Sub-Seasonal Climate Forecast Rodeo

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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/
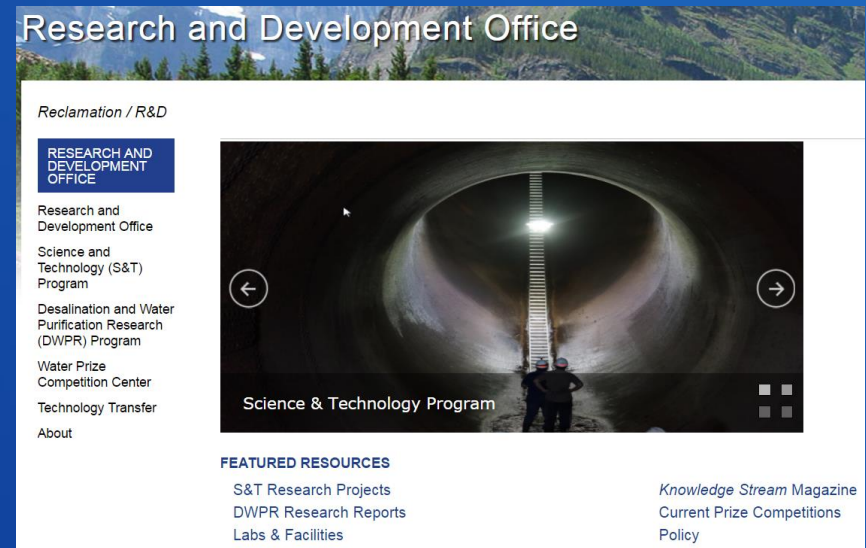
Knowledge Stream Magazine

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R&D Customers

- **<u>Primary</u>:** Reclamation resource and facility managers, customers, and stakeholders.

- **<u>Secondary</u>:** As federally funded R&D Office, we serve the broader communities of practice in water and water-related resources and the U.S. public.
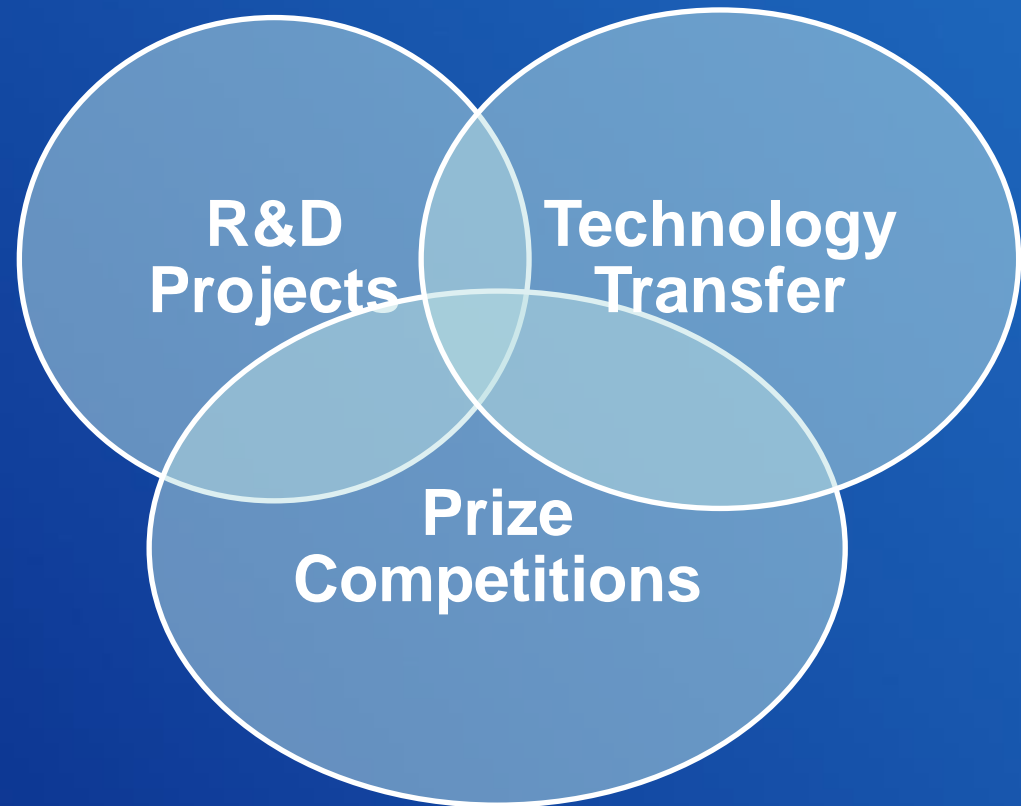
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S&T Program Goals and Tools

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

R&D Projects

Technology Transfer

Prize Competitions

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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

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
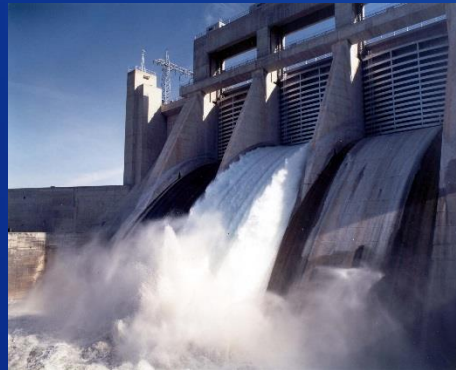
Forecast Rodeo

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

- 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

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.**

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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**
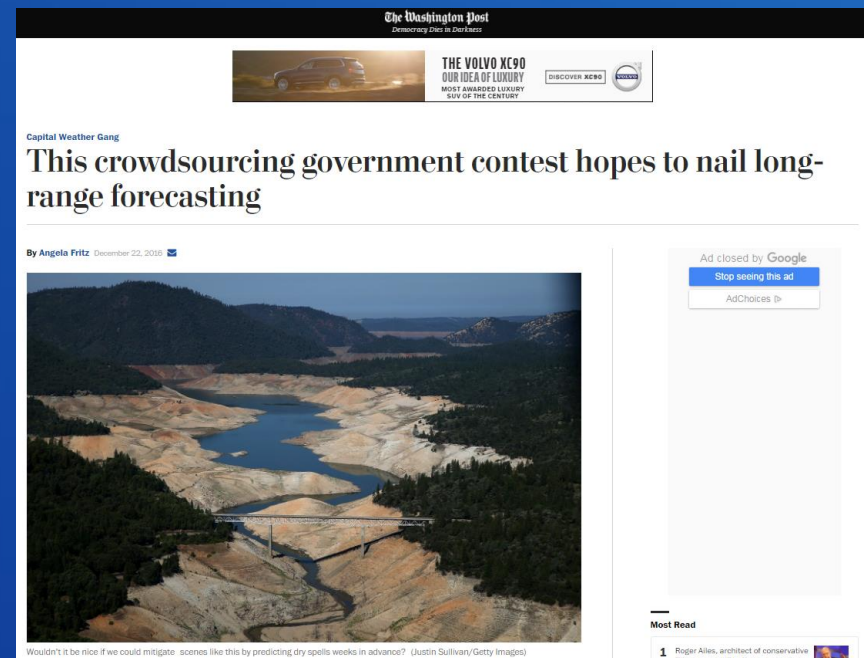
Capital Weather Gang article

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**

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
prxwx	-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 5&6 Temperature

Team	Newest Score	Average Score ▽
bgzimmerman	0.0108	0.263
CFSv2	**0.1144**	**0.2069**
StillLearning	-0.1346	0.2068
prxwx	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 3&4 Precipitation

Team	Newest Score	Average Score ▽
Salient	0.7758	0.2144
prxwx	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 Precipitation

Team	Newest Score	Average Score ▽
Salient	0.7926	0.2013
prxwx	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**

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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"

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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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