IM3 INTEGRATED MULTISECTOR MULTISCALE MODELING

EXPLORING THE CONSISTENCY OF INFERRED WATER SHORTAGE VULNERABILITIES IN A MULTI-ACTOR, MULTI-SECTOR RIVER BASIN THROUGH THE USE OF DYNAMIC AND ADAPTIVE WATER RIGHT TRANSFERS

AUTHORS

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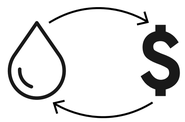
RIGHTS' HOLDERS IN WESTERN RIVER BASINS ARE ENGAGING IN FORMAL AND INFORMAL RIGHTS TRADING

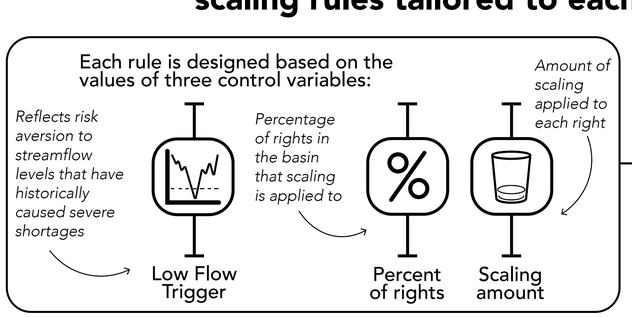
Such transfers modulate the effects of drought for downstream water users. Financial compensation from state agencies could also help augment the basin's downstream deliveries.

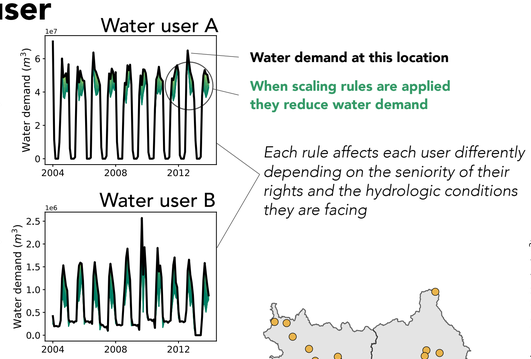


This study is focussing in the Upper Colorado River Basin within the state of Colorado. We take advantage of the state-developed StateMod model for the basin that accounts for water supply and allocation at a fine scale.

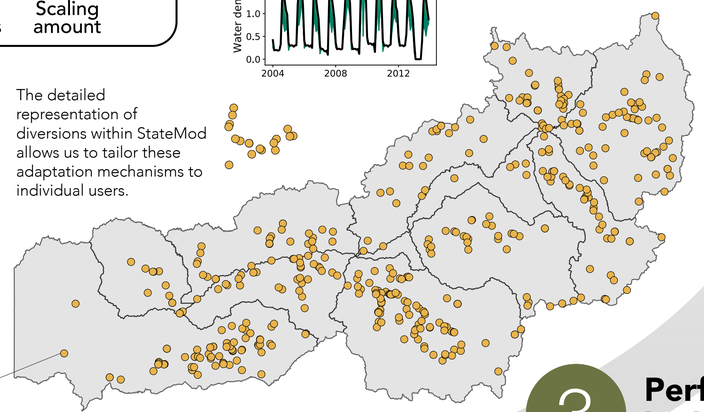
SCOPE AND INNOVATION OF EXPERIMENT

1 Create 600 exploratory adaptive demand scaling rules tailored to each user

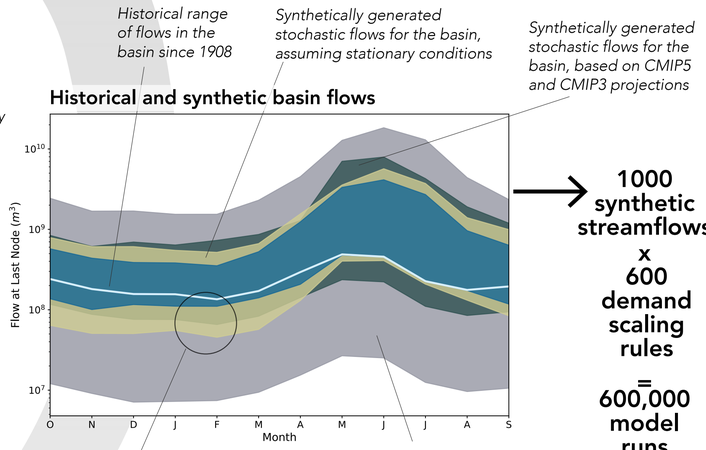




The detailed representation of diversions within StateMod allows us to tailor these adaptation mechanisms to individual users.

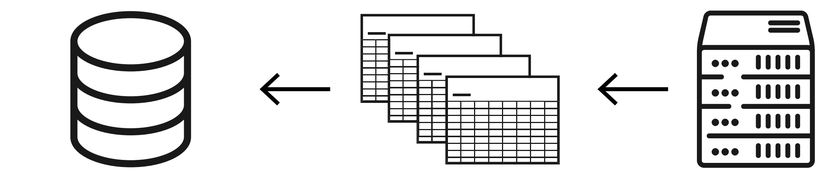


2 Test rules under increasingly stressed hydrologic conditions



1000 synthetic streamflows x 600 demand scaling rules = 600,000 model runs

3 Perform computational experiment on high-performance computing resources



Use 20,000 core hours to perform 600,000 model executions

Looking at data for 350 users across all moder runs results in **259 billion records**

Compress outputs to much smaller storage volume using compressed **.parquet** *file formatsing*

4 Manage and analyze dataset with SQL and DuckDB

Use queries to process and store data in tabular formats (e.g., dataframes), while allowing for interactive analysis and visualization.

DuckDB

SQL

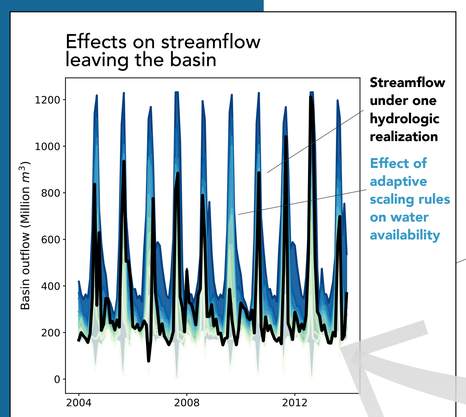
THIS STUDY ADDRESSES TWO QUESTIONS:

1) How much can dynamic & adaptive informal water tranfers affect overall water availability?

Simple transfer mechanisms that operate within the current doctrine of prior appropriation can be used to ensure water deliveries for the users that engage in them. This study explores how such transfers affect water availability in the Upper Colorado River Basin within the state of Colorado, if applied to an increasingly larger scale. We explore this using an ensemble of scaling 'rules' that differ in when they are triggered, the number of rights they include and the degree of scaling they consider.

2) What are their limits in an increasingly stressed basin?

Under an increasingly stressed future–where dry conditions are becoming longer and more frequent–we would like to understand the capacity of such adaptive behavior to modulate more extreme droughts. More specifically, we'd like to identify if and under what conditions adaptive water transfers become insufficient tools in ensuring both water availability for rights' holders and deliveries downstream.



Preliminary results show that while adaptively scaling of individual water demands generally increases water availability in the basin, the effectiveness of this mechanism varies as a result of its interactions with the hydrologic conditions it's applied to.

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