EMERGING NEEDS HYDROMETEOROLOGICAL FORCINGS

An Operational Perspective to Support Integrated & Adaptive Water Resources Management

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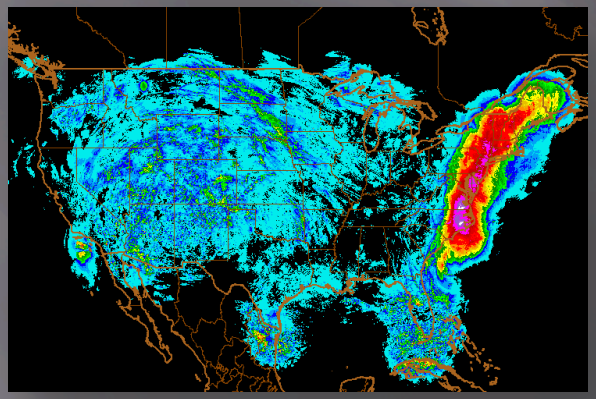

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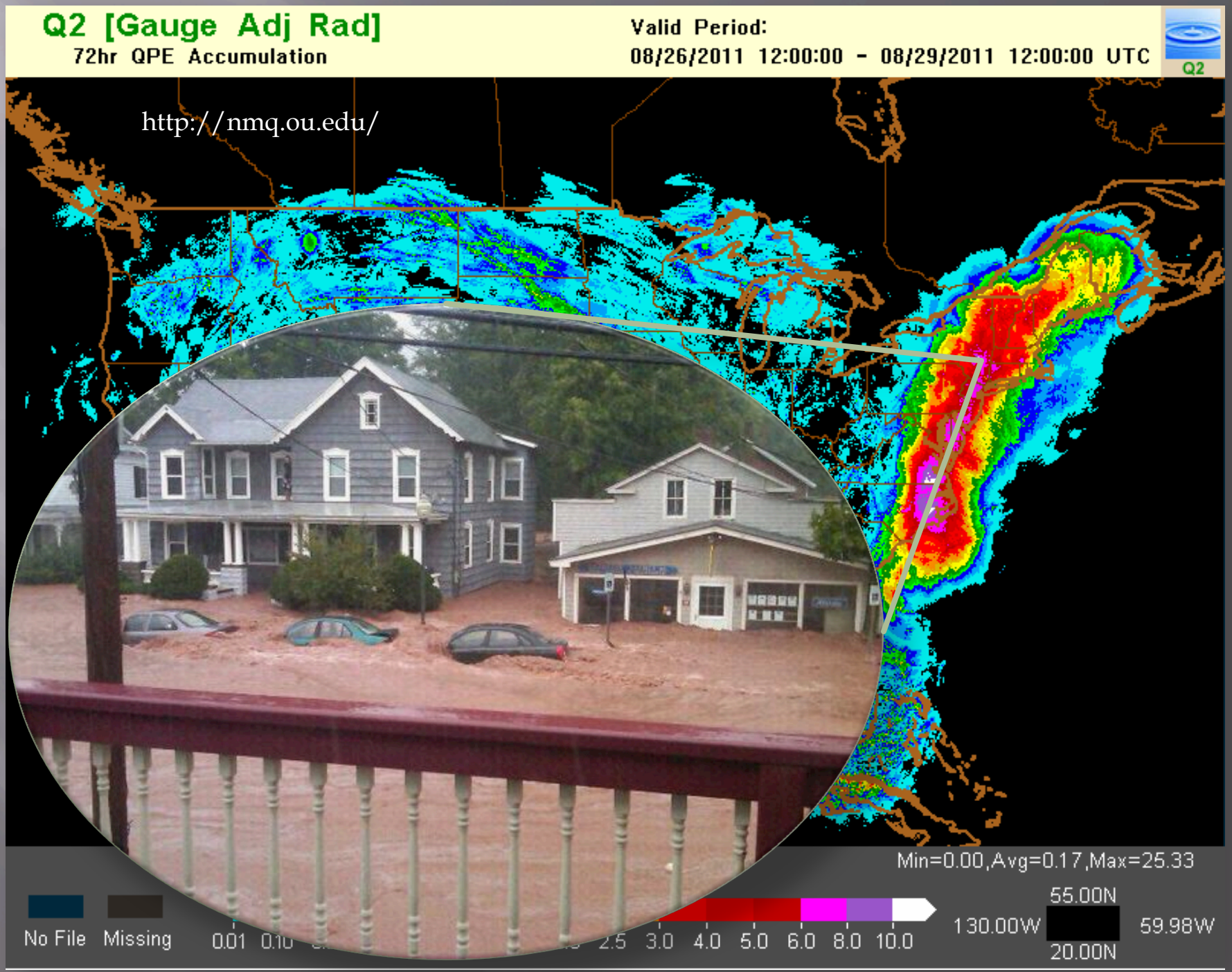
HURRICANE IRENE



Hydrometeorological Forcing Requirements

Operational Imperatives for IWRSS

Scope

U.S., North America, Global
- Summit to Sea
- Anywhere, anytime

Scale

Gridded Information
- "High resolution"
- NWC Initial Goal: 0.5 km; 0.5 hour

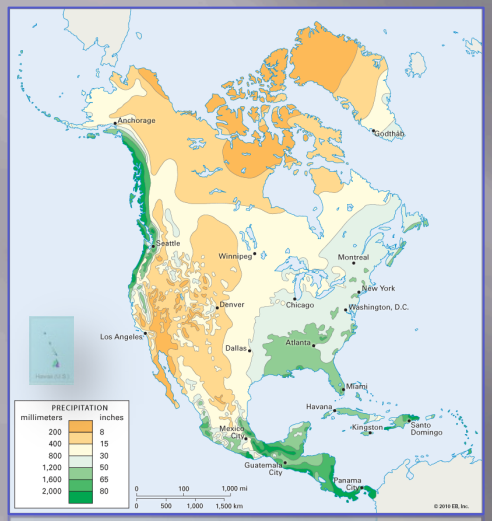
Qualities

Continuous Record: Past – Present – Future
- Internally consistent
- Best possible (we want it all: observations; models)
- Interoperable: e.g. NOAA AOR & USGS Water Census

Fields

Hydrologic Forcings
- Precipitation (Amount, Type, & Density); 2m Air Temperature, Pressure, Humidity; 10 m Vector Winds; Radiation
- Support State Parameters: e.g. Soil Moisture; ET; etc.

IWRSS Scope



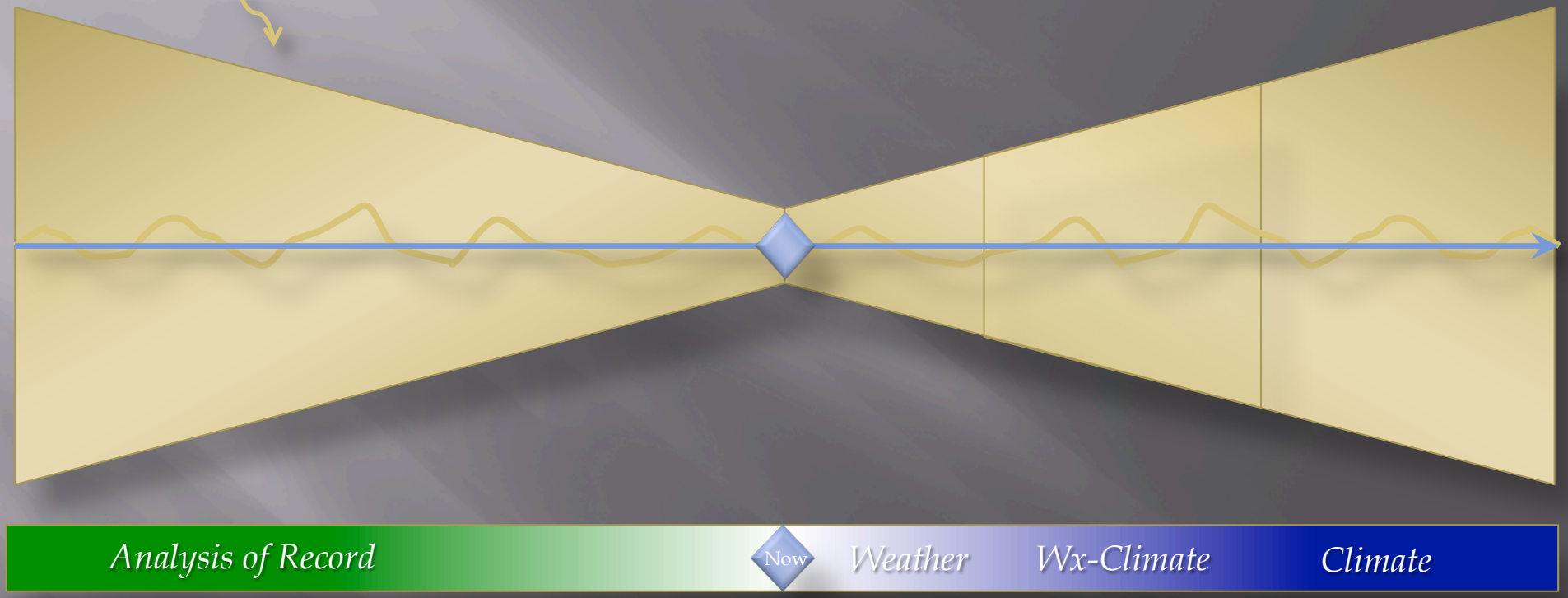
*Provide summit to sea, high-resolution (goal: half hour; half km) gridded water resource information for the **United States** & **North America** and globally (at lower resolution); derived from observations and model output*

IWRSS Scope

*Provide summit to sea, high-resolution (goal: half hour; half km) gridded water resource information for the United States & North America and **globally** (at lower resolution); derived from observations and model output*

Continuous Record/Best Possible
A bit of a Conundrum

Cone of uncertainty…



~ -50 yrs+ ~ -30 yrs ~ -20 yrs 0 yrs

Emerging Needs
Water Now, Next & Future

Modeling

- Reanalyses & Forecasts
- High resolution
- Coupled/integrated

Assimilation

- Intelligent integration of observations and models
- Direct (nudging); variational; sequential (EnKF)
- Conservative (close the water cycle budget)
- Atmospheric, LSMs; hydrology models

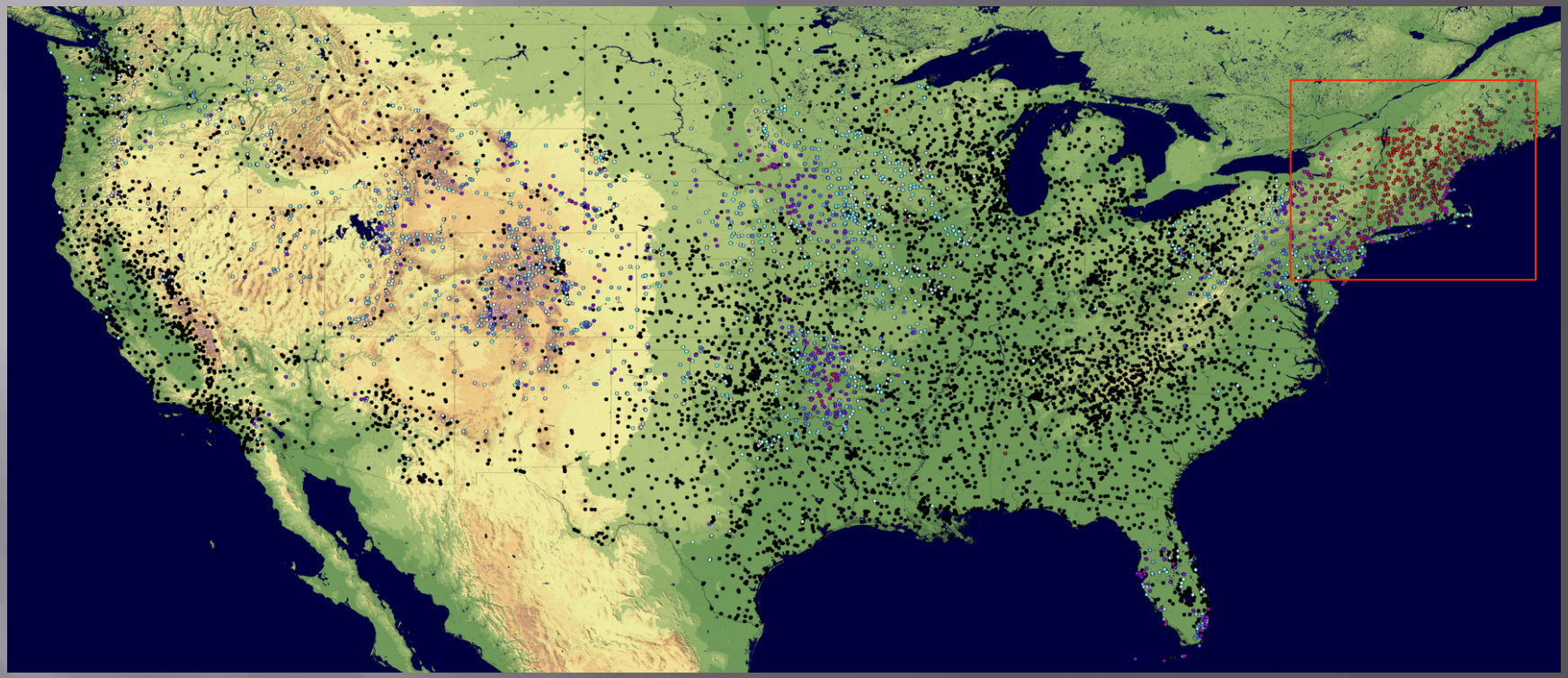
Observations

- High quality, long-term
- Validation
- Process studies/physics
- Optimal network design (OSSEs/OSEs)

Downscaling

- Low density of observations
- High spatial & temporal variability of phenomena
- Statistical, physical, climatological

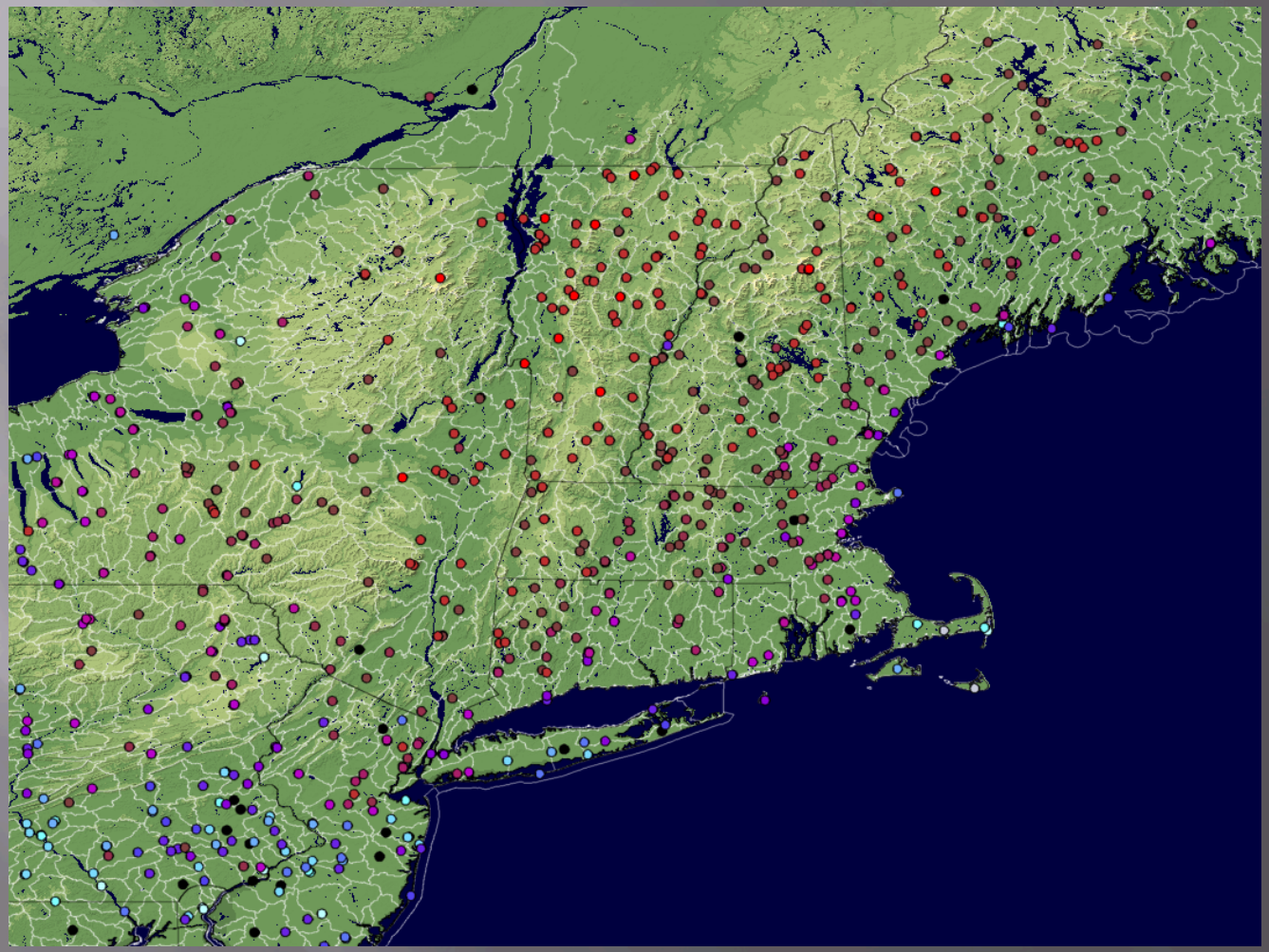
Sampling Issues



NOHRSC: 10,000 points (once daily). Sounds like a lot, but…

Courtesy of Greg Fall

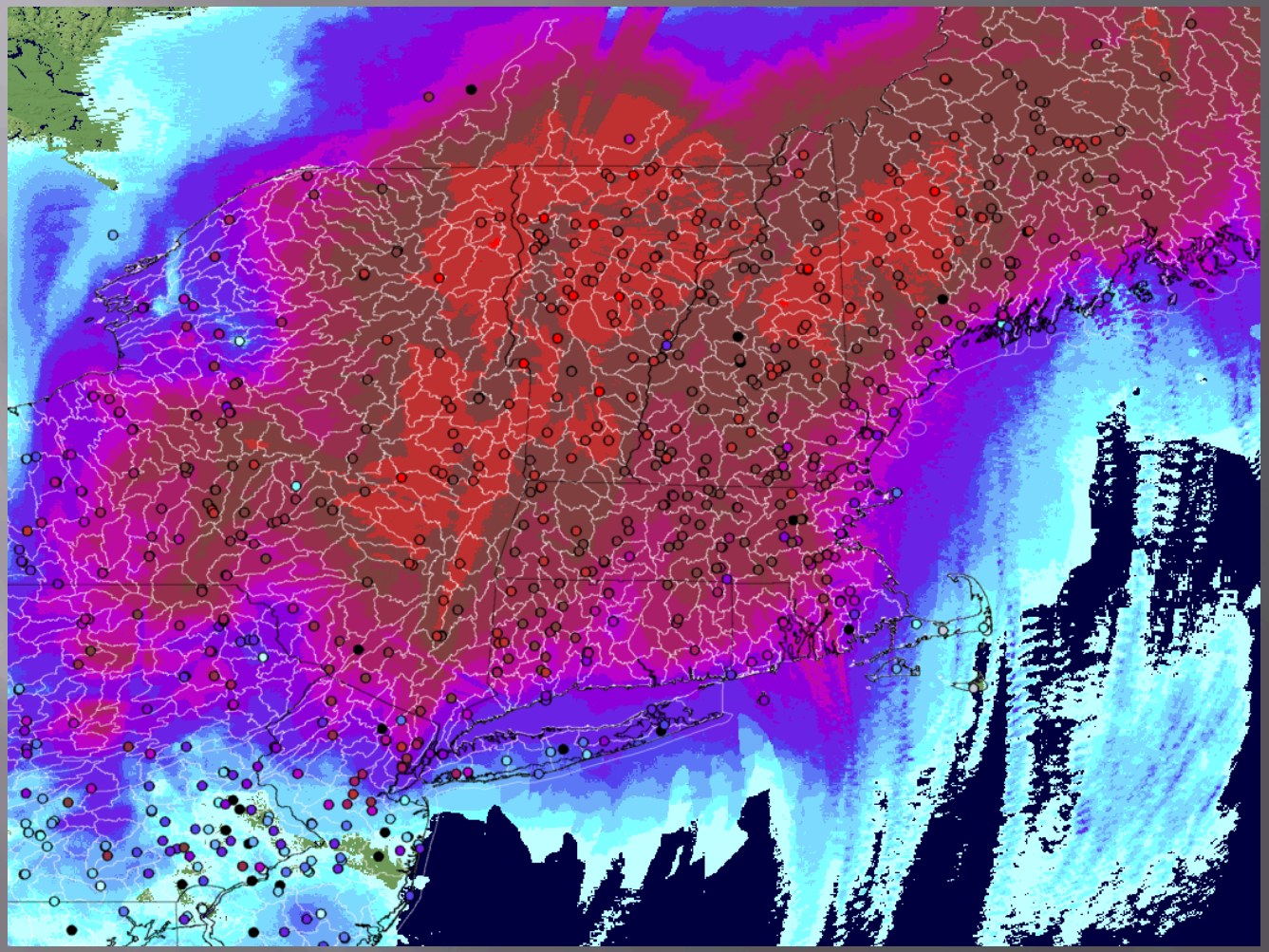
Sampling Issues



24 hour totals from gages: New England is relatively "data rich"
HUC 10 "Watershed" Boundaries in white

Courtesy of Greg Fall

Sampling Issues

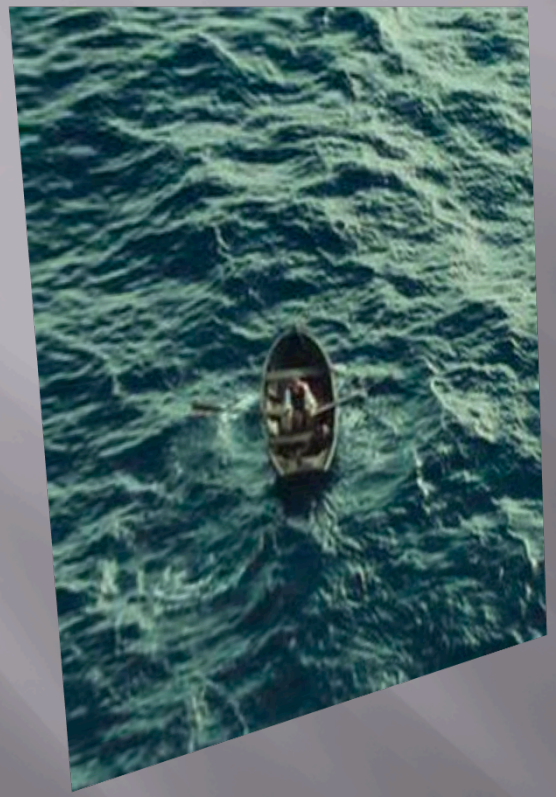


24 hour totals from gages (dots) & gage adjusted radar (Q2)
HUC 10 "Watershed" Boundaries in white

Courtesy of Greg Fall

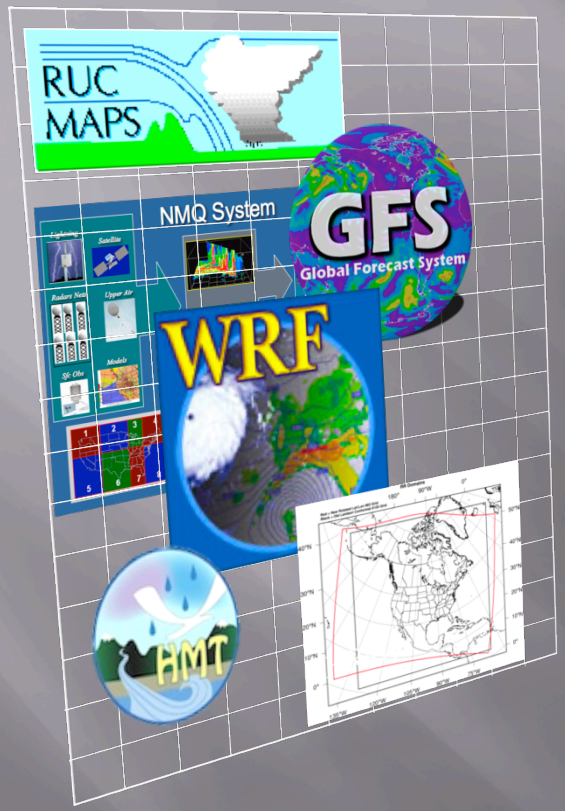
A metaphor for downscaling…

There is water everywhere…



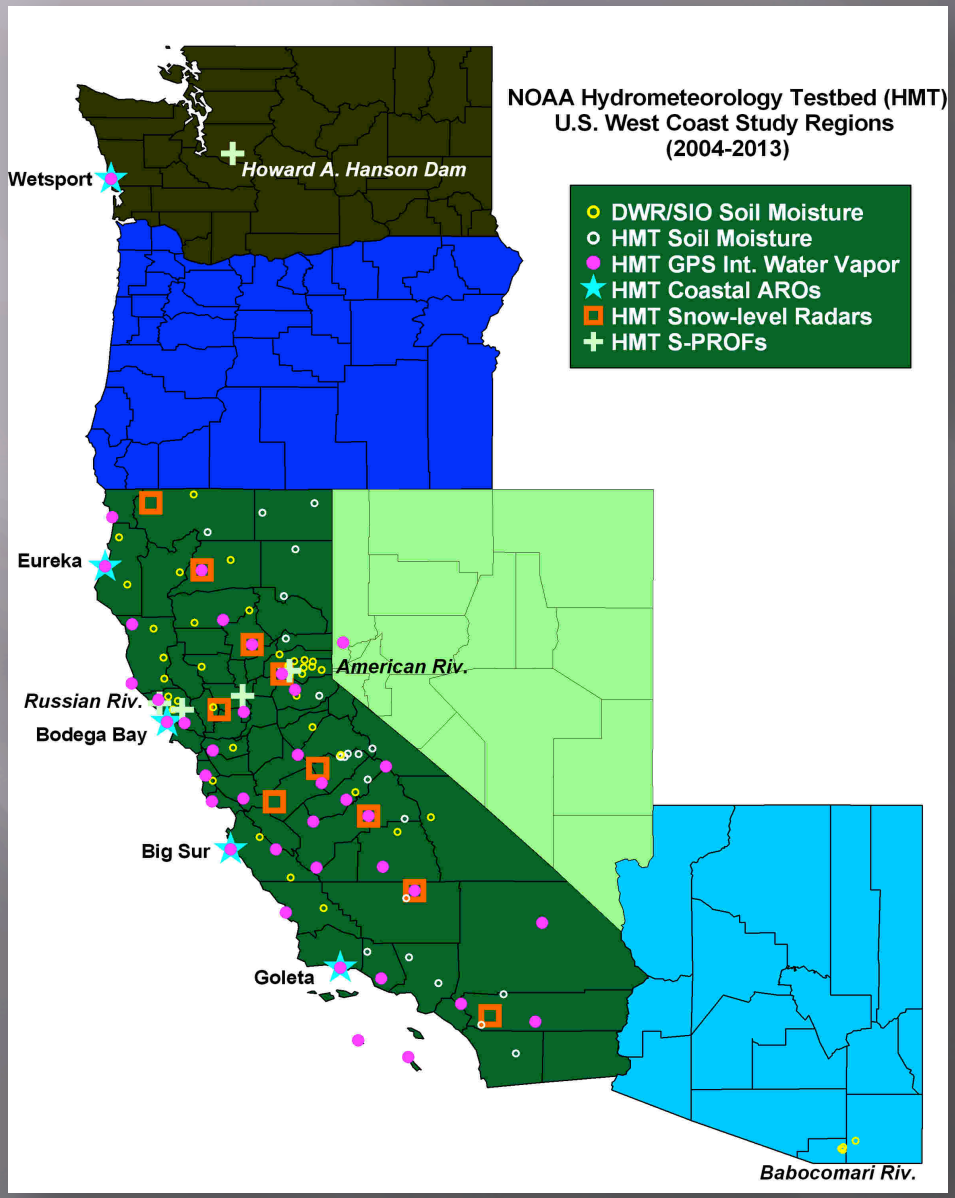
A metaphor for downscaling…

There is data everywhere…



But, nothing at the required resolution…

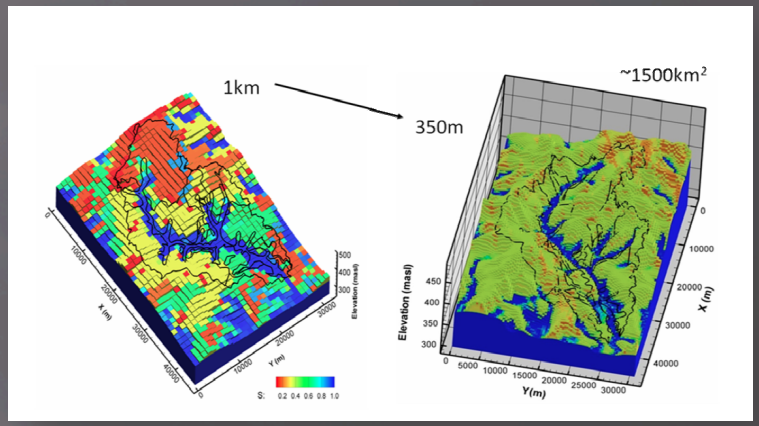
A Role for Testbeds: HMT



- Observational framework
- QPE
- QPF
- Snow Information
- Hydro-Apps & Surface Processes
- Decision Support

Water Now, Next & Future

- Hydromet Forcings:
  - The lesson of GIGO…
- Challenge Remains:
  - Water Forecasting
- High Resolution, Gridded Info:
  - "Model-driven" process
  - Downscaling
  - Smoothed fields (process filters extremes)
  - Hyper-resolution modeling
- Best-possible, continuous record
  - Reanalysis (AOR) – Analysis – Forecast (Weather & Climate)
  - How to blend observations & model information
  - Assimilation
- High resolution coupled/integrated modeling
- Physics/process-based
- Research to Operations

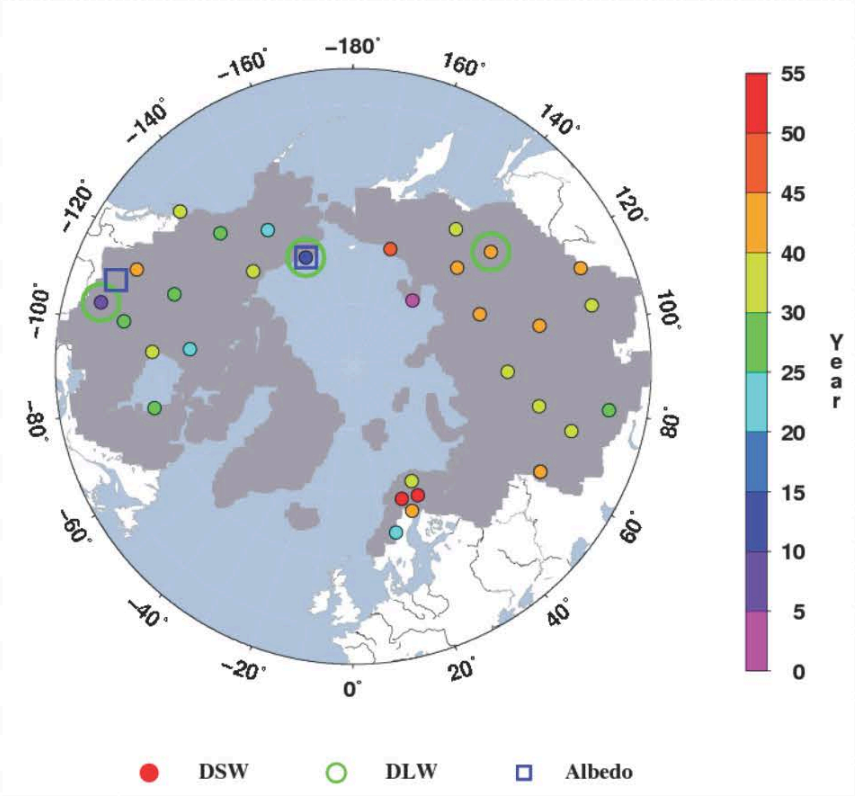


Wood et. al. 2011

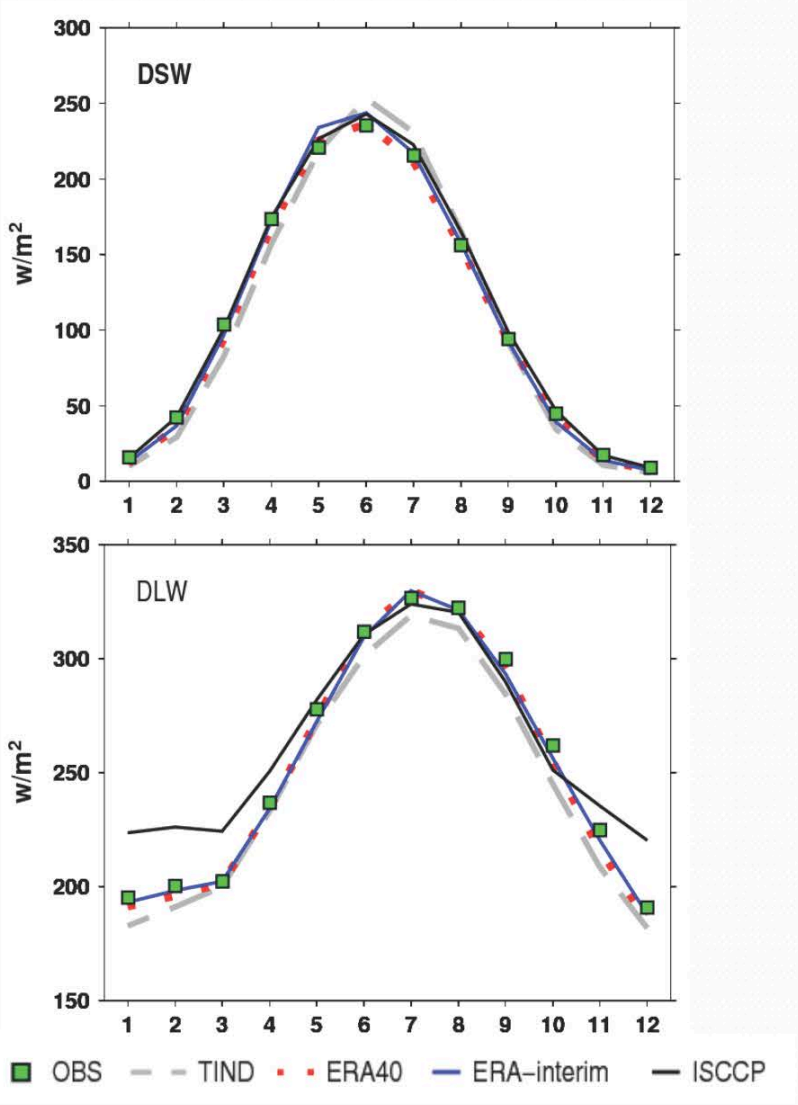
Thank You!

Radiation Challenges

Surface radiative fluxes evaluation over the pan-Arctic



GEBA (Global Energy Balance Archive) station locations

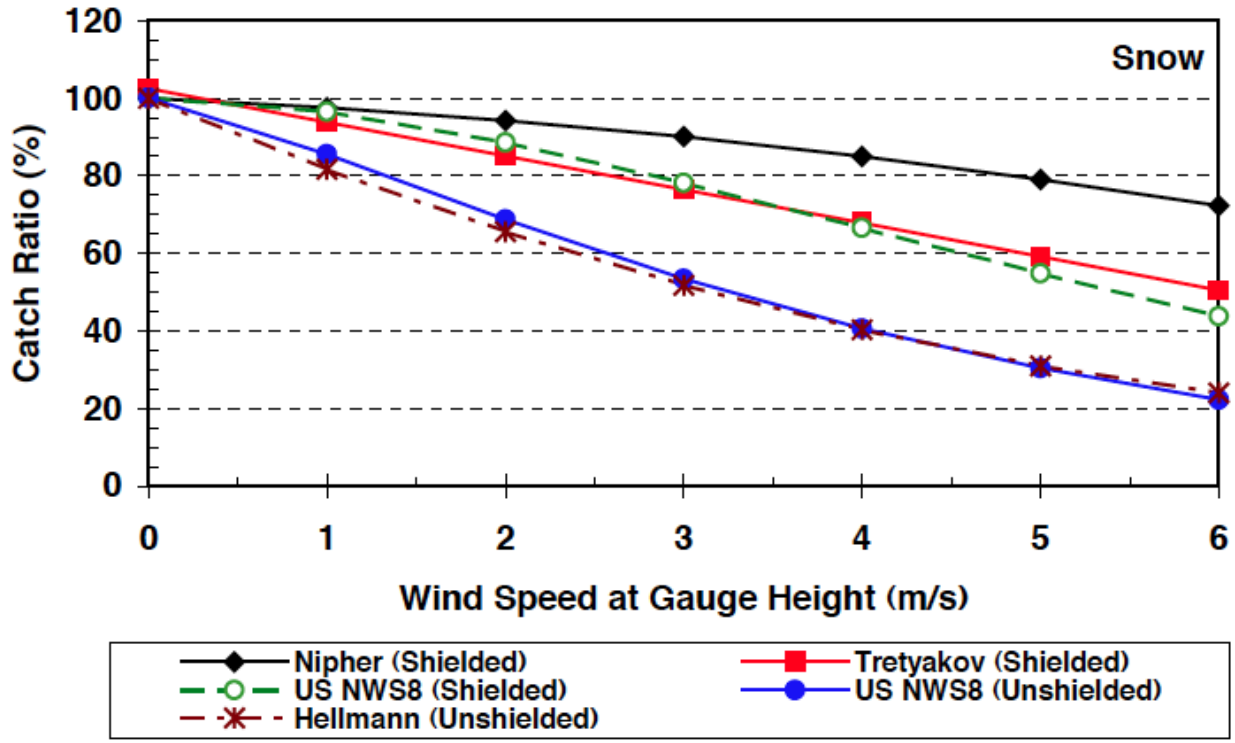


Note: DSW (downward shortwave radiation); DLW (downward longwave radiation).

Courtesy of X. Shi & D. Lettenmaier

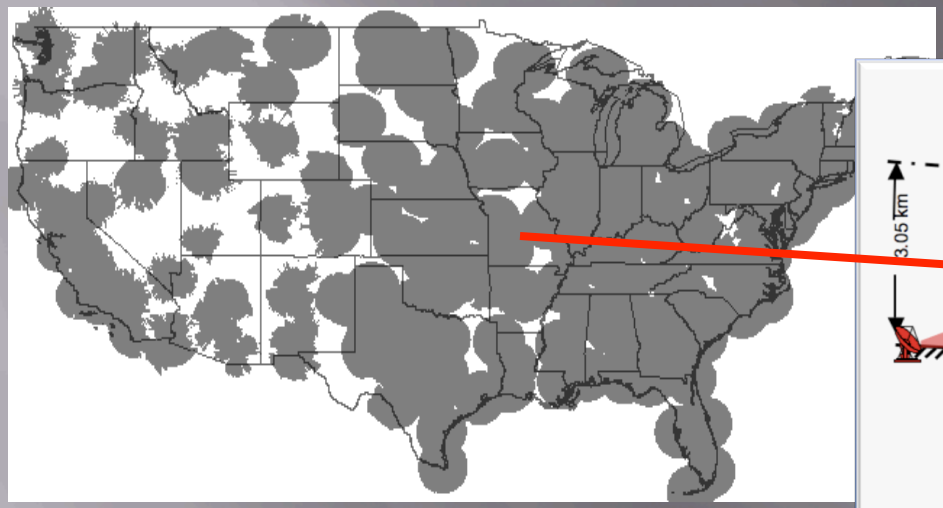
Precipitation Challenges

Figure 2 Plot of Catch Ratios versus Wind based on best fit regression equations shown in Table 3 for snow; the Tretyakov curve was plotted for T_{max} = -2.0 °C.

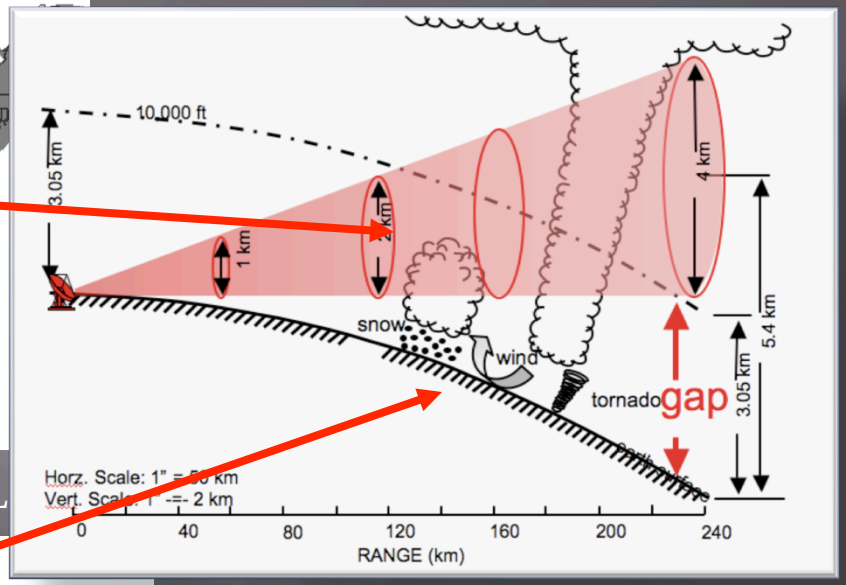


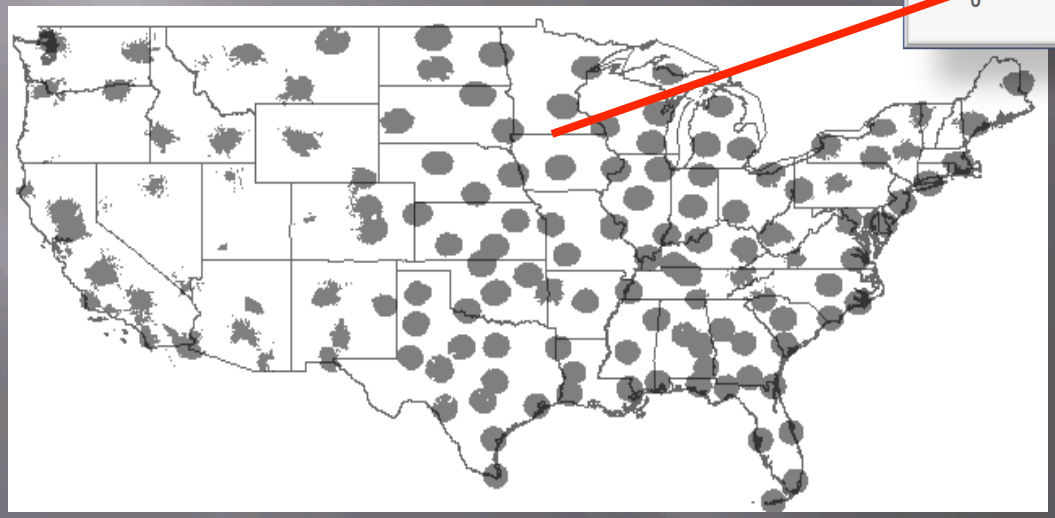
Goodison, 1998

Radar Gaps: the CASA Model



NEXRAD coverage at 3 km (10,000 ft) AGL





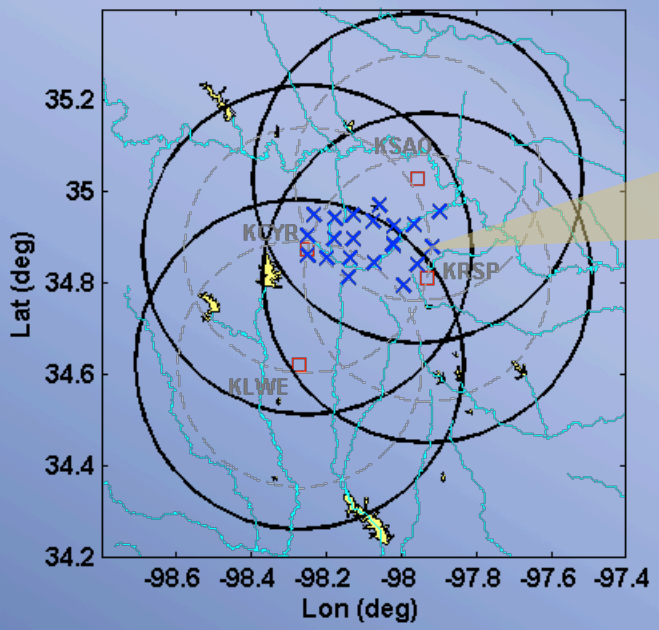
NEXRAD coverage at 1 km (~3200 ft) AGL.

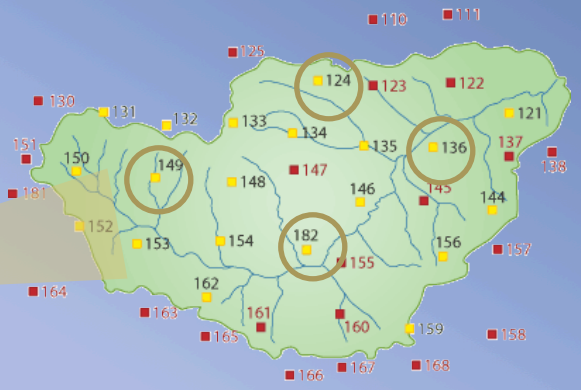
- Radar "Gap"
- Spatial Resolution
- Temporal Resolution
- Radars function autonomously

Courtesy of V. Chandrasekar

Validation Study

- Gauge comparison was investigated to evaluate the QPE system
- USDA ARS Micronet – A rain gauge network located at the center of the IP1 test bed





Source: http://ars.mesonet.org

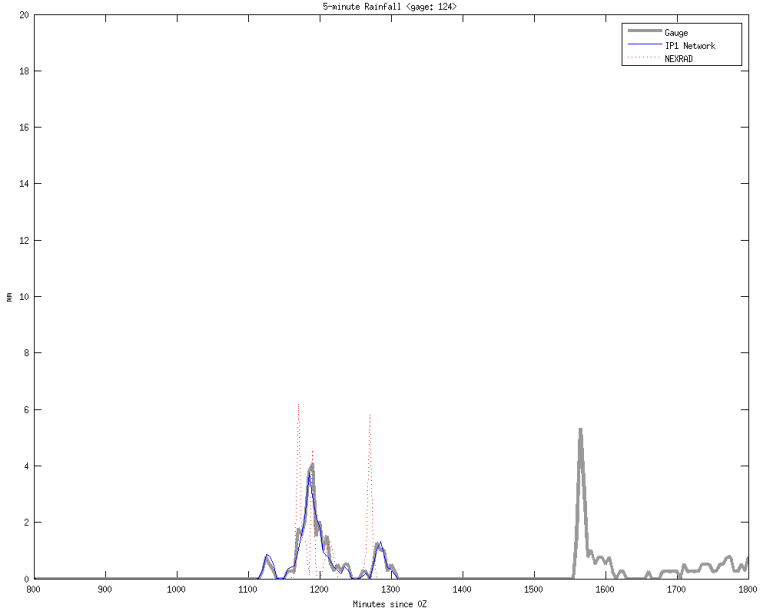
Little Washita

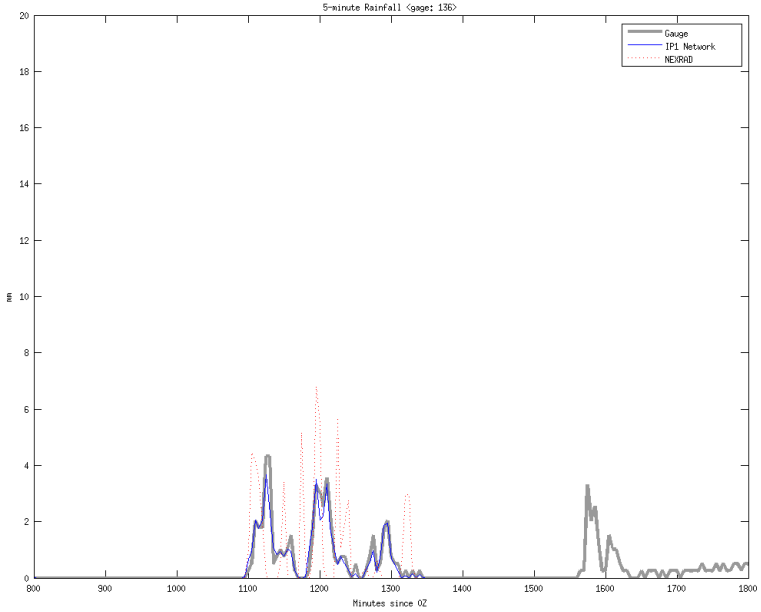
Watershed size: 611 km^2

Mean annual precipitation: 760 mm

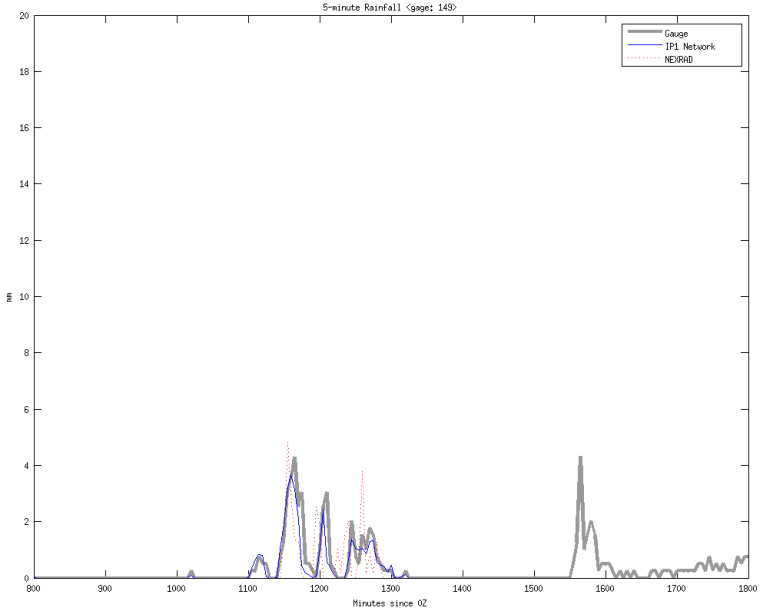
Gauge network: 20 tip-bucket stations

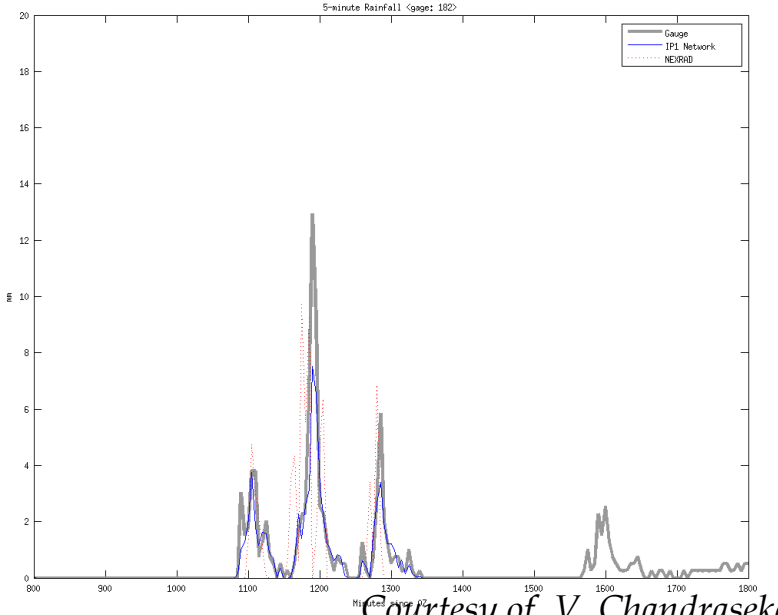
Courtesy of V. Chandrasekar





Comparison of 5-minute rainfall from CASA IP1, NEXRAD and rain gauges





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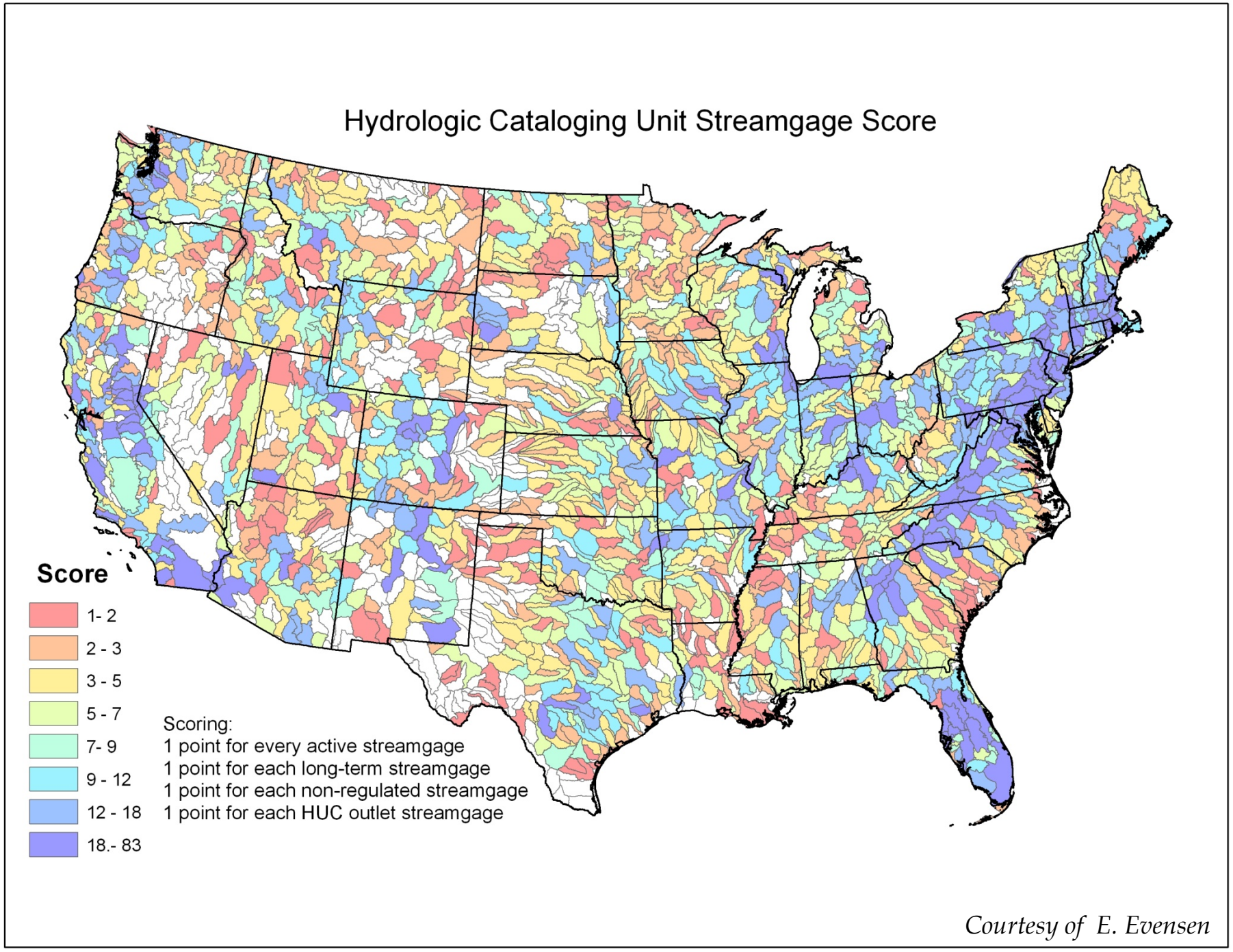

Courtesy of E. Evensen