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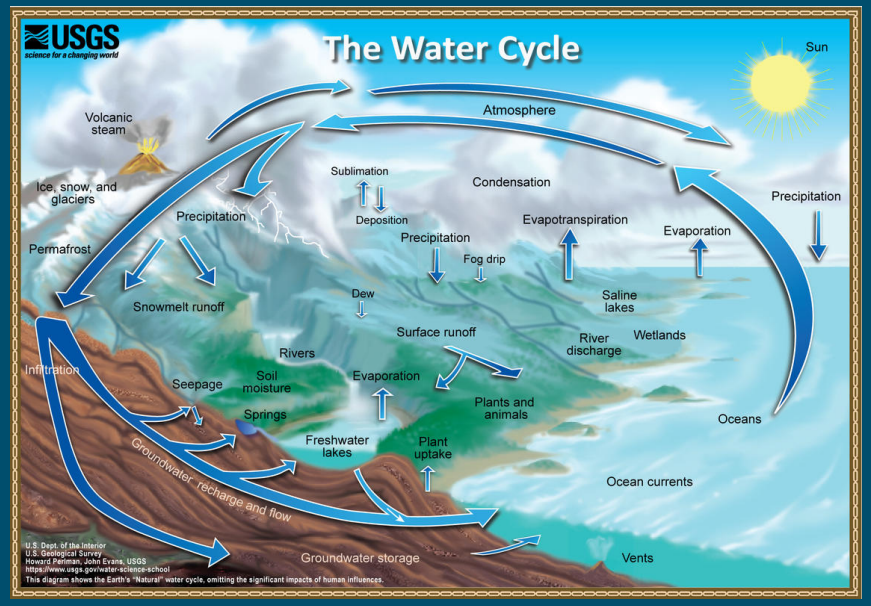
USGS Water Budget and Water Use Science

As part of the USGS Water Availability and Use Science Program Strategy

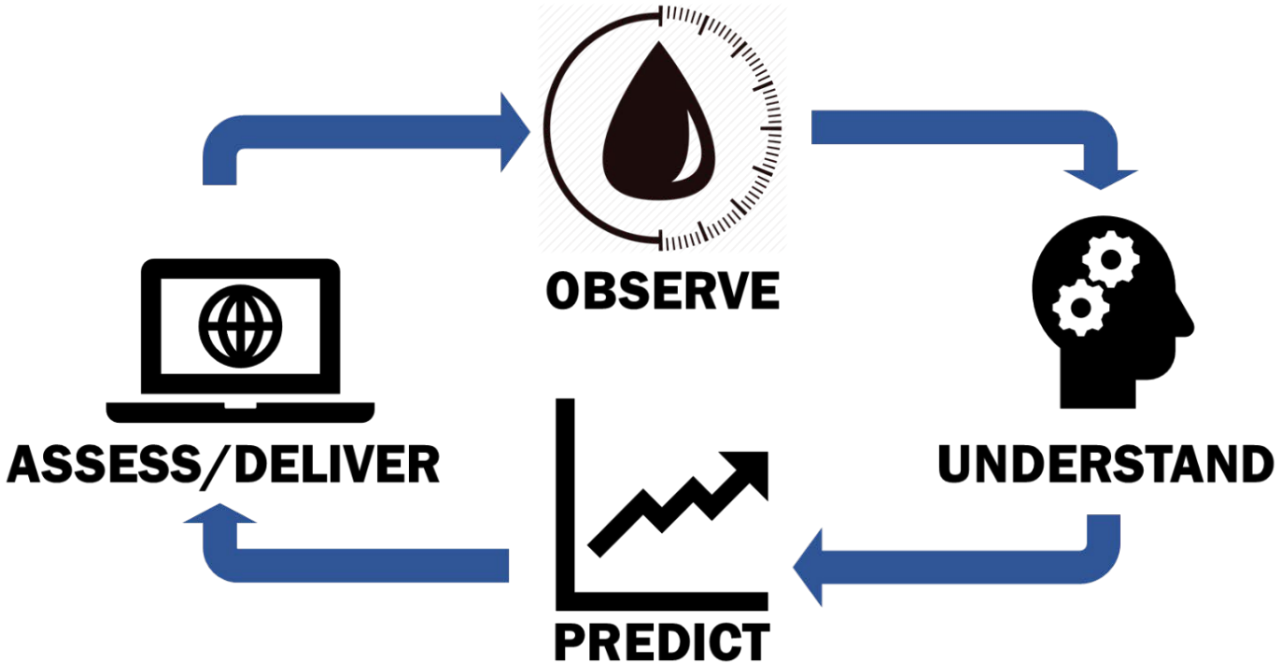


Jaime Painter, USGS Program Manager for Water Budget and Water-Use Science

Great Lakes-St. Lawrence River Water Resources Regional Body/Compact Council Meeting

December 8, 2021

Water Mission Area Strategic Science Priorities



Portfolio	Subsidiary Portfolio	Program
Water Observing Systems Portfolio (WOSP)	Observing Systems	Next-Generation Water Observing System Program
		National Hydrologic Monitoring Program
		Water Hazards Program
	Data Systems	NWIS Modernization Program[a]
		Data Cyberinfrastructure and Information Delivery Program[a]
Water Resources Availability Portfolio (WRAP)	National Water Census	Integrated Water Availability Assessments Program
		Water Use Program
		Ecoflows Program
		Drought Program
	Water Prediction and Information Delivery	Integrated Water Prediction Program
		NWIS Modernization Program[a]
		Data Cyberinfrastructure and Information Delivery Program[a]
	High Impact Hydrologic Research	Water Budget Program
		Social and Economic Drivers Program
		Water Quality Processes Program
		Water Availability Impacts of Extreme Events Program

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National Water Census

- Systematically provide information that will allow resource managers to assess the supply, use, and availability of the Nation's water
  - Help in the discovery access and use of foundational data and models
  - Near-term information
  - Long-term trends in water availability in the nation
  - Use of consistent methods that are well-documented
  - Uncertainty
- Requires integrated science

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Water Budget Science

Deliver methods for estimating water budget components that improve representation of water budget processes and reduce uncertainty at a range of spatial and temporal scales

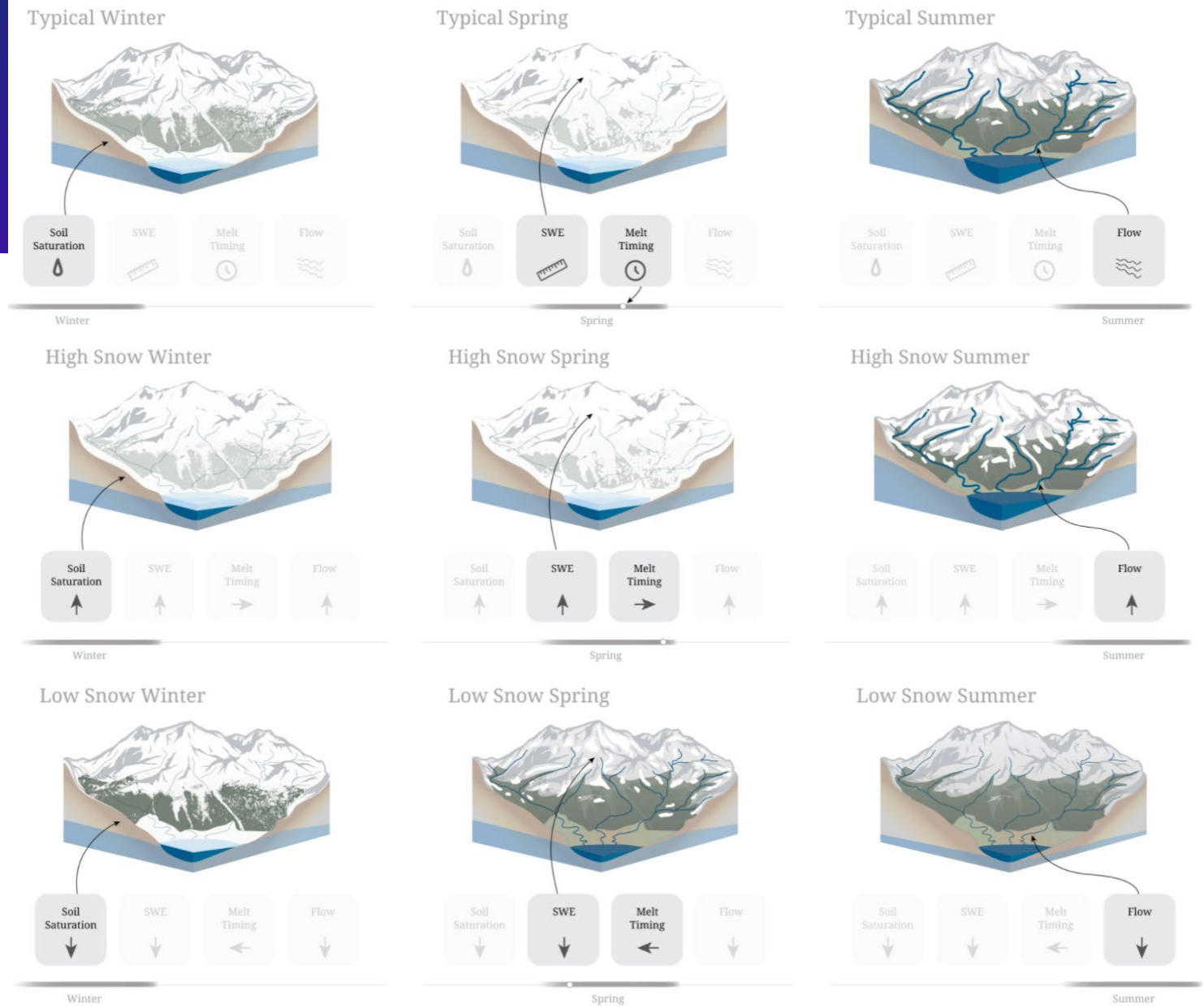
- Understand each component of the water budget, the processes that influence each component, and how changes in the quantity and timing of each component may impact water availability for both human and ecological uses.
- Methods for quantifying and representing water budget components are imbedded into hydrologic modeling approaches at national, regional, and local scales yet predictive ability, accuracy within a holistic water budget and user feedback must be elevated as new data sources and methods are available to enhance resolutions and reduce uncertainty.
- Assess data worth, statistical models, deterministic simulations, field and lab experiments
- Precipitation, groundwater-surface water interactions, groundwater recharge, infiltration and runoff, evapotranspiration, snowpack, soil moisture and streamflow
- Prioritize research on components based on ability for most impact to improve accuracy

Current activities

- Water Budget Baseline Project
  - Evaluating current state of the science
    - Evaluating capability to represent processes and translate water budget estimates between local, regional, national scales
    - Identifying uncertainties in measuring, scaling, and modeling water budget components
    - Hydrology model skill- USGS and Partner models
  - Using Integrated Water Science Basins as areas for scaling evaluation (East River, Colorado; Neversink, New York)

Current Activities

- Snow Hydrology Project
  - From Snow to Flow (usgs.gov)
  - Improve representation of snow water equivalent (SWE) and snow processes in models.
  - Simulation of snowpack accumulation, ripening, sublimation and snowmelt timing, duration, and relation of these processes to streamflow through modeling approaches
  - Quantification of the sensitivity of simulated streamflow to the timing and duration of snowmelt and related snow processes.



Next for Water Budget Science

- Systematic research and method development or enhancement for each water budget component
- Priorities based on ability to improve accuracy
  - ET- partnership with OpenET
  - Soil Moisture

Long history of Water Use Reporting

1950 — 1st National report of Estimated Use of Water

1978 — Establishment of National Water Use Information Program

2002 — **NAS Assessment of National Water Use Information Program**

2009 — **SECURE: Establishes the National Water Census and WUDR**

2015 — 1st Water Use Data and Research (WUDR) awards to state agencies

2018 — **NAS Direction for USGS to address future water priorities**

2020 — **Transition toward better integration and enhanced products**

Publications

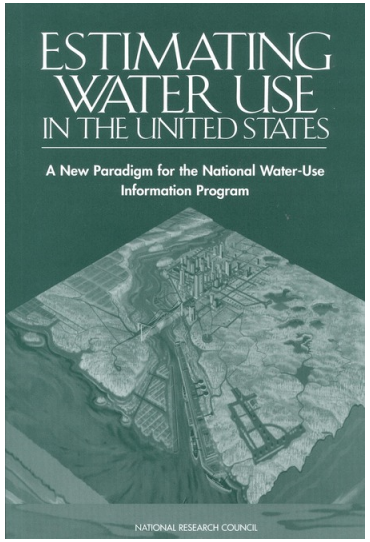
Estimated Use of Water in the United States

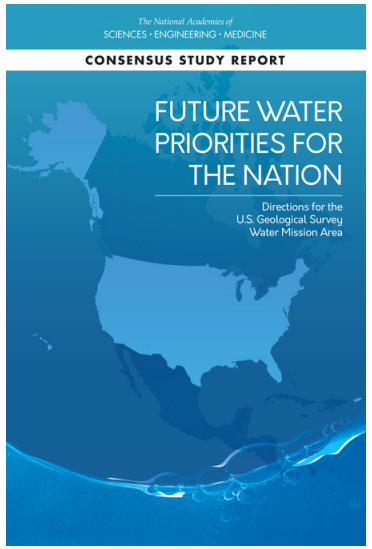
Comparison of water-use categories over the history of these reports

Data downloads

1950 1955 1960 1965 1970 1975 1980 Map report

1985 1990 1995 2000 Fact sheet 2005 Fact sheet 2010 Fact sheet 2015 Fact sheet





"this is an exciting time to consider the possibilities for new directions for a program that has served the nation well in the past but needs some reorientation to continue to serve the nation." (2002, NAS)

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National Water Use Reporting:

Should:

- Be comprehensive and include uncertainty
- Include estimates of consumptive and non-consumptive water use (withdrawals and losses and returns)
- Identify spatial and temporal patterns of water use (seasonal and sub-seasonal)
- Provide estimates for both groundwater and surface water
- Be easily integrated with other water budget components and included in USGS modeling and assessments
- Be available in near-real time

Should inform:

- How do we use water?
- Do we have enough water for future needs?
- How have we changed the way we use water, and why?
  - What impacts do land-use, climate, and socio-economic changes have on water needs?
  - What impacts do management decisions have on water use?
- How might our ways of using water change in the future, and how would that be affected by changes in water quality and quantity? Example: water use changes due to the development of new energy supplies
- Adaptive water management strategies.

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Where are we going?

Develop an operational system for estimating and forecasting water use and transfers nationally

Focusing in 4 critical areas:

1. Enhance the collection and completeness of water use information. Striving for automated transfer of necessary water use information, in coordination with partners
2. Build data driven and process driven models that establish nationally consistent estimation methodology and uncertainty in those estimates
3. Develop methods that quantify and trace the movement of water over the landscape
4. Integrate forecasting targets into models

Current activities:

Actively engaged in data discovery and building tools to automate the collection, evaluate and quality check, and format data for integration into modeling approaches.

- Focus on site-specific information.
- Data to understand the timing, location, and quantity of water used (climate, landscape, social and economic info)

Building water withdrawal models for Public Supply, Crop Irrigation, and Thermoelectric

- version 1 output due December 2022.
- Monthly estimates for 2000-2020 at HUC12 scales
- + Consumptive use for crop irrigation and thermoelectric
- **Continued enhancement post 2022**

Researching methods and building approaches to trace and quantify the movement of water from place of withdrawal, to place of use, and to potential returns to a water source for future use. Quantifying losses and inefficiencies along the way.

- Interbasin Transfers
- Deliveries from Public Water Suppliers
- Conveyance and System efficiencies for irrigation

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Near-term products

In 2023:

- 2000-2020 monthly water withdrawal estimates for Public Supply, Irrigation, Thermoelectric at HUC12 spatial resolution (with uncertainty)
  - + Consumptive Use for Irrigation and Thermoelectric
  - + Water Service Area boundaries (geospatial)
  - + Annual irrigated field polygon data (LANID) (in collaboration with University of Wisconsin)
  - + Domestic Per Capita use maps
- 2000-2020 monthly withdrawal estimates for continuous oil and gas development-Permian at HUC-12 (with uncertainty)
  - + Operational model to be applied across the nation in areas of COG is the goal

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Next Steps:

- Beginning in FY23
  - Establish model strategies and begin development on models for other categories of self-supplied use.
    - Industrial, Mining, Aquaculture, Livestock, Domestic, (golf irrigation?)
    - Sub-categories will be addressed. Example: Water withdrawals and use for a particular type of industry (NAICS code).
  - Establish forecasting targets and integration strategies for all categories of use
    - Includes additional social and economic information
    - Potentially integrates water governance and management information
    - Triggers that change demand/use

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Enhanced National Water Use information

- requires **collaboration with groups outside USGS**
- identifies opportunities where data and method development would be more efficiently performed through collaborations and investing in jointly aligning projects and products of other groups with USGS
- highlights data sharing challenges and limitations with current collections (data latency)

Thank you!

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