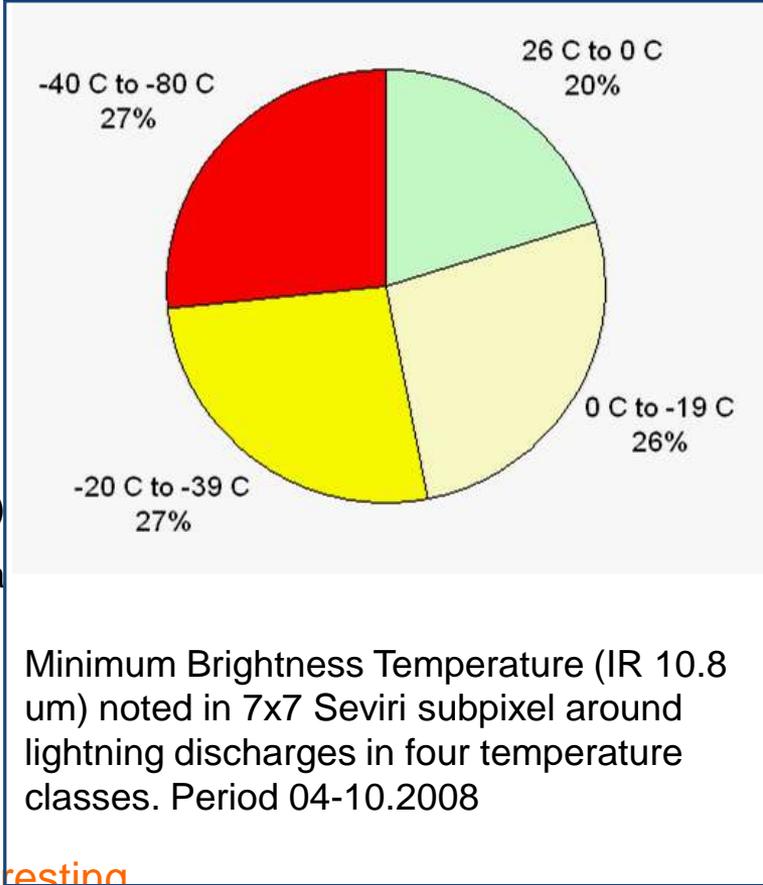Average number of days with thunderstorm in Poland in the period 2004-2008. based on PERUN data.

Day with thunderstorm. PERUN –lightning detection system measurements.

Method 2a. Combined use of PERUN/lightning and Meteosat9/satellita data.

o Correction of Perun **CC + CG** data with satellite data.

• Satellite data from radiometer SEVIRI /Meteosat9 – thermal channel IR 10,8 um were used. Calibrated to brightness temperature. Year 2008 only.

Method of correction. (simplification)
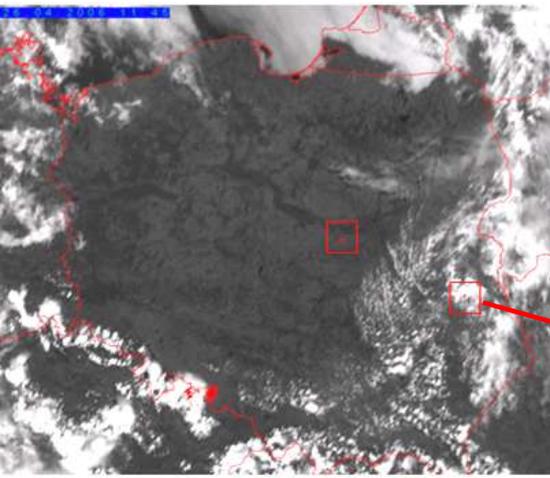
-3	-3	-3	-3	0	0	1
-4	-3	-3	-4	1	3	3
-60	-50	-10	-2	6	7	7
-55	-64	-10	3	5	7	7
-38	-19	-11	4	4	7	7
-44	-19	-11	18	4	4	4
-55	-12	13	15	17	17	10

7 Seviri Pixels (~45 km)

Paralaxa

Perun

Minimum Brightnes Temperature

Discharge

Minimum Brightness Temperature (IR 10.8 um) noted in 7x7 Seviri subpixel around lightning discharges in four temperature classes. Period 04-10.2008

o Method of correction of full set of Perun data seems interesting

o. Other satellite products could be used for correction. (In progress)

o only discharges Cloud to Ground (CG) were processed.

- better localisation in Perun system – three detection station

- less noise then CC

- indicator of well developed convective cloud
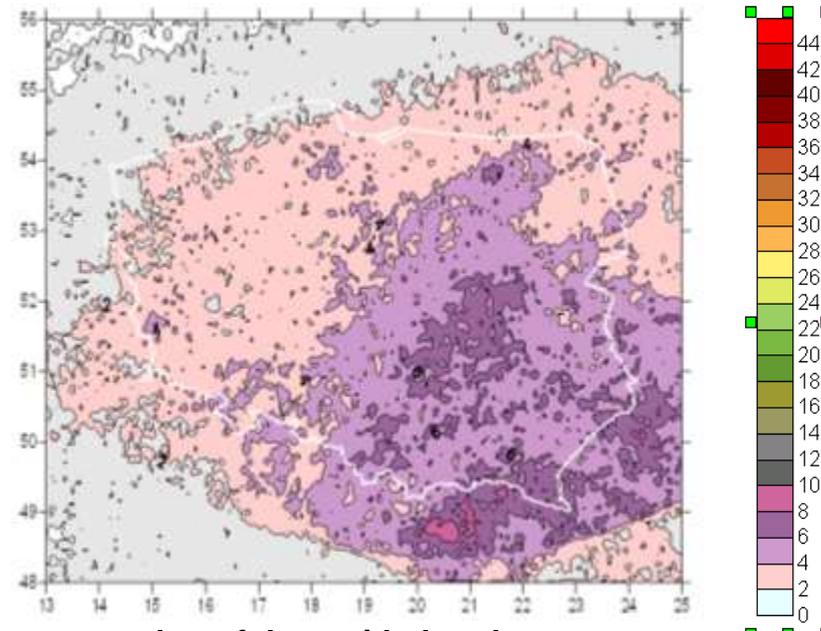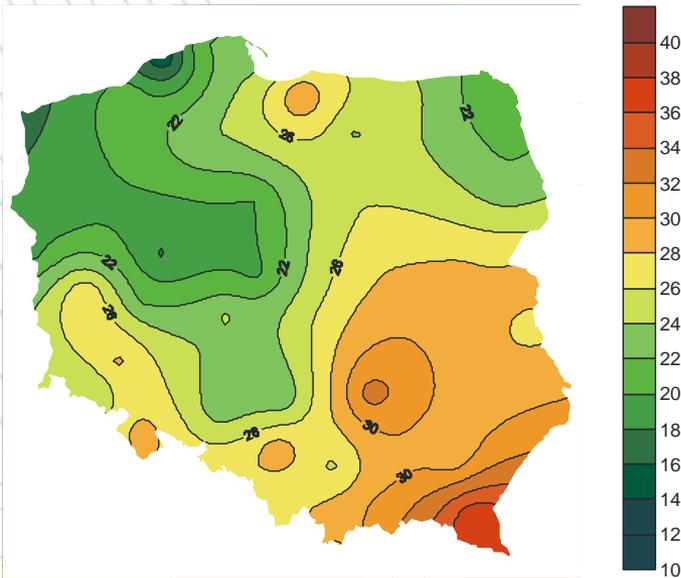
**Average number of days with thunderstorm
Poland 2004-2008. Based on PERUN data. Grid size 0,05 x 0,05 °**

oCalculation for different box size was made.

o=>The greater box size the more days with thunderstorm

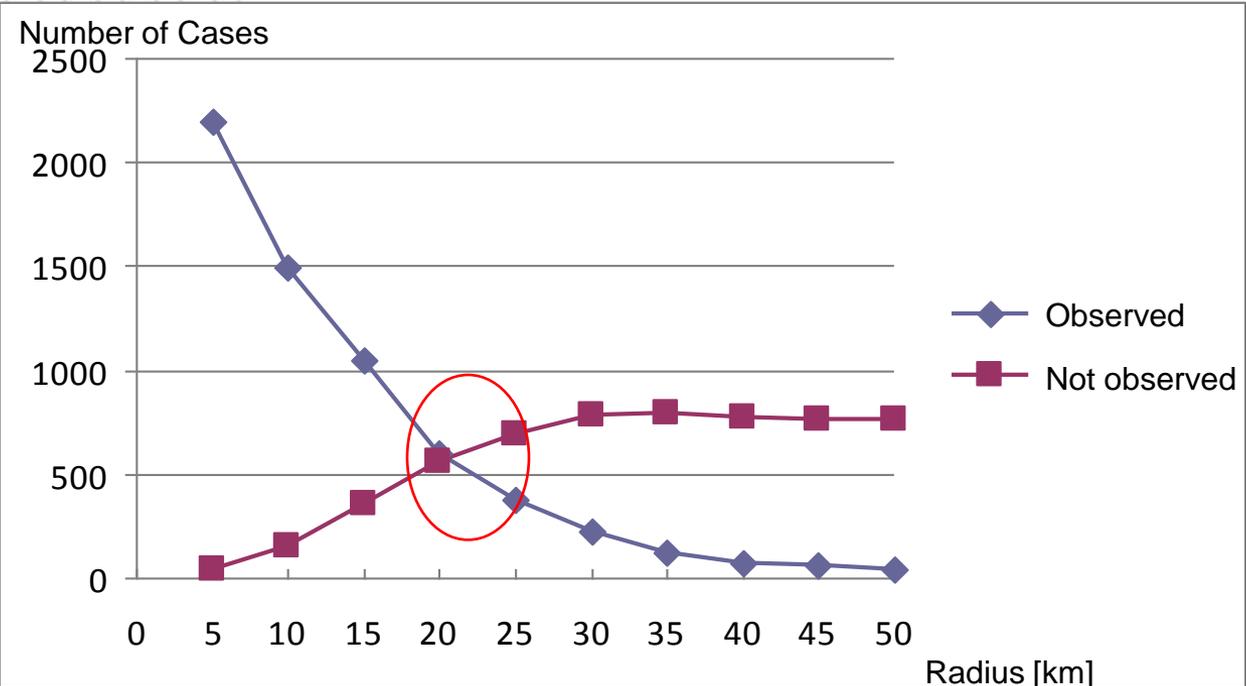oWhat should be ideal box size? => What is an **effective radius of storm observation** at Synop station?

Effective radius of thunderstorm observations.

Based on data from Synop and Perun/Safir stations.
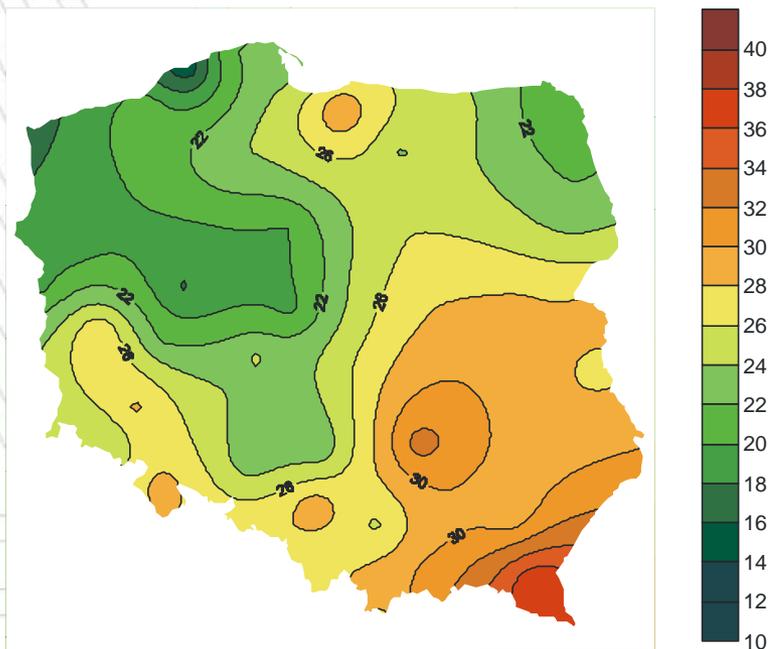
From the period 2004-2008 IV-X

Distance of the nearest lightning detected by Perun system in case of storm 1) was **observed** or 2) **not observed** at synoptic station

The effective radius for whole Poland is above 20 km.

Number of Days with Thunderstorm in Poland based on data from synoptic stations and Perun/Safir lightning detection system. Climatology for period 2004-2008

Preliminary Final Results.

Made with own developed methodology: preprocessed/corrected data, calculated effective radius, way of mapping.

**Average number of days with thunderstorm
 in Poland in the period 2004-2008, based on synoptic data**
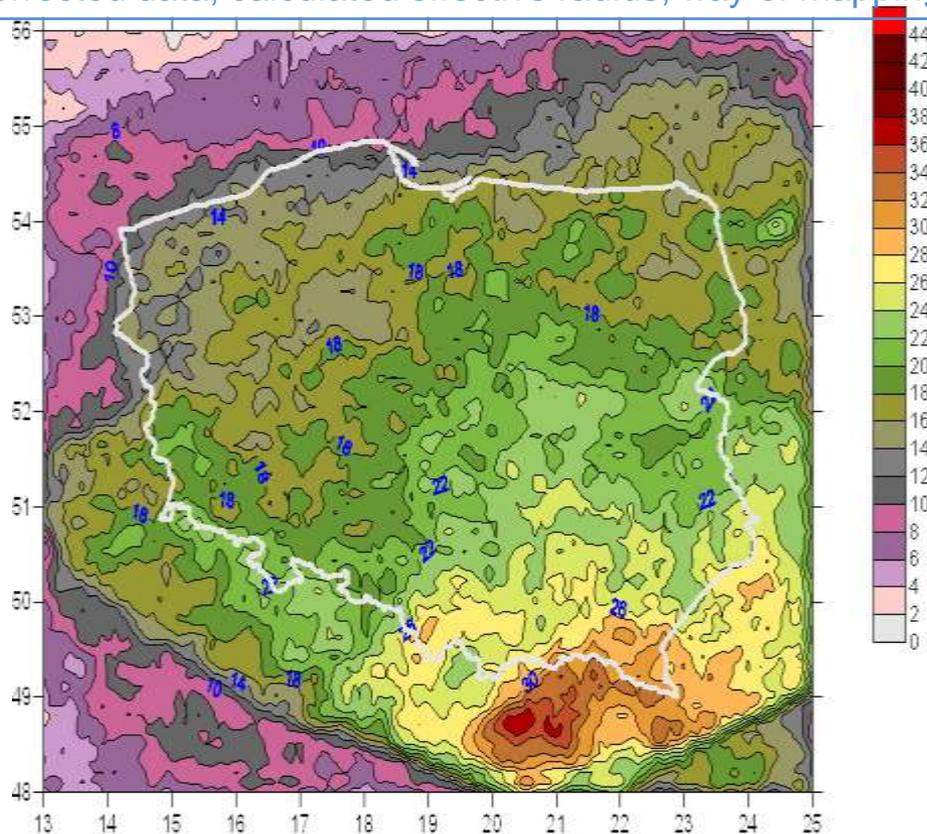
**Average number of days with thunderstorm
 in Poland in the period 2004-2008 based on Perun data**

- ➢ Keep in mind :   Datasets and methods are not perfect.

- ➢ Important: Careful pre-processing of datasets.

       Careful processing and reprocessing if necessary.

- ➢ Important: Detailed description of datasets and methodology used.

- ➢ Problem: Huge amount of data to collect and processed. Time and computer power consumption.

- ➢ The level of agreement between synoptic stations observations and Perun detection system was tested.

- ➢ The spatial distribution of storm days in Poland was determined on the basis of synoptical observations and lightning detection system (corrected by satellite data) with use of effective radius of thunderstorm observations build on the base of data from Synop and Perun/Safir stations.

- ➢ The works are ongoing.