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

NRLC Conference – Boulder, CO
June 2005
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
Probabilistic Output – Reservoir Percentiles

Powell EOCY Percentile Elevations

Pool Elevation (ft)


Year

90th Percentile

50th Percentile

10th Percentile

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

RECLAMATION
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?