Challenges in Improving QPE Directed Toward Improving Flash Flood Warning Guidance

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“While tremendous progress has been made in the last quarter-century in many areas of QPE and VSTQPF, significant gaps continue to exist in both knowledge and capabilities that are necessary to produce accurate high-resolution precipitation estimates at the national scale for a wide spectrum of users.”

“To meet the nation's needs for the precipitation information effectively, the authors herein propose a community-wide integrated approach for precipitation information that fully capitalizes on recent advances in science and technology, and leverages the wide range of expertise and experience that exists in the research and operational communities.”
Q2 Implementation

Q2 exists today as a scientific and community-based convergence towards accurate very high-resolution multi-sensor precipitation estimates on a national scale.

Q2 is a continuation of NSSL's departure from a radar-centric approach to precipitation estimation towards a integration of radar, satellite, model, and surface observations.

Q2 goal is to glean the best practices and techniques from the NOAA’s River Forecast Centers, Forecast Offices, Office of Hydrology, domestic and international organizations and universities.
Q2 Philosophy

Real-time means real world - Q2 R&D concepts and techniques are implemented in a ‘real time’ system.

Transparency - We can explain and document what we are doing and why.

Operations centric - R&D focused on operational challenges and needs for critical decision support.

Challenges:
Q2 Vision Developmental Core Technologies

1. National Basin Delineation Project and Repository
2. Radar Reflectivity Comparison Tool
3. Q2 National Mosaic and Quantitative Precipitation Estimation System
4. Central Weather Bureau of Taiwan - International Collaboration
Objective: To create a national dataset of flash-flood-scale basins delineated from high-resolution digital elevation data to support the NWS Flash Flood Monitoring and Prediction (FFMP) program.

- This effort has spanned the past 10 years.
- NSSL has had ongoing interaction and coordination with:
  - Every Weather Forecast Office
  - FFMP developers (MDL)
  - OCWWS, OHED
  - RFCs and other dataset users
- Significant accomplishments include:
  - Creation of a national seamless flash-flood-scale basin and stream dataset

Publication:
Objective: A real time system to monitor the quality of base level data to determine potential calibration offsets and transmitter drift.
Real time platform to develop, test, and assess advanced techniques in quality control, data integration and precipitation estimation and short term forecasting.

http://nmq.ou.edu
Q2 Domain

~140 WSR-88D, 31 Canadian, 2 TDWR, 1 TV station radar
Bugs, birds and all that glitters….

Nearly 60% of our Q2 basic research and development has been focused on issues related to quality control.
Q2 National Mosaic & QPE

National 3D Mosaic
(1x1 km, 21 vertical levels)
5-minute update cycle
Image looping

National Q2 QPE
(1x1 km, 5-minute update)
Image looping
Q2 Precipitation & Diagnostic Grids

NSSL produces and disseminates a suite of high resolution grids depicting the type and amount of precipitation reaching the earth’s surface over North America (1-km, 5-minutes)
Q2 Collaborators

Q2 Precipitation Products And Diagnostics

Stand Alone Q2 System

NSSL Laboratory Review February 17-19, 2009
National Radar Mosaic
Operational Impact

12z - 00z (12-h period) 1 June to 31 Aug 2008

Equitable Threat Score

0.3
0.25
0.2
0.15
0.1
0.05
0

Threshold (in / 12-h)

0.01 0.10 0.25 0.50 1.00 1.50 2.00

12-h Radar RUC
4x3-h Radar RUC
4x-3h Oper RUC
12-h Oper RUC

Courtesy Weygandt et al. 2009
NSSL researchers receive feedback, comments and ideas from the operational personal, private sector and other researchers to improve the quality and accuracy of the precipitation estimates.
NSSL researchers and collaborators can assess and compare the quality of precipitation estimates using a spectrum of independent observing networks and techniques.
Verification

Q2 Radar Only

Q2 Gauge Correct

NWS RFC Stage 4

NESDIS HydroEst
On a daily basis we verify 7600+ Q2/gauge pairs
Taiwan warm season hydrometeorological challenges are possibly the most difficult in the world.
Hydrometeor Classification Results
(20080614 1100 UTC)

- GC: Ground Clutter
- BS: Biologic Scatterers
- DS: Dry Snow
- WS: Wet Snow
- CR: Crystals
- GR: Graupals
- BD: Big Drops
- RA: Rain
- HR: Heavy Rain
- RH: Rain/Hail
Q2 Future Research Activities

Seamless Integration of Radar Advances, Systems, and Networks

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North America Resolution and Refresh Rate

1km/5m ➔ 1km/2m ➔ 500m/2m ➔ 250m/1m ➔ 100m/1m
Q2 system and/or components infusion into NWS operations

Integration of dual polarization moments and techniques into the Q2 framework

- enhance quality control
- enhance QPE performance

Seamless integration of radar systems and radar networks - forward compatibility

Higher resolution in both space and time to address the urban flash floods

Q2 as a national hydromet testbed for ‘real time’ hydromet technique development and product evaluation