First Annual UFS Users' Workshop:

Continental Scale Heterogenous Channel Routing Strategy for Operational Forecast Model

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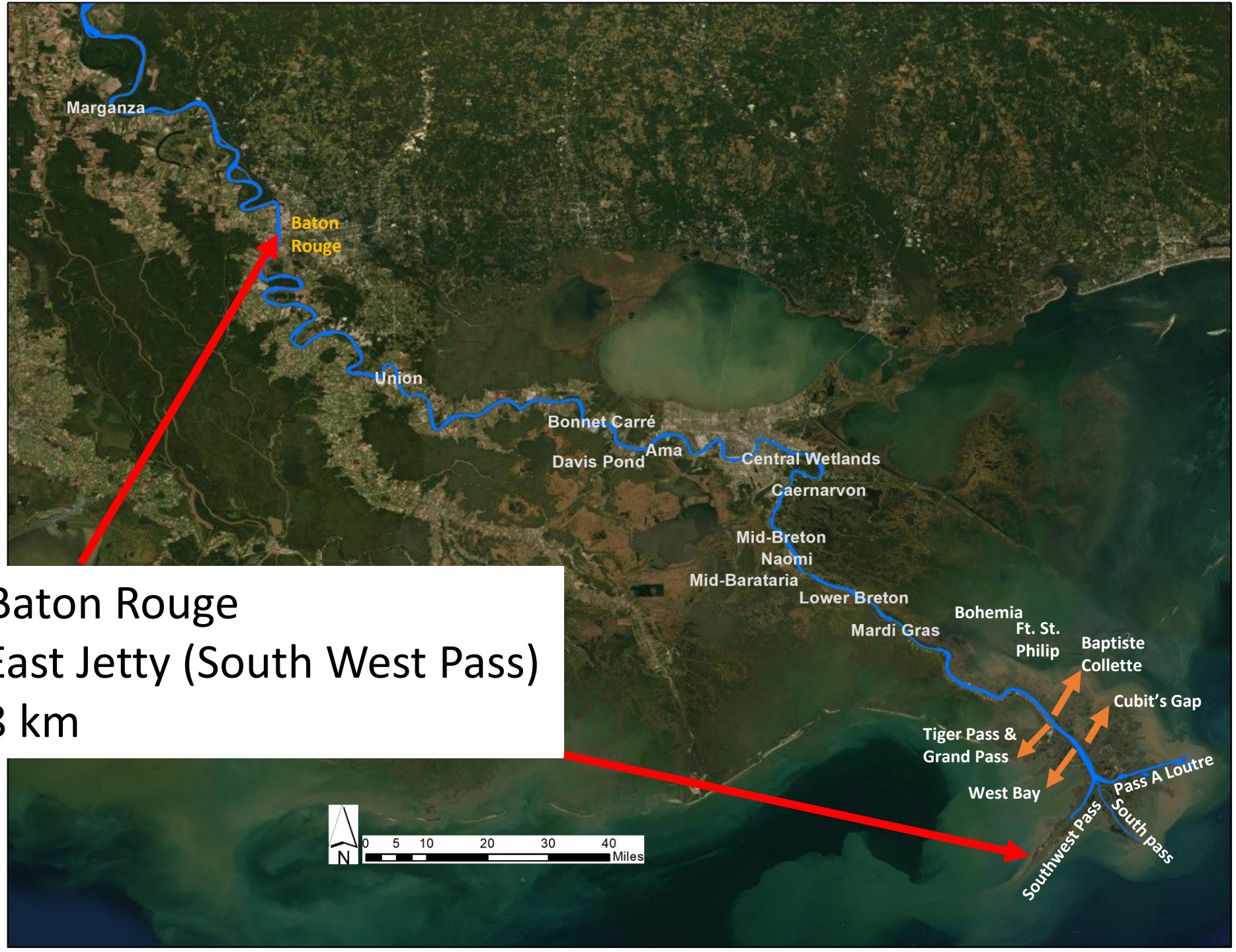
Lower Mississippi River Model Domain

- U/S Boundary at Baton Rouge
- D/S boundary at East Jetty (South West Pass)
- River length 411.8 km



LMR Experiment: Model Performance

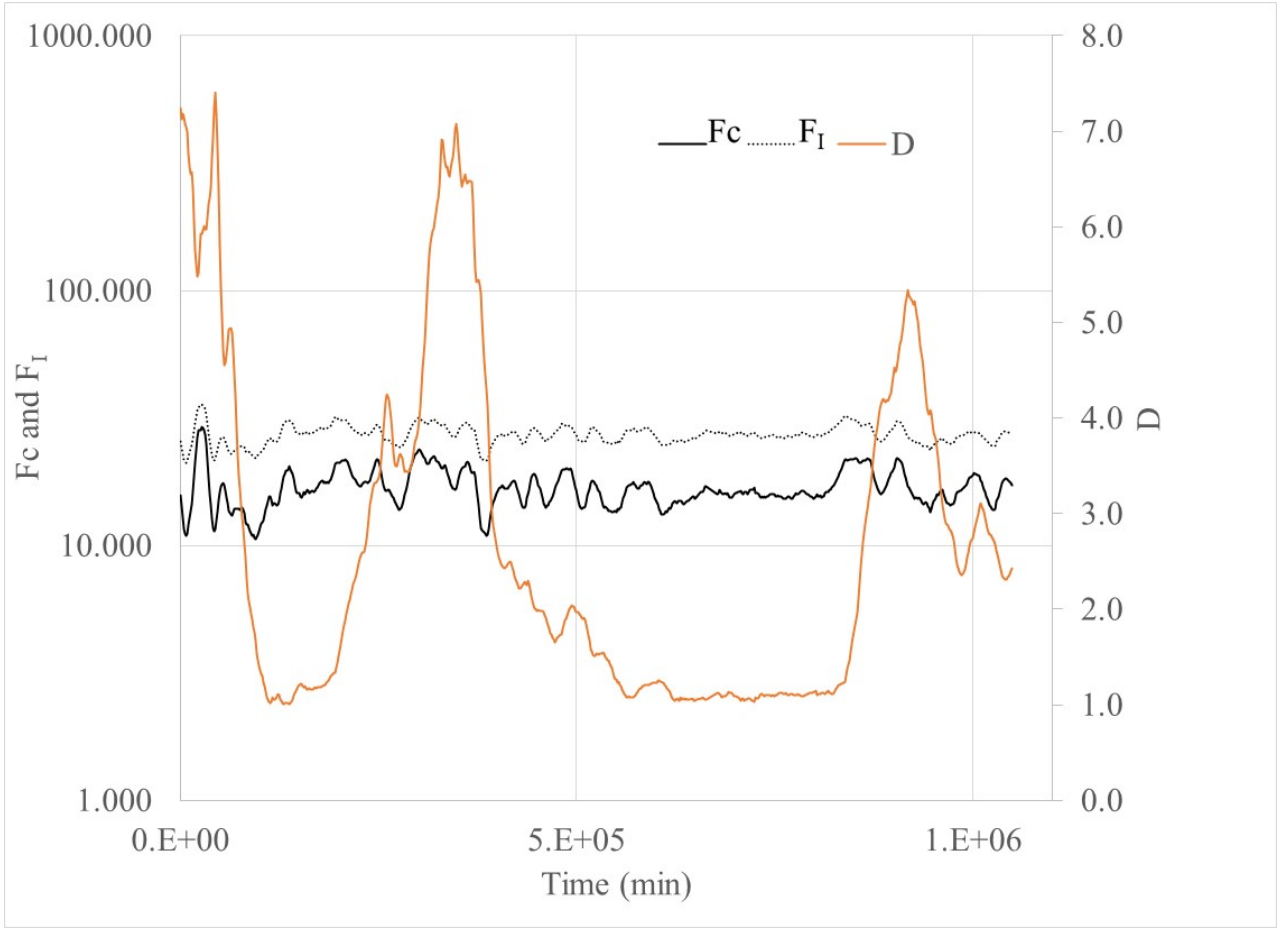
- Simplified cross section representations
- Simplified bed slope (only positive/downward slope)

	No of X-secs	Max Δx (m)	Min Δx (m)	Ave Δx (m)
Dynamic Wave	280	2,184	796	1,423
Diffusive Wave	280	2,184	796	1,423
Muskingum Cunge	280	2,184	796	1,423

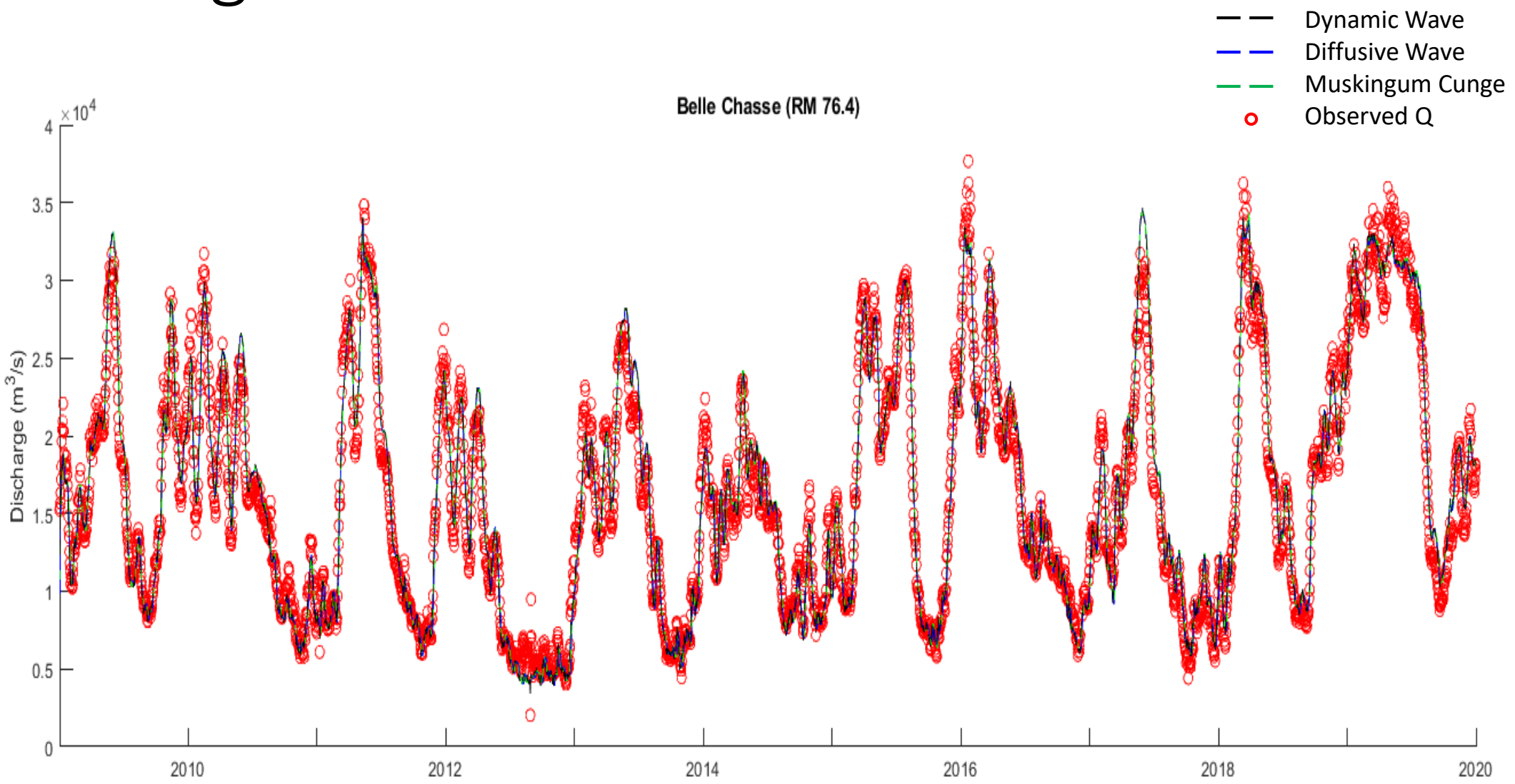
	Δt (S)	Simulation Duration (Yrs)	Run Time (S)	Courant No (-)	Run Time for NHD+/per hour (s)
Dynamic Wave	240	11	1,590	0.706	200
Diffusive Wave	Var	11	370	1.0	47
Muskingum Cunge	240	11	536	--	67

Channel Flow Routing: Scaling Parameters

- Friction Parameters (F_c & F_I) >> 1
  - Bulk Waves
- Diffusion Coefficient (D) >1
  - Diffusive Wave

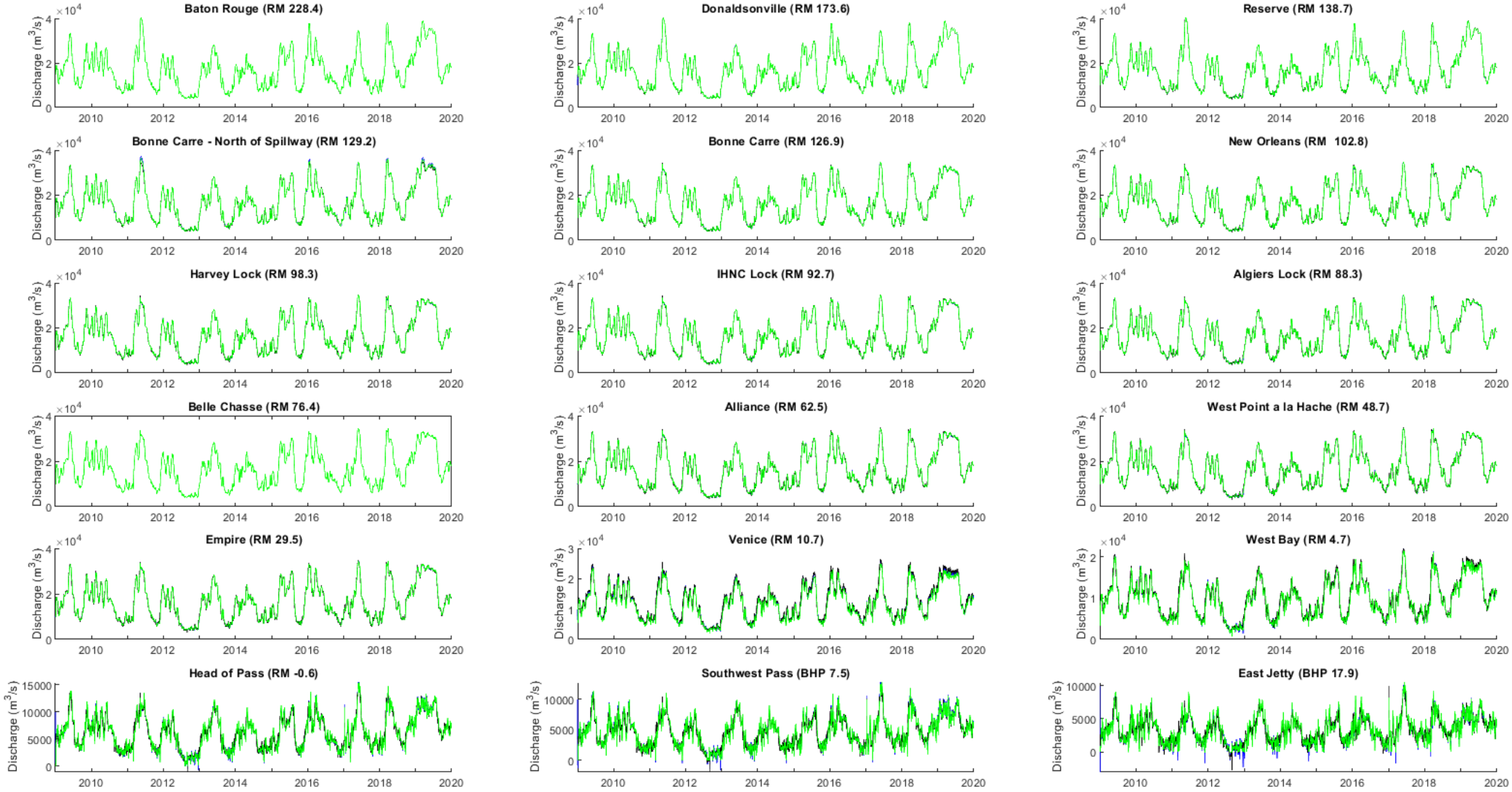


Discharge at Belle Chasse

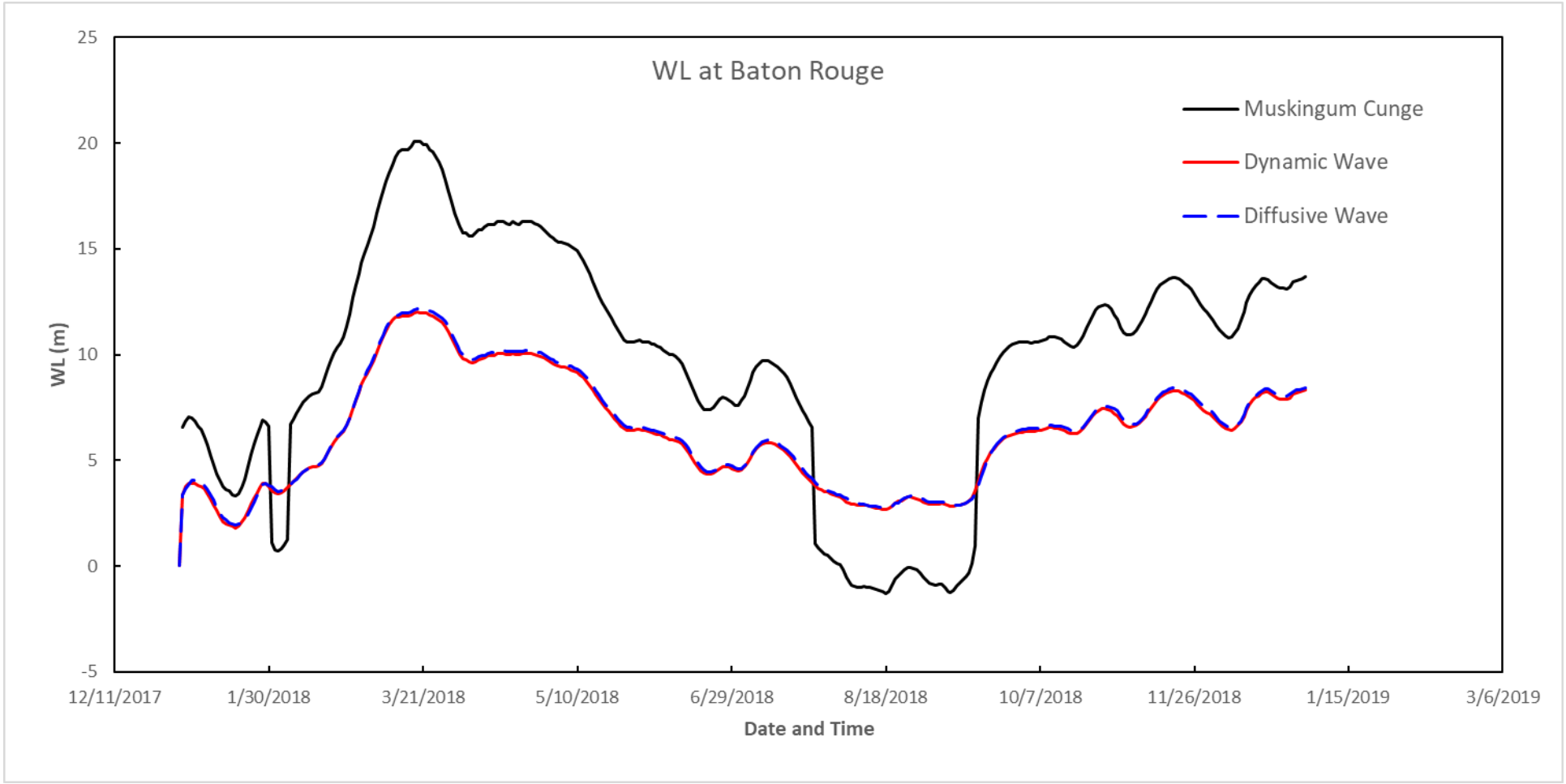


Discharge Along the River Length

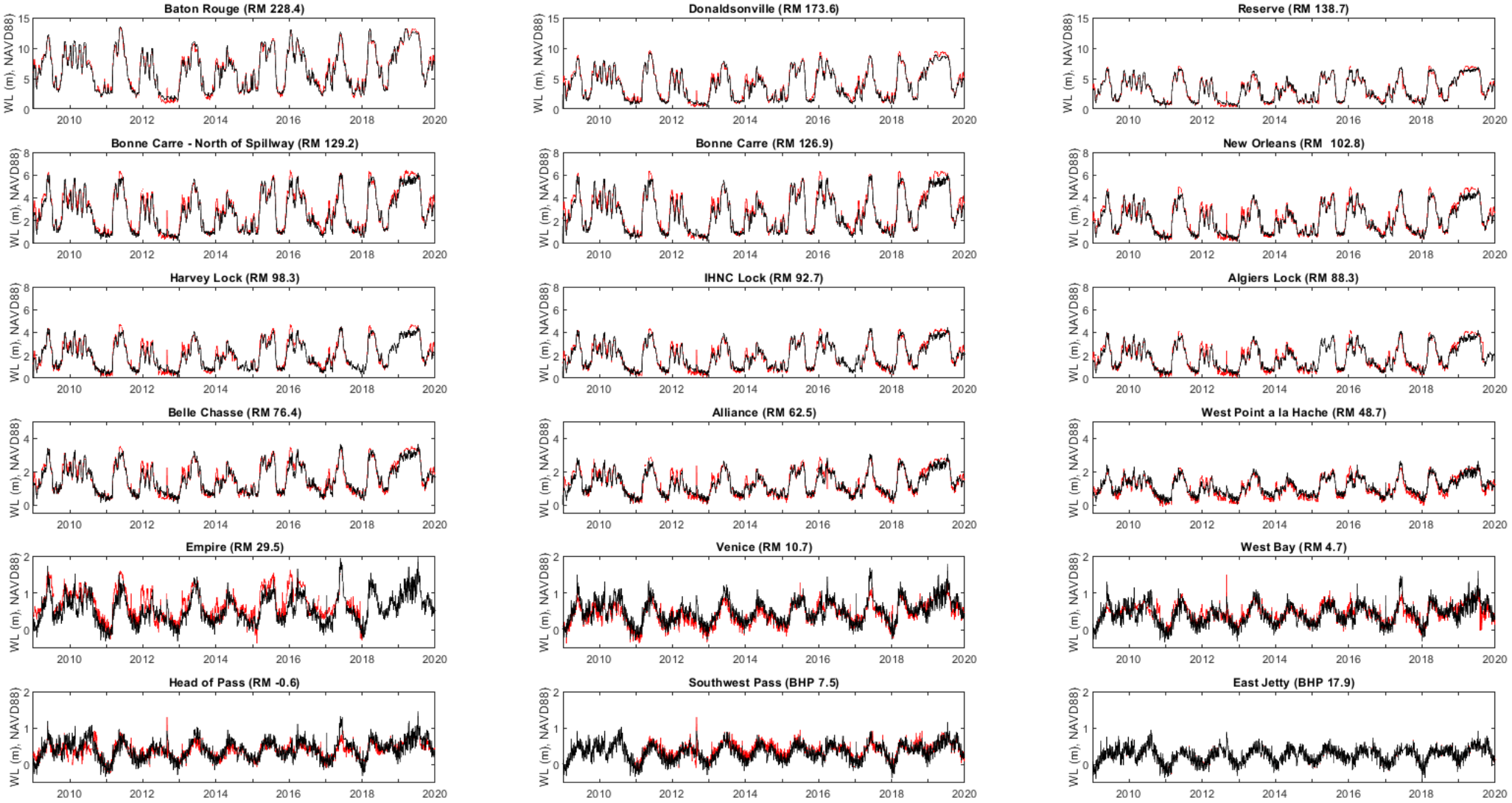
Dynamic Wave
Diffusive Wave
Muskingum Cunge



Water Level at Baton Rouge

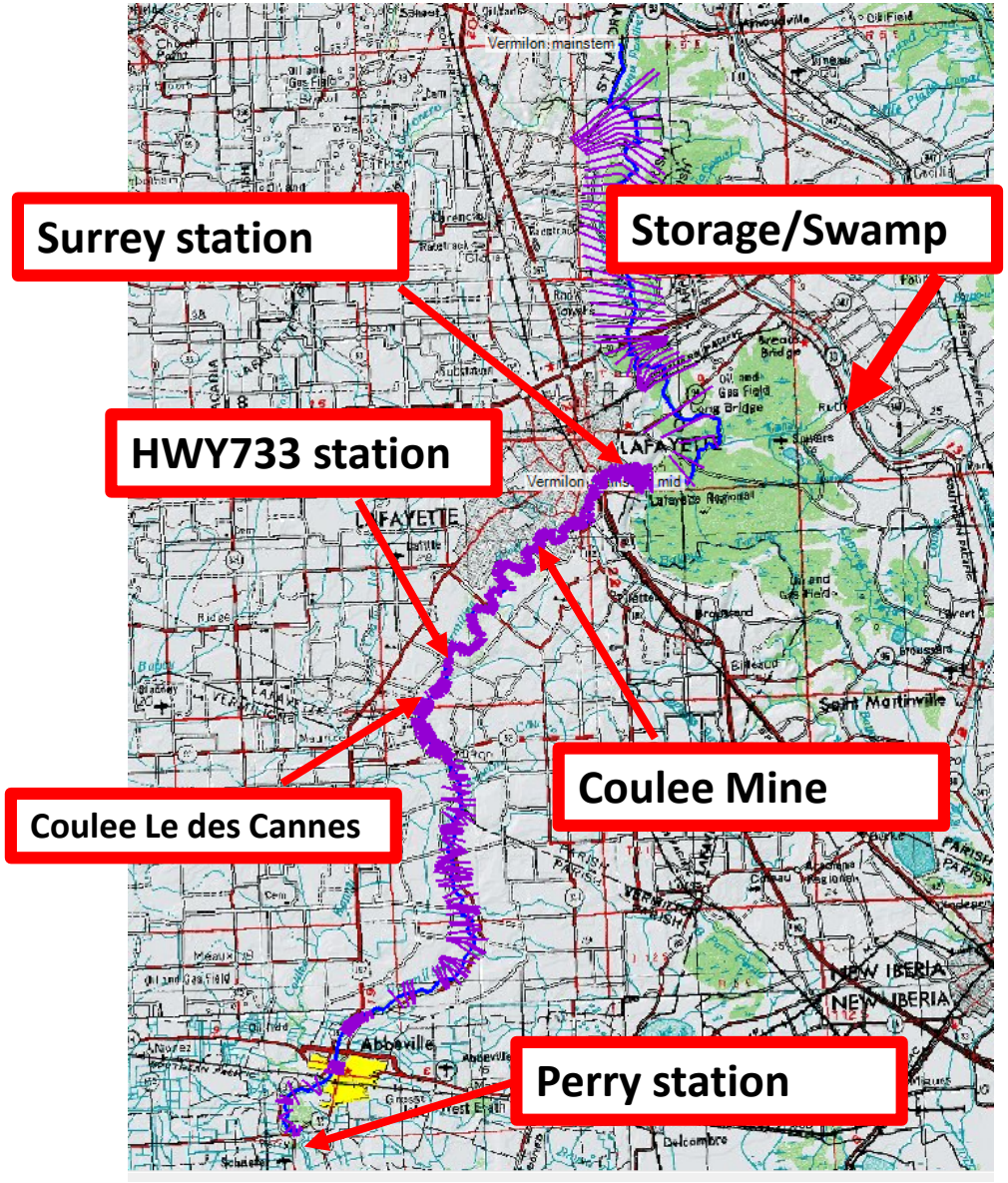


Dynamic/Diffusive Wave: 11-Year Validation



Red: Observed data Black: Simulated data

Vermilion River Experiment

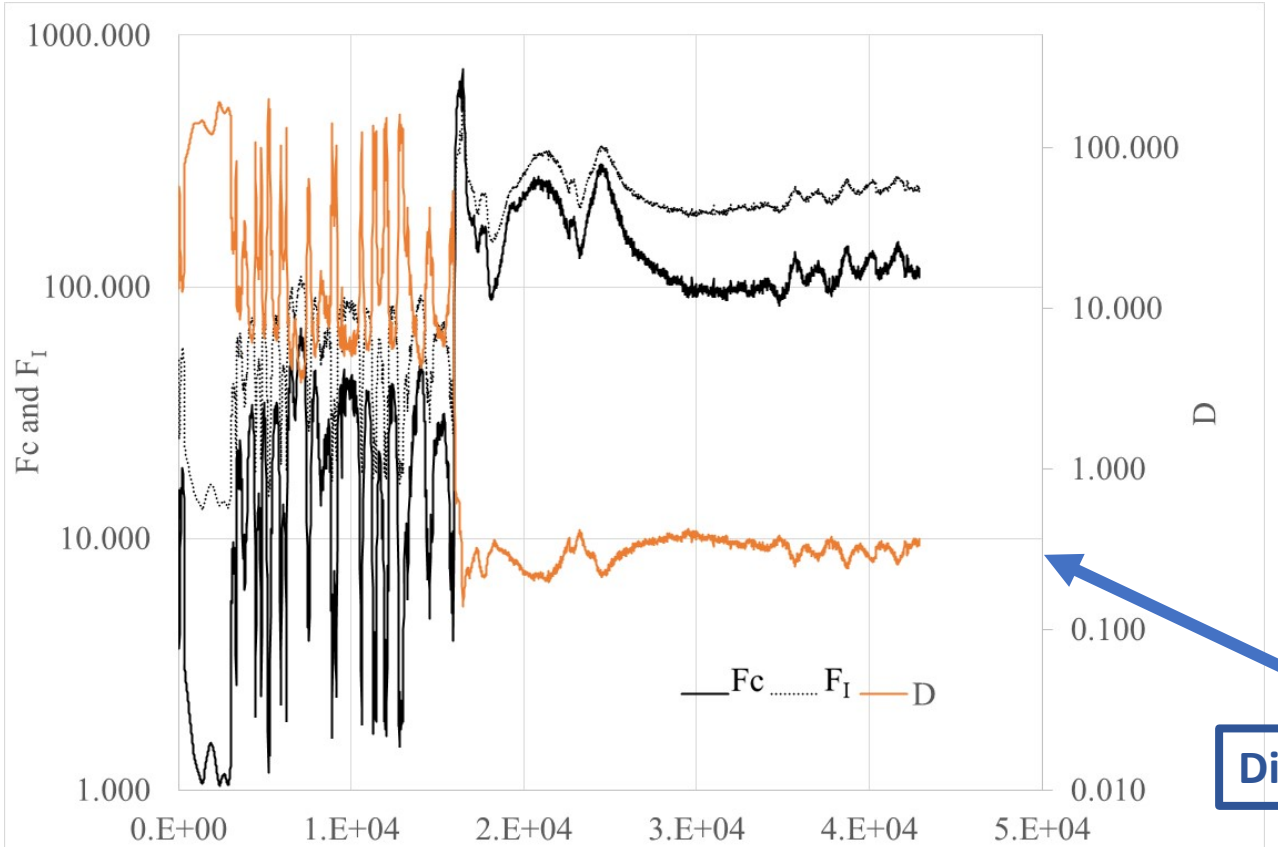


- Primary stream for a HUC-8 in South Central Louisiana
- Upstream at river station 281,095
- Downstream at river station 90,452
- Data source: UL Lafayette (Dr. Habib)
- River reach length: 58.1 km
- Upstream Boundary: Q (time series)
- Downstream Boundary: WL (time series)

No of cross sections	Maximum dx (m)	Minimum dx (m)	Average dx (m)
373	457.2	42.2	156.2

Channel Flow Routing: Scaling Parameters

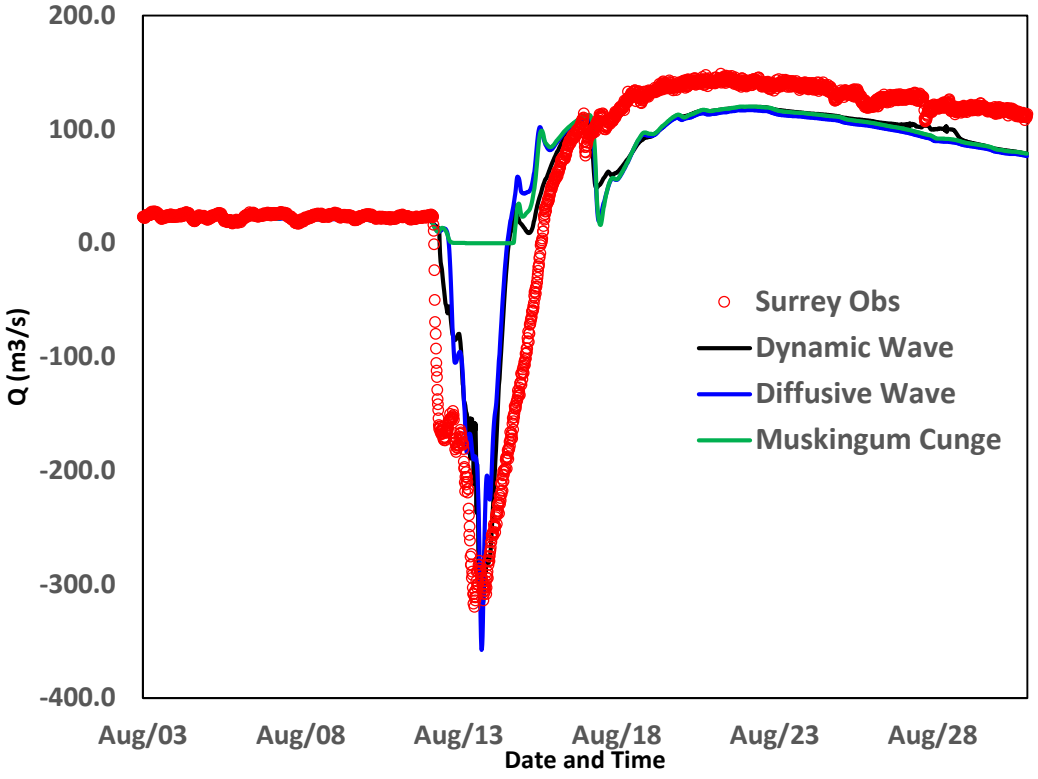
- Friction Parameters (F_c & F_I) ~ 1: Dynamic Waves
- Friction Parameters (F_c & F_I) >> 1: Bulk Waves
  - Diffusion Coefficient (D) >1: Diffusive Wave

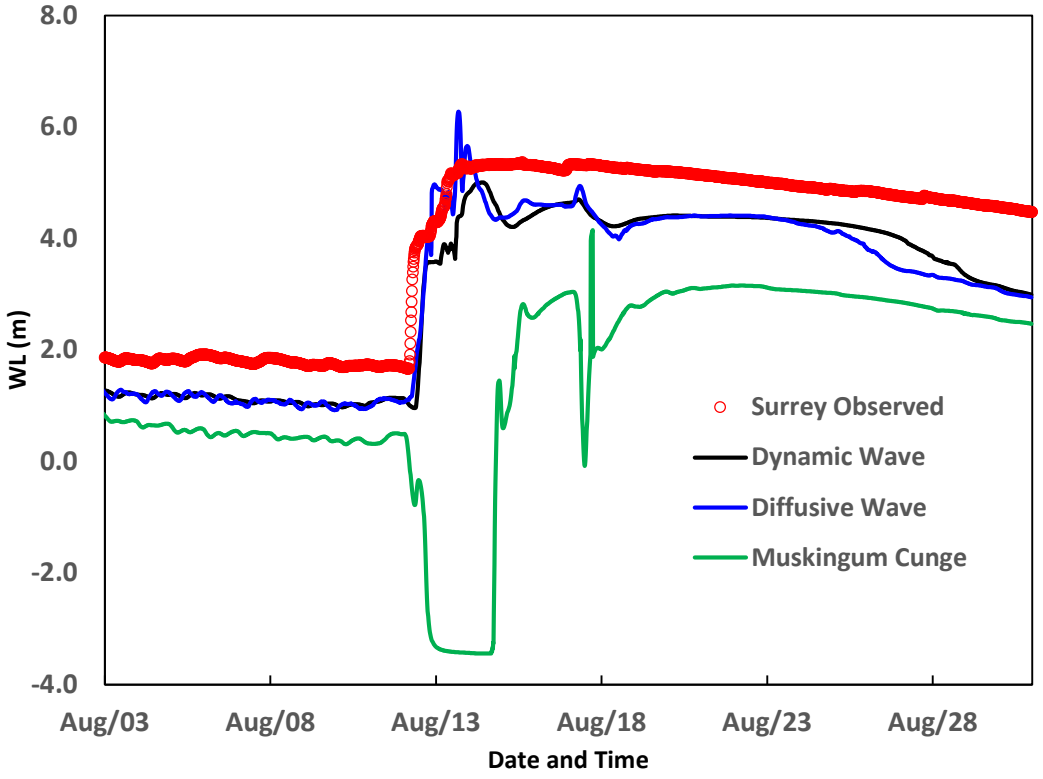


Dynamic Routing Needed

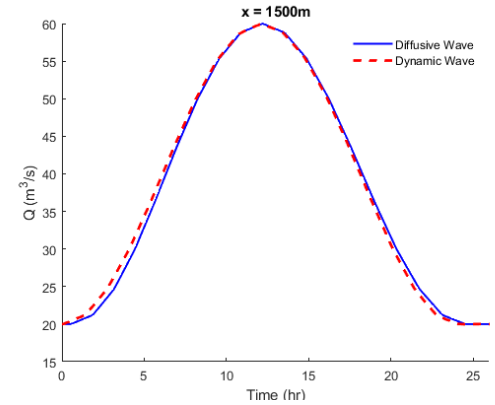
Diffusive Routing Sufficient

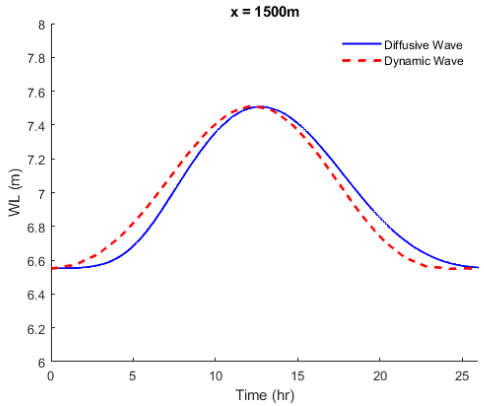
Discharge & WL Comparisons

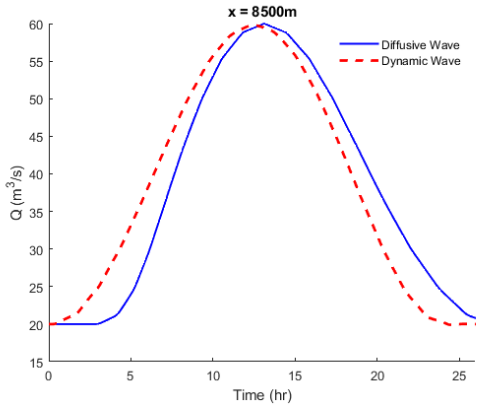


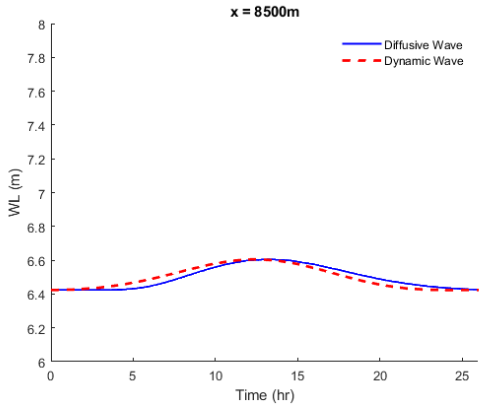


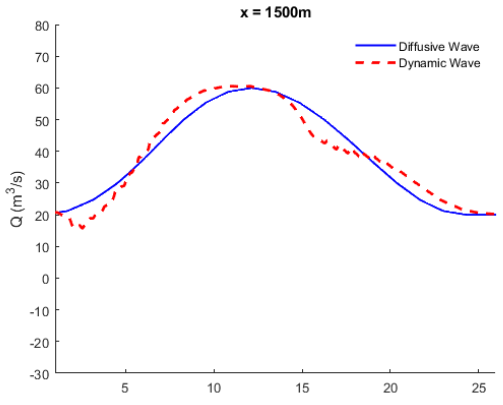
Wave Routing in a Tidal channel

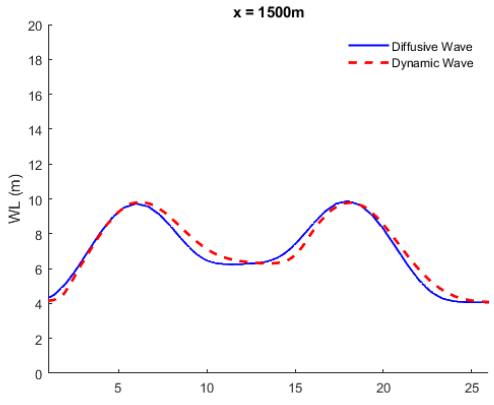


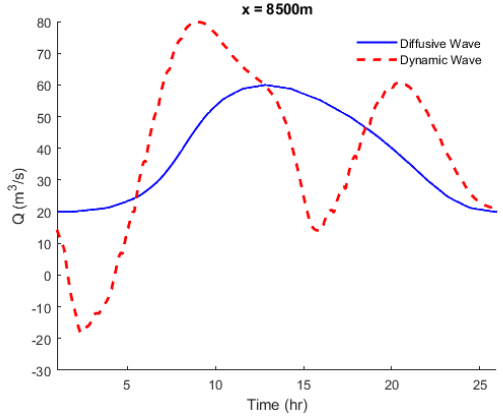


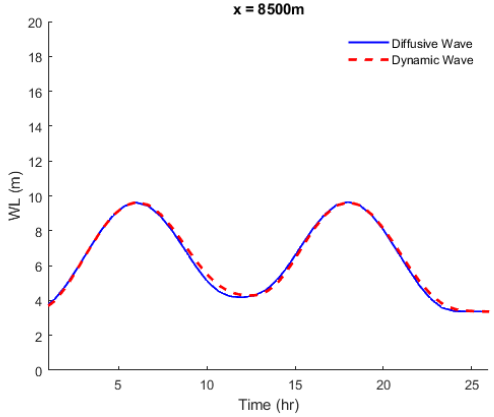


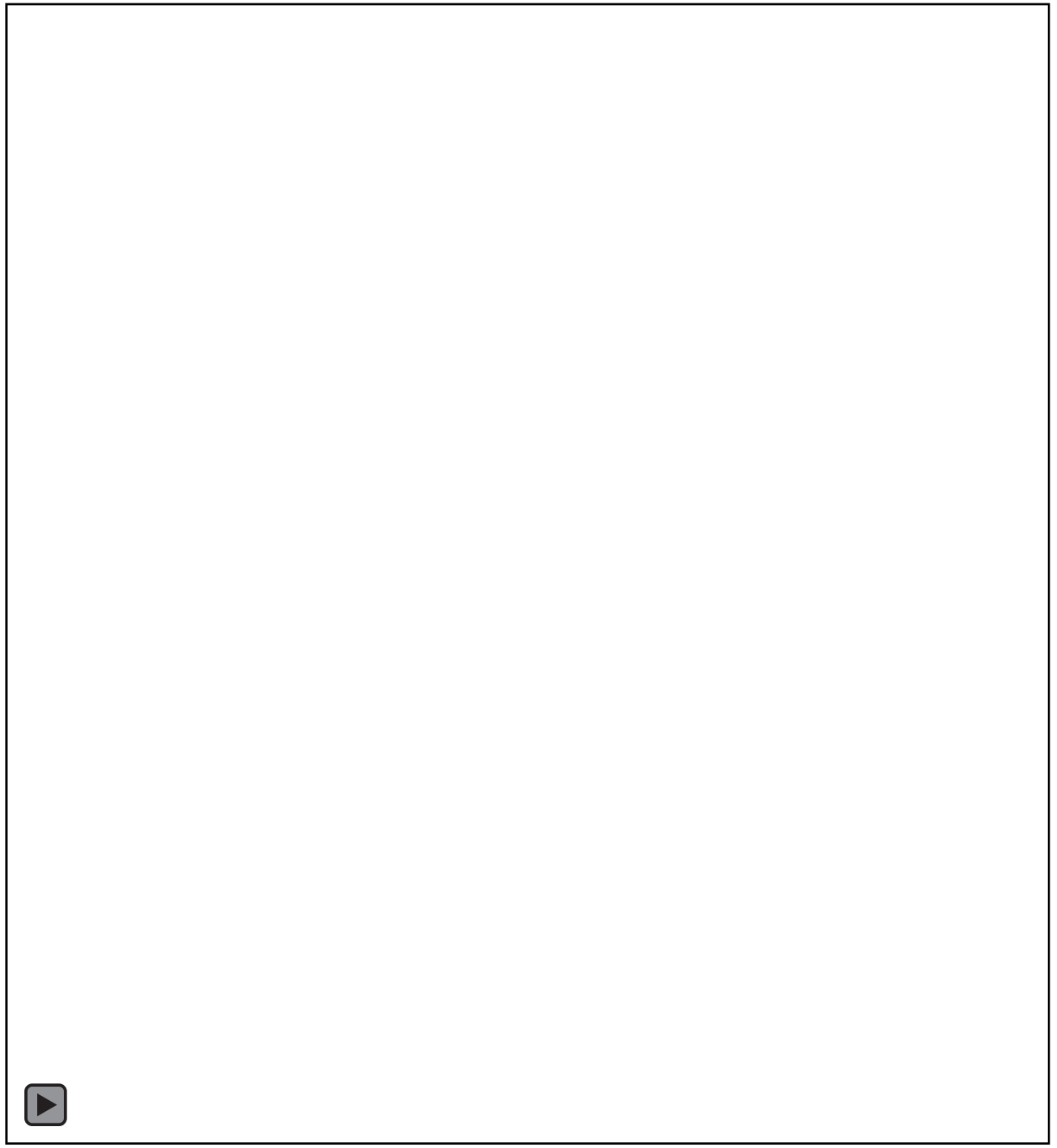












Findings

- Dynamic wave:
  - Applicable to, but unnecessary and expensive to be used for, all hydraulic conditions
  - Should be limited to transition zone or when flow acceleration is significant
  - Code can be optimized with potential of substantial speedup
- Diffusive wave:
  - Applicable to a broad set of conditions: no limits on bed slope (including adverse)
  - Captures backwater effects quite well
  - Provides a stable solution even when acceleration terms are significant
  - Faster than Muskingum-Cunge despite being more rigorous
- Muskingum-Cunge:
  - Stable and computationally efficient
  - Slope limitations
  - Unable to capture downstream effects

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