Estimating Drought Recovery in the Climate Toolbox

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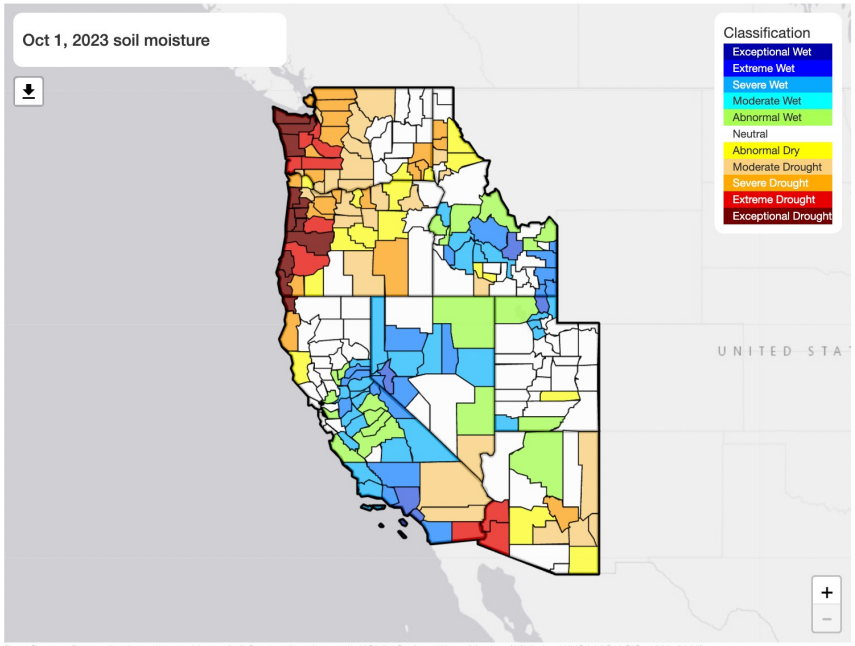
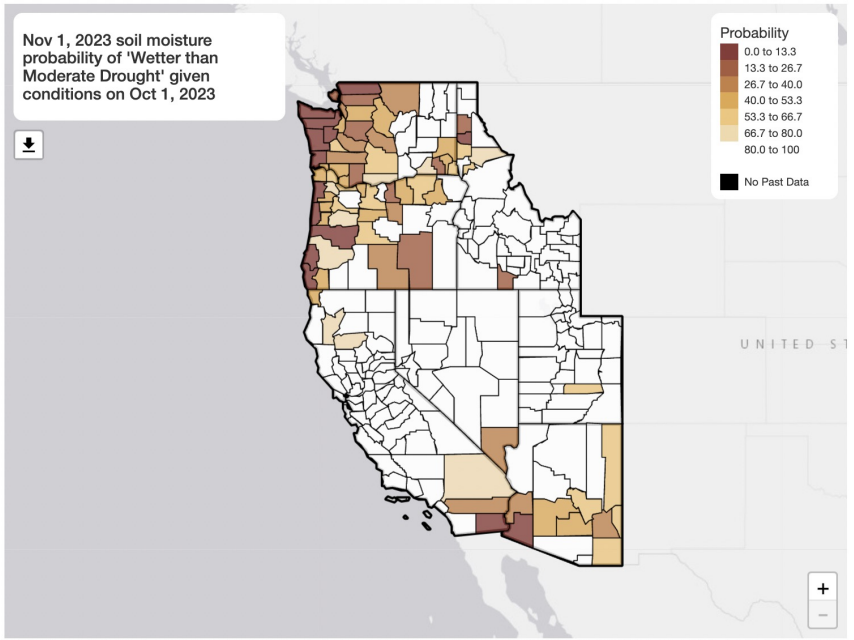
INITIAL MONTH



Data Source: Percentiles based on rankings of all Oct 1 soil moistures in UCLAs Surface Water Monitor (1/16-deg WUSA VIC-ACIS, 1920-2020).

FORECAST MONTH



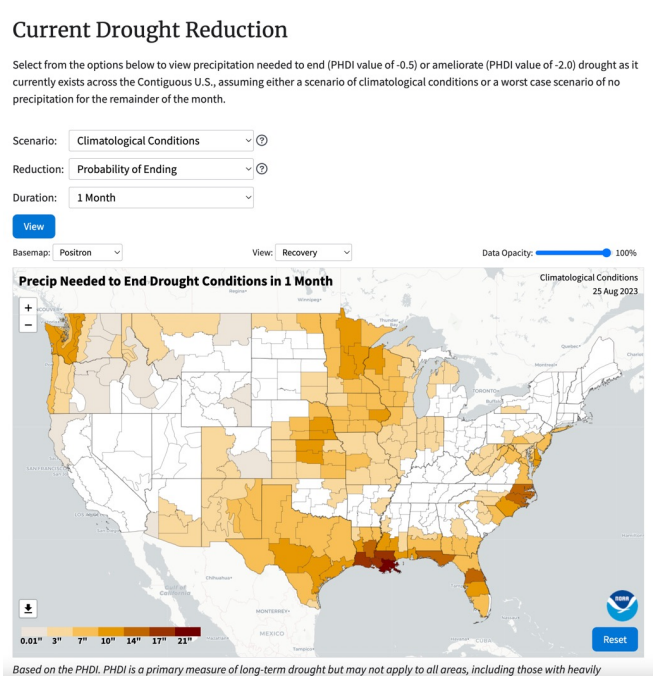
Data Source: Drought recovery probabilities are calculated as the complement of empirical conditional probabilities using all Oct 1's in UCLAs Surface Water Monitor (1/16-deg WUSA VIC-ACIS, 1920-2020) with similar classifications for soil moisture as on Oct 1, 2023. Drought recovery is defined as 'Wetter than Moderate Drought'.

ClimateToolbox.org

Other Drought Recovery Tools

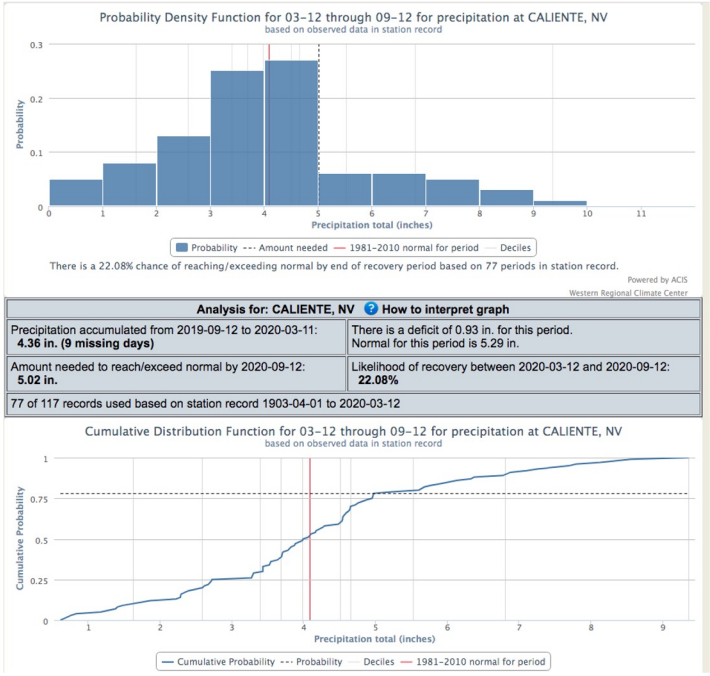
Calculate the likelihood of recovering from a precipitation deficit or reaching a precipitation threshold

NOAA's Drought Reduction Tool



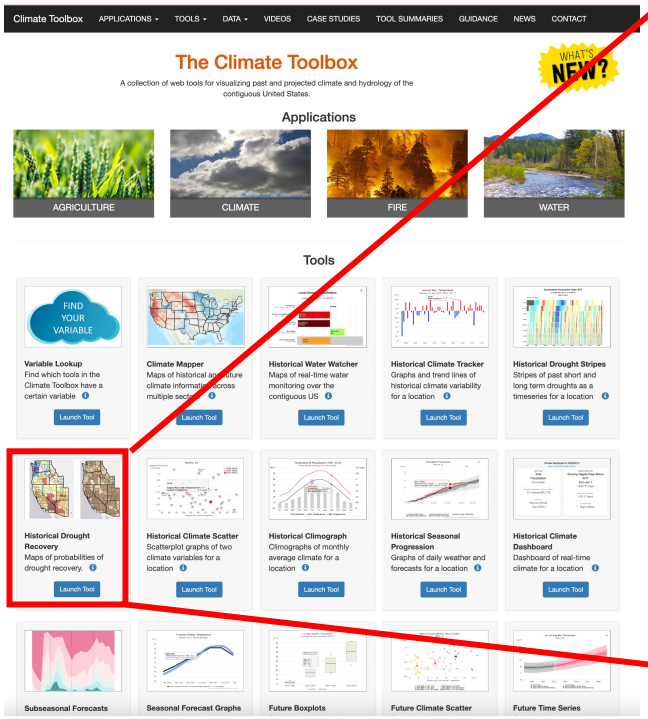
https://www.ncei.noaa.gov/access/monitoring/drought-recovery/current

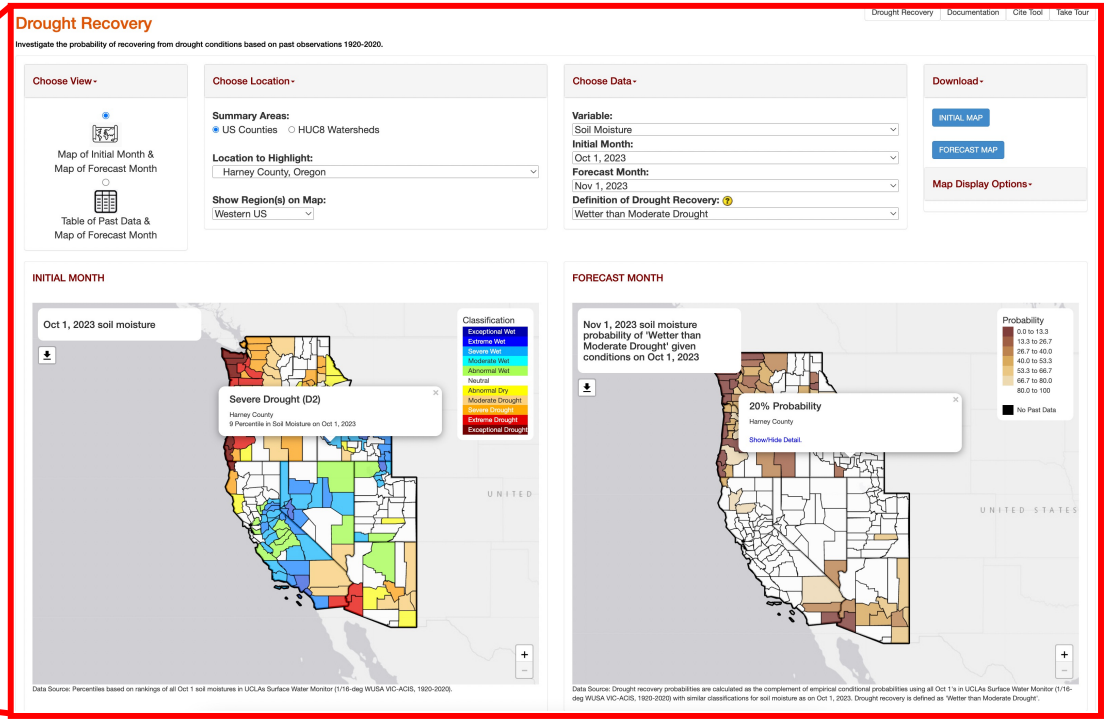
WRCC's Climate Outcome Likelihood Tool



~~https://wrcc.dri.edu/col/~~ (No Longer Exists)

Drought Recovery Tool





NIDIS

RISA Regional Integrated Sciences and Assessments

CIRC Climate Impacts Research Consortium

A NOAA RISA TEAM

ClimateToolbox.org

Data

100 years of hydrology modeled data from UCLA's Drought Monitoring System

Model:

Variable Infiltration Capacity (VIC)

Variables:

Soil Moisture (Sum of 3 VIC soil layers)

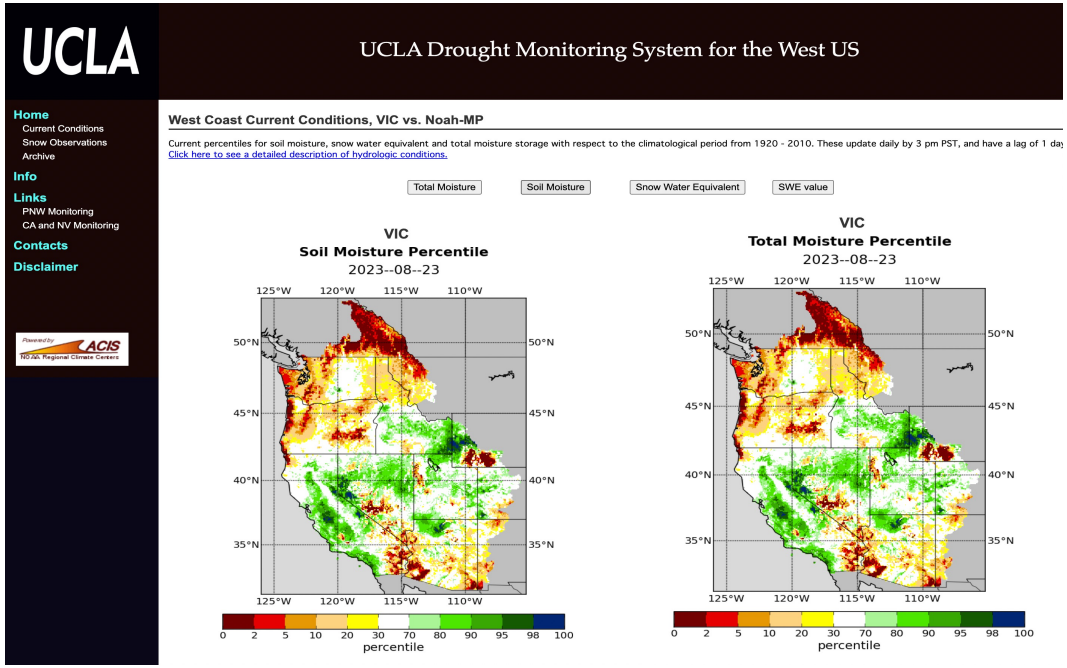
Total Moisture (Soil + Snow Water Equivalent)

Dates:

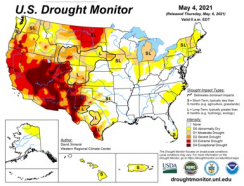
First of month from daily data (1920-2020)

Geography:

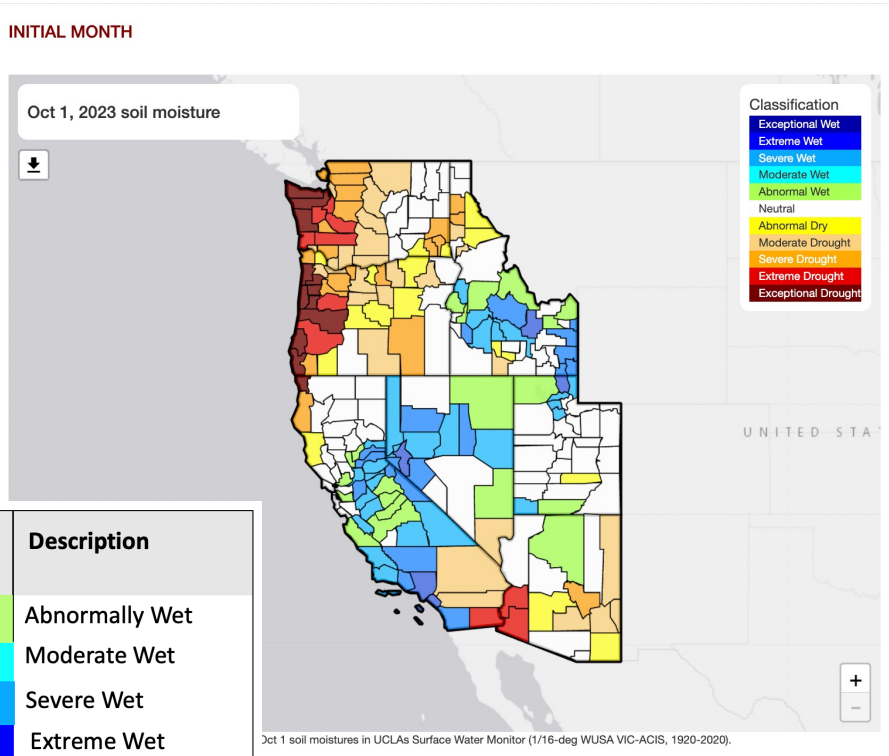
Western US (1/16-deg grids)



Drought Classification



US Drought Monitor (USDM) Colors & Classifications



Calculations:

Percentiles (p) of soil moisture and total moisture

Classifications:

Percentiles map to USDM classifications & colors

Percentile (p)	Category	Description
0 ≤ p < 2	D4	Exceptional Drought
2 ≤ p < 5	D3	Extreme Drought
5≤ p < 10	D2	Severe Drought
10 ≤ p< 20	D1	Moderate Drought
20 ≤ p< 30	D0	Abnormally Dry
30 ≤ p< 70	N	Neutral or Wet

Percentile (p)	Category	Description
70 ≤ p < 80	W0	Abnormally Wet
80 ≤ p < 90	W1	Moderate Wet
90 ≤ p < 95	W2	Severe Wet
95 ≤ p < 98	W3	Extreme Wet
98 ≤ p ≤ 100	W4	Exceptional Wet

Drought Recovery

Examples of 'No Drought' in a Future Month:

- Wet Category
- Neutral
- Abnormally Dry (? For some states?)

We let the User Decide what 'No Drought' Looks Like:

- Wetter than Abnormally Dry (W0-4 + N)
- Wetter than Moderate Drought (W0-4 + N + D0)
- Wetter than Severe Drought (W0-4 + N + D0 + D1)
- …

Percentile (p)	Category	Description
$0 \leq p < 2$	D4	Exceptional Drought
$2 \leq p < 5$	D3	Extreme Drought
$5 \leq p < 10$	D2	Severe Drought
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Percentile (p)	Category	Description
$70 \leq p < 80$	W0	Abnormally Wet
$80 \leq p < 90$	W1	Moderate Wet
$90 \leq p < 95$	W2	Severe Wet
$95 \leq p < 98$	W3	Extreme Wet
$98 \leq p \leq 100$	W4	Exceptional Wet

Likelihood of Drought Recovery

Unconditional Probabilities

Since our wet/dry classifications are percentile based:
the unconditional probability of 'No Drought' is:

P(Wetter than Moderate Drought (W0-4 + N +D0))
= 80 %

Conditional Probabilities

Using current drought conditions,
the conditional probability of 'No Drought' is:

P(No Drought in {future month} /
Current Drought Conditions)

Percentile (p)	Category	Description
$0 \leq p < 2$	D4	Exceptional Drought
$2 \leq p < 5$	D3	Extreme Drought
$5 \leq p < 10$	D2	Severe Drought
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$98 \leq p \leq 100$	W4	Exceptional Wet

Probability of Drought Recovery

Method:

Empirical drought recovery method based on 100 years of data used in the Masters thesis of D. Moruzzi (OSU, 2019) to look at drought in Washington state counties.

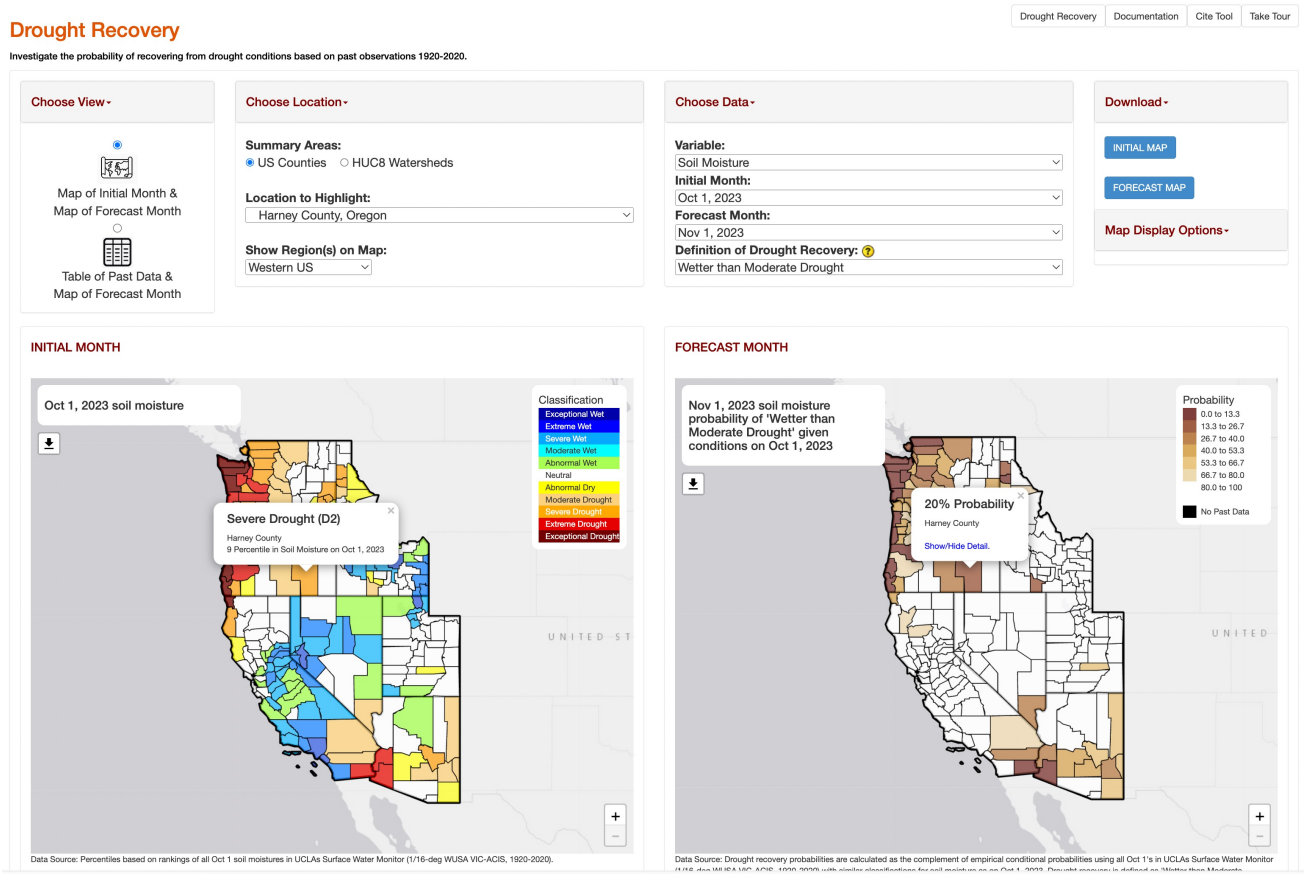
Drought Recovery Probability

P(No Drought in {future month} / Current Drought Conditions in {current month})

$$= \frac{\text{Number Years with No Drought in \{future month\} AND Current Drought Conditions in \{current month\}}}{\text{Number Years with Current Drought Conditions in \{current month\}}}$$

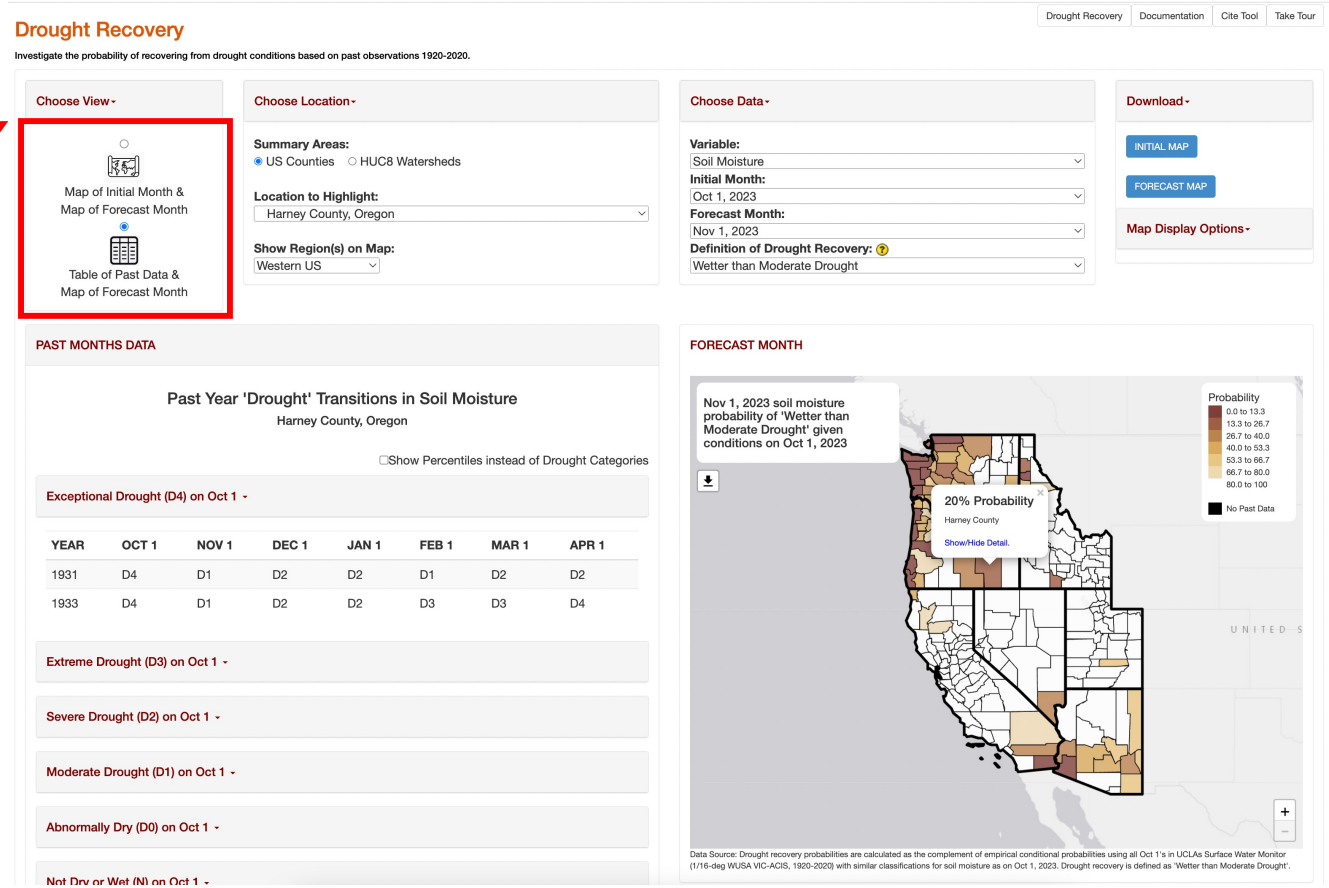
Drought Recovery Tool

Designed with help from state water managers:
J. Marti (WA), D. Hoekema (ID), K. Stahr(OR)



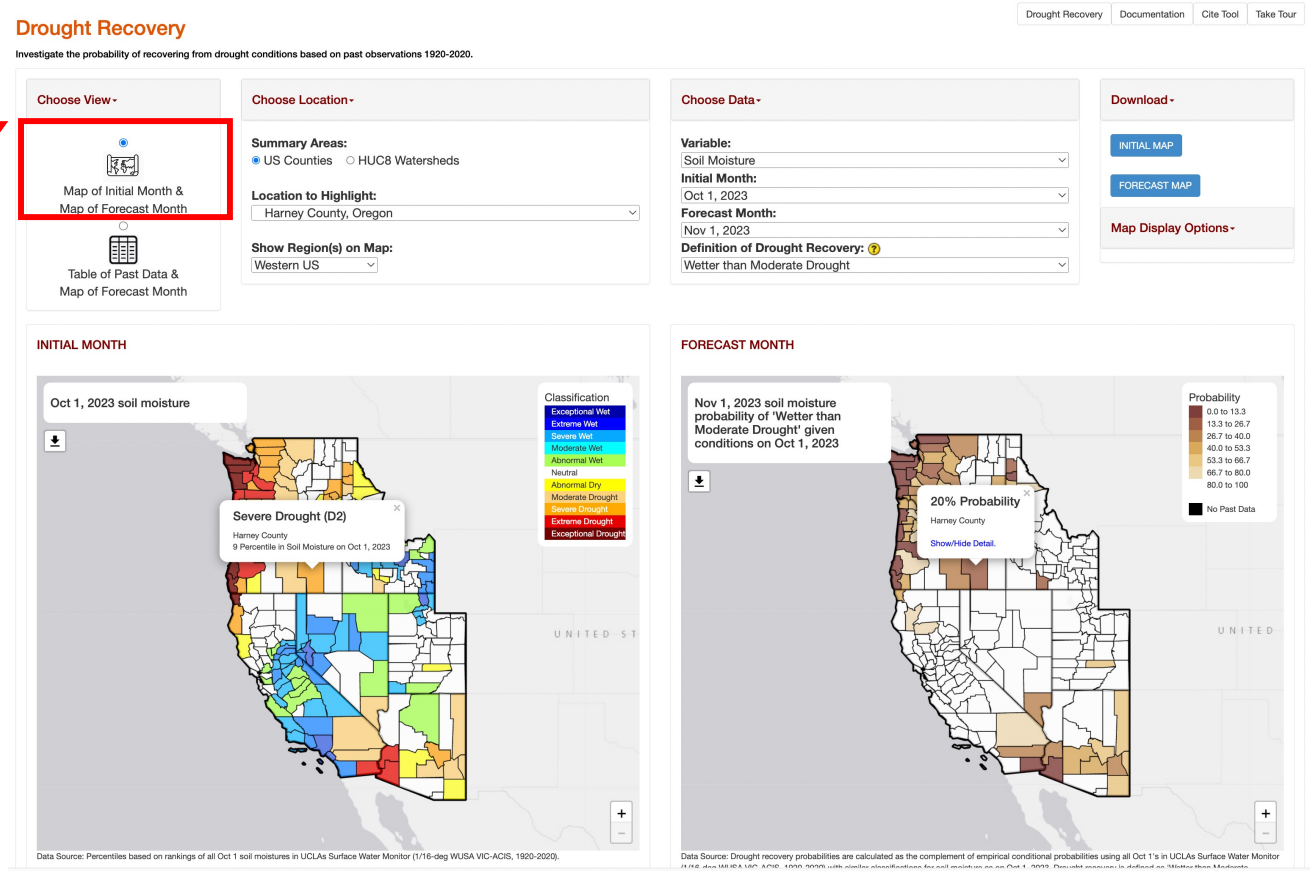
Drought Recovery Tool

Users can view data tables or maps.



Drought Recovery Tool

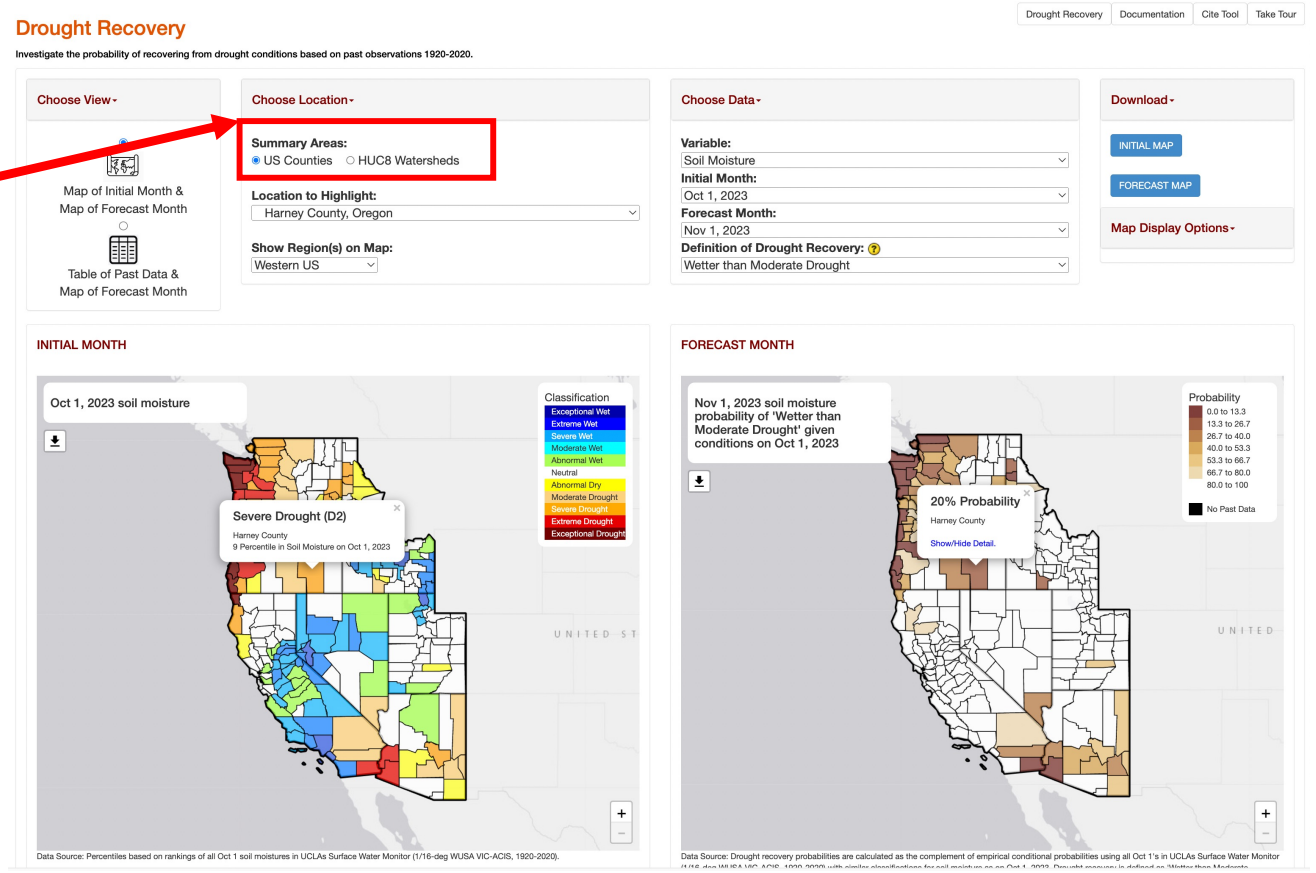
Map View



Drought Recovery Tool

Users can select to view results over counties or watersheds.

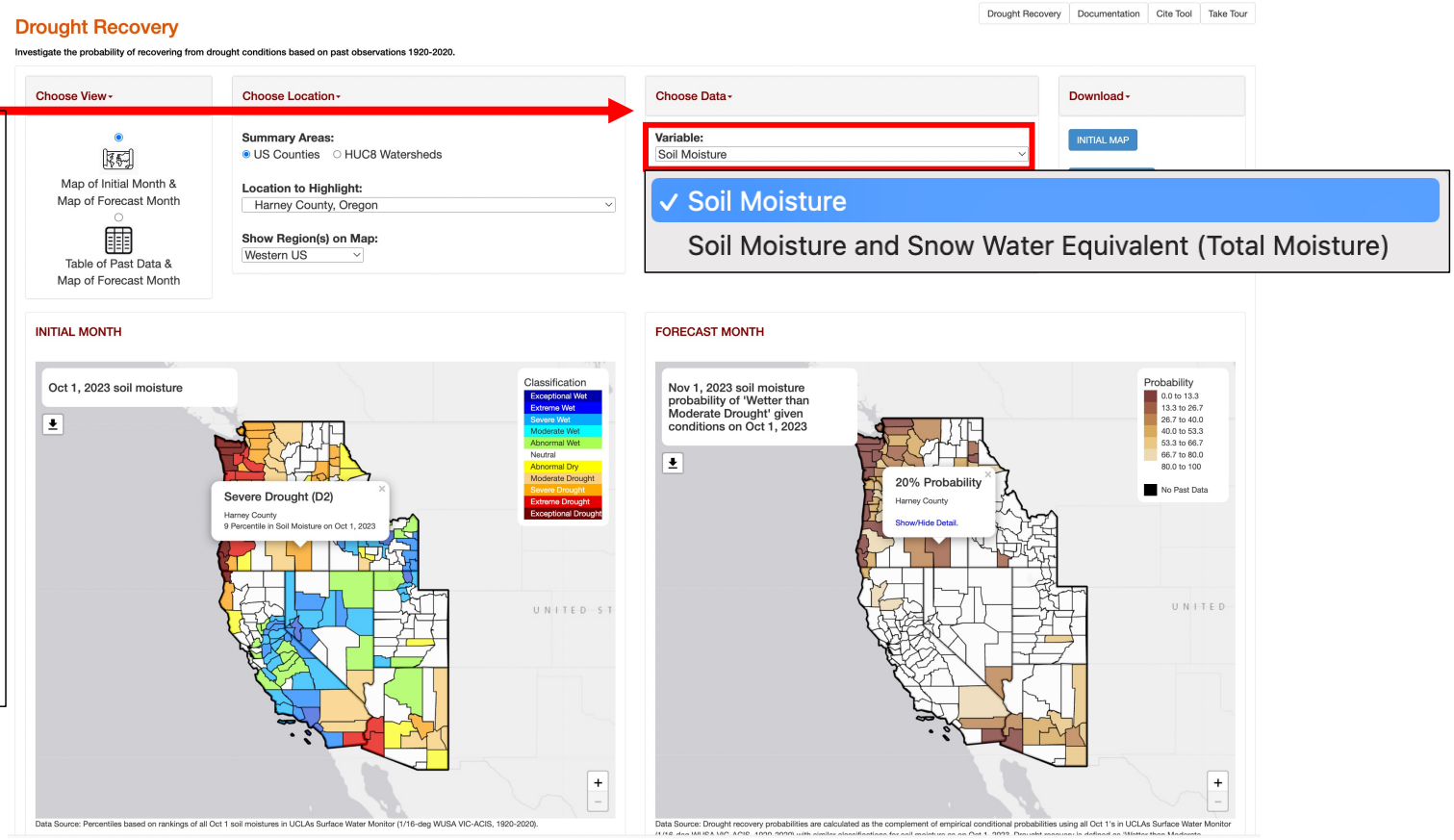
State drought decision making is at the county & watershed level.



Drought Recovery Tool

Users can select to look at drought in either soil moisture or total moisture.

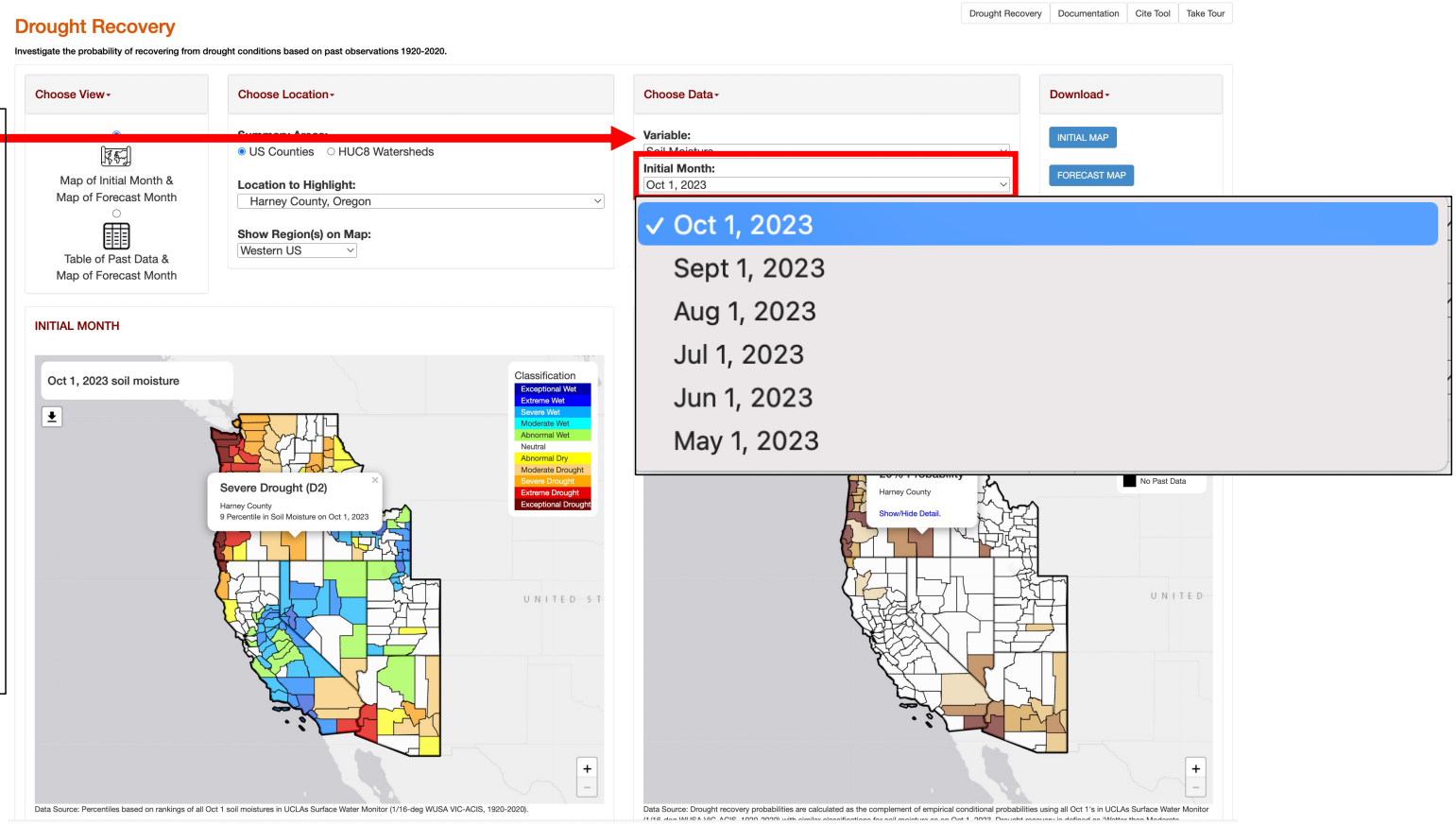
These metrics have good memory of drought conditions and are good indicators of agricultural & ecological drought



Drought Recovery Tool

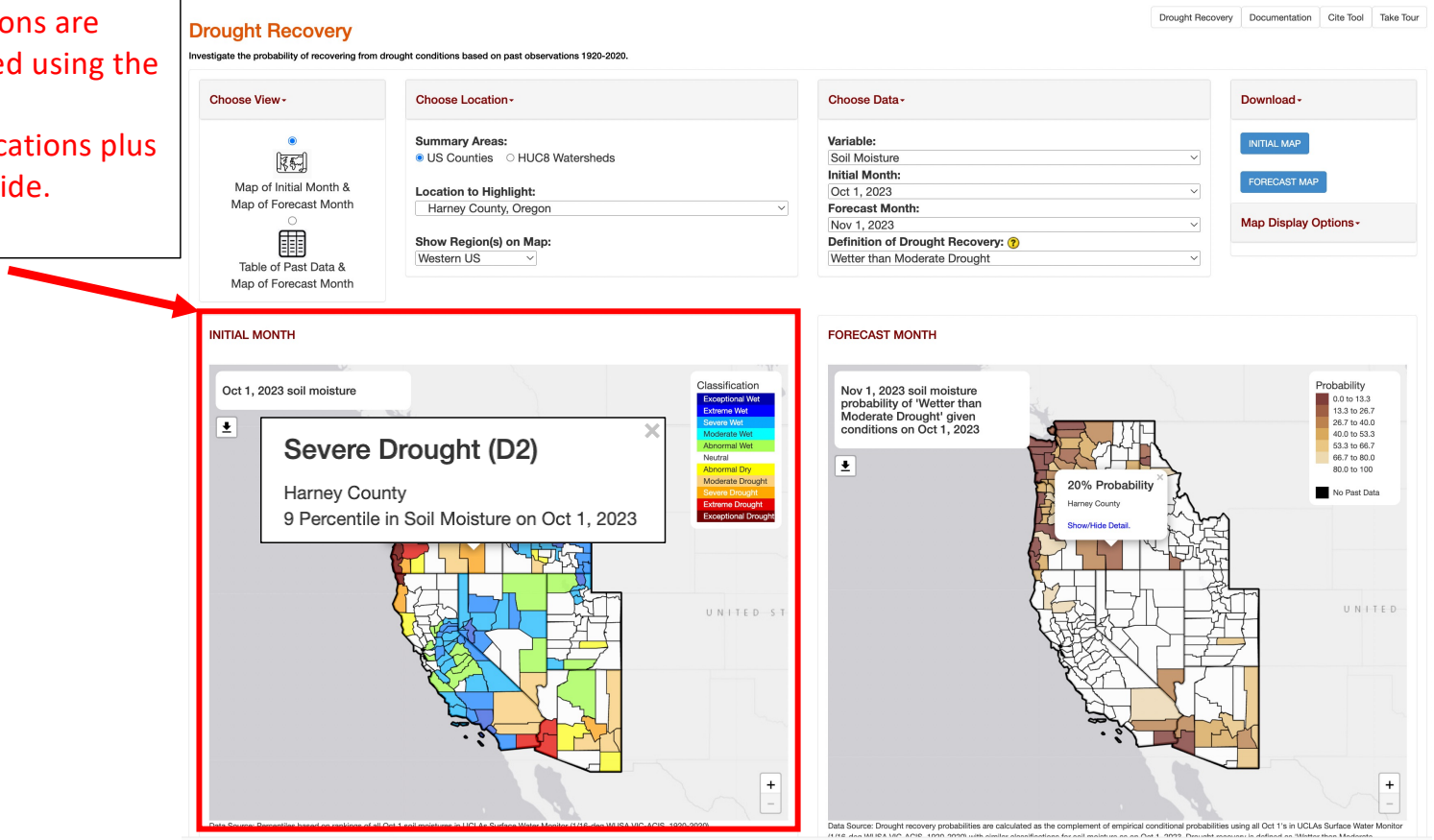
Users can look at current month or a previous month in the last 5 months.

Drought managers expressed to us their interest in looking back at data from previous months to understand how things are evolving.



Drought Recovery Tool

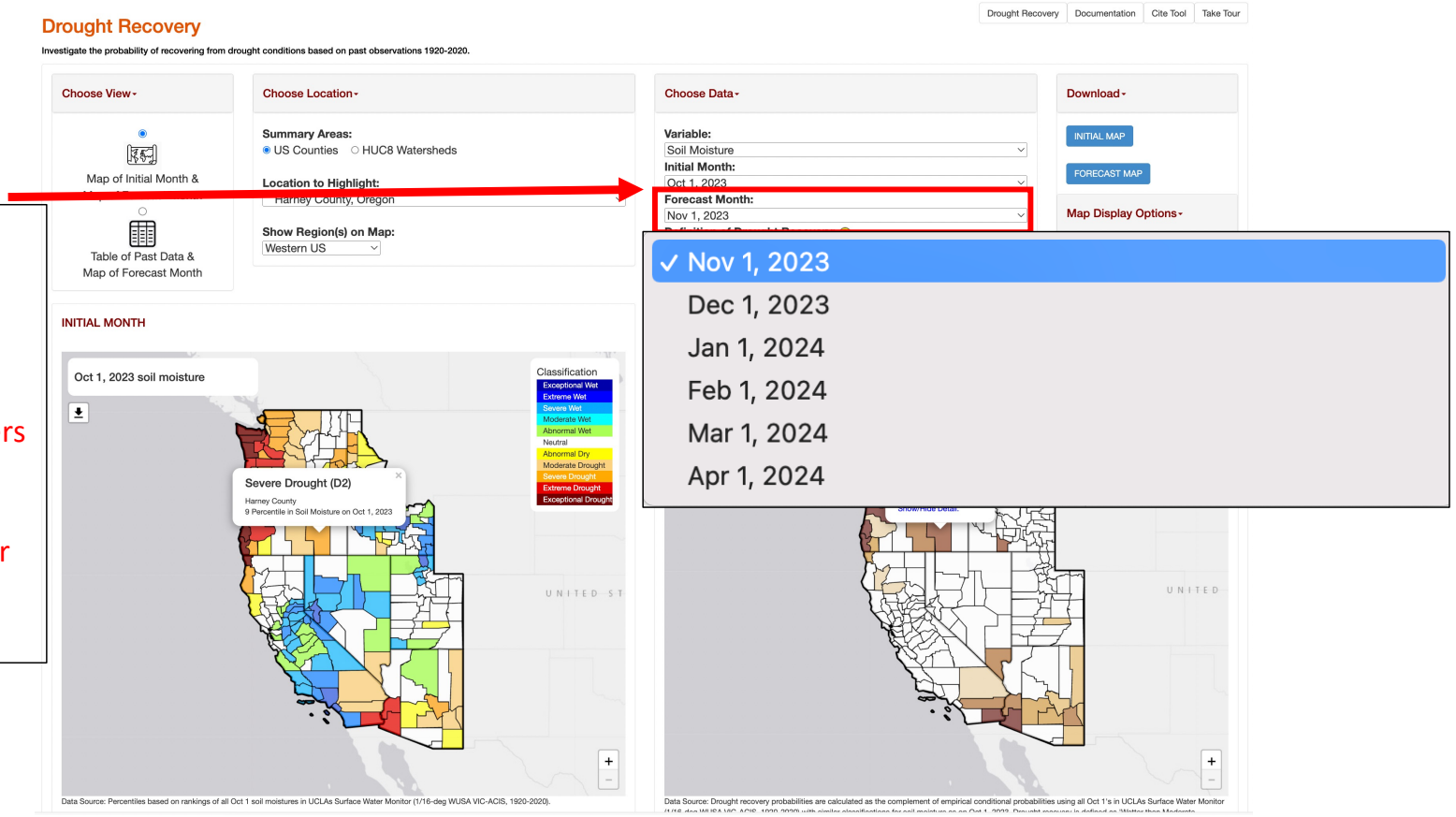
Current drought conditions are assessed using the USDM classifications plus a wet side.



Drought Recovery Tool

Users can look forward to months up to 6 months ahead.

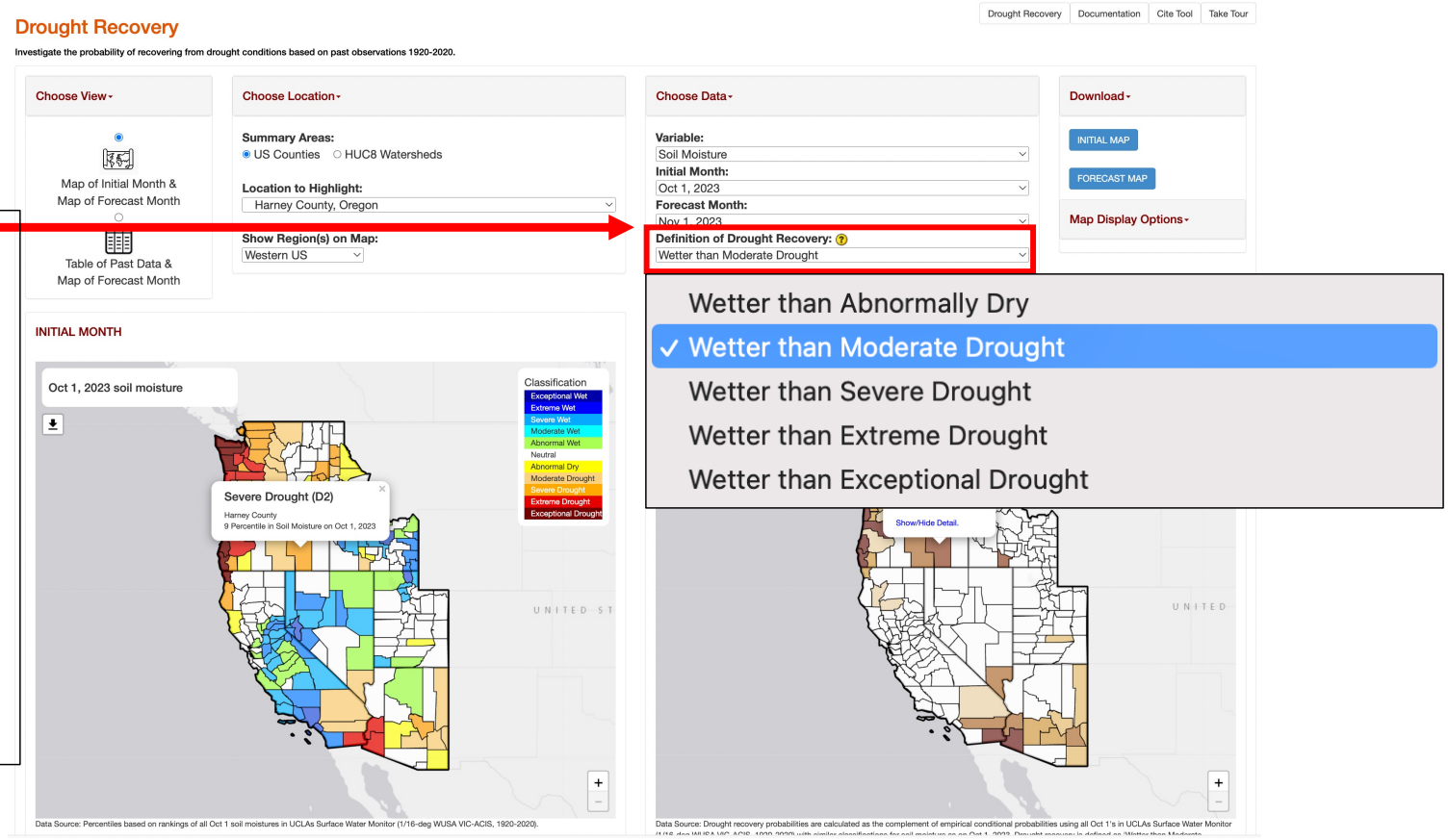
Drought managers are interested in certain target months for water demand.



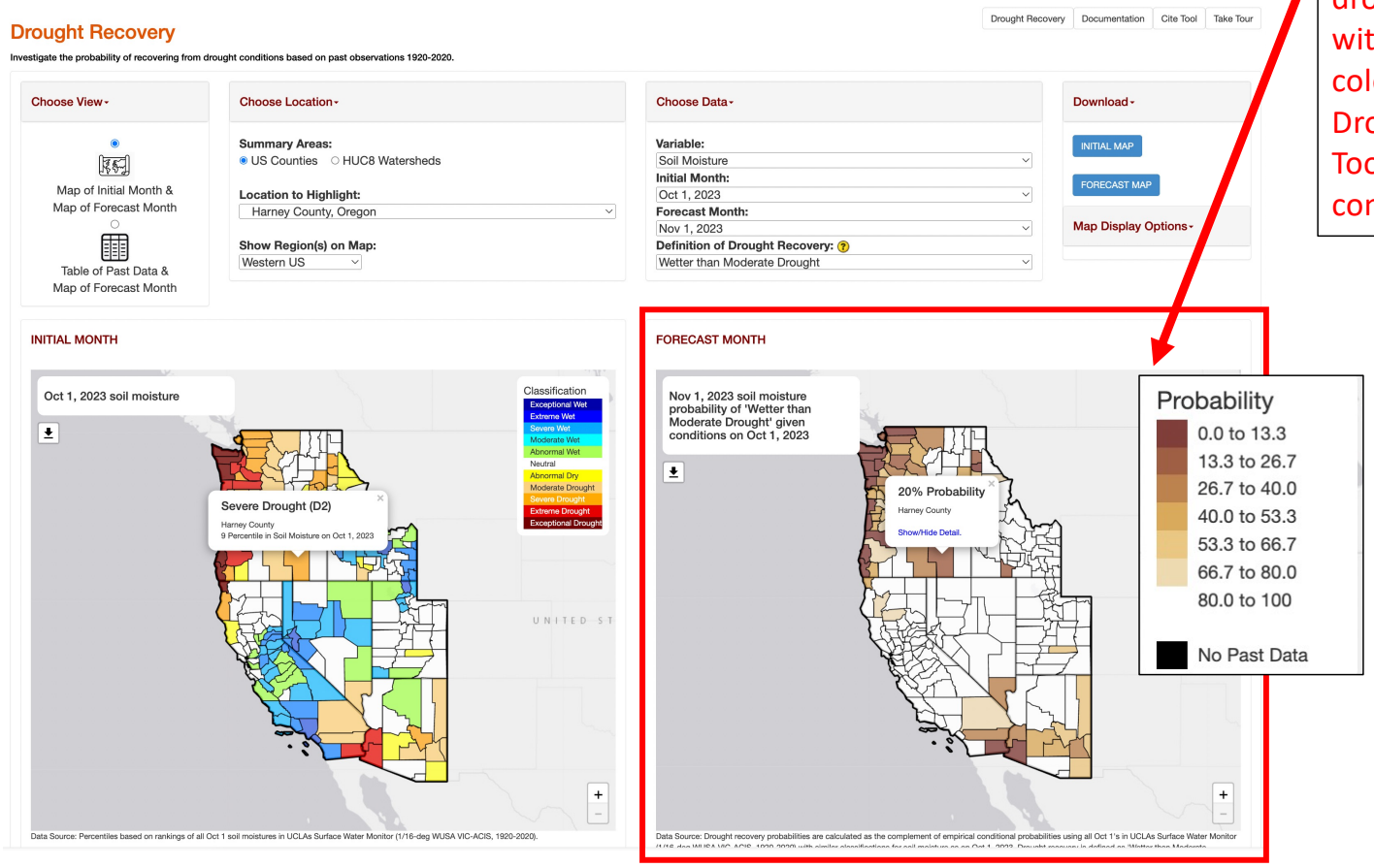
Drought Recovery Tool

Users can select the intensity of drought they are concerned with.

Drought managers have different thresholds for drought that will trigger decision making actions. This provides flexibility.

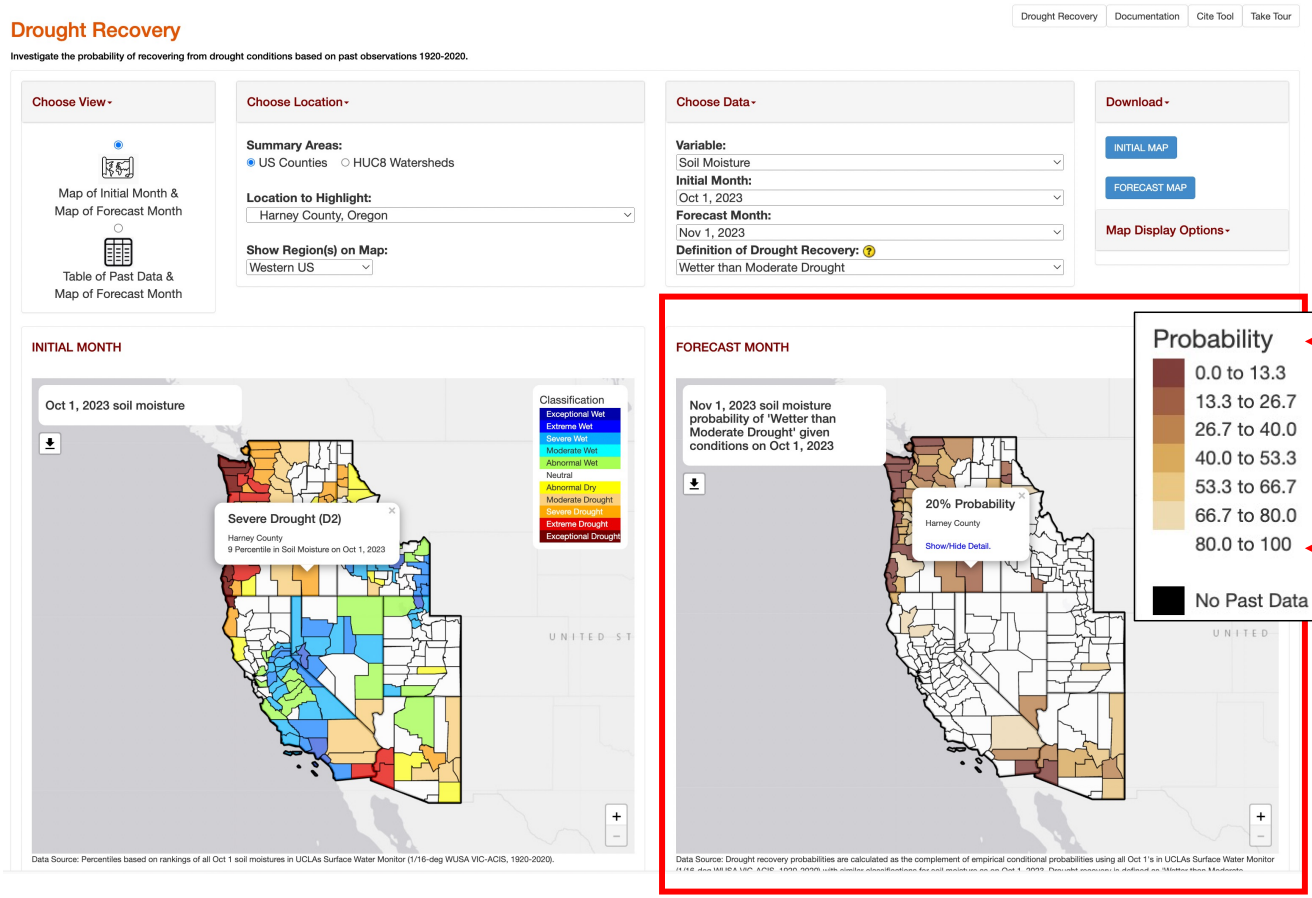


Drought Recovery Tool



Probabilities of no drought are shown with the same colors as NOAAs Drought Reduction Tool for consistency.

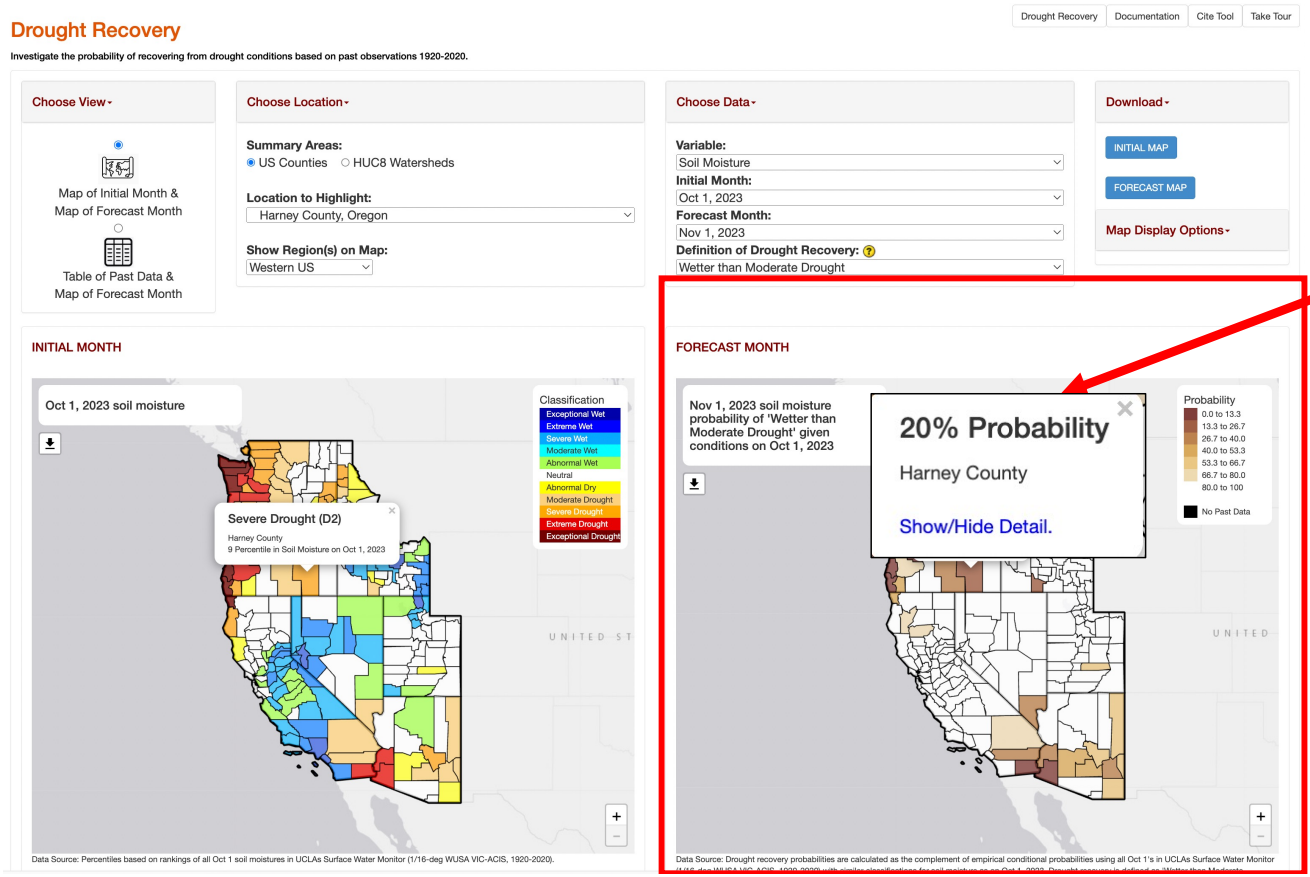
Drought Recovery Tool



Brown colors are where persisting (or new) drought is likely.

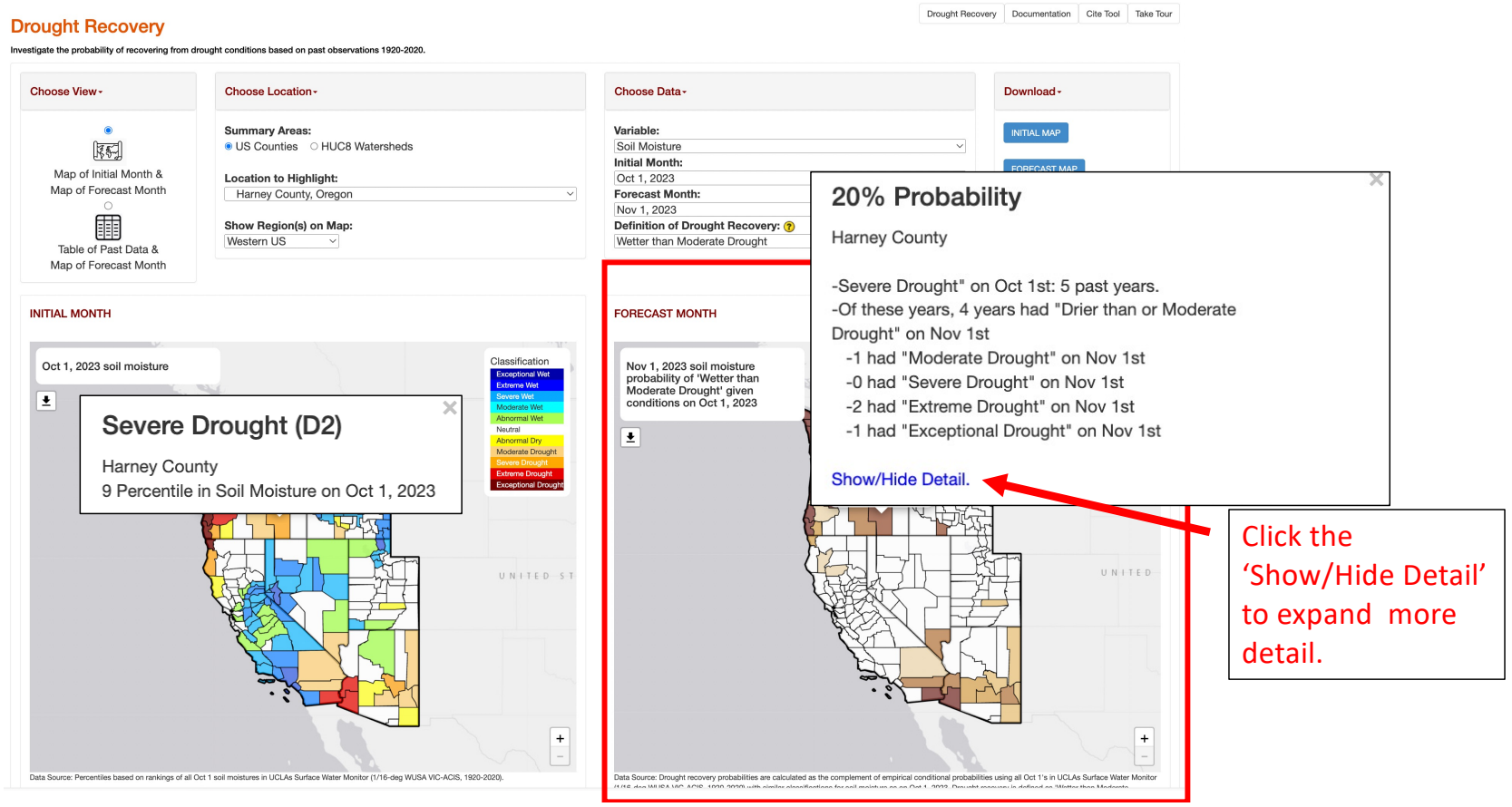
White colors are where no drought is likely.

Drought Recovery Tool



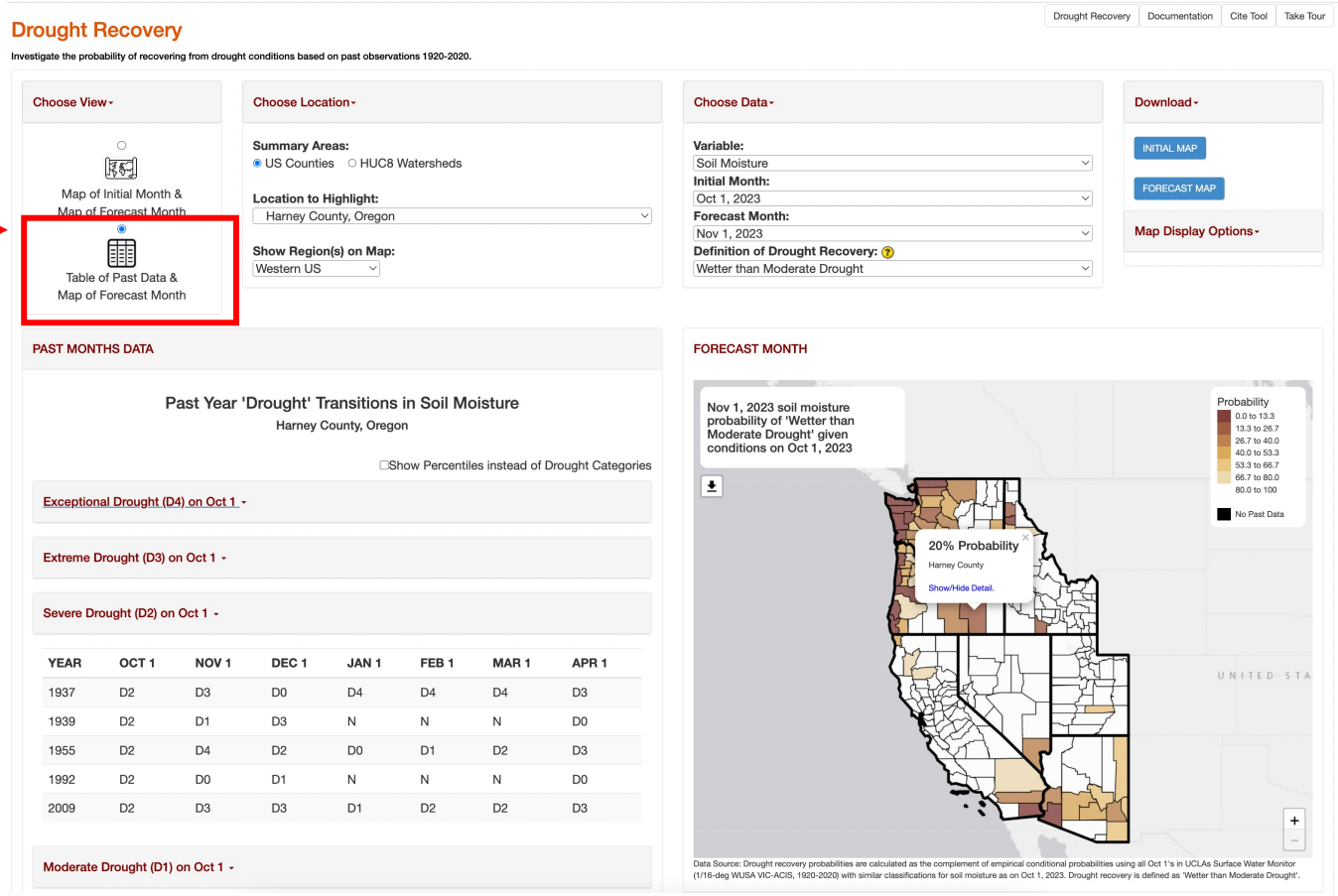
Popups show the probabilities for each region.

Drought Recovery Tool

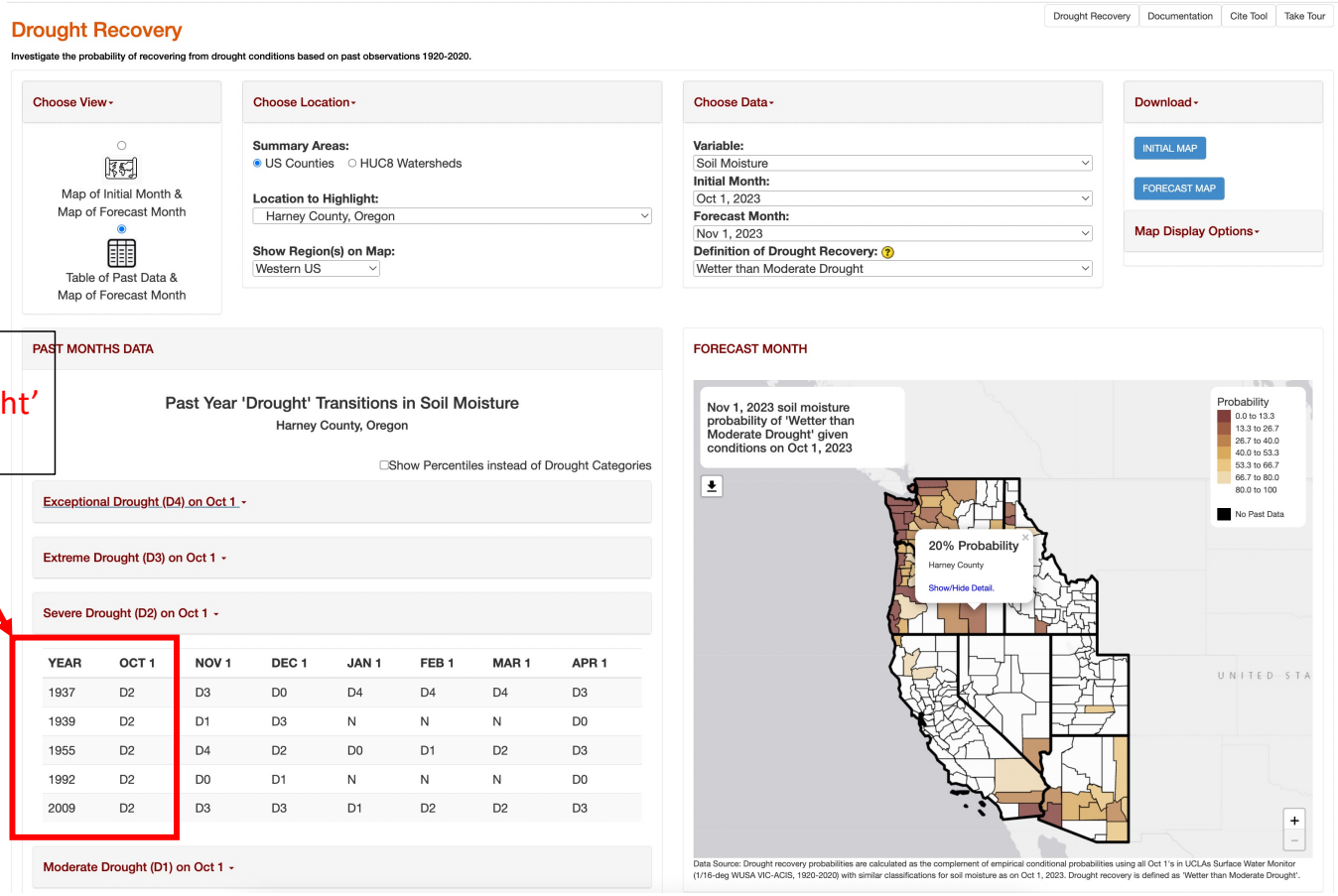


Drought Recovery Tool

You can explore the data with tables of past data.

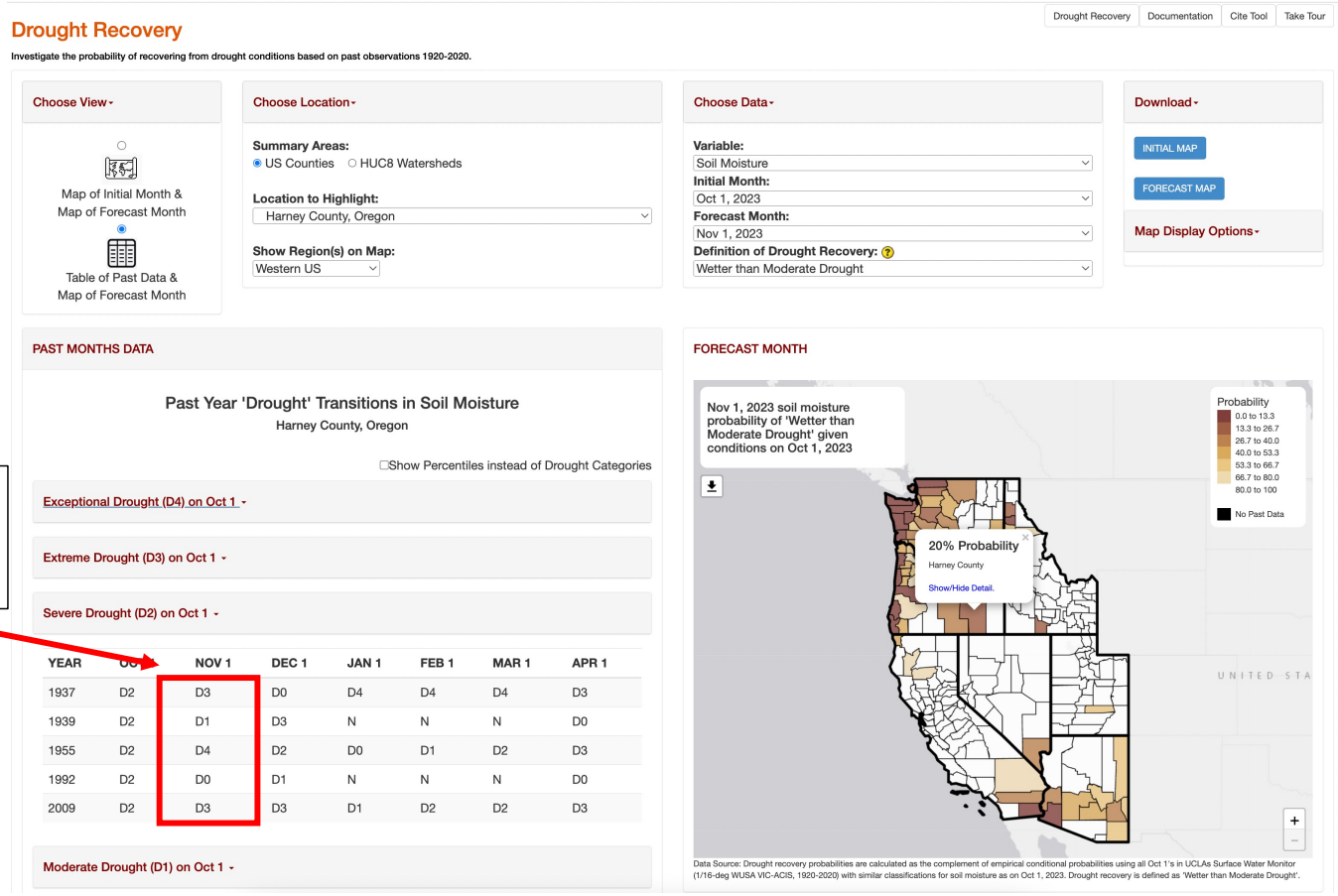


Drought Recovery Tool



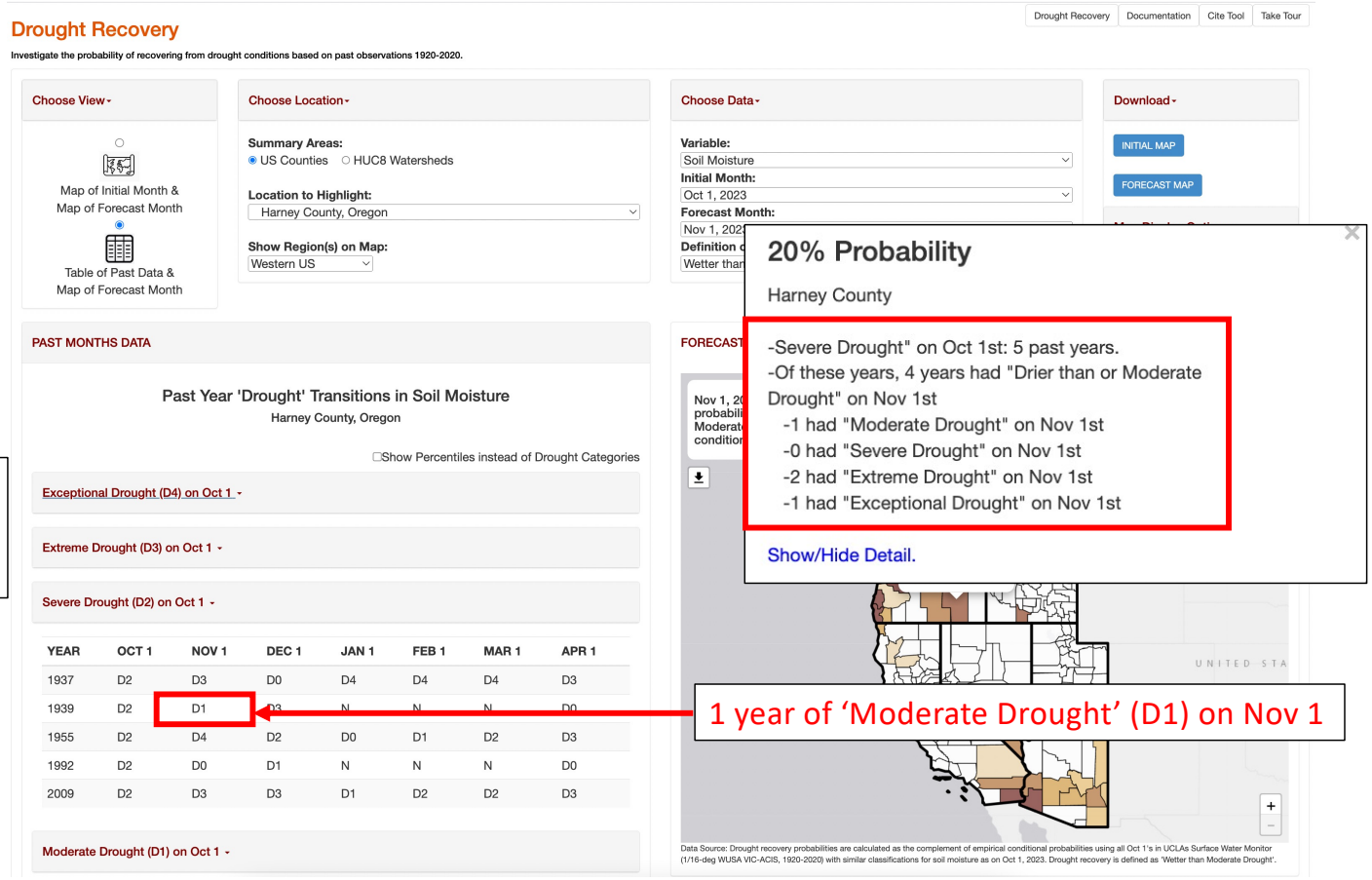
5 years of 'Severe Drought' (D2) on Oct 1

Drought Recovery Tool



What happened
In those years
on Nov 1

Drought Recovery Tool



What happened
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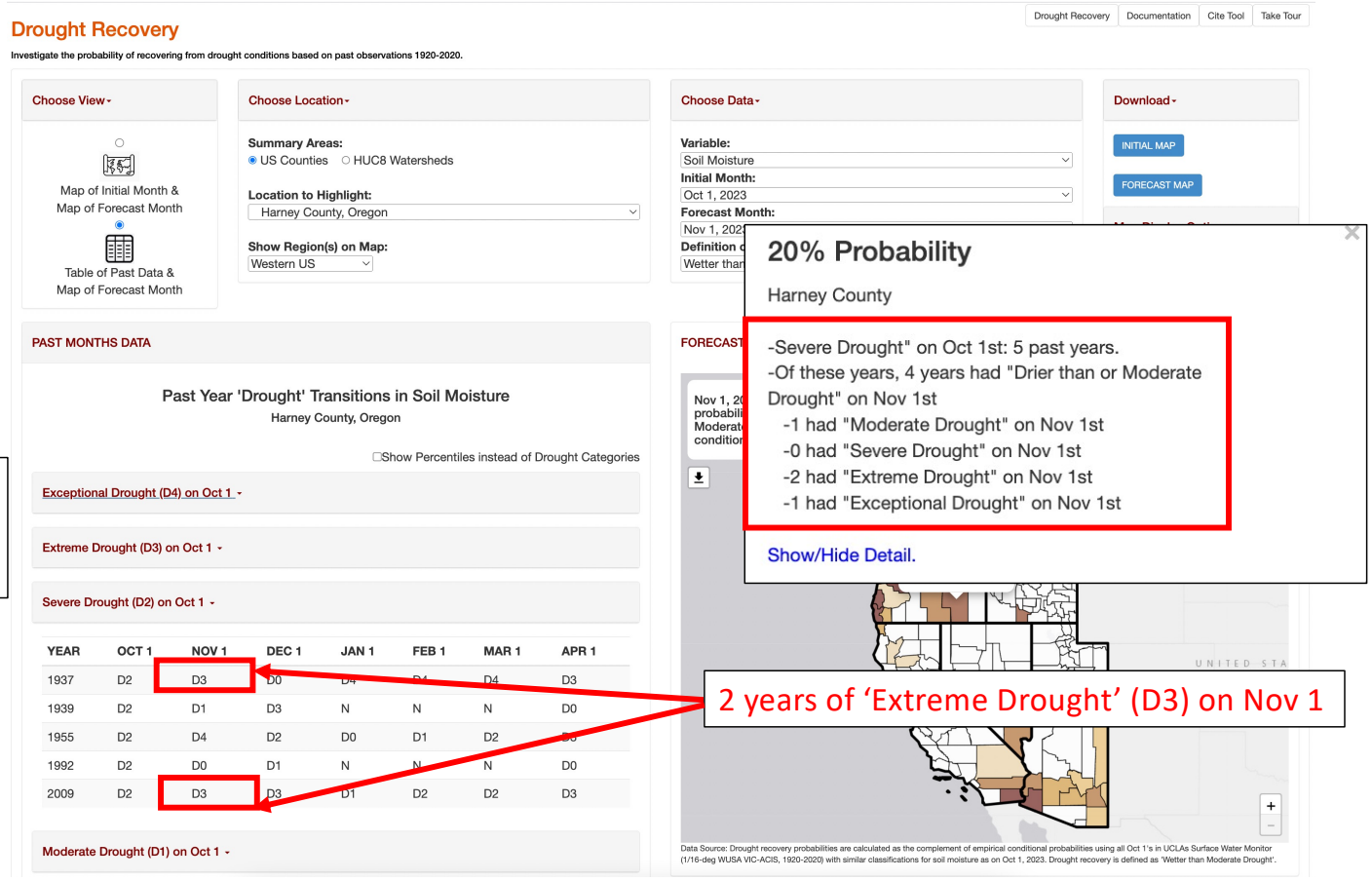
Drought Recovery Tool



What happened
In those years
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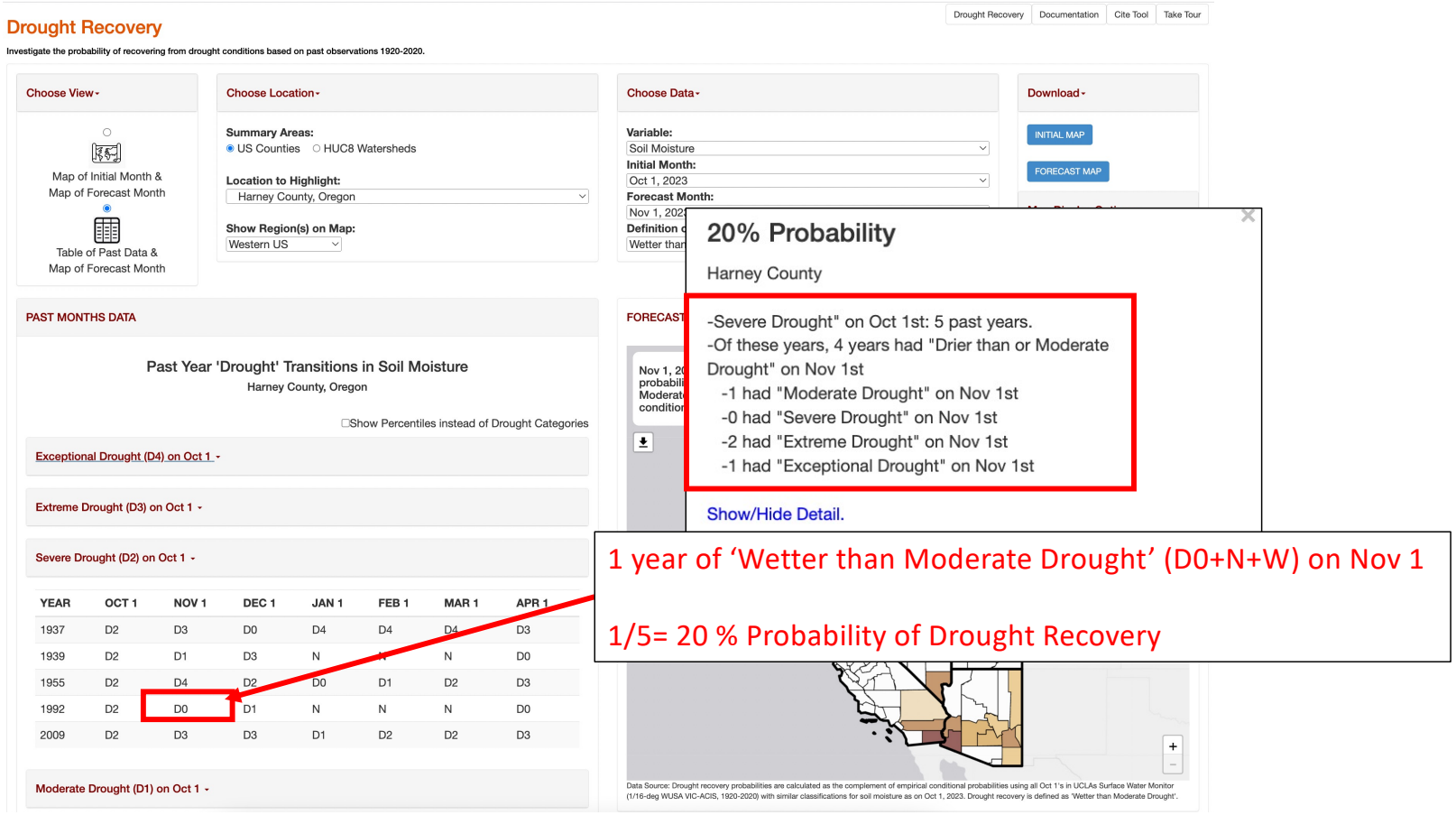
Drought Recovery Tool

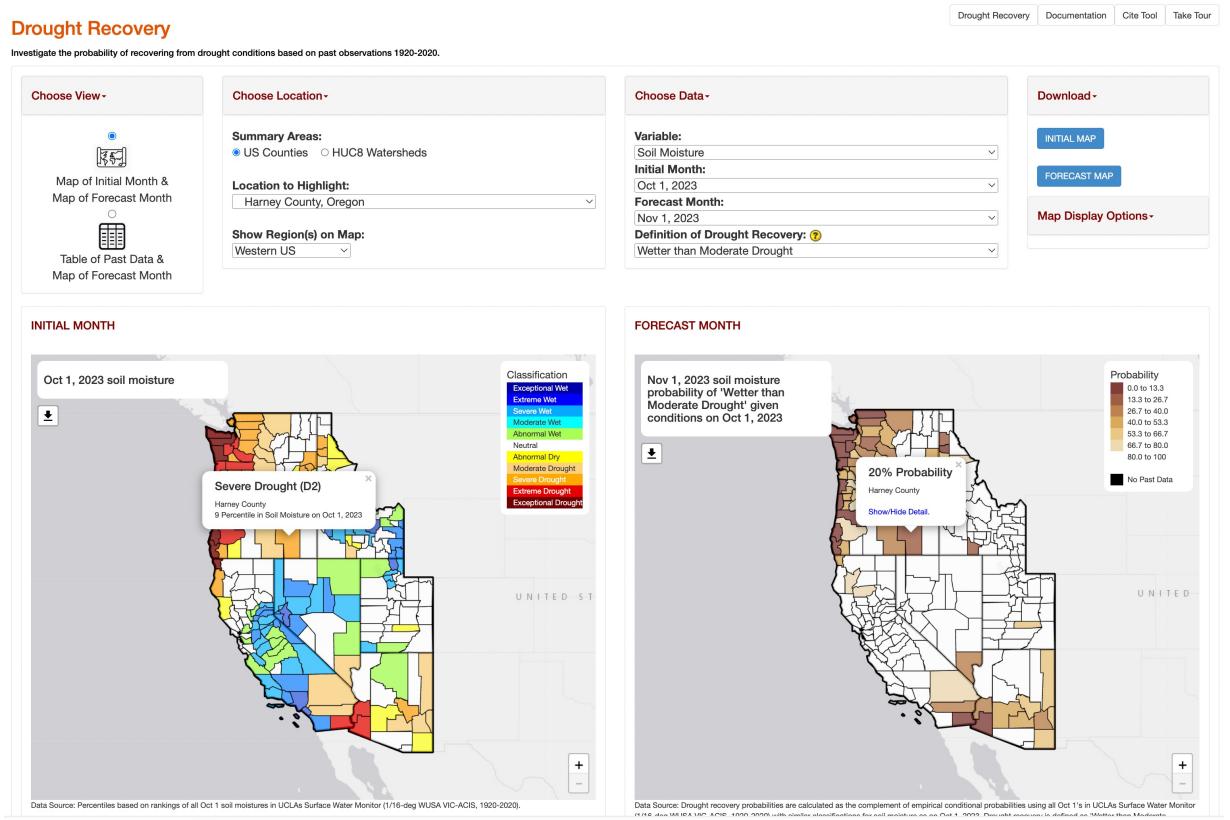


Conclusions

- The Climate Toolbox's Drought Recovery Tool is:
  - Applicable – data at scales useful for decisions
  - Flexible – several ways to tailor drought question
  - Interactive – more detail available through clicks or data views

The Climate Toolbox's Drought Recovery Tool

https://ClimateToolbox.org



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