Meteorological Phenomena Identification Near the Ground (mPING)

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February 25–27, 2015

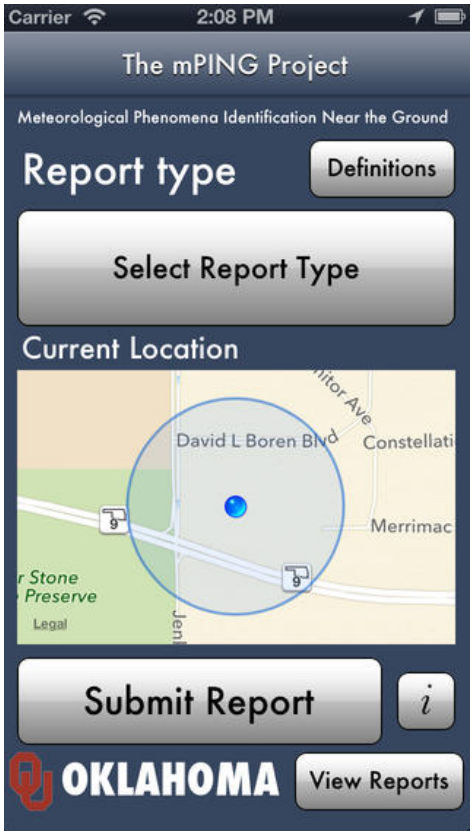
National Weather Center

Norman, Oklahoma

A Brief History of mPING

- Relevance: Knowing winter surface precipitation type is critical to city and emergency managers, aircraft operations, and quantitative precipitation estimation
- Started as an exercise to determine original HCA applicability to surface precipitation type – *a misapplication!*
  - Results showed very limited skill at surface
- HCA2 Working Group created through Director's discretionary funds to create a winter surface precipitation type algorithm
  - Success hinges on CONUS-scale verification/development data that includes ice pellets – ASOS does not qualify
  - Prior experience demonstrated that Citizen Scientists can properly identify winter precipitation types
- "There should be an app for that…"
  - mPING app appears in Apple App Store and Google Play on 19 Dec 2012

The mPING App



- Precipitation
  - None
  - Drizzle
  - Rain
  - Freezing Drizzle
  - Freezing Rain
  - Snow
  - Ice Pellets
  - Mixed Rain & Snow
  - Mixed Rain & Ice Pellets
  - Mixed Ice Pellets & Snow
- Wind Damage
  - 5 Levels
- Flooding
  - 4 Levels
- Hail
  - 0-10”, 0.25” steps
- Tornado*
- Landslide
- Blowing Dust
- Fog

*Only to NWS

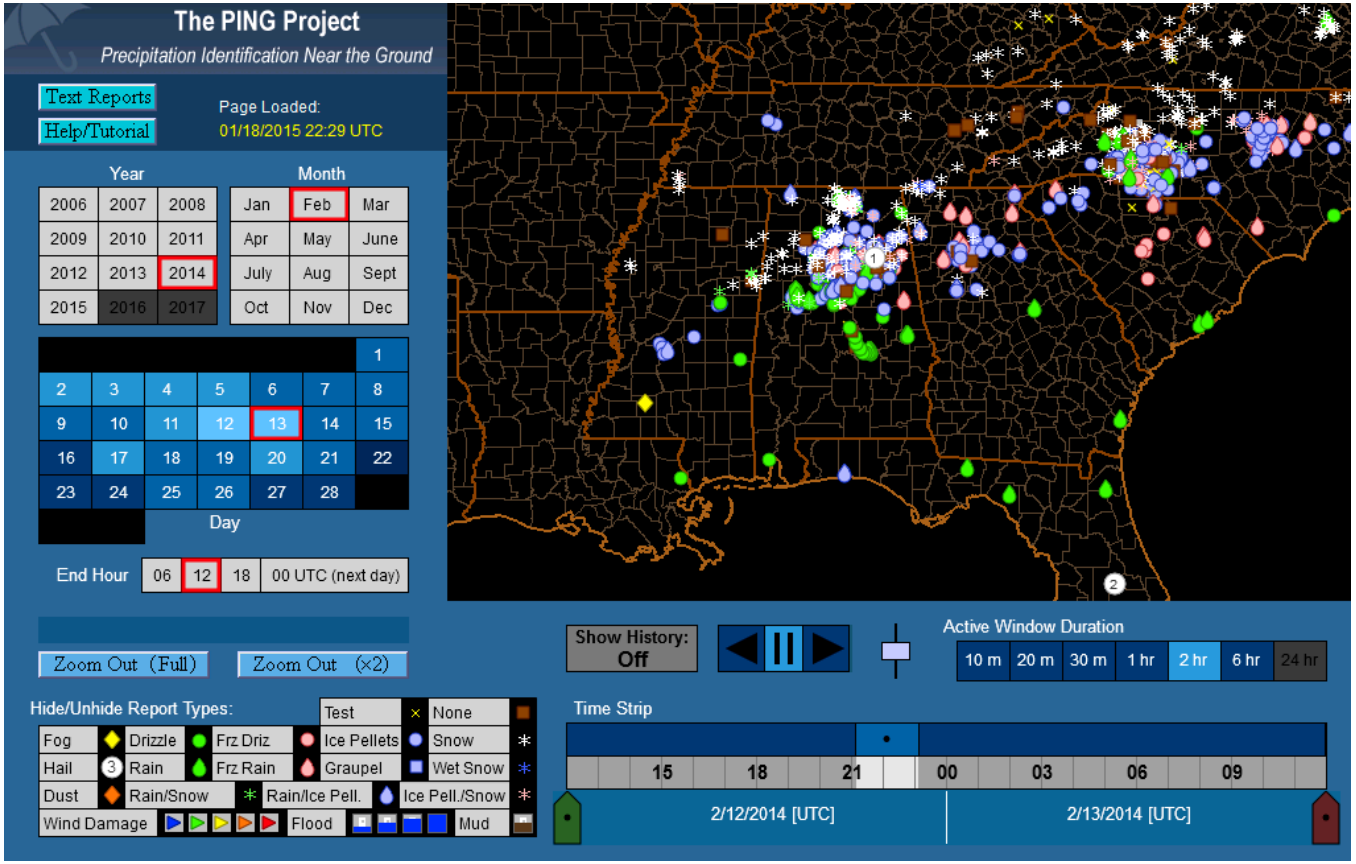
How is mPING doing?

78,000 downloads of the app

720,000 reports submitted via mPING

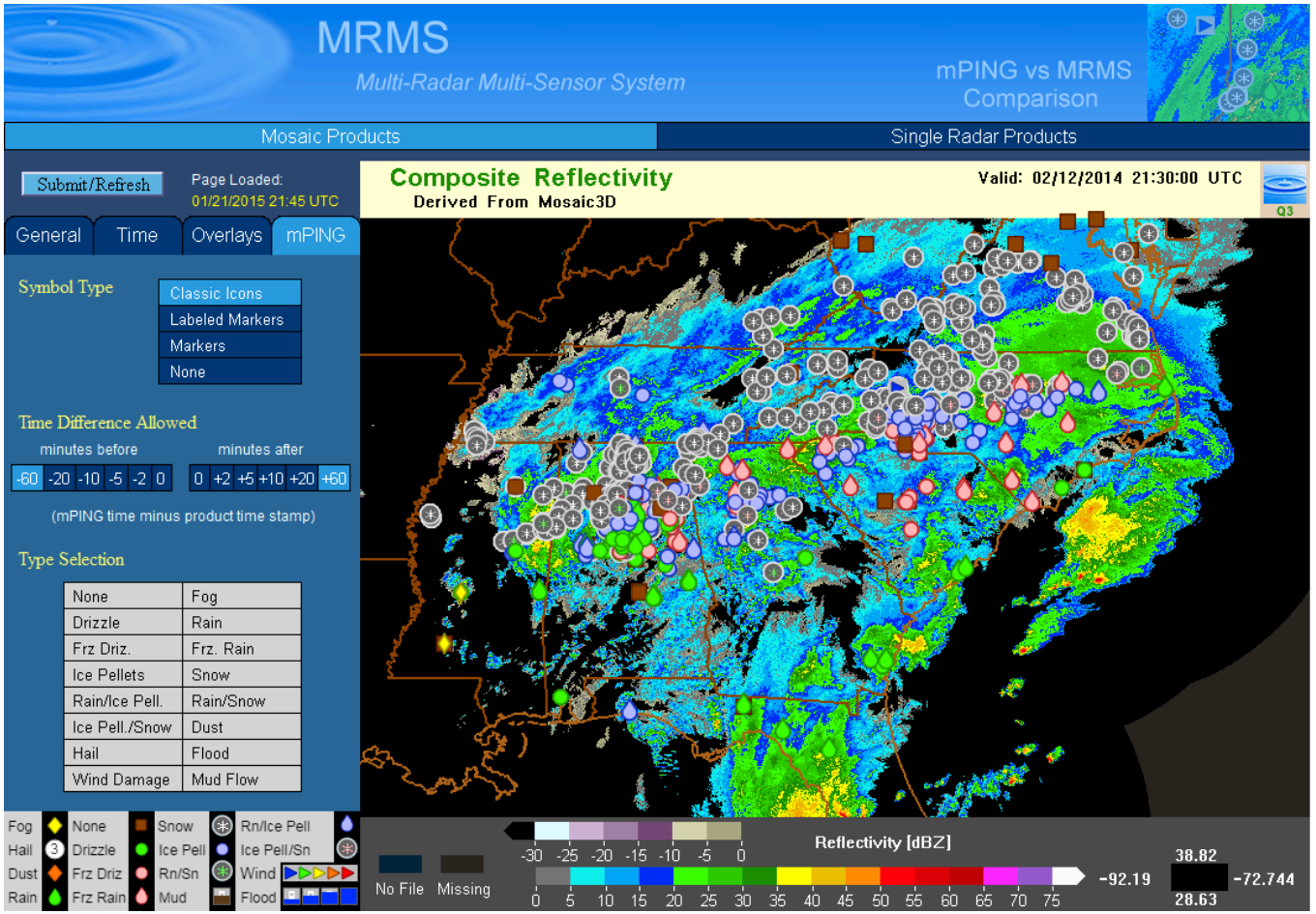
The Public-Facing mPING Display

The busiest 24 h yet recorded by mPING: 9744 reports; approximately 1,600 reports within this 2 h period.

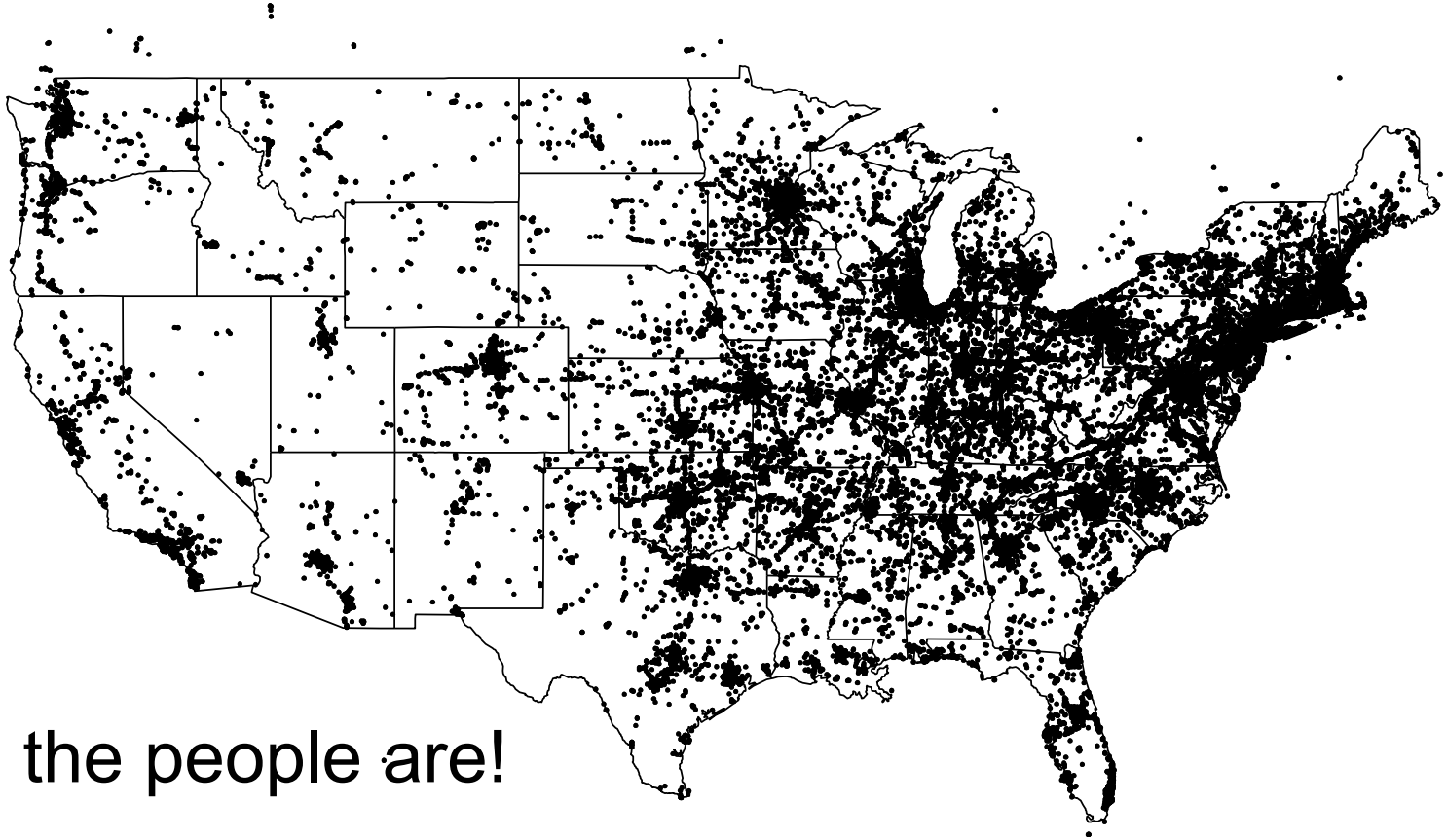


mPING on MRMS

Approximately the same data period shown previously, but now on top of radar reflectivity.



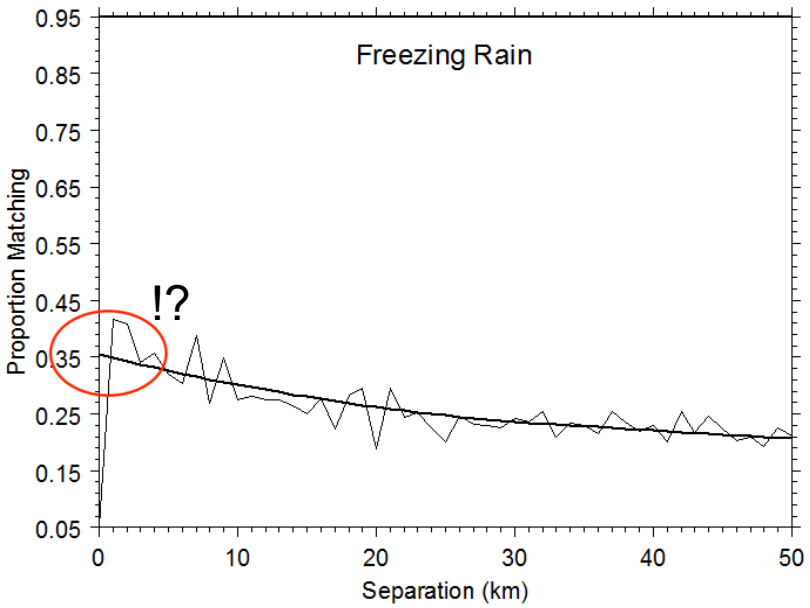
Where do mPING Observations Come From?

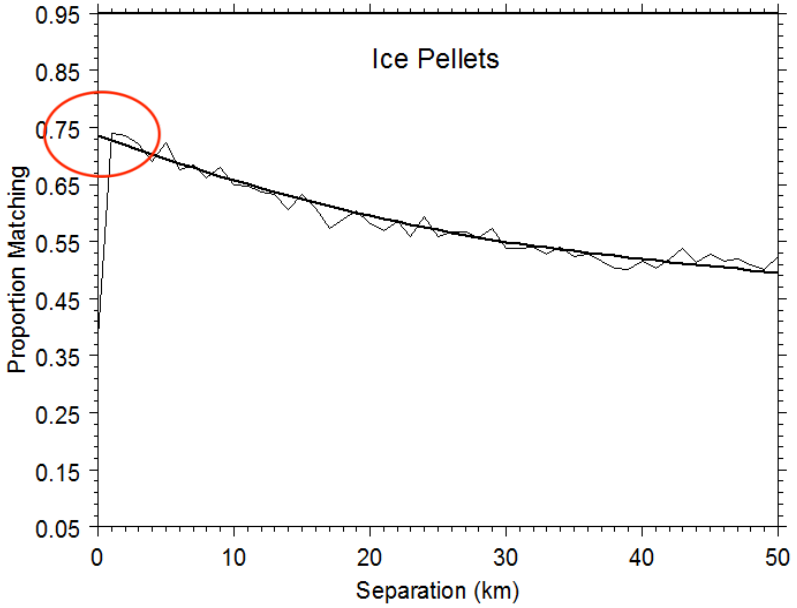


Where the people are!

Are mPING Observations Any Good?

Quality: How consistent are mPING observations (do neighbors match)?



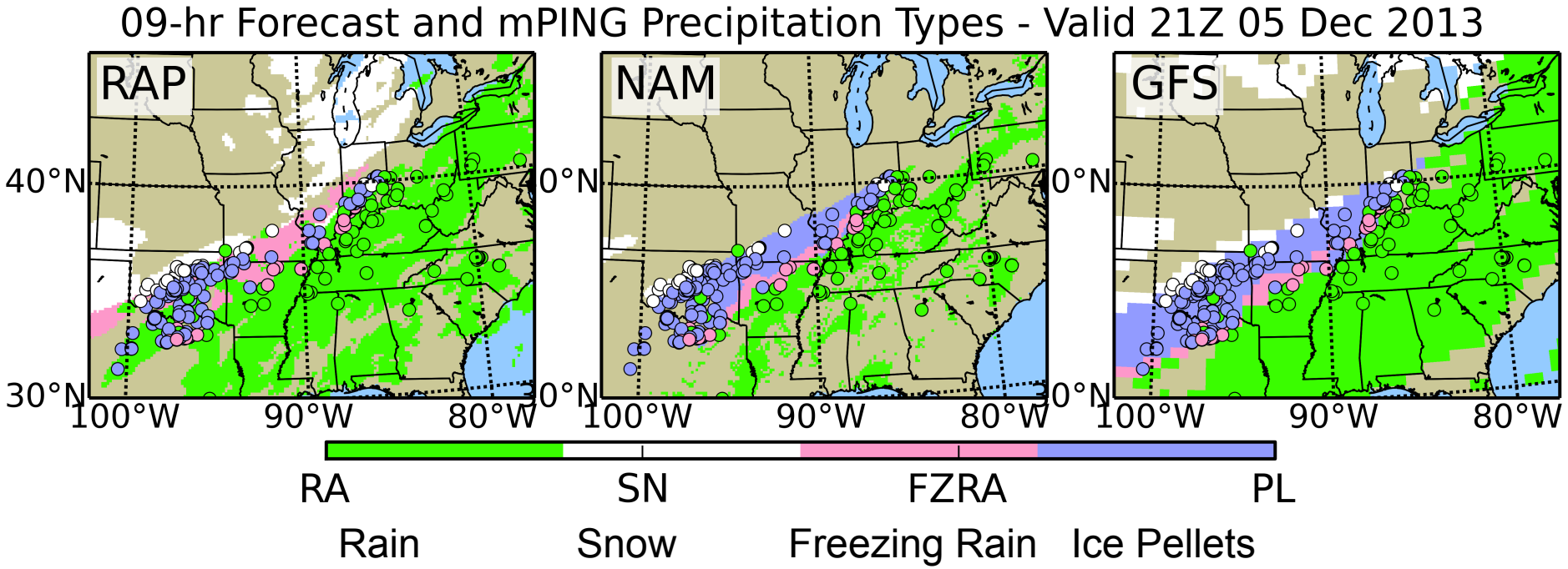


Only 17% of disagreeing observations are rain (the most likely error) but 60% are ice pellets

Of disagreeing observations for ice pellets, approximately 66% are snow

Observers are most likely correct: freezing rain is highly variable in time and space

mPING Overlaid on Model Precipitation Type Forecast

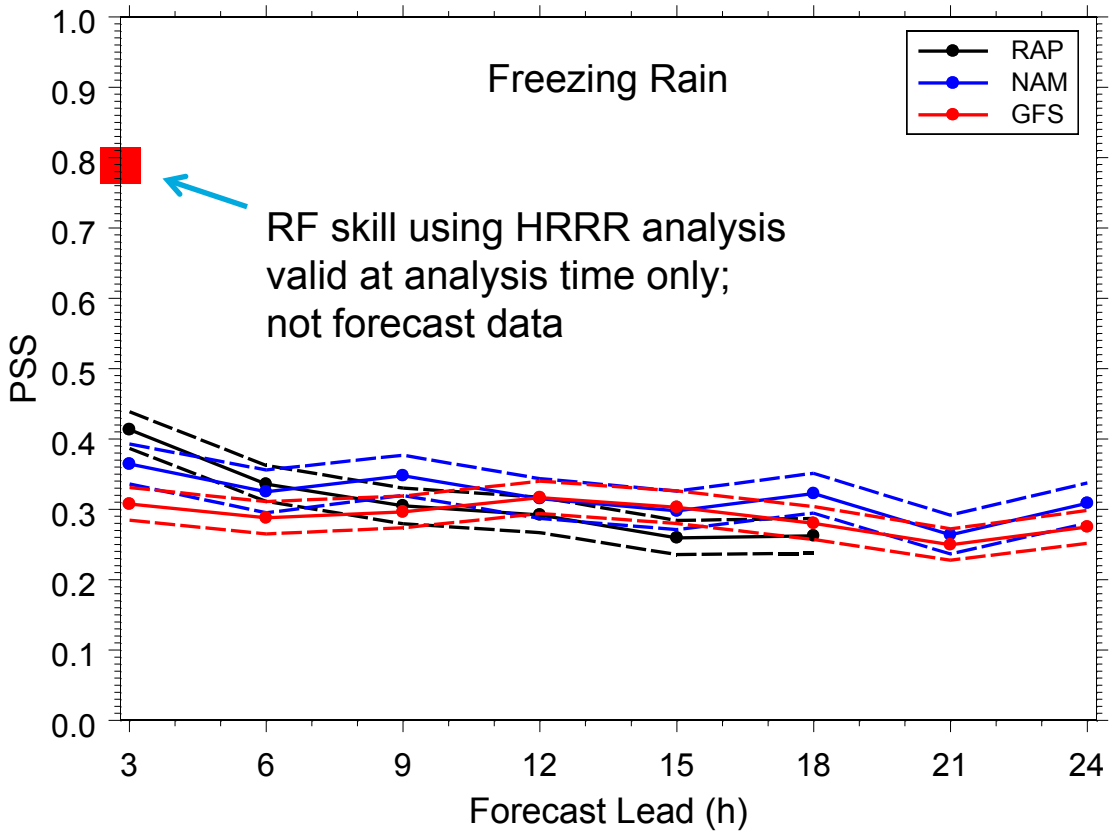


Dots are mPING observations within the hour centered on the forecast valid time, color indicates precip type, shaded areas are model forecast precipitation extent and type

What About a Better Winter Surface HCA? Use mPING Data to Drive a Statistical Background Classifier

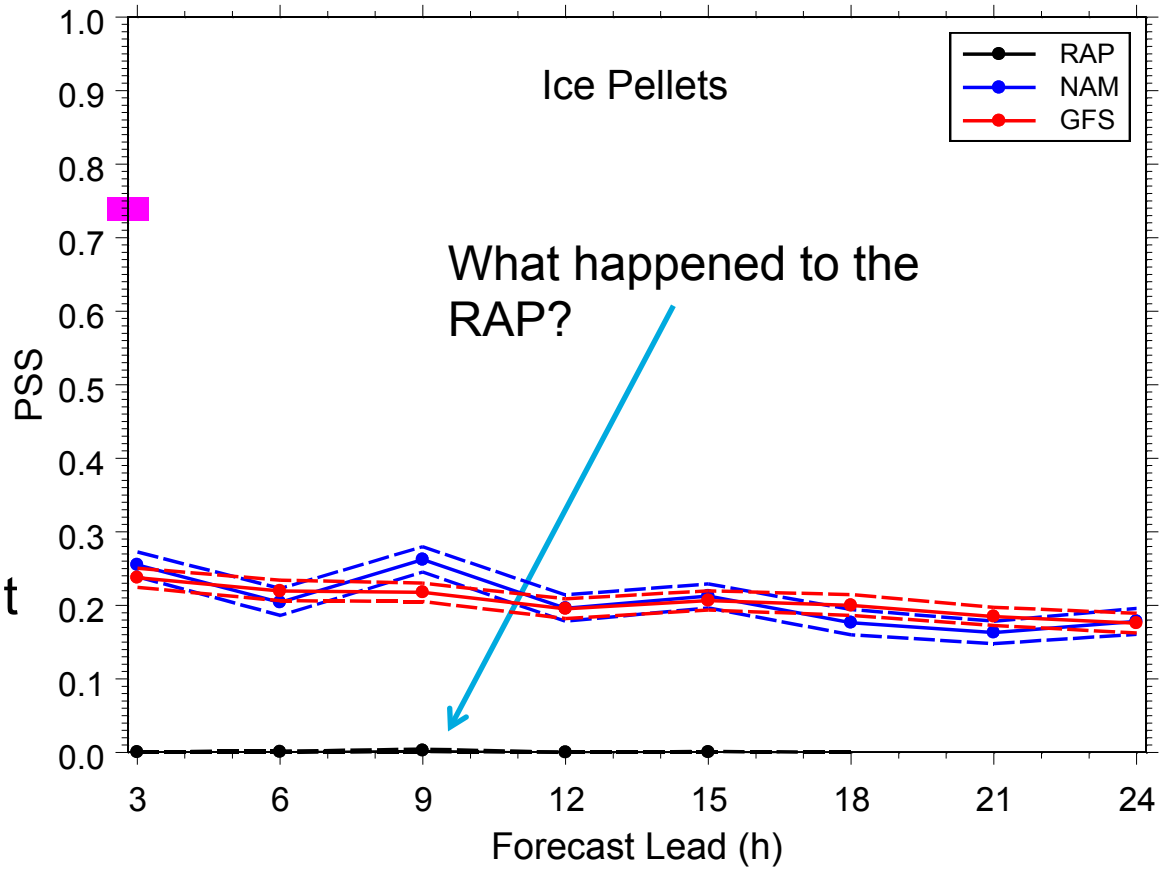
Performance: Use model forecast ptype performance as a benchmark

- Drive a Random Forest (RF) statistical classifier using mPING data and HRRR analysis fields for background classification
- Evaluate quality using the Peirce Skill Score (PSS), which is equitable
- Dashed lines show 95% confidence interval around PSS for each operational models
- Colored square indicates RF performance, width shows 95% confidence interval; *very significant potential performance improvement!*



More Statistical Background Classifier Results

- mPING obs revealed a problem in the RAP – effectively no ice pellets
- ESRL notified; discovered and fixed an otherwise unknown problem
- Relevance: mPING leads directly to RAP improvement
- RF is even better: 3X improvement in PSS.



mPING Directly Helps NWS

- Relevance: mPING data used operationally by NWS leading to an updated forecast:

437
FXUS64 KFWD 130157 AAB
AFDFWD

AREA FORECAST DISCUSSION...UPDATED
NATIONAL WEATHER SERVICE FORT WORTH TX
757 PM CST WED NOV 12 2014

.DISCUSSION...
A SHORTWAVE CONTINUES MOVE INTO WEST TEXAS EARLY THIS EVENING. MID LEVEL MOISTURE AND SOME ENHANCEMENT INDICATING VERTICAL MOTIONS ALOFT HAVE BEEN NOTED ALONG THE RED RIVER VALLEY WITH A FEW MPING REPORTS OF SOME VERY LIGHT SLEET. ANALYSIS OF OUR LATEST 00Z FWD SOUNDING SEEMS TO CONFIRM THAT SLEET WOULD BE THE MAIN PRECIPITATION TYPE WITH AN ELEVATED ENVIRONMENTAL WARM NOSE OF NEAR 6 DEG C AT 740MB BUT FALLING BELOW FREEZING AROUND 800MB WITH AN INCREASINGLY DRY LOW LEVEL AIRMASS.

BOTTOM LINE IS YES SOME VERY LIGHT SLEET IS POSSIBLE HERE AND THERE OVERNIGHT BUT IS NOT LIKELY TO ACCUMULATE OR CAUSE TRAVEL IMPACTS.

Summary

- Successes
  - Quality:
    - Data from participants are reliable and accurate
    - mPING data are without precedent – no equivalent exists anywhere
    - Each observation is tagged with GPS location and time
  - Relevance:
    - Since inception, between 200 and 300 “tweets” about mPING from NWS forecast offices
    - Encourage downloading the app
    - Solicit mPING report submissions during events
    - Comments on forecasts influenced by mPING observations
    - mPING data are *essential* to winter surface HCA development
    - Only data available for assessing performance of *any* Winter Surface HCA algorithms
    - Has already directly lead to improvements in operational NWP models
    - *Required* for driving developing any classifiers
    - mPING data are global
  - Performance:
    - mPING data used to drive a RF that can generate very skillful ptype classifications

Summary

- Remaining Challenges
  - Publicity
    - Address through public release of the mPING interface specifications – mPING capability can be integrated into other apps, which leads to more exposure, etc.
  - Better spatial coverage: is there a bias based on population density?
    - More users won't eliminate bias, but will allow enough data in otherwise sparse areas to characterize any bias
  - Incorporate mPING data into NWS WFOs and NCEP verification