

RECLAMATION

Managing Water in the West

Sub-Seasonal Climate Forecast Rodeo

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U.S. Department of the Interior
Bureau of Reclamation

Bureau of Reclamation

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

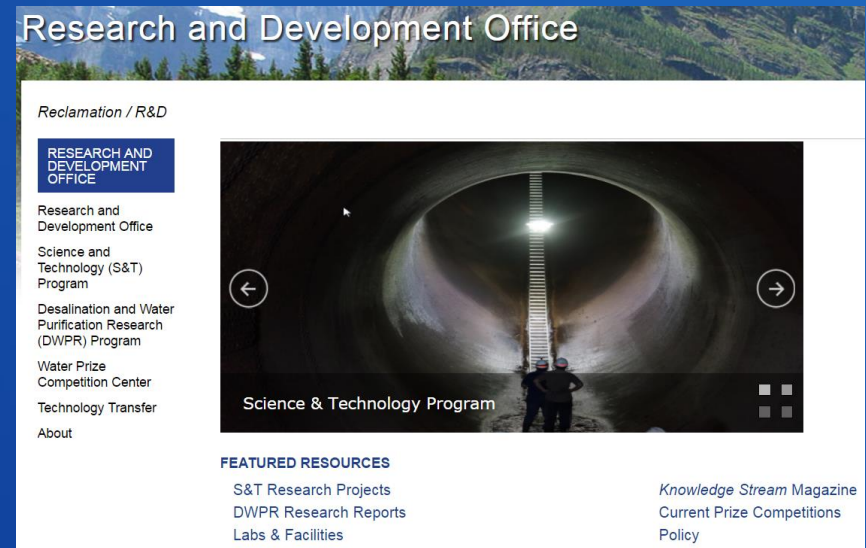
- **Manage water in 17 western states**
- **Operate 337 reservoirs**
- **Largest wholesaler of water in the country; provides 1 out of 5 Western farmers with irrigation water for 10 million farmland acres**
- **Second largest hydropower producer; 53 hydroelectric powerplants providing 14000+ MW capacity; generate enough electricity to power 3.5M U.S. homes**



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Bureau of Reclamation Research & Development (R&D) Office

- **Science and Technology Program**
 - R&D Projects
 - Water Prize Competition Center
 - Technology Transfer
- **Desalination and Water Purification Program**



<https://www.usbr.gov/research/>

[Knowledge Stream Magazine](#)

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R&D Customers

- Primary: Reclamation resource and facility managers, customers, and stakeholders.
- Secondary: As federally funded R&D Office, we serve the broader communities of practice in water and water-related resources and the U.S. public.

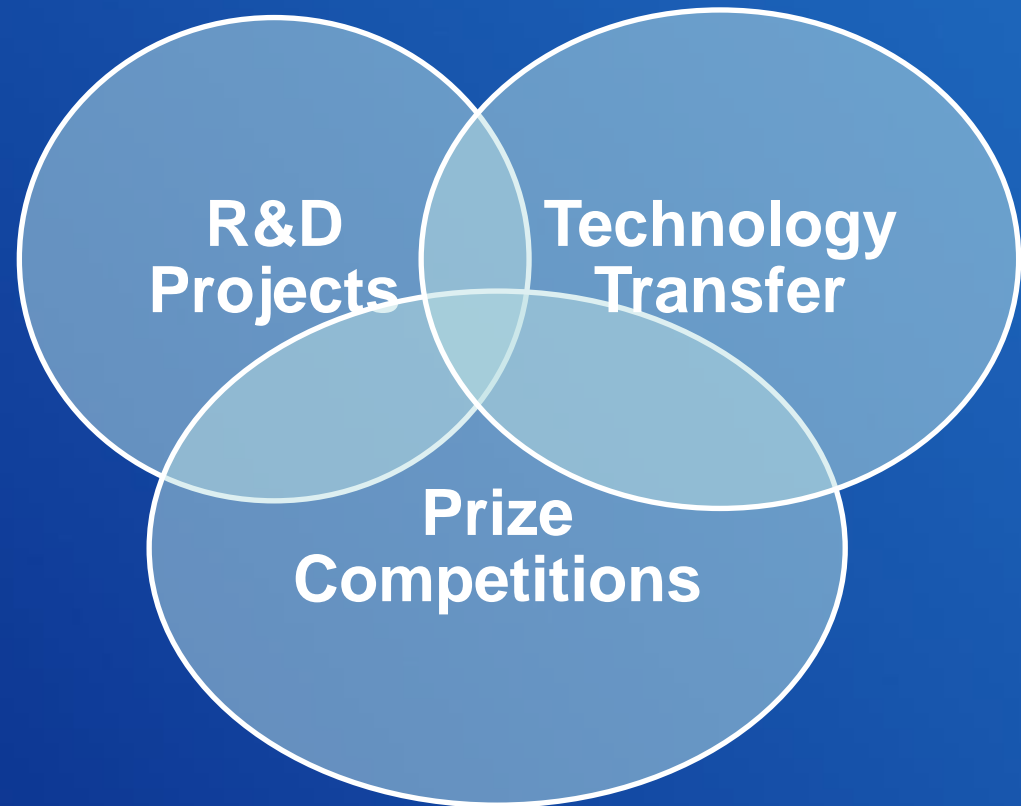
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S&T Program Goals and Tools

Goals

- Develop cost-effective solutions for technical and scientific problems
- Partner with other research entities
- Build and strengthen scientific and engineering capacity for Reclamation
- Communicate solutions to Reclamation offices, other water and power management officials, and the general public

Tools



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Presentation Overview

- Prize Competitions 101
- Sub-Seasonal Forecasting
- The “Rodeo”

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What are Prize Competitions?

Prize competitions are a form of crowd sourcing and a way to reach a broader group of thinkers to address difficult topics.



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How Competitions Work

- Issue a national challenge to solve a specific, typically difficult problem.
- Establish monetary and/or non-monetary incentive prizes.
- Winners must achieve predetermined performance metrics established by sponsors.
- Anyone can compete at their own risk.

R&D Water Prize Competition Center



The screenshot shows the Reclamation Research and Development Office website. The header features the Reclamation logo with the tagline "Managing Water in the West" and a search bar. A navigation menu includes links for Water & Power, Resources & Research, About Us, Recreation & Public Use, and News & Multimedia. The main banner displays a mountain landscape with the text "Research and Development Office". Below this, the breadcrumb trail reads "Reclamation / R&D / Water Prize Competition Center". The left sidebar contains a "RESEARCH AND DEVELOPMENT OFFICE" header, followed by links to the Research and Development Office, Science and Technology (S&T) Program, Desalination and Water Purification Research (DWPR) Program, and the Water Prize Competition Center. The Water Prize Competition Center section is highlighted, showing a "Current" link and an "Upcoming" link. The main content area has the heading "Water Prize Competition Center" and the subheading "Share your expertise and ideas!". It contains two paragraphs: "You can help solve some of the most critical water and water-related resource problems facing our Nation." and "You can also help us think of problem topics especially well-suited to solve through prize competitions. Review the [Prize Competition Candidate Topics](#) to learn more about Reclamation's problem spaces." Below this is a section titled "Follow Reclamation's Competitions".

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Managing Water in the West

Search

Water & Power | Resources & Research | About Us | Recreation & Public Use | News & Multimedia

Research and Development Office

Reclamation / R&D / Water Prize Competition Center

RESEARCH AND DEVELOPMENT OFFICE

Research and Development Office

Science and Technology (S&T) Program

Desalination and Water Purification Research (DWPR) Program

Water Prize Competition Center

Current

Upcoming

Water Prize Competition Center

Share your expertise and ideas!

You can help solve some of the most critical water and water-related resource problems facing our Nation.

You can also help us think of problem topics especially well-suited to solve through prize competitions. Review the [Prize Competition Candidate Topics](#) to learn more about Reclamation's problem spaces.

Follow Reclamation's Competitions

<https://www.usbr.gov/research/challenges/index.html>

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Sub-Seasonal Forecasting – Relevance to Reclamation

During the past eight years, every state in the Western United States has experienced drought that has affected the economy both locally and nationally through impacts to agricultural production, water supply, and energy.

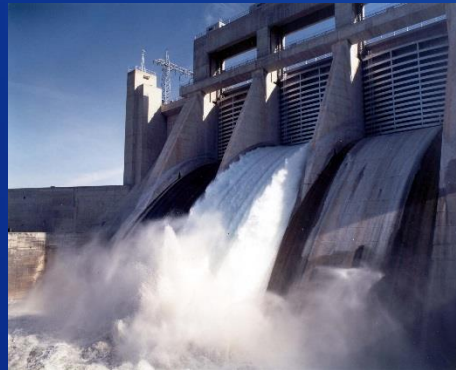
Improved sub-seasonal forecasts for temperature and would allow water managers to better prepare for shifts in hydrologic regimes, such as the onset of drought or occurrence of wet weather extremes.

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Sub-Seasonal Forecasting – Relevance to Reclamation

In addition to managing for drought, improved sub-seasonal forecast would enhance other aspects of Reclamation's operations including:

- Water Allocations
- Flood Management
- Stakeholder Planning
- Environmental Compliance



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Forecast Rodeo

A year long, real-time sub-seasonal forecasting competition



WATER
PRIZE COMPETITION CENTER

\$800,000 in prize \$\$\$!

**Saddle up
for the
Sub-
Seasonal
Climate
Forecast
Rodeo!**

March 2, 2016 Forecast (in) .01 .10 .25 .50 1 2 3 4 5 7.5 10 15

Map showing forecast precipitation across the Western United States, with major cities labeled: Seattle, Spokane, Portland, Boise, Billings, Bismarck, Rapid City, Medford, Salt Lake City, Cheyenne, Reno, Sacramento, San Francisco, Fresno, Las Vegas, Denver, Los Angeles, Phoenix, San Diego, Tucson, El Paso, Albuquerque, and Am.

usbr.gov/research/challenges

Competition Sponsor: **RECLAMATION**
Managing Water in the West

Competition Partners: NOAA, US Army Corps of Engineers, USGS

- Genesis: Drought
 - Definition
 - Agricultural
 - Meteorological
 - Hydrological
 - Others
 - Common Ground
 - Temperature
 - Precipitation
- Objectives
 - Advance Science
 - Raise Awareness
 - Provide Evaluation Platform

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Competition Partners



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Forecast Rodeo – Design, Refereeing and Communication

- **Design**
 - Input from numerous organizations (NOAA, USGS, USACE, USDA, BOR, CA DWR)
- **Refereeing & Communication**
 - NOAA CPC providing obs datasets for forecast skill evaluation and also the CFSv2 as a benchmark (post-processed for bias and regressed to competition template)
 - NOAA ESRL providing damped persistence benchmark, has set up the forecast skill assessment apparatus, and is developing the forecast visualization products and stats that are being served at the NIDIS leaderboard.
 - NIDIS – set up web portal for competition information, including Leader Board, articles, etc.

Forecast Rodeo Structure

- Forecasts
 - Resolution: a 1x1 grid
 - Variables: Temperature and Precipitation
 - Outlooks: Weeks 3&4 and 5&6
 - Frequency: 2 Weeks
 - Duration: 13 Months
 - Domain: 17 Western States
- Benchmarks
 - CFSv2 (32 member ensemble)
 - Damped persistence
- Schedule
 - Announced: Dec 12, 2016
 - Pre Season: Mar 21, 2017
 - Regular Season: Apr 18, 2017
 - Final Submission: May 3, 2018
 - Winners Announced (est): Sep 8, 2018



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Forecast Rodeo Structure

- Final Submission
 - Code
 - Documentation
 - Hind-Cast*
- Scoring
 - Spatial Anomaly Correlation
 - Drought.gov Leader Board
- Prizes
 - 4 Forecast Categories
 - 1st: \$100,000
 - 2nd: \$50,000
 - 3rd: \$25,000
 - An additional \$25,000 prize may be awarded per category based on hind-cast performance solely

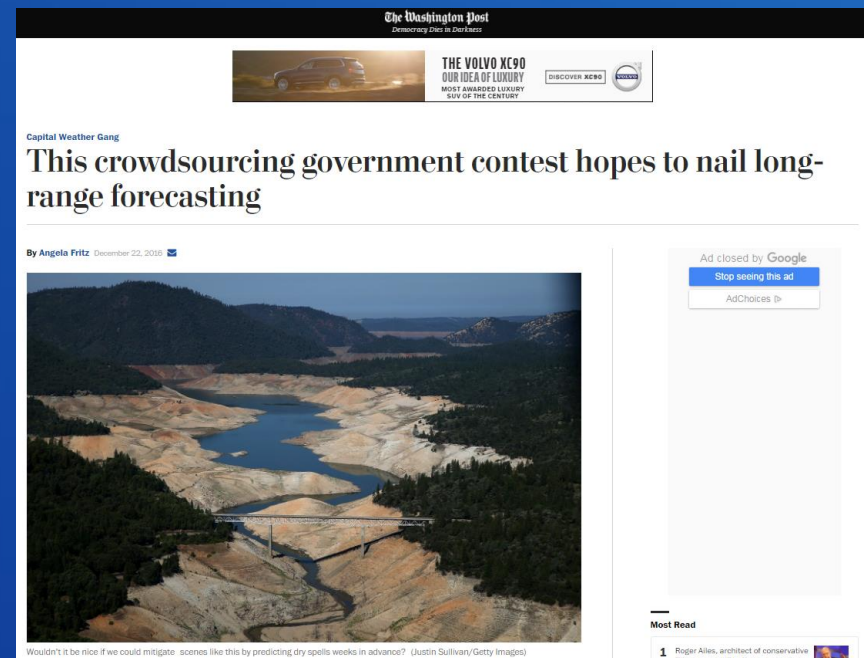


*Hind-cast is period is 1999-2010. Performance must be equal to or better than the CFSv2 to be eligible for prizes.

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Recruiting Solvers, Building Interest

- Media Release
- WSWC Newsletter
- Social Media (BOR, NIDIS, CBRFC, AMS, SWCSC, NCAR)
- Mailing lists (UCAR Opps List, ClimList)
- AGU Mtg exhibit
- AMS Mtg exhibit and talk
- Web postings at: [BOR Water Prize Competition Center](#), [Challenge.gov](#) and [Innocentive](#)



[Capital Weather Gang article](#)

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Recruiting Solvers – Results...

- **188 Active Solvers at Innocentive = people who were interested and registered to get more information about the competition...**
- **... leading to 7 Competitors = Active Solvers who opted to build a forecasting apparatus and enter the competition**

Recruiting Solvers – Thoughts...

- Clearly had hopes for more Competitors...
- Outreach was aggressive, but we're not experts on how to build this kind of solver community
 - Use other solver pavilions, like Top Coder?
 - Different outreach/media strategy?
 - Different incentives?
 - Different terms of solver agreement?
- Bright Side
 - We only pay purses when Competitors beat benchmarks
 - If all Competitors stay engaged, this could be great value

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Current Standings

- 10 of 26 weeks 3&4 forecasts scored
- 9 of 26 weeks 5&6 forecasts scored
- Both temperature outlooks are very competitive
- Precipitation scores significantly lower

Weeks 3&4 Temperature

Team	Newest Score	Average Score ▼
bgzimmerman	-0.0994	0.2855
prwx	-0.1821	0.2265
StillLearning	0.029	0.217
DampedPersistence	-0.0794	0.1952
CFSv2	-0.3997	0.1589
asanteko2000	-0.1117	0.0909
lupoa13	-0.2187	0.0895
Salient	0.05	-0.1365

Weeks 3&4 Precipitation

Team	Newest Score	Average Score ▼
Salient	0.7758	0.2144
prwx	0.0921	0.1711
lupoa13	-0.1367	0.1246
CFSv2	0.1837	0.0713
StillLearning	0.7987	0.0227
bgzimmerman	0.1087	-0.0221
asanteko2000	-0.7981	-0.0612
DampedPersistence	-0.7996	-0.1463

Weeks 5&6 Temperature

Team	Newest Score	Average Score ▼
bgzimmerman	0.0108	0.263
CFSv2	0.1144	0.2069
StillLearning	-0.1346	0.2068
prwx	0.0011	0.1983
lupoa13	0.0626	0.1976
asanteko2000	-0.1308	0.0975
Salient	0.2831	-0.0607
DampedPersistence	0.3333	-0.0836


Weeks 5&6 Precipitation

Team	Newest Score	Average Score ▼
Salient	0.7926	0.2013
prwx	0.2306	0.1217
lupoa13	-0.1008	0.0932
StillLearning	-0.255	0.0746
bgzimmerman	-0.4534	0.0683
CFSv2	0.5098	0.0208
asanteko2000	-0.7149	-0.0692
DampedPersistence	-0.7983	-0.1503

Track Results at NIDIS' Leader Board

- Leader Board is live! [LINK](#)
- Features
 - Rankings by forecast category
 - Time series plots of forecast scores for top 5 teams and benchmark forecasts
 - Individual team pages
 - Visualize forecast with corresponding observations and benchmark forecasts
 - Time series plots of forecast scores
 - Tabular forecast scores
 - Competition “news feed”

NATIONAL
INTEGRATED
DROUGHT
INFORMATION
SYSTEM



Drought.gov
U.S. Drought Portal

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Sub-Seasonal Climate Forecast Rodeo

And they're off: Solvers compete for up to \$800,000 in prizes

The Rodeo is a year-long, real-time forecasting competition, focused on western U.S. temperature and precipitation for weeks 3&4 and weeks 5&6. The Bureau of Reclamation is sponsoring the competition in partnership with NOAA, USGS, and the U.S. Army Corps of Engineers. Forecasts are issued every other week and evaluated as observed data become available. To be eligible for cash prizes, teams must outperform benchmark existing forecasts.

Improved sub-seasonal forecasts for weather and climate conditions (lead-times ranging from 15 to 45 days and beyond) would allow water managers to better prepare for shifts in hydrologic regimes such as the onset of drought or occurrence of wet weather extremes. The challenge with sub-seasonal weather and climate forecasting is that it encompasses the time frame where initial state or condition information and slowly varying long-term states, such as sea surface temperature, soil moisture, and snowpack, become more important to predictions. In addition, the relative importance of the initial state or condition, versus the longer term state, depends on the lead time, region of interest, and time of year.

Winners are anticipated to be announced in September of 2018. Check back for new scores and other updates over the next year!

Category	First Place	Second Place	Third Place
Weeks 3&4 Temperature	\$100,000	\$50,000	\$25,000
Weeks 3&4 Precipitation	\$100,000	\$50,000	\$25,000
Weeks 5&6 Temperature	\$100,000	\$50,000	\$25,000
Weeks 5&6 Precipitation	\$100,000	\$50,000	\$25,000

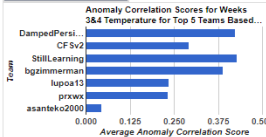
FORECAST RODEO LEADER BOARD

Weeks 3&4 Temperature

Weeks 5&6 Temperature

Weeks 3&4 Precipitation

Weeks 5&6 Precipitation



Checkout the Forecast Rodeo Leader Board

FORECAST RODEO UPDATES

Dry Out West and Hurricane Harvey in Texas

Another warm and dry couple of weeks over most of the competition region for the period ending on September 4th. However, the southeast area and especially Texas was cool and wet. This was largely due to Hurricane Harvey, which dumped upwards of 50 inches of rain in th

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Questions?

Links:

<https://www.usbr.gov/research/challenges/forecastrodeo.html>

<https://www.drought.gov/drought/utility-type/forecast-rodeo-update>

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