Quantitative Precipitation Estimation in the National Weather Service

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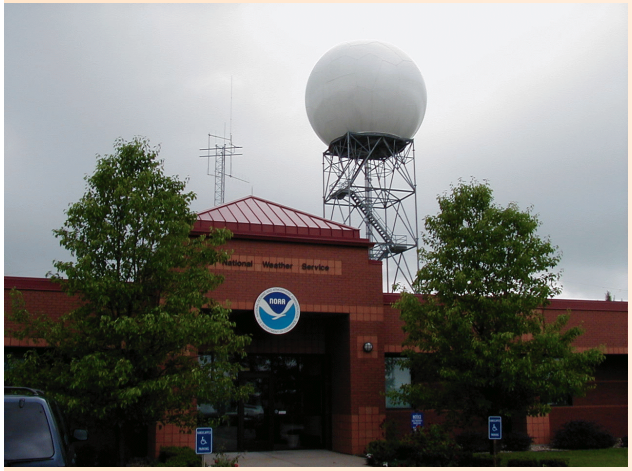
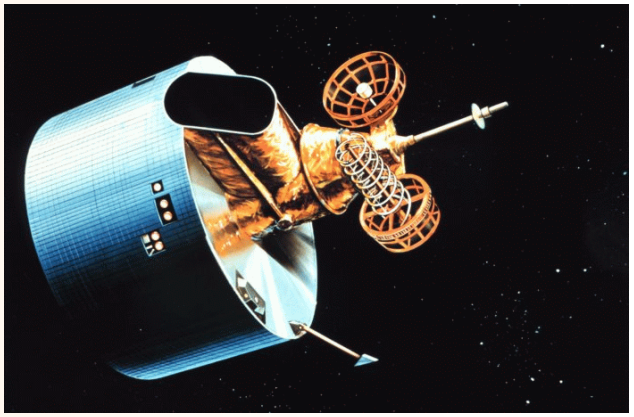
Quantitative Precipitation Estimation in the National Weather Service

Multisensor Approach to Optimally Combine Information from Multiple Sensors



WSR-88D Radar

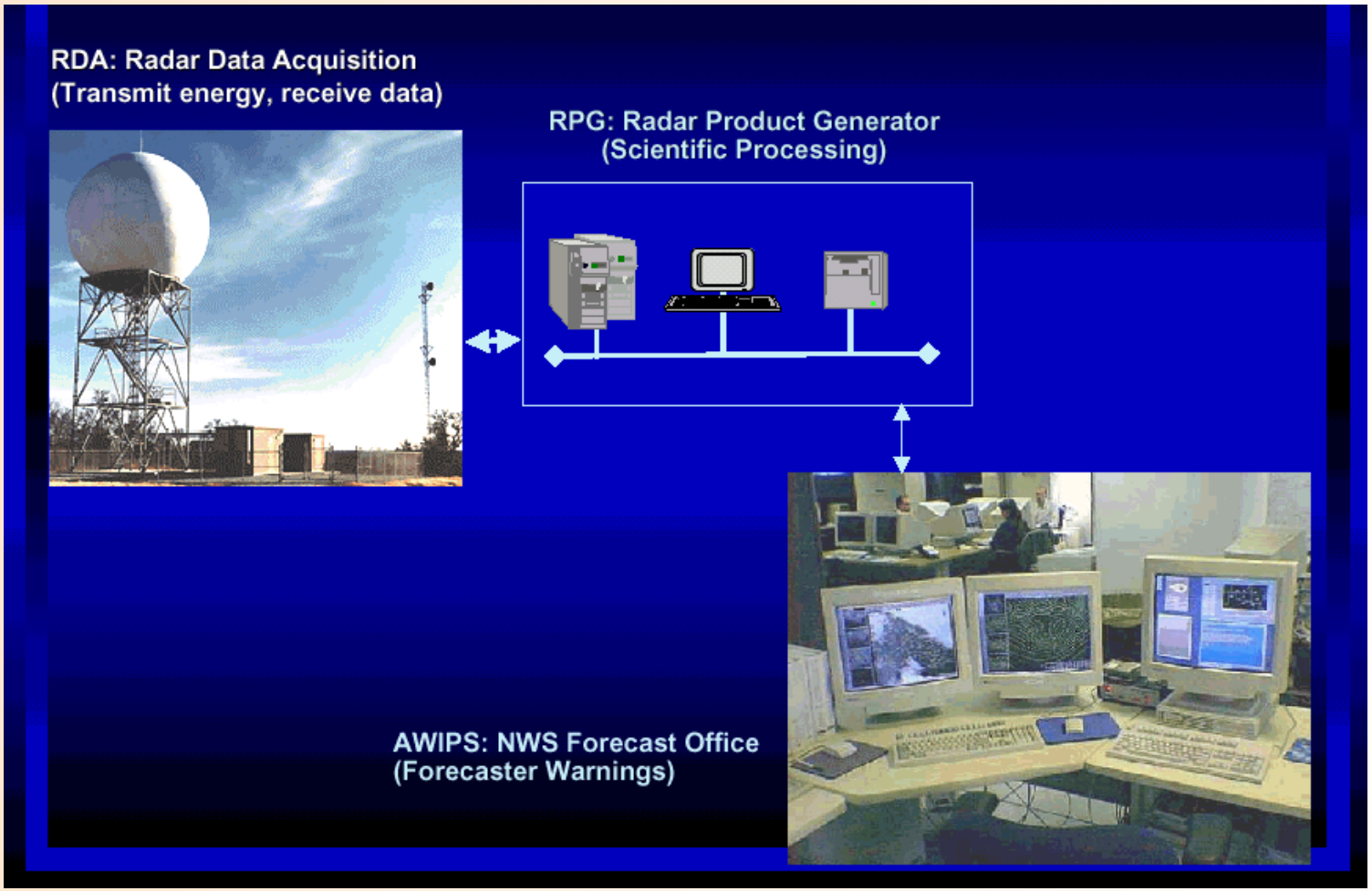
Rain Gauges



Satellite

Quantitative Precipitation Estimation in the NWS

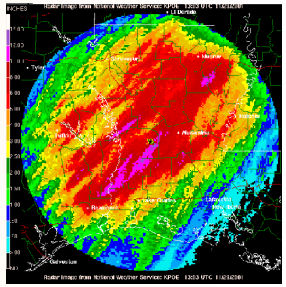
A Blend of Automated & Interactive Procedures



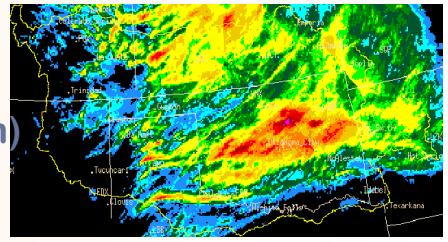
Quantitative Precipitation Estimation in the NWS

Multistep, End-to-end Sequential Processing from Local to Regional to National Levels

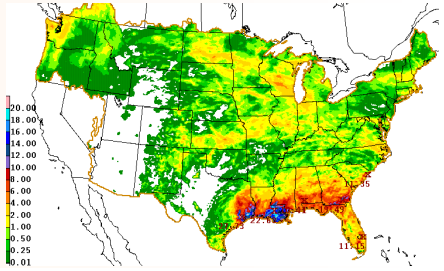
- Local = Weather Forecast Offices (WFO)
  - Precipitation Processing System (PPS) (=Stage I)
  - Stage II Precipitation Processing (old paradigm)
  - Multisensor Precipitation Estimator (MPE) (new paradigm)



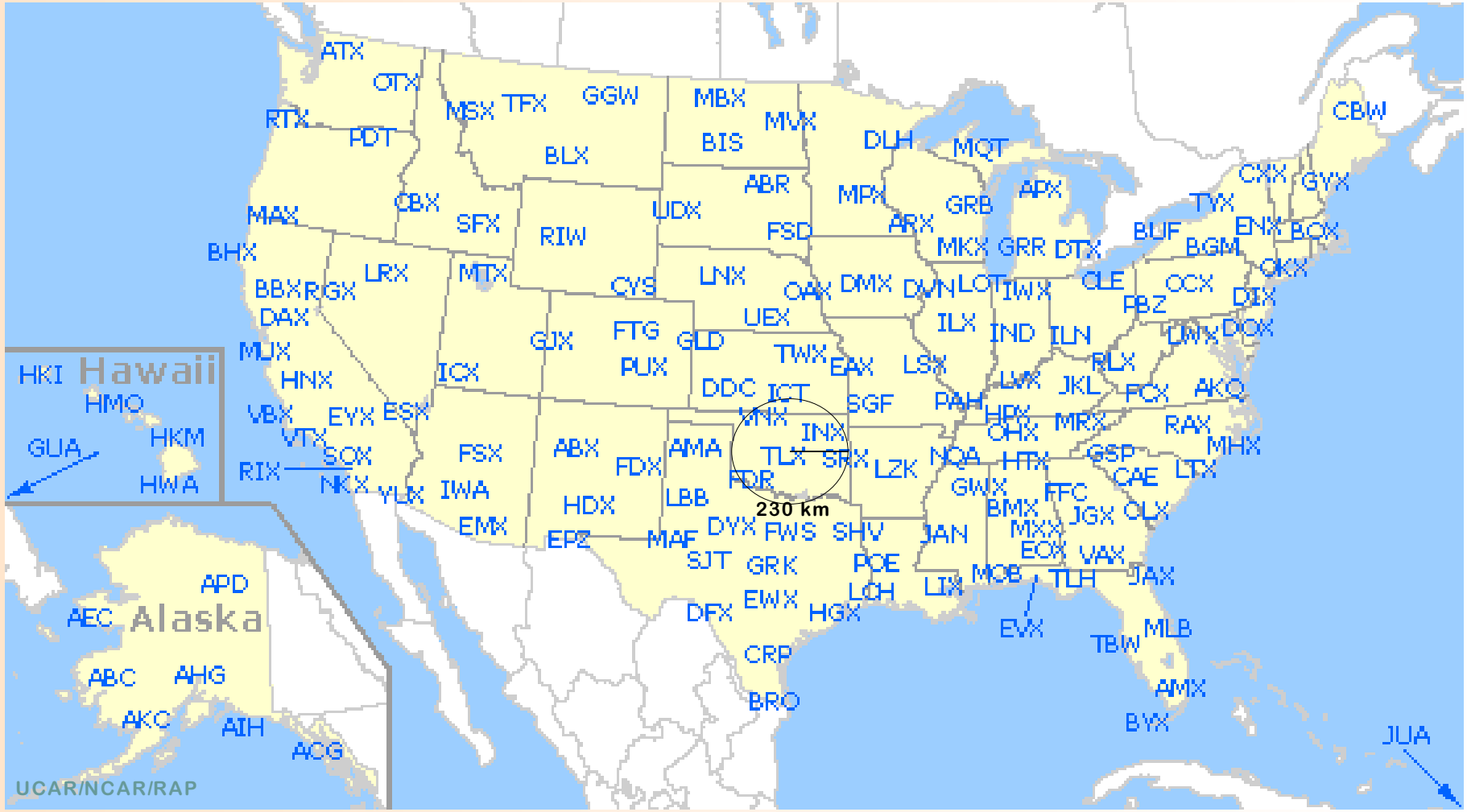
- Regional = River Forecast Centers (RFC)
  - Stage II and III Precipitation Processing (old paradigm)
  - Multisensor Precipitation Estimator (new paradigm)



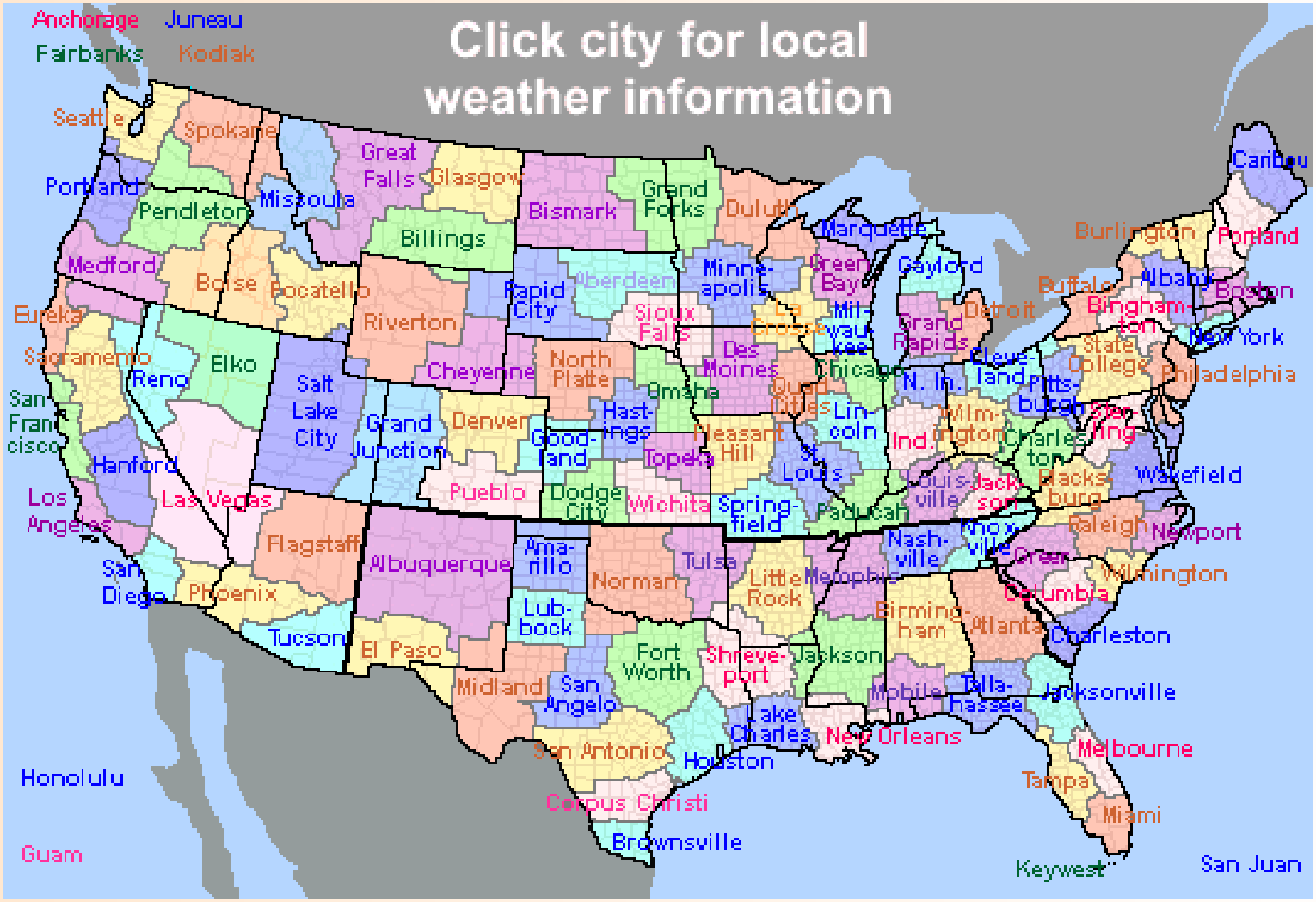
- National = National Center for Environmental Prediction (NCEP)
  - Stage IV Precipitation Processing



160 WSR-88D Doppler Radars



Weather Forecast Offices



First Step (Local)

Generate single-radar WSR-88D rainfall products at each WFO every 5-10 minutes using Precipitation Processing System (PPS)

- Quality control near-ground radar reflectivity data
- Account for beam blockages by terrain
- Compute and apply range corrections due to vertical reflectivity gradients (coming soon)
- Convert reflectivity to rainrate to accumulation
- Apply mean-field raingauge-radar bias correction to account for site-specific calibration and/or Z-R errors
- Generate digital and graphical rainfall products for follow-on processing steps
- Fulton et al., 1998: The WSR-88D rainfall algorithm. Weather and Forecasting, 13, 377-395.

National Weather Service

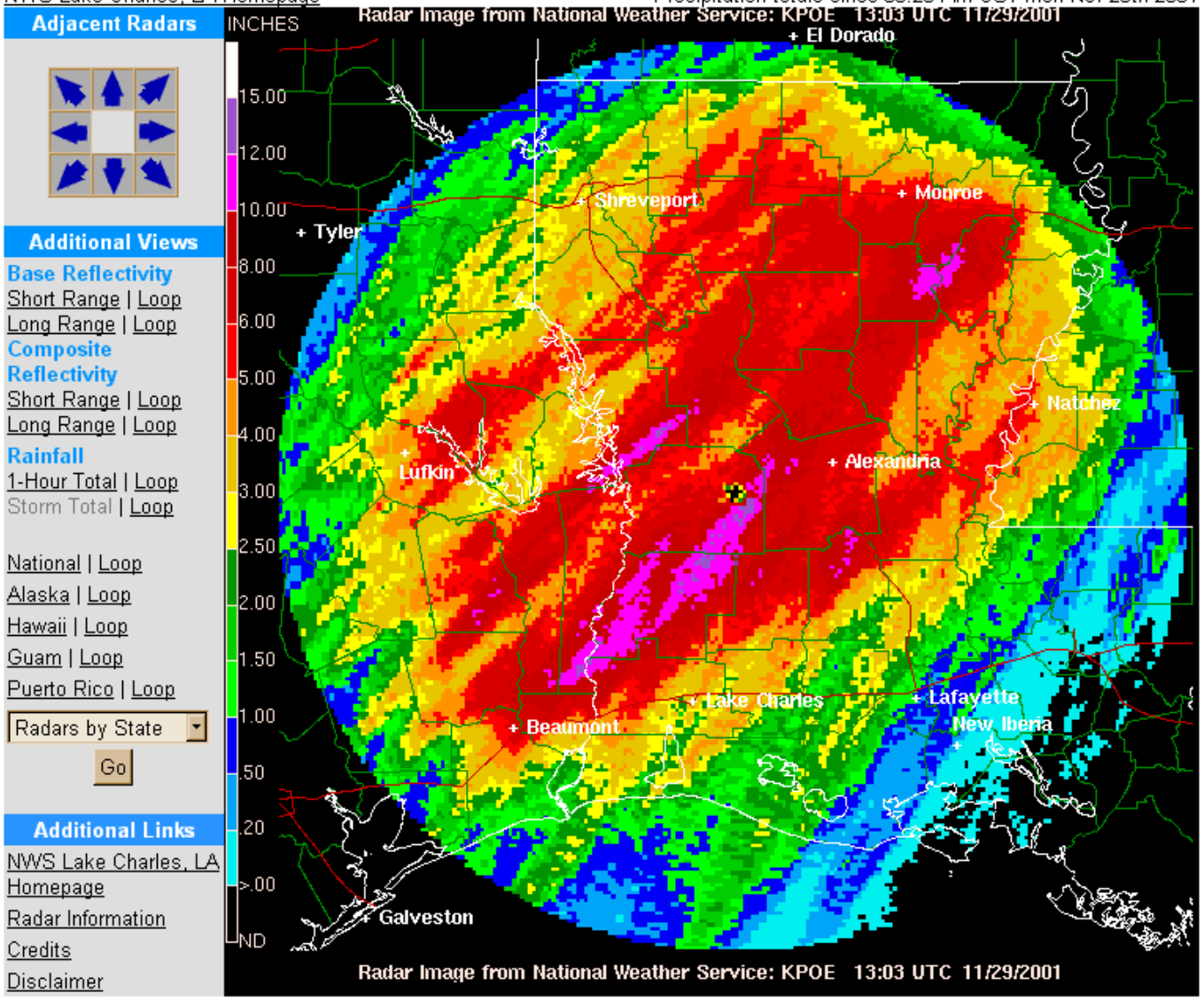
Fort Polk, LA Radar

Storm Total Precipitation

07:17 AM CST Thu Nov 29th 2001

NWS Lake Charles, LA Homepage

Precipitation totals since 06:20 AM CST Mon Nov 26th 2001



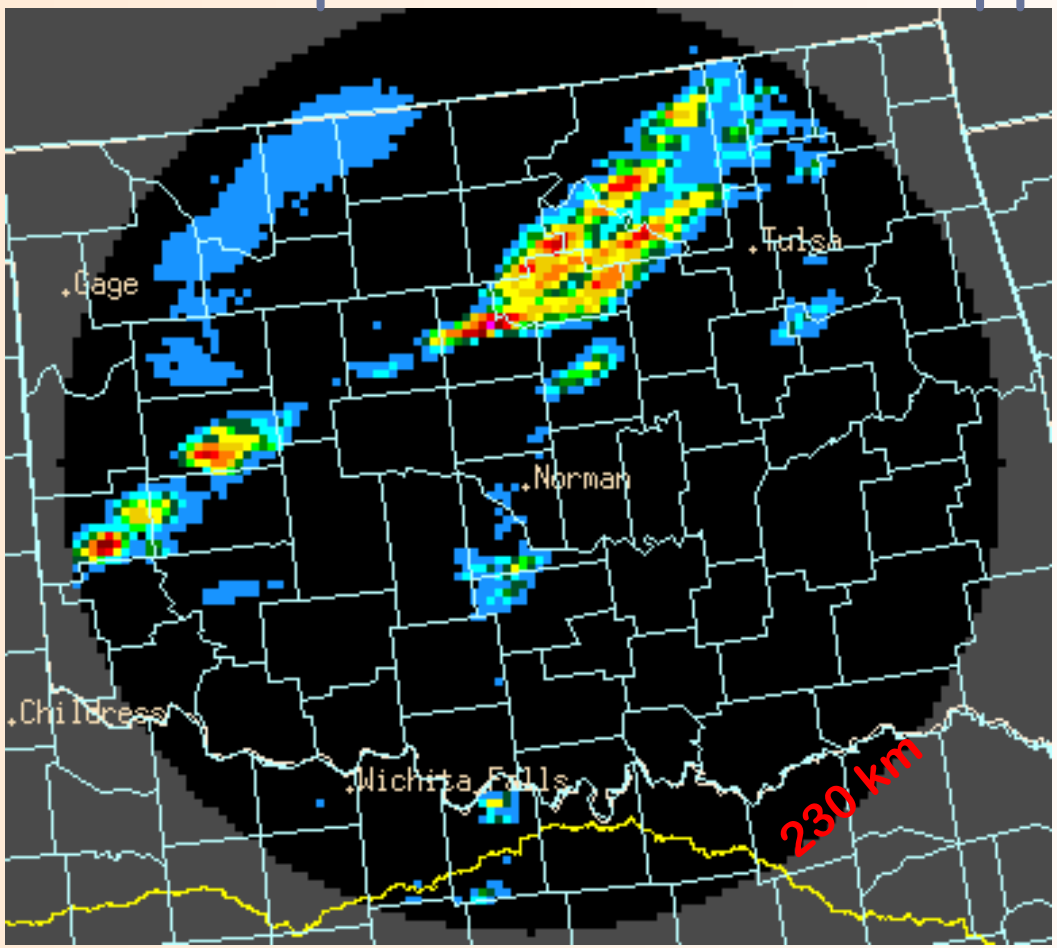
Time and date in red indicates image is at least one hour old.

Graphical 16-level image products

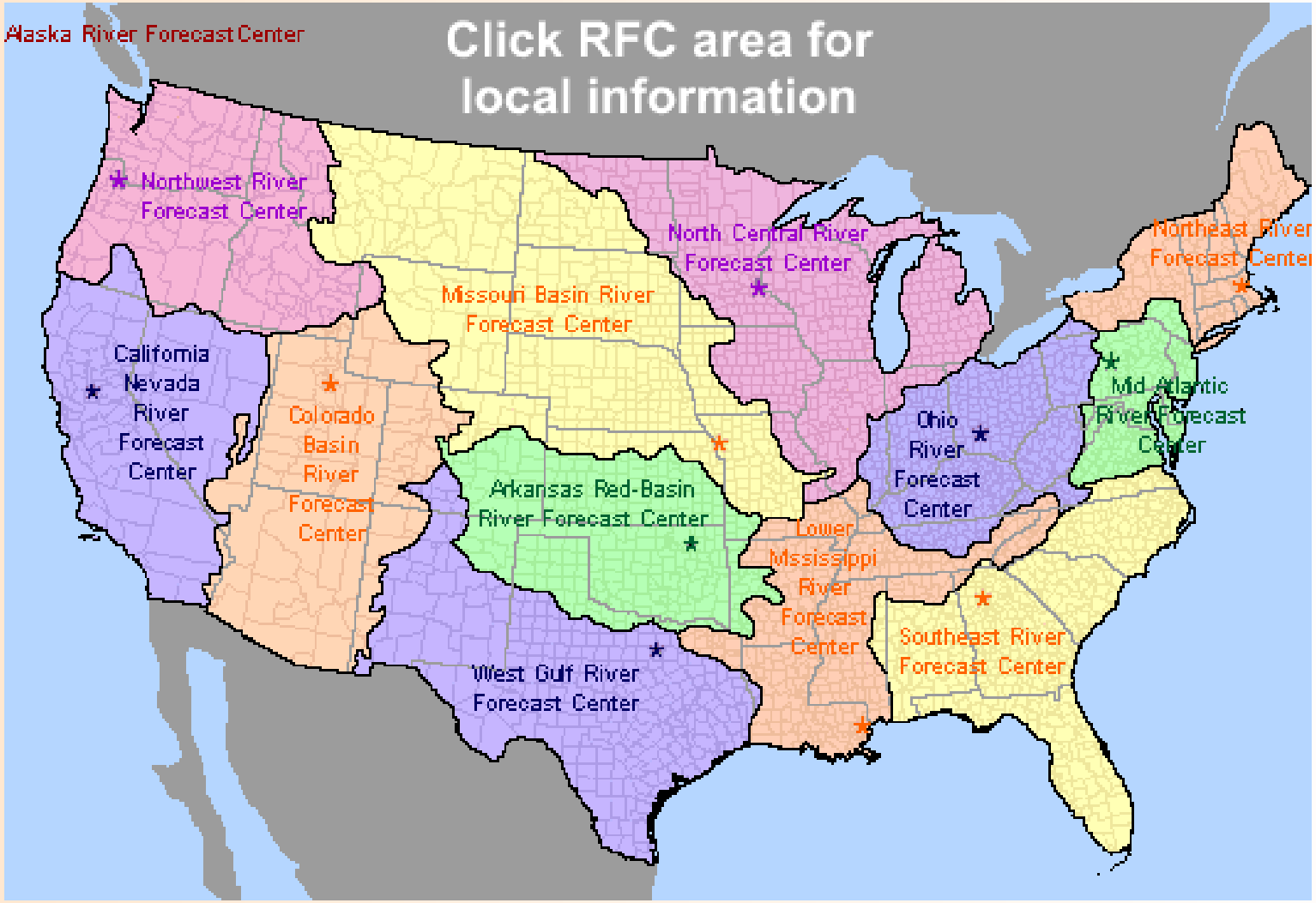
1-hr, 3-hr, storm-total, & user-defined accumulation periods

Hourly Digital Precipitation Array (DPA) Product

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



13 River Forecast Centers

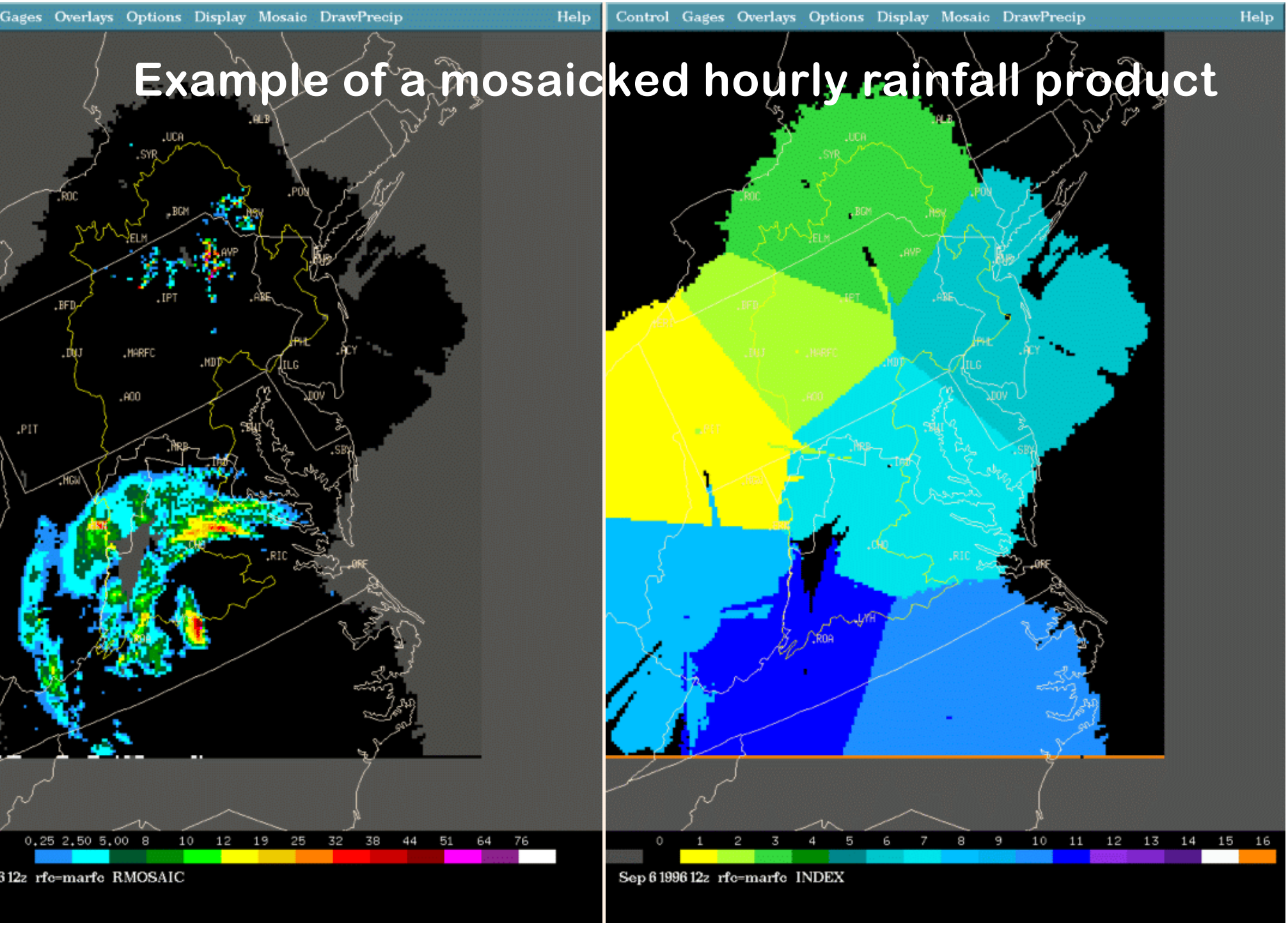


Second Step (Regional)

Generate 4-km **regionally-mosaicked** hourly
multisensor rainfall products at each RFC (and WFO soon)
using **Multisensor Precipitation Estimator (MPE)**

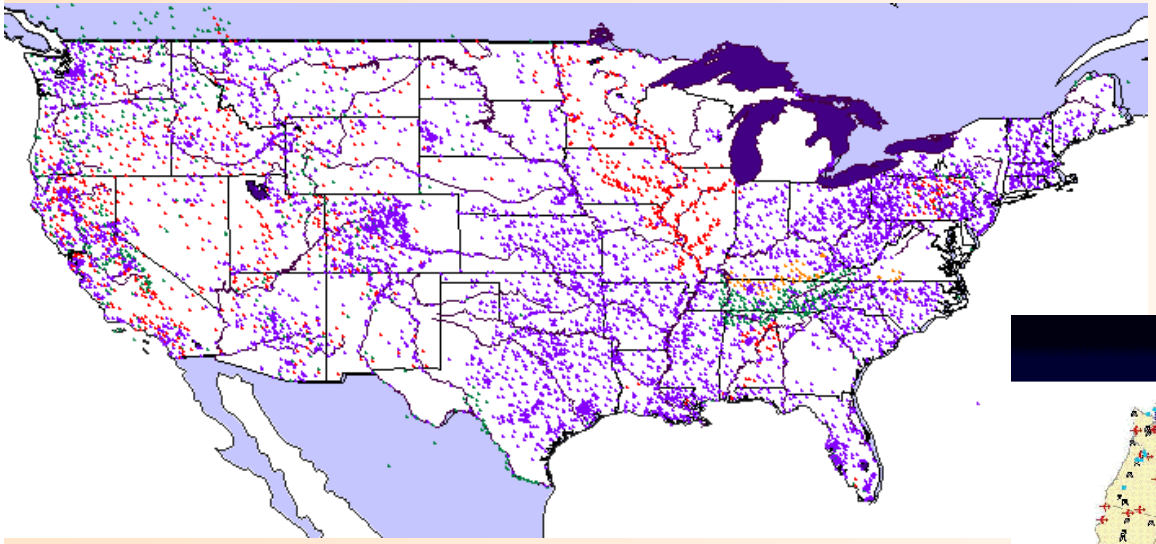
- Compute & apply hourly mean-field raingauge-radar corrections for each WSR-88D radar in RFC service area
- Regionally mosaic these hourly rainfall products
- Merge radar, gauge, and satellite rainfall estimates on a pixel-by-pixel basis to generate optimal multisensor rainfall grids
- Interactively quality control real-time rain gauge, radar & satellite rainfall estimates; iterate the above if needed
- Generate optimal hourly regional multisensor rainfall mosaic products on the 4-km HRAP grid
- http://www.nws.noaa.gov/oh/hrl/presentations/mpe_training_wkshp_0601/course_outline.htm

Example of a mosaicked hourly rainfall product



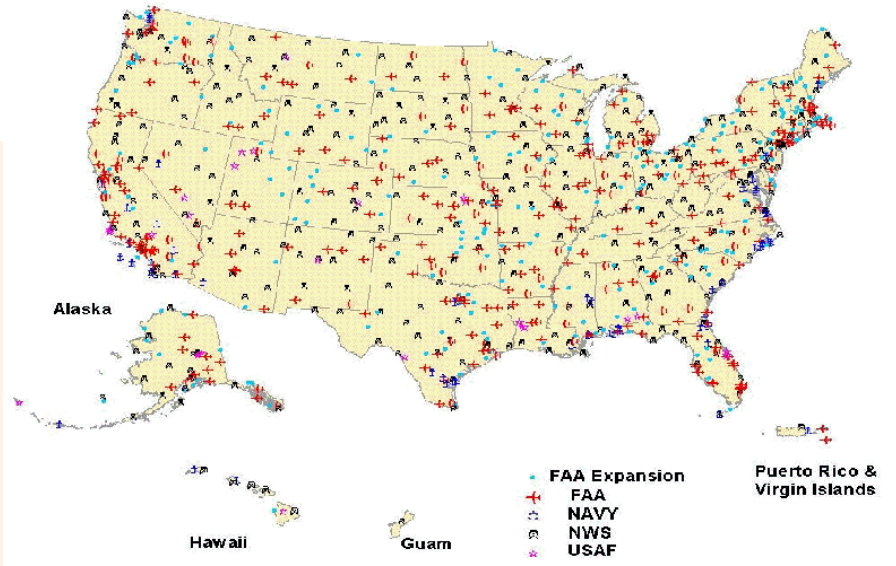
Utilize available real-time automated hourly rain gauge data

GOES Data Collection Platform Locations

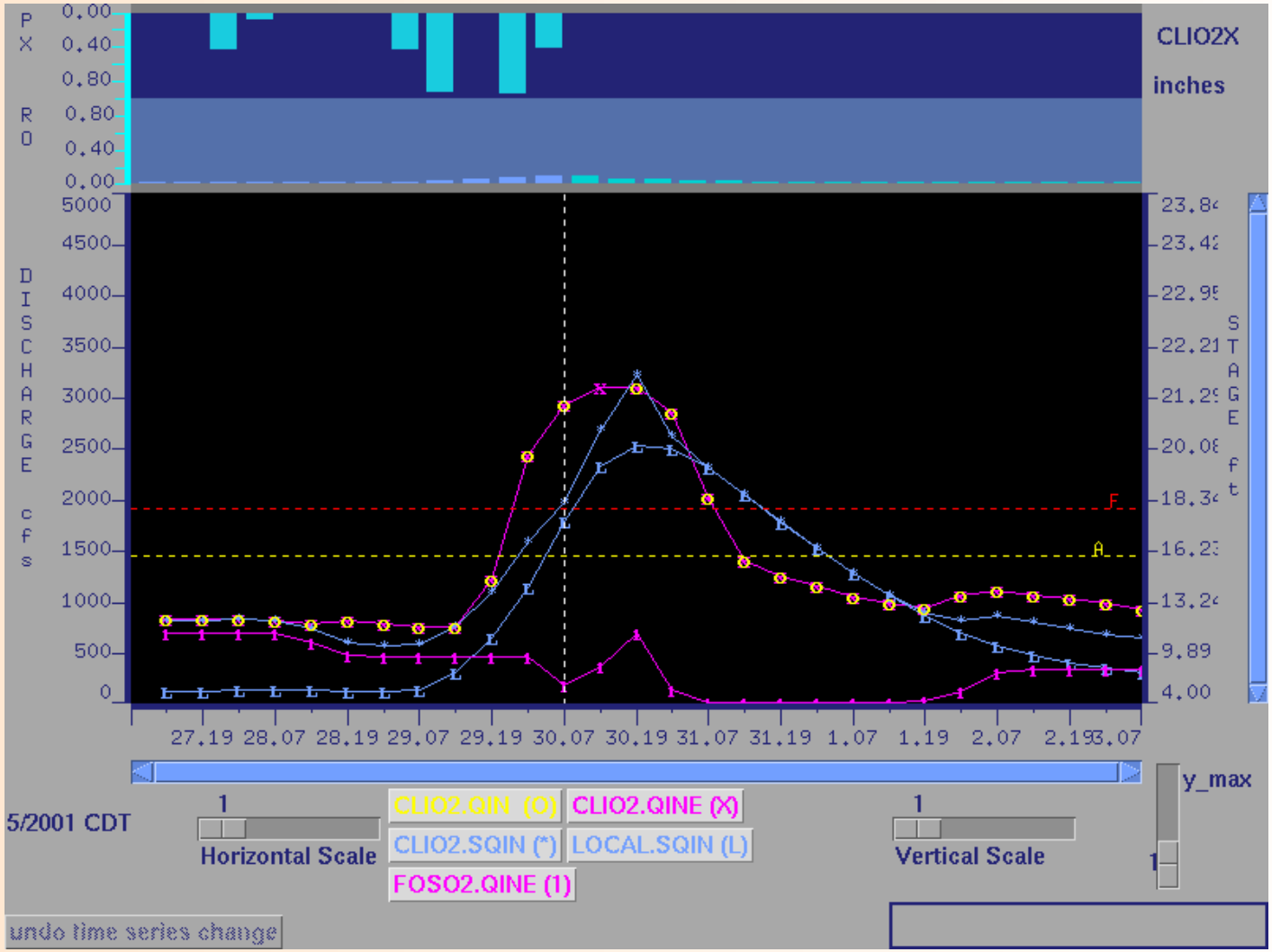


Other networks: ALERT, IFLOWS, local networks

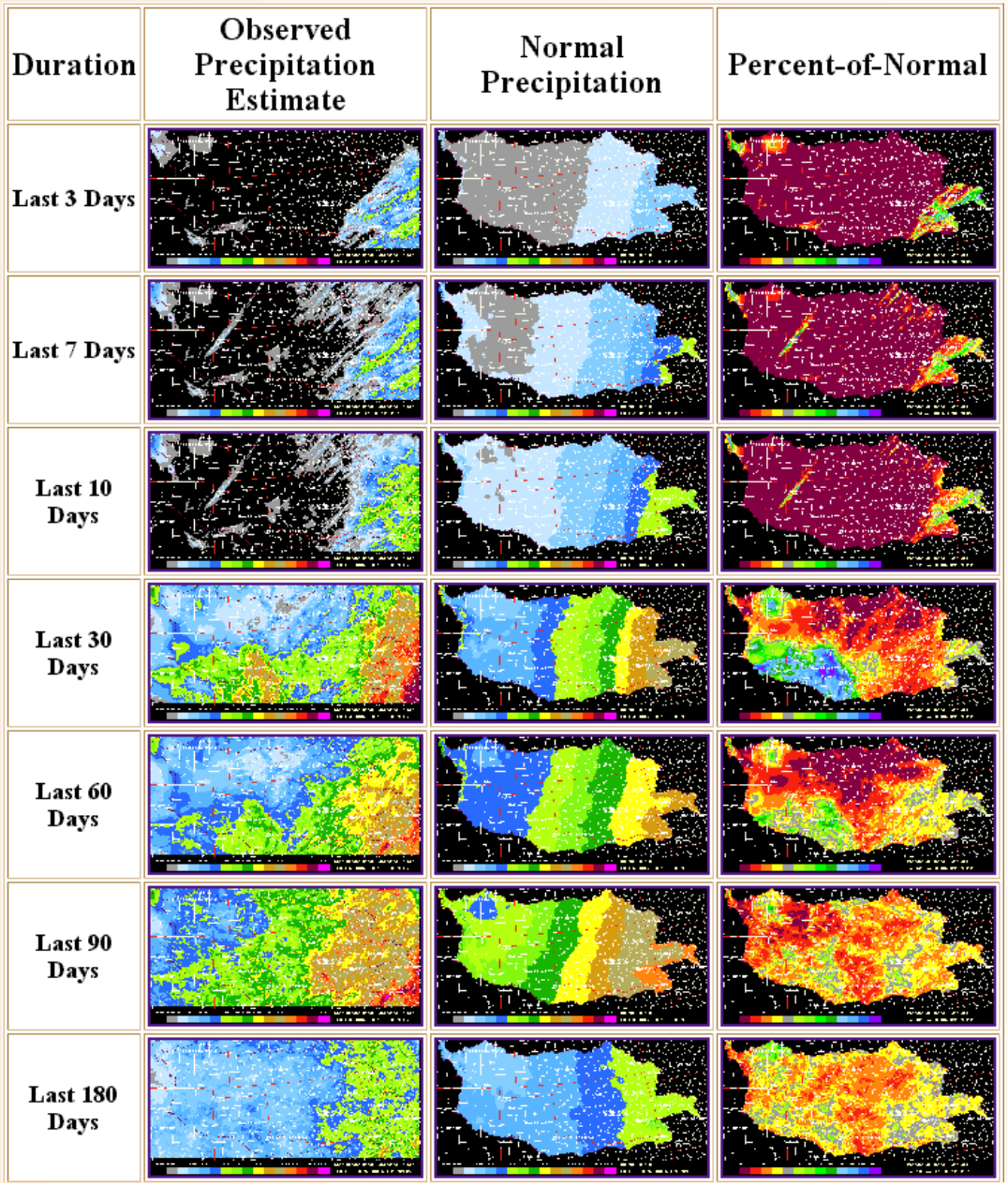
ASOS Locations



Regional hourly multisensor rainfall products may then be used as input to hydrologic forecast models of the River Forecast System



Regional hourly multisensor rainfall products can also used to monitor long-term rainfall and soil moisture



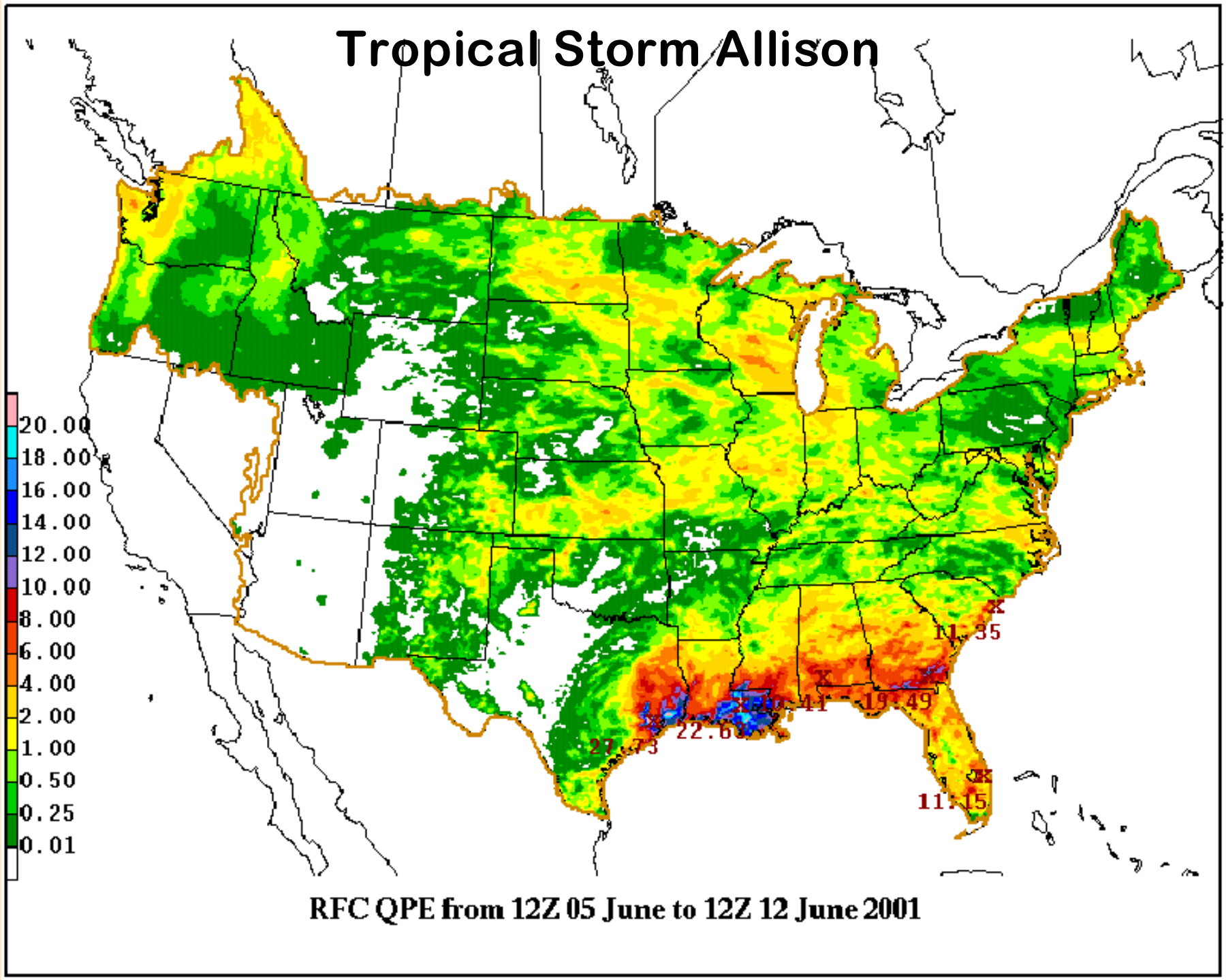
From ABRFC

Third Step (National)

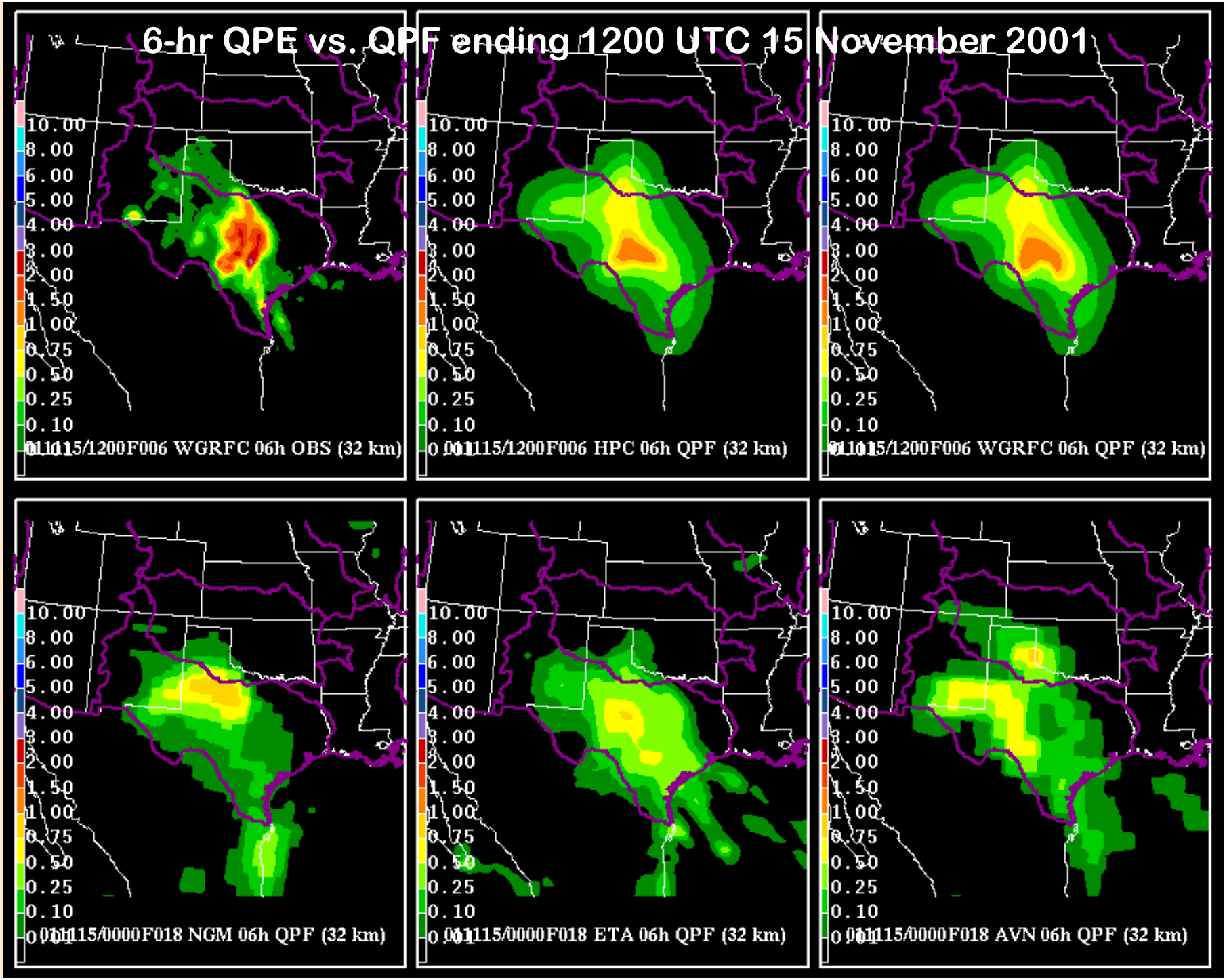
Generate National Mosaic of Hourly Rainfall Products using Stage IV Precipitation Processing algorithm

- NWS/NCEP performs national 10-km rain mosaicking
  - http://www.emc.ncep.noaa.gov/mmb/stage2/
  - Baldwin and Mitchell, 1997: The NCEP hourly multisensor U.S. precipitation analysis for operations and GCIP research. Preprints, 13th AMS Conference on Hydrology, 54-55
- Used as input to NWS numerical weather prediction models to improve quality of:
  - 4-d data assimilation of precipitation (Eta Data Assimilation System) and short-term Eta model precipitation forecasts
  - Other water cycle components, e.g., soil moisture
  - Lin et al., 1999: Test assimilations of real-time multisensor hourly precipitation analysis into the NCEP Eta model. Preprints, 8th Conf. Mesoscale Processes, 341-344
  - Lin et al., 2001: Spring 2001 changes to NCEP Eta analysis and forecast system: Assimilation of observed precipitation data. Preprints, 9th Conf. Meso. Proc., J92-J95
- Used for verification of QPFs from NCEP NWP models and HPC and RFC forecasters
  - http://www.hpc.ncep.noaa.gov/npvu/

Tropical Storm Allison



6-hr QPE vs. QPF ending 1200 UTC 15 November 2001



Summary

NWS Operational Quantitative Precipitation Estimation products are:

- Multisensor…for optimal rainfall estimation
- Multistep processing…for distributed computing
- Blend of automated and human-interactive techniques…for flexibility and ease-of-use
- Peer reviewed and based on 10 years of operational experience in the U.S.
- Applicable to a wide range of geographic locations and climate regimes
- Used for a wide range of applications
- Not perfect…improved data is needed and improved techniques are being developed