



2021 Annual Report

Western Water Applications Office



Welcome

Welcome to NASA's Western Water Applications Office 2021 Annual Report. 2021 was a special year for us as the WWAO program turned five years old. It was a time to take stock of our impact, the connections we've made to the water community in the U.S., and the bridges we've built between NASA data and decision makers on the ground. It was also a chance to look forward and forge a vision of how WWAO can expand its impact over the next five years.

In the face of COVID's many challenges, WWAO has remained agile and responsive to water management needs in the western U.S. The program launched 10 new water projects addressing issues in the Columbia River Basin and beyond. We continued to engage water stakeholders in the public sector at federal, state, tribal and local levels, and build up our Water Alliance with the private sector. In many ways, the past year was a watershed for climate change-related disasters, with the world ravaged by heat, floods, drought and fire. As exceptional drought gripped the already dry American west, WWAO supported national calls for more drought data and insights from NASA.

Within the realm of moving research to operations, WWAO continued to push the envelope, exploring ways to bring together government agencies to evolve data-driven water management, and leading an interagency publication on best practices. We are proud to remain at the forefront of a vibrant and diverse community of practice involving water practitioners, NASA scientists and technologists, decision makers and academics.

Today's world is awash with information. Getting the right data where they are needed most is no small task. I'm grateful to the WWAO team, our water partners, and cadre of NASA scientists for their dedication to finding ways to improve the way we manage water, one of our most precious resources.



Indrani Graczyk
Western Water Applications Office Director,
February 2022



Our Mission

WWAO's mission is to improve how water is managed in the arid western U.S. by getting NASA science, data and technology into the hands of water managers and decision makers.

The western U.S. faces growing water challenges, mostly related to increasing demand, unpredictable supply in the face of climate change, and ageing infrastructure. The region is generally defined as the part of the U.S. west of the 100th meridian. NASA has been partnering with western water agencies for decades, and WWAO was set up to continue that work.

Our program involves three main thrusts:

- identify water decisions in the west where NASA's unique capabilities can have an impact;
- connect NASA's science and technology to water organizations through new projects and initiatives;
- transition water tools and data to decision makers to infuse into their operations over the long-term.

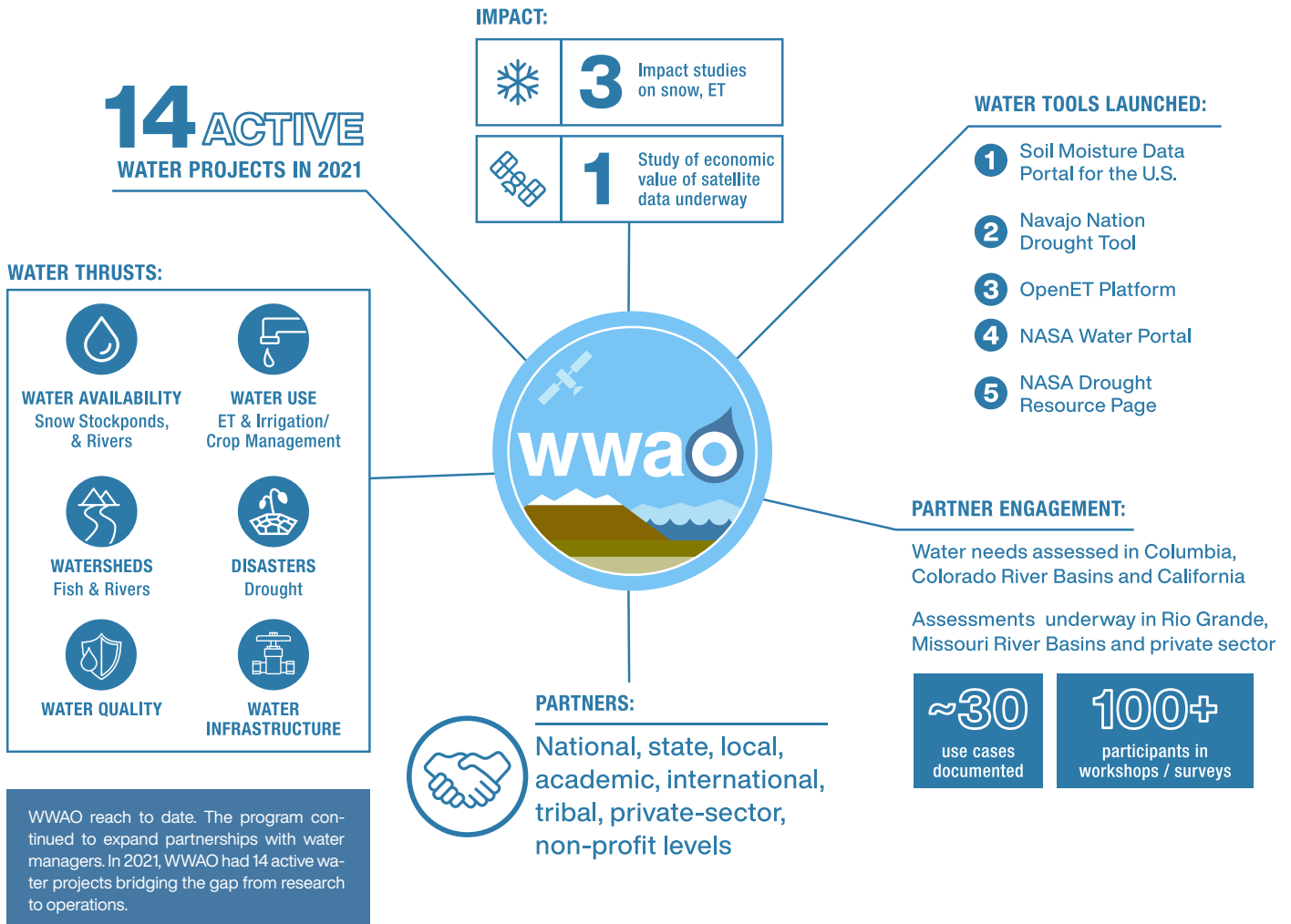


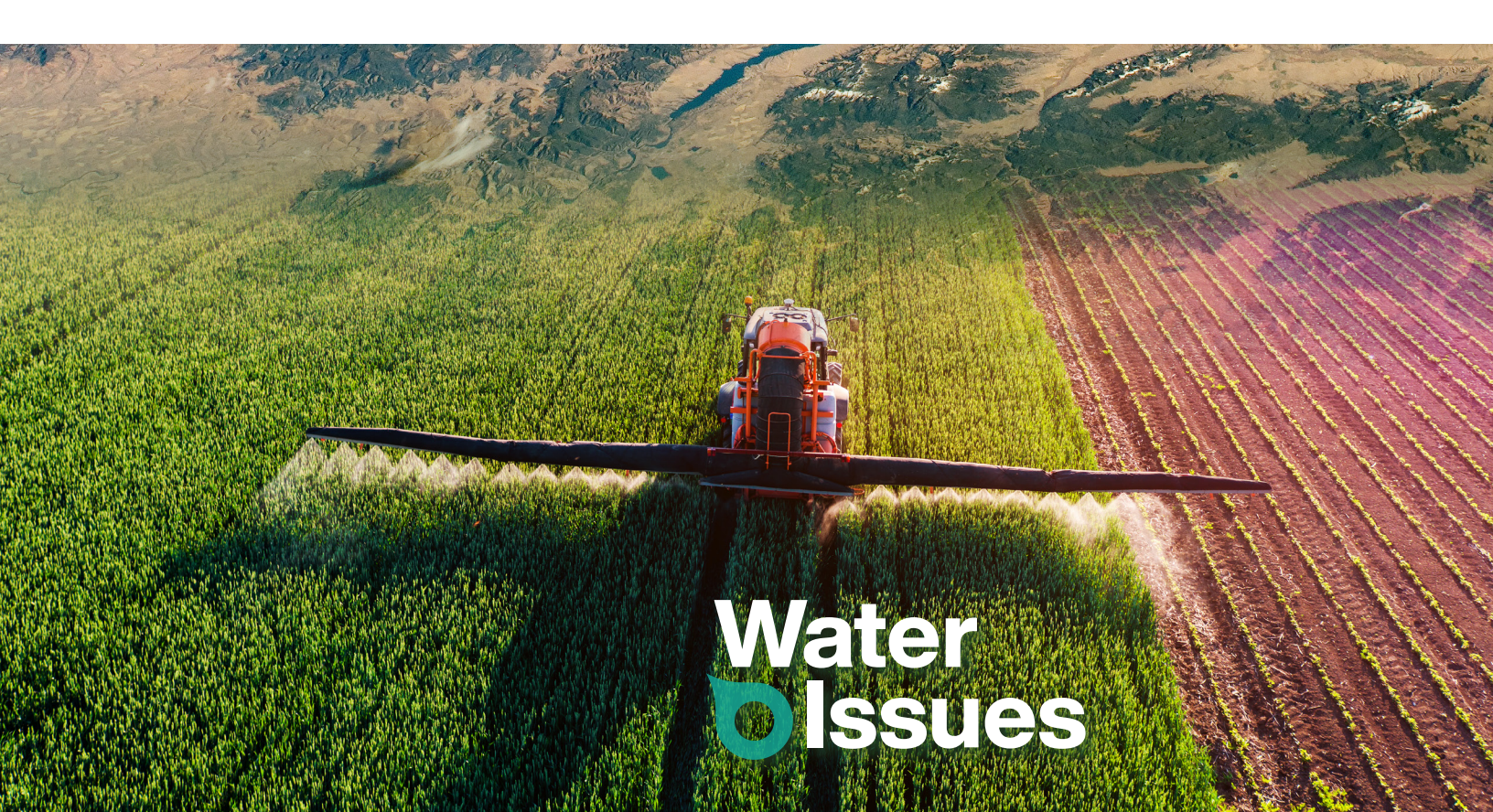
Our Impact

WWAO had a busy year, expanding its reach into the Columbia, Missouri and Rio Grande River Basins. 10 new water projects were initiated with partners in Idaho, Washington and beyond, including 8 in the Columbia River Basin addressing water use, monitoring of rivers from space, and the impact of agricultural land use on water management.

WWAO worked with the Natural Resources Conservation Service to launch a project that harnesses satellite data to monitor snow levels and predict river flows. In addition, we collaborated with NASA's DEVELOP Program to support the creative use of satellite data in helping land managers and ranchers monitor water in stock ponds in the American southwest.

In spring, WWAO released a new Soil Moisture Data System – Crop-CASMA – with the U.S. Department of Agriculture. 2021 saw WWAO launch its Connecting the Drops newsletter and NASA Drought Resources page to strengthen connections between scientists and decision makers working to solve compelling water issues. Our focus on Science to Action continued through discussions with the private sector, partnerships with key federal, state and local players, and by leading technical sessions at science meetings such as the American Geophysical Union's Fall Meeting.





Water Issues

This year, WWAO continued to collaborate with a diverse range of water stakeholders at national, state and local levels. In-person Needs Assessment workshops and meetings were not possible in 2021 due to

the pandemic. However, WWAO expanded its reach across the western U.S. by holding virtual Needs Assessments surveys in the Rio Grande and Missouri River Basins and with the private sector.



ENGAGING PUBLIC PARTNERS

WWAO completed characterization studies for the Missouri and Rio Grande River Basins, building on from its assessments in the Columbia and Colorado River Basins as well as California. Our team continued to collaborate with a host of water managers in the west through working groups, roundtables, exploratory discussions, and presentations.



ENGAGING PRIVATE PARTNERS

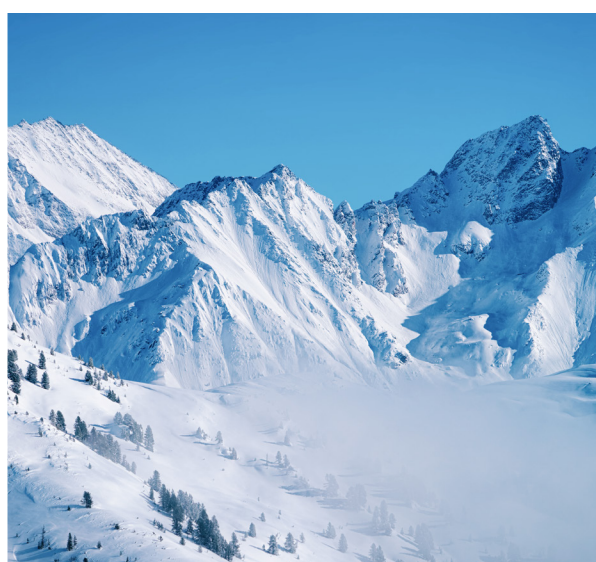
WWAO continued to build its Water Alliance with the private sector, engaging organizations involved in water infrastructure, management, treatment and water-based consumer products in the western U.S.



ENGAGING NASA MISSIONS

WWAO continued to connect with NASA water missions, scientists and data to find synergies between what NASA's Eyes on the Earth can do and what water managers need.

Water Solutions



SNOW

Mountain snow – a bank account for water across the western U.S. – continued to turn up insufficient funds in 2021. The Sierra Nevada snowpack melted nearly a month earlier than usual, leaving reservoirs low and the need for snowpack data more critical. WWAO's project with Airborne Snow Observatories, Inc. worked to establish an operational pathway for remotely-sensed snowpack data to be used by the Colorado River Basin Forecast Center. With the Natural Resources Conservation Service (NRCS), WWAO launched a project to measure the benefit of using NASA remotely-sensed snow data to improve NRCS' river prediction models and offer a cross-check on its Snotel system.



DROUGHT

Drought continued to plague the west in 2021. Better information on drought is needed across the west. WWAO continued its collaboration with the Colorado Climate Center to build a Western Land Data Assimilation System that will feed finer-grained drought data into the Center's critical weekly drought reports.



WATER FOR FOOD

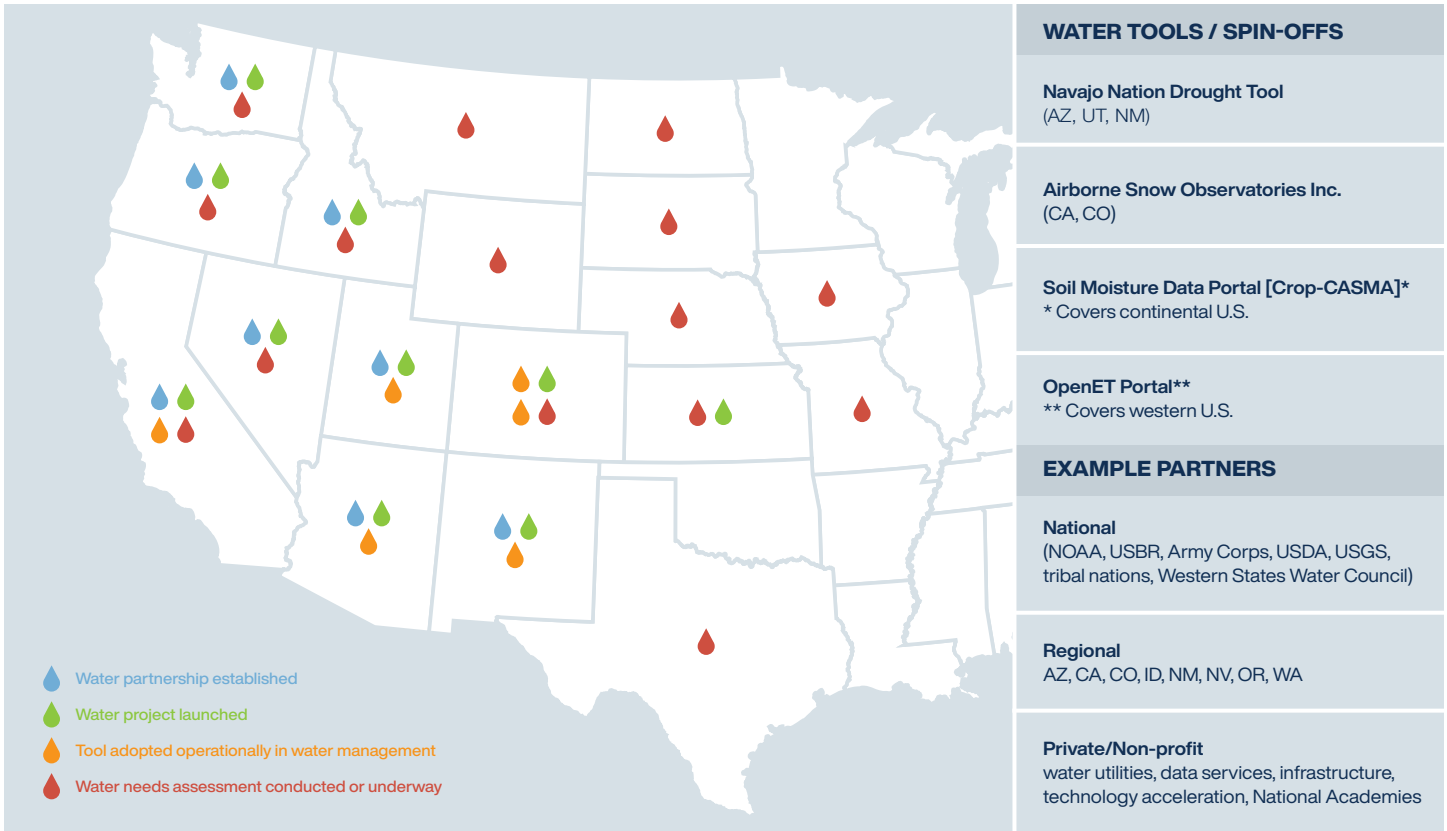
Agriculture can be the largest consumer of water in the west. WWAO helps farmers use NASA observations to better understand conditions in their fields, and to conserve water while preserving crop yields. With WWAO's support, NASA satellite data have been incorporated into the CropManage tool used by grower to improve the management of irrigation.

EVAPOTRANSPIRATION (ET)

ET – a critical measure of the water that is consumed and removed from a water system – is the largest share of water use in more arid environments around the world. The need for ET data is emerging as a key to monitoring water use in the dry American west. WWAO launched a range of projects focused on measuring ET in the Columbia River Basin, and continued to develop its Operational Evapotranspiration Visualizer tool with the New Mexico State Engineer's Office, enabling more informed decisions on water-rights transfers. With the U.S. Bureau of Reclamation, WWAO is working to more deeply understand ET by comparing different models and finding out which ones are best suited to particular ground conditions.

From Science to Action

WWAO's Reach



WWAO Testimonials



“I’m full-blooded Navajo. It is monumental to have NASA work with us to diversify and augment the water tools we have.”

Carlee McClellan, Senior Hydrologist, Navajo Nation Department of Water Resources



“One area of a state might be wet, while another dry. These new [satellite-derived] data deliver local moisture readings – this is what matters to the farmer.”

Zhengwei Yang, Research Scientist, U.S. Dept. of Agriculture National Agricultural Statistics Service



“We value [our] partnership with NASA and ... the ability of their remote sensing to integrate data over large scales, which is useful for assessing drought impacts.”

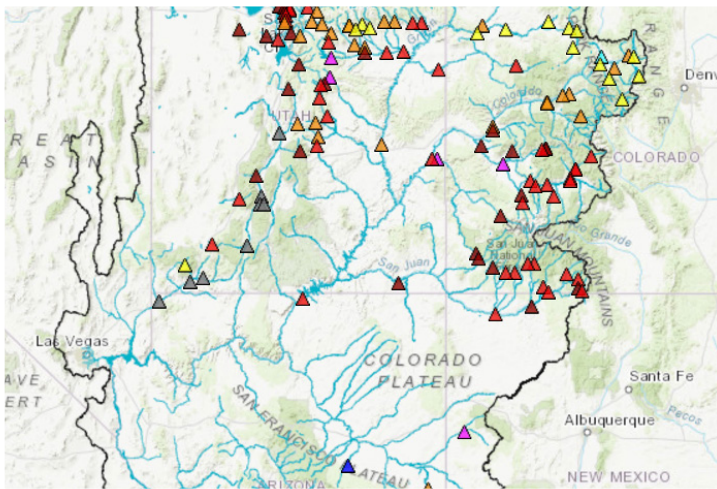
Jeanine Jones, Interstate Water Resources Manager, California Dept. of Water Resources



“Reliable water data is almost as critical to farmers and water managers as water supply. OpenET helps plan for agricultural water needs in a way that just wasn’t possible before.”

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

Sustainable Impact



WWAO works to bridge the gap between research and operations. It is uniquely placed to help transition water technology out of NASA by building paths to water operations and spinoffs.

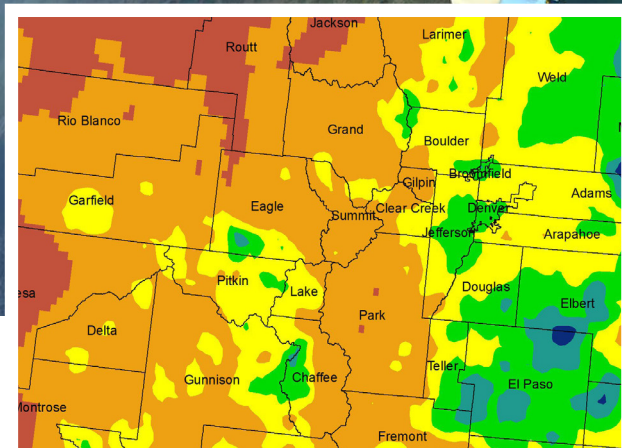
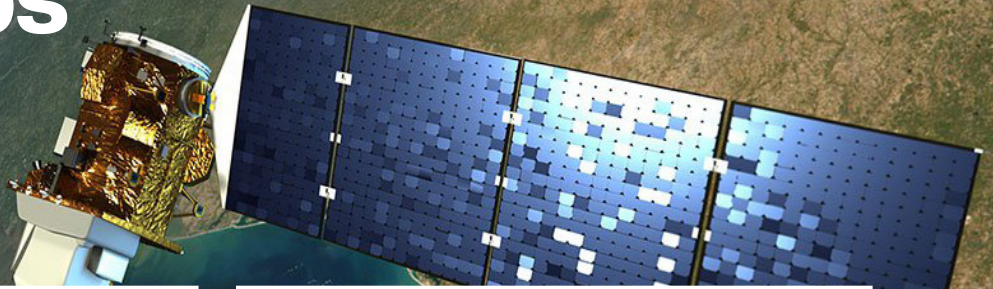
In April 2021, WWAO's new Soil Moisture Data System was handed off to its partner, the U.S. Department of Agriculture (USDA). The tool delivers field-scale soil wetness to the USDA's National Agricultural Statistics Service, pinpointing water availability and helping to inform crop operations.

The U.S. Bureau of Reclamation, a WWAO partner, announced \$2.5M to advance snow technology and water-supply forecasts. Part of this went to supporting snow surveys done by Airborne Snow Observatories Inc., a spin-off of NASA's Airborne Snow Observatory airborne mission that WWAO helped support, which was transferred from NASA to the private sector in 2019.

With government agency partners, WWAO explored how best to make research-to-operations happen, and led the development of a research-to-operations conceptual framework and set of best practices with the U.S. Environmental Protection Agency, Western States Water Council and others.

In the field of ET, WWAO completed a market survey of the opportunities and challenges associated with using field-scale ET data, as well as assessing the benefits of using ET data in New Mexico. Open-ET – a public-private water initiative involving NASA and WWAO – was launched. The platform uses publicly-available data to provide satellite information on ET, mainly from the Landsat program. In tandem, the U.S. government introduced the Open Access Evapotranspiration (OpenET) Act, aimed at establishing a program to provide water-use data to farmers, ranchers, and decision makers from satellites and weather

Connecting the Drops



EYES ON THE DROUGHT

2021 was one of the planet's warmest years on record, with rainfall and snowfall in the western U.S. well below average, and devastating wildfires on the horizon. In the face of drought emergencies being declared, WWAO launched a NASA Drought Portal in response to calls from government and decision makers. The portal highlights how NASA's eyes on the drought – its satellites, aircraft missions, models and experts – help farmers, reservoir managers and leaders track and monitor drought, predict how much water will be available, and improve how we use the water we have

TRIBAL CONNECTIONS

In 2020, WWAO delivered the Drought Severity Evaluation Tool (DSET) to the Navajo Nation, helping the community allocate emergency relief when drought hits. As the west descended into deeper drought in summer 2021, DSET was used by the Navajo Nation Department of Water Resources to assess drought severity within the context of declaring a drought emergency. This led to increased resources for mitigation efforts across the Navajo communities.



2021 also saw WWAO launch a project with the Columbia River Intertribal Fish Commission, in partnership with the Pacific Aquatic Monitoring Partnership and National Oceanic and Atmospheric Administration. The initiative is working to build a platform that will make satellite data relevant to fish habitats more accessible. Ultimately, it will lead to the improvement of decision tools that link freshwater habitat quantity and quality to salmon life history characteristics, such as fish productivity and survival.

Look Ahead



Bringing Science to Action is inspiring and challenging. Time and again, it's clear that trust and committed partnerships are at the heart of delivering the full impact of NASA's science, technology and data. In 2022, WWAO will continue to nurture partnerships with water managers, stakeholders and decision makers.

The program will expand its assessment of water needs beyond the Rio Grande and Missouri River Basins, and deepen collaborations with the private sector. WWAO will continue to develop new solutions with water managers, with an eye to scaling up solutions and accessibility through more teaming and networking with the western water community.

Delivering sustainable impact remains central to what we do. In 2022, WWAO will continue to build a research-to-operations community that can help transition NASA technology and data to water operations. The program will continue to work with strategic partners in the public and private sectors to measure the economic benefits of using NASA data to manage water, and to build the processes and infrastructure that enable NASA to spin off its tools and technology to those who need them most. We look forward to seeing WWAO grow from strength to strength over the next 5 years.

