Written Testimony of the
WESTERN STATES WATER COUNCIL

Submitted to the
Senate Committee on Commerce, Science, and Transportation
Subcommittee on Space and Science

on
Landsat at 50 & the Future of U.S. Satellite-based Earth Observation

December 1, 2022

The Western States Water Council (WSWC) is a bi-partisan government entity created by Western Governors in 1965 that represents eighteen states. Our members are appointed by and serve at the pleasure of their respective Governors, advising them on water policy issues. Our mission is to ensure that the West has an adequate, secure, and sustainable supply of water of suitable quality to meet its diverse economic and environmental needs now and in the future.

Landsat

The WSWC has long supported the use of remote sensing technologies and data from Landsat missions to improve the measurement and monitoring of consumptive water use through a partnership between the National Aeronautics and Space Administration (NASA) and U.S. Geological Survey (USGS). We wish to express our longstanding and continued support for the past, present, and future Landsat missions, particularly maintaining data continuity and integrity with Landsat thermal-infrared (TIR) and reflected-light imagery.

Recently, the WSWC again reiterated its support for NASA's applied science program, which has led to the use of TIR data available from Landsat 8 and Landsat 9 to measure and monitor agricultural and other outdoor water uses and needs, and is increasingly important for present and future management of our scarce water resources (attached Position #487 – October 21, 2022).

The WSWC has been an active advocate for TIR as an increasingly essential tool for water resource monitoring and management applications in the western United States. Landsat is the only operational satellite having both thermal data and a spatial resolution fine enough to map water-resources use at the level of agricultural fields, which is critical for water management and water rights administration. Landsat data pixel size is well matched to support land and water management applications.

The full suite of Landsat spectral measurements – both thermal and reflected – and with measurement accuracy and quality consistent with previous Landsat missions are important to western water managers and administrators. Typical applications include mapping irrigated lands (by far the predominant use of water in the West) as well as crop type, measuring and monitoring consumptive irrigation uses, mapping and determining the extent of surface and groundwater use,

as well as allocating and administering rights to the use of water, including approval of water rights transfers and consideration of water right "calls."

Water managers are increasingly using Landsat-derived maps to monitor and manage water rights, both spatial and temporal data (seasonal and inter-annual), to evaluate beneficial consumptive use, administer negotiated interstate agreements and monitor interstate compacts, determine allocations for agriculture and urban use, estimate water-use by invasive species, monitor water and food sustainability and security, and to provide information to help forecast and moderate commodity market fluctuations.

State agencies using Landsat data as an element of their water planning and water rights management programs include the California Department of Water Resources (DWR), Idaho DWR, Nevada DWR, Colorado Division of Water Resources; New Mexico Office of the State Engineer (OSE), Wyoming OSE, Montana Department of Natural Resources and Conservation, Nebraska Department of Natural Resources, as well as the North Platte Decree Committee and a growing number of water conservation and irrigation districts. This data is also used extensively by federal agencies, including USDA's Agricultural Research Service, the Bureau of Reclamation, and the U.S. Department of Justice.

None of these applications would be possible without Landsat providing both thermal and reflected imagery from the same platform, which ensures the accuracy of evapotranspiration (ET) evaluations when wetting events occur, during periods of rapid vegetation growth, senescence and stress onset, and when crops are harvested or killed by frost, disease or pests. These are all precisely the types of localized conditions that Landsat is uniquely well-suited to monitor.

The WSWC strongly supports spatial resolution at land and water management scales to build on the 30-year global archive of Landsat data. Image procurement each 8 days, initially, and 4 days, eventually would be ideal. This means that multiple future Landsat missions need to be considered and planned simultaneously. There is a need to accelerate, not delay, policy and funding decisions in order to ensure there are no future data gaps and evaluate the need to build multiple satellites simultaneously. Uncertainty regarding future funding and TIR data availability has been an obstacle to building operational water resources planning, monitoring and management programs that are beginning to flourish.

The western water community worked hard to secure a place for the TIR imager onto both Landsat 8 and Landsat 9, and we will continue to work to ensure that quality TIR imagery remains available as part of future Landsat missions. We also expect to see further innovations in the use of TIR data under a continuation of the existing policy of no-cost data access for all archived and future scenes.

OpenET

Landsat data is also a key component of OpenET, which uses best available science to provide easily accessible satellite-based estimates of evapotranspiration (ET) for improved water management across the western United States. Using the Data Explorer, users can explore ET data

at the field scale for millions of individual fields or at the original quarter-acre resolution of the satellite data. See openetdata.org.

The OpenET consortium is a broad network of collaborators to refine, develop applications, and operationalize the use of OpenET, providing credible, transparent, automated, and easily accessible consumptive water use data across the West. There is a need for monitoring technologies such as OpenET that provide more timely data availability and more refined spatial coverage. Previously, access to satellite and ET data was generally limited and expensive, keeping it out of the hands of many water users and decision-makers. OpenET allows water managers to assess how much water is being used via a cost-effective and easy-to-use web-based platform, filling a critical water data management gap. Landsat 9 and ongoing efforts to define the next Landsat mission help ensure that the data necessary for an operational OpenET program are available.

Agrimet

Similarly, the WSWC has supported the Bureau of Reclamation's Agrimet network of weather stations that provide data that serves as an important and efficient ground-truthing, calibration, and model validation tool for analysis of information products derived from satellite platforms such as OpenET. Agrimet provides basic data on precipitation, temperature, solar radiance, wind speed and humidity required to calculate reference ET and inform remote-sensing platforms. The Agrimet weather observing network suffers from the challenges of aging instrumentation infrastructure, deferred maintenance, need for technology upgrades, and funding that fails to keep up with these needs, making it difficult to maintain data continuity and coverage for users.

NOAA

Recently, the WSWC readopted a resolution on Strengthening the Resiliency of Our Nation to the Impacts of Extreme Weather Events (attached Position #483 – August 5, 2022). The resolution recognizes present water resources planning and sound decisionmaking depending on our ability to understand, monitor, predict, and adapt to droughts, floods, extreme storms, and other weather events. In the West, that requires accurate and timely data on precipitation, and the WSWC has specifically called for "…advancing research within the physical sciences, and dynamical and statistical modeling to improve our subseasonal-to-seasonal (S2S) forecasting capabilities."

The resolution adds, "Investments in observations, research, forecasting, and monitoring the development of extreme weather events provide an opportunity to significantly improve real-time water rights administration, planning and project design, and forecast informed reservoir operations (FIRO) to maximize storage, avoid or minimize the loss of life and property, as well as mitigate economic and environmental damages."

The WSWC has and continues to urge NOAA to place a high priority on investments to improve S2S precipitation forecasting, specifically at an operational time scales, as well as demonstrating the potential for improving extreme event forecasting at all time scales. Moreover,

the WSWC supports climate trend analysis associated with extreme storms and has specifically called for advancing research within the physical sciences, and dynamical and statistical modeling to improve our S2S forecasting capabilities.

Lastly, the WSWC supports reauthorization of the National Integrated Drought Information System (NIDIS), and co-chairs the NIDIS Executive Council together with NOAA and USDA.

We appreciate the opportunity to provide this written testimony, and would be happy to answer any questions.

Position #487
Revised and Readopted
(*Originally adopted Oct 29, 2010 and revised and readopted on October 3, 2013; September 30, 2016; and October 18, 2019.*)

POSITION
of the
WESTERN STATES WATER COUNCIL
regarding
NASA'S APPLIED SCIENCE RESEARCH PROGRAM

Sulphur, Oklahoma
October 21, 2022

WHEREAS, the Western States Water Council is a policy advisory body representing eighteen states, and has long been involved in western water conservation, development, protection, and management issues, and the member states and political subdivisions have long been partners in cooperative federal water and climate data collection and analysis programs; and

WHEREAS, in the West, water is a critical, vital resource (much of which originates from mountain snows) and sound decisionmaking demands accurate and timely mapping of, and data on, altimetry, topography, precipitation, temperature, snow water content, groundwater, land use and land cover, water use, water quality parameters, and similar information; and

WHEREAS, the demands for water and related climate data continue to increase along with the West's population, and this information is used by federal, state, tribal, and local government agencies, as well as private entities and individuals to: (1) forecast flood and drought occurrence; (2) project future water supplies for agricultural, municipal, and industrial uses; (3) estimate streamflows for hydropower production, recreation, and environmental purposes; (4) facilitate water management and administration of water rights, decrees, interstate compacts, and international water treaties; (5) assist in disaster response; (6) assess impacts of climate variability and change; and

WHEREAS, thermal infrared imaging data available from Landsat 8 and Landsat 9 is used to measure and monitor agricultural and other outdoor water uses and needs, and is increasingly important for present and future management of our scarce water resources, and is an example of the application of basic science pioneered by the National Aeronautics and Space Administration (NASA); and

WHEREAS, the ability to use interferometric synthetic aperture radar (InSAR) to measure land subsidence due to groundwater extraction has already been demonstrated, and there are promising research approaches for developing a method to directly measure snow depth using Lidar measurements from the Ice, Cloud, and Land Elevation Satellite-2 (ICESat-2);[1] and

WHEREAS, NASA research has enabled operational use of airborne snow observations; and

WHEREAS, additional airborne and spaceborne remote sensing research and observations have a potential to provide other information on varied temporal and spatial scales that could with sustained engagement focus on transition of research to operations and ultimately be useful for water resources planning, management and decisionmaking; and

[1] NASA Scientist Discovers New Means to Measure Snow Depth from Space | NASA

WHEREAS, NASA has identified the "water and energy cycle" and "water resources" as topics to support in the agency's research and applications programs respectively; and

WHEREAS, NASA's demonstration project on California applications for use of remote sensing information has illustrated that the potential exists for repurposing data collected from certain present NASA missions for water management applications, and that additional potential exists for research applications with sensors planned in future Decadal Survey missions such as the NASA-ISRO Synthetic Aperture Radar (NISAR), which is designed to observe and take measurements of the planet's crust and disturbances, including subsidence due to groundwater pumping; and

WHEREAS, the successful transfer of technology from the research domain to the applications domain or research to operations (R2O) is dependent, in part, on on-going communication between researchers and those responsible for resource management and policy decisions and a long-term commitment to maintain such communication.

NOW THEREFORE BE IT RESOLVED, that the Western States Water Council urges the Administration and NASA to enhance the agency's focus areas on research for water resources applications, and to promote long-term engagement with the Council and the state and regional agencies in the western United States responsible for water management and water policy to maximize benefits to the public from NASA's existing and future investments in Earth observations, Earth system models and systems engineering.

BE IT FURTHER RESOLVED, that the Council supports efforts to advance linkages between NASA's capabilities and water managers' needs, such as NASA/JPL's Western Water Applications Office (WWAO).

BE IT FURTHER RESOLVED, that the Council urges the Administration and NASA to plan and provide for long-term continuity of observations from key sensors such as the thermal infrared sensor and InSAR used in water management.

BE IT FURTHER RESOLVED, that the Council strongly supports a continuing National Land Imaging Program, including existing thermal imaging capabilities, and expresses its strong support for the expedited approval and construction of the Landsat Next mission – while exploring the potential for medium and longer-term advances in technology, design and future capabilities to meet existing and future uses.

BE IT FURTHER RESOLVED, that the Council supports and strongly encourages interagency cooperation, including collaborative efforts between NASA, NOAA, and USGS to move research towards operational applications that inform and improve State water resources management and decisionmaking.

Position No. 483
(*See also Position #435, 7/18/19; #392, 7/15/16; and #352, 6/26/13*)

POSITION STATEMENT
of the
WESTERN STATES WATER COUNCIL
in support of
STRENGTHENING THE RESILIENCY OF OUR NATION
TO THE IMPACTS OF EXTREME WEATHER EVENTS

Polson, Montana
August 5, 2022

WHEREAS, the West and the Nation continue to suffer the effects of increasingly extreme weather events, including tornadoes, hurricanes, extreme precipitation, flooding and drought, resulting in the loss of life and economic, social, and environmental damages; and

WHEREAS, Western States have recently experienced extreme seasonal and year-to-year weather volatility that has brought record or near-record events with floods, followed by drought and wildfires, as well as devastating tornadoes, all threatening public safety and property, and often taxing the capacity of our aging water infrastructure; and

WHEREAS, widespread flooding along many western rivers and streams, including the Clark Fork, Flathead, James, Tanana, Yellowstone, and others, have demonstrated the continuing need for more flood control capacity and early warning systems, with timely and accurate forecasts; and

WHEREAS, there is a need for developing new monitoring technologies such as remote sensing that provide more timely data availability and better spatial coverage for assessing flooding and drought impacts; and

WHEREAS, prolonged drought increasingly afflicts the West and the Nation, and affects the performance of interstate compacts and international treaties; and

WHEREAS, extreme prolonged drought has led to the cooperative development and implementation of the Drought Contingency Plans (DCPs) by the Seven Colorado River Basin States, the United States and Mexico and calls by the Department of the Interior for further reductions in water use; and

WHEREAS, flood control, drainage and other water resource issues also involve relations with Canada, including negotiations over renewing the Columbia River Treaty; and

WHEREAS, present water resources planning and sound decision-making depends on our ability to understand, monitor, predict, and adapt to droughts, floods, extreme storms, and other weather events; and

WHEREAS, in the West, sound decisionmaking demands accurate and timely data on precipitation, temperature, soil moisture, snow depth, snow water content, streamflow, and similar information; and

WHEREAS, investments in observations, research, forecasting, and monitoring the development of extreme weather events provide an opportunity to significantly improve real-time water rights administration, planning and project design, and operations to maximize storage, avoid or minimize the loss of life and property, as well as mitigate economic and environmental damages; and

WHEREAS, the Weather Research and Forecasting Innovation Act of 2017 was reauthorized in 2019, together with the National Integrated Drought Information System Act, and both are soon due for reauthorization; and

WHEREAS, the Council continues to support NOAA's National Integrated Drought Information System, implementation of the Weather Research Act, and emergency drought response authorities for the Bureau of Reclamation and other federal agencies; and

WHEREAS, a National Academy of Sciences' report suggests a pathway and 10-year research agenda for advancing our capabilities with a vision of a decade from now using subseasonal to seasonal (S2S) forecasts as widely as we now use 5-10 day weather forecasts; and

WHEREAS, the Council has urged NOAA to implement the western pilot project for improving S2S precipitation forecasting contained in its 2020 report to Congress pursuant to the Weather Research Act; and

WHEREAS, NOAA has allocated minimal resources for improving the skill of S2S forecasts (forecasts extending from 3 weeks to 2 years); and

WHEREAS, western states' precipitation originates as storms moving over the Pacific Ocean and Gulf of Mexico, and the absence of key ocean observations constrains the ability to improve the skill of precipitation forecasting at near-term weather and S2S timescales; and

WHEREAS, advances in weather forecasting and research, such as that of NOAA's Hydrometeorological Testbed program on West Coast atmospheric rivers, demonstrate the potential for improving extreme event forecasting at the operational time scale; and

WHEREAS, the Council has supported development of an improved observing system for western extreme precipitation events, to aid in monitoring, prediction, and climate trend analysis associated with extreme storms; and

WHEREAS, there is a need for maintaining and improving existing monitoring networks that help provide early warning as well as tracking impacts of extreme events; and

WHEREAS, there is a need for improving precipitation forecasting at all time scales to support implementation of Forecast-Informed Reservoir Operations (FIRO); and

WHEREAS, there is a continuing need for greater collaboration between and among federal agencies, state agencies, local governments, non-governmental organizations and public/private organizations and businesses.

NOW THEREFORE BE IT RESOLVED, that the Western States Water Council supports as a high priority appropriate federal appropriations and actions to plan, prepare for and avoid, minimize or mitigate the impacts of extreme weather events, including implementing the S2S forecasting pilot project recommended in NOAA's report to Congress and implementing NOAA's proposed Precipitation Prediction Grand Challenge.

BE IT FURTHER RESOLVED that the Western States Water Council also supports legislation advancing the goals of: (1) minimizing the loss of life and property and economic, environmental and social cost from extreme weather events; (2) improving collaboration and coordination among agencies and organizations at all levels; (3) increasing consultation with state, local and tribal governments; (4) maintaining and enhancing data gathering and monitoring, as well as communication capabilities, identifying and addressing gaps and overlap; (5) identifying and addressing federal agency responsibilities, as well as regulatory and other preparedness and response barriers, (6) recognizing and addressing regional differences; and (7) advancing research within the physical sciences, and dynamical and statistical modeling to improve our S2S forecasting capabilities.

BE IT FURTHER RESOLVED that the Western States Water Council pledges to work with the Administration and the Congress to appropriately address current and future needs to improve S2S forecasting and extreme events response and resiliency.