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SLIDES: CRSS lite: Screening Model for Operating Policy Evaluation and Negotiation on the Colorado River Basin

Carly Jerla

Carly Jerla, *CRSS lite: Screening Model for Operating Policy Evaluation and Negotiation on the Colorado River Basin*, *in* HARD TIMES ON THE COLORADO RIVER: DROUGHT, GROWTH AND THE FUTURE OF THE COMPACT (Natural Res. Law Ctr., Univ. of Colo. Sch. of Law, 2005).

RECLAMATION

Managing Water in the West

CRSS-Lite: Screening Model for Operating Policy Evaluation & Negotiation on the Colorado River Basin

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Bureau of Reclamation

Presentation Overview

- Motivation
- Development
- Modeling Approach
- Key Features & Description
- Demonstration
- Strengths & Limitations of CRSS-Lite
- Questions

Motivation

- Prior to CRSS-Lite, 2 models used to analyze operating strategies
  - CRSS
    - Official planning model
    - Monthly timestep
    - Detailed with long run-time and a lot of data
  - CRSSez
    - “Hard-coded”, screening model
    - Annual timestep
    - Approximate operations of a virtual reservoir in the Upper Basin
    - Users can’t modify or view policy
- CRSS is too detailed, CRSSez is not detailed enough

Development: *Requirements*

- Stakeholder team interviewed to identify user requirements.
- Requirements
  - Must accurately represent complex *Law of the River*
  - Must accurately represent physical system
  - Must be flexible enough to investigate policy alternatives
  - Must provide a way to view policy to communicate alternatives and outcomes more effectively
  - Run fast enough to investigate multiple scenarios in one sitting

Development: *Challenges*

- Greatest modeling challenge was balancing speed and accuracy
  - Need an annual timestep for speed but Powell and Mead operations are inherently monthly in logic
  - Upper Basin operation time consuming but not part of analysis for Powell & Mead interactions
  - However, need monthly inflows from Powell and monthly storages in 5 Upper Basin reservoirs to operate Lower Basin

Modeling Approach

- Implemented in RiverWare
  - Provides programming language separate from compiled code to express policy
  - Policy drives the simulation
  - Riverware Policy Language (RPL) user-oriented, easy to write and read
- Took detailed CRSS and tried to preserve accuracy but make it faster

Key Features of CRSS-Lite

- Powell and Mead operations contained in a single rule that performs 12 monthly iterations at each run timestep
- Mead flood control algorithm implemented in C++ to improve run-time
- Required monthly data is disaggregated automatically within the model (no need for extra processing)
- Relevant data from Upper Basin above Powell operation is imported via seamless data transfer routines from CRSS
- Lower Basin detail same as CRSS

CRSS-Lite: Policy Screening Model

- Closely based on CRSS
- Objects simulate on an annual timestep
- Powell inflow and Upper Basin reservoir storages supplied as input
- Matches CRSS within 0.001%
- Run-time cut by about 70% - requires about 15 minutes for a complete run (90 traces)

Hydrologic Scenarios & Probabilistic Output

- Index Sequential Method
  - Cycles through period of record hydrology (1906-1995) resulting in 90 hydrologic scenarios (traces)
- Graphical Policy Analysis Tool (GPAT)
  - Computes statistics on model output
  - Displays statistics graphically

Interpreting & Viewing Model Output

- Many tools available to analyze model results
  - Graphical Policy Analysis Tool (GPAT)
  - System Control Table (SCT): View current state of the model in compact, easy way
  - Data Management Interface (DMI) Routines, Output Manager and Individual Slot Export as a way to transfer model results to another application for analysis
  - Snapshots & Plotting: powerful tool for analysis within the model

Demonstration 1 - *View Effect of Coordinated Management on Reservoir Contents*

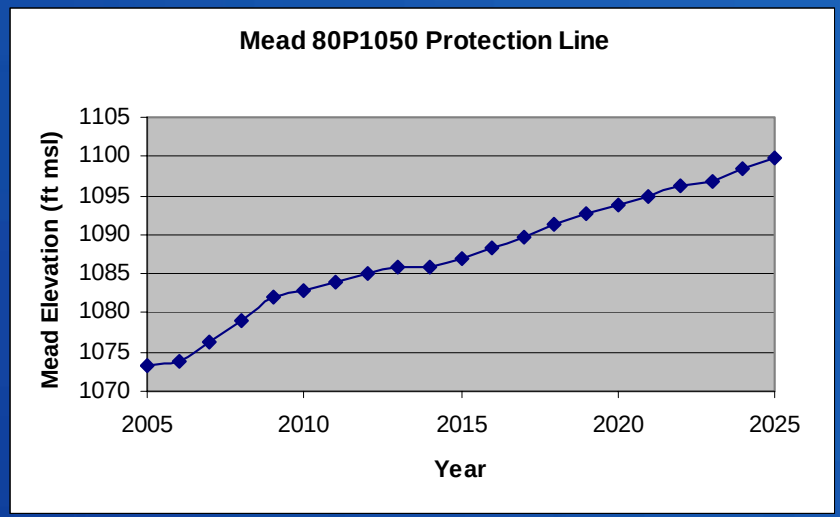
- Compare Powell and Mead storages under *"Balance Contents"* and *"Protect Mead 1000"* scenarios
  - Run using Trace 80 hydrology, starting in 1986 – 1995 and wrapping around to use 1906 – 1916
  - Use RiverWare's Snapshot Management tool & plotting to compare results

Demonstration 2 – *View Tradeoffs of Alternative Shortage Policies*

- Compare Mead elevation & Lower Basin shortage under *"Protect Mead 1000"* and *"Protect Mead 80P1050"*
  - *Protect Mead 1000* is absolute protection
  - *Protect Mead 80P1050* is probabilistic approach
  - Run using Trace 25 hydrology, starting in 1931 – 1951
  - Use Snapshot Management tool, Model Run Analysis & plotting to compare results

Probabilistic Shortage Policy
"Protect Mead 80P1050"

- Uses probabilistic elevation triggers to protect Mead at 1050 with 80% assurance probability
- Triggers are a function of Upper Basin demand and historical inflow to Powell
- Shortages of smaller magnitudes are incurred earlier than in *Protect Mead 1000*



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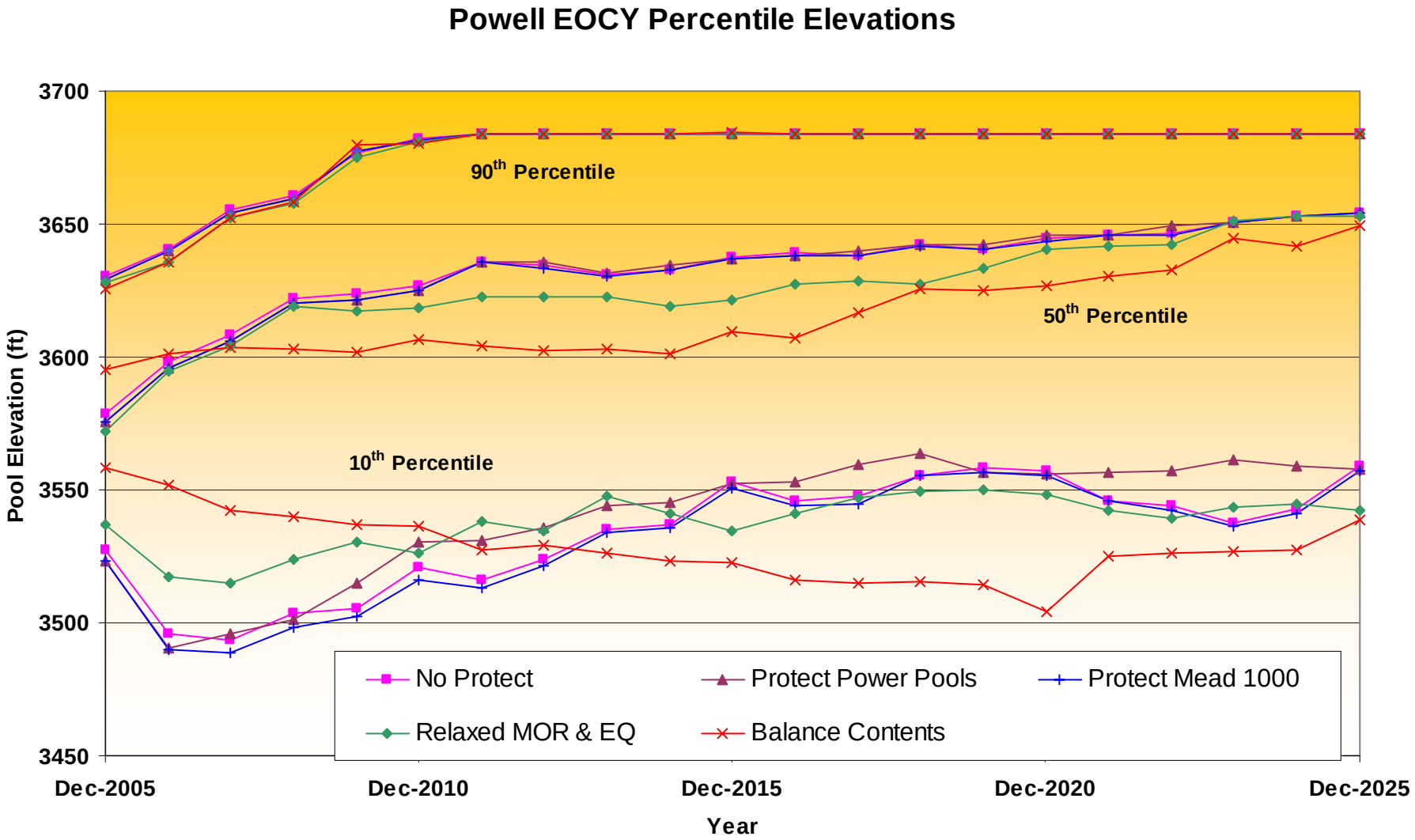
Probabilistic Output – Reservoir Percentiles



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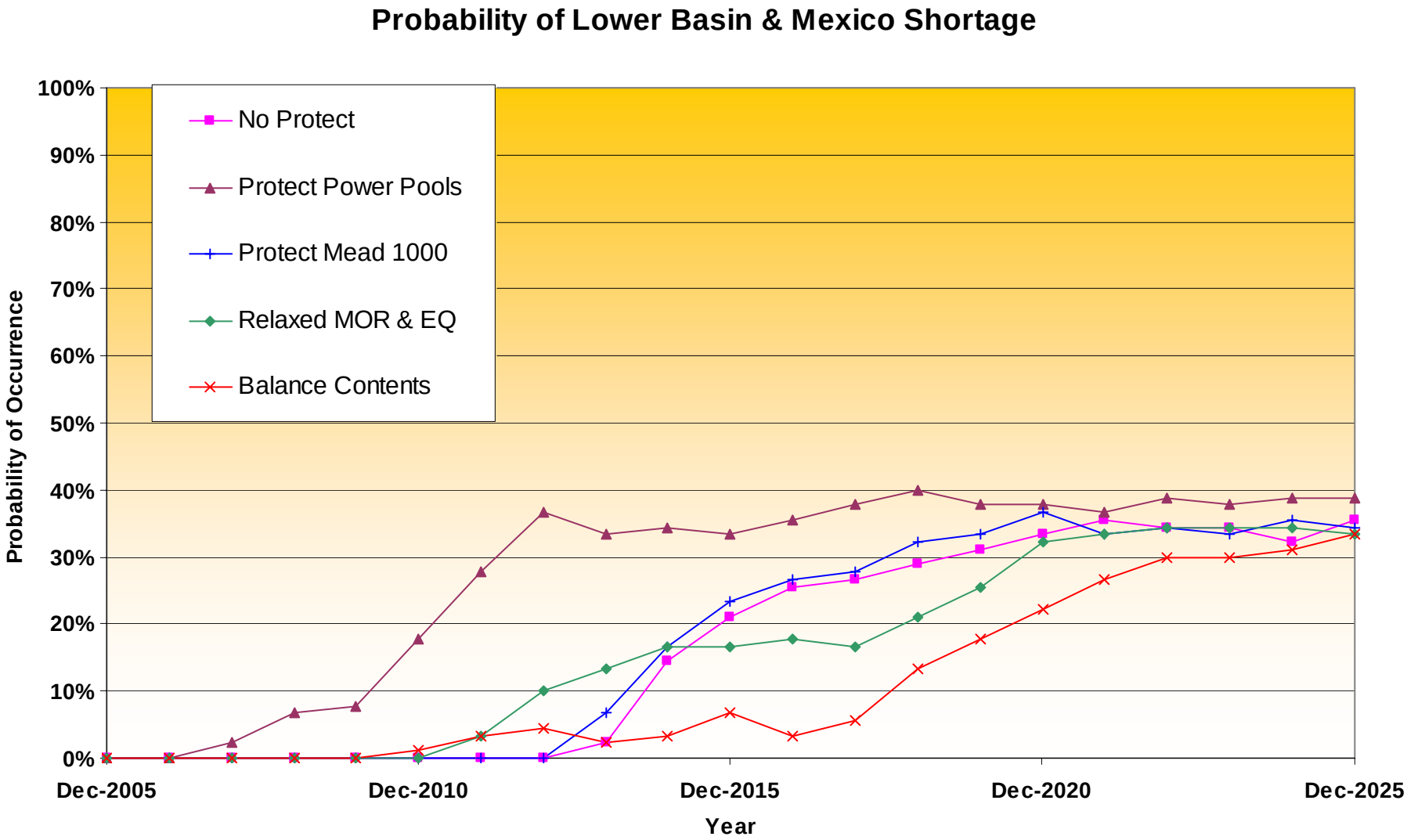
Probabilistic Output – Occurrence Probabilities



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Strengths & Limitations of CRSS-Lite

- Strengths
  - Run-time reduced, accuracy preserved
  - Operational policies can be viewed and modified by user
- Limitations
  - Inflows to Powell are input, would need to run CRSS to address “Compact Call”

Questions?