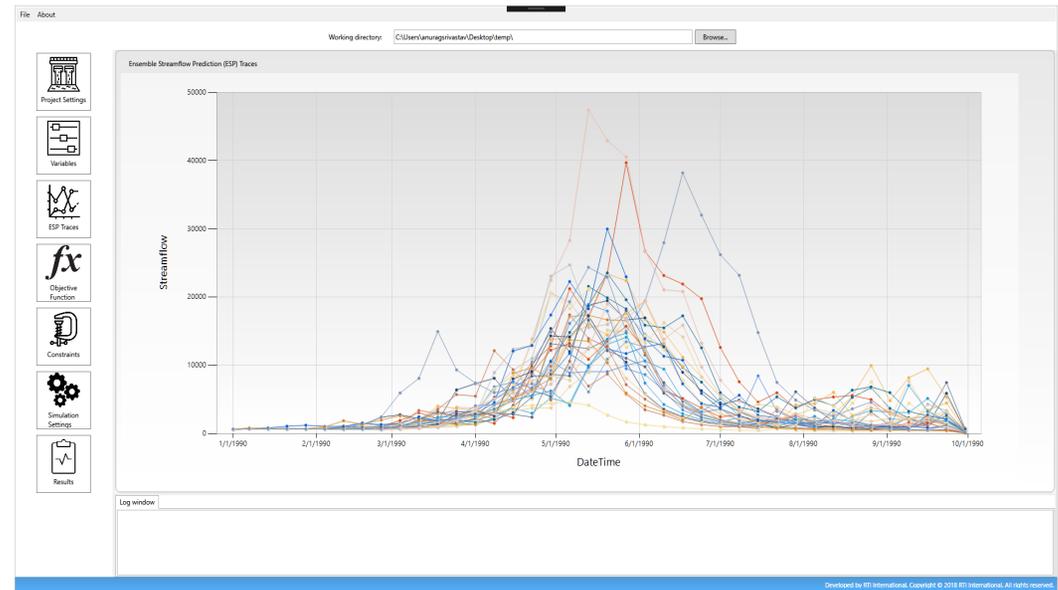


Applications and Perspectives of Forecast Informed Reservoir Operations

Joint TWDB-UTA-NIDIS Workshop on Forecast-informed Reservoir Operation (FIRO) and Water Resources Management

Jonathan Quebbeman, Phil Burkhalter, Noah Friesen
September 12, 2019





RIVERSIDE

global science solutions

= RTi



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Applied-Side of FIRO

“...to identify gaps and obstacles that hinder the operational use of forecasts”

Applied

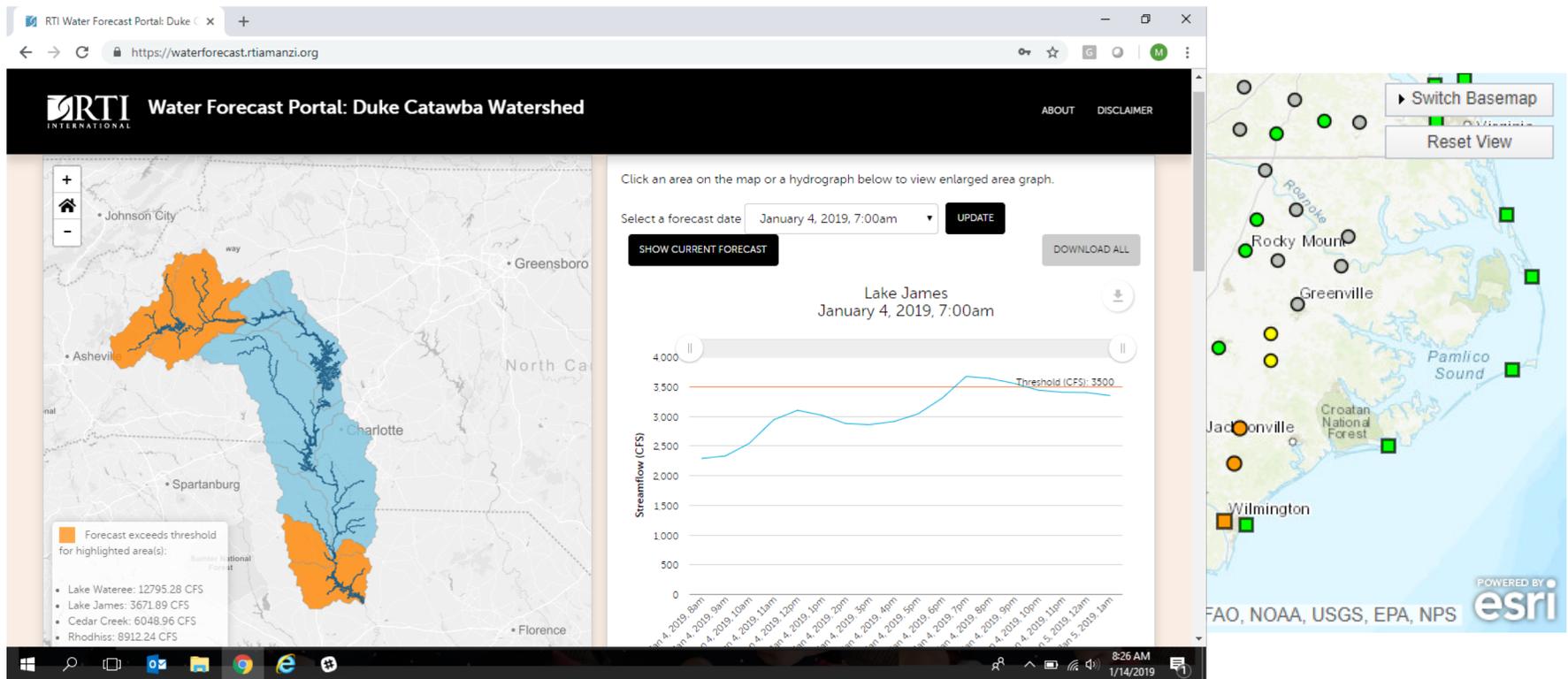
“...spur actions to facilitate the adoption of FIRO paradigms”

So, what is considered “FIRO” in the industry?

FIRO...

Forecast *Ignorant* Reservoir Operations (FIRO)

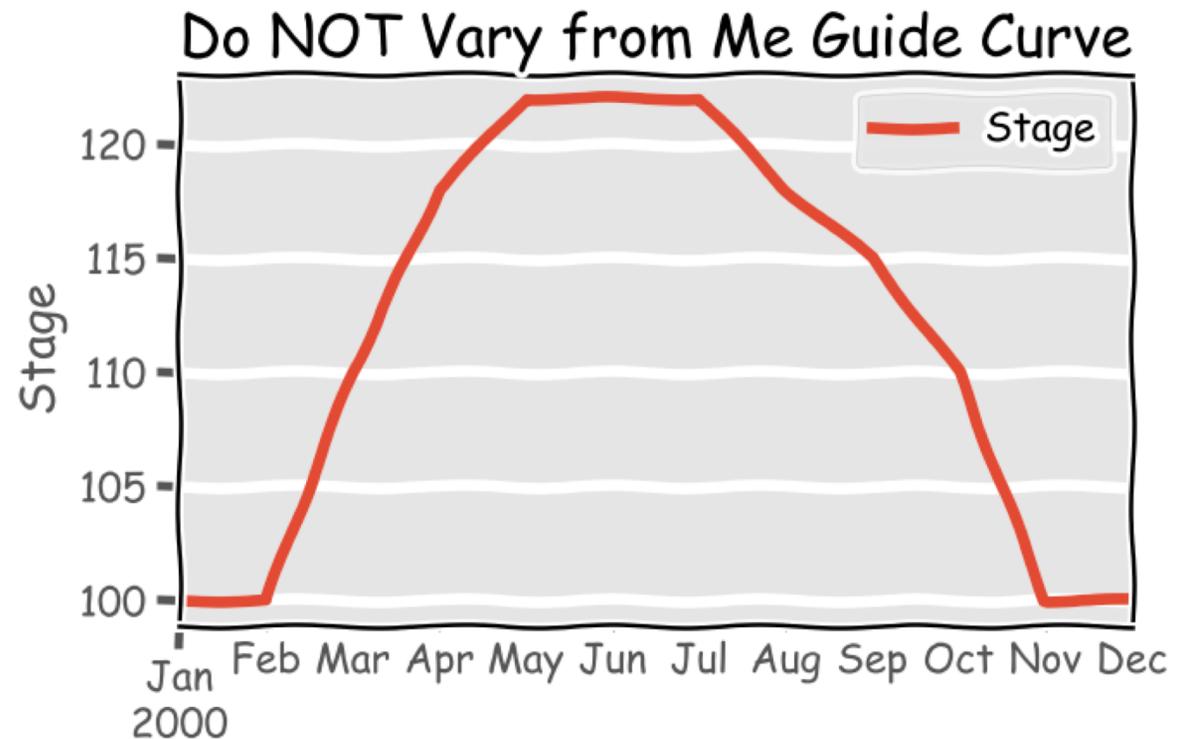
- Forecasts unavailable
- Lack of awareness
- Lack of (easy) access / ingestion



FIRO...

Forecast *Ignored* Reservoir Operations (FIRO)

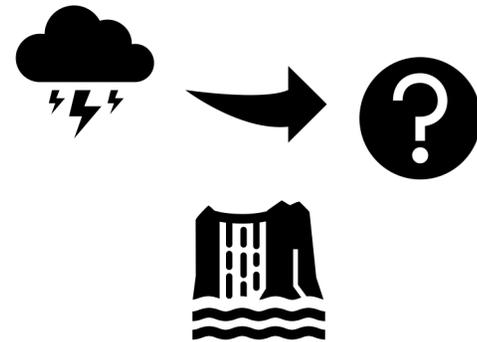
- Prescriptive operations
- e.g. FERC license agreements



FIRO...

Forecast *Intimidated* Reservoir Operations (FIRO)

- Lack of available system models
- Limited / complex tools for real-time management
- Ability to store / process forecast data
- Demonstratable value to management



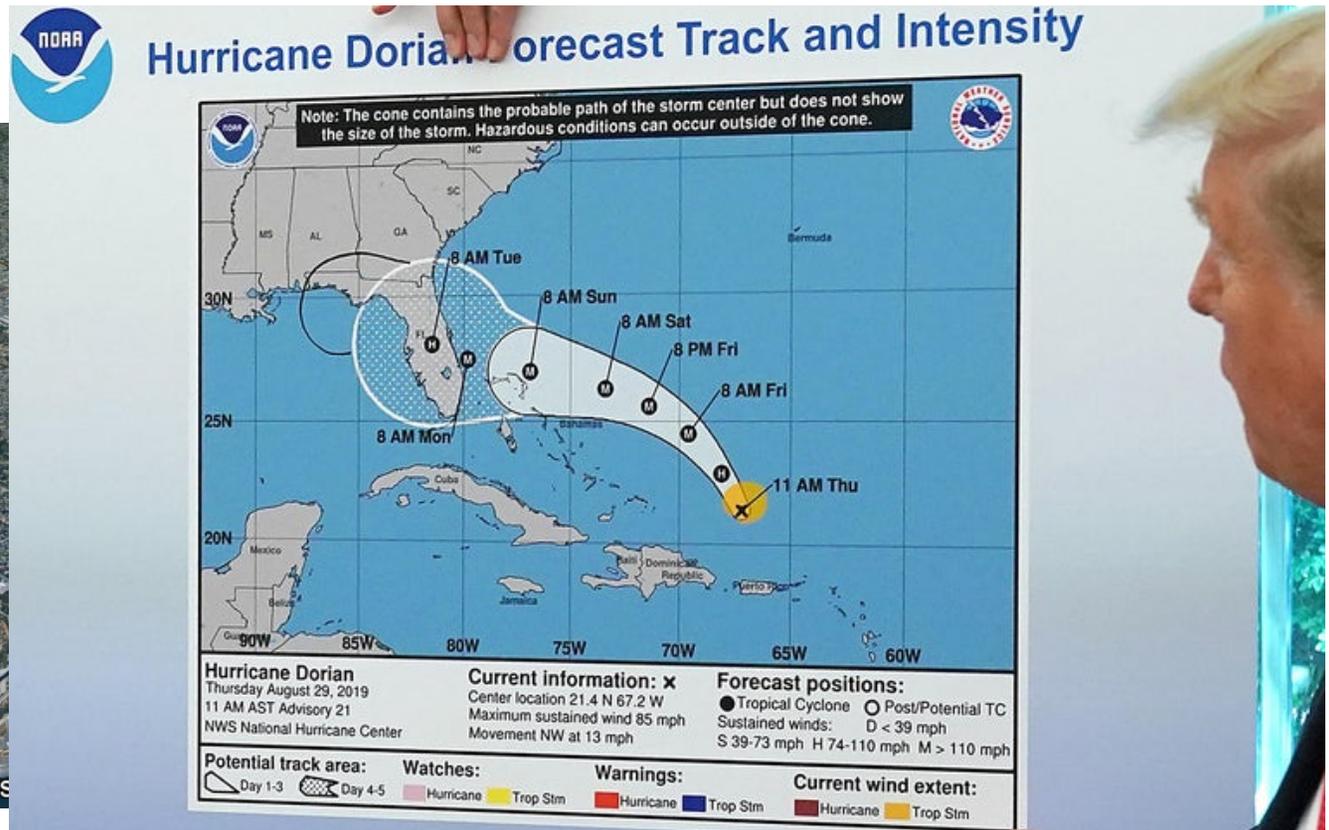
J. Quebbeman, G. Day, J. Labadie, C. Caldwell, and S. Nebiker, "Benchmarking of Ensemble Streamflow Forecast Usage in Hydropower Planning," CEATI International Inc., No. T162700-0429, 2018.

<https://www.ceati.com/projects/publications/publication-details/?pid=0429>

FIRO...

Forecast *Influenced* Reservoir Operations (FIRO)

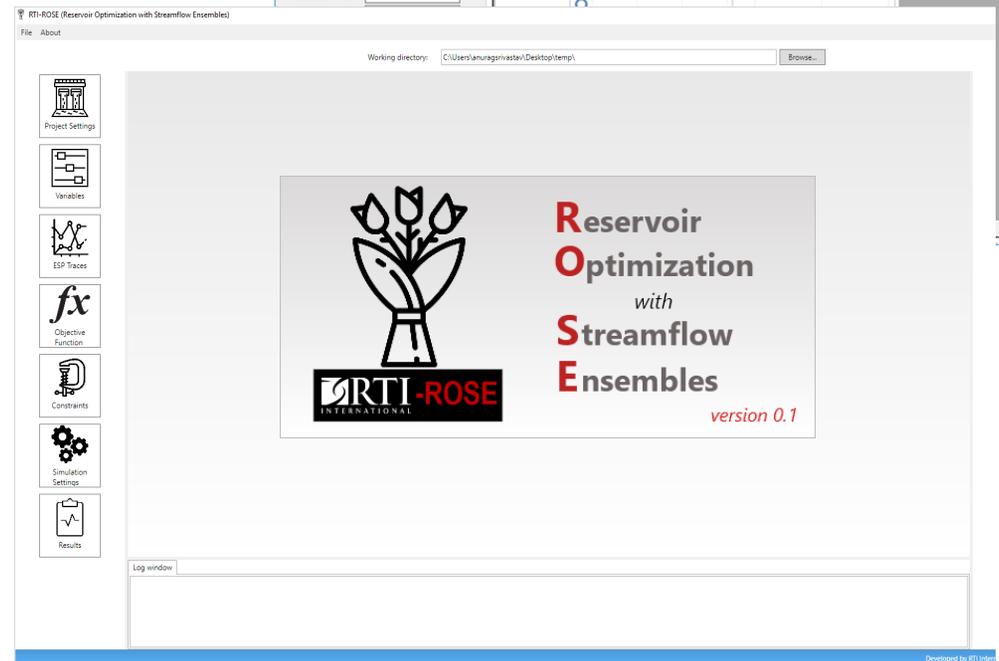
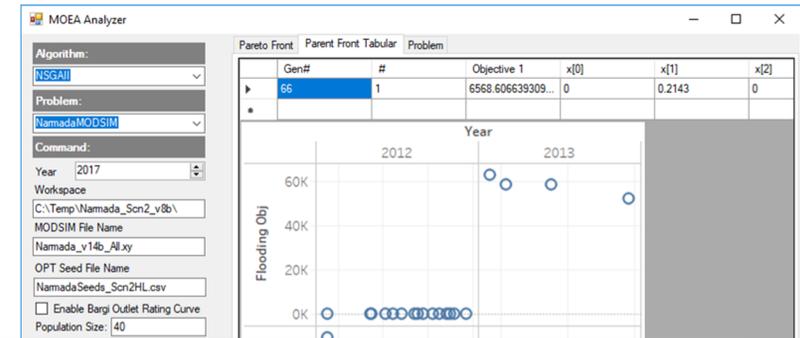
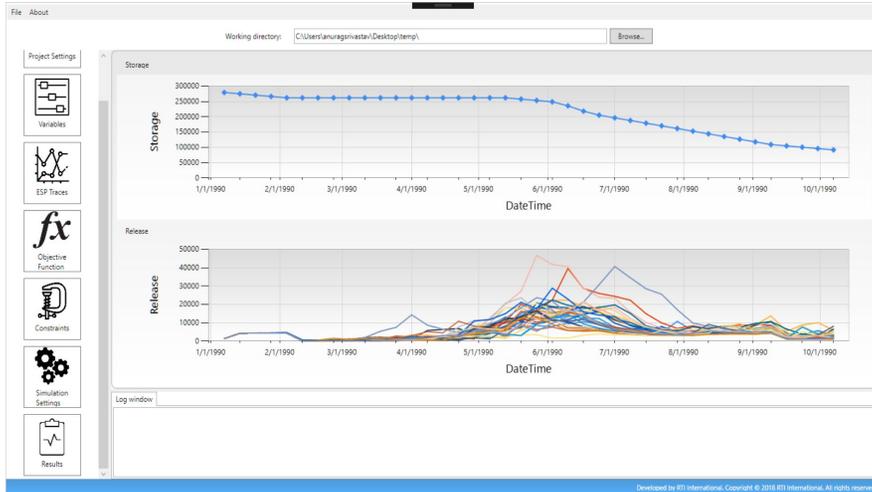
- Social and environmental pressures
- Politics
- Personal interests



FIRO...

Forecast *Ideal* Reservoir Operations (FIRO)

- “Optimal”
- Challenge: Preferences required when tradeoffs
- Solutions:
 - SSDP (RTI-ROSE)
 - GA-MODSIM



FIRO...

Forecast *Informed / Improved* Reservoir Operations (FIRO)

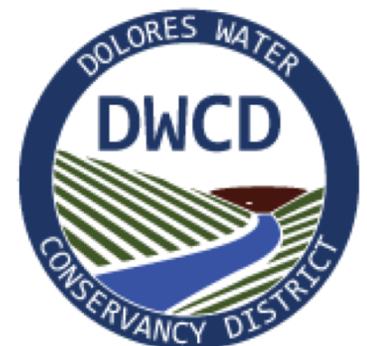
- Industry metric is use-based
- Not a measure of optimality



Forecast Informed Reservoir Operations

FIRO is a proposed management strategy that uses data from watershed monitoring and modern weather and water forecasting to help water managers selectively retain or release water from reservoirs in a manner that reflects current and forecasted conditions.

FIRO is being developed and tested as a collaborative effort in the Russian River Basin (Lake Mendocino) and the Santa Ana River Basin (Prado Dam) that engages experts and stakeholders in civil engineering, hydrology, meteorology, biology, economics and climate from several federal, state and local, universities and others. There is significant interest and support for developing FIRO at other appropriate locations in the Western U.S. and elsewhere.



Responses to improve FIRO?

FIRO	Description	Action
Ignorant	Not available	<ul style="list-style-type: none"> • Awareness • Access • Development of new systems
Ignored	Available but operations prescribed	<ul style="list-style-type: none"> • Ingest into policy and regulation • Work with owners (\$) • Risk assessment / management
Intimidated	Lacking capacity to use information	<ul style="list-style-type: none"> • Education • Generalized software • Demonstration of benefits
Influenced	Political; External pressures	<ul style="list-style-type: none"> • Early dialogues • Documentation of processes • Updated studies
Ideal	Optimal solutions	<ul style="list-style-type: none"> • Need generalized tools • Operator trust in algorithms • Stakeholder tradeoff dialogues
Informed / Improved	Information used for better decisions	<ul style="list-style-type: none"> • Share successes and failures

Thank you

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