Weather Observation Improvements: Evolving Automated Present Weather Reporting via User Interactions



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## Set Up

To view weather event online:

YouTube URL:

### https://www.youtube.com/watch?v=rg7yNLttaAE&t=5s

https://ral.ucar.edu/solutions/products/identifying-precipitation-types-and-intensity-changes

To Volunteer for a Team:

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## The Automation of Present Weather Observing is Challenging!!!!







## Introduction

The Weather Observation Improvements (WOI) program demonstrated that industry has the sensor technology to discriminate and report the occurrence of ice pellets and drizzle.

- There are many challenges to integrating this ability into ASOS.
  - During my previous briefing, I focused on technical details that confront the automated reporting of three precipitation types and intensities.
  - Today I hope to translate those technical details into a framework that creates four teams who are determined to improve automated present weather reporting.
- Four Proposed Teams:
  - Precipitation Detection Team
  - Intensity Reporting Team
  - Success Criteria/Ground Truth Team
  - Tailored Observation Team





# **Precipitation Detection Team**

Mission: Understanding and Integrating Industry and System Capabilities.

Focus: An Airfield-Representative Observation?

Communicating Automated Multiple Precipitation Type Reporting!

- How do we want our sensor data formatted?
- Techniques Precedence vs Dominance vs Occurrence
- Onset and Cessation management and reporting





## What's Available?

### **Much Greater Sensor Resolution!**

	Human Truth Consensus & Raw										Raw Output Codes KACY January 03, 2022 10:33-10:38 UTC (5 minu											nut	es	)																																			
Truth_P						Р	L												P	L												PL												PL										P	<u>ال</u>				
Truth_S						R	A												R	A												RA												RA										S	N				
Truth_T						SI	N												SI	N												SN												SN										R	A				
FD70_01_P	ZR2	2R2 Z	R2 7	ZR2	ZR2	ZR2	2 ZR2	2 ZR	2 ZF	2 Z	R2 Z	ZR2	ZR2	ZR2	ZR2	ZR2	ZR	2 ZR	2 ZF	2 Z	R2 Z	.R2 Z	R2 Z	ZR2 2	ZR2 Z	R2	ZR2	ZR2	ZR2	ZR2 2	ZR2	ZR2	ZR2 Z	ZR2 R	1 R	1 R1	R1	R1	R1	R1	R1	R1	R1 R	1 IP	2 IP2	2 IP2	IP2	IP2	IP2 IP	2 IP2	2 IP2	S2							
FD70_01_S		// //	11 -	//	///	///	///	///	///	///	///		- ///	- ///	' <i>II</i>		1 1	1 1	///	///	///	///		- ///	- 11	/ ]//	1 1	11 1	11 - 1	11 11	11 1	/// /.	// .	///	///	///	/// /	///		/// /	'// S	1 S:	1 S1	S1	S1	S1	S1	S1	S1	S1 S	1 //			111	111 1				111
FD70_01_T	///	11 1	11 1	11	///	///	///	///	///	111	111		1///	- ///			1 1	1 1	//	///	///	///		- ///	- 11	/  //	1 1	11 1	11 1	11 1	11 1		// .	///	///	///	111	///		/// /	'// Z	ro zi	RO ZR	O ZRO	D ZRO	ZRO	ZRO	ZRO	ZRO	ZRO Z	RO //			111	111				111
FD70_02_P	ZR1 2	2R1 Z	R1 7	ZR1	ZR1	ZR1	ZR1	ZR1	IPO	IPO	IPO	ZR1	ZR1	L ZR:	1 IP	0 IP	0 IF	PO 1	PO	IPO	IPO	ZR1	ZR1	ZR	L ZR	11 IP	0 11	PO 1	PO I	PO IF	PO 2	ZR1 Z	R1	R1	R1	R1	IPO I	R1	R1	R1 Z	KR1 R	1 R	1 R1	R1	R1	R1	R1	R1	R1	R1 R	1 R	i R1	R1	R1	IPO /	IPO R	. S1	R1	R1
FD70_02_S	IPO	PO I	PO I	PO	IPO	IPO	IPO	IPO	ZR1	ZR1	ZR1	IPO	IPO	IPC	D ZR	1 ZF	1 Z	R1 Z	ZR1	ZR1	ZR1	IPO	IPO	IPC	) IP	O ZF	R1 Z	R1 Z	.R1 Z	R1 Z	IR1 I	IPO II	PO	SO	SO	SO	ZR1	SO	SO S	SO I	PO S	0 S(	D SC	SO	SO	SO	SO	SO	SO	SO S	o sr	) SO	SO	SO	ZR1 7	ZR1 SC	R1	SO	SO
FD70_02_T	///	11 1	11 1	11	///	///	///	///	///	111	///		///	- ///			1 1	1 1	//	///	///	///		- ///	- 11	/  //	1 1	11 1	11 1	11 1	11 1		// :	ZRO	ZRO	ZRO	RO I	IPO	IPO	PO F	RO Z	ro zi	RO ZR	O ZRO	D ZRO	ZRO	ZRO	ZRO	ZRO	ZRO Z	RO ZF	1// 0		111	RO /	RO IP	0 IPO	) IPO	IPO
PWD53		IP			IP-			IP-			IP-			IF	•			IP			IP			L I F	•			IP		1	IP-			IP-			IP-			IP		1	P		IP			IP			IP		IP			IP		IP	
PWD22						IP	-												IP	-												IP-												R-										R	l-				
																																																		<u>i</u>									
10	33											1	0:34													10:35	5											10:	36										10	:37									10:3

<u>Value</u>: Technology exists to manage precipitation type reporting at resolutions that offer multiple operational translations





## **Current ASOS/AWOS Algorithm**

- <u>Not</u> designed to AUTOMATICALLY report more than one precipitation type at a time (mixed precipitation) in the present weather field.
- Populates the present weather field based on output derived from a ten-minute window to capture airfield-wide conditions.
- Corresponding start/end times are reported in the remarks field via a separate algorithm.
- The ten-minute window in the PW algorithm is based on precedence assignments.
- Does not account for intensity!



	Alternate Table	
1	Ice Pellets	
2	Snow	<b>F</b> rozen v
3		-
4		
5		
6		
7		
8		
9		

Frozen vs. Frozen?

### SNOW, RAIN OR UP WOULD BE REPORTED FOR SAMPLE CASE





## **System Integration Challenges**

Establish an Industry Standard for Present Weather Message Type!

- Informs sensor vendors of expected sensor message format.
  - Managing the format and nomenclature of messages received from the present weather sensor is crucial for baselining ASOS reporting capabilities.





## **Sensor Message Type** Current Industry Nomenclature

Precipitation	NWS Code
Clear	С
Precipitation	Р
Precipitation, slight or moderate	P-
Precipitation, heavy	P+
DRIZZLE	L
Drizzle, not freezing slight	L-
Drizzle, not freezing moderate	L
Drizzle, not freezing heavy	L+
Drizzle, freezing slight	ZL-
Drizzle, freezing moderate	ZL
Drizzle, freezing heavy	ZL+
Drizzle and rain, slight	RL-
Drizzle and rain, moderate	(RL)
Drizzle and rain, heavy	RL+

Precipitation	NWS Code
ICE PELLETS	IP
Ice Pellets, slight	IP-
Ice Pellets, moderate	IP
Ice Pellets, heavy	IP+
SNOW GRAINS	SG
Snow Grains, slight	SG-
Snow Grains, moderate	SG
Snow Grains, heavy	SG+
ICE CRYSTALS	IC
Ice Crystals slight	IC-
Ice Crystals moderate	IC
Ice Crystals heavy	IC+
SNOW pellets	SP
Hail	А

Precipitation	NWS Code
RAIN	R
Rain, slight	R-
Rain, moderate	R
Rain, heavy	R+
Rain, freezing, slight	ZR-
Rain, freezing, moderate	ZR
Rain, freezing, heavy	ZR+
Rain (or drizzle) and snow, slight	RS-
Rain (or drizzle) and snow, moderate	RS
Rain (or drizzle) and snow heavy	RS+
SNOW	S
Snow Slight	S-
Snow, moderate	S
Snow, heavy	S+

### **Industry Readiness Finding:**

- Limited ability to identify concurrent precipitation types due to ASOS three-character limit.
- Specification must standardize coding.







## **Demonstrated Message Type & Codes**

### 2021-04-19T12:37:00Z 00 15256 10394 P6 ZR2 A0 67

Precipitation	NWS Code	Precipitation	NWS Code	Precipitation	NWS Code
Clear	С	ICE PELLETS	IP	RAIN	R
Precipitation	Р	Ice Pellets, slight	IP-	Rain, slight	R-
Precipitation, slight or moderate	P-	Ice Pellets, moderate	IP	Rain, moderate	R
Precipitation, heavy	P+	Ice Pellets, heavy	IP+	Rain, heavy	R+
DRIZZLE	L	SNOW GRAINS	SG	Rain, freezing, slight	ZR-
Drizzle, not freezing slight	L-	Snow Grains, slight	SG-	Rain, freezing, moderate	ZR
Drizzle, not freezing moderate	L	Snow Grains, moderate	SG	Rain, freezing, heavy	ZR+
Drizzle, not freezing heavy	L+	Snow Grains, heavy	SG+	Rain (c: drizzle) and snow, slight	RS-
Drizzle, freezing slight	ZL-	ICE CRYSTALS	IC	Rain (or drizzle) and snow, nicderate	RS
Drizzle, freezing moderate	ZL	Ice Crystals slight	IC-	Rain (or drizzle) and snow heavy	P.S+
Drizzle, freezing heavy	ZL+	Ice Crystals moderate	IC	SNOW	S
Drizzle and rain, slight	RL	Ice Crystals heavy	IC+	Snow Slight	S-
Drizzle and rain, moderate	RI	SNOW pellets	SP	Snow, moderate	S
Drizzle and rain, heavy	RLI	Hail	А	Snow, heavy	S+

Removes combinations, three individual types with individual intensity assigned (0-9)



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## **Techniques - Automated Detection Reporting**



## **Precipitation Detection Team Goals**

- Clarify intent of automated airfield-wide reporting
- Tackle sensor message type and inform requirements development from Agency through ICAO
- Define detection of each precipitation type according to dominance, prioritization, and occurrence calculations
- Expand Onset and Cessation detection requirements for mixed precipitation events
- Examine new detection techniques and advocate for further research (Sensor-based Freezing Drizzle)
- Collaborate with other teams!





# **Intensity Reporting Team**

Mission: Update Intensity Reporting Techniques and Requirements (METARS)

Focus: Explore Automated Intensity Reporting for Multiple Precipitation Types

- Single or combination intensity for multiple precipitation types
- Examine role of fall-rate (PWS) derived intensities vs Light, Moderate, Heavy

Clarify LWE- and Visibility-based intensity reporting overlaps

Explore whether Ice Pellets require an intensity (vs. just occurrence reporting)

Analyze management of SPECI reporting and Remarks reporting





### Beyond Rain - Fall Rate Intensity? (Drop Distribution Intensity)



Issue: Vendors formulation of Light, Moderate, Heavy is different from system formulation. Just keep numbers?





## **Demonstrated Message Type & Codes**

### 2021-04-19T12:37:00Z 00 15256 10394 P6 ZR2 A0 67

Precipitation	NWS Code	Precipitation	NWS Code	Precipitation	NWS Code
Clear	С	ICE PELLETS	IP	RAIN	R
Precipitation	Р	Ice Pellets, slight	IP-	Rain, slight	R-
Precipitation, slight or moderate	P-	Ice Pellets, moderate	IP	Rain, moderate	R
Precipitation, heavy	P+	Ice Pellets, heavy	IP+	Rain, heavy	R+
DRIZZLE	L	SNOW GRAINS	SG	Rain, freezing, slight	ZR-
Drizzle, not freezing slight	L-	Snow Grains, slight	SG-	Rain, freezing, moderate	ZR
Drizzle, not freezing moderate	L	Snow Grains, moderate	SG	Rain, freezing, heavy	ZR+
Drizzle, not freezing heavy	L+	Snow Grains, heavy	SG+	Rain (c: drizzle) and snow, slight	RS-
Drizzle, freezing slight	ZL-	ICE CRYSTALS	IC	Rain (or drizzle) and snow, nicderate	RS
Drizzle, freezing moderate	ZL	Ice Crystals slight	IC-	Rain (or drizzle) and snow heavy	P.S+
Drizzle, freezing heavy	ZL+	Ice Crystals moderate	IC	SNOW	S
Drizzle and rain, slight	RL	Ice Crystals heavy	IC+	Snow Slight	S-
Drizzle and rain, moderate	RI	SNOW pellets	SP	Snow, moderate	S
Drizzle and rain, heavy	RLI	Hail	А	Snow, heavy	S+

Removes combinations, three individual types with individual intensity assigned (0-9)



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## **Automated Intensity Reporting**



## **Intensity Overlaps for LWE and VIS**









# **Intensity Team Goals**

- 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











# **Success Criteria/Ground Truth Team**

Mission: Develop cost-effective, repeatable ground-truthing to evaluate sensor and system performance. Communicate with industry!

Focus: Derive ground truthing techniques from requirements (from detection and intensity teams)

- Expect and manage sensor and system differences for like phenomena
- Expect temporal stressing of requirements during mixed precipitation events
- Develop terminology to capture the subjective, fast-paced nature of identifying mixed precipitation
  - Pass/Fail, Hit/Miss, Null, Push, Sensor Ramp Up/Down, System Ramp Up/Down





For a self-introduction to WOI ground truth procedures see:

•URL: https://ral.ucar.edu/solutions/products/identifying-precipitation-types-and-intensitychanges





[Full Playlist]

which would be used for comparison against the sensor data.







# Holdover/Allowance Time

### **Aircraft Deicing Guidance**

#### FAA Holdover Time Guidelines

Winter 2023-2024

### TABLE 20: GENERIC HOLDOVER TIMES FOR SAE TYPE IV FLUIDS<sup>1</sup>

Outside Air Temperature <sup>2</sup>	Fluid Concentration Fluid/Water By % Volume	Freezing Fog, Freezing Mist <sup>3</sup> , or Ice Crystals <sup>4</sup>	Very Light Snow, Snow Grains or Snow Pellets <sup>,5,6,7</sup>	Light Snow, Snow Grains or Snow Pellets <sup>,5,6,7</sup>	Moderate Snow, Snow Grains or Snow Pellets <sup>5,7</sup>	Freezing Drizzle <sup>8</sup>	Light Freezing Rain	Rain on Cold- Soaked Wing <sup>9</sup>	Other <sup>10</sup>
	100/0	1:15 - 2:40	1:55 - 2:20	1:00 - 1:55	0:30 - 1:00	0:40 - 1:10	0:20 - 0:35	0:08 - 1:05	
-3 °C and above (27 °F and above)	75/25	1:25 - 2:40	2:05 - 2:25	1:15 - 2:05	0:40 - 1:15	1:00 - 1:20	0:30 - 0:50	0:09 - 1:20	
(	50/50	0:30 - 0:55	1:00 - 1:10	0:25 - 1:00	0:10 - 0:25	0:15 - 0:40	0:09 - 0:20		
below -3 to -8 °C	100/0	0:20 - 1:35	1:45 - 2:05	0:55 - 1:45	0:25 - 0:55	0:25 - 1:10	0:20 - 0:25		
(below 27 to 18 °F)	75/25	0:30 - 1:20	1:50 - 2:10	1:05 - 1:50	0:30 - 1:05	0:20 - 1:05	0:15 - 0:25		
below -8 to -14 °C	100/0	0:20 - 1:35	1:30 - 1:50	0:50 - 1:30	0:25 - 0:50	0:25 - 1:10 <sup>11</sup>	0:20 - 0:25 <sup>11</sup>	0.011710	NI:
(below 18 to 7 °F)	75/25	0:30 - 1:20	1:40 - 2:00	0:55 - 1:40	0:25 - 0:55	0:20 - 1:05 <sup>11</sup>	0:15 - 0:25 <sup>11</sup>	No holdove	n: r time
below -14 to -18 °C (below 7 to 0 °F)	100/0	0:20 - 0:35	0:30 - 0:45	0:09 - 0:30	0:02 - 0:09			guidelines	exist
below -18 to -25 °C (below 0 to -13 °F)	100/0	0:20 - 0:35	0:10 - 0:20	0:03 - 0:10	0:01 - 0:03				
below -25 °C to LOUT <sup>12</sup> (below -13 °F to LOUT)	100/0	0:20 - 0:35	0:07 - 0:10	0:02 - 0:07	0:00 - 0:02				

### Holdover Table

Generic holdover time tables for Type IV Anti-Icing fluids and allowance times for ice pellets (FAA 2023). It should be noted the intensities shown in these tables are **based on visibility reductions and not LWE rates.** 

### Allowance Table

This language is more descriptive of weather, but does not align with WMO, etc and METARS

FAA Holdover Time Guidelines

Winter 2023-2024

### TABLE 48: ALLOWANCE TIMES FOR SAE TYPE IV ETHYLENE GLYCOL (EG) FLUIDS<sup>1,2</sup>

			Outside Air	de Air Temperature						
Precipitation Types or Combinations	Applicable METAR Codes	-5 °C and above <sup>3</sup> (23 °F and above)	Below -5 to -10 °C <sup>3</sup> (Below 23 to 14 °F)	Below -10 to -16 °C <sup>3</sup> (Below 14 to 3 °F)	Below -16 to -22 °C <sup>3,4</sup> (Below 3 to -8 °F)					
Light Ice Pellets	-PL	70 minutes	50 minutes	50 minutes	30 minutes					
Light Ice Pellets Mixed with Light Snow	-PL SN, -SN PL	50 minutes	30 minutes	25 minutes						
Light Ice Pellets Mixed with Light Freezing Drizzle or Moderate Freezing Drizzle	-PL FZDZ, -FZDZ PL, FZDZ PL	40 minutes	30 minutes							
Light Ice Pellets Mixed with Light Drizzle or Moderate Drizzle	-PL DZ, -DZ PL, DZ PL	40 minutes <sup>5</sup>		Caut No allowa	tion: nce times					
Light Ice Pellets Mixed with Light Freezing Rain	-PL FZRA, -FZRA PL	40 minutes	30 minutes	current	ly exist					
Light Ice Pellets Mixed with Light Rain	-PL RA, -RA PL	40 minutes <sup>6</sup>								
Moderate Ice Pellets (or Small Hail <sup>7</sup> )	PL, GS	35 minutes	25 minutes	15 minutes	10 minutes					
Moderate Ice Pellets (or Small Hail <sup>7</sup> ) Mixed with Moderate Freezing Drizzle	PL FZDZ, GS FZDZ,	20 minutes	10 minutes							
Moderate Ice Pellets (or Small Hail <sup>7</sup> ) Mixed with Moderate Drizzle	PL DZ, GS DZ	20 minutes <sup>8</sup>		Caut No allowa current	tion: nce times ly exist					
Moderate Ice Pellets (or Small Hail <sup>7</sup> ) Mixed with Moderate Rain	PL RA, GS RA, RA PL, RA GS	15 minutes <sup>9</sup>								



# **Ground Truth**

Name of	f Observer:			
Time	P-D	P-S	P-T	Notes
	10.22			
	10:33			
	10:34			
	10:35			
	10:36			
	10:37			

P-D – Dominate Precipitation

- P-S Secondary Precipitation
- P-T Tertiary Precipitation





# Temp Dew Pt RH Wind Accum

Time	Temp ⁰C	DP ⁰C	RH%	Rel AP (in/mg)	WS (m/s)	Wdir (º)	Precip Q (in)	Time	Temp ⁰C	DP ⁰C	RH%	Rel AP (in/mg)	WS (m/s)	Wdir (º)	Precip Q (in)
1/3/2022 10:33	0.9	9 -2.9	89.9	1015	7.2	1 238.6	5 1.73	1/3/2022 10:36	0.9	-2.9	89.6	1014.8	3 7.2	2 208.4	4 1.73
1/3/2022 10:33	0.9	9 -2.9	89.9	1015	-	7 236.2	2 1.73	1/3/2022 10:36	0.9	-2.9	89.6	1014.8	6.3	1 218.2	2 1.73
1/3/2022 10:33	0.9	9 -2.9	89.9	1015	11.6	5 237.9	9 1.73	1/3/2022 10:36	0.9	-2.9	89.6	1014.8	5 7.0	5 224.0	6 1.73
1/3/2022 10:33	0.9	9 -2.9	89.8	3 1015	10.3	3 228.	7 1.73	1/3/2022 10:36	0.9	-2.9	89.7	1015	9.4	4 228.4	4 1.73
1/3/2022 10:33	0.9	9 -2.9	89.8	3 1015	10.3	3 231.0	5 1.73	1/3/2022 10:36	0.9	-2.9	89.7	1015	8.8	8 210.8	8 1.73
1/3/2022 10:33	0.9	9 -2.9	89.8	3 1015	10.3	3 220.3	1 1.73	1/3/2022 10:36	0.9	-2.9	89.7	1015	9.3	3 233.3	3 1.731
1/3/2022 10:34	0.9	9 -2.9	89.8	3 1015	9.4	4 222.	7 1.73	1/3/2022 10:37	0.9	-2.9	89.7	1015	6.5	5 217.4	4 1.731
1/3/2022 10:34	0.9	9 -2.9	89.8	3 1015	8.7	7 213.3	3 1.73	1/3/2022 10:37	0.9	-2.9	89.7	1015		7 222.:	1 1.731
1/3/2022 10:34	0.9	9 -2.9	89.8	3 1015	6.9	9 209.	5 1.73	1/3/2022 10:37	0.9	-3	8 89.7	1015	8.	5 214.0	6 1.731
1/3/2022 10:34	0.9	9 -2.9	89.6	5 1015	8.9	9 188.:	1 1.73	1/3/2022 10:37	0.9	-3	8 89.7	1015	8.2	2 211.4	4 1.731
1/3/2022 10:34	0.9	9 -3	89.6	5 1015	6.8	8 229.9	9 1.73	1/3/2022 10:37	0.9	-3	8 89.7	1015	6.	7 218.	1 1.731
1/3/2022 10:34	0.9	9 -3	89.6	5 1015	10.6	5 214.	7 1.73	1/3/2022 10:37	0.9	-3	8 89.7	1015	8.:	1 211.2	2 1.731
1/3/2022 10:35	0.9	9 -3	89.6	5 1015	-	7 205.4	4 1.73	1/3/2022 10:38	0.9	-3	8 89.7	1015	7.0	5 209.9	9 1.731
1/3/2022 10:35	0.9	9 -3	89.6	5 1015	6.2	1 212.9	9 1.73	1/3/2022 10:38	0.9	-3	8 89.7	1015	;	9 210	0 1.731
1/3/2022 10:35	0.9	9 -3	89.6	5 1015	5	5 205.2	2 1.73	1/3/2022 10:38	0.9	-3.1	. 89.7	1015	8.4	4 215.9	9 1.731
1/3/2022 10:35	0.9	9 -2.9	89.6	5 1014.8	8.4	4 208.4	4 1.73	1/3/2022 10:38	0.9	-3.1	89.8	1015	7.0	6 223.9	9 1.732
1/3/2022 10:35	0.9	9 -2.9	89.6	5 1014.8	8.3	3 212.0	5 1.73	1/3/2022 10:38	0.9	-3.1	89.8	1015		7 230.3	8 1.732
1/3/2022 10:35	0.9	9 -2.9	89.6	5 1014.8	5	3 212.3	3 1.73	1/3/2022 10:38	0.9	-3.1	89.8	1015	5.9	9 208.9	9 1.732





## Visibility

Time	Vis (sm)
1/3/2022 10:33	6.93
1/3/2022 10:34	7.14
1/3/2022 10:35	7.4
1/3/2022 10:36	7.77
1/3/2022 10:37	7.87
1/3/2022 10:38	8.03

## **Freezing Rain Sensor**

Time	Status	Curr Freq	Base Freq
1/3/2022 10:33	Р	39901	39993
1/3/2022 10:34	Р	39902	39993
1/3/2022 10:35	Р	39899	39993
1/3/2022 10:36	Р	39899	39993
1/3/2022 10:37	Р	39898	39993
1/3/2022 10:38	Р	39898	39993

## LWE

Time	Int RT (mm/hr)	Acc RT NRT (mm)	Acc NRT (mm)	ACC tot NRT (mm)	Bucket RT (mm)	Bucket NRT (mm)
1/3/2022 10:33	0	0	0	168.07	1077.687	1077.546
1/3/2022 10:34	0	0.06	0.05	168.122	1077.682	1077.572
1/3/2022 10:35	0	0.05	0.05	168.173	1077.695	1077.608
1/3/2022 10:36	0	0	0	168.176	1077.721	1077.638
1/3/2022 10:37	0	0	0	168.176	1077.735	1077.657
1/3/2022 10:38	0	0.05	0.05	168.23	1077.745	1077.68





# **PWS Output (Translated to a 1-minute ob)**

		Current PWD-22	
	P-D		
10:33	PL		
10:34	PL		
10:35	PL		
10:36	RA		
10:37	RA		
10:38	RA		

	Prototype	
	PWD-53	
P-D	P-S	P-T
PL		

Comm	nercial – Proto	o Msg	
	FD70_1		
P-D	P-S	P-T	
RA			
RA			
RA			
RA	SN	RA	
PL	SN	RA	
SN	RA	PL	

Comm	nercial – Proto	o Msg
	FD70_2	
P-D	P-S	P-T
RA	PL	
RA	PL	
PL	RA	RA
RA	SN	RA
RA	SN	PL
RA	SN	PL

### KACY METAR

SPECI KACY 031028Z 36010G18KT 4SM FZRA BR OVC060 01/M01 A3004 RMK AO2 UPE0957RAB0957E22FZRAB22 P0003 I1001 T00061011= SPECI KACY 031043Z 01011G17KT 3SM -SN BR OVC060 00/M01 A3003 RMK AO2 UPE0957RAB0957E22FZRAB22E37SNB37 P0005 I1001 T00001011=





## **PWS Current vs PWS New**

PWD22_01	IP-									TIME	10:33		PWD22_01	R-								TIME	10:36		
PWD53_01	IP-	IP-	IP-	IP-									PWD53_01	IP	IP	IP	IP								
FD70_01	ZR2	ZR2	ZR2	FD70_01	ZR2	ZR2	ZR2	R1	R1	R1	R1	R1	R1	R1	R1	R1									
	///	///	///	///	///	///	///	///	///	///	///	///			///	///	S1	S1	S1	S1	S1	S1	S1	S1	S1
	///	///		///	///		///	///	///	///	///	///			///	///	ZR0	ZR0	ZR0	ZR0	ZR0	ZR0	ZR0	ZR0	ZR0
FD70_02	ZR1	IP0	IP0	IP0	ZR1	FD70_02	R1	R1	ZR1	R1	R1	R1	R1	R1	R1	R1	R1	R1							
	IP0	ZR1	ZR1	ZR1	IP0		SO	S0	IP0	S0	S0	S0	S0	S0	S0	S0	S0	S0							
	///	///	///	///	///	///	///	///	///	///	///	///		IP0	IP0	RO	ZR0	ZR0	ZR0	ZR0	ZR0	ZR0	ZR0	ZR0	ZR0
PWD22_01	IP-									TIME	10:34		PWD22_01	R-								TIME	10:37		
PWD53_01	IP	IP	IP	IP									PWD53_01	IP	IP	IP	IP								
FD70_01	ZR2	ZR2	ZR2	FD70_01	R1	R1	IP2	IP2	IP2	IP2	IP2	IP2	IP2	IP2	IP2	S2									
	///	///	///	///	///	///	///	///	///	///	///	///		S1	S1	///	///	///	///	///	///	///	///	///	///
	///	///	///	///	///	///	///	///	///	///	///	///		ZR0	ZR0	///	///	///	///	///	///	///	///	///	///
FD70_02	ZR1	ZR1	IP0	IP0	IP0	IP0	IP0	IP0	ZR1	ZR1	ZR1	ZR1	FD70_02	R1	R1	R1	R1	R1	R1	IP0	IP0	R1	S1	R1	R1
	IP0	IP0	ZR1	ZR1	ZR1	ZR1	ZR1	ZR1	IP0	IP0	IP0	IP0		SO	SO	S0	S0	S0	S0	ZR1	ZR1	SO	R1	S0	S0
	///	///	///	///	///	///	///	///	///	///	///	///		ZR0	ZR0	ZR0	///	///	///	RO	RO	IP0	IP0	IP0	IP0
PWD22_01	IP-									TIME	10:35		PWD22_01	R-								TIME	10:38		
PWD53_01	IP	IP-	IP-	IP-									PWD53_01	IP	IP	IP-	IP-								
FD70_01	ZR2	ZR2	ZR2	FD70_01	S2	S2	S2	R1	R1	R1															
	///	///	///	///	///	///	///	///	///	///	///	///		///	///	///	///	///	///	///	///	///	S1	S1	S1
	///	///	///	///	///	///	///	///	///	///	///	///			///	///	///	///	///	///	///	///	IP0	IP0	///
FD70_02	IP0	IP0	IP0	IP0	IP0	ZR1	ZR1	R1	R1	R1	IP0	R1	FD70_02	R1	S1	S1	S1	R1	R1	R1	R1	R1	R1	S1	S1
	ZR1	ZR1	ZR1	ZR1	ZR1	IP0	IP0	SO	S0	SO	ZR1	SO		SO	RO	RO	RO	S0	S0	S0	S0	S0	S0	R1	RO
		///	///	///	///	///	///	ZR0	ZR0	ZR0	RO	IP0		IP0	IP0				///						
E.		FA	A																Ne	$\rightarrow X$		<b>7</b> -	=N		





Obs	erve	r 1	_	Ob	serve	er 2		<u> </u>	serve	er 3	0	serve	er 4		Ob	serve	er 5	_	Ob	serv	<u>er 6</u>			Obs	erve	'e
P-D P	P-S	P-T		P-D	P-S	P-T		P-D	P-S	P-T	P-D	P-S	P-T		P-D	P-S	P-T		P-D	P-S	P-	Т	Р	P-D	P-S	;
PL F	RA			PL	RA	SN		PL	RA	SN	PL	SN	RA		PL				PL	SN			F	PL		
PL F	RA			PL	RA	SN		PL	RA	SN	PL	SN	RA		PL				PL	SN			F	PL		
PL F	RA			PL	RA	SN		PL	RA	SN	PL	SN	RA		PL				PL	SN			F	PL		
PL F	RA			PL	RA	SN		PL	RA	SN	PL	SN	RA		PL				PL	SN			F	PL		
PL F	RA	SN		PL	RA	SN		PL	RA	SN	PL	SN	RA		PL				PL	SN			F	PL		
	RA .	SN		PL	RA	SN		PL	RA	SN	PL	SN	RA		PL				PL	SN			F	PL	SN	
					_		_	<u> </u>							_		Obs	1 50	6>	Ob	s 2 4	0%>	>	Obs	s 3 (	6
bs M	aj <mark>R</mark> A	A PL	SN	GS G	R DZ	SG	VL	SNT							Б	[ime	Obs D	1 50 S	6> Г	Ob D	s 2 4 S	ю%> т	>	Obs D	s 3 (	6
<b>bs M</b> 7 3	aj <mark>R</mark> A	A PL 7	<b>SN</b> 4	GS GI	R DZ	SG	VL	SNT 4							1	<b>ime</b>	Obs D	1 50 S	6> Г	Ob D	s 2 4 S	0%> T	>	Obs D	s 3 ( S	6
7 3 7 3	<b>aj RA</b> 3 4 3 4	A PL 7 7	<b>SN</b> 4	GS G	R DZ	SG	VL	<b>SNT</b> 4 4							<b>1</b> 1	<b>[ime</b> 0:33	Obs D PL Pl	1 509 S RA S	6> r N	Ob D PL PI	s 2 4 S RA	0%> T SN	>	Obs D PL PI	s 3 ( S	6
Ibs         Mi           7         3           7         3           7         3           7         3	aj RA 3 4 3 4 3 4	<ul> <li>PL</li> <li>7</li> <li>7</li> <li>7</li> <li>7</li> </ul>	<b>SN</b> 4 4	GS G	R DZ	SG	VL	<b>SNT</b> 4 4							<b>1</b> 1 1	<b>1 ime</b> 0:33 0:34	Obs D PL PL	1 50 S RA S RA S	6> r N N	Ob D PL PL PI	s <b>2 4</b> S RA RA	0%> T SN SN		Obs D PL PL	s 3 (	6
Ibs         Mi           7         3           7         3           7         3           7         3           7         3           7         3           7         3	aj RA 3 4 3 4 3 4 3 4	<ul> <li>PL</li> <li>7</li> <li>7</li> <li>7</li> <li>7</li> <li>7</li> </ul>	SN 4 4 4 4	GS G	R DZ	SG	VL	<b>SNT</b> 4 4 4 4							1 1 1 1	<b>lime</b> 0:33 0:34 0:35 0:36	Obs D PL PL PL	1 509 S RA 3 RA 3 RA 3	6> r N N	Ob D PL PL PL	s 2 4 S RA RA RA	0%> T SN SN SN	>	Obs D PL PL PL	s 3 (	6
Ibs         Ma           7         3           7         3           7         3           7         3           7         3           7         3           7         3           7         3           7         3           7         3           7         3	aj     RA       3     4       3     4       3     4       3     4       3     4       3     4	<ul> <li>PL</li> <li>7</li> <li>7</li> <li>7</li> <li>7</li> <li>7</li> <li>7</li> <li>7</li> <li>7</li> </ul>	SN 4 4 4 4 4	GS G	R DZ	SG	<b>VL</b>	<b>SNT</b> 4 4 4 4 4 4							1 1 1 1 1 1	<b>lime</b> 0:33 0:34 0:35 0:36 0:37	Obs           D           PL           PL           PL           PL           PL           PL           PL           PL           PL	1 509 S RA 9 RA 9 RA 9 RA 9 RA 9	6> r N N N	Ob D PL PL PL PL	s 2 4 S RA RA RA RA	0%> T SN SN SN SN		Obs D PL PL PL PL	s 3 (	6
	P-D         F           PL         I           PL         I           PL         I           PL         I           PL         I           PL         I           PL         I	P-D         P-S           PL         RA           PL         RA           PL         RA           PL         RA           PL         RA           PL         RA	P-D         P-S         P-T           PL         RA            PL         RA            PL         RA            PL         RA            PL         RA            PL         RA            PL         RA	P-D         P-S         P-T           PL         RA	P-D         P-S         P-T         P-D           PL         RA         PL         PL           PL         RA         SN         PL	P-D         P-S         P-T         P-D         P-S           PL         RA         PL         RA         PL         RA           PL         RA         PL         RA         PL         RA	P-DP-SP-TPLRAPLPLRAPLRAPLPLRAPLRAPLPLRAPLRAPLPLRAPLRASNPLRAPLRASNPLRAPLRASNPLRAPLRASNPLRAPLRASNPLRAPLRASNPLRA	P-DP-SP-TPLRAPLPLRAPLRAPLRASNPLRAPLRASNPLRAPLRASNPLRASNPLRASNPLRASN-PLRASNPLRASN-PLRASNPLRASN-PLRASN	P-DP-SP-TP-DP-SP-TP-DPLRAPLRASNPLPLRAPLRASNPLPLRAPLRASNPLPLRAPLRASNPLPLRASNPLRASNPLPLRASNPLRASNPLPLRASNPLRASNPL	P-DP-SP-TP-DP-SP-TP-DP-SPLRA <td>P-DP-SP-TP-DP-SP-TPLRAPLRASNPLRASNPLRAPLRASNPLRASNPLRAPLRASNPLRASNPLRASNPLRASNPLRASNPLRASNPLRASNPLRASNPLRASNPLRASNPLRASNPLRASNPLRASNPLRASNPLRASNPLRASNPLRASN</td> <td>P-DP-SP-TP-DP-SP-TP-DP-DP-SP-TPLRAIPLRASNPLRASNPLPLRAIPLRASNPLRASNPLPLRAIPLRASNPLRASNPLPLRAIPLRASNPLRASNPLPLRASNPLRASNPLRASNPLPLRASNPLRASNPLRASNPLPLRASNPLRASNPLRASNPLPLRASNPLRASNPLRASNPL</td> <td>P-DP-SP-DP-SP-TP-DP-SP-TP-DP-</td> <td>P-DP-SP-DP-SP-TP-DP-SP-TP-DP-SP-TPLRACPLRASNPLRASNPLSNRAPLRACPLRASNPLRASNPLSNRAPLRASNPLRASNPLRASNPLSNRAPLRASNPLRASNPLRASNPLSNRAPLRASNPLRASNPLRASNPLSNRAPLRASNPLRASNPLSNRAPLRASNPLRASNPLSNRA</td> <td>P-DP-SP-DP-SP-TP-DP-SP-TPLRAPLRASNPLRASNPLSNRAPLRASNPLRASNPLRASNPLSNRAPLRASNPLRASNPLRASNPLSNRAPLRASNPLRASNPLRASNPLSNRAPLRASNPLRASNPLSNRAPLRASNPLRASNPLSNRAPLRASNPLRASNPLSNRAPLRASNPLRASNPLSNRA</td> <td>P-DP-SP-TP-DP-SP-TP-DP-SP-TP-DP-SP-TPLRASNPLRASNPLRASNPLSNPLPLPLPLPLRASNPLRASNPLRASNPLSNRAPLPLRASNPLRASNPLRASNPLSNRAPLPLRASNPLRASNPLRASNPLSNRAPLPLRASNPLRASNPLRASNPLSNRAPLPLRASNPLRASNPLSNRAPLPLPLRASNPLRASNPLSNRAPLPLRASNPLRASNPLSNRAPLPLRASNPLRASNPLSNRAPL</td> <td>P-DP-SP-DP-SP-DP-SP-TP-DP-SP-TP-DP-SP-TPLRASNPLRASNPLRASNPLSNRAPLPLPLPLRASNPLRASNPLRASNPLSNRAPLPLPLRASNPLRASNPLRASNPLSNRAPLPLPLRASNPLRASNPLRASNPLSNRAPLPLPLRASNPLRASNPLRASNPLSNRAPLPLPLRASNPLRASNPLRASNPLSNRAPLPLPLRASNPLRASNPLRASNPLSNRAPLPLPLRASNPLRASNPLRASNPLSNRAPLPLPLRASNPLRASNPLSNRAPLSNPLSNPLPLRASNPLRASNPLSNRAPLSNPLSNPLPLRASNPLRASNPLSNRAPLSNSNPLSNSNSNSNSNSNPL<td>P-DP-SP-DP-SP-TP-DP-SP-TP-DP-SP-TPLRASNPLRASNPLRASNPLSNRAPL&lt;</td><td>P-DP-SP-DP-SP-TP-DP-SP-TP-DP-SP-TPLRASNPLRASNPLRASNPLSNRAPLPLPLPLPLRASNPLRASNPLRASNPLSNRAPLPLPLPLPLRASNPLRASNPLRASNPLSNRAPLDLDLPLRASNPLRASNPLRASNPLSNRAPLDLDLPLRASNPLRASNPLRASNPLSNRAPLDLDLPLRASNPLRASNPLRASNPLSNRAPLDLDLPLRASNPLRASNPLSNRAPLDLDLDLPLRASNPLRASNPLSNRAPLDLDLPLRASNPLRASNPLSNRAPLDLDLPLRASNPLRASNPLSNRAPLDLDLPLRASNPLRASNPLSNRAPLDLDLPLRASNPLRASNPLSNRAPL&lt;</td><td>P-DP-DP-SP-TP-DP-</td><td>P-DP-DP-SP-TP-</td><td>P-DP-DP-SP-TP-</td><td>P-DP-DP-DP-SP-TP-DP-SP-TP-DP-SP-TP-DP-SP-TPLRASNPLRASNPLRASNPLRASNPLSNRAPLSNSNPLSNSNPLSNSNPLSNSNPLSNSNPLSNSNSNPL<td>P-DP-DP-SP-TP-SP-TP-TP-</td><td>P-DP-DP-DP-SP-TP-DP-SP-TP-DP-SP-TP-DP-SP-TP-DP-</td><td>P-DP-SP-TP-DP-</td></td></td>	P-DP-SP-TP-DP-SP-TPLRAPLRASNPLRASNPLRAPLRASNPLRASNPLRAPLRASNPLRASNPLRASNPLRASNPLRASNPLRASNPLRASNPLRASNPLRASNPLRASNPLRASNPLRASNPLRASNPLRASNPLRASNPLRASNPLRASN	P-DP-SP-TP-DP-SP-TP-DP-DP-SP-TPLRAIPLRASNPLRASNPLPLRAIPLRASNPLRASNPLPLRAIPLRASNPLRASNPLPLRAIPLRASNPLRASNPLPLRASNPLRASNPLRASNPLPLRASNPLRASNPLRASNPLPLRASNPLRASNPLRASNPLPLRASNPLRASNPLRASNPL	P-DP-SP-DP-SP-TP-DP-SP-TP-DP-	P-DP-SP-DP-SP-TP-DP-SP-TP-DP-SP-TPLRACPLRASNPLRASNPLSNRAPLRACPLRASNPLRASNPLSNRAPLRASNPLRASNPLRASNPLSNRAPLRASNPLRASNPLRASNPLSNRAPLRASNPLRASNPLRASNPLSNRAPLRASNPLRASNPLSNRAPLRASNPLRASNPLSNRA	P-DP-SP-DP-SP-TP-DP-SP-TPLRAPLRASNPLRASNPLSNRAPLRASNPLRASNPLRASNPLSNRAPLRASNPLRASNPLRASNPLSNRAPLRASNPLRASNPLRASNPLSNRAPLRASNPLRASNPLSNRAPLRASNPLRASNPLSNRAPLRASNPLRASNPLSNRAPLRASNPLRASNPLSNRA	P-DP-SP-TP-DP-SP-TP-DP-SP-TP-DP-SP-TPLRASNPLRASNPLRASNPLSNPLPLPLPLPLRASNPLRASNPLRASNPLSNRAPLPLRASNPLRASNPLRASNPLSNRAPLPLRASNPLRASNPLRASNPLSNRAPLPLRASNPLRASNPLRASNPLSNRAPLPLRASNPLRASNPLSNRAPLPLPLRASNPLRASNPLSNRAPLPLRASNPLRASNPLSNRAPLPLRASNPLRASNPLSNRAPL	P-DP-SP-DP-SP-DP-SP-TP-DP-SP-TP-DP-SP-TPLRASNPLRASNPLRASNPLSNRAPLPLPLPLRASNPLRASNPLRASNPLSNRAPLPLPLRASNPLRASNPLRASNPLSNRAPLPLPLRASNPLRASNPLRASNPLSNRAPLPLPLRASNPLRASNPLRASNPLSNRAPLPLPLRASNPLRASNPLRASNPLSNRAPLPLPLRASNPLRASNPLRASNPLSNRAPLPLPLRASNPLRASNPLRASNPLSNRAPLPLPLRASNPLRASNPLSNRAPLSNPLSNPLPLRASNPLRASNPLSNRAPLSNPLSNPLPLRASNPLRASNPLSNRAPLSNSNPLSNSNSNSNSNSNPL <td>P-DP-SP-DP-SP-TP-DP-SP-TP-DP-SP-TPLRASNPLRASNPLRASNPLSNRAPL&lt;</td> <td>P-DP-SP-DP-SP-TP-DP-SP-TP-DP-SP-TPLRASNPLRASNPLRASNPLSNRAPLPLPLPLPLRASNPLRASNPLRASNPLSNRAPLPLPLPLPLRASNPLRASNPLRASNPLSNRAPLDLDLPLRASNPLRASNPLRASNPLSNRAPLDLDLPLRASNPLRASNPLRASNPLSNRAPLDLDLPLRASNPLRASNPLRASNPLSNRAPLDLDLPLRASNPLRASNPLSNRAPLDLDLDLPLRASNPLRASNPLSNRAPLDLDLPLRASNPLRASNPLSNRAPLDLDLPLRASNPLRASNPLSNRAPLDLDLPLRASNPLRASNPLSNRAPLDLDLPLRASNPLRASNPLSNRAPL&lt;</td> <td>P-DP-DP-SP-TP-DP-</td> <td>P-DP-DP-SP-TP-</td> <td>P-DP-DP-SP-TP-</td> 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<td>P-DP-SP-TP-DP-</td>	P-DP-DP-SP-TP-SP-TP-TP-	P-DP-DP-DP-SP-TP-DP-SP-TP-DP-SP-TP-DP-SP-TP-DP-	P-DP-SP-TP-DP-

### Consensus per percentage

### KACY METAR

SPECI KACY 031028Z 36010G18KT 4SM FZRA BR OVC060 01/M01 A3004 RMK AO2 UPE0957RAB0957E22FZRAB22 P0003 I1001 T00061011= SPECI KACY 031043Z 01011G17KT 3SM -SN BR OVC060 00/M01 A3003 RMK AO2 UPE0957RAB0957E22FZRAB22E37SNB37 P0005 I1001 T00001011=





## **Final Considerations for Multiple Precip Reporting**

Intensity reporting challenges appear more complicated than Detection reporting challenges

Technological
 Impact to METAR formulation
 METAR Re-education for all users

Ground Truth development stress-tests the detection and intensity paradigms

Sustainment Mode leaves little-to-no room for any of this!

However, planned ground truthing for legacy sustainment of LEDWI is still not clear.

Emerging IP infrastructure is presenting opportunities to do more with sensors messages beyond formulating METARS





# **Tailored Observation Team**

Scope Supplement METAR with tailored products? (While still using ASOS/AWOS equipage)

Focus Tailored detection and intensity reporting

Tailored temporal resolution

NextGen/WXXM Compliant

Terms of Use





# **Tailored Observation Team**

Aviation Weather Research Program Weather Sensors Product Development Team is exploring techniques for employing raw sensor data for tailored product development.

This work:

- Leverages emerging NAS IP infrastructure
- Non-evasive to ASOS/AWOS baseline
- NAS Security Compliant
- Database-centric
- WXXM adaptable

We will brief/demonstrate proposed techniques at first meeting!



