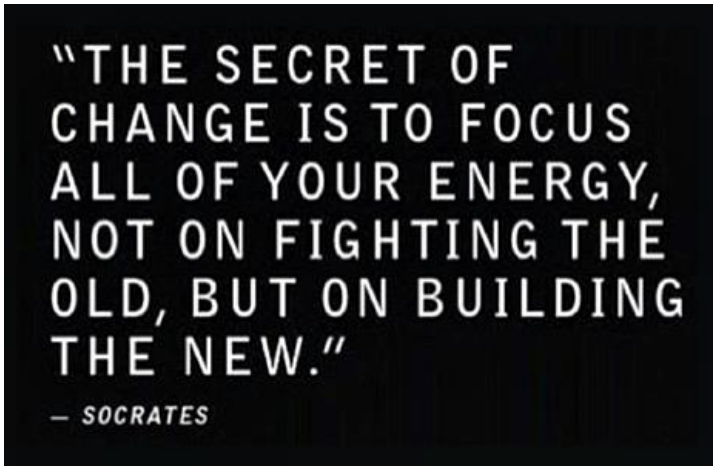
WY2021 Water Resources Update – October 29, 2020

Summary:

- Major CNRFC modeling change occurred on Oct 19, 2020, affecting Water Supply Forecasts;
- New climatology for HEFS ensembles is now WY1980- 2018;
- This update will help to explain some of the WY2021 HEFS modeling changes.

Details:



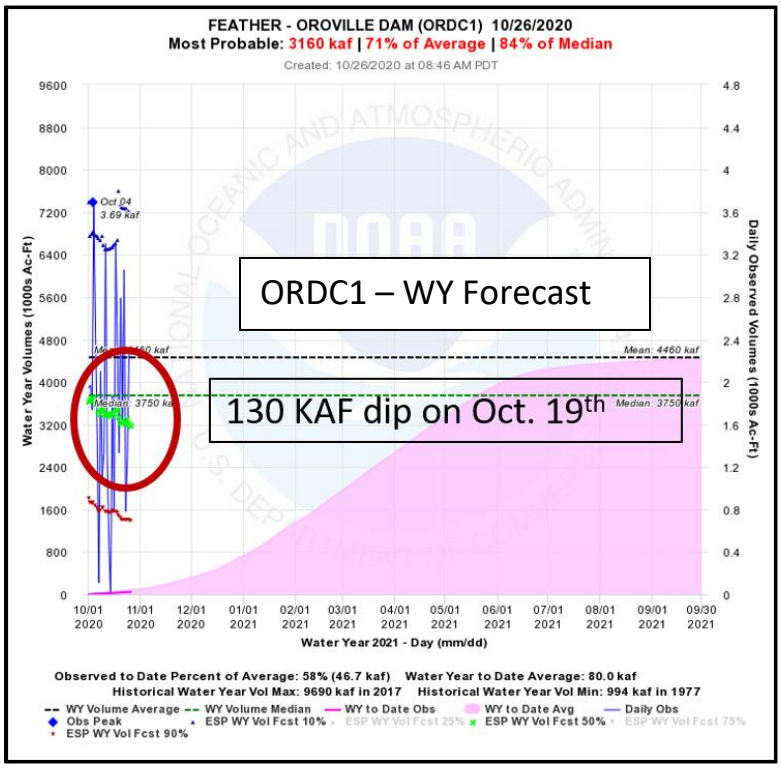
For many years we've noticed biases in our water supply forecasts. Some basins had too much snow accumulation, others not enough. With a warmer climate, we knew there were issues in using precipitation and temperature data from the 50's and 60's. We have also been wanting to utilize our archive of QC'd precipitation which has been used in our real-time operations over the past 15 years.

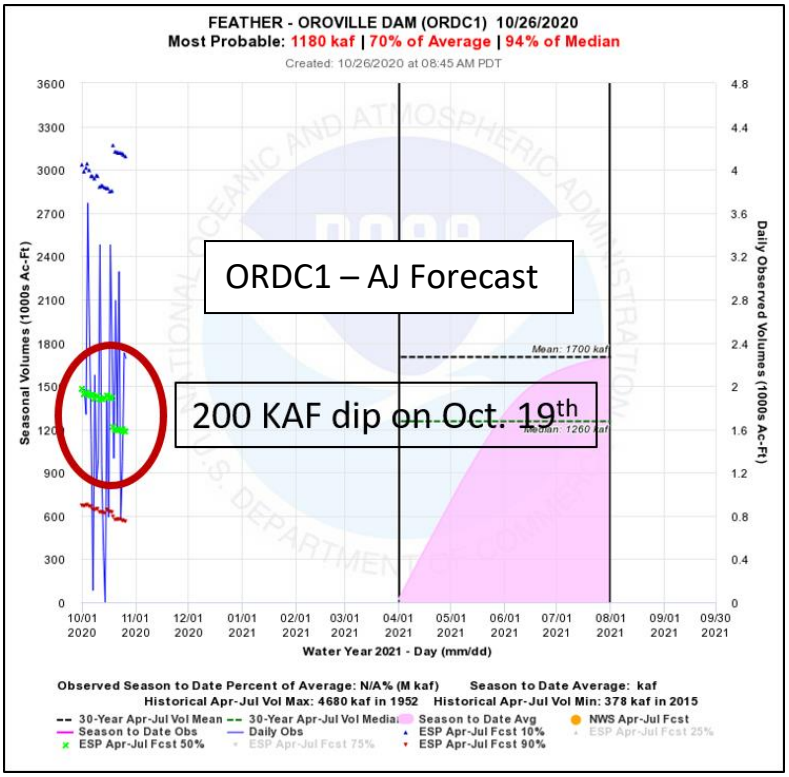
During this past summer, we took the deep dive into revamping our modeling system. For the first time, we were able to utilize in our calibrations a gridded freezing level data set (ERA5), which aligns with our operational freezing level forecasts. We also tapped our archive of Mean Areal Precipitation (MAP) data and used the new Analysis of Record for Calibration (AORC) grids for our historical temperatures (MAT). These new forcings required a recalibration of our snow and soil models to ensure that no new biases were introduced.

Below is a table highlighting the switch in historical forcings, which are used both in calibrating our models and for our climatology in our HEFS ensembles.

Variable	Legacy Data Sources	New Data Sources
Precipitation (MAP)	NWS COOP stations; SNOTEL;	CNRFC Operational MAPs ('04-'19) + Legacy MAPs (WY1980-2004)
Temperature (MAT)	NWS COOP stations	AORC MAT data (WY1980-2019)
Freezing Level (ZELV)	Derived from MAT timeseries	ERA5 (ECMWF reanalysis) (WY1980-2019)

New HEFS Output





Our new forcings data, along with our new model parameters, were all implemented into our operational configuration on Oct. 19, 2020.

As the two images of Oroville reservoir inflow forecasts on the left exemplify, there were noticeable dips in the median forecast produced by HEFS in some locations. Other HEFS forecasts remained fairly consistent with those from before Oct. 19th, while other locations showed jumps in the median forecast. I think the three main sources of change are:

1. Change in period of record;
2. Reduction of previous biases;
3. Shift to a warmer climatology

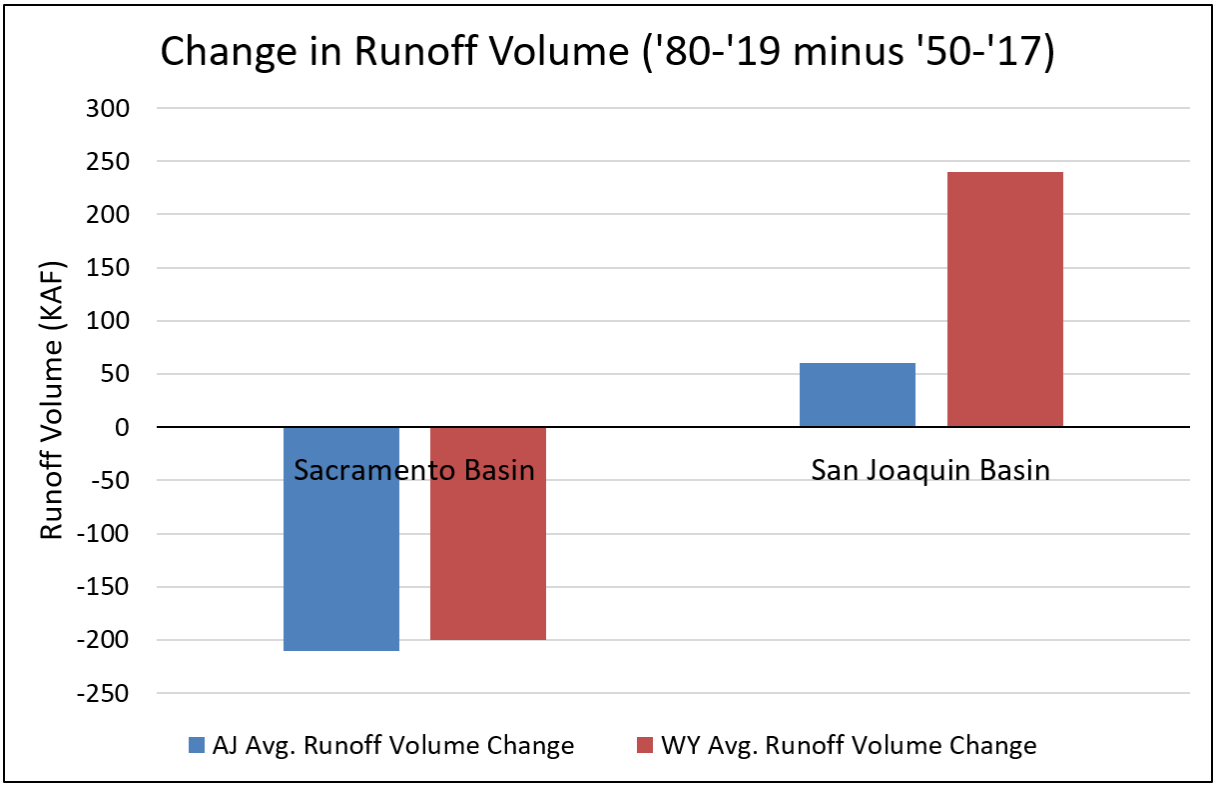
Change in the period of record:

Previously HEFS output was based on 68 ensemble years – WY1950-2017. The new HEFS output is based on 39 ensemble years – WY1980-2018.

The difference in the observed runoff from these two periods highlights the source of many of the jumps and dips in forecasts. Interestingly, basins in the Sacramento basin (as a whole) were drier during the 1980-2019 period of record; but basins in the San Joaquin watershed were wetter during the 1980-2019 period. The new HEFS output reflects this shift.

Below:

The chart below is derived from the WSI data compiled by the DWR: https://cdec.water.ca.gov/reportapp/javareports?name=WSIHIST



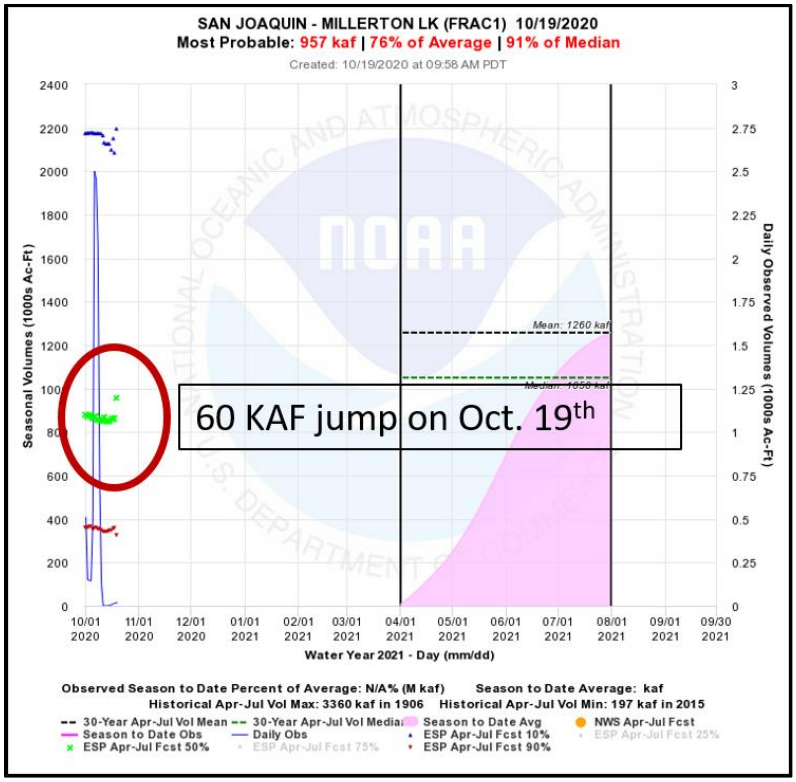
Reduction of previous biases

One of the weaknesses in our previous historical calibrations, was that some biases in the MAPs were not adjusted for. When we lacked data in the earlier part of the period of record (say the 50's and 60's), we worked hard to create MAPs that were unbiased. But that was not always the case. We focused on the most recent 20-30 years to make sure our biases were minimal there, but not necessarily over the entire period of record.

For example, looking at the calibration for the inflow to Friant Dam (FRAC1), a 5.4% negative bias is present in the previous period of record for the April-July (AJ) period. The new calibration only had a negative 0.9% bias. So one would expect there to be a jump in the AJ forecast of around 50-60 KAF, and this is what did occur with the new Oct. 19th forecast (see below).

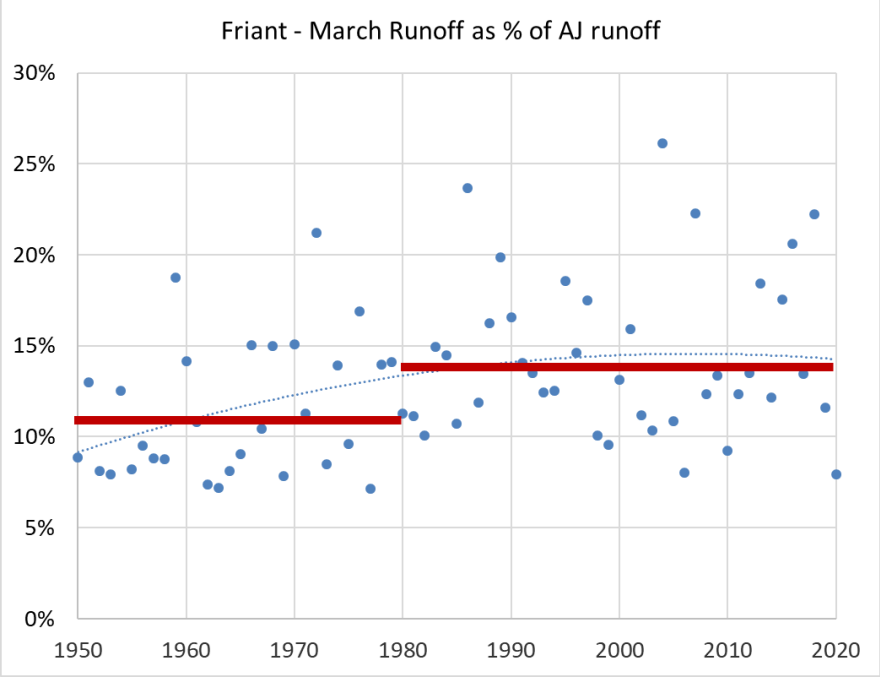
Observed vs. Simulated AJ runoff for Friant Dam

POR	AJ Obs (KAF)	AJ Sim (KAF)	Bias	Diff
1960-2017	1169	1236	-5.4%	-67 KAF
1980-2019	1239	1250	-0.9%	-11.5 KAF



Shift to a Warmer Climatology

By shifting to a more recent climatology, HEFS ensembles will have a more realistic distribution of snowmelt. By removing 30 colder water years (WY1950-1979), we'd expect to see more snowmelt runoff occurring in March and less in July.



Left:

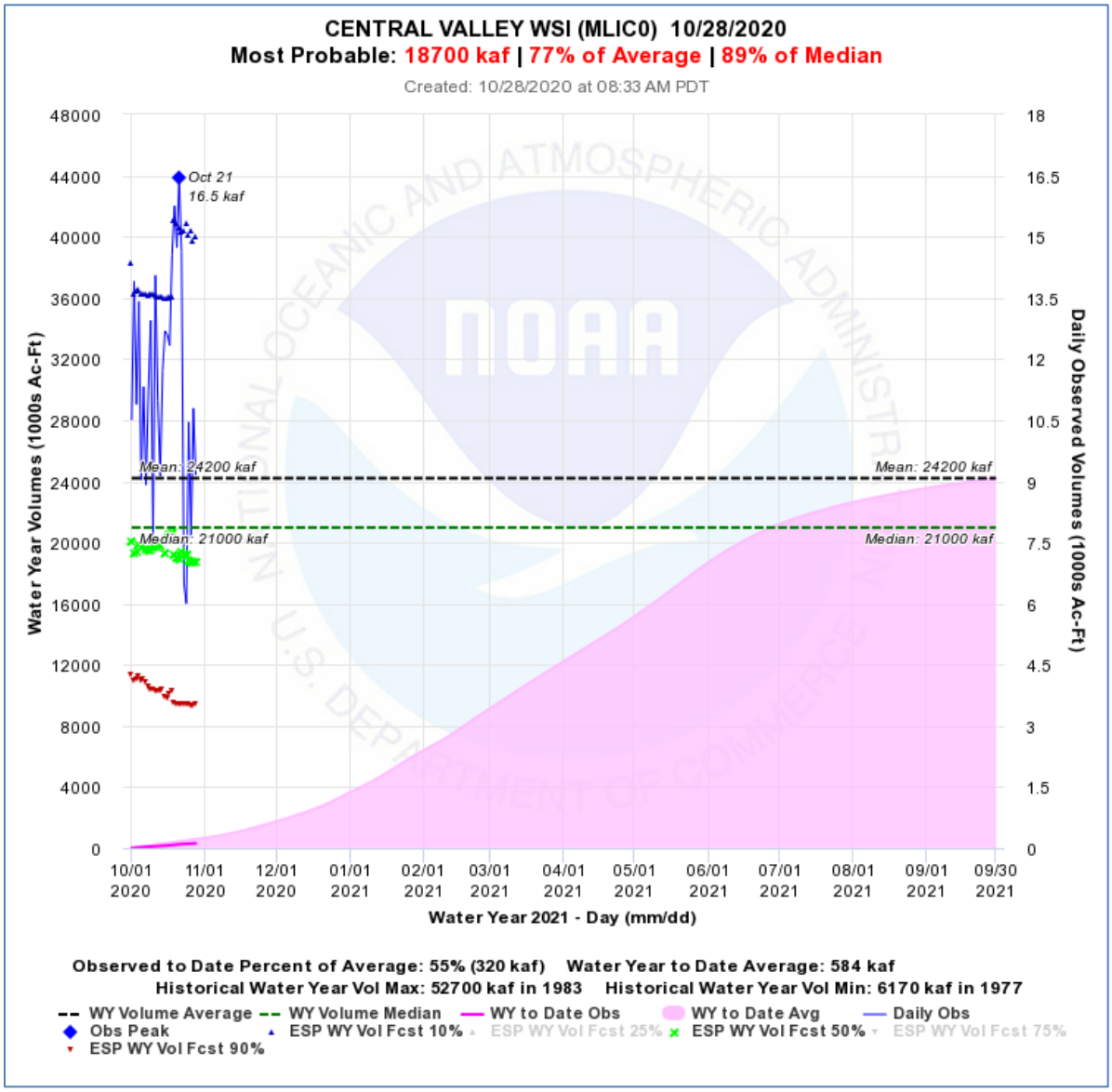
March runoff into Friant Dam as a percent of the April-July Runoff.

The '80-'19 average is 3.3% higher than the '50-'79 average inflow, which amounts to about 43,000 ac-ft increased runoff in the month of March.

Ensemble Spread

One other observation: the ensemble spread in HEFS as represented by the 90% and 10% exceedance values, showed an increase. This makes sense in that we've seen greater variability in our climate over the past 40 years when compared to earlier years. Most noticeable has been the increase in the 10% exceedance values with the new HEFS products, meaning that the wet year runoff that occurs about once every 10 years is wetter than before. The 90% exceedances were generally closer to previous values but sometimes showed a slight drop.

Below is the Central Valley HEFS forecast. Note how the 10% exceedance numbers are 5000 KAF larger than the previous set of ensembles. The 10% exceedance value only dropped a couple hundred KAF. The median forecast of 89% is fitting given that we had a dry WY2020, a dry start to this year, and we have a dry forecast for the next week or two.



Summary:

Advantages to the CNRFC new modeling configuration:

1. Aligns better with real-time forcings.
2. Reduction of old calibration biases.
3. More representative of the more recent climate.
4. Greater volatility (spread) in the 10-90 exceedances.

Disadvantages:

1. Loss of the 1976-1977 minimum drought traces. **
2. Loss of older flood events (like 1955, 1964).
3. Fewer traces leads to more day-to-day variations in median values.

** One note about the maximum and minimum traces: Most basins have maximum traces from 1983 or 2017. While the '76-'77 drought was a water year minimum in many locations, WY2013 had the driest 9 months from January – September.

Conclusion:

Hopefully these pictures and explanations help to clarify a little of what has changed in the CNRFC modeling of water supply going into water year 2021. Overall we are optimistic that this year will have fewer systemic biases than before. We're still looking at how to address some of the disadvantages, but believe the new process as a whole will be more reliable.

We're still in the process of double checking parameters and model configuration. So in the coming weeks there may be model changes on some isolated forecast points. Please contact us with any questions or concerns.