LI-STAR tool DEMO

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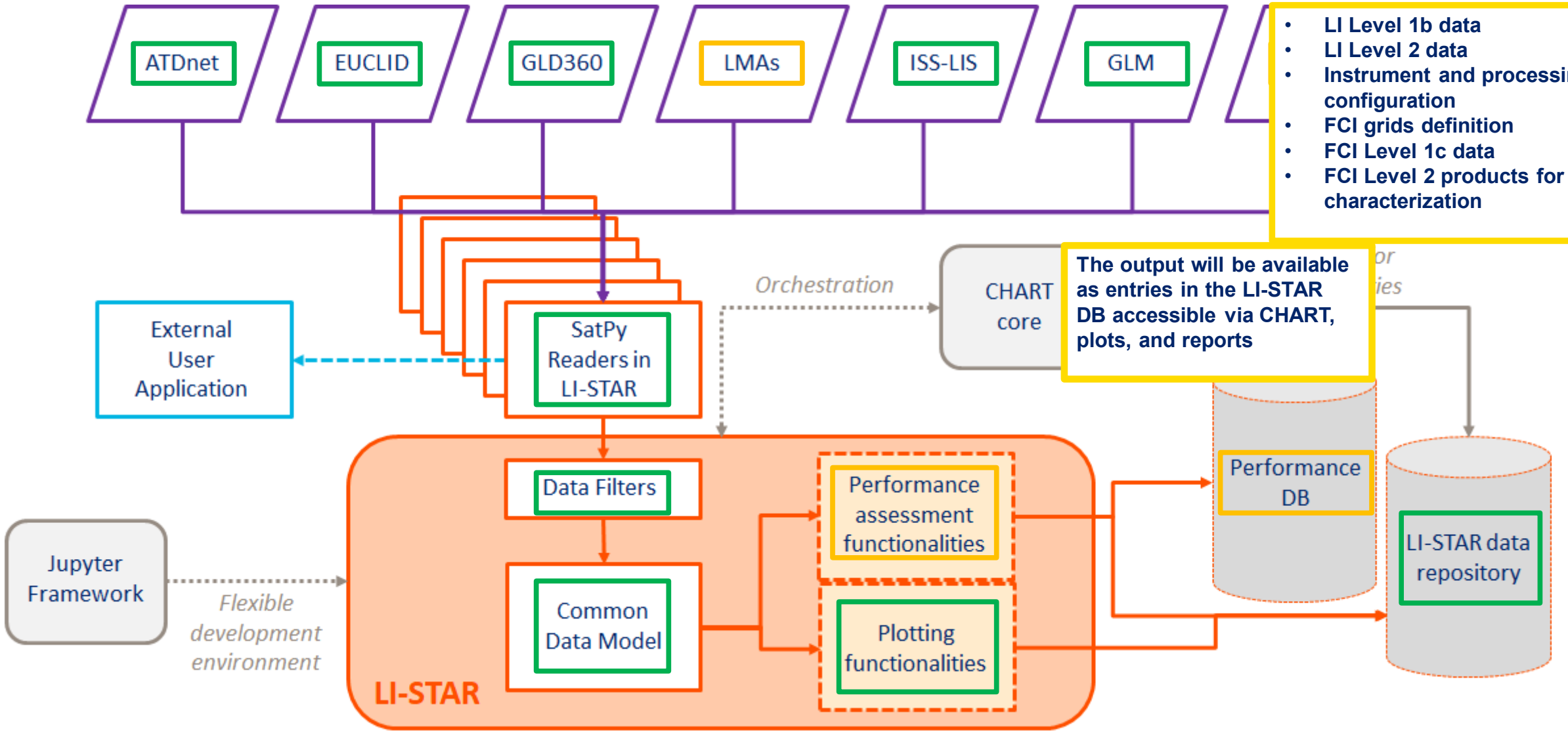
EUMETSAT LI IFCT

Introduction – LI-STAR at a glance



LISTAR available test data

Network	Data period(s)	Data area	Data level(s)
ATDnet	01/01/2018 - now*	All but ATDnet spatial range is mostly limited to Europe, N Africa, the Atlantic, S-America	Groups***
EUCLID	09/2018	All but EUCLID only detects in Europe.	Groups***, flashes
GLD360	09/2018, 01/07/2020 - 04/01/2021 15:00UTC	75N-75S, 75W-75E**	Groups***, flashes
GLM	09/2018, 01/10/2020 - now*	Full GOES-16 GLM FOV	Groups, flashes
ISS-LIS	09/2018, 01/07/2020-29/11/2020	All but consider ISS-LIS short view times from LEO	Events, groups, flashes

`*` now normally means until the end of the last hour, but keep in mind that the data is received and processed during the next hour, i.e. is not immediately available.

`**` 09/2018 is also available for the Americas (60N-60S, 135W-15W, contains full GOES16 GLM FOV).

`***` coded as `group_level` in LISTAR but scientifically strokes/pulses for ground-based LLSs.

LISTAR output types

Daily filtered lightning data files

Common data model

- Instrument and processing configuration
- LI background images
- FCI grids definition and data

Simple flash/group stats

- Time evolution of the number of flash/group detections.
- Comparison of time evolution between different networks.
- Spatiotemporal flash/group distribution maps.
- Flash/group accumulation/climatology maps.

Matching

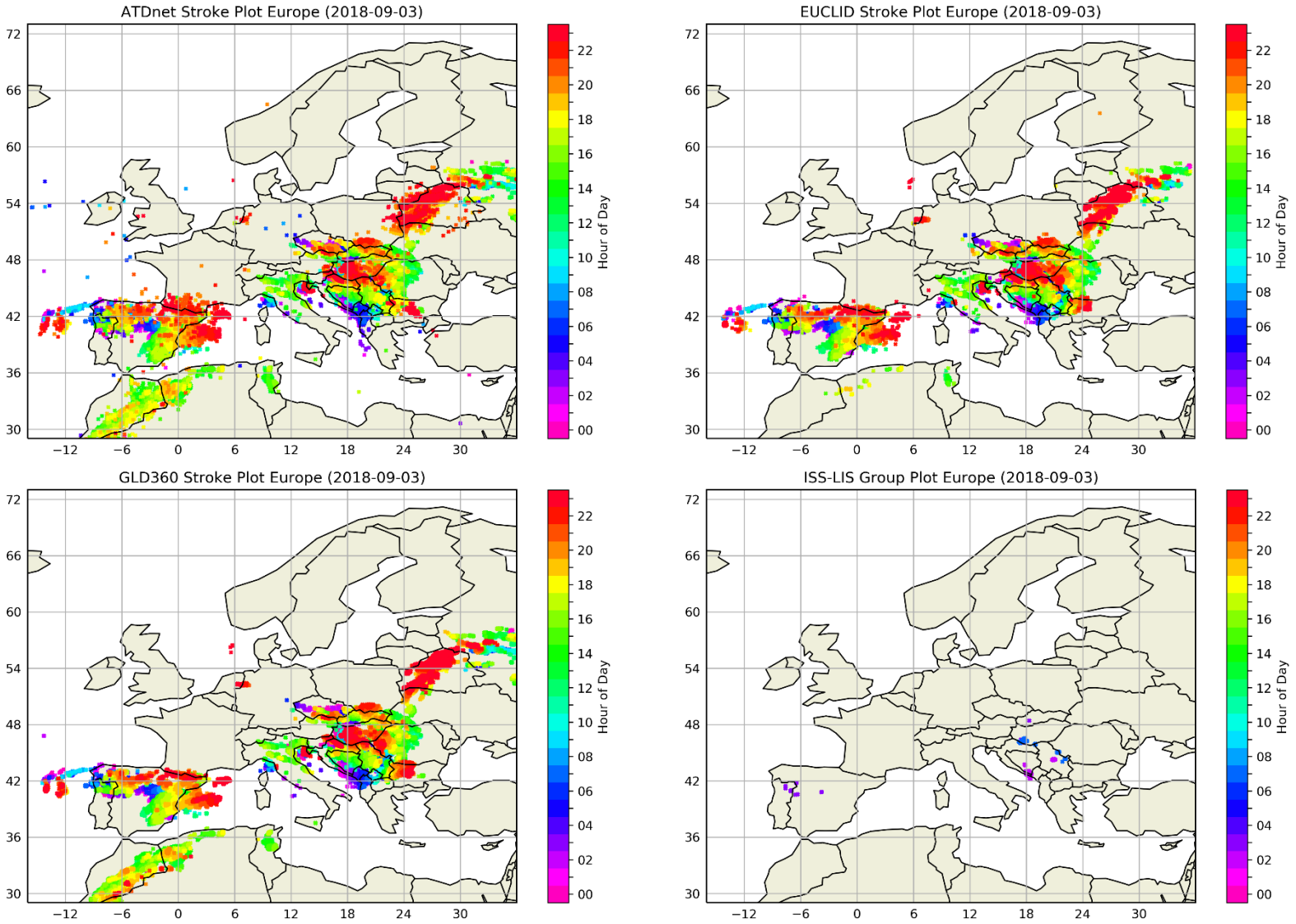
Matching stats

- RDE heatmaps.
- Test-ref spatial offset (histograms and maps).
- Test-reference spatiotemporal offset histograms.
- Diurnal changes in RDE.
- …

Additional performance stats

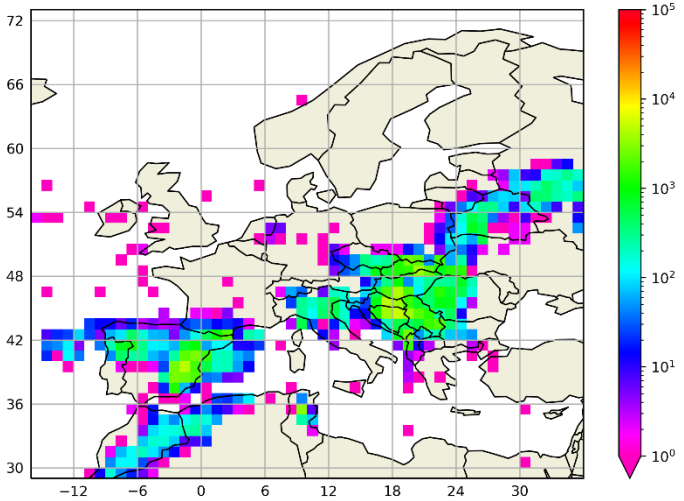
- Radiometric performance assessment.
- Meeting the LI geodisk coverage requirement.
- …

Spatiotemporal group/stroke distribution maps

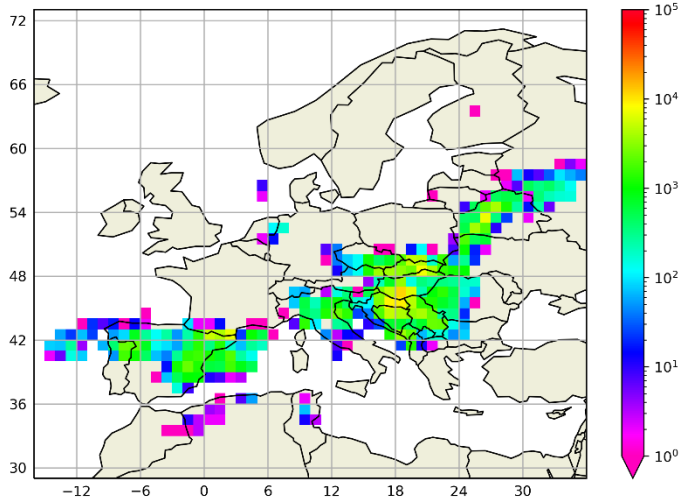


Group/stroke accumulation maps

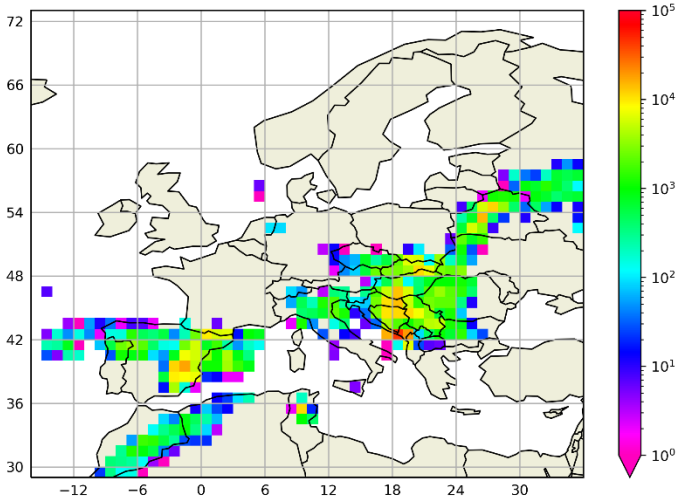
ATDnet Accumulated Strokes Europe 2018-09-03



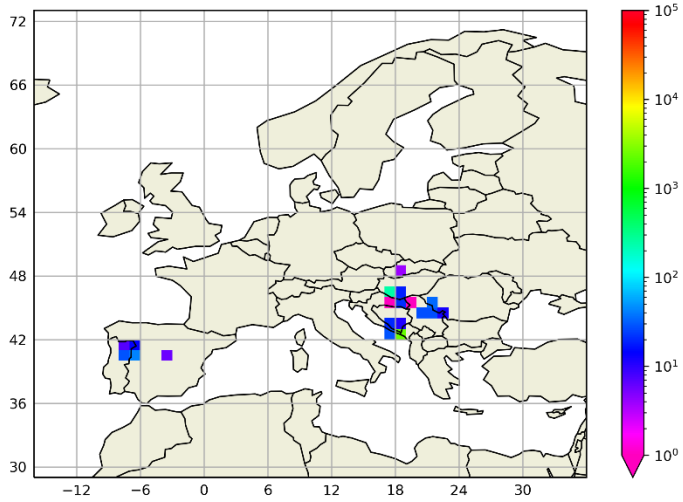
EUCLID Accumulated Strokes Europe 2018-09-03



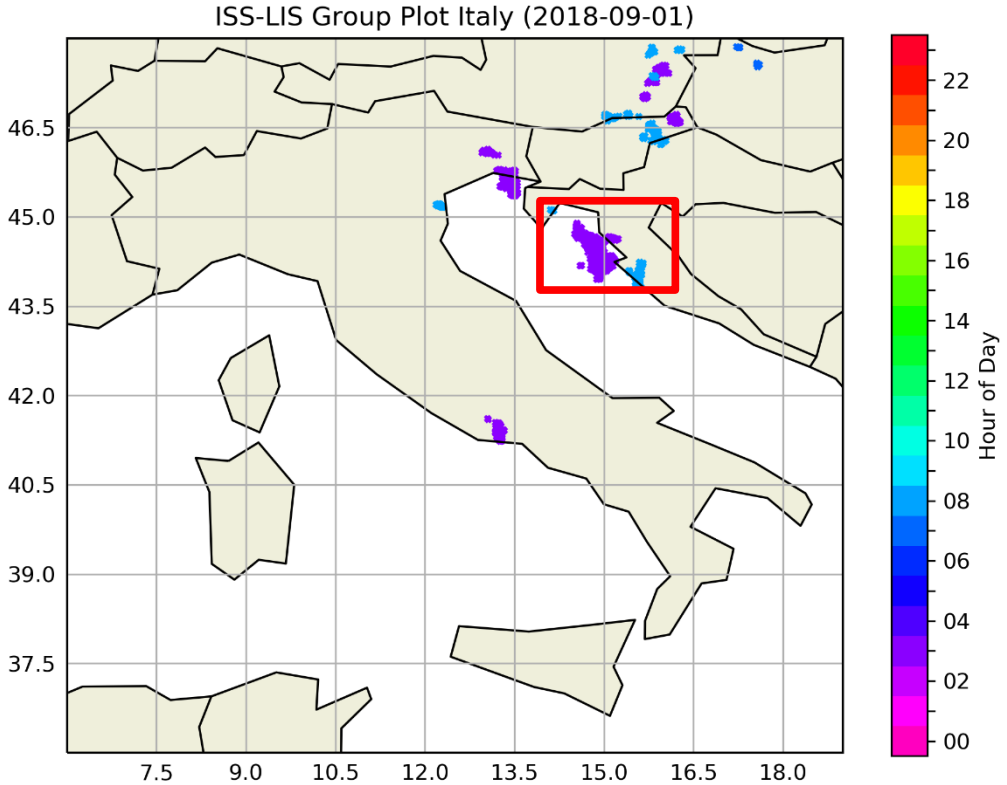
GLD360 Accumulated Strokes Europe 2018-09-03

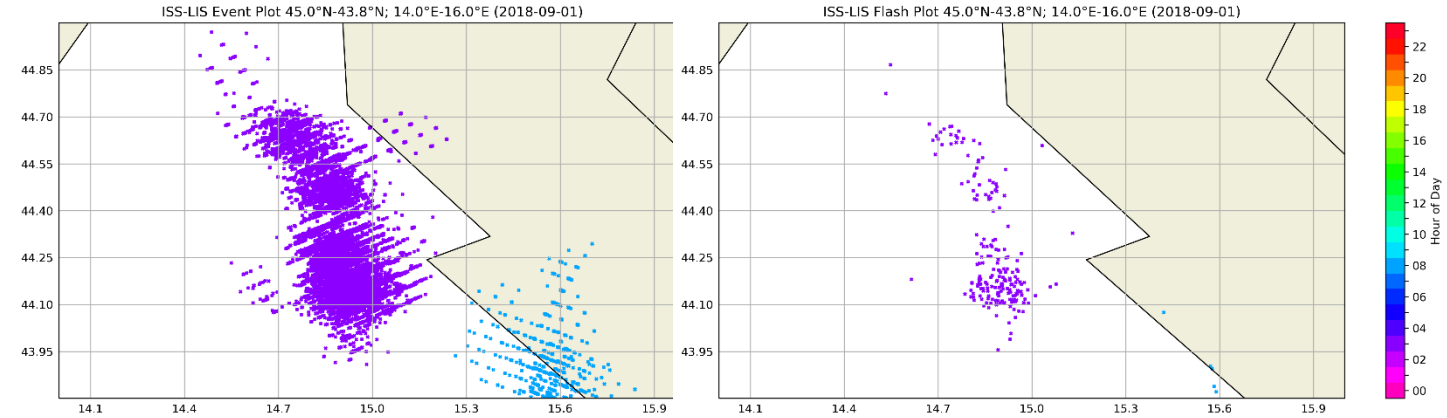


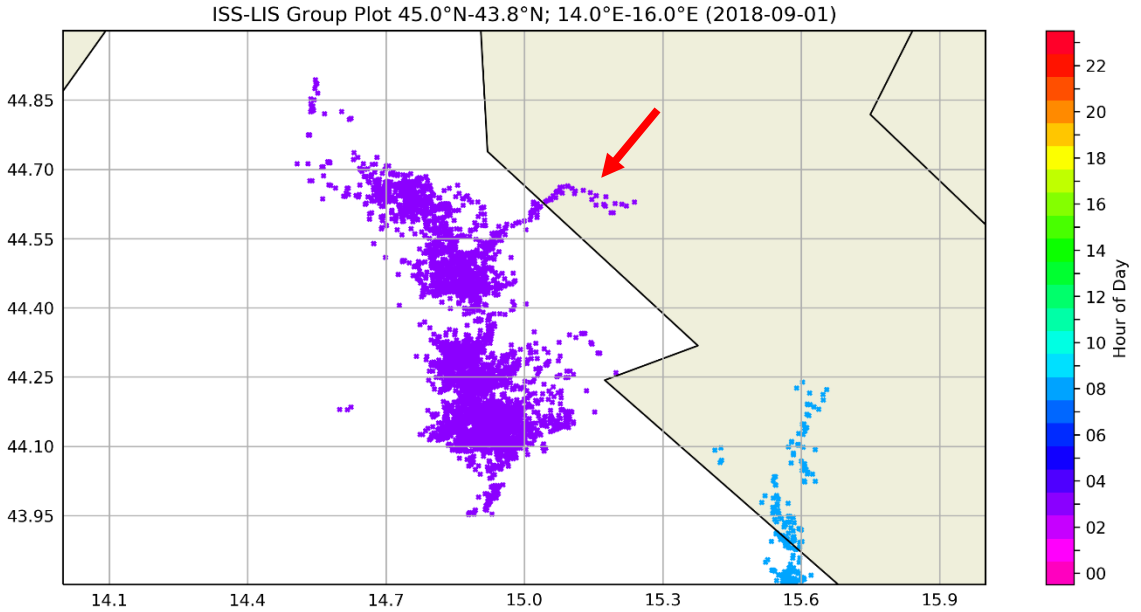
ISS-LIS Accumulated Groups Europe 2018-09-03



Spotting interesting features in ISSLIS data

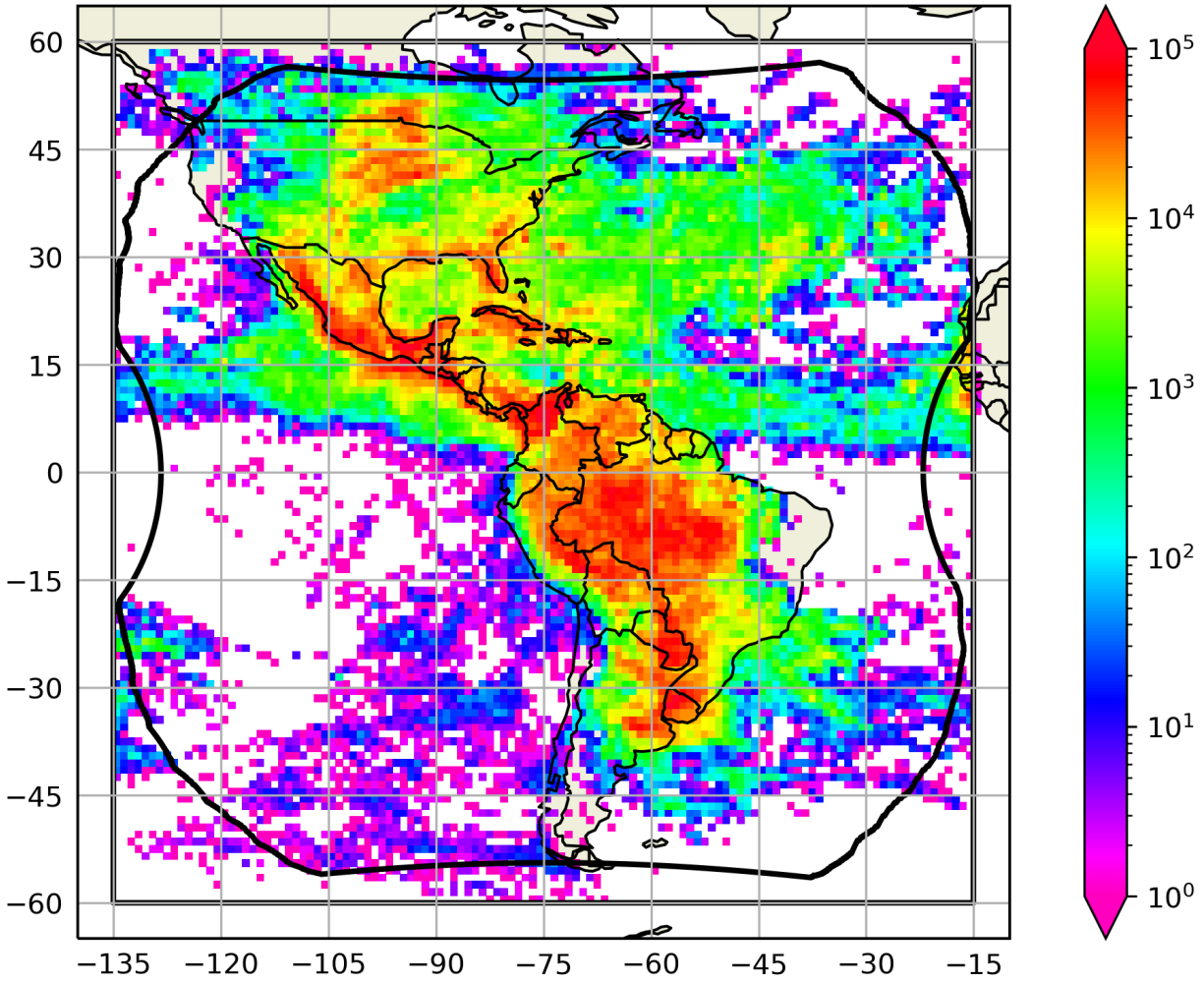




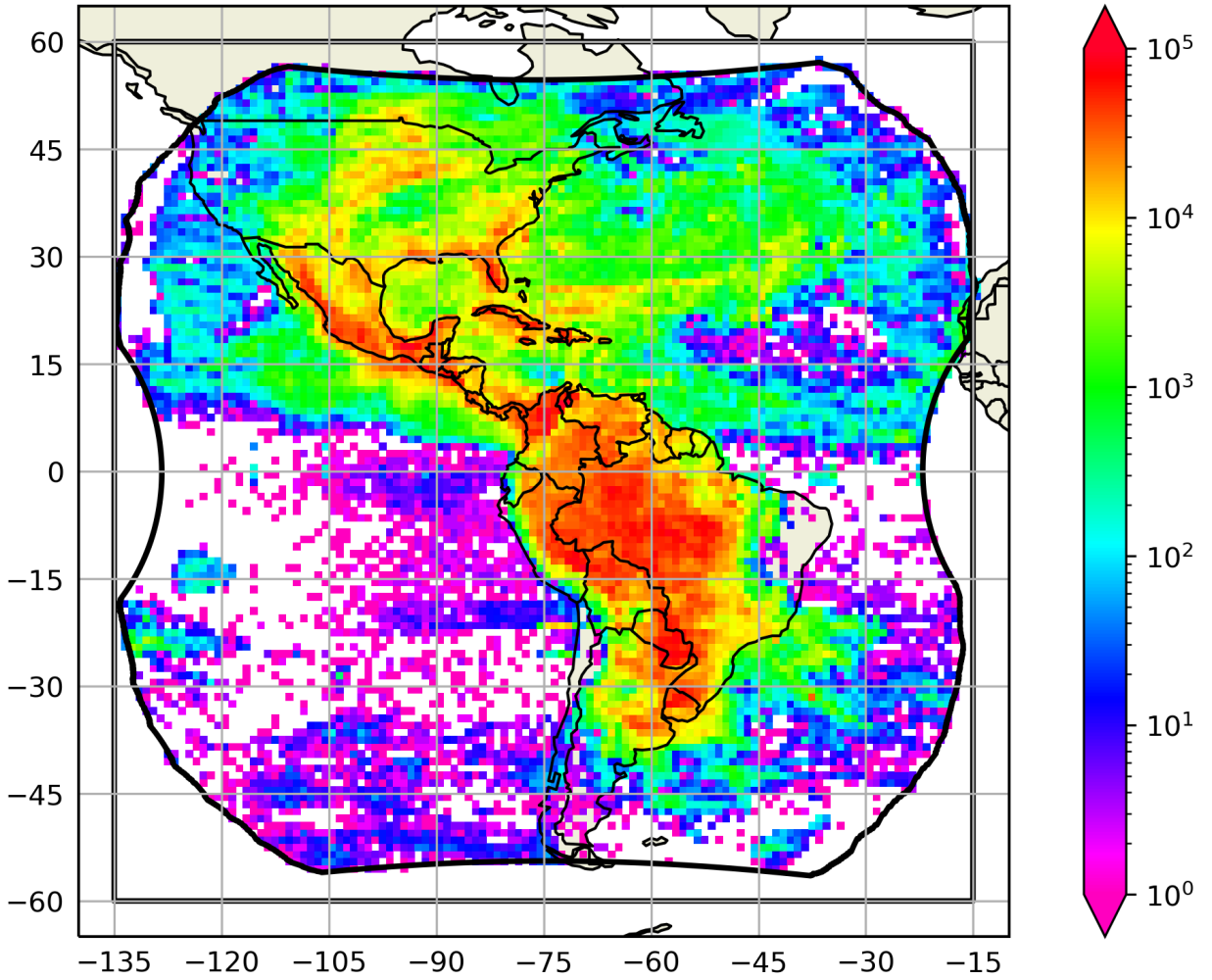


GLD360 and GLM flash accumulation September 2018

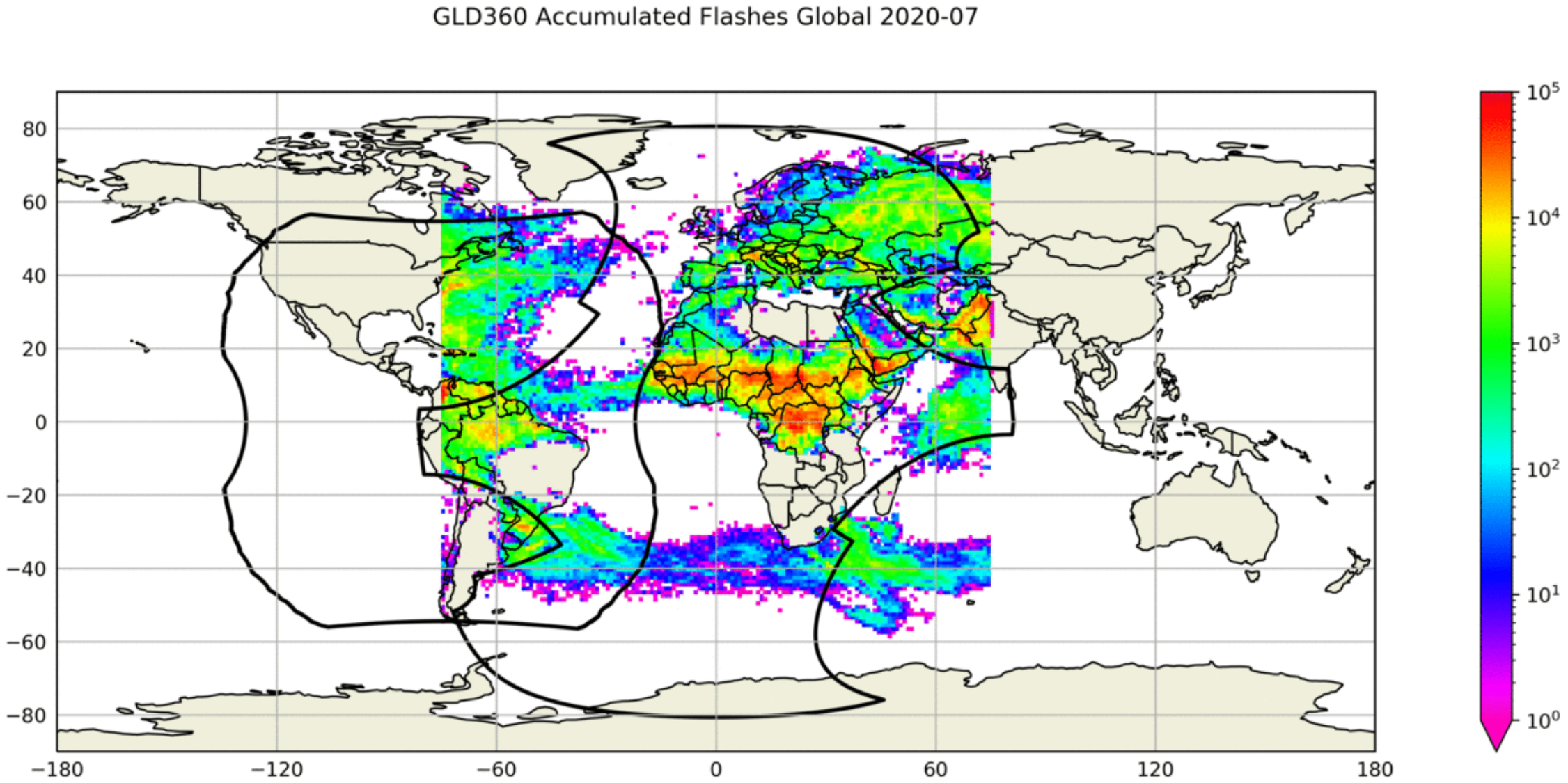
GLD360 Accumulated Flashes Gld 2018-09



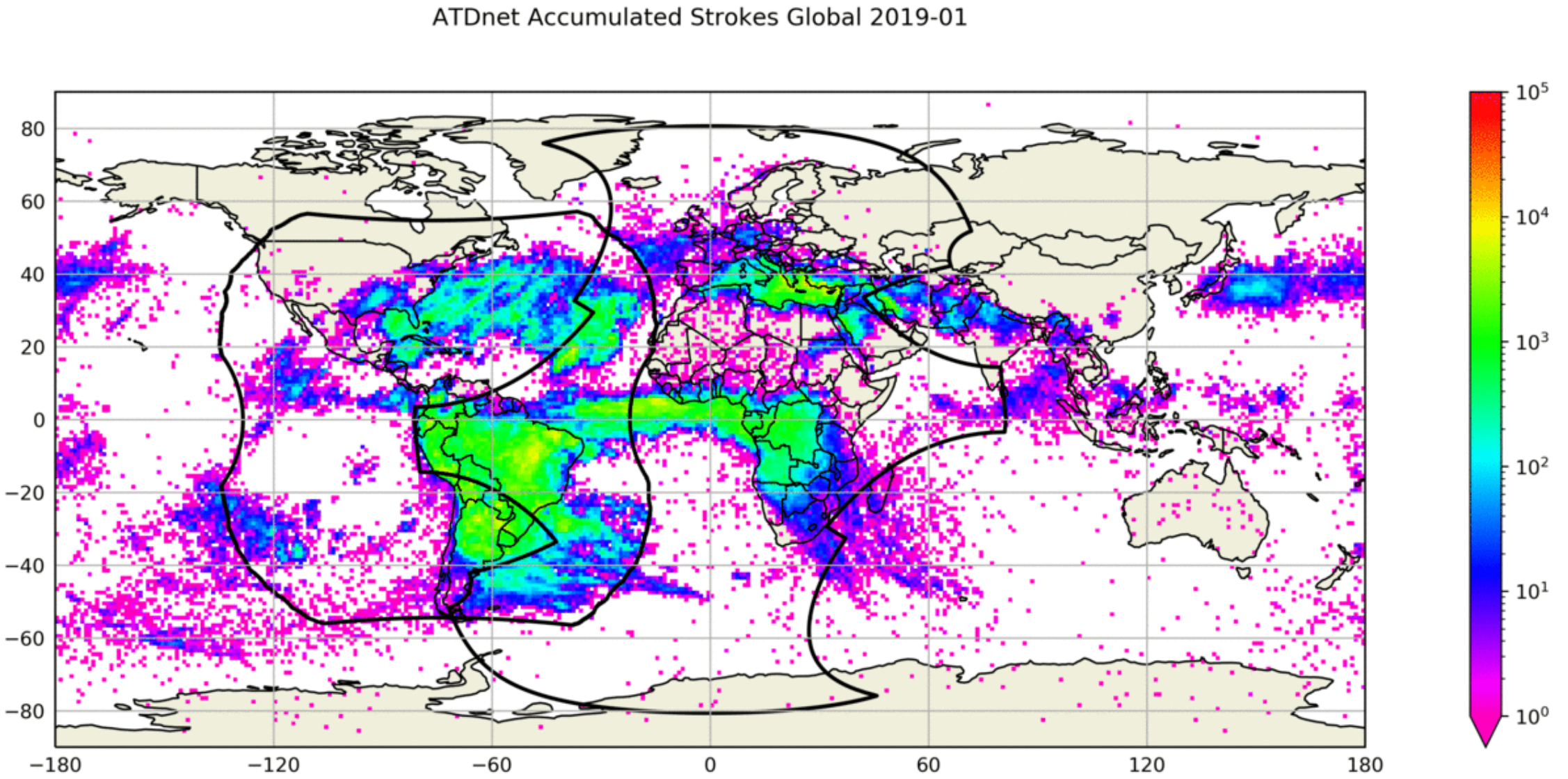
GLM Accumulated Flashes Gld 2018-09



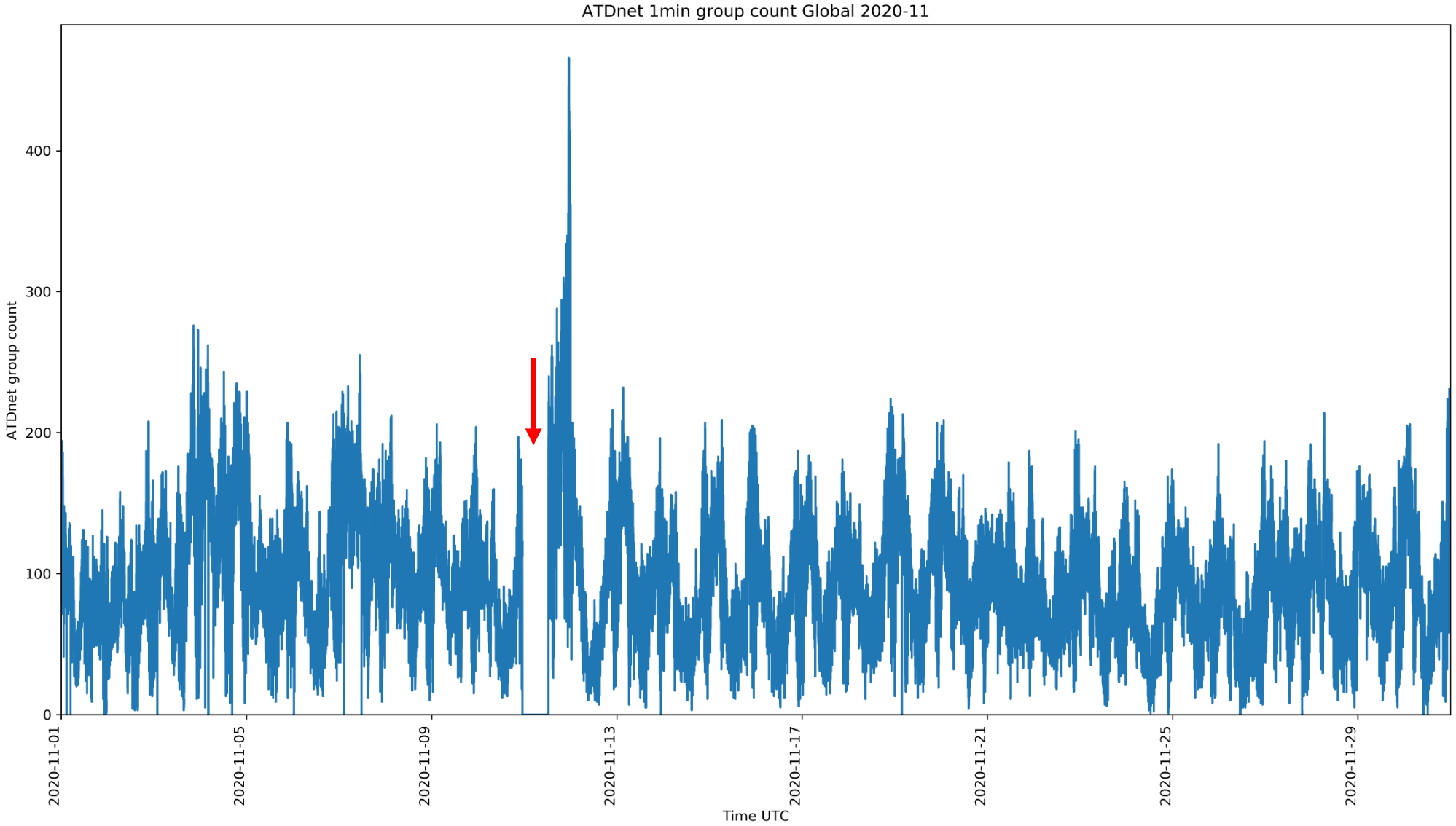
GLD360 monthly flash accumulation July-October 2020



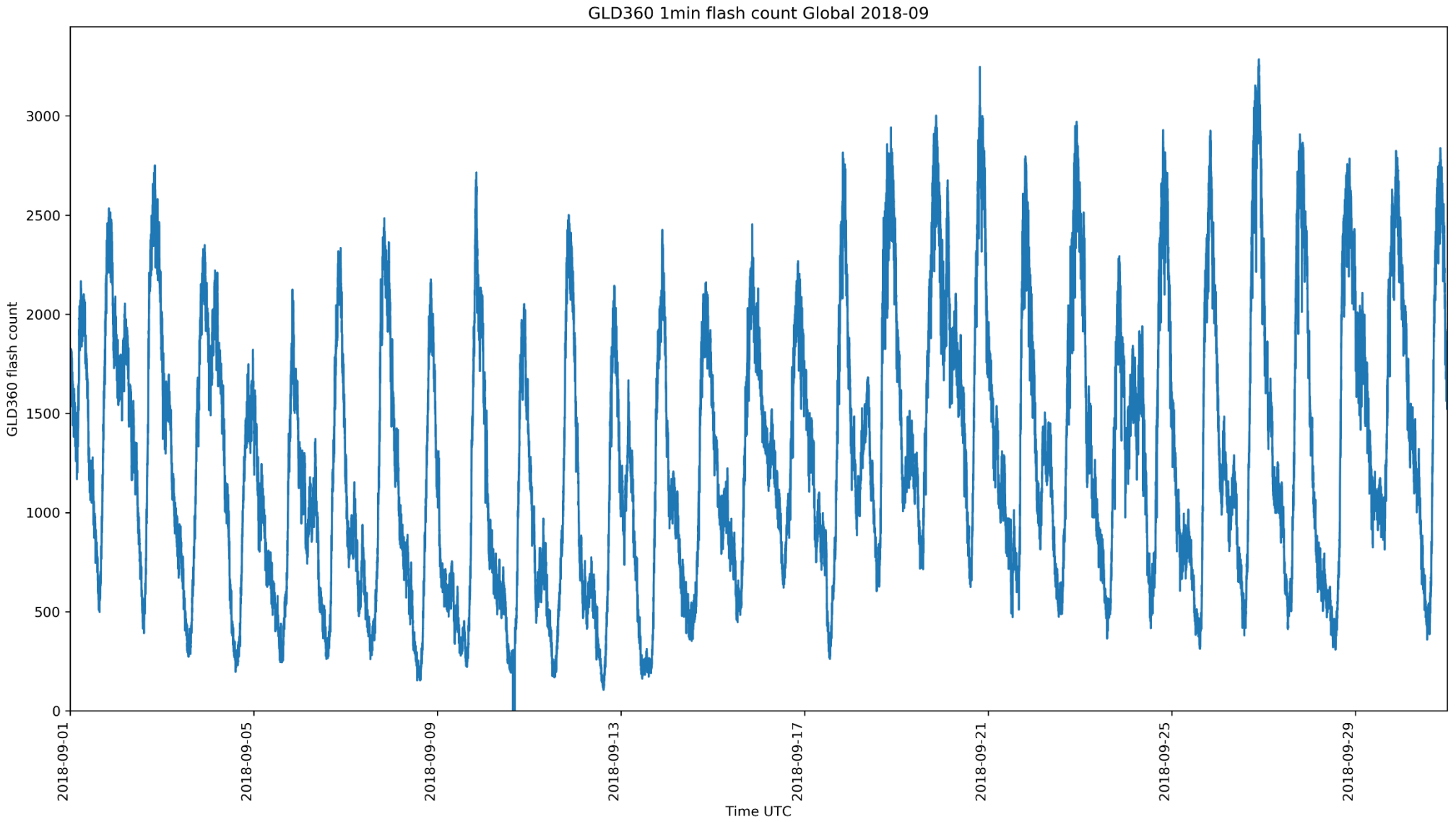
ATDnet monthly stroke accumulation 01-2019…10-2020



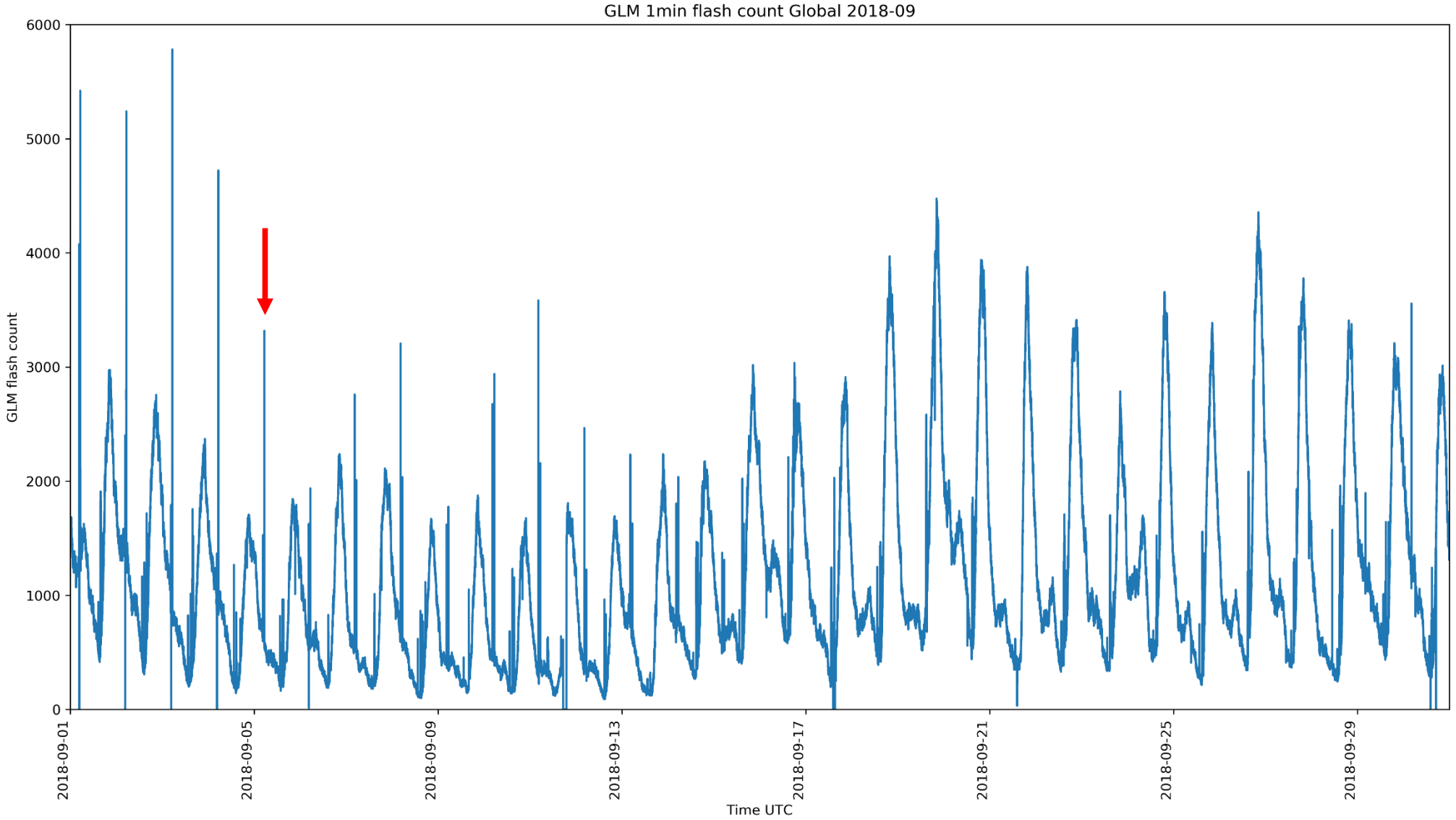
ATDnet flash counts by minute November 2020



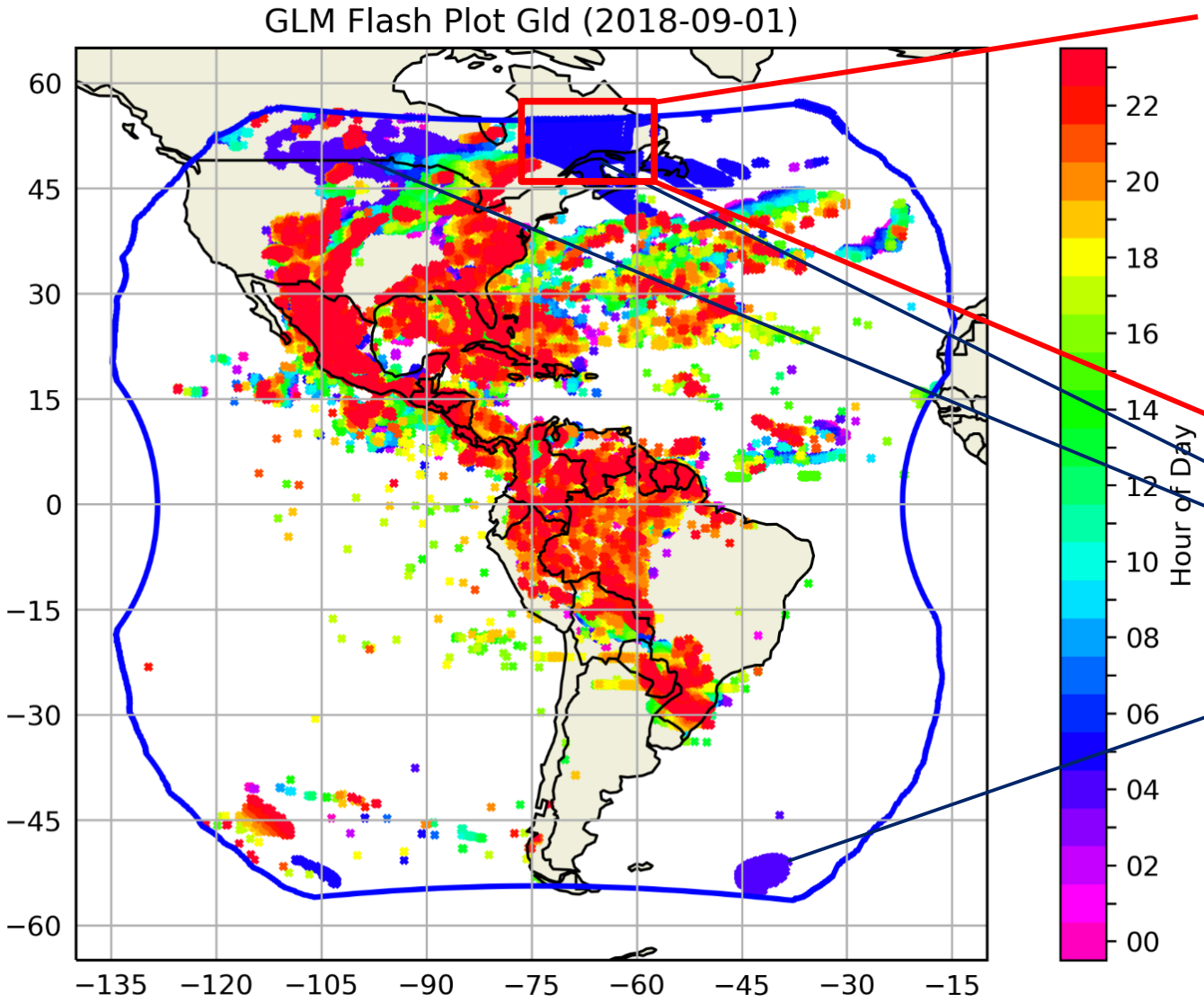
GLD360 flash counts by minute September 2018

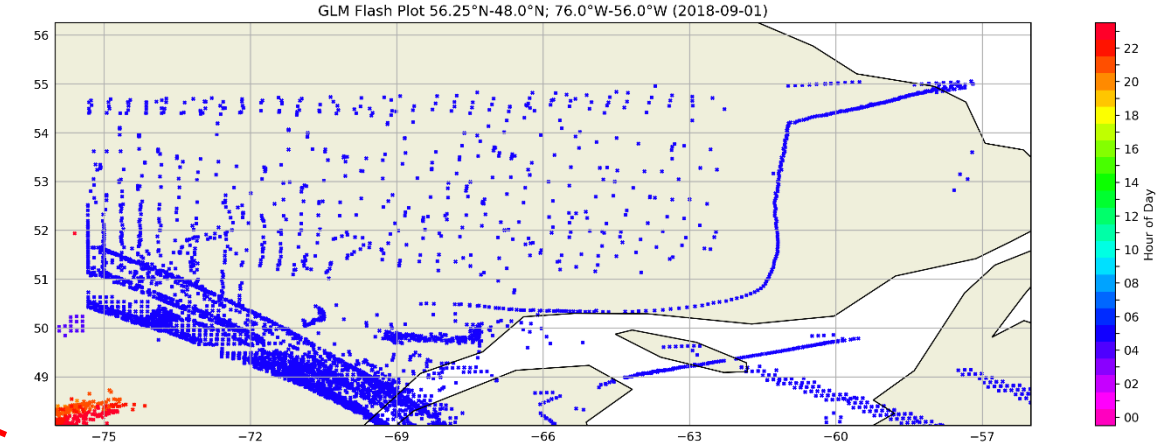


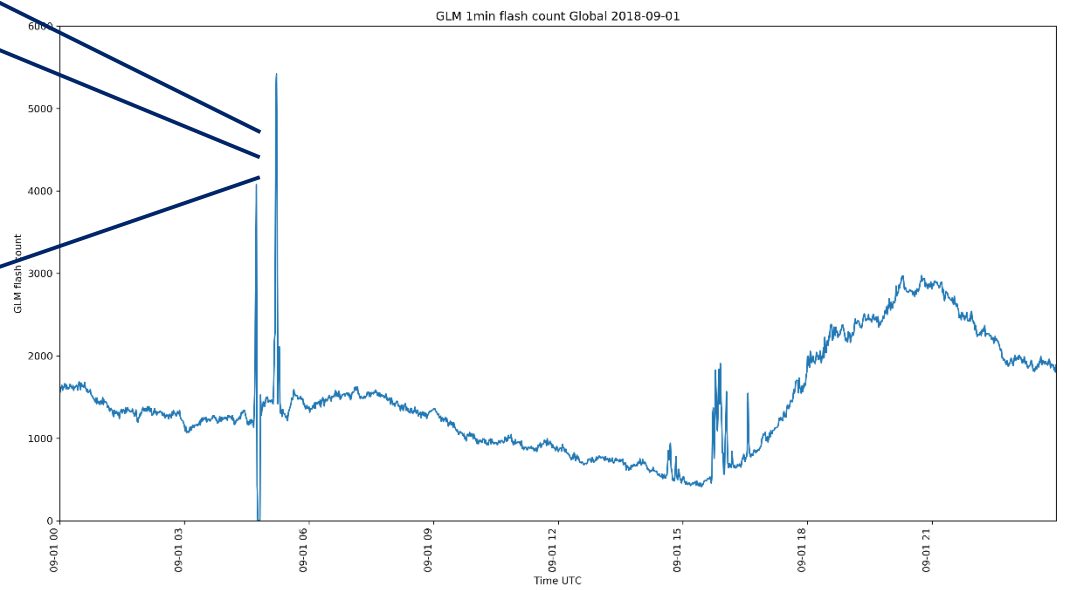
GLM flash counts by minute September 2018



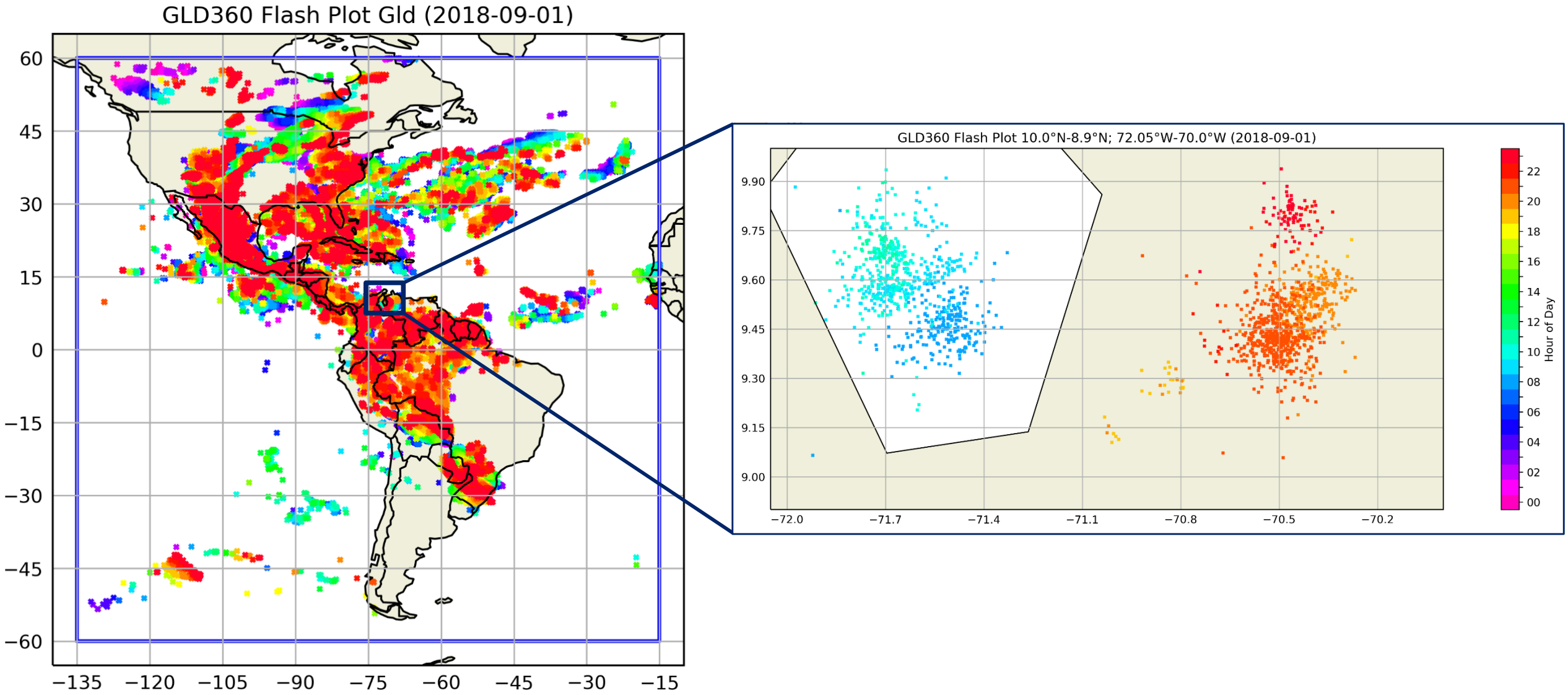
GLM flashes 01-09-2018



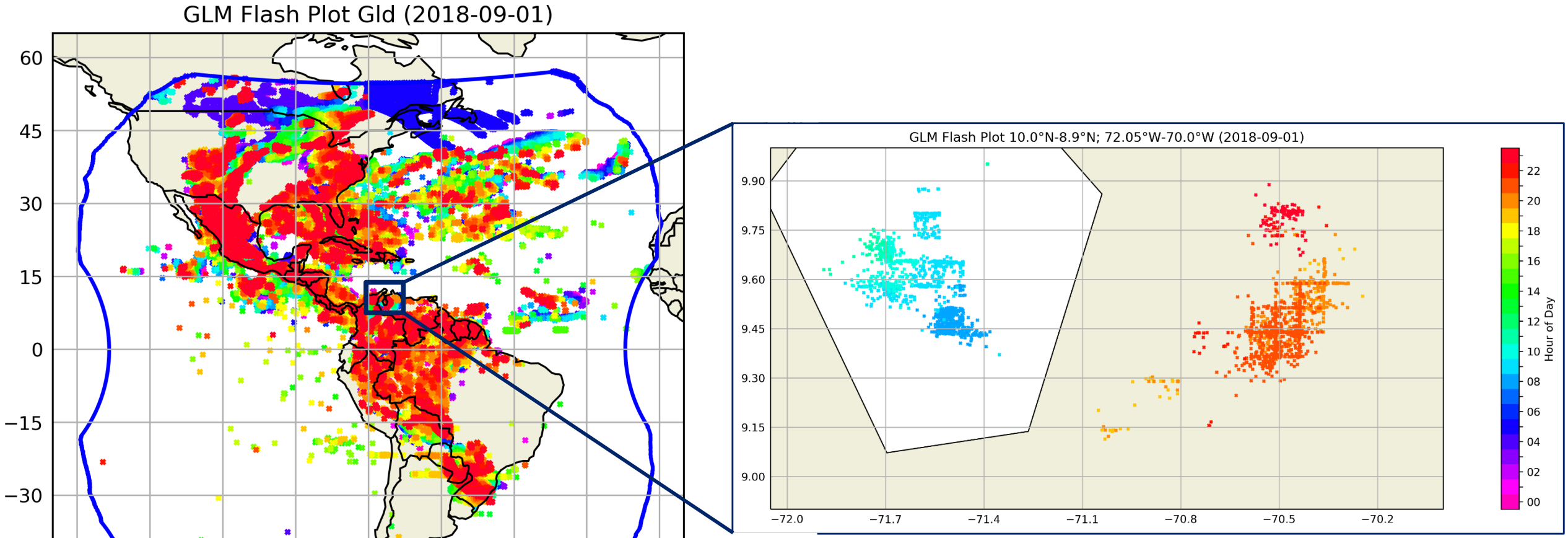




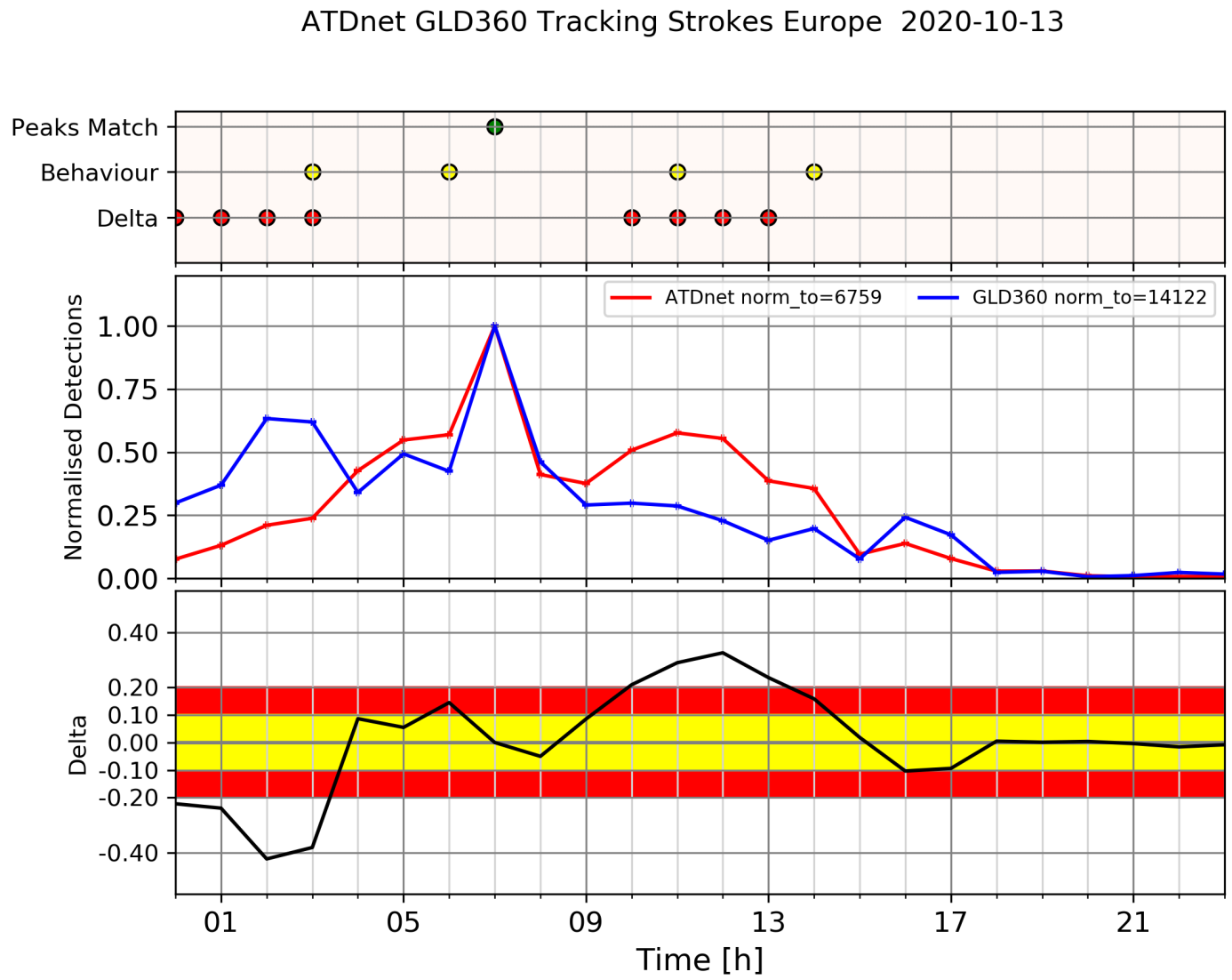
Space vs ground based differences at high zoom level



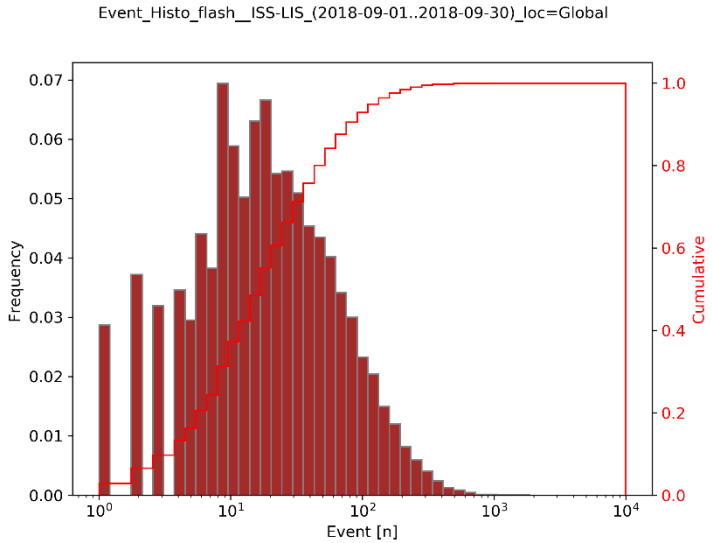
Space vs ground based differences at high zoom level

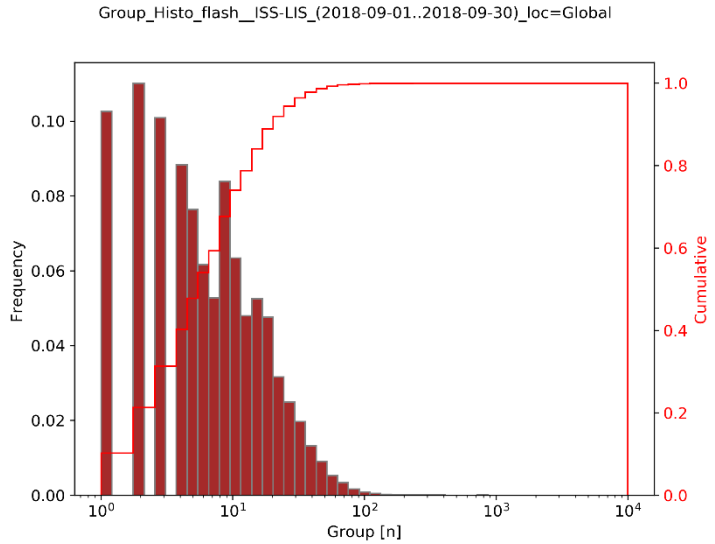


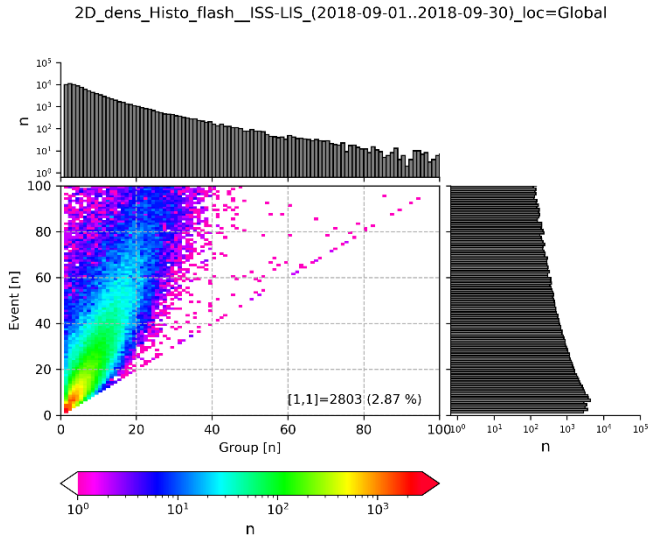
Relative time evolution ATDnet and GLD360 groups

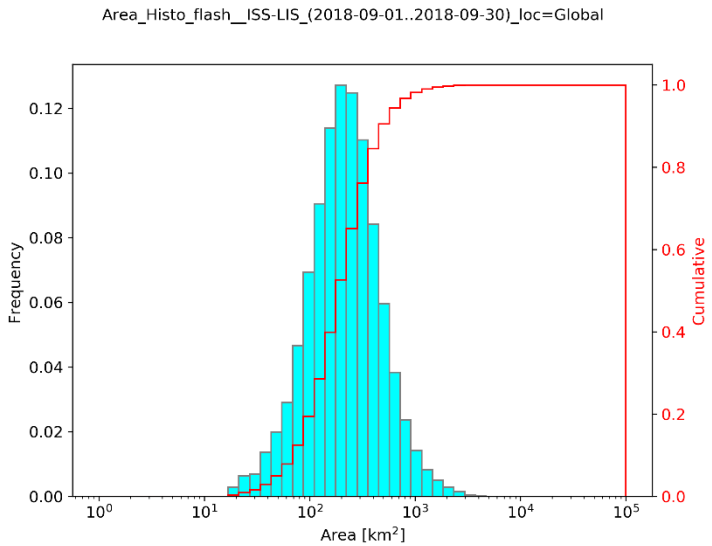


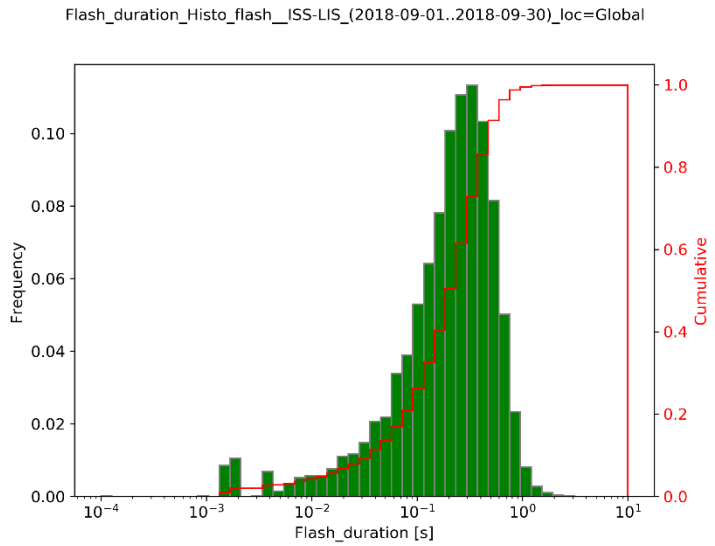
Exploring ISSLIS flash and group properties

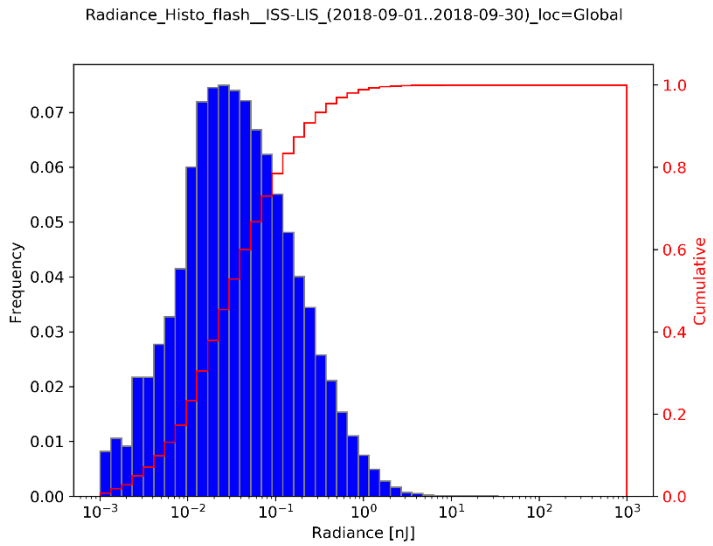




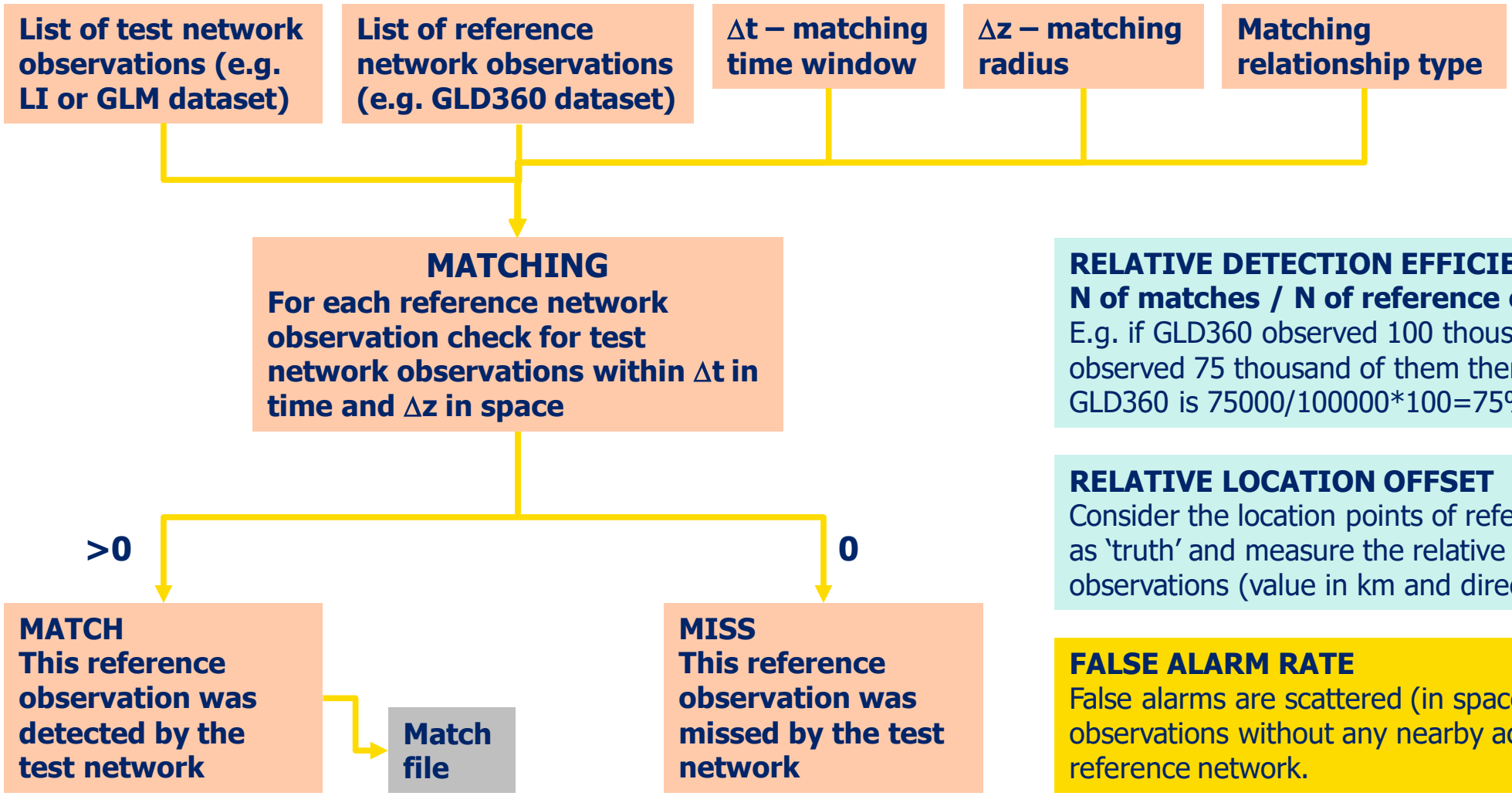








LISTAR matching and comparison of networks

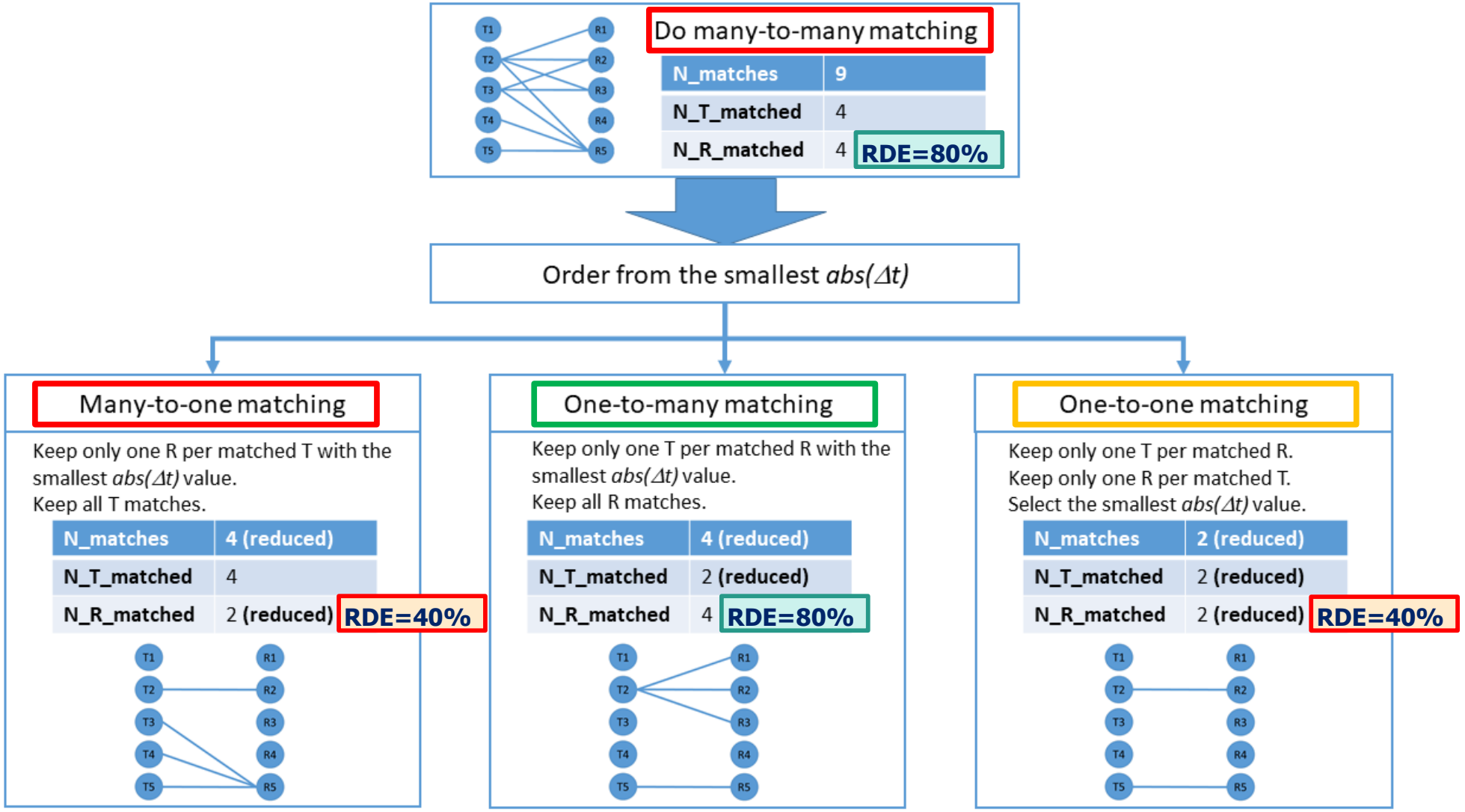


RELATIVE DETECTION EFFICIENCY (DE)
N of matches / N of reference observations * 100
E.g. if GLD360 observed 100 thousand flashes and GLM observed 75 thousand of them then GLM DE relative to GLD360 is 75000/100000*100=75%

RELATIVE LOCATION OFFSET
Consider the location points of reference network observations as 'truth' and measure the relative offset of test network observations (value in km and direction in space)

FALSE ALARM RATE
False alarms are scattered (in space and time) test network observations without any nearby activity observed by the reference network.

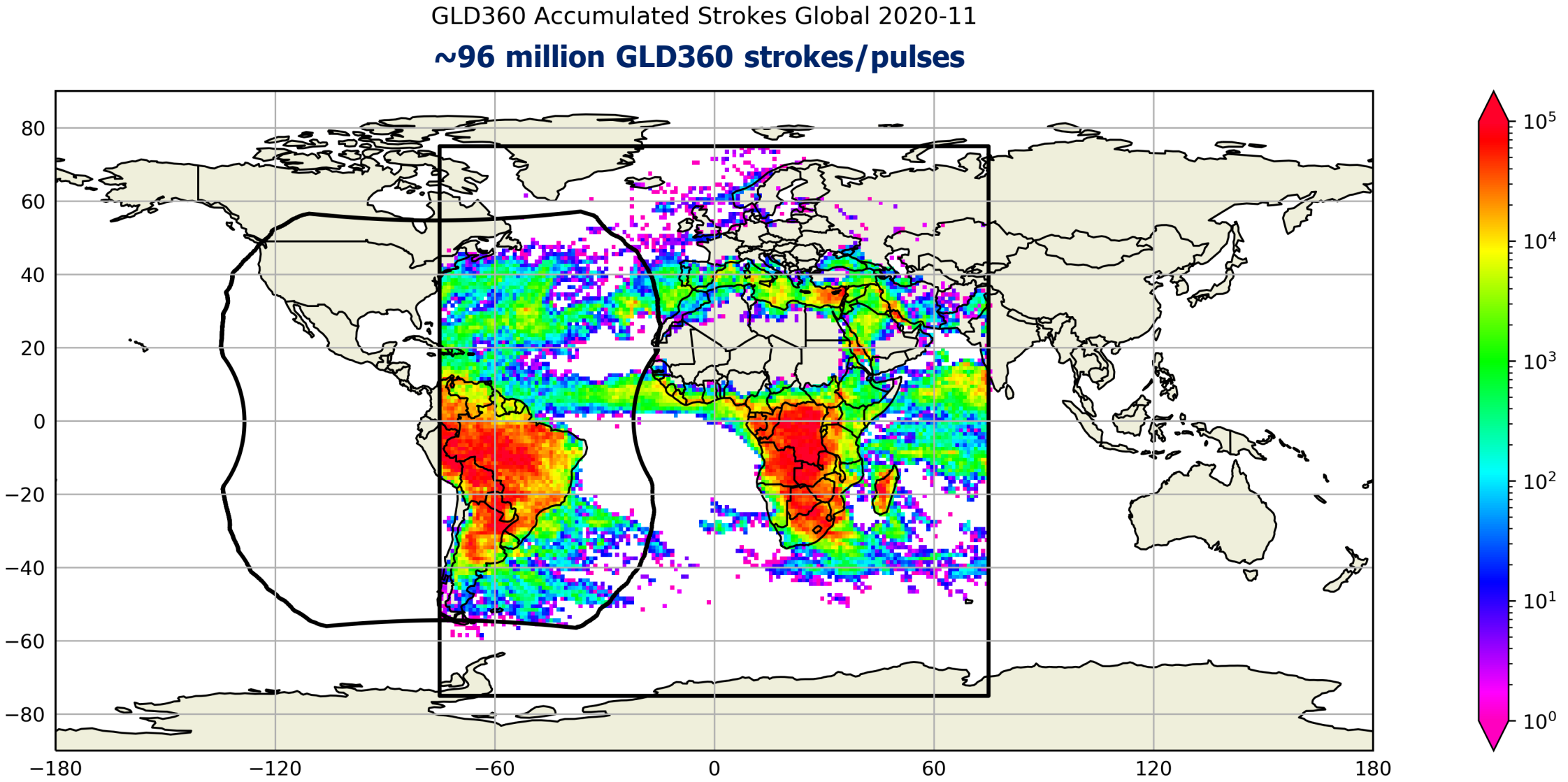
LISTAR matching scheme and relationship types



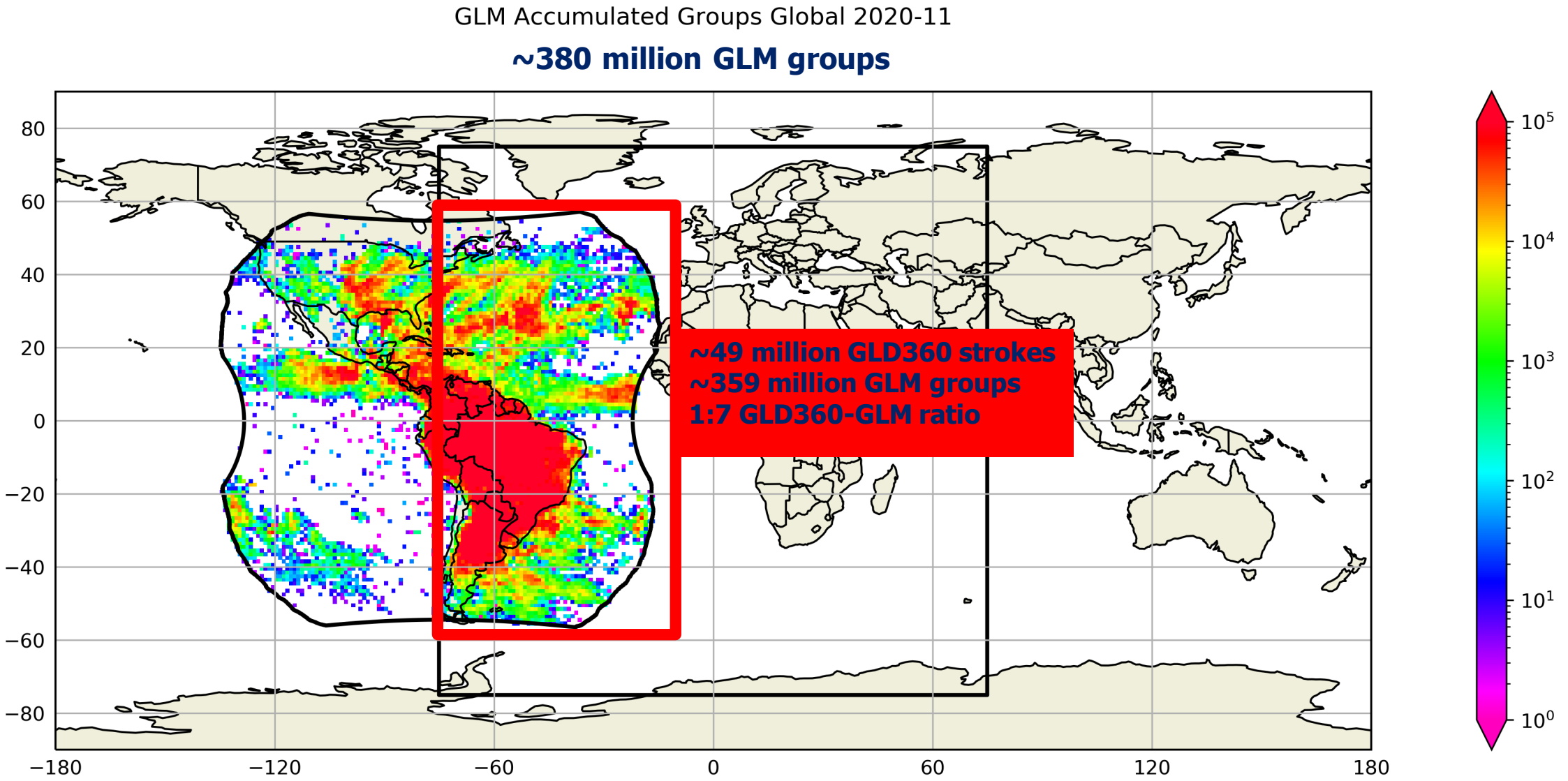
One-to-many vs one-to-one matching

- Matters if the reference network observes much more, e.g. GLD strokes against GLM groups:
  - One-to-one gives **notably better** time distribution and slightly better distance distribution.
  - One-to-one gives **much lower** relative DE.
- Much smaller impact if the reference network observes much less, e.g. GLM groups against GLD strokes:
  - One-to-one can give slightly better time and distance distribution.
  - One-to-one can give slightly lower DE.
- Now showing some GLD-GLM examples.

GLD360 monthly stroke accumulation 11/2020



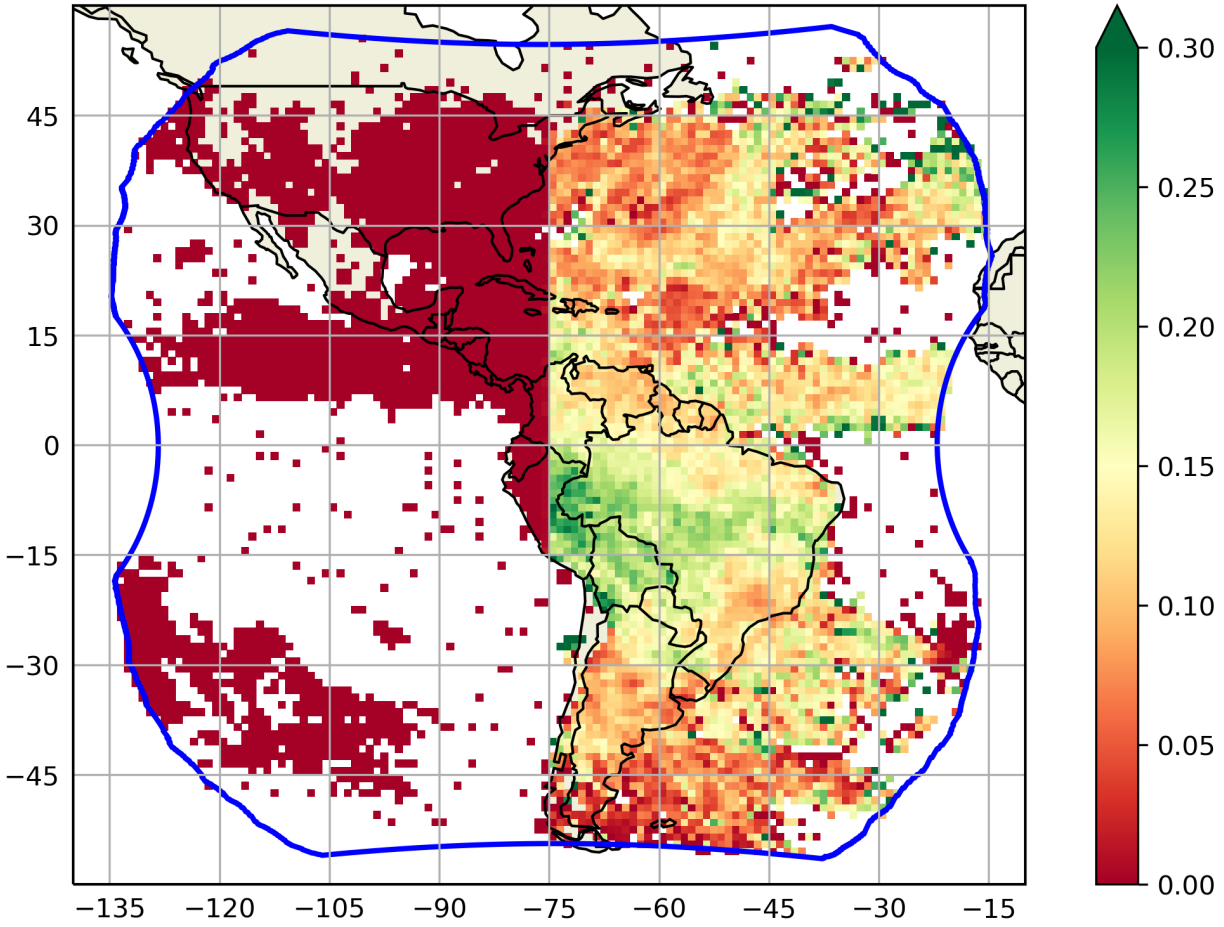
GLM monthly group accumulation 11/2020



GLD-GLM 11/2020 one-to-many matching

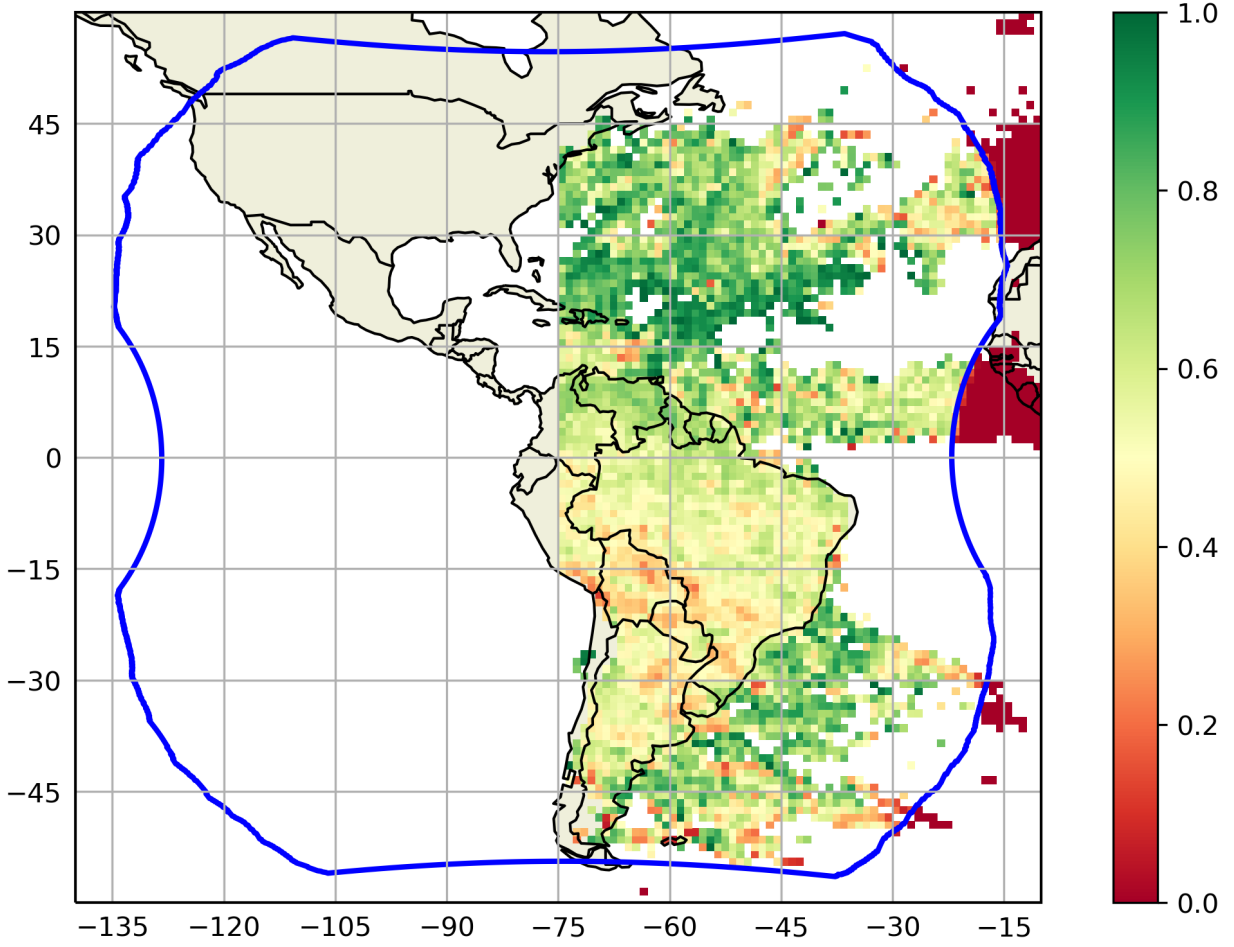
P(GLD360 | GLM) Strokes Americas 2020-11

Δtb=10ms, Δta=5ms, Δz=50 km, 1-to-many matching



P(GLM | GLD360) Groups Americas 2020-11

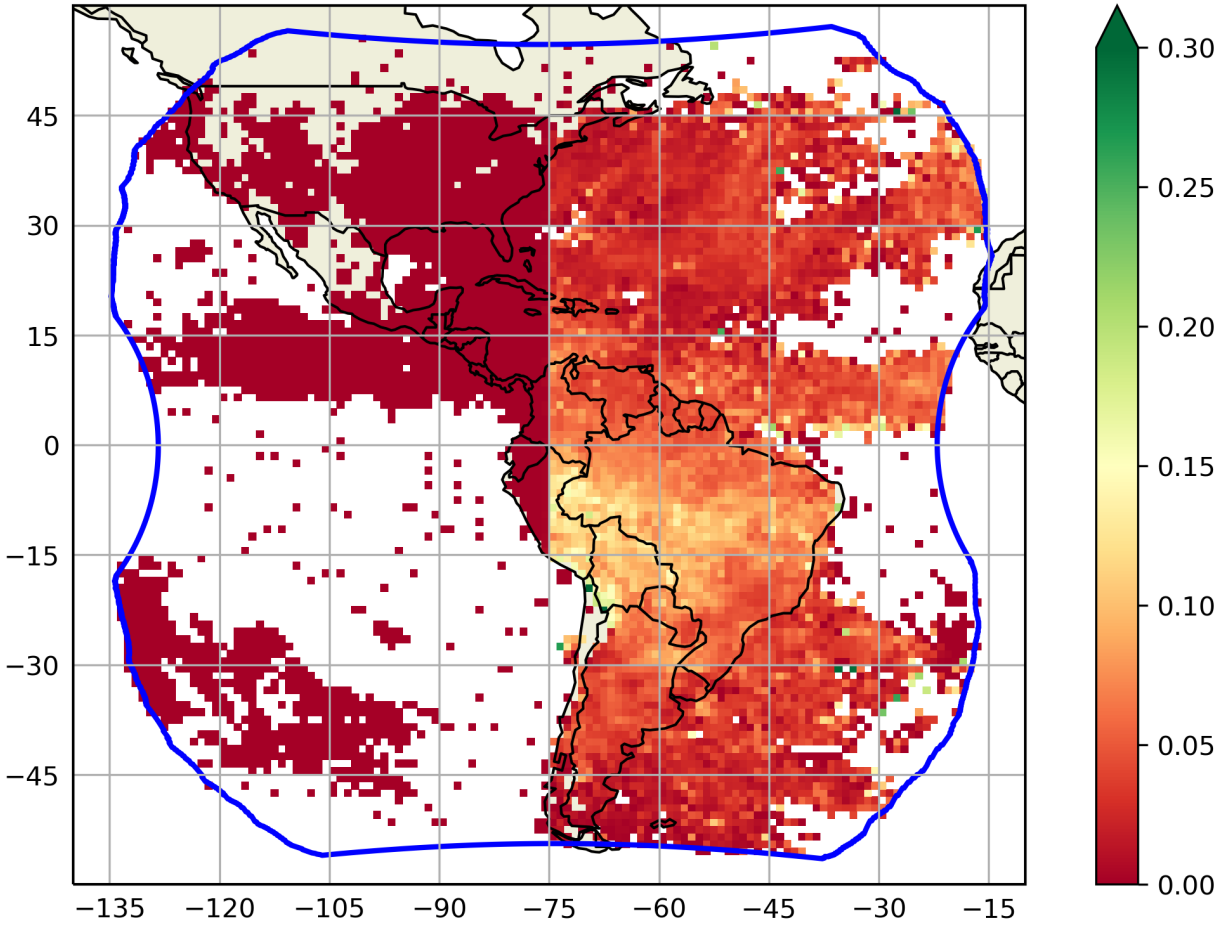
Δtb=5ms, Δta=10ms, Δz=50 km, 1-to-many matching



GLD-GLM 11/2020 one-to-one matching

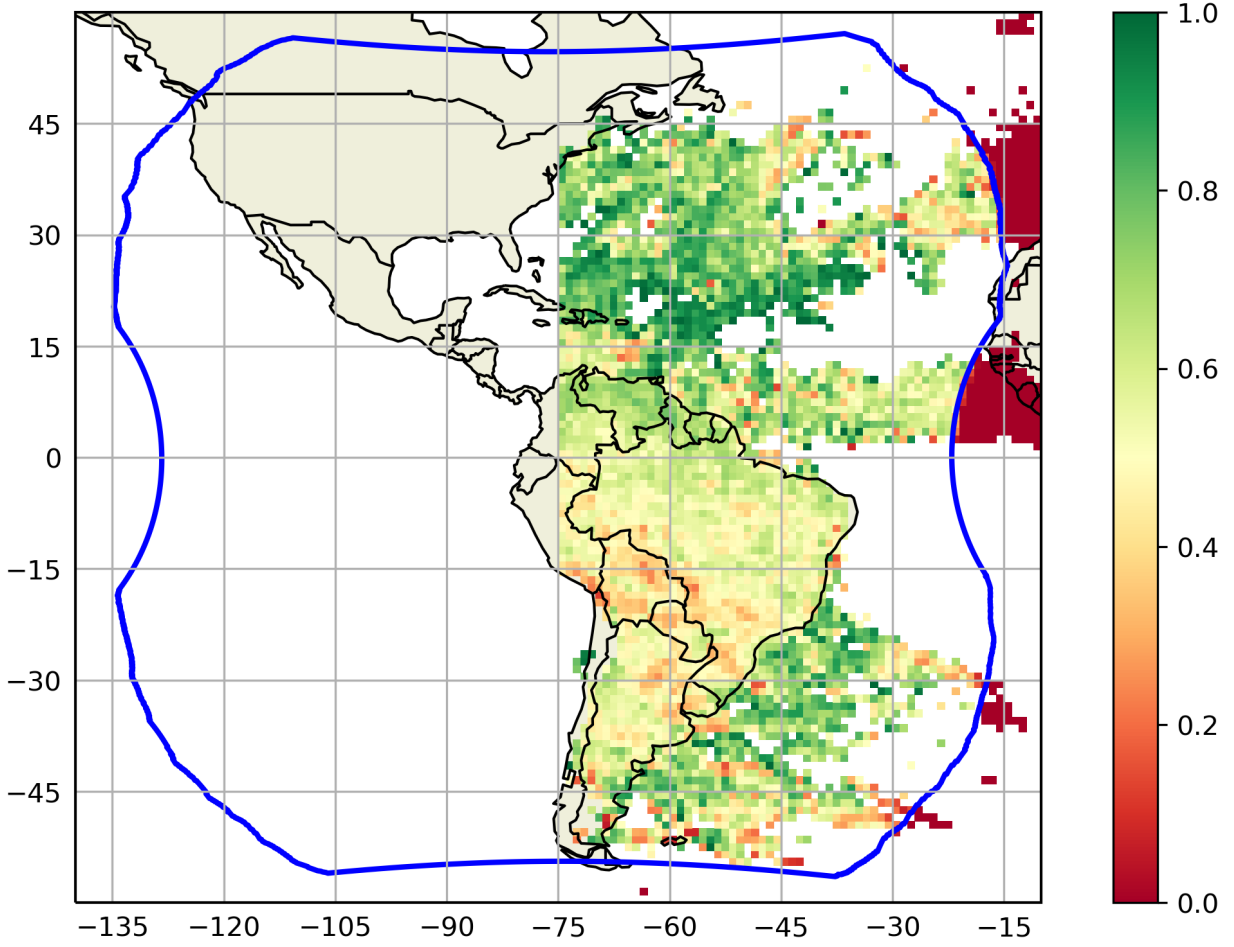
P(GLD360 | GLM) Strokes Americas 2020-11

Δtb=10ms, Δta=5ms, Δz=50 km, 1-to-1 matching

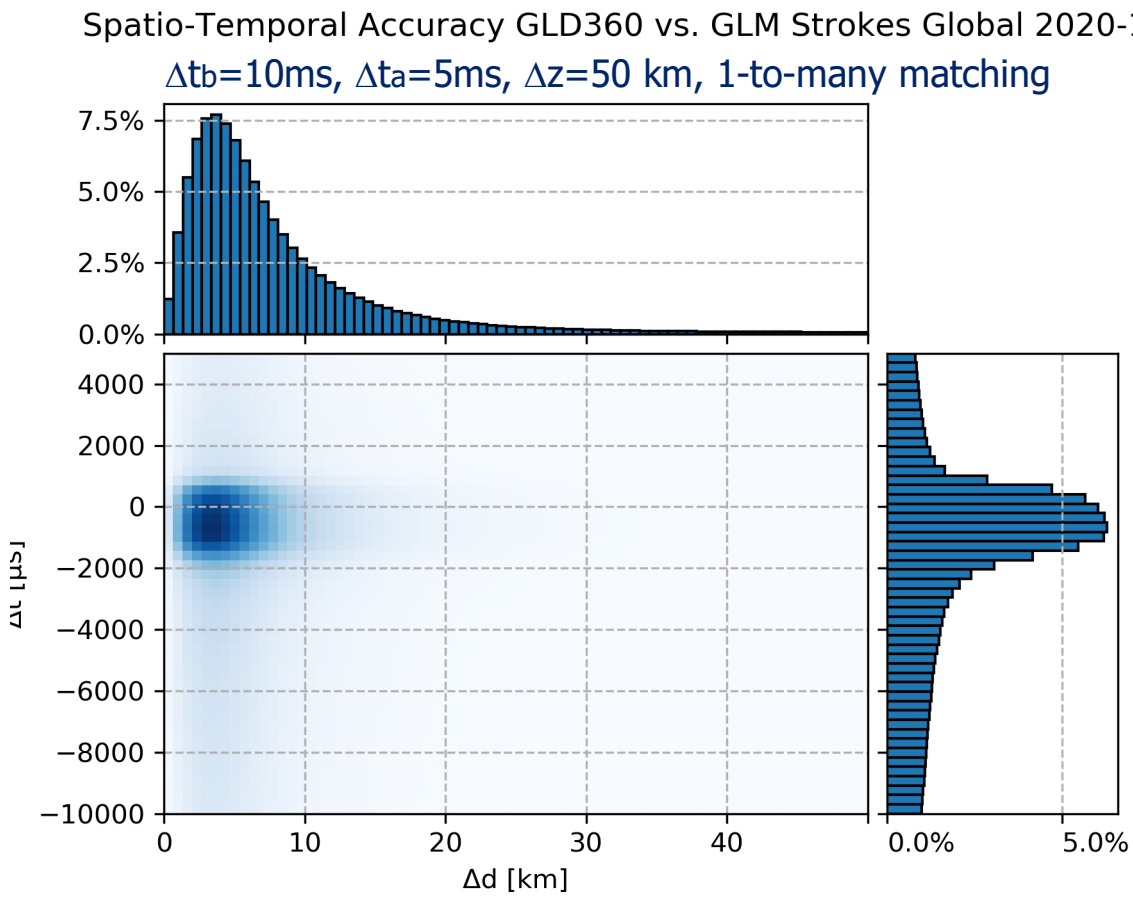


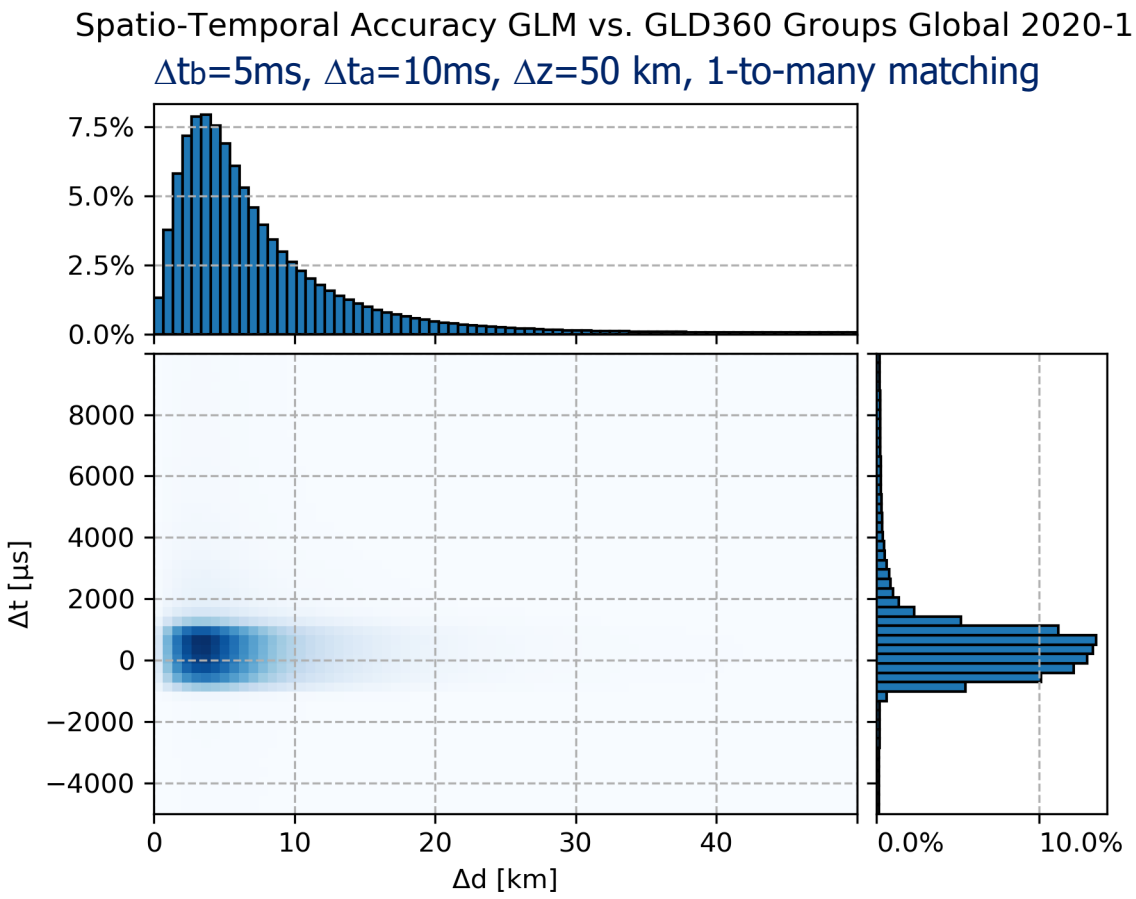
P(GLM | GLD360) Groups Americas 2020-11

Δtb=5ms, Δta=10ms, Δz=50 km, 1-to-1 matching

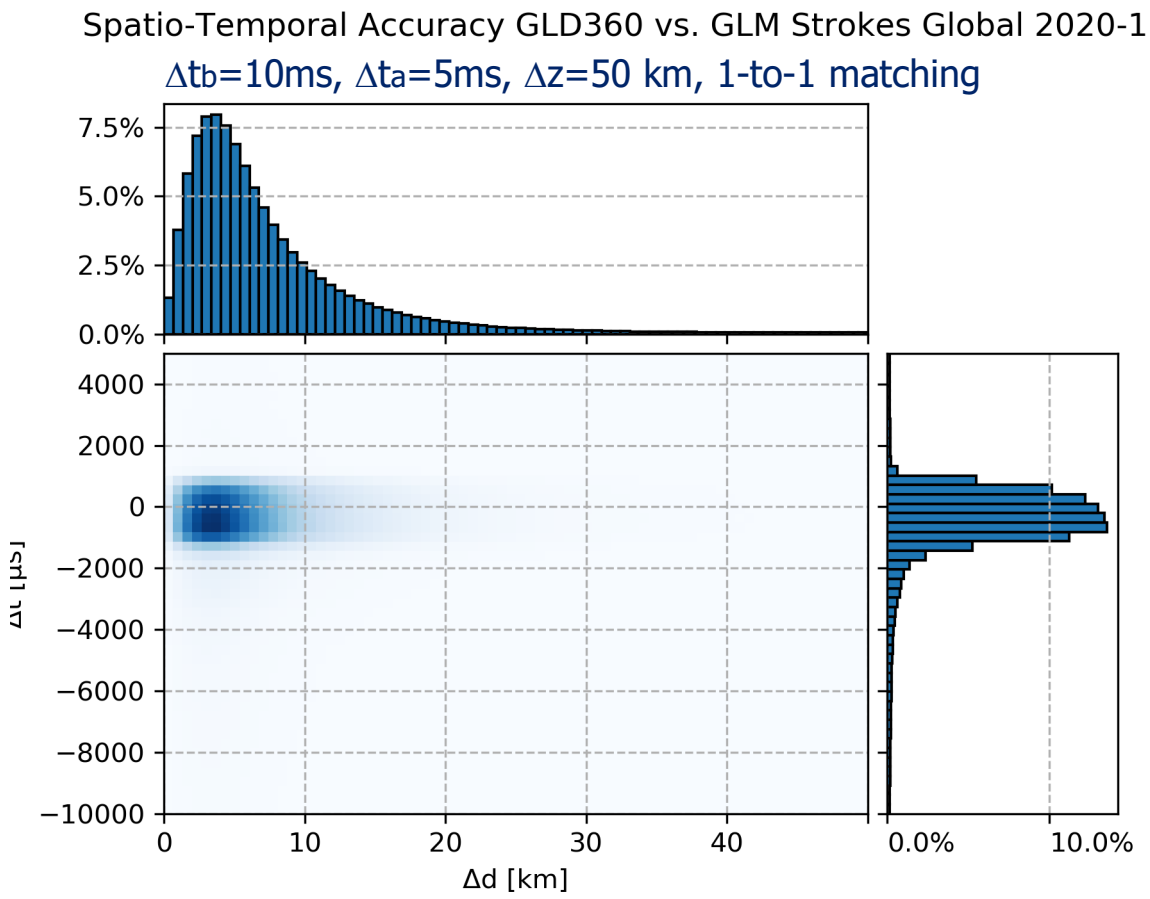


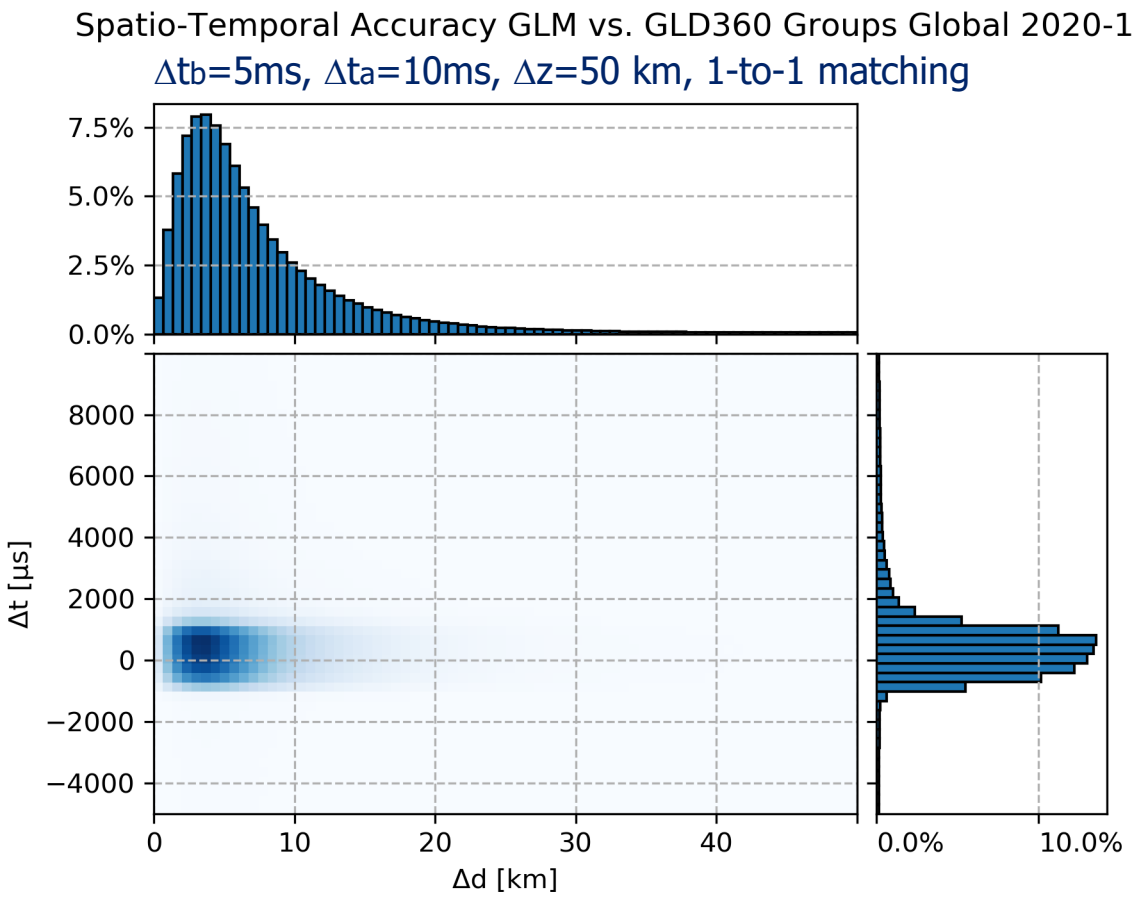
GLD-GLM 11/2020 one-to-many matching





GLD-GLM 11/2020 one-to-one matching

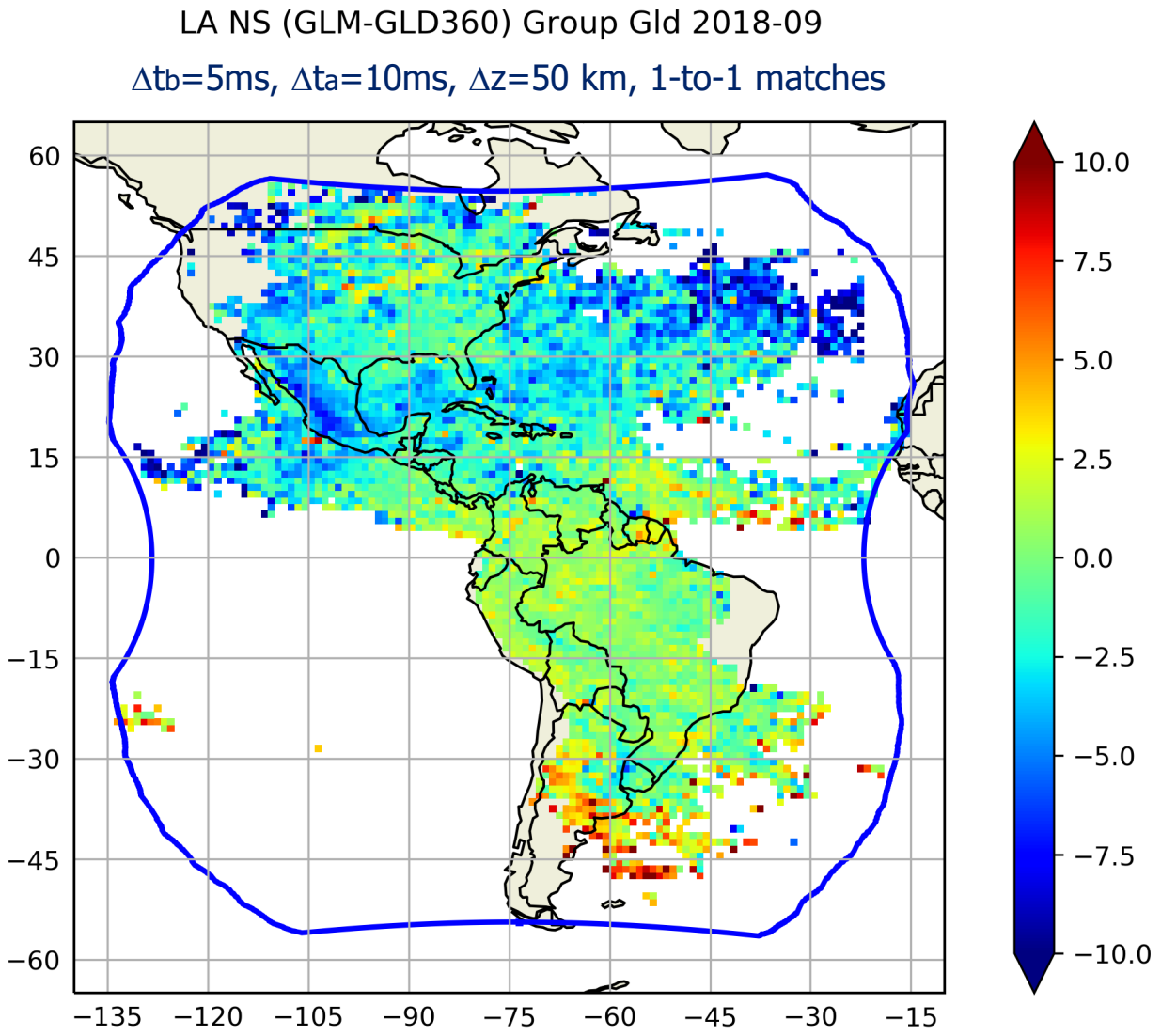


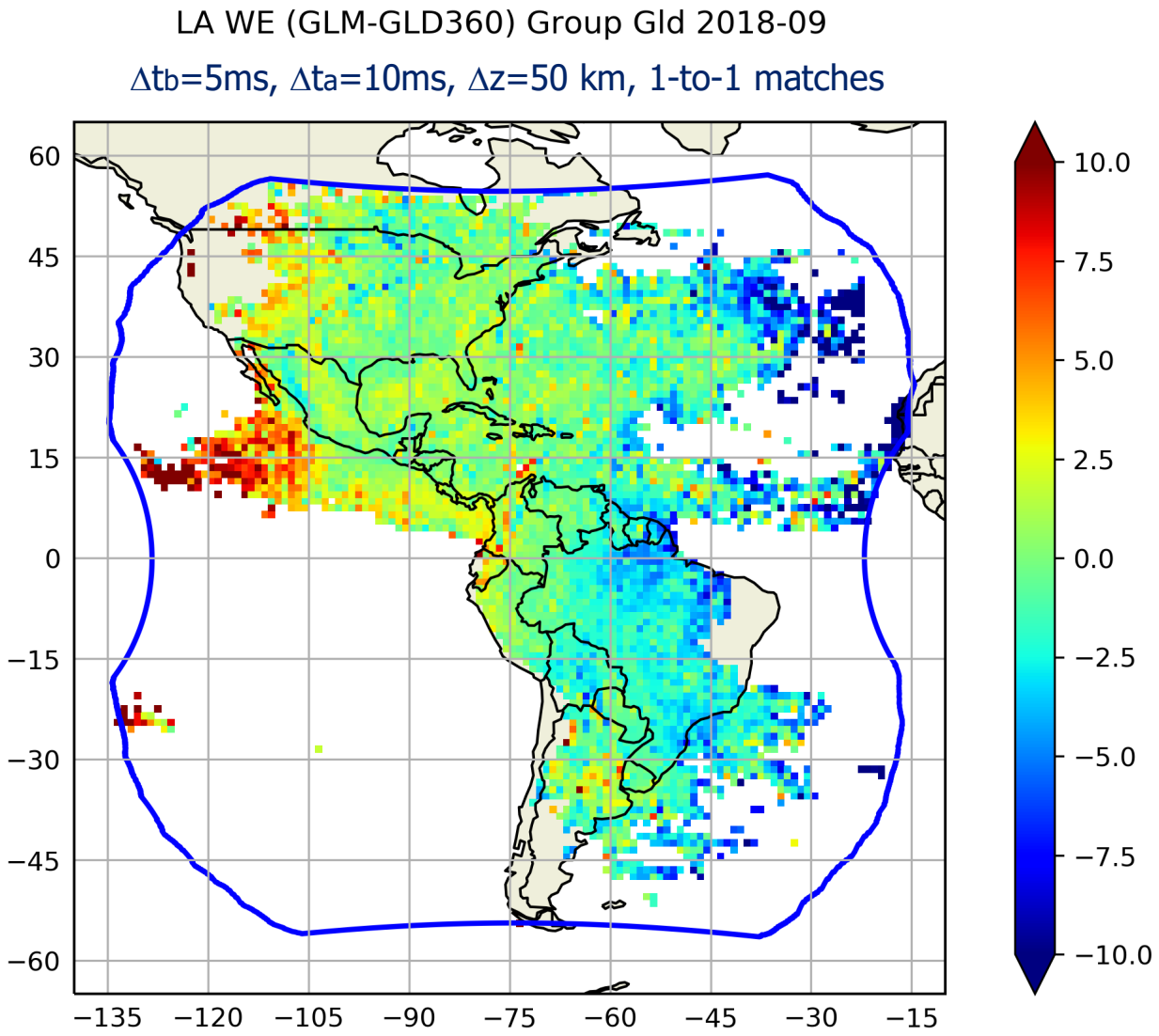


LISTAR matching type conclusion

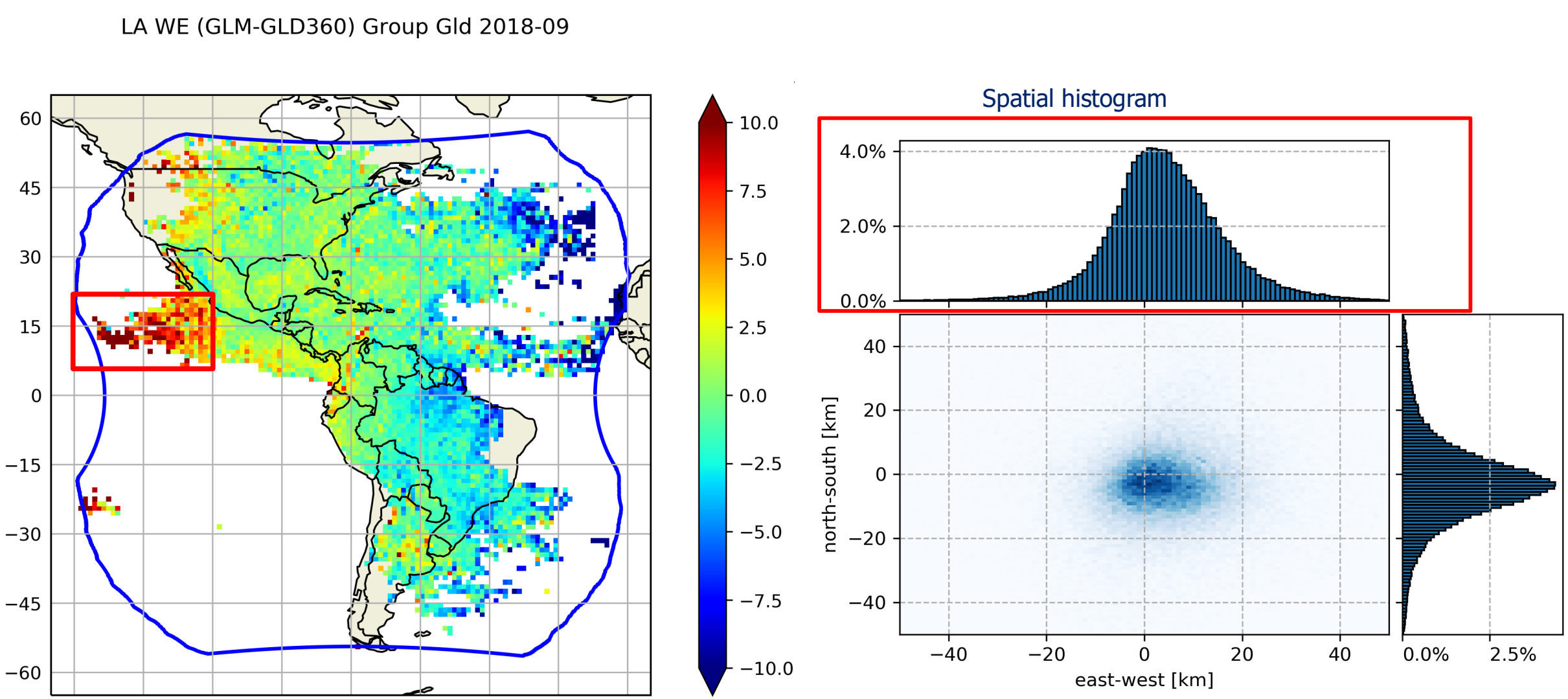
- Two main possibilities.
- ‘Coarse’ approach:
  - Use one-to many relationship for all, i.e. detection efficiency, location offset and time offset.
- ‘Fine’ approach:
  - Use one to many relationship for detection efficiency.
  - Use one-to-one relationship for location and time offset.
- Any feedback?

GLM group offset relative to GLD360 September 2018

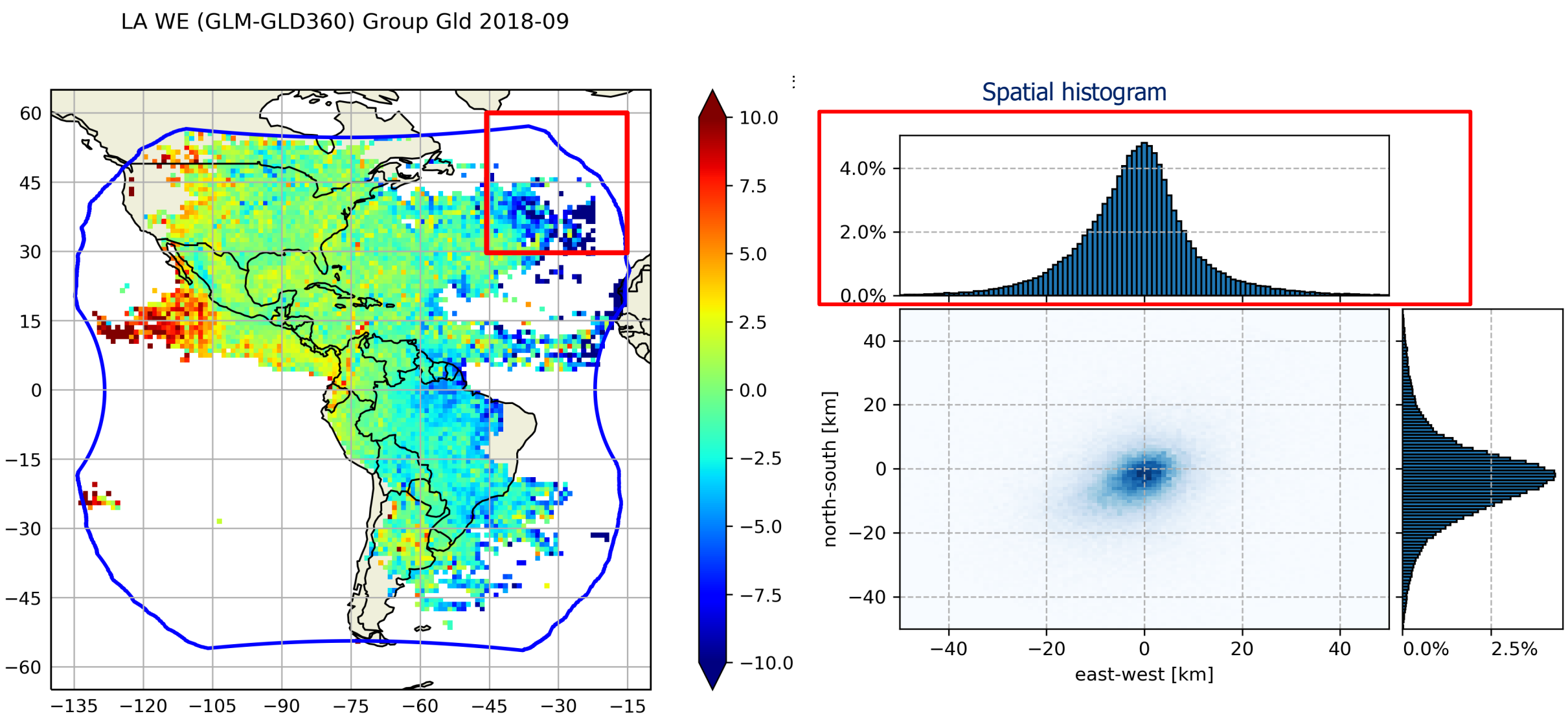




GLM group WE offset September 2018 area I

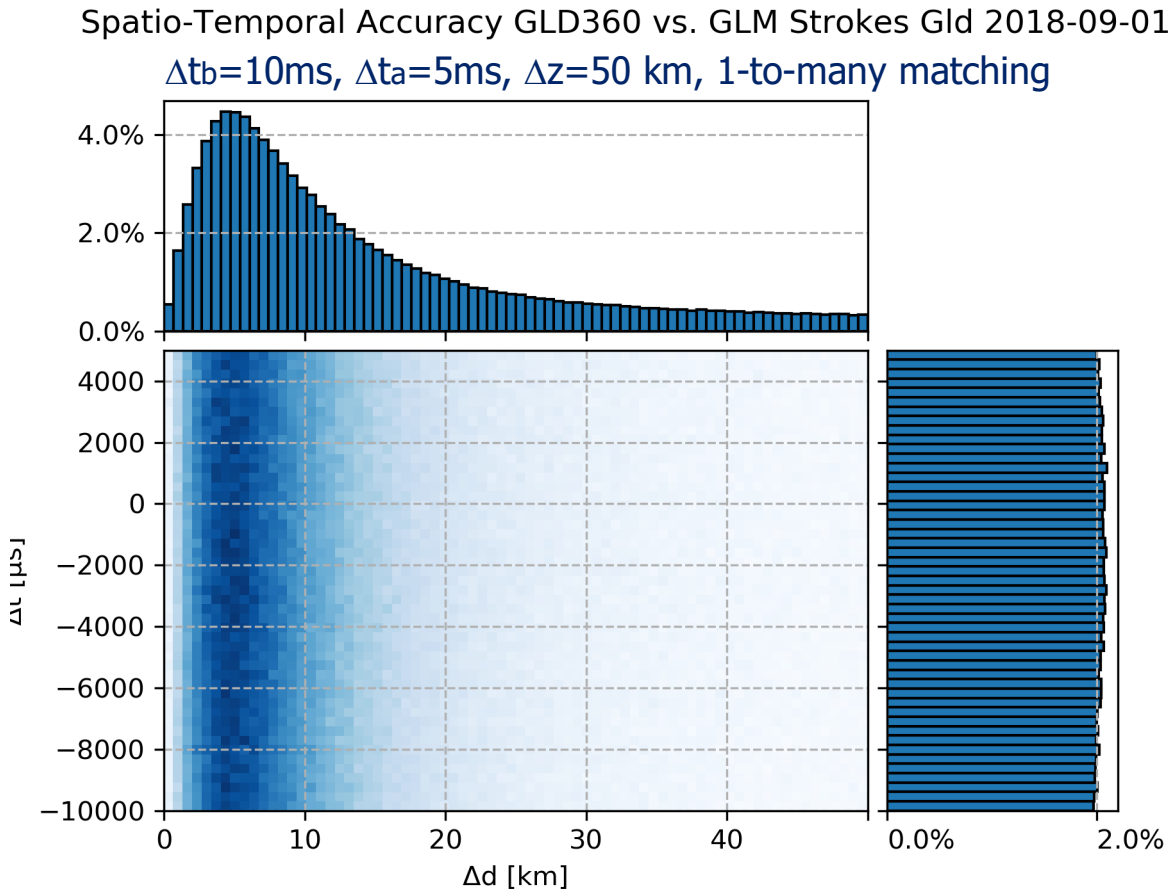


GLM group WE offset September 2018 area II

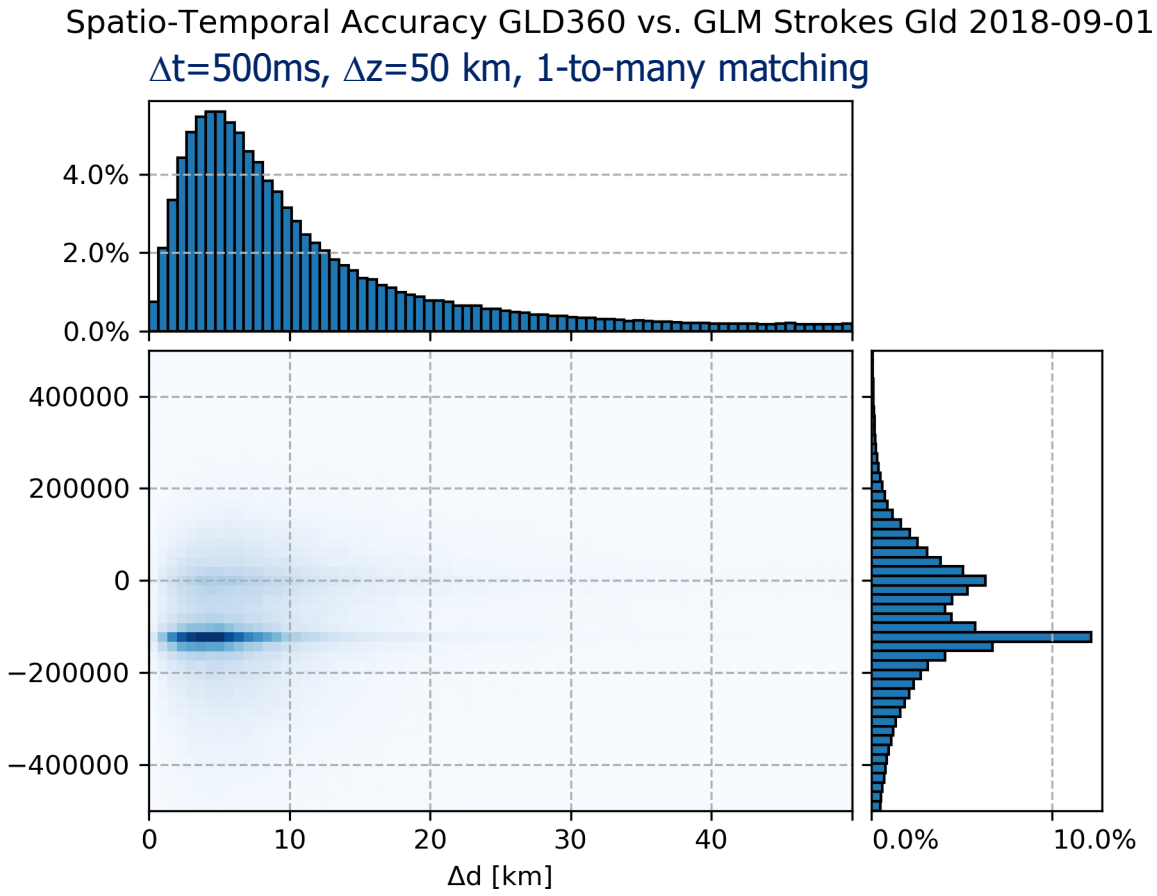


Spatiotemporal histogram in problem investigation

What if facing something like that?

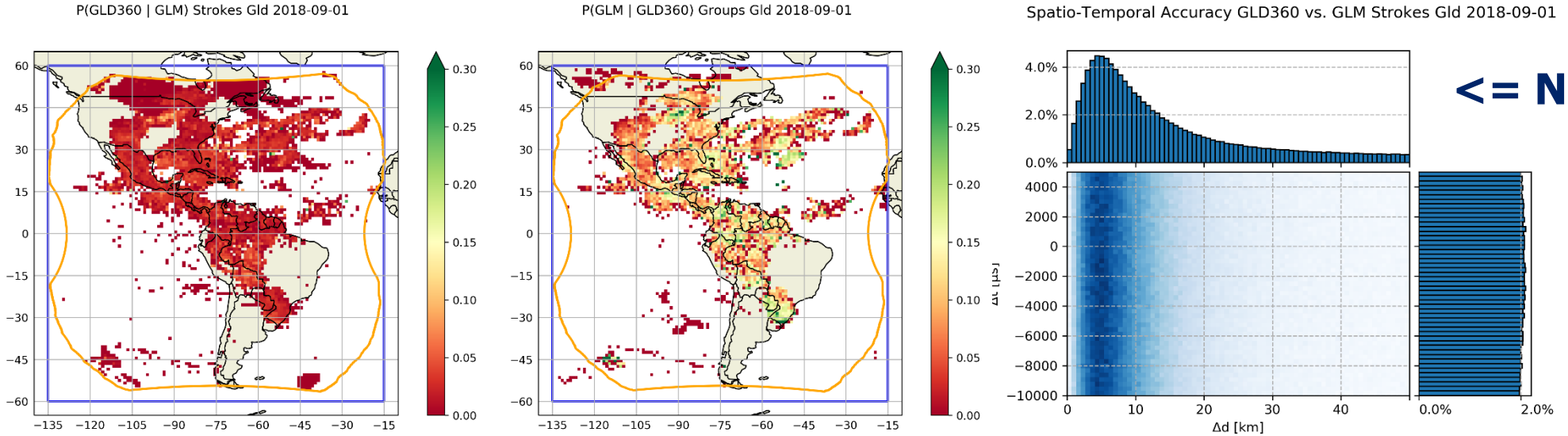


Can redo matching, using much wider time window, to check for possible timing errors/problems.

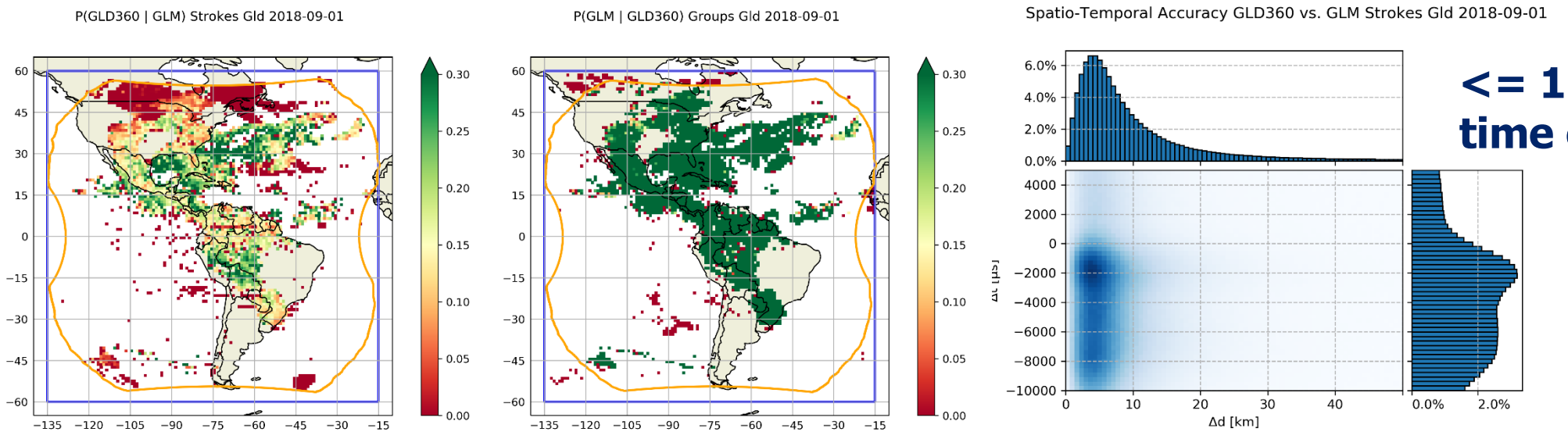


Conclusion – GLM times not photon travel time corrected (09/2018)

Testing coarse 120 ms GLM group time correction



<= No time correction



<= 120 ms GLM group time correction

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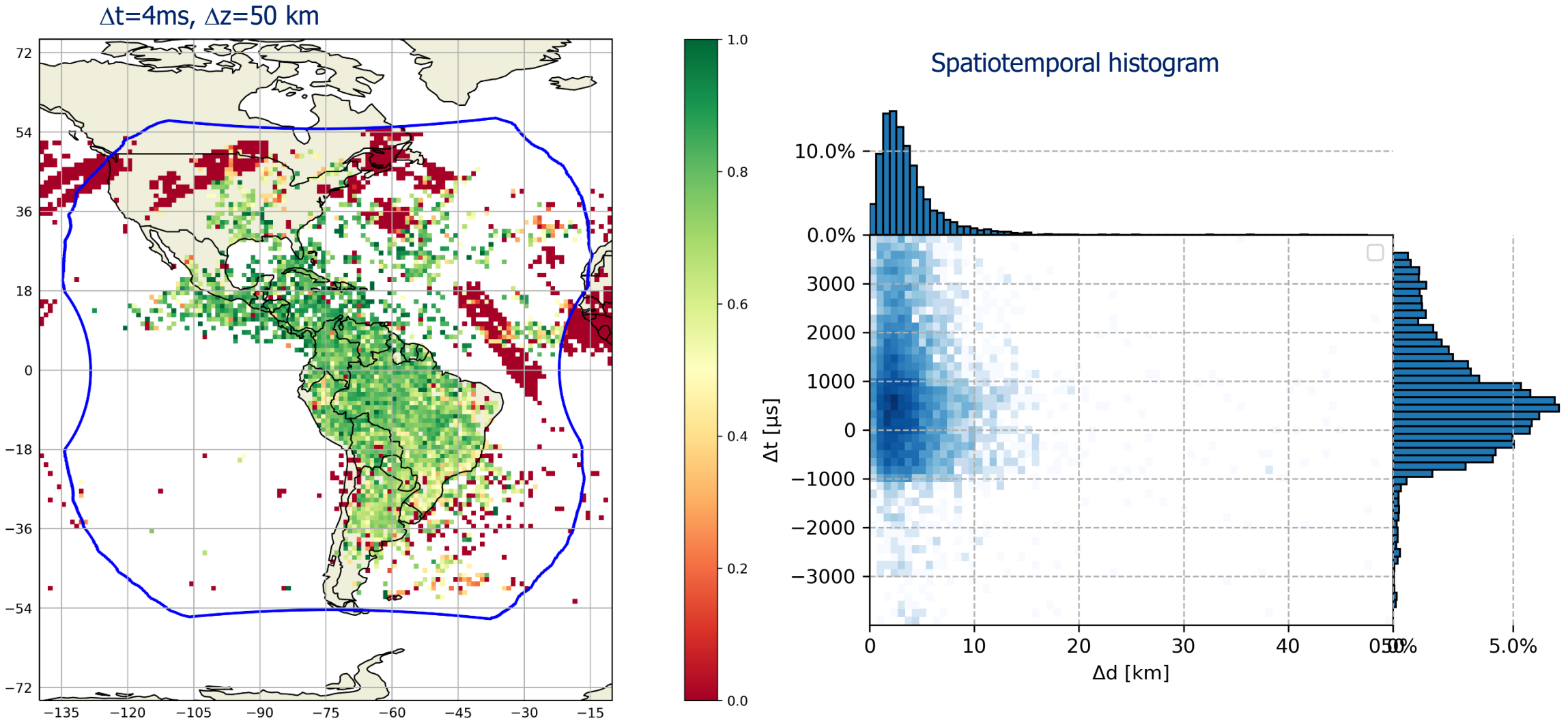
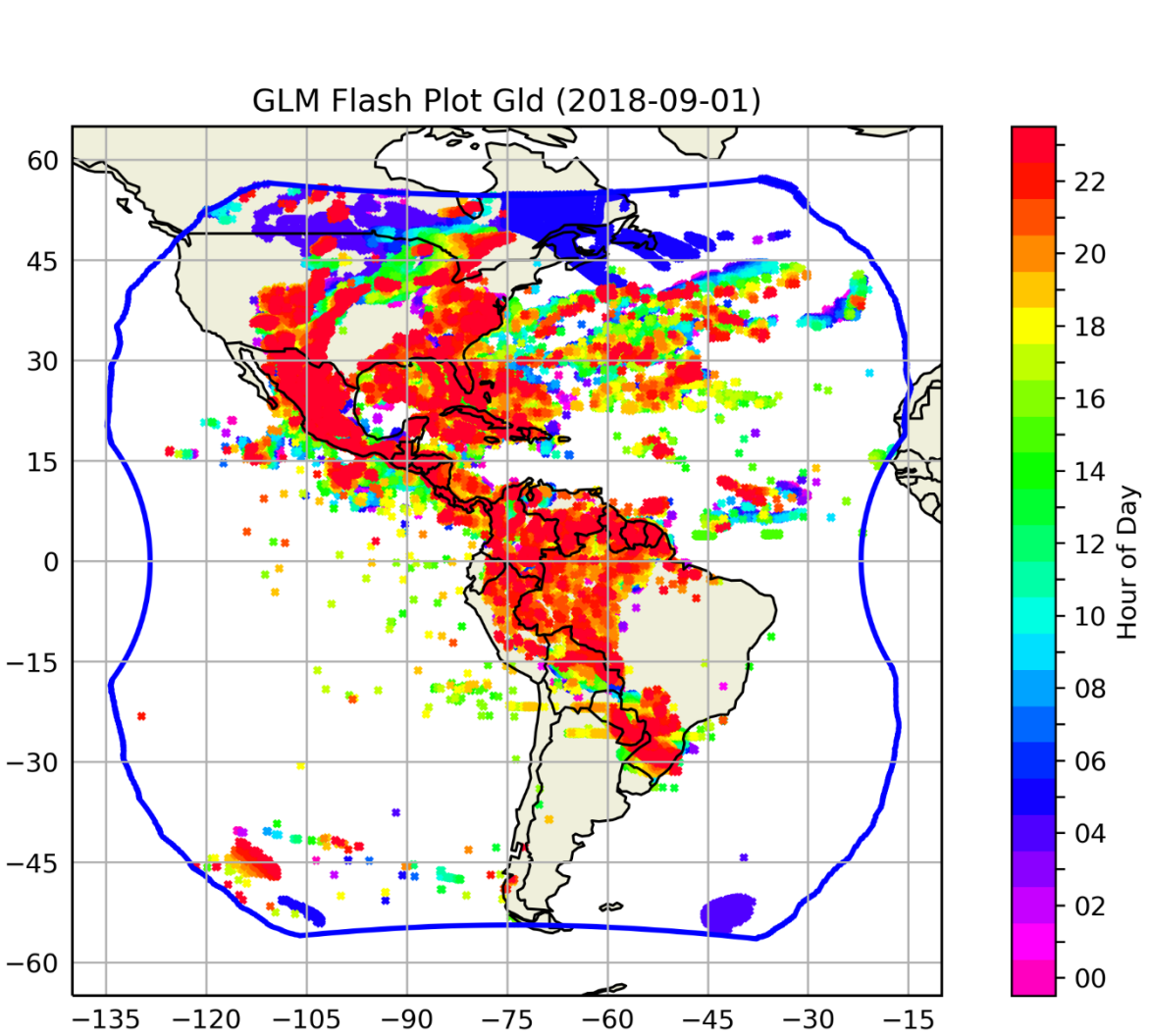
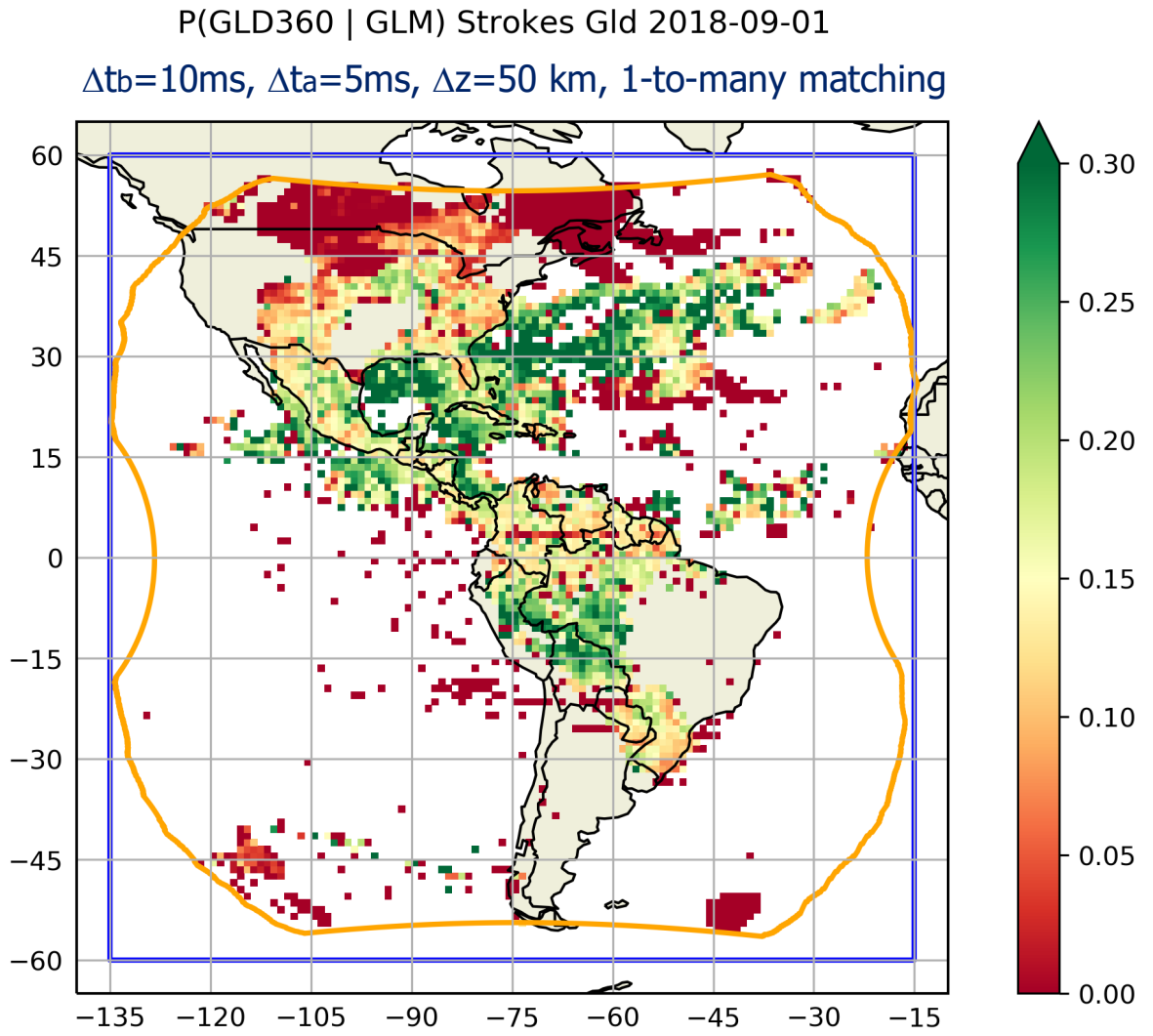
ISSLIS vs GLM group DE Oct-Nov 2020

P(GLM | ISS-LIS) Groups Glm 2020-10-01..2020-11-30

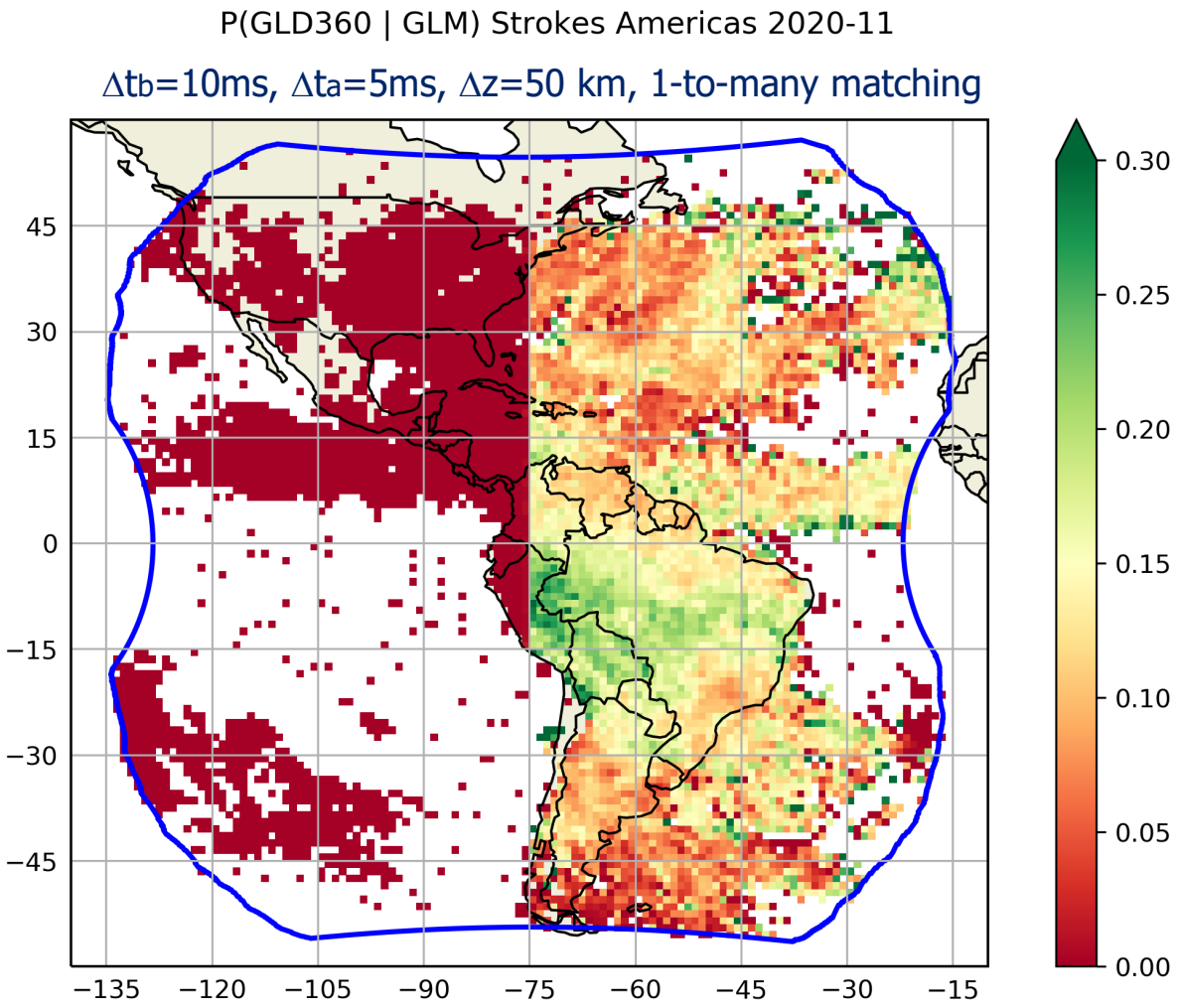


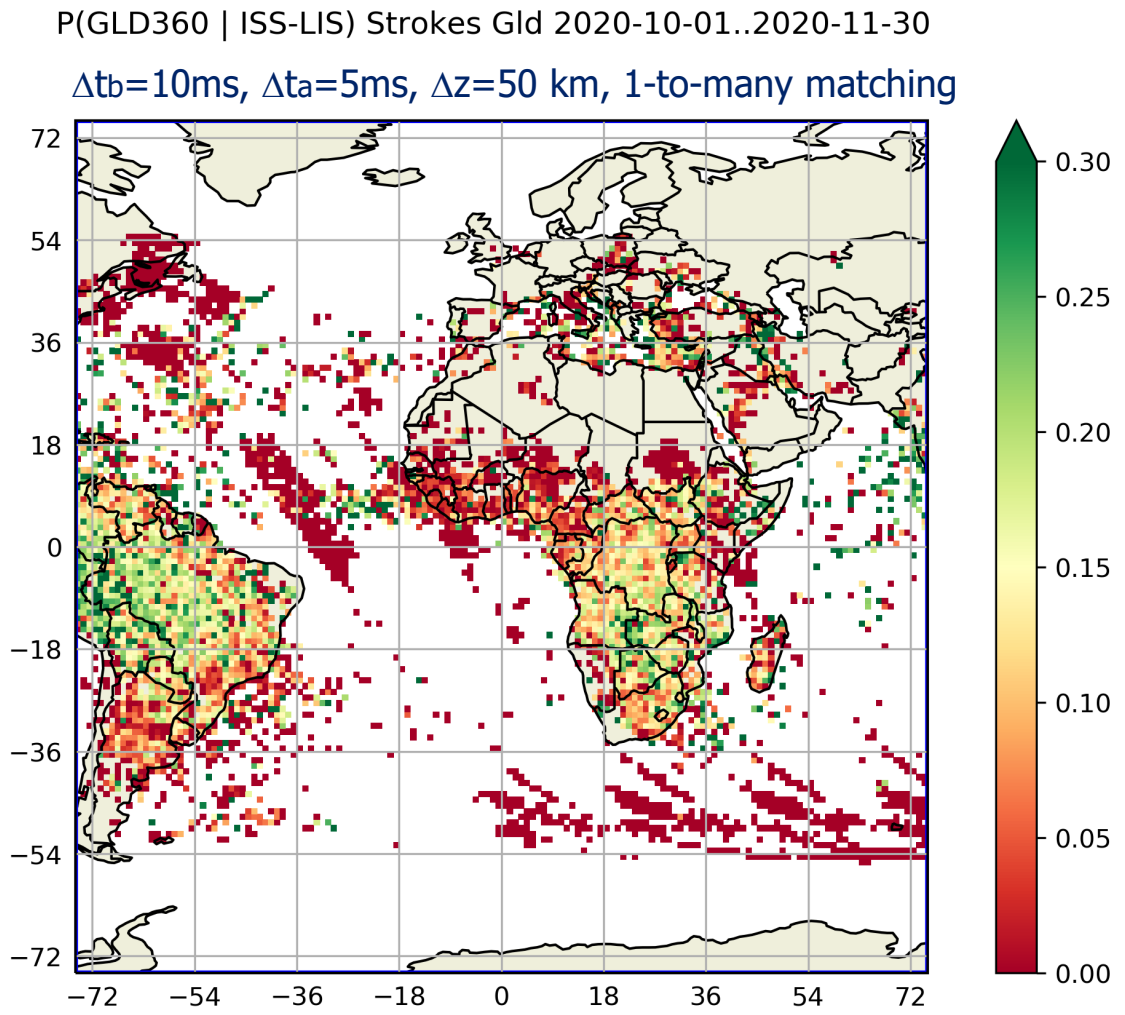
GLD360-GLM group DE 01-09-2018





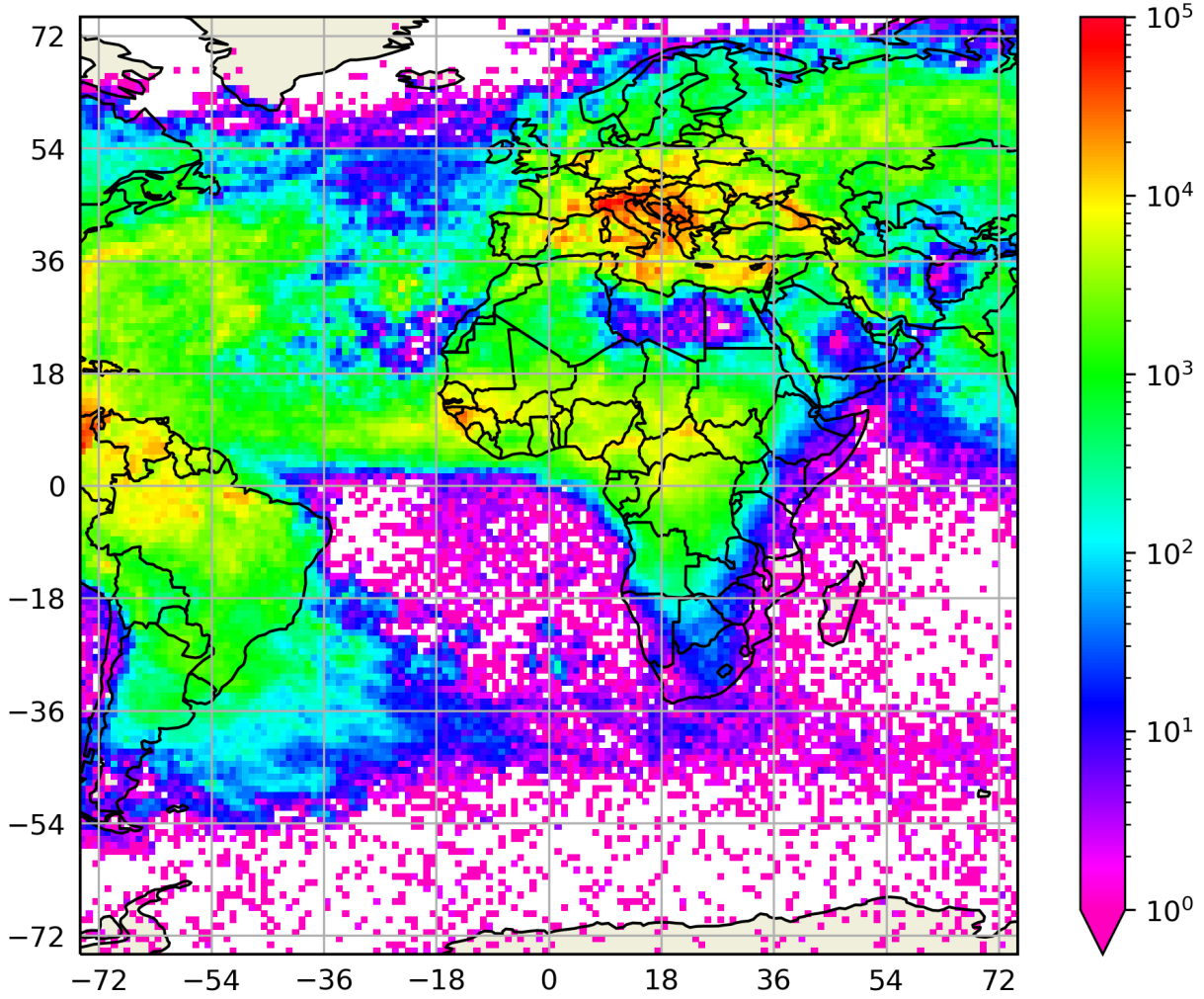
GLD has higher GLM and lower ISSLIS group DE?



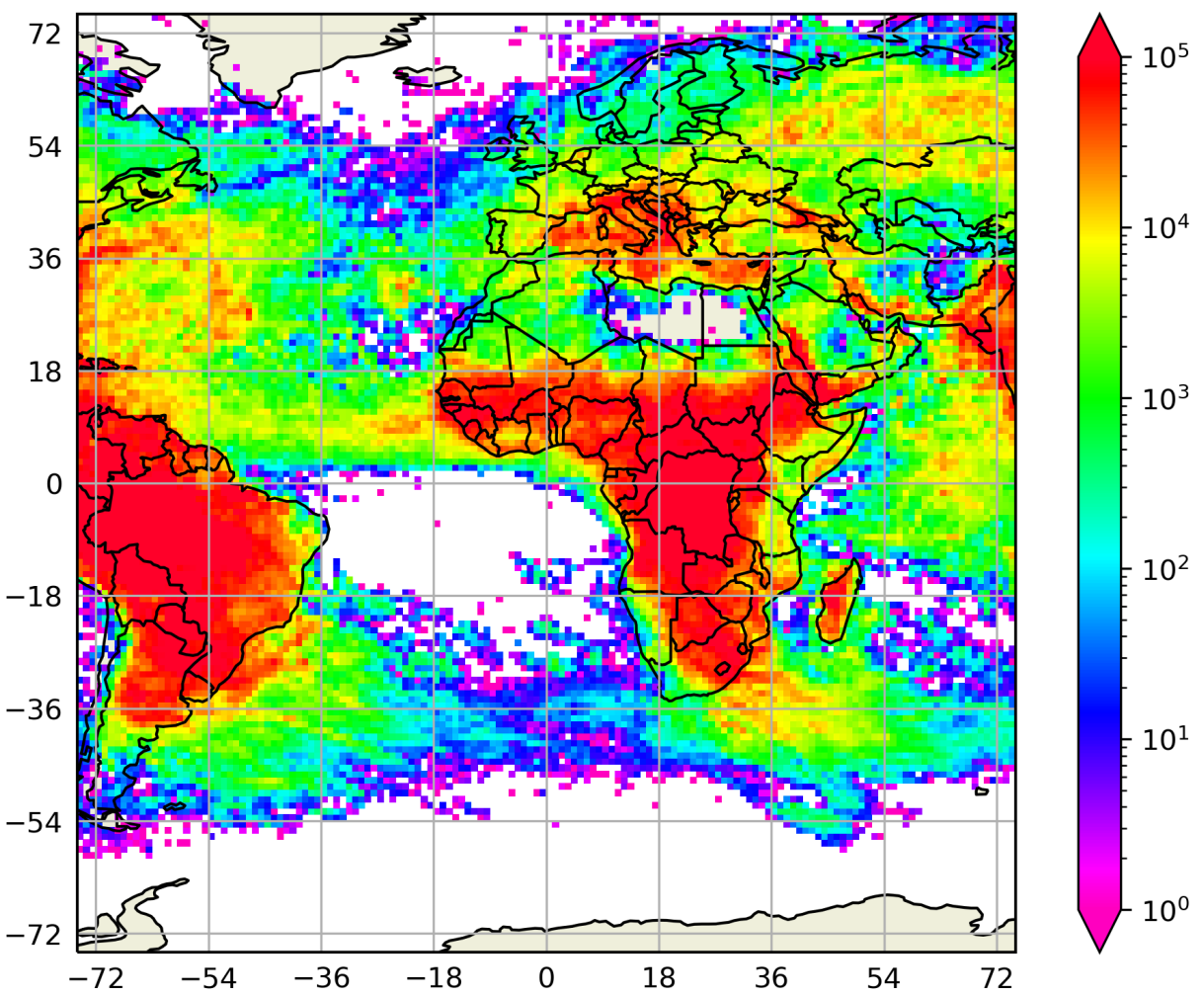


Assessing ATDnet spatial range I

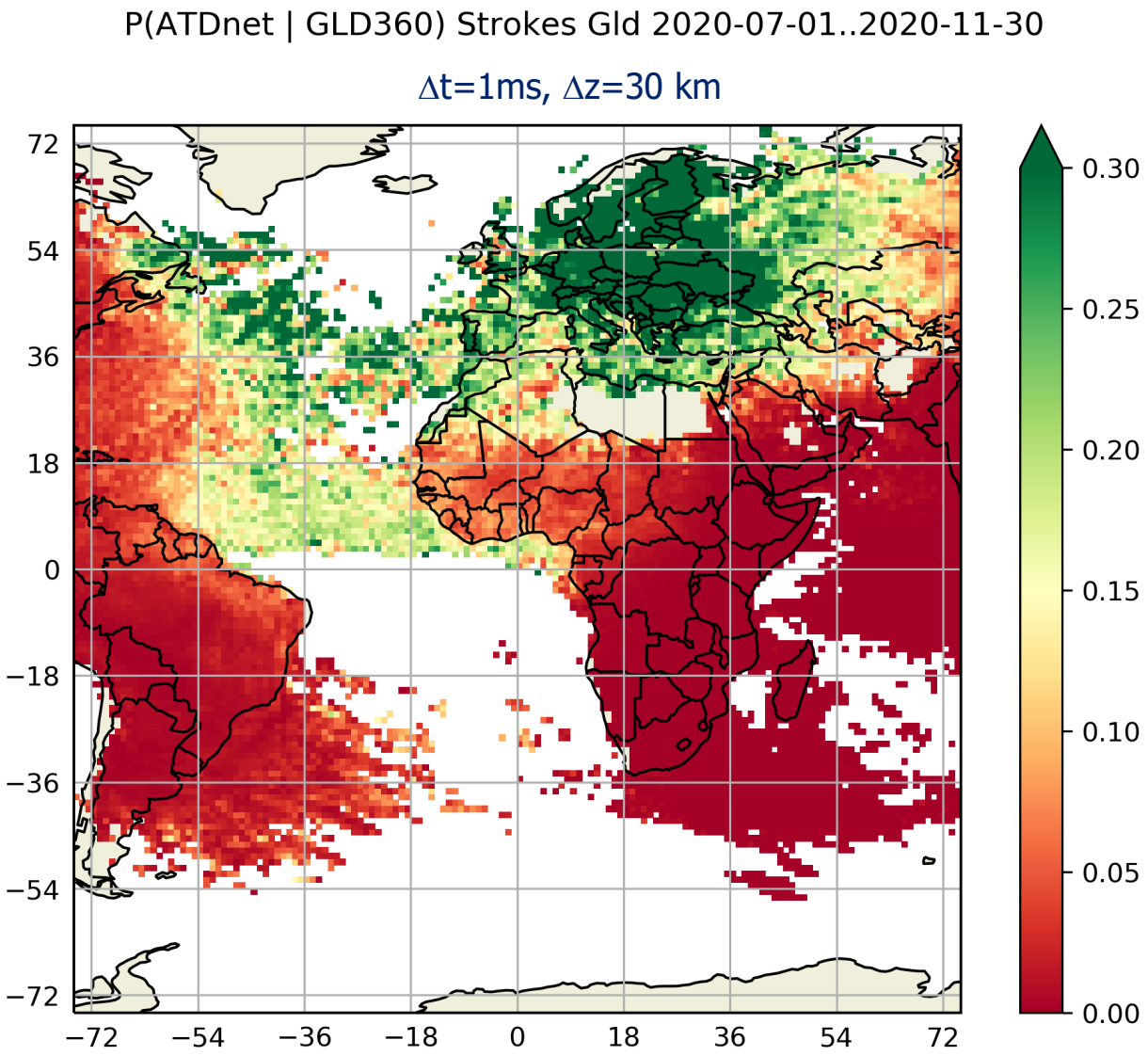
ATDnet Accumulated Strokes Gld 2020-07-01..2020-11-30



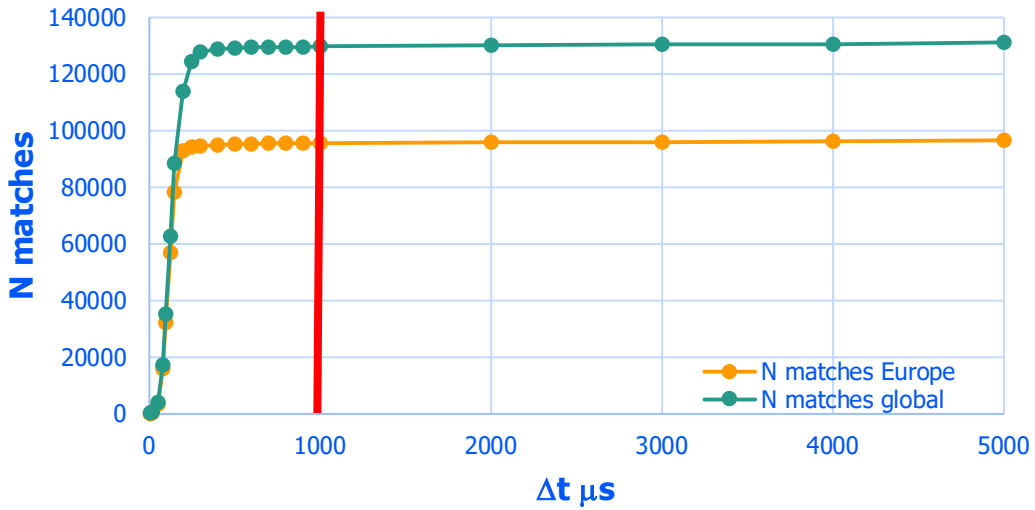
GLD360 Accumulated Strokes Gld 2020-07-01..2020-11-30

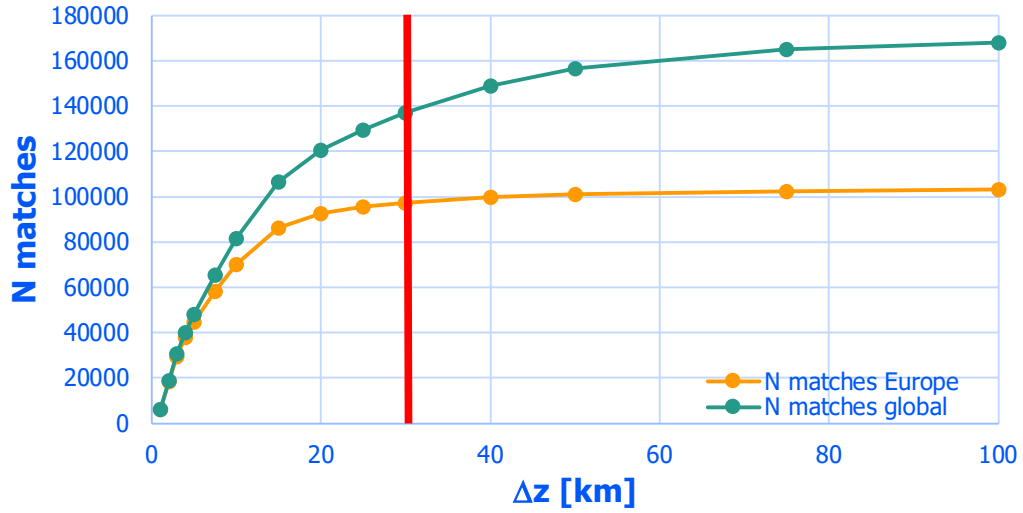


Assessing ATDnet spatial range II



Why Δt=1ms, Δz=30 km?





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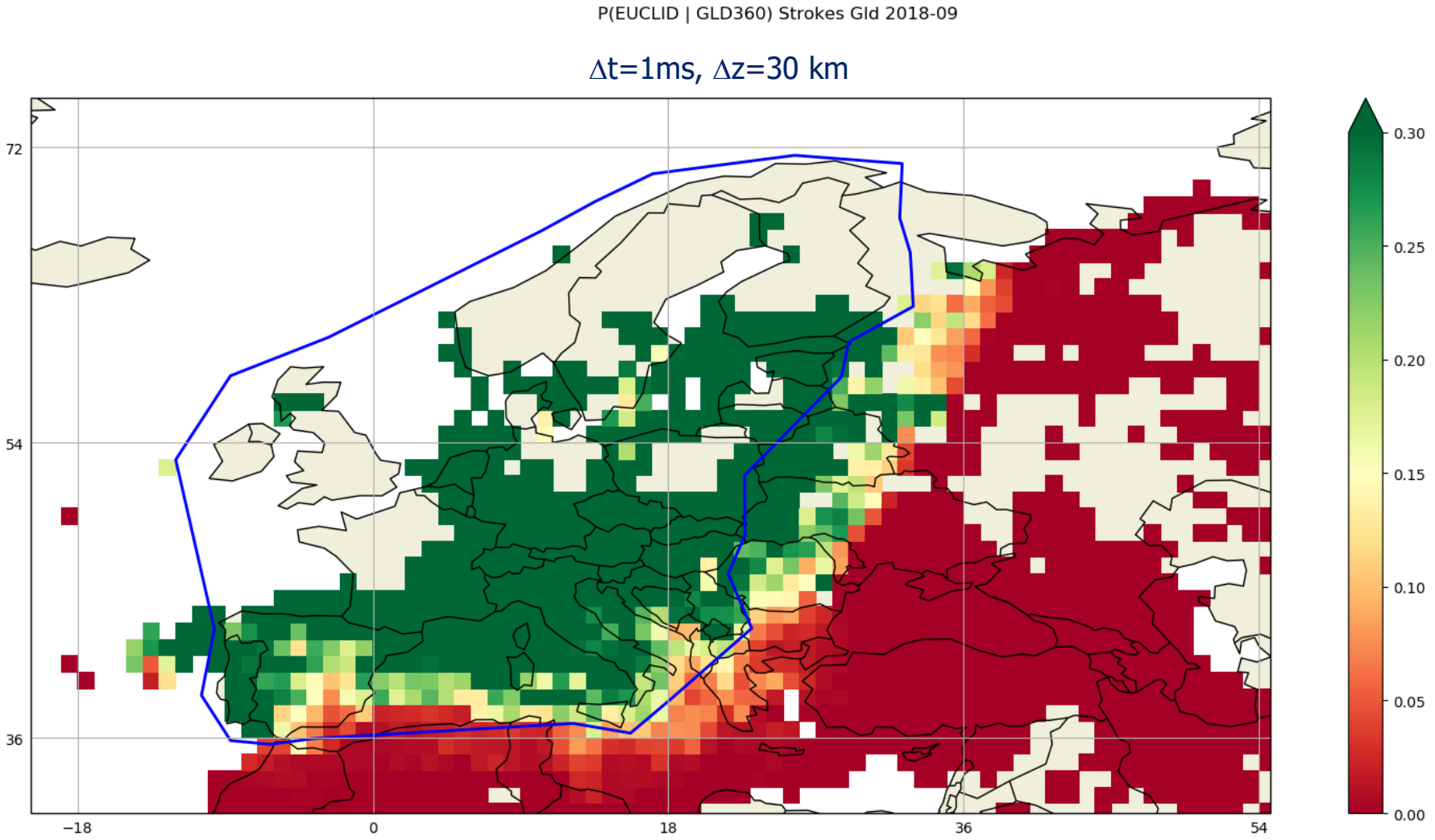
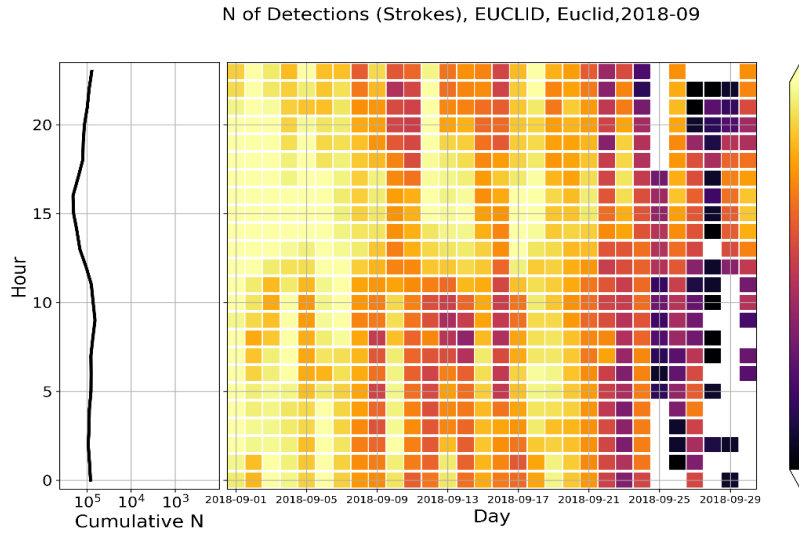
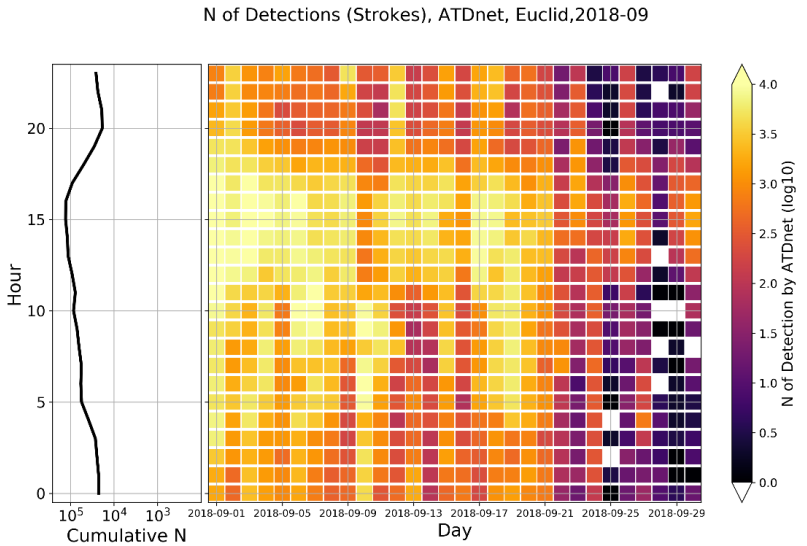
Checking EUCLID spatial range

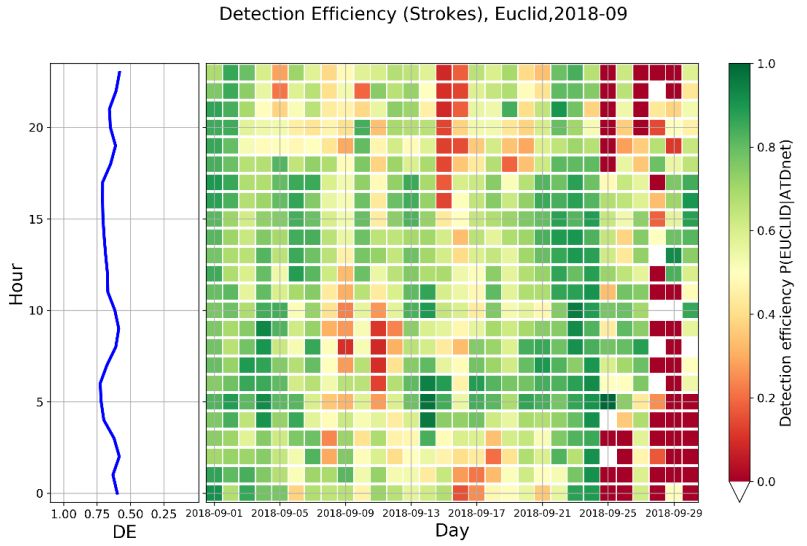


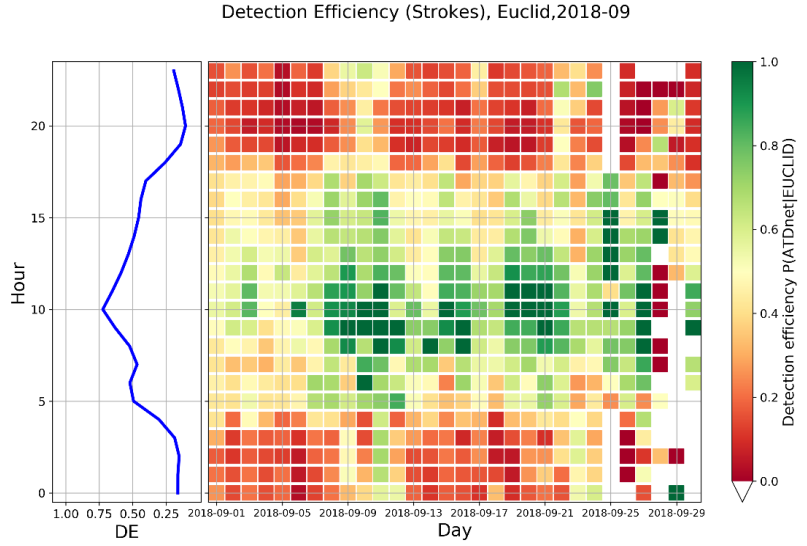
ATDnet vs EUCLID strokes September 2018 I





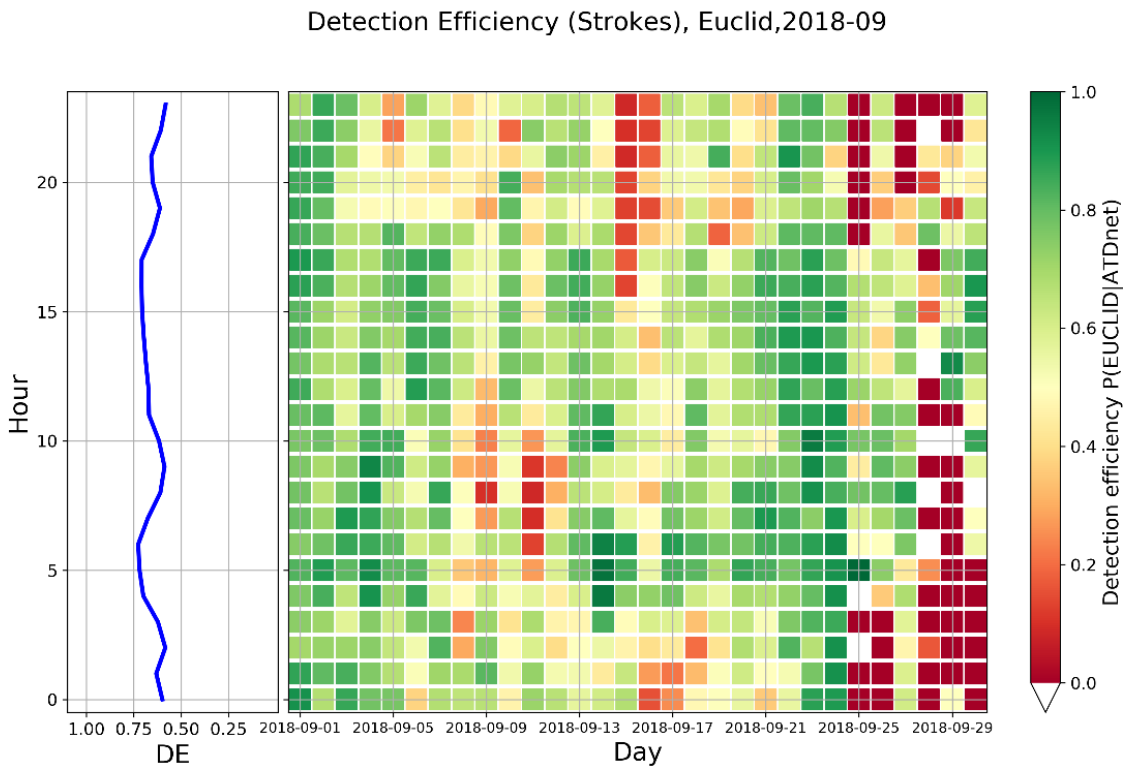
<= stroke counts

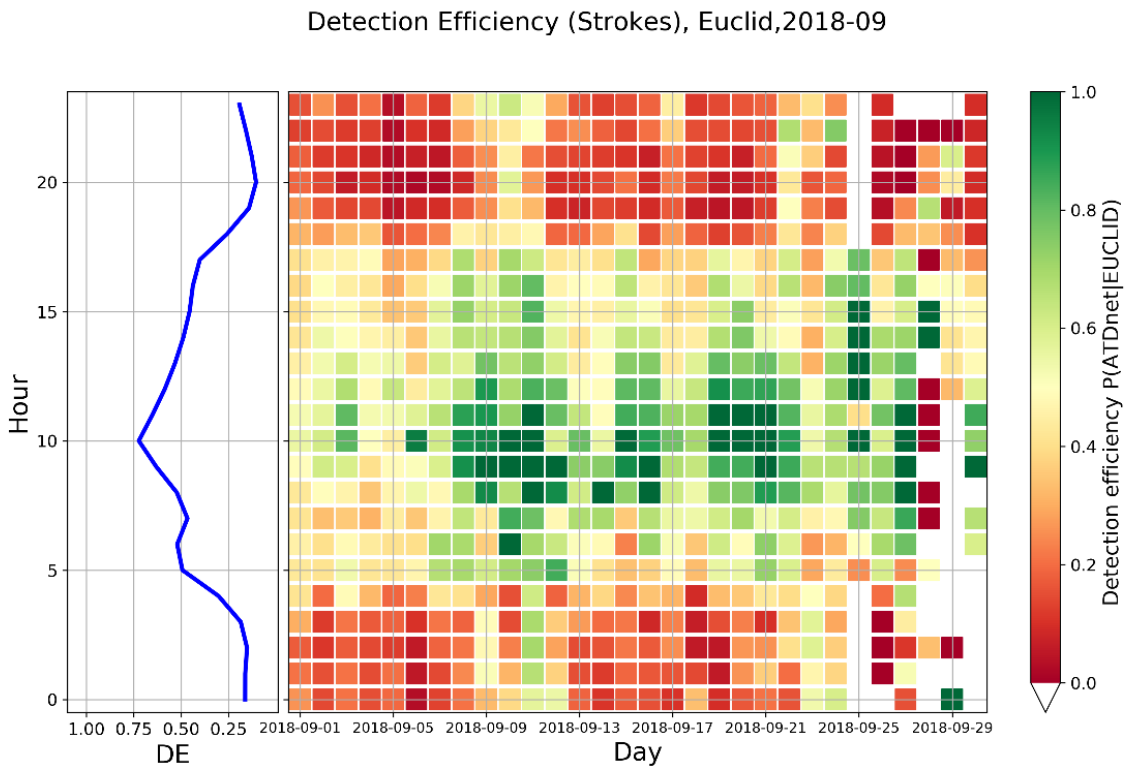




<= relative DE

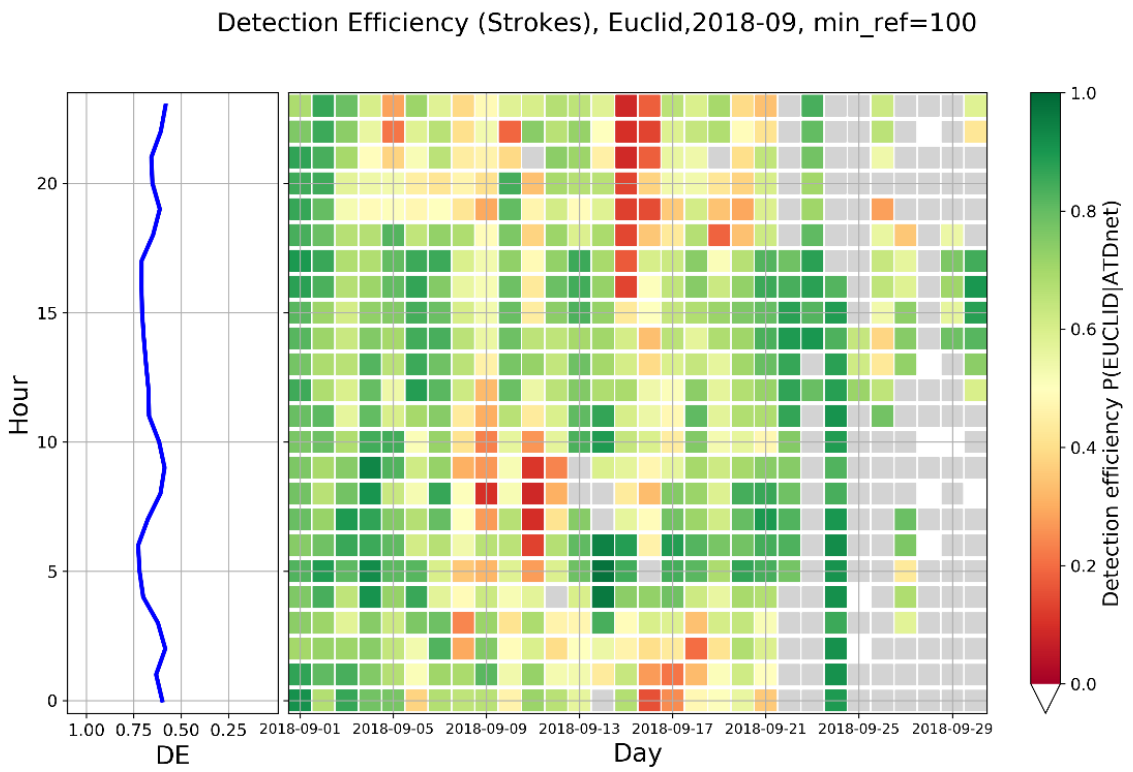
ATDnet vs EUCLID strokes September 2018 II

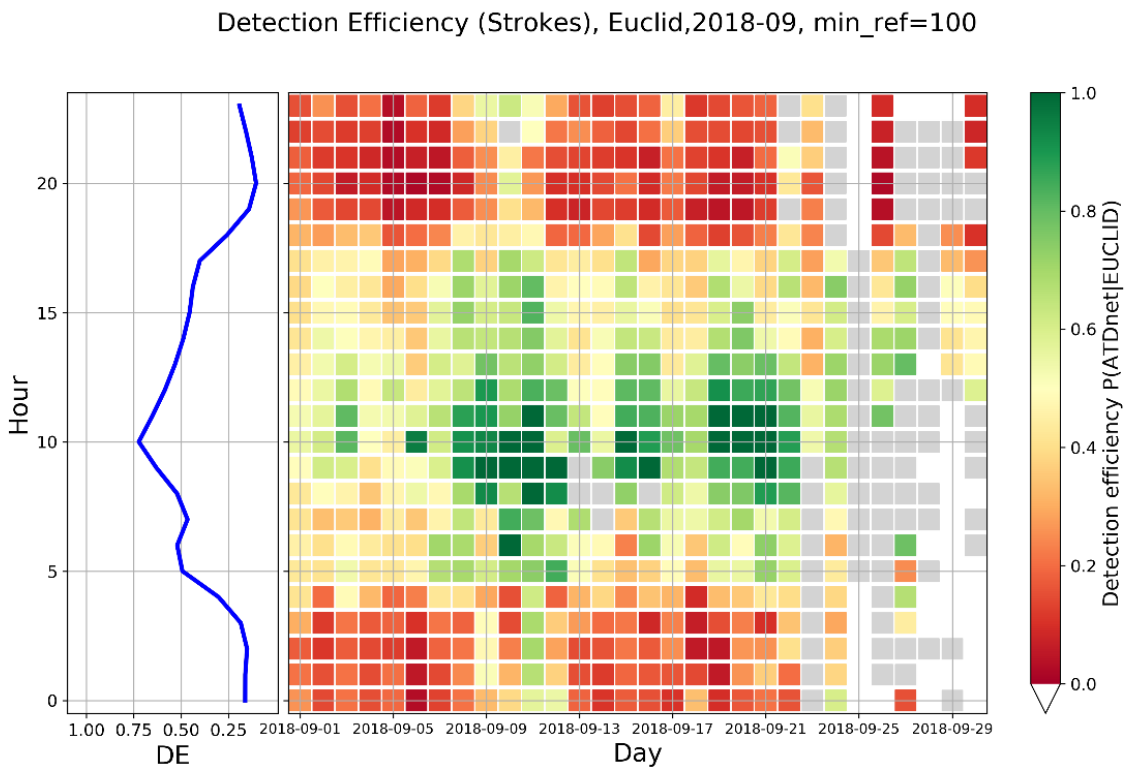




Hours with too low lightning activity will give unreliable results…

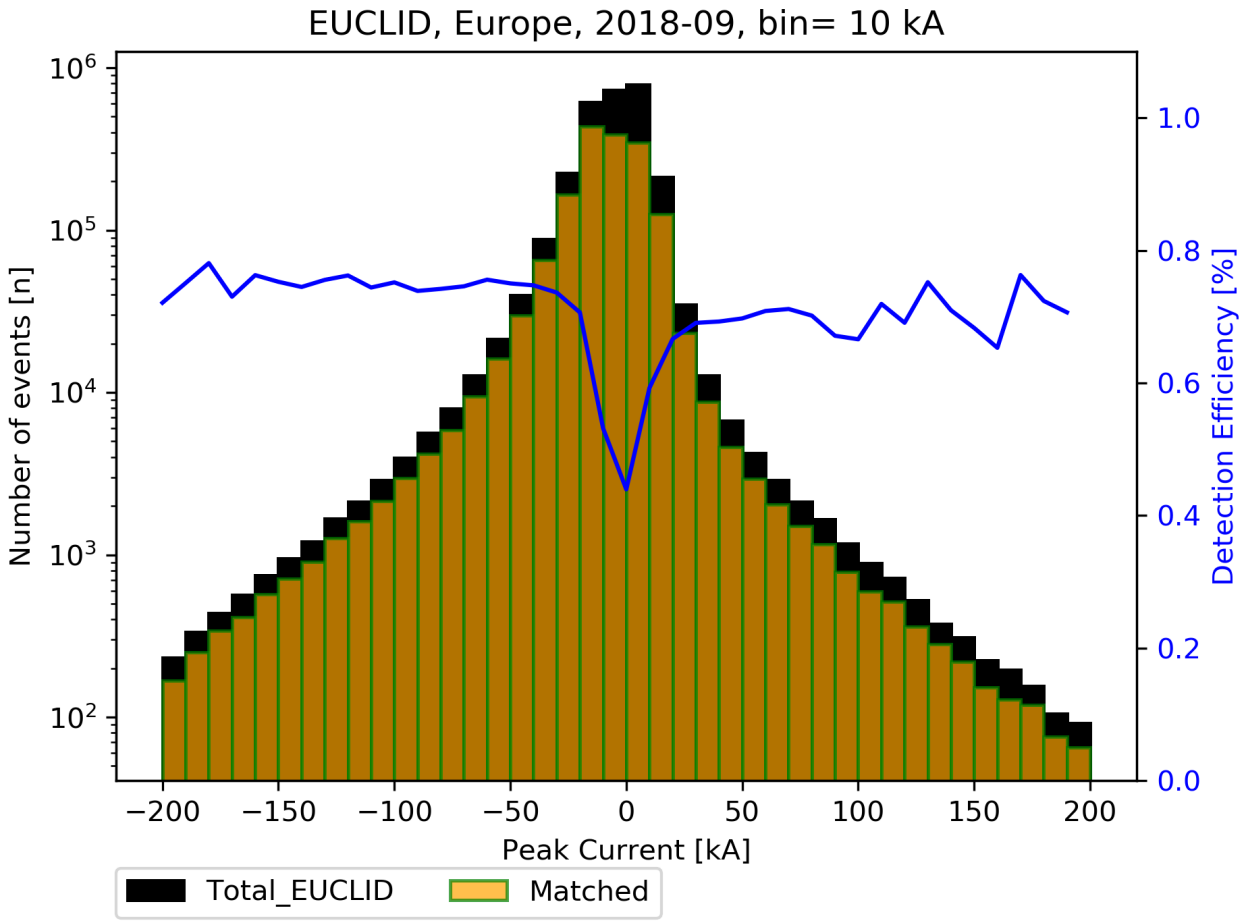
ATDnet vs EUCLID strokes September 2018 III

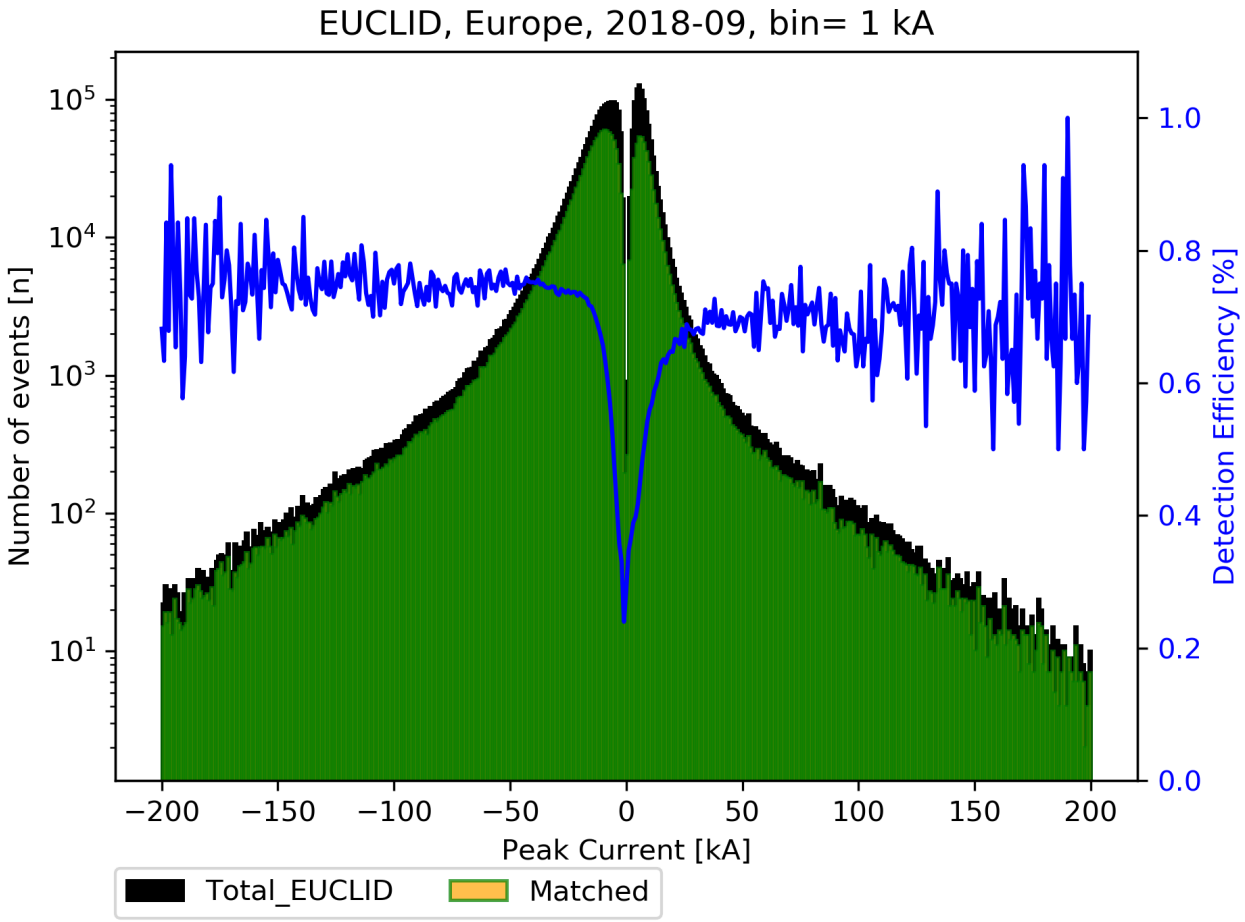




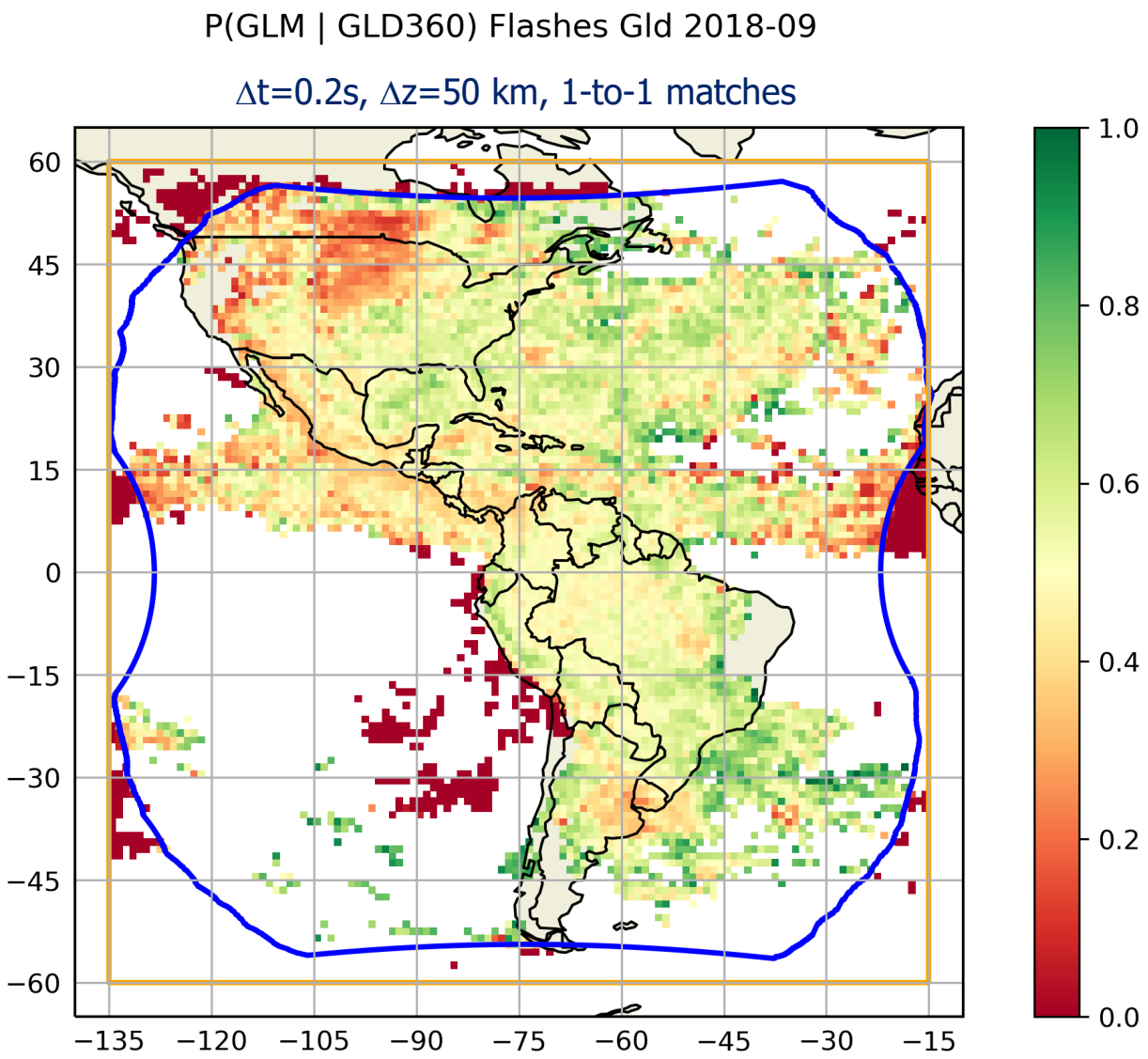
…so remove hours with <100 reference network strokes.

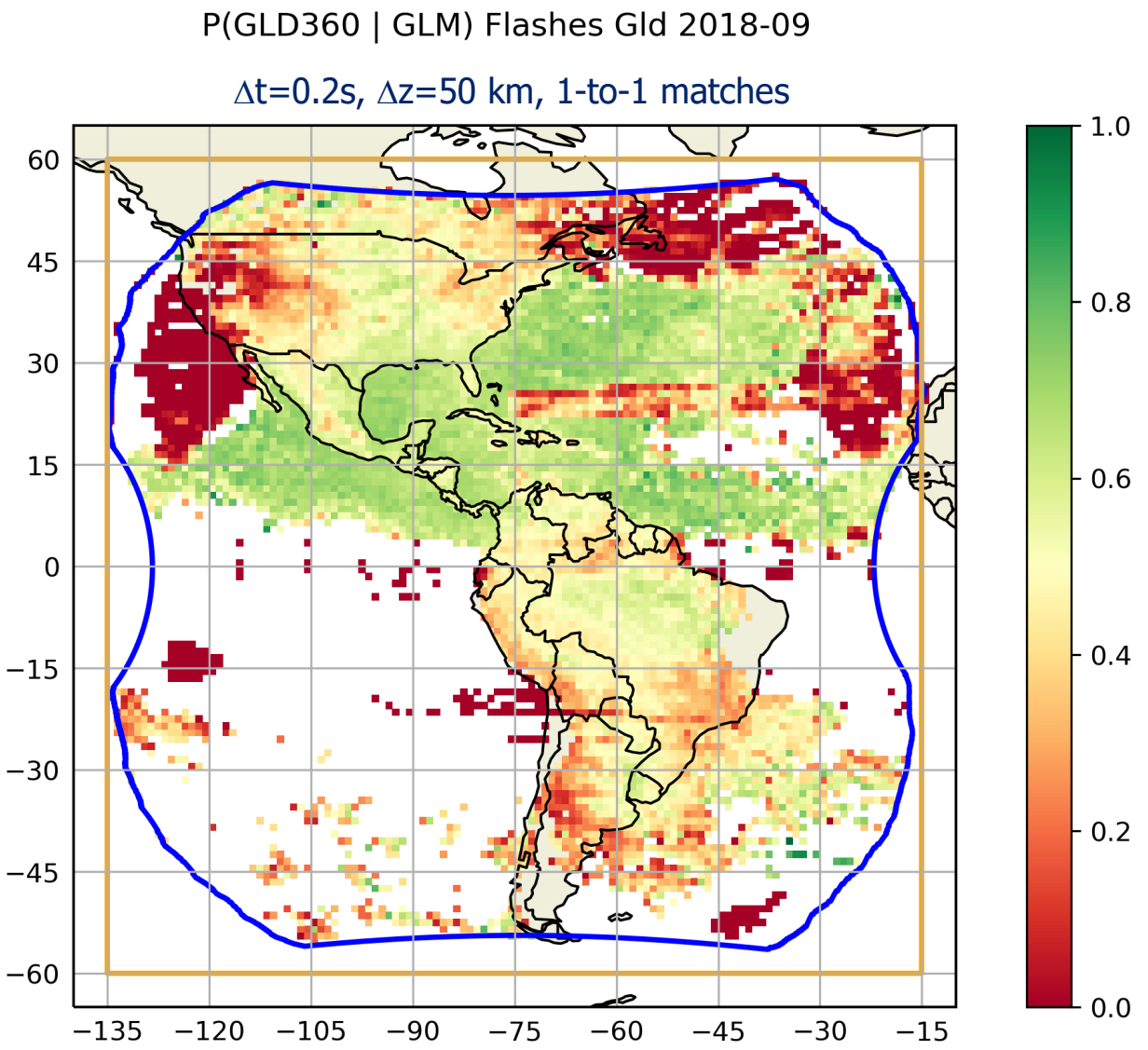
ATDnet vs EUCLID stroke DE vs peak current



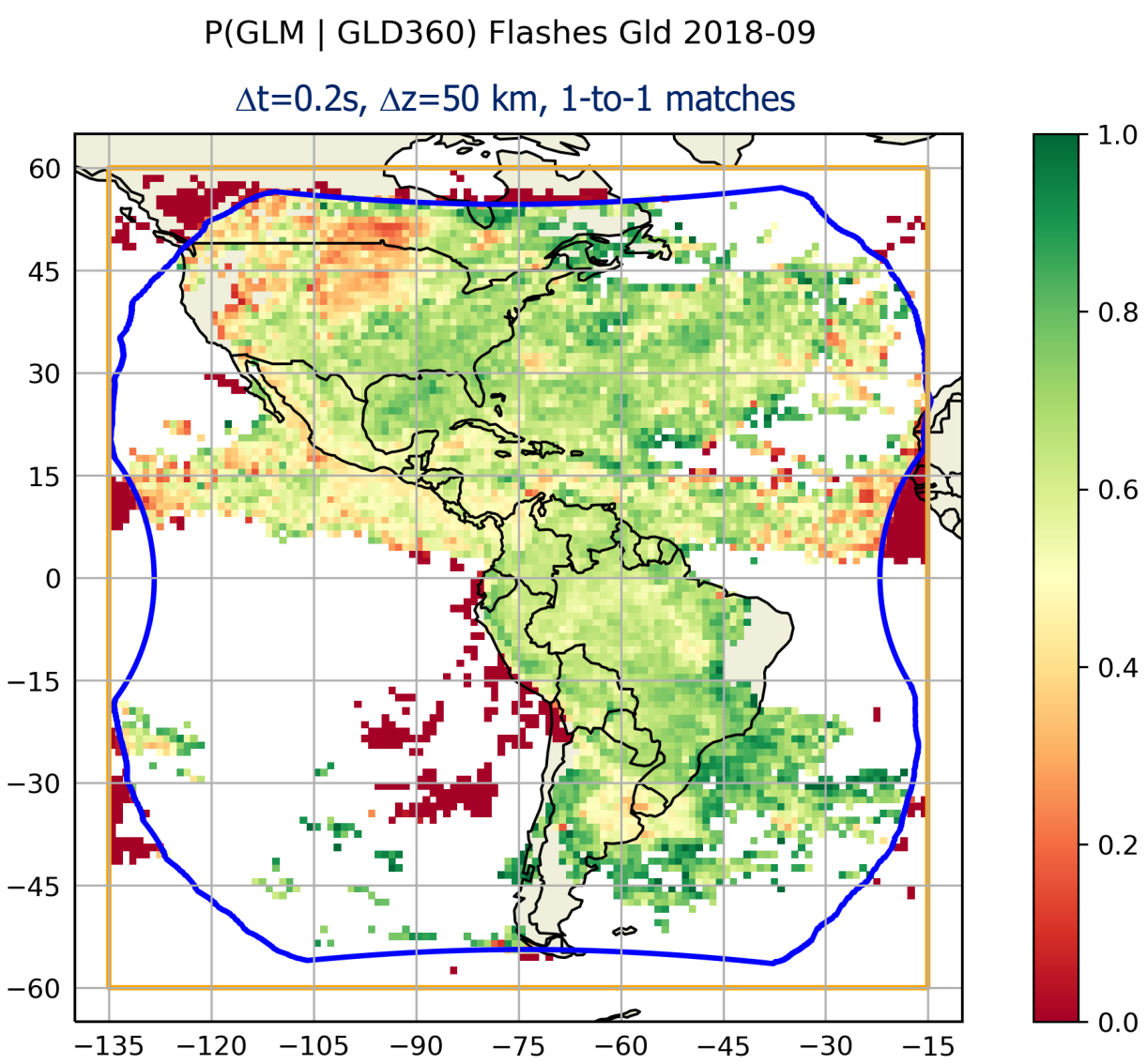


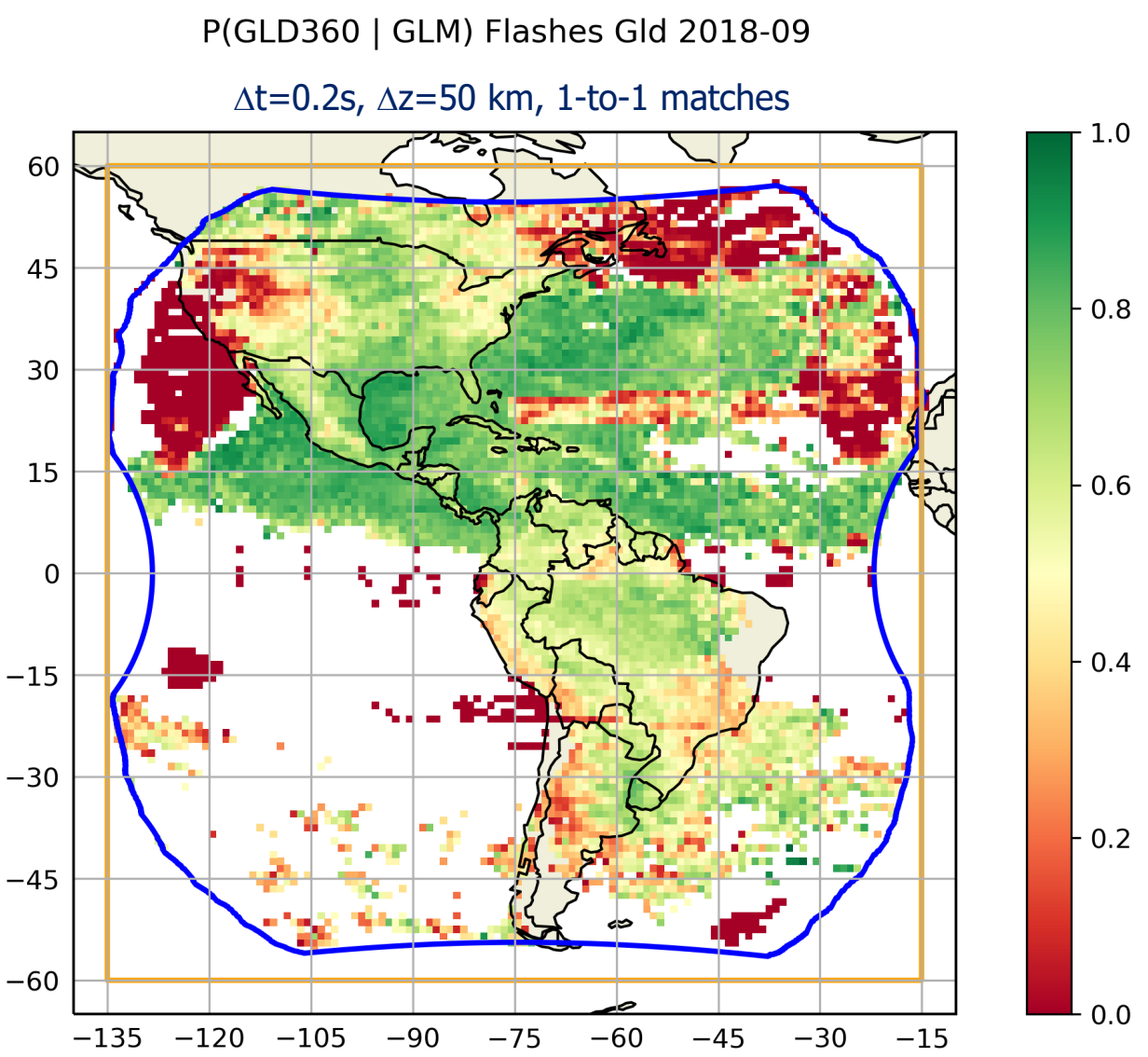
GLD360 and GLM flash DE September 2018 - primitive





GLD360 and GLM flash DE September 2018 - advanced





The current stroke/pulse/group matching parameters

Reference network	Test network				
	ATDnet	**EUCLID**	**GLD360**	**GLM**	**ISSLIS**
ATDnet		*Δt=1 ms* *Δz=30 km*	**Δt=1 ms** **Δz=30 km**	*Δtb=5 ms* *Δta=10 ms* *Δz=50 km*	*Δtb=5 ms* *Δta=10 ms* *Δz=50 km*
EUCLID	*Δt=1 ms* *Δz=30 km*		*Δt=1 ms* *Δz=20 km*		*Δtb=5 ms* *Δta=10 ms* *Δz=50 km*
GLD360	**Δt=1 ms** **Δz=30 km**	*Δt=1 ms* *Δz=20 km*		**Δtb=5 ms** **Δta=10 ms** **Δz=50 km**	*Δtb=5 ms* *Δta=10 ms* *Δz=50 km*
GLM	*Δtb=10 ms* *Δta=5 ms* *Δz=50 km*		**Δtb=10 ms** **Δta=5 ms** **Δz=50 km**		*Δt=4 ms* *Δz=50 km*
ISSLIS	*Δtb=10 ms* *Δta=5 ms* *Δz=50 km*	*Δtb=10 ms* *Δta=5 ms* *Δz=50 km*	**Δtb=10 ms** **Δta=5 ms** **Δz=50 km**	**Δt=4 ms** **Δz=50 km**	

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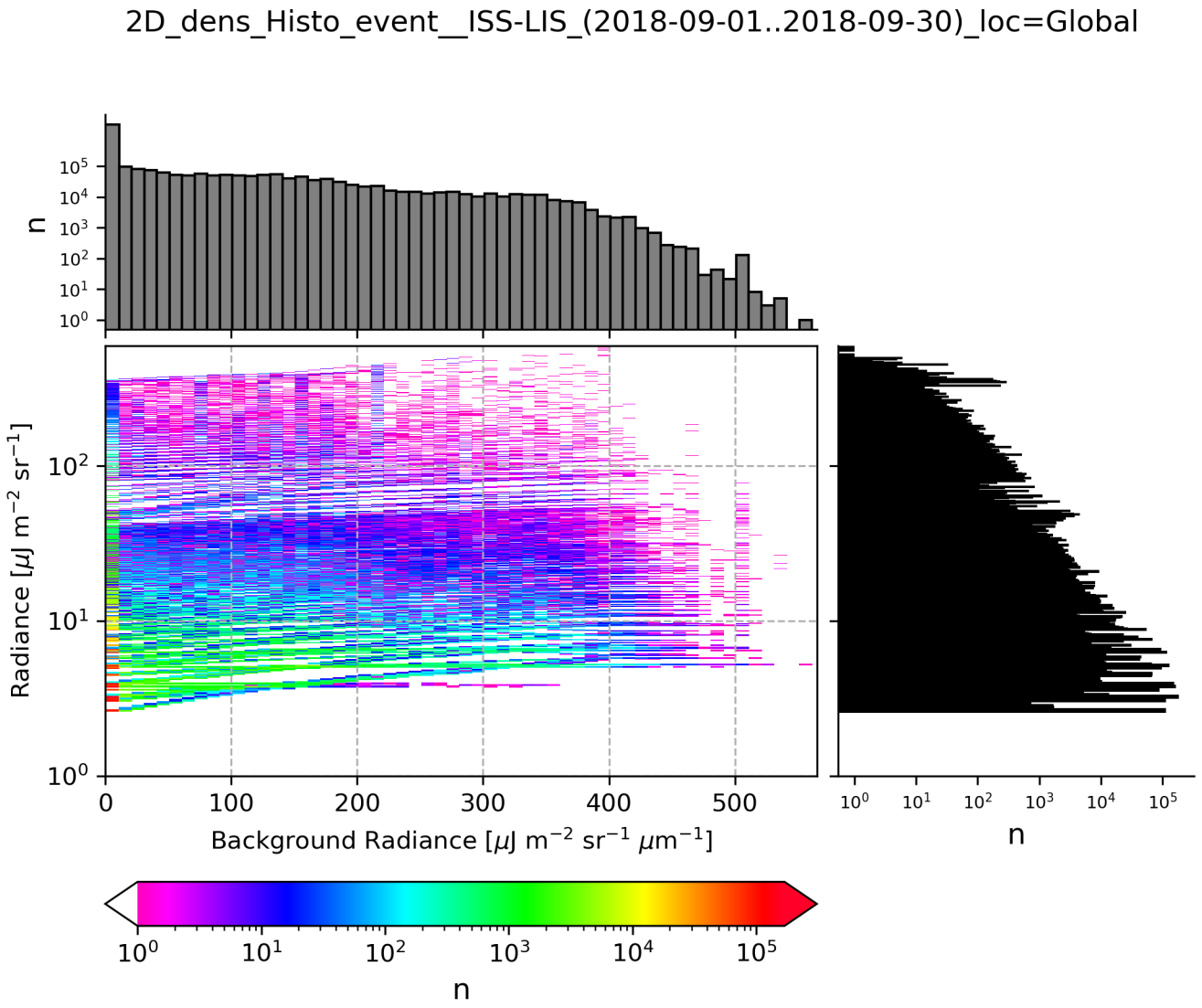
The current flash matching parameters

Reference network	Test network				
	ATDnet	EUCLID	GLD360	GLM	ISSLIS
ATDnet					
EUCLID					
GLD360				**Δt=200 ms Δz=50 km**	*Δt=200 ms Δz=50 km*
GLM			**Δt=200 ms Δz=50 km**		*Δt=200 ms Δz=50 km*
ISSLIS			*Δt=200 ms Δz=50 km*	*Δt=200 ms Δz=50 km*	

- ATDnet does not provide flashes, only pulses/strokes are available.
- EUCID does not provide flash duration.
  - Could only do *group matching with extended time window* type of very primitive flash matching.

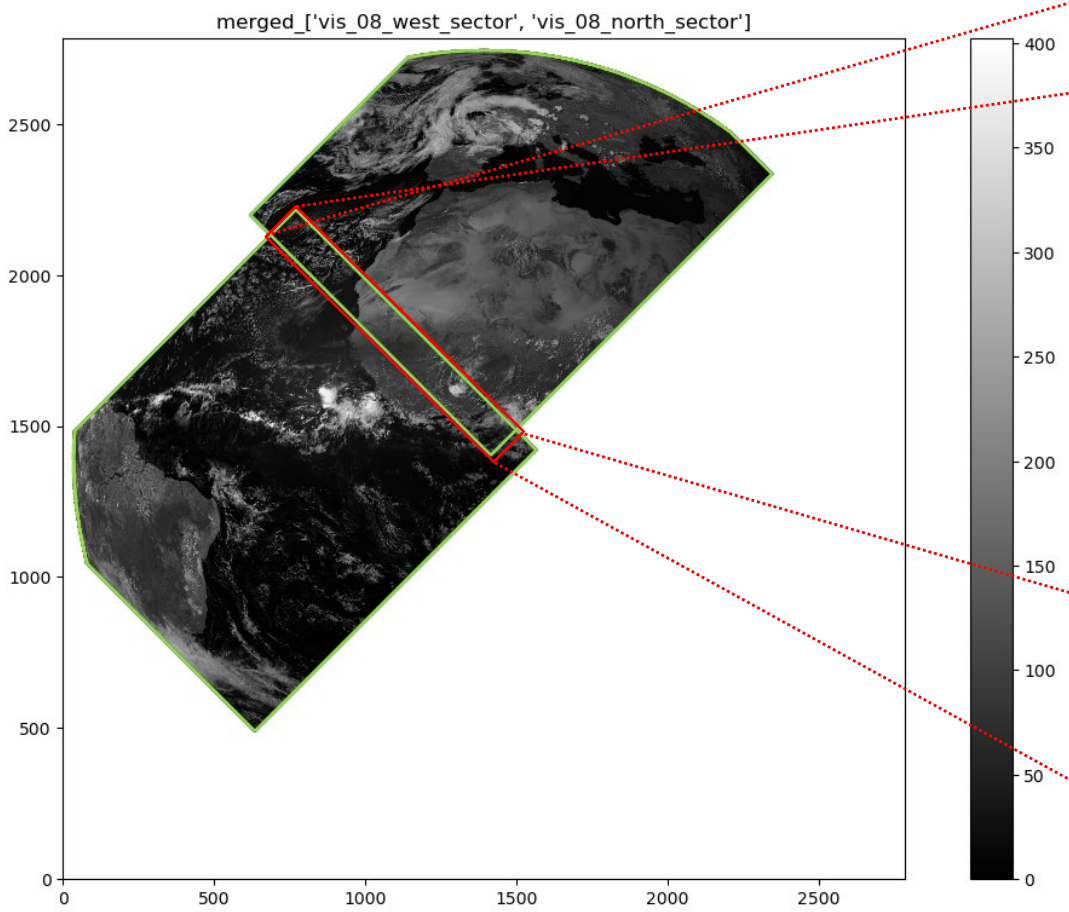
LI-STAR additional capabilities I

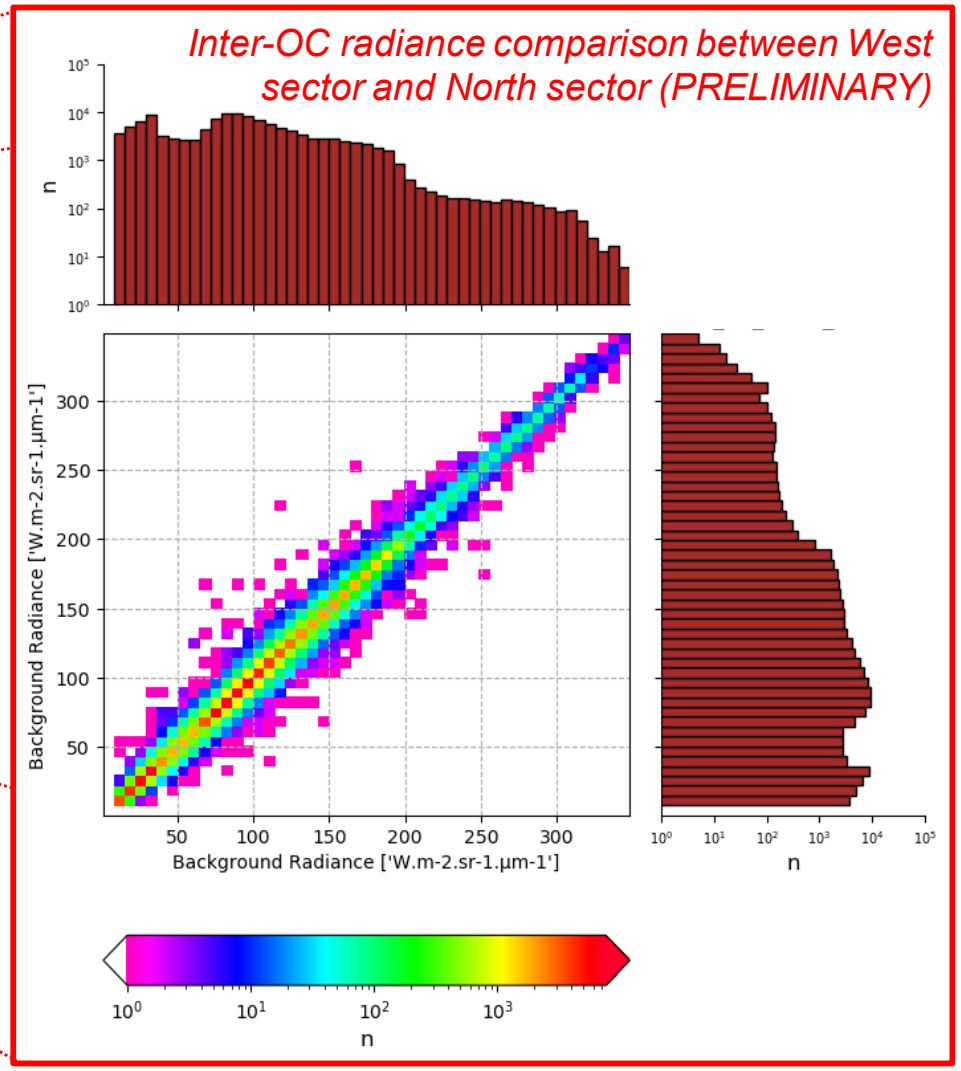


Monitoring event radiance vs background radiance. In this example using ISSLIS event information.

LI-STAR additional capabilities II

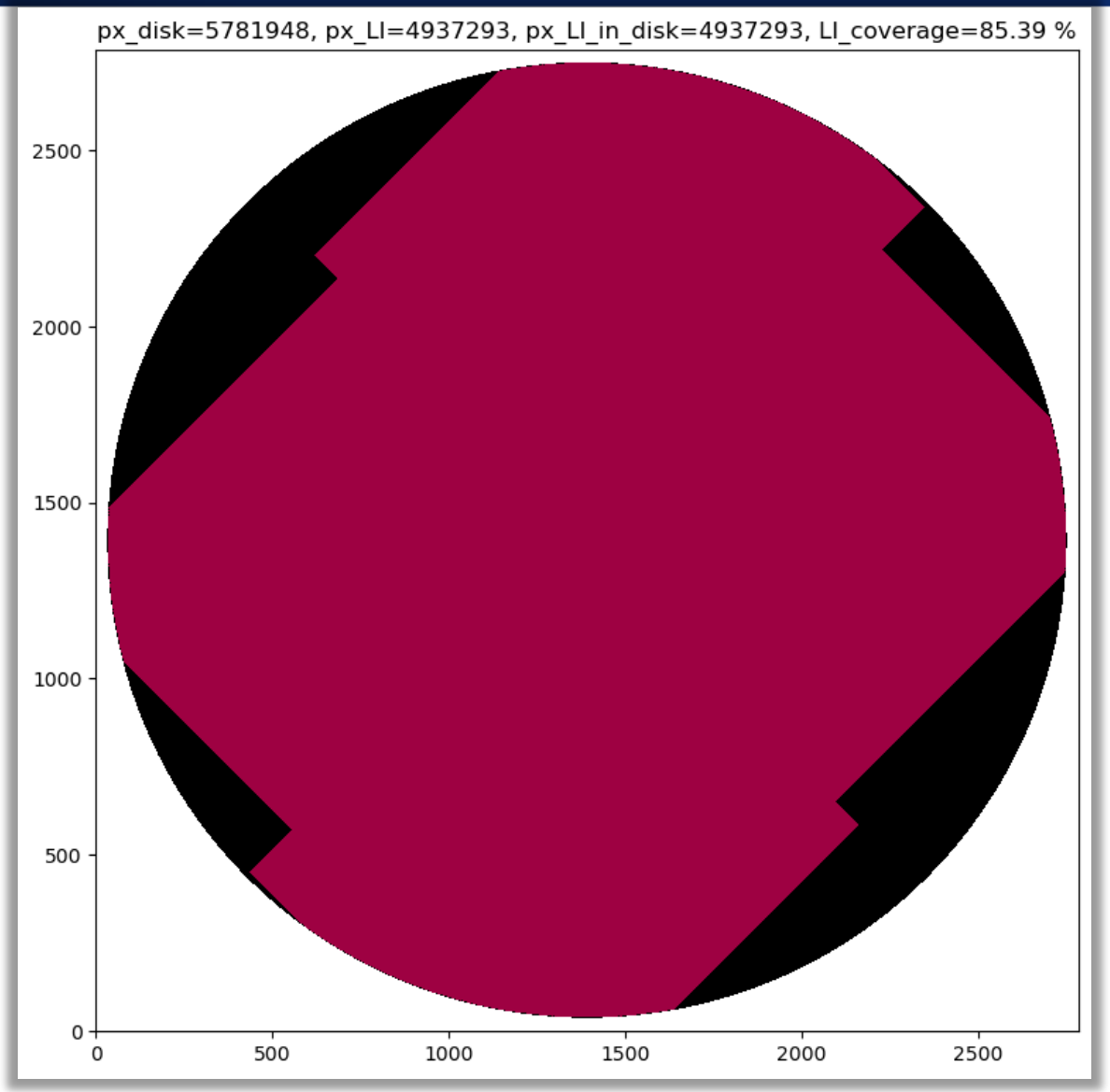
Monitoring of both radiometric and geometric performances





LI-STAR additional capabilities III

Monitoring the coverage against geo disk and against the member states



MISSING INFORMATION

- The LMA data over the US to compare against GLM.
- The description of the FOV of the LMA networks.
- Time information description in UTC (all external lightning datasets).
- Is GLM with photo travel time correction available for 09/2018?