Weather Observation Research

FPAW 10/9/2025

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Federal Aviation Administration

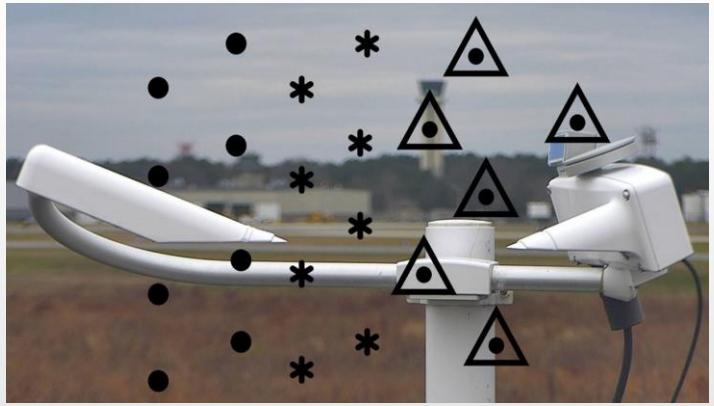
Prior Research and Current Status

PRIOR RESEARCH

- ANG's Weather Observation program developed requirements for the automated sensing of ice pellets, drizzle, and up to three simultaneously occurring precipitation types.
- Integration of enhanced sensing will resolve key automated winter weather reporting gaps.

CURRENT/FUTURE STATUS

- AWOS-C - Enhanced sensing Present Weather Sensor planned for integration into the baseline
  - Legacy reporting of only Rain and Snow provided initially
  - Phased approach to enhanced sensing reporting
- ASOS
  - NWS released amended solicitations for PWS in Q4FY25
  - Awaiting NWS plans for enhanced sensing and reporting.
- Future Enhanced PWS Algorithm
  - Enhanced PWS algorithm to account for ice pellets, drizzle and up to three simultaneous precipitation types to be developed by FAA and NWS
  - Enhanced present weather algorithm will have test period



Current Weather Sensor Observation Pad
Atlantic City Research Airport

New Areas of Research

- ASOS/AWOS Sensor data access outside the METAR
- Runway Rain Rates
- Precipitation Intensity for up to 3 simultaneous precipitation types

Sensor Data Access Outside of the METAR

LTE (Long-Term Evolution) Routers/Conversion Appliance System

LTE: NWS is replacing dial-up telephone lines to ASOS locations with LTE routers

Research Tasking:

Implement LTE routers for tipping bucket data transfer to assess transfer rates and power consumption

- Tipping buckets are connected to Campbell Dataloggers (similar to those planned for ASOS) and will continue to collect data even if LTE communications are interrupted

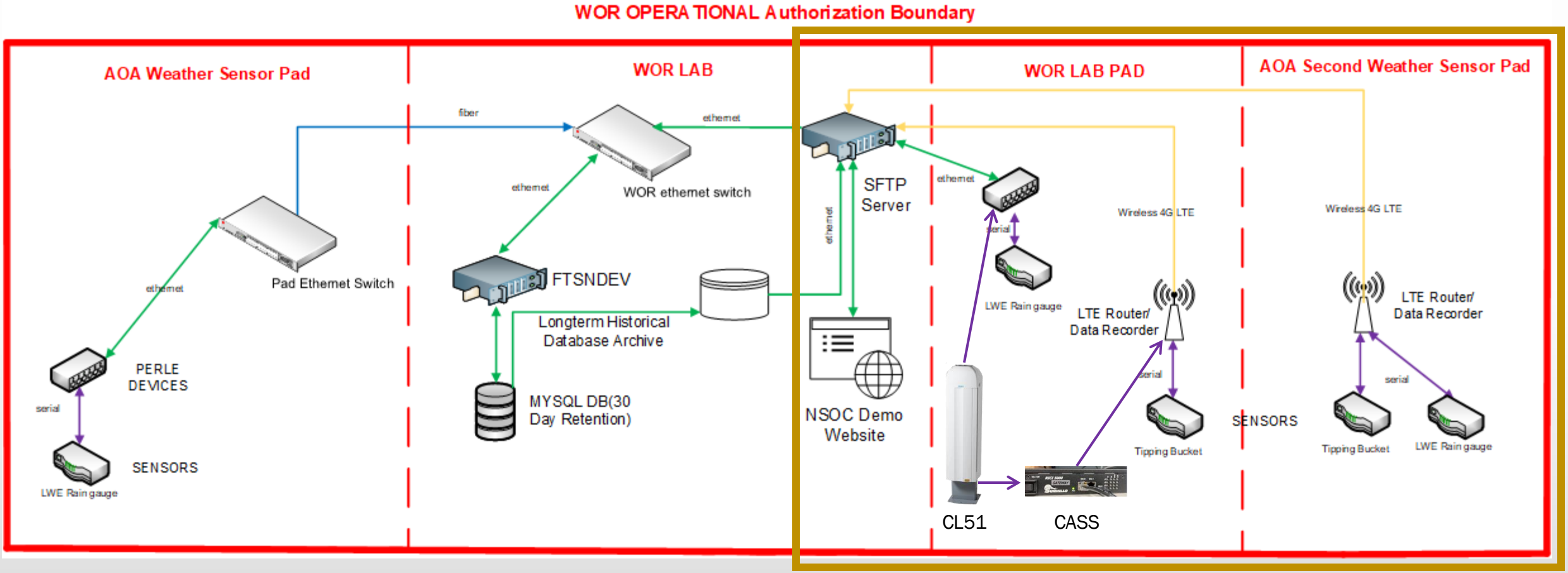
Combining LTE routers with tipping buckets and batteries/solar panels provides a cheaper, more efficient solution for real-time rainfall rates anywhere around airports for use by pilots, FAA users, and ground operations

Time Division Multiplexing to Internet Protocol (TDM/IP)

Research Tasking:

- Demonstrate use of CASS to "Listen" for individual sensor data and direct data to destination.
- Creates ability to collect raw sensor data for alternative processing techniques; (e.g. other-than-METARs)

WJHTCAA Laboratory / Weather Sensor Pad Configuration



Runway Rain Rates

Present Research

NTSB Recommendations (May 2024)

Addressing a pressing issue

ASOS/AWOS inability to report Heavy + Heavy ++ and Heavy +++ rainfall rates, not to mention the challenges associated for these short-lived events. RVR like systems to report Runway Condition Assessment Matrix (RCAM)

Draft Safety Recommendations

Update the rainfall intensity descriptors used in aviation weather reports to identify achievable rainfall intensities that can significantly exceed the current “heavy rain” threshold of 0.3 inches per hour.

Tailored Rain Intensity Product

One-minute rain gauge information could become available to a “listener” for configuration into tailored products.

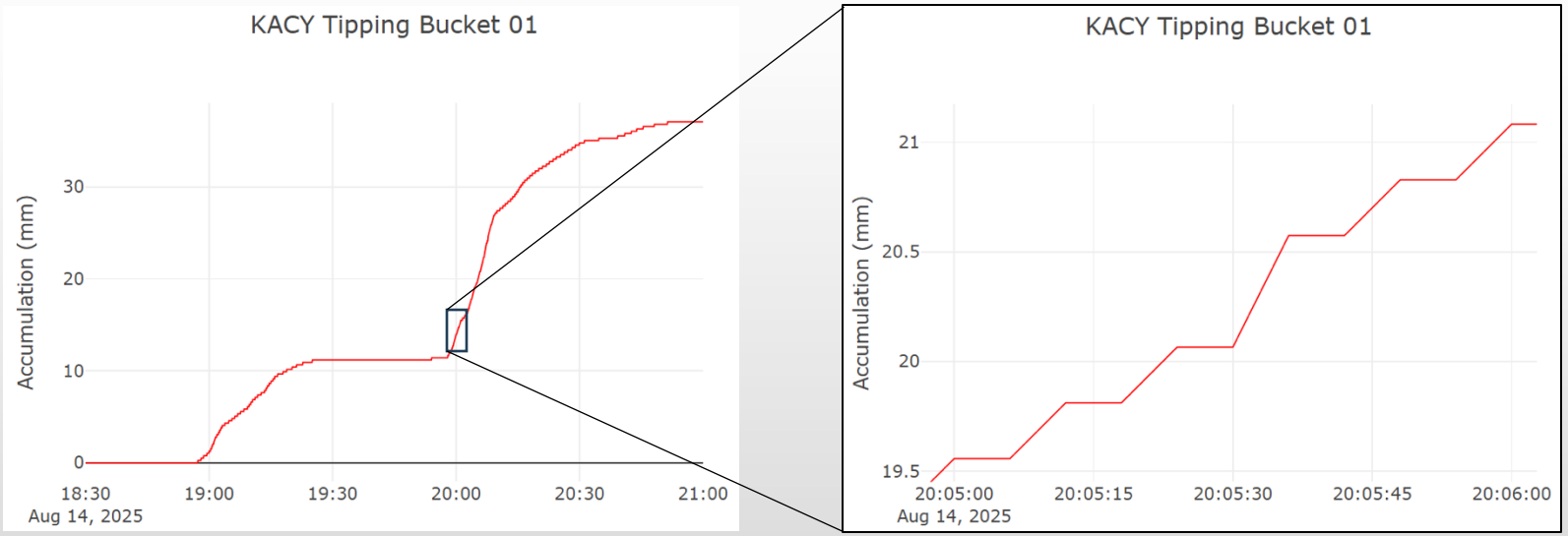
Very light, light, moderate, heavy, very heavy

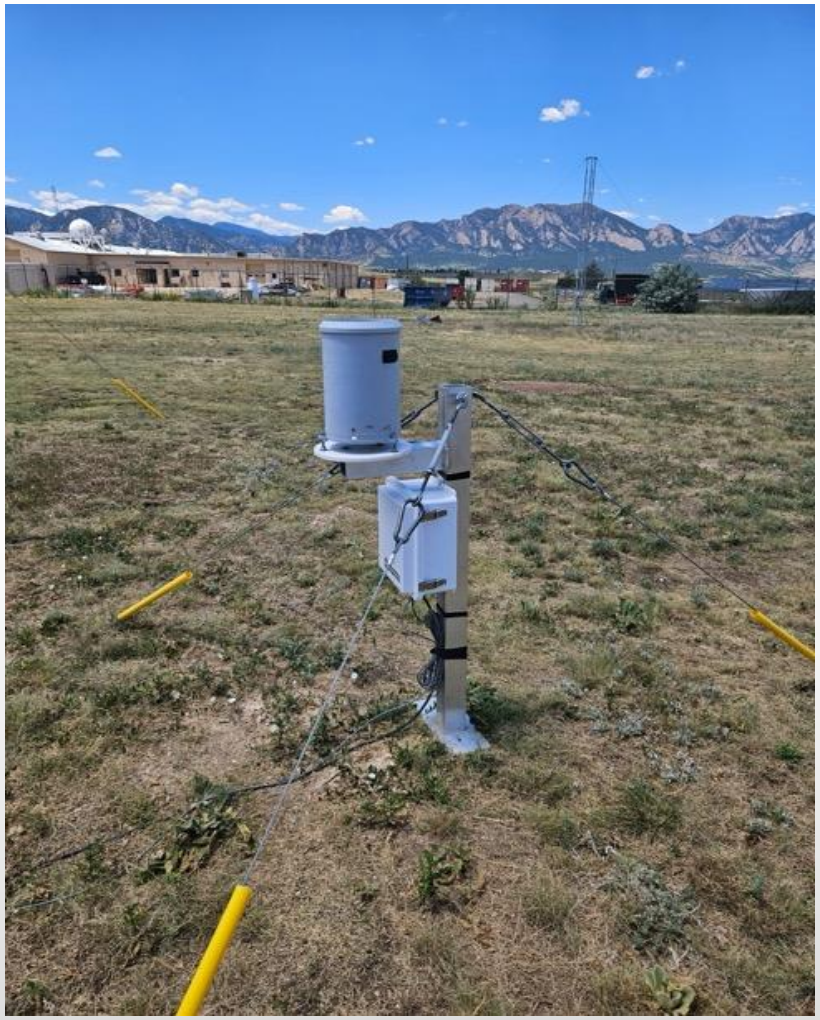
- Heavy + boundaries are .5” to .9” per hour
- Heavy ++ boundaries are .9” to 1.3” per hour
- Heavy +++ boundaries are above 1.3” per hour

Present Research

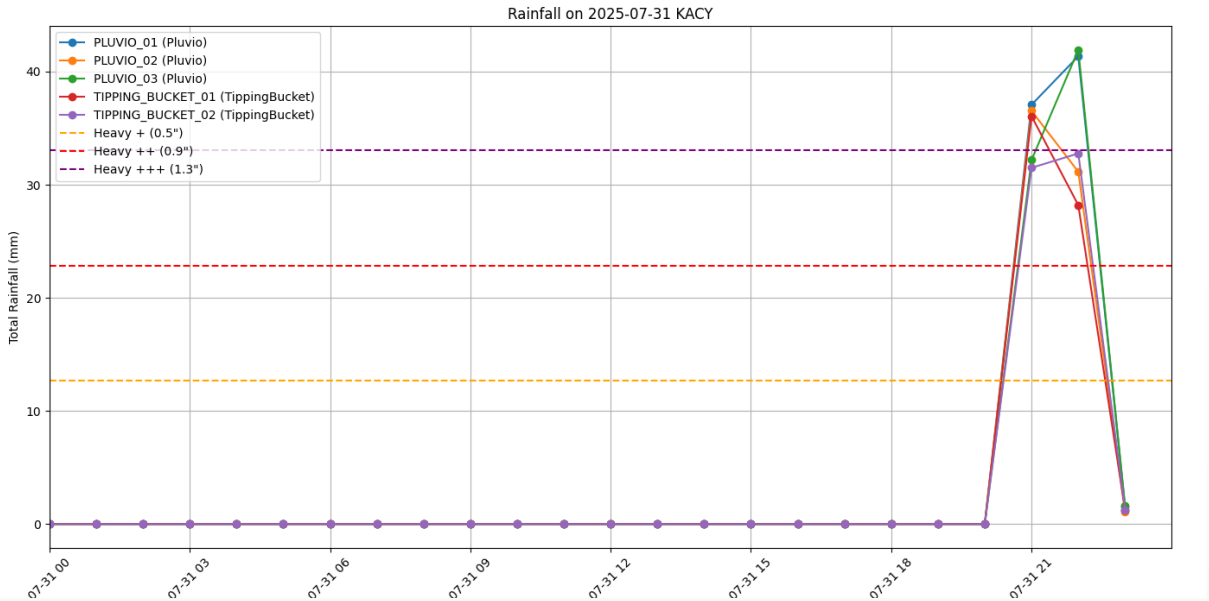
Deployed tipping bucket gauges at NCAR Marshall Field Site and Atlantic City Research Airport for comparison against existing weighing gauges

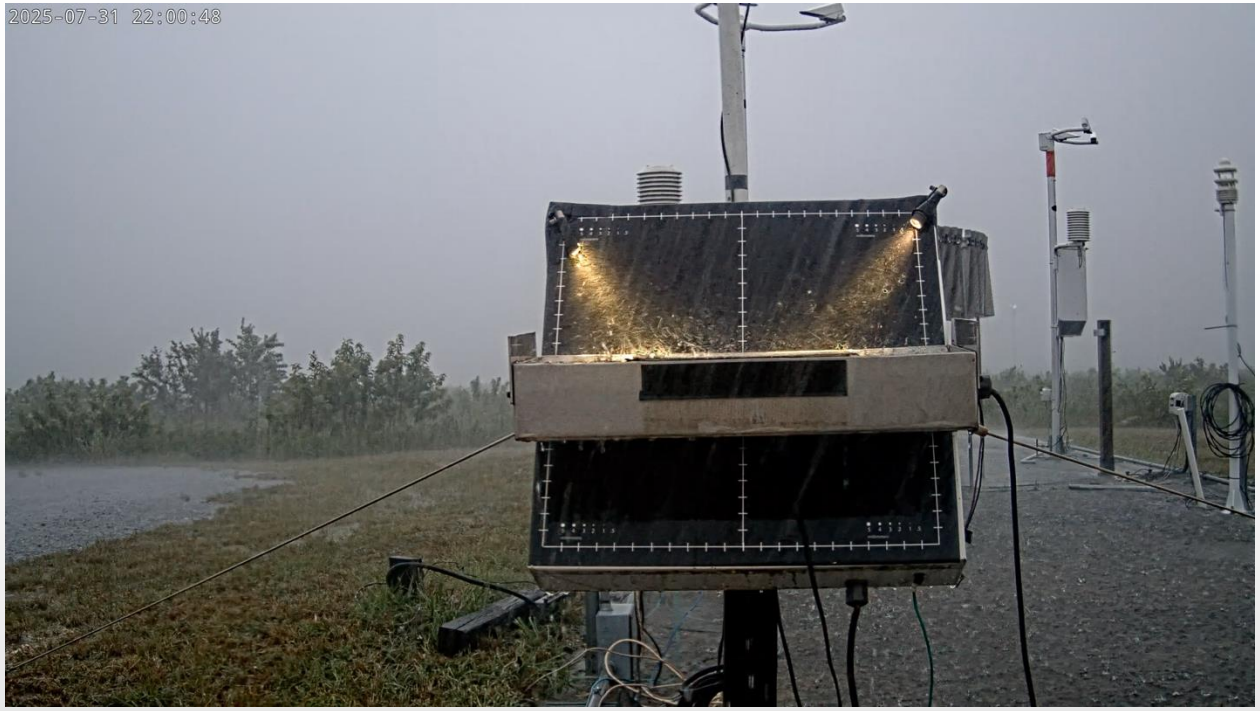
- Tipping buckets placed to capture/assess spatial variations (e.g. a rain event that may impact one end of a runway but not the other)
- Collecting data at 6-second intervals
- Using LTE routers to transfer data in real time





Case: 7/31/2025 Heavy +++ Event





TIPPING BUCKET 02
2025-07-31 21:35:12 | Device: TIPPING_BUCKET_02 | Rain_mm_Tot: 0.508 | Tips: 2 in 30s | Alert: Heavy +
2025-07-31 21:39:18 | Device: TIPPING_BUCKET_02 | Rain_mm_Tot: 0.762 | Tips: 3 in 20s | Alert: Heavy +++
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2025-07-31 21:48:00 | Device: TIPPING_BUCKET_02 | Rain_mm_Tot: 0.762 | Tips: 3 in 20s | Alert: Heavy +++
2025-07-31 21:58:30 | Device: TIPPING_BUCKET_02 | Rain_mm_Tot: 0.762 | Tips: 3 in 20s | Alert: Heavy +++
2025-07-31 22:09:00 | Device: TIPPING_BUCKET_02 | Rain_mm_Tot: 0.762 | Tips: 3 in 20s | Alert: Heavy +++
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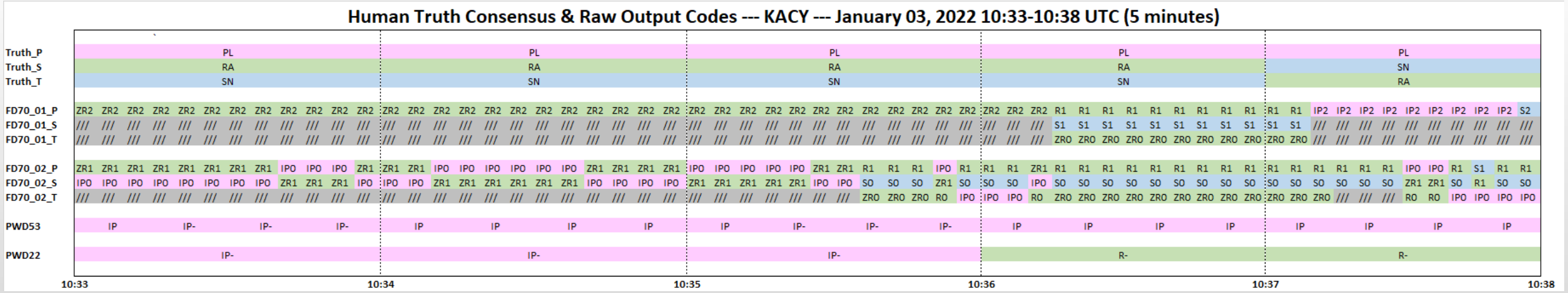
Intensity for Multiple Simultaneous Precipitation Types

Upcoming Winter 2025/26

- Evolve Automated Intensity Reporting for Multiple Precipitation Types
- Recommend single or combination intensity for multiple precipitation types
- Examine role of fall-rate, sensor-derived intensities
- Answer whether Ice Pellets require an intensity (vs. just occurrence reporting)
- Recommend management of SPECI reporting and Remarks reporting
- Clarify LWE- and Visibility-based intensity reporting overlaps



Planned Research (Longer-Term)

- Assist NWS with development of precipitation type algorithms for use on ASOS/AWOS
  - Develop methods to determine and derive the individual rates and intensities of each precipitation type when multiple types are occurring simultaneously
- Assess feasibility of deploying tipping bucket gauges at an airports prone to heavy rainfall conditions
- Provide runway rain rate data independent of METAR for use with Runway Condition Assessment Matrix (RCAM)
  - Heavy + precipitation types and mixed winter weather precipitation

Runway Condition Assessment Matrix (RCAM)

Assessment Criteria		Downgrade Assessment Criteria		
Runway Condition Description	Code	Mu (μ)[1]	Vehicle Deceleration or Directional Control Observation	Pilot Reported Breaking Action
Dry	6	40 or higher	—	—
Frost Wet (includes damp and 1/8" or less of water) 1/8" (3mm) depth or less of: Slush Dry snow Wet snow	5		Braking deceleration is normal for the wheel braking effort applied AND directional control is normal.	Good
5° F (–15° C) and colder outside air temperature: Compacted snow	4	39 to 30	Braking deceleration OR directional control is between Good and Medium	Good to Medium
Slippery when wet (wet runway) Dry snow or wet snow (any depth) over compacted snow Greater than 1/8" (3mm) depth: Dry snow Wet snow Warmer than 5° F (–15° C) outside air temperature: Compacted snow	3		Braking deceleratiion is noticeably reduced for the wheel braking effort applied OR directional control is noticeably reduced.	Medium
Greater than 1/8" (3mm) depth: Water Slush	2	29 to 21	Braking deceleratin OR directional control is between Medium and Poor.	Medium to Poor
Ice	1		Braking deceleration is significantly reduced for the wheel braking effort applied OR directional control is significantly reduced.	Poor
Wet ice Slush over ice Water on top of compacted snow Dry snow or wet snow over ice	0	20 or lower	Braking deceleration is minimal to non-existent for the wheel braking effort applied OR directional control is uncertain.	Nil

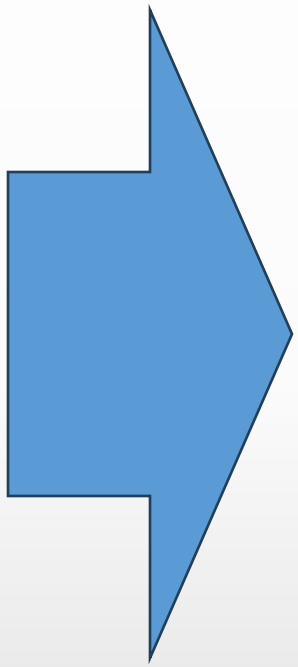
Questions?

Backups

Success and Future

SUCCESS: Criteria for past winter weather work

- Procure the sensor!
  - Maximizing the sensor's potential in ASOS can be accomplished incrementally.
    - Step 1 – Acquire sensor with Legacy Mode feature to ensure continuity of service
    - Step 2 – PMO secures endorsement from all interagency ASOS users to implement drizzle and ice pellets per WOIs standards (ice pellets over snow, accumulation rate requirement for drizzle)
    - Step 3 – PMO develops and secure endorsements for new ASOS present weather algorithm that can report multiple precipitation types simultaneously and deliver an automated solution that meets or exceeds Contract Weather Observer capabilities.



CURRENT/FUTURE

- AWOS-C
  - New PWS is planned to be integrated into the baseline
    - Only Rain and Snow reporting provided initially
- ASOS
  - NWS to release amended solicitations for PWS in Q4FY25
  - New PWS to be integrated into baseline
    - Only Rain and Snow reporting provided initially
- Enhanced PWS Algorithm
  - PWS sensor algorithm to developed by FAA and NWS
  - Updated present weather algorithm available for winter testing

Ceilometer Backscatter Data through the CASS

Current CASS Ceilometer Data Flow

CL51 / Wx Sensors

RS232
Serial

CASS Device

IP

Data Collection Server

SFTP Server

Future Plans for CASS Data Flow

CL51 / Wx Sensors

RS232
Serial

IP

Data Collection Server

SFTP Server

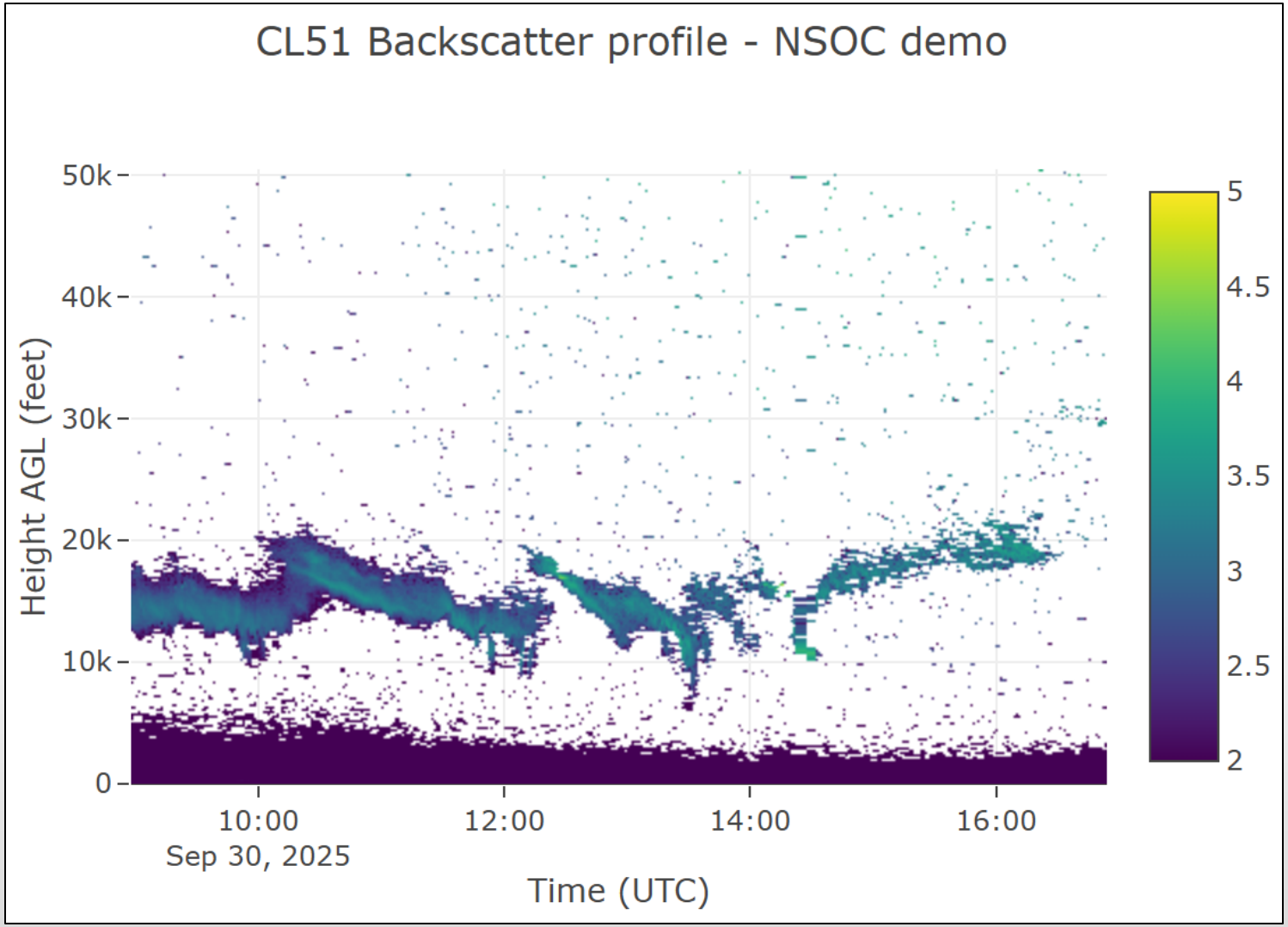
CASS Device

IP

LTE

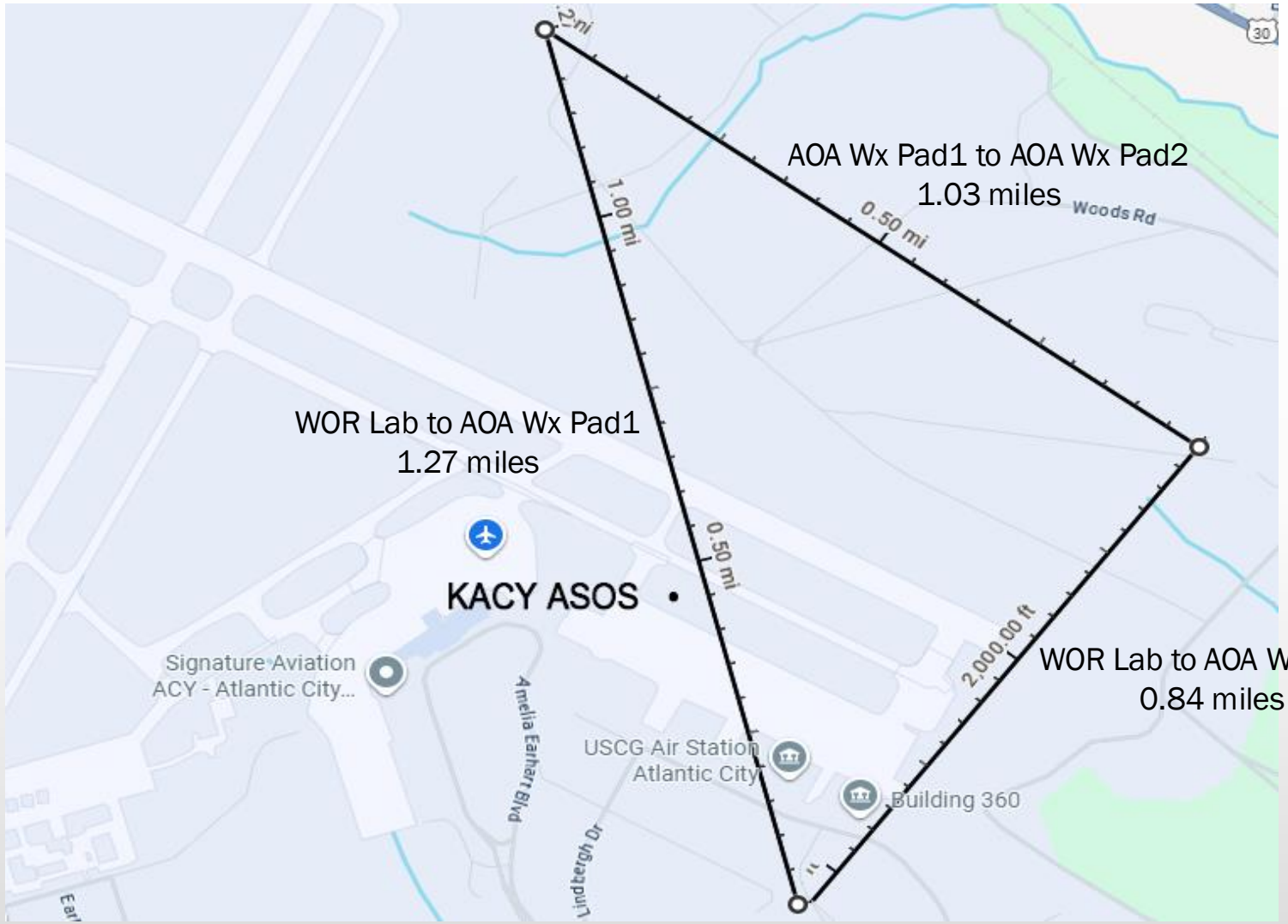
IP

Ceilometer Backscatter Data through the CASS



Leveraging the LTE and CASS technology, we have demonstrated access to Ceilometer Backscatter Data

KACY Sensor Distances



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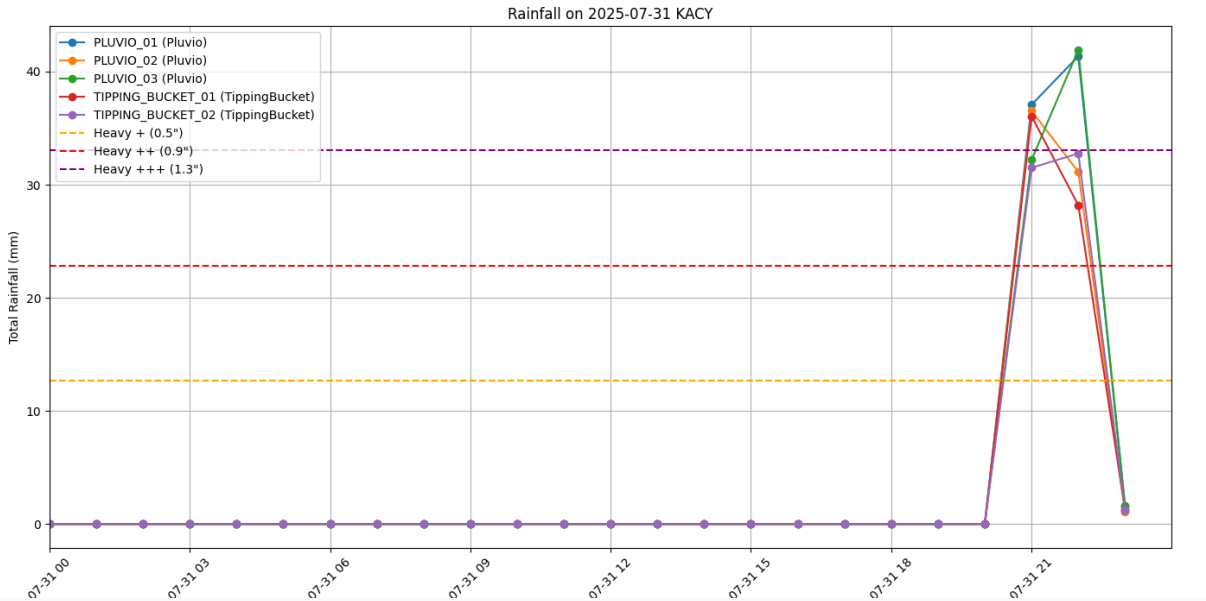

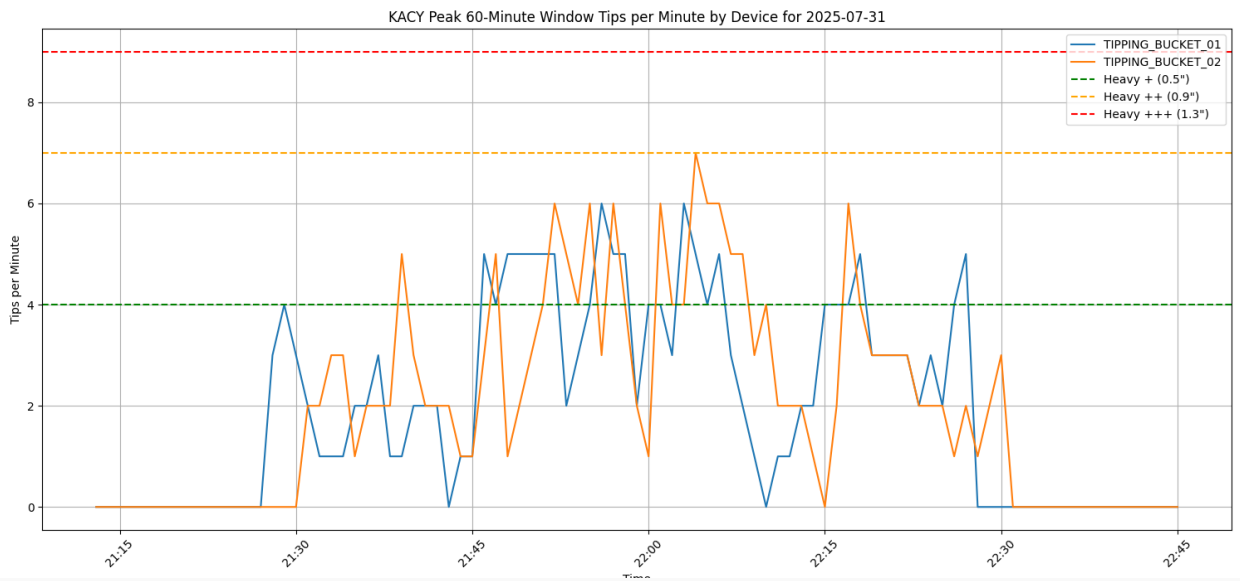

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2025-07-31 22:06:54 | Device: TIPPING_BUCKET_01 | Rain_mm_Tot: 0.762 | Tips: 3 in 20s | Alert: Heavy +++
2025-07-31 22:14:06 | Device: TIPPING_BUCKET_01 | Rain_mm_Tot: 0.508 | Tips: 2 in 30s | Alert: Heavy +
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