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

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Managing Uncertainty in Water Management
Ensemble Streamflow Forecasts

- Observed Weather
- Short Term Weather Models (Days 1-15)
- Climatology (Days 16-365)
- Streamflow Forecasts
- Model States
How to Make Ensemble Forecasts Usable for Water Managers

- water/flood management agencies use:
  - spreadsheet-based models
  - tools that easily ingest spreadsheet compatible inputs
Hydropower Management
Sacramento Municipal Utility District

American River Basin CNRFC Model

Legend
- Reservoir
- Gage
- Tunnel/Diversion
- Stream
- Un-modeled Reservoir

Legend:
- Reservoir: Name, ID, Capacity
- Gage: Name, ID
- Tunnel/Diversion: Name
- Stream: Name
- Un-modeled Reservoir: Name, Capacity
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 planes to simulate the operation of the UAPP & CHRI Bar given the NWS’ 3/17 Ensemble Forecast.
Power Generation Forecast
Sacramento Municipal Utility District

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

- 5th Percentile = 700 GWh
- Median = 850 GWh
- 95th Percentile = 1,400 GWh

* This forecast was created using PLEXOS to simulate the operation of the UARP & Chel Bar given the NWS' 3/17 Ensemble Forecast.
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®

Traces drive RiverWare®

Traces brought into Excel

Output Spreadsheet
Example of Decision Support in 2013

Lake Tahoe Elevation
Tahoe Total Volume and Useable Volume (to scale)

1600 ft (Max Depth)

6.1 ft
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 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

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*.

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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