# OPENET   Filling the Biggest Data Gap in Water Management

*This document highlights data access benefits of the CA-DWR and OpenET partnership, under contract through spring 2027, which supports Groundwater Sustainability Agencies and other state agencies in advancing sustainable groundwater management across California.*

## What is OpenET?

OpenET uses the best available science to provide easily accessible satellite-based evapotranspiration (ET) data. A key goal of OpenET is to make consistent and accurate ET and consumptive water use information more accessible to support the work of water managers. OpenET provides flexible data services that can simultaneously support individuals exploring near-real-time ET data while also enabling third-party software to automatically access and retrieve ET data for larger areas.

### How are OpenET and the California Department of Water Resources working together?
OpenET has entered into a three-year contract (through spring 2027) with the California Department of Water Resources (CA-DWR) to provide ET data products to state agencies and local entities, including Groundwater Sustainability Agencies (GSAs). This collaboration ensures the availability of consistent, cost-effective, and scientifically vetted ET data to support water management, planning, and Sustainable Groundwater Management Act (SGMA) implementation.

### How does OpenET benefit groundwater management & planning in California?
ET approximates total consumptive water use—water that leaves the land surface and cannot be recaptured or reused. Consumptive use data is essential for accurate water budgeting and often the first step towards proactive groundwater management. In cases where runoff returns to a canal or river and deep percolation returns to the aquifer, ET can be used as an accurate consumptive use approximation. Examples of how OpenET data are applied include:
- **Water accounting platforms**: OpenET enables all water users to easily track and manage their water budgets. OpenET data services can be integrated into third-party software, custom interfaces, and dashboards.
- **Water banking & trading programs**: Satellite-based ET can be used to monitor reductions in consumptive use and serve as a basis for water trading. OpenET data can help water managers determine how much extra water landowners have banked that is available to use at a later date or sell to other users in the basin.
- **Model integration**: OpenET data have been utilized to enhance the representation of irrigation and applied water within hydrological models used for scenario planning and long-term management.
- **Long-term planning**: Evaluating water consumption and demand can support informed long-term planning decisions. OpenET data support the evaluation of trade-offs between different strategies to conserve water, including investments in infrastructure and water-use efficiency, as well as land-use transitions, among others.

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**What is different about OpenET relative to other sources of ET data?**
OpenET includes six commonly utilized, independent satellite-driven ET models and an ensemble ET value that leverages the strengths of the different models for any given land cover type and setting. By working with an ensemble of ET models, the OpenET science team can identify individual model biases and resolve those differences by continually improving each model over time. All models included in OpenET are well documented, and open-access code repositories are available. OpenET data have also undergone the most extensive ground-based accuracy assessment to date. Transparent, reproducible methods and published, rigorously peer-reviewed accuracy evaluations enable open dialogue and engagement with data adopters about how ET data are produced and evaluated.

## Data Access

**What is included in the state-provided data package and what is the spatial coverage, temporal frequency, and time period covered?**
The ET models are operationally run across the western U.S. and provide a consistent, reliable, up-to-date ET dataset at a spatial resolution of 30m x 30m (0.22 acres per pixel) for croplands and other landcover types. OpenET currently provides daily, monthly, and annual data on ET, reference ET (ETo), ETo Fraction (EToF), precipitation, and vegetation conditions at field scales. For California, OpenET uses CIMIS-based ETo to generate ET data at both the daily and monthly timestep. A custom Application Programming Interface (API) for California offers scalable data access to designated personnel, while the Farm and Ranch Management Support (FARMS) tool provides an easy interface for creating custom reports for select locations.

**How do these datasets differ from the existing publicly available OpenET resources?**
For the CA-DWR contract, additional rasters (provided in GeoTIFF format) are made available to support larger-area analyses and expanded data services are made available through a custom API. A monthly ET GeoTIFF data archive, spanning from 2004 through present, has been created using OpenET Collection 2.0. The monthly dataset includes ET and ETo fraction (EToF) data from all six OpenET models, as well as the ensemble value, in addition to Normalized Difference Vegetation Index (NDVI) data. Additionally, daily ET data for select years have also been produced in coordination with CA-DWR and made available as GeoTIFFs. The daily and monthly GeoTIFF data archives are accessible through SGMA-OpenET-California. Please coordinate any questions about the GeoTIFF data archives with Lan Liang of CA-DWR (lan.liang@water.ca.gov).

The California API provides expanded OpenET data access to designated users. The California API supports requests of ET data for larger areas allowing users to download ET data for an entire GSA boundary. The table below details the access limits relative to the publicly available API. Contact cadwr-support@openetdata.org to request information on gaining access to the California API.

| Category | Public Data Quota | CA API Data Quota |
|---|---|---|
| Monthly Request Limit | 100 | 1,000 |
| Maximum Field IDs | 100 | 5,000 |
| Maximum # of Polygons | 50 | 8,000 |
| Maximum Area/Request (acres) | 50,000 | 10,000,000 |

### What tools or platforms are available for viewing and downloading OpenET data?

Data from OpenET can be accessed in multiple ways in a variety of formats. The OpenET Data Explorer, the Farm and Ranch Management Support (FARMS) user interface, and the public OpenET API all provide access to monthly ET data. Additionally, monthly ET data are available statewide from 1999 to present via Google Earth Engine's (GEE) Public Data Catalog. One caveat to data available via the Data Explorer, FARMS, or GEE is that the default meteorological data are from gridMET rather than CIMIS. For access to ET data produced with CIMIS, users should download data from the SGMA-OpenET-California folder hosted by DWR or by using the API.

### Is there a cost to GSAs or their consultants to access or use the CA-DWR OpenET data?

Under the California–OpenET contract, GSAs and designated consultants have free expanded access to OpenET data through the California API through March 2027. The OpenET team can also provide support related to data access and guidance on appropriate use. Please reach out to cadwr-support@openetdata.org for more information.

### What happens to large users of OpenET data products when the CA-DWR/OpenET contract ends?

Providing free and easily accessible ET data to the public is a core mission of the OpenET non-profit and consortium. All OpenET data produced and archived for California under this contract will continue to be publicly available. OpenET will be working with federal, state, and local partners and stakeholders to develop a longer-term support plan that minimizes any potential data access costs to promote reliable, sustained access to higher ET data volumes for planning and water management.

### How can GSAs and their consultants access the state-provided OpenET data?

GSAs and designated consultants can reach out to cadwr-support@openetdata.org. The DWR SGMA Office can also provide information on how to access the resources made available through this contract.

## Data Quality & Use

### What is the spatial and temporal resolution of OpenET data?

OpenET produces daily and monthly data at a spatial resolution of 30m x 30m (0.22 acres). Data production currently covers the 23 most western states. Daily data are available from 2016 to

present. Monthly data are available from 2004 to present. OpenET data can also be aggregated for individual fields or other locations of interest by calculating the average data value for the field at each timestep.

### How accurate is the OpenET data for our region or crop types?

OpenET data have been evaluated at 152 ground-based sites nationwide. ET accuracy varies with time aggregation and data is most accurate when ET values are aggregated to growing season or annual sums. The OpenET ensemble ET value has a relative mean bias error (rMBE) of -2% for the 39 national cropland sites evaluated when aggregated to the growing season. Monthly ensemble ET data show good accuracy for all croplands (rMBE: -5.2%), annual crops (rMBE: -6.0%), orchards (rMBE: -9.4%), and vineyards (rMBE: +4.7%). Further accuracy information can be found in the Nature Water manuscript.

The OpenET team is currently working on a California-focused model intercomparison and accuracy assessment using ground-based measurements in California. A report summarizing OpenET accuracy for California will be completed as part of the work with DWR. Additionally, because OpenET data are made publicly available, ground evaluations have also been completed by scientists and researchers independent from OpenET. In California, ground comparisons have focused on cool-season vegetable crops, almond orchards, a citrus orchard, and vineyards. OpenET embraces open science and sees the scientific peer-review process as an appropriate way to evaluate the validity of ground-based comparisons of OpenET data. A summary of findings from peer-reviewed studies is available on the OpenET website (etdata.org).

### What is the uncertainty associated with OpenET values, and how should it be accounted for in our groundwater models or water budgets?

OpenET data are more accurate for cropland systems and during summer months relative to other natural land uses and winter. The OpenET peer-reviewed accuracy assessment published in Nature Water provides detailed information on the accuracy of OpenET data from each model across multiple time aggregations (e.g. daily to calendar year). For water-year budgets, the OpenET ensemble showed good performance over croplands with rMBE -7.5% and relative mean absolute error (rMAE) 11.3%. Individual models also show good performance, with errors ranging from -14.8% to +2.8% rMBE. For groundwater models, OpenET data can be used to inform irrigated water requirements through the parameterization of crop coefficients or data assimilation.

### What is the latency of OpenET data?

OpenET produces provisional daily ET data as soon as satellite data and meteorological data are available to integrate into the OpenET modeling system. On average, users can expect the provisional daily data to be made available within 2-6 days of an overpass. Provisional monthly ET values are made available within 3-6 weeks of the end of a month.

### How often are OpenET models updated?

An important part of the mission for OpenET is to continue advancing the underlying science. Our goal is to continue to improve the ensemble and individual model accuracies over time. The release of additional OpenET data collections can be triggered by OpenET model version updates or input forcing data source changes. In general, OpenET will consider updates to the models at most once per year. An annual review and update cycle was decided to primarily provide a consistent ET dataset during the growing season. Any new OpenET data collections resulting from changes to input data sources or updated models will have undergone review against the benchmark ET dataset and previous data collection.

## Equity and Transparency

### Are there considerations for using OpenET data in adjudicated or highly litigated basins?

If a GSA or consulting group is interested in using OpenET data in a highly litigated basin, it's important to keep in mind that the data from OpenET do not represent a direct measurement of total applied water or the consumptive use of water applied for irrigation, but rather a computed value for actual ET based on satellite observations and meteorological inputs to the models. OpenET provides transparent methods for producing data and evaluating accuracy to help guide user decisions. OpenET is committed to making iterative improvements in accuracy to ensure a consistent and accurate data source is available to support water accounting and management.

### What steps can GSAs take to help landowners and water users build trust in OpenET data?

- **Share the OpenET website and the OpenET Data Explorer with  users**. The OpenET website (etdata.org) provides information on ET data, model descriptions, prior accuracy assessments, data applications, and other ongoing activities.
- **Clearly communicate what OpenET does and does not provide**. OpenET uses satellite-driven models based on best available science to produce 'actual ET'.
- **Discuss the value of open science and transparent, reproducible ET data** as it relates to water management. Democratizing ET data access allows all water users within a GSA to look at the same information. Transparency in methods and ground evaluations build trust in ET data.
- **Encourage users to look at the data and provide feedback.** OpenET accuracy evaluations show when and where OpenET data are most accurate. However, like every ET data source, OpenET data have an error range associated with the ET value. OpenET welcomes feedback from GSAs, landowners, and water users to better understand which locations and times periods users have concerns about OpenET data fidelity. Capturing this feedback can accelerate model improvements.

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OpenET is committed to providing the best available ET data to support water management. The expert scientists are actively working to make iterative improvements to ensure reliability and consistency across all land covers and crop types.

## Technical Integration

*Can OpenET data be easily integrated into existing GSP tools such as water budget models, groundwater models, or accounting frameworks?*
Yes, OpenET data can be integrated into sustainability plans. Multiple GSAs have integrated OpenET into water budgets, groundwater models, and water accounting frameworks. Please reach out to cadwr-support@openetdata.org if you would like to set up time to connect with OpenET scientists on how to best leverage this resource for your GSA.

*What data formats are available (e.g., GeoTIFF, CSV, API access), and how do they align with our technical workflows?*
Monthly ET state-wide GeoTIFFs data archive has been created using OpenET Collection 2.0 (2004 - present). The monthly dataset includes ET, EToF, and NDVI data from all 6 OpenET models and the ensemble value. Additionally, daily ET data for select years has also been produced in coordination with DWR and made available as GeoTIFFs. The daily and monthly GeoTIFF data archives are publicly available at SGMA-OpenET-California.

Time series of daily or monthly ET data for user-defined areas can be easily accessed from the California API to support GSA applications. Documentation on data formats can be found on etdata.org. Please reach out to cadwr-support@openetdata.org for any support requests.