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

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

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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
• 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*
Powell EOCY Percentile Elevations

- 90th Percentile
- 50th Percentile
- 10th Percentile

Pool Elevation (ft)

Dec-2005 to Dec-2025

- No Protect
- Protect Power Pools
- Protect Mead 1000
- Relaxed MOR & EQ
- Balance Contents
Probabilistic Output – Occurrence Probabilities

Probability of Lower Basin & Mexico Shortage

- No Protect
- Protect Power Pools
- Protect Mead 1000
- Relaxed MOR & EQ
- Balance Contents

Year:
- Dec-2005
- Dec-2010
- Dec-2015
- Dec-2020
- Dec-2025

Probability of Occurrence:
- 100%
- 90%
- 80%
- 70%
- 60%
- 50%
- 40%
- 30%
- 20%
- 10%
- 0%
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?