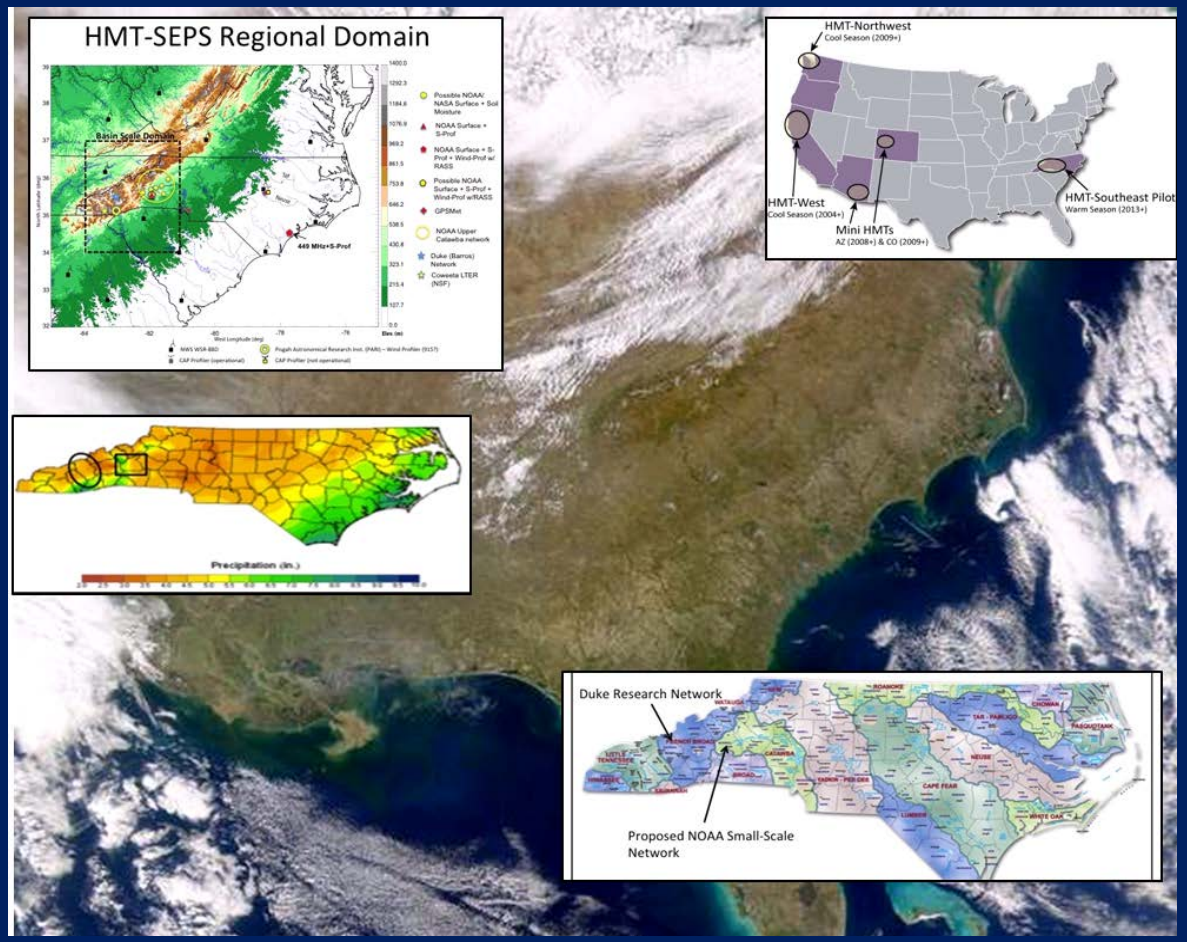
HMT-Southeast Overview



Annual HMT Science Meeting

8 November 2012

Outline

1. Overarching goals and drivers
2. FY12 Accomplishments
3. FY13 Plans
4. Discussion

Outline

1. **Overarching goals and drivers**
2. FY12 Accomplishments
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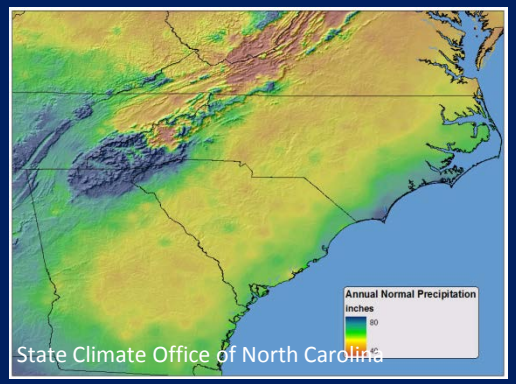
HMT-Southeast: Overarching goals and drivers

- The Southeast U.S. a key region of interest because:
  - Experiences extreme rainfall during all seasons
  - Large variability in types of weather systems capable of producing flooding; region comprised of both coastal and mountainous terrain
  - Known regional challenges exist for quantitative precipitation forecasting (QPF) and estimation (QPE) – especially for extreme precipitation
- For HMT-SE, NOAA HMT seeks to:
  - Conduct region-specific research on precipitation and weather conditions that can lead to flooding
  - Broaden impact of HMT to test existing and new hypotheses related to orographic precipitation in different regions
  - Foster transition of scientific advances and new tools into forecasting operations

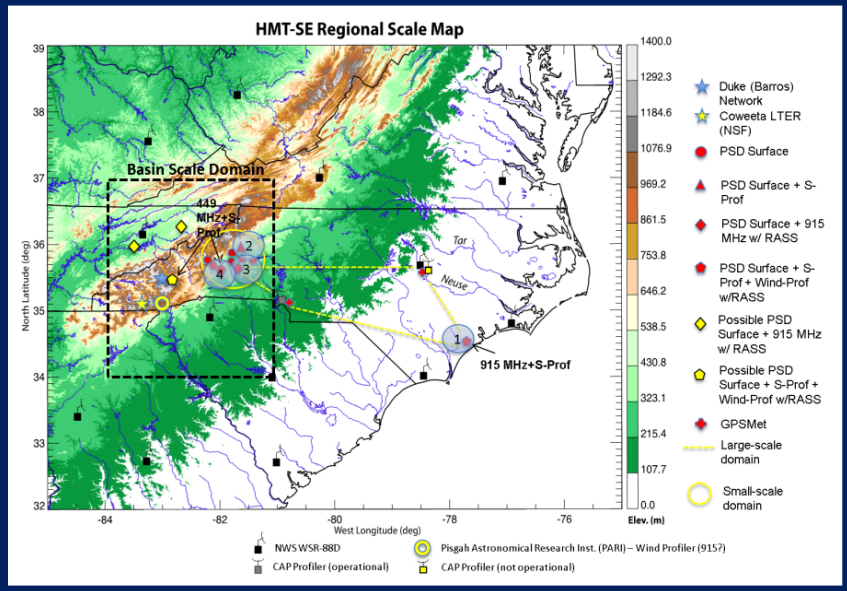
Annual Normal Precipitation



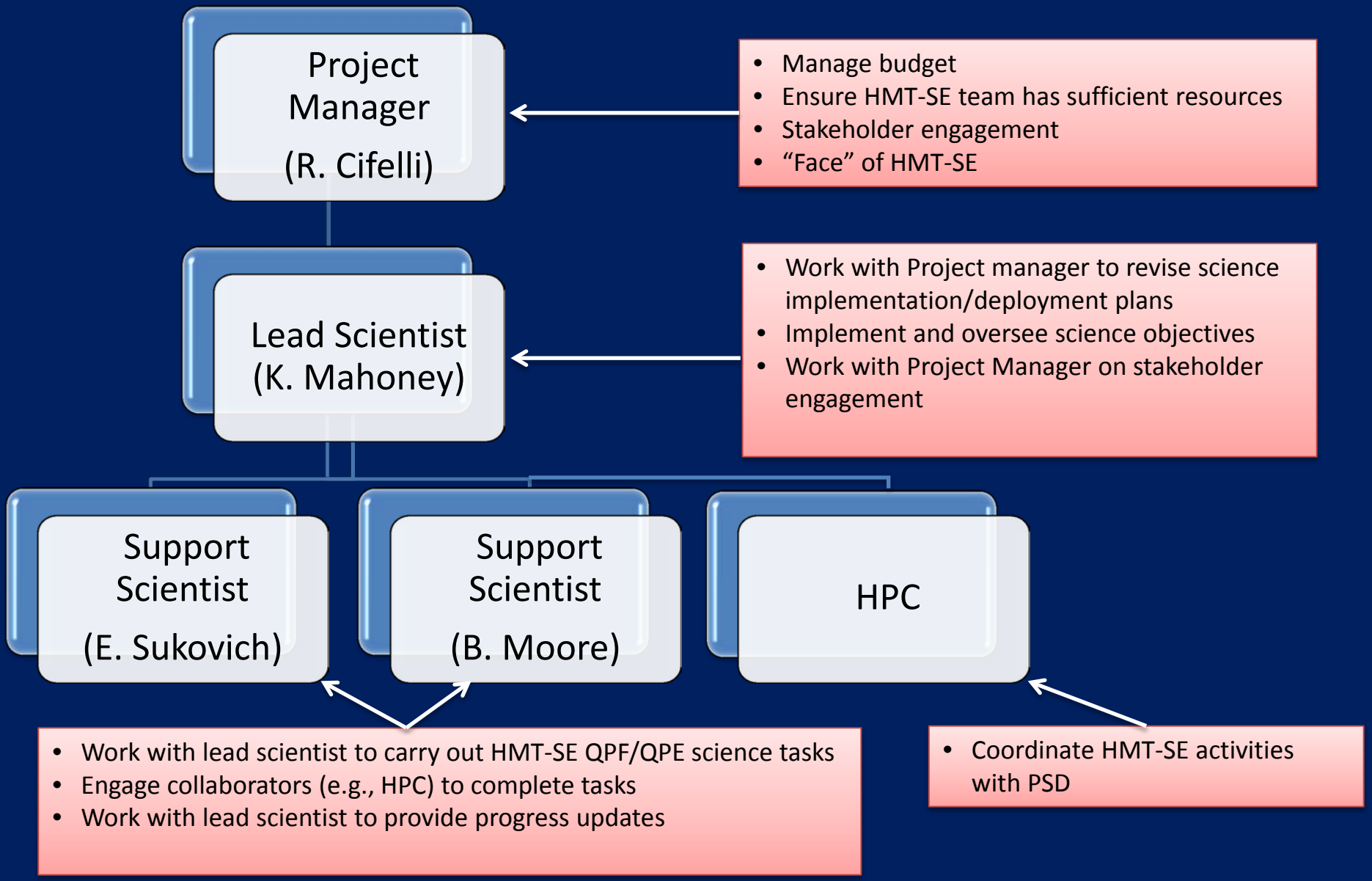
Flooding in Asheville, NC from Hurricane Frances (2004)

HMT-Southeast: Overarching goals and drivers

- HMT-Southeast: 2 parts
  1. Pilot Study in western North Carolina (Spring 2013 – Fall 2014)
  2. Operationally-oriented research on extreme precipitation and forecast challenge identification
- HMT-Southeast Pilot Study ("HMT-SEPS")
  - Planned for May 2013 – September 2014 in western North Carolina
  - Largely focused on QPE in western NC (but some instrumentation in central and eastern NC)
  - NOAA will bring instrumentation and also leverage additional assets from NASA ground validation campaign



HMT-SE Management Structure: FY12 Roles



HMT-Southeast: Overarching goals and drivers

Main tasks as described in Science Plan:

- Quantitative precipitation estimation (QPE)
  - Deployment
  - Data management
  - QC radar data
  - Calibration of profiler/disdrometer data
  - Profiler drop size distribution (DSD) retrievals/partition profiler data
  - NEXRAD DSD retrieval/rainfall rate comparisons
  - Integration/evaluation of QPE in NMQ/MPE
  - Manuscript preparation

- Quantitative precipitation forecasts (QPF)
  - Extreme precipitation climatology
  - QPF verification of extreme precipitation, error identification
  - Process studies
  - Case study analysis
  - Manuscript preparation

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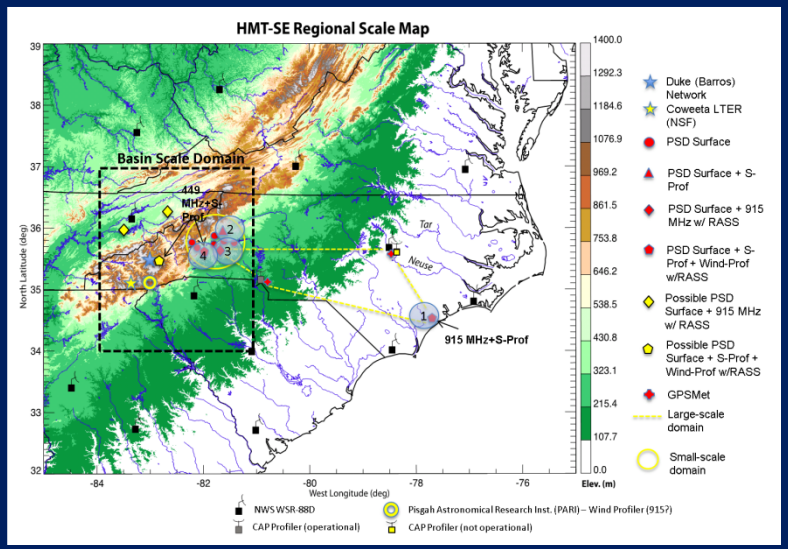
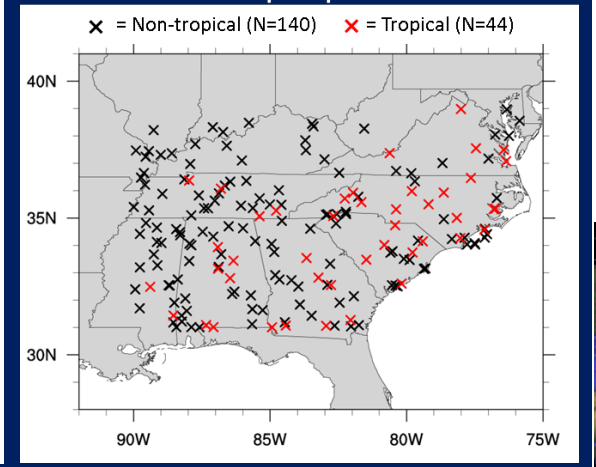
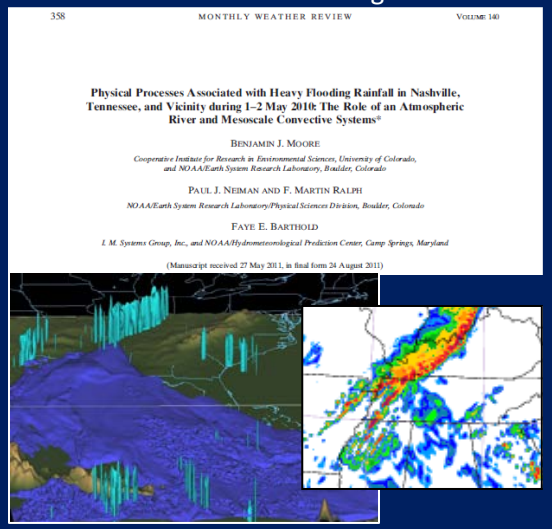
FY12 Accomplishments

- FY12 activities and milestones:
  1. Prepare HMT-SE Science and HMT-SE Study Plan and share with broader NOAA/NWS community for input
  2. Prepare collaborative joint agreement with NASA to support HMT-SE Pilot Study
  3. Re-engage broad HMT-SE stakeholder community (>200 contacts), including NWS Eastern and Southern Region Headquarters, in renewed HMT-SE planning efforts
  4. Develop HMT-SE extreme precipitation climatology
  5. Use high-res WRF model to examine the primary sources of moisture and moisture transport mechanisms associated with two recent extreme precipitation events
  6. Initiate HMT-SE collaboration with NWS HPC
  7. Publish case study of 2010 Tennessee flood event





Tennessee 2010 floods: Publication and model-based investigation



FY12 Accomplishments: Primary accomplishments and impacts

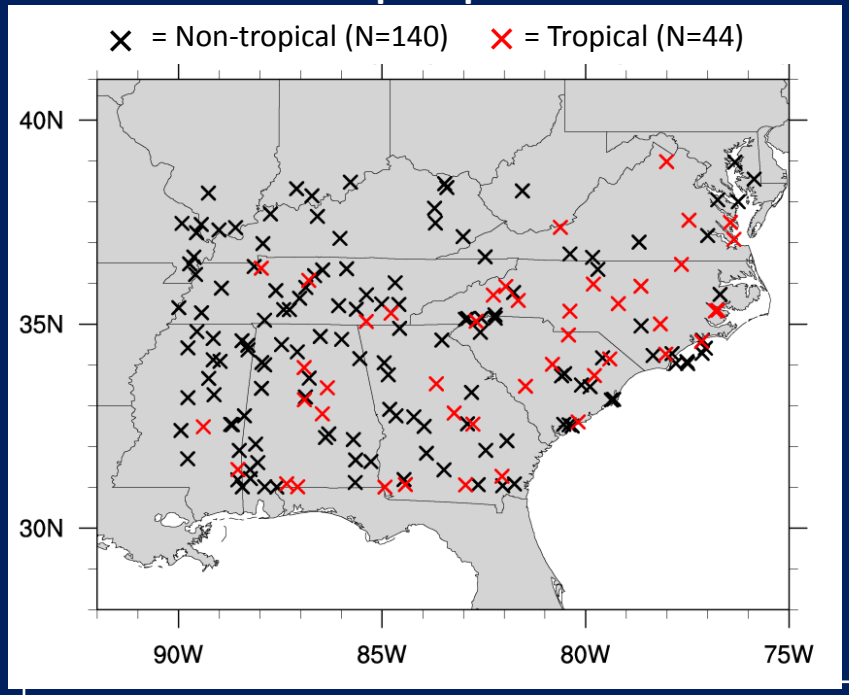
- Pilot study planning and preparation:
  - Updated and distributed HMT-SE Science Plan and HMT-SEPS instrument deployment plan
- Publications:
  - Moore, Benjamin J., Paul J. Neiman, F. Martin Ralph, Faye E. Barthold, 2012: Physical Processes Associated with Heavy Flooding Rainfall in Nashville, Tennessee, and Vicinity during 1–2 May 2010: The Role of an Atmospheric River and Mesoscale Convective Systems. *Mon. Wea. Rev.*, **140**, 358–378.
  - Moore, Benjamin J., Lance F. Bosart, Daniel Keyser, Michael L. Jurewicz: Synoptic-scale Environments of Predecessor Rain Events Occurring East of the Rocky Mountains in association with Atlantic Basin Tropical Cyclones, *Mon. Wea. Rev.*, **in press.**
- Research:
  - Southeast US extreme precipitation climatology
  - Numerical experiments using high-resolution WRF to isolate, quantify roles of moisture sources, transport processes
  - Case studies: Tennessee flood event of 2010, Atlanta floods of 2009
  - QPF error climatology for extreme precipitation events per HPC's Day 1 forecast.
- Presentations:
  - 25th Conference on Weather Analysis and Forecasting/21st Conference on Numerical Weather Prediction/46th Congress of the Canadian Meteorological Society, 29 May 2012, Montreal, Canada: Extreme precipitation events in the Southeast US: A preliminary investigation of operational forecast challenges related to moisture sources and transport.
  - NOAA Testbed Workshop, May 2012: Improving prediction of extreme precipitation events in the Southeast US: Moisture sources and transport mechanisms
  - NASA 5th International Workshop for GPM Ground Validation, July 2012. Toronto, Canada

FY12 Accomplishments:

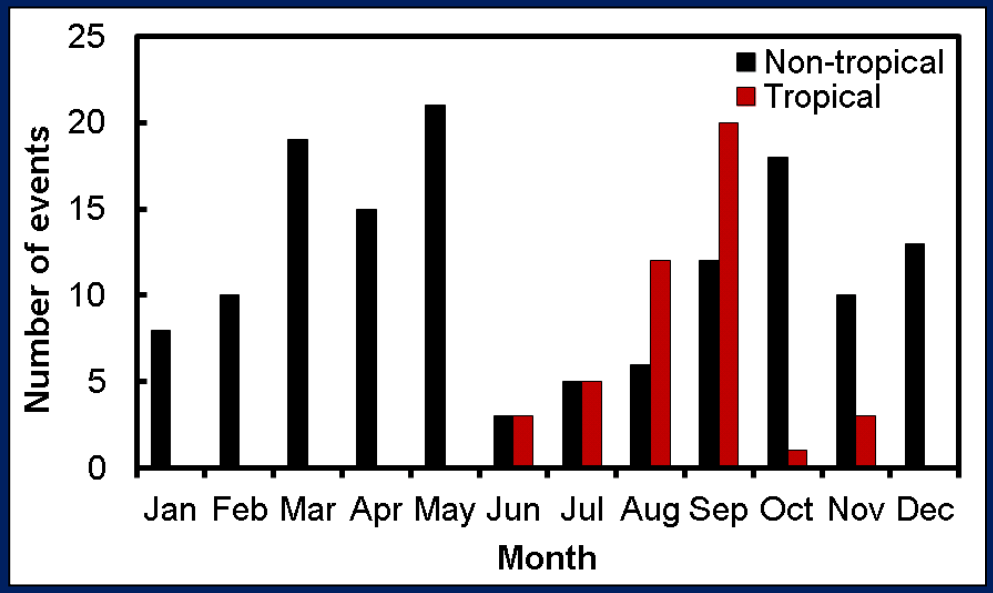
Primary accomplishments and impacts: Research examples

Climatology of extreme precipitation events in the Southeast

Locations of maximum 24-h precipitation for each extreme precipitation event



Monthly frequency distribution of non-tropical and tropical events

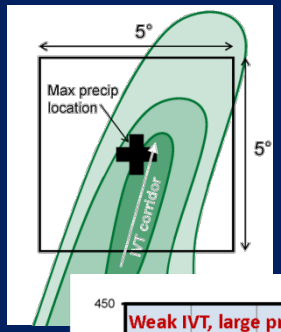


Salient climatological characteristics:

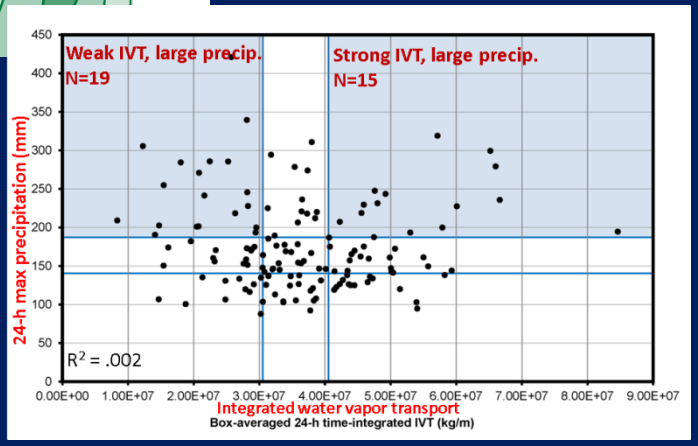
- Non-tropical events most common in interior southeast; tropical events most common along east coast
- Extreme precipitation events occur in all months in southeast; least common in summer months
- Non-tropical events most frequent in May; tropical events most frequent in Sept
- West of Appalachians and in Gulf Coast states, non-tropical events most frequent in DJF and MAM
- East of Appalachians, non-tropical events most frequent in SON

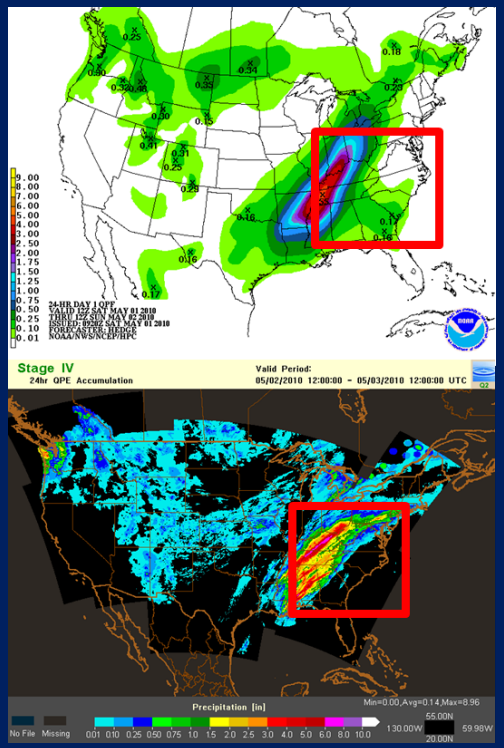
FY12 Accomplishments:
Primary accomplishments and impacts: Research examples
QPF verification, Extreme event case studies, Predictability

- QPF verification climatology (HPC Day 1 24-h QPF): Weak IVT cases: underforecast at higher precipitation amounts
- Case studies, WRF model process studies initiated for three events so far: diagnostic assessments, NWP sensitivity experiments

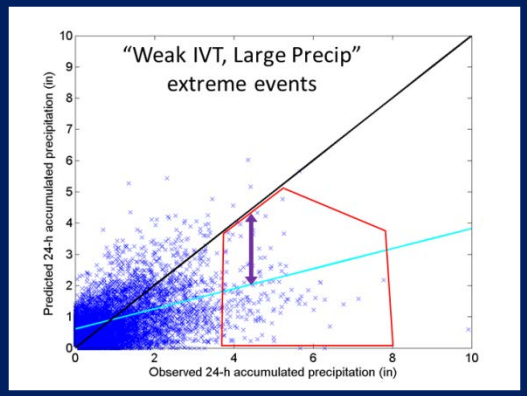


Classifying events by IVT strength





Examining forecast error by IVT strength



Weak IVT cases: underforecast at higher precipitation amounts

(Strong IVT cases: also underforecast at higher precipitation amounts, but not by as much)

FY12 Accomplishments: Research-to-Operations Activities/Outreach

1. Overall partner and community re-engagement:
    1. Solicitation, incorporation of community comments into revised draft of science plan
    2. Establishment of semi-regular communication with key NWS Eastern Region and Southern Region Headquarters contacts, HPC
2. June 2012 Community update: 60+ participants
3. Engagement and subsequent management of potential partners:
    1. NASA/Duke/COPrHEX partners
    2. Southeast NWS FO's, Raleigh, Greenville-Spartanburg in particular
    3. NCSU/CSTAR (Lackmann, Parker, Basu, Yuter)
    4. NIDIS (Lisa Darby)
    5. GSD (Brian Etherton, Ligia Bernadet)
    6. TRMM (Bob Rabin et al.)
    7. GOES-R (Kuligowski, Goodall. Ferraro, et al.)
    8. Climate Testbed (Jin Huang, PingPing Xie)
    9. NSSL (J. J. Gourley)
    10. Doug Miller/UNC Asheville
    11. GOES-R/JPSS Visiting Scientist Program
    12. Glenn Austin (National Hydrologic Warning Council)
    13. HMT-SE Contact List/ "Community" of over 210 people

FY12 Accomplishments: Shortfalls and recommended adjustments

→ A lot to manage, limited team, time

i. Updating and curating Science Plan

ii. Planning Pilot study/instrument deployment with NASA, COPrHEX collaborators

iii. Research:

a) Climatology,

b) QPF verification,

c) Modeling, physical process studies

iv. Many partners/interested parties

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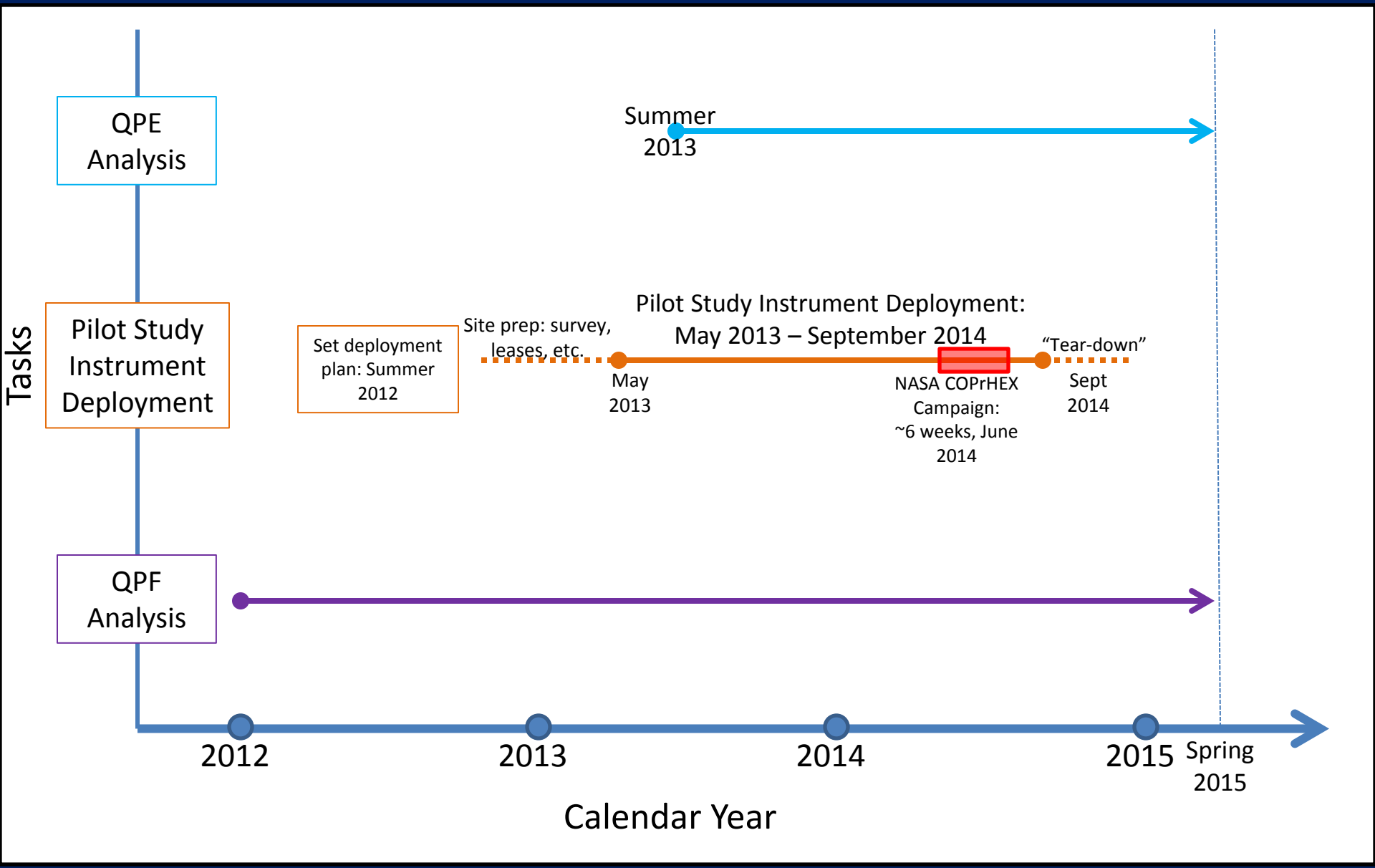
FY13 Plans:
Proposed FY13 activities and milestones: Timeline



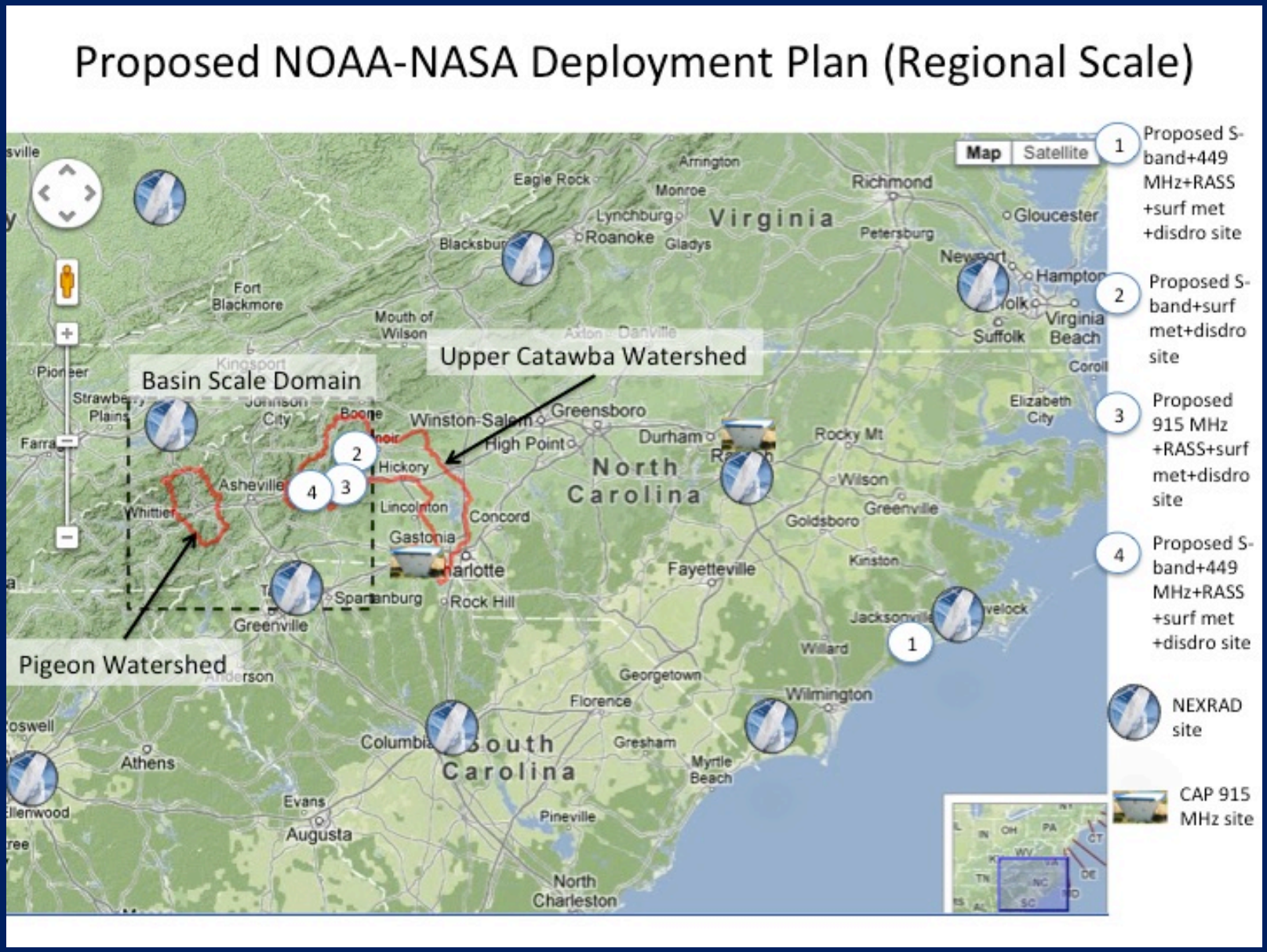
FY13 Plans:
(Very) Specific Proposed FY13 activities and milestones

	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Program planning/Guidance documents				
1. Obtain lease agreements and finalize plans for HMT-SEPS instrumentation			X	
2. Update and re-distribute Science Plan and HMT-SEPS deployment plan to reflect new collaborations and changes resulting from initial stage of instrument deployment				X
3. Design HMT-Ensemble with high-resolution Southeast nest to run for HMT-SEPS		X		
Deployments				
1. Fix Raleigh CAP profiler		X		
2. Update software on Raleigh and Charlotte profilers				X
3. Deploy 6 surface stations and 4 profilers for HMT-SEPS			X	
Research				
1. Publish Southeast extreme precipitation climatology			X	
2. Develop QPF verification metrics for climatology and key extreme events (Tennessee (2010) and Atlanta (2009) floods).				X
3. Conduct WRF model case studies on Tennessee (2010) and Atlanta (2009) floods. Present at AMS Annual Meeting Jan 2013.		X		
Stakeholder engagement, R2O transitions				
1. Hold community update telecom/meeting to brief on final HMT-SEPS deployment, communicate opportunities and methods for collaboration, data sharing			X	
2. Hold biannual meetings with HPC regarding ongoing collaborations and new opportunities		X		X

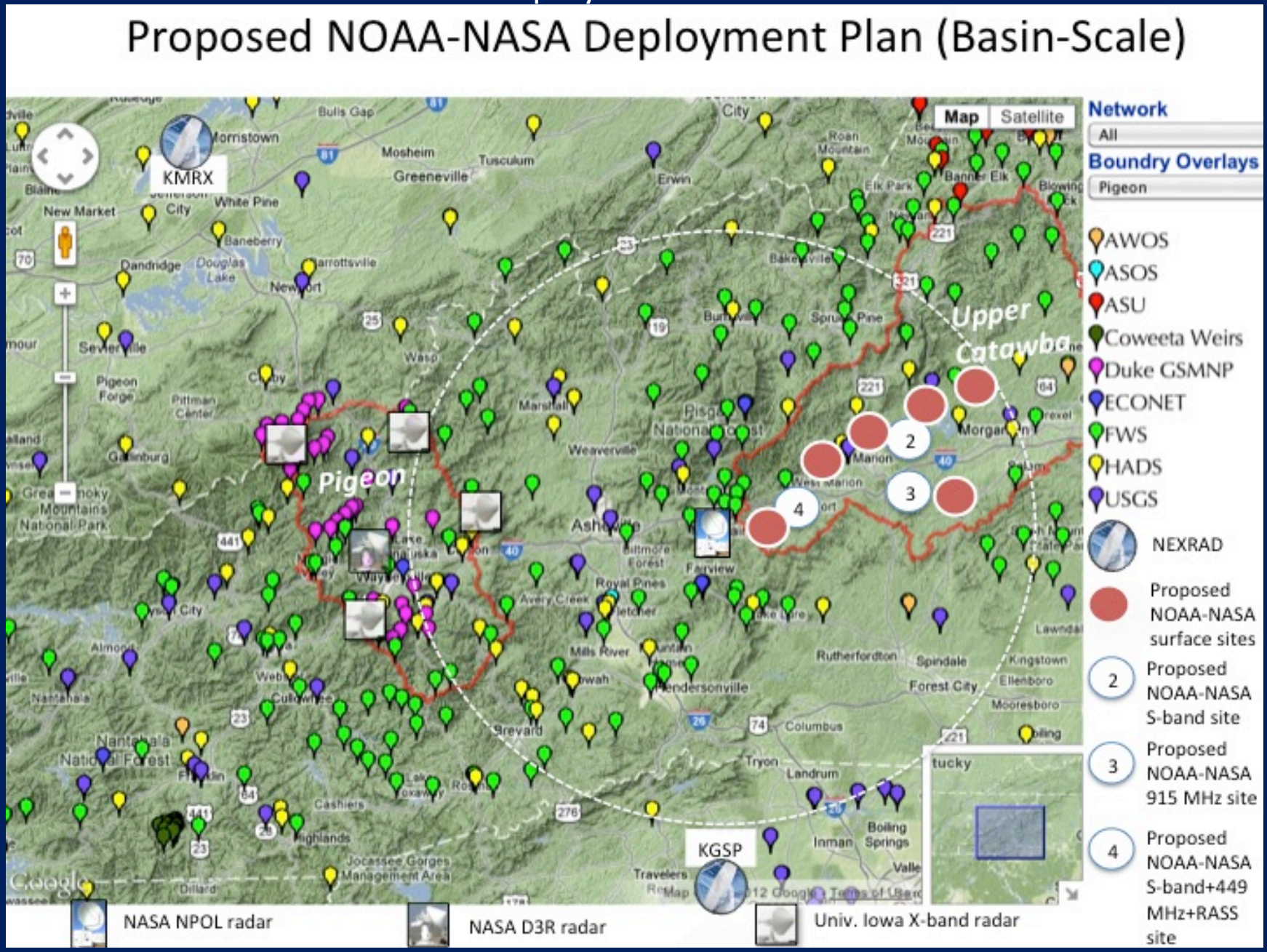
FY13 Plans:
Proposed FY13 activities and milestones:
Tentative Deployment for HMT-SEPS

- May 2013 - September 2014
- Instrument deployment to be supported by NOAA and NASA (exact details TBD)
- Current plan includes:
  - 4 profiler sites
  - 6 separate surface sites (gauges, disdrometers, soil moisture)
- Focus on QPE

Proposed FY13 activities and milestones: Tentative Deployment for HMT-SEPS



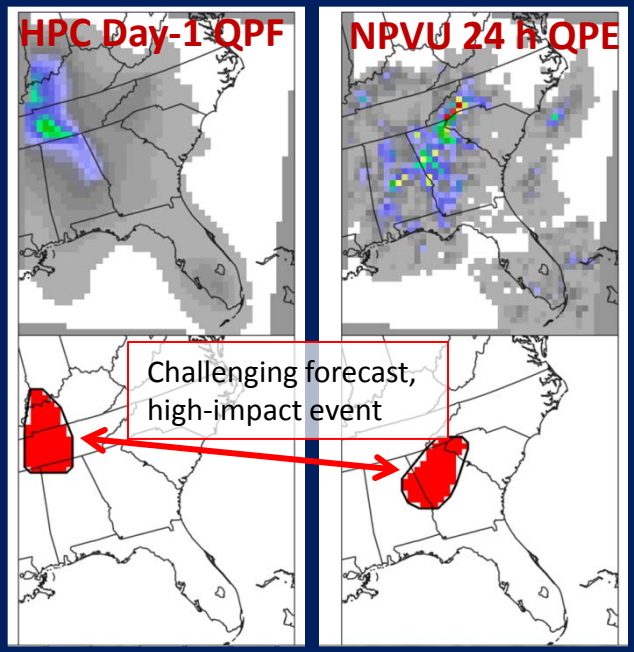
Proposed FY13 activities and milestones: Tentative Deployment for HMT-SEPS



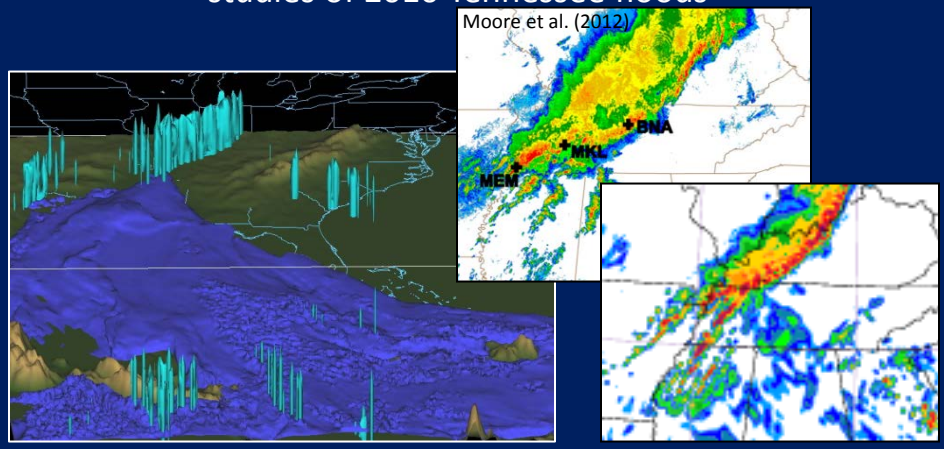
FY13 Plans: Proposed FY13 activities and milestones:
QPF research: Ongoing work and future directions

- Climatology: More compositing, sub-regional event types, focus on event subsets associated with largest QPF errors
- QPF: QPF error assessments using traditional verification metrics and spatial verification, expand to additional forecast datasets (NWP and human-generated)
- Case studies, process studies: diagnostic assessments, NWP experiments
- Use reforecast dataset, HMT-Ensemble, and operational forecast models to investigate predictability of events/event types of interest

Object-based spatial QPF verification example:
Atlanta floods: 20 September 2009



Case study example: WRF model diagnostic/sensitivity studies of 2010 Tennessee floods



WRF simulated water vapor (purple) and rain (cyan) mixing ratio surfaces

Observed vs. WRF-simulated radar reflectivity

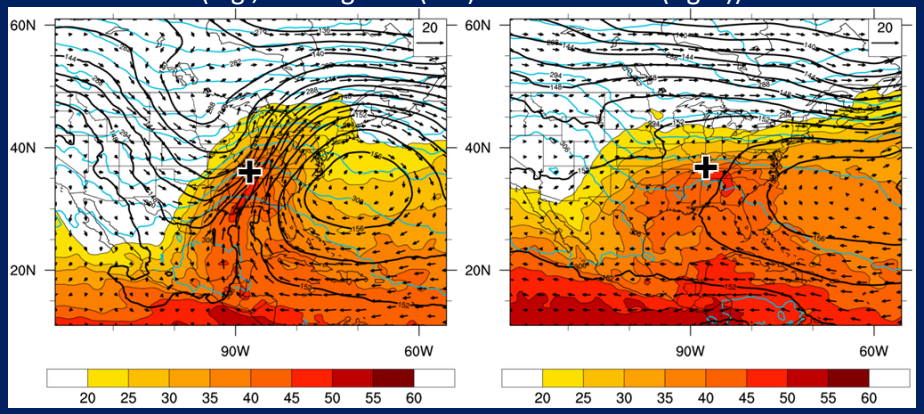
FY13 Plans:
Expected transition to operations activities

1. Possible extreme event forecasting experiment (either real-time or retrospective)
    1. In conjunction with HPC's flash flood experiment?
    2. Or separately, analogous to ARRFEX?
2. Visiting scientist exchange with NOAA GPM (pending acceptance)
3. Ongoing collaborations with previously-discussed partner groups

FY13 Plans: Expected impacts

1. HMT-SEPS deployment: Obtain and archive hydrometeorological data to benefit HMT, NASA, regional partners for multitude of purposes
2. Profiler fixes and updates to benefit NWS, university partners, regional stakeholders:
    1. Research utility: boundary layer wind profiling for wind shear profiles in severe weather/tornado cases, CAD erosion, NWP PBL parameterization
    2. University: Educational benefits: there are many!
    3. Improved forecasts of complicated air mass "sandwiches" situations (e.g., "wintery mix" situations with cold air damming and warm overrunning)
    4. Land-falling hurricane rainbands, boundary layer rolls, extreme precipitation distribution and boundaries
3. Extreme precipitation research: Add operationally-useful knowledge, publications in scientific literature
4. HMT-SEPS ensemble forecasts: Add regionally-focused model forecast tool for forecasters, produce data that can be used for predictability research

Improved understanding of extreme precipitation climatology, predictability (e.g., “strong IVT” (left) vs. “weak IVT” (right))



High-impact wind shear event: One of last data images available from Raleigh wind profiler