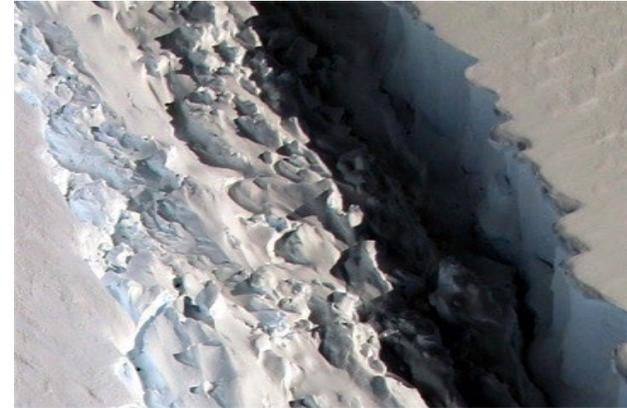




# SCIENCE



## WWAO Public Sector Engagement and Needs Assessments

**Stephanie Granger<sup>1</sup>, Forrest Melton<sup>2,\*</sup>**

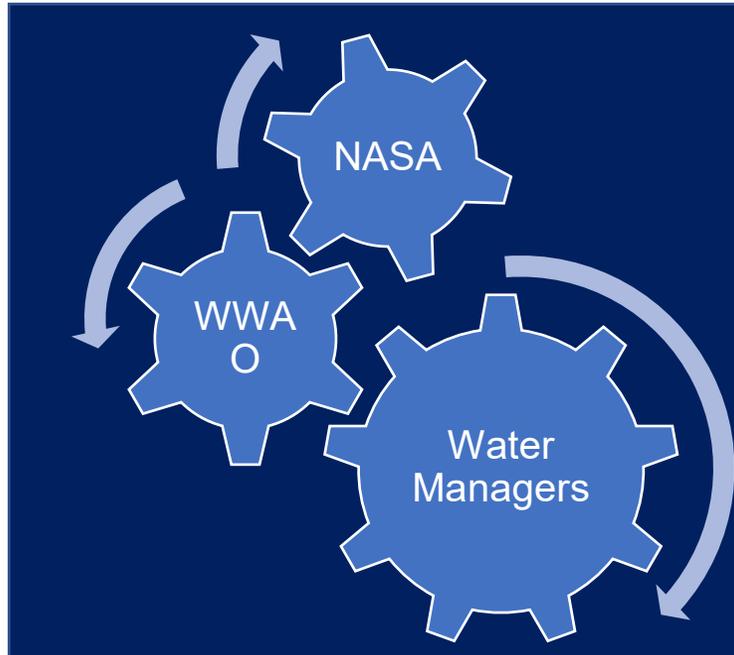
<sup>1</sup>WWAO Program Strategist

<sup>2</sup>WWAO Program Scientist

*\*Presenter*

# NASA's Western Water Applications Office

Tools for managing a scarce resource



## WWAO's Mission

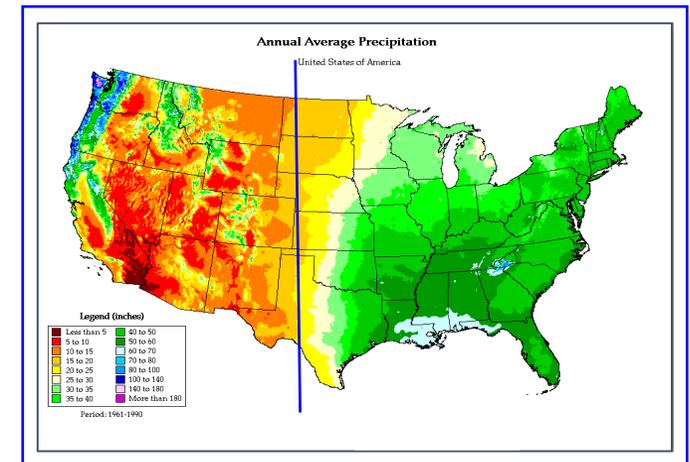
- **Improve how water is managed by increasing access to NASA data, technology, and tools for western water managers**

## WWAO does this by:

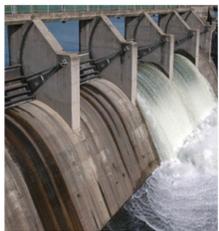
- **Identifying Needs** in western water management for information and decision support that NASA can address
- **Making Connections** between stakeholders and NASA scientists, technology, tools, and data, and supporting projects to address needs
- **Transitioning** water applications into operations to achieve a sustainable and long-term impact

## Why WWAO?

- NASA's science, remote-sensing data and expertise can bring a unique set of capabilities to solving water challenges
- Remote-sensing data can have a real impact on water management
- WWAO leverages decades of investment in science and technology, as well as well-established relationships with stakeholders

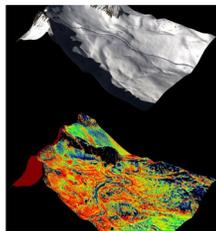


# WWAO Goals



## Identify

- A successful program will identify and address western water management decisions in which NASA's unique capabilities can have an impact



## Connect

- It will foster and support cost-effective projects which bring NASA's Earth science results to western water management organizations in a usable and actionable format



## Transition

- A fully successful program will have its projects advancing to the point where stakeholders realize the value and assume ownership of the process and products

# WWAO's Processes

- Develop strategic relationships with key partners / stakeholders in western water management
- Conduct assessments to identify water needs
- Develop Needs Catalog and make it widely available to applied science community

Identify

- Develop capabilities catalog of NASA applications
- Match needs to capabilities
- Formulate and implement "Needs Driven" projects or activities with strong stakeholder engagement

Connect

- Develop business cases and transition plans for promising applications
- Establish a research to operations community w/in water management

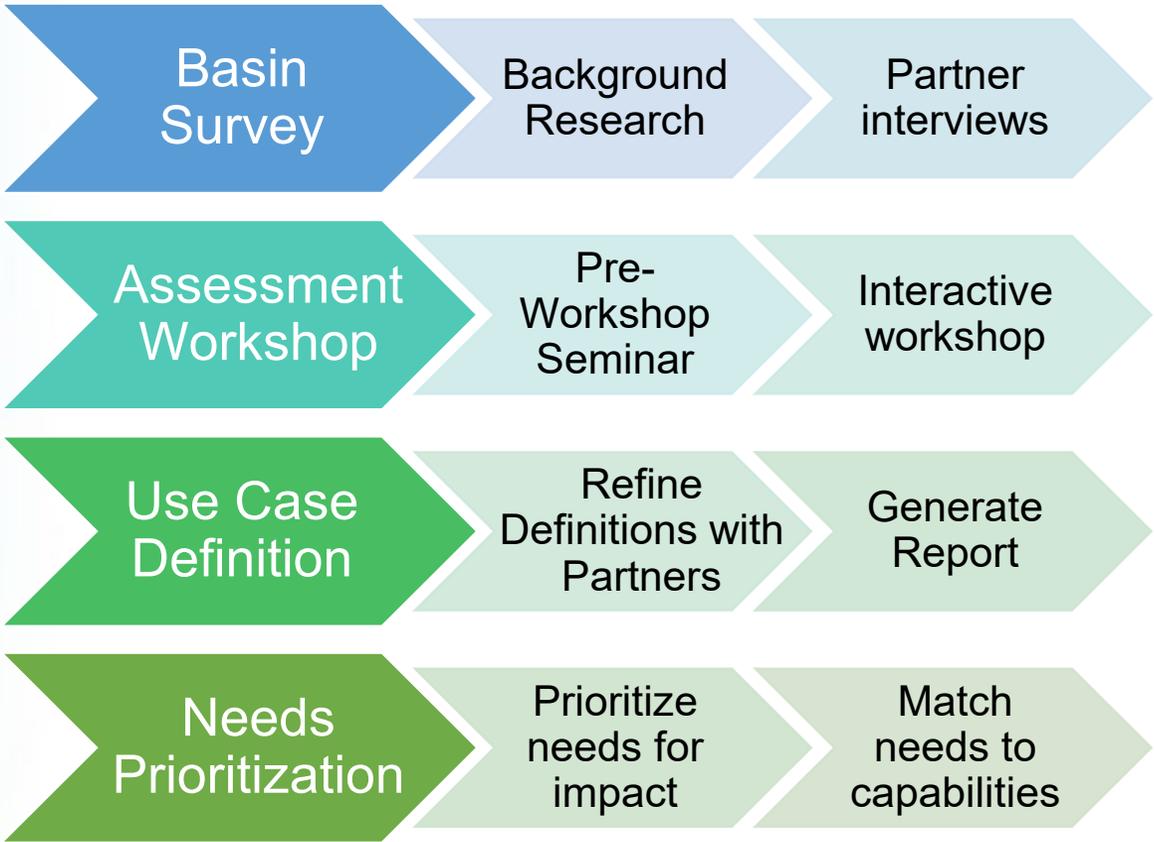
Transition

# Basin Needs Assessments

A Needs Assessment, as defined here, is a multi-part process of identifying and understanding water resources gaps (needs) in the Western U.S.



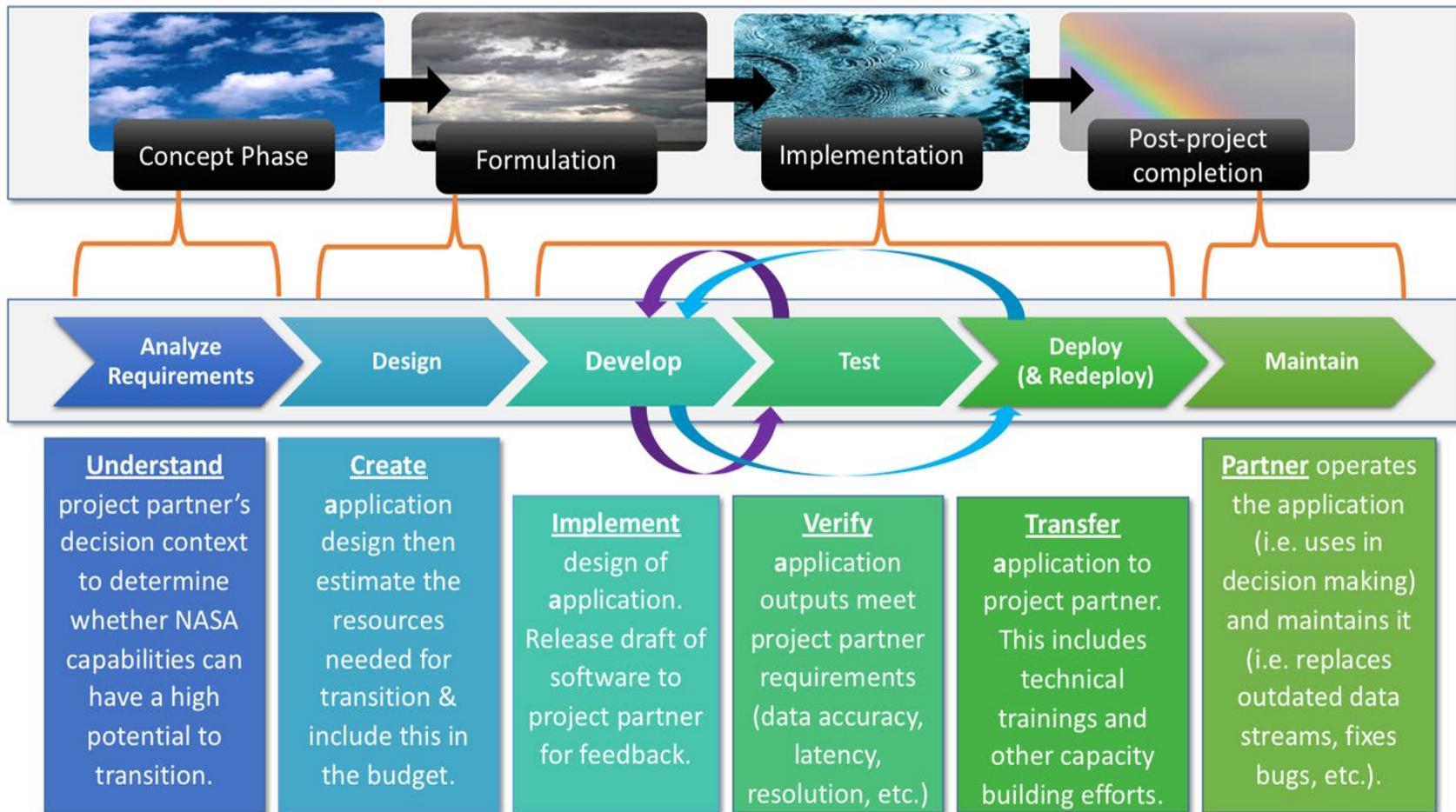
Future Assessments will cover Arkansas Red River Basin, Alaska, Hawaii





# Research to Operations

Working with water managers and scientists through the lifecycle of a project to deliver sustainable operational applications for use in water resources management in the Western U.S.



WWAO activities to support R2O

Impact Assessments

Technology Transfer Guide

Business Case Analysis

R2O Community Building, Workshops and Discussions

# The WWAO Portal

<https://wwao.jpl.nasa.gov/portal/>

The screenshot shows the NASA Water Portal website. At the top, there is a navigation bar with links for ABOUT, PROGRAMS, NASA WATER PORTAL, NEWS & INSIGHT, RESOURCES, and CONNECT WITH US. Below the navigation bar, a message reads: "We welcome submissions to our Needs and Capabilities catalog. **Share your Water Need or Water Capability and you will be in touch.**" This message is highlighted with a yellow circle. Below this, a bold instruction states: "Please click on any water droplet on the map below to explore the Needs and Capabilities by state and river basin." Underneath, there is a "Filter By Water Topic:" section with icons for All Topics, Water Availability, Water Use, Water Quality, Disasters, Watershed Health & Management, and Water Infrastructure. A "Map View" button is selected, and there are options for "Hide Basins", "List View", and "Thumbnail View". The main content is a map of the United States with various river basins highlighted in different colors. A pop-up window is open over the Colorado River Basin, titled "CAPABILITY: A Consistent Method for Estimating Evapotranspiration in the Colorado River Basin". The pop-up contains the text: "Water Use Estimation of consumptive use from ET in the upper Colorado River Basin for the US Bureau of Reclamation." and a link for "more info > contact us >". A legend in the bottom left corner identifies the map elements: Water Need (blue droplet), NASA Capability (green droplet), California Watershed (green circle), Upper Colorado River Basin (orange circle), Lower Colorado River Basin (light orange circle), Columbia River Basin (light blue circle), Great Basin (red circle), Missouri River Basin (brown circle), and Rio Grande River Basin (yellow circle).

- The WWAO Portal is an on-line resource for both water managers and scientists
- Water managers can browse data products relevant to Western Water
- Scientists can learn more about potential use cases for their work
- On-line submission is the start of a dialog with WWAO, and we will continue to take an active role in connecting needs with capabilities



# The WWAO Team



Indrani Graczyk (JPL)

Program Manager



Forrest Melton (ARC)

Program Scientist



Stephanie Granger (JPL)

Program Strategist



Sharon Ray (JPL)

Stakeholder Engagement

Stephanie Granger (JPL),  
Forrest Melton (ARC),  
Chris Hain (MSFC)  
Amber McCullum (ARC)  
Mark Davidson (JPL)

Stakeholder  
Engagement Working  
Group



Hiring (JPL)

Science Engagement



Amber Jenkins (JPL)

Information Architectures



Amber McCullum (ARC)

Applications Transition

Lee Johnson (ARC),  
Bailing Li (GSFC)

Capabilities Working  
Group

# Results

# Overview of Results



## Identify

- 3 Major Basin Needs Assessment Workshops Completed
- 6 Western Basins / Watersheds Studied
- 35+ Use Cases Documented
- 120+ Participants in Workshops / Surveys



## Connect

- 4 Award Rounds
- 8 Completed Projects
- 10 Active Projects with 6 started this year
- 11 Project Partners
- 4 Impact Assessments Underway
- 12 Articles + 10 Papers Published/Pending on Project Results



## Transition

- 3 Capabilities Transitioned
- 1 New Company Formed
- 1 Research to Operations Workshop
- 1 Research to Operations Paper

# Snow

WWAO is uniquely placed to help transition water tech out of NASA by building paths to water operations and spinoffs.



## Western Water Needs

Better snowpack information is a common need within the Colorado, Columbia and Missouri River Basins:

- Snow Water Equivalent
- Runoff Forecasting
- Streamflow Forecasting
- Flood Prediction

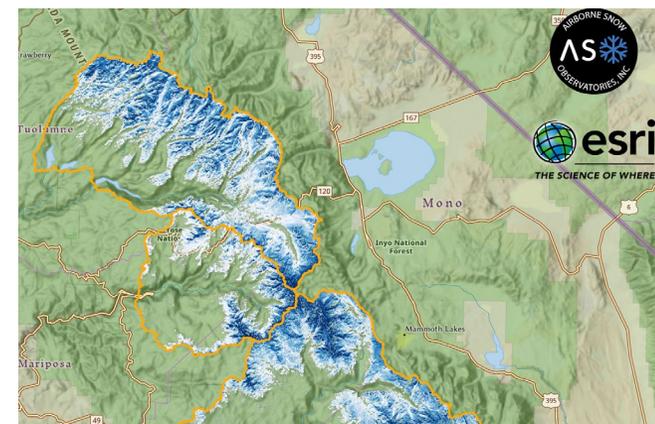
## NASA's Capabilities

NASA's work in Snow Science has created multiple relevant capabilities

- Airborne Snow Observatory
- Snow Data System
- Real-time snowpack estimation from satellite data

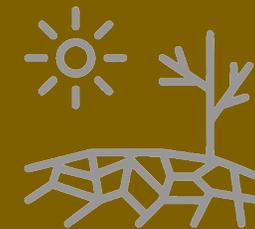
## WWAO's Impact

- Established on operational pathway for remote sensing data to be used by the Colorado River Basin Forecast Center
- In 2020, ASO Inc., a NASA spinoff, delivered SWE estimates to California, Colorado and USBR
- As a private-sector entity, ASO Inc.'s outreach to Congress has led to funding bills for a DoI/USBR Snow Water Supply Forecasting Program



# Drought

WWAO delivers operational drought tools that use the power of remote sensing to combat drought where and when it is most needed.



## Western Water Needs

Drought continues to challenge the West. Better information on drought conditions is a key need for the Colorado, Rio Grande and Tribes:

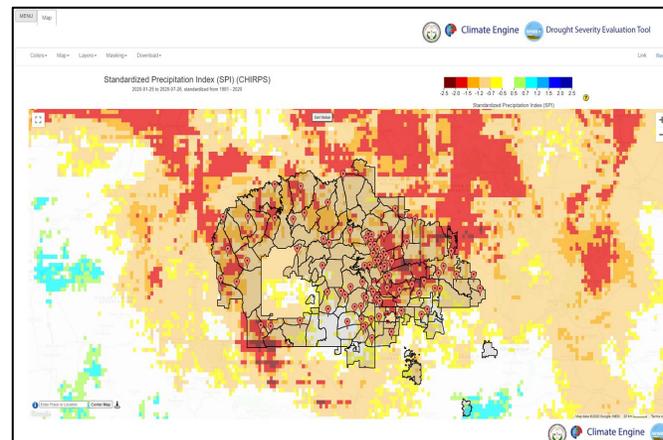
- Drought Severity Prediction + Mapping
- Drought Indicators
- Climate Change Impacts on Drought

## NASA's Capabilities

NASA's work in Drought Science has created multiple relevant capabilities:

- High-Resolution Drought Indicators
- Drought Severity Tool
- UAVSAR Drought-Related Subsidence Hotspots

## WWAO's Impact



- WWAO's Drought Severity Tool (DSET) is helping the Navajo Nation allocate emergency relief when drought hits
- After significant training and support, the Navajo Nation is taking operational responsibility for DSET
- WWAO's Western Land Data Assimilation System will feed finer-grained drought data into the Colorado Climate Center's weekly drought reports

# Agriculture

WWAO is helping farmers use NASA observations to better understand field conditions and conserve water use while preserving yield.



## Western Water Needs

As agriculture can be the largest consumer of water in the West, methods to measure and manage agricultural water are of great interest:

- Satellite Data for Irrigation Management
- Soil Moisture Monitoring
- Land-Use and Irrigation Status

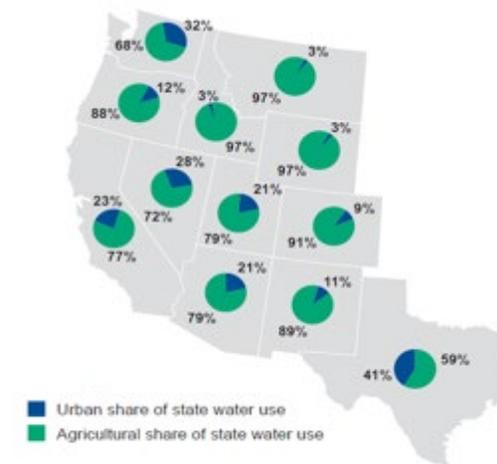
## NASA's Capabilities

NASA's observations enable several new decision-support tools for agricultural water management:

- Satellite-Based Irrigation Management
- Soil Moisture Maps
- Fallowed Land Mapping

## WWAO's Impact

- WWAO's Crop-CASMA Soil Moisture App delivers field-scale soil wetness to USDA NASS, pinpointing water availability and informing crop operations
- With WWAO's help, NASA satellite data have been incorporated into the CropManage tool to improve irrigation management
- Satellite Mapping of Fallowed Land on-demand, tracking drought-hit agricultural land at a monthly timestep developed for CA, NV and WA.



# Evapotranspiration

Evapotranspiration is an emerging need in monitoring water use, and NASA's capabilities could enable game-changing decision tools.



## Western Water Needs

Field-Scale Evapotranspiration Data is a prevalent need for Western water managers for a range of decisions:

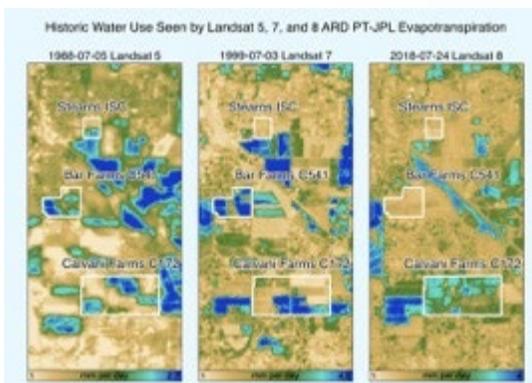
- Irrigation scheduling
- Monitoring water use
- Balancing water supply and demand

## NASA's Capabilities

NASA has supported several approaches to estimate ET from satellite data:

- ALEXI / DisALEXI (with USDA)
- METRIC (with U. of Idaho and UNL)
- PT-JPL
- SEBAL (via international partners)
- SIMS
- SSEBOP (with USGS)

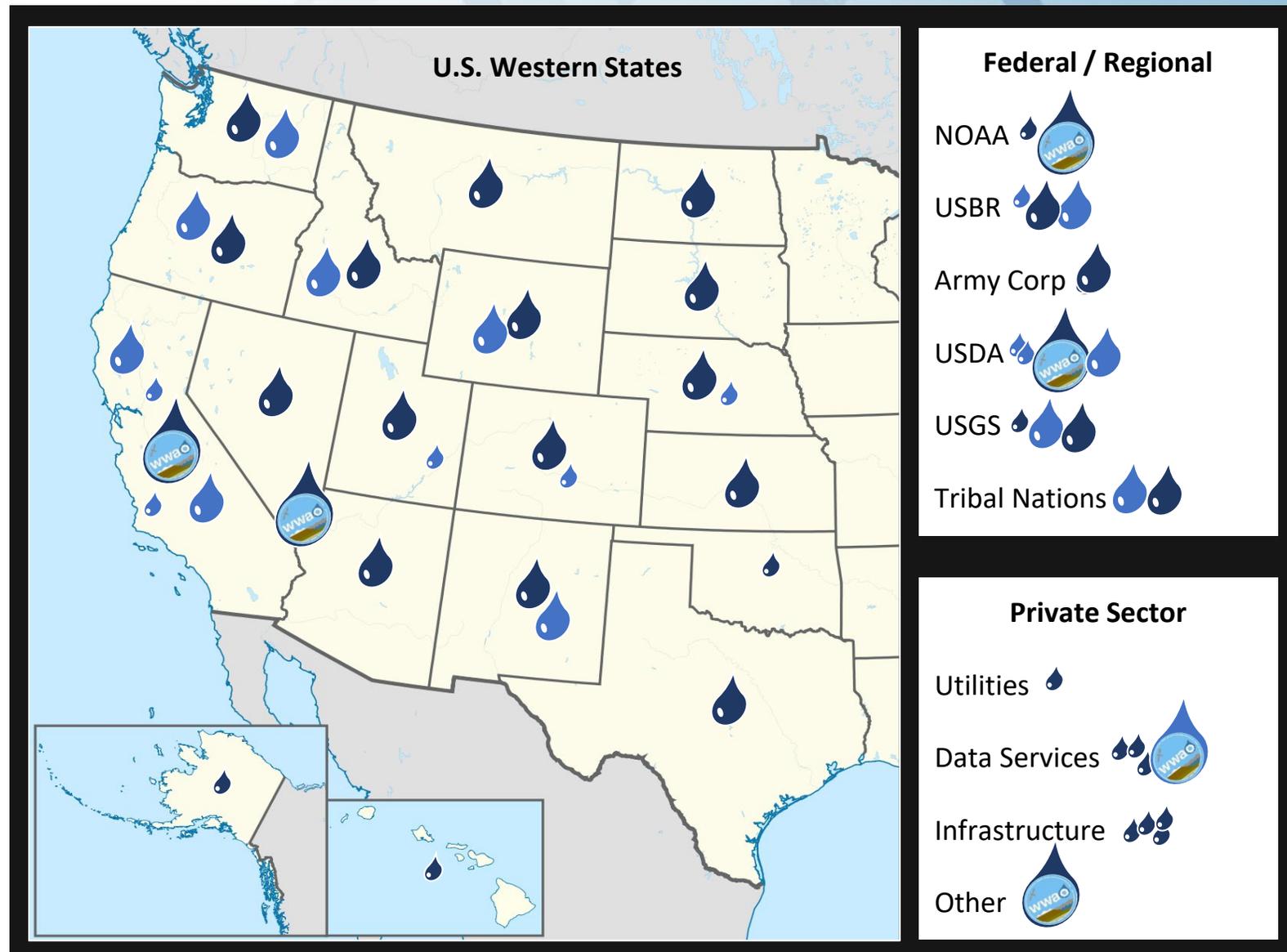
## WWAO's Impact



- WWAO's Operational Evapotranspiration Visualizer enables the New Mexico State Engineer's Office to make more informed decisions on water-rights transfers
- WWAO funded an Intercomparison Study of Satellite ET Models with the U.S. Bureau of Reclamation to deliver insights into which models are best suited to particular ground conditions
- OpenET, an effort supported by NASA and philanthropic foundations to make satellite ET data available online, is a potential platform for transition to operations

# WWAO Dashboard

Legend	
	Planned engagement
	Preliminary or higher-level engagement; Participation in conferences / workshops
	Partner contributed to a Study or Assessment; Needs entered into WWAO Needs Catalog
	Strategic relationships established with ongoing needs discussions and broader engagement on NASA Earth Observations
	Partner working with WWAO to advance an application from WWAO Capabilities Catalog
	Partner adopting a NASA application into water management operations
	Partner using a NASA application operationally and/or NASA application transitioned to a Partner to provide operational product/service





# SCIENCE

# Questions?

Thank you!

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[Forrest.S.Melton@nasa.gov](mailto:Forrest.S.Melton@nasa.gov)



# Partner Testimonials

***"I'm full-blooded Navajo – I grew up on the Navajo Reservation. It is monumental to have an organization like NASA work with us to diversify and augment the water tools we have at our disposal."***

Carlee McClellan, Navajo Nation Department of Water Resources

***"Reliable water data is almost as critical to farmers and water managers as the water supply itself. With added pressure from population growth and the uncertainty that climate change impacts have on existing and future water supply, OpenET allows planning for agricultural water needs in a way that just wasn't possible before."***

E. Joaquin Esquivel, Chair, California State Water Resources Control Board

***"Before ASO, we were sometimes flying blind with regards to measuring upper-elevation snowpack when trying to predict high-volume runoff events. This technology, combined with traditional snow surveying and water prediction methods, allowed us to better understand and predict runoff volumes, which in turn allowed water managers to more appropriately respond to the wet conditions ... in 2017."***

David Rizzardo, California Department of Water Resources, Chief for the Snow Surveys Section / Water Supply Forecasting Division

***"We value the partnership with NASA and the ability of their remote-sensing resources to integrate data over large spatial scales, which is useful for assessing drought impacts."***

Jeanine Jones, Interstate Water Resources Manager, California Department of Water Resources

***"We are very pleased to release the Crop-CASMA web-based application. These satellite-derived vegetation condition indices and soil moisture condition maps show first-hand the ever-changing face of U.S. agriculture. They contribute extensively to operations and research on various issues, including agricultural sustainability and extreme weather events, such as flooding and drought."***

Rick Mueller, USDA NASS Spatial Analysis Research Lead

***"The product [from this work] will be used by the Colorado Basin River Forecast Center and the Bureau of Reclamation to help improve streamflow forecasts and reservoir operations in the Colorado River Basin."***

Seth Shanahan, Southern Nevada Water Authority

***"The ASO program is the best solution going forward for the next generation."***

Wes Monier, Turlock Irrigation District, Chief Hydrologist