# Total Lightning Activity of Afternoon Thunderstorms over Taiwan

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# Outline

- Brief of lightning data
- General characteristics of total lightning
- Cases analysis
- Conclusion

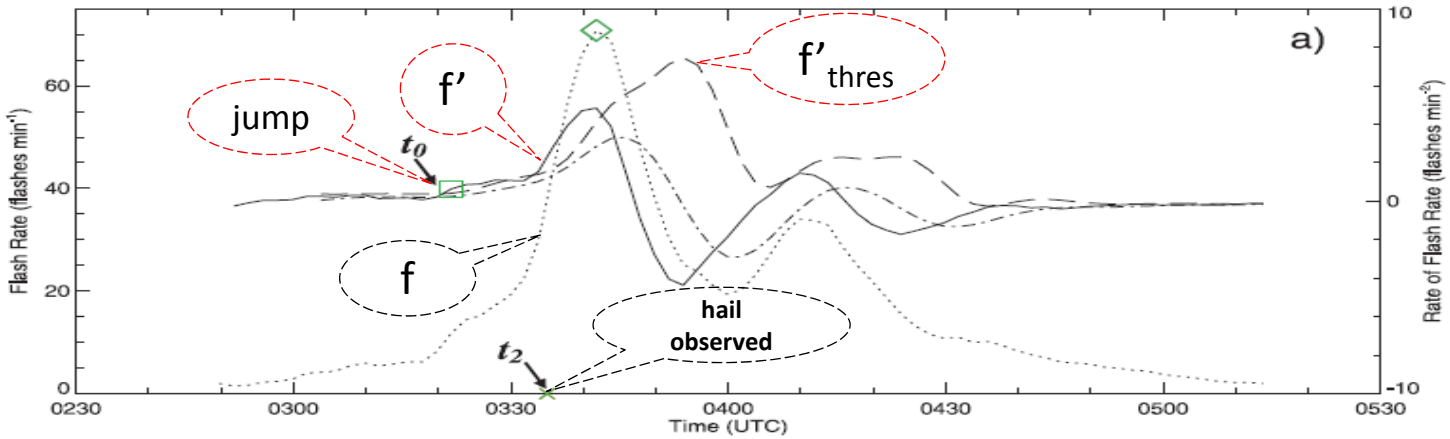
Brief of lightning data

1. The rapid increases in the total flash rate, termed lightning jumps, are indicative of updraft intensification, have been observed to occur as severe weather manifests within the storm (Gatlin and Goodman 2010).

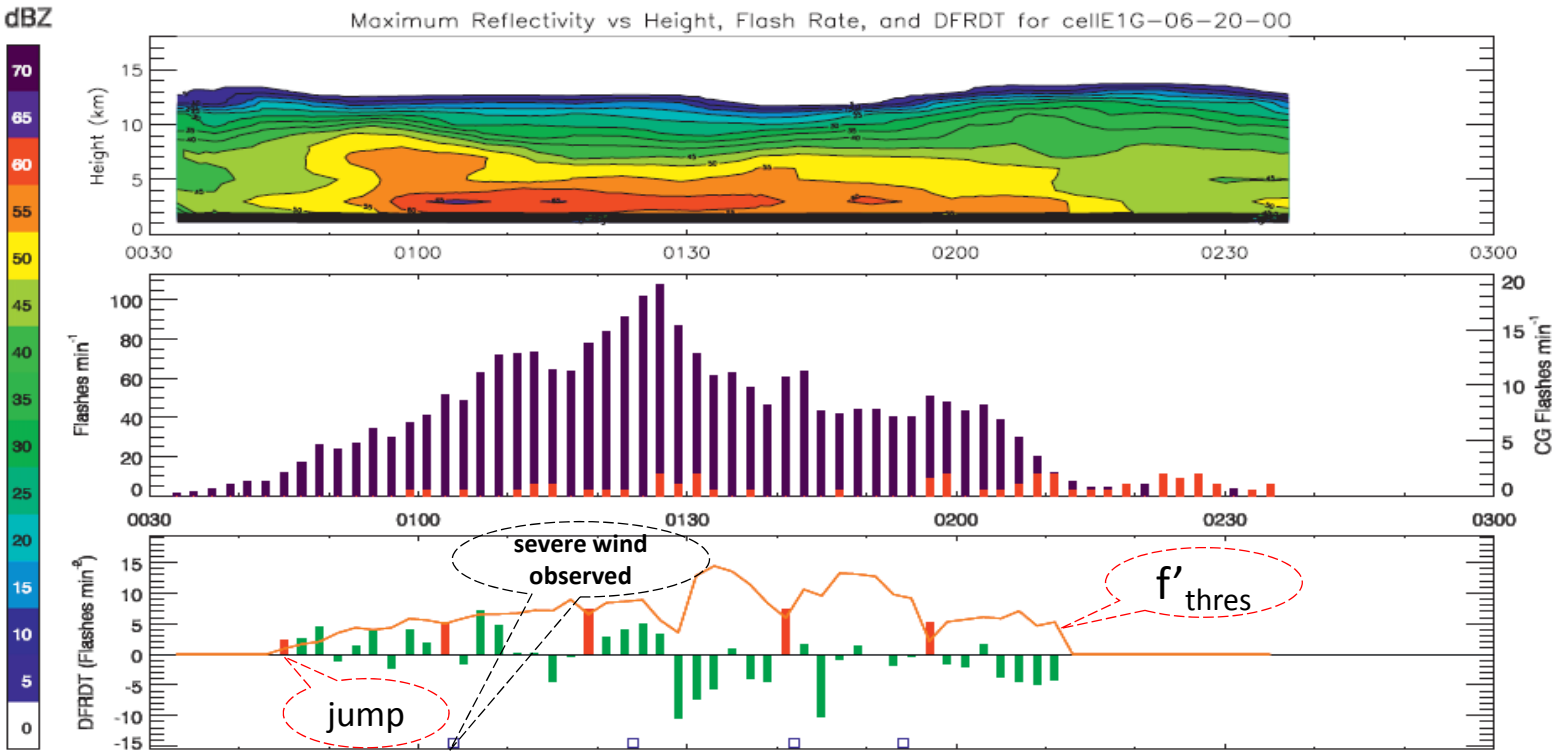
2. The trends in total lightning are more robustly correlated to severe weather occurrence, with rapid increases in total lightning observed 10s of minutes prior to the onset of severe weather (Schultz et al. 2011).

3. Regional rain-yield could be evaluated by diagnosing radar reflectivity and IC or CG simultaneously (Petrova et al. 2014)

# Brief of lightning data




application of lightning jump of a nontornadic severe storm (Galtin and Goodman 2010)




application of lightning jump of severe wind produced by thunderstorm (Schultz 2011)

Brief of lightning data

1. Before 2004, the lightning data contains only one type:
   cloud-to-ground from Lightning Detection System.

2. After 2004, there are 6 types in Total LDS:
   TYPE 0: single intra-cloud (IC)
   TYPE 1: start point of consecutive IC
   TYPE 2: middle point(s) of consecutive IC
   TYPE 3: end point of consecutive IC
   TYPE 4: cloud-to-ground (CG)
   TYPE 5: step strikes of cloud-to-ground

(private discussion with Tai-power engineer)
(http://www.wmo.int/pages/prog/www/IMOP/meetings/Upper-Air/RemoteSensing/Doc.5.1(1)_Lightning.pdf)
OPERATIONAL USE OF LIGHTNING DETECTION METHODS
Report on the Operational use of Lightning Detection Methods in Brazil (WMO, 2005)

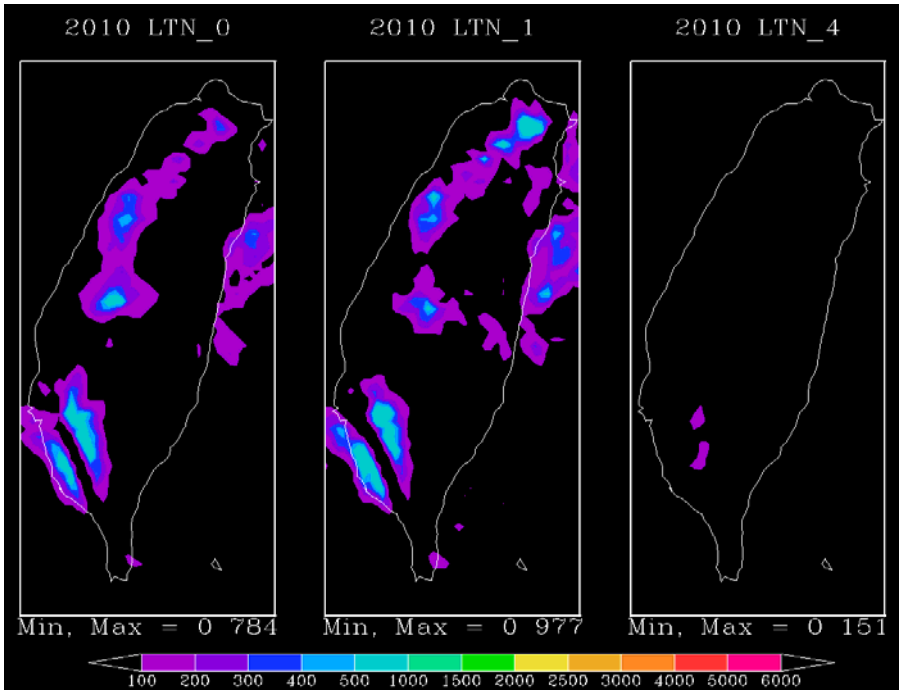
3. To distinguish the flash from IC and CG is based on the quantify of current. (CG larger than IC of O(1)~O(2))

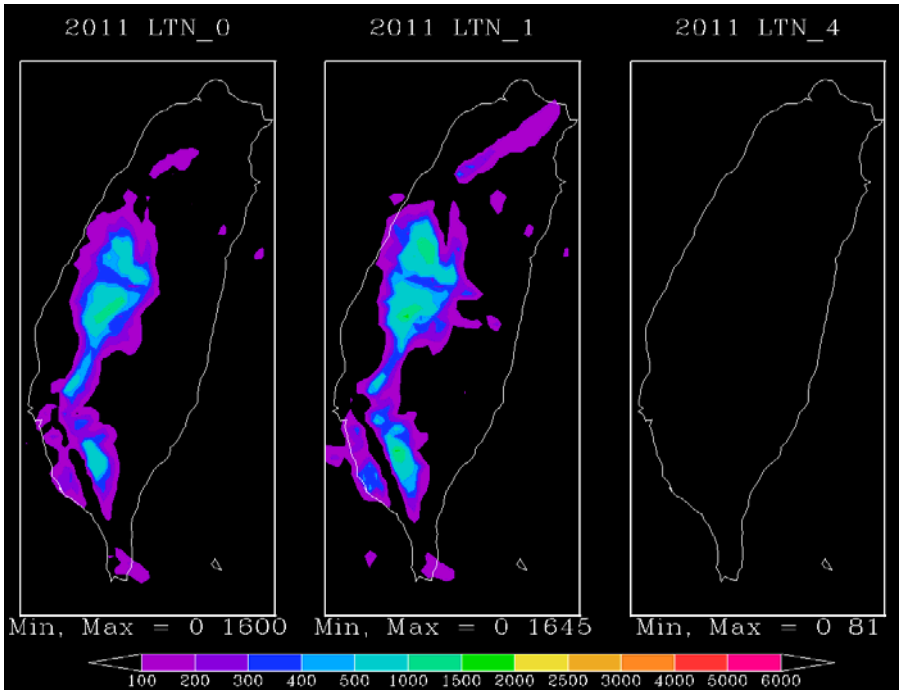
4. IC is positioned by high frequency of electric pulse.

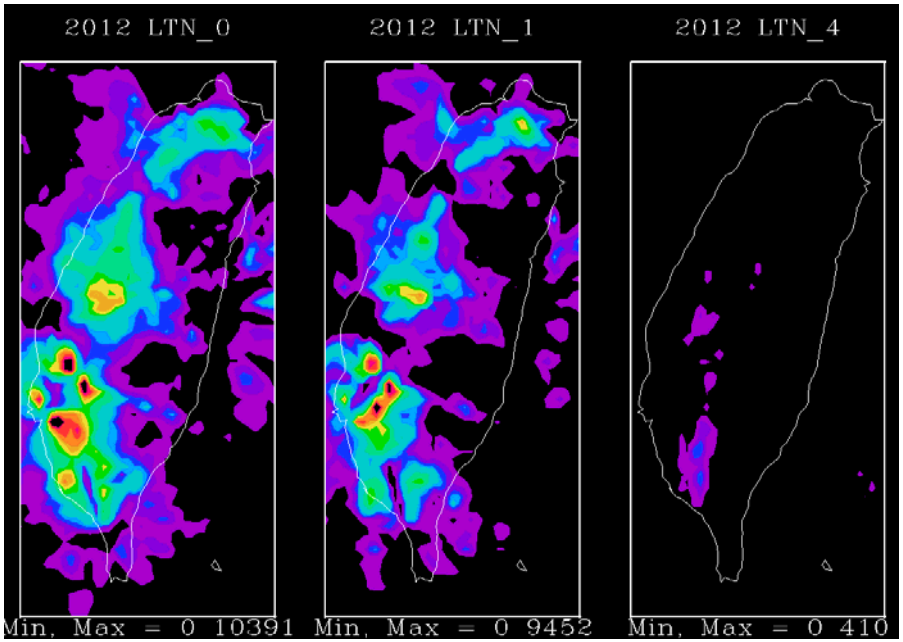
5. The CG position error is about 1km, but the position error of IC is unknown and (mostly) larger than CG.

6. New CWB's system will be evaluated soon.

# Brief of lightning data



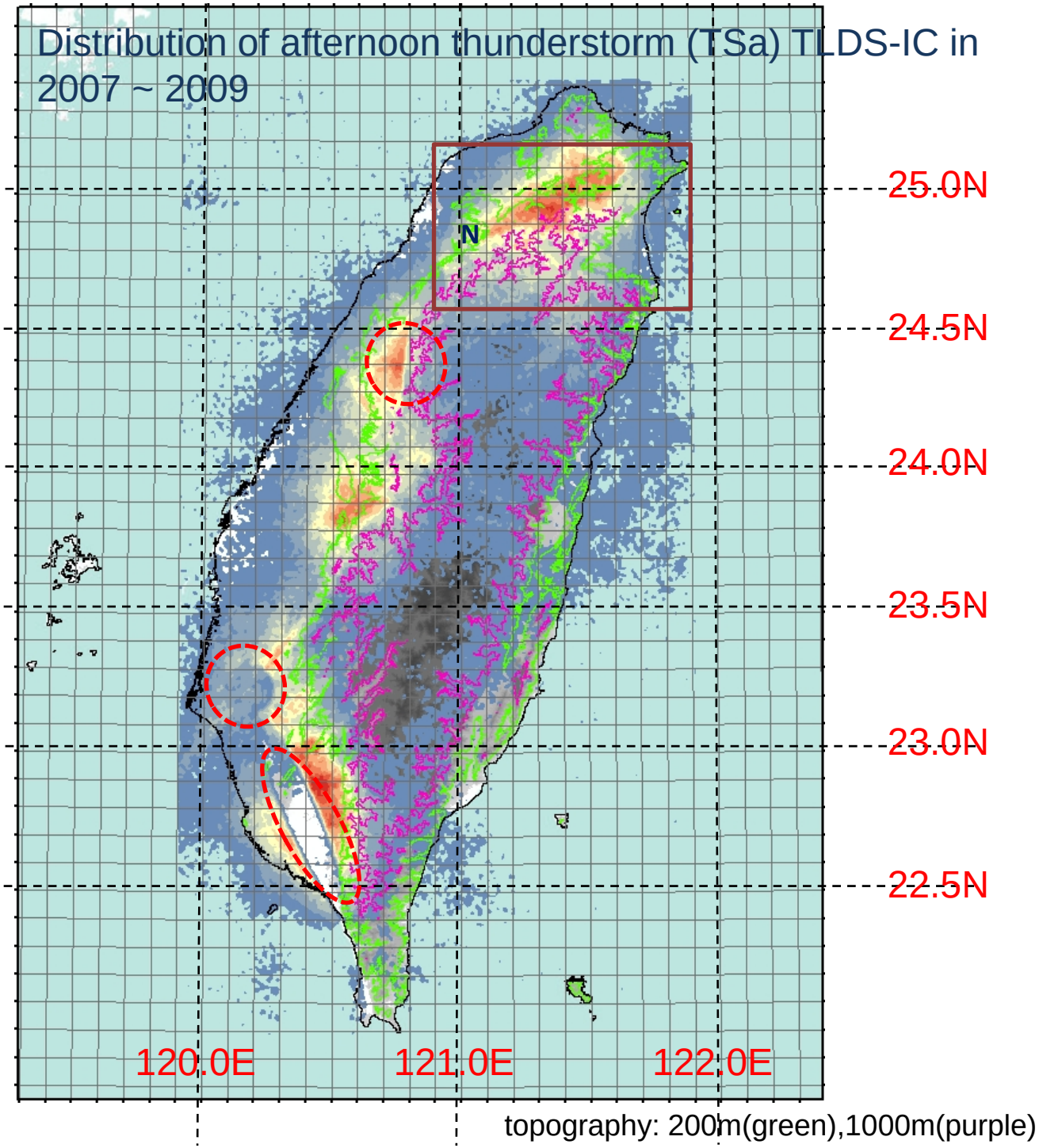



General characteristics of total lightning

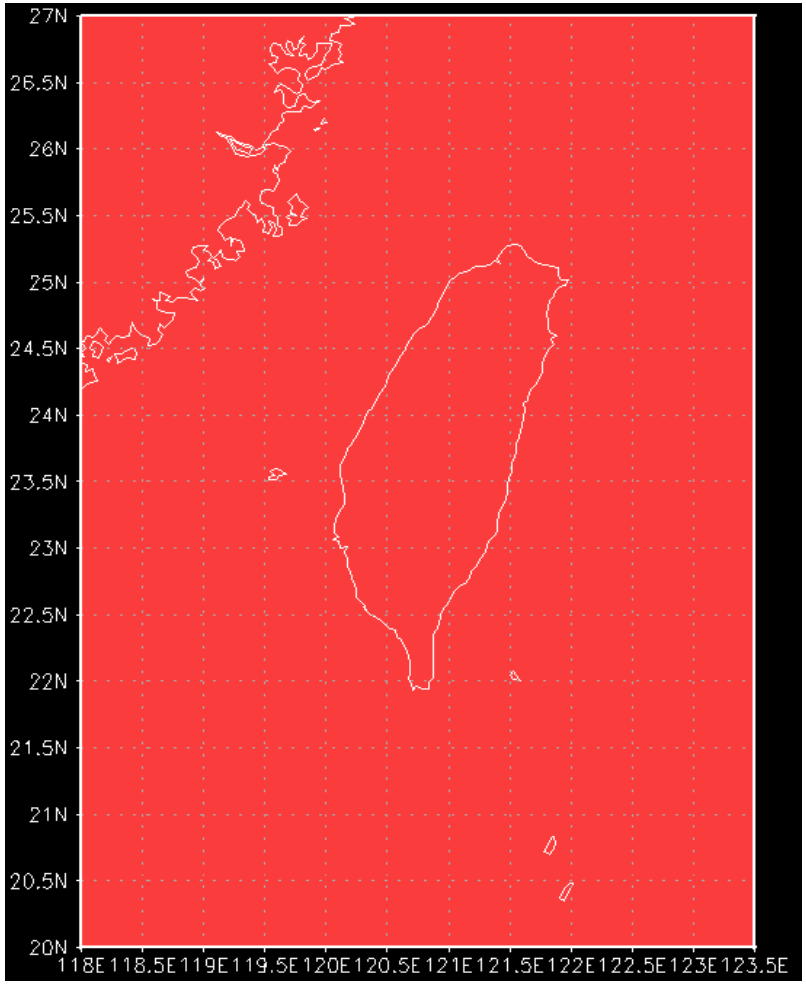
Division N:
24.60-25.10、
120.90-121.90

position uncertainty



# Data analysis processes

1. QPESUMS: 10-min interval, 23 CAPPI levels (using CV),
   $0.0125^\circ \times 0.0125^\circ$ horizontal resolution,
   lon. 118°E~123.5°E,
   lat. 20°N~27°N (441 × 561)

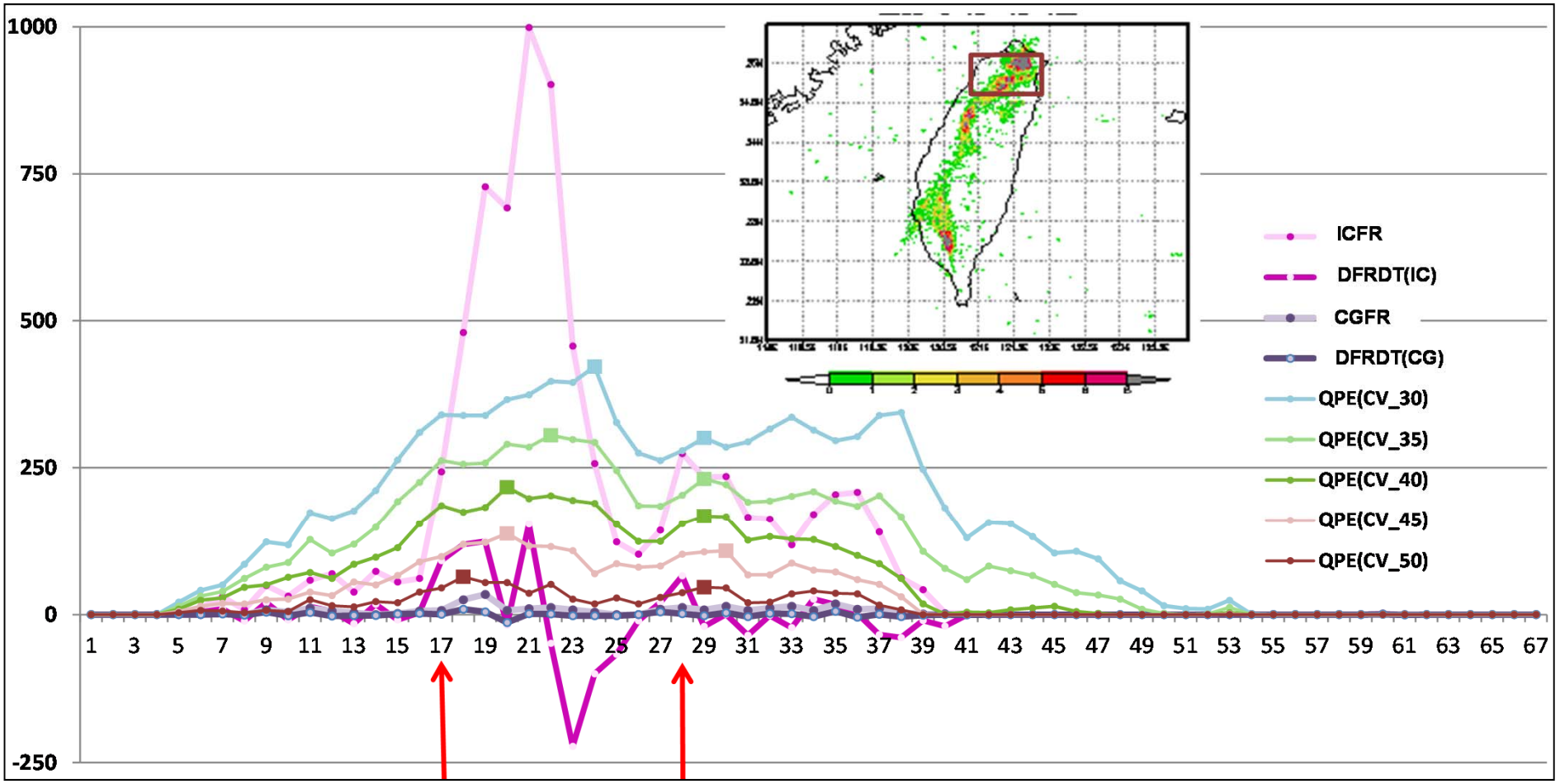



2. TLDS: 2 types lightning data
   (IC, CG)
   same with QPESUM region
   integrated from 10 min. before

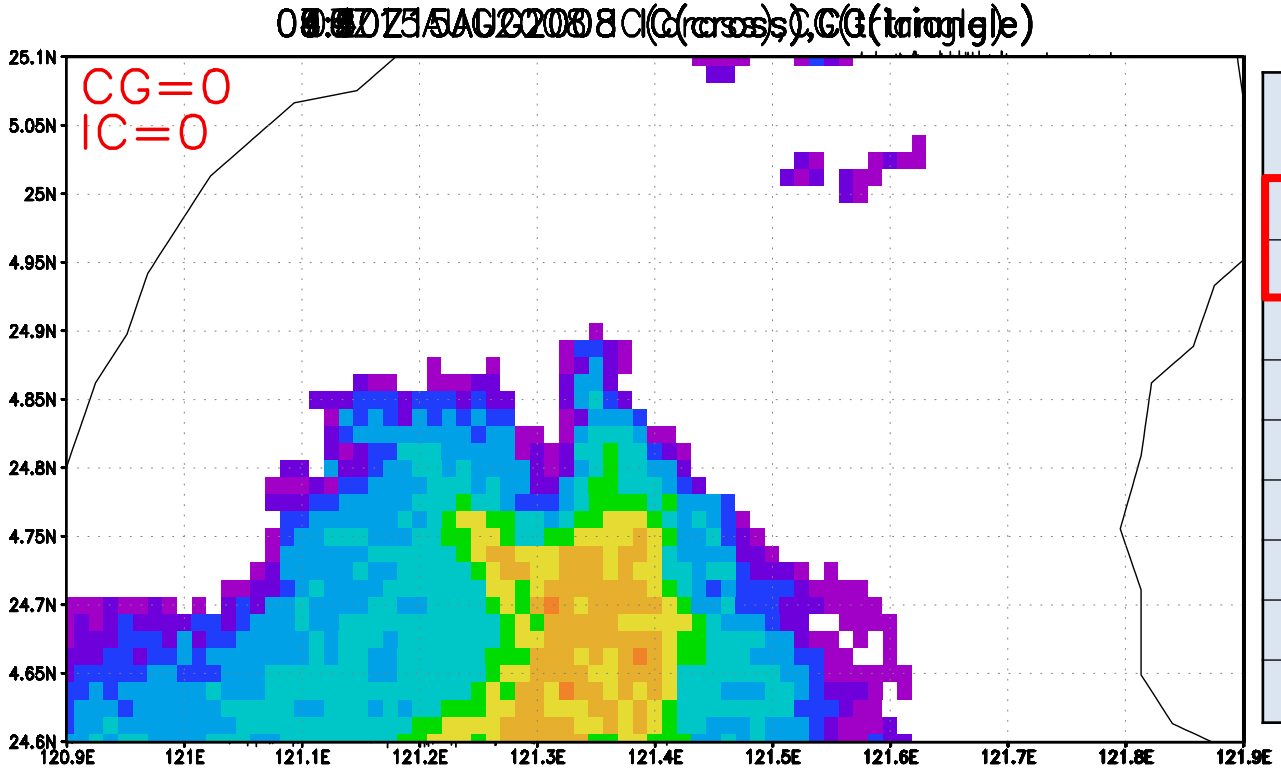
QPESUMS: 00:00Z~23:00Z, time=139
LTN data: 00:10Z~24:00Z, time=144

Cases analysis

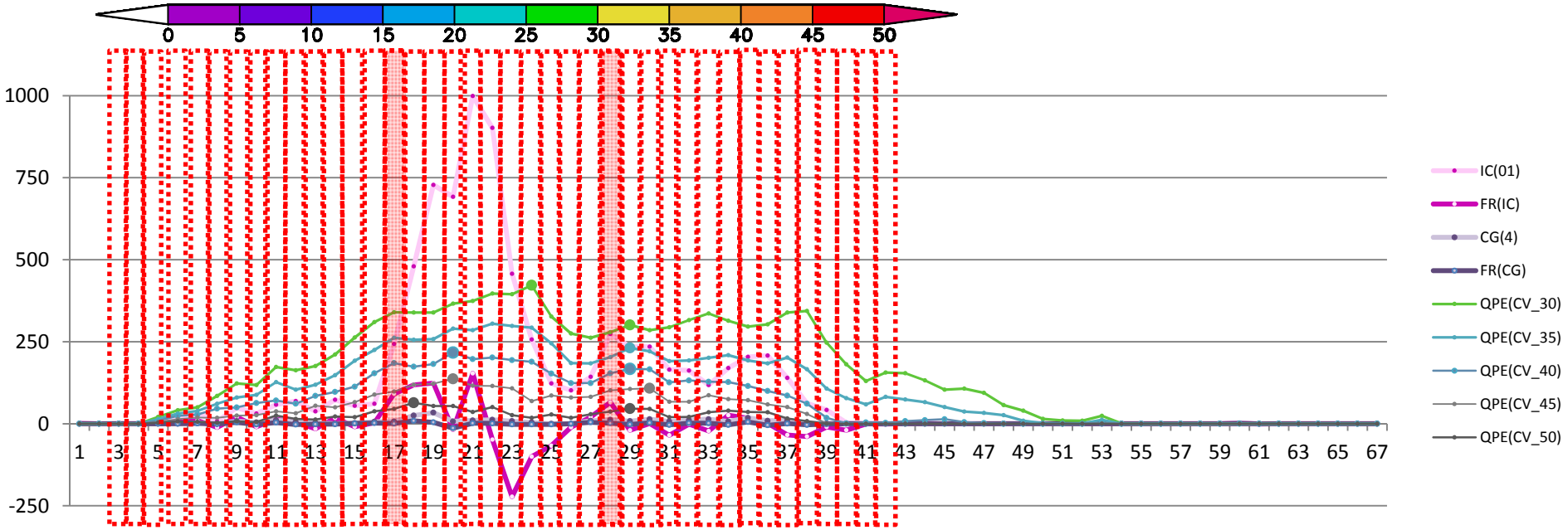
8/15/2008




**FR: number of IC in past 10 min**
**DFRDT: time rate of FR**

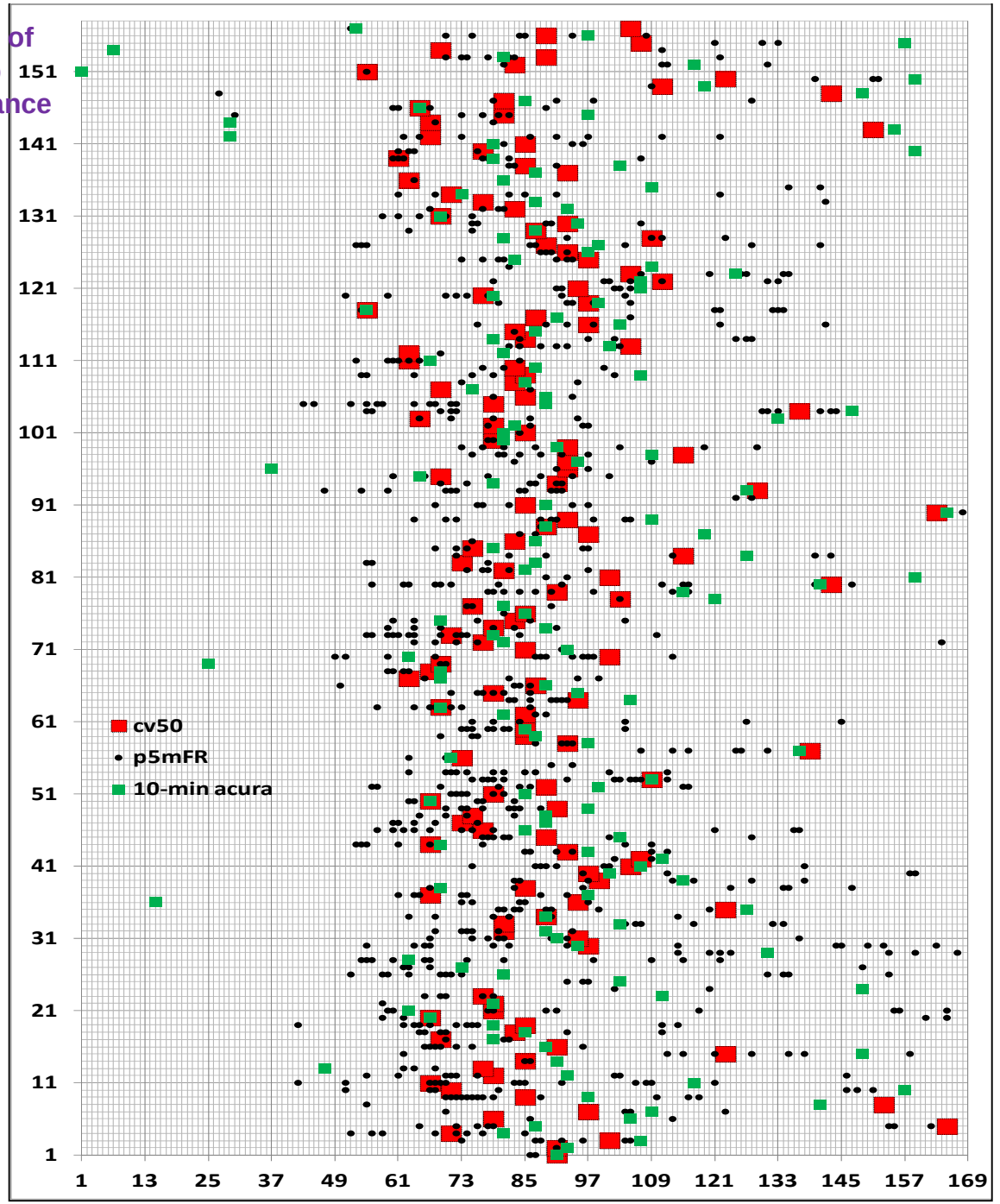



| cases | jump | Leading (in minute) |
|---|---|---|
| 8/15/2008 (N) | 3 → 91 | 10~30 |
| | 20.5 → 65.5 | 10~20 |
| 8/15/2008 (NC) | 2.5 → 78.5 | 0~30 |
| | 9.5 → 86 | 10~20 |
| 8/15/2008 ( C) | no significant jump | |
| 6/16/2008 (N) | 2.5 → 36 | 20~40 |
| | 43.5 → 65.5 | 20 |
| 9/15/2009 (NC) | 12.5 → 29.5 | 20~30 |
| 9/15/2009 ( C) | 1.5 → 25 | 20~40 |



# Cases analysis

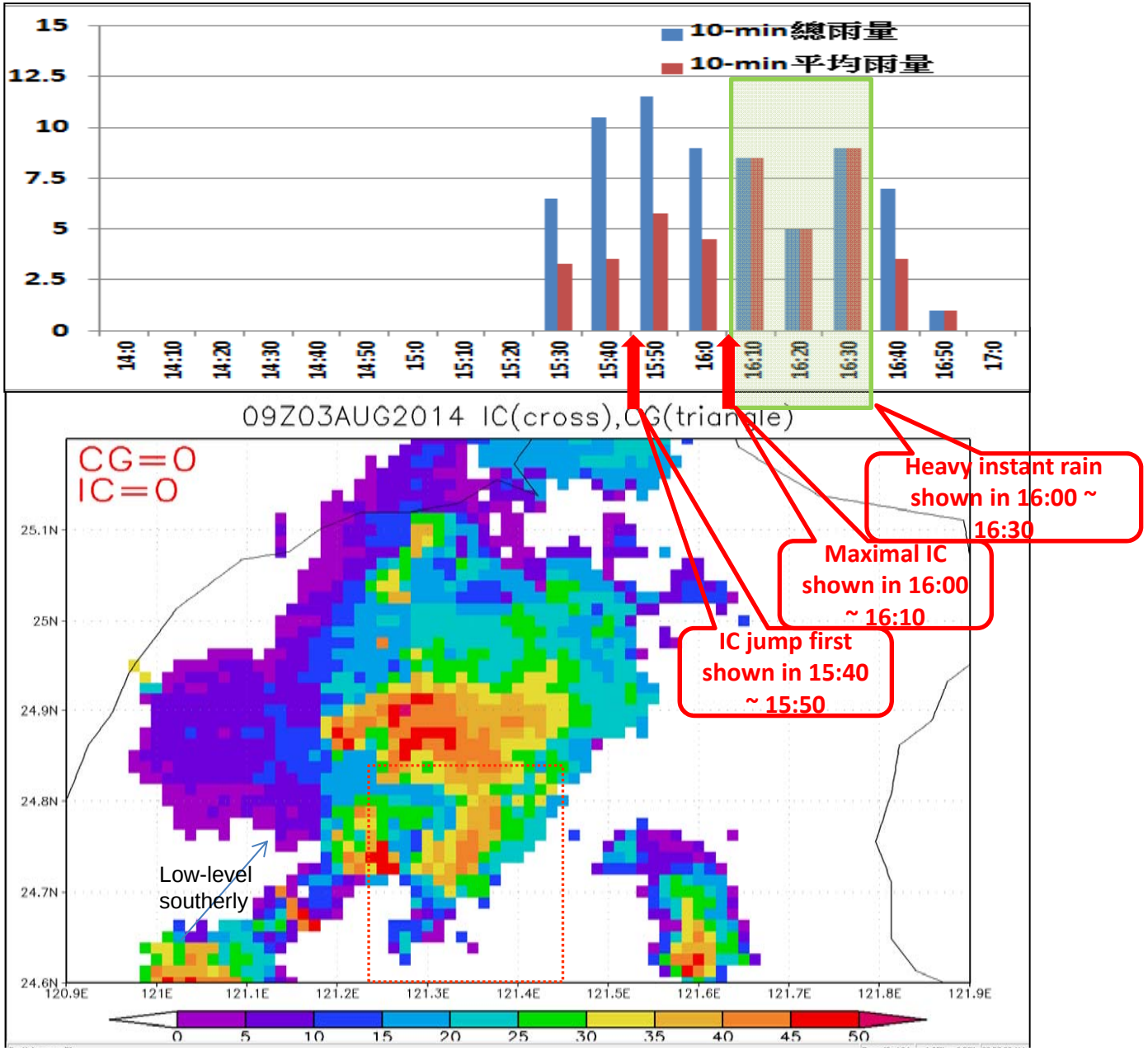
- 157 cases reach simpler IC jump criteria (defined as 0-1-3 flashes/5-min during 3 consecutive 5-min time intervals)
- 144 TSa cases available because of the CV data leakage
- IC jump generally lead the maximal total number of CV pixels for TSa cases with reflectivity over 30/40/50/60 dBz (cases with leading effect reaches 86/83/77/70 %).
- IC jump also lead the instantaneous TSa rainfall which is defined as averaged rain amount ≧ 2.5 mm/10-min (cases with leading effect reaches 72 %).



# Cases analysis

## Application testing ： 8/3/2014

- 3 SFC stations for rain
- jump probably resulting form another system



At least, for the selected afternoon thunderstorms:

- CG lightning is of very limited use.
- IC jump leads the regional maximal CV pixels for thresholds $\leqq$ 50 dBZ.
- IC jump leads the regional averaged instantaneous rainfall.
- Chasing the time rate of total lightning rate could benefit the identification of TSa intensity evolution.