12A.3 AN UNTAPPED MESONET – CROWDSOURSING PRIVATE WEATHER STATIONS

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1. INTRODUCTION

At the National Weather Service (NWS) Lower Mississippi River Forecast Center (LMRFC), extensive use is made of data from private weather station (PWS) networks which provide their data via the internet. These networks of stations form a very widespread "informal" mesonet, with one specific network consisting of roughly 16,000 stations across the continental United States. Data from private stations has been very useful in the investigation of previous rainfall and associated flooding events as well as providing a secondary and independent network useful for hydrologic forecasting. This presentation discusses benefits and challenges of working with the PWS data at the LMRFC and how the challenges have been overcome.

2. PROGRESSION OF PWS DATA USE

The utilization of data from PWSs began during an analysis of rainfall in New Orleans during Hurricane Isaac [Lincoln, et. al., 2012]. Post event analysis found gaps in the NWS raingauge network that were filled using data from other mesonets, including PWSs (Figure 1). Analysis of other extreme rainfall evens, particularly those leading to flash flooding followed (Figures 2 and 3) and use of PWS data is now routine. Issues with retrieving PWS data (see Section 4) led to automation of the retrieval process. Forecasters then realized the data could be utilized in near real time to support hydrologic forecasting.

3. BENEFITS OF PWS DATA

PWS data is useful in filling data gaps, covering short term outages, and provding expanded data sets for event analysis. In one online network, Weather Underground (www.weatherunderground.com), there are approximately 16,000 PWSs in the continental United States, with about 1600 stations in the LMRFC area of responsibility (Figure 4). These stations provide a secondary, independent data source to NWS networks. Thus, the data can be utilized in support of NWS forecasting activities.

4. CHALLENGES AND OVERCOMING THEM

Difficulties using private weather station data include the non-standard, varying format used by each of the private networks, the widely varying quality of reported meteorological data, as well as the sheer volume of data. Finding 16,000 stations, or even around 100 in a weather forecast office county warning area, is a tedious, if not daunting task. Also difficult is determining the stations' exact location for purposes of georeferencing/mapping. The information is available, though, and is automatically gathered from the website.

Even if a list of stations is known for a given area it can be mind-numbing to look at 100+ stations' websites to gather rainfall data so, again, the data retrieval process is automated via programming. The Weather Underground website is very good at displaying current data. However, it is not designed specifically for NWS use. The LMRFC needs rain totaled over given intervals and at specific times, e.g. generally 1hour total at the top of the hour, 6 hour total at synoptic times, and 24 hour total from 12Z to 12Z. Using the raw PWS data these values are calculated.

Unfortunately, the reliability of any given gauge's data can be questionable for a variety of reasons. The forecaster is ultimately responsible for determining if the data is usable in their work and to aid in this decision a simple statistical analysis was developed to provide an indication of gauge reliability.

The use of scripting allows LMRFC staff to quickly and easily gather private weather station data. Programs have also been developed quality control it against neighboring stations and official networks The collected data is converted to a shapefile format making it viewable in the NWS AWIPS2 environment where it can be used to support forecast operations (Figure 5).

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5. CONCLUSIONS AND FUTURE WORK

It is important to note that the private weather station networks provide very useful data and the websites are wonderful tools. However, several issues, including data format and quality, preclude easy use of the information. Despite these issues, with the improved data access through scripting, we have found that private weather stations can be readily viewed as an extended mesonet and the data they provide can be utilized to support both studies of past events and operational forecast operations.

PWS data is useful in event analysis and the operational setting. Data from PWS can be used to confirm NWS data or fill gaps in NWS observing systems, serving as a secondary, independent data set. Lots of information is collected by PWSs and with automation via scripting/programming, basic quality control, and forecaster judgment this information turns into useful data.

Although the initial impetus of this project was to obtain rainfall data, several local NWS weather forecast offices have expressed interest in viewing additional station parameters. Given a basic data structure, any parameter collected by the PWS can be extracted and utilized.

6. ACKNOWLEGMENTS

Thanks are due to Mr. Connor Baird, formerly a student at the University of South Alabama for volunteering time and effort to develop the basic PWS rainfall quality control methodology and beginning the programming to automate the process and to Dr. Jeff Masters and Shaun Tanner from WeatherUnderground for supporting the efforts to utilize PWS data from the WeatherUnderground website.

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7. REFERENCES

Lincoln, W. S. (2014). Analysis of the 15 June 2013 Isolated Extreme Rainfall Event in Springfield, Missouri. *J. Operational Meteor.*, 233-245.

Lincoln, W. S. and D. Schlotzhauer (2013). Reconciling New Orleans Pumping Data with Gauge Observations of Isolated Extreme Rainfall Due to Hurricane Isaac. NOAA/NWS Lower Mississippi River Forecast Center Technical Report [http://www.srh.noaa.gov/images/lmrfc/tech/Isaac_pumping.pdf]

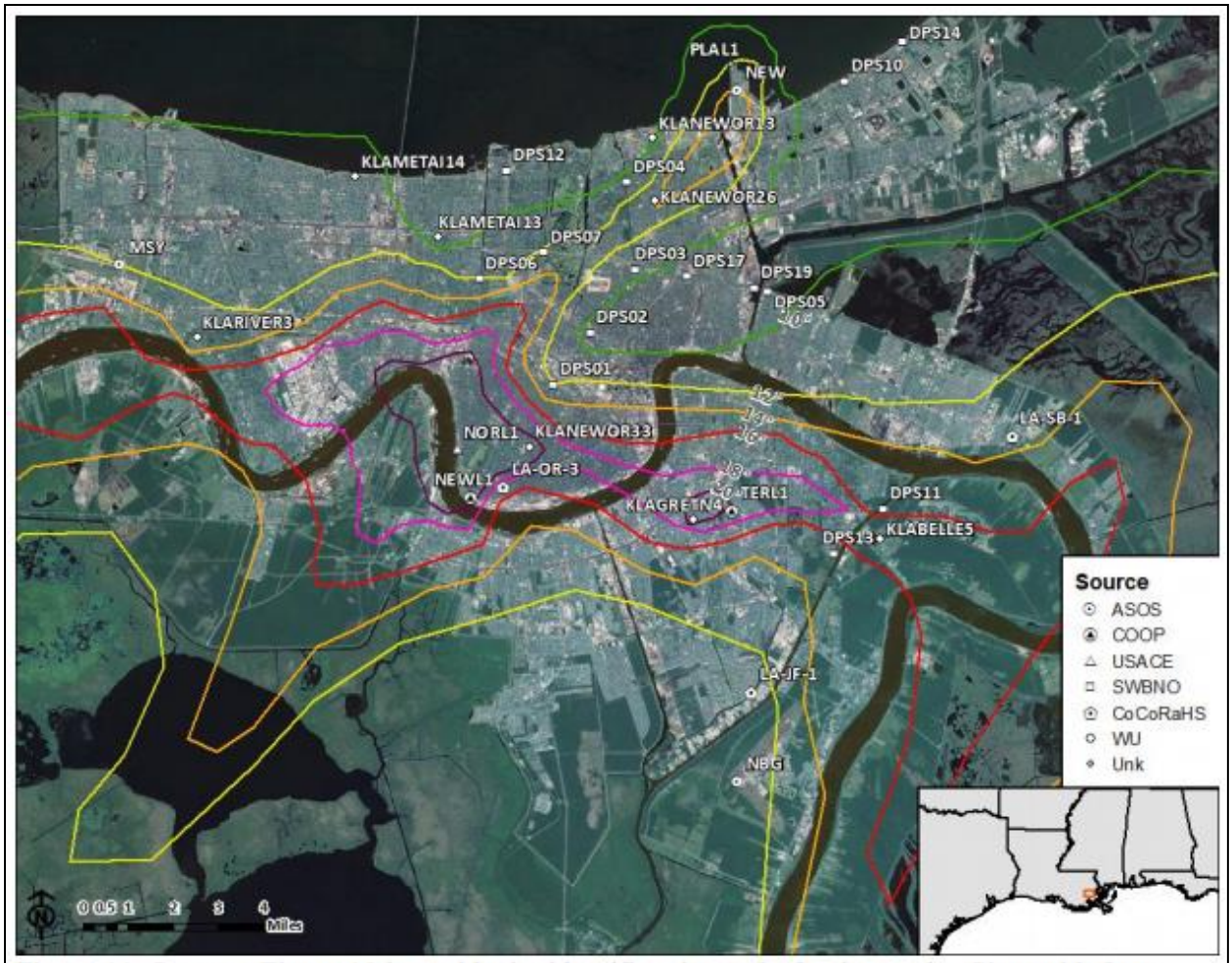

Figure 11. Same as Figure 10 but with site identifiers instead of point totals. Sites with four characters and a number are sites that come in through the HADS network and have an identifier set by local NWS WFOs. Sites with three characters are ASOS/AWOS airport stations. Sites starting with "DPS" are SWBNO pumping stations. Sites with eight characters and two numbers are Weather Underground PWS sites. Sites starting with "LA" followed by two additional characters and a number are CoCoRaHS sites.

Figure 1: Mesonet stations and PWS used in addition to the NWS observing network for Hurricane Isaac rainfall post even analysis (Lincoln and Schlotzhauer, 2013)

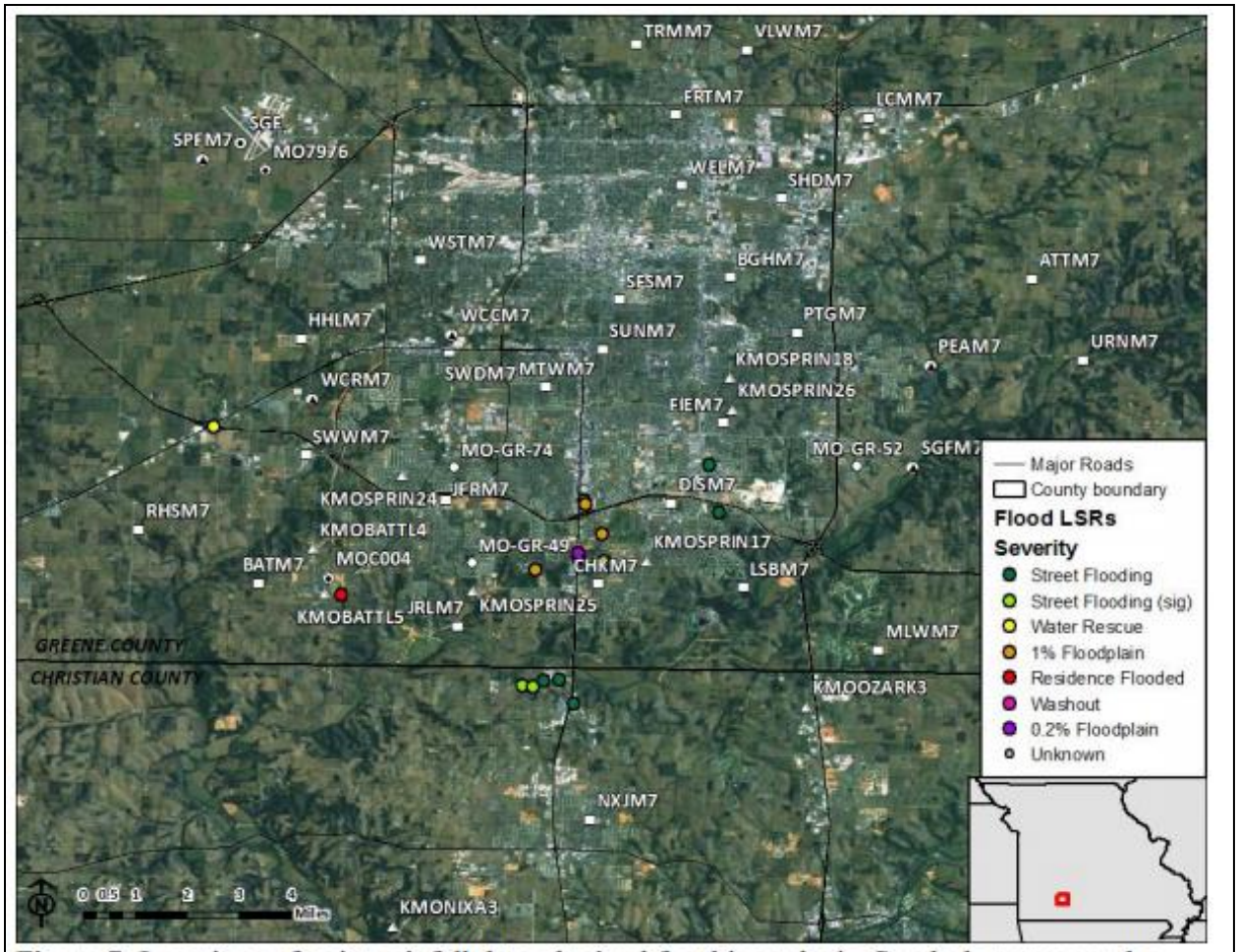

Figure 7. Locations of point rainfall data obtained for this analysis. Symbols represent the different sources of rainfall data. Locations of flooding repored to the NWS and digitized from media photos/video are added as a reference and are colored based upon relative flood severity (greens represent low-severity flooding, orange/red/purple represent high-severity flooding).

Figure 2: PWS data utilized in flash flood analysis. (Lincoln, 2014)

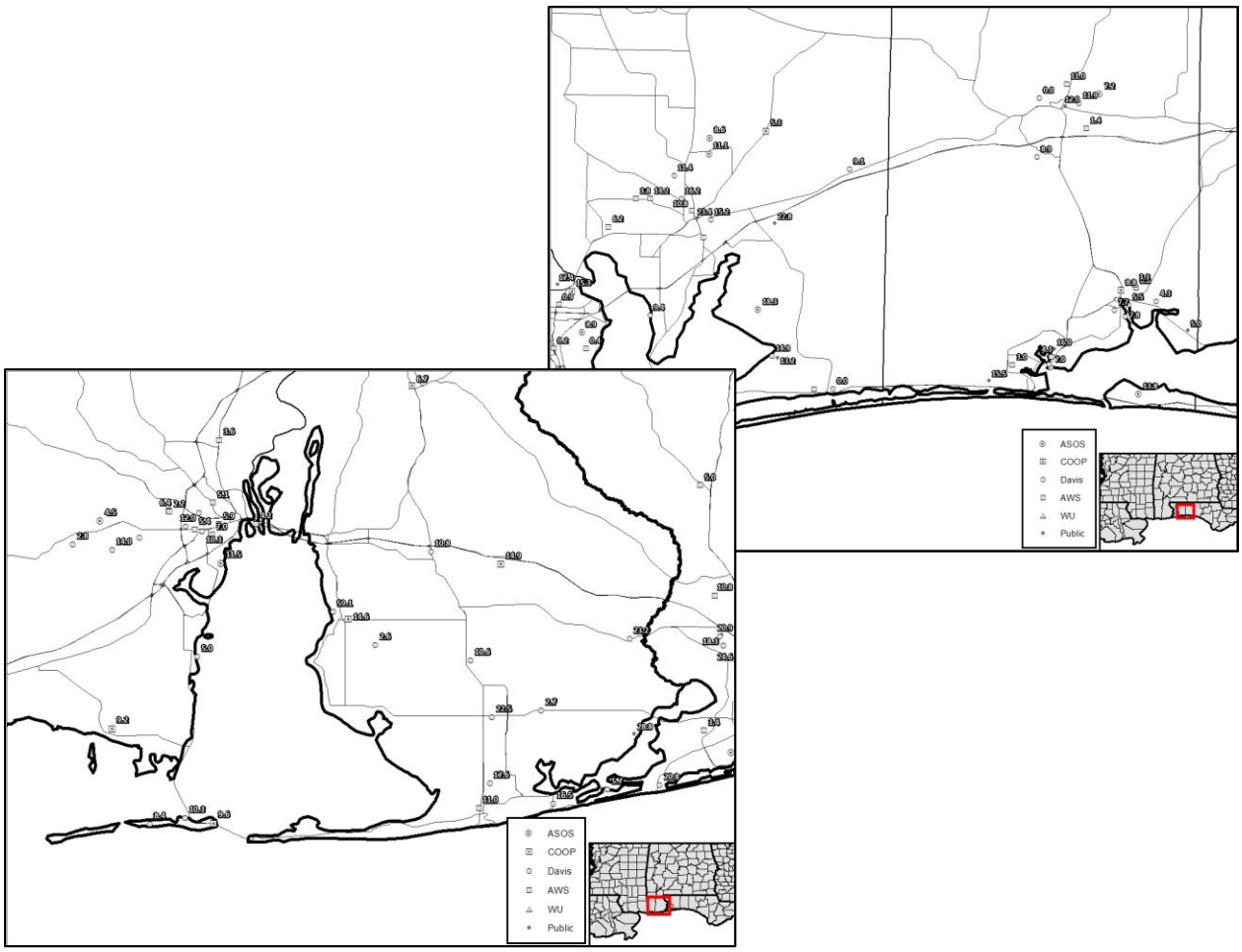

Figure 3: Station locations utilized in analysis of flash flooding in Mobile, AL and Pensacola, FL area, April 2014 (work in progress by W. S. Lincoln, LMRFC and J. Werner, WFO MOB). Notable are the numbers of stations available for analysis; of 80 stations, 63 are PWSs.

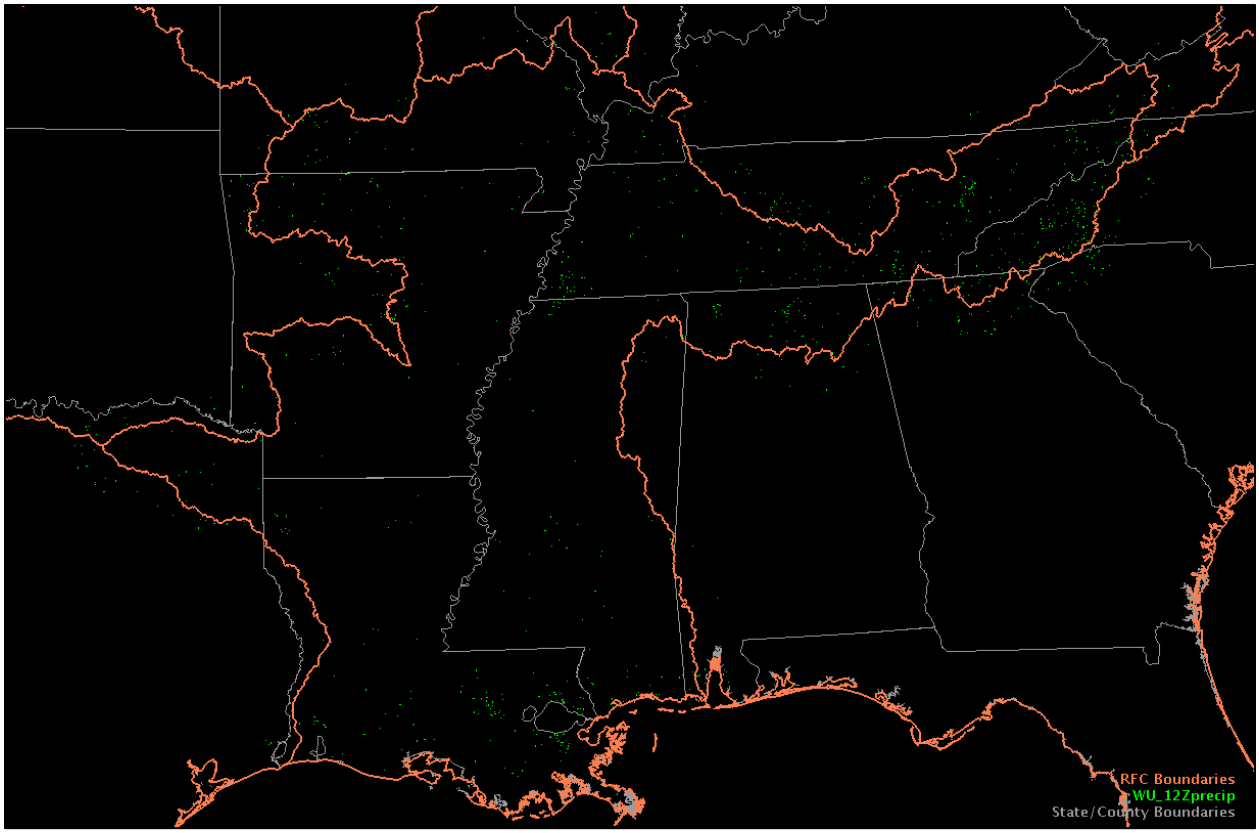

Figure 4: AWIPS2 D2D display of shapefile showing locations of Weather Underground PWSs in Lower Mississippi River Forecast Center area of interest.

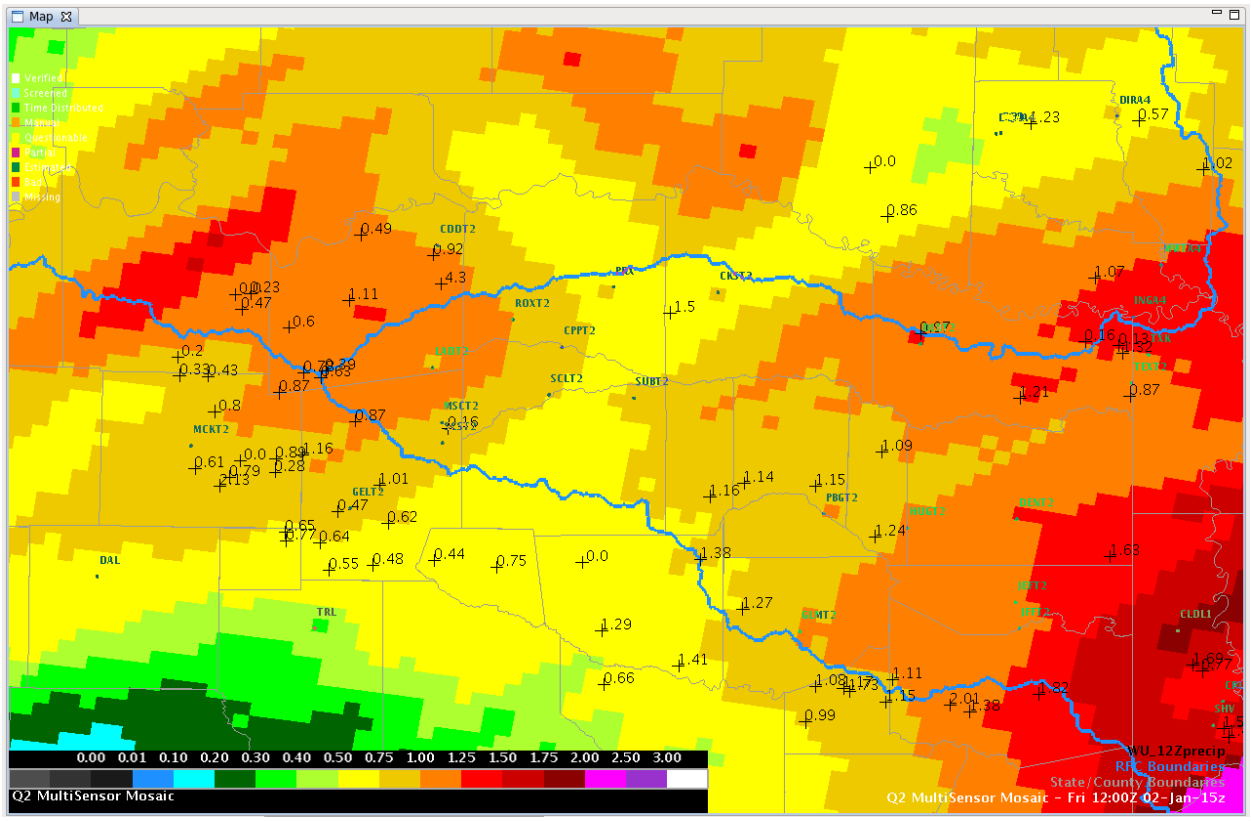

Figure 5: AWIPS2 Multisensor Precipitation Estimator (MPE) display showing radar/gauge (Q2) estimate of rainfall with Weather Underground PWS gauge values (indicated by “+” and numeral) overlaid.