



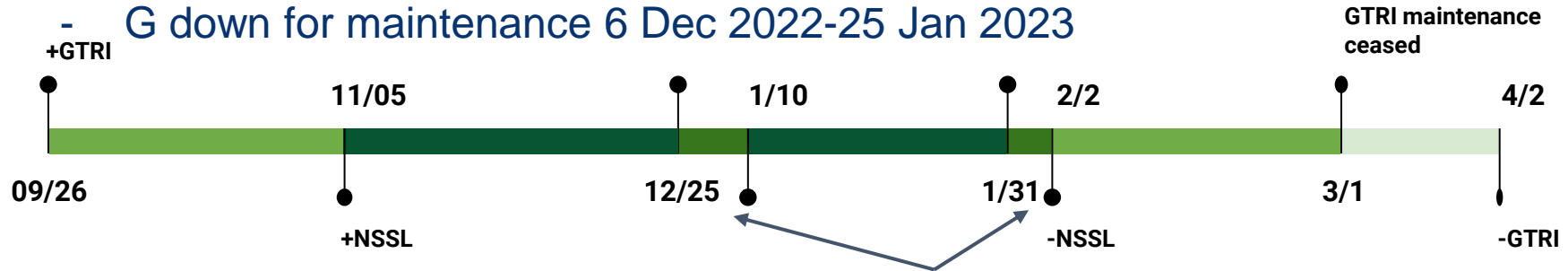
LMA: Summary of data collection and access





Important dates

- Full period with GTRI network: 26 September 2022 - 2 April 2023
- + NSSL LMAs: 5 November 2022 to 2 February 2023
- Individual sensor issues listed in README on EOL
 - N down for maintenance 5 Oct 2022-10 Jan 2023
 - G down for maintenance 6 Dec 2022-25 Jan 2023





Which stations were active during each time period?

Check the file headers

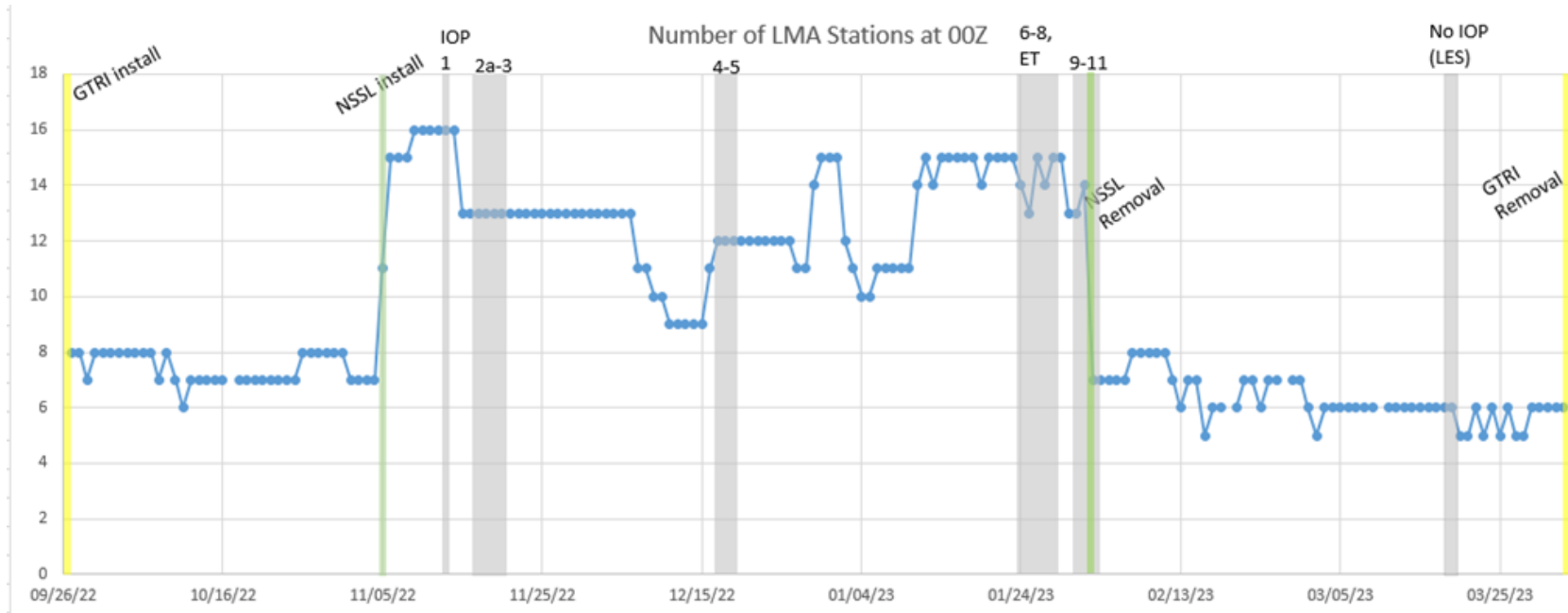
- Active station listed in “Active stations” line
- Each station in the network is also listed as **Active** or **Not active** in the “Station data” table
- Note: only 5 stations are strictly necessary for 3D solutions
 - more stations = more sensitivity and accuracy
 - Decreasing returns with increasing station counts

```
Lightning Mapping Array analyzed data
Analysis program: ./lma analysis -d 20230108 -t 120000 -s 600 -l /raid/lng2/data
/mobile/locations/mobile_LEE_221216.loc -a -n 5 -o /raid/lng1/analyzed_data_v10/
deployments/LEE/2023/01/08/ -q
Analysis program version: 10.14.5R
File created: Wed Jan 25 08:38:21 2023
Data start time: 01/08/23 12:00:00
Number of seconds analyzed: 600
Location: NSSL Mobile
Coordinate center (lat,lon,alt): 43.5861878 -75.7169257 220.76
Coordinate frame: cartesian
Maximum diameter of LMA (km): 99.721
Maximum light-time across LMA (ns): 332699
Number of stations: 15
Number of active stations: 11
Active stations: A B C D F E R S T U W
Minimum number of stations per solution: 5
Maximum reduced chi-squared: 5.00
Maximum number of chi-squared iterations: 20
Station information: id, name, lat(d), lon(d), alt(m), delay(ns), board_rev, rec
ch
Sta info: A Site 1 43.9077669 -75.7100771 358.94 100 52 3
Sta info: B Site 2 43.5299437 -75.4711200 509.00 100 52 3
Sta info: C Site 3 43.3470481 -75.7544386 142.61 100 52 3
Sta info: D Site 4 43.6868811 -75.2862067 363.88 100 52 3
Sta info: F Site 6 43.2532712 -75.5339088 121.89 100 52 3
Sta info: E Site 5 43.5298968 -75.8189444 272.80 100 52 3
Sta info: H Site 8 43.6456100 -76.0141589 248.88 100 52 3
Sta info: N UNIT N 43.8399011 -75.4290750 215.63 100 51 6
Sta info: R UNIT R 44.0405522 -75.8609833 136.85 100 51 6
Sta info: S UNIT S 43.5524731 -76.1223458 104.30 100 51 6
Sta info: T UNIT T 43.4380567 -75.2255694 337.83 100 51 6
Sta info: U UNIT U 43.9892703 -76.0237369 73.12 100 51 6
Sta info: V UNIT V 43.3682175 -75.9103411 194.93 100 51 6
Sta info: W UNIT W 43.3345047 -75.1781767 357.42 100 51 6
Sta info: X UNIT X 43.8612794 -76.0149547 158.52 100 51 6
Station data: id, name, win(us), dec_win(us), data_ver, rms_error(ns), sources,
%, <P/P_m>, active
Sta data: A Site 1 80 12 70 1404 43.9 0.07 A
Sta data: B Site 2 80 12 70 1448 45.3 0.17 A
Sta data: C Site 3 80 12 70 1120 35.1 2.95 A
Sta data: D Site 4 80 12 70 954 29.9 0.95 A
Sta data: F Site 6 80 12 70 1355 42.4 0.94 A
Sta data: E Site 5 80 12 70 1730 54.1 0.03 A
Sta data: H Site 8 0 0 70 0 0.0 0.00 NA
Sta data: N UNIT N 0 0 70 0 0.0 0.00 NA
Sta data: R UNIT R 80 10 70 1612 50.5 1.90 A
Sta data: S UNIT S 80 10 70 2008 62.8 7.71 A
Sta data: T UNIT T 80 10 70 1191 37.3 2.32 A
Sta data: U UNIT U 80 10 70 1488 46.6 0.45 A
Sta data: V UNIT V 0 0 70 0 0.0 0.00 NA
Sta data: W UNIT W 80 10 70 1668 52.2 1.67 A
Sta data: X UNIT X 0 0 70 0 0.0 0.00 NA
Metric file version: 4
Station mask order: XWVUTSRNHFEDCBA
Data: time (UT sec of day), lat, lon, alt(m), reduced chi^2, P(dBW), mask
Data format: 15.9f 12.8f 13.8f 9.2f 6.2f 5.1f 6x
Number of events: 3195
```





LMA station count over the LEE observation period



- Number of active stations at 00Z each day from THREEEDS catalog
- EOL catalog and THREEEDS does not include 8 active GTRI stations from 11/5 through 11/16. They have been added here.
- Maintenance of GTRI array ceased 3/1/23





The EOL archive

https://data.eol.ucar.edu/master_lists/generated/lee/

Processed data with NSSL+GTRI sensors, full project period, 5 station minimum, gzip text files

[Combined NSSL and GTRI Lightning Mapping Array Data \[NSSL, GATech\]](#)

New
2023-06-28



Electric Field Meter Data [NSSL]

Raw data for each network which could be used to reprocess, binary files (LARGE)

[GTRI LMA Raw Station Data \[GATech\]](#)

New
2023-07-10



[National Lightning Detection Network \(NLDN\) Data \[NLDN\]](#)

2022-10-18

[NSSL LMA Raw Station Data \[NSSL\]](#)

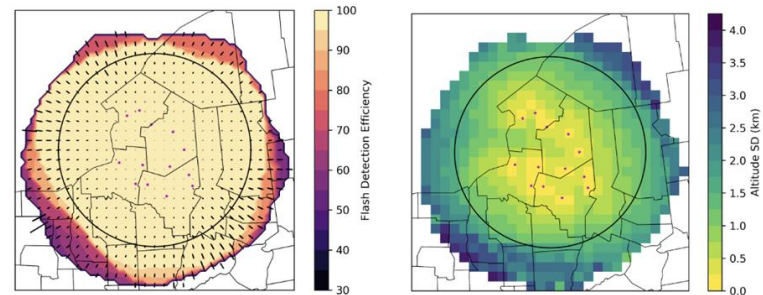
New
2023-07-06



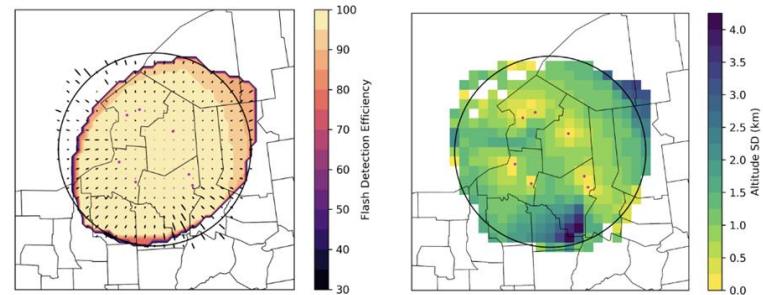


Information in the README

- Estimated performance for each IOP
 - Flash detection efficiency
 - Altitude errors
- Information on data file formats and processing version
- Documentation of station issues



IOP10, 1-2 February 2023, 1100-0000 UTC



IOP11 (GTRI sensors only), 2-3 February 2023, 2200-0330 UTC





NSSL THREDDS endpoint

Same data. Please use DOI on EOL catalogue for all publications.

<https://data.nssl.noaa.gov/thredds/catalog/WRDD/OKLMA/deployments/LEE/catalog.html>

Plus Imatools flash-sorted files with 5-station minimums per source:

https://data.nssl.noaa.gov/thredds/catalog/WRDD/OKLMA/deployments/flashsort/h5_files/catalog.html

Or 6-station minimums per source:

https://data.nssl.noaa.gov/thredds/catalog/WRDD/OKLMA/deployments/flashsort/6/h5_files/catalog.html

All organized in 10-minute files in year, month, day directories



Flash sorted files

Used Imatools: <https://doi.org/10.5281/zenodo.32510>

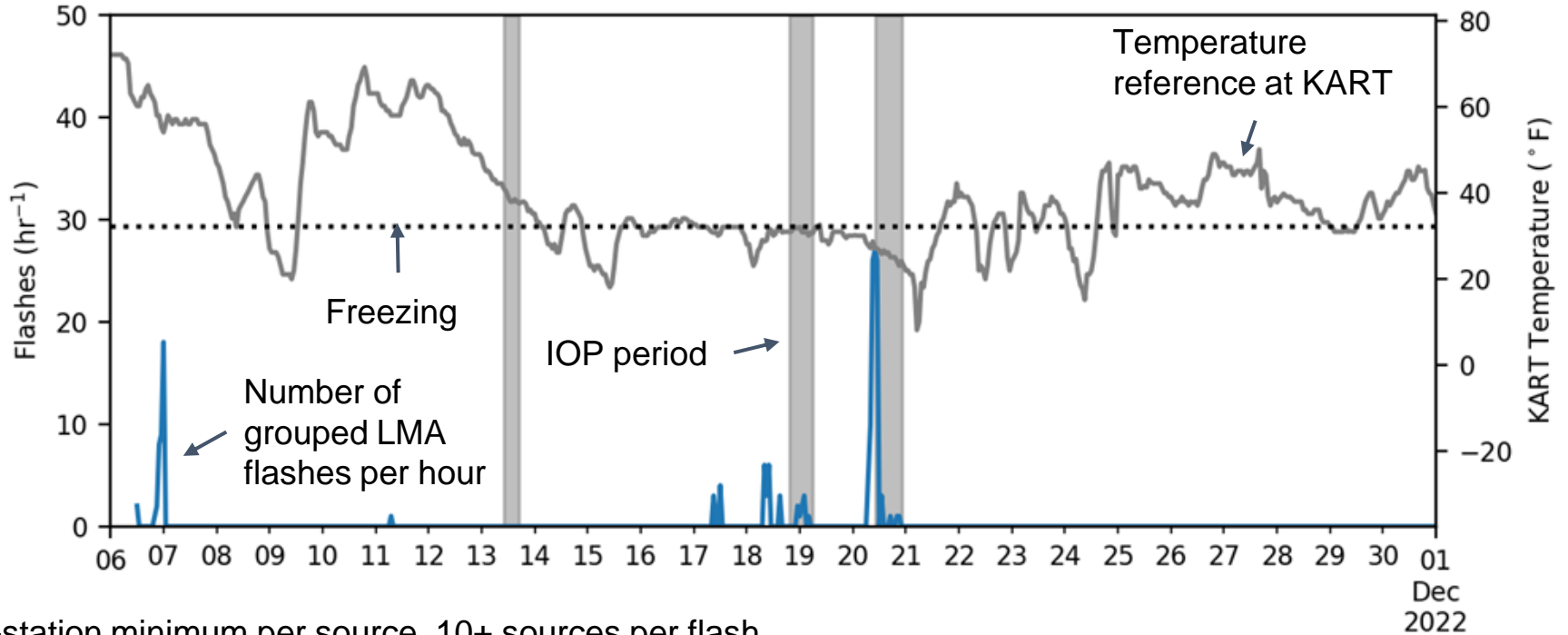
Flash grouping criteria:

- Reduced $\chi^2 \leq 1$ per VHF source
- Distance threshold: 3 km
- Time threshold: 0.15 s
- Max duration: 3 s

Format: h5 files containing events (VHF sources) with flash assignments and flash characteristics (initiation points, centroids, convex hull areas, etc.)



Time series - November

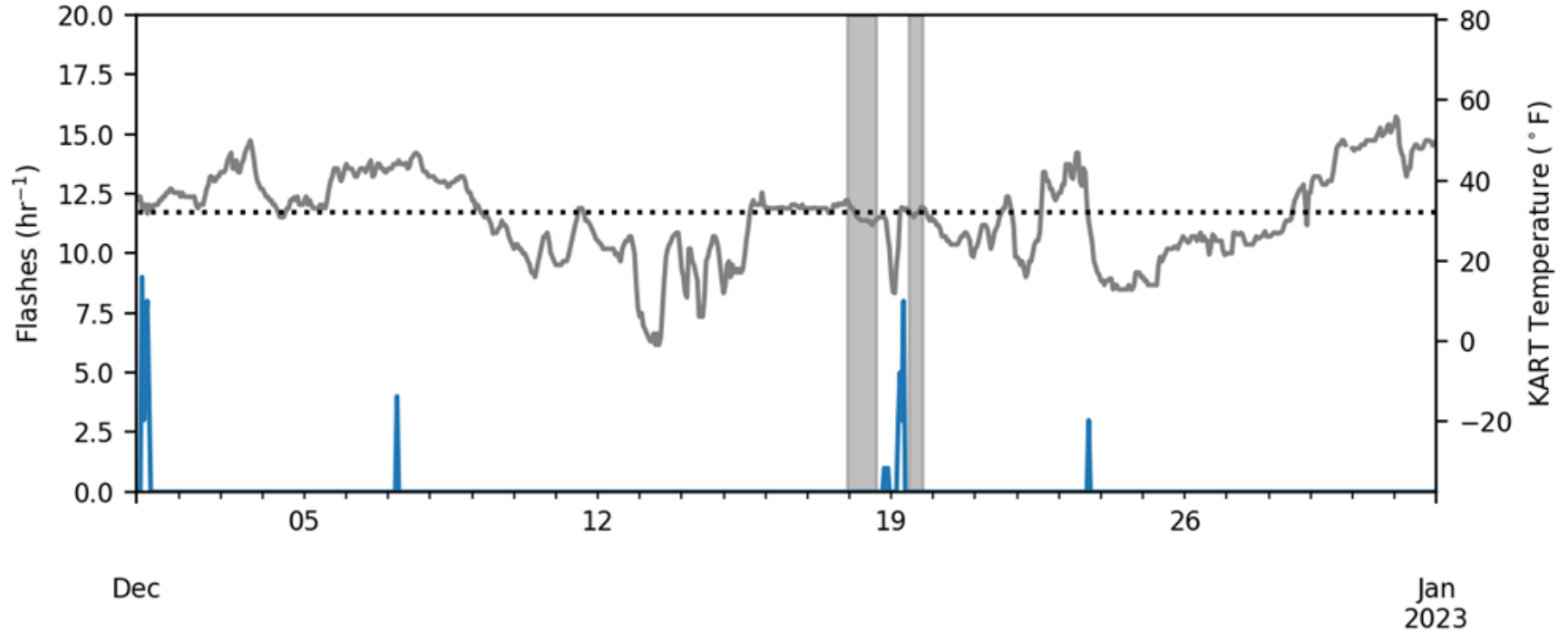


6-station minimum per source, 10+ sources per flash,
some artifacts manually removed



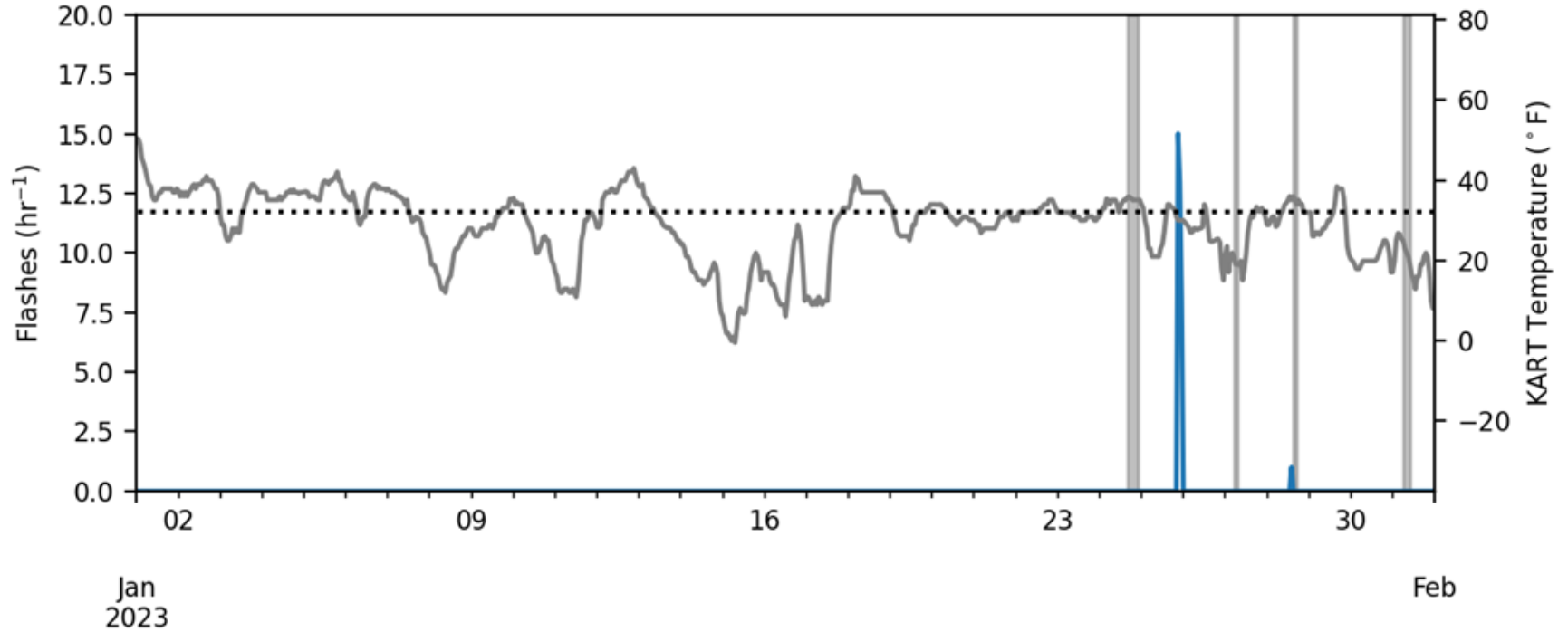


Time series - December



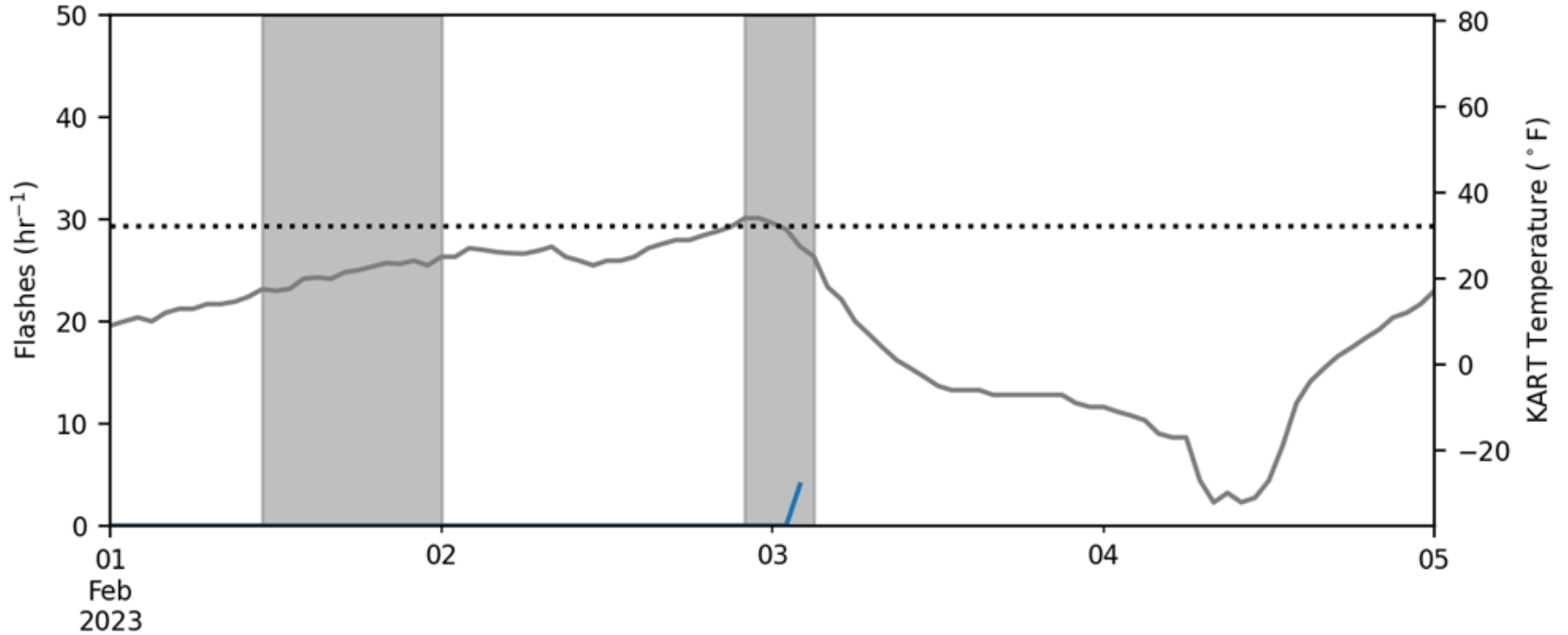


Time series - January





Time series - February





How many flashes did we capture?

Nov-Feb period
Imatools version

	5-station min	6-station min
Flashes in IOPs	72	98
Flashes not in IOPs, KART temperatures below freezing	118	159
Flashes not in IOPs, KART temperatures above freezing	85	114

In use, look out for: aircraft tracks, extra noise counted as flashes





IOPs with flashes

- *IOP2a (11/17/22, no supporting DOW data, lightning along the southern shore)*
- IOP2 (11/18-19/22)
- IOP3 (11/20/22)
- IOP11 (2/2-3/22, GTRI LMA data only)

NOTE: This is just from the automatically sorted flashes! Some events were likely missed.





Other days with flashes

- September 28, 2022 - lake effect rain event (GTRI LMA data, soundings)
- November 6-7
- November 17-18 before IOP2 (11/18 0800-1100 UTC; 1500 UTC)
- November 20 between IOPs 2 and 3 (0700-1000 UTC)
- December 1 over turbines (0200-0900 UTC)
- December 7
- December 18-19 flashes between IOPs (2000, 2200; 0500-0800 UTC)
- December 23 over Tug (1600-1800 UTC)
- January 25 ET cyclone
- January 28

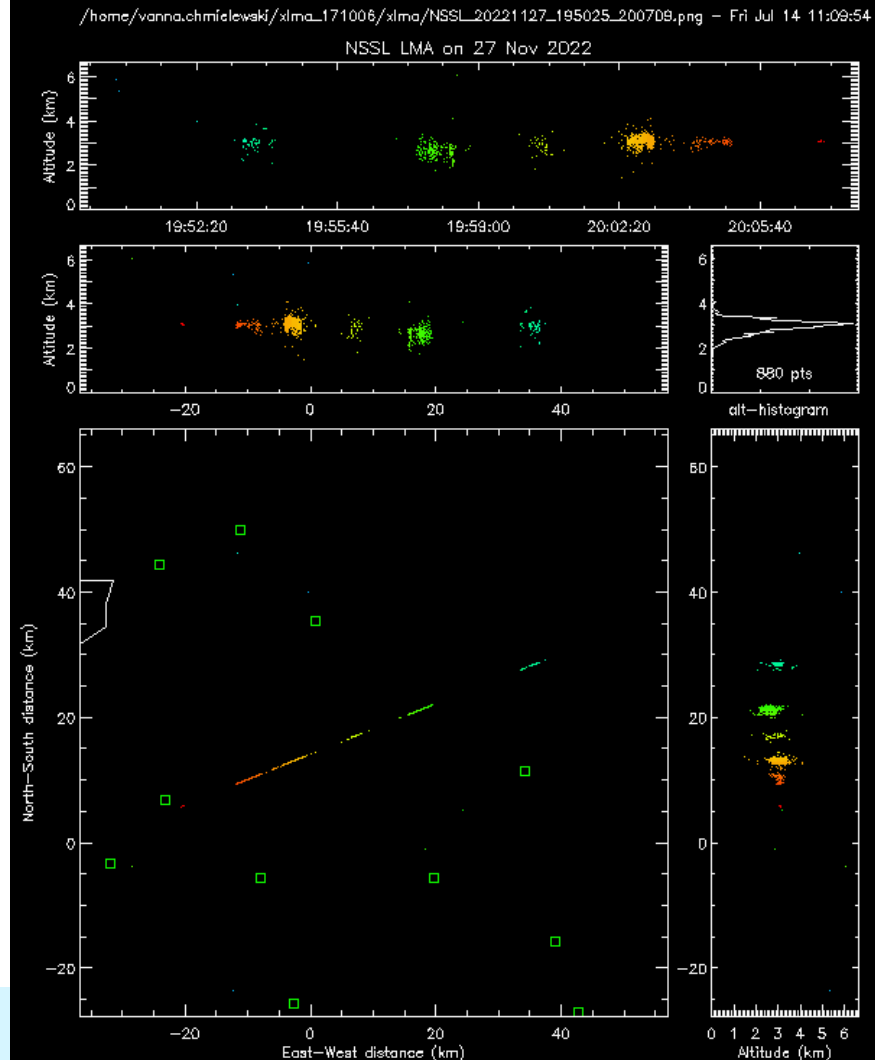
And maybe others

Lots of days with aircraft tracks



What does an aircraft track look like?

- Straight or curved path
- Single height, may be noisy
- Consistent path in time





What does an aircraft track look like?

- Straight or curved path
- Single height, may be noisy
- Consistent path in time
- Low VHF power

