Reservoir System Modeling Technologies Conference

Portland, Oregon
21-22 February 2012

Bonneville Power Administration

Federal Columbia River Power System (FCRPS)

- The FCRPS is includes 31 hydroelectric projects and one nuclear power plant.
  - Hydroelectric projects are owned and operated by the U.S. Army Corps of Engineers and the Bureau of Reclamation.
  - The Bonneville Power Administration (BPA) is responsible for managing and transmitting the power produced at federal facilities while operating within authorized purposes and special operations.

Federal Columbia River Power System (FCRPS)

- Hydroelectric projects are operated for multiple purposes.
  - Flood control
  - Navigation
  - Fish & Wildlife
  - Irrigation
  - Power
  - Recreation




Federal Columbia River Power System (FCRPS)

Federal Columbia River Power System (FCRPS)

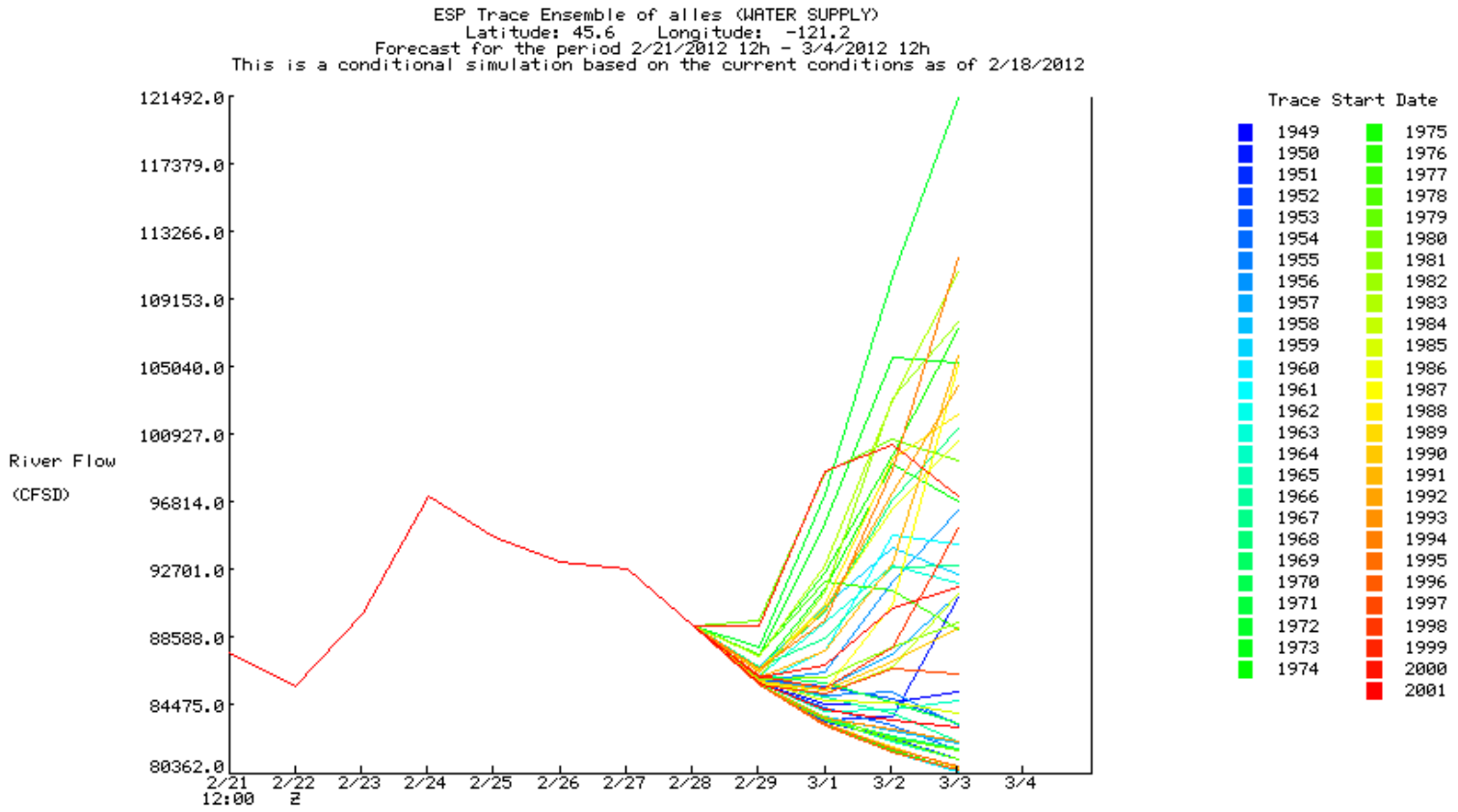
- The objectives, requirements, and constraints of the FCRPS operation are fairly well understood.
- The mixture of power and non-power constraints and objectives is complex.
- The generation of the FCRPS is for the most part not economically dispatched.

Managing Uncertainty

- While the objectives and constraints are known, significant uncertainty exists in fundamental inputs and operations.
  - Stream flows
  - Load obligations
  - Non-federal project operations, including intermittent generation resources (e.g. wind)
  - Balancing reserves

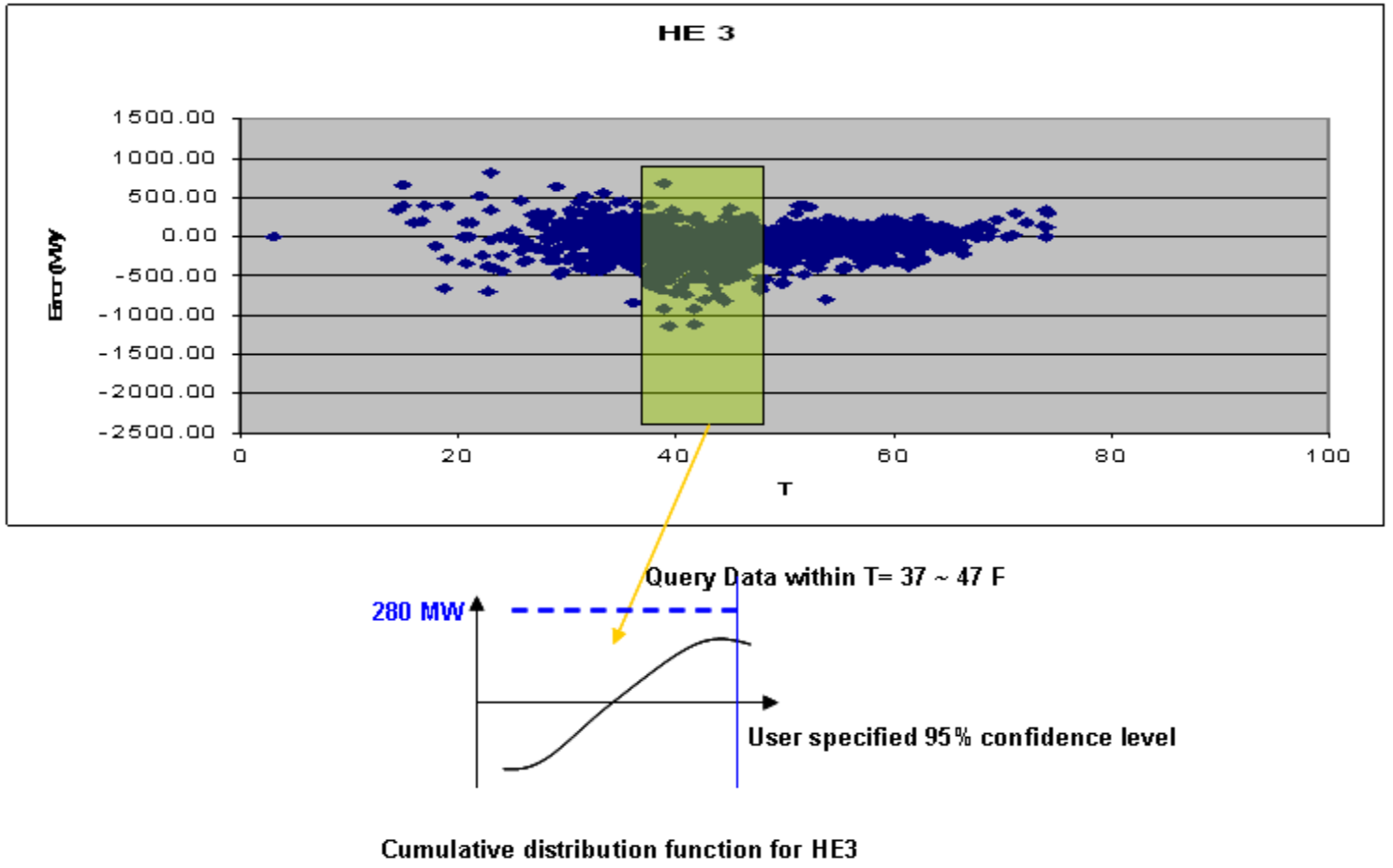
Managing Uncertainty

- There is a significant distribution of future stream flow scenarios in the short- and long-term.



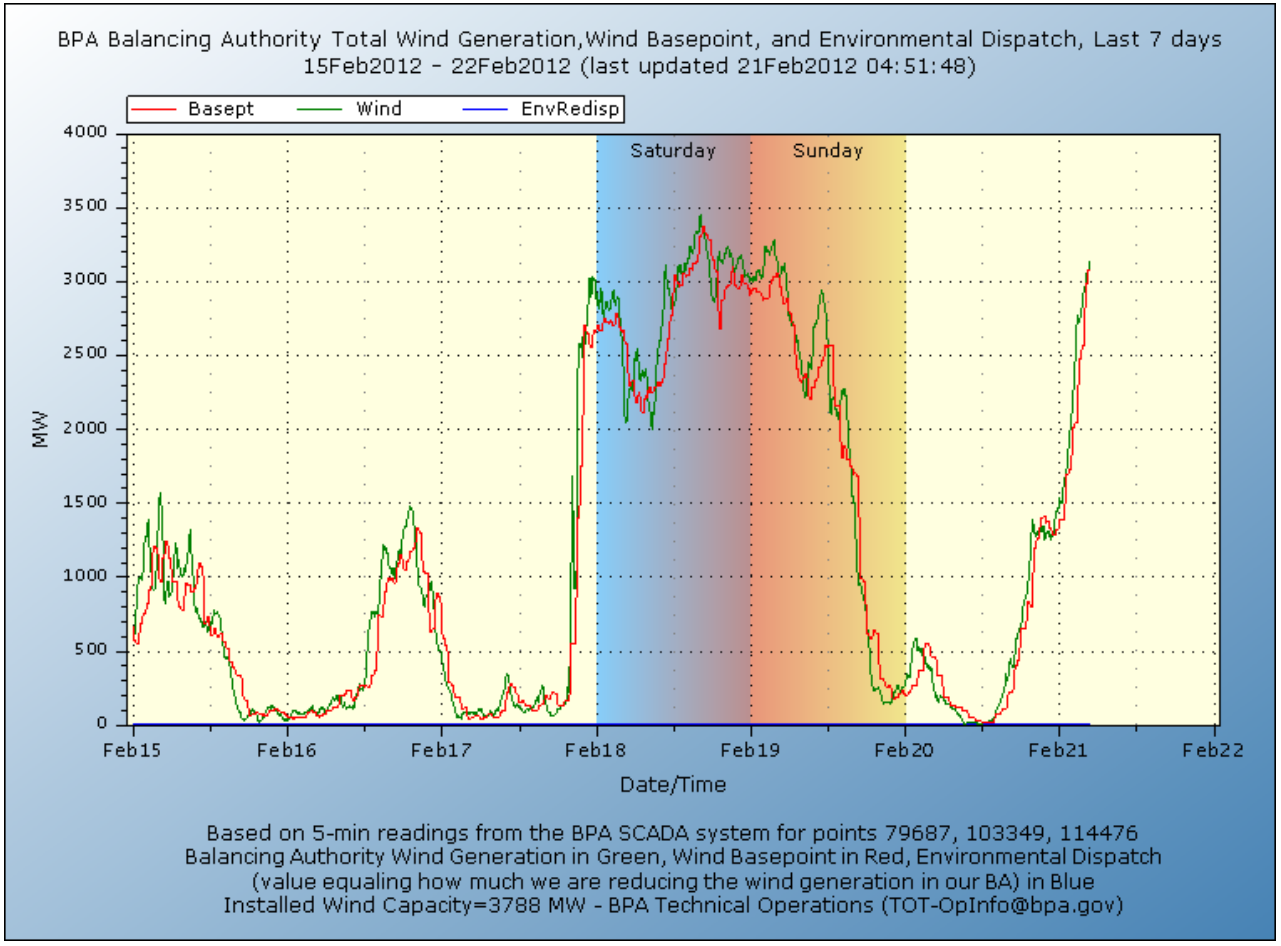
Managing Uncertainty

- Similar to the uncertainty in stream flows there is a large distribution of possible future load obligation scenarios



Managing Uncertainty

- Wind generation is variable and requires other generating resources to balance and maintain reliability.



Managing Uncertainty

- To maintain reliable delivery of energy, BPA deploys Balancing Reserves carried on the FCRPS to balance variability associated with intermittent generation resources and load.

Modeling Technology Needs

- The hydro resources of the Pacific Northwest are of tremendous value to the region.

- It is important to be able to accurately model system operations with known constraints and be able to manage inherent uncertainty.

Modeling Technology Needs

- Models need to provide analysts the ability to:
  - Run multiple scenarios
  - Develop a probabilistic view of operations, power inventory, and capacity
  - Support grid operations by providing accurate generation inputs
  - Identify flexibility and manage it to obtain the greatest value for the system.
  - Support risk-based operational and marketing decisions.
  - Quantify the likelihood of meeting system objectives.

Modeling Technology Needs

- Feasible, stable results
  - The solution should be something the system operators would actually implement
  - Solution should change proportionately and predictably with changes to inputs
- Quick execution time
  - Must be able to run fast enough to support real-time control and system planning.

Modeling Technology Needs

- Robust solution algorithm
  - The simulation and/or optimization must operate must find a solution within the defined constraints and objectives.
  - Capable of incorporating uncertainty to support decision-making process.
- High resolution
  - Flexibility is needed to run in time steps from sub-hourly to coarse blocks

Summary

- Reservoir systems in the Pacific Northwest are highly constrained by a complex mixture of non-power hydraulic constraints and objectives
- There is a tremendous amount of uncertainty in almost every aspect of reservoir system operations
- One must consider the whole range of operational possibilities to make risk informed decisions
- Water management agencies needs modeling capability to support the formulation of successful operations and marketing strategies