ABOUT THE IMPORTANCE OF PRECIPITATION QA/QC…and the role of NCRFC
Overview of NCRFC Precipitation Data & QC

- NCRFC forecast region covers ~350,000 sq miles...providing forecast services in 9 states and Canada.
- Process precipitation data from 26 radars and 20 NWS Forecast offices.
- Ingest and QC data numerous automated sources and networks such as ASOS/AWOS, selected CoCoRAHS, ARB, NDAWN, etc.
- Hourly & Daily precipitation is used for daily river forecasts and for historical input to calibration and ensemble probabilistic forecasts.
This represents precipitation reports corrected by NCRFC and transmitted in SHEF as MSPRRIMSR.

- Includes 4,339 stations - 76,638 daily reports from all sources defined in our database – NWS COOP, selected Cocorahs, ASOS/AWOS, mesonets, etc.
- Symbols are sized by how many times a station was corrected – ranged from 1 to 176 corrections.
- **Plot of MSR QC symbolized by count of reports...** With Gage type defined in database.
- **Look for black circles around red-purple sites** (more than 50 errors/corrections) that are also ‘Manual’ – most likely to be COOP, CocoRAHS, etc.
- **Often in Winter** Automated gages – ‘Tipping’ are not representative of precipitation so often deleted during events, and then after when snow melts in gage. This impacts observed and radar precipitation estimates.
- **Currently this data will only be correct if WFOs are correcting via WxCoder to NCEI/ACIS.**
- **WFOs can monitor RFC QC data to find issues they might have missed.**
- Timeliness of reporting is essential.
- NCRFC Corrections to Daily RZ Reports – 3168 stations and a total of 32,025 corrections.
- Symbols are sized by the delay between the observation time and the posting time of the report from ~1-30 days.
- The longer the delay the more difficult it is to QC because supporting evidence is harder to find.
- High quality climate data requires high quality ~real time QA/QC.
Zoomed in version if previous slide.

Several concentric circles show where observations are repeatedly several days late.

The largest circles represent sites that usually reports several weeks to a month at a time – this data is rarely QC’d by any WFO.
Building a Weather-Ready Nation

Overview of WFO RR3 precipitation reports March 2017-April 2018

- Query of NCRFC database to show reports received more than 6 hours past observation time.
- Data more than 6 hours old not used in morning river forecasts.
- Data 1-2 days old can be used for the next day.
- Data 2-10 days old can only be used with significant QC and special process.
- Data more than 10 days old not used in daily operations but needed for calibration and historical models.
RFCs use hourly and daily precipitation to help verify radar precipitation estimates, identify biases, and to augment amounts especially in poor radar coverage areas.

Year round quality observed data is needed in areas of beam blockage and where radar beam height can be too high above the surface for accurate precipitation estimates.

All these white areas show radar beam more than 10,000 feet above ground.
- These circles approximate the effective range of radar in our region.
- The red symbols represent ~4800 precipitation stations defined in our database for the river model.
- We need high quality hourly real time heated weighing precipitation gages in these areas.
A few details about RFC QC process...

Example of 24hr QPE under estimation
NW WI / blockage in UP

After QC incorporating hourly/daily precip reports.
RFCs can use ‘inav’ to compare hourly/daily precip reports with radar estimates and correct data.

This version could also be used by WFOs to help with checking precipitation data.

Data reports help improve radar estimates. We typically can reprocess going up to 3 days back when we find new data is available.
We evaluate observations compared to radar, satellite, nearby observations, and correct/delete if confident based on several sources.

We check report time vs observation time. Notice data for 04/01-04/17 was all sent on 04/17.

Many sites send a week to month of data between 1st and 15th of the next month.

Often reports are offset by a day or Mondays may include the entire weekend with bad zeroes Saturday/Sunday.

Often absence of entry erroneously filled with bad zeroes.
Example of bad report from DGTM4 – 1.08” sent for wrong day.

Impact of this report shown in river model Mean areal precipitation (MAP).

MAP is too high in the local area spreads to several surrounding basins.

Errors like this can effectively double MAP and spread too precip over two days which through the river model out of balance.

Errors like this can be difficult to detect when reports are late and during winter when it get hidden in snow accumulation.
Example of NWS COOP data retrieved from NCEI.

This observer routinely sends reports that are off by a day – almost every time it rains!

NCRFC QC’s data locally, sends corrections as MSPRR1MSR, but likely not ingested elsewhere.

At numerous locations reports shown at NCEI are incorrect...as shown here. This bad data also reappears in historical MAP/MAT data for calibration.
Here’s another example. Here every report here 0605 to 0615 and 0627 60 0629 was off by a day.

I verify every correction made by NCRFC based on QC’d radar, satellite, nearby reports, MTRs. etc.

Reports in data sparse areas are needed more, especially in also bad radar coverage.

As data reports become more sparse the impact increases.

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### Record of Climatological Observations

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Empty, or blank, cells indicate that a data observation was not reported.

*Ground Cover: 1=Gross; 2=Fallow; 3=Bare Ground; 4=Brune grass; 5=Sod; 6=Straw mulch; 7=Grass muck; 8=Bare muck; 9=Unknown

*This data value failed one of NCDIC’s quality control tests.

*A values in the Precipitation Flag or the Snow Flag column indicate a multiday total, accumulated since last measurement, is being used.

Data value inconsistency may be present due to rounding calculations during the conversion process from SI metric units to standard imperial units.
Example of minor change in MAP – (applied Multiplier 0.90 mod to reduce precipitation by 10%).

- Gray/black dot are river stage reports.
- Hydrograph blue line is model simulation.
- MAP from gage is the darker blue, from radar is the lighter blue.
- Flood stage is 12ft.
- This makes a 10,000 CFS difference... between a half foot above flood stage and below flood stage.
- Sample of historical mean areal precipitation (MAP) sourced from NCEI (NCDC) COOP and SAO stations.
- RFC staff analyze data for errors, identify and correct for biases.
- Hydrologists use this data for calibration of river model and ensemble streamflow prediction.
IN CONCLUSION... THE QUALITY OF PRECIPITATION DATA CAN BE SIGNIFICANTLY IMPROVED WITH MORE WIDESPREAD EFFORTS AND RESOURCES FOR COLLECTING AND CHECKING DATA IN A MORE TIMELY MANNER. THIS IS NECESSARY FOR DAILY NEAR REAL TIME USE AND FOR CLIMATE IMPACTS. RFCS DO HAVE A VERY IMPORTANT ROLE HELPING TO IDENTIFY THESE ISSUES, PARTICIPATING IN QUALITY ASSURANCE AND NEAR REAL TIME QUALITY.

I CAN SHARE MORE DETAILS ON ANY OF THIS INFO... XCEL, ARCMAP, DATABASE QUERIES...

HOLLY.RECKEL@NOAA.GOV
Sample of query to get MSR corrections to daily precipitation from our precip database.

```sql
select p.lid, lat, lon*-1,hsa, pe, dur, ts, value, obstime, producttime, product_id, (producttime - obstime) as delayed_send, date_part('day', (age(obstime, postingtime))) as delaydays
from rawpp as p, location as l
where pe='PP' and dur in (2001,5004) and l.lid=p.lid and product_id like 'KMSRR1MSR' and p.lid not like '%Q3' and p.lid not like '%Q6' and p.lid not like '%Q8'
order by p.lid, obstime;
```
Sample of WFO RR3s stored in NCRFC database in Xcel, and Query to retrieve RR3 precipitation data from our database.

In 2017 we were only storing data sent within 30 days, but recently increased storage to 45 days to capture and QC more reports....and still that does not capture them all.

```
select p.lid, lat, lon*-1, hsa, pe, dur, ts, value, obstime, producttime, product_id, (producttime - obstime) as delayed_send, date_part('day', (age(obstime, postingtime))) as delaydays from rawpp as p, location as l where pe='PP' and dur in (2001,5004) and l.lid=p.lid and obstime < producttime - interval '6 hours' and product_id not in ('KMSRR1MSR', 'OFSDEPC2PP', 'MSPRR2MSR', 'KMSRRMMSR', 'MSPRR8MSR', 'MSGPRODID','CALCPPQPPD') and product_id not like '%$RTP%' and p.lid not like '%$Q3' and p.lid not like '%$Q6' and p.lid not like '%$Q8' order by product_id, p.lid, obstime;
```