Modernizing River Representation in E3SM

Key Progress in the MOSART River Model

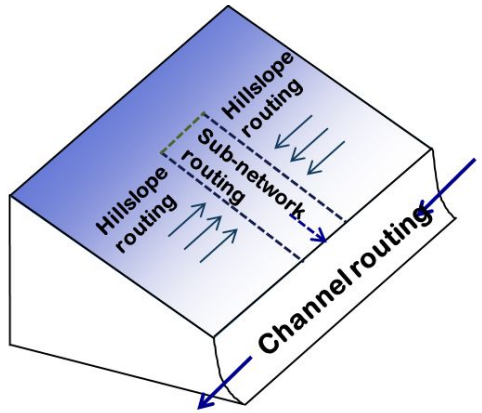
Presenter: Tian Zhou

Ruby Leung; Hong-Yi Li; Donghui Xu; Chang Liao; Matt Cooper; Zeli Tan; Gautam Bisht; Dongyu Feng ……

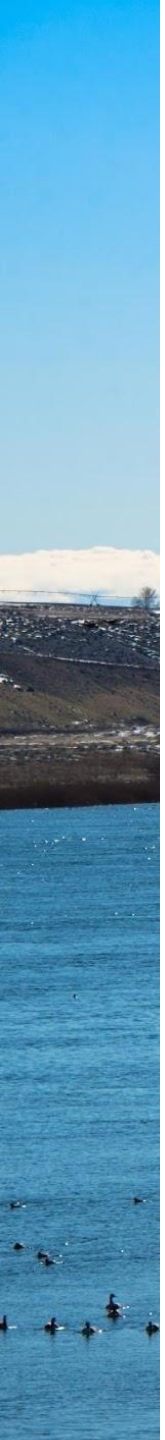
PNNL is operated by Battelle for the U.S. Department of Energy

Evolving River Modeling in ESMs

	Traditional river modeling
Processes	• Simplified natural processes
Integration	• One-way runoff transport from land to ocean
Resolution	• Relatively coarse spatial resolution (e.g. 0.5 deg or ~ 50 km)



Model for Scale-Adaptive River Transport (MOSART)



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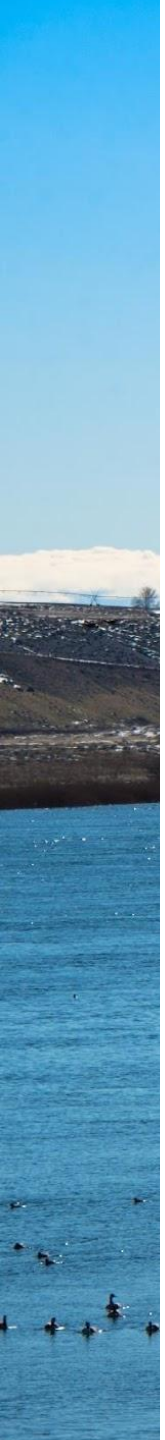

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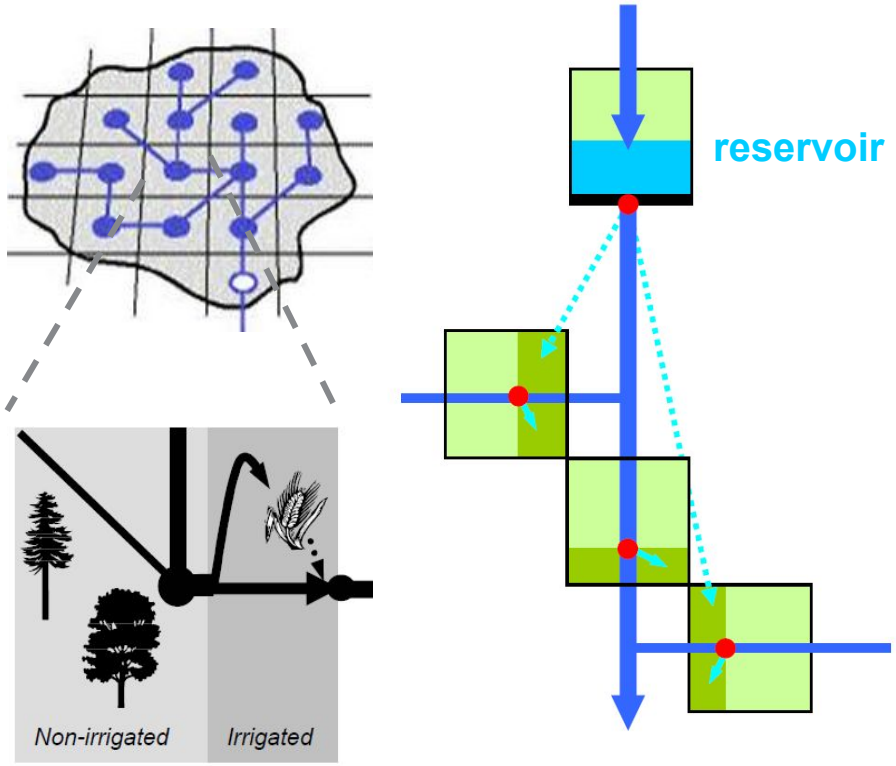
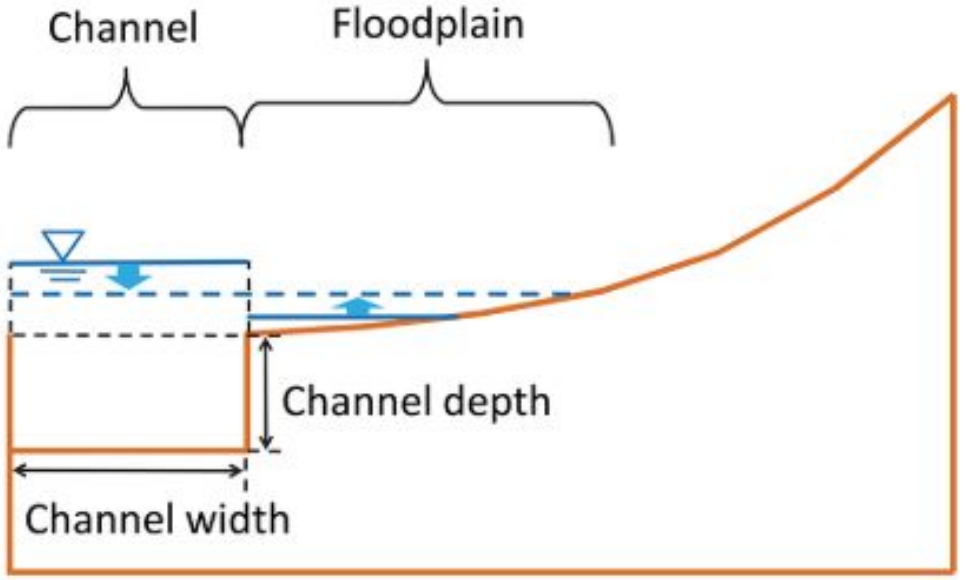
Human Activity



E3SM – MOSART Water supply and dam regulation schemes

Voisin et al., 2013

Key Natural Processes



E3SM – MOSART Flood inundation scheme

Luo et al., 2017

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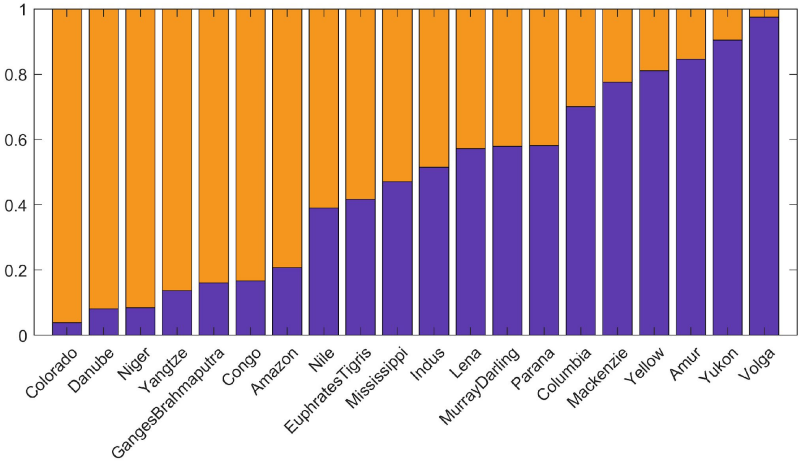
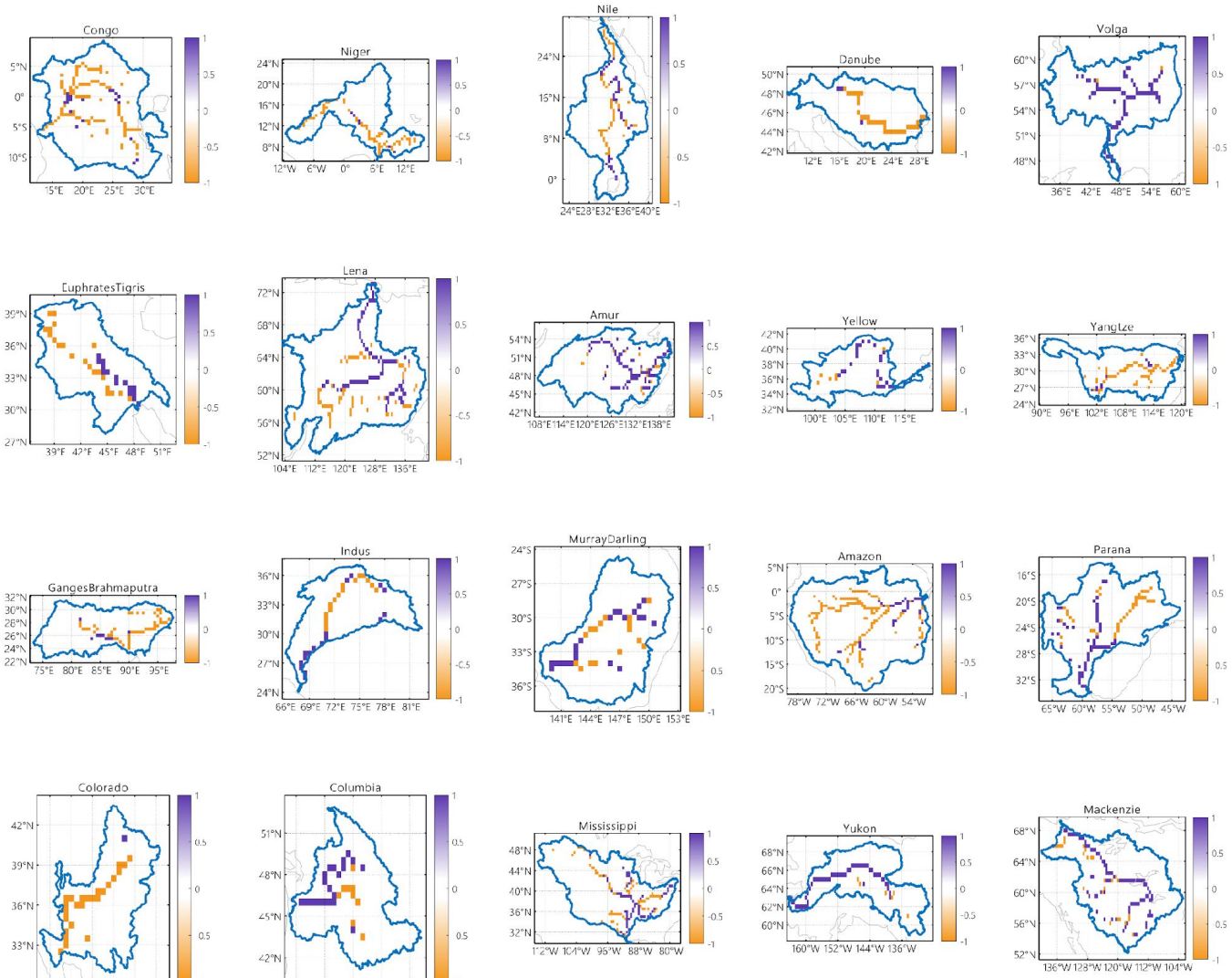
Impact of Water management on Flood Dynamics

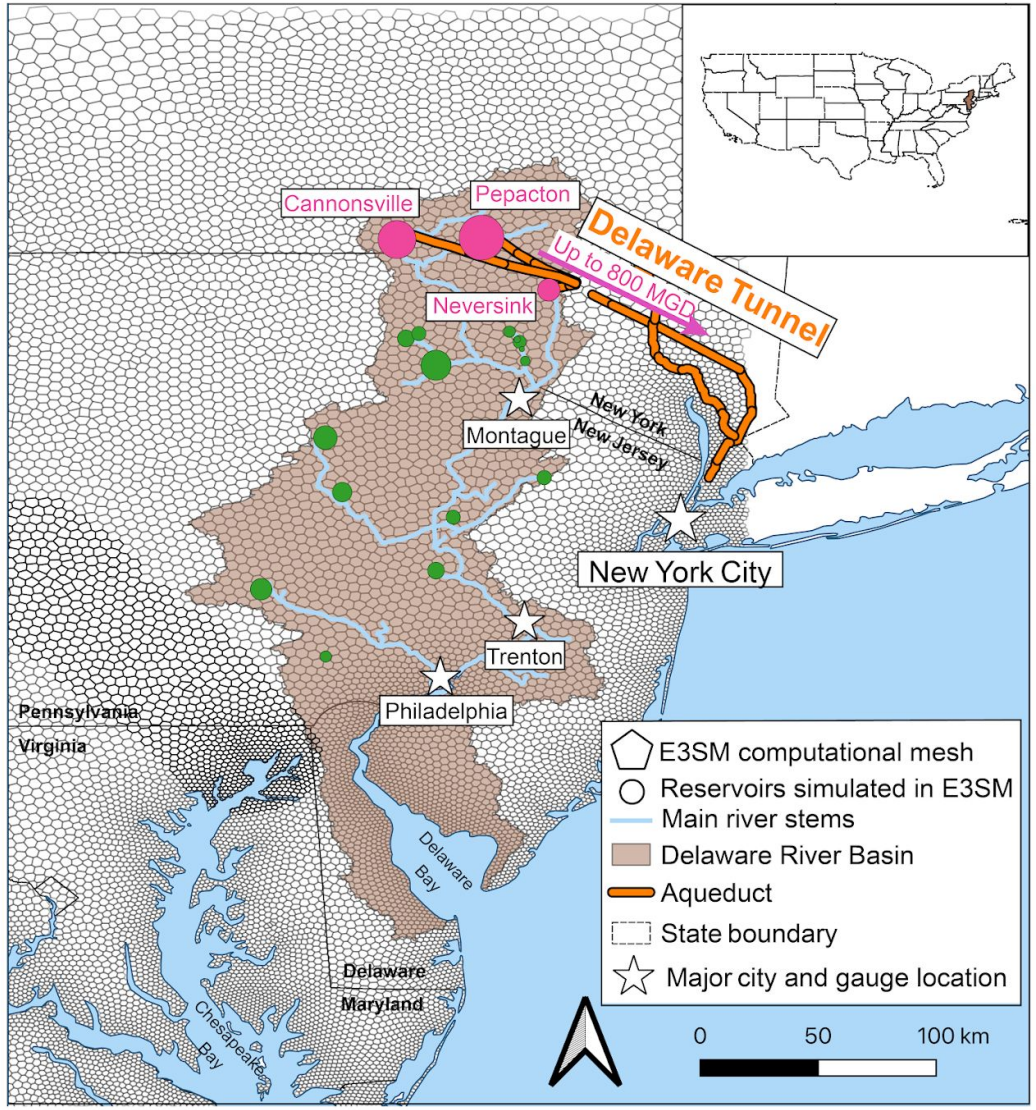
Water management does not alleviate future flood

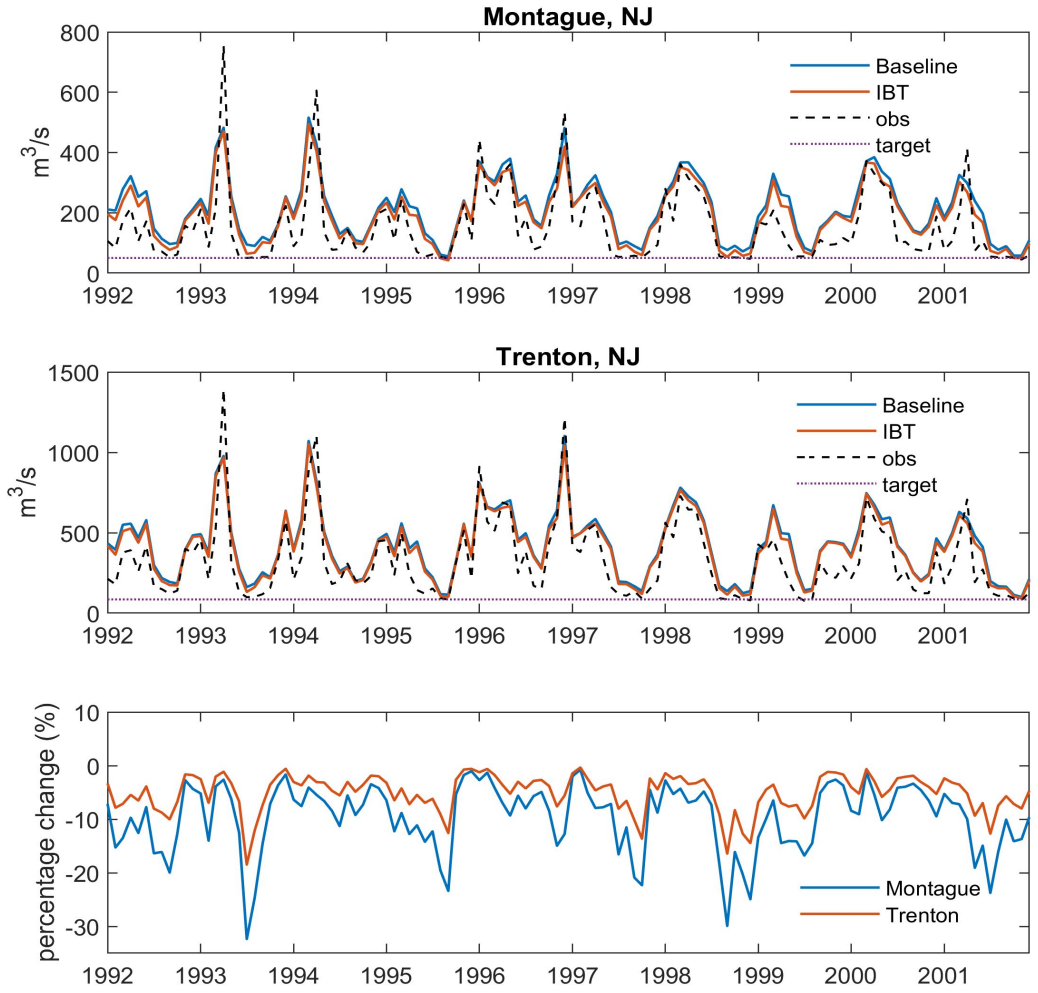
Water management alleviates future flood



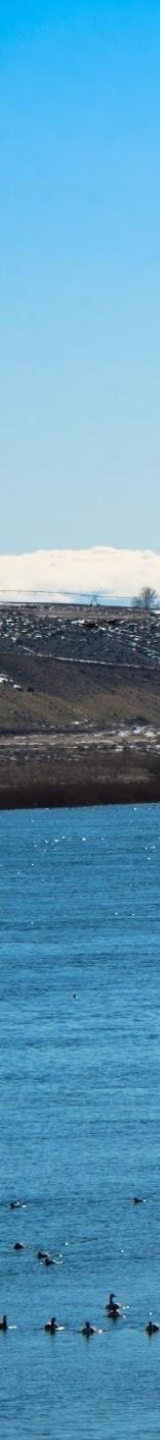


Inter Basin Water Transfer (IBT) Alters Hydrology





Zhou et al. (in prep)



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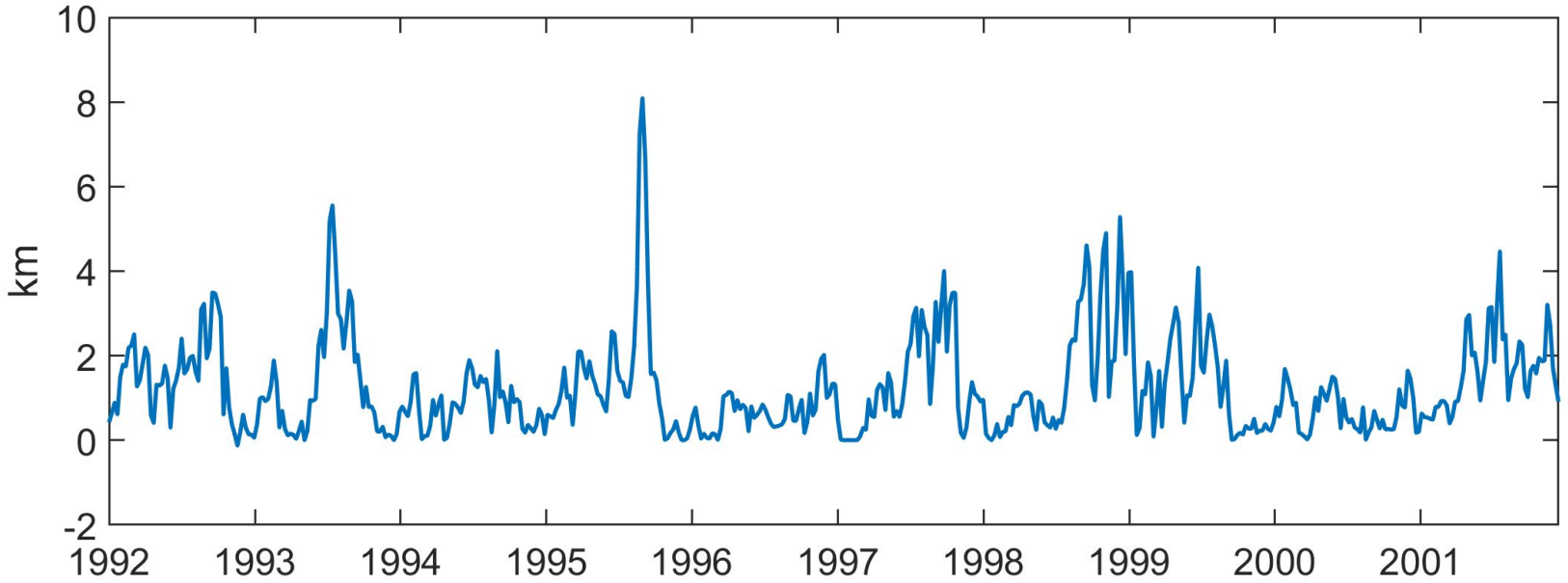
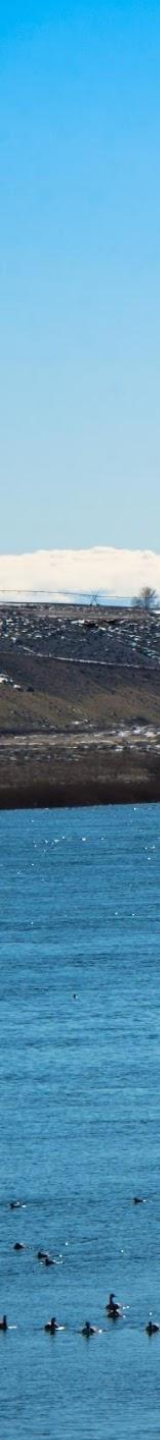
IBT Pushes Salt Waterfront Inland



- IBT could push the maximum salt front location upstream by nearly 8 km
- The findings also highlight the critical need to incorporate IBT into models that assess human impacts on large-scale hydrologic processes



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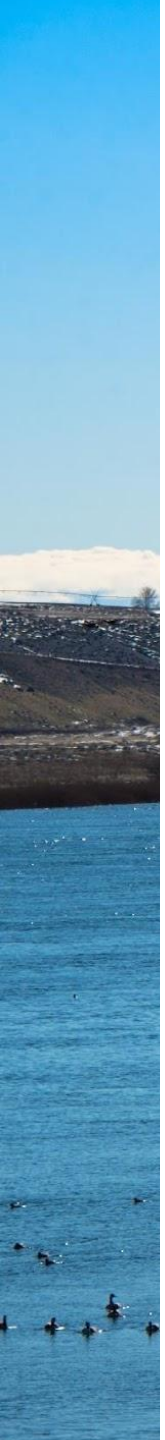

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New Processes

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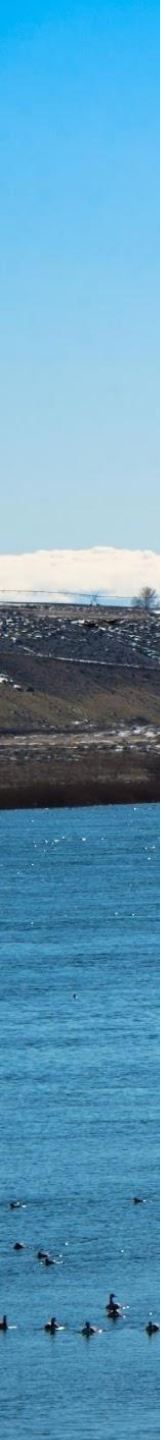

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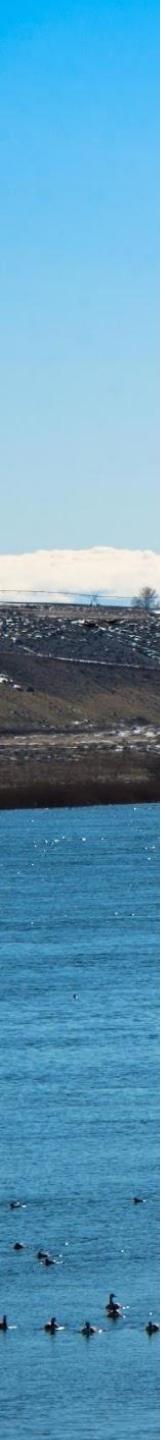

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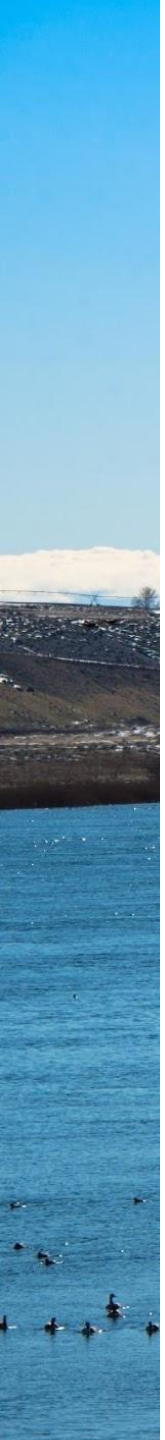

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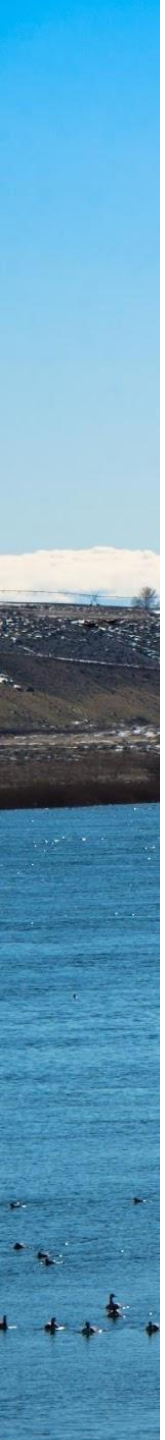

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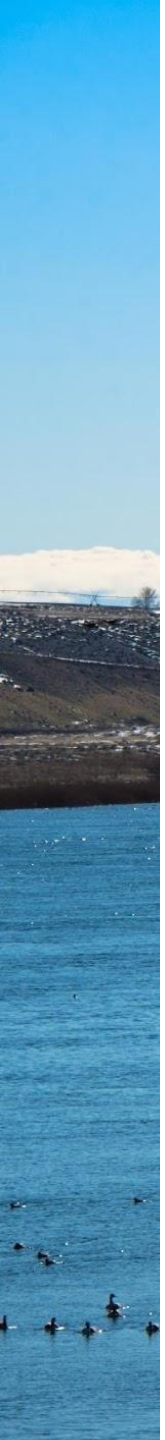

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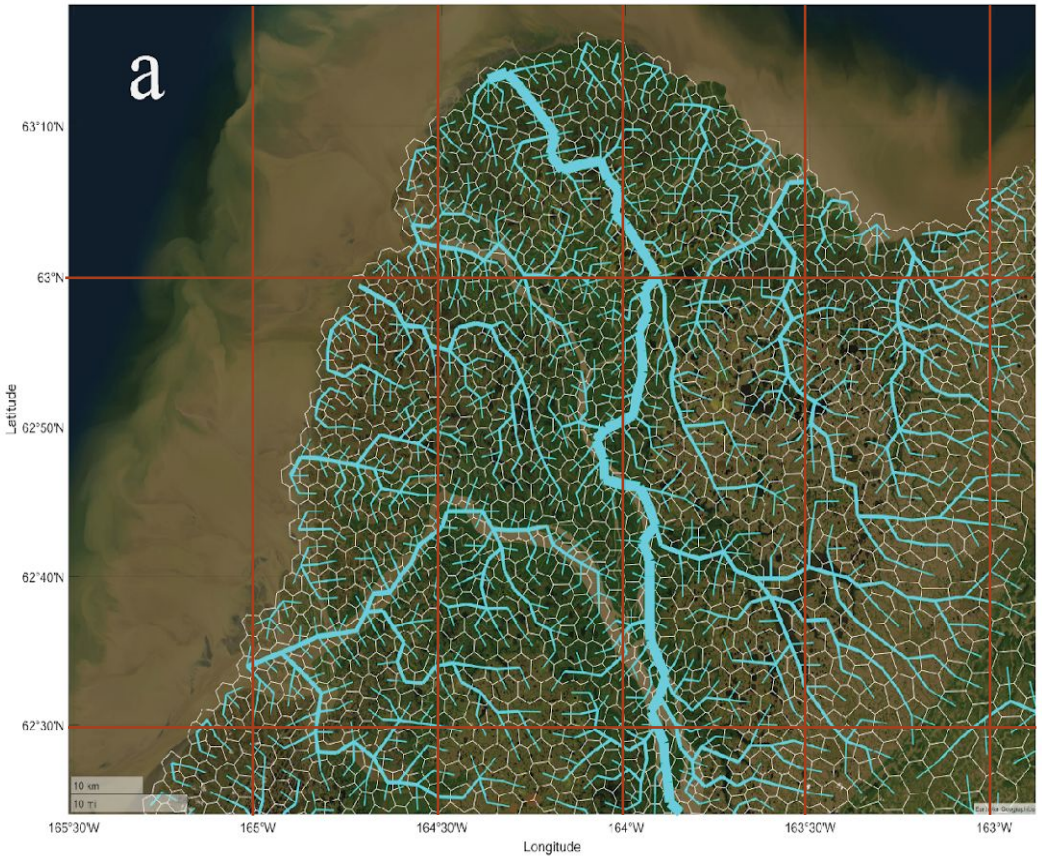
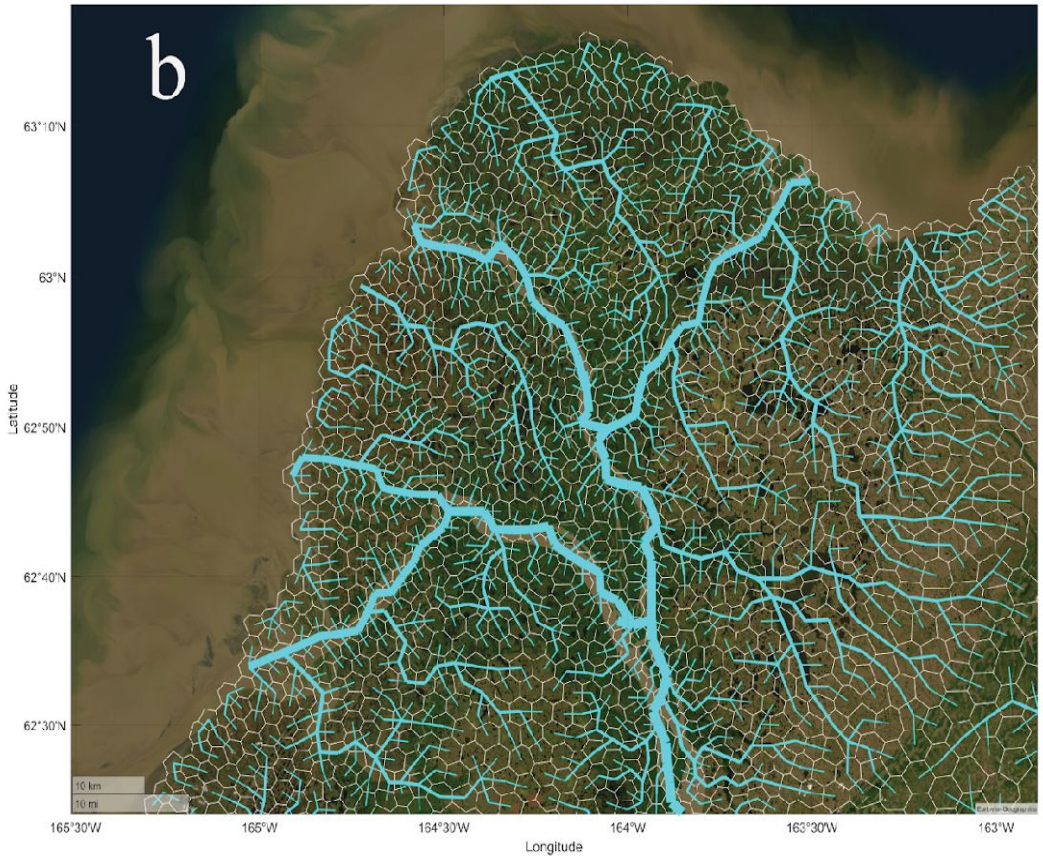
Challenges and Opportunities



Yukon River delta on 5km MPAS grid with current single outlet config



Proposed channel bifurcation feature to better capture flow network in this region

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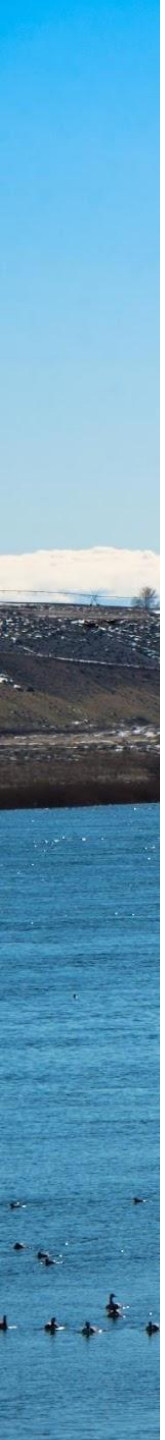
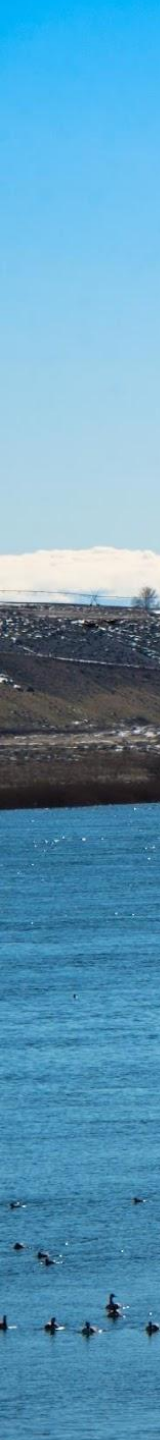
Thank you





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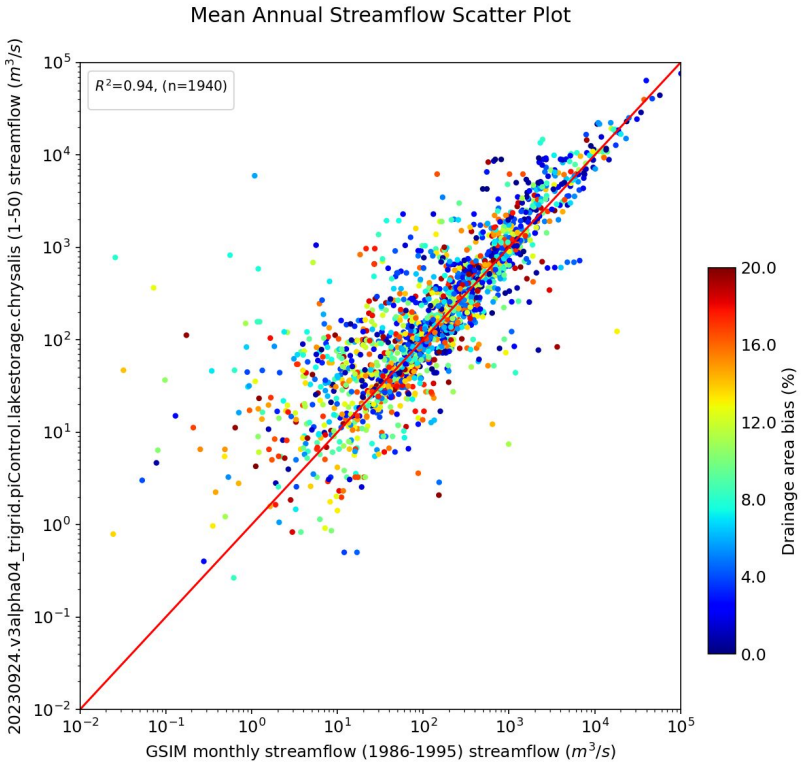
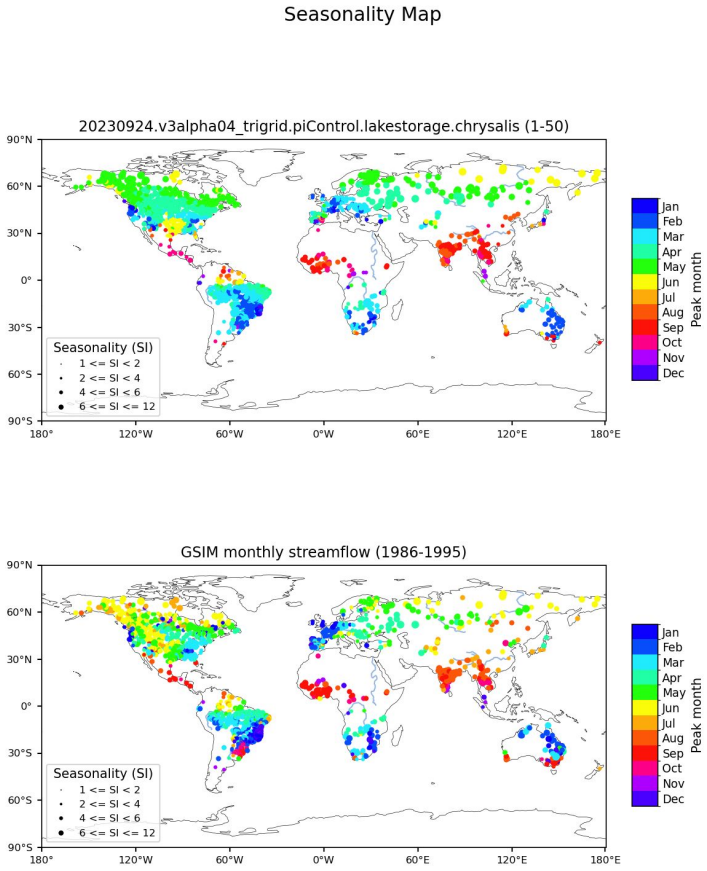
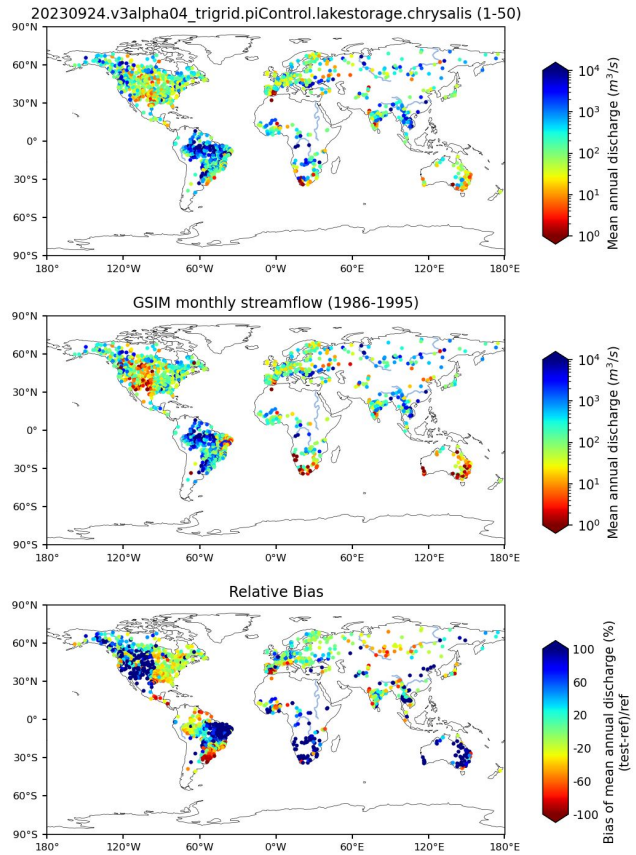
			• Obtain high quality data • Streamline diagnostics

Improving River Model Diagnostics







(*Zhang et al. 2022*)

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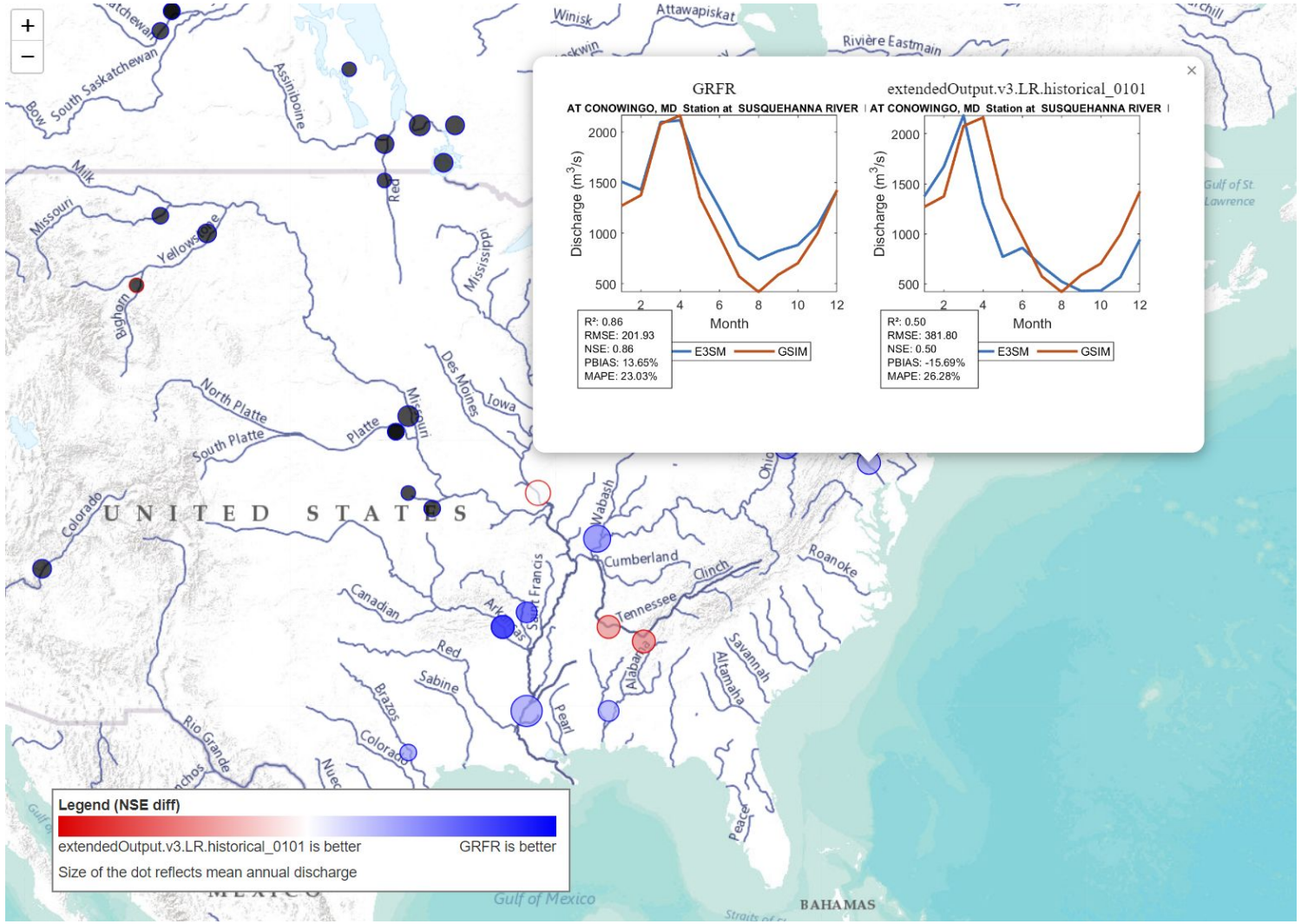

Interactive maps allow user to investigate and compare simulation results at gauge level