

EGU25-14901

Characterization of thunderstorms in South China that produced gigantic jets in a burst manner

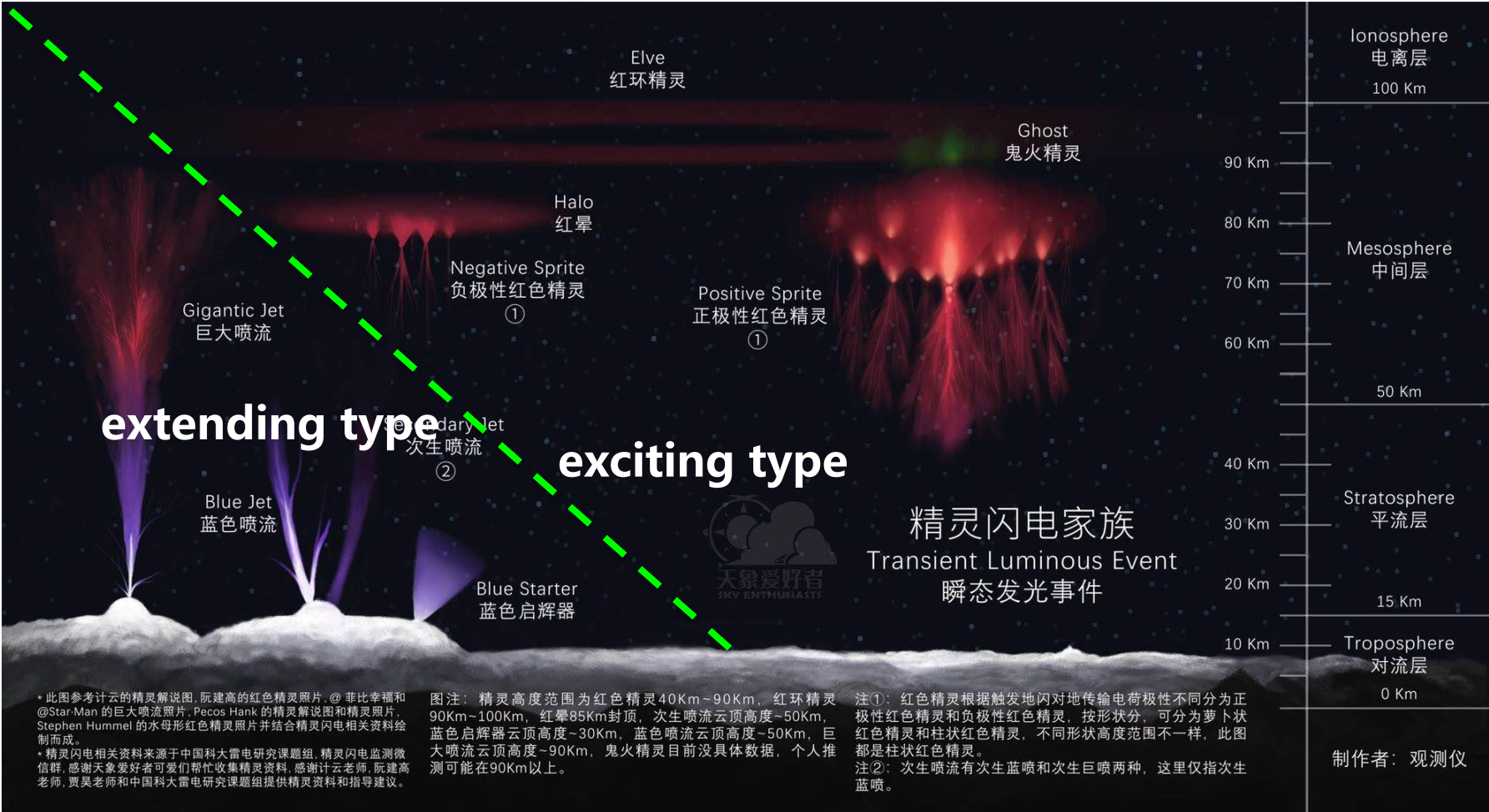
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Dong Zheng, Yang Zhang (CAMS-CMA)
GLD360 of Vaisala Inc.
TLE amateurs in China

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Mesospheric discharging phenomena (transient luminous events, TLEs)



Sprite over Africa seen by "YangWang-1" Space Telescope

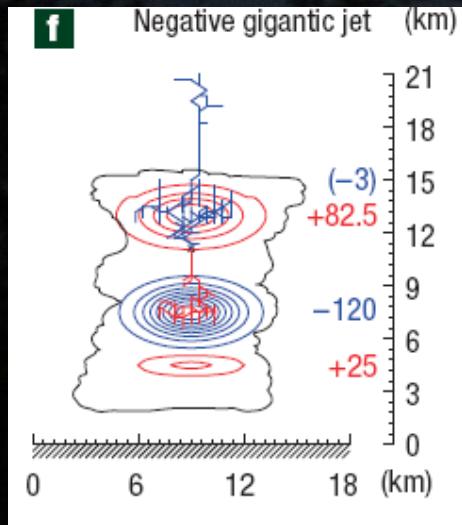


August 8, 2021

By "TLE lightning" amateurs in China

Gigantic jet: electrical fountain from thunderstorm

Charge imbalance theory of GJs



Krehbiel et al. [2008]-*Nature Geoscience*



Pasko et al. [2002]-*Nature*

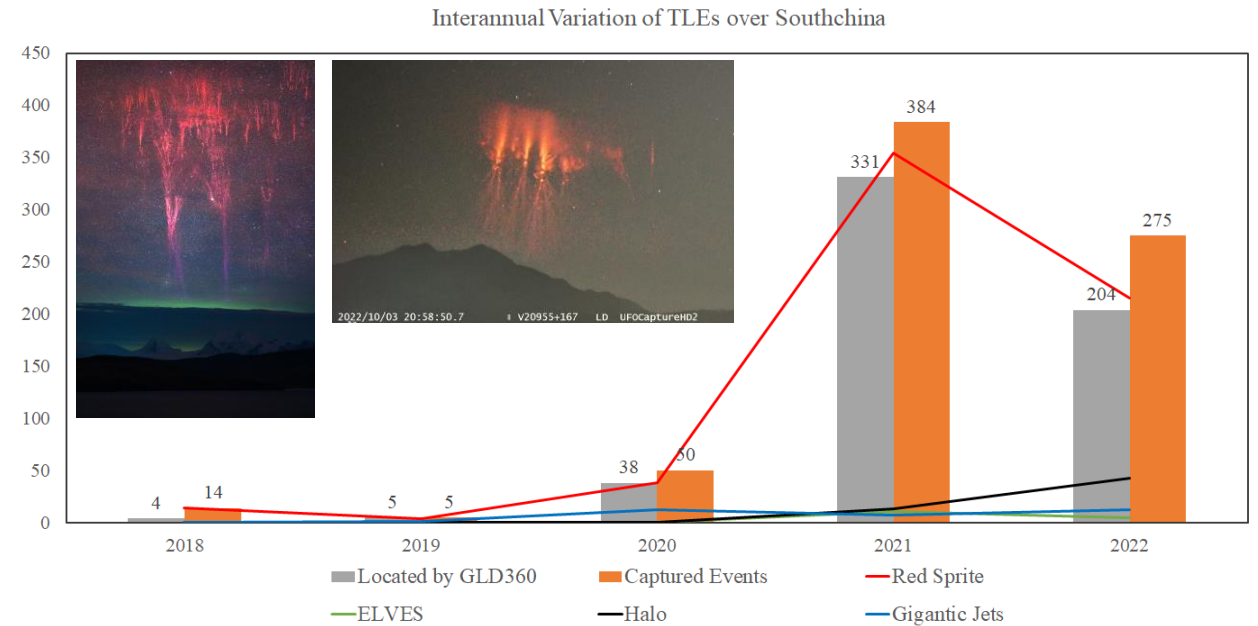


A chance to let people know the TLE research

Overview of TLE observations by amateurs in China during 2018-2022



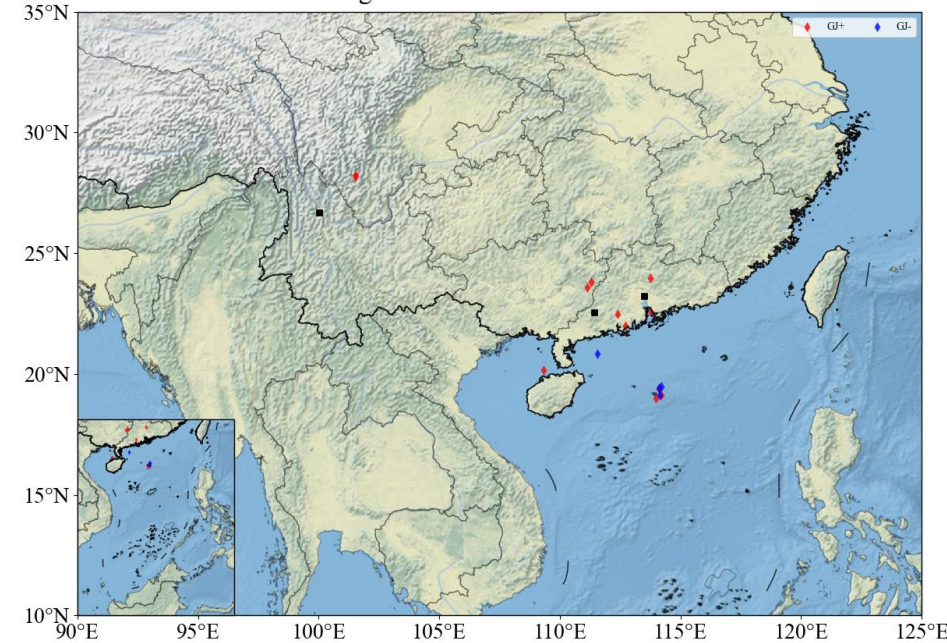
**A tour of chasing thunderstorm in
South China
June 18-July 10, 2020**



For comparison, “scientists” captured less than 100 sprites with SpriteCam installed at 6 stations from 2014-2018.

Observations of gigantic jets (and blue jets/starters)

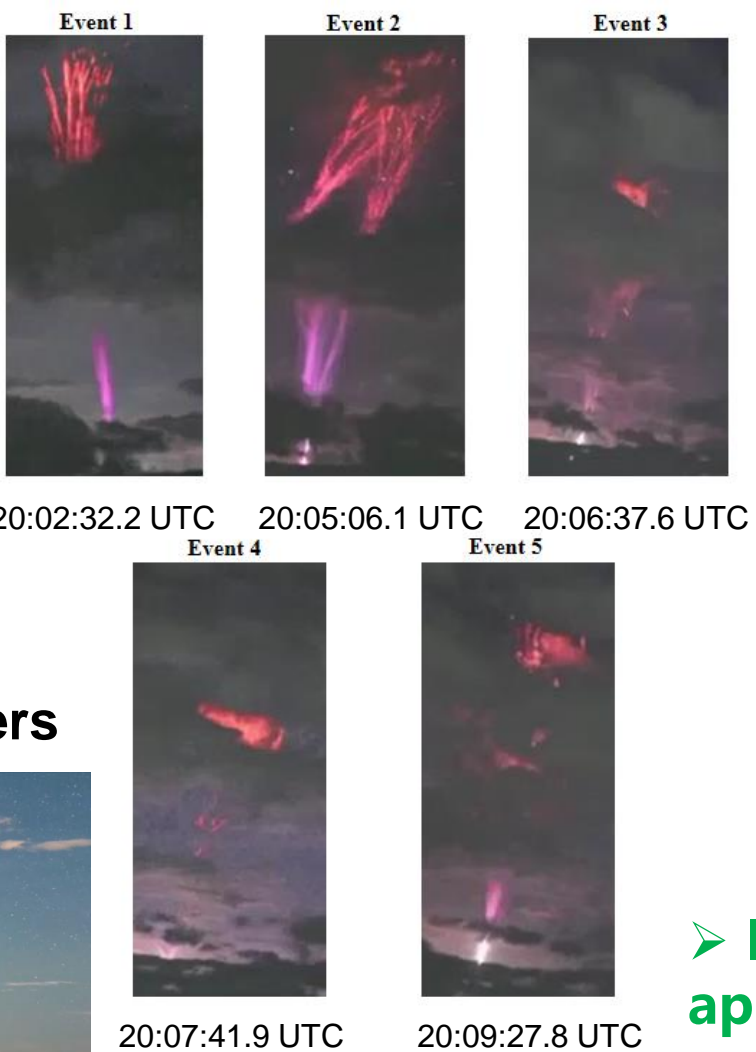
Gigantic Jets over South China



■ 38 gigantic jets, 10+ blue jets/starters



Five GJs within 9 minutes



August 18, 2022

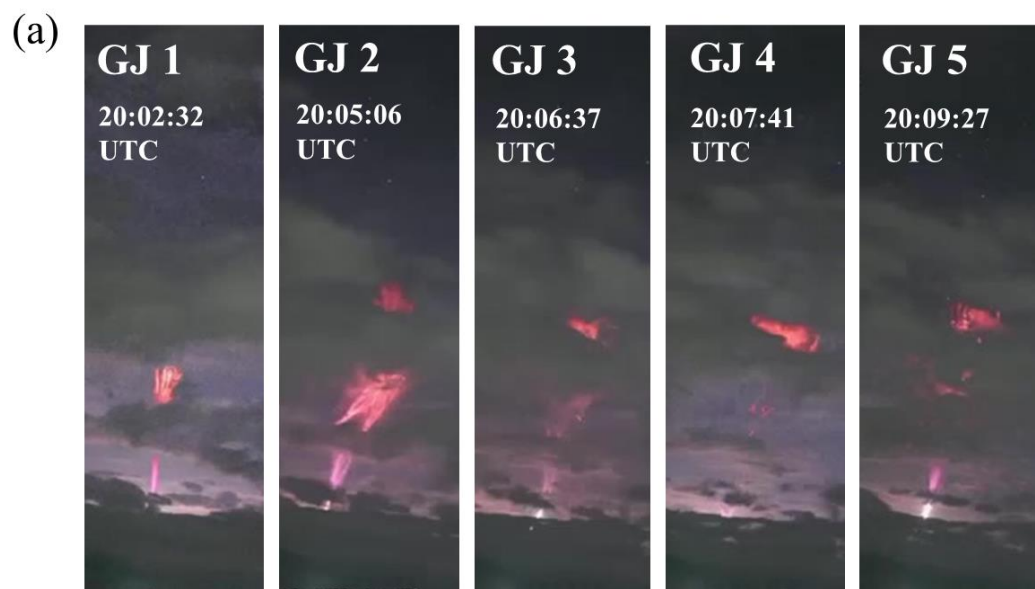
Six GJs within 20 minutes



June 9, 2023

➤ In several cases, GJs appeared to occur in a burst manner

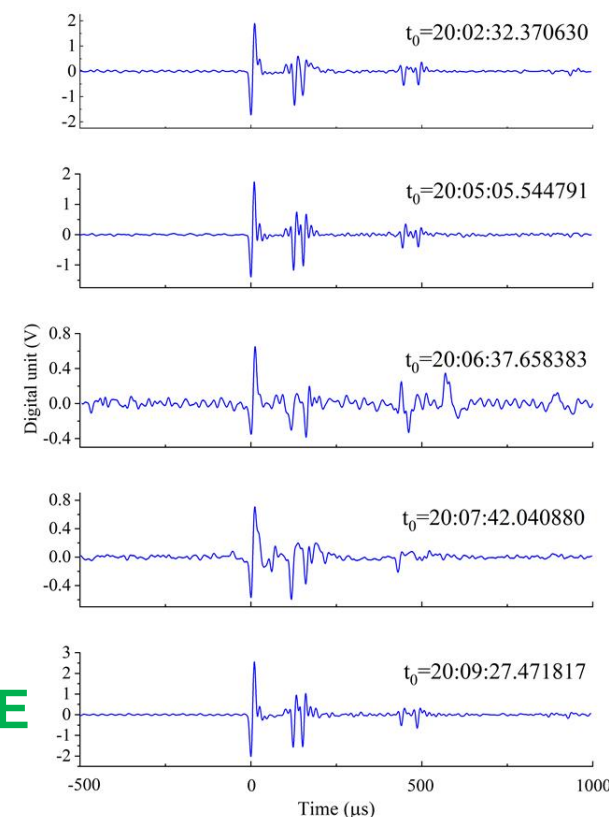
Case analysis on August 18, 2022



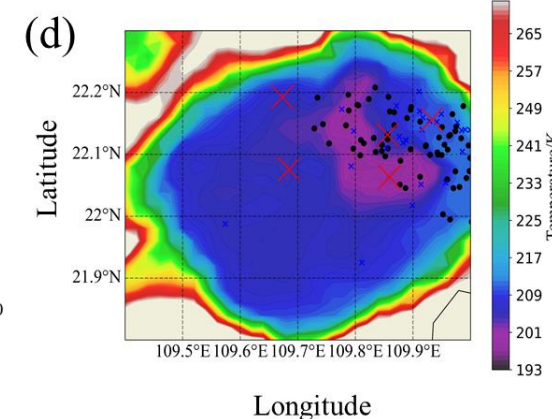
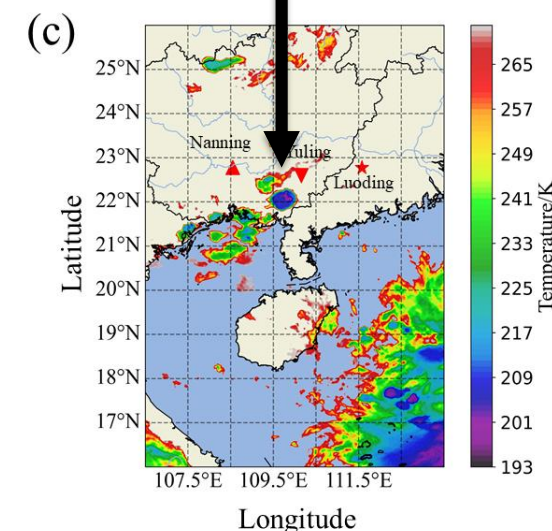
Captured with a Sony Alpha 7SII full-frame mirrorless camera with a 20-mm lens.

- At least five GJs captured within 7 minutes
- All GJs appeared to have corresponding +NBE signals, providing location of inception
- The parent thunderstorm is otherwise very ordinary in South China

(b) JASA-recorded NBEs

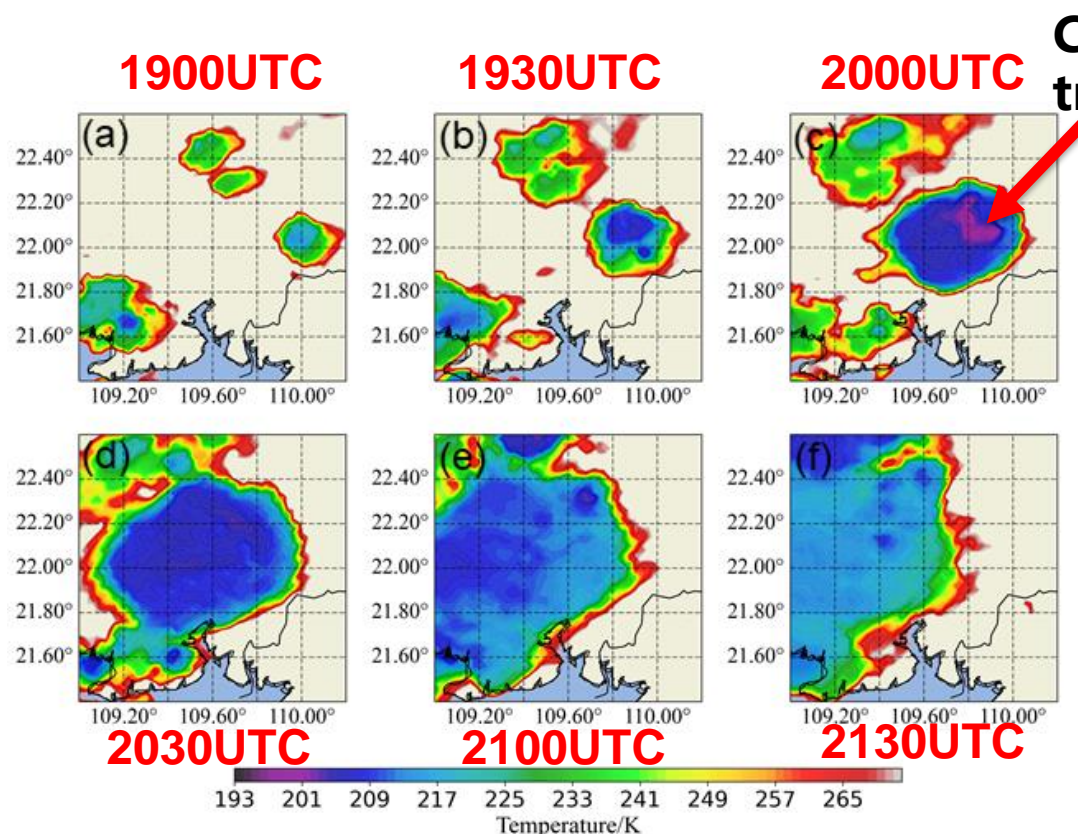


GJ-producing thunderstorm
Large CAPE value (2157 J/kg)

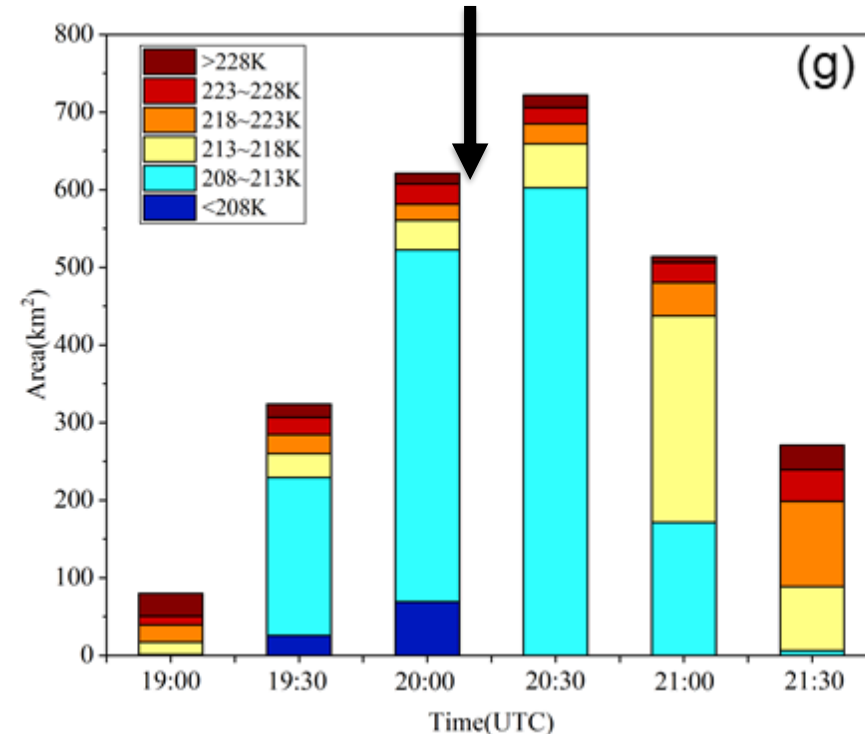


Implication from TBB analysis

- The outbreak of GJs occurred during the rapid development stage of thunderstorm
- GJs occurred in the region of coldest TBB ranging from 213 K to 208 K



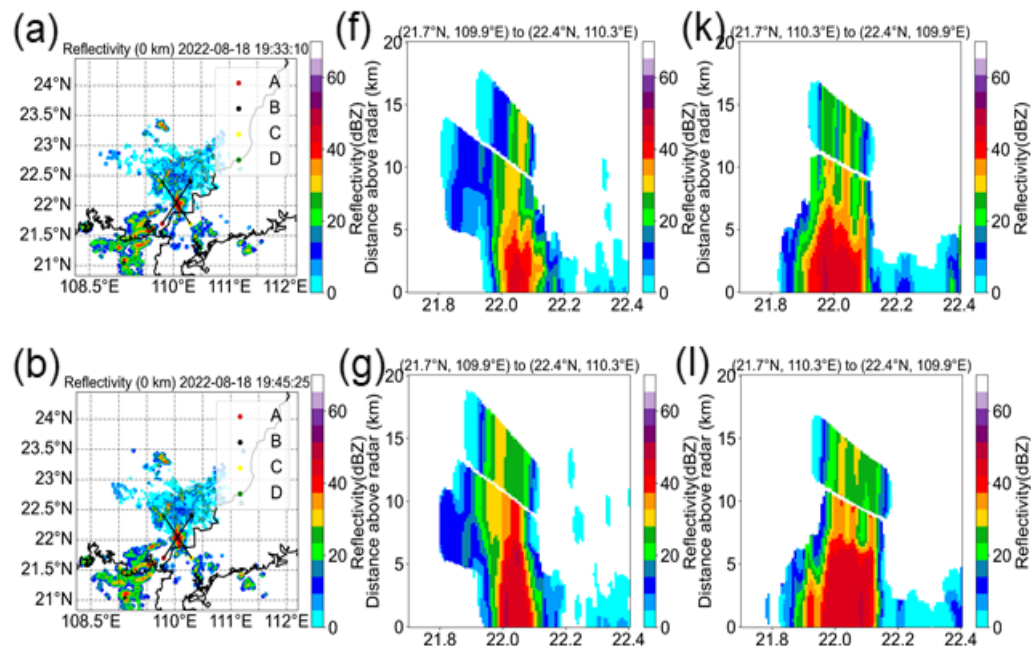
Outbreak of GJs



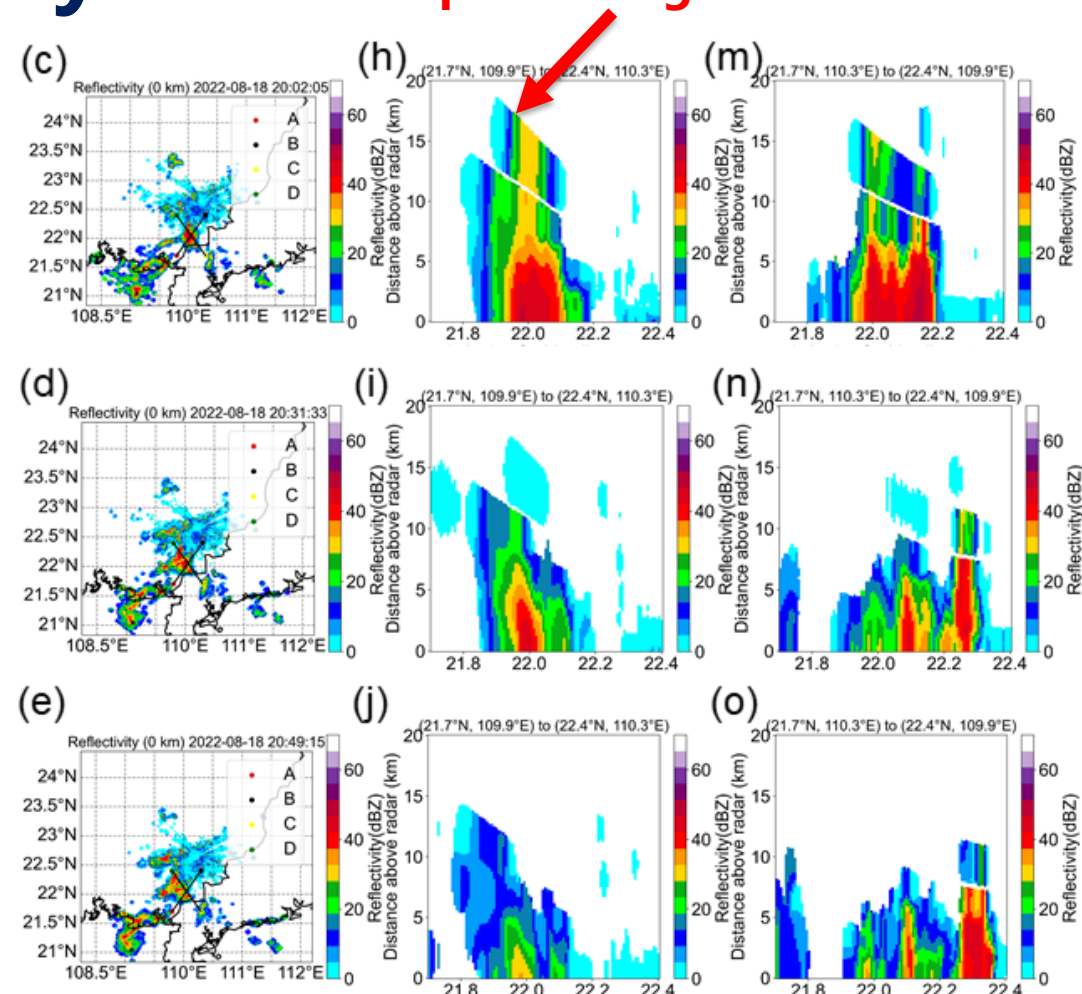
Cloud-top brightness temperature (TBB) as observed by Japanese Himawari-8 satellite

Results of radar reflectivity analysis cloud top reaching above 18 km

- Better demonstrating the association of overshooting with outbreak of GJs
- Deep convection and heavy precipitation
- Convection weakened after GJ outbreak



Before outbreak of GJs



Upon and after outbreak of GJs

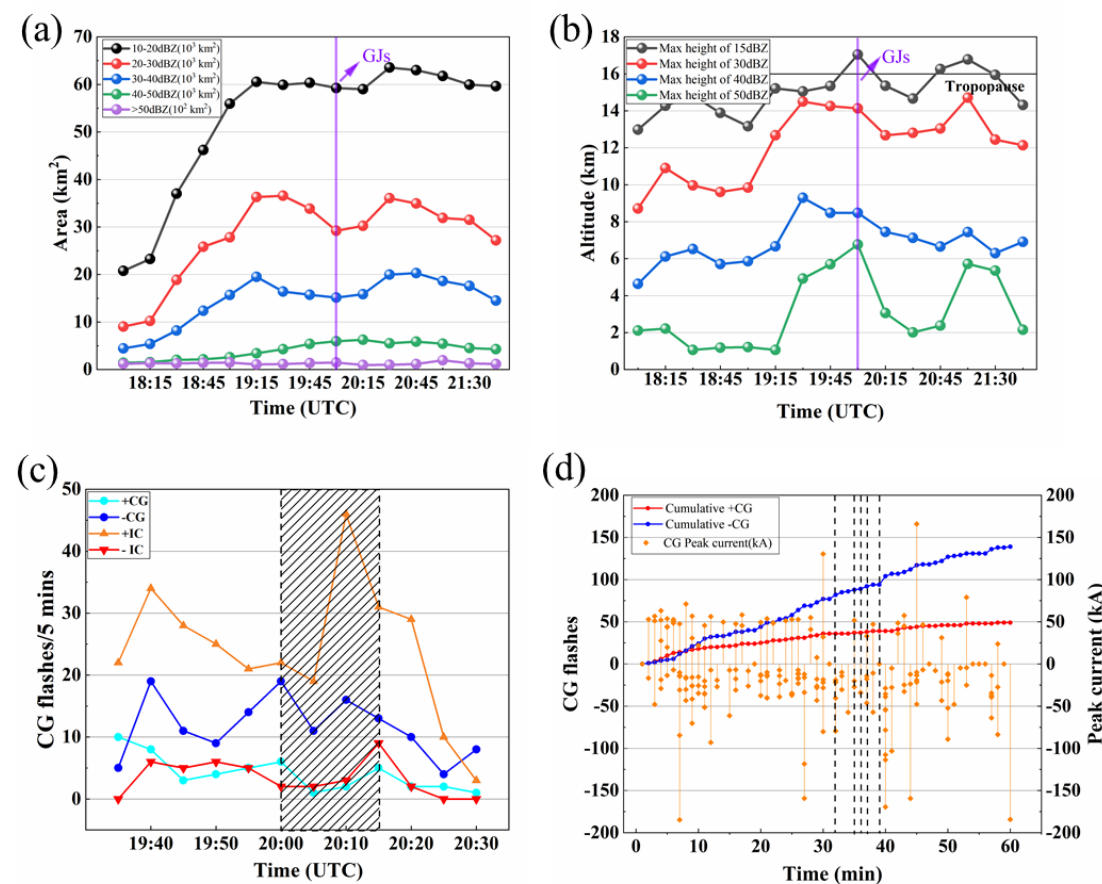
- Based on CINRAD/SA single-polarization Doppler radar from Yulin, Guangxi Province, about 200 km away

More hints from radar+lightning activity (from GLD360)

- The outbreak of GJs occurred during the intensification of IC lightning activity (enhanced convection/charge separation?)
- Overshooting of deep convection might open the window for the outbreak of GJs
- Meanwhile, negative CG lightning was seriously suppressed.



Correlation between outbreak of GJs and elevated main negative charge region?



Polarity transition of NBEs in upper part of storm

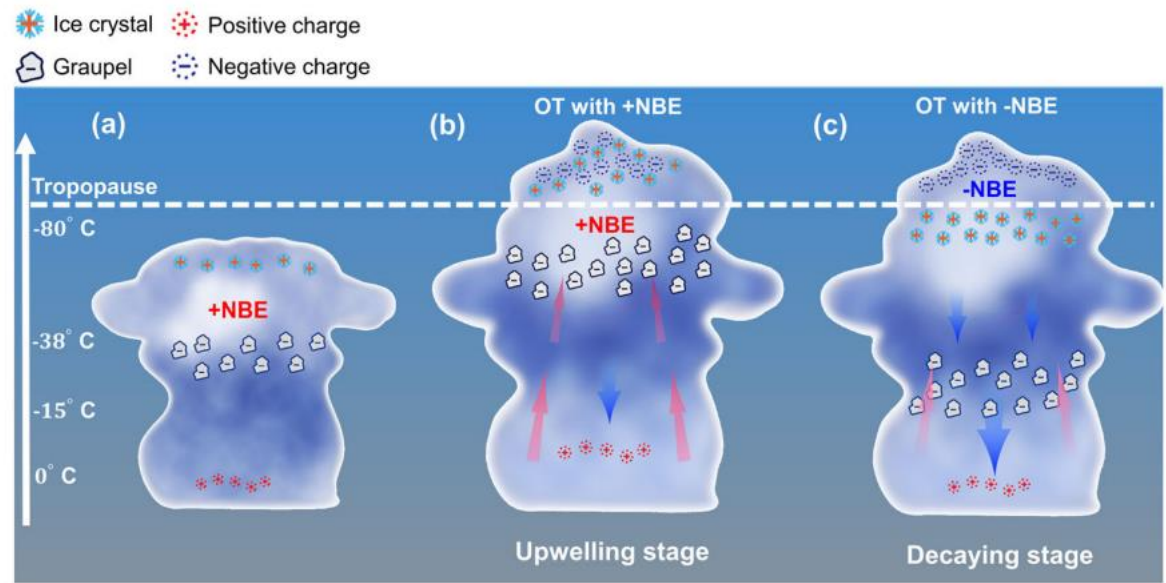
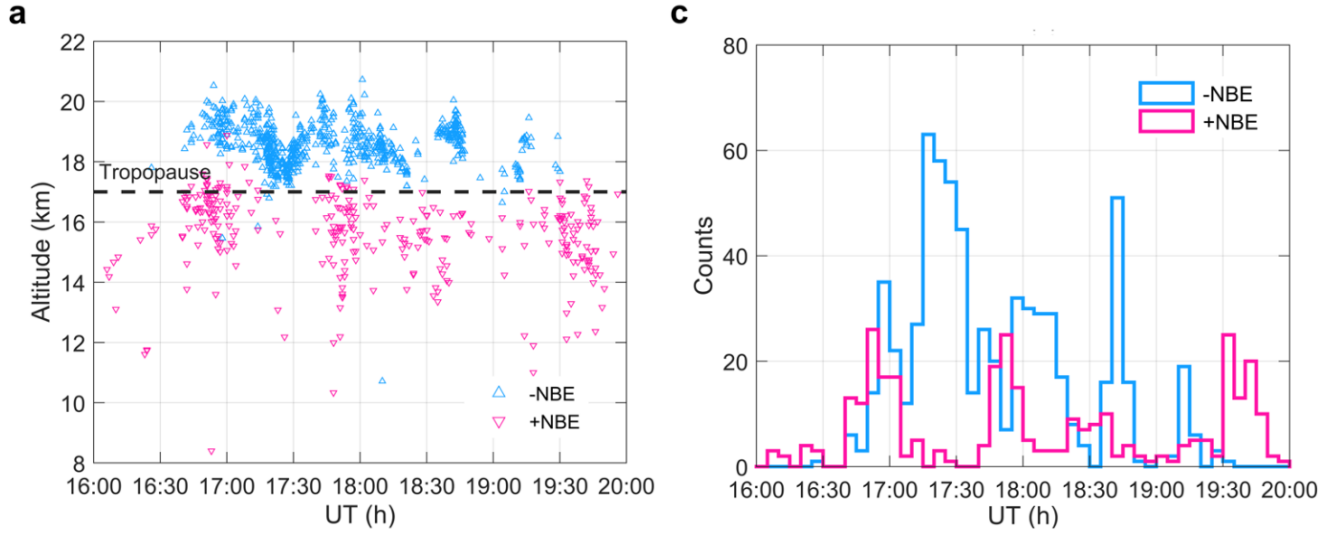
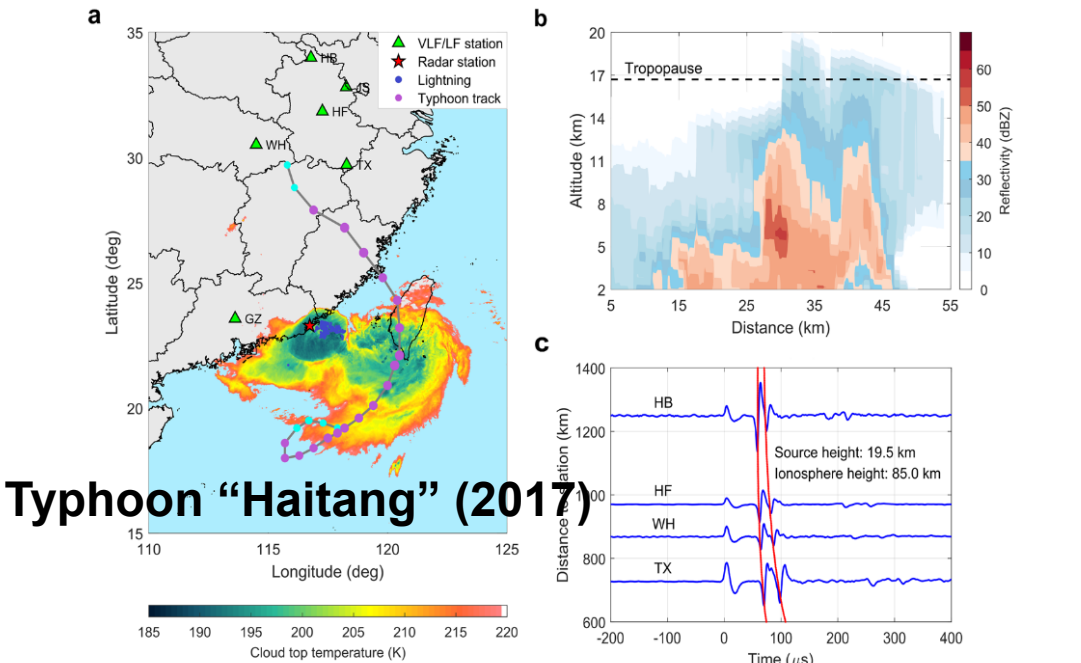
nature communications

Liu et al. (2024@NC)

Article <https://doi.org/10.1038/s41467-024-51705-y>

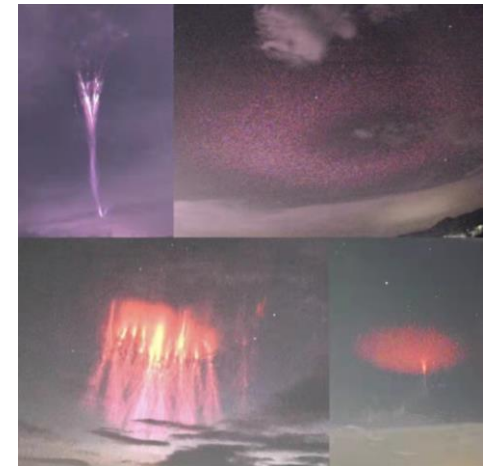
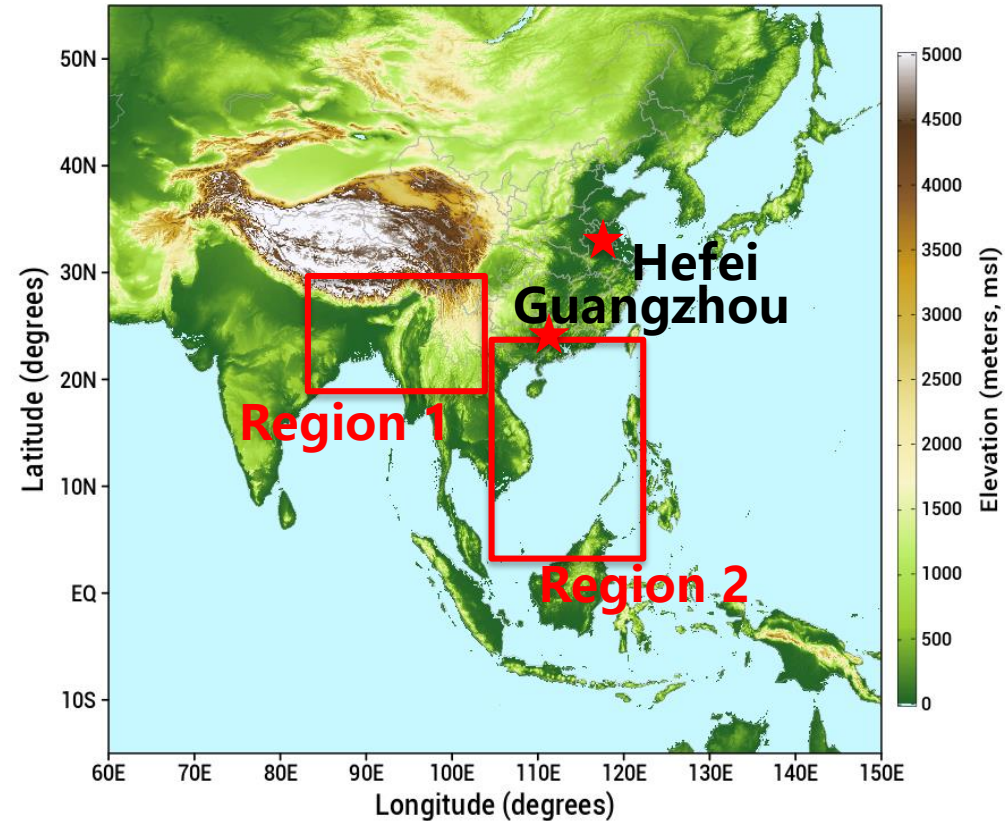
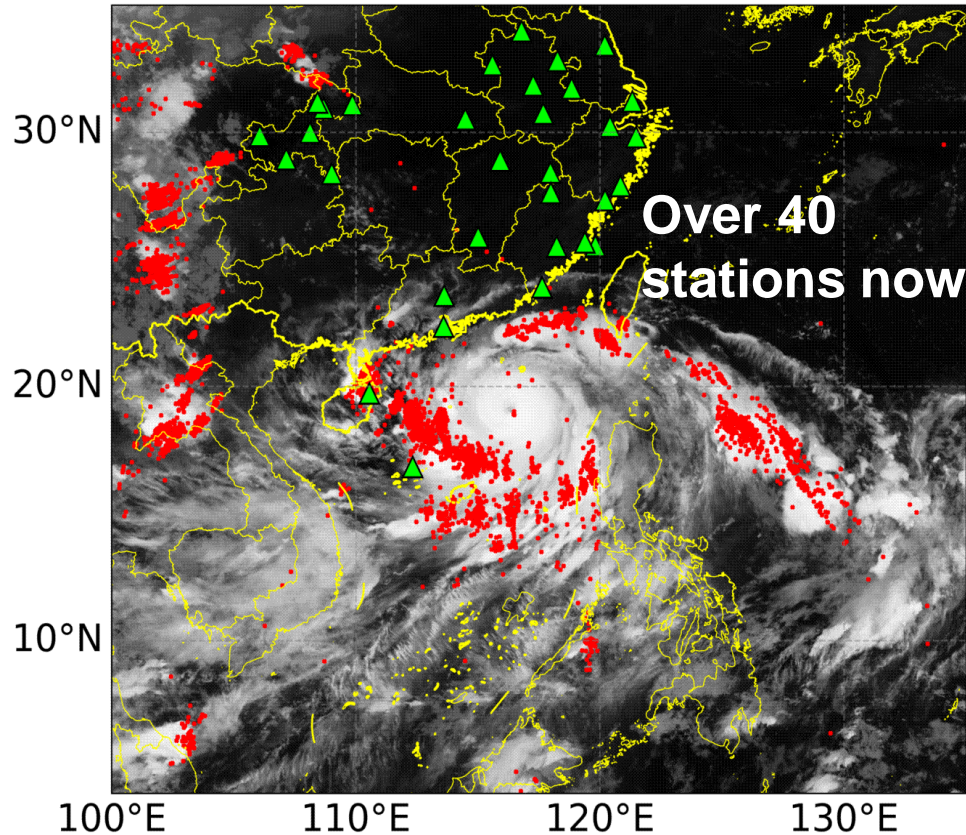
Polarity transitions of narrow bipolar events in thundercloud tops reaching the lower stratosphere

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Jiang-huai Area Sferic Array (JASA) of USTC

SuperTY 09-04 16:00 UTC



<http://222.195.83.28:8081>

- Real-time data transfer and processing on cloud server
- High-performance GPU computation

Summary of current understanding



- Quite many gigantic jets were observed near the coast of South China, especially in Beibu Gulf
- Deep convection of thunderstorms originating in the sea might provide favorable conditions for the outbreak of GJs
- There is a sweet spot for GJ hunting to be explored in 2025