The NSSL Q2 (next-generation QPE) Local Gauge Bias Corrected Radar QPE Product Suite

I. Introduction

This document describes a suite of gauge-bias corrected radar Quantitative Precipitation Estimation (QPE) products generated by the NSSL Q2 system.

II. Domain

- The Q2 gauge-bias corrected radar QPE product domain is shown in Fig.1.

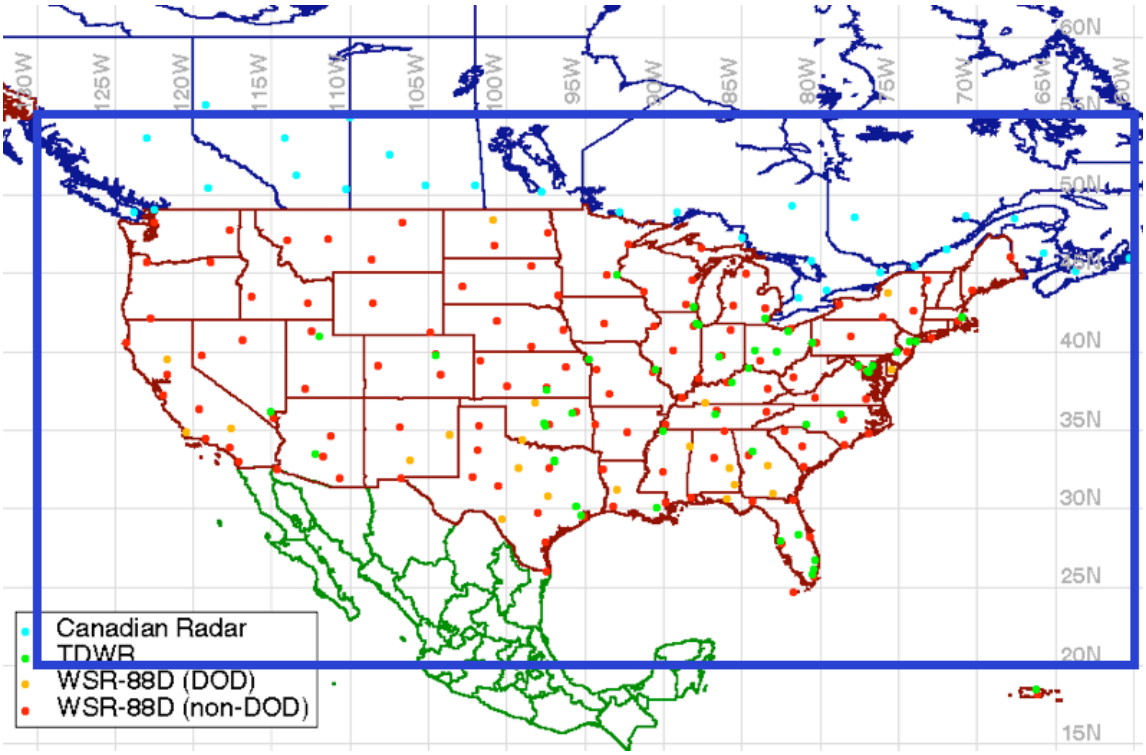

Fig. 1 The NMQ domain for the Q2 gauge-bias corrected radar QPE products.

- The Q2 gauge-bias corrected radar QPE domain parameters are shown in Table 1. The grid resolution in the west-east direction is dx (lon) = 0.01° . This is approximately 1.045km at the southern bound of the domain and about 0.638km at the northern bound of the domain. The grid resolution in north-south direction is dy (lat) = 0.01° which is 1.112km everywhere.

Table 1 Domain parameters for the NMQ – Q2 gauge-bias corrected radar QPE products

ctrlat (°N)	ctrlon (°W)	nx	ny	nz	SW corner	NE corner

37.5	-95W	7001	3501	1	20N, -130W	55N, -60W

III. Products

Currently there are following four groups of Q2 gauge-bias corrected radar QPE products available on the NSSL NMQ data server:

i) q2rad_hsr_gc_nc
ii) q2rad_hsr_gc_6hb_nc
iii) q2rad_lcref_gc_nc
iv) q2rad_lcref_gc_6hb_nc

Note that the affix "*_nc*" is an abbreviation for "NetCDF" since all product files are in the NetCDF format. Below are detailed descriptions of each group of products.

1. *q2rad_hsr_gc_nc*

The "*q2rad_hsr_gc*" product suite includes precipitation accumulations of 1-, 3-, 6-, 12-, 24-, 48-, and 72-hr. All these accumulation fields are computed hourly at the top of the hour and are output into one single file. The 1-h accumulation is the radar estimate adjusted by a spatial gage-radar bias analysis, i.e.:

$$R_e^{adj} = R_e - e^a \tag{1}$$

Here R_e is the radar based hourly rainfall estimate at any given NMQ grid cell (see "NSSL Q2 Radar QPE Products.pdf"), e^a is the analyzed gauge-radar difference (or, the radar estimate "error") at the grid cell, and R_e^{adj} is the hourly rainfall estimate after the gauge bias adjustment. The radar estimate error field is obtained by interpolating gauge-radar differences at the rain gauge locations onto the NMQ grid via an adaptive inverse distance weighted (IDW) mean technique, which is defined below:

$$e^a = \begin{cases} \alpha \cdot \sum_{i=1}^{N} w_i \cdot e_i^o; & \alpha \le 1 \\ \sum_{i=1}^{N} w_i \cdot e_i^o; & \alpha > 1 \end{cases} \tag{2}$$

$$w_i = \begin{cases} \dfrac{1/d_i^{\,b}}{\sum_{j=1}^{N} 1/d_j^{\,b}}; & d < r \\ 0; & d \geq r \end{cases} \tag{3}$$

$$\alpha = \sum_{i=1}^{N} \exp\left[-d_i^{\,2} \Big/ \left(\frac{r}{2}\right)^2 \right]; \tag{4}$$

Here, e_i^a is the difference between gauge hourly rainfall observation and the hourly radar rainfall estimate at the i^{th} rain gauge, N is the number of rain gauges within a radius of influence, r, of the given analysis grid cell, w_i is the weight on the i^{th} rain gauge, d_i is the distance between the NMQ grid cell and the i^{th} rain gauge, and b is an exponent, and α is a factor for adjusting the weighting function in regions with sparsely distributed gauges.

Both b and r are computed from a cross-validation procedure that tries to find "optimal" values for b and r that minimize the difference between radar and gauge differences at the gauge stations. The cross-validation procedure is running every hour in real-time resulting in dynamic updated values for b and r. Detailed descriptions of the cross-validation process can be found in the "NSSL Q2 Gauge QPE Products.pdf".

Once the 1-h accumulation is obtained, the 3- to 72-h accumulations are calculated by aggregating the 1-h rainfall fields.

2. *q2rad_hsr_gc_6hb_nc*

The "*q2rad_hsr_gc_6hb*" products are the same as the "*q2rad_hsr_gc*" except that they are calculated 6 hour behind the clock (here "*_6hb*" represents "6 hours behind"). This is to accommodate rain gauges that have long latencies. By examining the rain gauge data received at the NSSL, we found that by running the gauge analysis 6 hour behind the clock, over 90% of the rain gauge data can be included in the analysis.

3. *q2rad_lcref_gc_nc*

The "*q2rad_lcref_gc*" products are the same as the "*q2rad_hsr_gc*" products except that they are based on the hourly rainfall derived from the lower level composite reflectivity ("*q2rad_lcref*", see "NSSL National Radar QPE Products.pdf") instead of the hybrid scan reflectivity ("*q2rad_hsr*").

4. *q2rad_lcref_gc_6hb_nc*

The "*q2rad_lcref_gc_6hb*" products are the same as the "*q2rad_lcref_gc*" except that they are calculated 6 hour behind the clock (here "*_6hb*" represents "6 hours behind"). This is to accommodate rain gauges that have long latencies.

IV. Data format

All the NMQ gauge QPE products are in the NetCDF format (http://www.unidata.ucar.edu/software/netcdf/).

V. Product update cycle

The update cycle for the Q2 local gauge bias corrected radar QPE products is every hour.

VI. Data file size

The average size of the Q2 gauge bias corrected QPE product files (including all four groups, gzipped) is approximately 3GB per day over the NMQ domain.

VII. Dissemination

The users are encouraged to use LDM to receive the products and data sets. Anonymous FTP access can be setup if needed. The data server will hold 6-month worth of data online. Users can also view the product images on this website: www.nmq.nssl.noaa.gov.