

Analysis of Lightning Activity and Radar Reflectivity in Multicell Convective Clouds

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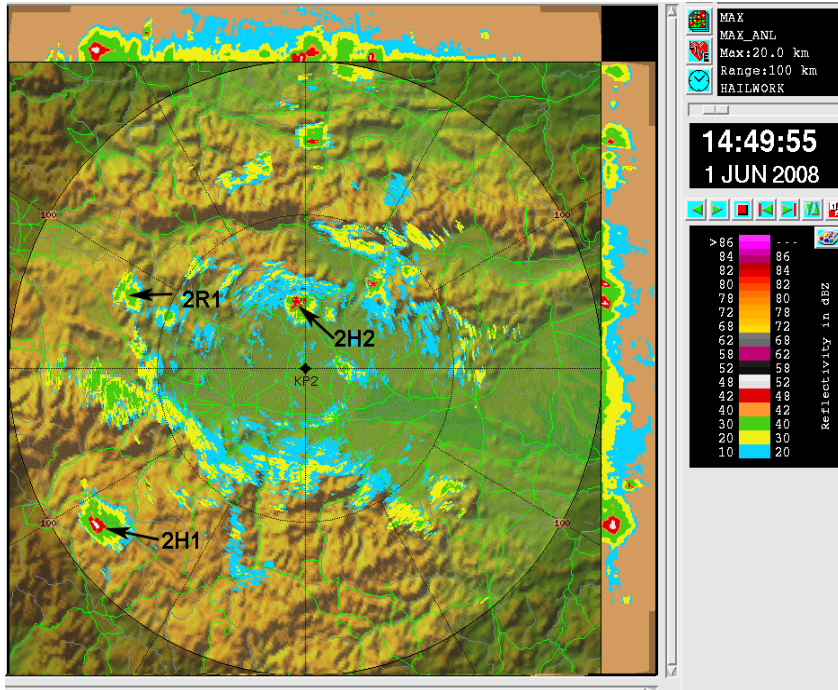
DATA

- Lightning activity - LINET (Lightning Detection Network):
- flash rate, location, polarity, peak current.
- Radar data - Hail Suppression Agency: Radar station MRL5-IRIS S band: max Radar Reflectivity (dBZ), H15, H45, HmaxRR
- Aerological sounding: H0°C, H-10°C, H-20° C
- 1 June 2008 rain (2R1) and hail clouds (2H1, 2H3, 2H4)

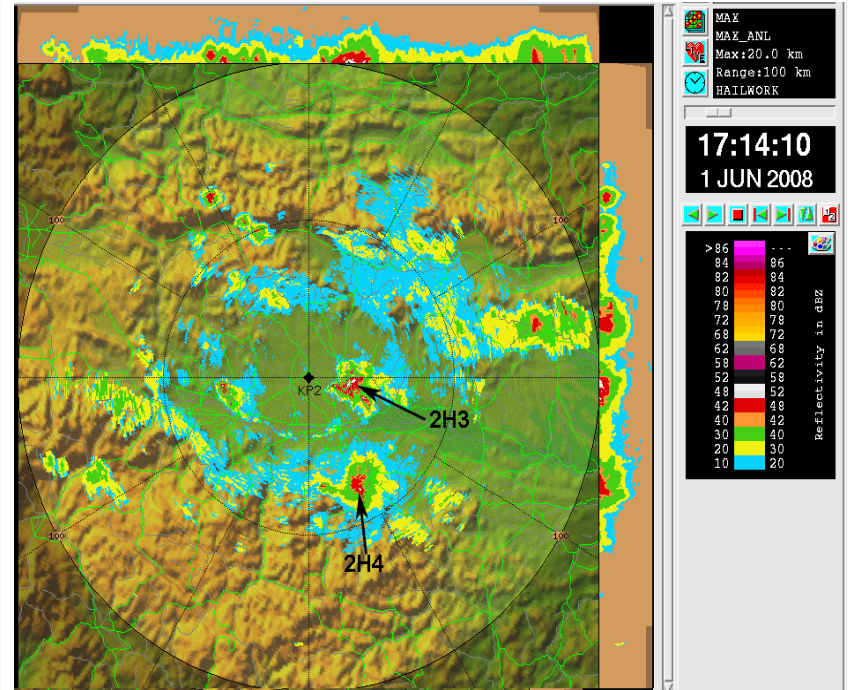
Region of study
(42.30N; 24.32E R=100 km)



Position of studied clouds



Radar reflectivity (dBz)
14:49:55 LTC (11:49:55 UTC)

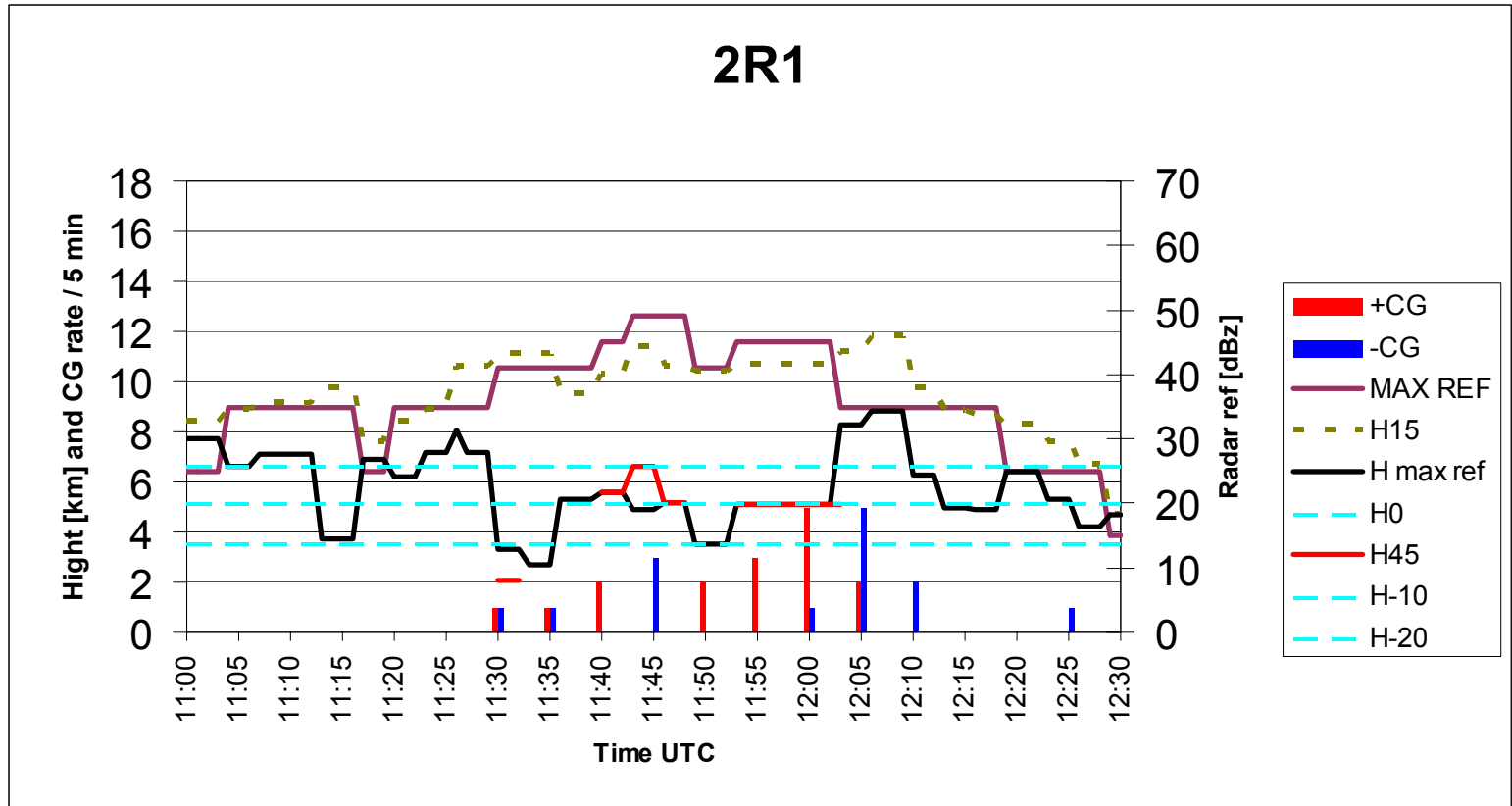


Radar reflectivity (dBz)
17:14:10 LTC (14:14:10 UTC)

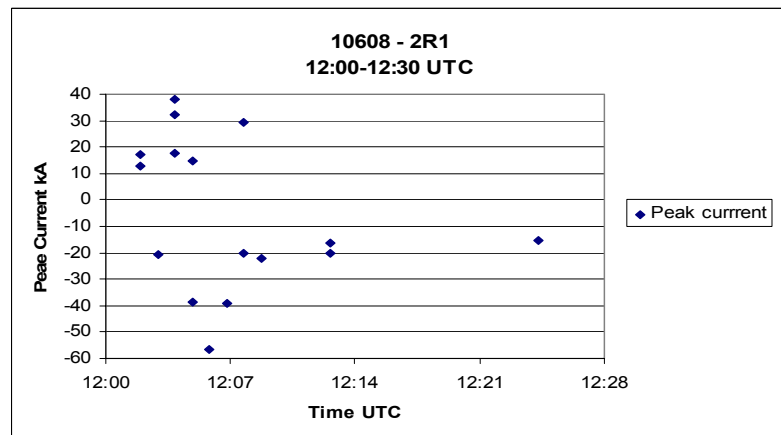
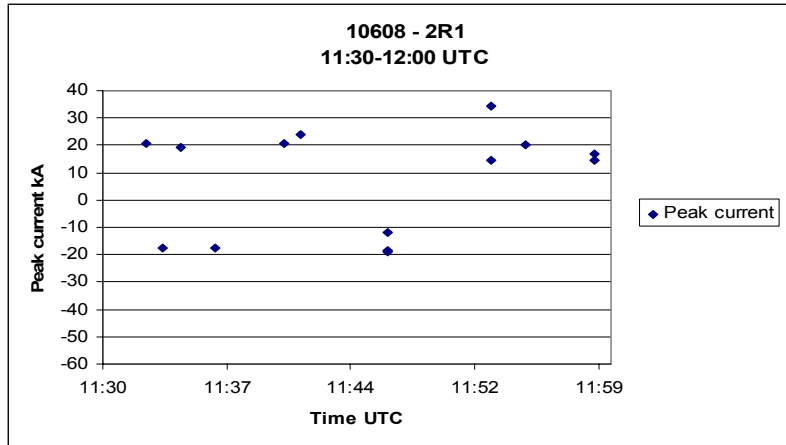
ANALYSIS

- Combined analyses of +CG and –CG flash rate and max RR, H45, H15, HmaxRR as a function of time
- Peak current (I) as a function of time
- Average, min, max of I^+ and I^-
- Average, min, max of +CG and –CG flash rates
- +CG and –CG flash rate as a function of RR (dBZ)
- Area of RR (dBZ) at the moment of max flash rate
- Lightning in the area of max RR (dBZ)
- Comparison between the above characteristics in the studied clouds

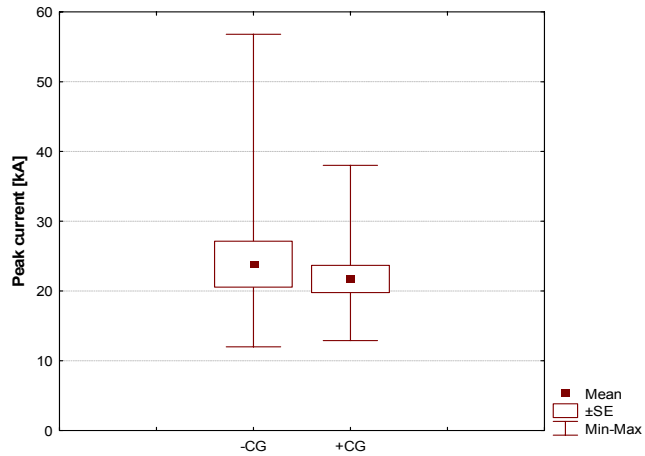
Combined analysis of flash rate and radar data for rain cloud 2R1



Peak current (kA) for rain cloud 2R1

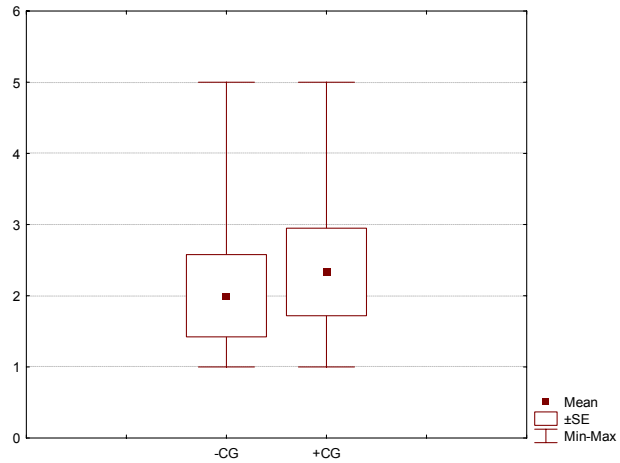


Peak current and flash rate for rain cloud 2R1



Peak current

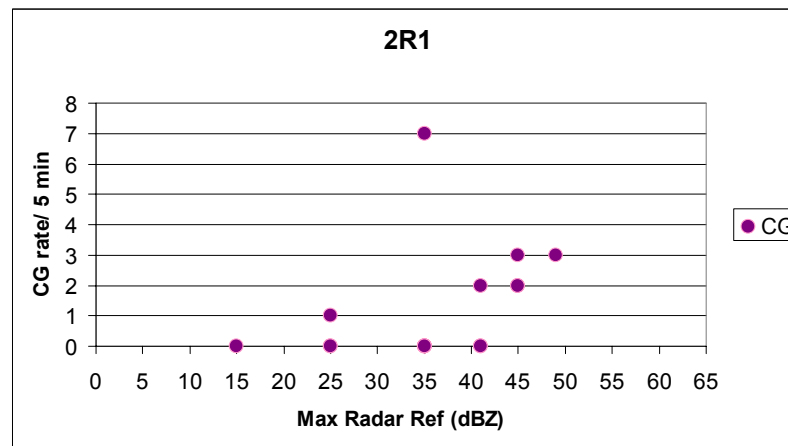
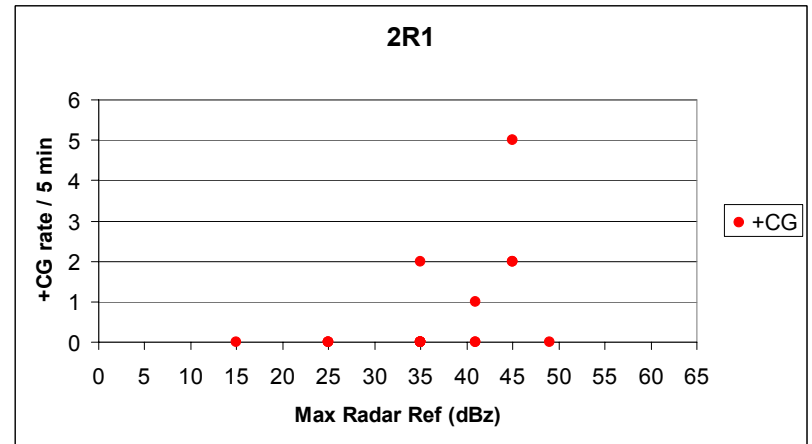
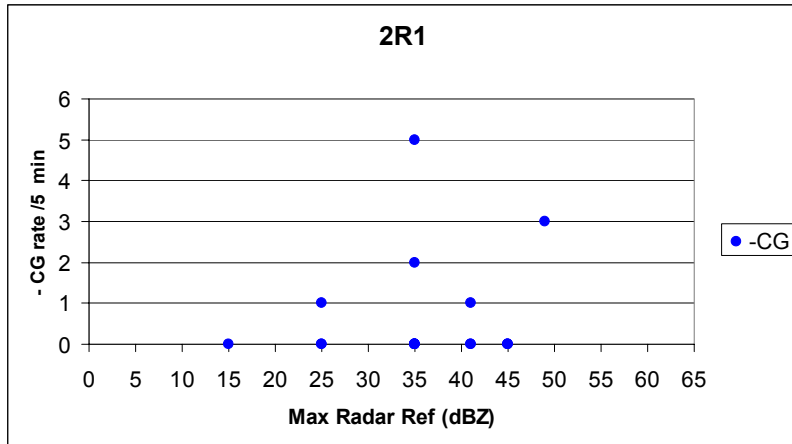
	-CG	+CG
mean	23.85	21.71
min	12.00	12.90
max	56.80	38.00



CG Flash rate / 5 min

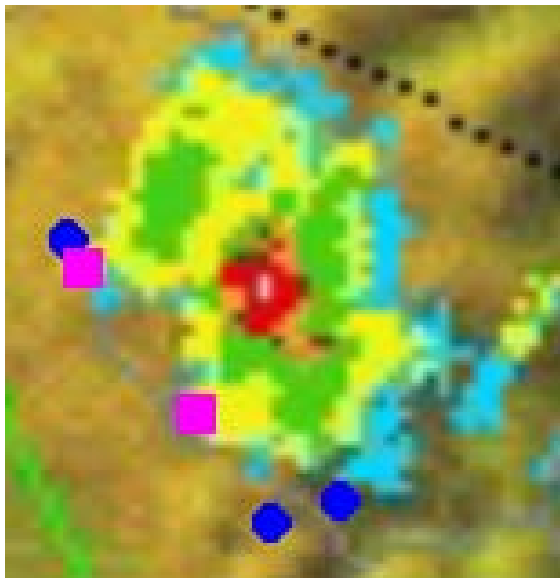
	-CG	+CG
mean	2.00	2.33
min	1.00	1.00
max	5.00	5.00

Flash rate as a function of radar reflectivity for rain cloud 2R1

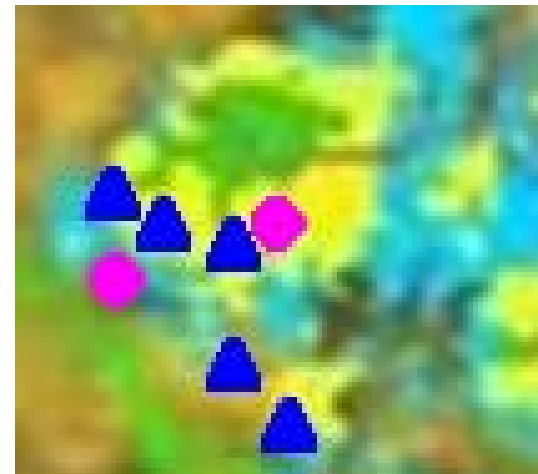


Lightning and radar reflectivity for rain cloud 2R1

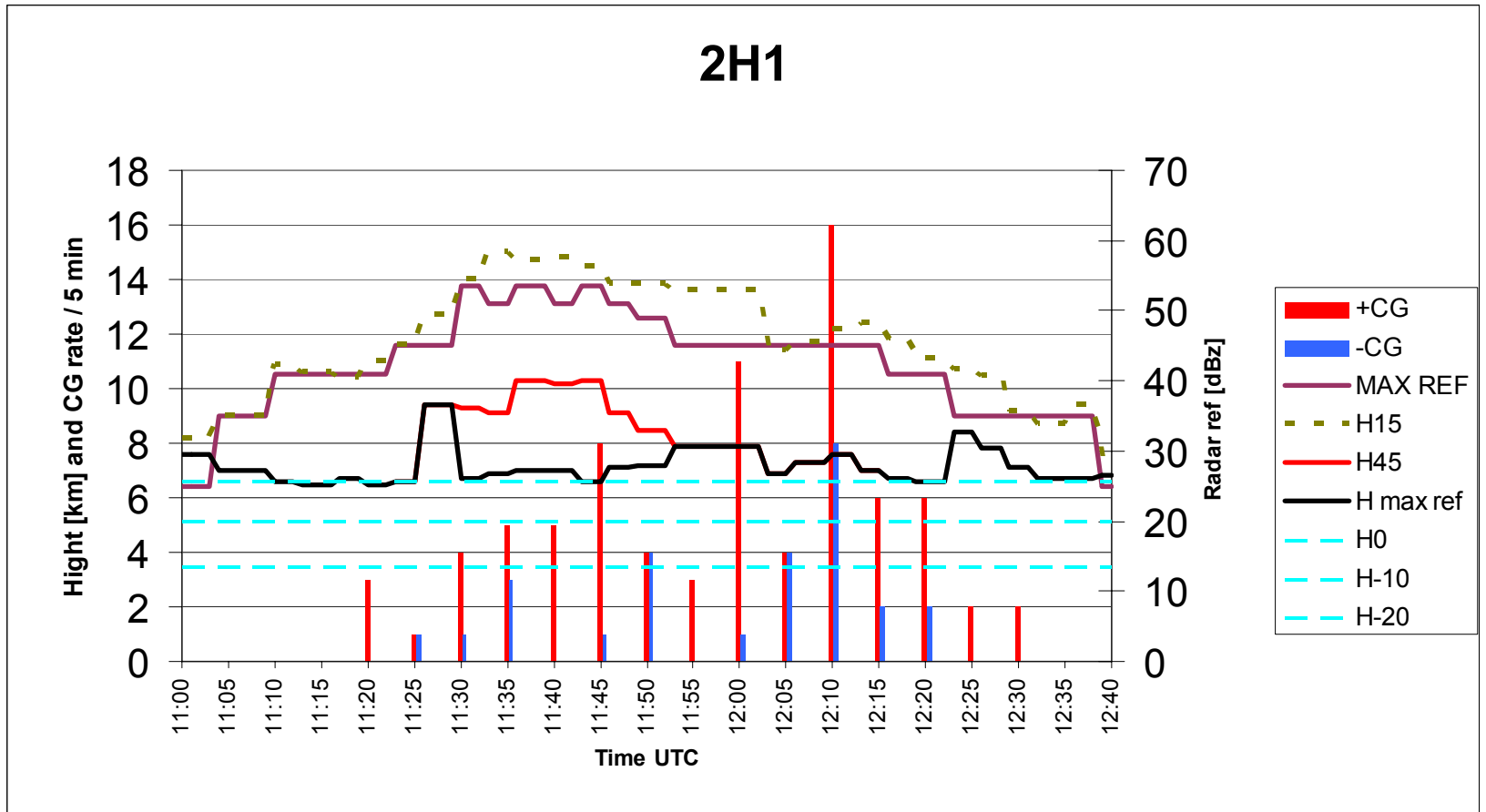
11:40 – 11:49 UTC
time of max dBZ



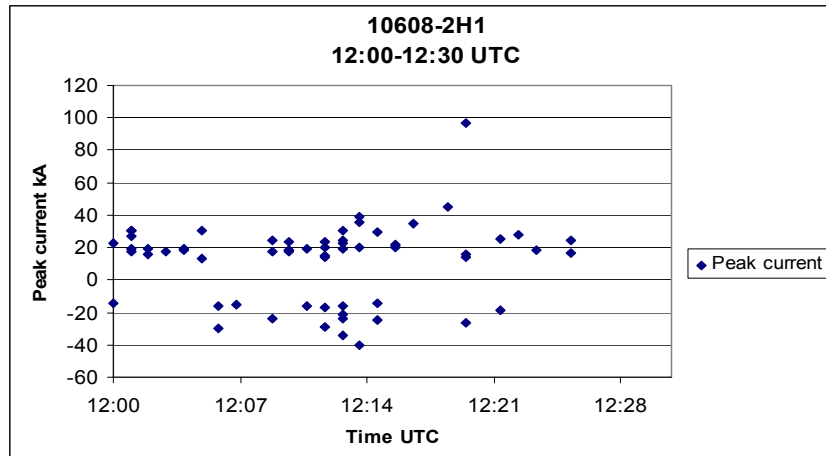
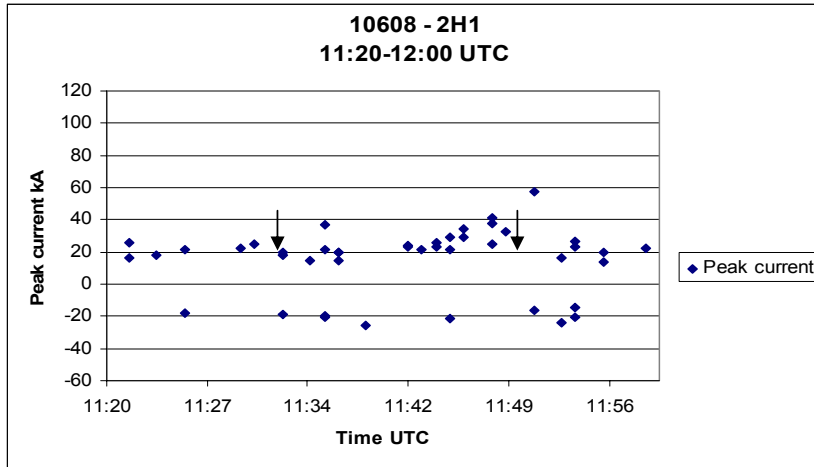
12:00 -12.05 UTC
time of max CG flashes



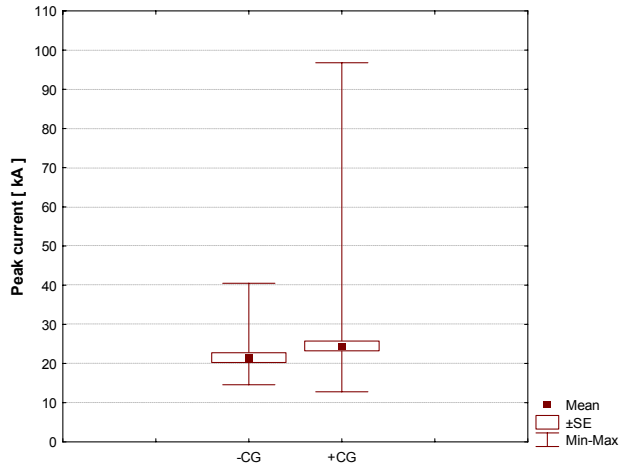
Combined analysis of flash rate and radar data for hail cloud 2H1



Peak current (kA) for hail cloud 2H1

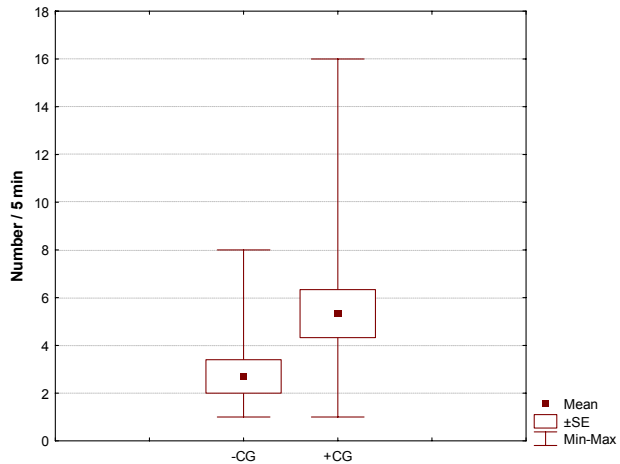


Peak current and flash rate for hail cloud 2H1



Peak current

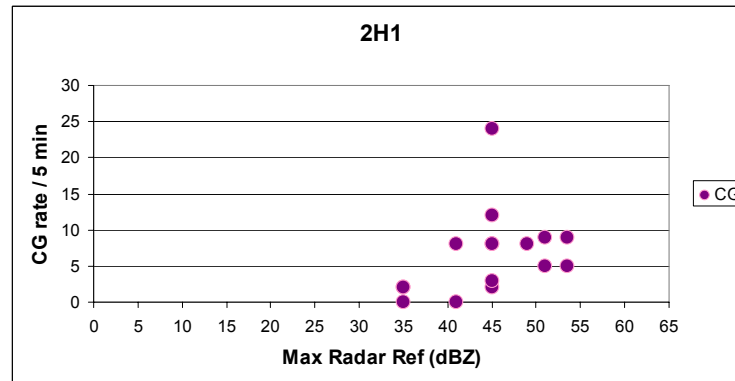
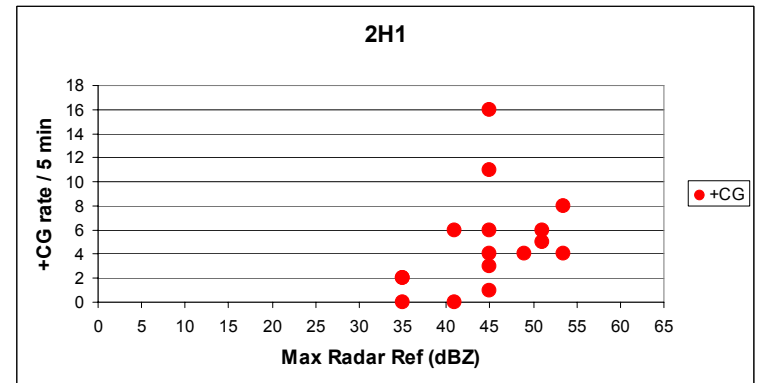
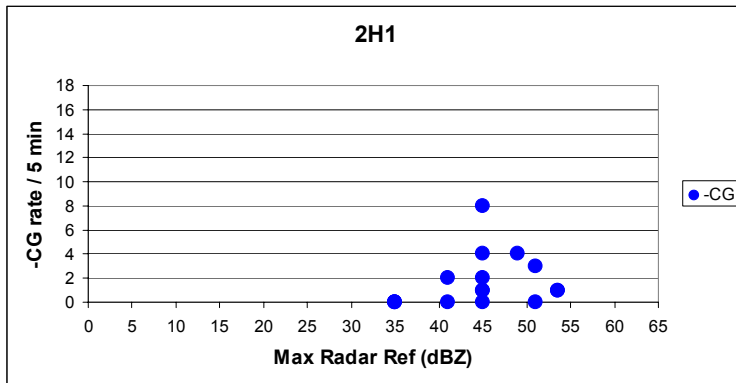
	-CG	+CG
mean	21.51	24.50
min	14.60	12.80
max	40.50	96.80



CG Flash rate / 5 min

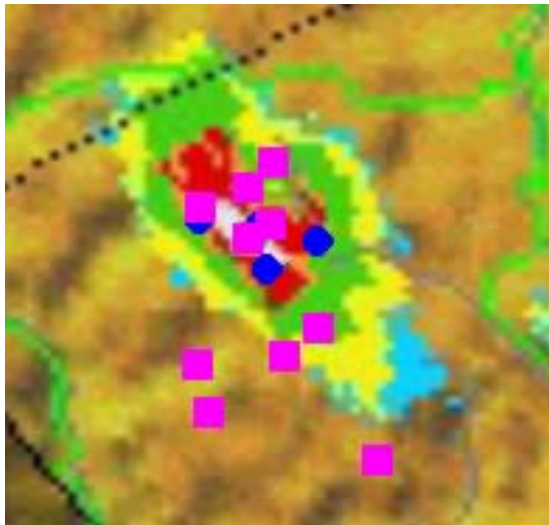
	-CG	+CG
mean	2.70	5.33
min	1.00	1.00
max	8.00	16.00

Flash rate as a function of radar reflectivity for hail cloud 2H1

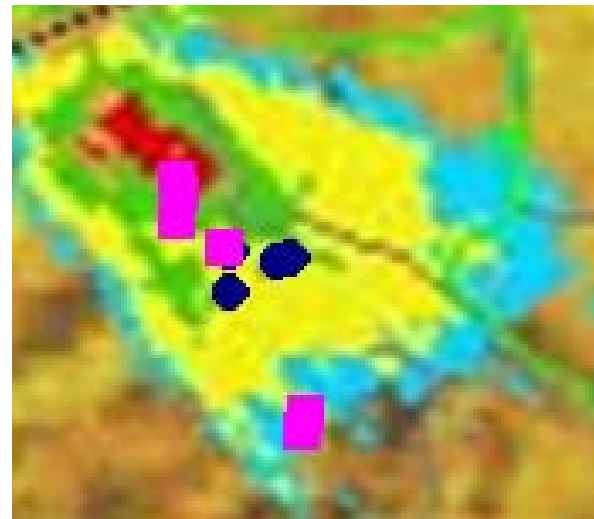


Lightning and radar reflectivity for hail cloud 2H1

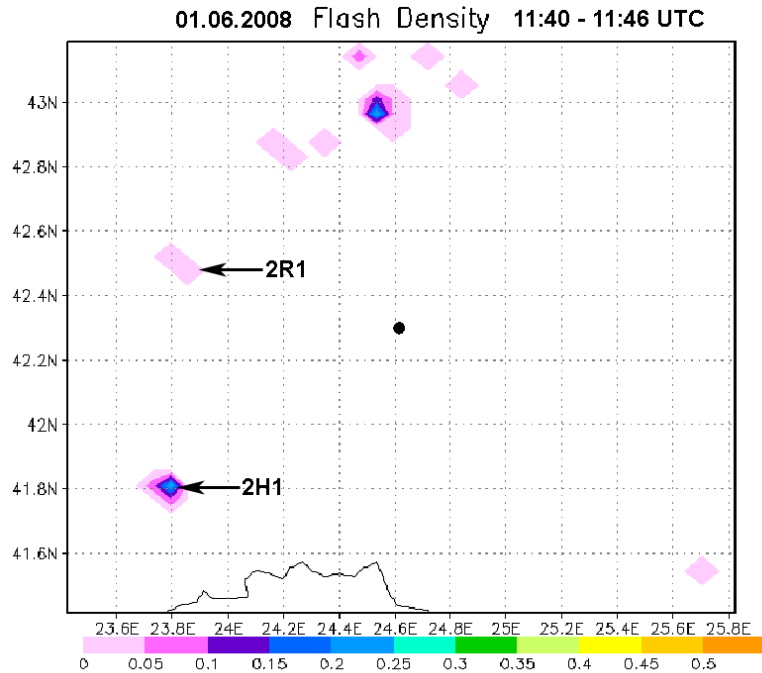
11:30 – 11:39 UTC
time of max dBZ



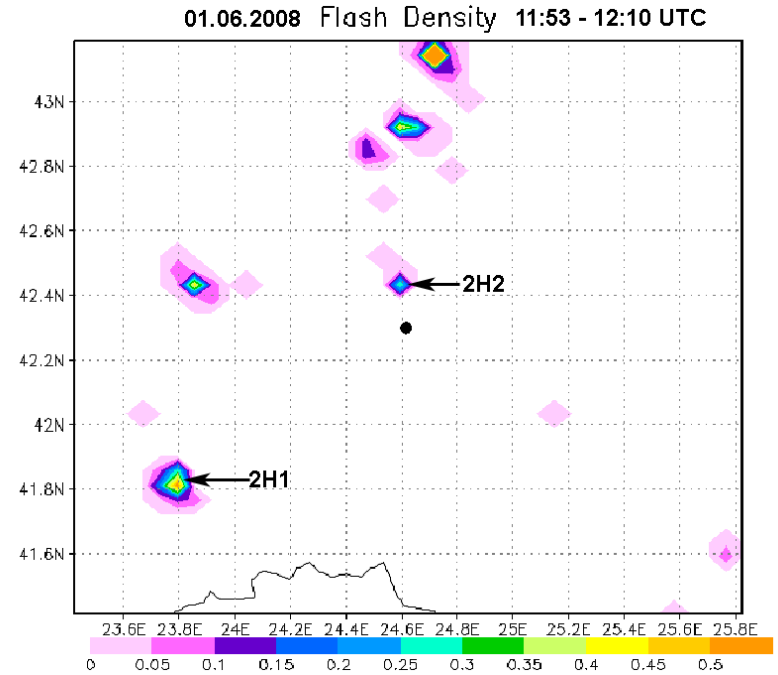
12:05 - 12:10 UTC
time of max CG flashes



Flash density in km^{-2} (averaged over $5 \times 5 \text{ km}^{-2}$)



Max flash density is $0,248 \text{ km}^{-2}$.



Max flash density is $0,536 \text{ km}^{-2}$

Comparison of peak current and flash rate for the four clouds

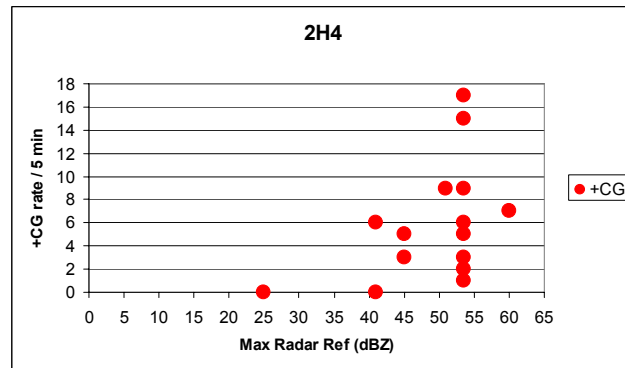
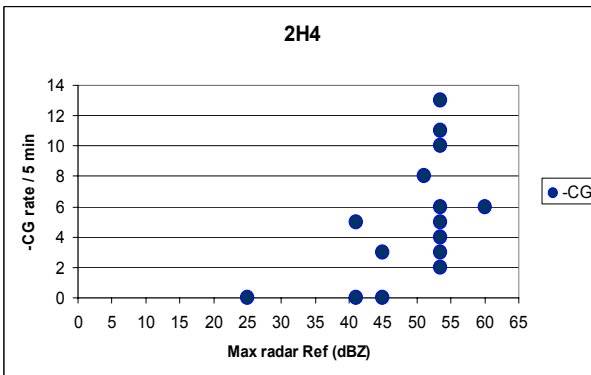
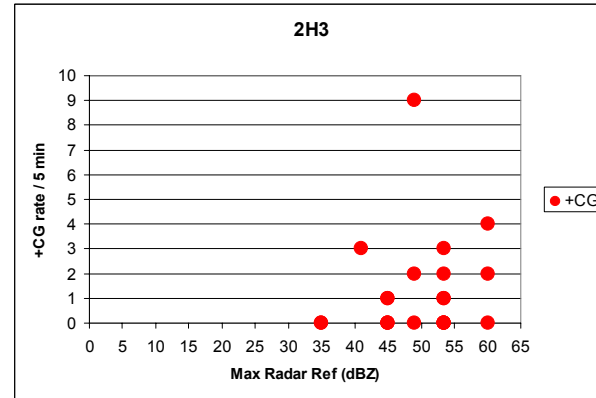
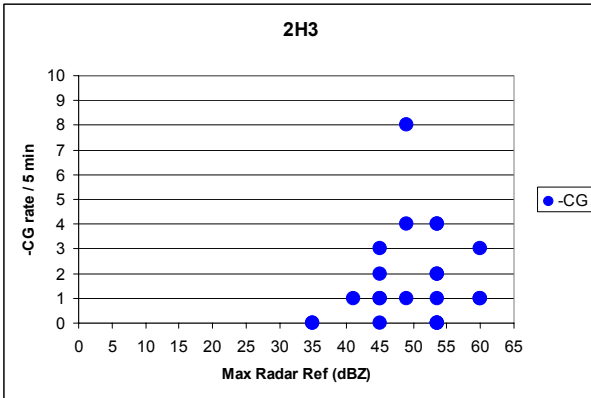
Peak current (KA)

	-CG	+CG
	mean	
2R1	23.85	21.71
2H1	21.51	24.50
2H3	18.01	20.46
2H4	20.48	19.86
	min	
2R1	12.0	12.9
2H1	14.6	12.8
2H3	11.0	11.1
2H4	11.4	11.5
	max	
2R1	56.8	38.0
2H1	40.5	96.8
2H3	34.2	50.4
2H4	51.0	48.6

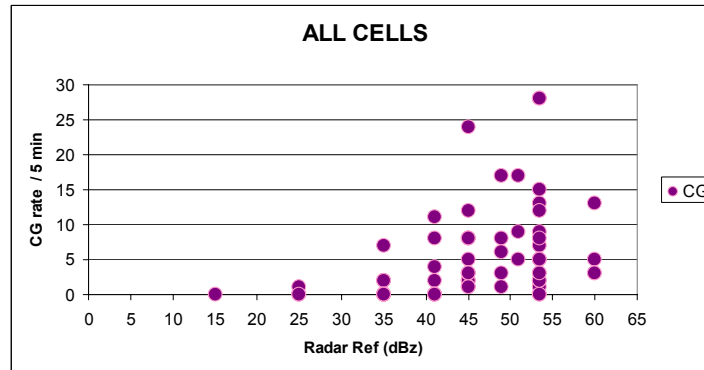
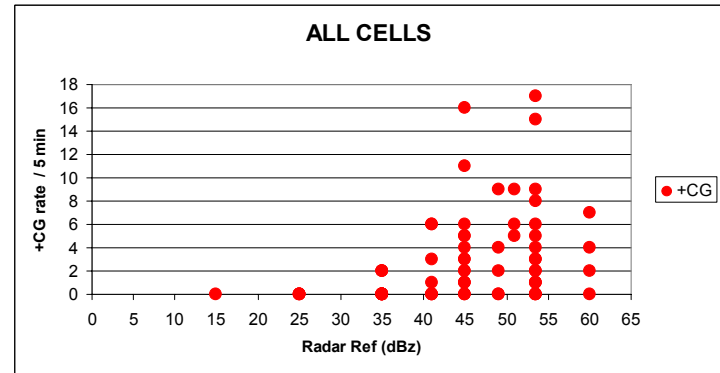
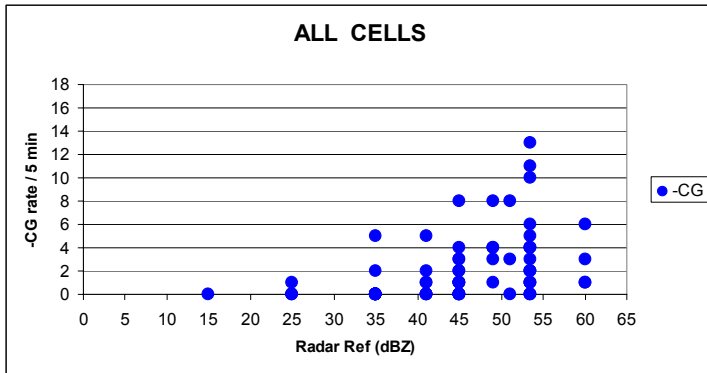
CG flash rate/ 5 min

-CG	+CG
Mean	
2.00	2.33
2.70	5.3
2.53	2.41
4.75	5.24
min	
1	1
1	1
1	1
1	1
max	
5	5
8	16
8	9
13	17

Flash rate as a function of radar reflectivity for hail clouds 2H3 and 2H4

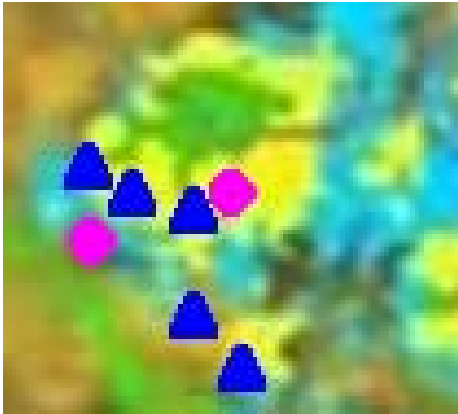


Flash rate as a function of radar reflectivity for the four studied clouds

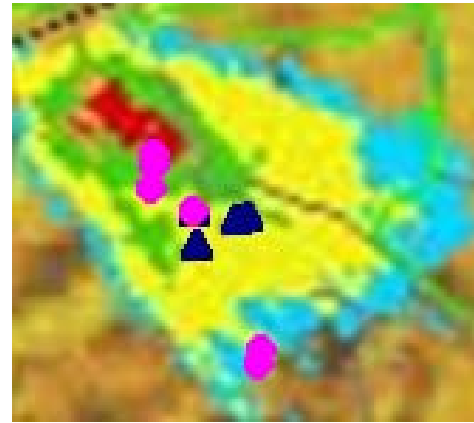


Radar reflectivity at the time of max CG

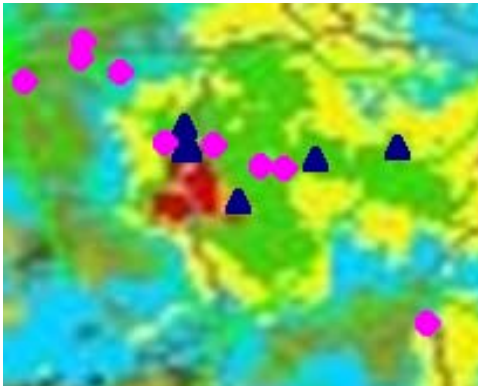
2R1



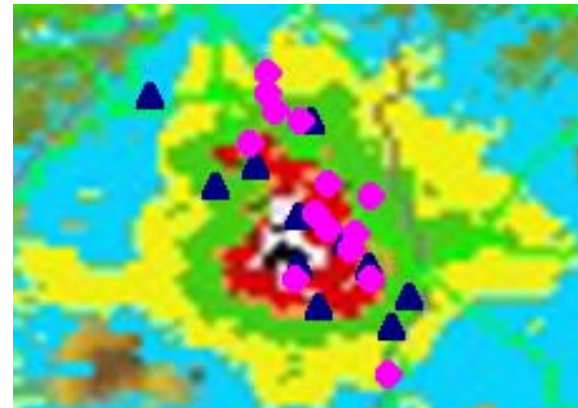
2H1



2H3

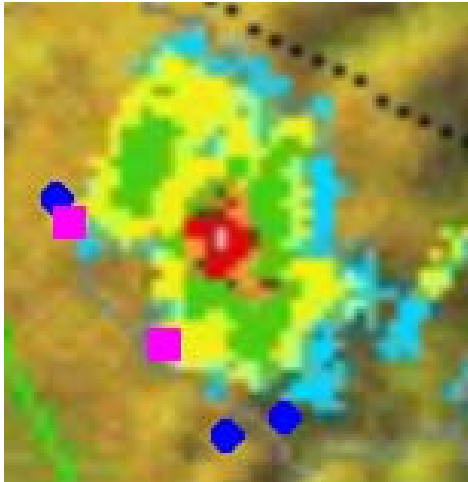


2H4

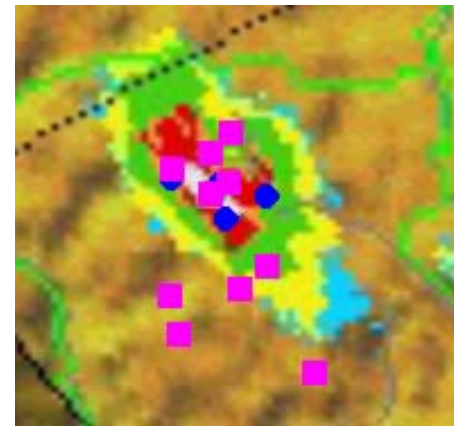


+CG and -CG at the time of max radar reflectivity

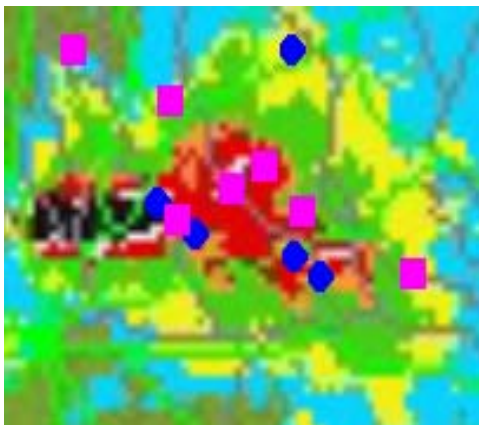
2R1



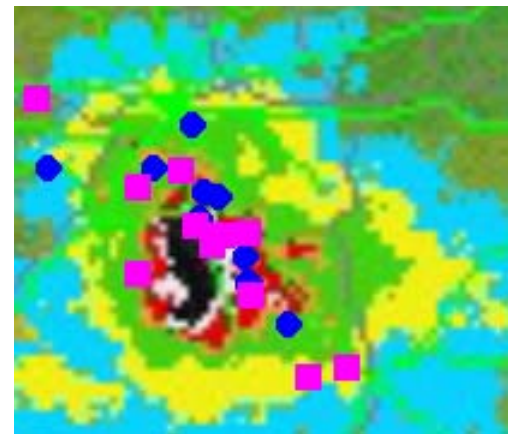
2H1



2H3



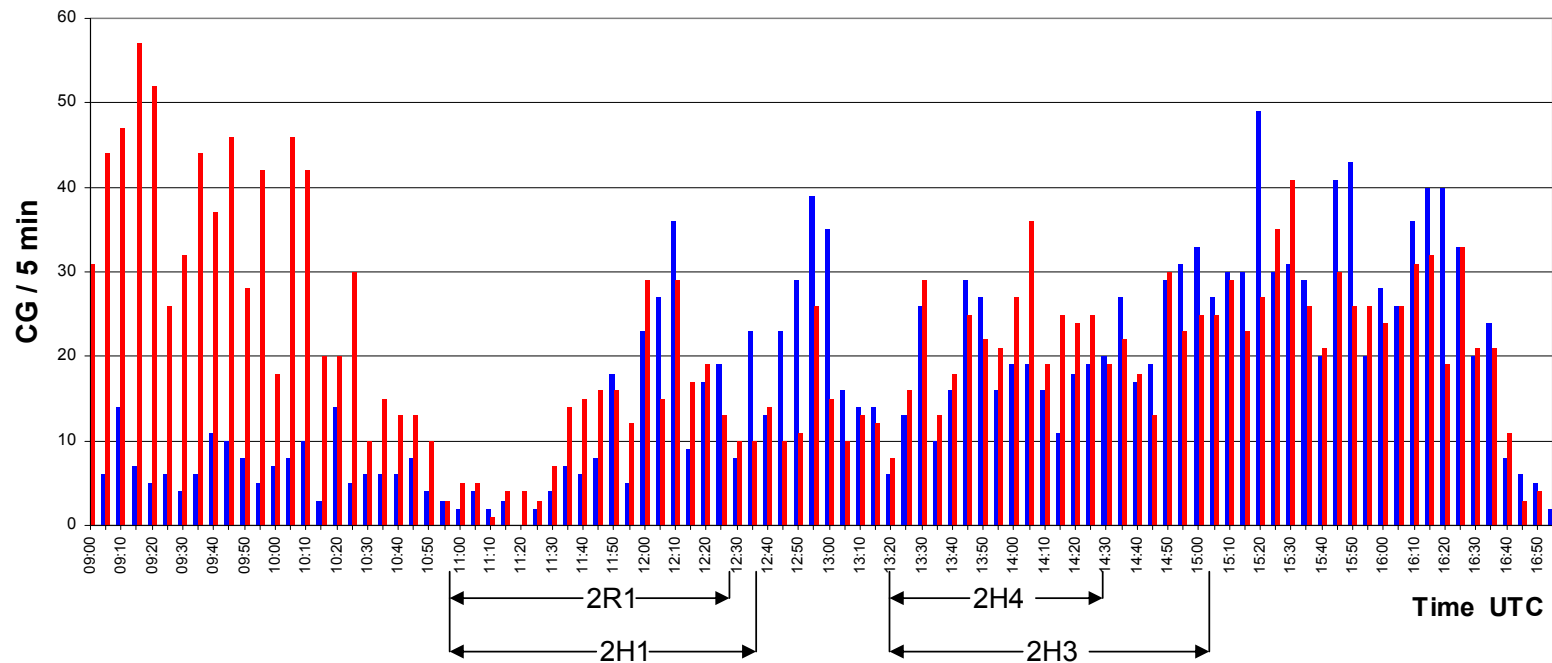
2H4



CG flash rate in square 100x100 km

01 June 2008 [42.30N 24.32E, R=100 km]

■ +CG
■ -CG



CONCLUSION

- No significant difference between mean peak currents of +CG and –CG flashes
- No significant difference between mean peak currents in rain and hail clouds
- In a hail clouds +CG flash rate is larger than –CG flash rate
- Flash density is higher for hail clouds than for rain
- The flash rate is max for radar reflectivity 45 - 55 dBZ
- The area of max flash rate does not overlap the area of max dBZ

THANK YOU !