University of Idaho

Global Models Underestimate Hydrological Drought: Evidence of Delayed Onset, Advanced Recovery, and Reduced Severity from GRACE/FO

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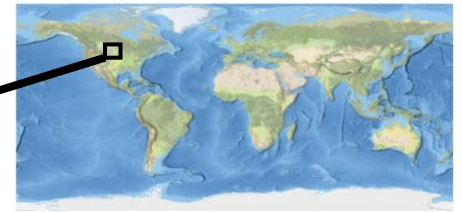
Unclear model capability to capture hydrological drought evolution

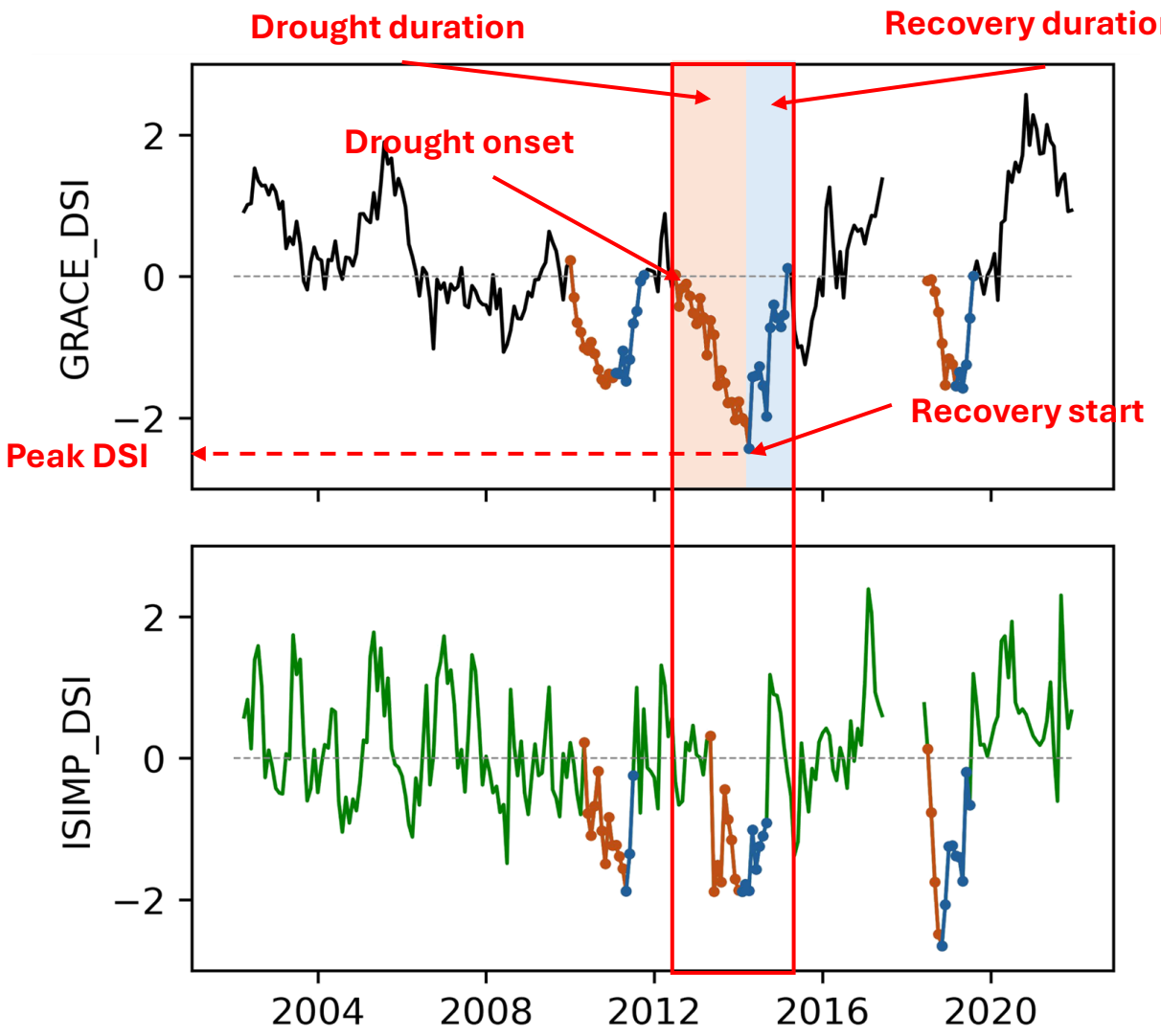
- Hydrological models are widely used to forecast future droughts and to assess their impacts on human health and socioeconomic systems.

- For decision makers, **drought evolution**—characterized by onset, peak, duration, and recovery—is of primary concern, yet it has not been systematically assessed.

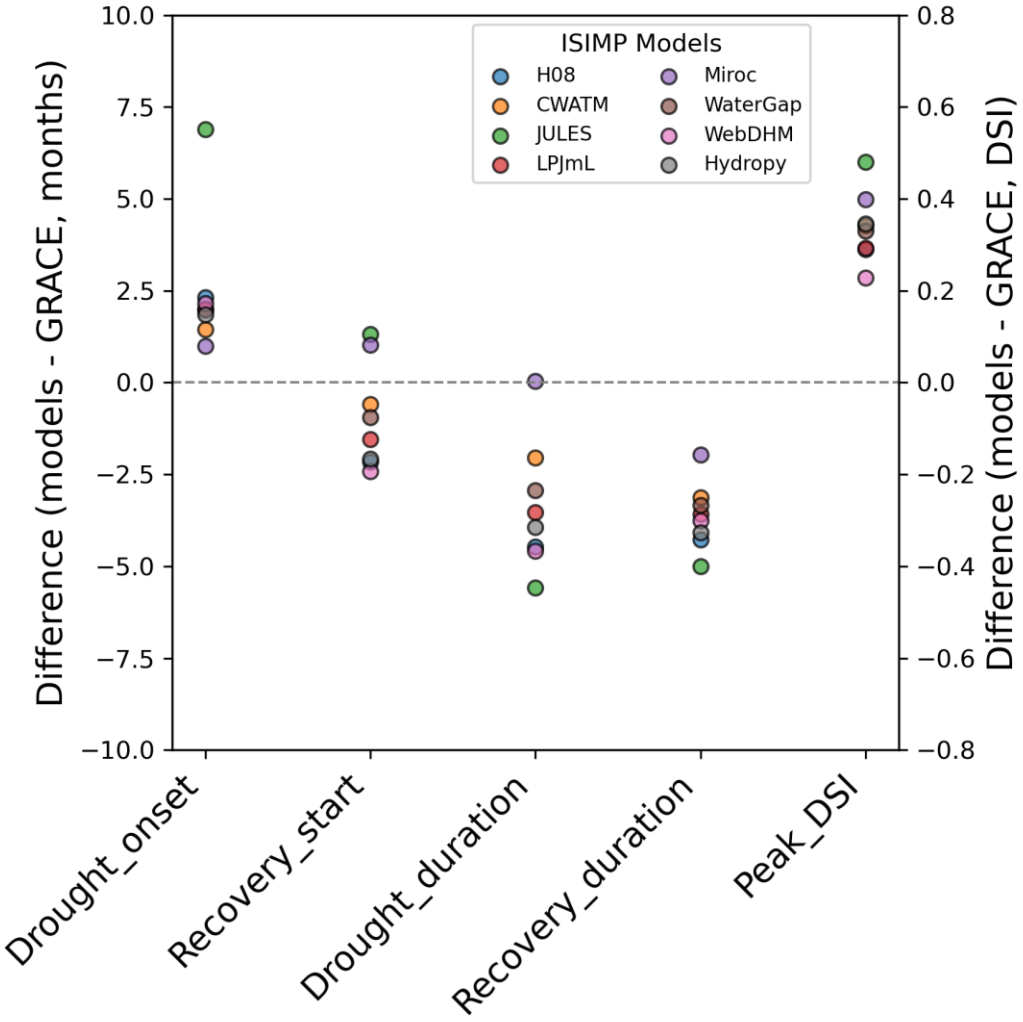
- Use the GRACE as a benchmark to evaluate the ability of eight ISIMP3a models to capture drought evolution.

Characterization of TWS drought evolution



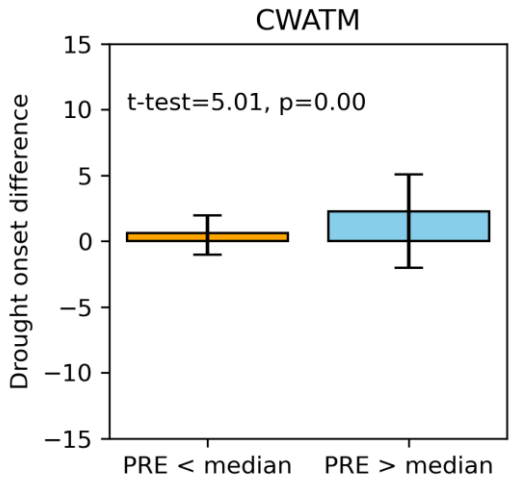


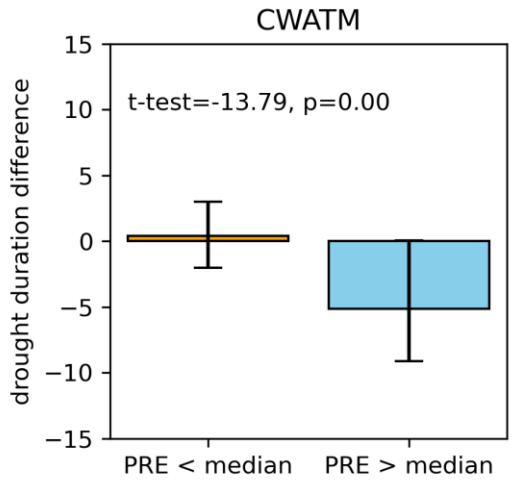
Differences in drought evolution indices between models and GRACE

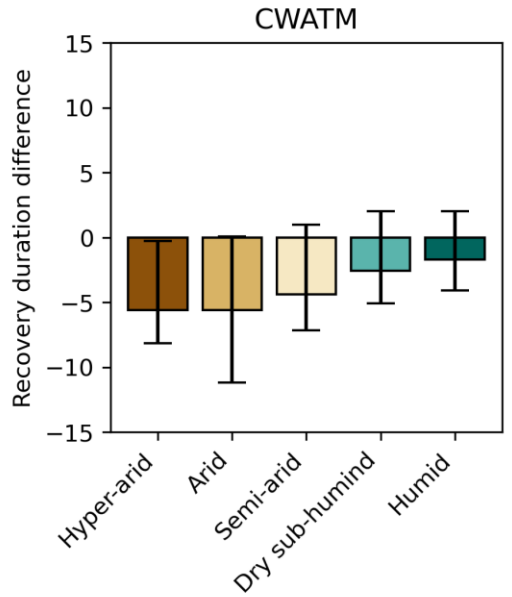


- ISIMP3a models tend to delay drought onset, advance recovery timing, and underestimate drought duration, recovery duration and severity relative to GRACE.

Potential drivers of model bias







- When the precipitation is relatively higher during droughts, the models tend to delay drought onset and underestimate the drought duration.
- Most ISIMP3a models simulate shorter recovery duration in dryer regions.

Takeaways

- Models underestimate hydrological drought.
- Modelled droughts start later, recover faster, are shorter, and less severe compared to GRACE/FO.
- Climate explains part of the bias.