PROJECT ORION

Observation, Reconnaissance, Intelligence, and Operations Network

DEVELOPERS

ISAIAH R. HARVILLE
Data Scientist
Graduate Student

AIDAN W. NEEL
Full Stack
Non-Student

JACOB D. NEEL
M&S Engineer
Senior

CADEN S.L. HERREN
Software Engineer
Freshman

PROBLEM SET: BOTTS

- Visualization Experience
- Modeling and Sim Experience
- Data Science Experience

OVERVIEW

A versatile software platform for mission-critical applications.

Core Capabilities

- **Observation & Reconnaissance:**
  Gathers real-time and historical data.
- **Intelligence & Operations:**
  Processes information for strategic decision-making.

Potential Applications

- **Public Safety**
- **Security**
- **Environmental Monitoring**
- **Defense**

Technology Highlights

- **(WIP) Machine Learning Integration:**
  Advanced data analysis
- **Multi-Source Data:**
  Combines inputs from multiple APIs
- **Extreme Portability:**
  Completely containerized, OS agnostic and served in a web app.

MACHINE LEARNING

Goal: Predict likelihood of Tornadoes in a given scan

Resources:

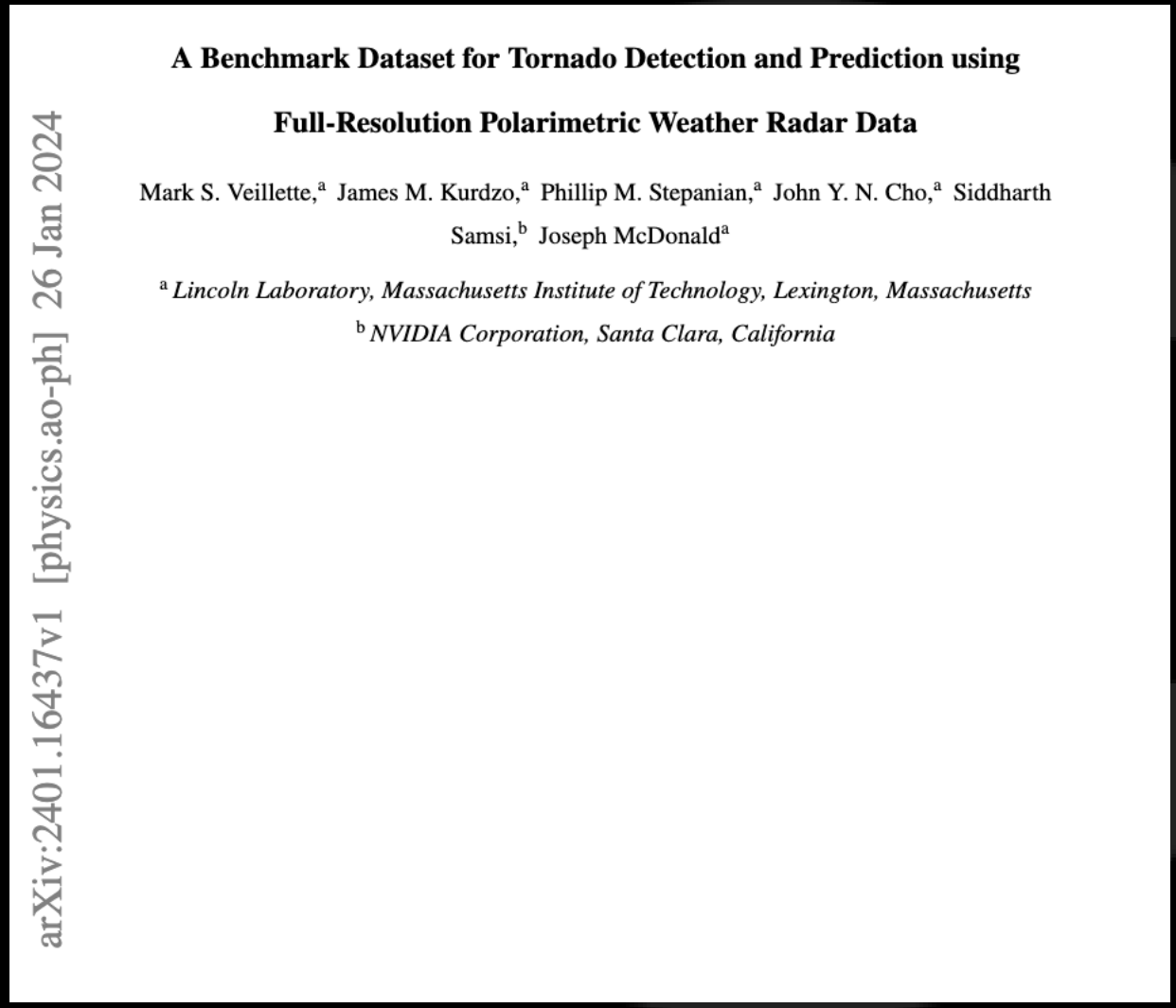
- Available literature is limited
- Identified paper from 2024 introducing an open-sourced dataset TorNet providing a series of NetCDF files from NEXRAD lv2 archives for training and inference
- NEXRAD AWS, provides recent radar data queryable by Radar ID

Limitations:

- Unable to finish streaming pipeline due to time constraints
- Unable to train custom DNN PyTorch model due to time constraints
- Dataset Quality

Accomplishments:

- Recreated paper results



A Benchmark Dataset for Tornado Detection and Prediction using Full-Resolution Polarimetric Weather Radar Data

Mark S. Veillette,[a] James M. Kurdzo,[a] Phillip M. Stepanian,[a] John Y. N. Cho,[a] Siddharth Samsi,[b] Joseph McDonald[a]

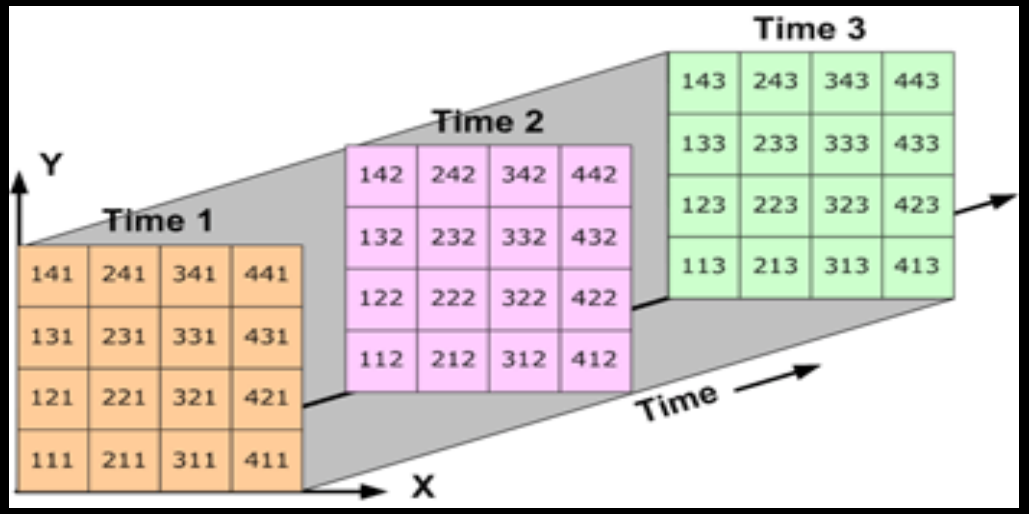
[a] *Lincoln Laboratory, Massachusetts Institute of Technology, Lexington, Massachusetts*

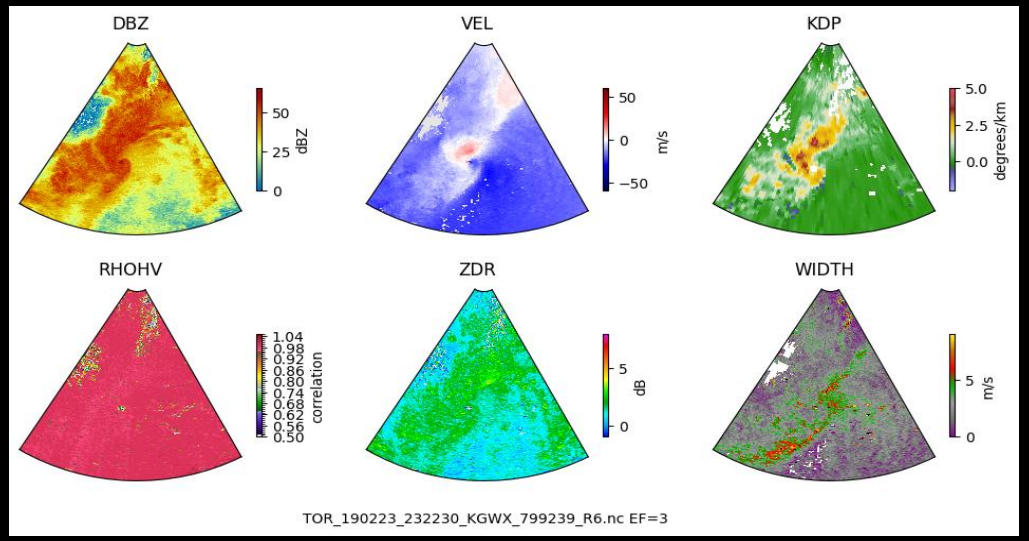
[b] *NVIDIA Corporation, Santa Clara, California*

M. S. Veillette, J. M. Kurdzo, P. M. Stepanian, J. Y. N. Cho, S. Samsi, and J. McDonalda, Lincoln Laboratory, MIT, Lexington, MA, and NVIDIA Corporation, Santa Clara, CA, 2024.

WEATHER DATA

- **Model Data:**
  - NetCDF, self describing, multi-dimensional binary format
  - NexradL2 data, converted to expected input shape of Neural Network in the NetCDF format utilizing pyart.
  - Inference data sourced from Nexrad II AWS service
- **Map Data (GUI):**
  - Real-time weather data sourced from RainViewer
  - Contains precipitation information





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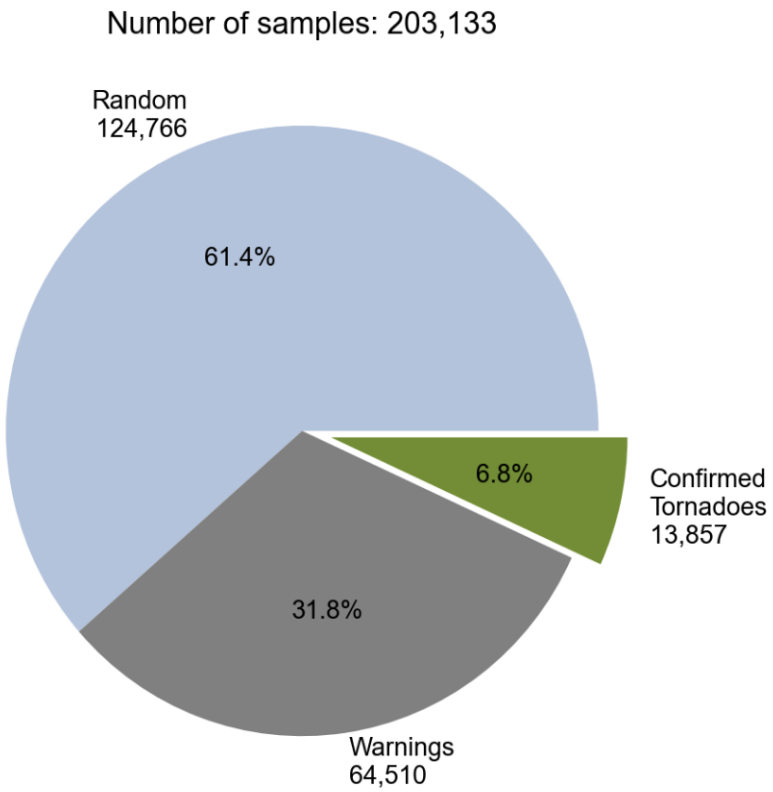
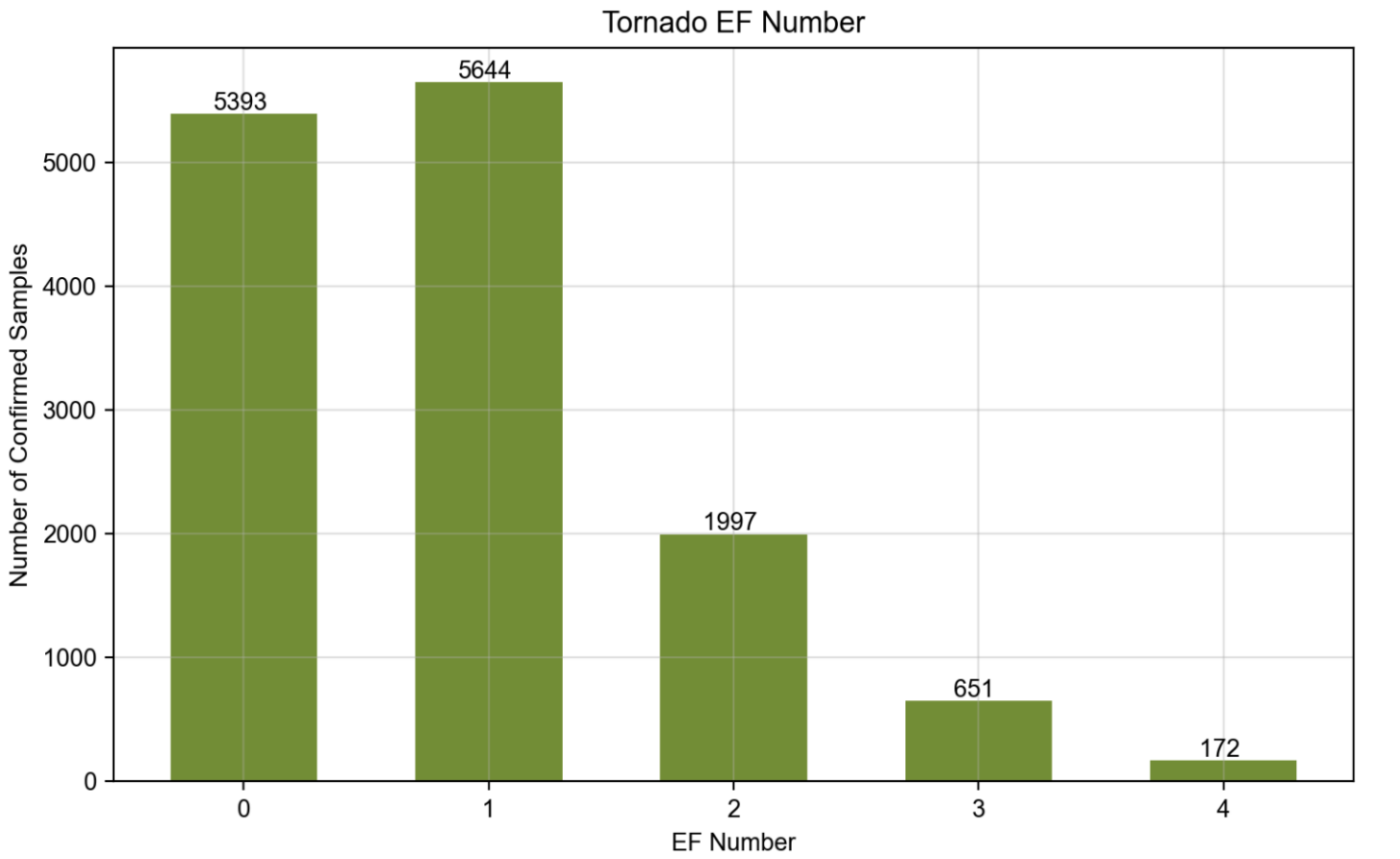
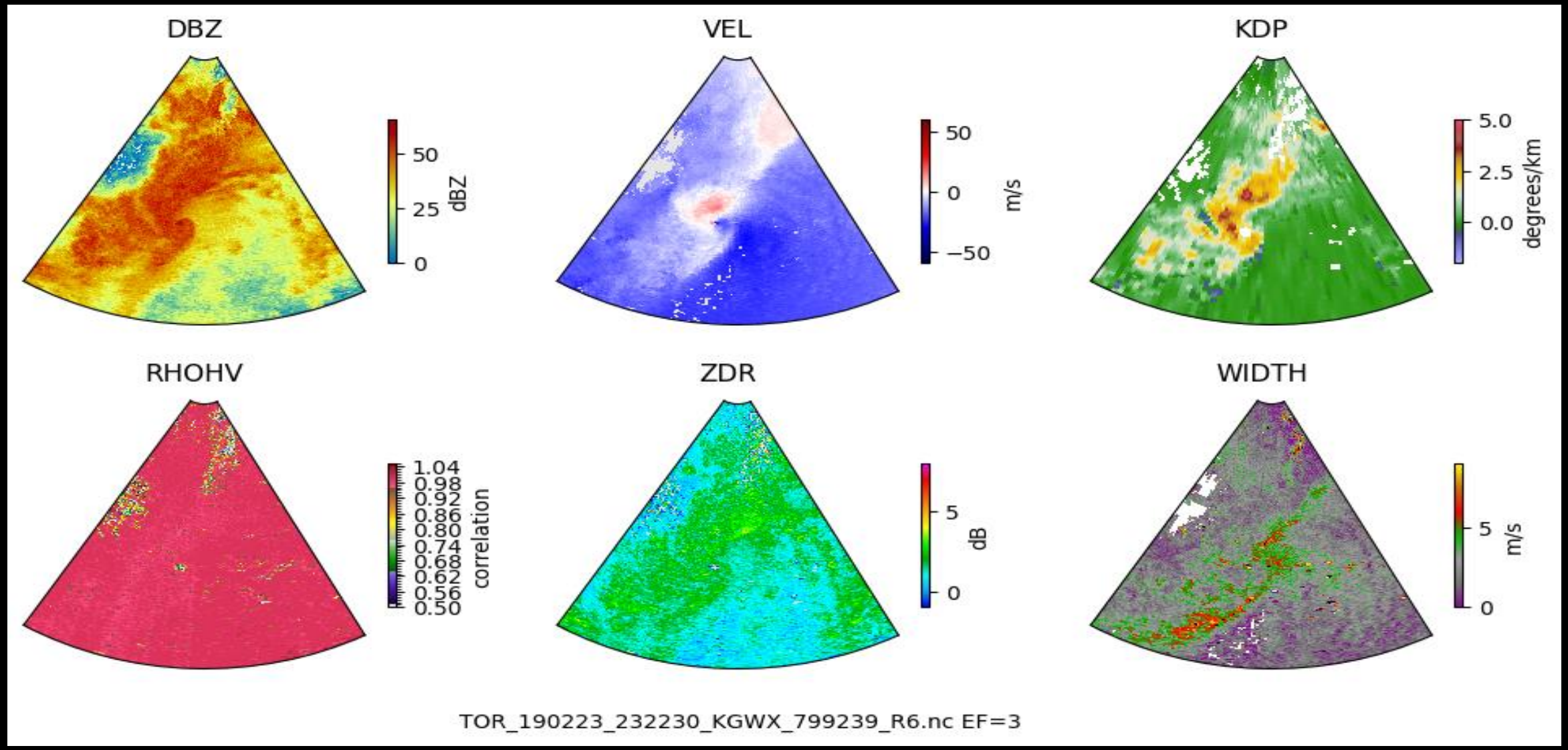
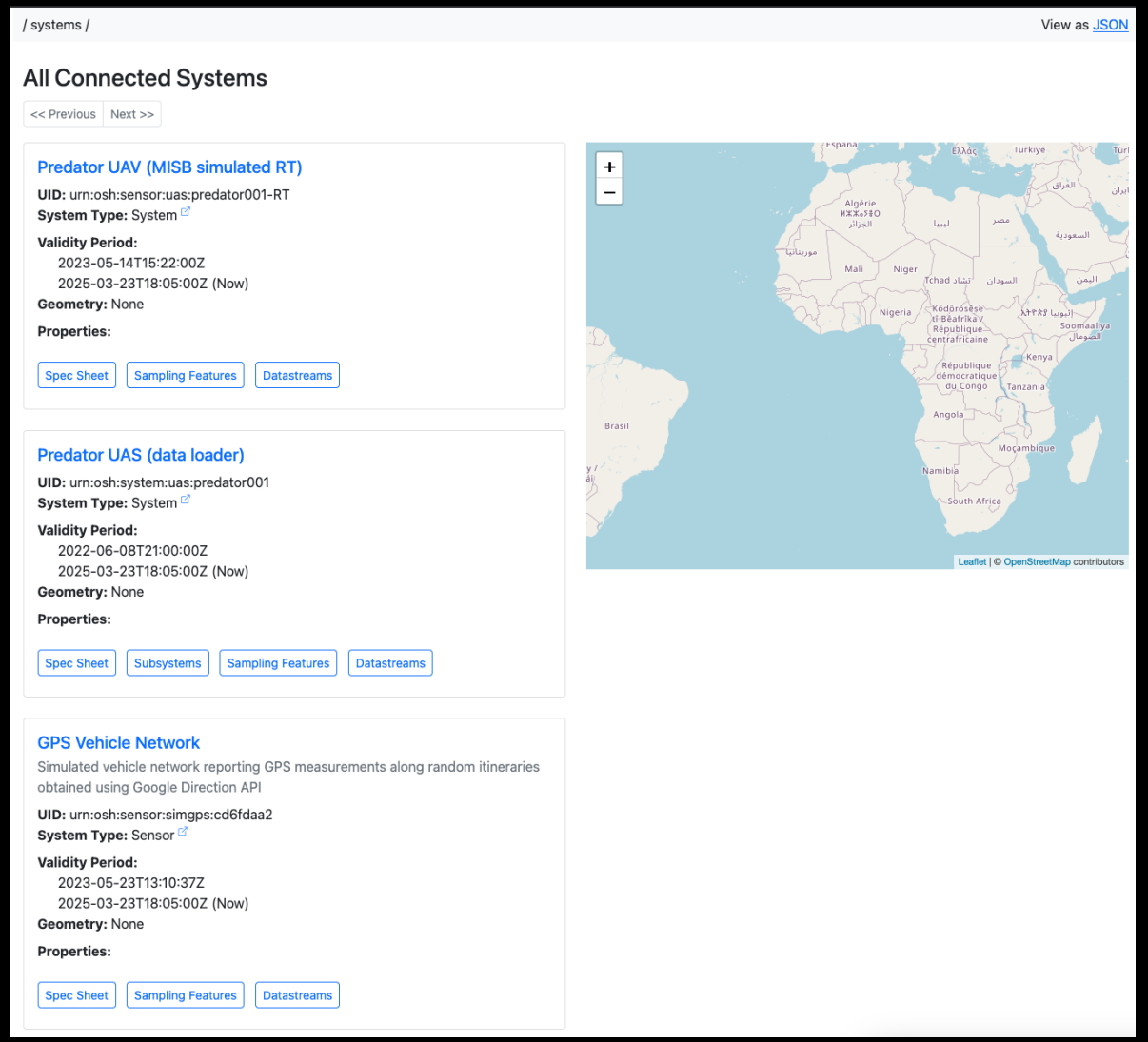

Number of samples: 203,133
Random
124,766
61.4%
6.8%
Confirmed
Tornadoes
13,857
31.8%
Warnings
64,510


Tornado EF Number
Number of Confirmed Samples
0
1000
2000
3000
4000
5000
5393
5644
1997
651
172
0
1
2
3
4
EF Number


DBZ
50
25
0
dBZ
VEL
50
0
−50
m/s
KDP
5.0
2.5
0.0
degrees/km
RHOHV
1.04
0.98
0.92
0.86
0.80
0.74
0.68
0.62
0.56
0.50
correlation
ZDR
5
0
dB
WIDTH
5
0
m/s
TOR_190223_232230_KGWX_799239_R6.nc EF=3

UAV / AIS DATA

- Historical & Simulated Real Time Data
- Track Friendly/Enemy, lat/lon/alt, and more
- Open Sensor Hub API

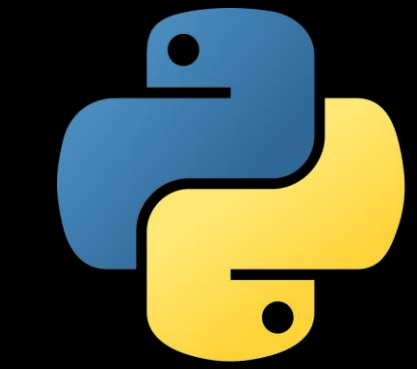
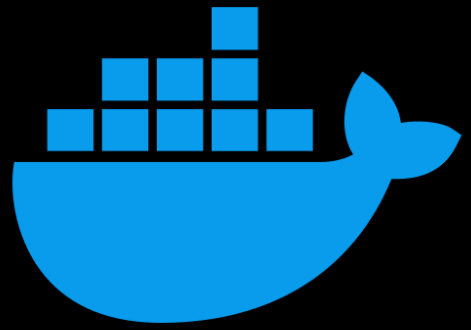


TECH STACK

- **Frontend:**
  - **Svelte Kit**
  - **Tailwind**
  - **RainViewer API**
  - **Open Sensor Hub API**

Backend:

- **PyTorch & Keras**
- **FastAPI**
- **Docker**
- **Python**



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DEMONSTRATION