NOAA/NCEI

Exploring Tools for Quantifying and Ameliorating Meteorological Drought

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Special Thanks

- National Integrated Drought Information System (NIDIS)
- Richard Heim, NOAA NCEI
- Russ Vose, NOAA NCEI
- Kevin Werner, NOAA NWS
- Mike Anderson, CA DWR
- Nina Oakley, DRI/WRCC
- Julie Kalansky, CNAP
- Alan Haynes, CNRFC
- Andrea Bair, NOAA NWS
- Alex Tardy, NOAA NWS
- NASA DEVELOP Program

Drought is Complicated

- Hydrological
  - Streamflow, reservoir stages, soil moisture
- Meteorological
  - Statistical deficits of rainfall
- Ameliorate or Terminate?
  - Ameliorate: recover to near normal
  - Terminate: end the drought

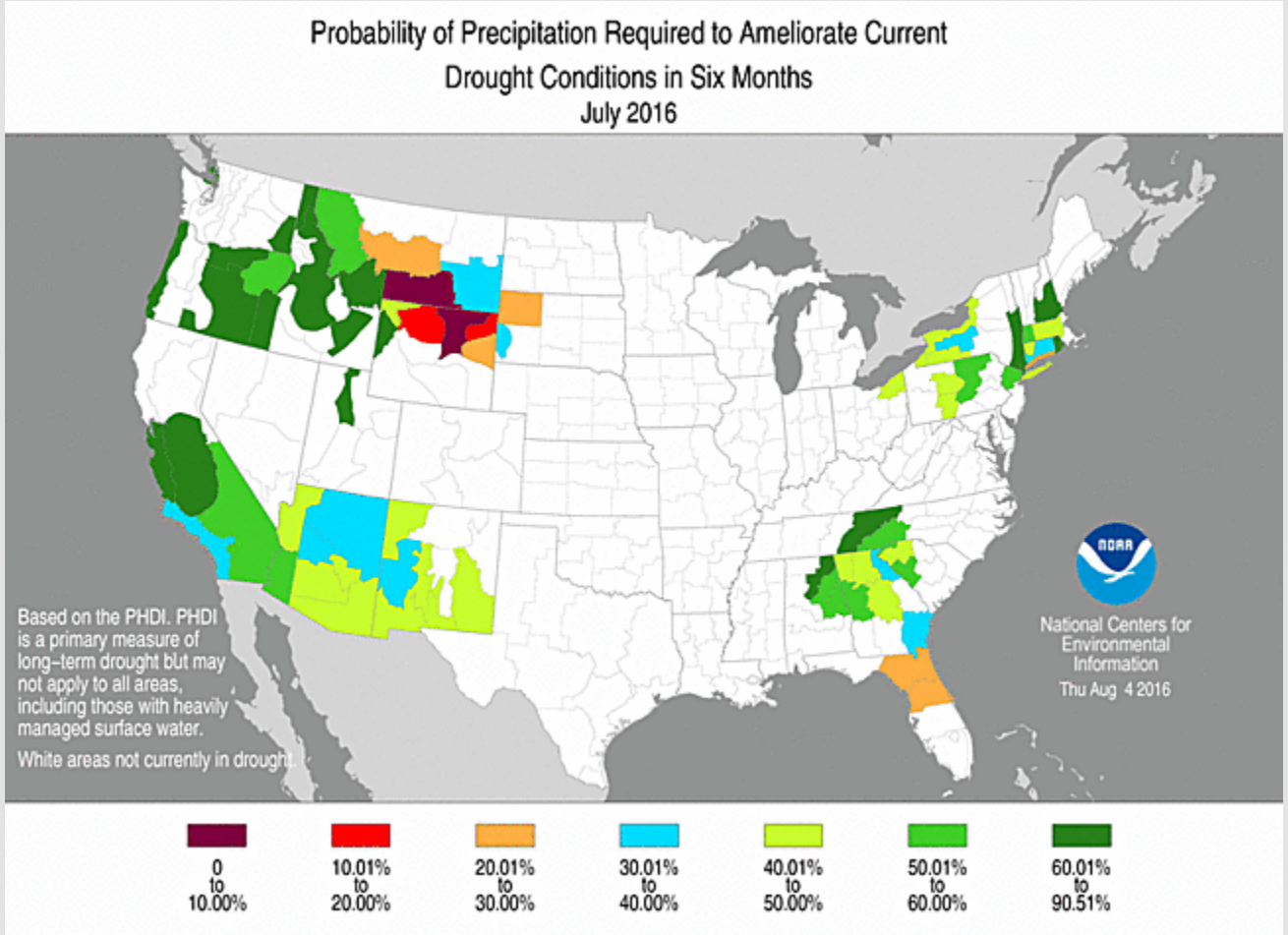
Drought is Complicated

- "Drought ends with a bang but begins with a whimper."
- Drought impacts can be far-reaching:
  - Potable water, agriculture, livestock, tourism, economic setback, etc.
- Complex hydrological processes and water management practices affect quantity of rain to end a drought.
- How much rain does it take to end the drought?

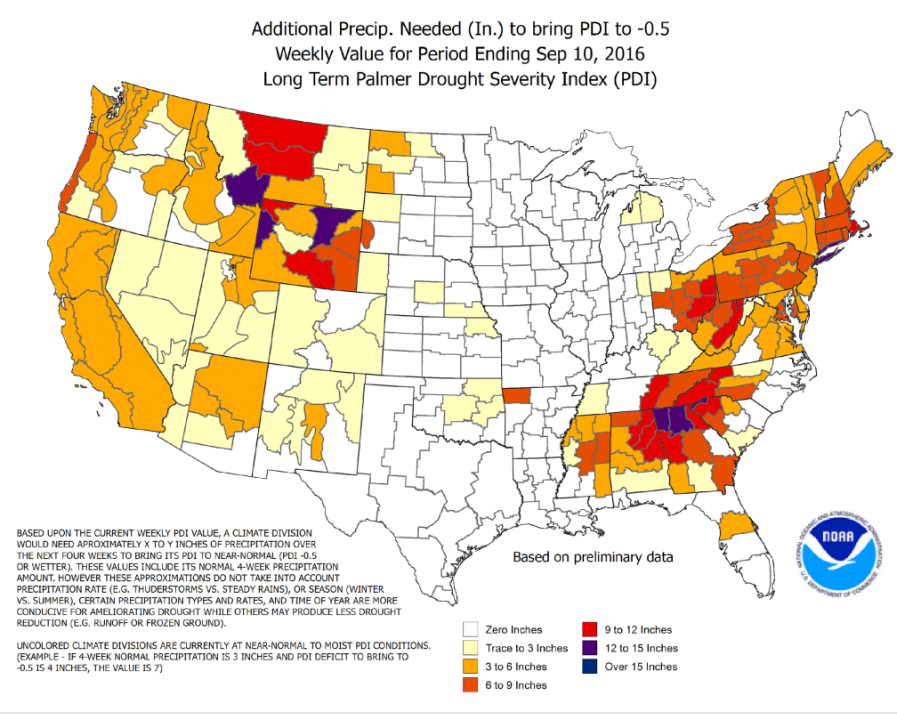
How Much Rain to End a Drought?

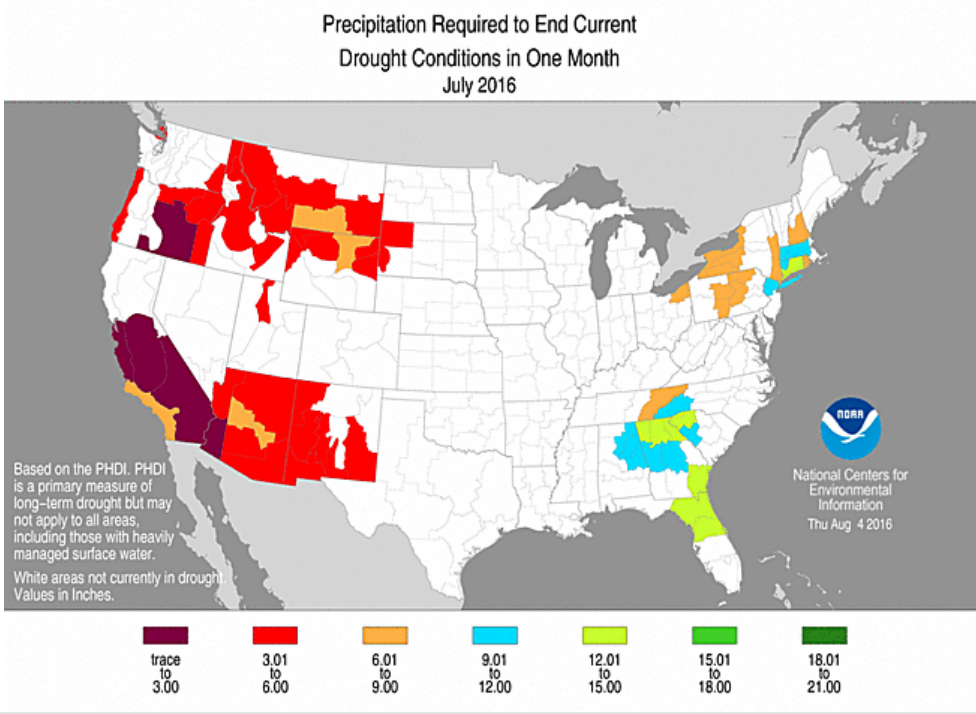
- Easy question, right?
- How does a climatologist determine the drought is over?
- How does <> determine the drought is over?
  - Water manager, Media, Political Leadership, Public
- Drought termination vs. drought recovery?

Ending the Drought?



But…But…But





Many ways to determine "how much rain must fall to end a drought."

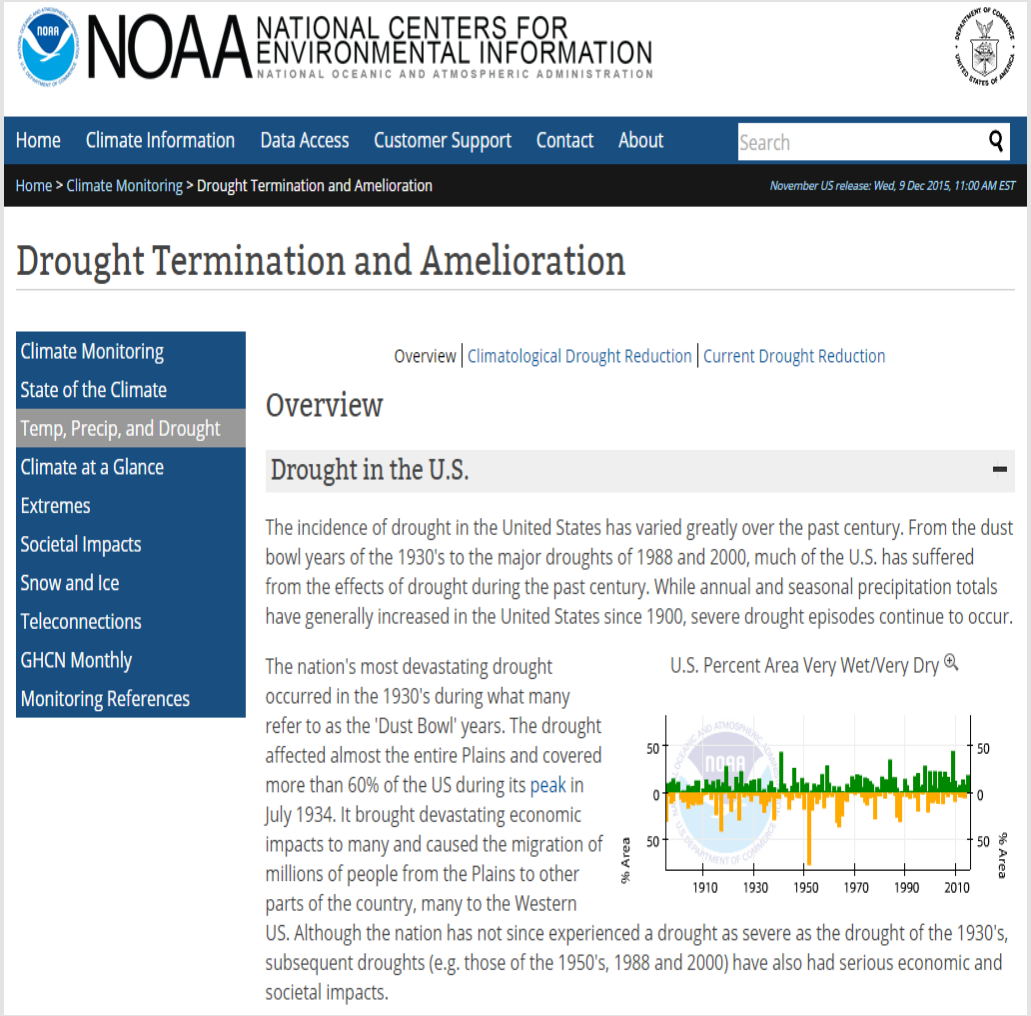
NOTE: products updated at different times scales – may miss ongoing or forecast storms.

Drought Amelioration Project Tasks

1. Reconcile product differences;
2. Assess and modify drought index to run daily;
3. Compare 5-station and 8-station indices against PDSI for California only;
4. Modify NCEI drought amelioration web page;
5. For the Cascades and Sierra Mountains, compare satellite-derived rainfall data against in-situ observations.

User-Engagement Workshop

- User-engagement workshop September 2015 in Irvine, CA.
  - Media, public, academia, water utilities, government, Weather Service
- Review existing drought recovery and termination tool.
  - Showcase other available tools.



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November US release: Wed, 9 Dec 2015, 11:00 AM EST

Drought Termination and Amelioration

- Climate Monitoring
- State of the Climate
- Temp, Precip, and Drought
- Climate at a Glance
- Extremes
- Societal Impacts
- Snow and Ice
- Teleconnections
- GHCN Monthly
- Monitoring References

Overview | Climatological Drought Reduction | Current Drought Reduction

Overview

Drought in the U.S.

The incidence of drought in the United States has varied greatly over the past century. From the dust bowl years of the 1930's to the major droughts of 1988 and 2000, much of the U.S. has suffered from the effects of drought during the past century. While annual and seasonal precipitation totals have generally increased in the United States since 1900, severe drought episodes continue to occur.

The nation's most devastating drought occurred in the 1930's during what many refer to as the 'Dust Bowl' years. The drought affected almost the entire Plains and covered more than 60% of the US during its peak in July 1934. It brought devastating economic impacts to many and caused the migration of millions of people from the Plains to other parts of the country, many to the Western US. Although the nation has not since experienced a drought as severe as the drought of the 1930's, subsequent droughts (e.g. those of the 1950's, 1988 and 2000) have also had serious economic and societal impacts.

U.S. Percent Area Very Wet/Very Dry

What did we ask?

- What information is needed to help decision-making?
- How do you see yourself using this tool?
- What products do you need that aren't available?
- What drought information is used for communication? Who is your audience?
- What other drought tools do you use and why?

What did we find?

- Drought termination much more important than drought recovery.
  - Question still stands: how much rain…?
- Voting results for top 3:
  - Workshop attendees requested regionally-relevant maps and legends.
    - Climate division scale too big
  - NOAA should collect all drought recovery tools into simplified dashboard.
    - Water Resources Monitoring Outlook (WRMO)
  - A single drought index to rule them all
    - Too many varying answers to the same question.

Reconciliation

Drought Recovery Tools

- Climate Monitoring
- State of the Climate
- Temp, Precip, and Drought
- Climate at a Glance
- Extremes
- Societal Impacts
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Overview | Why It's Hard to Estimate Precip Needed to End Drought | Differences between Tools | Links

Differences between Drought Recovery Tools

The basic root cause of a drought is lack of precipitation, so the early drought indices were largely someway of measuring or expressing the precipitation deficit and included such indices as precipitation deficit, percent of normal, or number of days since the last significant rain. Beginning with the Palmer Index in the 1960s, more sophisticated drought indices and models were developed which incorporate a measure of water supply (usually precipitation), water demand (usually evapotranspiration based on temperature), and water storage (a soil moisture, reservoir, or snowpack component) and which address the integrated total moisture status.

Precipitation Deficit — One of the simplest tools and easiest to understand, the precipitation deficit simply tells you how far behind normal the precipitation that has fallen is. The longer a drought lasts and more severe it is, the greater the precipitation deficit. In order to recover from a drought, one needs to get the normal precipitation plus enough precipitation beyond normal to erase the deficit. Comparing the amount of precipitation that has fallen to the historical precipitation record allows you to compute its historical rarity (sometimes expressed as a percentile). Comparing the size of the precipitation deficit (how much precipitation is needed to recover) to the historical record allows you to compute the probability of getting the needed precipitation (the probability of ending the drought), based on the climatological record. Tools based solely on the amount of precipitation don't take into account the form of precipitation (rain vs. snow) or other components of the hydrologic system (such as soil moisture, reservoirs, groundwater, etc.).

Multi-Station Indices — The California Department of Water Resources uses a *5-Station Index for San Joaquin precipitation*, an *8-Station Index for Northern Sierra precipitation*, and a *6-Station Index for Tulare Basin precipitation*. These are high-elevation stations located in the headwaters of these regions. Cumulative daily and monthly totals of precipitation are computed and compared to normal as well as to historical dry and wet years. These multi-station indices deal with just precipitation, they don't take into account the form of precipitation (rain vs. snow) or other components of the hydrologic system (such as soil moisture, reservoirs, groundwater, etc.).

Workshop participants requested that NCEI include a description of the differences between the varying drought recovery tools, drought indices, and use case scenarios.

This gateway page is in direct response to that request.

http://www.ncdc.noaa.gov/temp-and-precip/drought/recovery-tools/

National Aeronautics and Space Administration

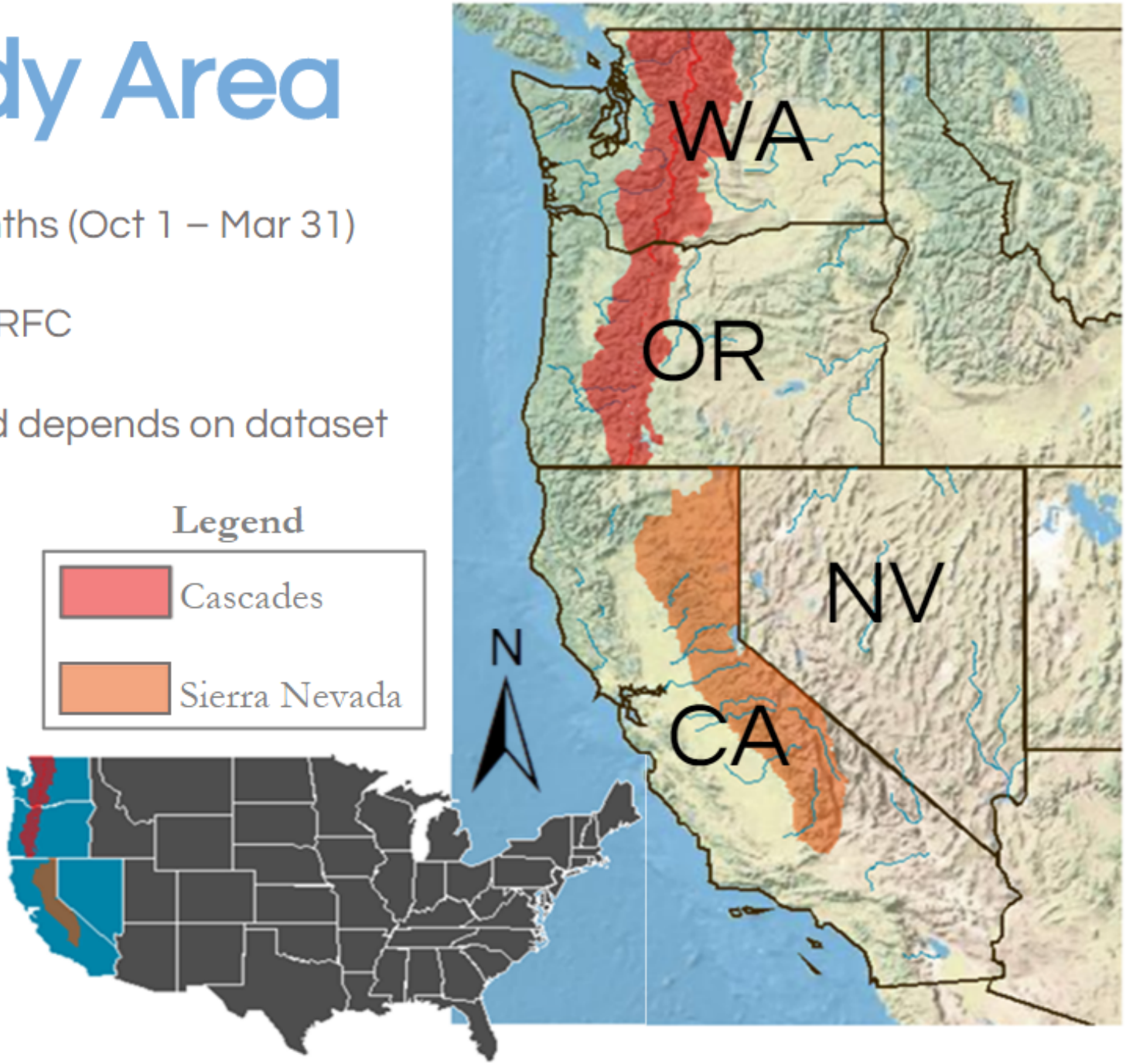
Cascade & Sierra Nevada Mountains Water Resources

A Comparison of Remotely-Sensed Climate Data Records for Improved Climate Monitoring

Sam Swanson (Project Lead) Kevin Rapa

Study Area

- Winter Months (Oct 1 – Mar 31)
- Divided by RFC
- Time period depends on dataset

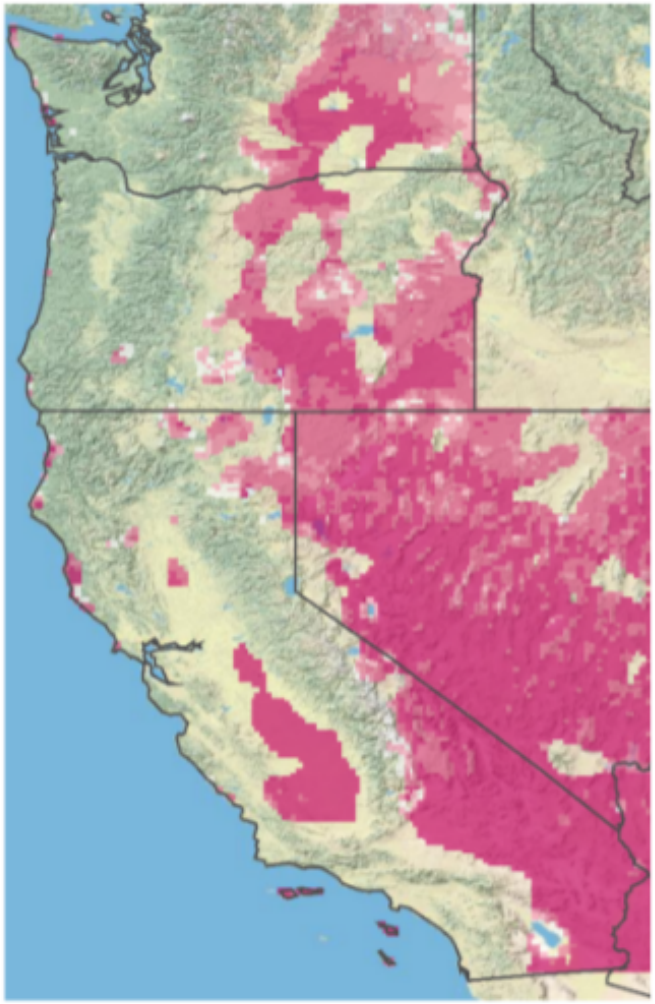


Results

CMORPH Benefits

GHCN Densities

Combined Benefits



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Pink areas most likely to "benefit" from satellite-derived rainfall estimates.

Magnitude of difference Between CMORPH and PRISM

- 0.00 - 0.56 mm/day
- 0.57 - 1.11 mm/day
- 1.12 - 1.67 mm/day
- 1.68 - 2.23 mm/day
- 2.24 - 2.79 mm/day

Future Work

- Based on feedback, there are 3 primary "wants":
  1. The science community should develop a new drought index that accounts for complex water delivery systems in California;
  2. NCEI should update its drought recovery web tool to incorporate existing climate outlooks for precipitation and temperature;
  3. Consolidate drought recovery tools. With so many agencies rolling out tools, they are often disparately located and contain conflicting information.

Welcome to Phase 2

- Collaborators submitted new proposal to address these wants → Phase 2 project begins October 1.
  1. Improve drought termination outlooks.
     a) Use existing seasonal outlooks to produce “future PHDI” maps.
  2. Enhance NCEI drought amelioration web page.
     a) Daily maps, future maps, regional, grids
  3. Circle-back with users
     a) Science experts will also gather to discuss “one index.”
     b) Review enhancements, determine what else is needed.
  4. Promote and deliver drought termination products to the Water Resources Monitoring and Outlook program.

Take Home Points

- User-engagement critical to success of the project and identifying project requirements.
- Drought termination much more important than drought amelioration.
- Drought indices need to be more current - incorporate recent storms.
- New project will begin in October 2016 to address evolving user requirements.