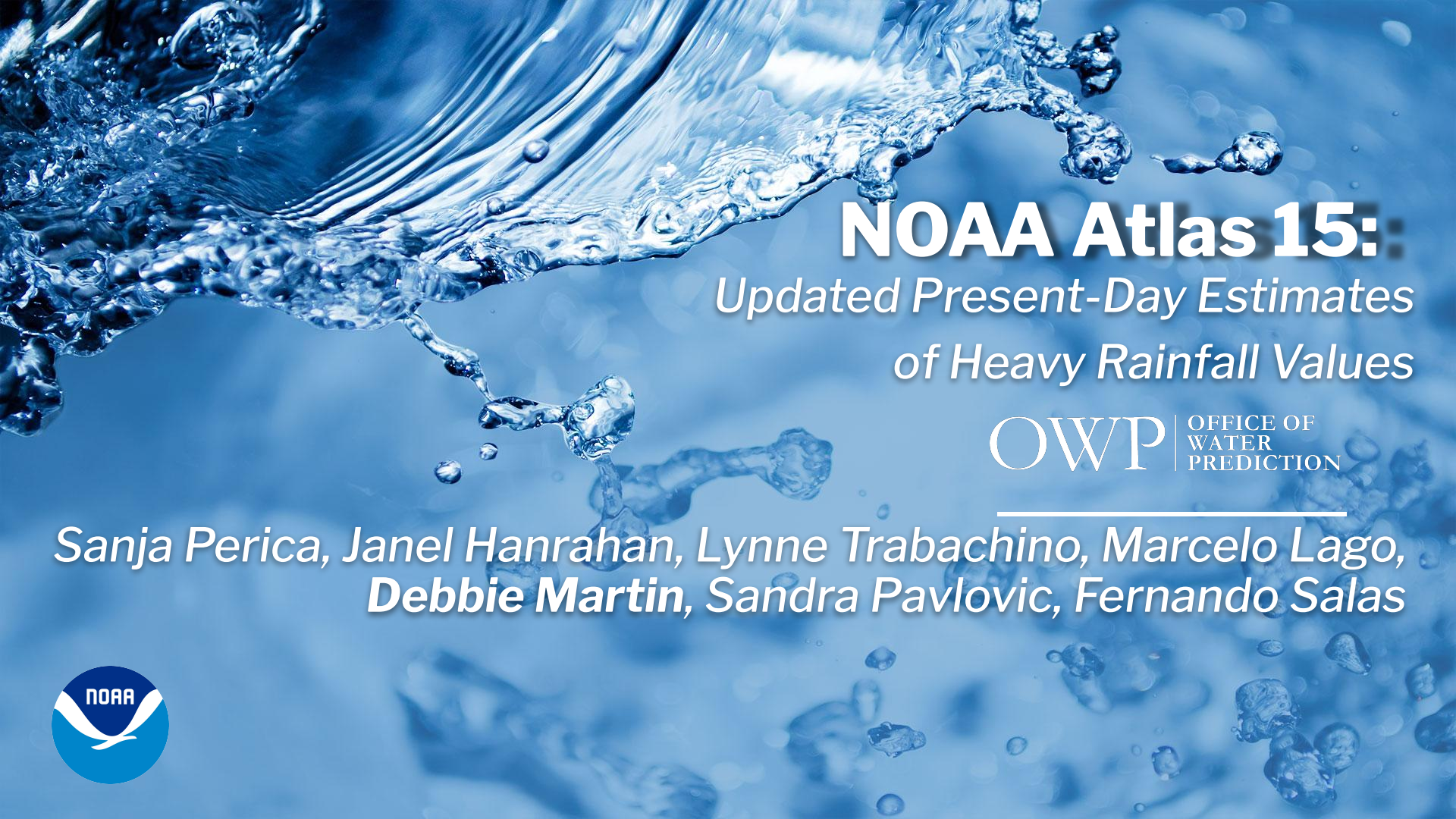

NOAA Atlas 15:

Updated Present-Day Estimates of Heavy Rainfall Values

OWP | OFFICE OF WATER PREDICTION

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NOAA

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Sandra Pavlovic, Greg Fall, Fernando Salas, Fred Ogden

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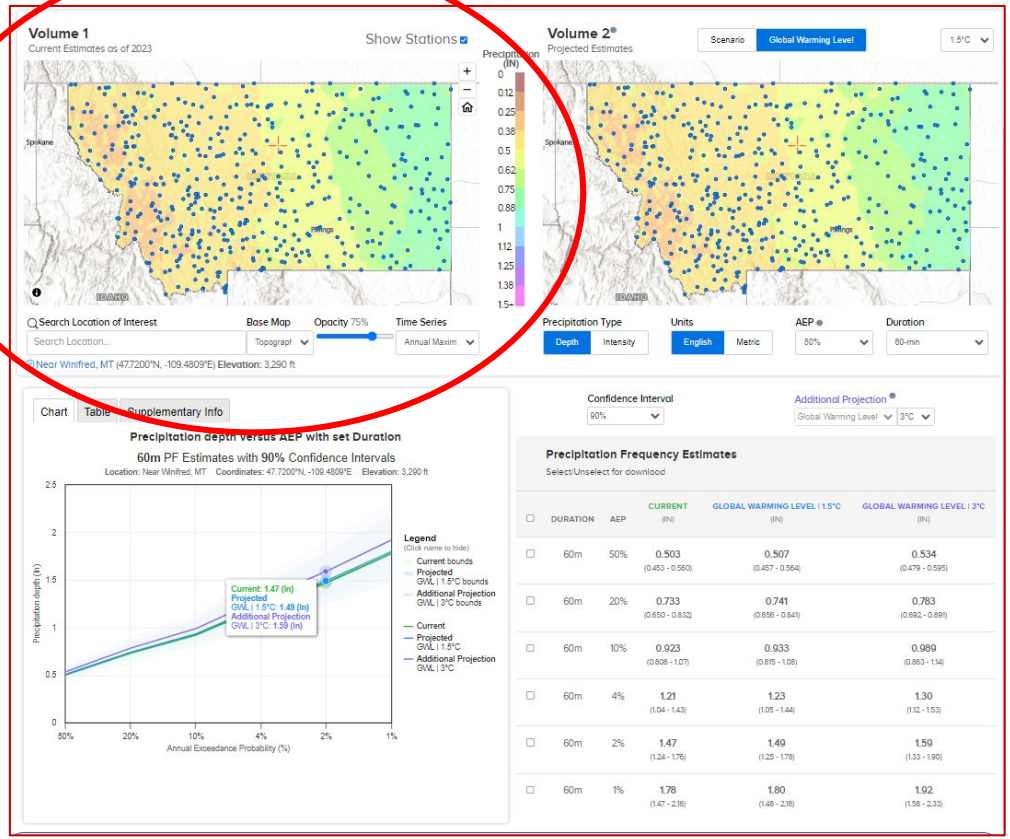
Overview

- **Volume 1**
  - Accounts for temporal trends in historical observations
  - 5-minute to 60-day
  - 1/2 to 1/1000 probabilities
  - Gridded CONUS and OCONUS
- **Volume 2**
  - Future estimates through year 2100 based on future climate model data up to 5℃ of warming
    - SSP2-4.5, SSP5-8.5



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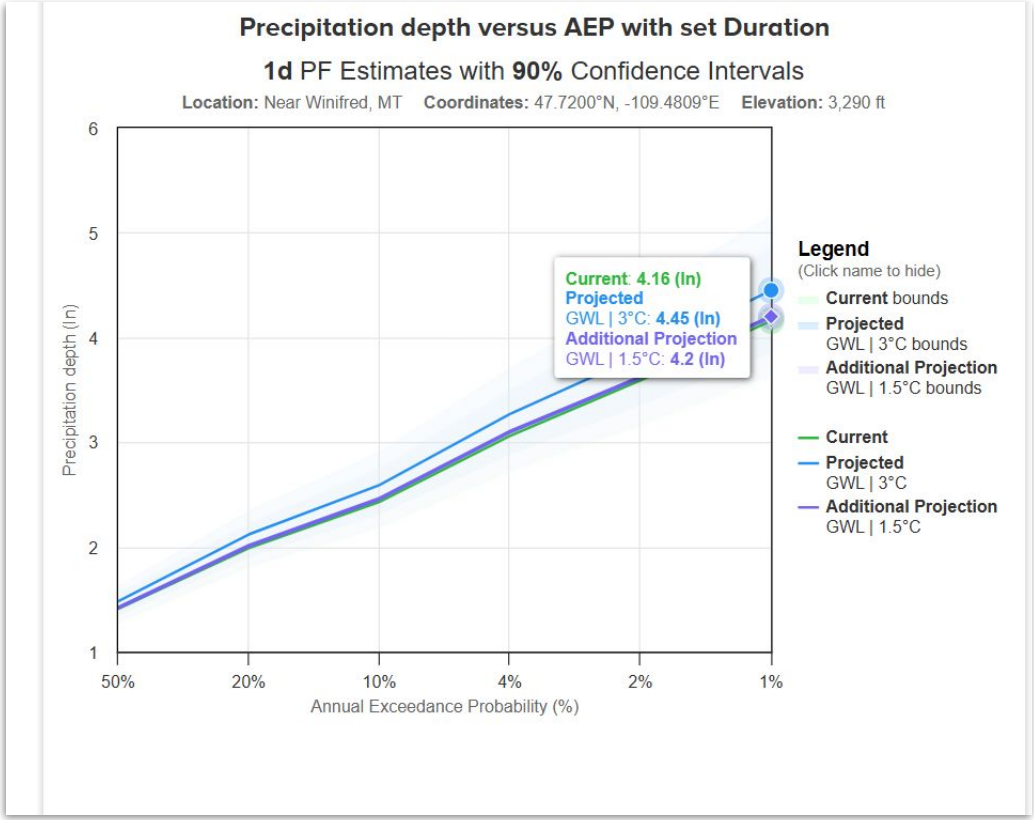
A15 Volume 1 Approach



- **Computation of precipitation frequency estimates at station locations**
  - **Nonstationary** - incorporates temporal covariate
  - **Regional** - automated scheme for regionalization, spatial covariates
  - **Precipitation frequency analysis** - Maximum Likelihood Estimation (MLE) to estimate distribution parameters
- **Spatial mapping of precipitation frequency estimates to high-resolution grids**

A15 Volume 1 - Nonstationary PF analysis method

- Regional Nonstationary Maximum Likelihood Estimation (MLE) method used to estimate **GEV distribution parameters (location, scale, and shape)** at each target station
- Spatial covariate: **Mean Annual Maximum (MAM)** precipitation
- Temporal covariate: **Global Warming Level (GWL)**

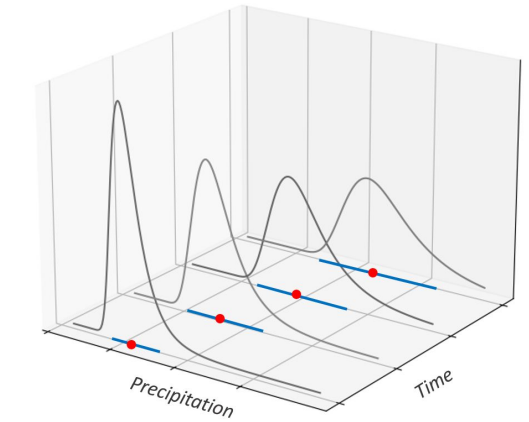
Probability density function of the GEV distribution:

$$f(x,t) = \frac{1}{\sigma}\left\{1-\xi\frac{x-\mu}{\sigma}\right\}^{\left(\frac{1}{\xi}-1\right)} exp\left(-\left\{1-\xi\frac{x-\mu}{\sigma}\right\}^{\frac{1}{\xi}}\right)$$

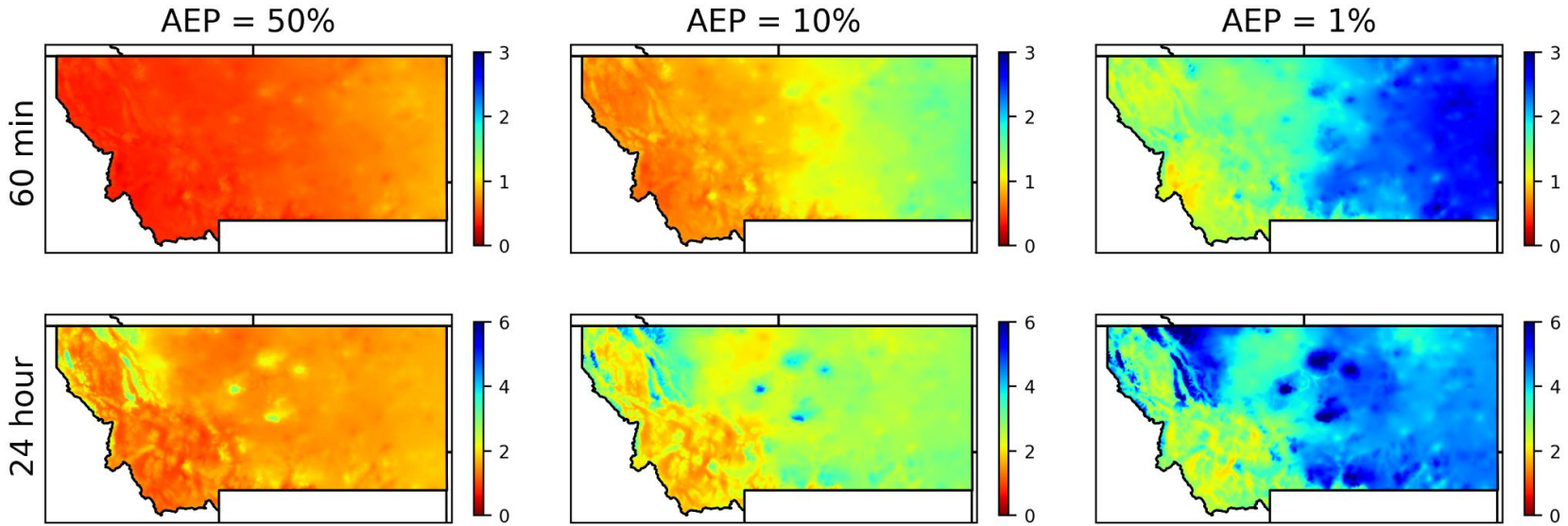
Location: $\mu(x,t) = a_1 \times MAM(x)[1 + a_2 \times GWL(t)]$

Scale: $\sigma(x,t) = b_1 \times MAM(x)[1 + b_2 \times GWL(t)]$

Shape: $\xi = c_0$



A15 Pilot Volume 1 - Estimates – Under Peer Review Now



Atlas 15 Pilot Volume 1 present-day precipitation frequency estimates (inches)

Available for Atlas 15 prototype	
Durations	**60-min**, 2-hr, 3-hr, 6-hr, 12-hr, **24-hr**, 2-day, 3-day, 4-day, 7-day, 10-day
AEPs	**1/2 (50%)**, 1/5 (20%), **1/10 (10%)**, 1/25 (4%), 1/50 (2%), **1/100 (1%)**

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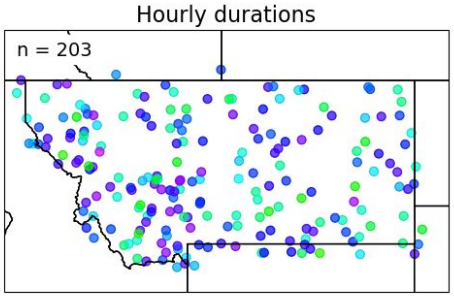
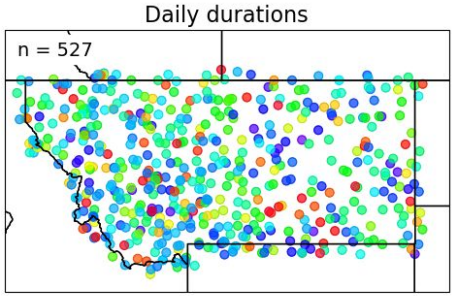
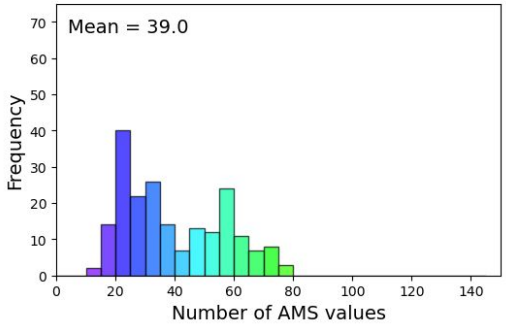
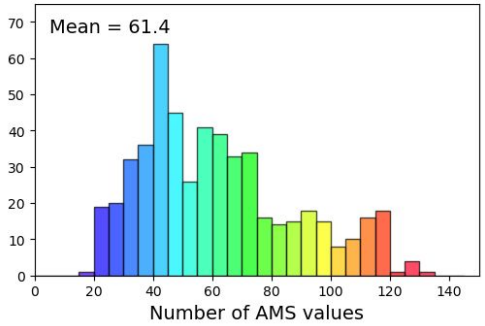
A15 Volume 1 - Pilot Data

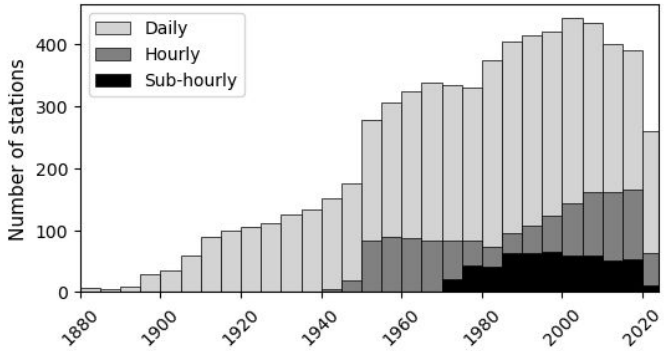






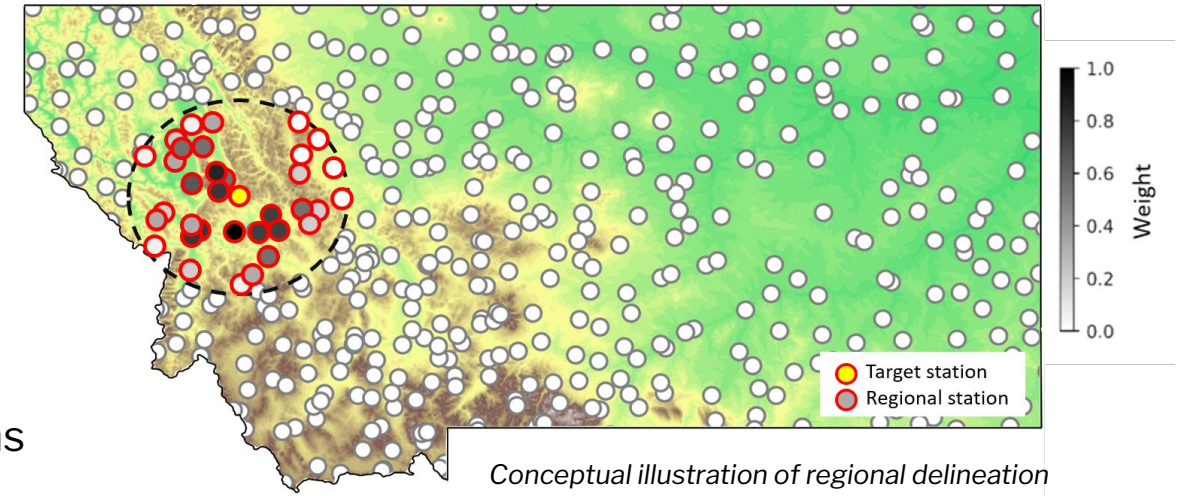


- Atlas 14 Vol. 12 quality controlled metadata and AMS data
- Gridded PRISM mean annual maximum (MAM) and mean annual precipitation (MAP)
- Annual near-surface temperature anomalies from NCEI
- NASA's SRTM90 DEM grids



A15 Volume 1 - Regionalization approach

- Regional stations around target stations are identified
- Stations weighted based on:
  - geographical features
  - meteorological attributes
  - statistical testing
- Weights determine extent of contribution by regional stations
- PF estimates are computed for each station location within the domain



Conceptual illustration of regional delineation and weighting within Pilot domain

Regionalization (Pilot)

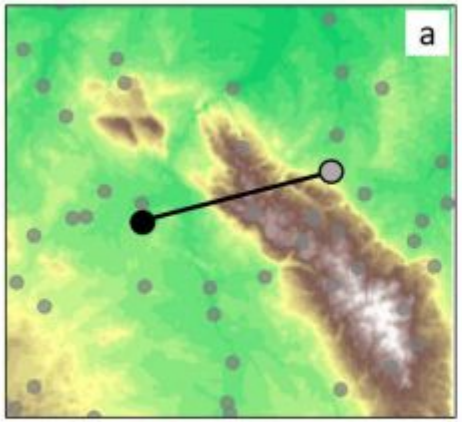


Table 2. Attribute parameters used in weighting of regional stations.

Attribute	$W = 1$	$1 > W > 0$	$W = 0$
Distance	x ≤ 70 km	70 < x < 160 km	x ≥ 160 km
MAP difference	x ≤ 70%	70 < x < 100%	x ≥ 100%
MAM difference	x ≤ 40%	40 < x < 75%	x ≥ 75%
Elevation difference	x ≤ 700 m	700 < x < 1200 m	x ≥ 1200 m
Obstacle height	x ≤ 600 m	600 < x < 1100 m	x ≥ 1100 m
Elevation range	x ≤ 1200 m	1200 < x < 1700 m	x ≥ 1700 m
P-value based on two-sample statistical tests	x ≥ 0.2	0.2 > x > 0.05	x ≤ 0.05

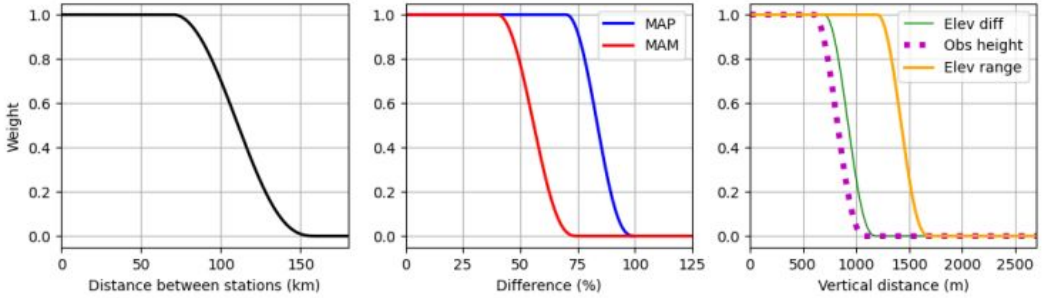
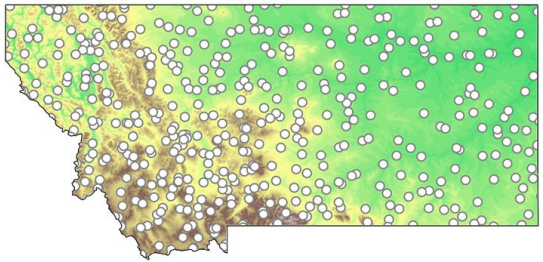
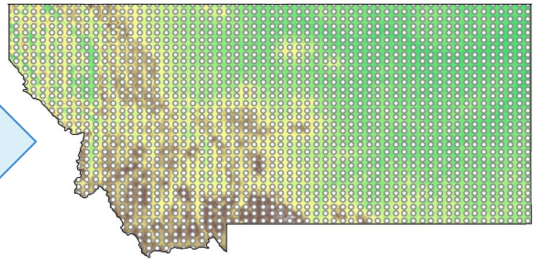


Figure 5. Depiction of weights based on selected attributes from Table 2.

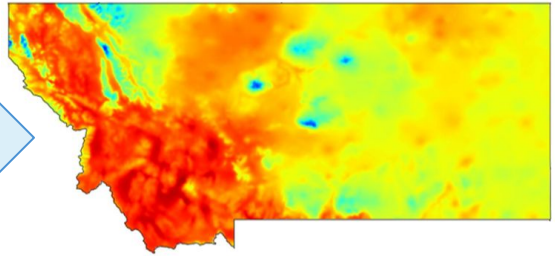
A15 Volume 1 - Interpolation to a grid



PF estimates computed at station locations



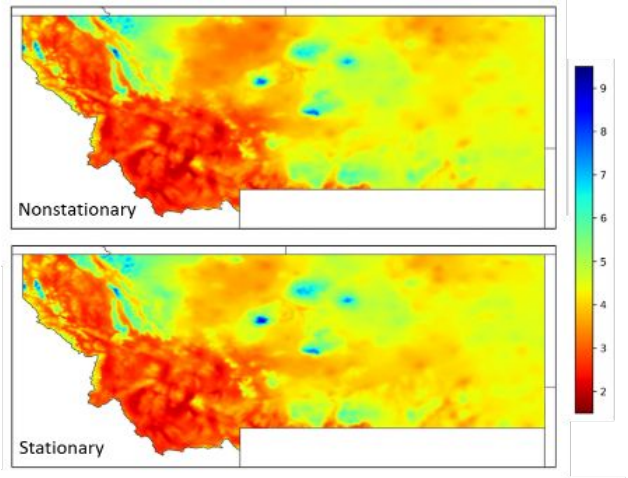
Gridded MAM values used to compute gridded ratios



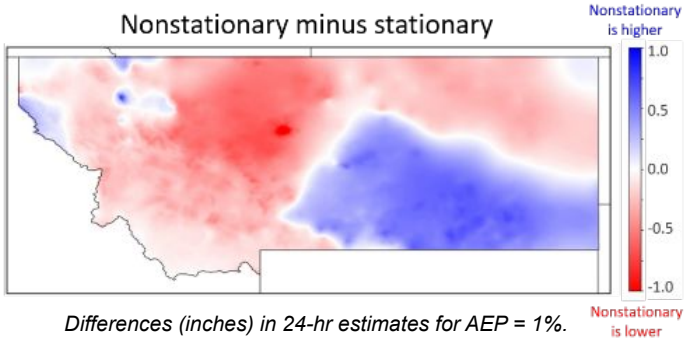
Ratios used to compute gridded PF estimates

A15 Volume 1 - Nonstationary vs. Stationary Estimates

- A15 nonstationary and stationary estimates are similar
- Present-day differences are within ~15% and reflect trends in gauge data

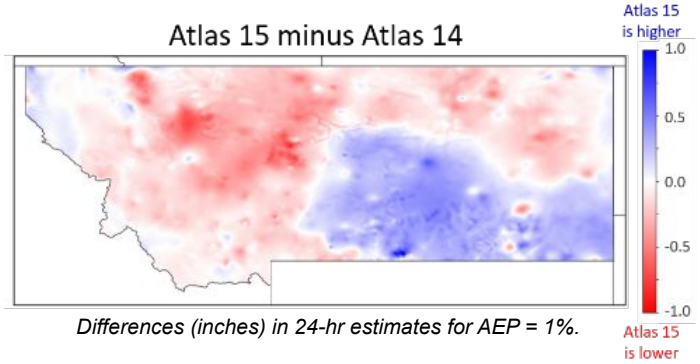


24-hr estimates (inches) for AEP = 1%.



Differences (inches) in 24-hr estimates for AEP = 1%.

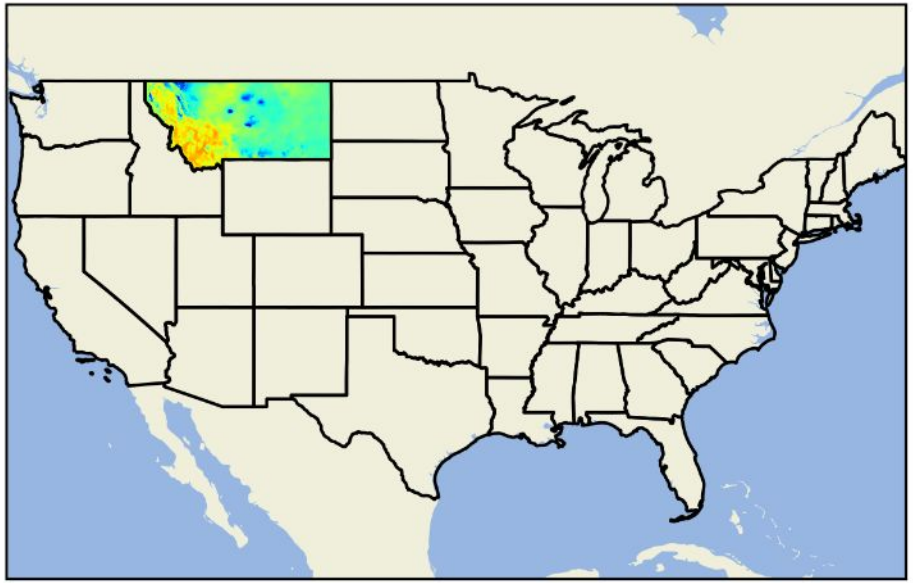
- Large-scale differences between A15 Nonstationary and A14 (stationary) are largely due to the implementation of a nonstationary framework



Differences (inches) in 24-hr estimates for AEP = 1%.

A15 development - Moving on to CONUS (then oCONUS)

- Adapt framework for implementation across CONUS, pending completion of repository and MAM grid development



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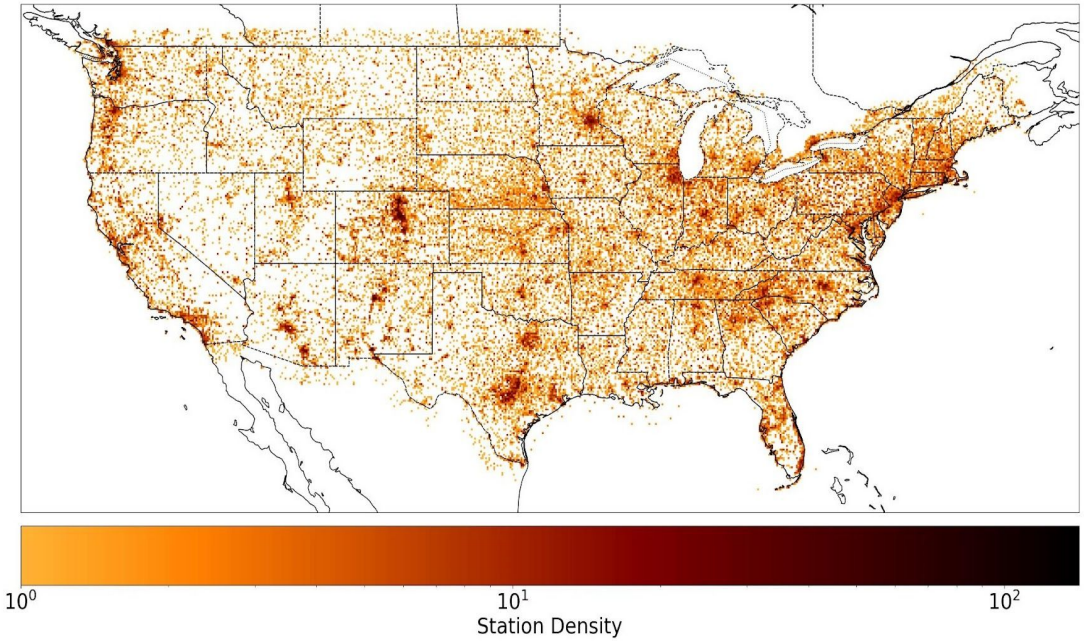
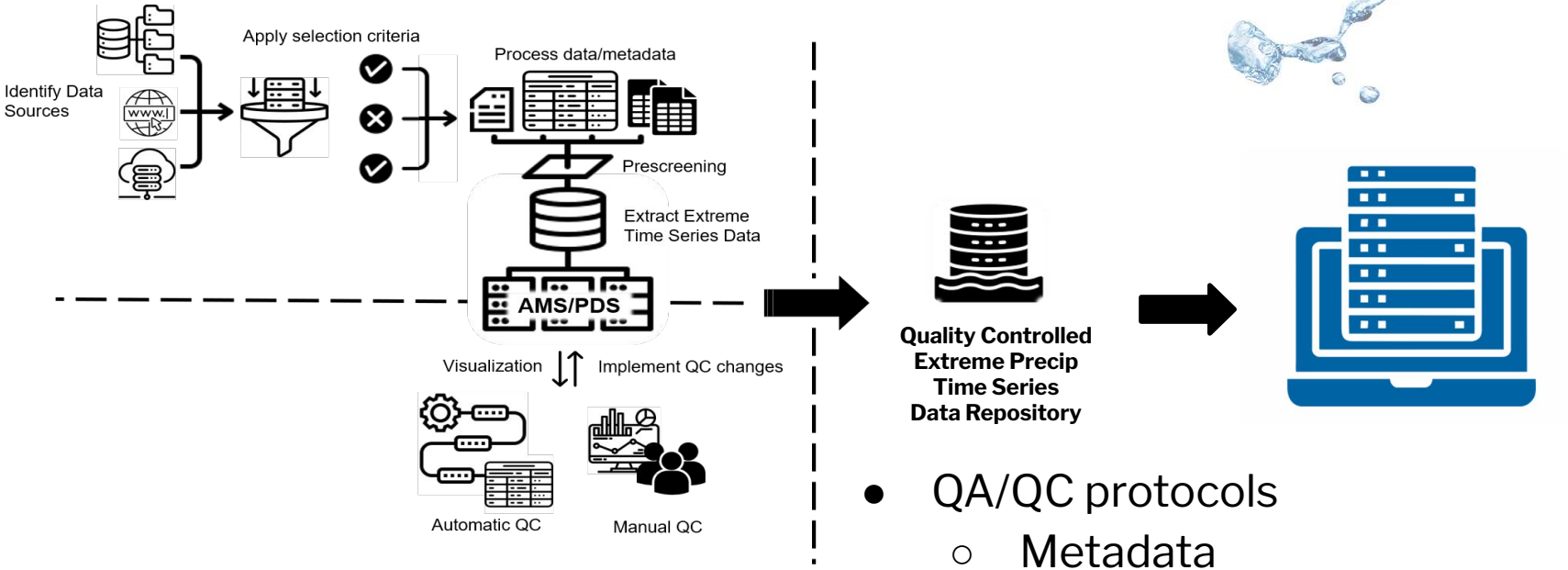


Developing Precipitation Extreme Time Series Data Repository

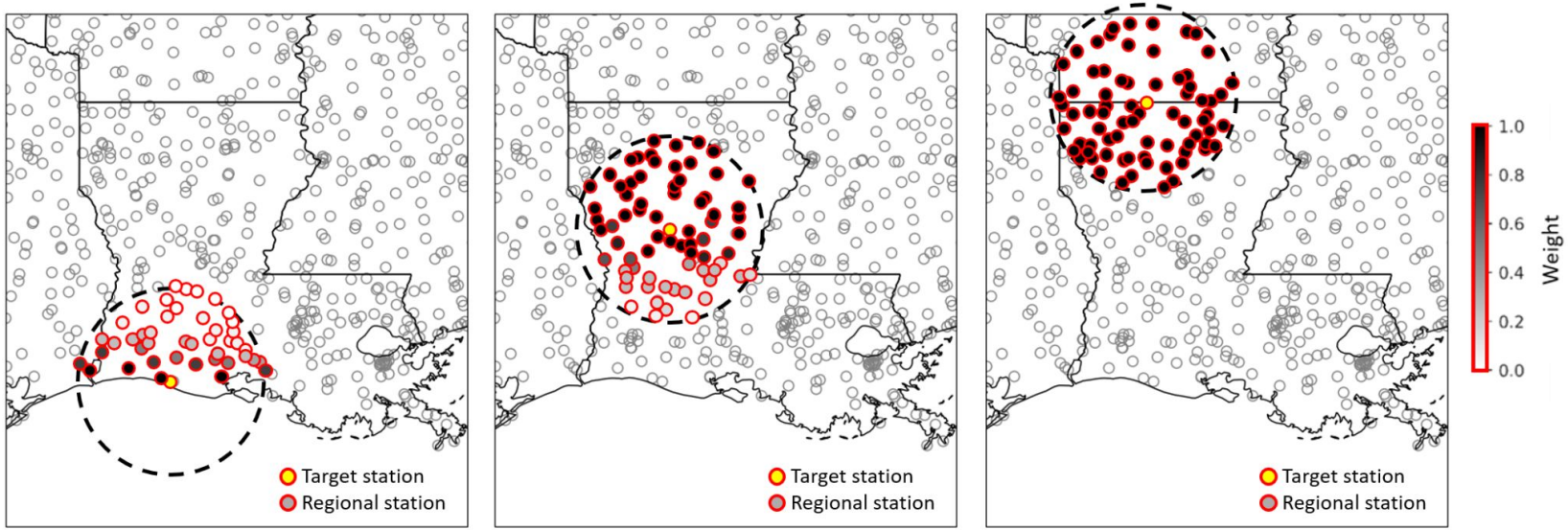


- QA/QC protocols
  - Metadata
  - Station cleanup
  - Annual maximum series (AMS)

CONUS: Evolve Framework - Current Work Example

Expanding Framework to CONUS

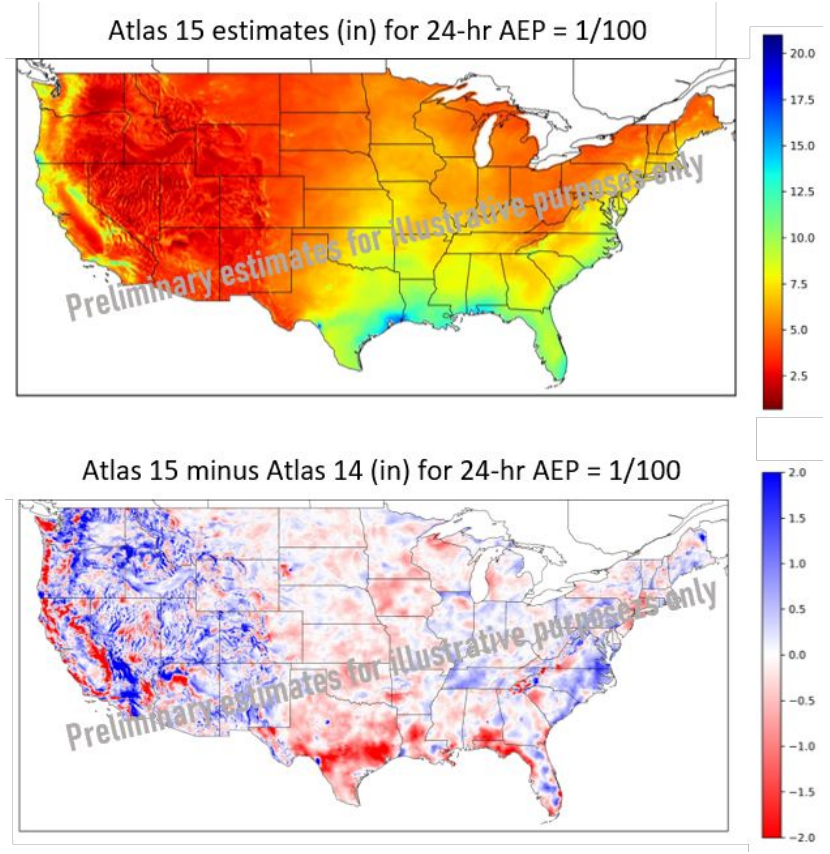
- Updated regionalization now includes distance to coast
- Currently investigating bounds on other attribute weights

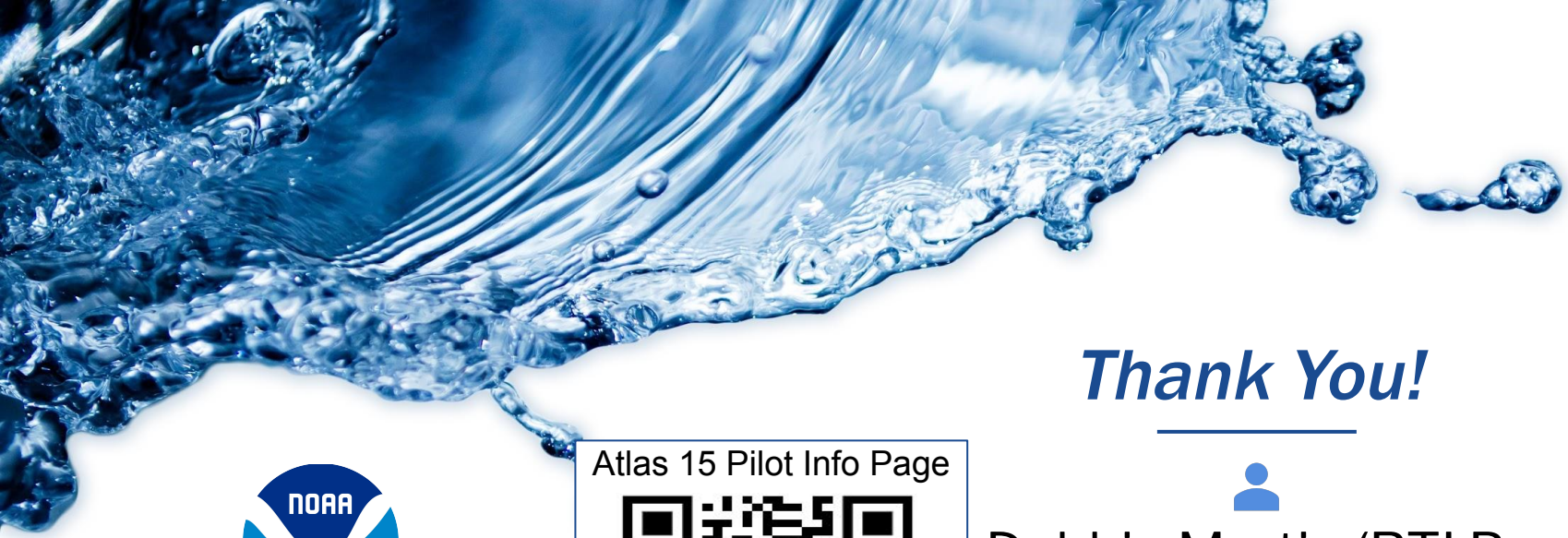


Conceptual illustration of weighting based on distance to coast

CONUS: Evolve Framework - Next Steps

- Continue investigating MAM grid development approaches
- Revisit regionalization framework
- As repository data are updated, produce new MAM grids and CONUS-wide PF estimates
- Continue alignment of V1 and V2 frameworks
- Incorporate peer-review feedback





Thank You!

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