



Projecting Water Scarcity Across Scales: Case Study of the Colorado River Basin

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Motivation

- Water scarcity is a growing concern globally that depends on multiple considerations and may evolve across scales
- The United States' Colorado River Basin (CRB) is a critical water resource that is now requiring management action
- Multiple types of water management (WM) models available for different purposes:
 - Planning: Colorado River Simulation System (CRSS)
 - Research: MOdel for Scale Adaptive River Transport-Water Management (MOSART-WM)

Study Objectives

Study Focus: Compare water shortage projections from different water management models

- This study seeks to answer:
 - How is water shortage impacted by changing climate conditions?
 - How sensitive are estimates of water shortage to the scale and purpose of model?

Methods

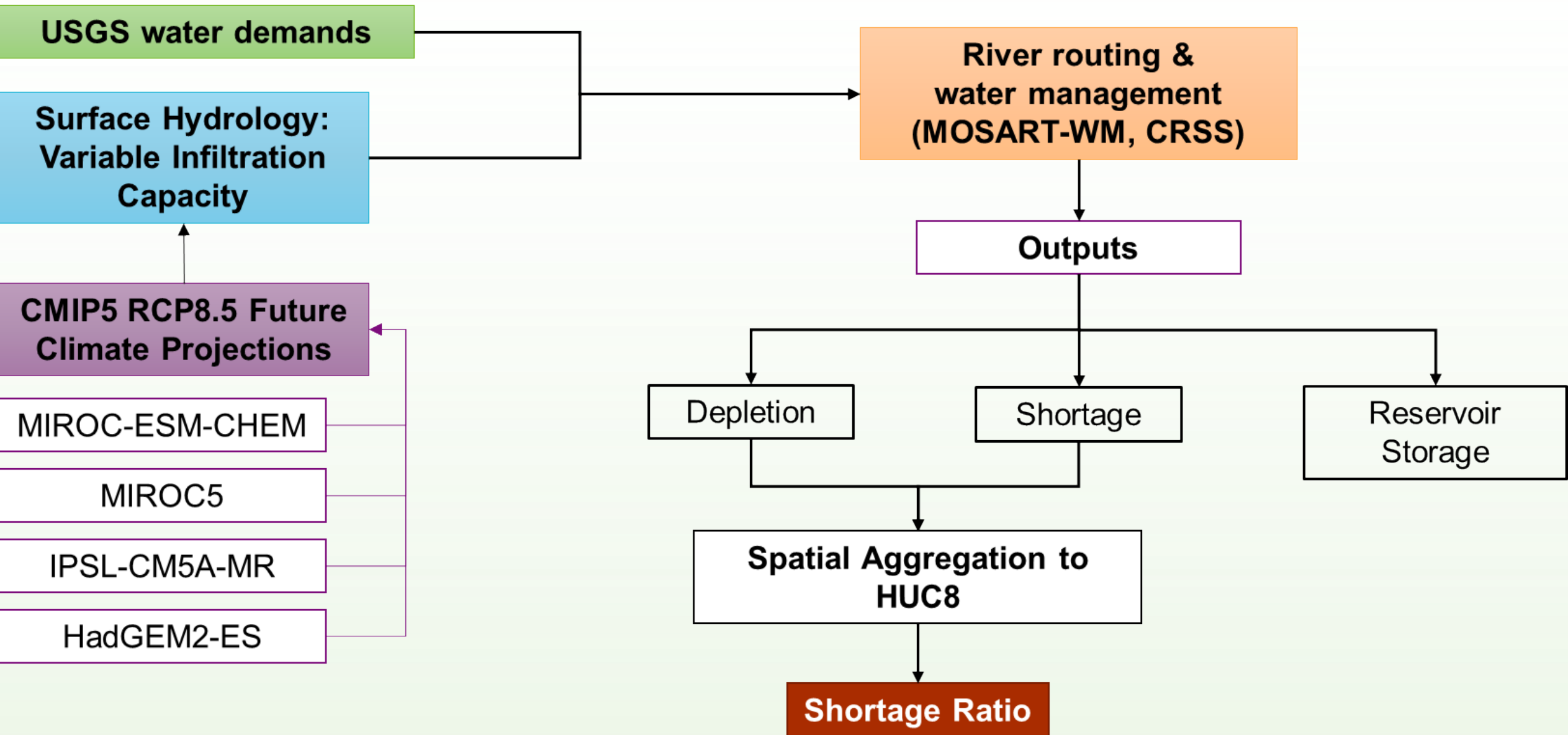


Figure 1. Overview of datasets and models used in this study.

Study Findings

Water Scarcity Across Scales, Models, and Projected Climates

- Water management models produce dissimilar results across scales(basin and subbasin) and climate models
- Basin-level projections of future water scarcity suggest different trends and intensities of water shortages across climate models (see **Figure 2**).
- Observed spatial heterogeneity of projected mean water scarcity with CRSS missing the lower CRB (see **Figure 3**).

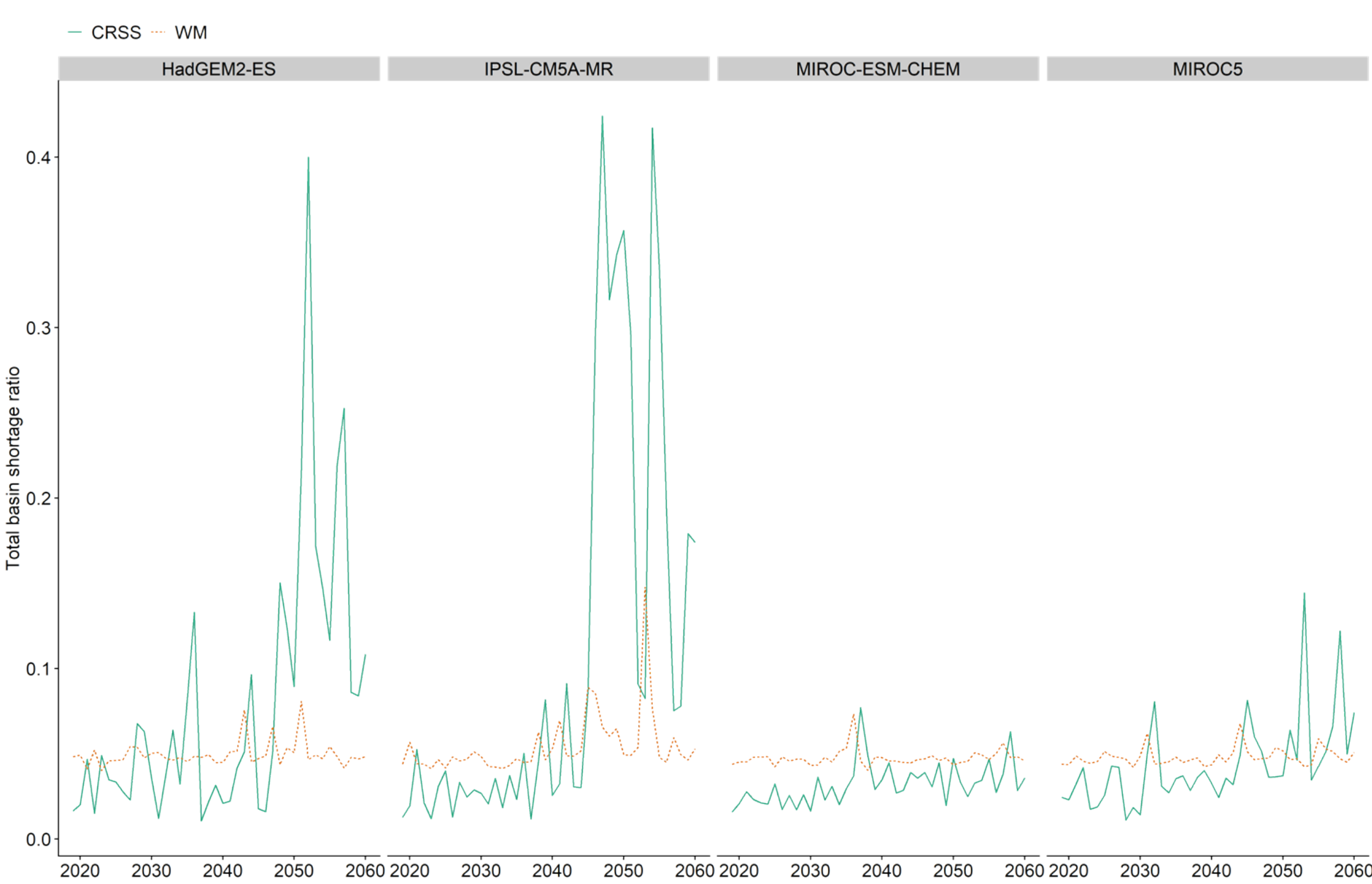


Figure 2. Time series of projected water scarcity at the basin scale by climate model.

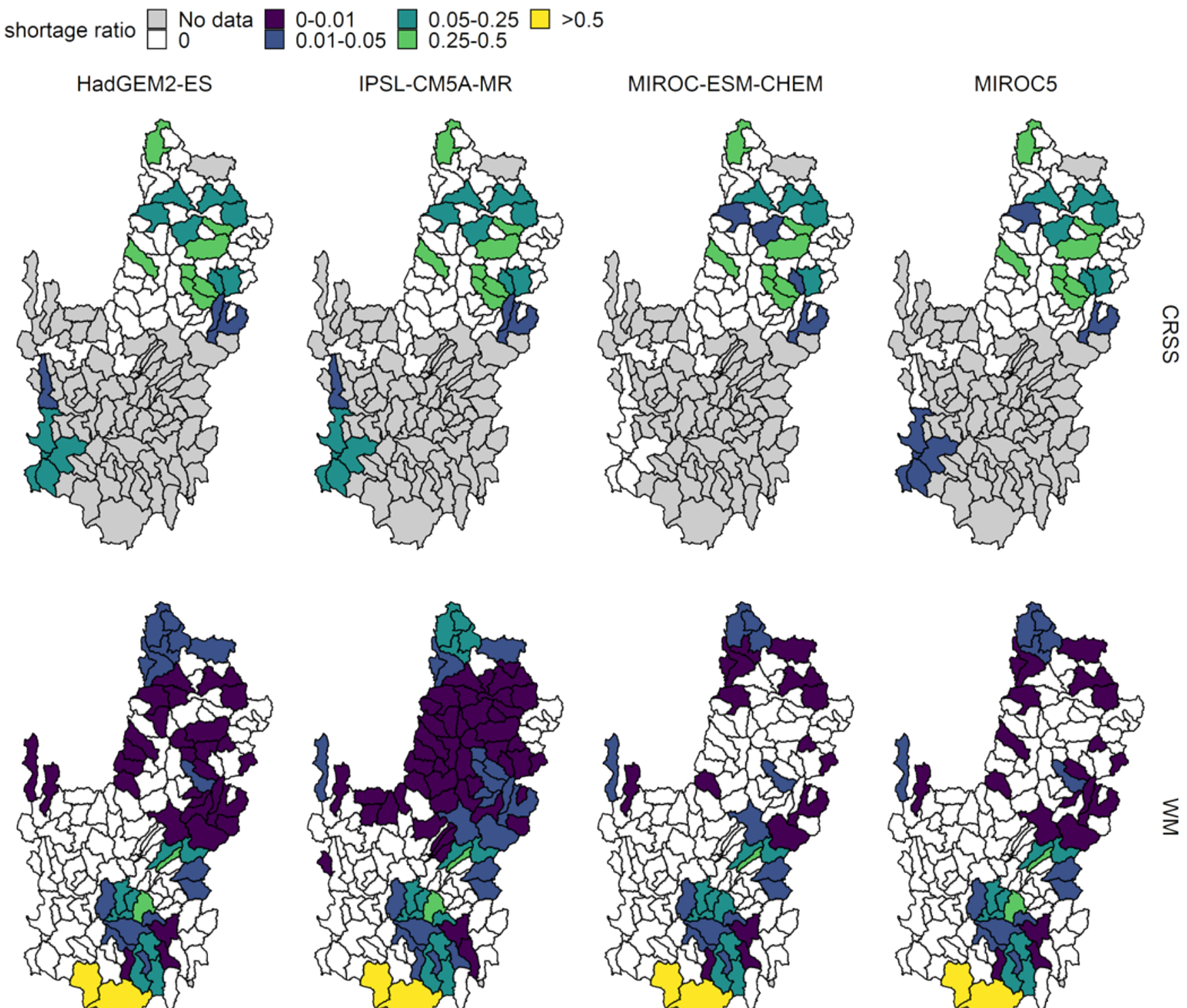


Figure 3. Mean projected water scarcity at the HUC8 subbasin scale.

Attributes Contributing to Modeling Differences

MOSART-WM and CRSS (RiverWare) are fundamentally different WMs that yield different results.

1 Difference in treatment of **inter- and intra-basin transfers** affect depletions throughout the basin

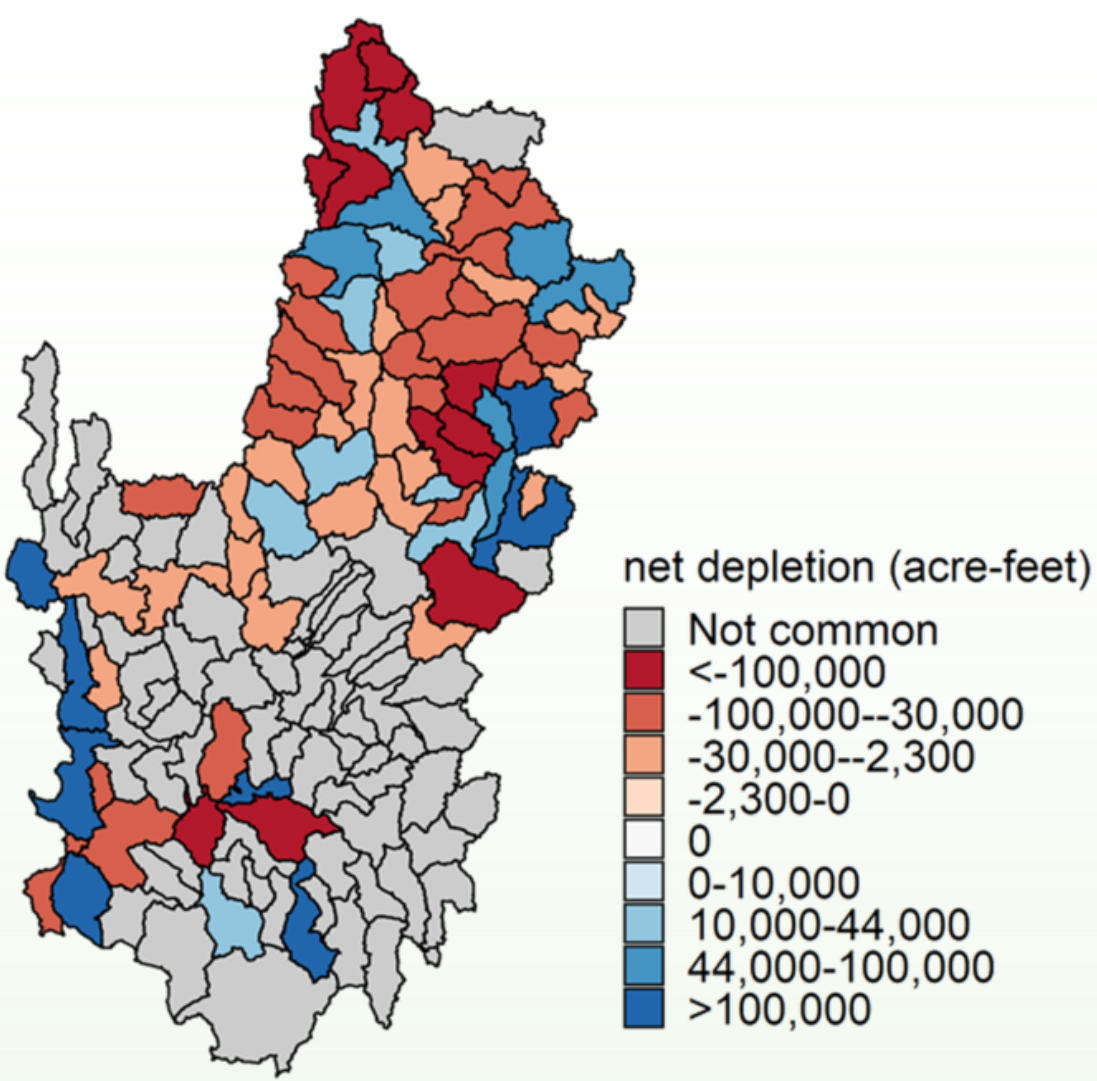


Figure 4. Difference in mean projected depletions between CRSS and WM using the IPSL-CM5A-MR GCM.

2 Model representation of the basin and **inter-basin transfers** affects the basin's depletions over time



Figure 5. Time series of projected total basin depletions across GCMs accounted for different model representations.

3 **Number of reservoirs** and available **storage capacity** between CRSS and WM

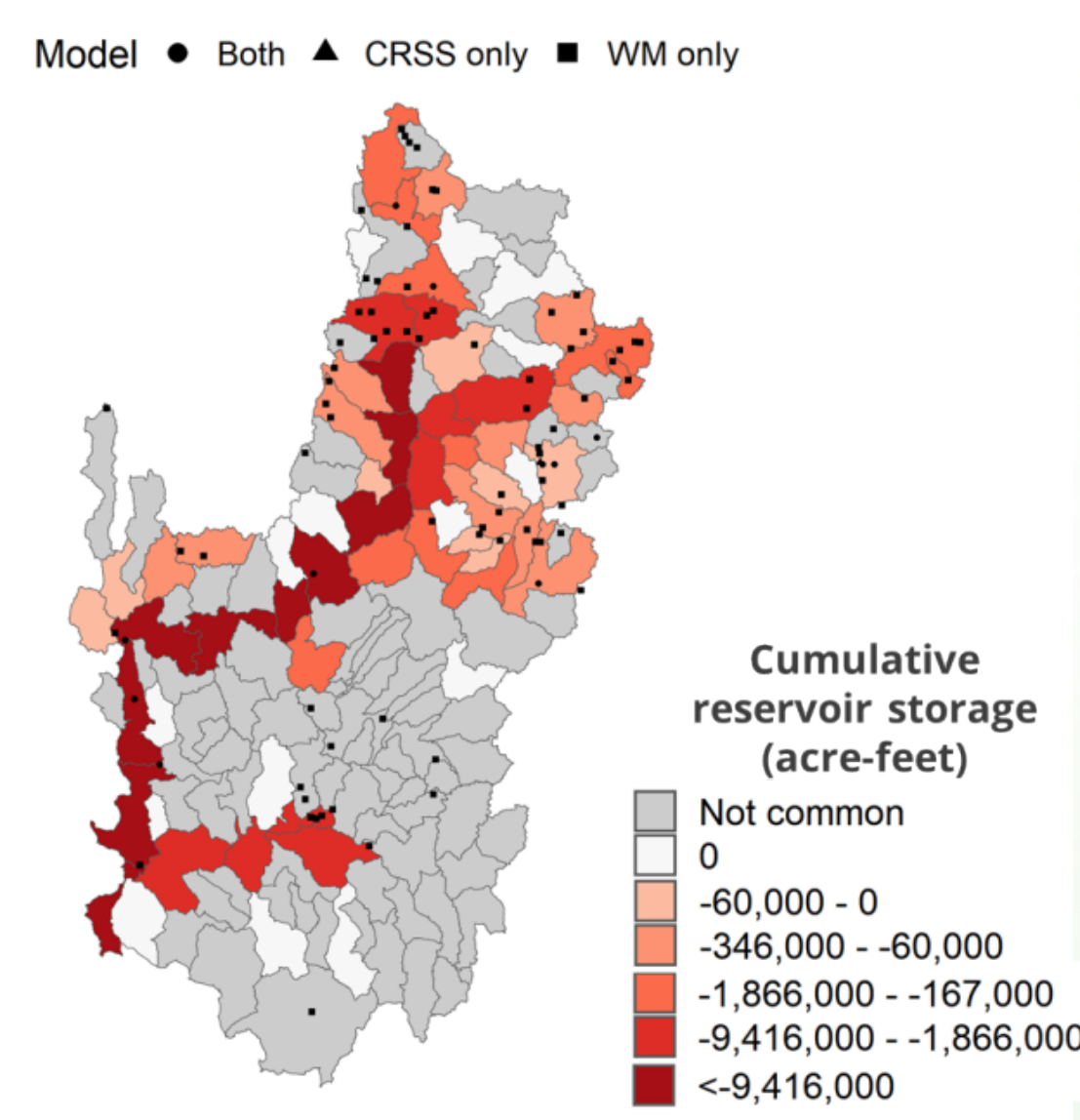


Figure 6. Difference in reservoir storage between CRSS and WM throughout the CRB.

Correcting for model differences improves CRSS' spatial extent but magnitude of water scarcity overall spatial similarity shows persistent issues with both models

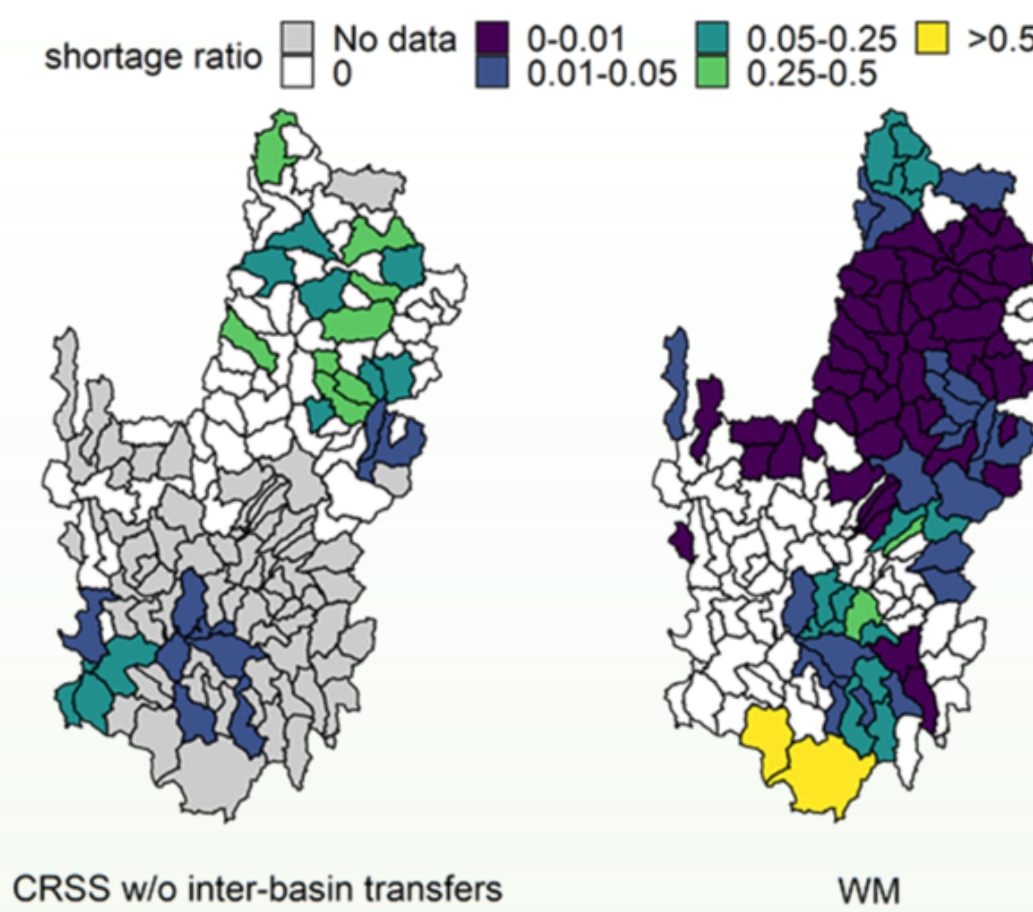


Figure 7. Mean projected subbasin water scarcity with basin transfer corrections using the IPSL-CM5A-MR GCM.