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CTBT: SCIENCE AND TECHNOLOGY CONFERENCE

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Design of a real-time radiation sensor network for atmospheric radiotracer experiments

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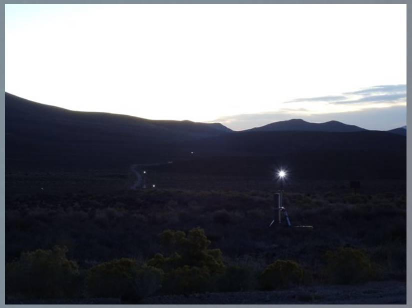
START



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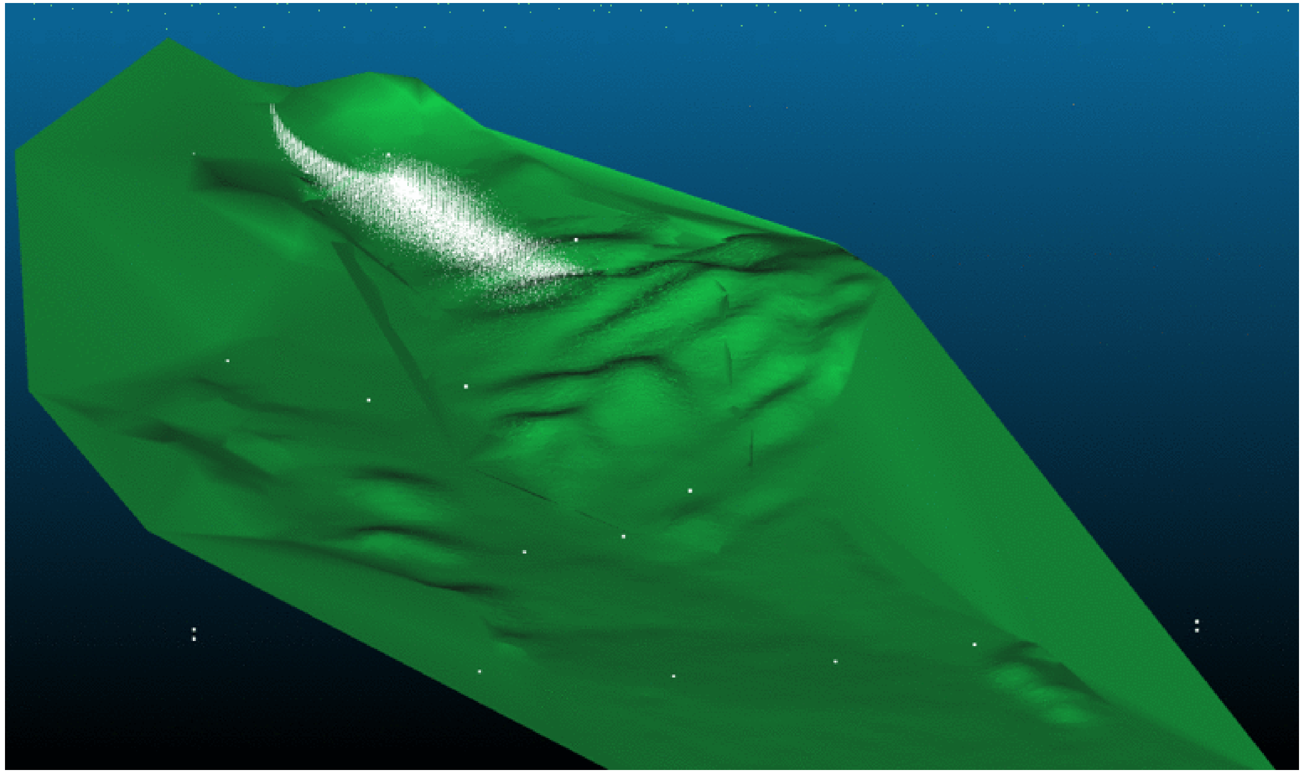
Introduction

- Instrumenting a series of atmospheric transport experiments to refine meteorological models in complex terrain at short distances
- Data collected using an array of 22 real-time radiation sensors dispersed over a 5 km region
- Omnidirectional sensitivity to large distance depending on gamma-ray energy
- Expected Minimum Detectable Concentration based on simulations: 5-10 Bq/m^3
- Successfully deployed and operated over four radiotracer releases

Objectives

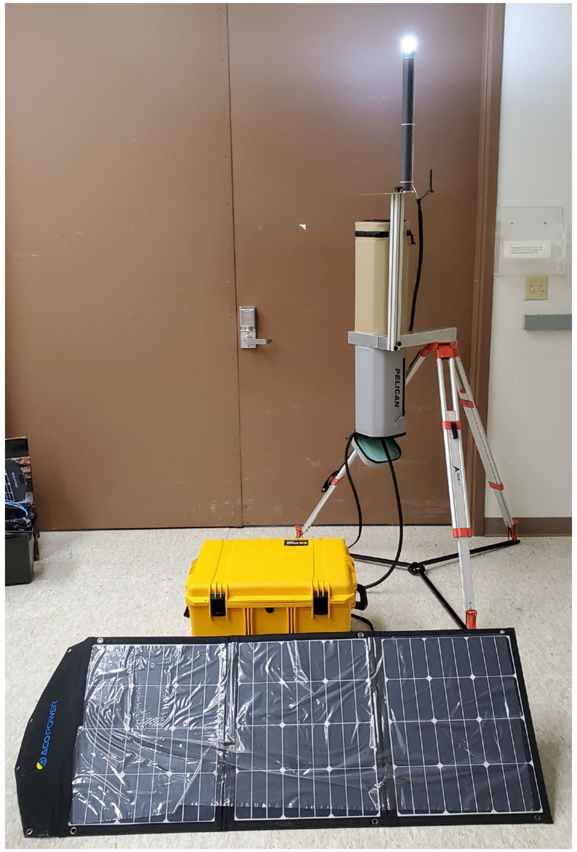
- Refine meteorological models in complex terrain at short distances
- Collect time of arrival and strength of signal information
- Combine with simulated detector response models
- Sensors need to be capable of running autonomously for multiple weeks
- Want to minimize visits to systems
- State of health strobe visible from kilometers away
- All data to be transmitted automatically after collection
- Must be capable of performing well in a variety of weather conditions (heat, cold, rain, wind)



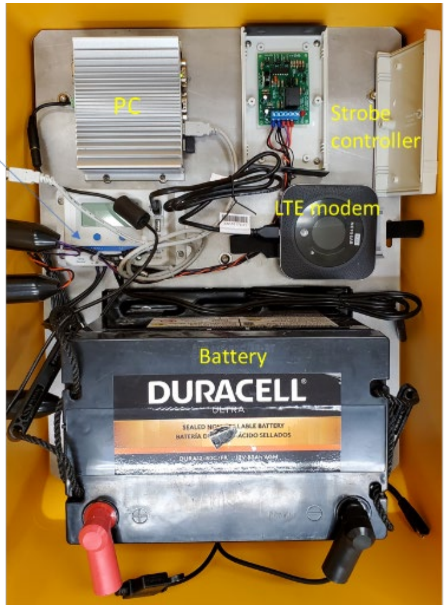
FLEXPART-WRF Time-lapse from 5 to 40 minutes after release

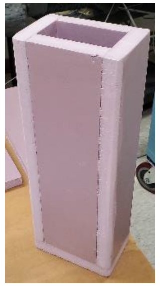
Methods

- 5×10×40 cm sodium iodide scintillator gamma-ray detector
- Photomultiplier + OSPREY digital tube base for readout
- Solar array/battery power system
- Cell phone communications via wireless hotspot
- Ruggedized low-power computer for control and local data storage
- 20 second 2048 bin spectra in N42 format
- Foam insulation to protect crystal from thermal shocks
- Bright state-of-health strobe
- Extensive laboratory and outdoor testing to ensure system readiness
- Tested outside for three weeks of continuous operations
- Chose detector placement based on HYSPLIT and Aeolus modeling and typical weather



Charge controller





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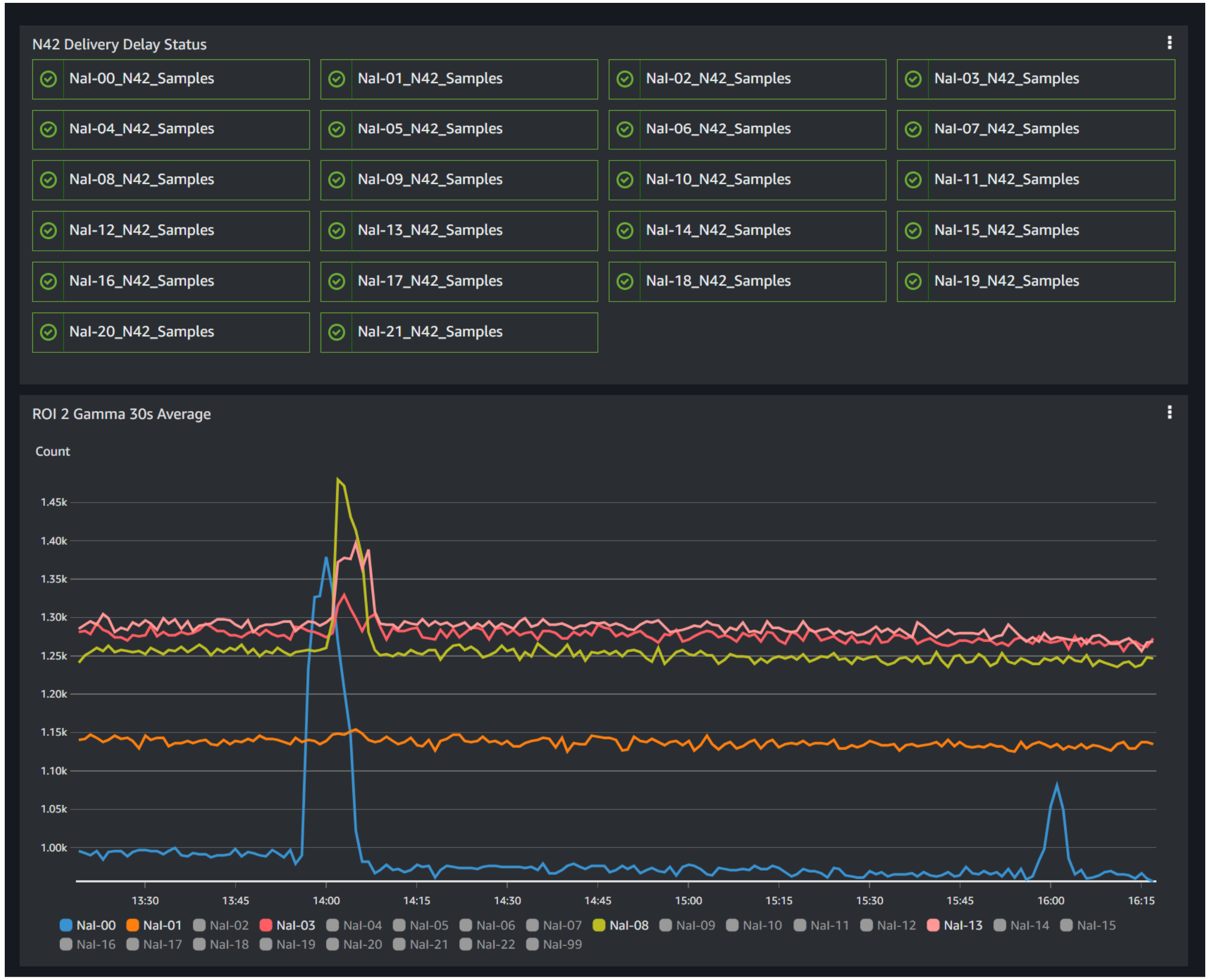
Results

- Observed four radiotracer releases in October 2022
- Online dashboard shows green checks for presence of live data
- Dashboard using Amazon Web Services showing the region of interest raw counts versus time for closer-in sensors
- Observed clear elevations in counts at times in 20 second steps
- Second peak near 16:00 UTC is the release system purge
- Preliminary off-line gain stabilization and background subtraction in the region of interest have been performed
- Comparing results with Aeolus and FLEXPART-WRF models using measured meteorological conditions



Radiotracer Release #4

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Conclusion

- A new array of 22 real-time radiotracer sensors has been developed and deployed
- Sensitive to gamma rays from tens of keV up to 3 MeV with the current settings
- Full spectral information saved
- Online dashboard shows near real-time counts in variable regions of interest
- Will be comparing detailed meteorological model results with timing and magnitude of detections to refine the models

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