Preliminary Evaluation of the Real-time Lightning Jump Algorithm

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Ongoing and Completed Objectives of the National Field Test of the Lightning Jump Algorithm (LJA)

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- Implement and refine a **fully automated, real-time and objective** storm tracking and LJA system for operational evaluation
- Conduct extended field tests of the real-time LJA system using total flash rate from Lightning Mapping Arrays (LMAs)
- *Preliminary evaluation of the 2013 field test with an emphasis on a direct comparison to the **research study of Schultz et al. (2011)***

Ingredients of the LJA evaluation performance

3 LMA's (OK, N. AL and DC)
~130 storm days (April-August 2013)
>7,000 WDSS-II tracked clusters
Ground severe weather reports (NOAA/SPC)

Lots of patience and data analysis

LJA's Lexicon

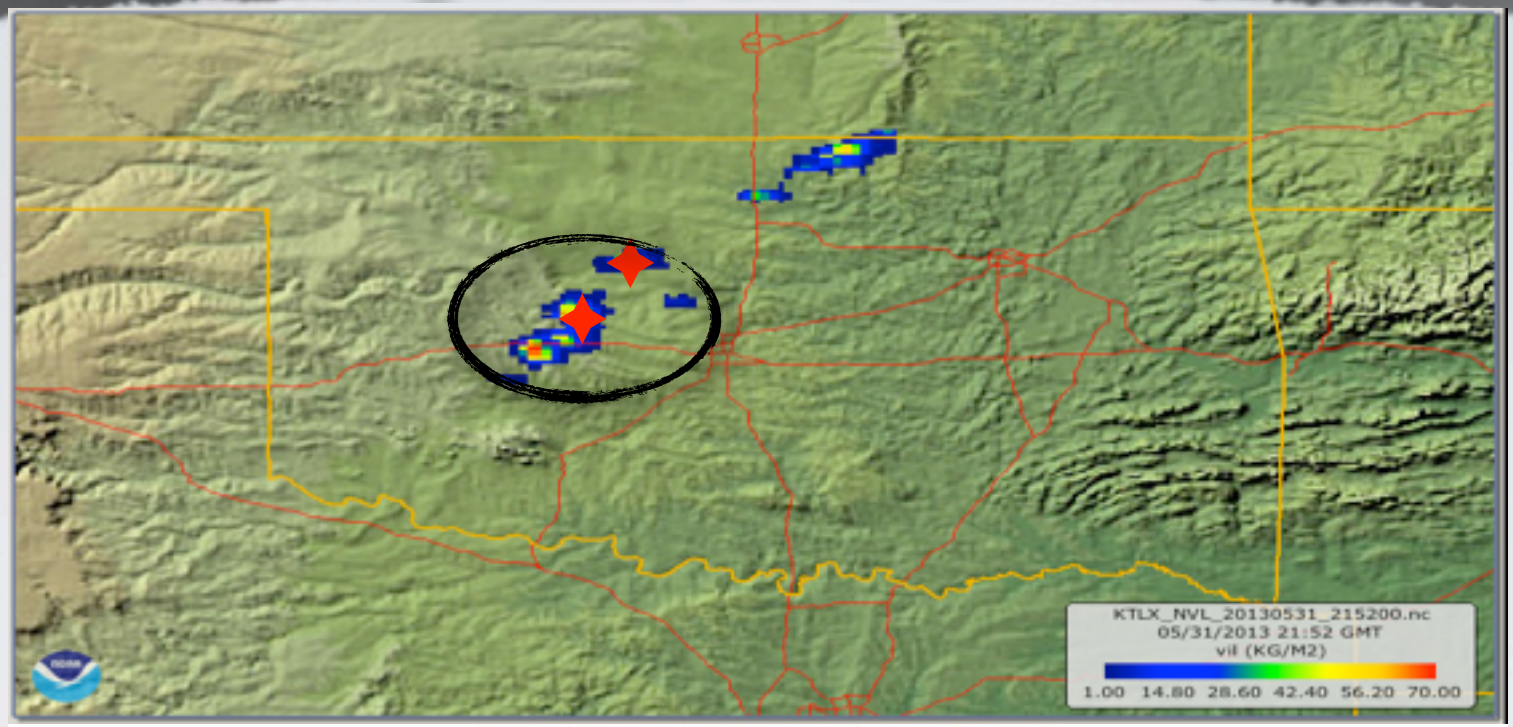
Lightning "jump": 15 minutes total flashes (LMA), computation of df/dt, exceed ***sigma*** 2.0 σ | ***flash rate*** > 10

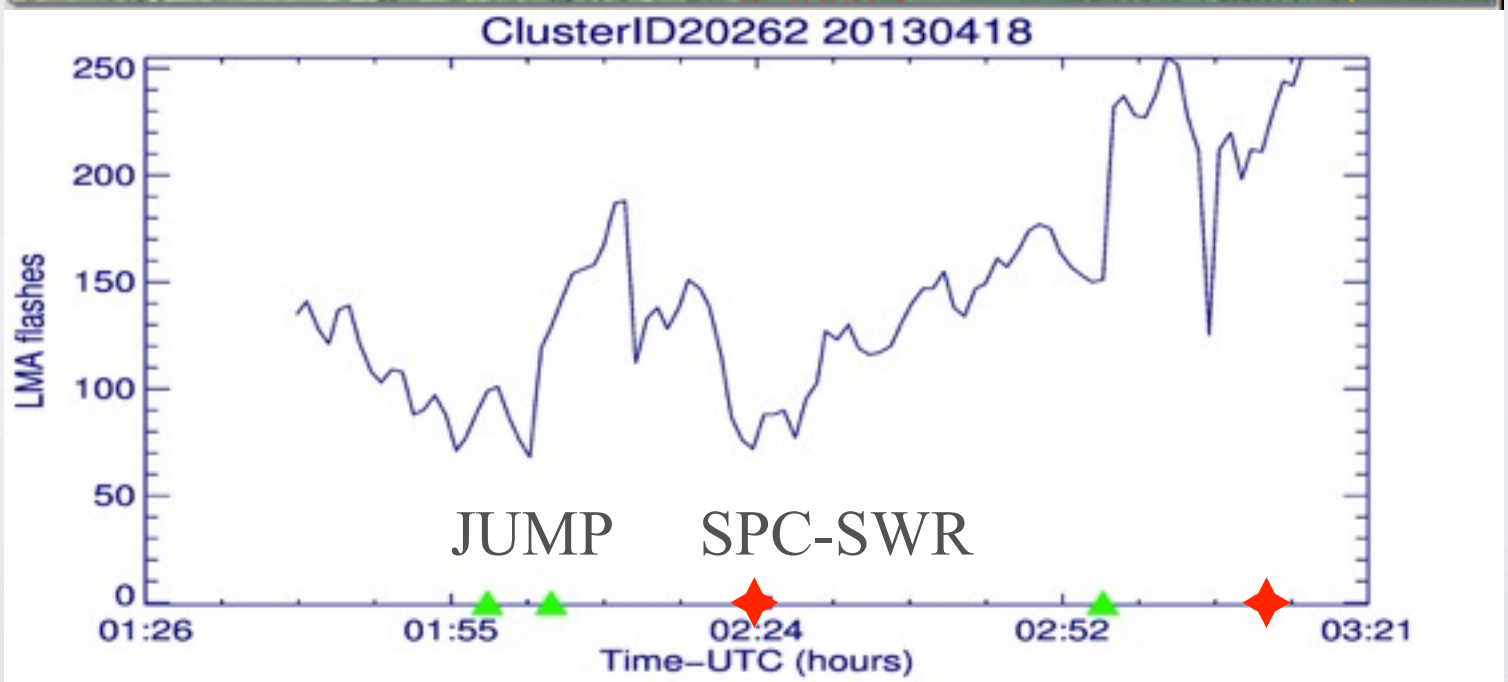
Cluster: an "object" consisting of a set of lat/lon points which have common statistical properties (WDSS-II, K-means)

Severe weather reports (SPC-SWR): NOAA-Storm Prediction Center (gust, hail, tornado)

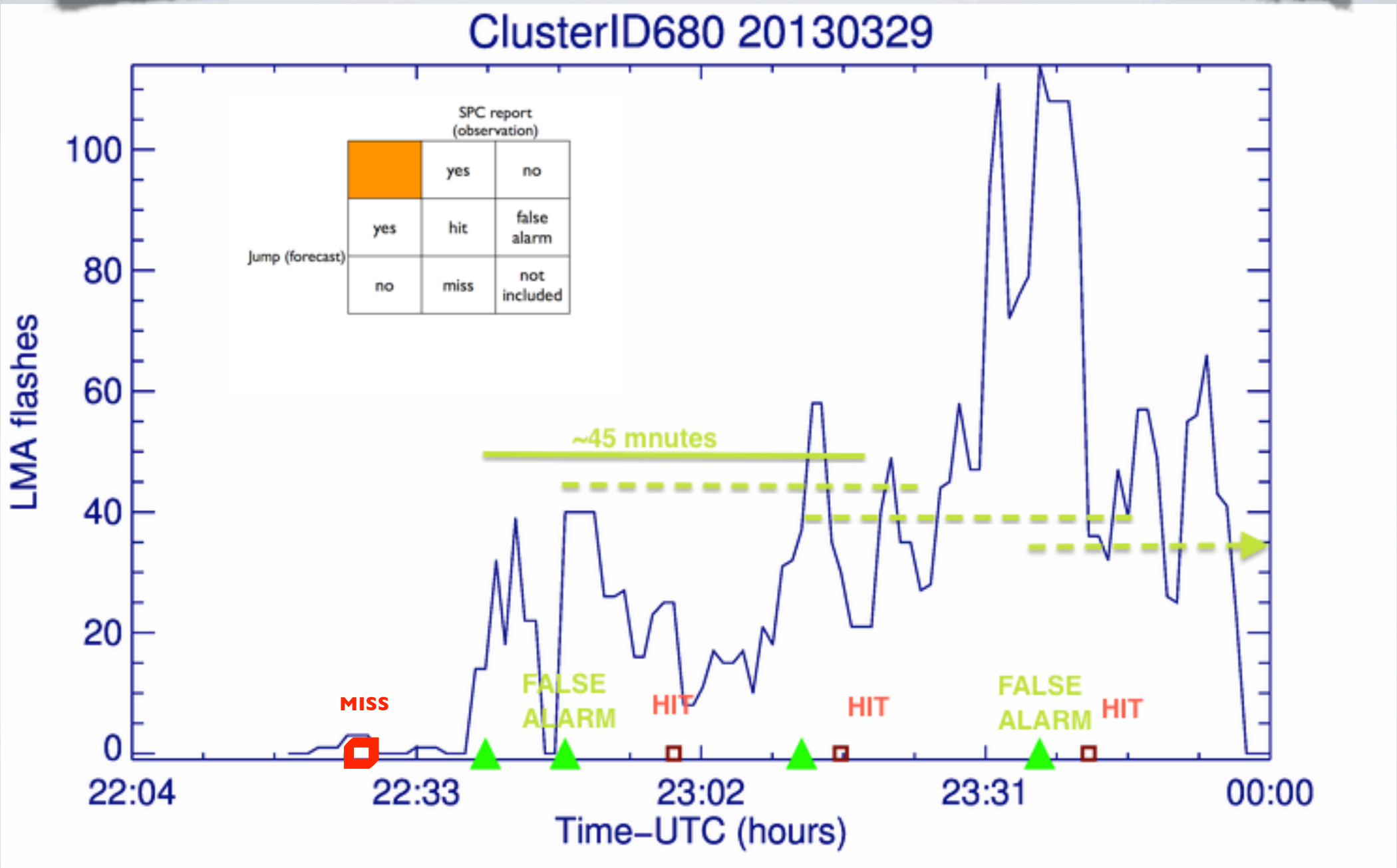
SPC-SWR-cluster matching: the spatial/temporal difference between the SPC and a footprint pixel <5km/ 10min

Jumps and SPC-SWR





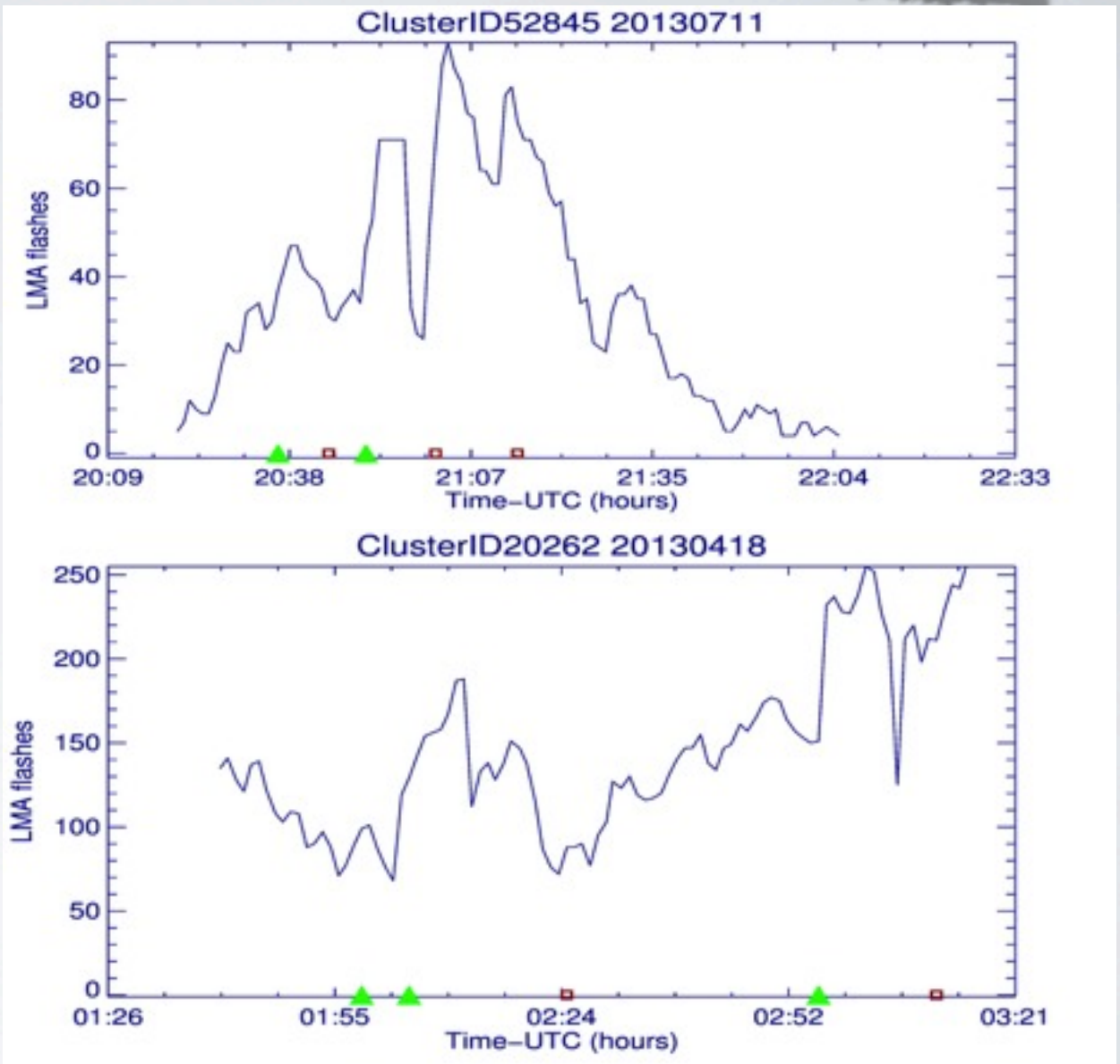
POD-FAR calculation



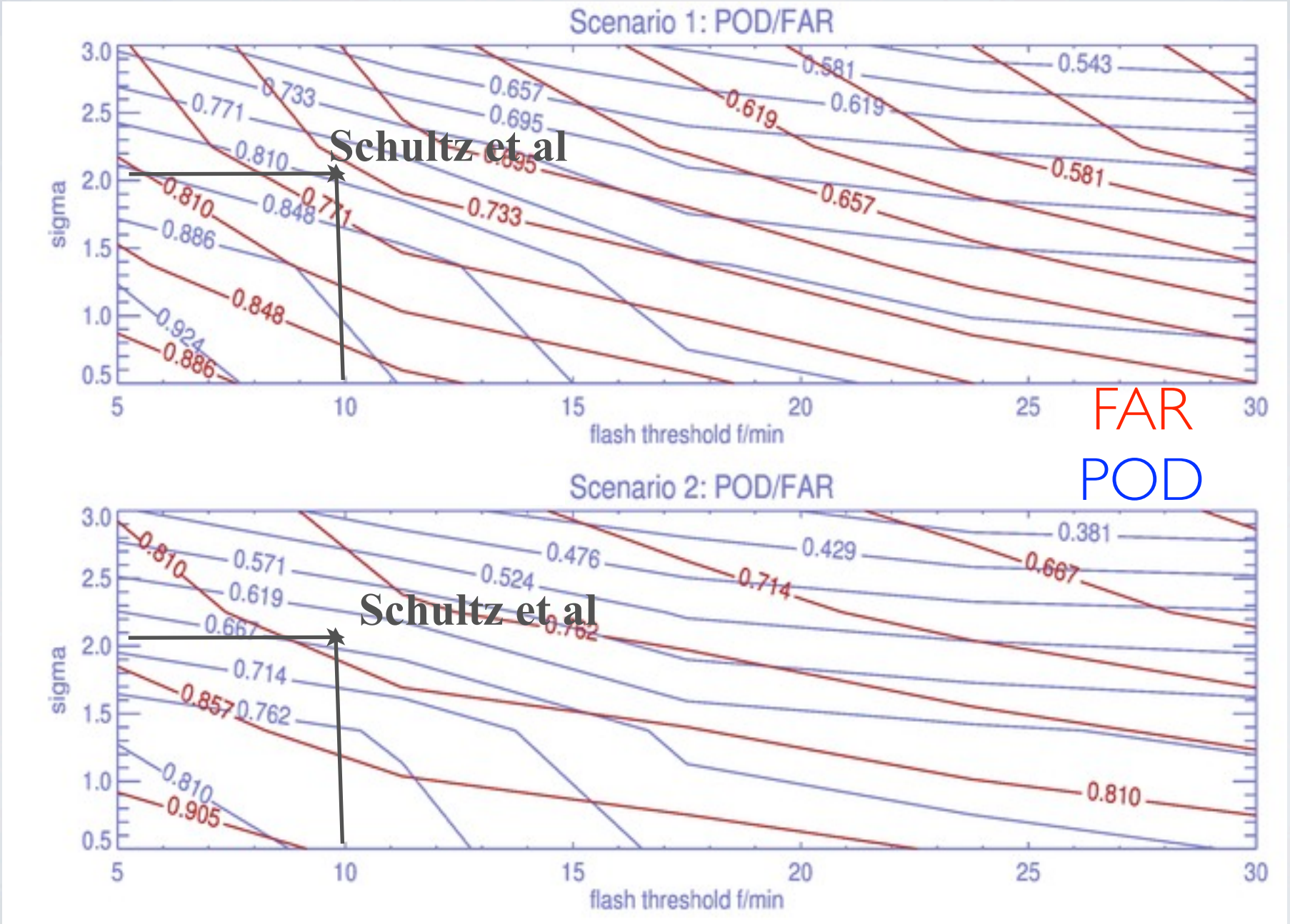
QC

Scenario 1: only clusters which are initiated or end at a "low" flash rate" are included

Scenario 2: all clusters included, no matter what the "suspected" tracking efficiency may be



POD-FAR vs. Schultz et al.



Assessment vs. Schultz et al

Depending on the Scenario, POD and Lead Time remains in the **>65%** and **25-26 min** range**,** consistent with the previous studies **while FAR is significantly deteriorated** (75-80%, as compared to 35-40% in Schultz et al). The fact that cluster track is an automated process ***is believed to be one of the reasons (closer to Scenario 1)***.

But is that all? Is in fact LJA useful in severe weather nowcasting?

(e.g. FAR<75% and POD>65%)

LJA "tuning"

FAR and POD evaluation shows improved values

IF

actual severe weather exists

e.g. in this study, more than 70% of the SPC-SWR occurred

over OK alone.

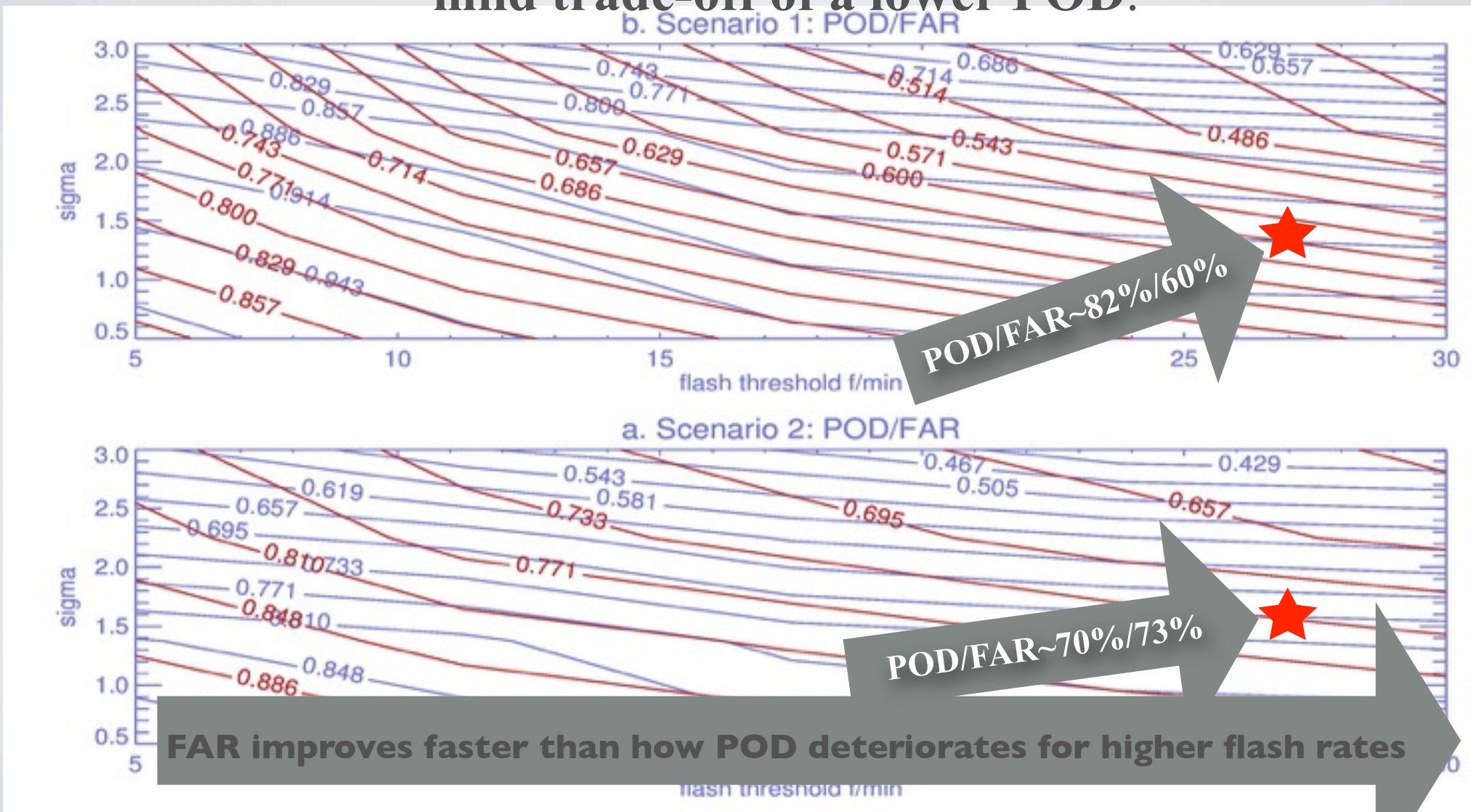
FAR and POD are computed as 65% and 61% respectively.

Therefore, ***sample size has a substantial effect of the LJA statistical evaluation***

(note: Shultz et al studies, the ratio of severe vs. non-severe weather was higher than this study)

LJA "tuning"

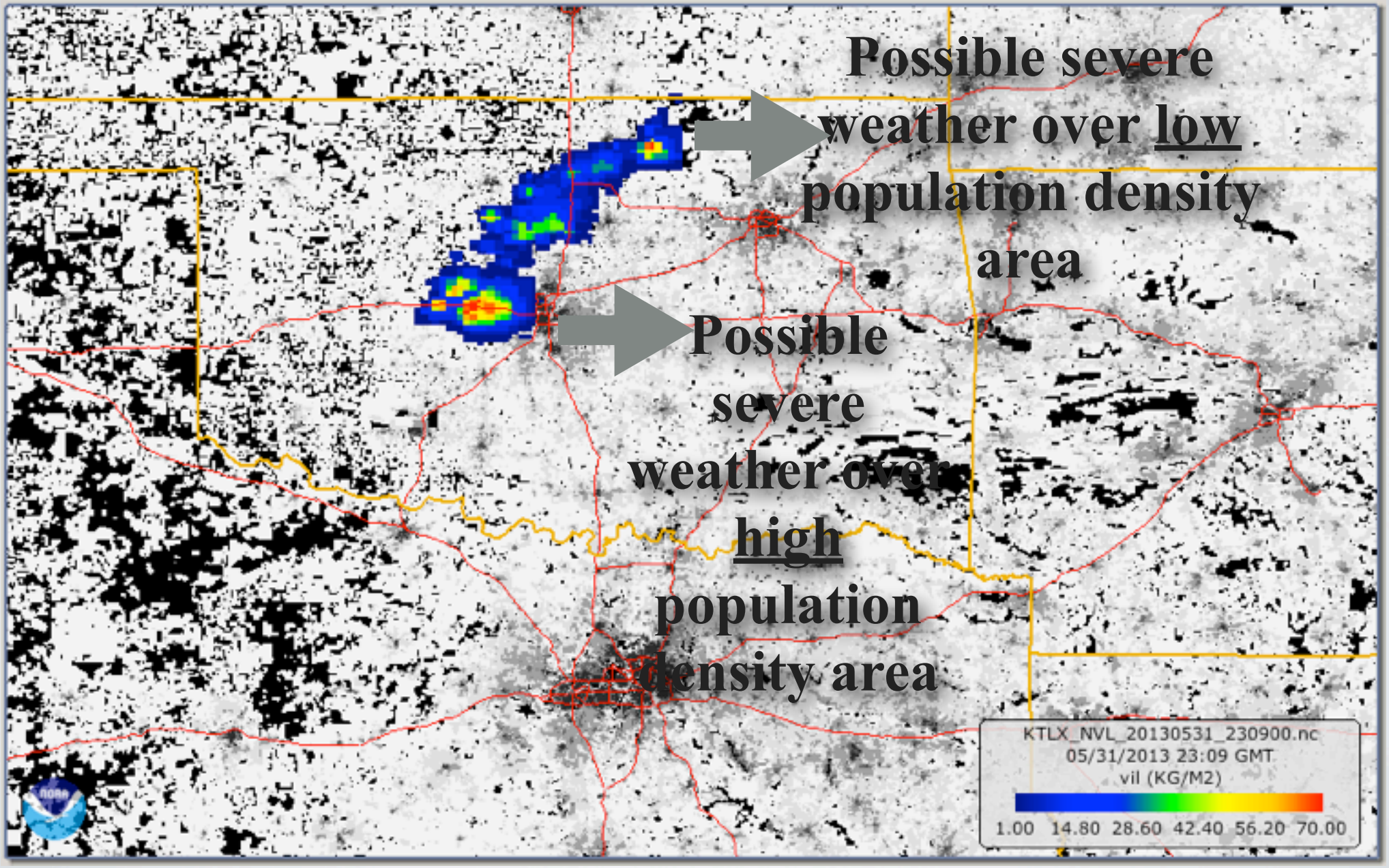
Employing **higher flash rates** (as a kickstart to the LJA, originally set at 10 f/m) shows an **improvement of FAR, with a mild trade-off of a lower POD**.



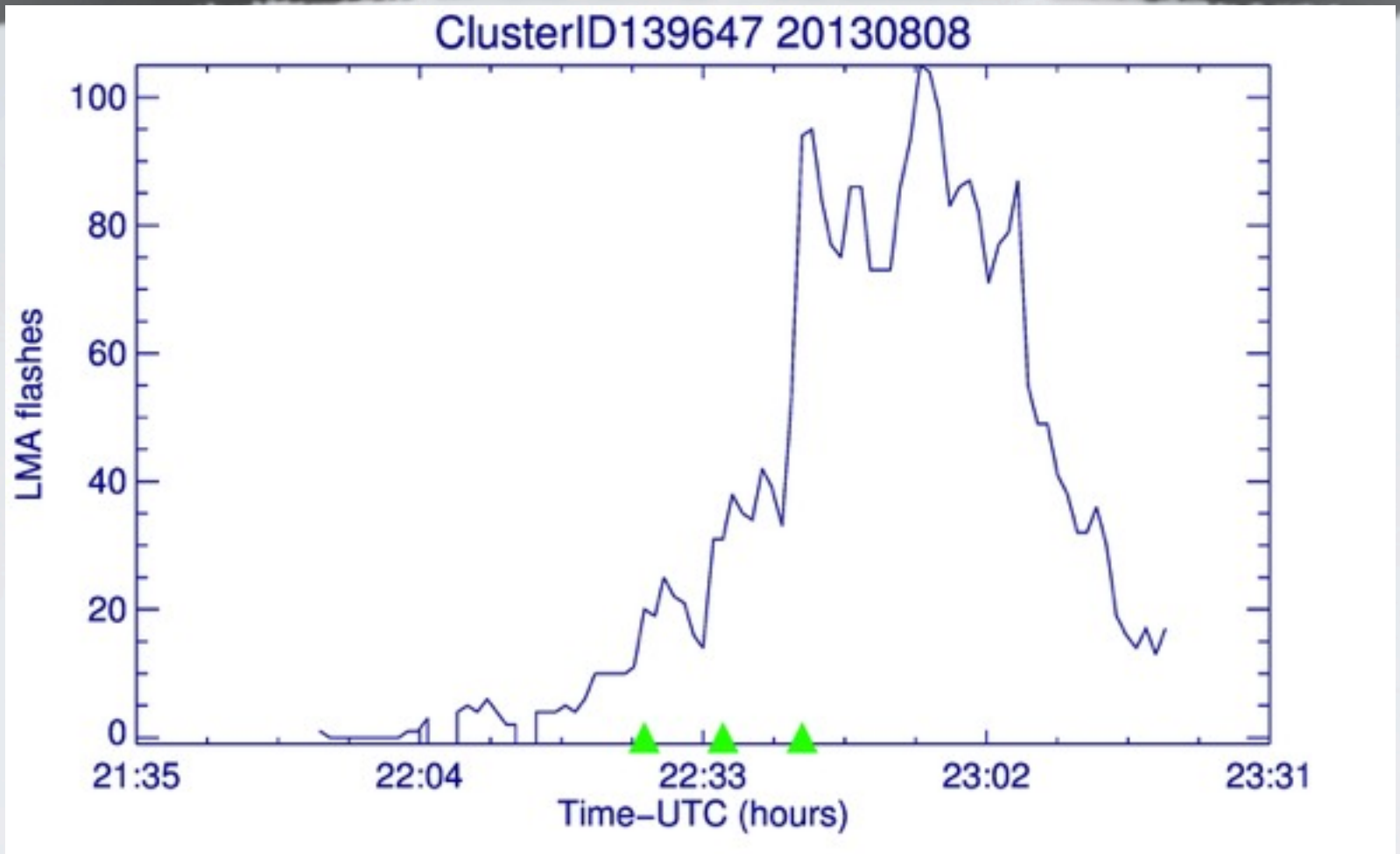
The False Alarm Ratio and the Heisenberg Principle of Uncertainty

"The position and momentum of a particle cannot be known at the same time..."

"The position and timing of severe weather cannot be accurately known throughout the LJA evaluation domain"


Possible severe weather over low population density area
Possible severe weather over high population density area
KTLX_NVL_20130531_230900.nc
05/31/2013 23:09 GMT
vil (KG/M2)
1.00 14.80 28.60 42.40 56.20 70.00

LJA's Evaluation Achilles Tendon



A substantial number of jump clusters "appear" severe based on high sustained flash rate AND/OR high radar MESH and yet match to NO SPC-SWR. The result is

a deteriorated FAR

Tackle the SPC-SWR discontinuum

Use population density is proven challenging since clusters maybe "crossing" between low/high population density areas. Other approaches are:

Under the assumption that 1) clusters with jumps and **sustained flash rate>50 f/m** and 2) clusters with jumps and **MESH values>25 mm** do NOT COUNT as false alarms (i.e. they did at some point produce severe weather, the **FAR is further reduced an additional 5-7%.**

For example over OK

FAR~58-68%

(depending on the Scenario)

Conclusions

DIRECT COMPARISON TO SCULTZ ET AL REVEALS THAT:

1. POD/LT are comparable

2. FAR is significantly deteriorated and this may be mainly attributed to a) the number of severe storms evaluated b) the subjective tracking methodology and c) LMA data quality

THIS REPORT FURTHER UNDERLINES

1. FAR can be optimized if higher flash rates and slightly lower sigma values are implemented

2. FAR will be always **dependent on the sample size of the evaluated storms**

3. FAR will be always **dependent on the tracking efficiency** *(i.e. Scenarios)*

4. "Removing" the uncertainty stemming from the SPC overall decreases FAR by ~5-7%

Looking forward to...

ENHANCED VERIFICATION

SPC reports can be a significant source of FAR. **Severe Hazards Analysis & Verification Experiment** (SHAVE) data will provide more continuity and accuracy in the overall statistics.

PROXIES

GLM, ENTLN for the “jumps” and Radar (MESH, VIL etc.) can be used at the same time as ground-based severe weather reports

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LMA DATA QUALITY

Implement data quality flags in real time

Enhanced Verification example

Harford Co, MD

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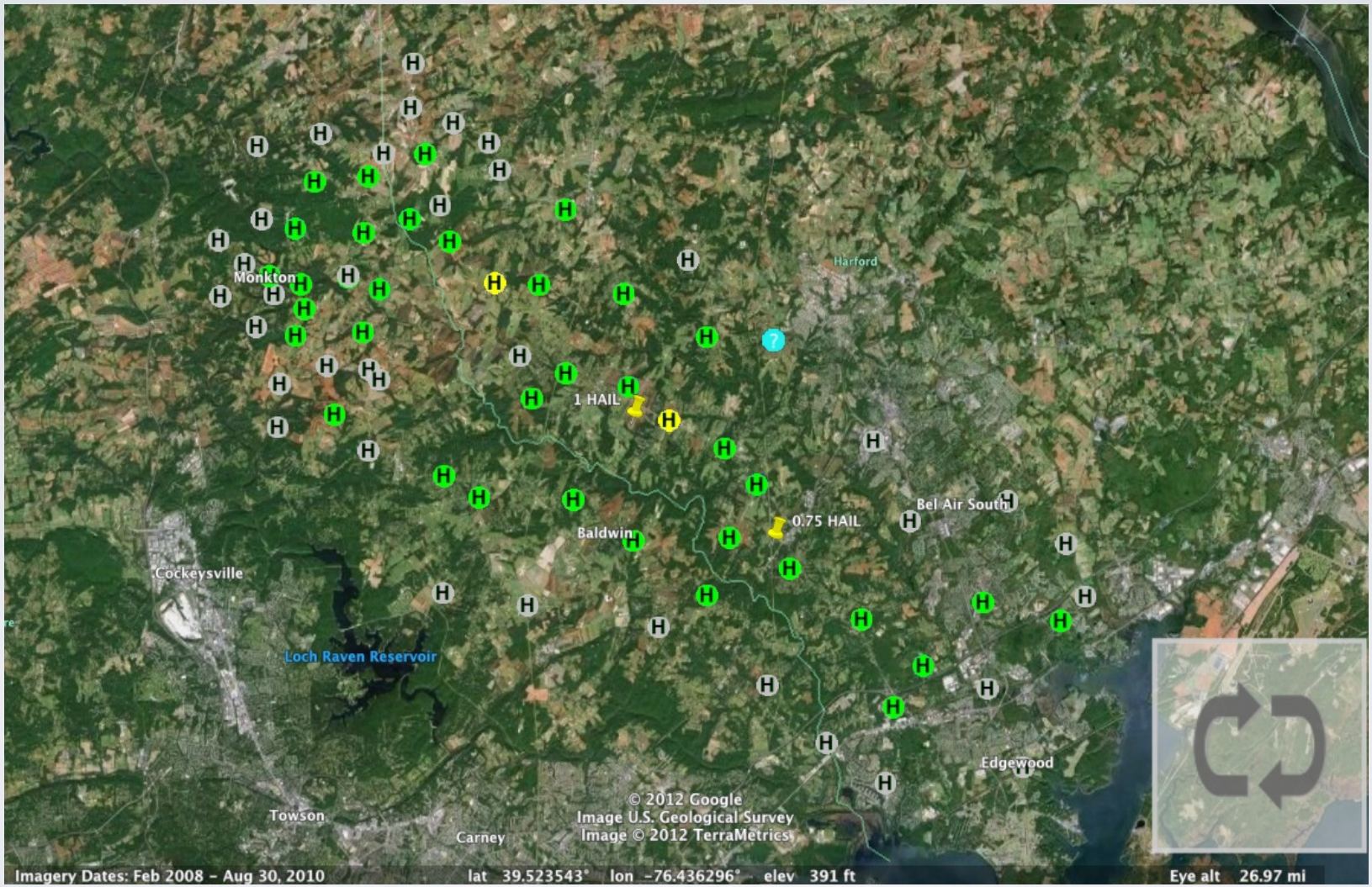
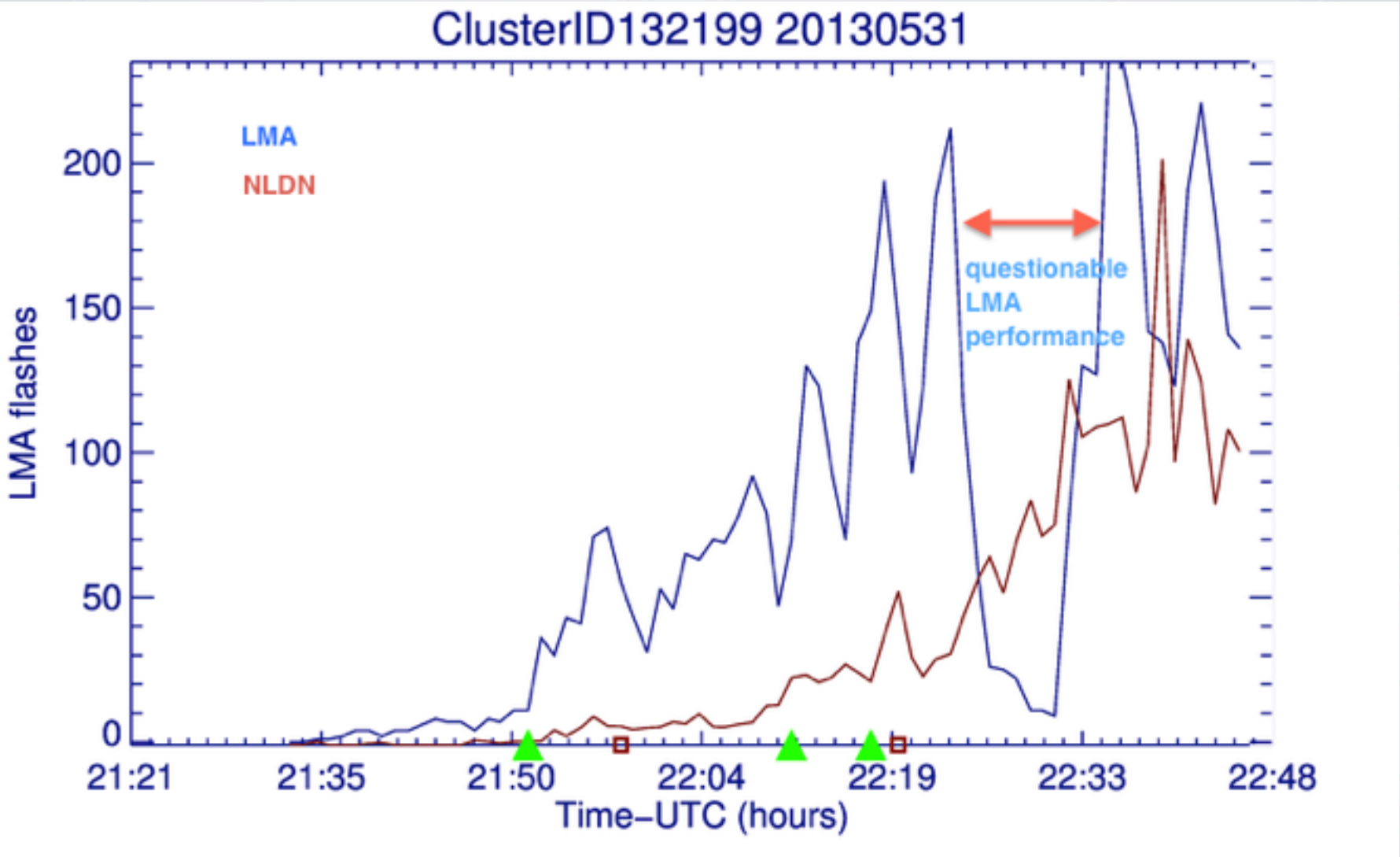


LMA data quality



This study would not be feasible without...

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