NOAA's National Weather Service

Colorado Basin River Forecast Center

Precipitation Analysis over the Colorado River Basin

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Overview

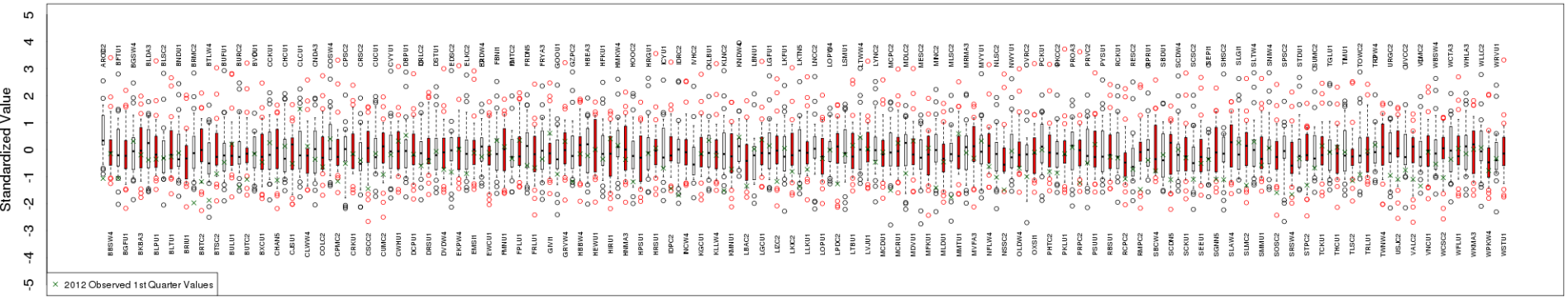
- *Questions regarding the probability of precipitation reaching average conditions over the Colorado River Basin given current (dry) 1st Quarter WY (Oct-Dec) conditions have been asked.*
- *Initial analysis by the CBRFC and ESP model runs yielded pessimistic outlooks, so we wanted to confirm with a more detailed analysis.*
- *How does 1st Quarter WY conditions compare to January through May conditions?*

Data

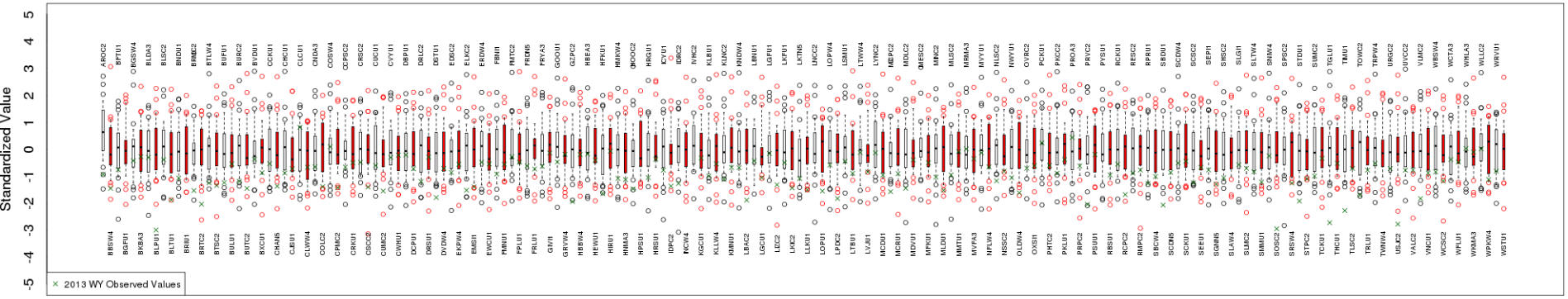
- ***Queried database for precipitation data from SNOTEL precipitation sensors.***
  - **Query resulted in 186 stations with derived averages from the calmonly table, the table within the CBRFC database which stores the data through which the model is calibrated.**
  - **Derived standardized values for each of these stations between water years 1981 and 2010 (30 years).**
- ***Empirical probabilities derived here are over that historical period.***

Summary of All Gage Statistics

Standardized 1st Quarter Precipitation Totals Over the Colorado River Basin



Standardized Jan-May Precipitation Totals Over the Colorado River Basin



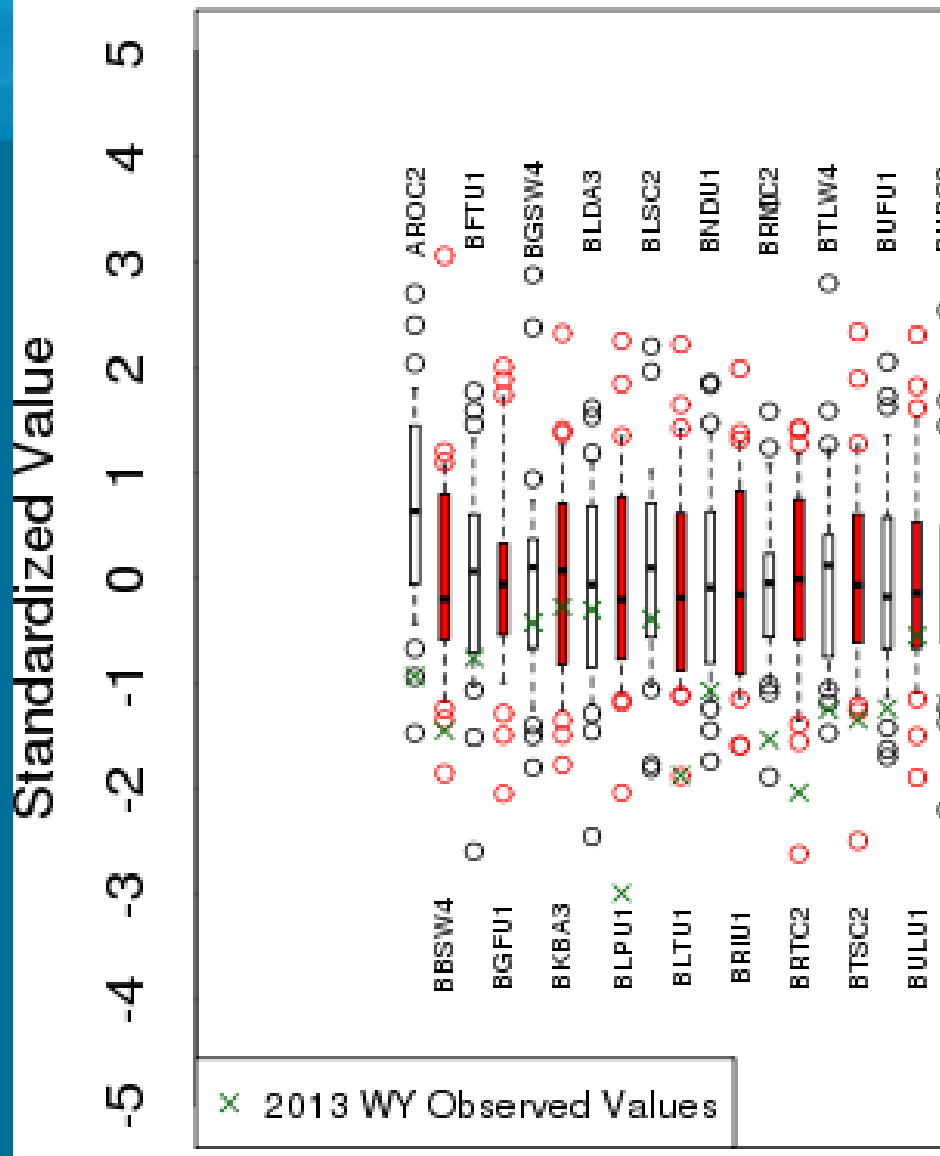
Summary of All Gage Statistics

- *Historic spread of all the gages is similar.*
- *On average, there is more variability during the January through May season than in the 1st Quarter of the Water Year.*
  - **Mean variance in the 1st Quarter (Oct-Dec) is 8.95**
  - **Mean variance in Jan-May is 16.27**
- *Green "X's" in the top plot mark 2012 October through December values. These values are spread throughout.*
- *Green "X's" in the bottom plot mark 2013 WY values. These values are almost all below median in the lower quartile.*

Summary

As of today, there are only 7 gages (4%) that are at or above their historical (calibration record) median.

11 gages are on track to end lower than any value in the historical record.



What is “dry”?

- *Percentage values may be interpreted differently across gages. Using standardized values, we can attempt to make a more uniform comparison.*
- *For instance, we can set a threshold (e.g., standard deviation less than -1.0) to define “dry” conditions.*
- *This sort of standardizing is used in the Standardized Precipitation Index and Palmer Drought Severity Indices.*

Answering the question

Given "dry" conditions, what is the likelihood, based on historical observations, that an average spring precipitation total is met or exceeded?

Threshold	Number of Occurrences over gages in history	Probability based on historical observations
1st Quarter precipitation is ≤ -0.5	1,696	38%
1st Quarter precipitation is ≤ -1.0	740	39%

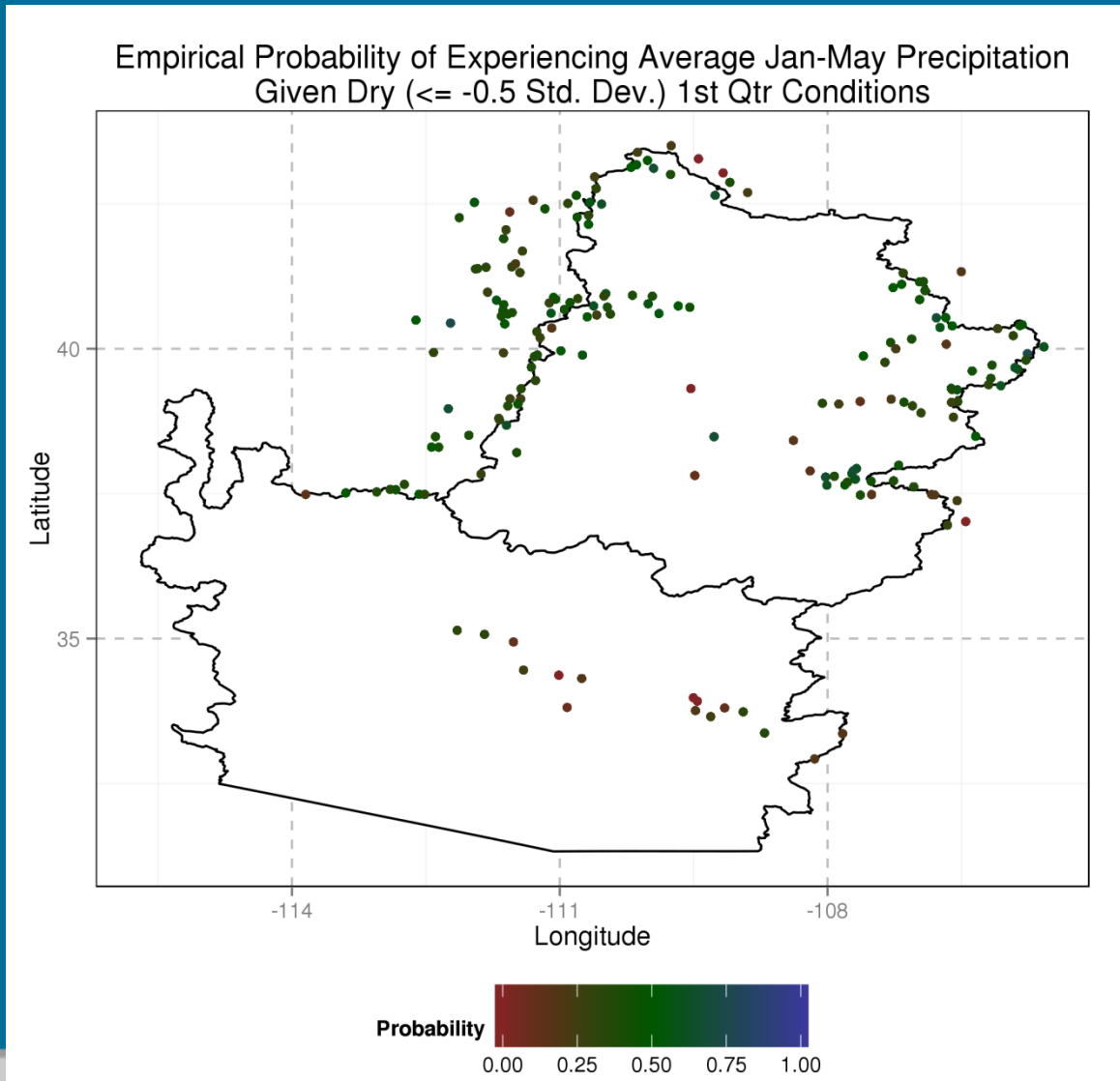
What about this year?

Given current precipitation conditions, what is the likelihood, based on historical observations, that an average spring precipitation total is met or exceeded?

Threshold	Number of Occurrences over gages in history	Probability based on historical observations
1st Quarter precipitation is ≤ current conditions	1,881	40%
1st Quarter precipitation is > current conditions	2,999	53%

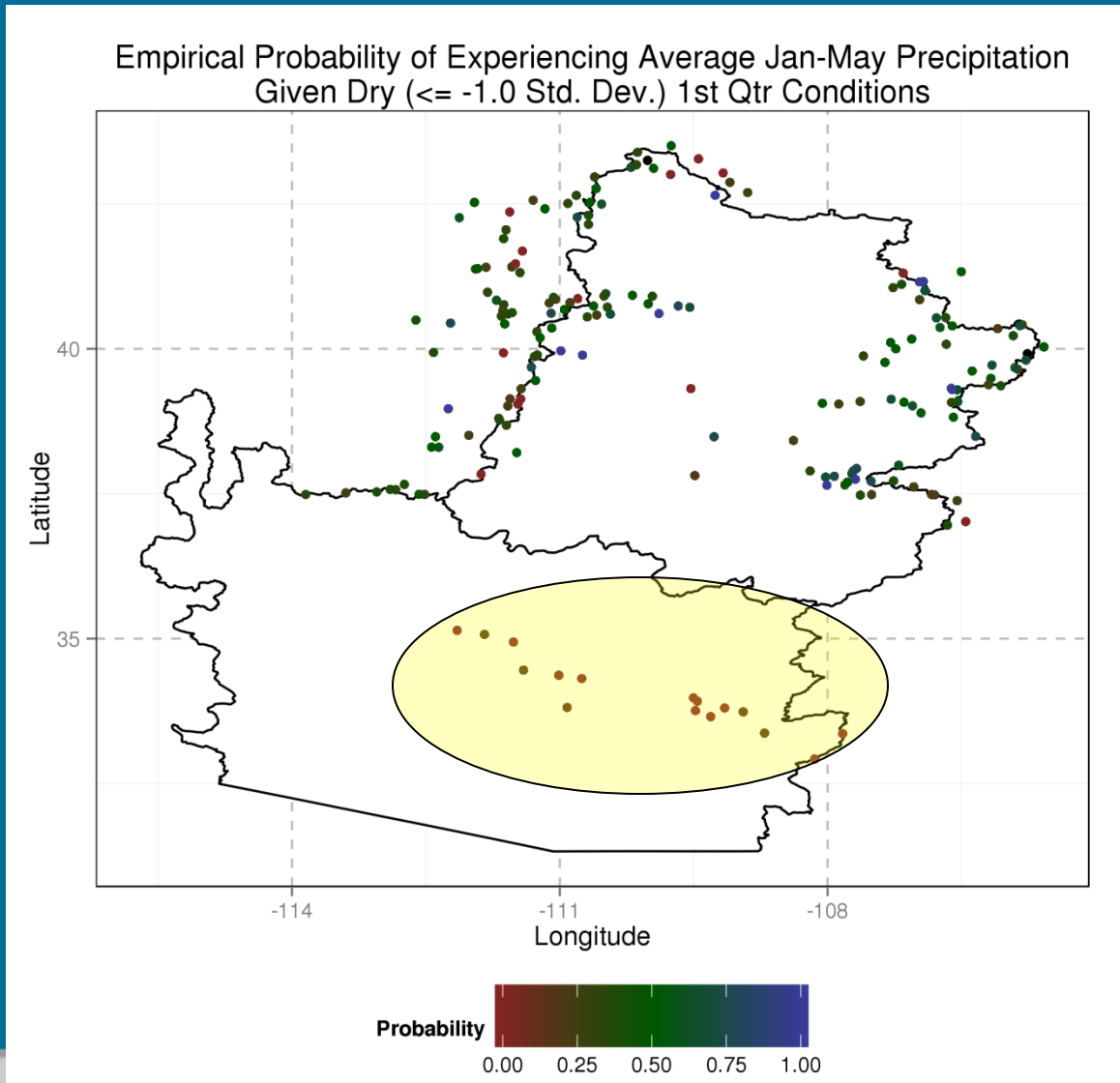
Is there a Spatial Correlation?

- *This is using a threshold of -0.5.*
- *Probability of reaching average spring conditions is approximately 50% across the upper basin.*
- *Probabilities in the lower basin appear to be around 25%.*



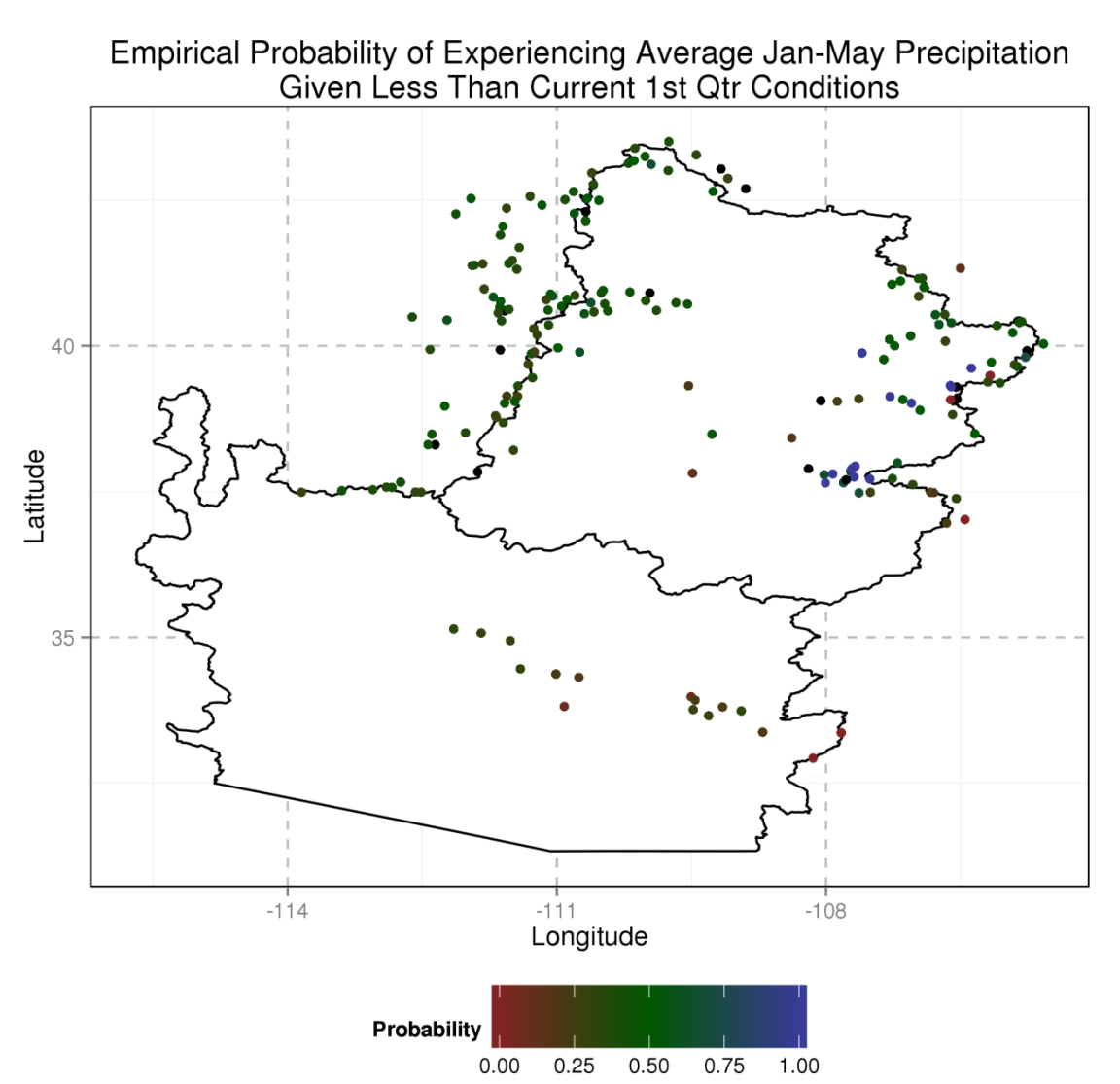
Is there a Spatial Correlation?

- *This is using a threshold of -1.0.*
- *May be a small cluster outside of the mainstem basin with higher probabilities.*
- *Lower basin probabilities are much lower.*



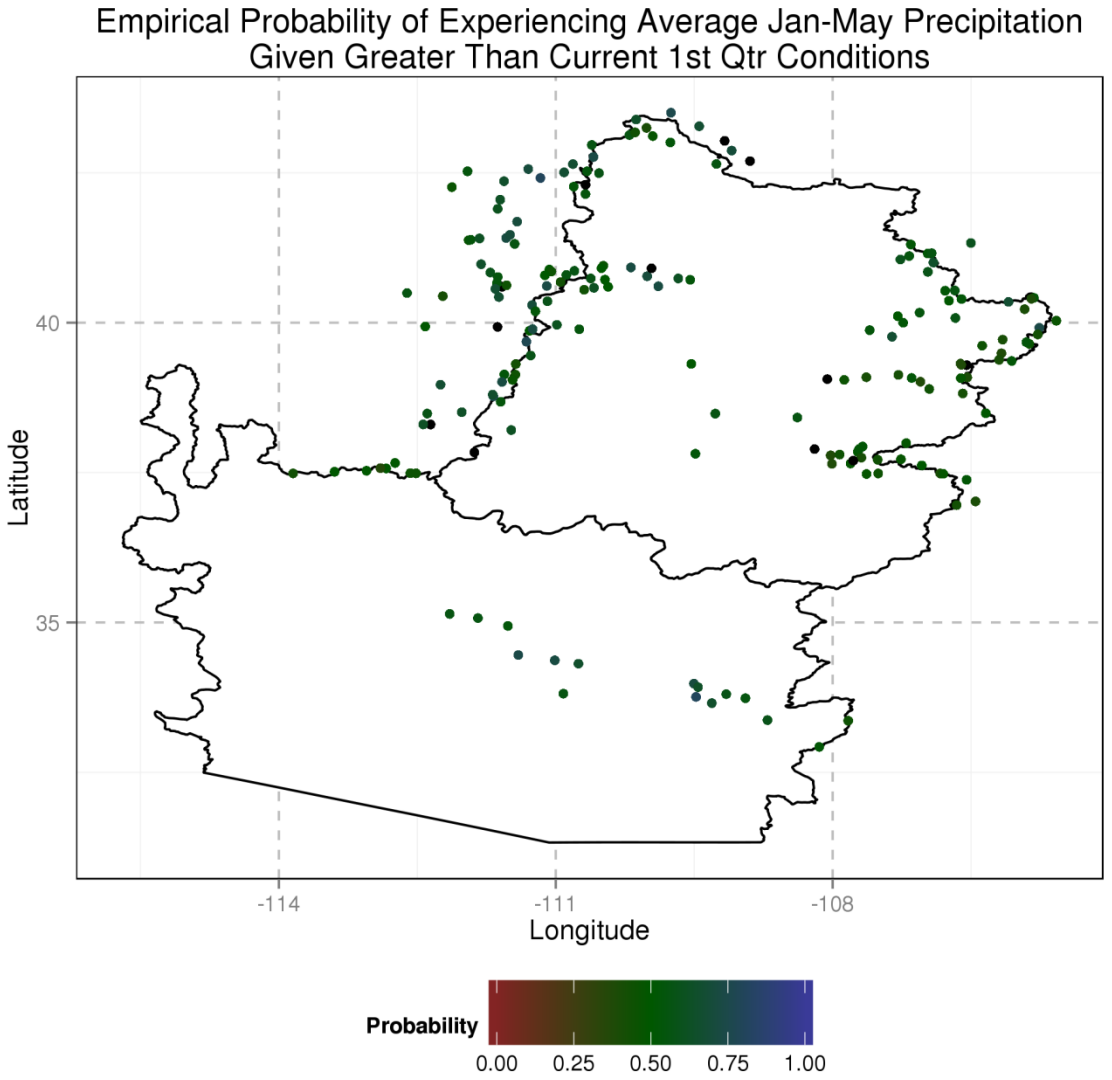
Is there a Spatial Correlation?

- *This is using a threshold of ≤ current conditions.*
- *Less than current winter conditions typically yield below average spring seasons in the lower basin.*



Is there a Spatial Correlation?

- *This is using a threshold of > current conditions.*
- *With current, or greater, winter conditions, there appears to be at least a 50% chance of seeing at least an average spring.*



Initial Conclusions

- ***1st Quarter precipitation conditions do seem to give some indication of the type of spring season that follows, but it appears to be a weaker correlation in the upper basin than in the lower basin.***
  - **This makes sense, since spring precipitation is more variable on average.**
  - **This analysis is limited from a site to site basis, since most stations only have about 15 years worth of data to test based on the thresholds used here.**
- ***It seems that low winter precipitation is more indicative of below average spring conditions in the lower basin.***

Continuing the Analysis

- *What if we examine what the probability of seeing at least an average TOTAL October through May precipitation season, given dry 1st quarter conditions?*
- *Variability characteristics remain the same.*
- *Basically, we want to see what the likelihood is that January through May precipitation can make up for a dry 1st Quarter.*

Answering the question

Given "dry" conditions, what is the likelihood, based on historical observations, that an average October through May precipitation total is met or exceeded?

Threshold	Number of Occurrences over gages in history	Probability based on historical observations
1st Quarter precipitation is ≤ -0.5	1,696	13%
1st Quarter precipitation is ≤ -1.0	740	7%

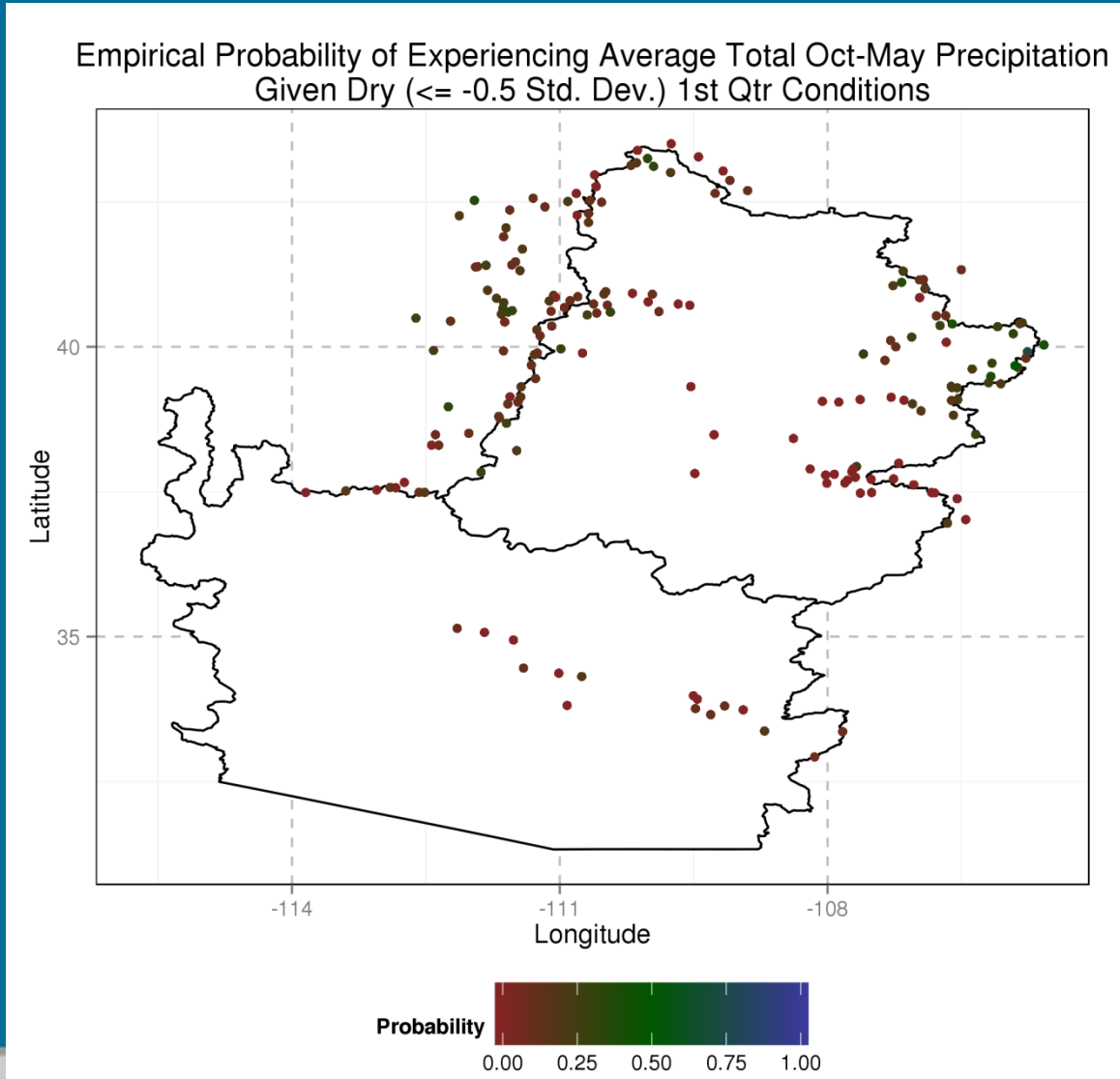
What about this year?

Given current 1st Quarter conditions, what is the likelihood, based on historical observations, that an average October through May precipitation total is met or exceeded?

Threshold	Number of Occurrences over gages in history	Probability based on historical observations
1st Quarter precipitation is ≤ current conditions	1,881	20%
Winter precipitation is > current conditions	2,999	62%

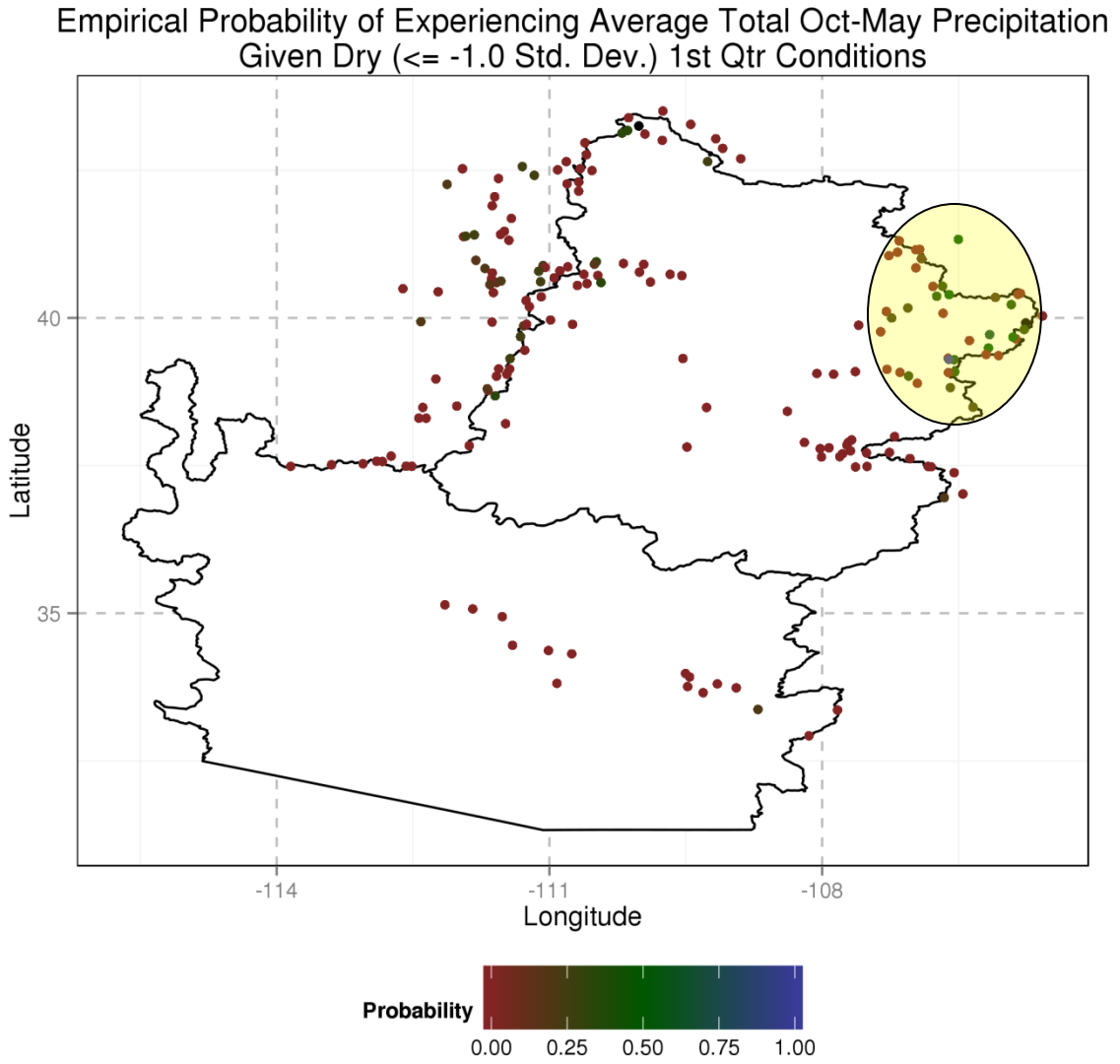
Is there a Spatial Correlation?

- *This is using a threshold of -0.5.*
- *Probability of reaching average annual conditions is low throughout the basin.*



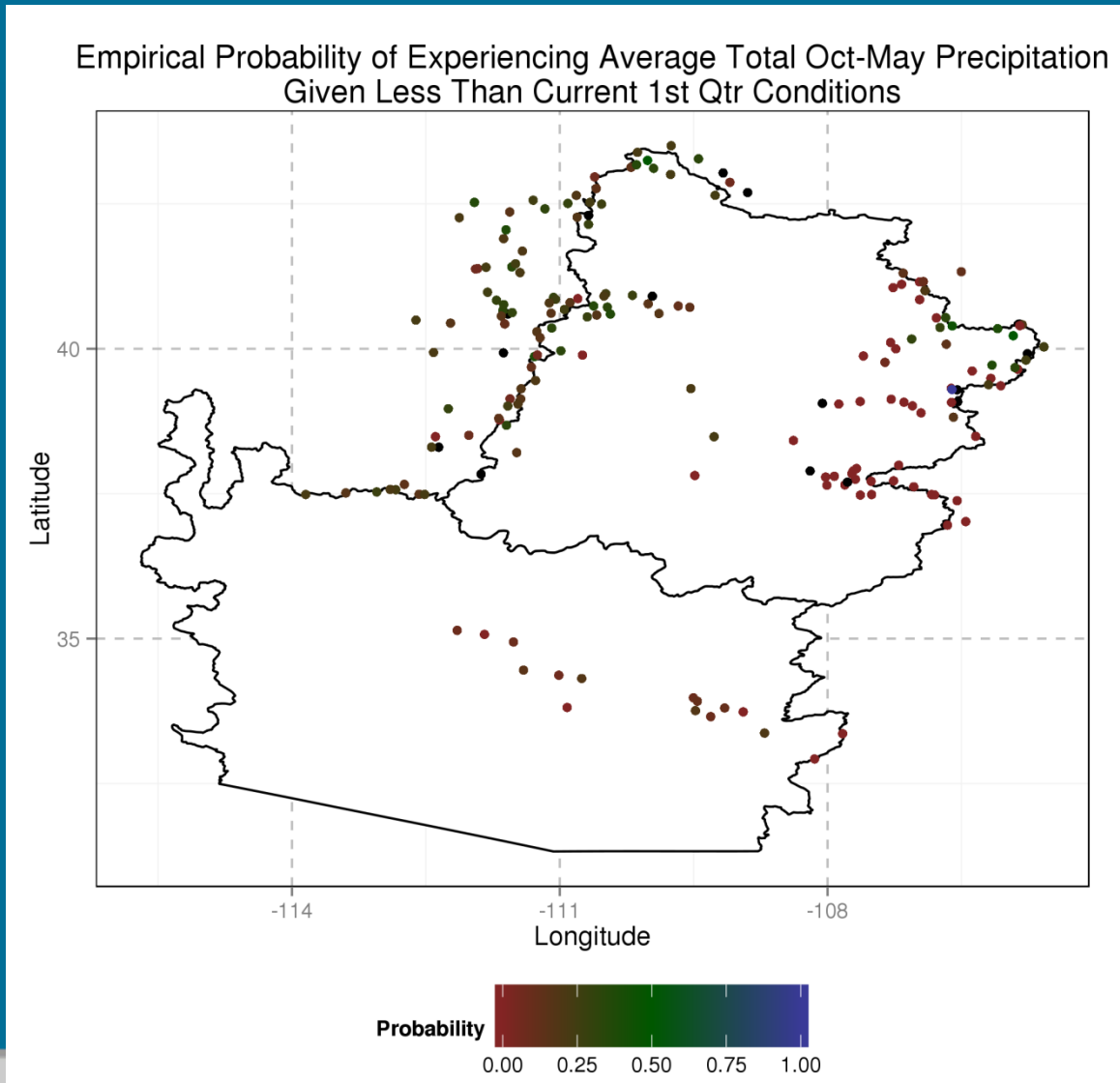
Is there a Spatial Correlation?

- *This is using a threshold of -1.0.*
- *May be a small cluster near the Colorado River headwaters with higher probabilities.*



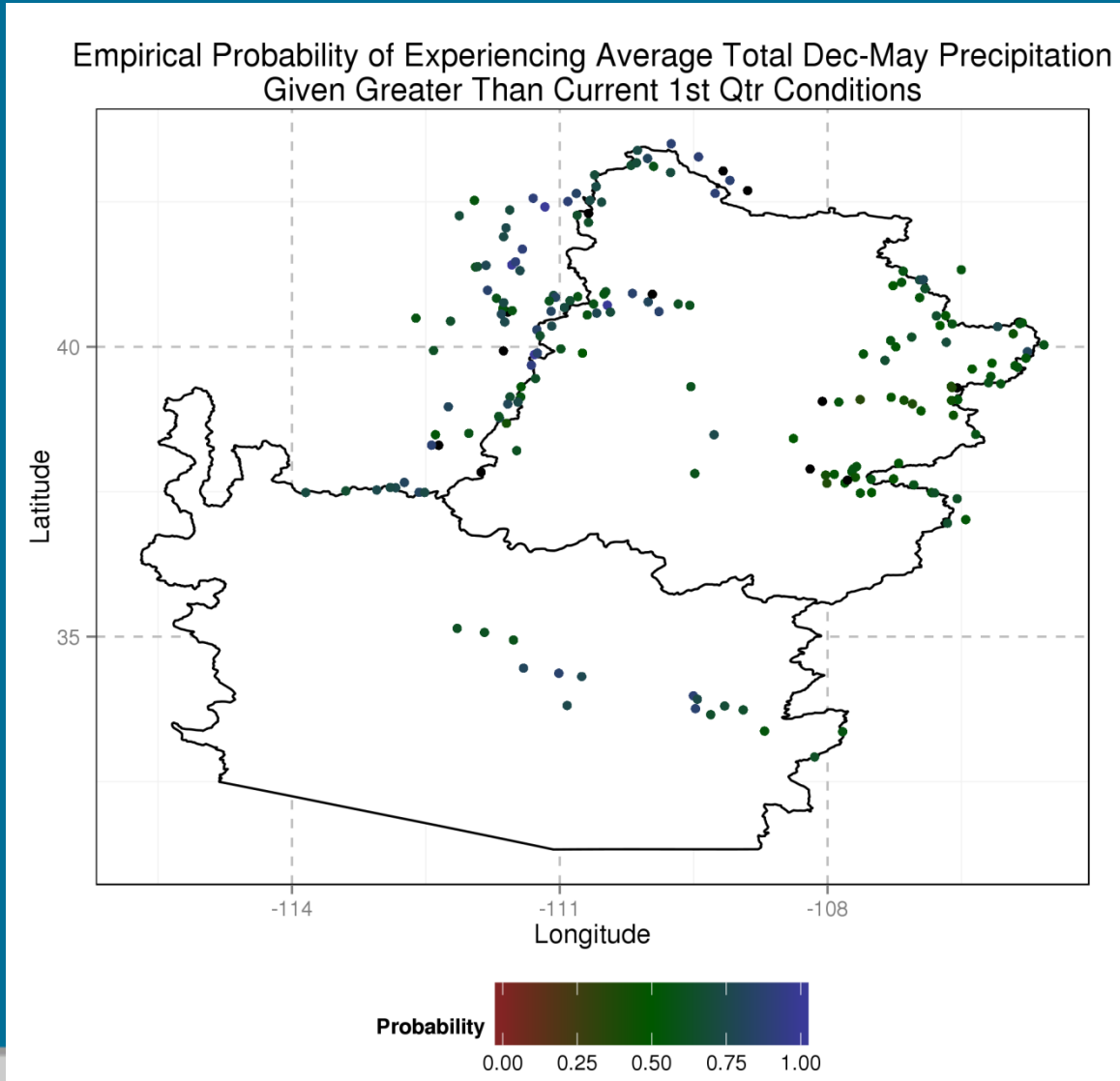
Is there a Spatial Correlation?

- *This is using a threshold of ≤ current conditions.*
- *Based on historical conditions, 1st Quarter precip at our current levels or lower does not typically yield average values.*



Is there a Spatial Correlation?

- *This is using a threshold of > current conditions.*
- *With greater 1st Quarter conditions, there appears to be about a 50% chance of at least an average Oct-May season total.*



PRELIMINARY RESULTS

Is there any hope this year?

Given current Oct – Feb conditions, what is the likelihood, based on historical observations, that an average January through May precipitation total is met or exceeded?

Threshold	Number of Occurrences over gages in history	Probability based on historical observations
Oct – Feb precipitation is ≤ current conditions	1556	39% (it's actually lower)
Oct - Feb precipitation is > current conditions	3085	53% (it's actually lower)

Is there any hope this year?

Given current Oct – Feb conditions, what is the likelihood, based on historical observations, that an average October through May precipitation total is met or exceeded?

Threshold	Number of Occurrences over gages in history	Probability based on historical observations
Oct – Feb precipitation is ≤ current conditions	1556	37% (it's actually lower)
Oct - Feb precipitation is > current conditions	3081	49% (it's actually lower)

Initial Conclusions

- ***Jan-May conditions seldom make up for dry 1st Quarter conditions throughout the basin***
  - **This analysis is limited from a site to site basis, since most stations only have about 15 years worth of data to test based on the thresholds used here.**
- ***Dry 1st Quarter conditions are indicative of a below average Oct-May precipitation total.***
- ***There is a very low probability that between now and May that this hydrologic deficit can be made up.***

QUESTIONS?