



NOAA
WEATHER
PROGRAM OFFICE

Dec 11th, 2022

Recent NOAA/OAR Hydrology and Precipitation Activities

WPO Subseasonal to Seasonal Program

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WE FUND RESEARCH TO IMPROVE FORECASTS

The Weather Program Office is a Program Office within NOAA Research that funds weather-related research.

Our aim is to integrate cutting-edge weather research into operational forecasts for the public, and to support innovative weather research to continually improve our understanding of weather phenomena.

Our Vision

A WEATHER READY NATION
powered by innovative research.

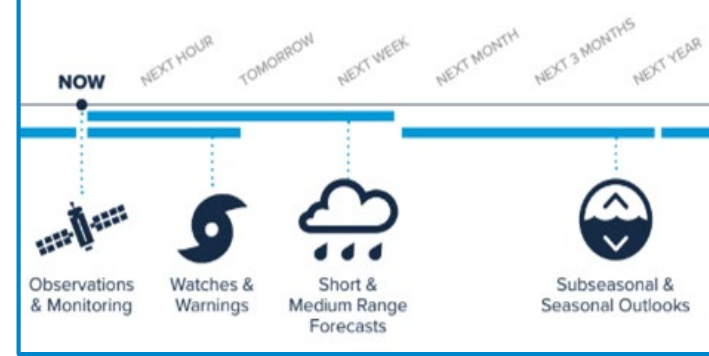
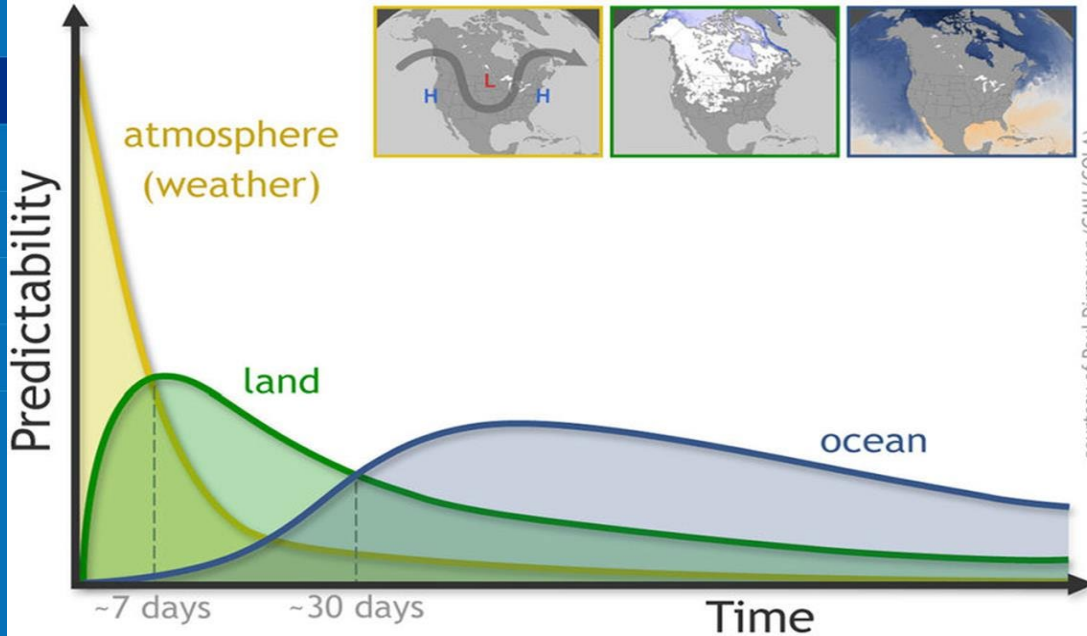
Our Mission

Driving collaborative weather research to develop and transition products and services that ensure accurate and actionable weather forecasts for all.

FORECAST FOCUS

NOAA provides a suite of weather and climate products from near-term forecasts to long-term projections.

- Tailored to stakeholder needs: help create jobs, boost economies, and build resilience to extreme events.



S2S FOCUS

The S2S program emphasizes global coupled modeling in the UFS, plus postprocessing and tools to support products.

- Modeling, product development driven by partner requests and stakeholder outreach.



ALIGNMENT WITH THE WEATHER ACT

The Weather Research and Forecasting Innovation Act bolsters OAR's commitment to advancing weather research and reinvigorating the weather portfolio.

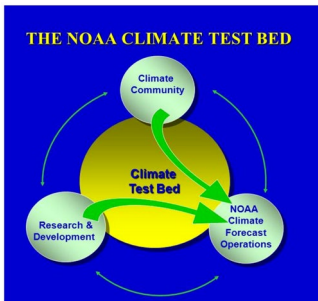
WPO leads in developing OAR's reports required by Congress for the Weather Act.

The Weather Research and Forecasting Innovation Act of 2017 (i.e. "The Weather Act") aims to:

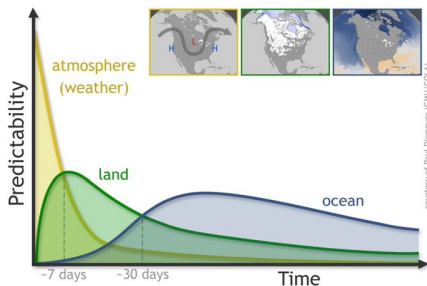
- Improve NOAA's weather research through investments in observational, computing, and modeling capabilities
- Support improvement in weather forecasting and prediction of high impact weather events
- Expand commercial opportunities for the provision of weather data.

Widely viewed as the first comprehensive weather authorization since the NOAA Authorization Act of 1992, the Weather Act is leading the charge for improved forecast and warning systems to build a Weather-Ready Nation, as well as the integration of social science and unified modeling capabilities.

WPO S2S Program: How WPO supports S2S



Climate Testbed
(high RL)



S2S Research Call
(low RL)



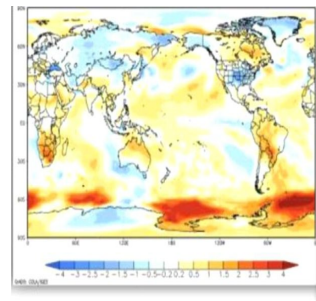
FY22 NOPP

External
funding calls
(NOFOs)

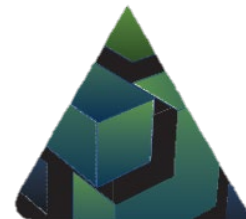
Internal/
external
partnering
efforts



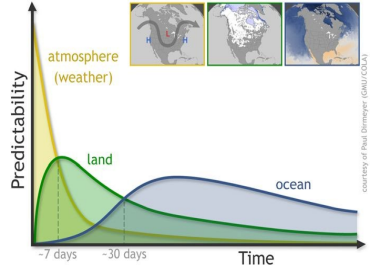
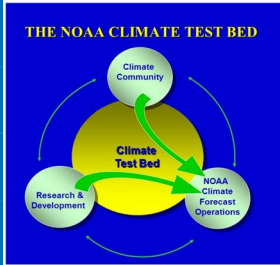
OAR-NWS/AFS
projects



Multi-Model Ensembles
(NMME, SubX)



ICAMS support



WPO S2S NOFO efforts

Emphasize UFS, coupled DA, ensembles and statistical post-processing

FY 2019 S2S (RL 2-4) call:

- 6 3-year projects emphasizing precipitation by improving stochastic parameterization, MJO/QBO/circulation regime characterization, calibration

FY 2020 CTB call:

- 4 2-year projects improving subgrid-scale parameterizations, storm track assessment, ensemble systems, ENSO/MJO diagnostics

FY 2022 call:

- 6 3-year projects advancing land modeling (snowpack, dynamic vegetation, integrated surface physics), ensemble modeling of precipitation extremes, and perturbations for data assimilation
- 4 2-year projects supporting improvements to atmospheric river prediction, MJO teleconnection diagnostics, aerosol reanalysis for DA, temporal/spatial error diagnostics

FY 2023 “Innovations” competition <https://www.grants.gov/web/grants/view-opportunity.html?oppld=343188>:

- Focus on SFS component/coupling improvements, coupled data assimilation to improve precipitation, drought, hydrology prediction
- Proposals received; in review

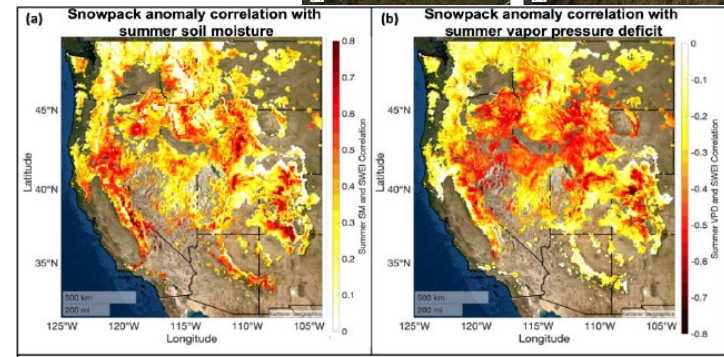
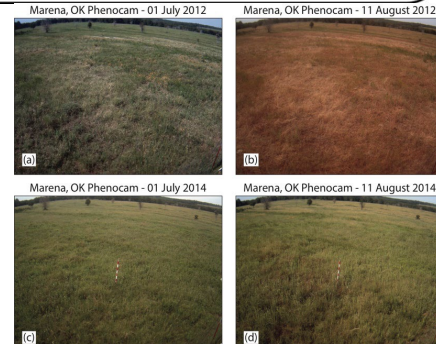
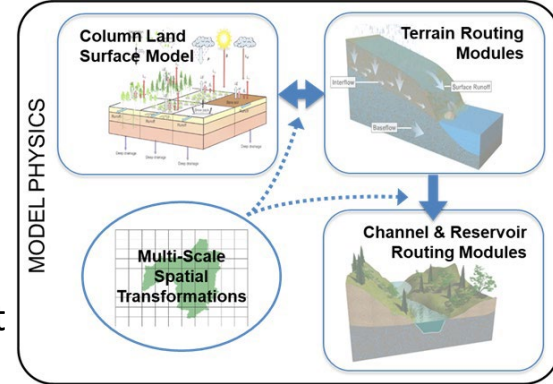


Close coordination between WPO programs, with EPIC; pushing PIs to leverage EPIC resources



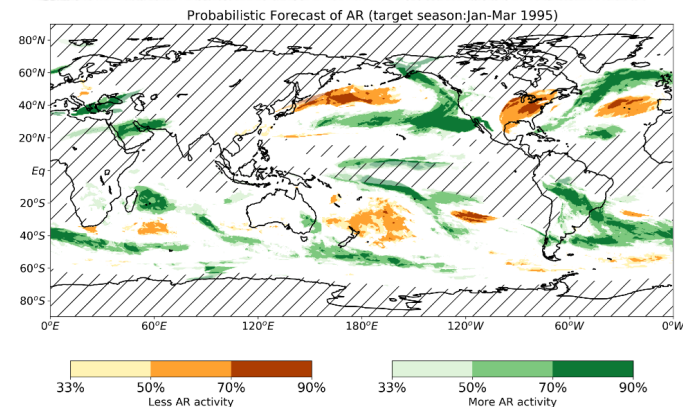
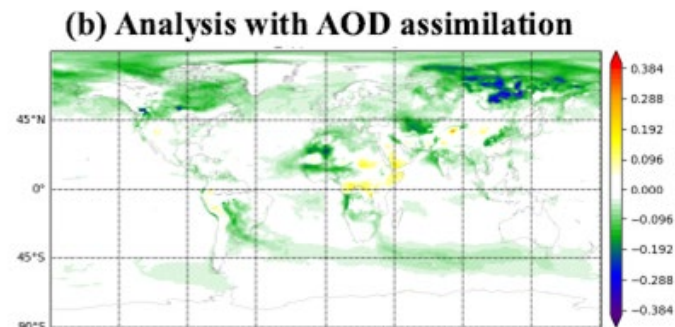
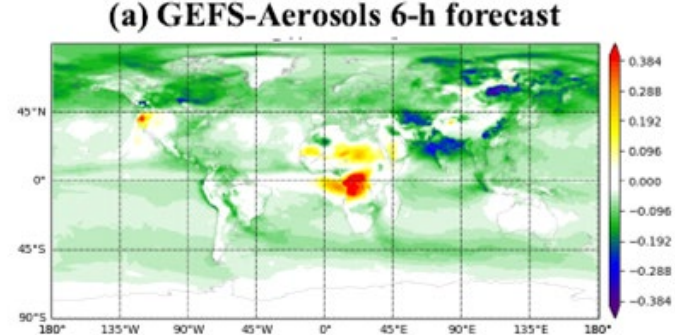
S2S RL 2-4 highlights: emphasize UFS, results for drought/hydrology

- David Gochis (NCAR) - Integrated surface physics for coupled hydrometeorology in the UFS for S2S prediction
 - Extend Noah-MP+WRF-Hydro globally, update coupling, to connect NWP→S2S terrestrial hydrologic processes
- Jason Otkin (U Wisc) - Assessing the impact of dynamic vegetation on drought forecasts
 - Compare UFS vegetation treatments, particularly flash drought
 - Enhance METplus with new verification tools evaluating accuracy of UFS land surface, land-atm coupling
- Cenlin He (NCAR) - Enhancing NOAA UFS subseasonal to seasonal predictions of precipitation and drought via improved representation of snowpack processes
 - Advance understanding/modeling of aerosols, vegetation, processes on snowpack in UFS—correlates with summer vapor pressure



CTB highlights: emphasize UFS and tools, results for drought/hydrology

- Bo Huang (CU Boulder) - Development of a Global Aerosol Reanalysis at NOAA in Support of Climate Monitoring and Prediction: adds a variable to JEDI-based DA
 - Aerosol Optical Depth assimilation is crucial for one of UFS components
- Baoqiang Xiang(UCAR/GFDL) - Transitioning NMME-based seasonal predictions of atmospheric river activity into an operational forecast product: goal is NMME-based seasonal AR forecast tool
 - Probabilistic seasonal AR activity by model, and ensemble aggregate
 - Skill measure (likely Heidke Skill Score)
 - Possible: probability of enhanced/suppressed AR-precip





National Ocean Partnership Program

<https://nopp.org/>

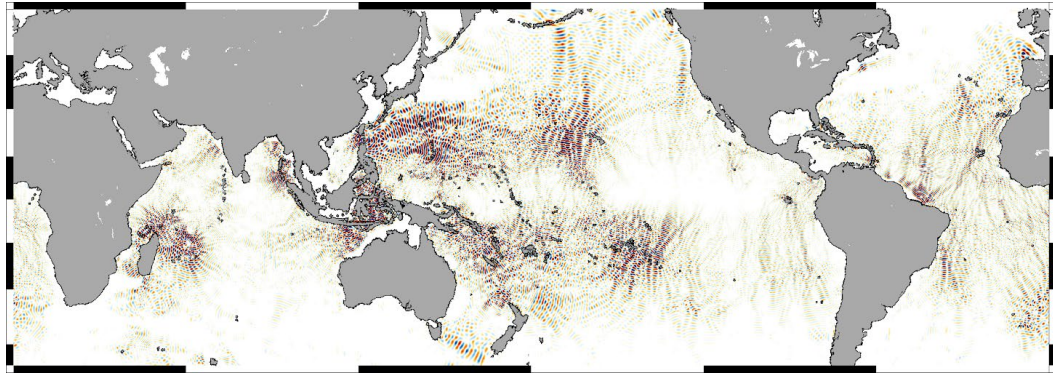
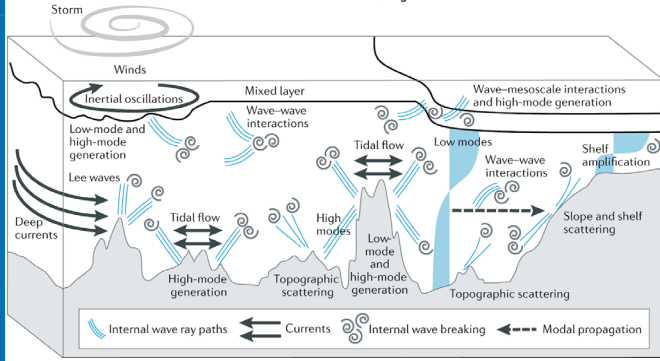
WPO participated in FY22 year's [ONR Broad Agency Announcement](#) for NOPP, for cross agency collaboration.

- Topic “High Resolution Ocean Models for Coupled Earth System Prediction Across Space and Time Scales”
 - co-drafted with ONR, NWS (STI, EMC)

- WPO’s interest:
 - high-resolution MOM6 projects
 - leverage NOAA NOPP matching
 - partnership with other agencies
- Selected one project
 - Enhancing the realism of MOM6-SIS2 simulations with ocean tides: Ed Zaron, OSU
 - Benefits ocean energy transfers, lateral boundary conditions for coasts, Arctic ice dynamics

MackKinnon et al. 2017

Internal wave-driven mixing

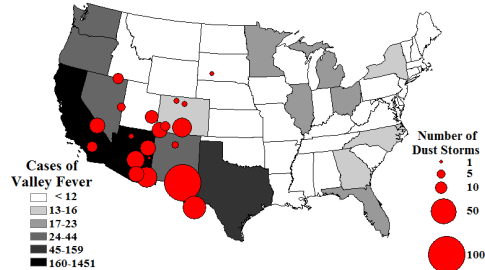
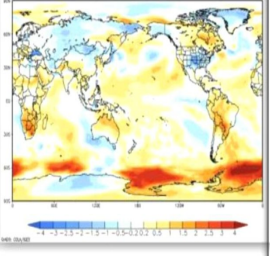


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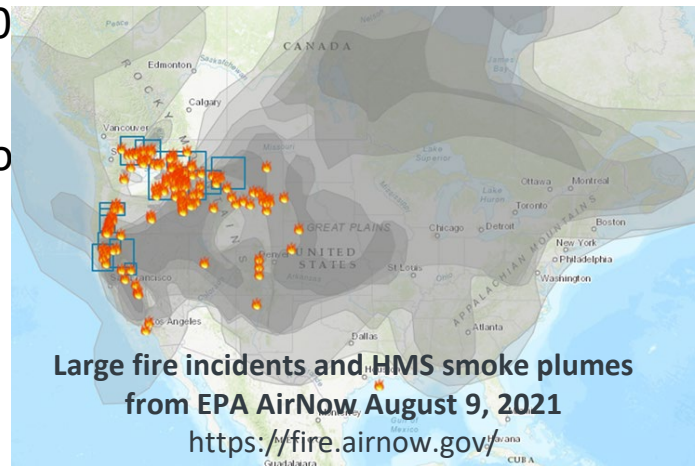
Infrastructure Support

Dual-use model output



High infection rate of Valley fever
in states frequented by dust
storms

- Enables broad community data-sharing
- Interagency, multi-model, real-time updating ensembles (NMME, SubX)
 - Provide additional information to decision support
 - Constantly updating research tool, material for case studies/process comparisons
 - Updated the NMME international agreement in 20
- Data library support at IRI
 - Provides Subseasonal real-time updating output to WWRP/WCRP S2S project
 - Enables easier research data availability than NOMADS



Large fire incidents and HMS smoke plumes
from EPA AirNow August 9, 2021

<https://fire.airnow.gov/>

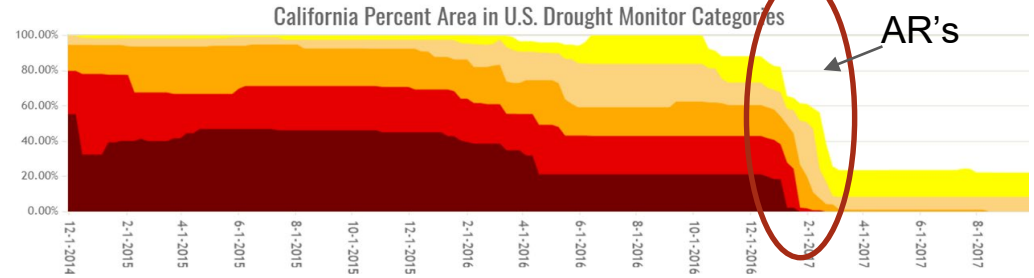
Emerging Focus on Hydrology

Requires incorporation of phenomena from short time scales... **to seasonal time scales** and beyond

Historic rainfall/flooding in Yellowstone



All models failed to predict this transition of the large scale atmospheric state and subsequent heavy rains beyond about two weeks lead.



Historic rainfall rates in NYC during Ida

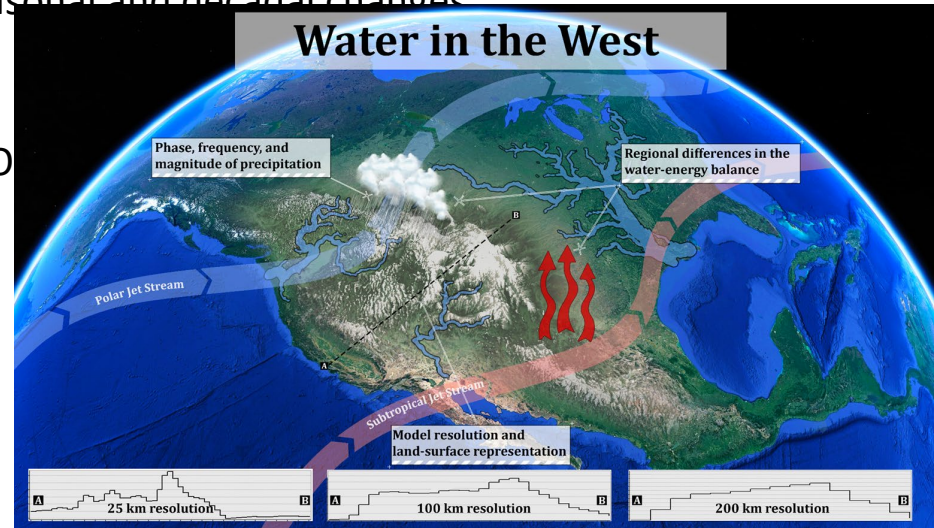


OAR Program Office foci:

OAR's CPO drove drafting, review, and submission of the [interagency plan](#); has been submitted

WPO received the **\$2M** plus-up, and responsibility for the [study](#). Accelerated drafting timeline . . . Funds provided to:

- GFDL for research/analyses of large-scale and km-scale changes in precip means, extremes, snow cover, heat waves etc. within both seasonal and decadal changes
- PSL for assessment of changes in baroclinic waves, atmospheric blocking, relationships to earth system modes e.g. MJO, QBO, ENSO within changing large-scale circulation patterns
- One added FY22 NOFO project to improve UFS prediction of WS hydrological factors (land modeling)



Goal: Seamless Weather to Climate

Need reliable S2S forecasts to support emergency managers, plan hazard response, increase community resilience

Prediction:

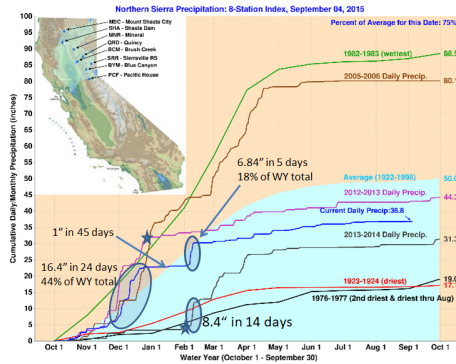
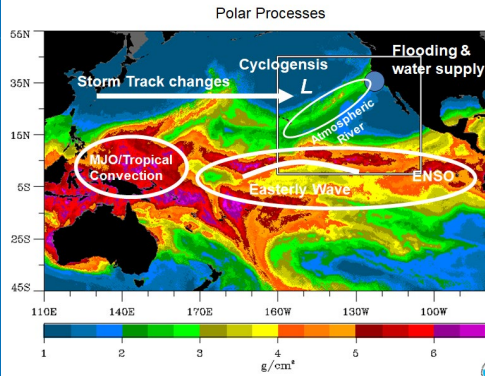
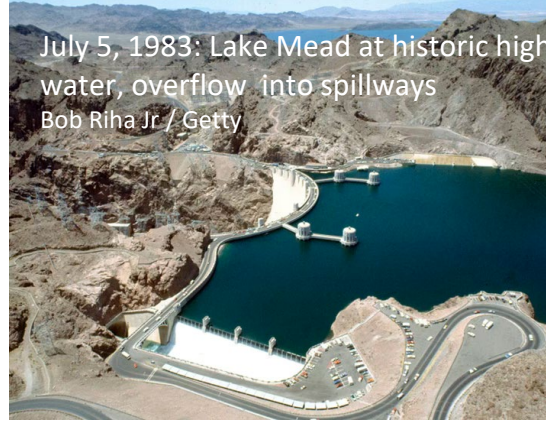
- Spectrum of extreme events, consistently

Modeling:

- Channeling improvements into UFS

Technical:

- Facilitate resolution changes, post-processing, ensemble design, reanalysis/reforecasting, DA, MMEs



WY2015:
121 days
37.24"

Precipitation/Drought/Hydrology

- Address challenges across scales and systems
- Include modes of variability & predictability: MJO, ENSO, etc.

★ 16.8"
404 Days

S2S encompasses broad phenomena—we leverage broad efforts, partnerships to improve prediction



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THANK YOU



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Backup

NOAA Language in FY22 Omnibus on Changing Hydroclimatology of the Western United States

As part of NOAA's focus on expanding climate services to inform climate adaptation efforts, NOAA, in collaboration with the Interagency Integrated Water Cycle Group (IWCG of the U.S. Global Change Resources Program (USGCRP), including NASA, the Department of the Interior, the U.S. Army Corps of Engineers, the Council on Environmental Quality, and other Federal agencies, as appropriate, shall **conduct a study of hydroclimatological changes in the major river basins of the Western United States over the next 30 years.**

Not later than 24 months after enactment of this Act, NOAA shall submit a report to the Committees on the results of the study, which shall include, to the extent possible, methodological evaluation and probabilistic modeling of future changes in the volumes of water naturally available and natural water cycle in the different regions of the West; taking into consideration the impacts of rising temperatures, changes to snowpack, hydrologic extremes, changes in the timing and quantity of runoff, and other factors, as deemed appropriate. The report shall also include a discussion of associated impacts on ecosystems, aquatic biology, and food production.

Further, not later than 270 days after the enactment of this Act, NOAA is directed, in collaboration with the Federal agencies listed above, to develop and deliver to the Committees **a plan to establish a long-term research and monitoring program to improve the understanding of the hydroclimatological changes in the major river basins of the Western United States.** This program shall be envisioned to publish updates to the study requested above at a cadence of 5-year intervals. The plan shall also identify sources of uncertainty in the hydroclimatological outlook for the Western United States and enumerate initiatives that associated Federal agencies might undertake to improve future studies.

To support this work on western water across timescales, as well as to advance the work on Sub-seasonal to Seasonal (S2S) weather prediction, the agreement provides an increase of **\$2,000,000** above the fiscal year 2021 enacted level to Climate Competitive Research.