



HEPEX 10th Anniversary Meeting

Hydrologic Ensemble Forecasts for Decision Makers:
Experimental Applications in California and Nevada for Water Distribution,
Hydropower Management, and Flood Risk Management

June 24th 2014

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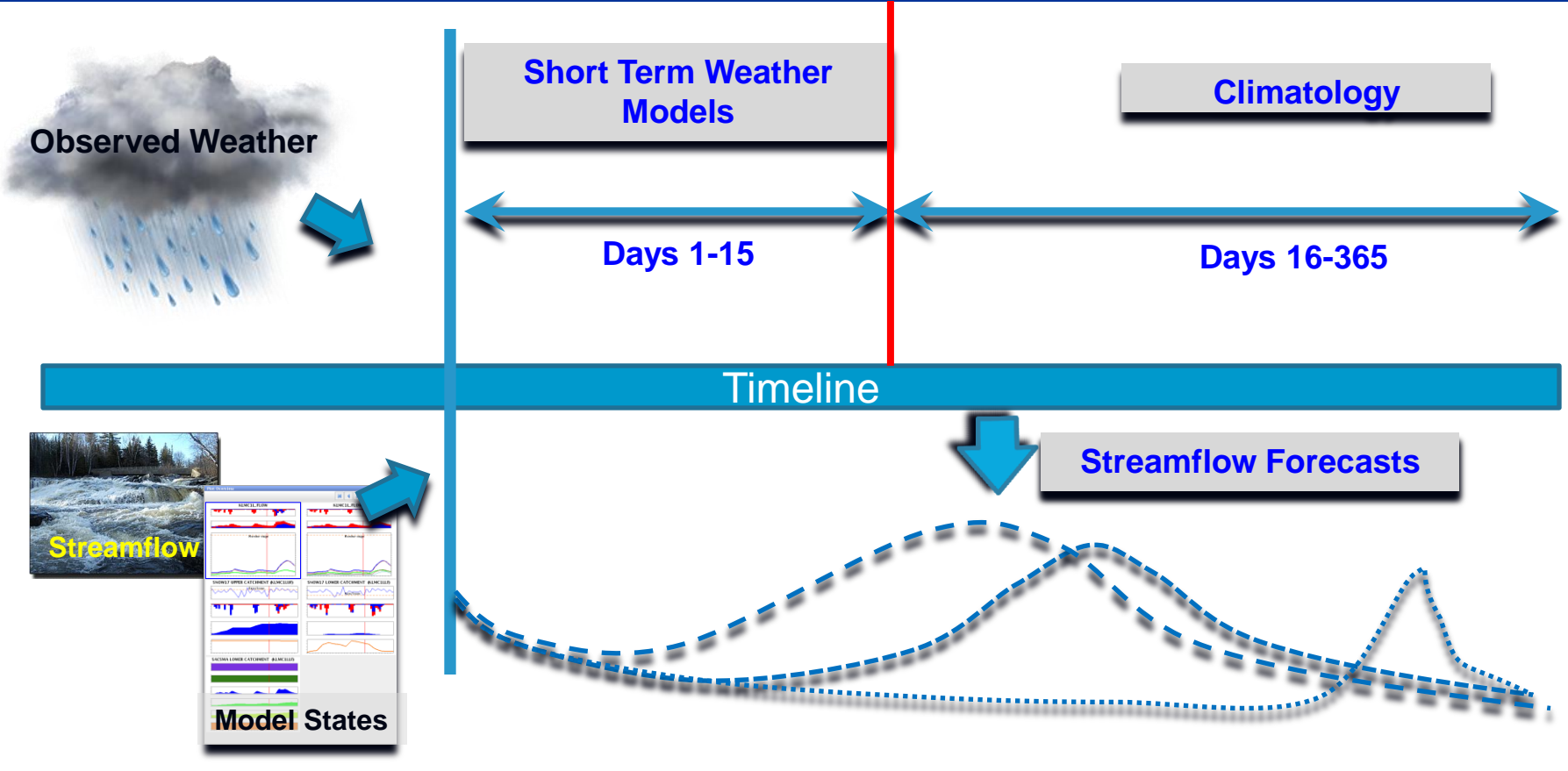


Managing Uncertainty in Water Management





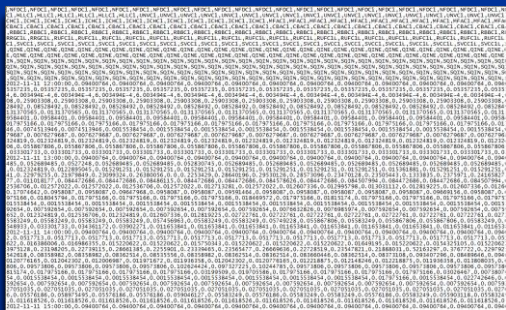
Ensemble Streamflow Forecasts



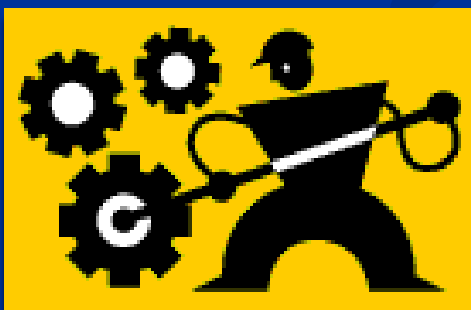


How to Make Ensemble Forecasts Usable for Water Managers

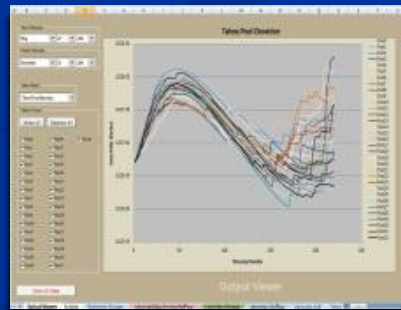
- water/flood management agencies use:
 - spreadsheet-based modelsor
 - tools that easily ingest spreadsheet compatible inputs



spreadsheet-compatible
CNRFC ensembles



user's
decision support tool

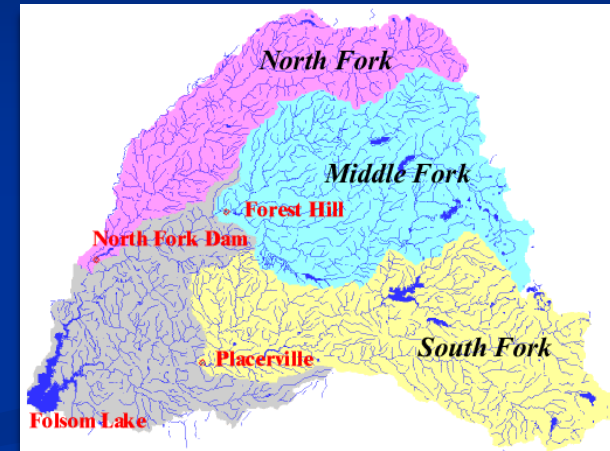
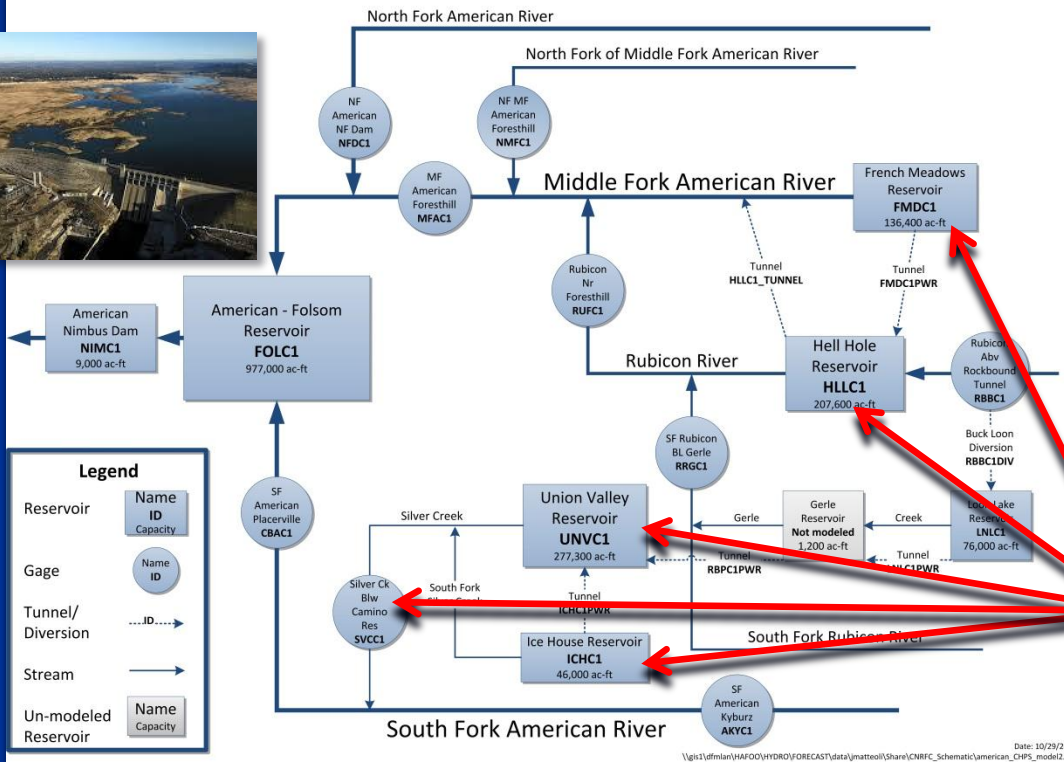


output from processed
CNRFC ensembles



Hydropower Management Sacramento Municipal Utility District

American River Basin CNRFC Model

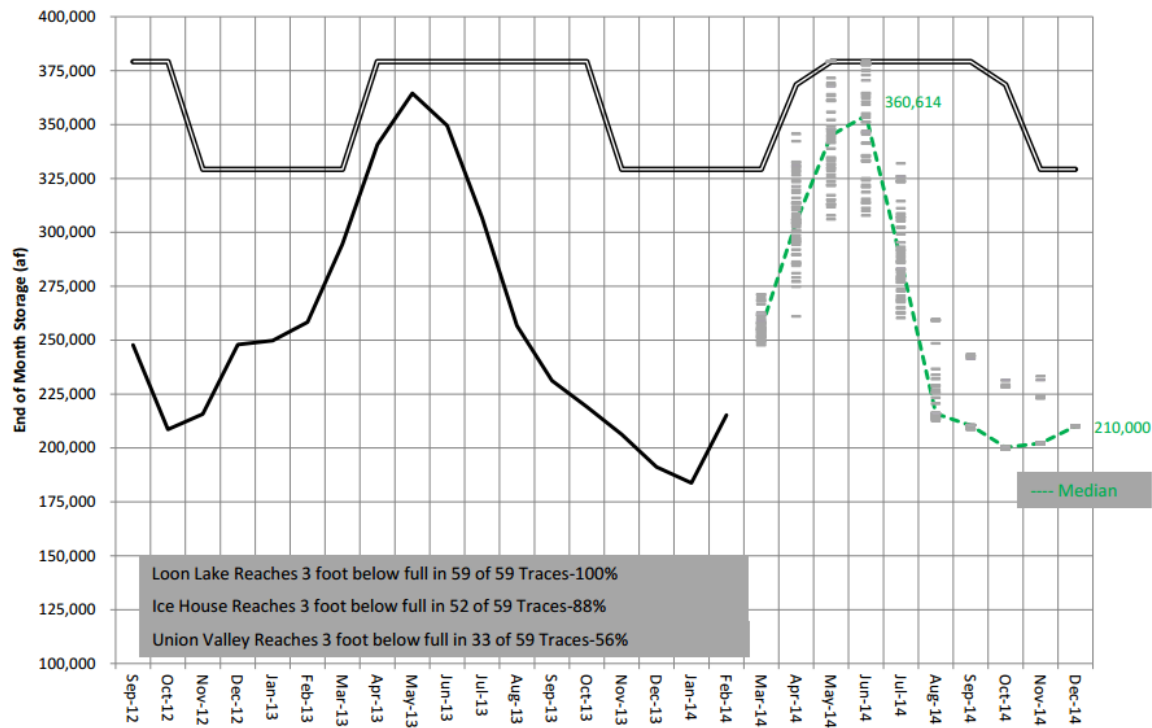


small hydropower operations



End of Month Storage Forecast Sacramento Municipal Utility District

Chart 2: End of Month Storage Forecast Given NWS's 3/17 Ensemble Forecast with 59 Traces



Loon Lake Reaches 3 foot below full in 59 of 59 Traces-100%
 Ice House Reaches 3 foot below full in 52 of 59 Traces-88%
 Union Valley Reaches 3 foot below full in 33 of 59 Traces-56%

* This forecast was created using Plexos to simulate the operation of the UARP & Chill Bar given the NWS' 3/17 Ensemble Forecast



Loon Lake



Ice House

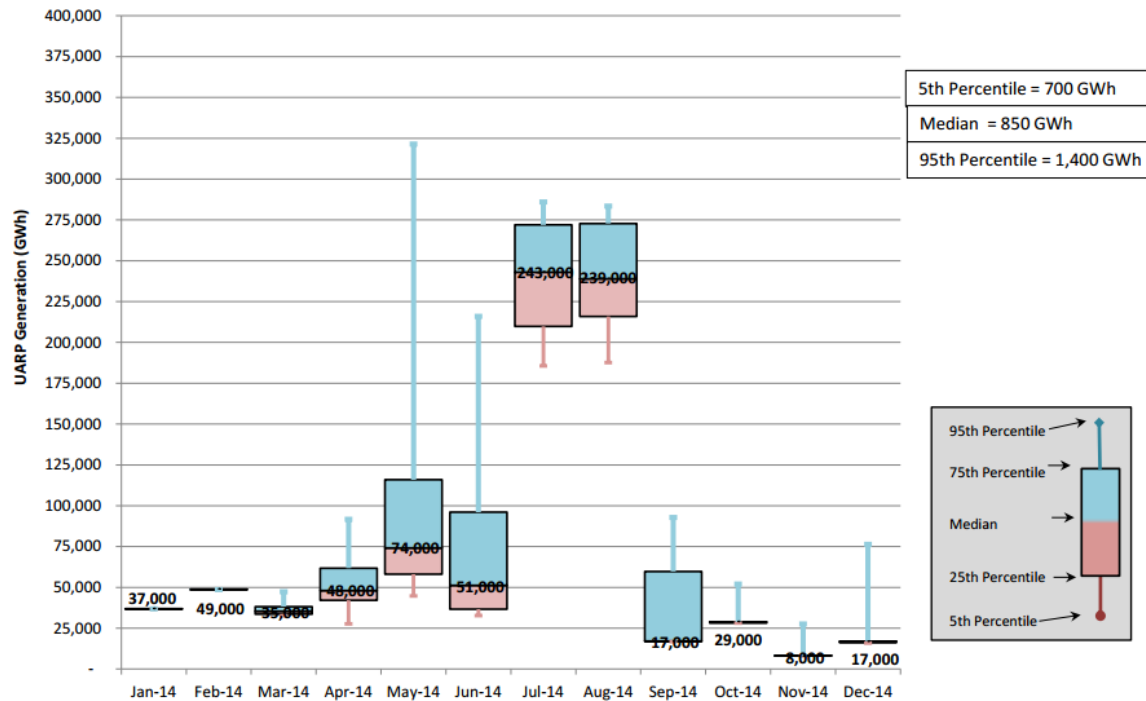


Union Valley



Power Generation Forecast Sacramento Municipal Utility District

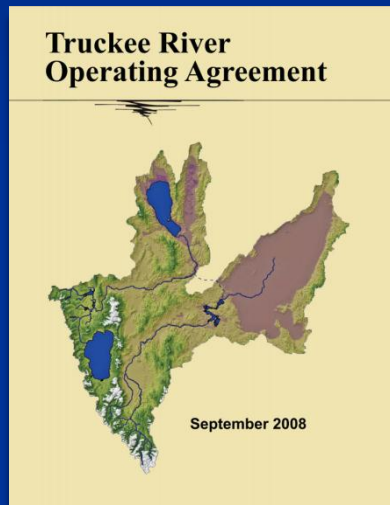
Chart 1: ET&C's 3/17 Forecast of Monthly UARP Generation



* This forecast was created using Plexos to simulate the operation of the UARP & Chili Bar given the NWS' 3/17 Ensemble Forecast



Water Management Application to USBR/TROA RiverWare®



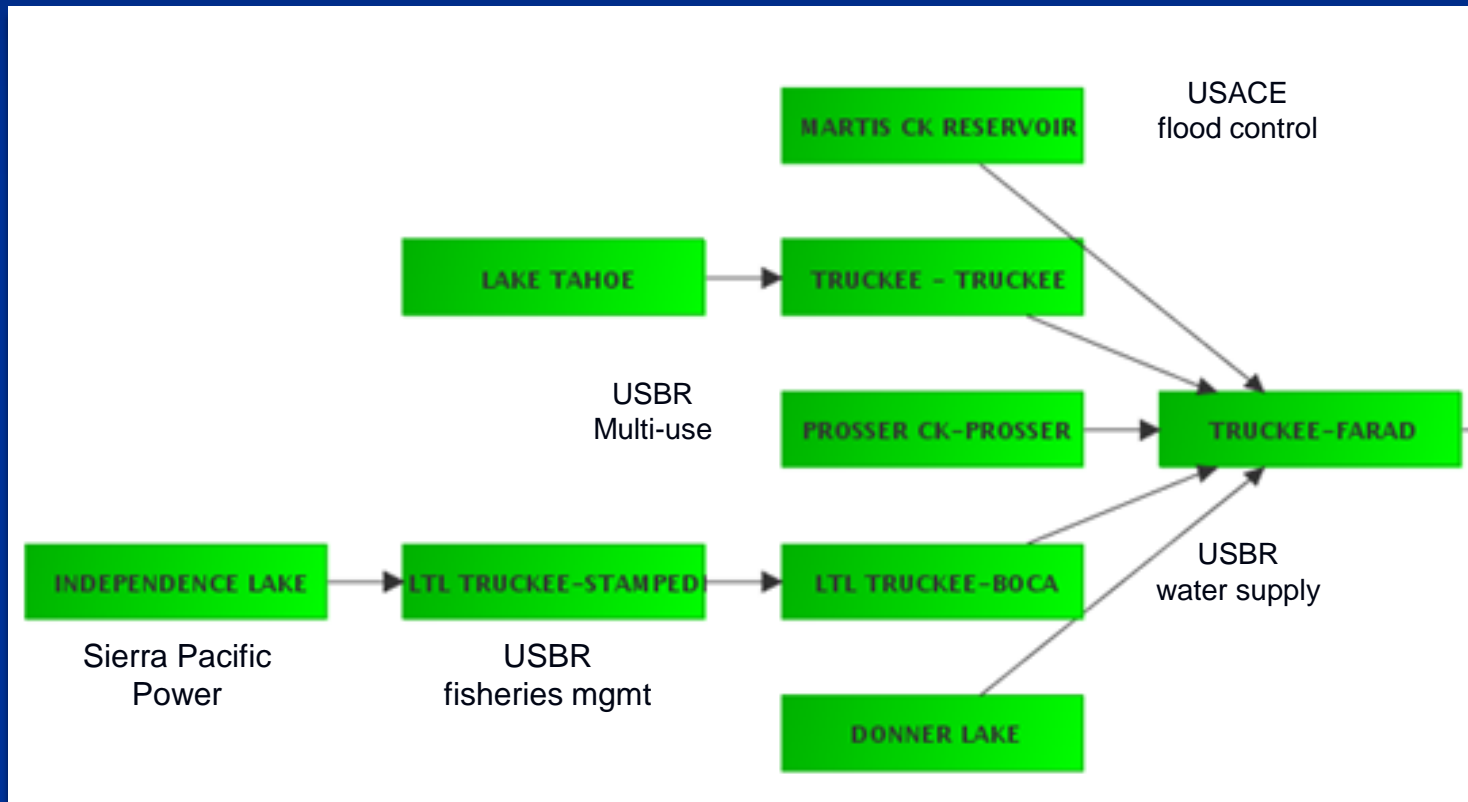
276 pages!

Managing competing interests in an environment of limited supply including:

- Satisfying all applicable dam safety and flood control requirements
- Providing for spawning flows at Pyramid Lake fishery (ESA)
- Carrying out agreement between local tribe and power company
- Ensuring that water stored in system reservoirs satisfies water rights conforming to earlier decrees



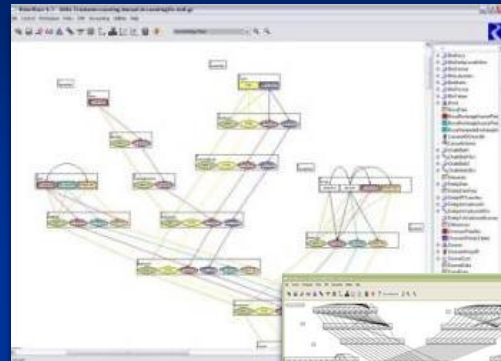
Water Management Application to USBR/TROA RiverWare®



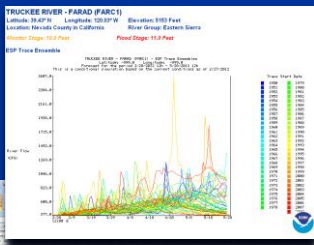
CNRFC Hydro Model Topology



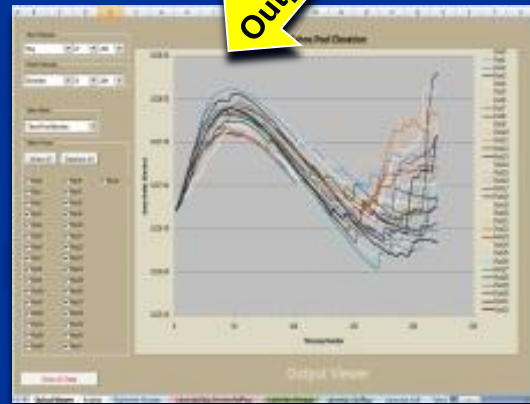
Water Management Application to USBR/TROA RiverWare®



Output Spreadsheet



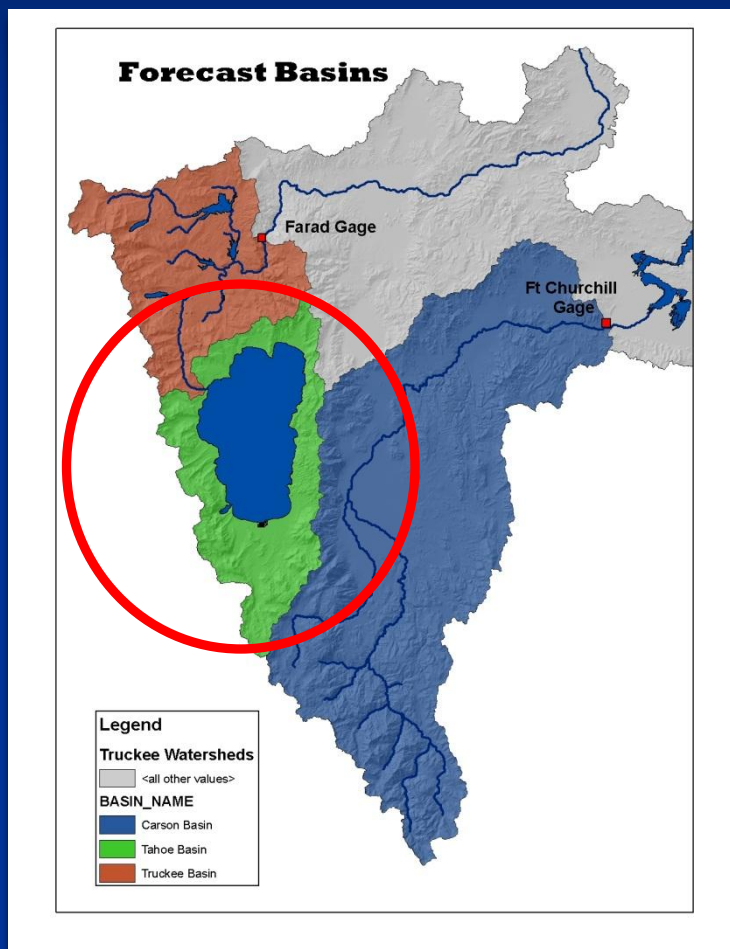
Traces
brought into
Excel





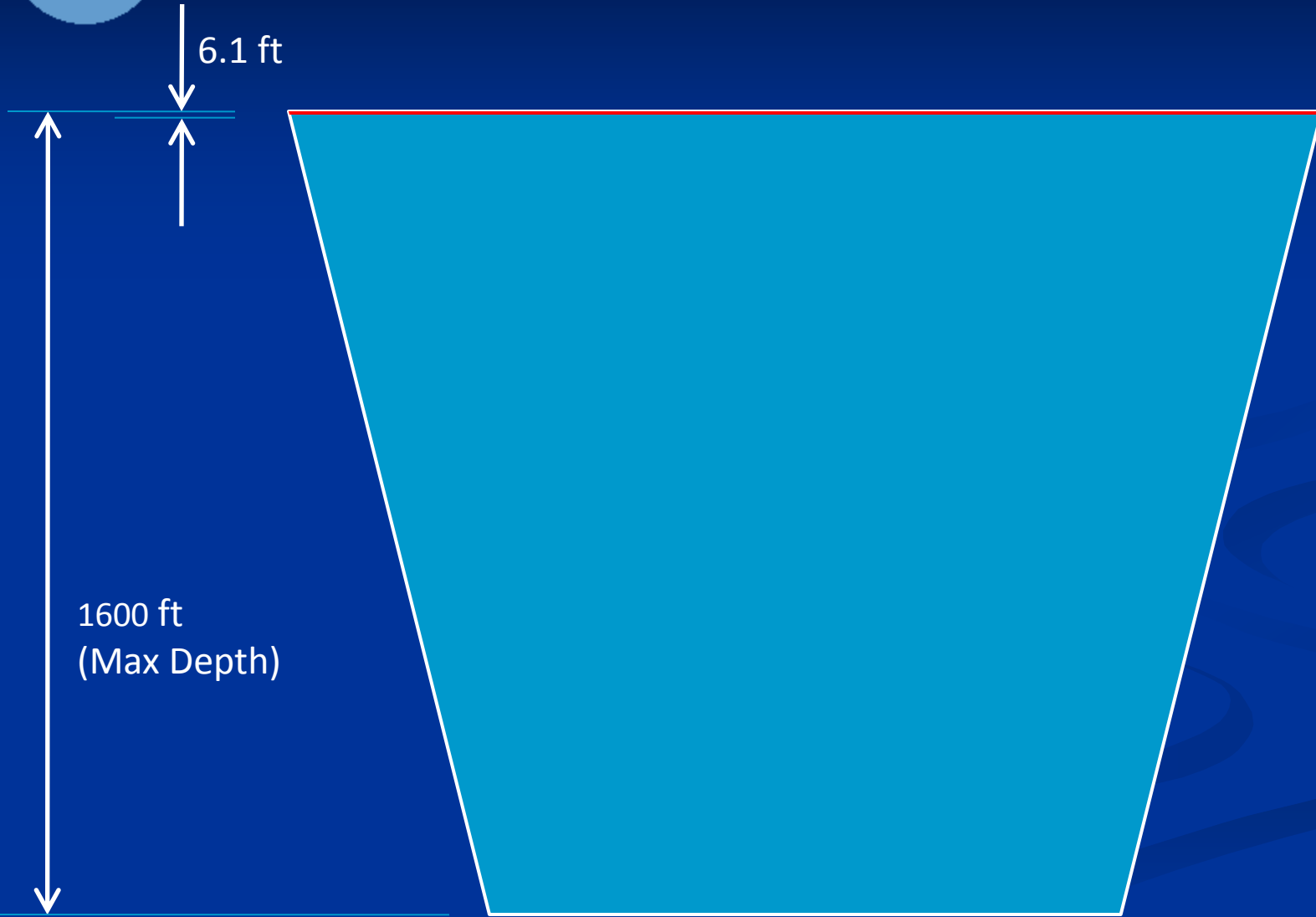
Example of Decision Support in 2013

Lake Tahoe Elevation





Tahoe Total Volume and Useable Volume (to scale)

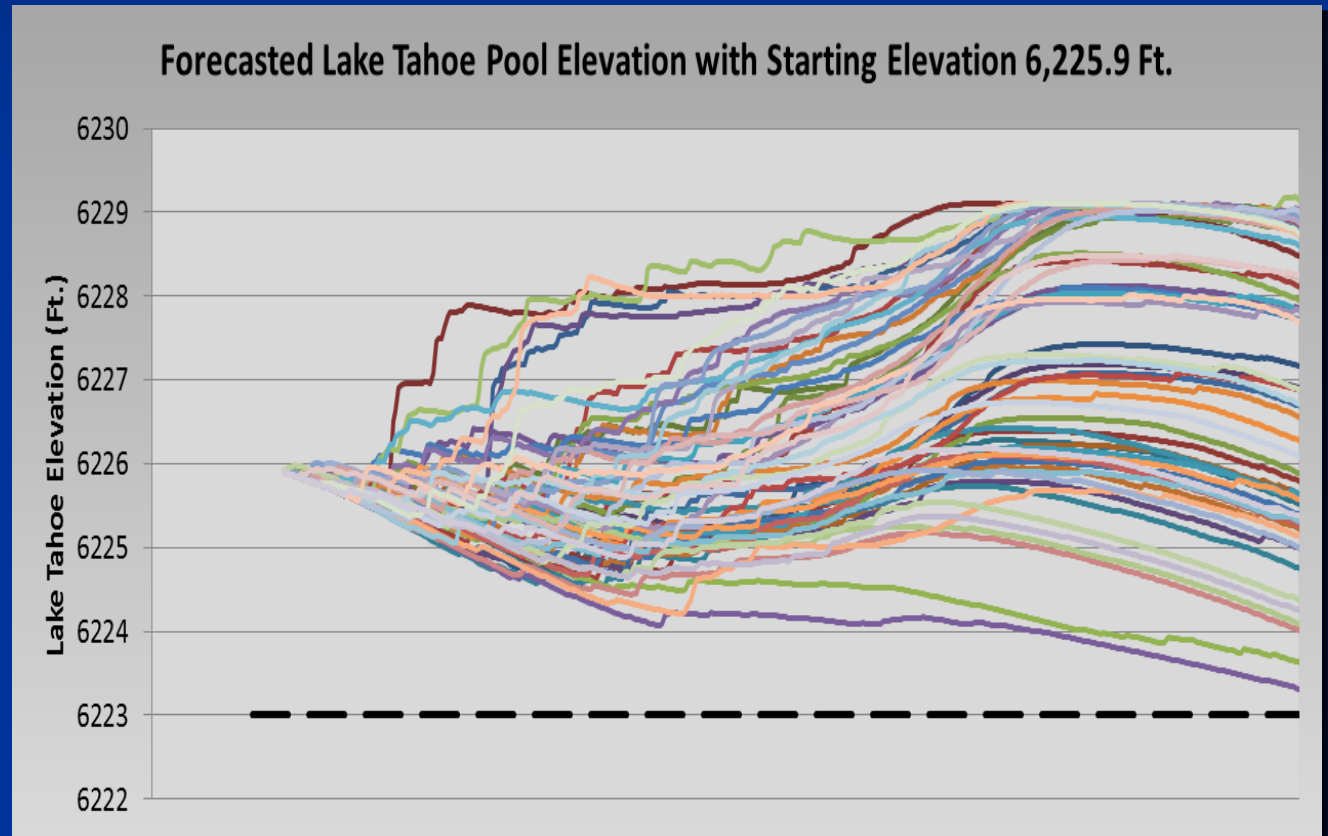




2013 Results Discussion

Lake Tahoe Elevation

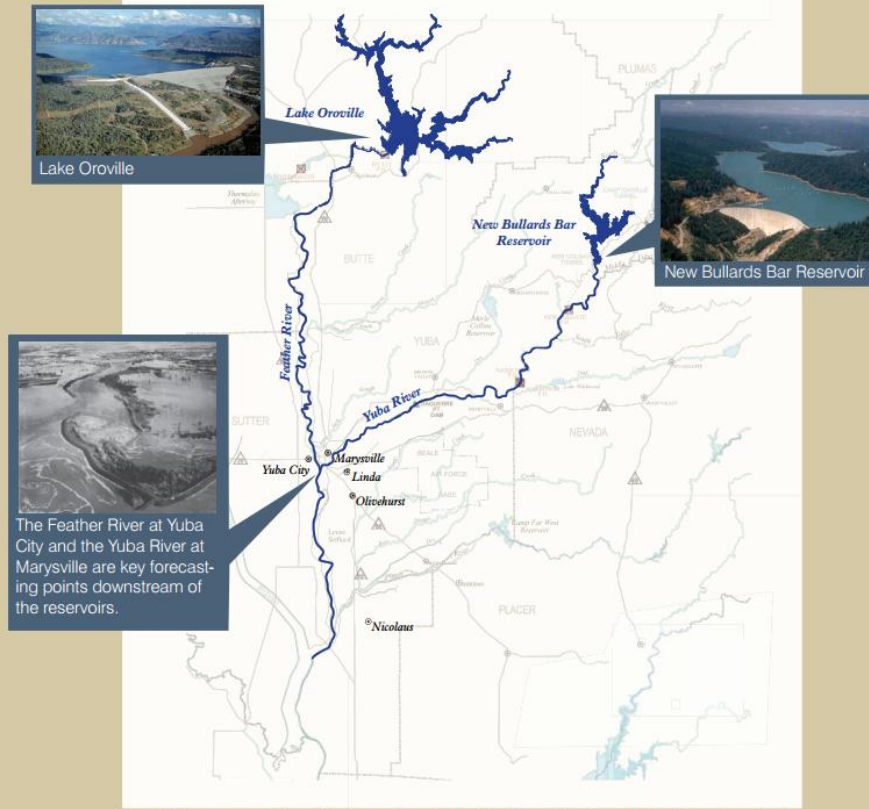
0 of 58 Forecasted Runs show Tahoe going below the rim (0%)





Flood Management Yuba/Feather F-CO Application

Coordinated Operations of Lake Oroville and New Bullards Bar Reservoir



The Feather River at Yuba City and the Yuba River at Marysville are key forecasting points downstream of the reservoirs.

The F-CO program coordinates flood operations of Lake Oroville and New Bullards Bar Reservoir, and using improved inflow forecasts, guides reservoir releases in advance of and during major flood events to reduce peak flood flows, resulting in additional levels of protection downstream.



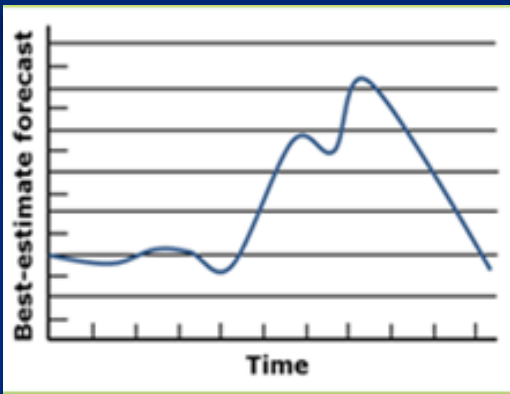
Flood Management Yuba/Feather F-CO Application





Flood Management Yuba/Feather F-CO Application

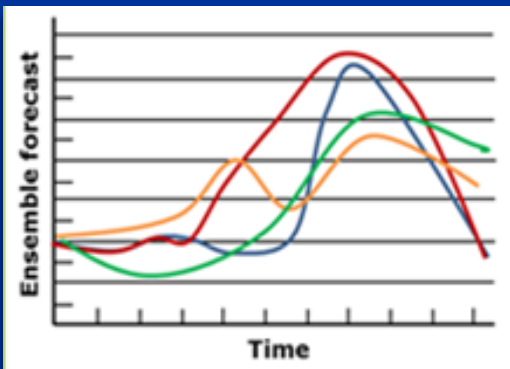
1.



CNRFC best estimate forecast

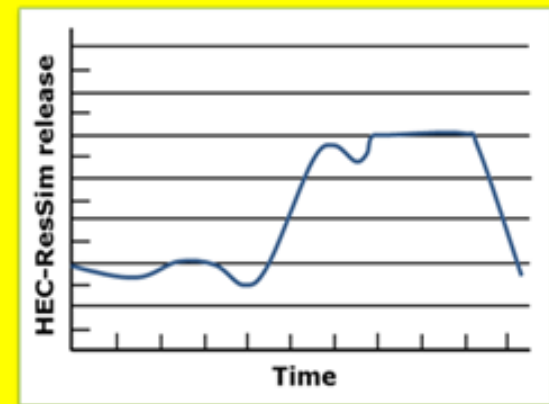


1.



CNRFC ensemble forecasts

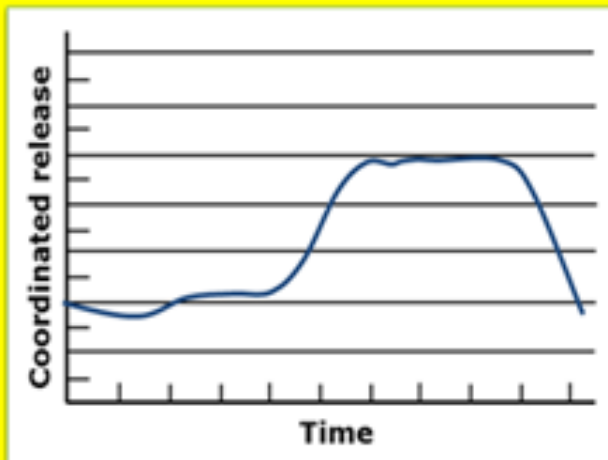
2. Operators run HEC-ResSim (through F-CO DSS interface) with best estimate forecast to identify recommended release schedule with strict interpretation of rules.



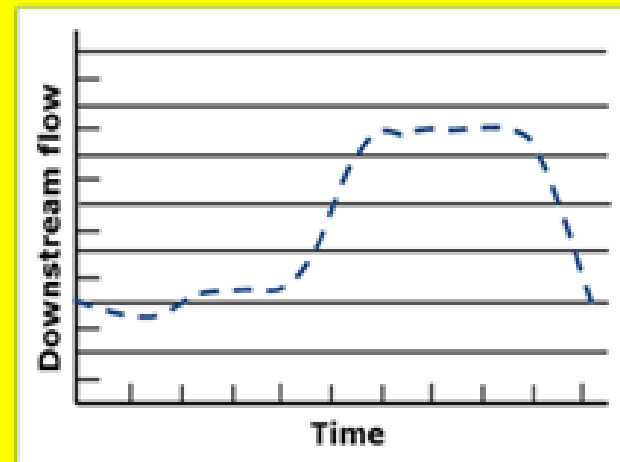


Flood Management Yuba/Feather F-CO Application

3. Operators review HEC-ResSim results, coordinate, collaborate to select *coordinated release schedule*.

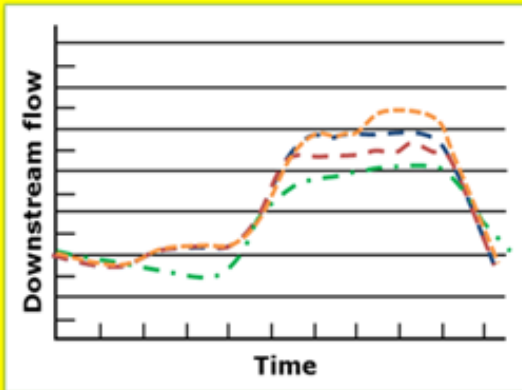


4. Downstream conditions computed with HEC-ResSim, using coordinated schedule.



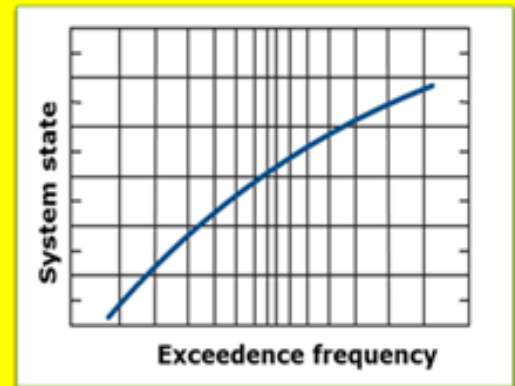


Flood Management Yuba/Feather F-CO Application



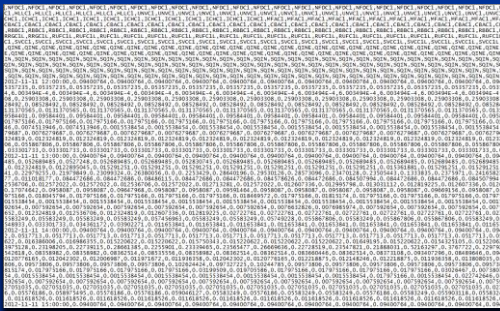
5. For each ensemble member, HEC-ResSim computes system states with coordinated release schedule from Step 3

6. Frequency of exceedence of critical system states analyzed and reported. If hazard deemed unacceptable, process is repeated starting with Step 3.

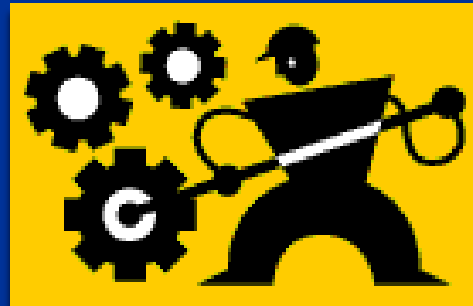




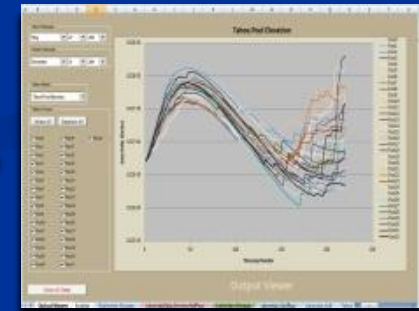
General Model for Ensemble Forecasts Usable for Water Managers



spreadsheet-compatible
CNRFC ensembles



decision support tool



output from processed
CNRFC ensembles



Questions?



California Nevada River Forecast Center



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