Activities to Improve WSR-88D Radar Rainfall Estimation in the National Weather Service

Richard Fulton

Hydrology Laboratory
Office of Hydrologic Development
National Weather Service
Silver Spring, Maryland

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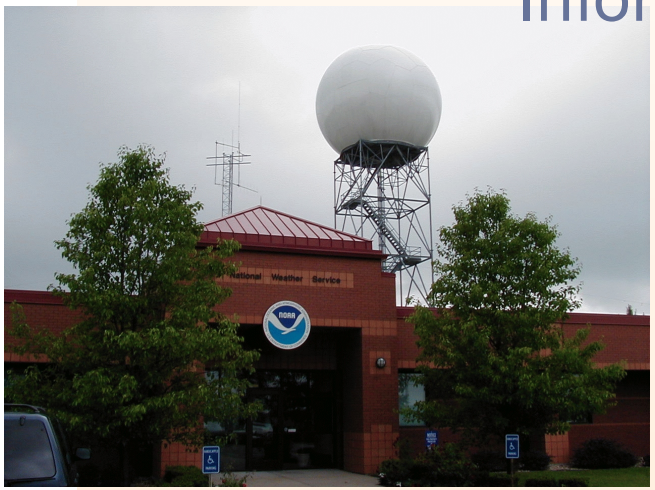
Outline

- Overview of operational NWS quantitative precipitation estimation (QPE) algorithms and products
- Near-term (0-2 yrs) scientific enhancements
- Long-term (3+ yrs) QPE science frontiers

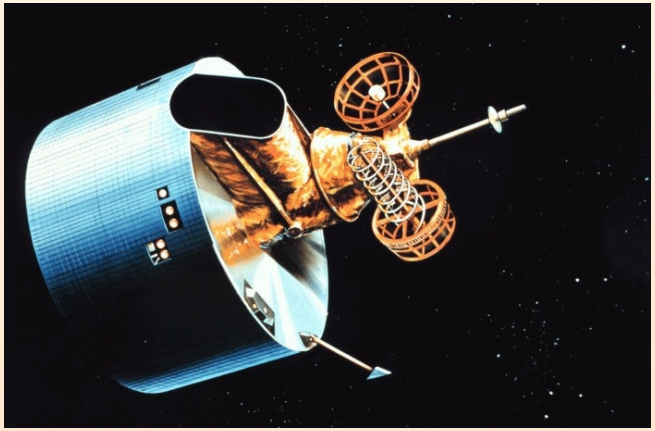
Quantitative Precipitation Estimation in the National Weather Service

Multisensor Approach to Optimally Combine Information from Multiple Sensors



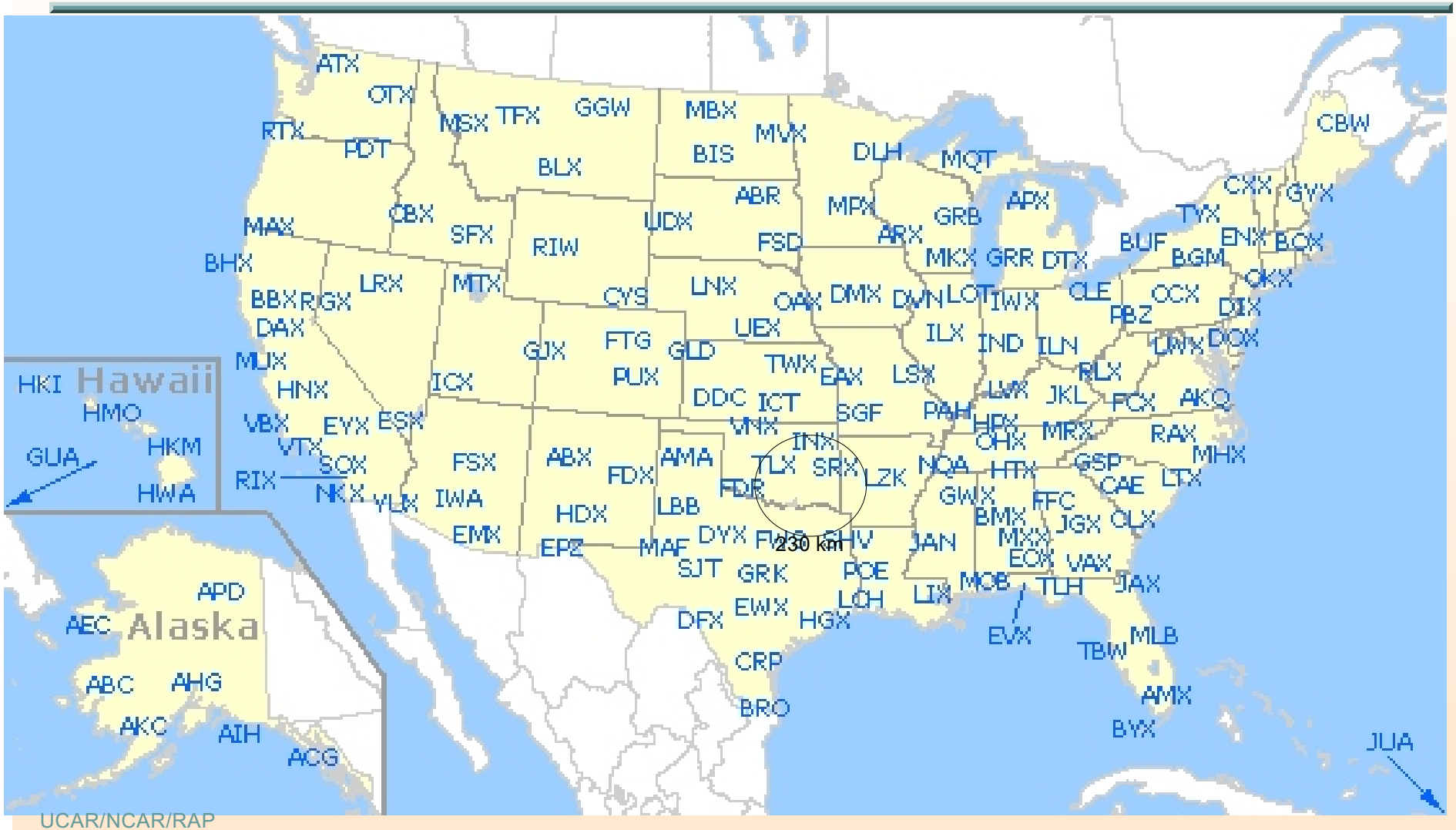
WSR-88D Radar

Rain Gauges



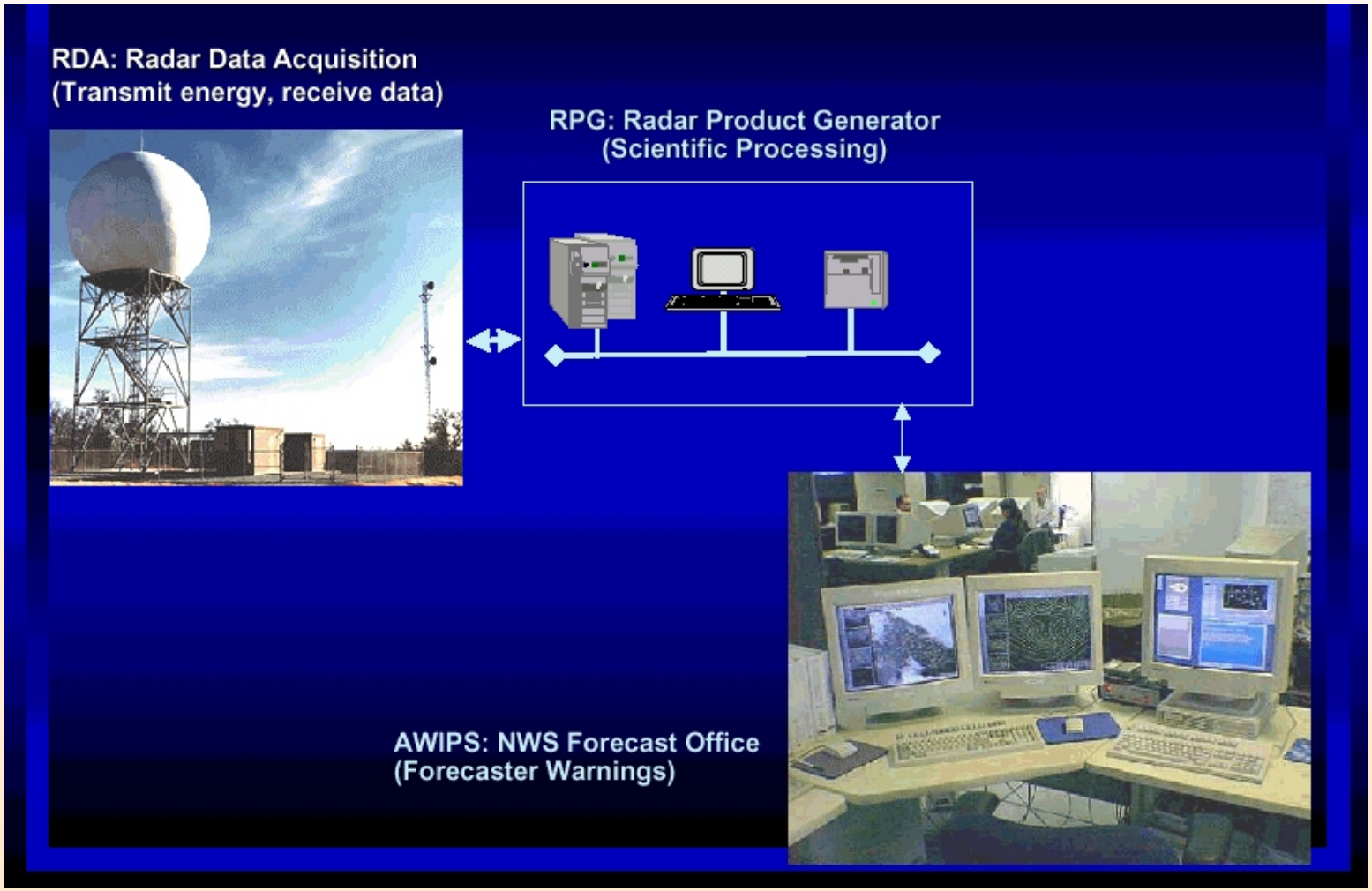
Satellite

160 NWS WSR-88D Doppler Radars



Quantitative Precipitation Estimation in the NWS

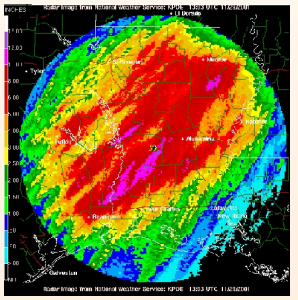
A Blend of Automated & Interactive Procedures



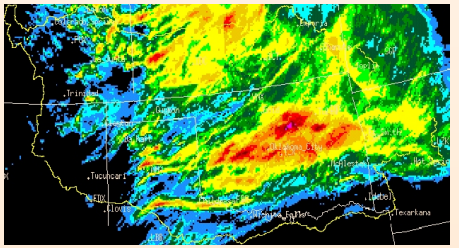
Quantitative Precipitation Estimation in the NWS

Multistep, Integrated Sequential Processing from Local to Regional to National Levels

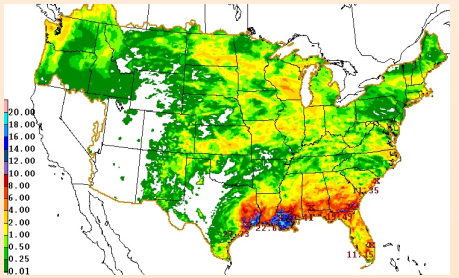
- *Local:* Weather Forecast Offices (WFO)
  - Precipitation Processing System (PPS)



- *Regional:* River Forecast Centers (RFC)
  - Multisensor Precipitation Estimator (MPE)



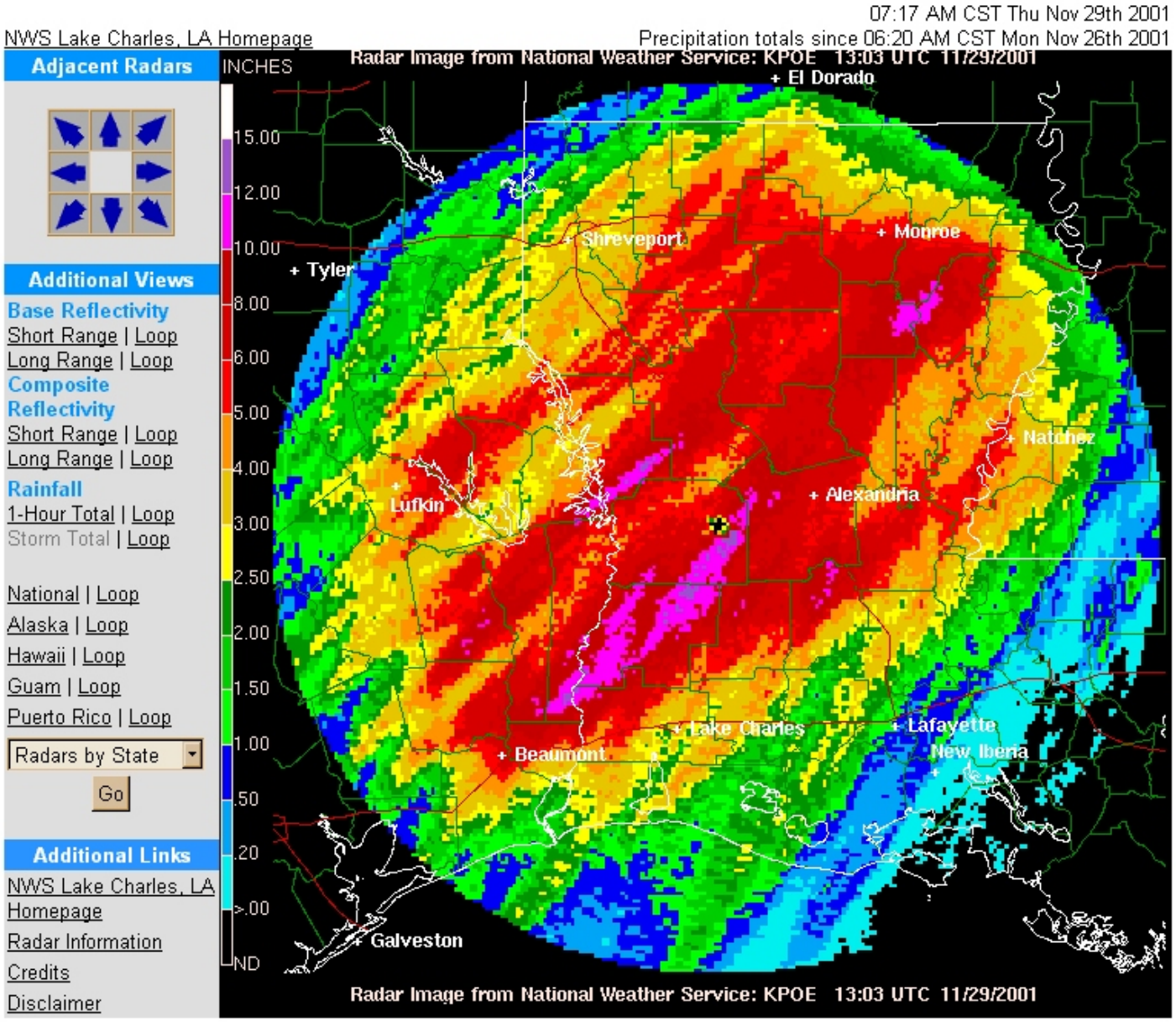
- *National:* National Center for Environmental Prediction (NCEP)
  - Stage IV Precipitation Processing



National Weather Service

Fort Polk, LA Radar

Storm Total Precipitation



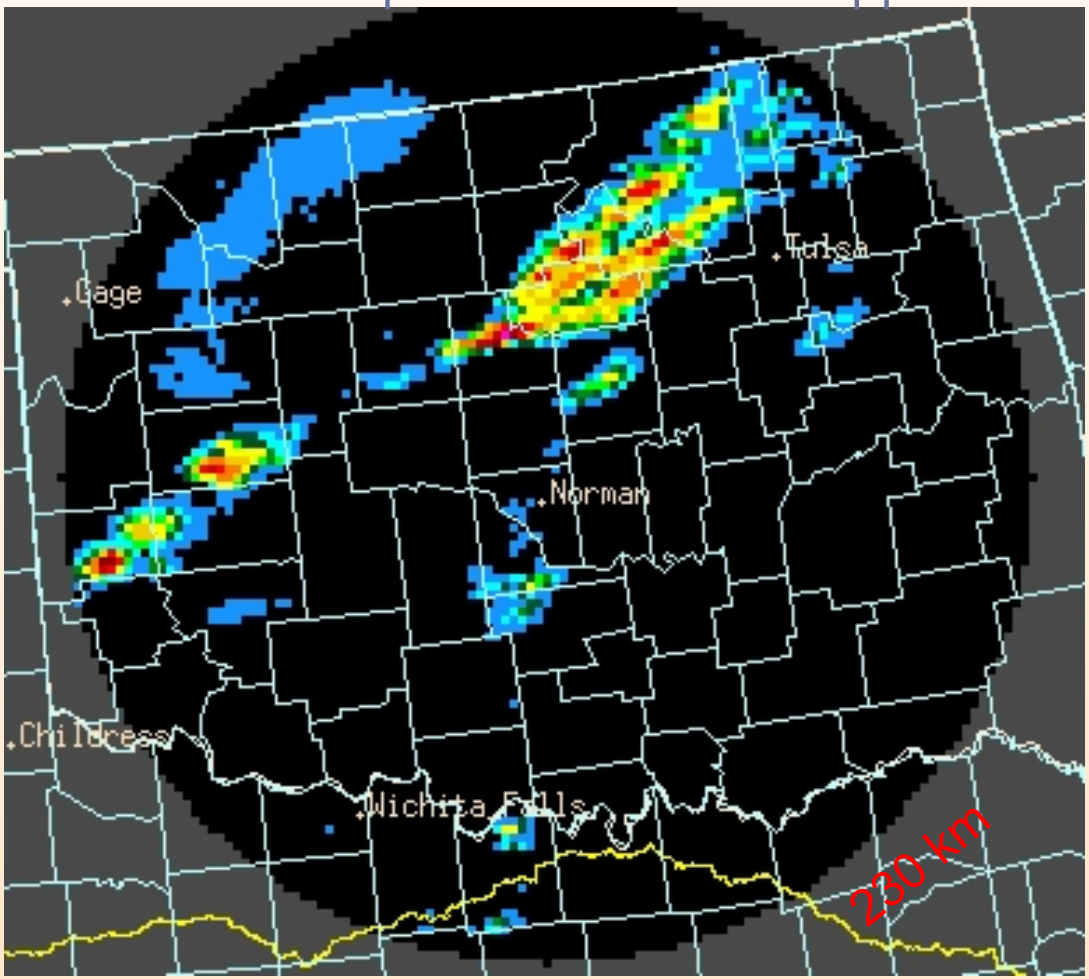
Time and date in red indicates image is at least one hour old.

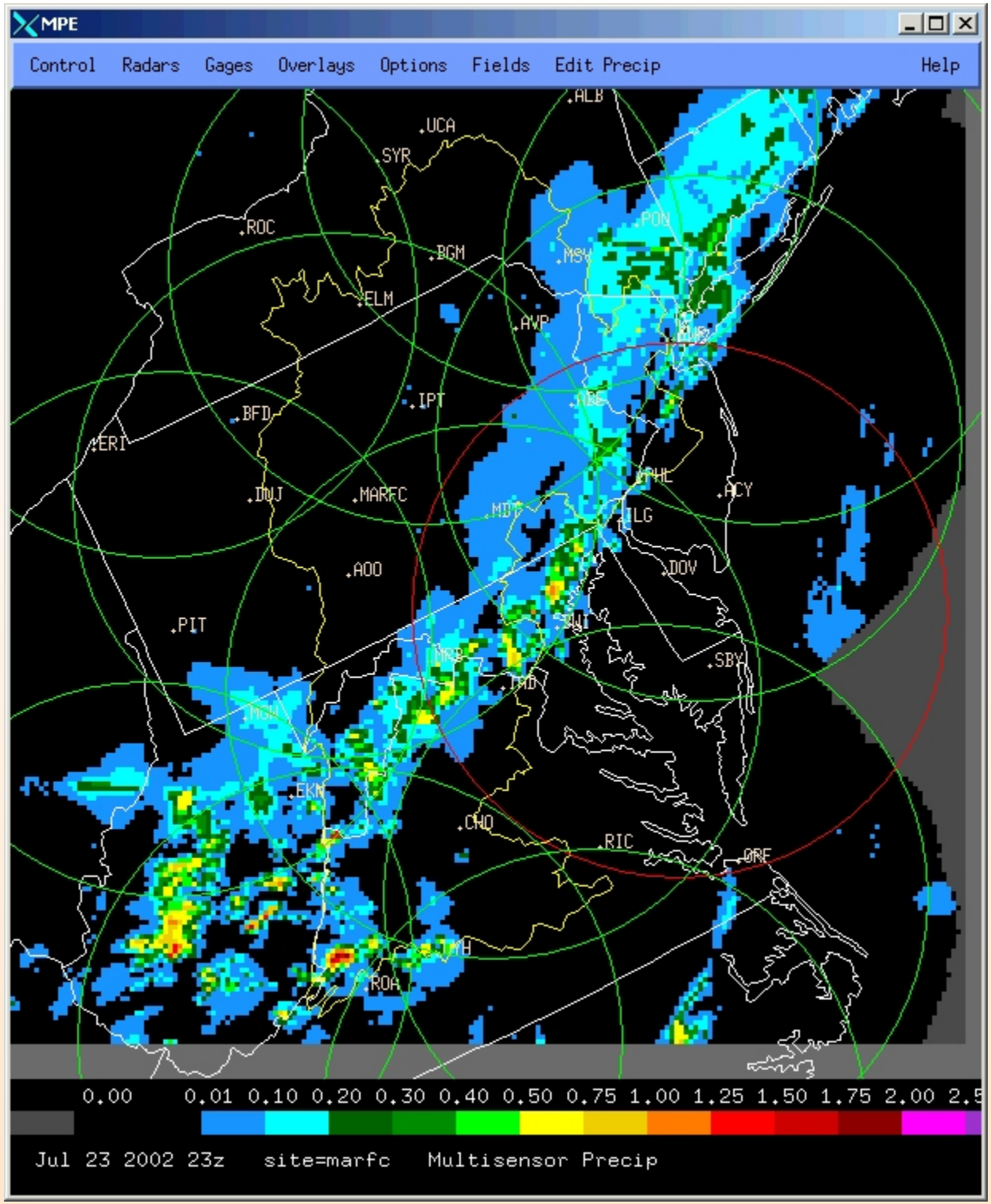
PPS generates graphical 16-level image products for each radar site

1-hr, 3-hr, storm-total, & user-defined accumulation periods

PPS's Hourly Digital Precipitation Array (DPA) Product

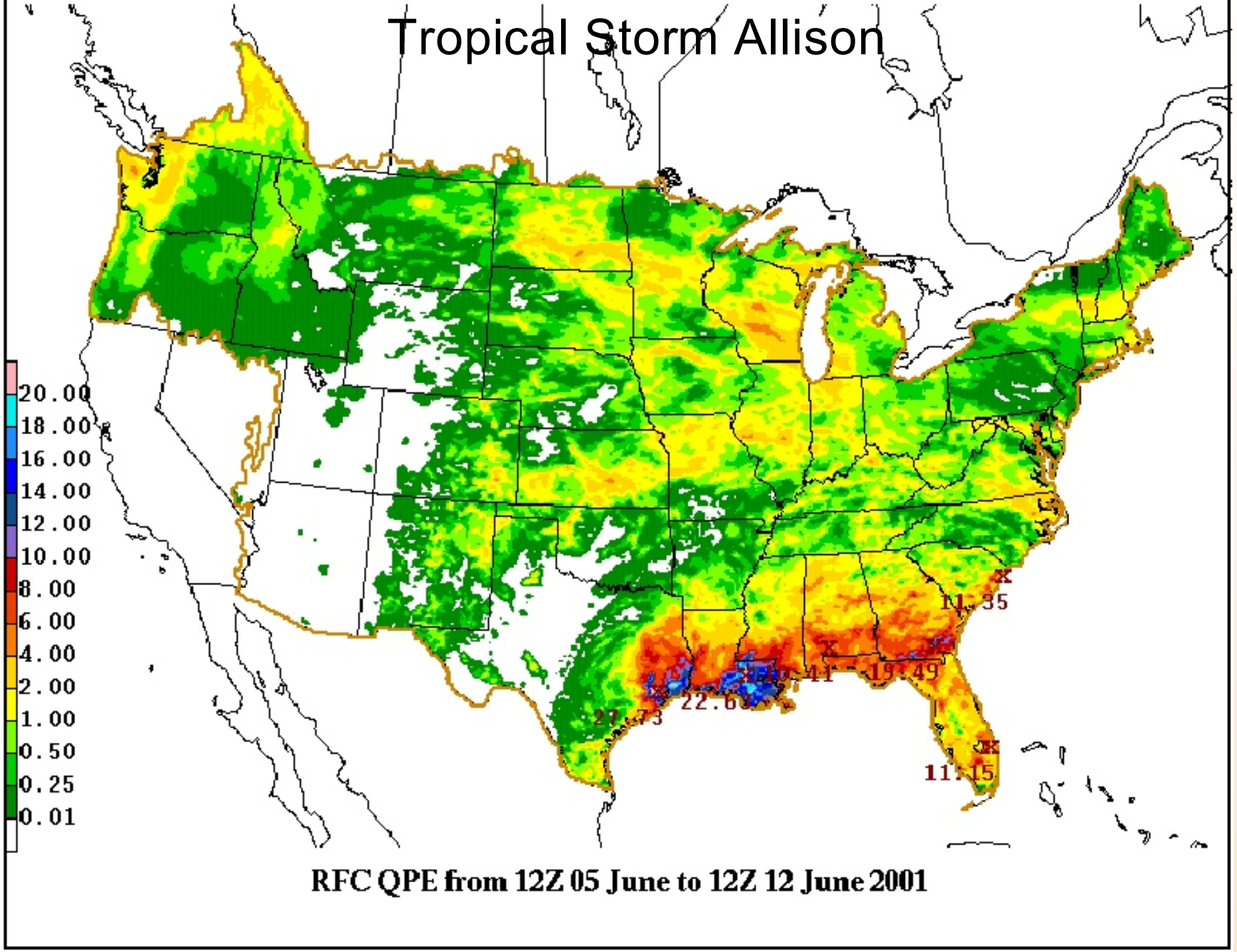
- Rectilinear 4-km national polar stereographic grid
- 256 rainfall data levels
- Used in follow-on quantitative rainfall applications (MPE)





Multisensor Precipitation Estimator (MPE) **generates one-hour regional radar + rain gauge + satellite rainfall accumulation mosaics**

Tropical Storm Allison



Near-term PPS Enhancements

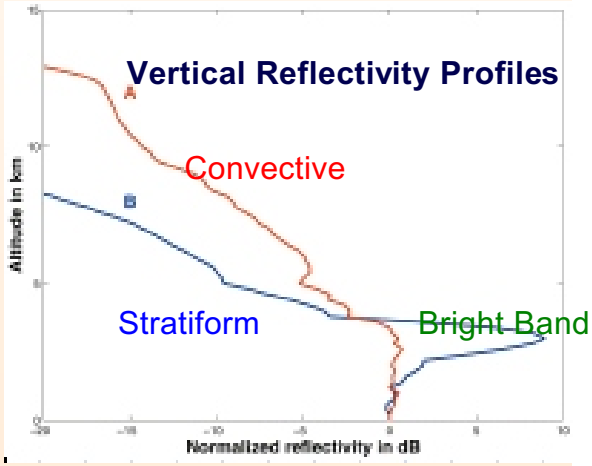
Nationwide Deployment beginning Spring 2003

- *New PPS product: Digital Storm-total Precipitation (DSP)*
  - 256-data-level, 0.01 inch resolution digital rainfall accumulation
  - Polar 2-km x 1-deg grid centered at each radar out to 230 km range
  - Generated and updated every 5 minutes
  - Differencing of consecutive products can produce accumulations of any arbitrary duration (e.g., 5-min, 30 min, 1.5-hr, 2-hr, 24-hr)
  - Available for use in hydrology applications outside of the WSR-88D to enhance flash flood services
    - **Flash flood monitoring and short-fuse forecast tools**
    - **Distributed hydrologic models**

Range Correction Algorithm (RCA)

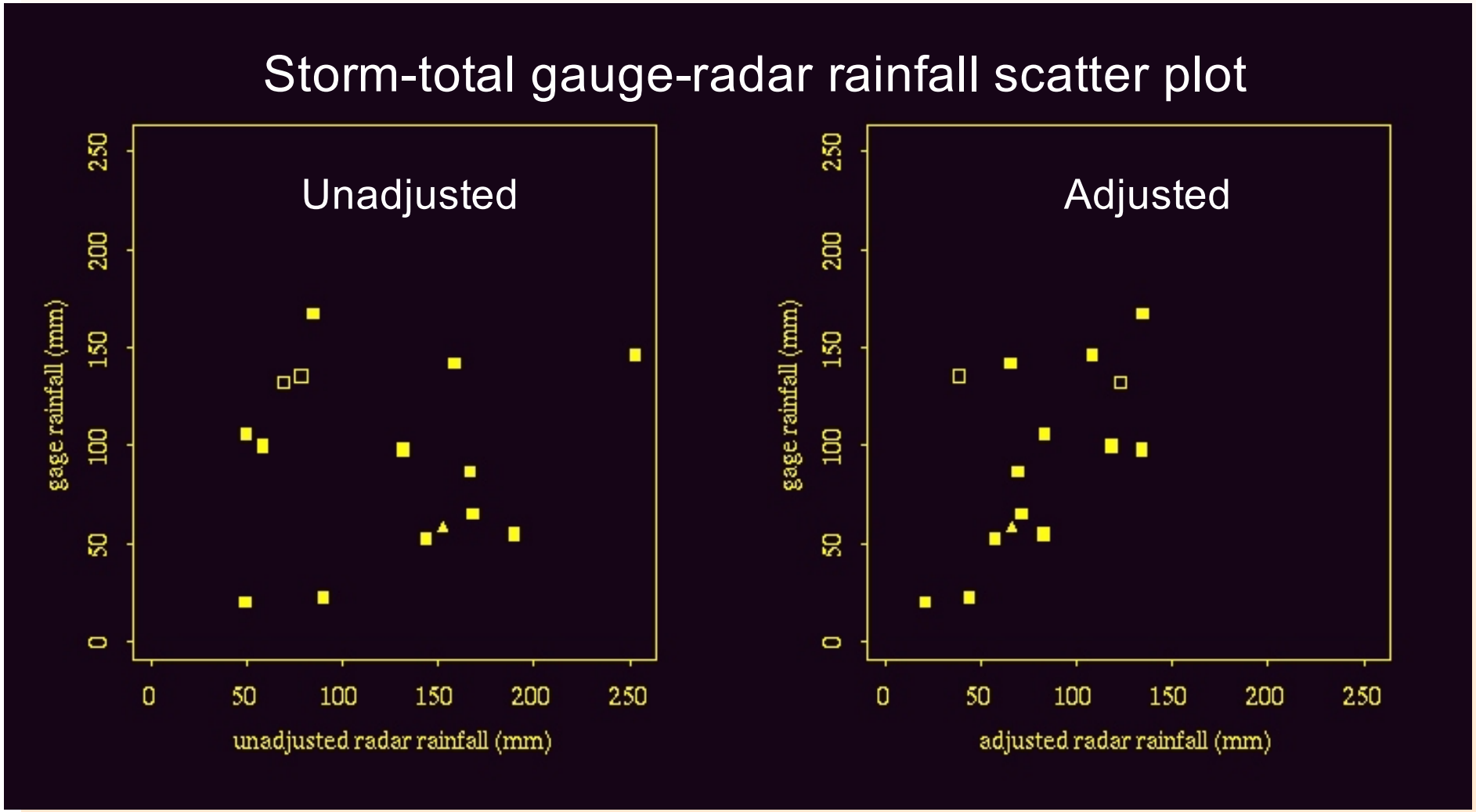
Field Deployment in Fall 2003

- One of the largest error sources for radar rainfall estimation is range-dependent bias due to vertical reflectivity gradients, including bright band
- Systematic underestimation biases...
  - Generally increase with range
  - Are greatest for stratiform rain events
  - Are greatest in cool seasons
  - Are greatest in northern latitudes
  - Are small for summer convection



- RCA will generate range- & elevation-dependent rainrate correction factors updated every 5 minutes and used to adjust PPS rainfall products

RCA produces rainfall estimates that better match rain gauge observations



Seattle, WA WSR-88D Feb. 6-8, 1996

Multisensor Precipitation Estimator (MPE) Enhancements

- Incorporate satellite QPEs into MPE
  - Using optimal estimation, regression, or neural network multisensor merging techniques
- Deliver MPE to Weather Forecast Offices and enhance it to serve their flash flood monitoring needs
  - First version: Hourly 4-km regionally-mosaicked multisensor products (same as current RFC capability)
  - Future version: Shorter accumulation periods and update times (minutes) and higher spatial resolution (1 km)

Major NWS QPE-related Science Frontiers For Next 5-10 Years

- Probabilistic/Ensemble QPE algorithms
  - To provide uncertainty information to aid water managers in cost-benefit decision making
- Polarimetric QPE algorithms
  - Future dual-polarized NWS radars (~2007) will provide improved rainfall estimates
- Use of other observed meteorological data (soundings, surface observations, lightning) and atmospheric model analysis fields to improve QPE analyses (e.g., rain vs snow, freezing level ident.)
- Snowfall estimation algorithms (depth and liquid water equivalent)
- Higher spatial and temporal resolution QPE products to better support the NWS flash flood warning program