



# Chasing the white lightning during the Lake-Effect Electrification (LEE\*) project with the Doppler on Wheels

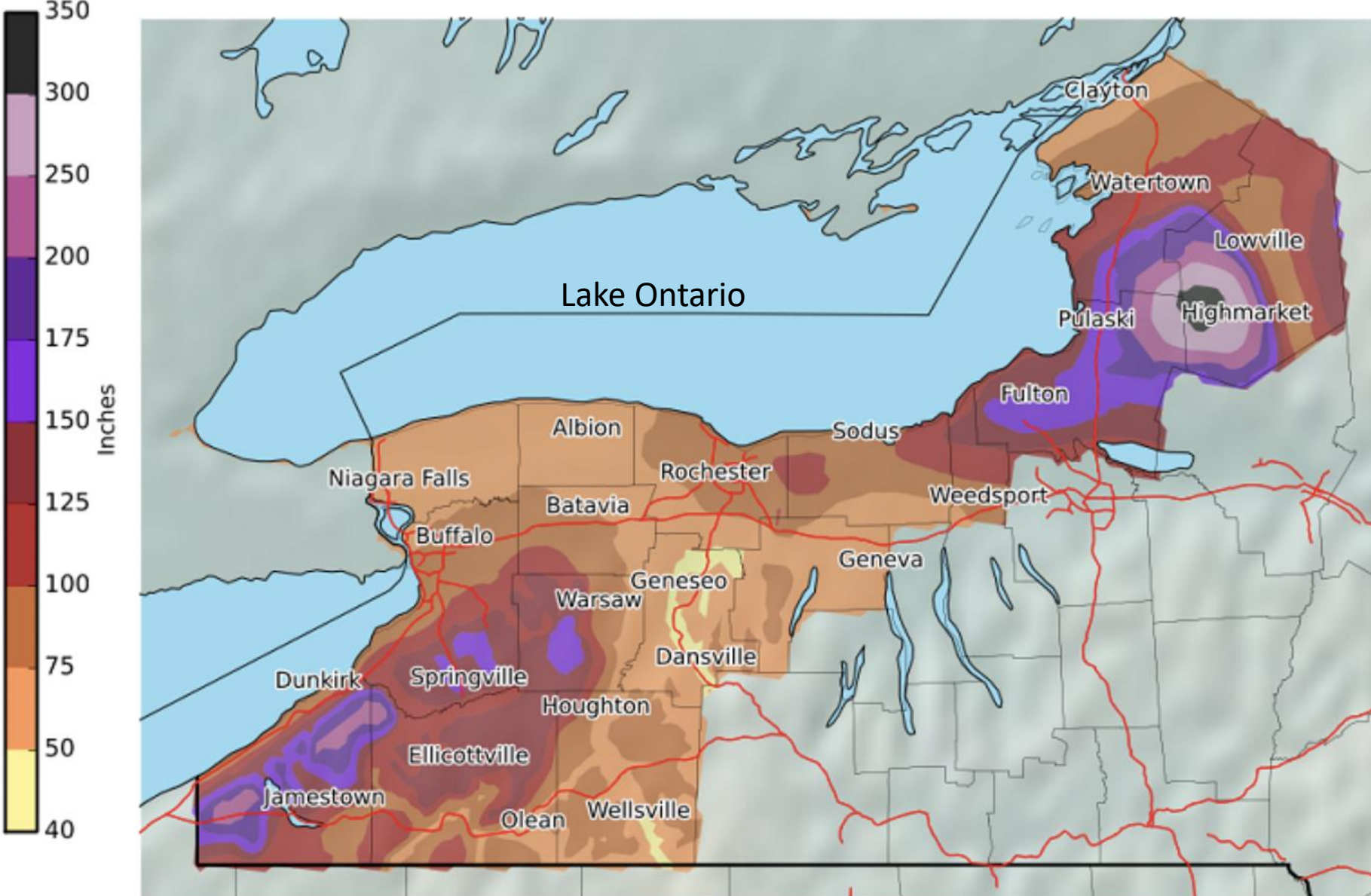
\*LEE Project sponsored by the National Science Foundation, FIRP-FARE Track 2 CIF program



Scott Steiger, SUNY Oswego,  
K. Kosiba, J. Wurman

### Average Annual Snowfall

Why LEE? Dependable, area-focused lab for winter electrification, easier to sample low clouds



# LEE Objectives

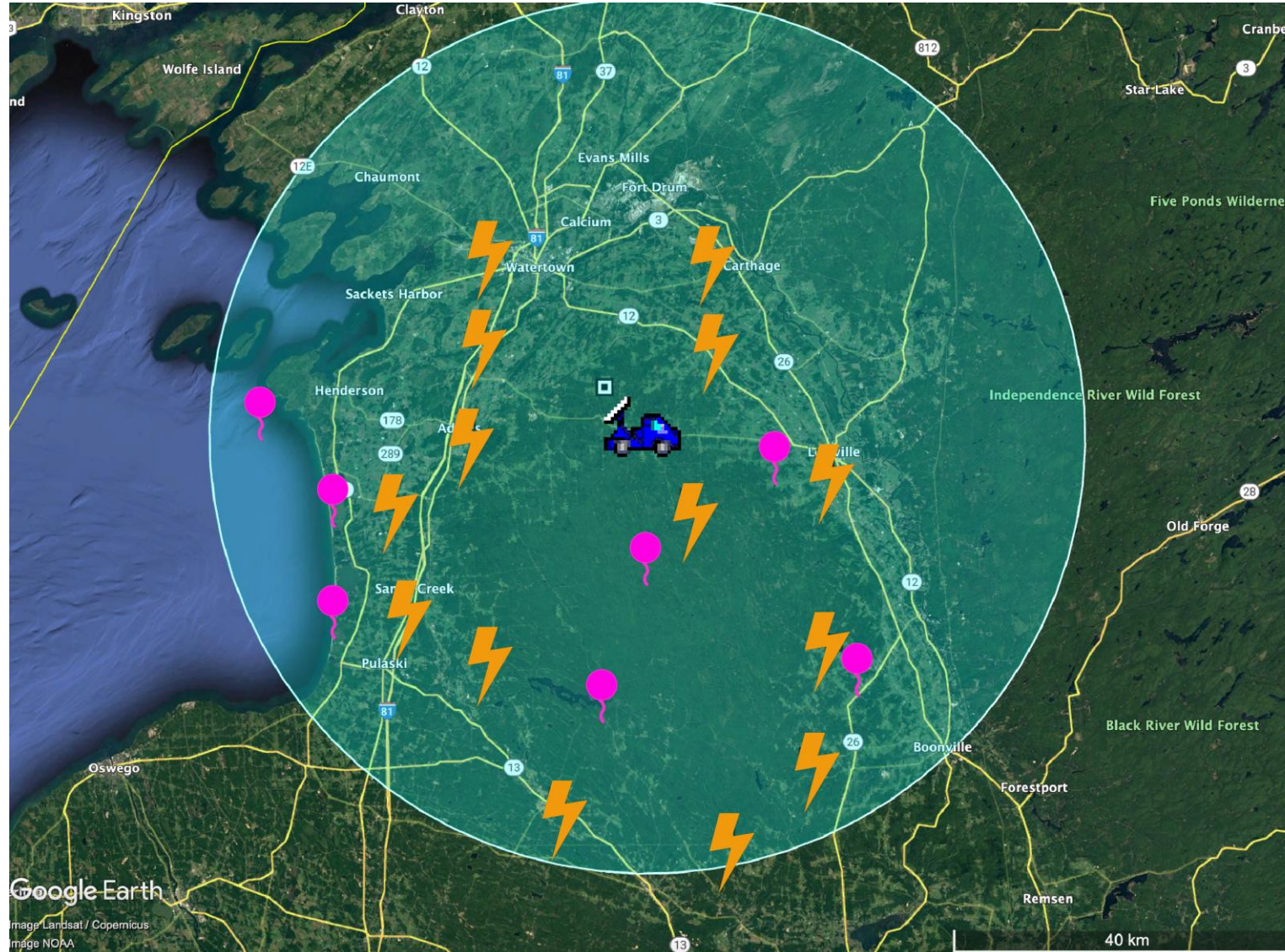
- For the first time, to document the electrical charge structure of lake-effect snow storms (surface-based convection to stratiform precipitation process), relate to hydrometeor (e.g., supercooled water, snow flakes) populations. (DOW integral)
- Improve the understanding of turbine-initiated lightning (~300 Tug turbines over 100 m tall!). This kind of lightning more likely during winter?
- Compare LEE findings with those from sea-effect (Japan), winter cyclone (e.g., Project IMPACTS) electrification studies.
- Determine flash sizes and energies of lake-effect lightning.
- Electrification modeling (e.g., WRF-elect)
- Overlap with IMPACTS Project, involve many undergraduates in the field (22)

# LEE Facilities & potential set-up

Bolts=LMA sensors, Balloons=sondes (inc. EFM's and PASIV), DOW truck

Georgia Tech and  
NSSL LMAs

DOW: Wurman  
et al. (2021)

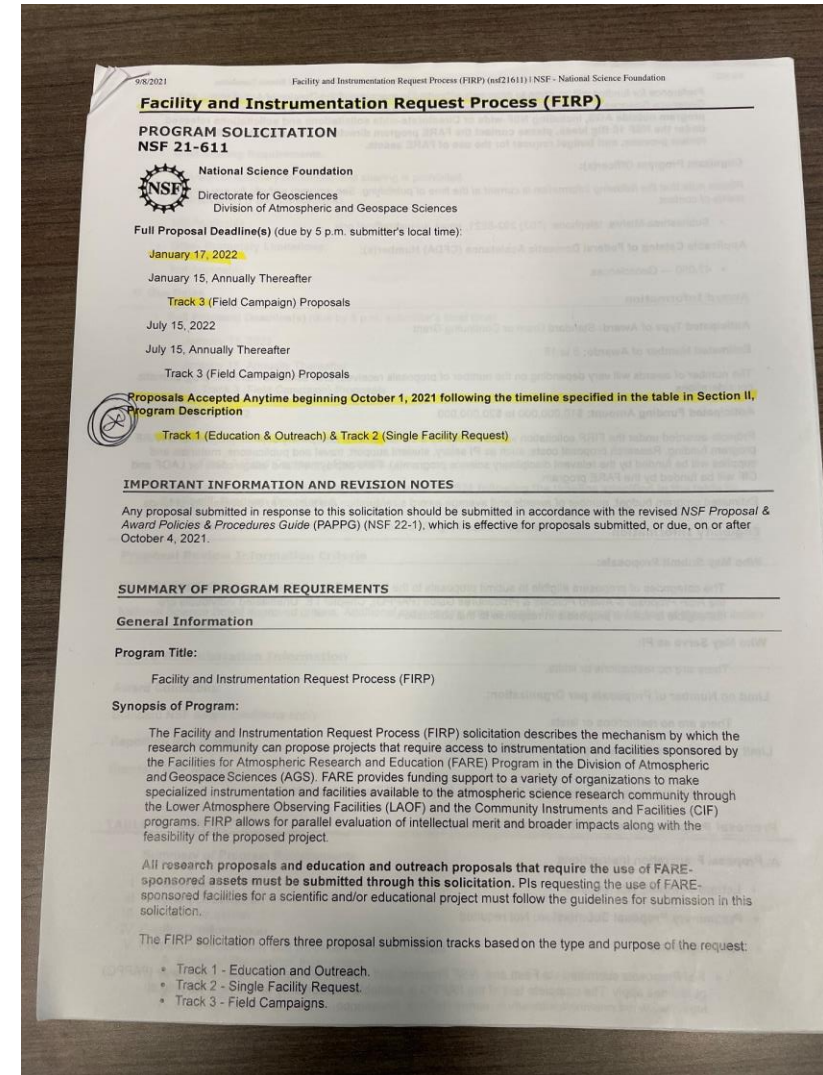


Environmental  
sonde Oswego;  
Hoped to do  
some over lake

Surface snow  
sampling teams at  
DOW and sonde  
locations

# Experiences with requesting a Doppler on Wheels (DOW)

- Subaward on a collaborative proposal (S. Steiger, E. Bruning, V. Chmielewski, J. Trostel, G. Stano); first time for me doing subaward process
- Shree, Josh and Karen big help as doing this via FIRP was new (to them and me!)
- Submitted Statement of Interest (SOI) mid-Sep 2021 (proposed project start Nov. 2022): 1 dual-pol, dual wavelength DOW
- Submitted full proposal Dec. 2021



new CIF awards are made. The list provides the names of point of contact (POC) for each LAOF/CIF.

the mechanism by which the atmospheric science co-sponsored by the FARE program.

capabilities, primarily undergraduate institutions, are especially encouraged to apply to the FIRP. For all future outreach efforts to broaden participation of

Statements of Interest (Sol) are recommended, but not required. Please follow the Sol instructions below.

Track 1 proposals should be submitted between 9 and 12 months prior to the start of the education and/or outreach activity, or at least 12 months prior to the start of the activity for aircraft-based proposals. If a Track 1 aircraft-based proposal intends to coordinate activities with a funded field deployment, the PIs must notify the FARE program director as soon as possible to allow enough time for coordination and planning.

Track 1 PIs should engage with the relevant Facility Provider listed on the FARE webpage during the proposal preparation process to ascertain facility availability and suitability for a Track 1 proposal. The Track 1 PI will submit a request for the use of the Facility to the Facility Provider with a copy to the FARE program director. The Facility Provider will be expected to provide a Facility Request Document with a Subaward budget that will be used in the Track 1 proposal. The Facility Request Document must be uploaded to the proposal as a Supplementary Document.

Track 1 proposals should be submitted to the FIRP Solicitation with FARE (1529) as the Unit of Consideration. Further guidance on proposal preparation is provided in Section V of this solicitation.

**Track 2 (Single Facility Request):**

If there is any ambiguity about whether a project belongs in Track 2, please contact the FARE Program Director on the same 24-month timeline as Track 3 (below). If a Track 2 proposal is submitted and NSF determines that it belongs in Track 3, it will be Returned Without Review (RWR).

PIs are required to submit a Sol via email to the FARE Program Director, with a copy to the relevant science Program Director, at least 15 months prior to the start of the research activity (not the proposed start date of the proposal). NSF will provide an email to the PI with the deadline information, and this email must be uploaded as a document entitled "FIRP - Program Officer Concurrence Email" in the Supplementary Documentation section.

Please follow the Sol instructions below.

Track 2 proposals should be submitted between 9 and 15 months prior to the start of the research activity.

Track 2 PIs should engage with the Facility Provider during the proposal preparation process to ascertain the facility availability and suitability for the proposed research. The Track 2 PI will submit a request for the use of the Facility to the Facility Provider and send a copy to the FARE program director. The Facility Provider will be expected to provide a Subaward budget and a Facility Request Document that can be used in the NSF proposal. The Facility Request Document must be uploaded to the proposal as a Supplementary Document.

Track 2 proposals should be submitted to the FIRP Solicitation with the most relevant science program as the Unit of Consideration. Further guidance on proposal preparation is provided in Section V of this solicitation.

**Track 3 (Field Campaign):**

2021

Facility and Instrumentation Request Process (FIRP) (nsf21611) | NSF - National Science Foundation

that are based on state-of-the-art pedagogical knowledge aimed at providing hands-on student training in field or laboratory based observational research, and/or provide significant public outreach through coordinated events. The total proposal cost must be under \$50,000.

An exception to the \$50,000 cap is allowed for aircraft-based educational deployments using the Wyoming King Air, and the NCAR-operated C-130 and G-V. Track 1 requests for the C-130 and GV may only be made in conjunction with an already-funded field campaign or planned test flights. Stand-alone Track 1 requests may be requested with the Wyoming King Air after consultation with the FARE program director.

ded field campaigns should include education and outreach in their original plans and not rely on Track 1 to augment the campaign. The focus of Track 1 proposals must be on education and outreach; projects with research components should be submitted under Track 2 or Track 3.

**Single Facility Request:** Track 2 proposals are for domestic research projects that require a single CIF or LAOF. All international collaborations with straightforward deployment requests may be requested for Track 2. PIs must consult with the FARE program director if an international deployment is requested under Track 2.

Track 2 activities including aircraft or a network of instruments, or multi-year deployments, are not eligible under Track 2. Track 2 activities include the use of laboratory-based equipment or a single mobile radar/lidar facility.

**Field Campaigns:** Track 3 proposals are for the deployment of major LAOF such as aircraft or a combination of LAOF or CIF. A proposal for a coordinated research campaign will fall under Track 3. Examples of Track 3 include research aircraft-based deployments, coordinated mobile remote sensing studies, and deployment of networks.

lines and process

ation and Outreach):

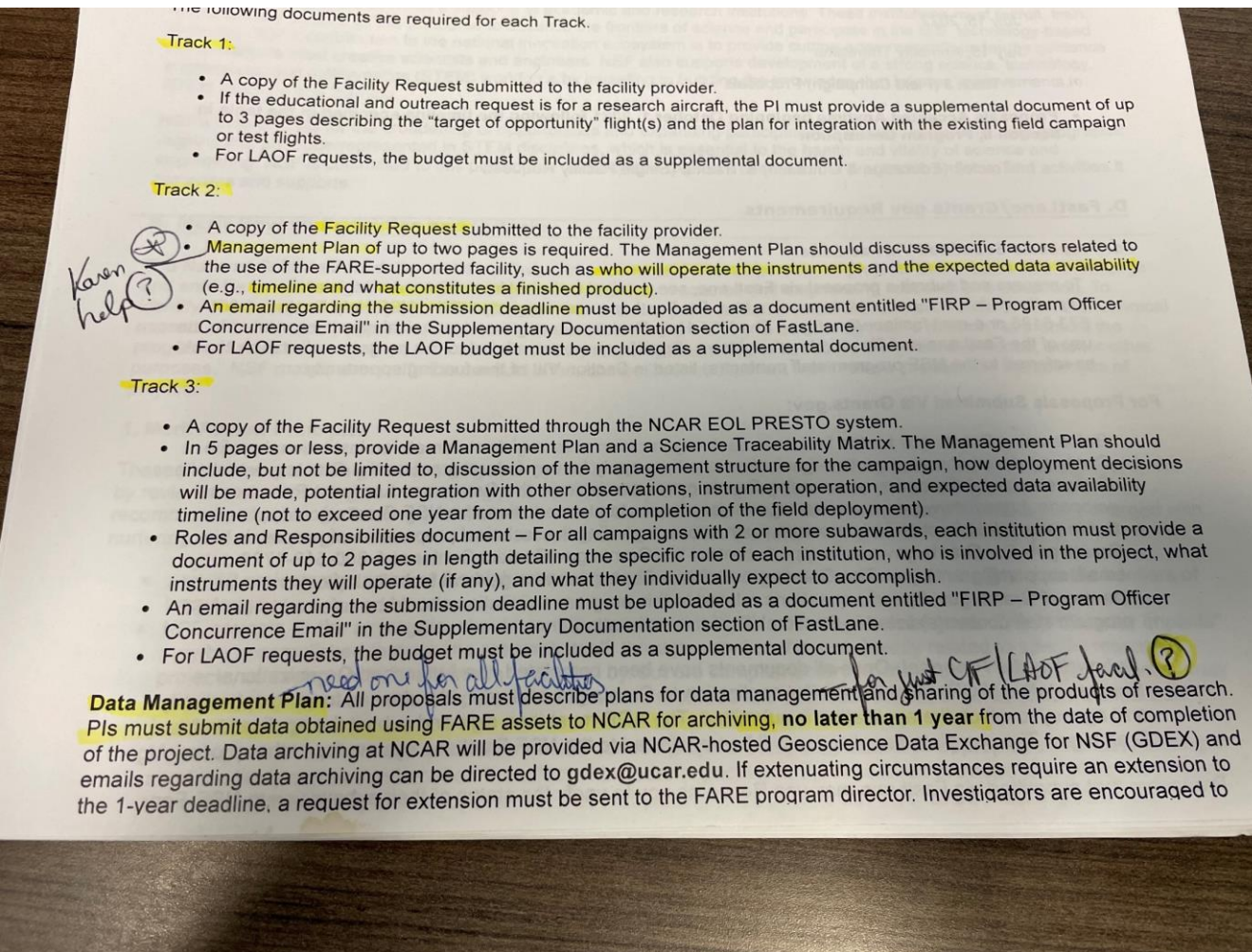
Interest (Sol) are recommended, but not required. Please follow the Sol instructions below.

als should be submitted between 9 and 12 months prior to the start of the education and/or outreach activity.

Track 1

Yes  
Shree also ask if track 2 ok when using other non-LAOF/LAOF CIF facilities like LMA

# Request cont.



- Data archival – NCAR EOL field catalog + long-term archival
  - Big shout-out to Greg Stossmeister, Carol Ruchti and Linda Cully for all of their help archiving all LEE data in one place!

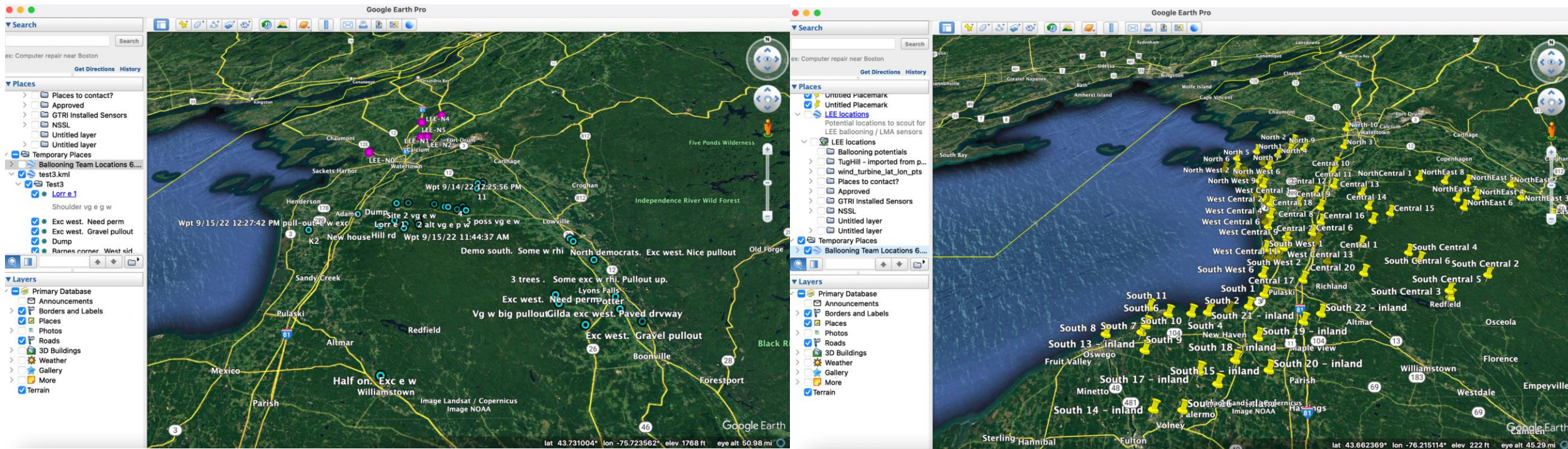
# Getting ready for LEE – Summer-Fall 2022

-Finding a garage to house the DOW: Watertown, NY airport

-Used OWLeS Project 2013-14 sites as first guesses, then Josh Wurman and Karen Kosiba visited October 2022; develop Google Earth file with notes, pictures taken as well

-Focus on RHIs

Students helped set up LMAs



Possible DOW sites & EFM launch locations, respectively



# Working with the DOW during the field project

- DOW part of LEE Project Open House 5 November 2022
- Daily weather briefings 1 pm EST from after Open House to early Feb. 2023
  - T-96 hrs. DOW team on STANDBY
  - T-72 hrs. book travel
  - T-48 hrs. GO/NO GO decision, teams begin travel
  - T-24 hrs. remote staff in study area
  - T-4 hrs. teams (DOW staff + Oswego student team of 2) depart local base; students needed 4WD vehicle + hotel some IOPs; do site prep
  - T-2 hrs. arrive at IOP site
  
  - The plan vs. reality...
  - Comms.: Zoom, Field Catalog, WhatsApp separate DOW IOP channel along with general LEE channel
  - Long deployments (>12 hrs) challenge



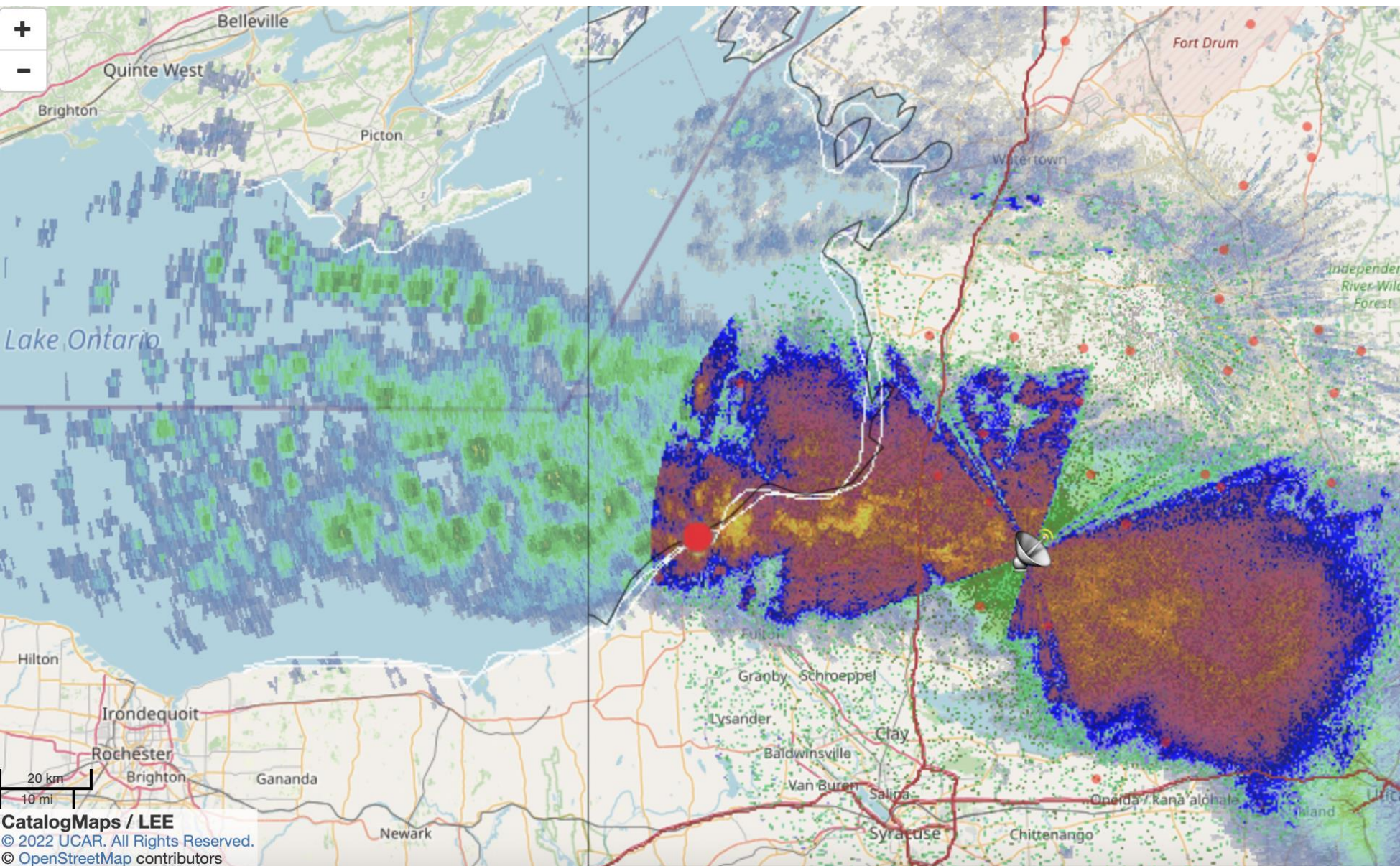
Open House pictures from in front of the Shineman Science Center, SUNY Oswego

# Field Operations time cont.

- Focus on RHIs along band (every 5-10° azimuth); Web quicklooks; DOW scanning defined IOP period
- Was this plan better than just having operators in field for entire IOP potential period (Nov – Feb, e.g., as during OWLeS 2013-14)?



Students help teams plow out location ahead of IOP. Photos: E. Caldon 1 Feb 2023



[CatalogMaps / LEE](#) ?  
 NCAR / EOL / DMS  
[Mobile Interface](#) | [Reset To Defaults](#)

**Time / Playback** ?  
 Mode: **Playback**  
 Map Time: **2022-11-20 17:14 UTC**  
[Reset to Latest](#)

**Time Step**  
 back | 1 minute | forward

**Date / Time Select**  
 November 2022  

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

 Hour: 17 | Minute: 14  
[Date / Time Select](#)

**Tools** ?

Example of real-time data on NCAR EOL's Catalog Maps used for situational awareness (KTYX and DOW reflectivity)

# Let's go do some field work (at night?!)

Student teams:

- DOW (2)
- EFM soundings (up to 16)
- Forecasters and launch Oswego sondes (2)

Before/after IOP: LMA sensor snow cleaners



# Slept in the office some nights...

I only live a 15 min walk from home, but some nights I forecasted until midnight and then had to give the DOW team a briefing by 4 am...



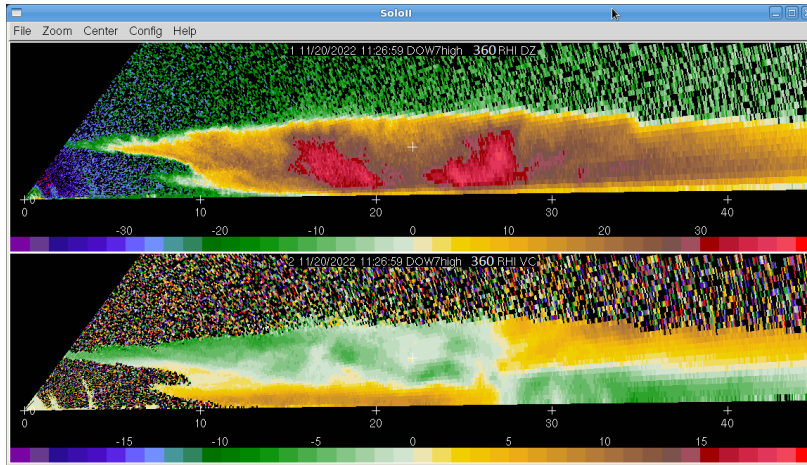
IOP10: 1 Feb 2023

# Safety key!

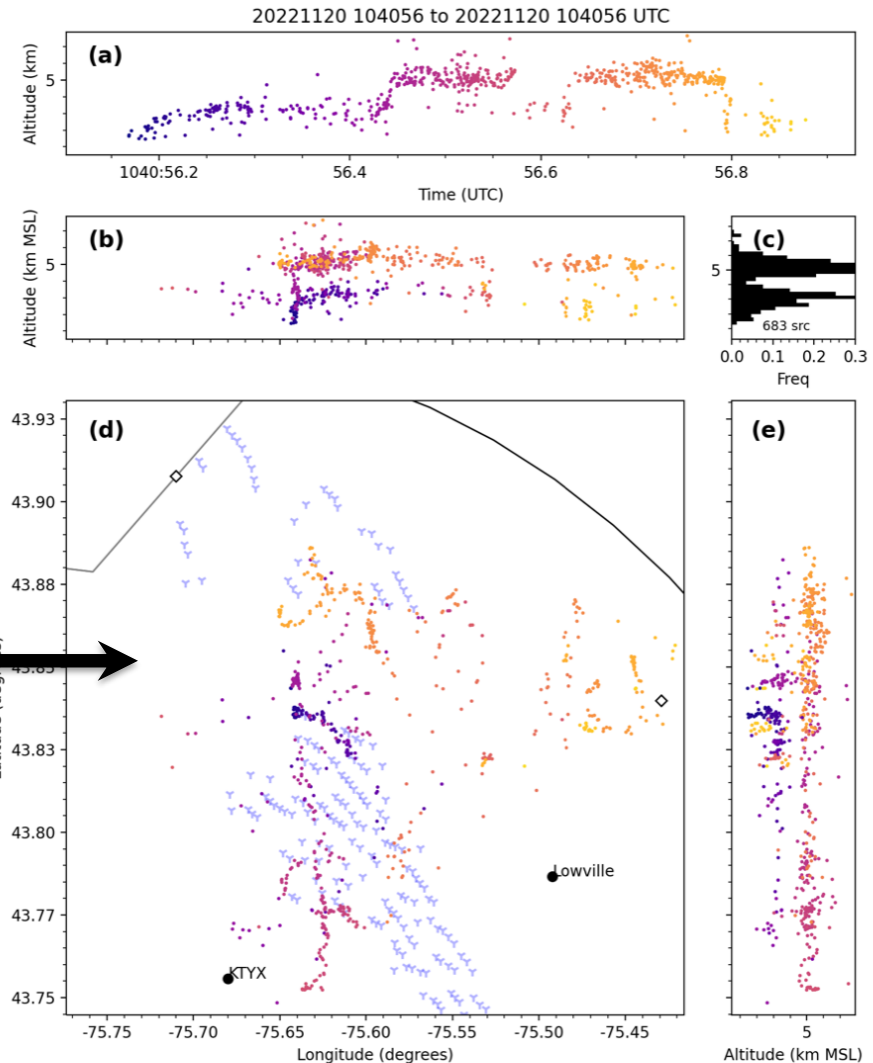
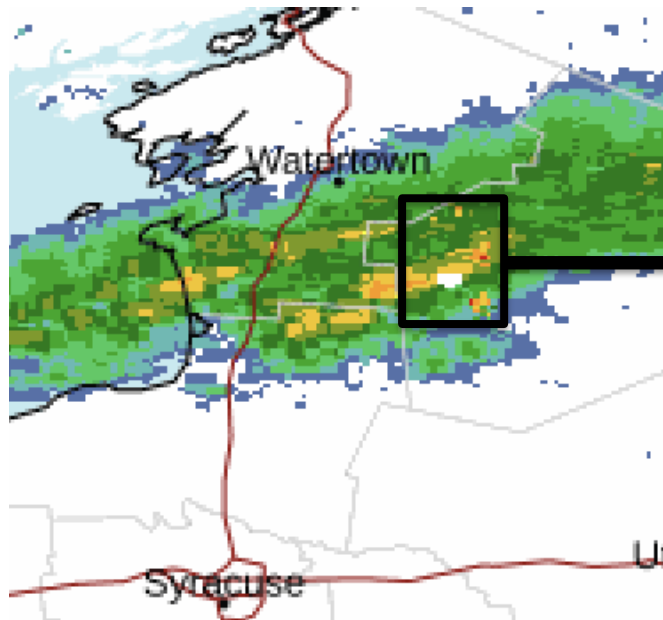


# IOP (Intensive Observation Period) 3: Single flash

1127Z DOW,  
Storm depth ~5  
km ARL. Image  
provided by P.  
Robinson.



KTYX 1041Z



Bi-level  
behavior as in  
Schultz et al.  
(2018)  
thundersnow  
study

# IOP3 cont.: 21Z

LMA points (white, see right) over DOW  
dBZ for flash hitting Oswego stack  
(below photo. From K. Jesmonth, SUNY  
Oswego, 2052Z)

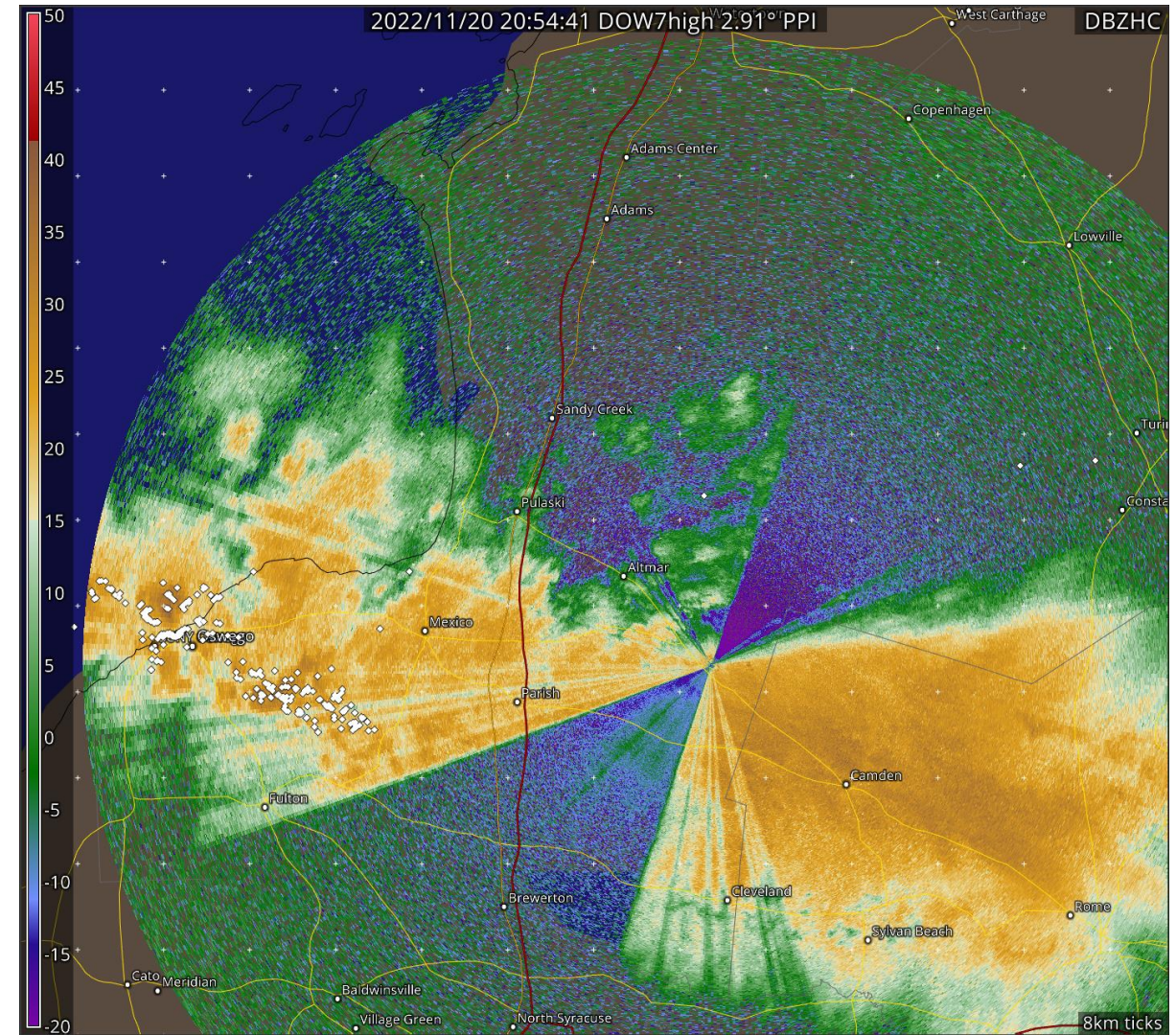


Image courtesy of Trevor White (U. Illinois)



# Huge Graupel IOP3!



Photo: Jake Rumowicz, SUNY Oswego

0.75" diameter

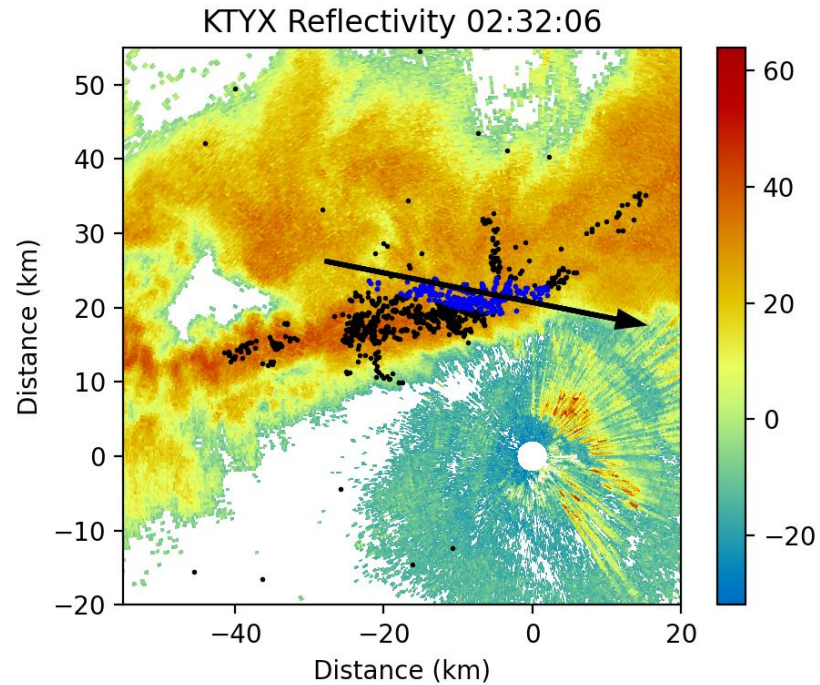


# DOW perspective

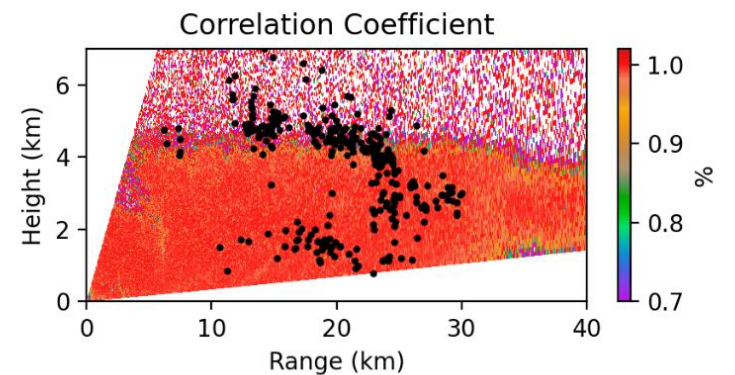
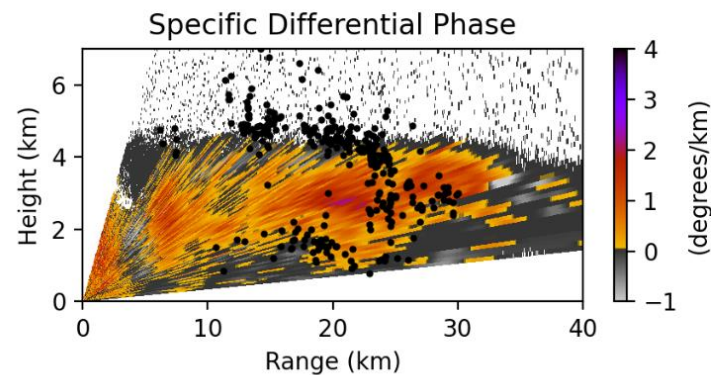
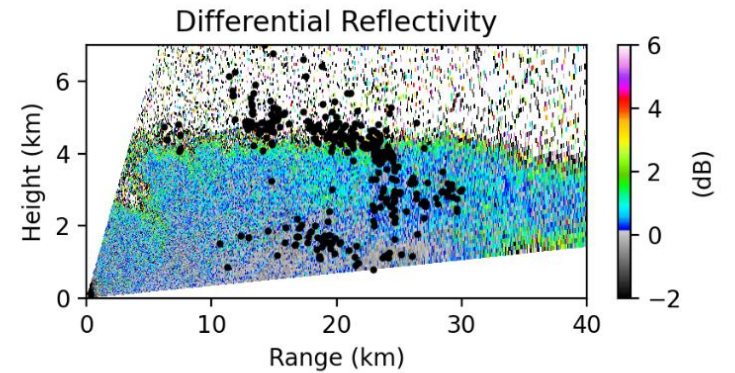
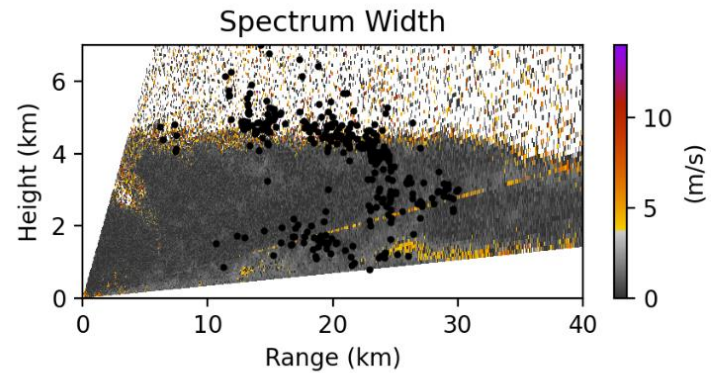
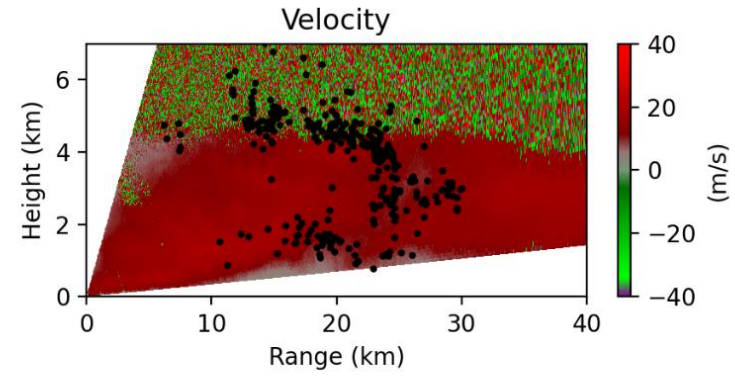
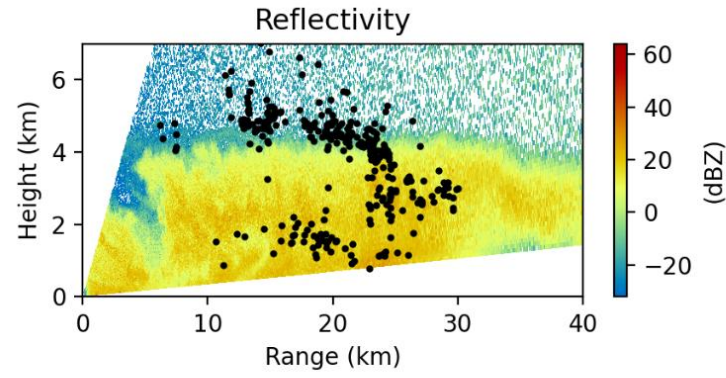
02:32:46.3 - RHI

02:35:30 - Flash

Initial analysis V. Chmielewski IOP2 19 Nov 2022



KTYX PPI reference  
DOW7 RHI at 101.3°



# Conclusions

- 11 IOPs (3 with lightning); 7 planned IOPs, 3 w/ lightning
- Overall, DOW process worked well with LEE. BUT stress levels probably would have been reduced if could keep operators in study domain unless obvious calm conditions will persist for over a week. How better plan for long IOPs?
- Follow us on Twitter/X @nsf\_lee
- Project website: [https://www.eol.ucar.edu/field\\_projects/lee](https://www.eol.ucar.edu/field_projects/lee)
- References available upon request (scott.steiger@Oswego.edu)
- Thank you to NSF: AGS Grant 2212177, and to all who collected the data, including 22 awesome Oswego undergrads!

# Video of lake-effect lightning flash strike to Oswego stack

2052Z 20 Nov 2022



Video captured by K. Jesmonth