

The background of the slide is a high-speed photograph of water splashing, creating a dynamic and textured blue surface with many small droplets and ripples.

OWP | OFFICE OF
WATER
PREDICTION

Hydrologic Ensemble Forecast Service - Supporting FIRO

September 21, 2023



HEFS Status

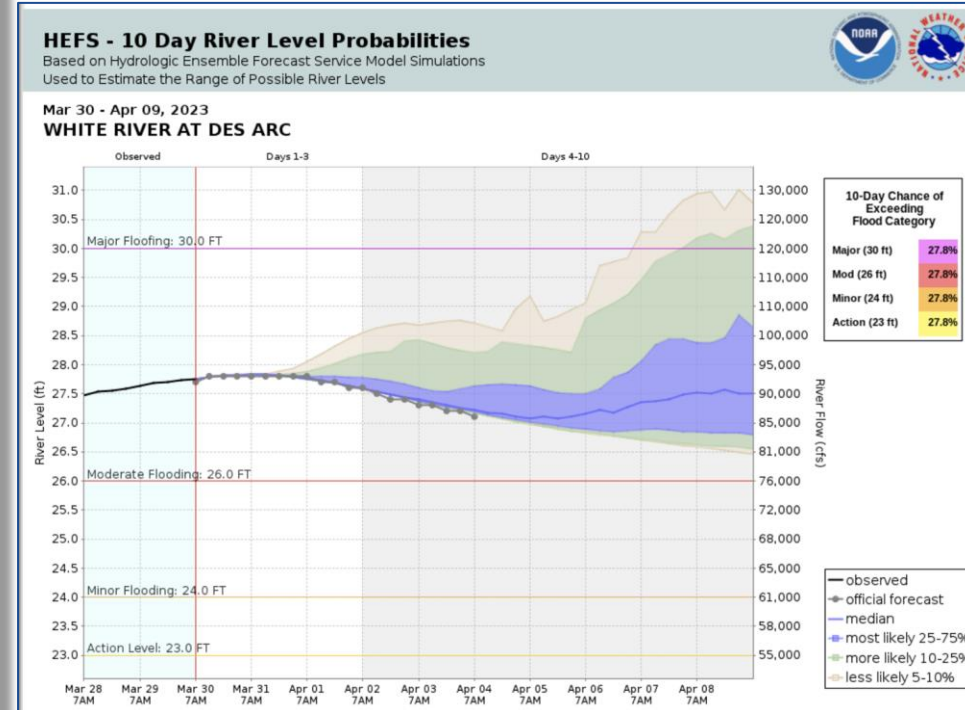
HEFS Forecasts:

- Span lead times from one hour to one year
- Are reliable, skillful, and account for both the meteorological and hydrologic uncertainties
- Are dependable (**consistent with retrospective forecasts**) and adequately verified
- Better inform user's decisions (**compatible with/support decision support systems**, e.g., NYCDEP, FIRO)

Implementation Status:

- More than 2700 river locations display HEFS experimental short and/or long-range products
- Baseline validation completed at more than 3500 river forecast locations
- Leverage GEFSv12 model forcings
- **By May 2023, NWS will complete implement of HEFSv1 at nearly 3600 service locations**

White River as Des Arc, AR





HEFS Forecast Point Locations

NWC National Water Center

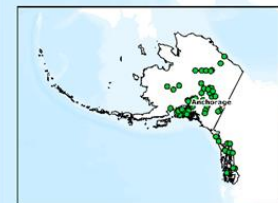
• HEFS Forecast Points

• Major U.S. Cities

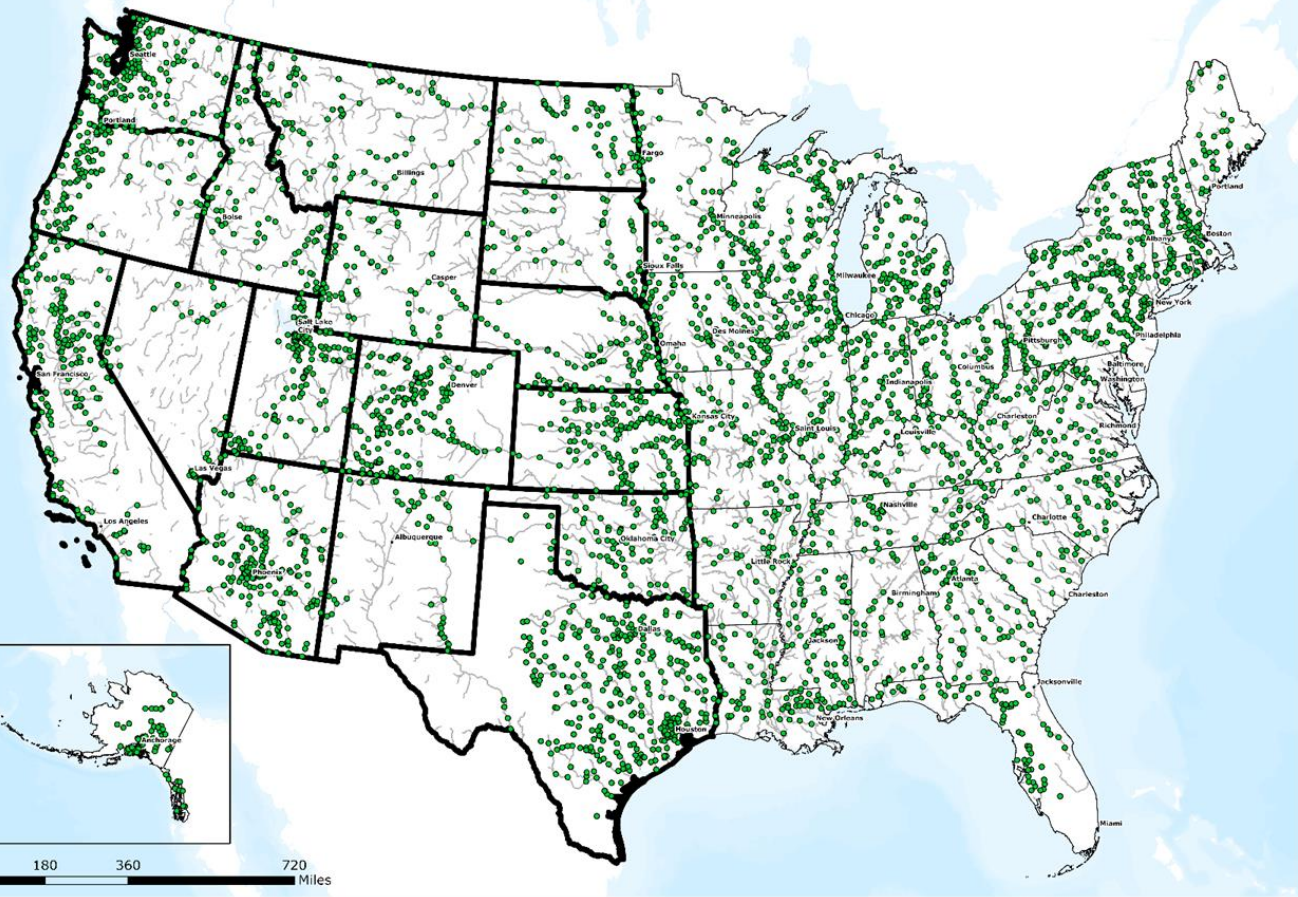
— Major Rivers

▭ U.S. States in Western Governor's Association

▭ U.S. States



0 180 360 720 Miles



HEFS Service and Science Improvements

TRACK 1: Short-term (1-3 yrs) improvements to existing framework

Improvements to HEFSv1 Software and Implementation

****CBPR+ECC to improve large event forecasts from MEFP****
****Add modeling of freezing level****
****Eliminate the forced diurnal pattern****
****Full evaluation of EnsPost****

Improvements to Archiving and Verification

HEFS data to WRDS
RFCs archive
Mods and states with FEWS Open-Archive

Improvements to Dissemination and Data Services

Customizable graphics and data downloads
Historical data viewer

TRACK 2: Longer-term (3-5 yrs) R&D

Better meteorological post-processing

Centralized meteorological post-processing
Alternative statistical model structures

Combine information from multiple models over the same time horizon
Use full information content from forecast ensembles instead of just the mean

Better hydrologic post-processing

Roadmap for source-based accounting of uncertainties
statistical model structures to better represent complex hydrologic simulation errors

Better seasonal/sub-seasonal forecasts

Evaluate skill of longer lead-time weather models (e.g. 3-4 weeks)
Evaluate alternative/additional predictors

Evaluate alternative statistical approaches to generate site-specific seasonal hydrologic forecasts

New Water Resources Cooperative Institute

Addressing Basic and Applied Research Needs, and Supporting
Research to Operations Activities



NOAA established a new NOAA Cooperative Institute (CI) in April 2022, managed by the NWS Office of Water Prediction

- Focused on addressing the Nation's growing water challenges
- Foundation for a critical, first-ever relationship with the academic community focused on operational hydrologic prediction
- Leverages talent and diversity from multiple universities to lead an interdisciplinary, systems-based research approach to seed new and improved operational services
- First Annual CIROH Science Meeting held at the University of Alabama in October 2022
- CIROH Training and Developers Conference held May 16-18, 2023 at the University of Utah

Advance Water Resources Prediction Capabilities

- Prediction system testbed
- Inputs, forcings, data assimilation
- Model and forecast evaluation

Advance and Accelerate Community Water Resources Modeling Development

- Research cyberinfrastructure
- Hydrologic process; AI/ML models
- Continental-scale modeling

Research Themes

Develop Innovative Hydroinformatics Solutions

- Flood inundation mapping
- User interaction & analytics
- Impact & risk assessment

Apply Social, Economic & Behavioral Science to Water Resources

- Risk perceptions and behaviors
- Improving forecasts for underserved
- Building community resilience

New Water Resources Cooperative Institute

Summary of Ongoing and New Projects



Projects Started FY22

- Water Prediction Extensions and Stakeholder Applications
- R2O Coordination between CIROH and NWC
- Integrated Model Evaluation, Validation and Forecast Verification
- Hydroinformatics Data, Interfaces and Analytics
- Forecast Design, Decision Science, and Community Resilience
- Flood Inundation Modeling and Mapping
- Community Water Model Testbed and Operational Prediction System Test Battery
- Community Water Model Infrastructure, Stewardship, and Integration
- Analysis and Demo of the NWM's Applicability to Community Resilience
- Advancing the Nextgen Hydrologic Model and Hydraulic Routing

Dr. Ximing Cai (Illinois)

Dr. Ming Pan (Scripps)

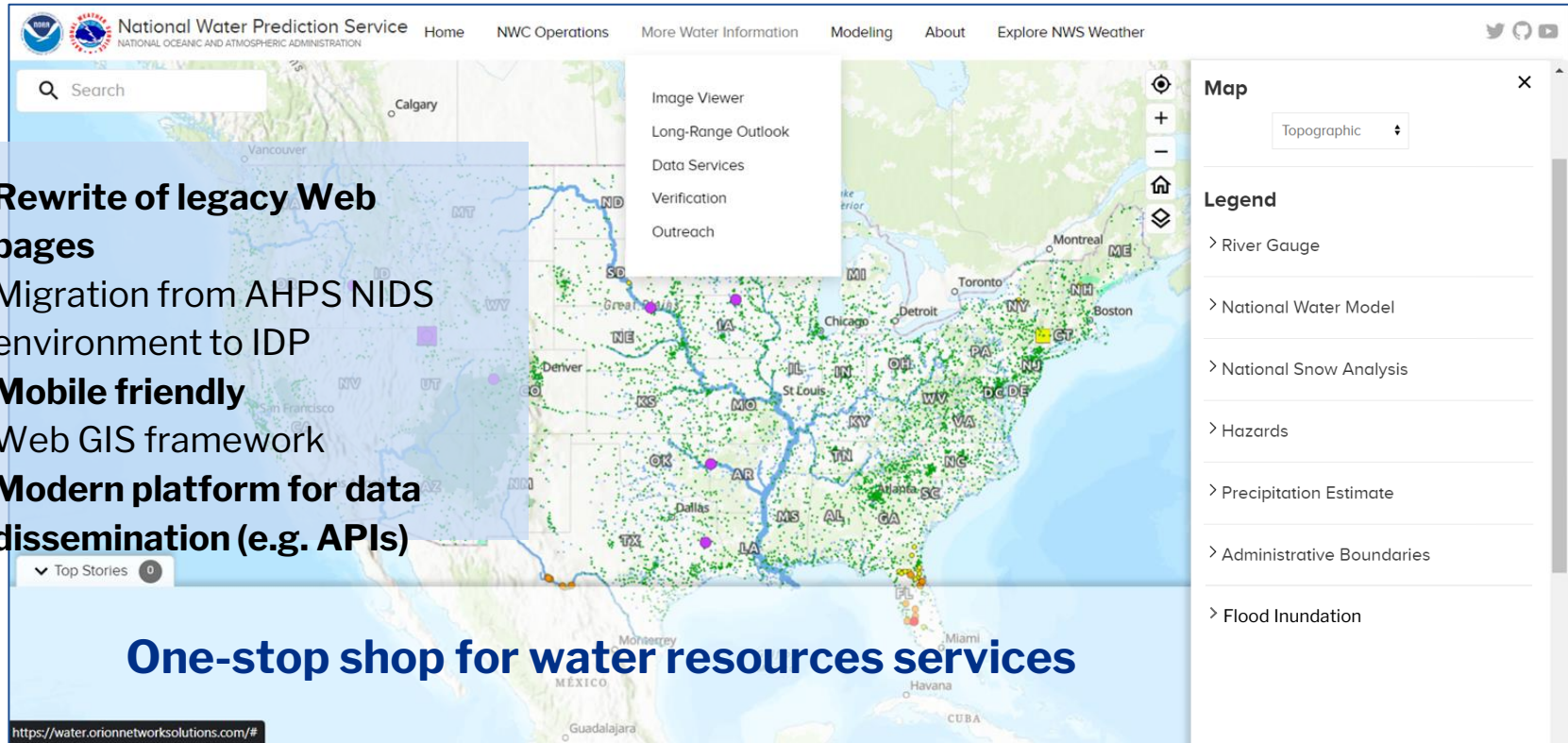
Subset of Projects Selected for Funding in FY23

- Developing and Refining Ensemble Streamflow Forecasts in Nextgen and RFC HEFS
- Investigating Model Complexity, Structure, Land Surface and Forcing Heterogeneity
- Improving NextGen Process Representations and Performance in Cold Regions: The Yukon River Basin
- Pathways to Using Multi-Model Mosaics for Operational Hydrologic Prediction
- Novel Geospatial Architecture of Channel and Floodplain in OWP Hydrofabrics
- Comparative Assessment of the NWM Channel Routing Models
- Modeling Community Trust: Collaborative Approach to Scoping NWM Forecasting Needs for Native American Communities in Northeastern Oklahoma
- ML-based Flexible Flood Inundation Mapping and Intercomparison
- Hydrologic Process Synthesis Across Diverse Landscapes
- Optimizing Flood Warning Information Sharing for Local Stakeholders
- Community Crowdsourcing Application of Water Related Hazards
- Examination of the Value of QPF for Streamflow Forecasting
- Forecast-Informed Reservoir Operation for Flood Risk Reduction
- Multi-Source Hydrological Source Augmentation for CHPS-HEFS Forecast System

The National Water Prediction Service (NWPS)

COMING MARCH 2024

- Rewrite of legacy Web pages
- Migration from AHPS NIDS environment to IDP
- **Mobile friendly**
- Web GIS framework
- **Modern platform for data dissemination (e.g. APIs)**



One-stop shop for water resources services

HEFS Gaps Analysis

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Towards Suite of NWPS Public API Services

National Water Prediction Service API 0.0.1

[swagger.json](#)

API for the National Water Prediction Service's hydrologic products.

[National Water Center - Website](#)

[Send email to National Water Center](#)

Schemes

HTTPS

[https://api.water.noaa.gov/v1/\[gauges, reaches, products\]](https://api.water.noaa.gov/v1/[gauges, reaches, products])

Authorize



Gauges



GET

[/v1/gauges](#) Gets a list of gauges.

GET

[/v1/gauges/{identifier}](#) Gets a gauge and it's metadata.

GET

[/v1/gauges/{identifier}/ratings](#) Get ratings for a gauge (sort is based off of STAGE data, limit defaults at 10,000 records, all defaults false)

GET

[/v1/gauges/{identifier}/stageflow](#) Gets observed and forecast stage/flow product data for a gauge.

GET

[/v1/gauges/{identifier}/stageflow/{product}](#) Gets observed or forecast stage/flow product data for a gauge.

Q4FY24 / Q1FY25

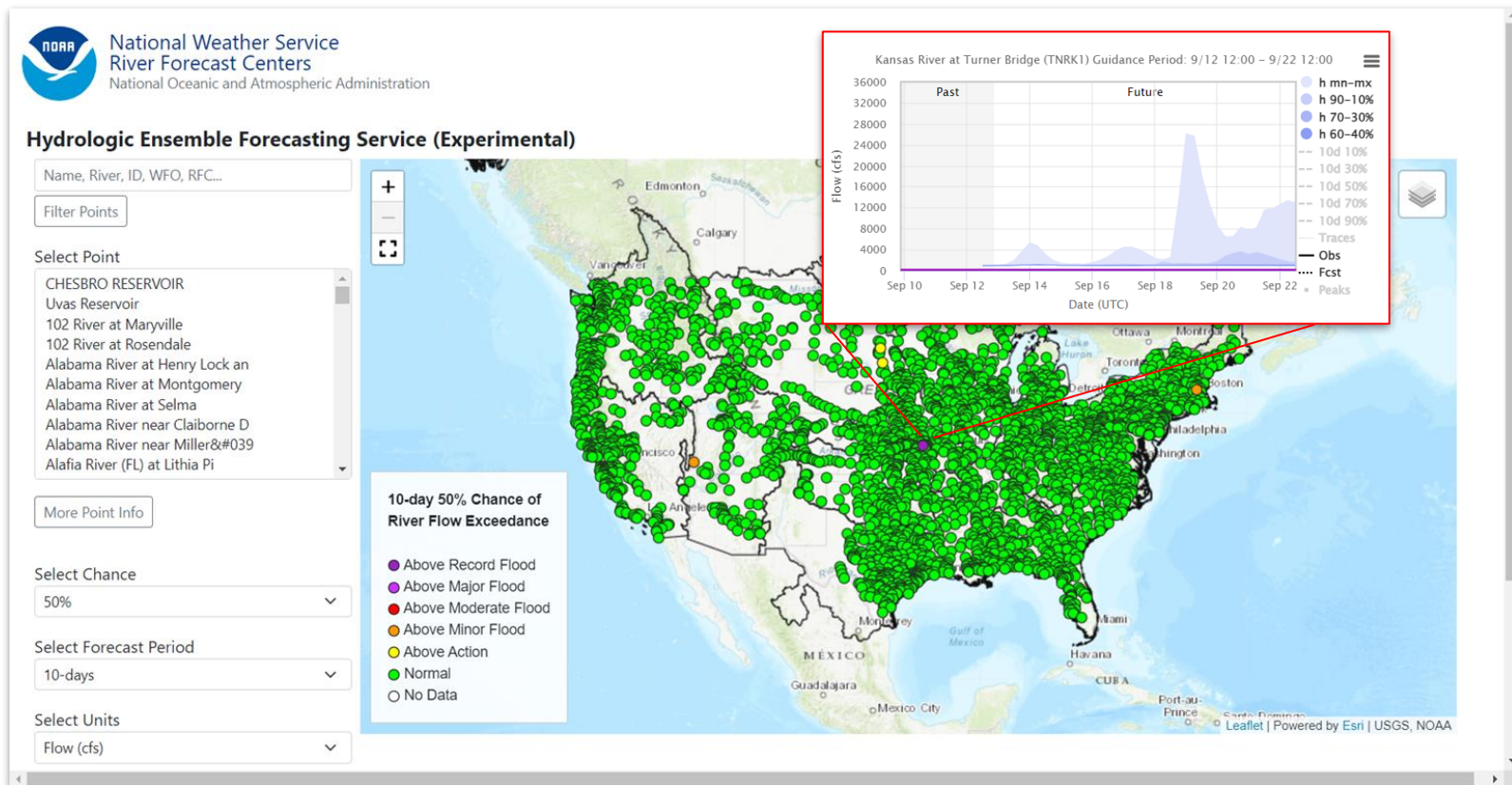


Development and Demonstration Activities

- HEFS API is the top development priority for the Water Resources Data Service (WRDS) project going into FY24
- WRDS has demonstrated the implementation of an HEFS API on the NWC infrastructure
 - `api.water.noaa.gov/v1/hefs/[series, ensembles, events, archive]`
 - Series metadata:
 - `location_id, station_name, parameter_id, ensembled_id, time_step_unit, start_date_date, start_date_time, end_date_date, end_date_time, forecast_date_date, forecast_date_time, miss_val, lat, lon`



HEFS Visualization





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Thank You!



Edward P. Clark



edward.clark@noaa.gov



<https://water.noaa.gov>