



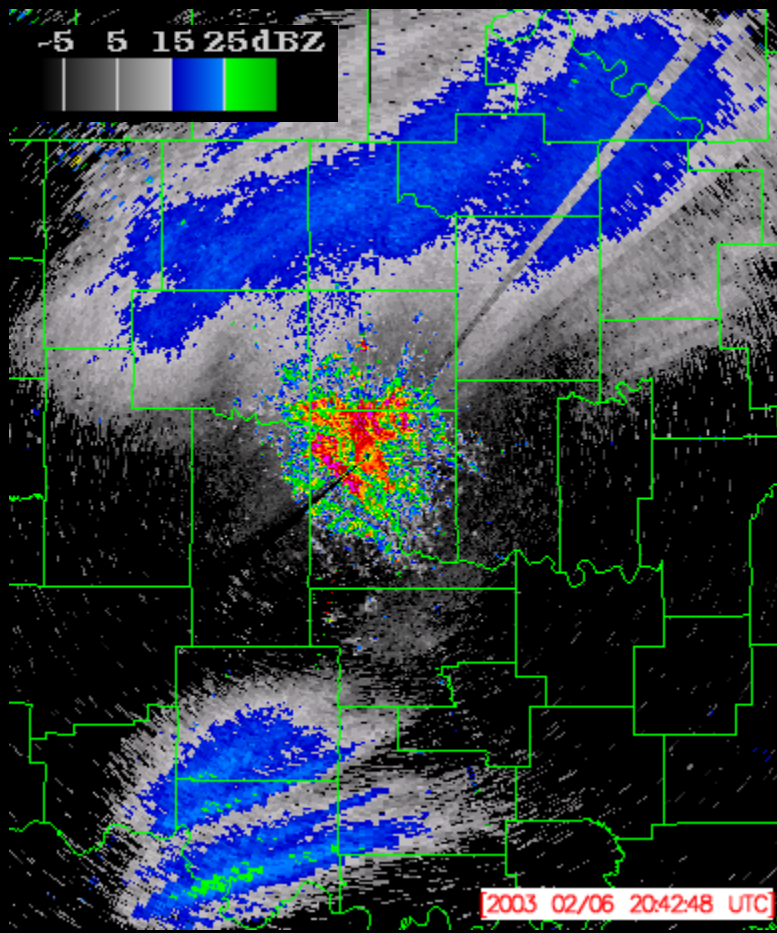
***mPING: Citizen Science  
Research***

**Kim Elmore (NSSL/CIMMS)**

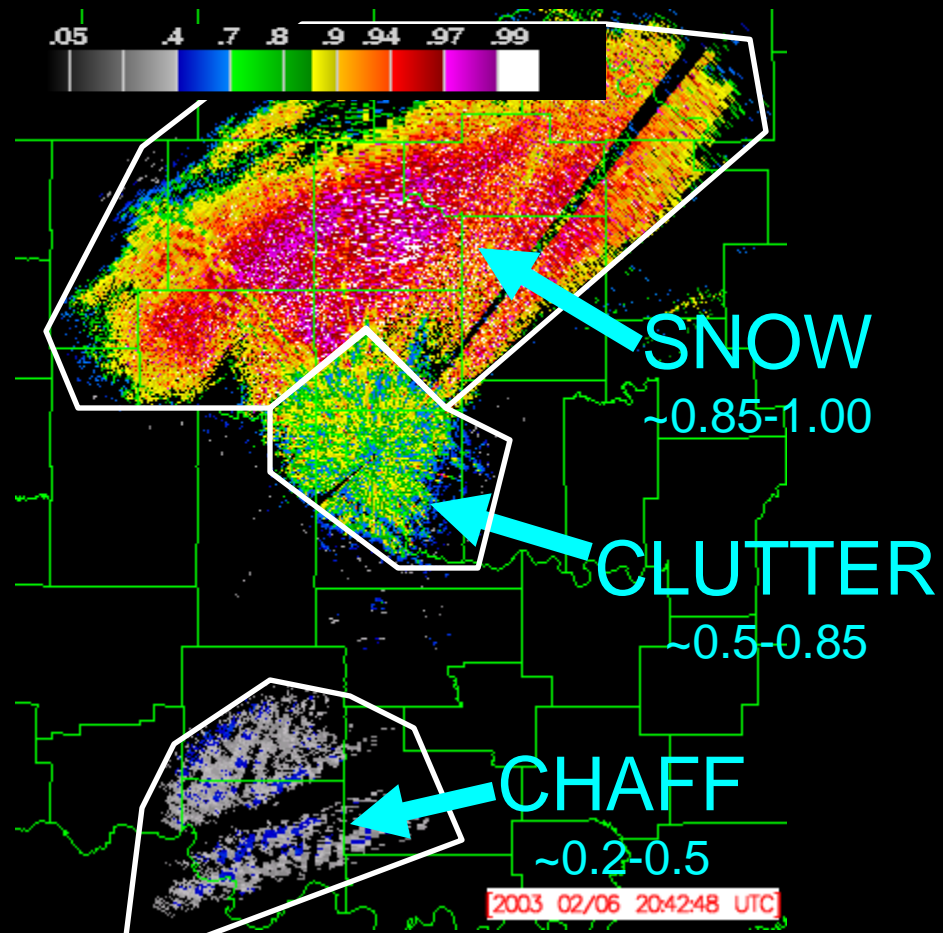
# mPING Motivation

- Hydrometeor typing:
- Summer: Hail vs. Rain
  - Very successful and well-established capability.
- Winter: Rain vs. Snow vs. Drizzle vs. Ice Pellets vs. Graupel vs. Freezing Rain vs. Freezing Drizzle vs. ...
  - Capability largely unknown.





Reflectivity



Correlation Coefficient ( $\rho_{HV}$ )

# In The Beginning...

- Winter 2006-2007: The **W**inter **H**ydrometeor **C**lassification **G**round **T**ruth Experiment (WHCGT)
- Purpose: attempt to validate HCA performance when applied to *winter surface precipitation*
- Local to KOUN (out to ~150 km)
- Depended upon active use of a (pretty klunky) web form by interested members of the public; required knowledge of lat/lon and date/time by general public.


# Getting the WHCGT Word Out

- Press Releases (TV, radio, newspapers)
- School contacts (interested teachers)
- NOAA Weather Radio (recurring announcement)
- NSSL Home Web Page
- OUN NWS Enhanced Web Page linked to NSSL mPING project page.

# Winter Report Form

Winter Hydrometeor Classification Ground Truth Experiment

Back Forward Reload Stop Home del.icio.us tag this http://www.nssl.noaa.gov/projects/winter06/form.php Google Adblock Plus



[NSSL Home](#)

[WHCGT Home Page](#)

**Precipitation Observation Report Form**

[WHCGT FAQ](#)

[Snowflake Identification NEW!](#)

[Questions and comments](#)

## Winter Hydrometeor Classification Ground Truth Experiment

**Project Status: Inactive**

2/23/07 -- No winter weather is expected for the next several days. March storms generate significant snowfall, so winter isn't over, yet! Also, a new web page is being designed for a Spring project to use the new radar to help determine hail size. More as the project develops.

### Precipitation Observation Report Form

Use this form to report information about winter precipitation observations in areas within 90 miles of Norman, Oklahoma.

\*Required fields

<b>Date*:</b>	<input type="text" value="26"/>	<input type="text" value="June"/>	<input type="text" value="2007"/>
<b>Time*:</b>	<input type="text" value="hh"/>	<input type="text" value="mm"/>	<input type="text" value="am"/>
<b>Precipitation Type*:</b>	<input type="text" value="None"/>		
<b>Location/ID*:</b> (complete address)	<input type="text"/>		
<b>OR</b>			
<b>latitude/longitude*</b>	<input type="text" value="latitude"/>	<input type="text" value="longitude"/>	
<b>Temperature:</b>	<input type="text"/>	° F.	
<b>Wind Speed:</b>	<input type="text"/>	mph	
<b>Wind Direction:</b>	<input type="text" value="None Specified"/>		

Done McAfee SiteAdvisor

# Events and Reports

- Main events were 29 November, 2 January, and 11 Jan (start times).
- 3-4 smaller events also occurred.
- Events tended to contain a lot of freezing precipitation, followed by frozen precipitation.
- A few convective events displayed the complete gamut of winter precipitation types!

# WHGCT Events and Reports (cont.)

- How many reports (total) for the 2006-2007 Winter season?

- Before QC:

2,659

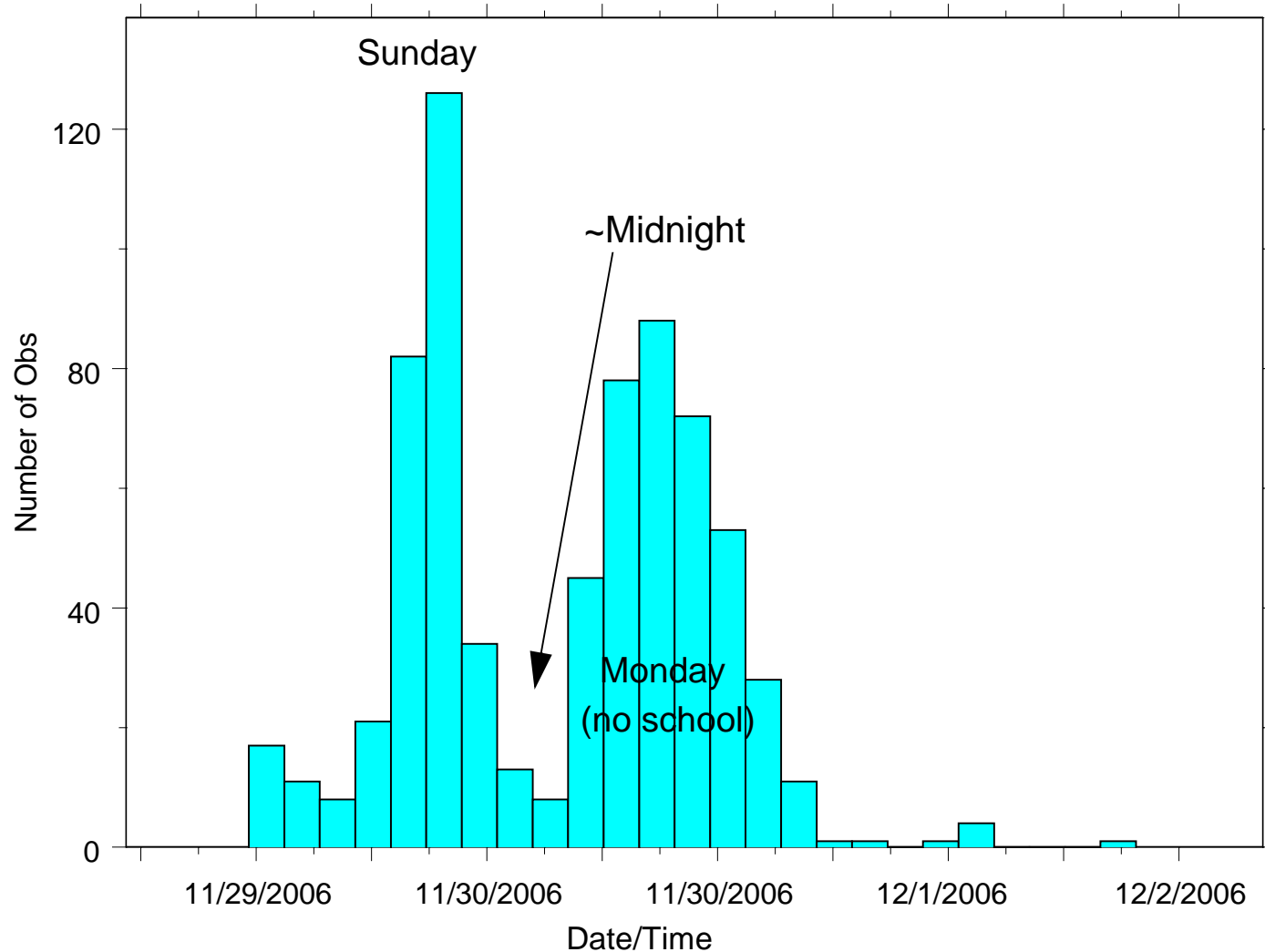
- After QC:

~2600



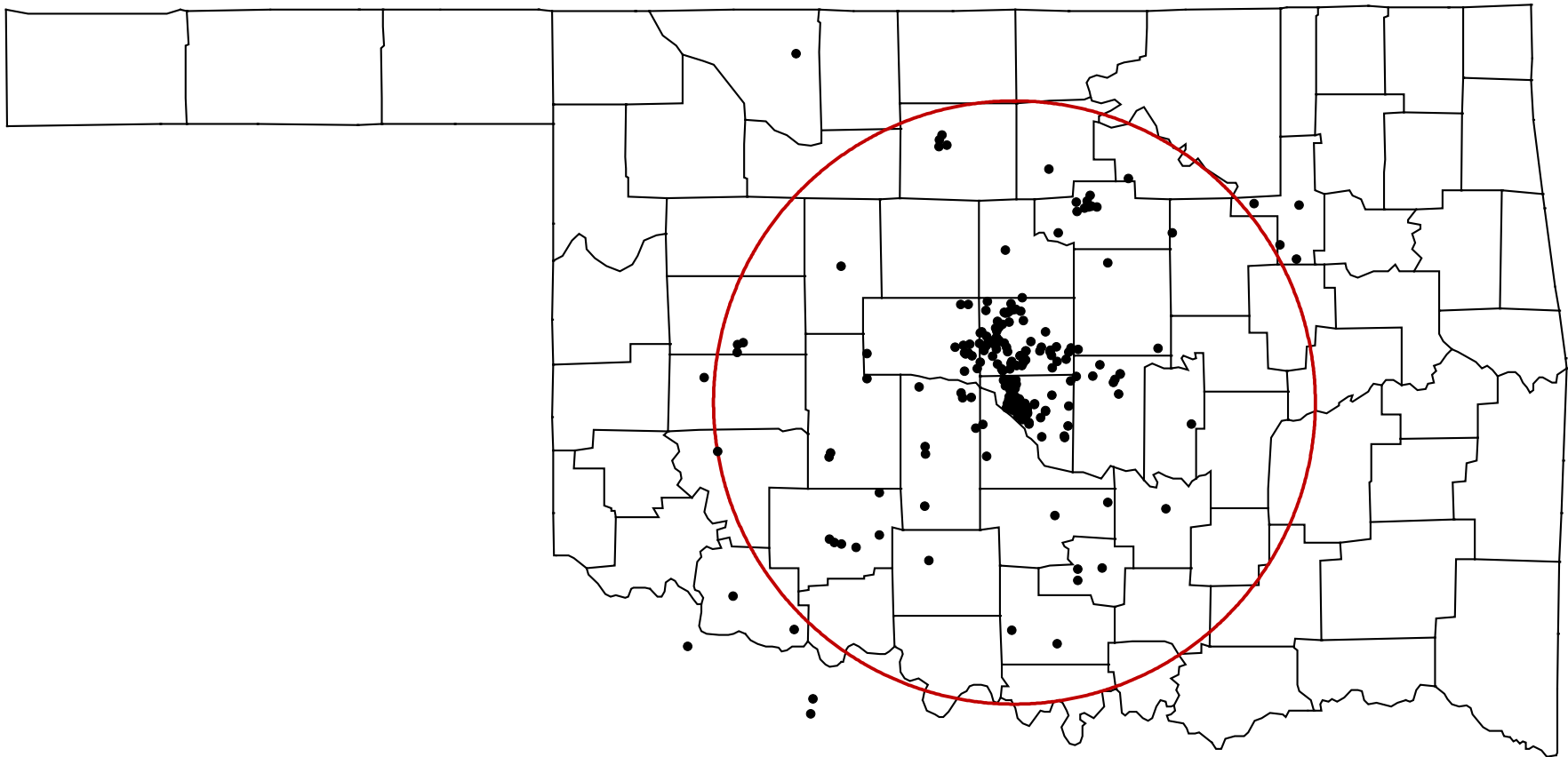
# Typical Distribution of Observations

Temporal Observation Distribution



# Event 1: Spatial Distribution of Observations

Spatial Obs Distribution, Event 1, All Precip Types



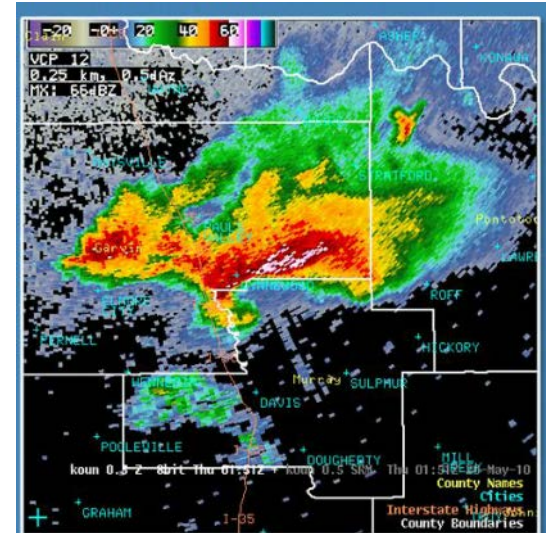
# Where We Are: Original HCA

Existing operational version of the hydrometeor classification algorithm (HCA) distinguishes between 10 classes of echo

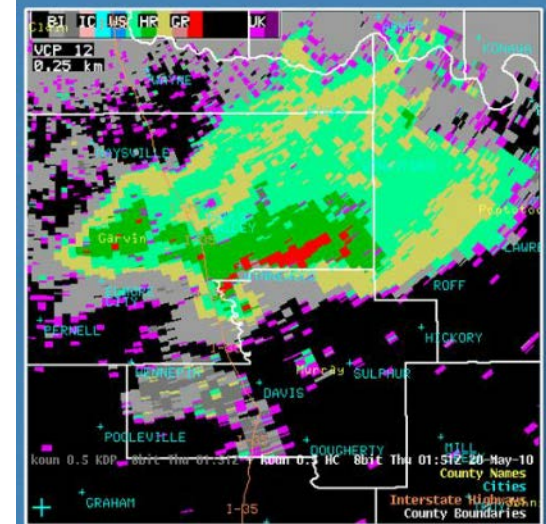
## Classes

1. GC/AP – ground clutter / AP
2. BS – biological scatterers
3. DS – dry aggregated snow
4. WS – wet snow
5. CR - crystals
6. GR – graupel
7. BD – “big drops”
8. RA – light and moderate rain
9. HR – heavy rain
10. HA – hail (possibly mixed with rain)

Reflectivity



Class



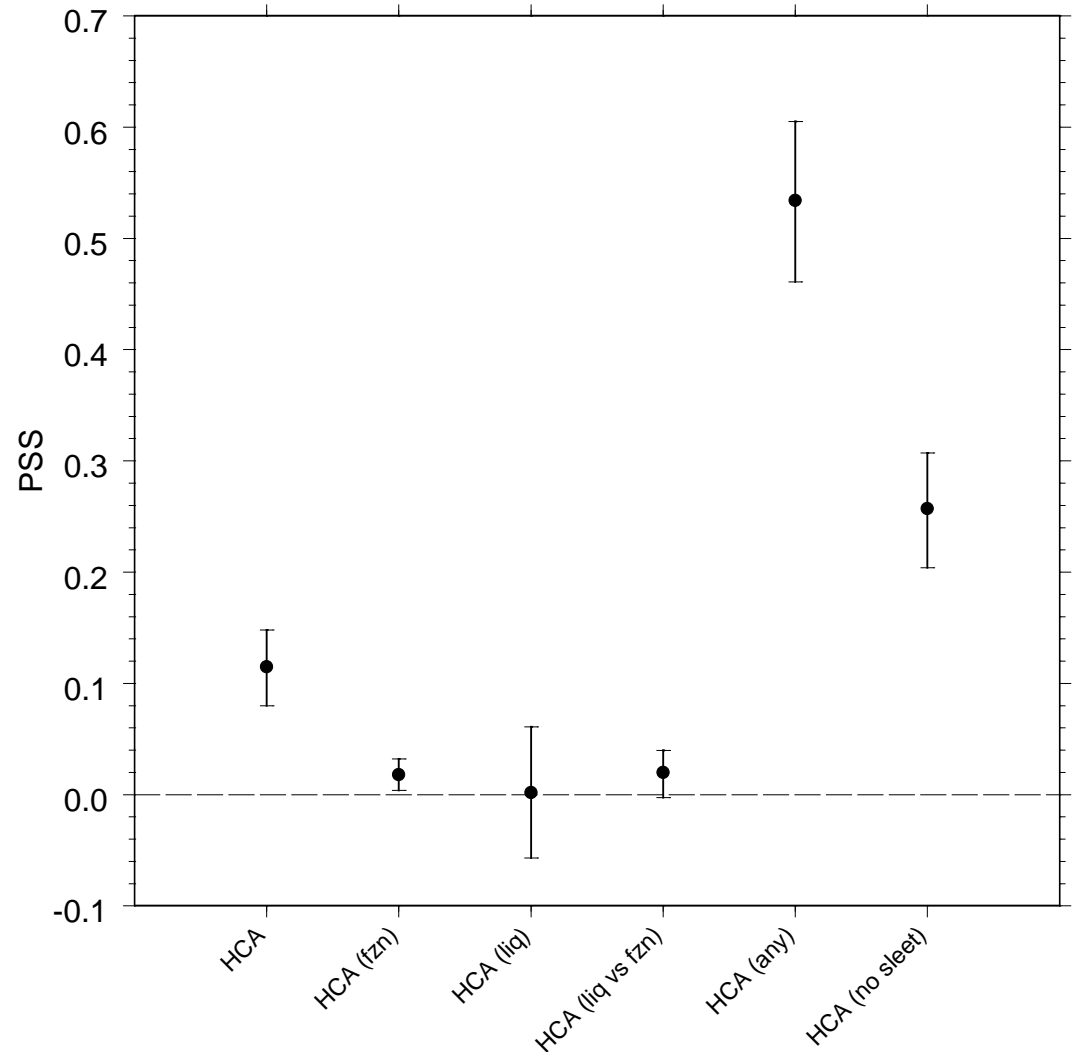
# Collapse Precip Types to the Bare Minimum

Collapse all observed and HCA types to only three:

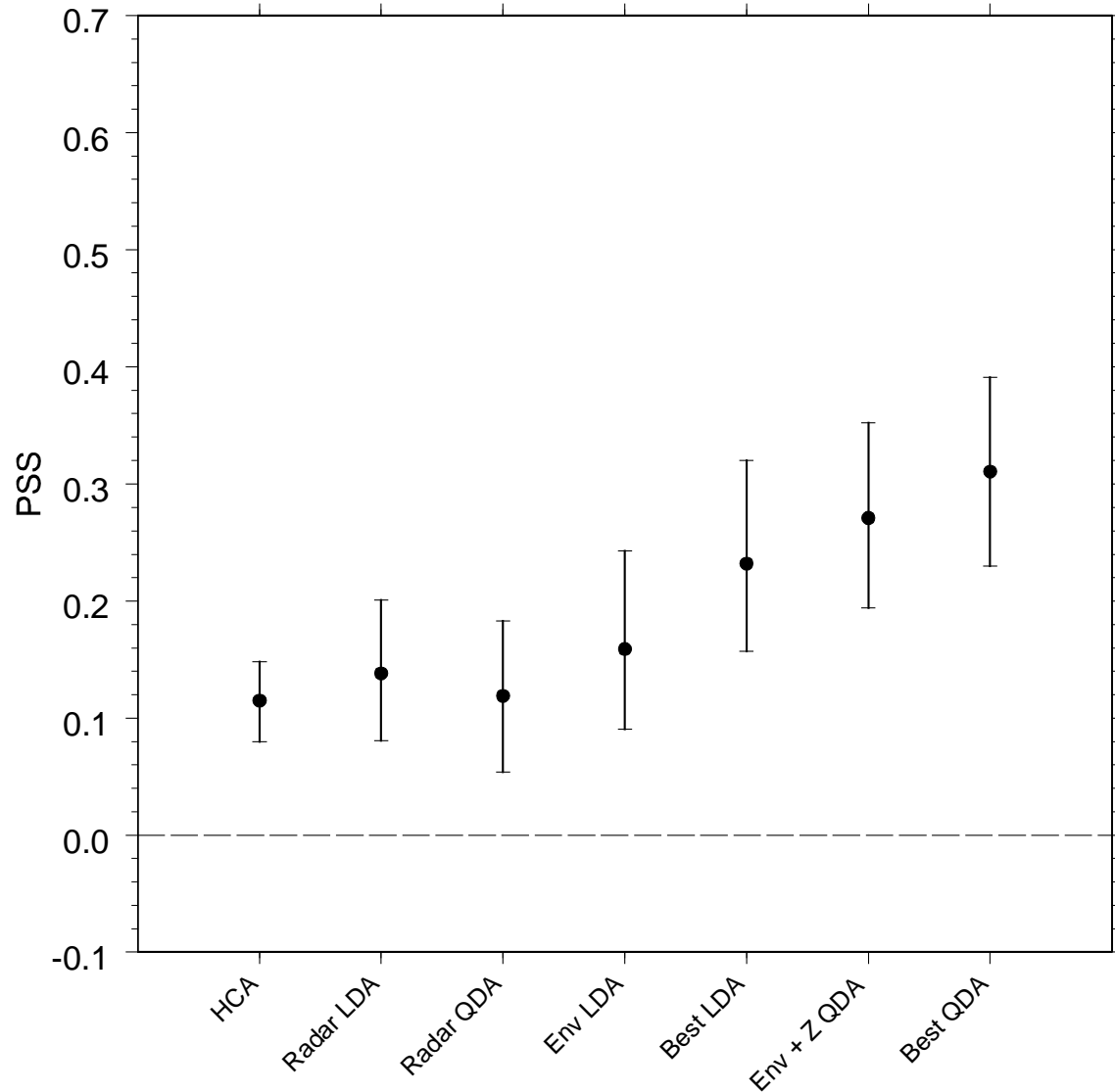
- *Liquid* (includes rain, drizzle, freezing rain, freezing drizzle)
- *Frozen* (includes any kind of snow, ice pellets, hail)
- *None*

# Original HCA Performance

Limit HCA data to the lowest data between 400 and 1200 m AGL that is not contaminated by ground clutter/AP (see Elmore 2011, *WAF*)



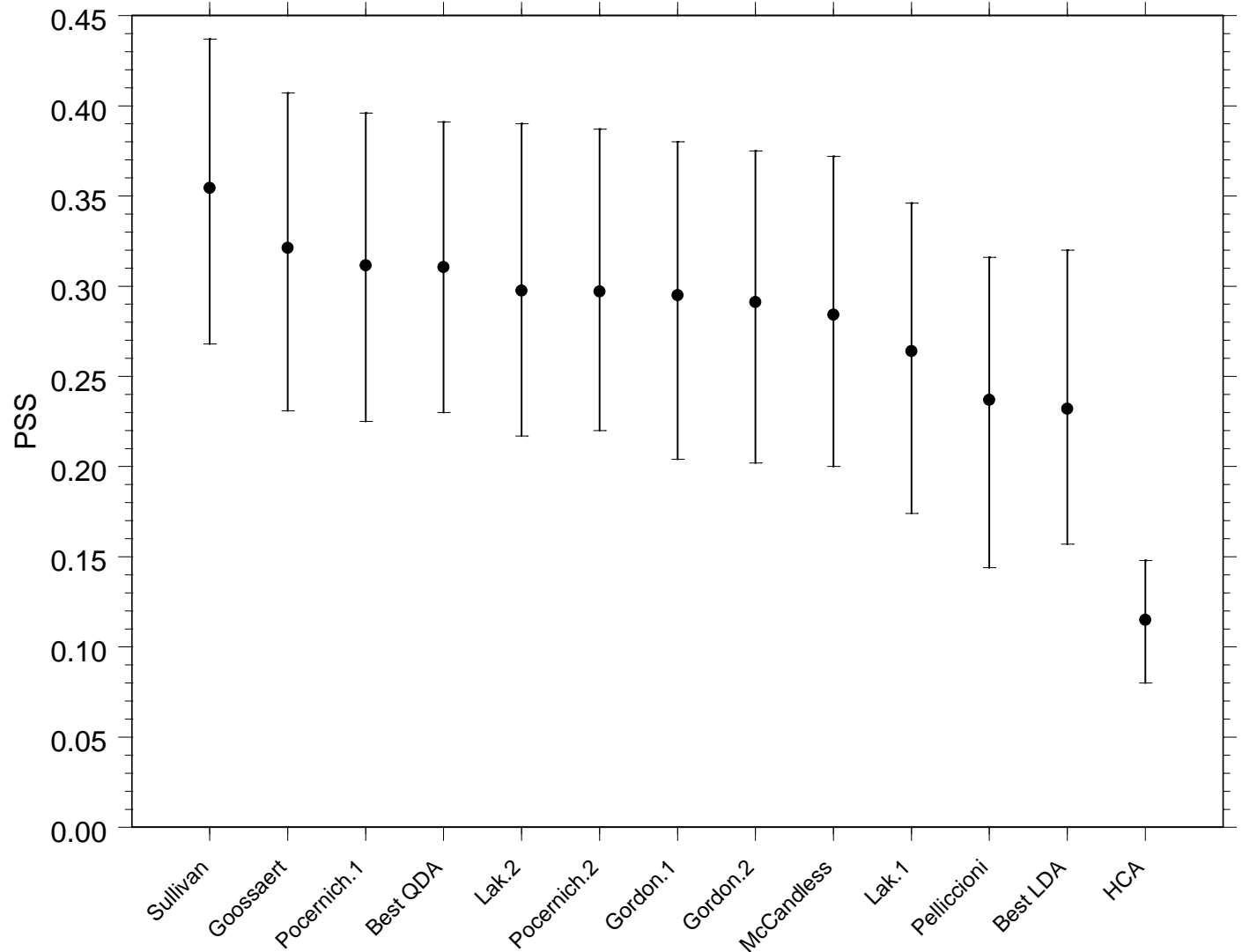
# More Original HCA Performance





# And Even More Original HCA Performance

A comparison of various precipitation classifiers submitted in the AMS Artificial Intelligence Contest (Lakshmanan et al. 2010, *BAMS*)



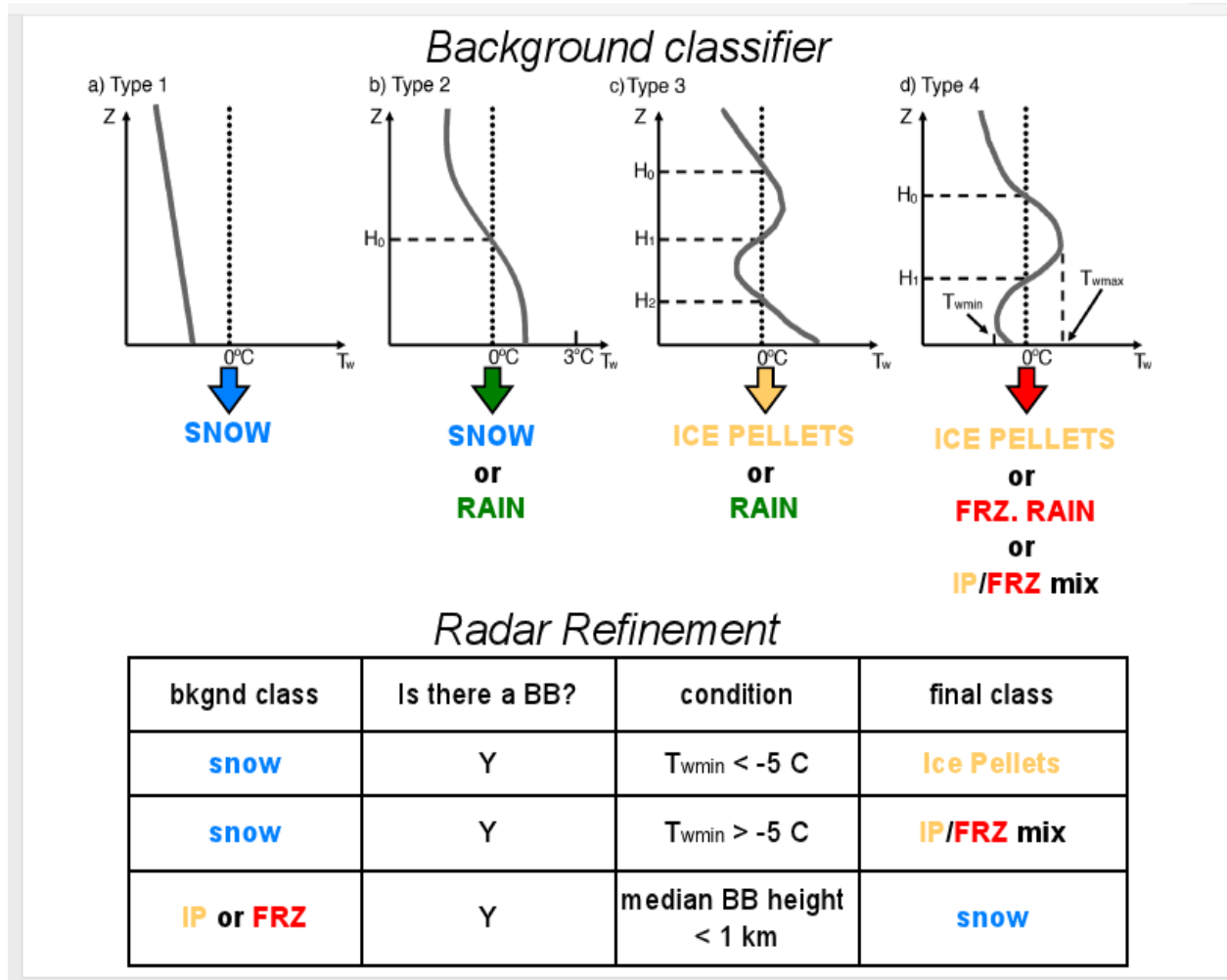
# Existing HCA Purpose

- Quantitative precipitation estimation (QPE)
  - Each precipitation type uses a different  $f(Z, Z_{DR}, K_{DP}) \sim R$  formulation
- **Not** intended to be used for classifying precipitation at the ground.
  - Yet, that's a natural response.

# Problems Applying HCA at the Surface...

- Classification is made on conical surfaces, *not* at the ground
- Does not identify precipitation types associated with transitional winter weather (e.g., freezing rain, ice pellets/sleet, mixtures)
- No thermodynamic environmental information is utilized
  - The algorithm is “local”– doesn’t use vertical profiles of radar and thermodynamic variables
- Assumes monotonic dependence of temperature with height (it’s always rain everywhere below the highest melting layer)
- Does not work well in situations with low bright band
- No information about hail size

# Building HCA2 (WSHCA)



# *Data Driven*

- Because we will soon have ~128 operational polarimetric radars, we can now *depend on the data we gather* to drive the nature of the classifier
- Will utilize statistical classifiers (neural nets, support vector machines, tree ensembles, random forests, etc.)
- But... We must have estimates of the environmental conditions
  - Hourly HRRR analysis serves as a proxy for the real atmosphere
- Must have observations of the precipitation type at the surface
  - ASOS won't do as it can't report on mixed types and can't report ice pellets. Besides, there aren't enough of them...
  - Enter Winter SHAVE and PING!

# “Active” Observation Gathering: Winter **Severe Hazards Analysis** and **Verification** *Experiment*





# Observations of SFC Precip Type

## WINTER SHAVE

*3 Feb 2012 – 8 Mar 2012*

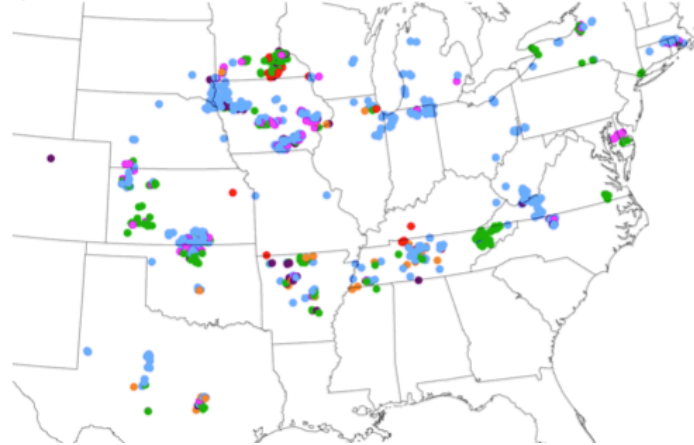
- 1266 reports (39% within 100 km of dual pol WSR-88D radars)
- 17 different dual pol WSR-88D radars in 11 states
- 14 distinct storm events under umbrella of dual pol WSR-88 radars

## HAIL

*1 Jan 2012 – 31 Aug 2012*

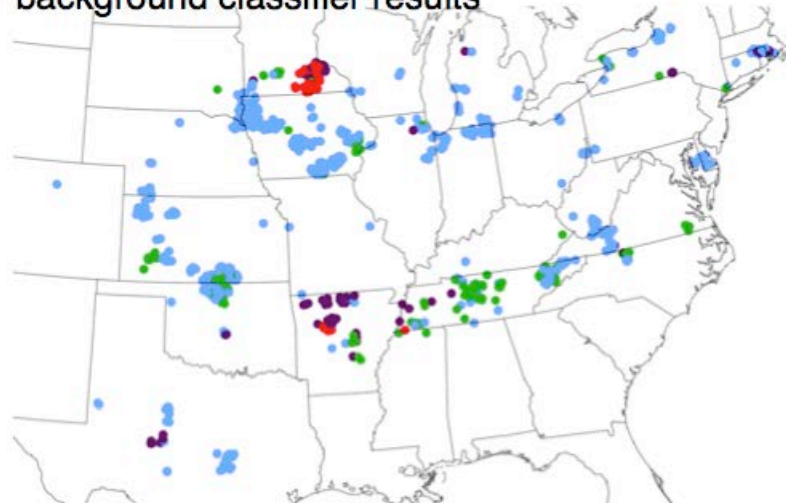
- 8910 reports (83% - small hail, 15% - large hail, 2% - giant hail)
- 48 different dualpol WSR-88D radars

spatial distribution of observations



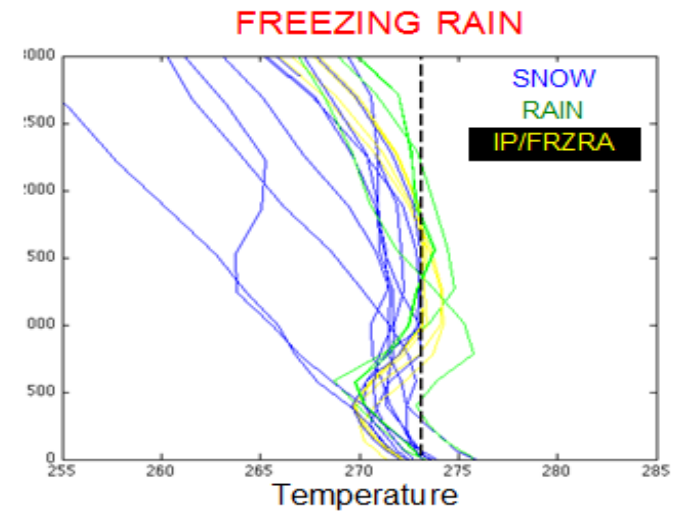
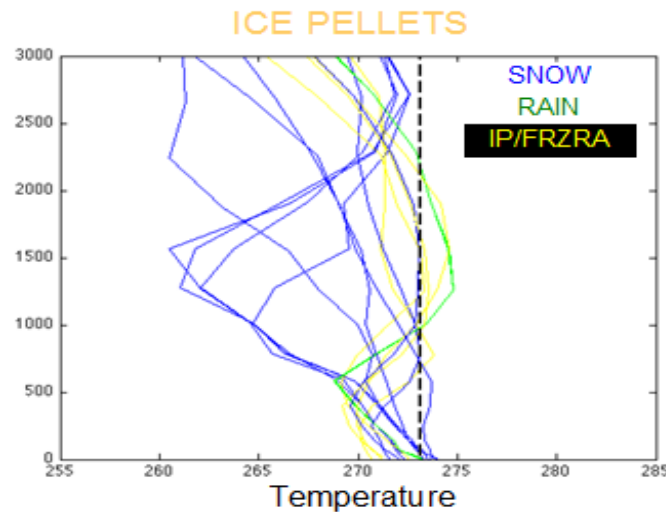
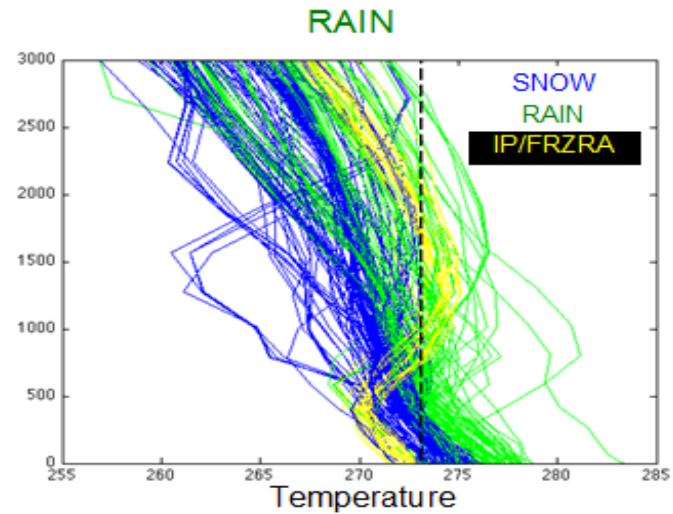
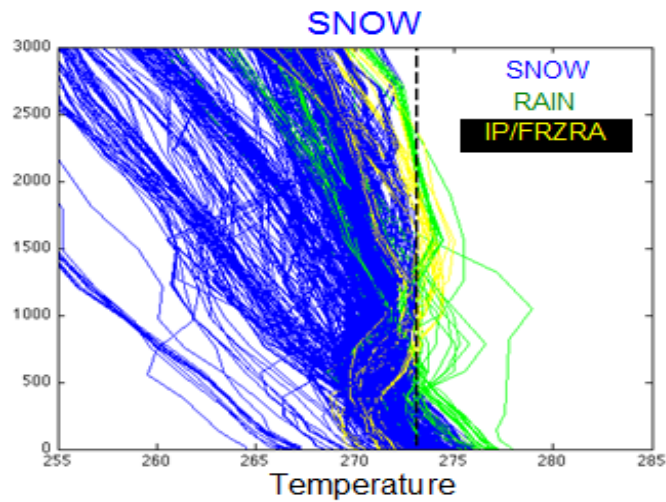
248 - rain  
616 - snow  
39 - ice pellets  
16 - freezing rain  
129 - rain/snow  
29 - rain/ip  
19 - ip/snow  
13 - rain/ip/snow  
7 - fzra/ip  
4 - frza/ip/snow  
3 - graupel/ip

background classifier results



228 - rain  
788 - snow  
0 - ice pellets  
26 - freezing rain  
78 - fzra/ip

# HRRR Analysis Soundings



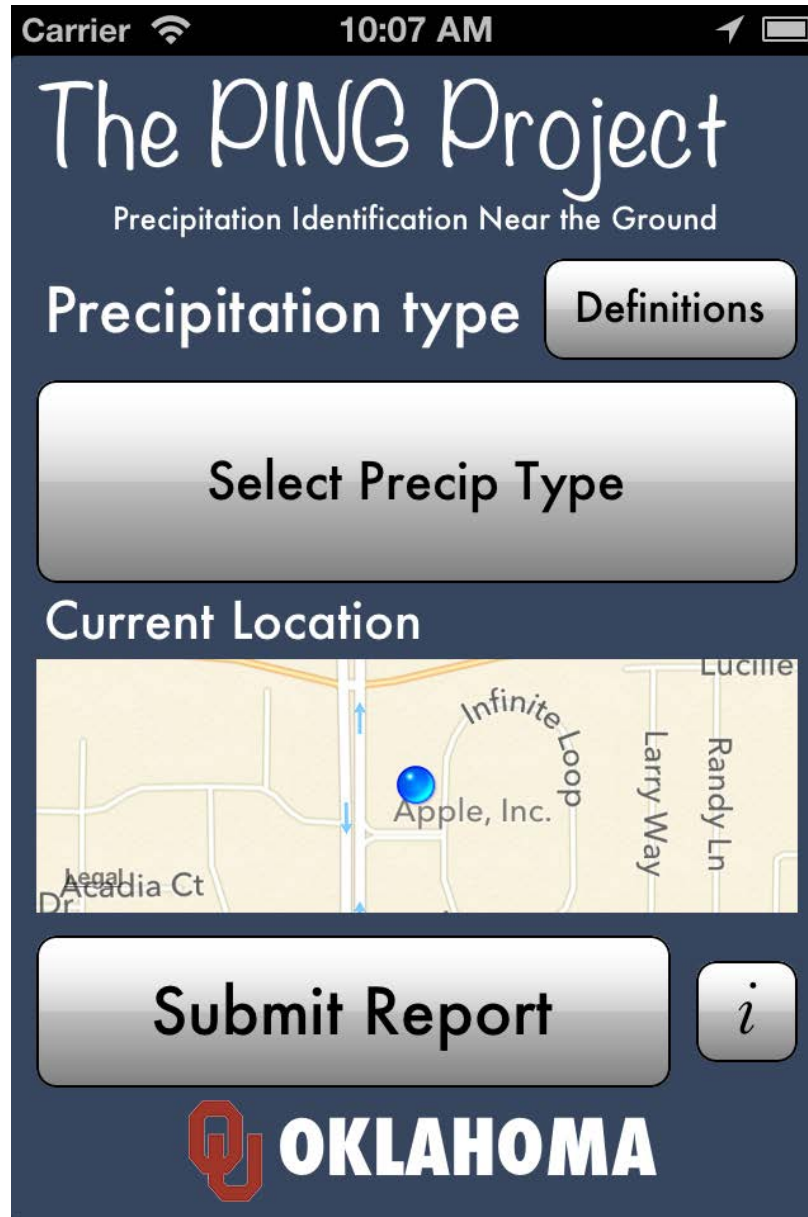
	Accuracy	POD	POFD	FAR	CSI	PSS
SNOW	0.76	0.86	0.54	0.17	0.71	0.37
RAIN	0.76	0.46	0.15	0.50	0.32	0.37

# Must Have More SFC Obs

- How many?
  - *Ideally, hundreds of thousands!*
- ***P*recipitation *I*dentification *N*ear the ***G*round****

PING

# The PING App



# The PING App (cont.)

## Additional Types are:

Wet Snow

Snow

Ice Pellets/Sleet

Graupel/Snow Grains

Carrier  10:08 AM  

**Test**

---

**None**

---

**Hail**

---

**Rain**

---

**Drizzle**

---

**Freezing Rain**

---

**Freezing Drizzle**

---

**Mixed Rain & Snow**

---

**Mixed Rain & Ice Pellets**

---

**Mixed Ice Pellets & Snow**

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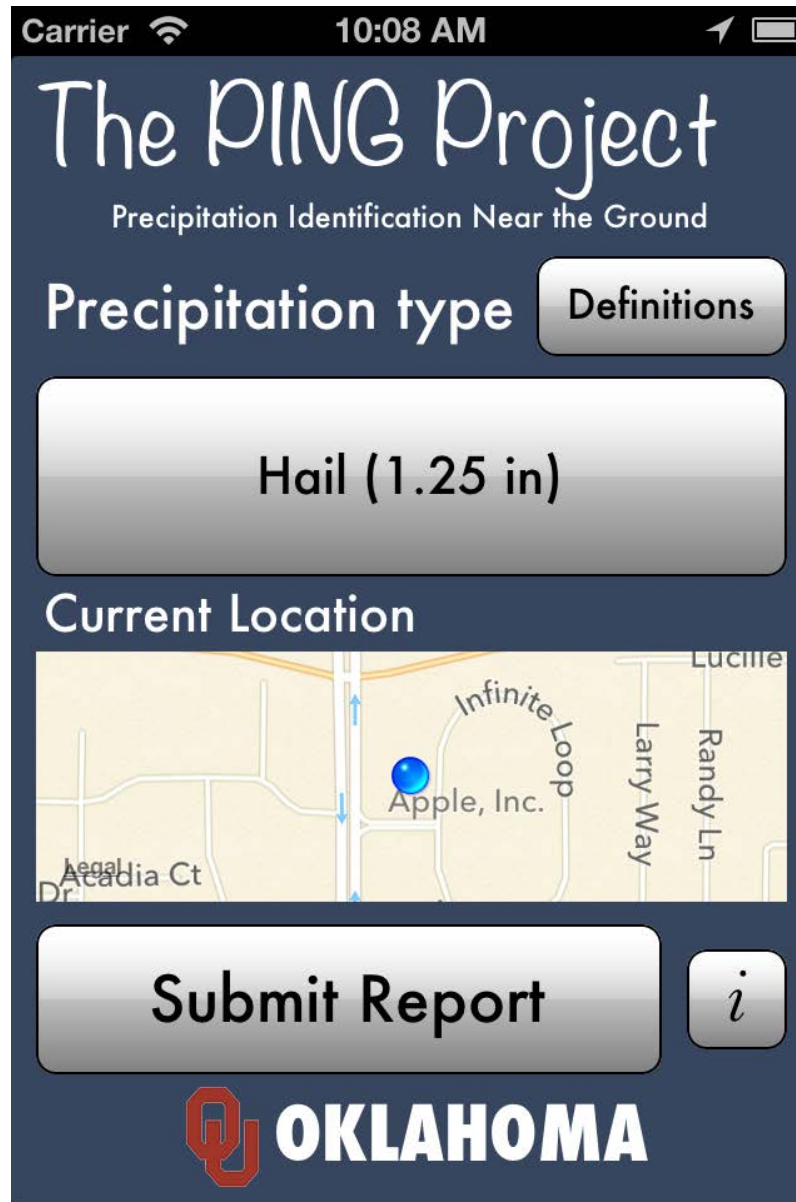
**Wet Snow**

# The PING App (cont.)

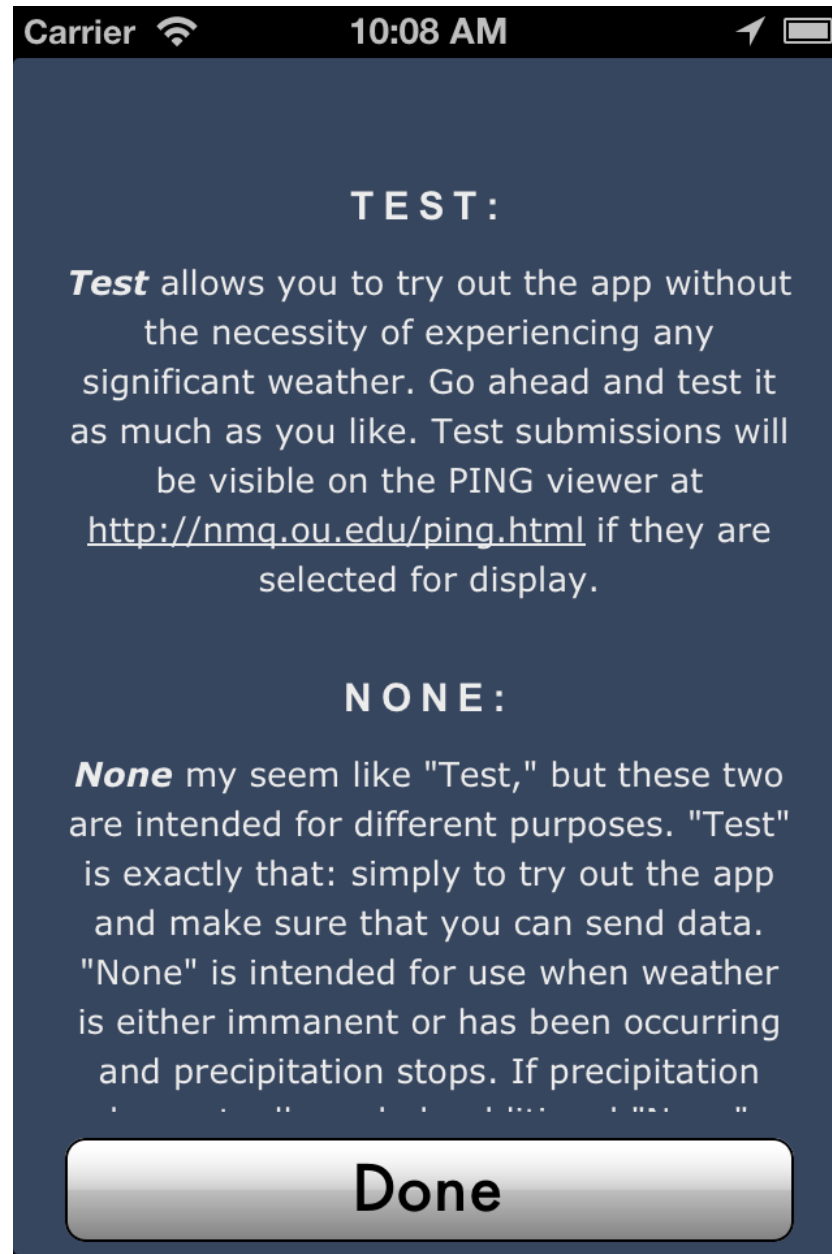




# The PING App (cont.)



# The PING App (cont.)



## TEST:

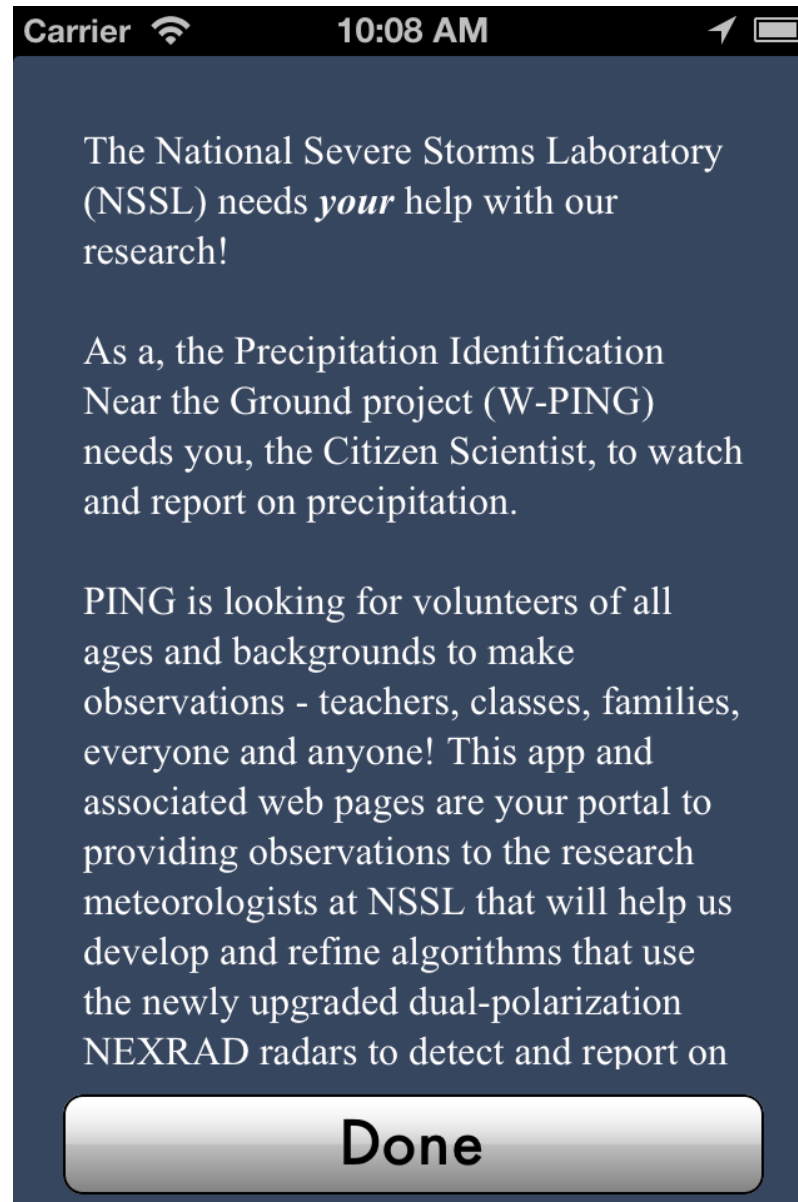
**Test** allows you to try out the app without the necessity of experiencing any significant weather. Go ahead and test it as much as you like. Test submissions will be visible on the PING viewer at <http://nmq.ou.edu/ping.html> if they are selected for display.

## NONE:

**None** may seem like "Test," but these two are intended for different purposes. "Test" is exactly that: simply to try out the app and make sure that you can send data. "None" is intended for use when weather is either immanent or has been occurring and precipitation stops. If precipitation

Done

# The PING App (cont.)



# 6 h of One Day: Feb 8, 2013

0500 through 1100 EST; 5500 total PINGs

**The PING Project**  
*Precipitation Identification Near the Ground*

[Text Reports](#)      Page Loaded: 04/16/2013 16:51 UTC  
[Help/Tutorial](#)

Year		Month		
2006	2007	Jan	<b>Feb</b>	Mar
2008	2009	Apr	May	June
2010	2011	July	Aug	Sept
2012	<b>2013</b>	Oct	Nov	Dec

Day						
					<b>1</b>	2
3	4	5	6	7	<b>8</b>	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28		

End Hour: 06 12 18 **00 UTC (next day)**

[Zoom Out \(Full\)](#)    [Zoom Out \(x2\)](#)

Show History: **On**    Active Window Duration: 10 m 20 m 30 m 1 hr 2 hr **6 hr** 24 hr

Hide/Unhide Precipitation Types:

Test	<input checked="" type="checkbox"/> Drizzle	<input checked="" type="checkbox"/> Frz Driz	<input checked="" type="checkbox"/> Ice Pellets	<input checked="" type="checkbox"/> Snow	*
None	<input checked="" type="checkbox"/> Rain	<input checked="" type="checkbox"/> Frz Rain	<input checked="" type="checkbox"/> Graupel	<input checked="" type="checkbox"/> Wet Snow	*
Hail	<input checked="" type="checkbox"/> Mixes: Rain/Snow	<input checked="" type="checkbox"/> Rain/Ice Pell.	<input checked="" type="checkbox"/> Ice Pell./Snow		*

Time Strip: 03 06 09 12 15 18 21

2/8/2013 [UTC]

# mPING

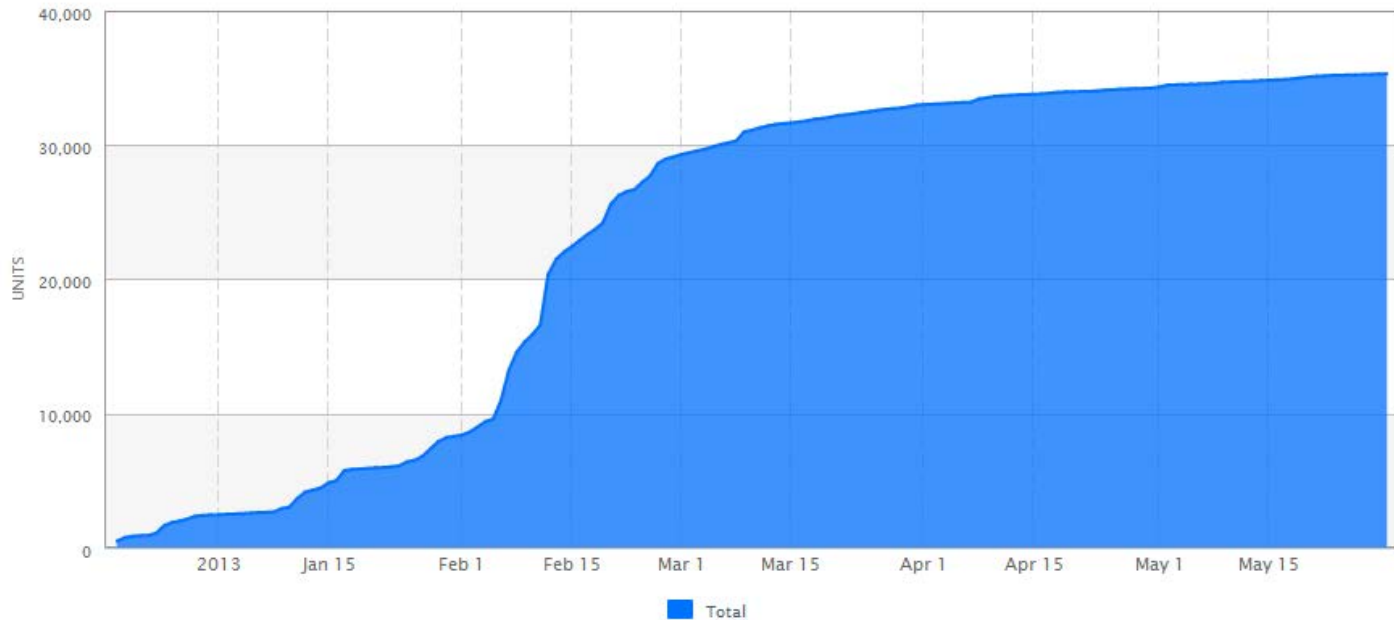
downloads <span style="color: green;">▲3,628%</span> <b>35,301</b> 217 per day	profit <b>\$0.00</b> \$0.00 per day	updates <b>39,623</b> 243 per day
all downloads 36,307	all profit \$0.00	all updates 39,623

••

country  overlay ranks from

## Chart

data **UNITS** PROFIT overlay **UPDATES** EVENTS TREND type **BAR** AREA LINE SMOOTH **COMBINE** CUMULATIVE



# How Many PINGs So Far (19 Dec 2012 to late May 2013)?

- Total: 252852
- Total non-test reports: 237412
- Total none reports: 53849
- ~ 200000 reports of “weather”