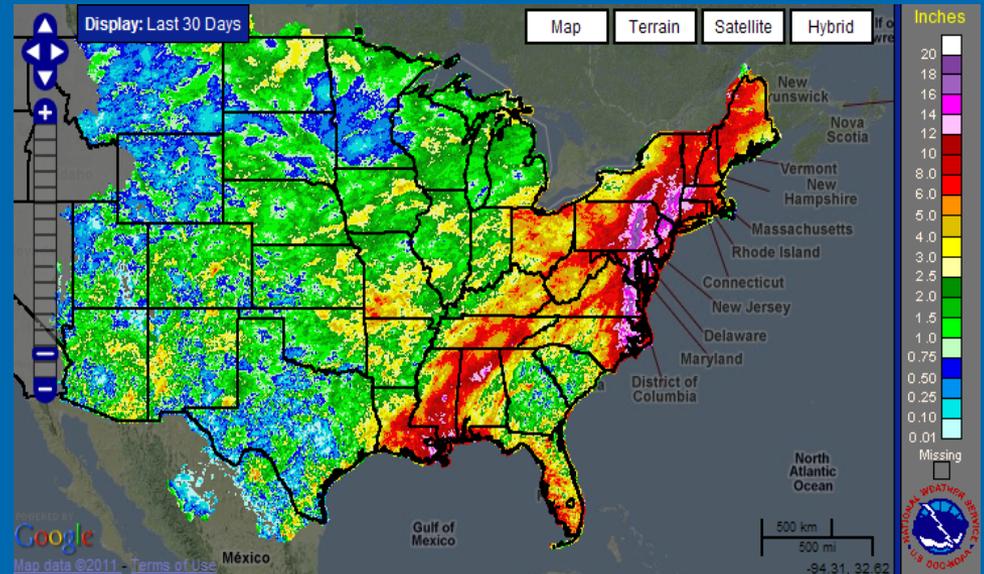
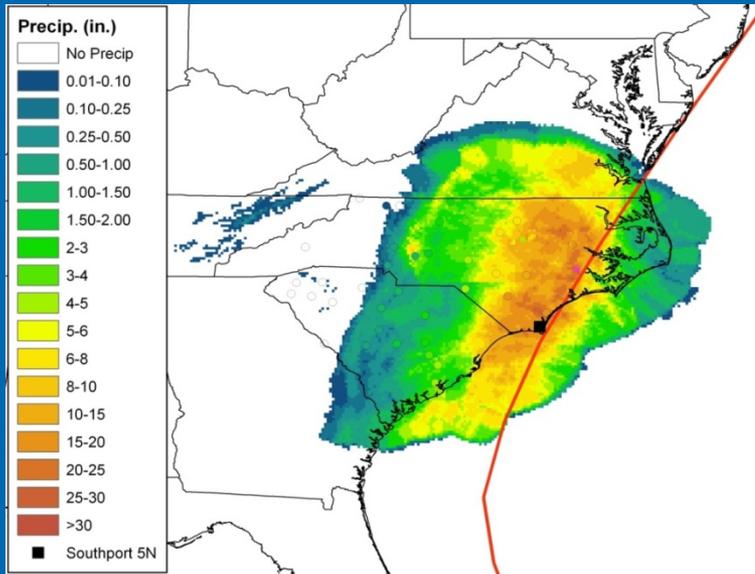


SOH - Extreme Storm Work Group Activities and Recommendations



ACWI Meeting
July 11, 2012

TVA



USGS
science for a changing world

NRCS



Extreme Storm Events Work Group Tasks (from 2008 Charge Statement)

1. Solicit Work Group membership: Federal, state agencies, universities, professional organizations, consultants: expertise in hydrometeorology.
2. Conduct a literature review of methods and databases.
3. Long-term plan to update the extreme storm catalog and NWS's HMRs/PMP with new technologies.
4. Identify and list Federal agency needs.
5. Inform SOH/ACWI on the need for Federal funding support to analyze extreme storm events.
6. Exchange information via teleconference calls, workshops, and correspondence.

SOH - Extreme Storm Work Group

Initial Work Group Activities

- **Commence Pilot Extreme Storm Study in Southeast U.S.** by U.S. Bureau of Reclamation for application to flood assessments of nuclear facilities funded by the U.S. Nuclear Regulatory Commission
- **Discuss ways to update generalized HMRs and PMP estimates**
- **Compare recent storm data** and PMP estimates to published PMP estimates in HMR 51
- **Review and analyze Depth-Area-Duration (DAD) data sets** used to develop generalized PMP estimates
- **Analyze Upper Missouri Pilot storm data** (Doug Clemetson and associates at USACE) for use in future storm transposition studies and HMR updates

Extreme Storm Events Work Group Task Status

1. Solicit Work Group membership
 - completed
2. Literature review
 - completed; review information in U.S. BoR reports to NRC.
3. Long-term plan to update the extreme storm catalog and HMRs/PMP w/new technologies
 - Under development, incomplete due to lack of staff resources.
4. List of individual Federal agency needs
 - Incomplete. Limited information from a few agencies on their needs for new activities and objectives for flood assessments and risk (workshop)
5. Inform SOH/ACWI on Federal funding support
 - Ongoing. Critical shortage of staff resources to estimate costs.
6. Conference calls, workshops, correspondence
 - Ongoing through initiatives by NRC, U.S. BoR and USACOE staff.

Extreme Storm Events Work Group Members

- NRC Staff continues to act as interim lead since Charter approval

- Active contributions primarily from three agencies
 - US Army Corps of Engineers
 - Bureau of Reclamation
 - U.S. Nuclear Regulatory Commission

- Cooperating Agencies
 - FERC, NRCS, NWS, TVA, USGS

Major Efforts, Progress and Accomplishments

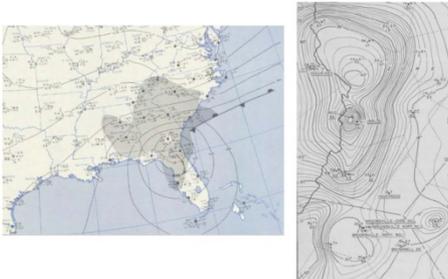
1. Reclamation pilot study funded by NRC for assessing PMP estimates for North and South Carolina
 - completed
 - existing and new data catalogs; analysis for annual exceedance probability
2. USACE Storm Data Collection, Data Base.
 - initial pilot database for Upper Missouri River Basin
 - ongoing data collection – **see presentation from USACE**
 - related projects – PMP in Alaska
3. Reclamation Extreme Storm research and Climate Change
 - Initial efforts funded by Reclamation S&T
 - Collaboration with NOAA and Cooperative Institute for Research in Environmental Sciences
 - just beginning work

Major Deliverables - Reports

RECLAMATION *Managing Water in the West*

Review of Probable Maximum Precipitation Procedures and Databases Used to Develop Hydrometeorological Reports

For the Nuclear Regulatory Commission
Office of Nuclear Regulatory Research



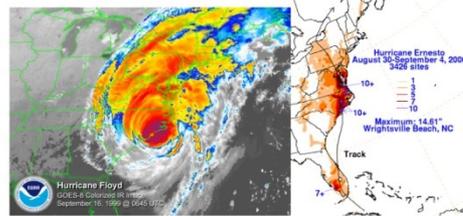

U.S. Department of the Interior
Bureau of Reclamation

December 2011

RECLAMATION *Managing Water in the West*

Application of Radar-Rainfall Estimates to Probable Maximum Precipitation in the Carolinas

For the Nuclear Regulatory Commission
Office of Nuclear Regulatory Research



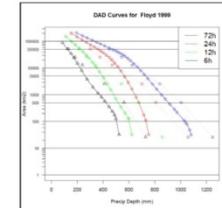

U.S. Department of the Interior
Bureau of Reclamation

December 2011

RECLAMATION *Managing Water in the West*

Synthesis of Extreme Storm Rainfall and Probable Maximum Precipitation in the Southeastern U.S. Pilot Region

For the Nuclear Regulatory Commission
Office of Nuclear Regulatory Research




U.S. Department of the Interior
Bureau of Reclamation

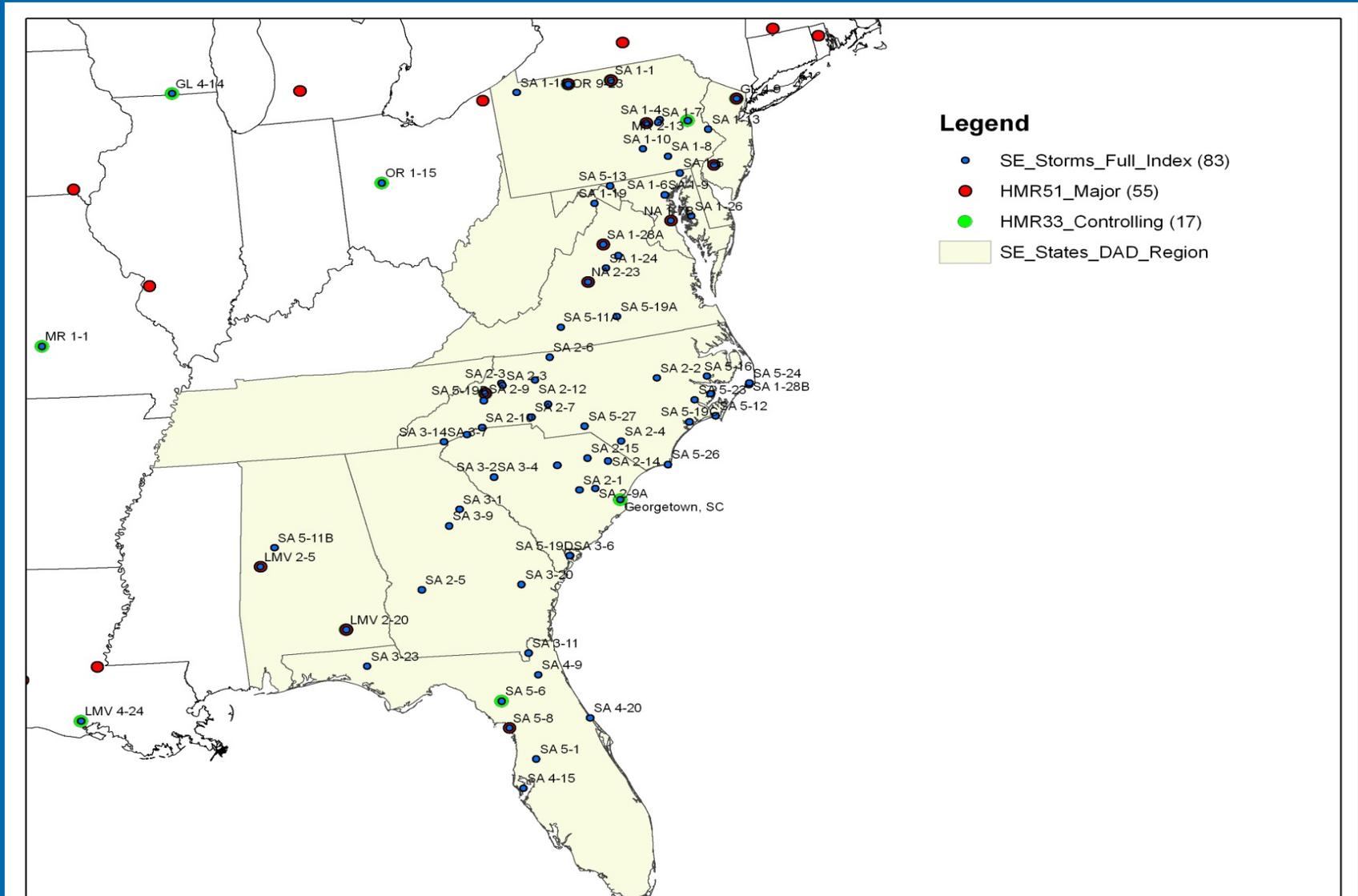
December 2011

<ftp://ftp.usbr.gov/jengland/NRC/reports/>

Southeast U.S. Extreme Storm Catalog from existing D-A-D Data for NRC Study

- Digital (GIS) HMR 51
- Storms analyzed and used in HMR 23, 33 and 51
- Focus on Critical and Controlling Storms in Southeast: **74 storms**
- PAPER copies of data – scanned for major storms
- Electronic Catalog

Southeast Storms – DAD Database



HMR 51 PMP: New Digital Layers

All HMR 51
Maps (30):

Electronic

Images

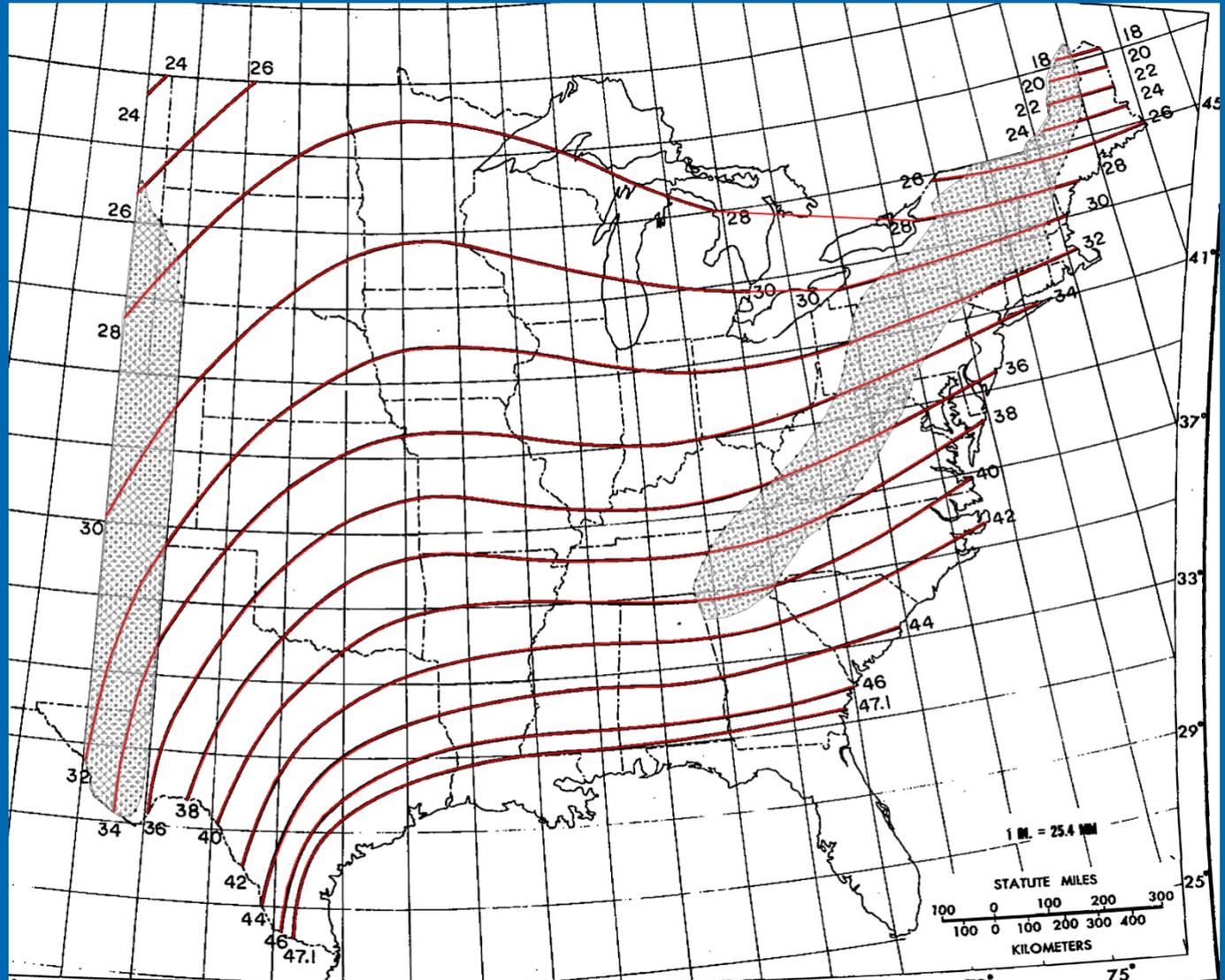
Grids

Shapefiles

e.g.

24 hr, 10

mi²

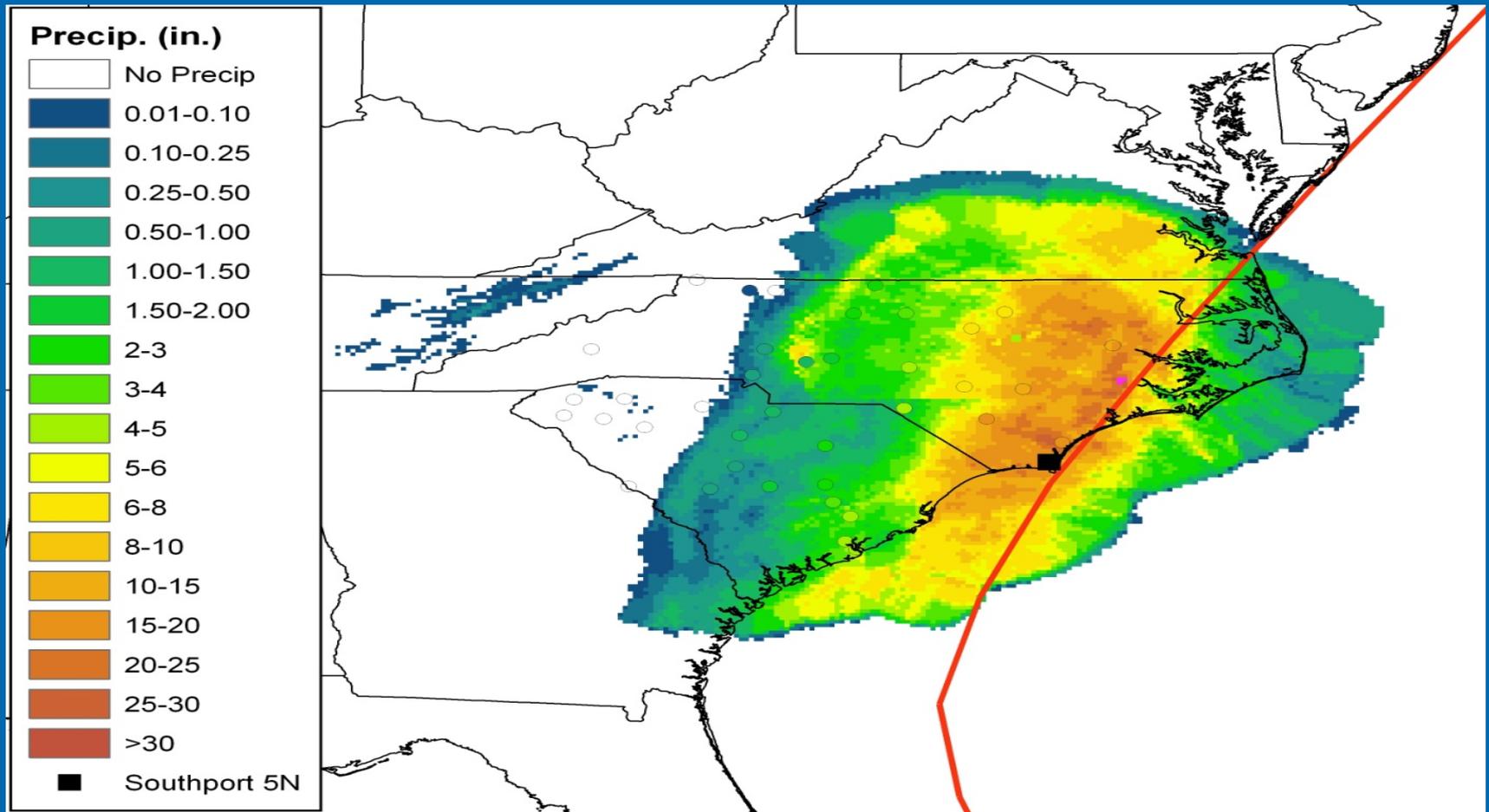


Floyd – HMR 51 24-hour and 72-hr

Floyd1999		24h			72h		
Area (km ²)	Area (mi ²)	HMR51	MPR	% diff	HMR51	MPR	% diff
25.9	10	1084.59	755.40	-43.58	1279.64	1085.44	-17.89
51.8	20	840.78	675.41	-24.48	1046.30	906.62	-15.40
2589.99	1000	731.55	601.39	-21.64	873.40	779.99	-11.98
12949.94	5000	485.41	504.01	3.69	651.87	650.61	-0.19
25899.88	10000	388.75	443.13	12.27	567.97	578.20	1.77
51799.76	20000	309.86	357.37	13.29	462.52	467.33	1.03

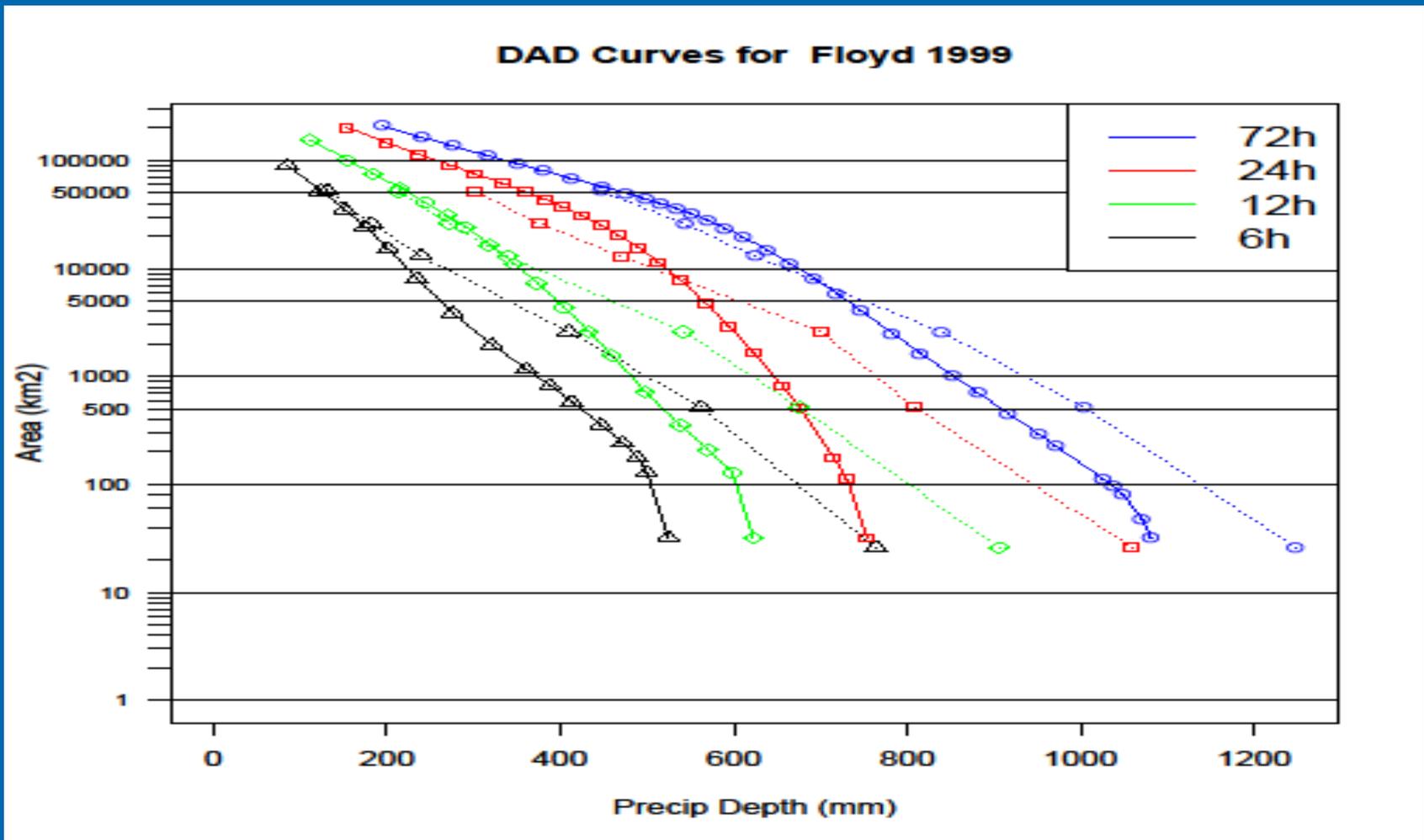
Comparison of PMP values from HMR51 grids and 24-hour and 72-hour DADx from MPR for Floyd 1999.

Hurricane Floyd – Southport, NC



Storm total precipitation for Hurricane Floyd with best storm track from NOAA shown in red. Hourly precipitation gauge accumulations are overlaid to indicate differences between gauge and radar estimates. [Location of the maximum point rainfall at Southport 5N along the southeast coast of North Carolina is shown as a black square.]

Hurricane Floyd – HMR 51



Comparison of DADx curves from MPR (solid) and HMR51 (dashed) for Floyd 1999. Exceedance of HMR51 PMP values are evident where solid lines cross dashed lines of the same color.

Reclamation/NRC Pilot Study

Principle Findings

- Pilot project in NC/SC centering on Multisensor Precipitation Reanalysis data from the NCDC
- New data analyses suggest ***HMR 51 PMP values too low*** for durations > 12 hrs and area sizes > 5,000 mi² along coastal Carolinas (Floyd and Fran)
- Other durations and area sizes unaffected in this location
- Storm maximized values somewhat sensitive to radar rainfall biases and use of maximized moisture
- Use of median moisture max ratio, Floyd still close to PMP

Principle Findings (continued)

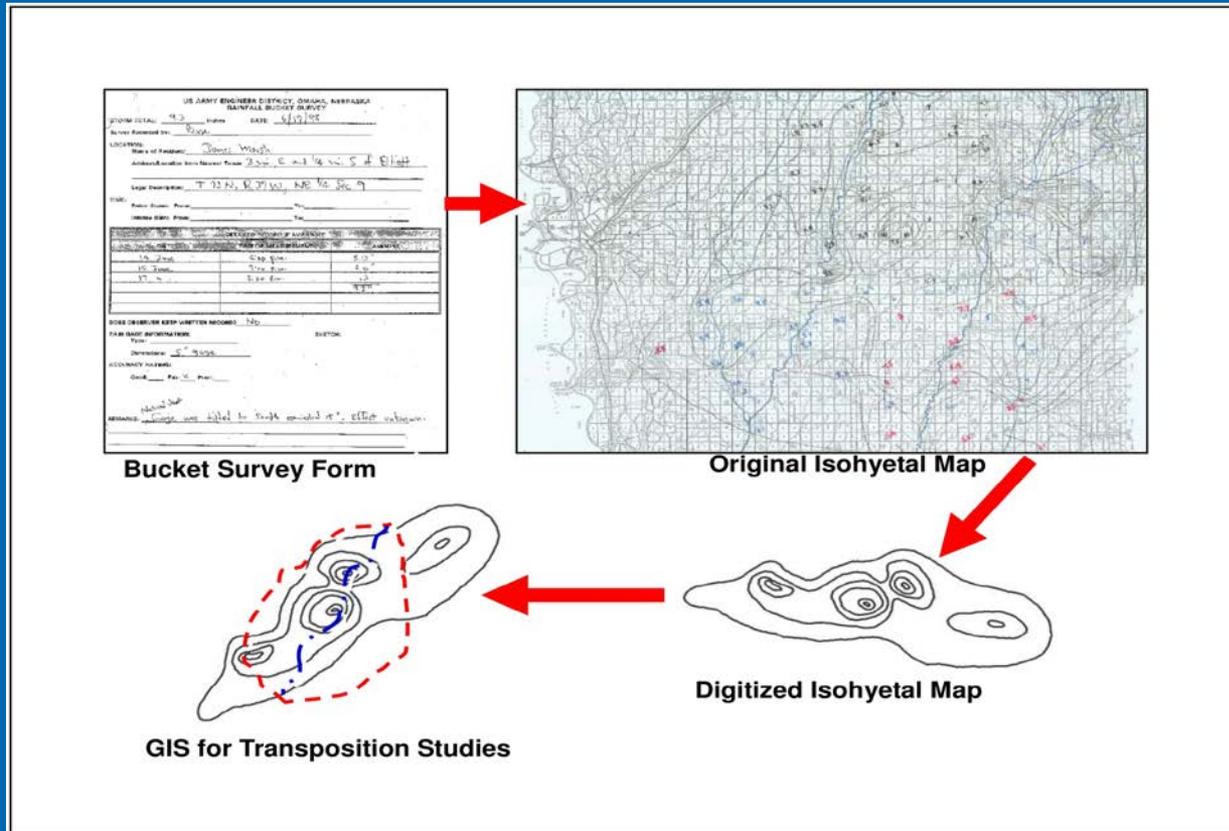
- No significant trends found in SST and Td grids; suggests stationary series for maximization
- Potential for increased temporal clustering of Tropical Cyclone events in August-September (1999, 2004, 2011)
- Longer-duration rainfalls (> 72 hr) and soil moisture for runoff may be changing factors
- PMP ratios to 1/1000 Annual Exceedance Probability of 24-hr rainfall range from 2 to 6 times
- PMP 24-hr, 10mi² return periods range from 10⁻⁵ to > 10⁻⁷
- Additional efforts needed to address orographic effects

Insights from Reclamation/NRC Pilot Study

Risk perspective:

- NOAA 14 extrapolations suggests PMP point values may be exceeded at 10^{-5} along coast and less frequent inland
 - problems with use of different distributions in space and extrapolations, especially generalized logistic analysis for western South Carolina
- Point frequency estimate confidence intervals need to be utilized (e.g. observed events)
- PMP amounts are ESTIMATES and can be exceeded
- Uncertainties of PMP estimates can be quantified for point values
- Further work needed for areal estimate uncertainties

USACOE Data Archiving and Analysis System



*Pilot Study on Upper Missouri River Basin by
Doug Clemetson and colleagues*

Extreme Precipitation Estimates

- Two Categories for Hierarchical Hazard Assessment – NRC; Risk for USBR, USACE
- ***Deterministic, Upper Limit***
 - Probable Maximum Precipitation
 - Used as Design Maximum Precipitation in NRC guidance
- ***Probabilistic, Risk-Based Estimates***
 - Precipitation Frequency (NOAA 14)
 - Stochastic Storm Transposition with Depth-Area-Duration (D-A-D) Data: Yankee Atomic Energy, 1985; NAS, 1988
 - Detailed Regional Precipitation Frequency using L-Moments (linear statistics used to summarize the shape of a probability distribution)

Ongoing Activities and Challenges

1. Extreme Storm Data Base

- Development of a data base and portal will be the focus over the next year and subsequent years.
- Extreme storm data based on radars (over the past 10 years) will be gathered and analyzed.
- We envision a national-scale effort to do this.

2. PMP Updates

- PMP Estimates in HMR 51 should be the first to be reviewed.
- User needs statements have been gathered.
- There are currently insufficient resources to complete a detailed proposal.

3. Storm Probabilities

- The work group is continuing conversations on probabilistic extreme storm alternatives to PMP.

Major Issues Needing Resolution

1. Designate a Lead Agency for Data and Analysis Repository
 - A lead agency is needed to coordinate the data collection and analysis effort, and serve as a repository of analyses and databases.
 - There are significant user and community needs on extreme storms - data and analyses.
2. Lack of Technical Resources, Organization and Community
 - There is a shortage of technical resources performing this type of work, with the needed knowledge and expertise.
 - Work is dispersed and highly-varied, depending on agency need.
3. Funding and Centralization of Effort
 - Coordination of financial and technical resources is a significant challenge.

SOH - Extreme Storm Work Group Recommendations to ACWI

- ACWI should recommend to the Water Information Coordination Program (WICP)
 - **Critical need exists for developing resources to analyze Extreme Storm Data and estimate PMPs and frequencies of extreme storm events**
 - **Reviews of Data and Estimates** every 10 years
 - **Designate Lead Agency** to accomplish this work
 - **Identify/Develop funding to support these activities** that are critical to flood assessments of dams and nuclear power stations, and for environmental assessments