

NASA's Western Water Applications Office (WWAO)

2020 Annual Report

Perspective

As for all, 2020 brought the challenges of COVID-19. Given WWAO's across-NASA team and distributed network of water partners, the program was able to pivot quickly to remote operations and continue growing from strength to strength.

The main impact of COVID-19 was on in-person interactions that had been planned for 2020 – primarily capacity-building workshops for mature projects, WWAO's second interagency Research to Operations workshop, and technical interchanges with WWAO's Water Alliance partners. Key workshops and conferences were held virtually, and in many cases WWAO was able to reach a broader-than-usual audience. While COVID-19 hampered water partners' ability to collect crucial ground-based data, WWAO's Navajo Nation drought tool and the Airborne Snow Observatory helped fill the gaps in drought reports and snow surveys, respectively. Capacity- and partnership-building were conducted virtually, as was WWAO's private-sector needs assessment.

Mission

[WWAO's mission](#) is to get NASA's data, tools and technology into the hands of water managers and decision makers in the western U.S. It identifies what water managers in the west need; matches top-priority needs to NASA capabilities and technology; and builds applied-science projects that translate NASA's power of perspective into action on 21st-century water issues. Through this, WWAO delivers operational tools that offer the power of NASA's remote sensing and data to water managers.

Water Projects

WWAO continued to fund five ongoing water projects – one of which was handed off (transitioned) to a partner entity and another of which came to an end during 2020*. WWAO also initiated two new projects that address drought and evapotranspiration gaps in the Colorado River Basin**. (See Appendix for detailed project overviews.) WWAO's 2020 projects were:

- Drought Severity Tool For The Navajo Nation (**transitioned to Navajo in 2020*)
- NASA Airborne Snow Observatory Runoff Forecasts (**ended in 2020*)
- Operational Evapotranspiration For New Mexico
- SIMS-CropManage Decision Support System
- High-Resolution Soil Moisture App For Crop Monitoring
- High-Resolution Drought Indicators For The Colorado Climate Center (***began in 2020*)
- Consistent Evapotranspiration Methodology For The U.S. Bureau of Reclamation (***began in 2020*)

[WWAO's Drought Severity Tool](#) transitioned to the Navajo Nation Department of Water Resources (NNDWR) for operational use, and a [user guide](#) released. It remains a sustainable application as a spin-off of Climate Engine with the support of the Desert Research Institute. Training and applications with other Navajo departments continue, funded by the S.D. Bechtel Jr. Foundation. Of the effort, Carlee McClellan (NNDWR) has said:

“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.”

WWAO’s Airborne Snow Observatory (ASO) Runoff Project established operational pathways for ASO data to improve forecasts at NOAA’s Colorado River Basin Forecast. Seth Shanahan (Southern Nevada Water Authority) spoke to the uptake of the data:

“The product 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.”

WWAO’s [High-Resolution Soil Moisture App, Crop-CASMA](#), was released for operational use by the USDA National Agricultural Statistics Service (NASS), giving farmers, researchers and meteorologists access to finer-grained soil data. WWAO’s collaboration with the USDA forms part of a larger [Memorandum of Understanding](#) signed at the end of 2020 between the USDA and NASA to strengthen agricultural and Earth science research. Rick Mueller, NASS Spatial Analysis Research Lead, commented on the transition:

“We are very pleased to release ... Crop-CASMA. These satellite-derived vegetation condition indices and soil moisture condition maps show firsthand 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.”

Water Management Needs

In 2020, WWAO published its assessment of public-sector water management needs in the U.S. Columbia River Basin (CRB). [The report](#) was the culmination of deep dives (through interviews and a workshop) with a cross-section of over 20 CRB stakeholders including policy makers, planners, water management officials and end-users. WWAO boiled down 15 top-priority stakeholder needs from an initial set of 54, and documented obstacles to meeting those needs. Key areas of need in the CRB include Water Use (agricultural), Water Quality, Water Availability, and Watershed Health.

WWAO began water needs assessments in the Missouri and Rio Grande River Basins, following a similar approach to what was developed for the Columbia and Colorado River Basins.

As part of WWAO’s Water Alliance with the private sector, the team conducted an assessment to understand views of needs in the water industry. Ten organizations, whittled down from a few hundred, took part in detailed interviews with WWAO. The inputs were published in an internal report. Those involved provide geospatial data (Esri, Quantum Spatial, Maxar Technologies); infrastructure, treatment and engineering services (Tetra Tech, Jacobs Engineering, Parsons, AECOM); water technology acceleration (Waterstart); and include a water utility (California Water Services Group) and foundation focused on freshwater conservation and restoration (The Freshwater Trust). On the whole, interviewees responded positively about exploring collaboration and technology-transition opportunities with WWAO. There was enthusiasm about how NASA might inform remote-sensing solutions for the water industry.

Technology Transition

WWAO is uniquely placed to help transition water technology out of NASA. Its focus on Research to Operations (R2O) carves paths to water decision makers and boosts spinoff. In 2020, WWAO co-wrote a paper on best practices for doing R2O in the water sphere with the Western States Water Council and U.S. Environmental Protection Agency. The conclusions follow WWAO's 2019 Technology Transition Workshop (report [here](#)) and ongoing work to boost federal R2O.

Remotely-sensed snow data: WWAO has worked with NASA's ASO since 2016 to transfer the potential of remotely-sensed snow data to western water managers. ASO can forecast snow water equivalent (SWE) with 98% accuracy and, in 2018, WWAO's business-case analysis determined that a commercial spin-off of ASO was viable. WWAO's snow projects from 2016 to 2020 established operational pathways for ASO data to improve forecasts at the California Department of Water Resources and Colorado River Basin Forecast Center. Collectively, this work helped culminate in ASO spinning off to the private sector in 2019.

In August 2020, authorization bills in the [U.S. Senate and House of Representatives](#) were put forward to fund ASO snow surveys under a Snow Water Supply Forecasting Program, run out of the Department of Interior / U.S. Bureau of Reclamation.

Value of evapotranspiration data: In 2020, WWAO also kicked off a market evaluation study to investigate the value of field-scale evapotranspiration data (ETD) within the private sector. This work will deliver to NASA a survey report with insights into the opportunities and challenges for ETD products.

Other Highlights

NASA Water Portal: WWAO launched an online [Water Portal](#) that catalogs the high-priority western water management needs it has identified and NASA capabilities that could be readily harnessed by stakeholders in the west. The portal is designed for use by water managers and researchers. Stakeholders can submit their own needs and capabilities and explore existing ones through an interactive map and interface. The [Internet of Water](#) invited WWAO to present its new Water Portal to its Board. WWAO also launched a redesigned version of [its website](#) to support the new Portal.

Engagement With NASA Missions: 2020 saw a series of technical interchanges held with NASA's NISAR, SWOT, ICESAT-2, GRACE-FO, GPM and SMAP Earth missions. WWAO shared its online catalog of water management needs with missions in an effort to ensure needs are considered for Science and Applications Traceability Matrices and community assessments. WWAO explored the mission science-team projects for data products relevant to water stakeholder needs.

Conference Sessions:

WWAO hosted a technical session at the virtual American Geophysical Union 2020 Fall Meeting. Entitled "Science to Action: Enabling Science- and Data-Driven Water Management", it featured presentations from 30 key stakeholders in the field. Among many efforts, WWAO gave a keynote talk at the Southwestern Extreme Precipitation Symposium, and is exploring opportunities for collaboration with NOAA and the USDA Natural Resources Conservation Service.

Lessons Learned

WWAO has refined its needs-assessment process and delivered a systematic catalog of water management needs as a result. Demand and interest for NASA applications is high, and WWAO needs to be strategic and selective in what it addresses.

WWAO has delivered several successful technology transitions. The overriding finding is that transition requires dedicated program support from project outset. Transition of applied science into action is a challenge faced across federal (and non-federal) agencies. Even the most “successful” projects may need ongoing resources (e.g. for data maintenance or computational resources that cannot be sustained by the partner). WWAO can define and track project-transition requirements, as well as help project leads communicate to partners the potential impact of the NASA capability on water decisions, which can be crucial for uptake.

Project formulation is non-trivial. To date, WWAO’s project-building approach has required intense programmatic resources, which limits the number of projects that can be undertaken as well as the number of partnerships that can be established. This makes it difficult to address the large number of needs that are uncovered through engagement with stakeholders.

Project teams value systematic, programmatic help with impact assessment from project beginning to end. Understandably, project leads often have neither the expertise nor the resources to deliver a full quantitative impact assessment (à la Theory of Change). WWAO tracks impact criteria as part of its project management, but more in-depth impact measurement may require the program to provide dedicated, cross-project resources.

While there is real interest in NASA from the private sector, partnerships with private entities need to have a well-defined return on investment for the partner to justify their investment in NASA over other opportunities. Collaborations must offer a win-win proposition.

2021 Outlook

At the start of 2021, WWAO will put out a [Request for Information](#) to water stakeholders to seed new projects in the Columbia River Basin, which will be launched later in the year. Three existing projects will transition technology to their partners (USDA NASS, New Mexico Office of the State Engineer, University of California Cooperative Extension and farmers in the west). On the water-management needs front, WWAO will complete its assessments underway in the Missouri and Rio Grande River Basins, and these will add to the catalog of needs in WWAO’s NASA Water Portal. Assuming COVID-19 shutdowns are largely lifted by late spring, WWAO plans to hold face-to-face needs assessments and a Research to Operations workshop in 2021.

Beyond water needs and projects, WWAO will continue to build strategic partnerships with stakeholders and deepen relationships with NASA missions and researchers. WWAO’s NASA Water Portal and Newsletter will aid strategic engagement, as will involvement in NASA’s Space to Farm communications campaign. WWAO will release Project Impact Briefs and highlights, and publish papers underscoring the power of remote sensing in decision making, and how best to bring NASA technology to bear on 21st-century water issues.