



MISSISSIPPI RIVER HYDRODYNAMICS AND DELTA MANAGEMENT STUDY BASIN-WIDE MODEL DEVELOPMENT

Delft3D Production Runs: 2020 – 2070

Land Building and Landscape Change

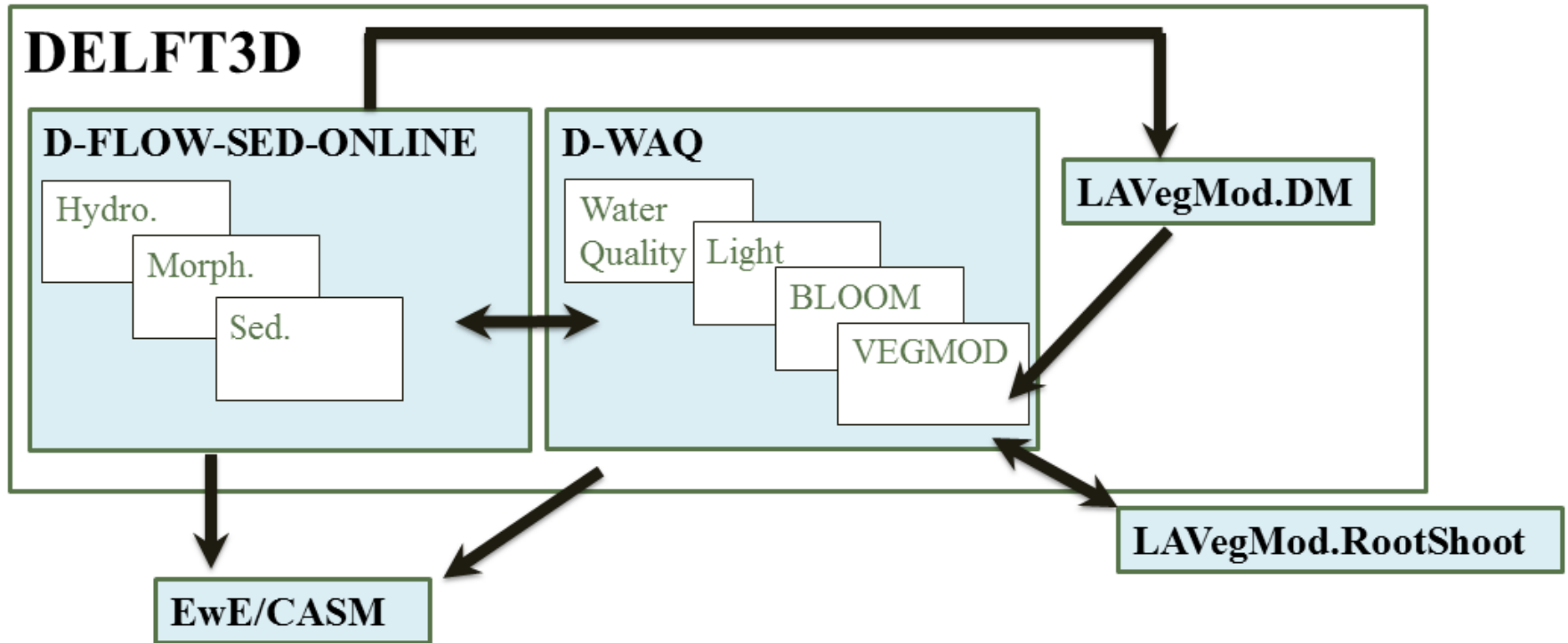
Ehab Meselhe, Kazi Sadid, and Fei Xing



**THE WATER INSTITUTE
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10/27/15**



MODEL OVERVIEW



SEDIMENT DIVERSION PRODUCTION RUNS (PR)

PR ID	Description	Operating Plan	Design Discharge (cfs)	Sea Level Rise	Subsidence Rate
PR1	Mid-Barataria	Less Aggressive	75K	Intermediate	20% into range
FWOP/PR2	Future Without Project	N/A (No Diversions)	N/A (No Diversions)	Intermediate	20% into range
PR3	Mid-Breton	Less Aggressive	35K	Intermediate	20% into range
PR4	Lower-Breton	Less Aggressive	50K	Intermediate	20% into range
PR5	Lower-Barataria	Less Aggressive	50K	Intermediate	20% into range
PR6	All Four Diversions	Less Aggressive	35K,50K,50K,75K	Intermediate	20% into range
PR7	All Four Diversions	Aggressive	35K,50K,50K,75K	Intermediate	20% into range
PR8	Marsh Creation/Dredge Only	N/A (No Diversions)	N/A (No Diversions)	Intermediate	20% into range
PR9	No Vegetation (20 yrs)	Less Aggressive	35K,50K,50K,75K	Intermediate	20% into range

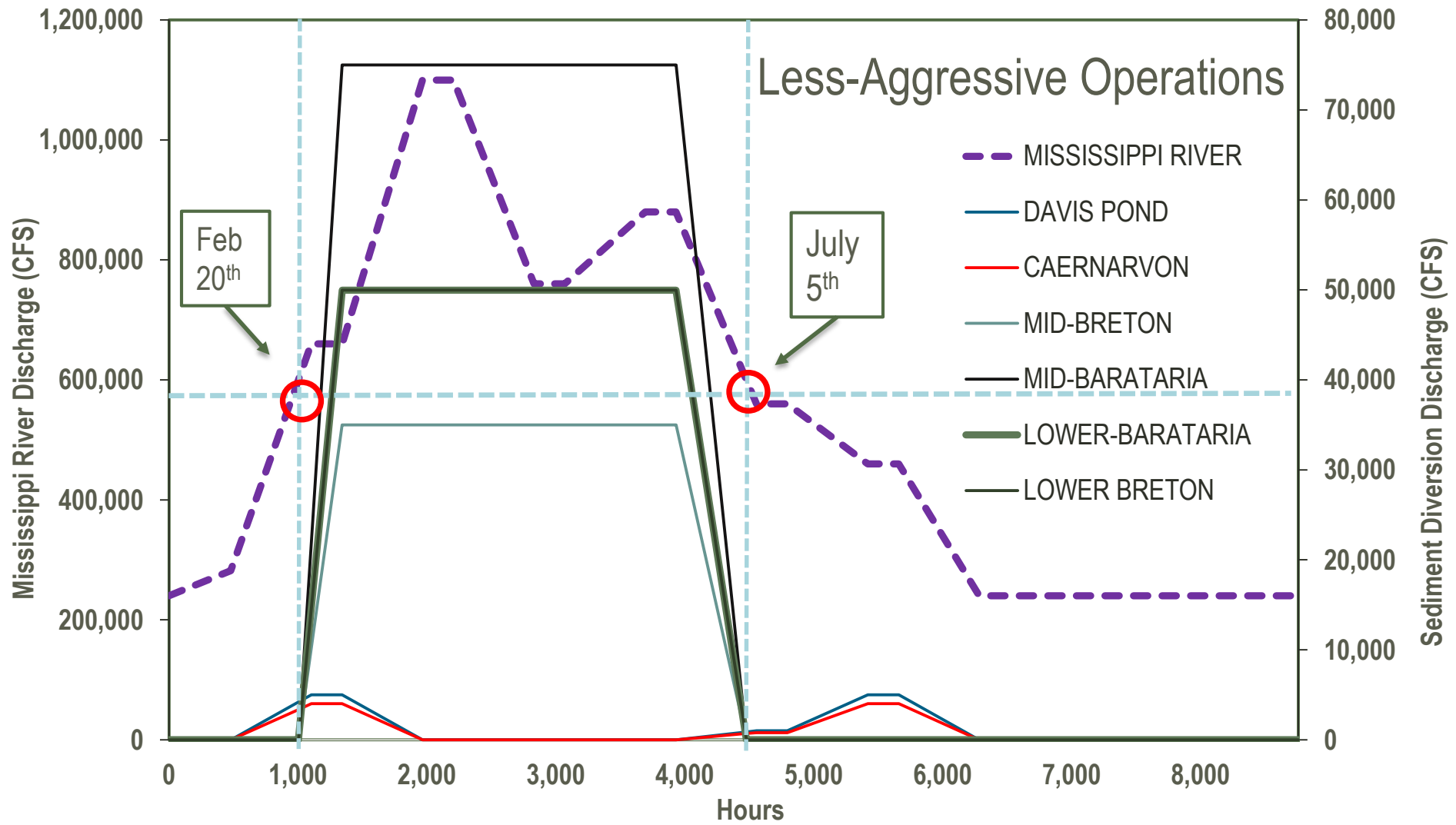
Less Aggressive = operation for 5 months

Aggressive = operation all year

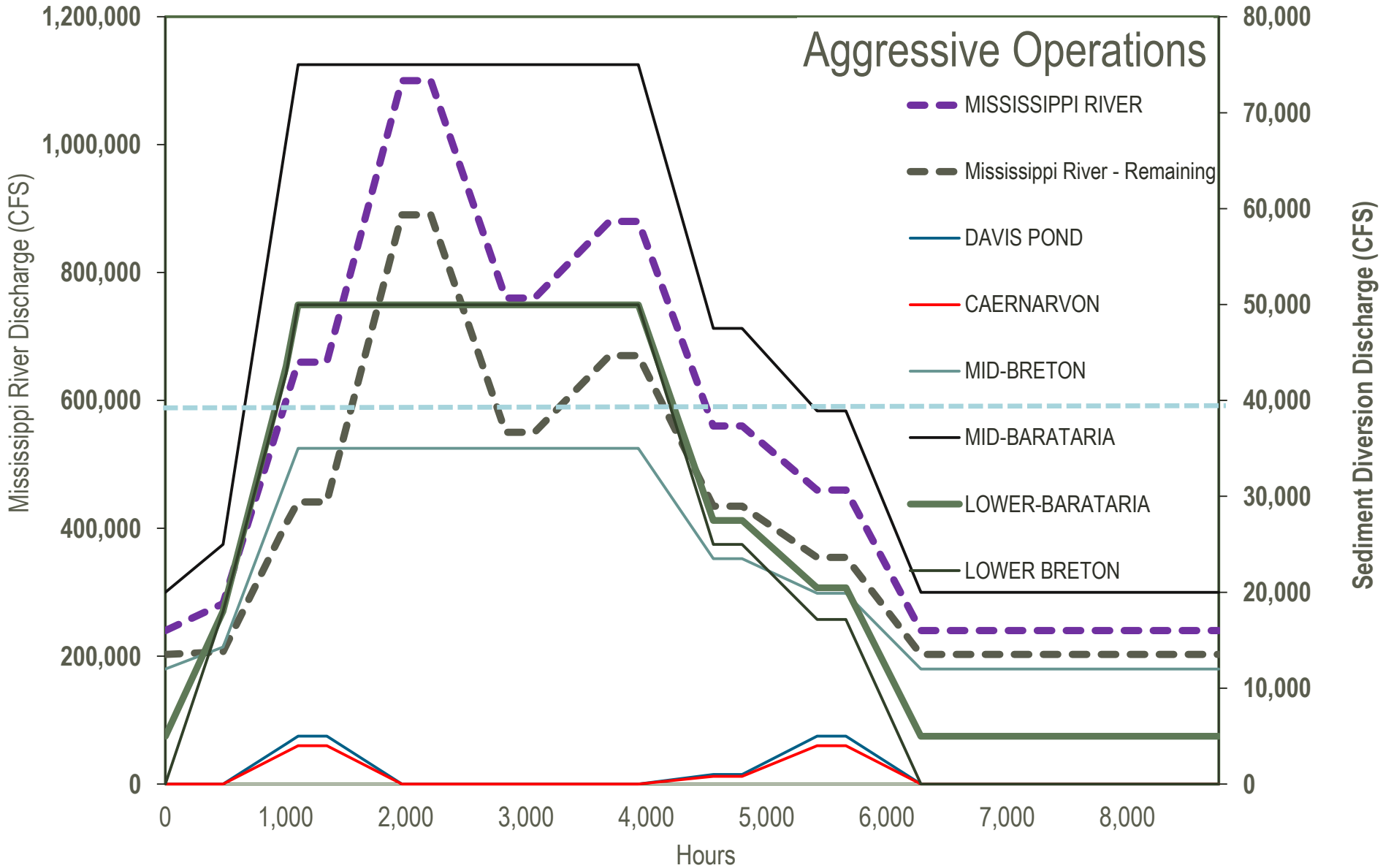
PR8 = PR6 diversion footprints with sediment from 11 river bars



OPERATION PLAN – LESS AGGRESSIVE

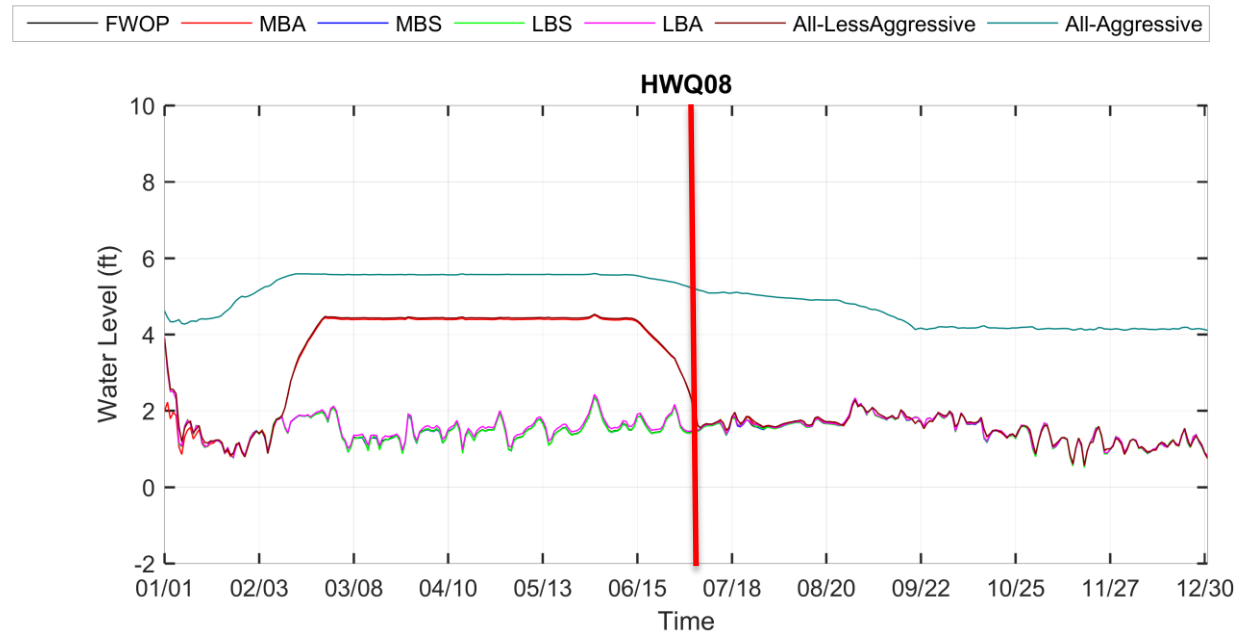


OPERATION PLAN - AGGRESSIVE



WATER LEVEL

MID BARATARIA OUTFALL AREA, YEAR 50

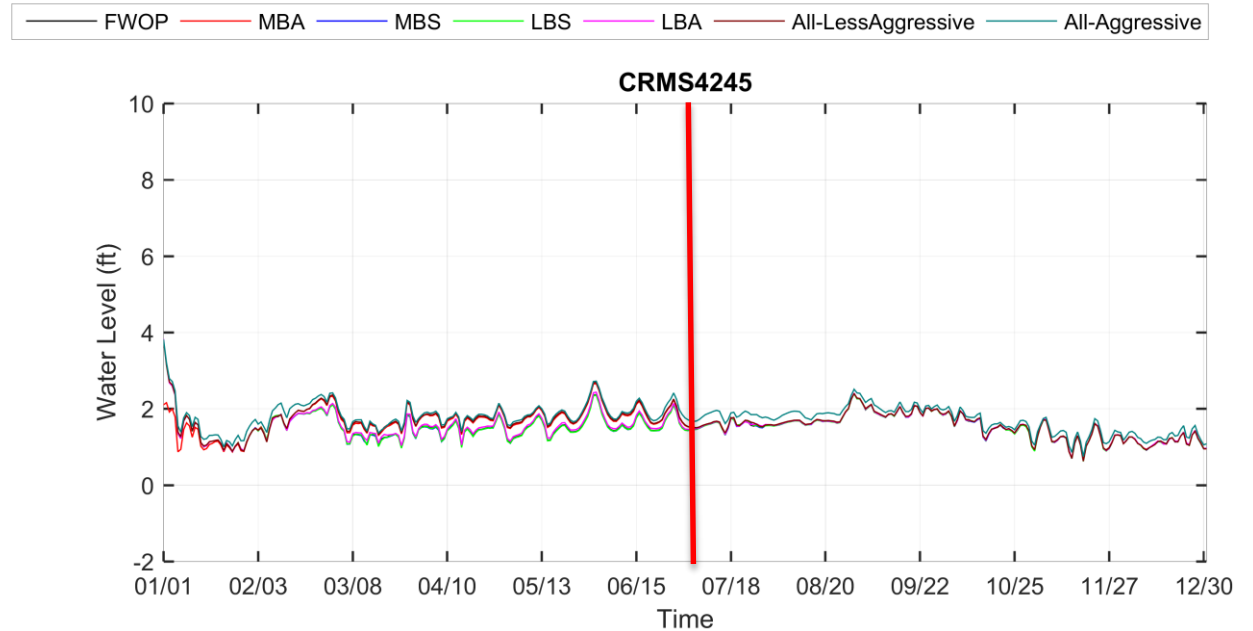


- MBA: Mid Barataria
- MBS: Mid Breton Sound
- LBS: Lower Breton Sound
- LBA: Lower Barataria

Note: Red Vertical Line represents annual end of less aggressive operational schedule



WATER LEVEL NEAR LAFITTE, YEAR 50



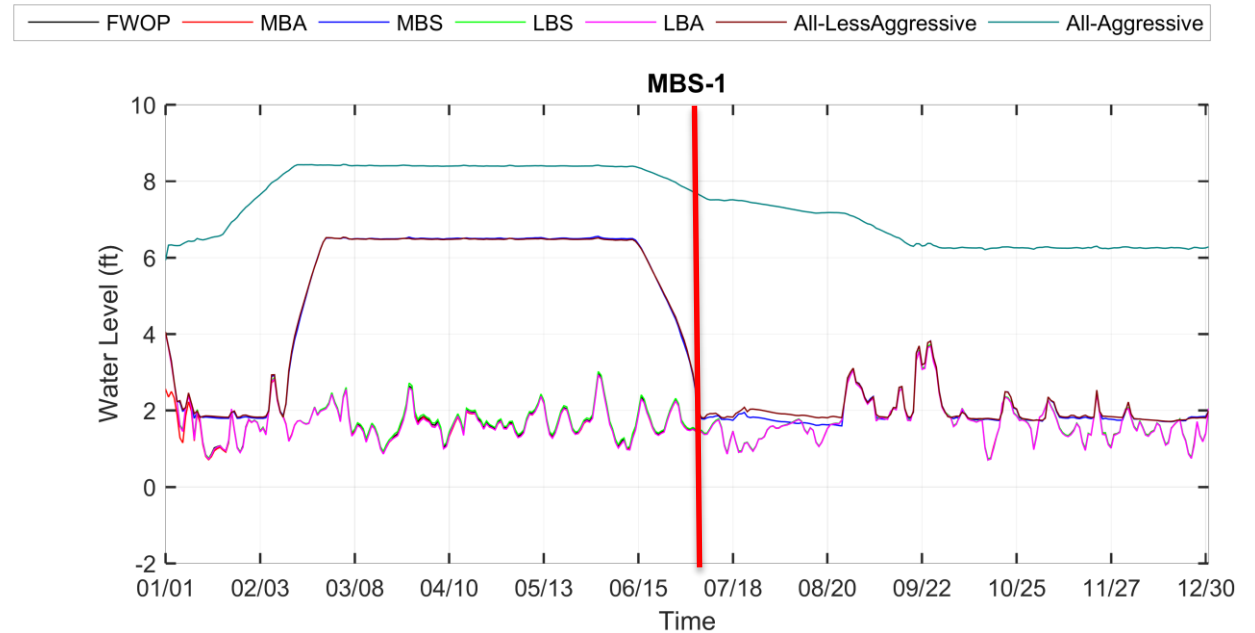
- MBA: Mid Barataria
- MBS: Mid Breton Sound
- LBS: Lower Breton Sound
- LBA: Lower Barataria

Note: Red Vertical Line represents annual end of less aggressive operational schedule



WATER LEVEL

MID BRETON OUTFALL AREA, YEAR 50



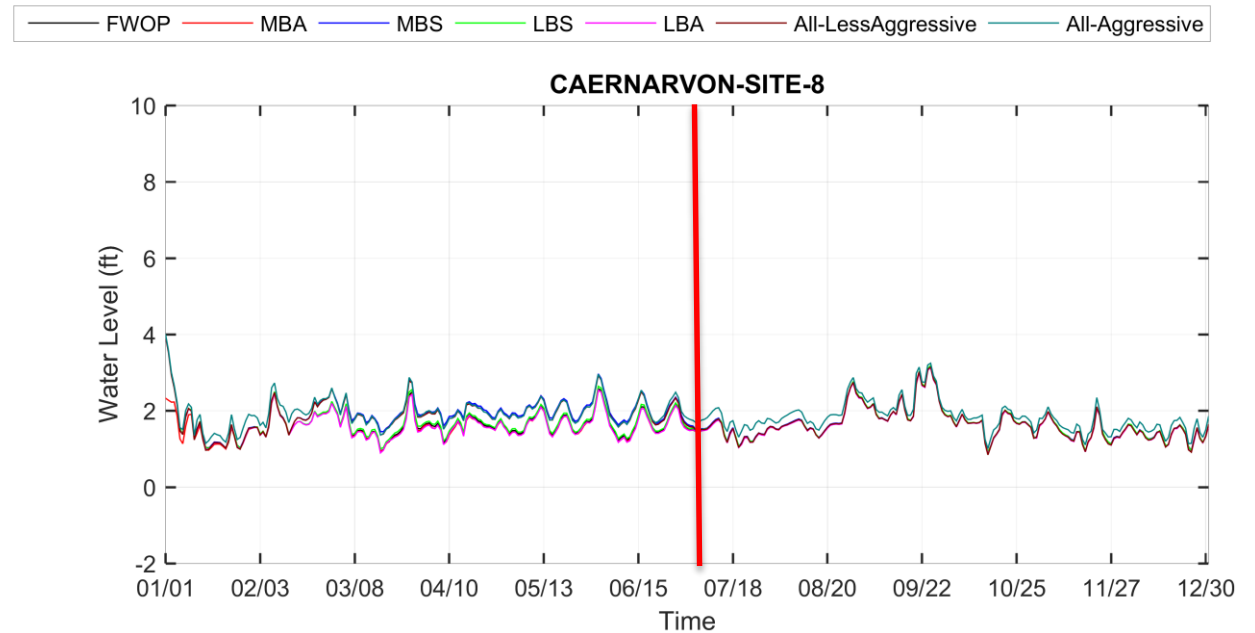
- *MBA: Mid Barataria*
- *MBS: Mid Breton Sound*
- *LBS: Lower Breton Sound*
- *LBA: Lower Barataria*

Note: Red Vertical Line represents annual end of less aggressive operational schedule



WATER LEVEL

NEAR DELACROIX, YEAR 50

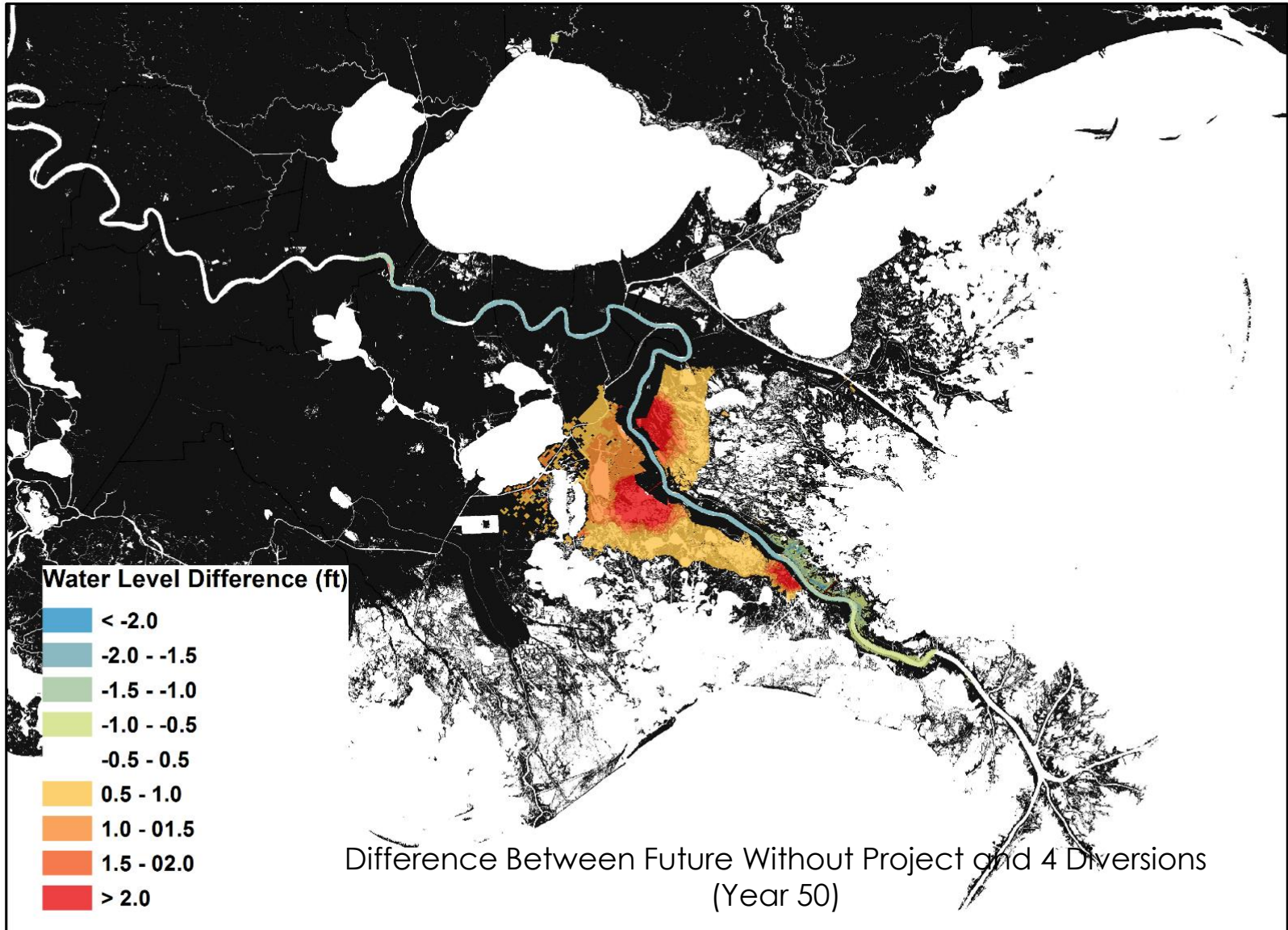


- *MBA: Mid Barataria*
- *MBS: Mid Breton Sound*
- *LBS: Lower Breton Sound*
- *LBA: Lower Barataria*

Note: Red Vertical Line represents annual end of less aggressive operational schedule

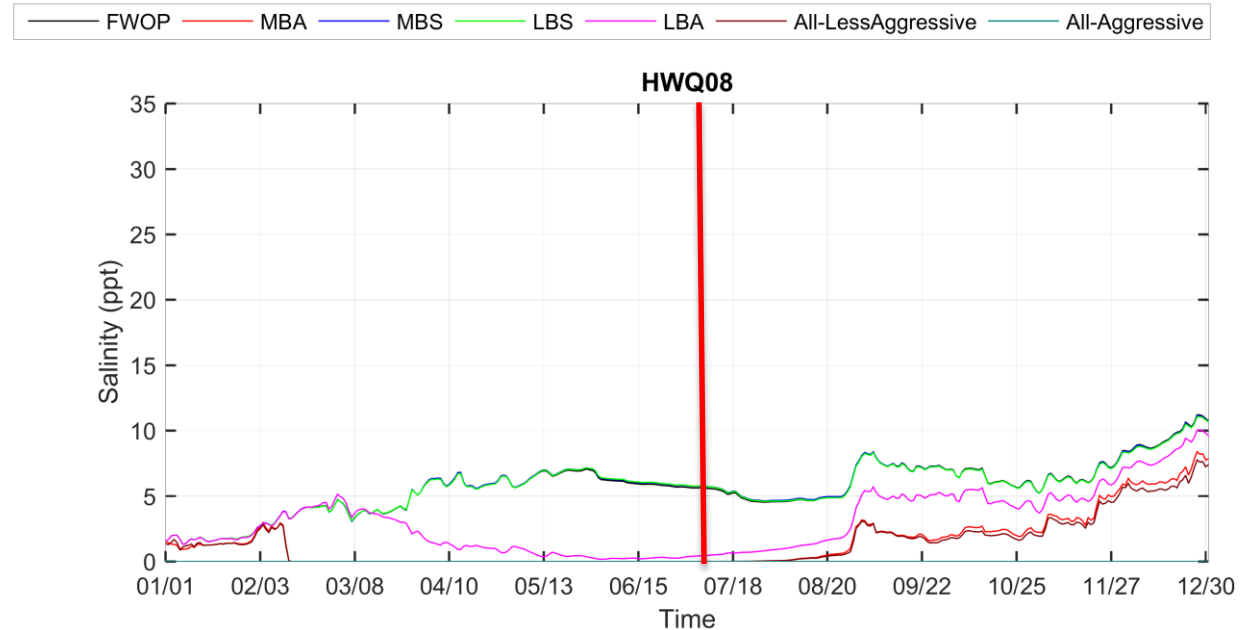


WSE DIFFERENCE: PR6-PR2(FT)



SALINITY

MID BARATARIA OUTFALL AREA, YEAR 50



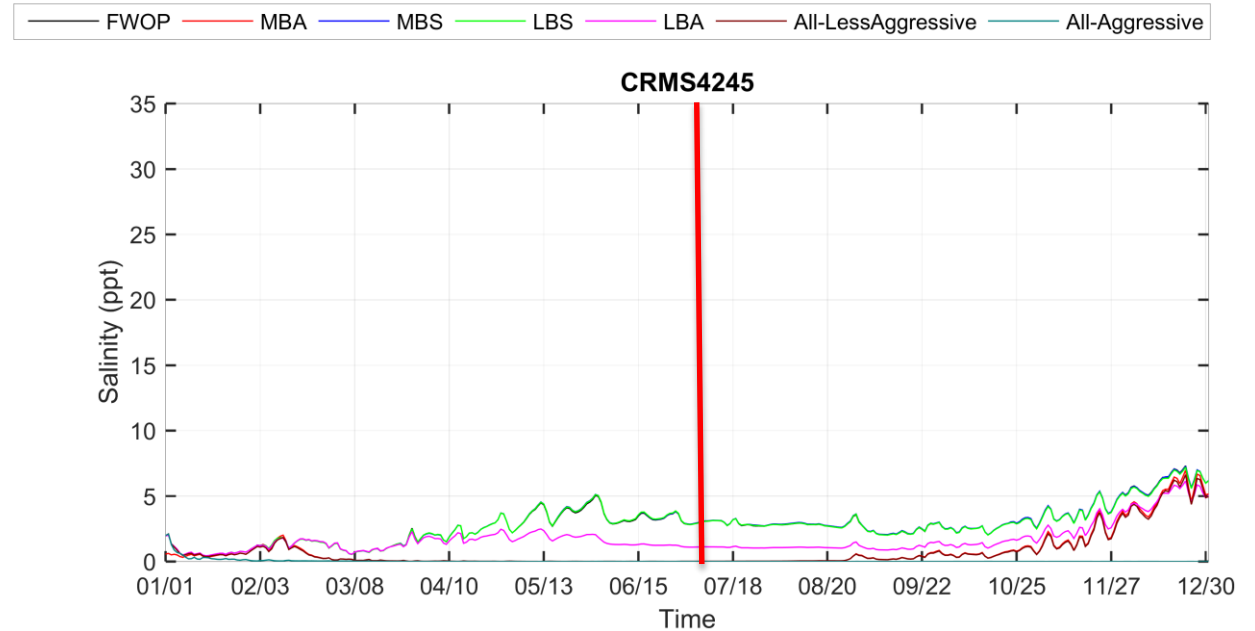
- MBA: Mid Barataria
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- LBS: Lower Breton Sound
- LBA: Lower Barataria

Note: Red Vertical Line represents annual end of less aggressive operational schedule



SALINITY

NEAR LAFITTE, YEAR 50



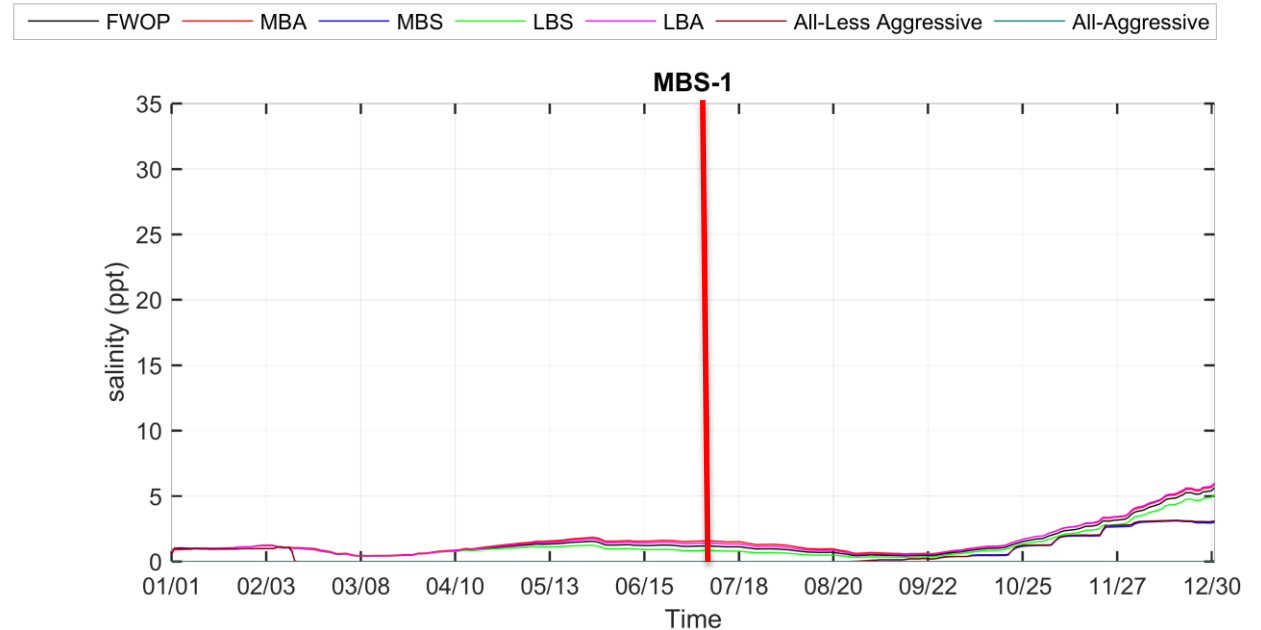
- MBA: Mid Barataria
- MBS: Mid Breton Sound
- LBS: Lower Breton Sound
- LBA: Lower Barataria

Note: Red Vertical Line represents annual end of less aggressive operational schedule



SALINITY

MID BRETON OUTFALL AREA, YEAR 50



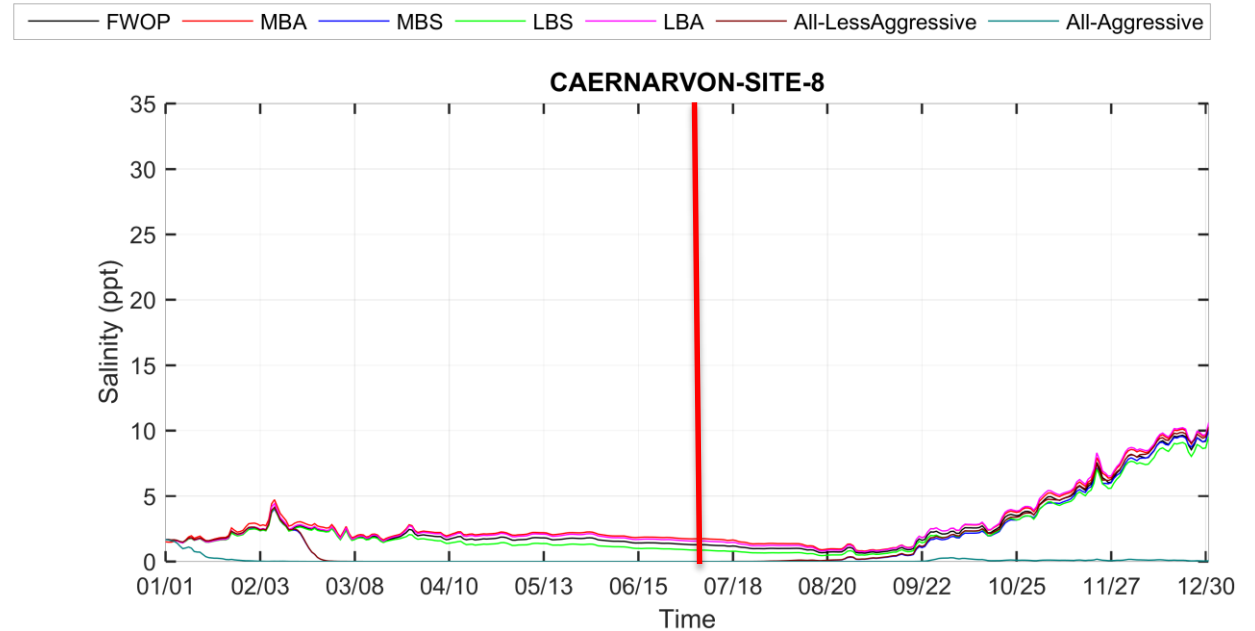
- MBA: Mid Barataria
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- LBA: Lower Barataria

Note: Red Vertical Line represents annual end of less aggressive operational schedule



SALINITY

NEAR DELACROIX, YEAR 50

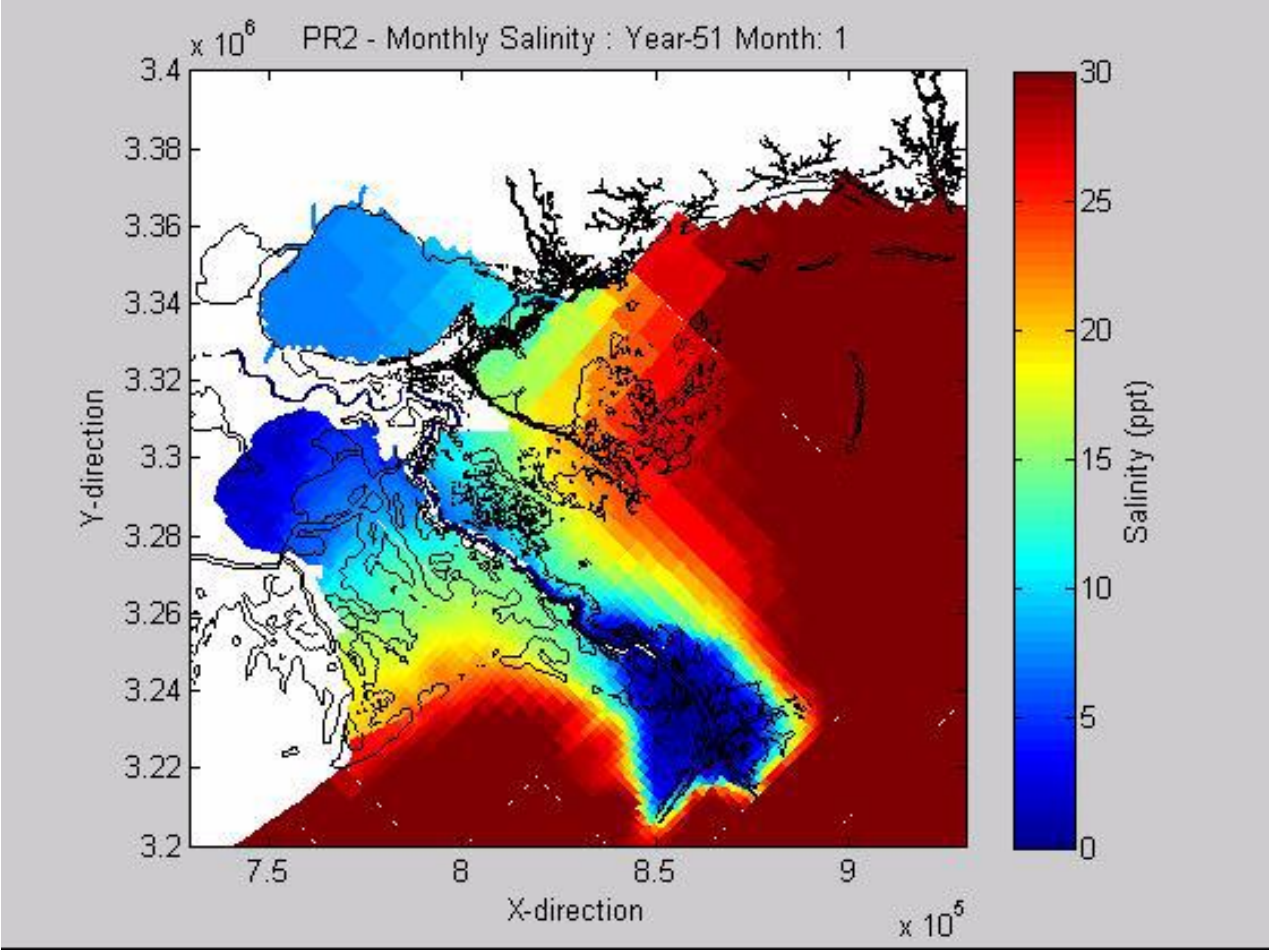


- *MBA: Mid Barataria*
- *MBS: Mid Breton Sound*
- *LBS: Lower Breton Sound*
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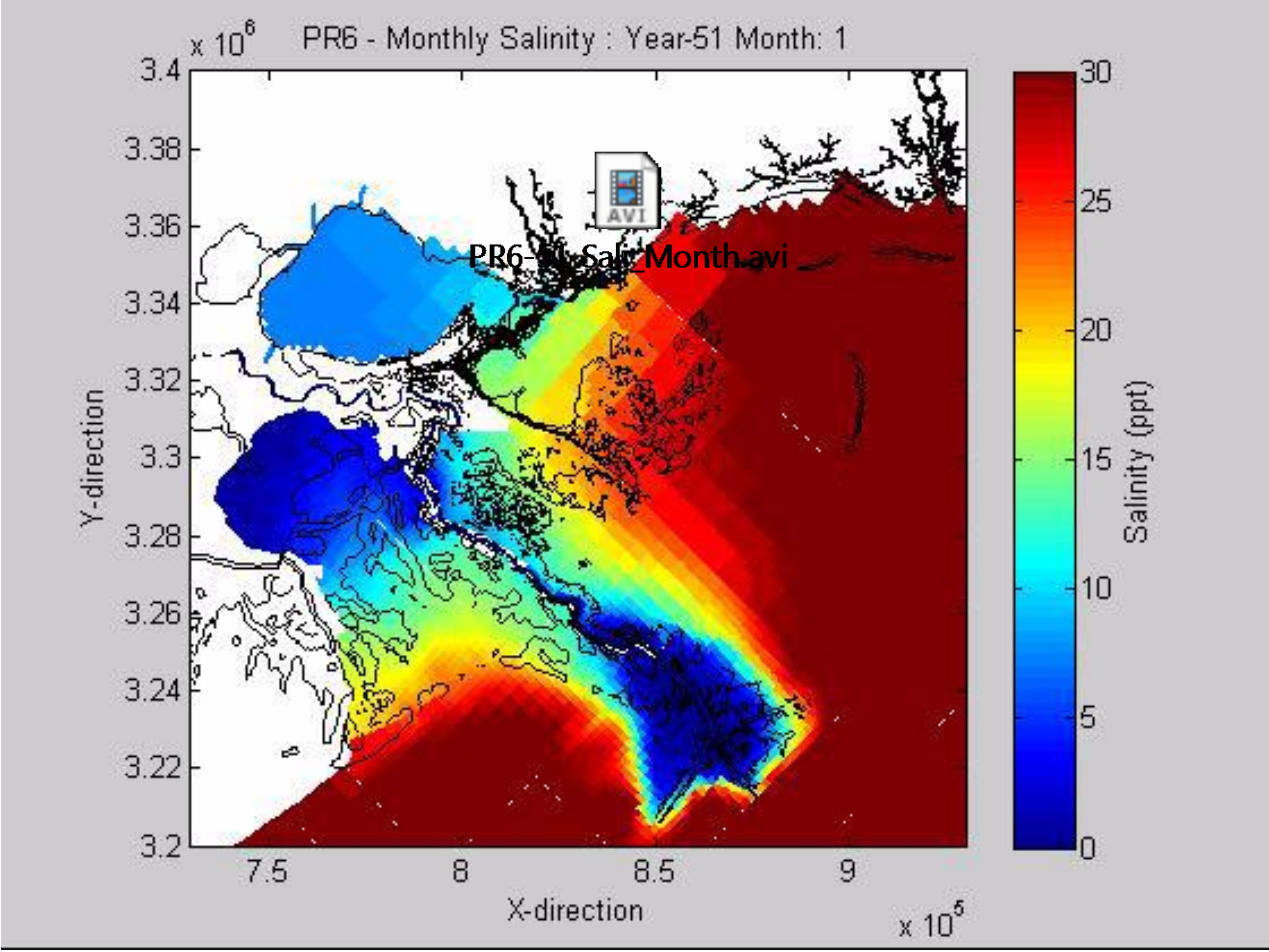
Note: Red Vertical Line represents annual end of less aggressive operational schedule



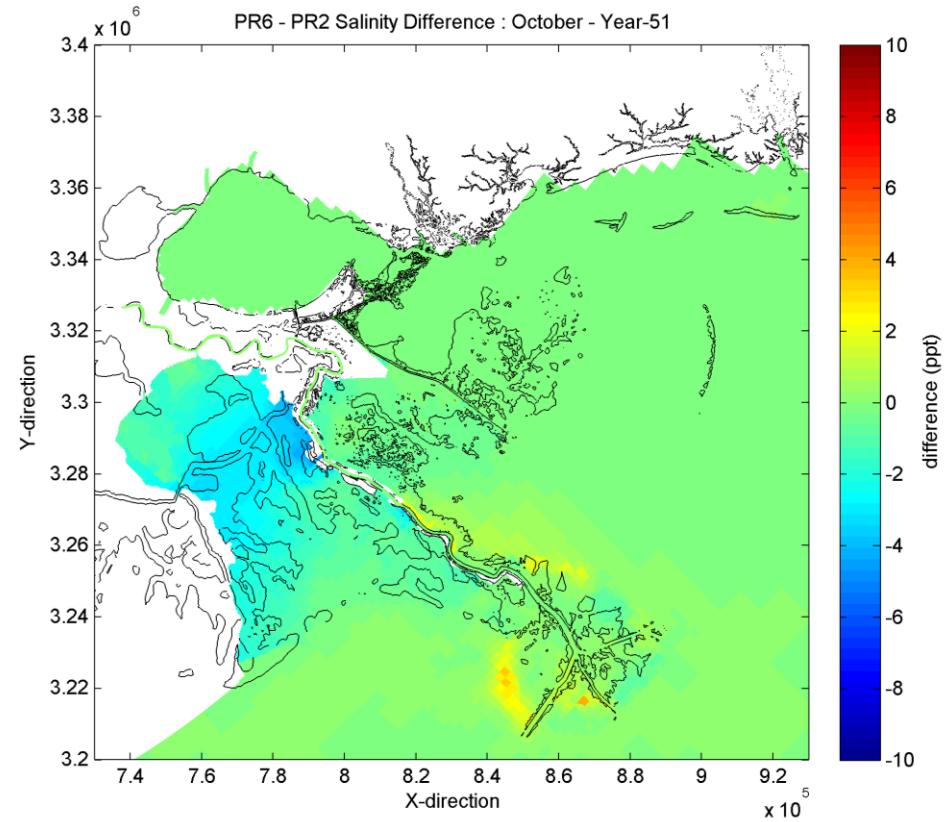
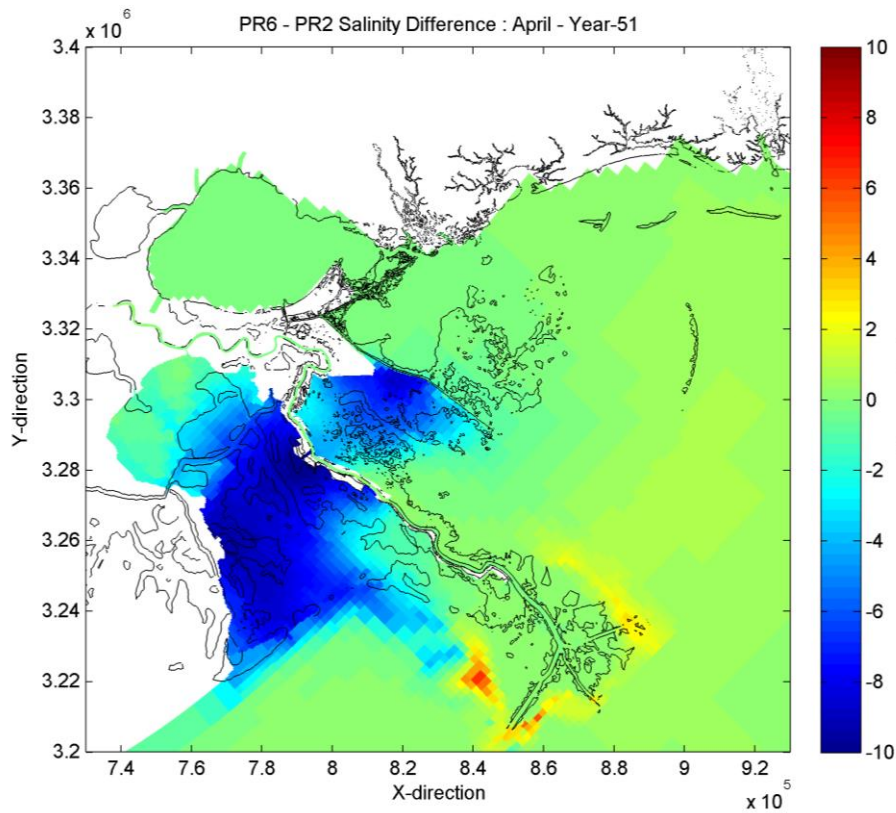
DELFT: PR 2 AT YEAR 50



DELFT: PR 6 AT YEAR 50



DELFT: PR 6-PR2 DIFFERENCE AT YEAR 50

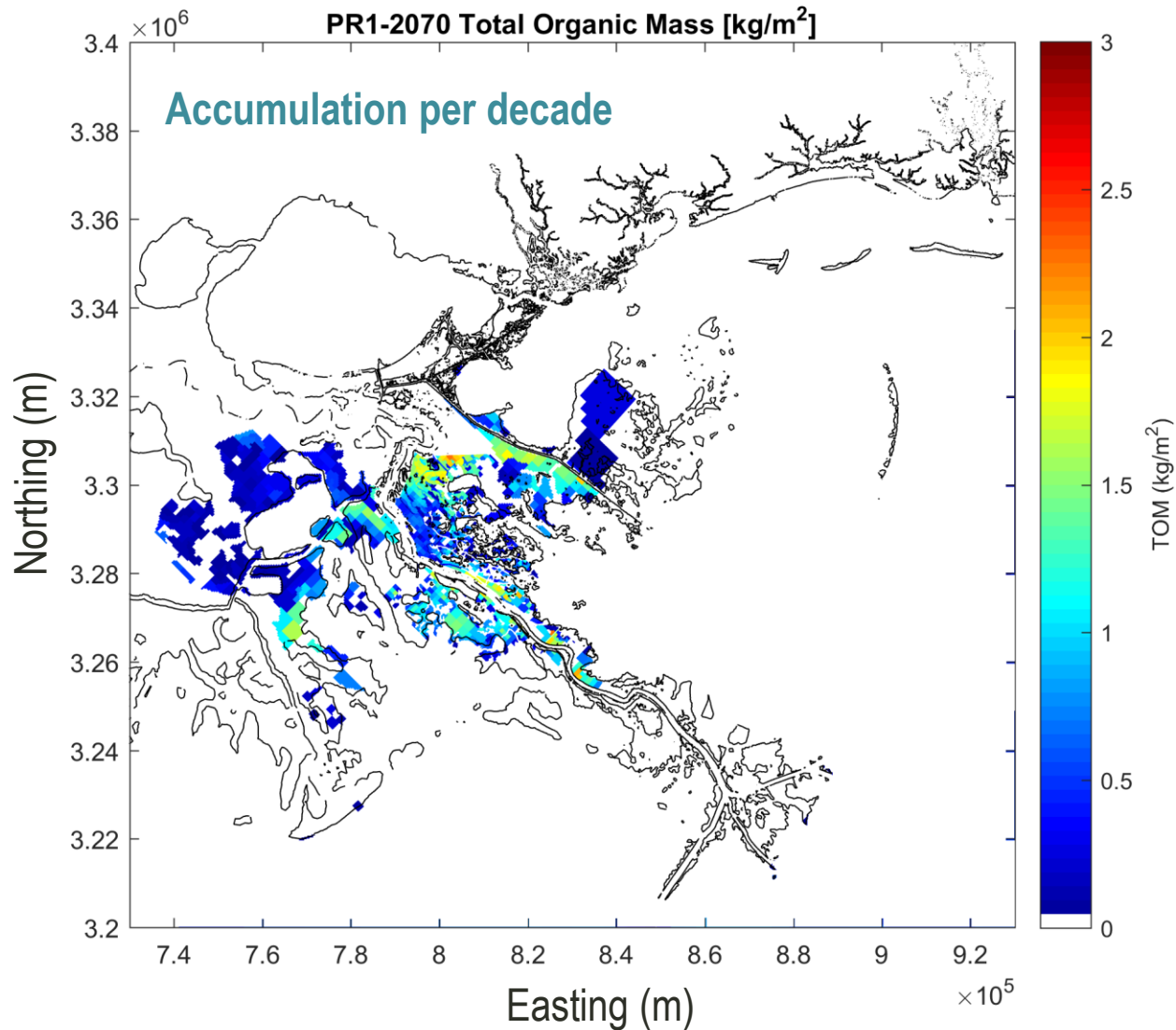


LAND BUILDING

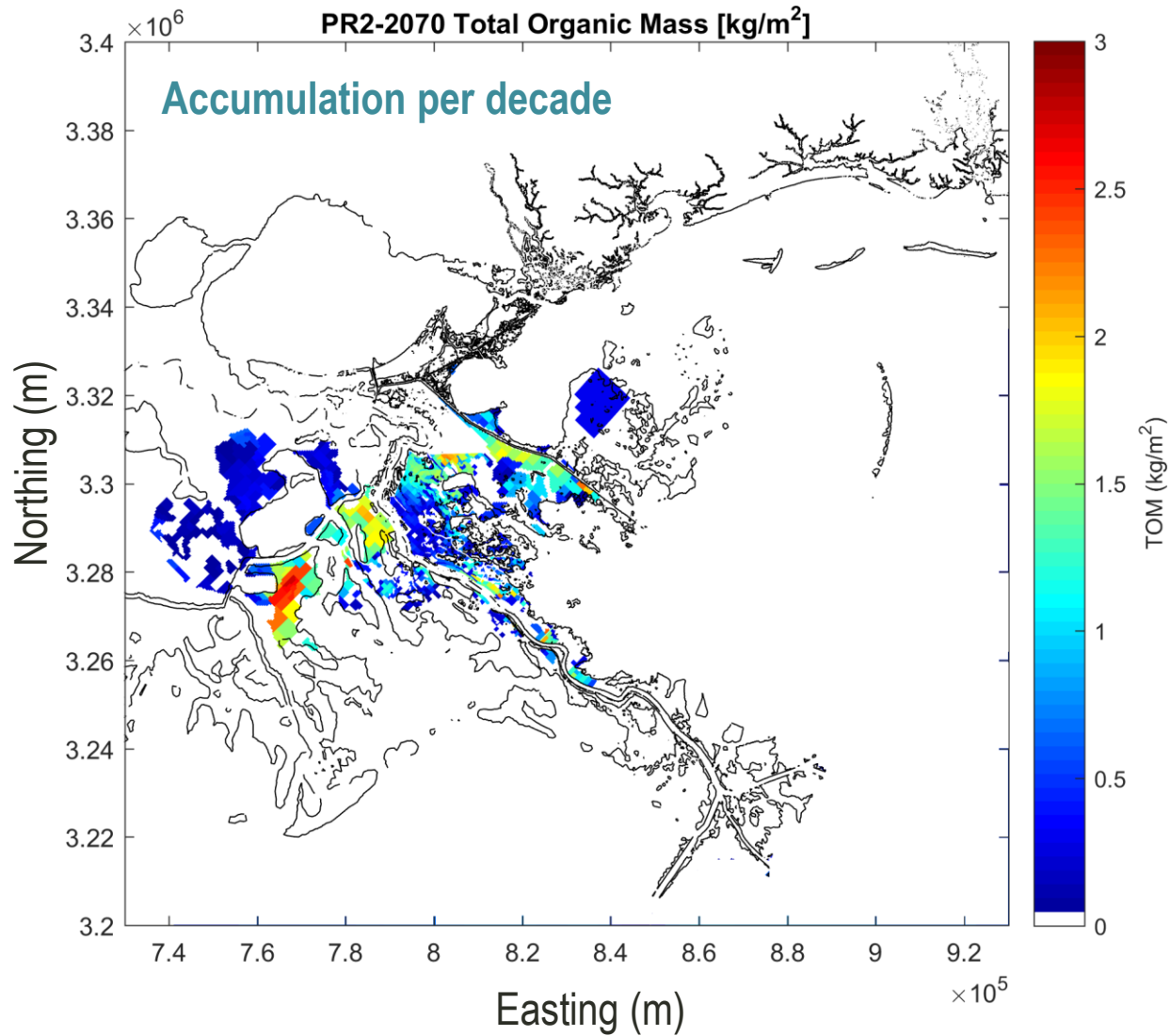
Organic Matter + Mineral Material



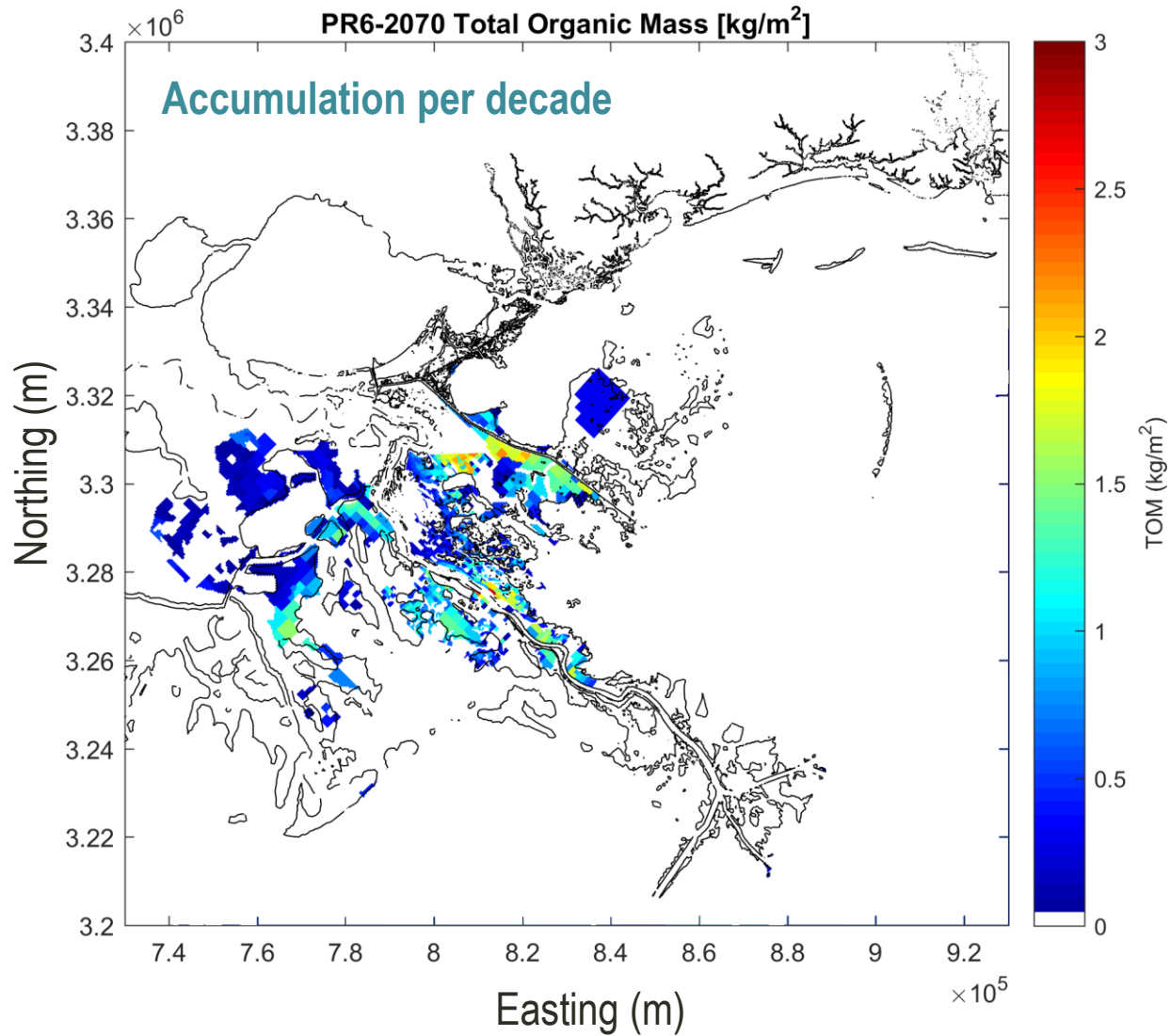
ORGANIC MATTER- PR1: 2070



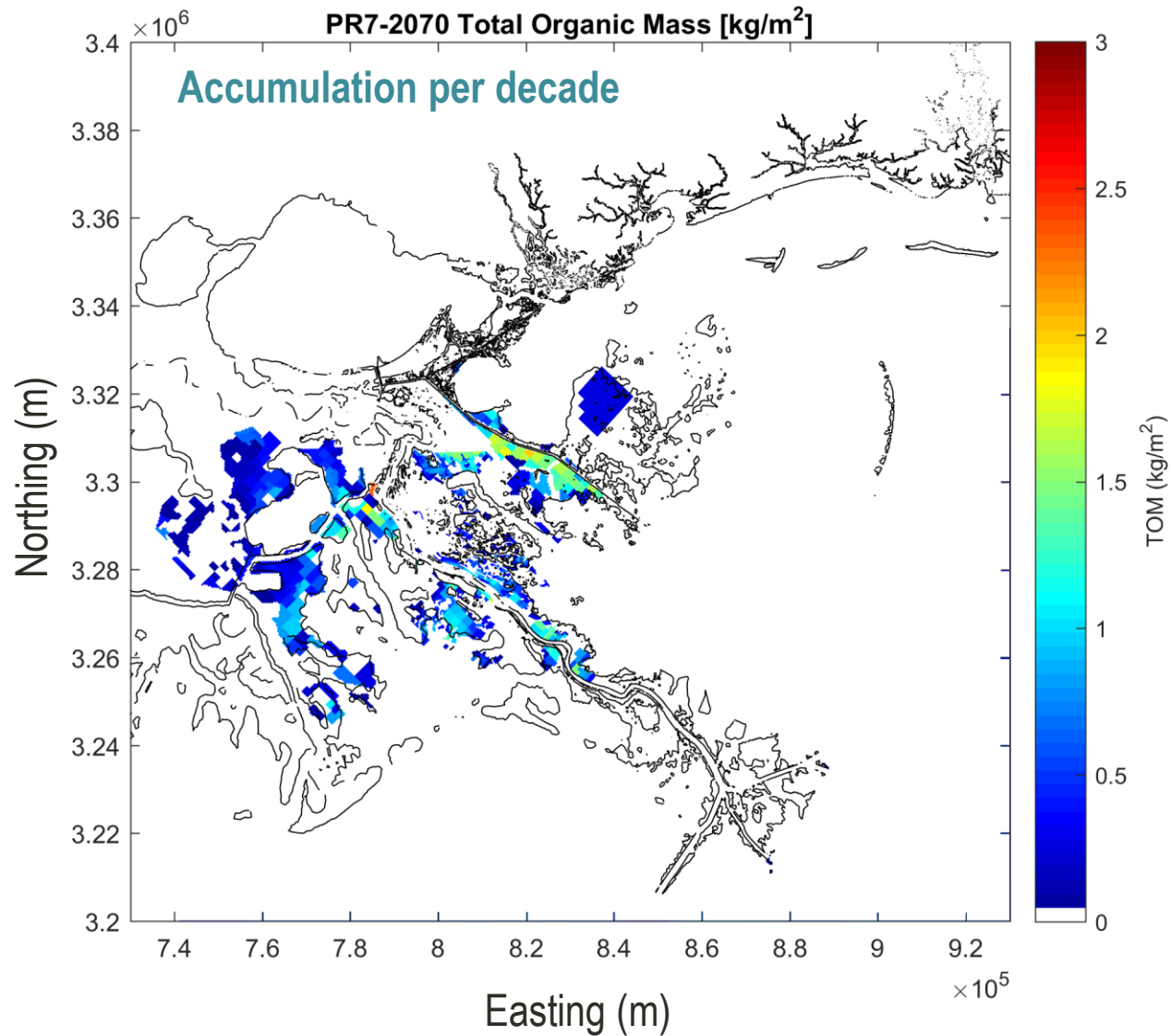
ORGANIC MATTER- PR2: 2070



ORGANIC MATTER- PR6: 2070



ORGANIC MATTER- PR7: 2070



ORGANIC MATTER ACCUMULATION

POM (g m ⁻² yr ⁻¹)	Location	Reference
100-300	Fresh, Intermediate, Brackish and Saline Marshes – Barataria Basin and Breton Basins	This study
328-580	Fresh and Brackish Marshes - Barataria Basin	DeLaune et al. 2013
~250	Fresh, Intermediate, Brackish and Saline Marshes – Barataria Basin	Hatton et al. 1983

Modeled organic matter accumulation values are near values reported by others in these basins.



LANDSCAPE CHANGE

- Land: area with a water depth < 0.5 ft
- Land lost: an area classified as land in FWOP (PR2) at a given time and classified as water in FWP at the same time
- Total Land gained: an area classified as water in FWOP (PR2) at a given time and classified as land in FWP at the same time



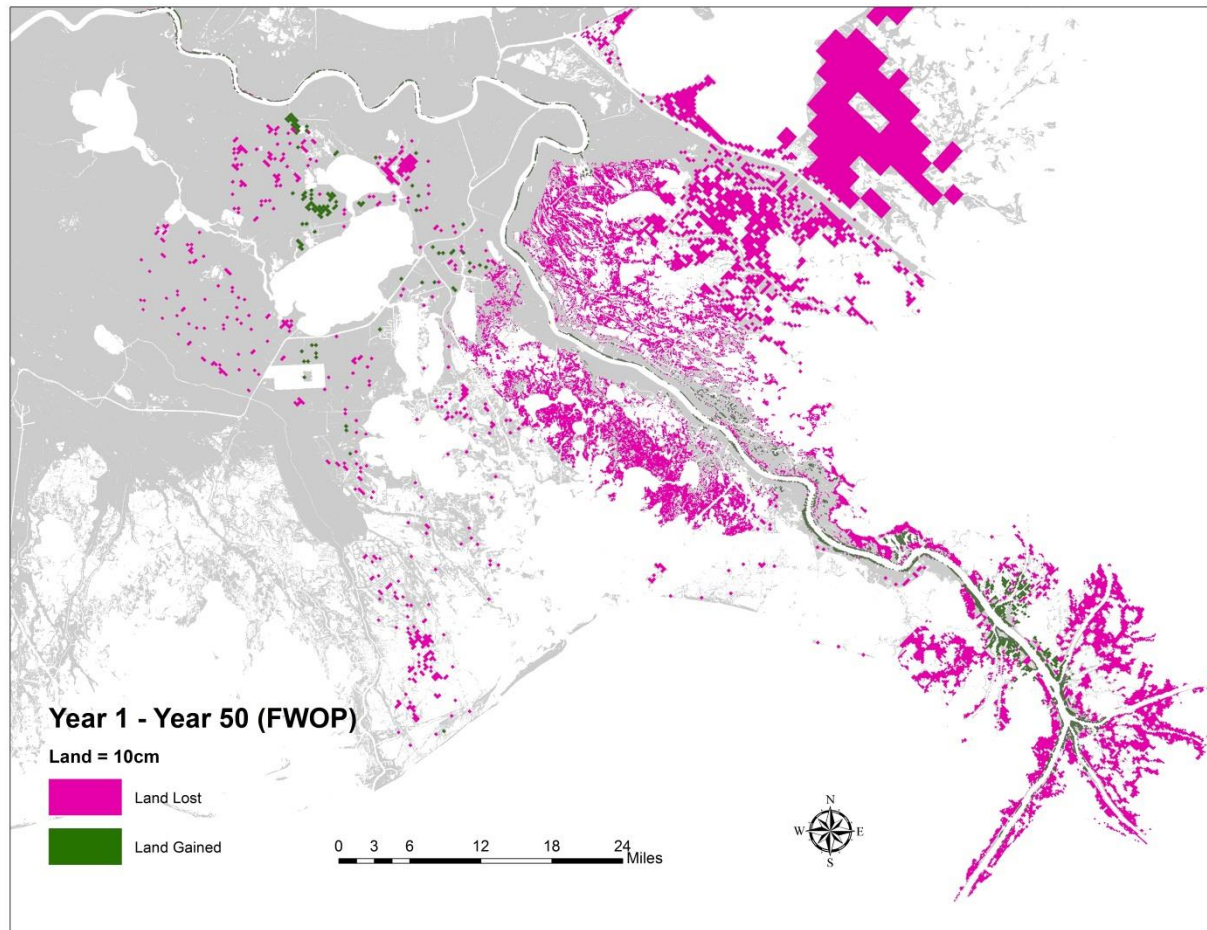
BREAKDOWN OF TOTAL LAND GAINED

- Land sustained: land lost in FWOP (PR2) and not lost (sustained) in FWP
- Land gained: land in FWP that is always water in FWOP (PR2)

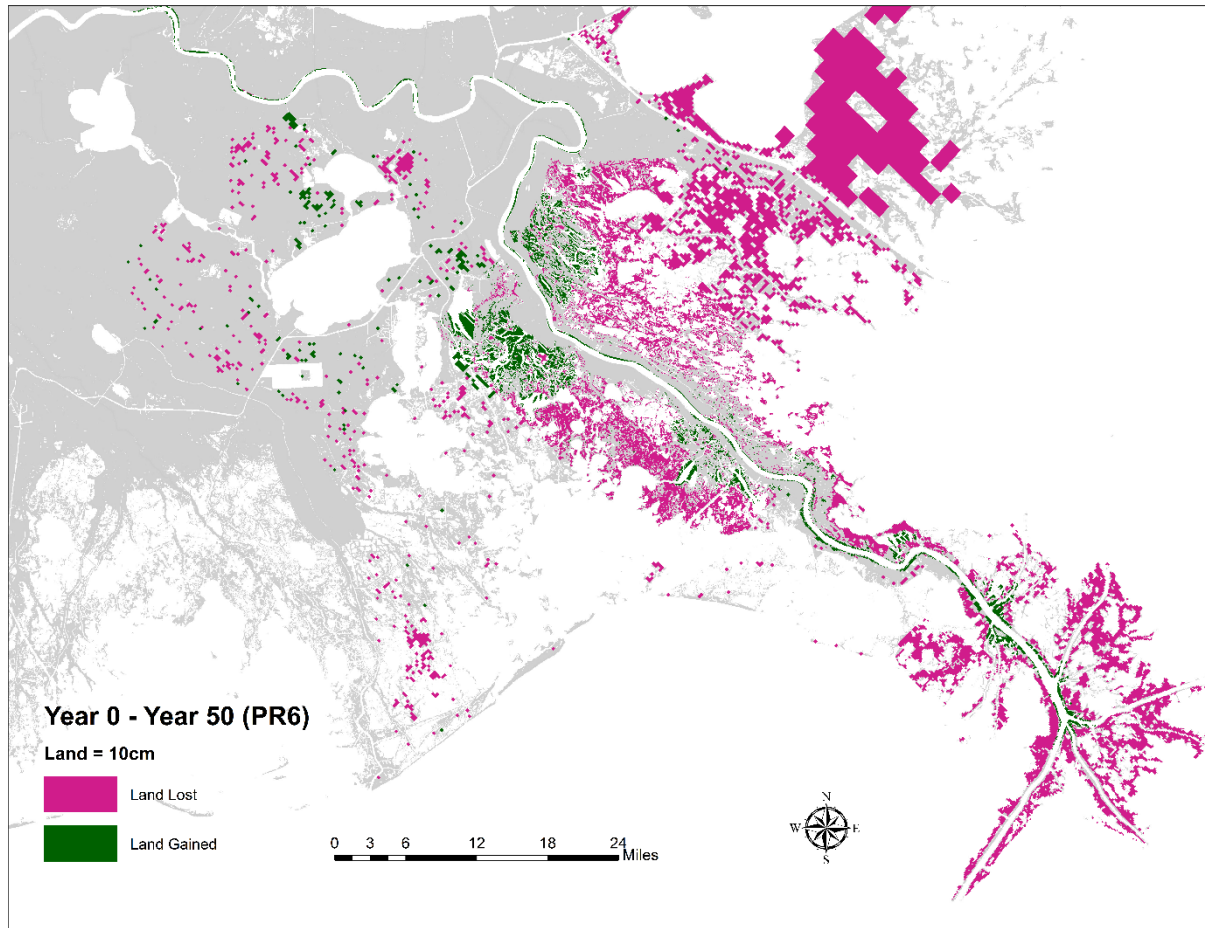


MRDM DELFT

LAND CHANGE - FWOP (YEAR 0-50)



MRDM DELFT LAND CHANGE - 4 DIVERSIONS (YEAR 0-50)

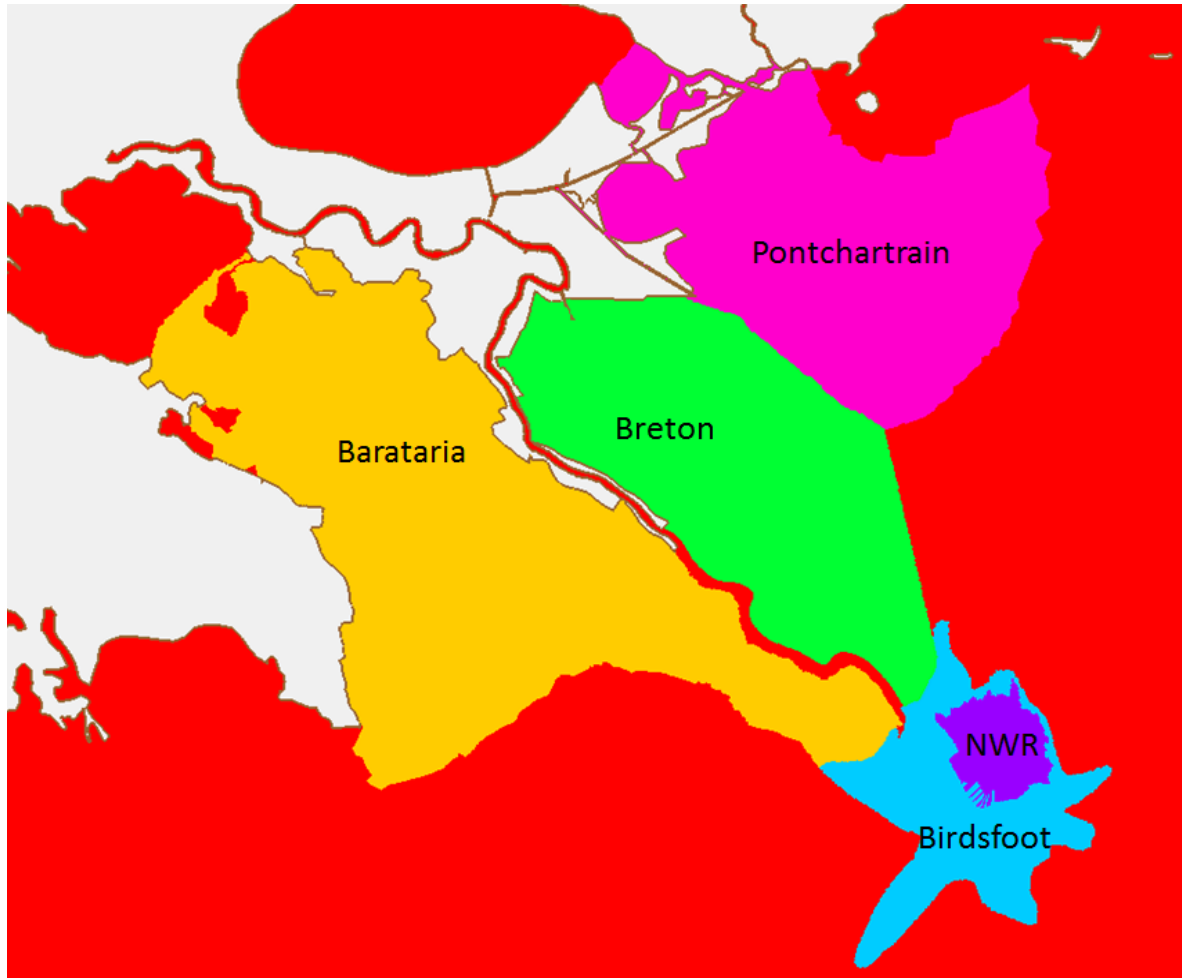


LAND BUILDING – MODEL DOMAIN

MR Delta Management Land Building Summary – 2070						
Referenced to PR2 (FWOP)						
			Acreage (Net Loss/Gain)			
ID	Name	Bed elevation > -0.5ftNAVD88	Water depth = 0 ft	Water depth ≤ 0.33 ft	Water depth ≤ 0.5ft	Water depth ≤ 1ft
PR1	Mid Barataria	16,269	25,744	26,740	28,062	24,209
PR3	Mid Breton	11,082	15,071	15,790	15,594	15,047
PR4	Lower Breton	3,844	5,063	3,205	4,298	1,706
PR5	Lower Barataria	3,193	5,553	6,201	6,020	8,342
PR6	All Diversions - Less Aggressive	33,844	41,141	42,746	43,175	40,619
PR7	All Diversions - Aggressive	47,432	35,556	39,256	36,852	38,640



SUMMARY TABLE – BY BASIN



SUMMARY TABLE – BY BASIN

MR Delta Management Land Loss in FWOP (PR2): 2020 - 2070				
		Acreage: Land Loss		
ID	Name	Barataria	Breton Sound	MR Delta and NWR
PR2	FWOP	-152,810	-96,687	-59,287

MR Delta Management Land Building Summary - 2070					
Referenced to FWOP (PR2)					
		Acreage: Net Land Gain/Loss			
ID	Name	Barataria	Breton Sound	MR Delta and NWR	Sum
PR1	Mid Barataria	28,490	389	-2,925	25,954
PR3	Mid Breton	-147	16,923	-1,598	15,178
PR4	Lower Breton	0	3,455	-1,812	1,643
PR5	Lower Barataria	6,089	745	-1,435	5,399
PR6	All Diversions - Less Aggressive	31,987	16,421	-7,888	40,520
PR7	All Diversions - Aggressive	27,221	15,559	-8,283	34,497



PR#6: ALL DIVERSIONS

Delft

AdH

Basin	PR6: Land Acreage	PR9: Land Acreage	PR6: Land change reference to FWOP	PR9: Land change reference to FWOP
Barataria	267,044	266,101	12,058	11,115
Breton	124,510	122,871	5,548	3,909
MR Delta and NWR	24,400	22,561	(8,893)	(10,732)
Sum	415,954	411,533	8,713	4,292
Basin	PR6: Land Acreage	PR9: Land Acreage	PR6: Land change reference to FWOP	PR9: Land change reference to FWOP
Barataria	347,348	168,429	8,087	6,771
Breton	159,213	89,122	4,061	980
MR Delta and NWR	39,208	24,067	(3,377)	(3,679)
Sum	545,769	281,618	8,771	4,072



PR#9: ALL DIVERSIONS – NO VEG

Delft

AdH

			PR6: Land change reference to FWOP	PR9: Land change reference to FWOP
Basin	PR6: Land Acreage	PR9: Land Acreage		
Barataria	267,044	266,101	12,058	11,115
Breton	124,510	122,871	5,548	3,909
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THANK YOU

Ehab Meselhe

 @TheH2OInstitute

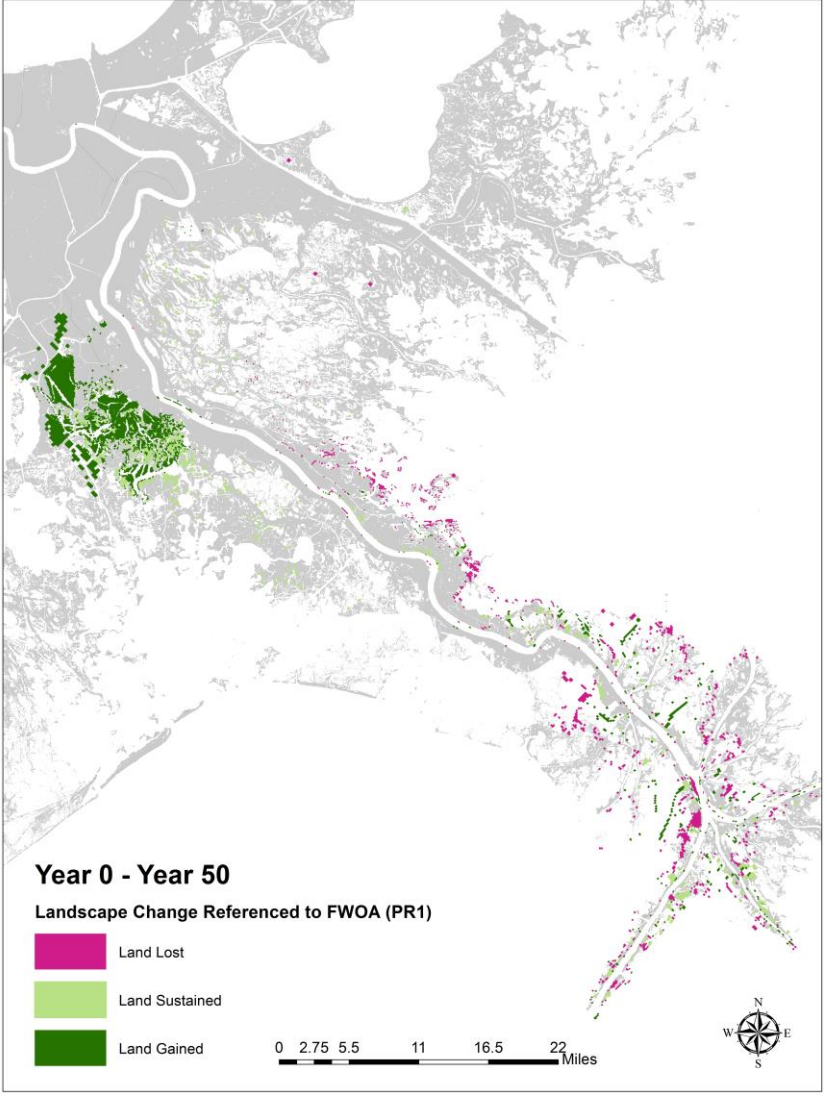
301 NORTH MAIN STREET, SUITE 2000
BATON ROUGE, LA 70825

(225) 448-2813

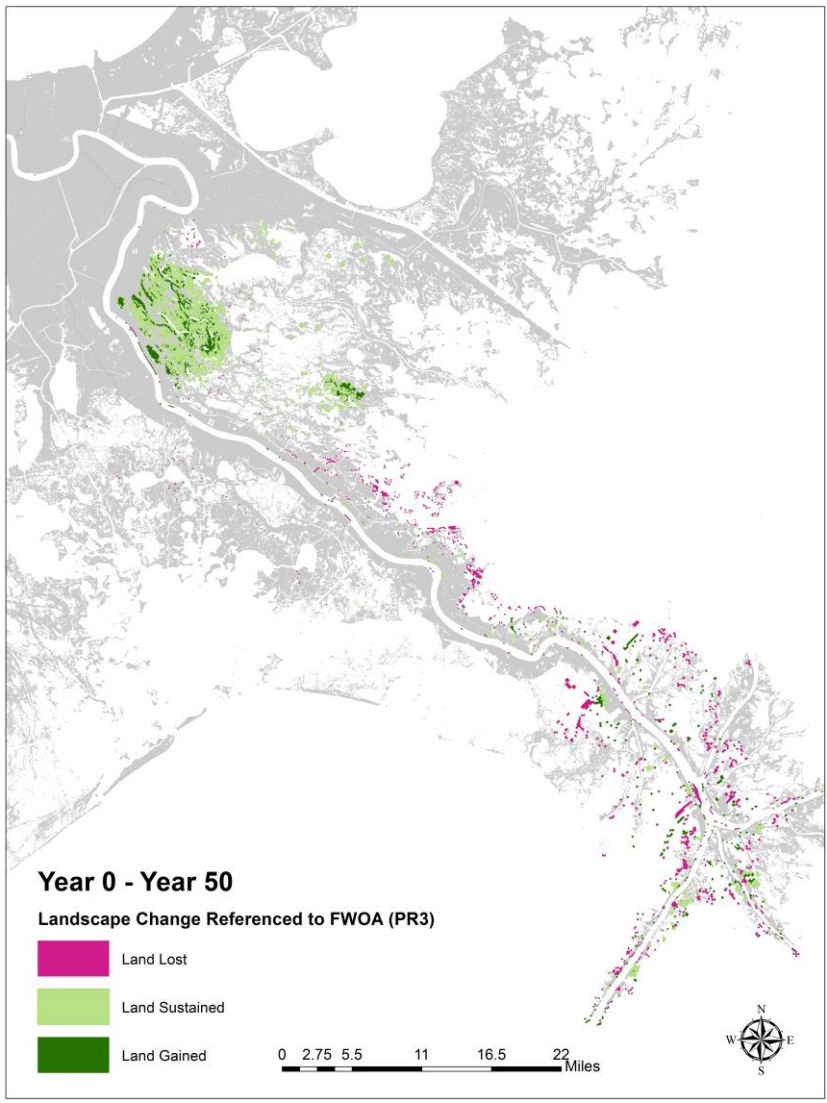
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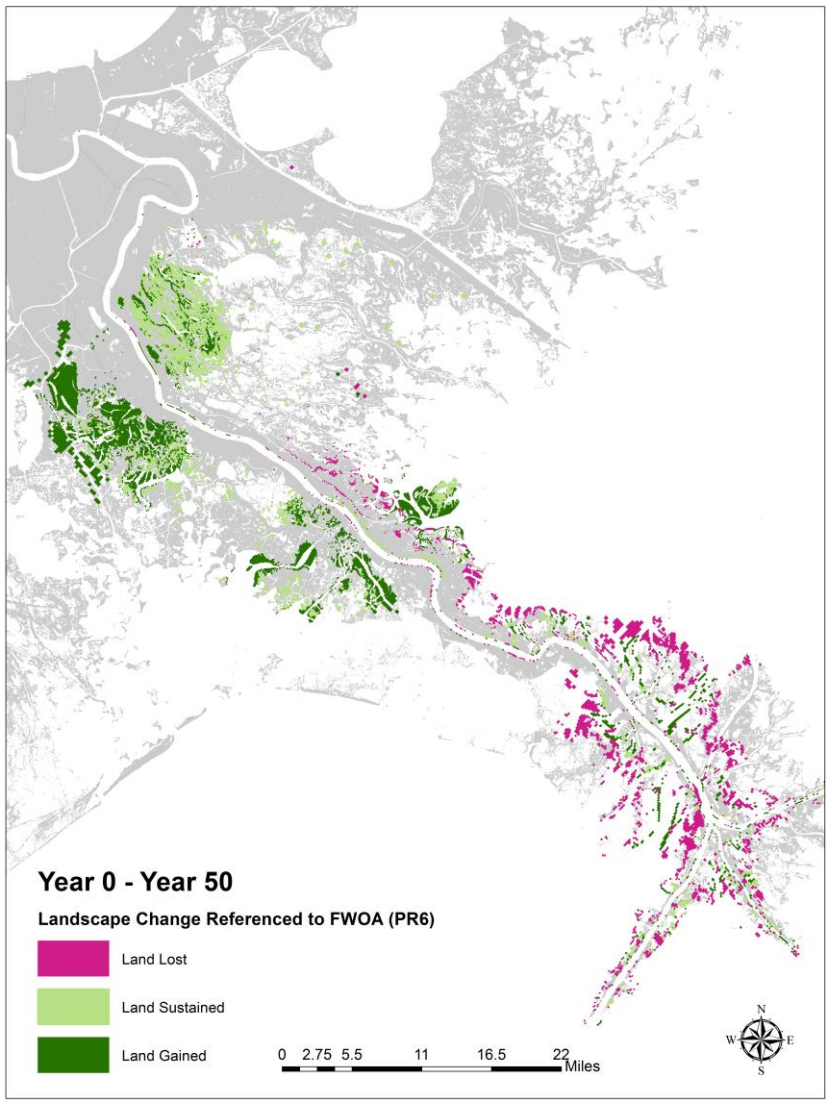
LAND BUILDING MAPS AT YEAR 50: PR1



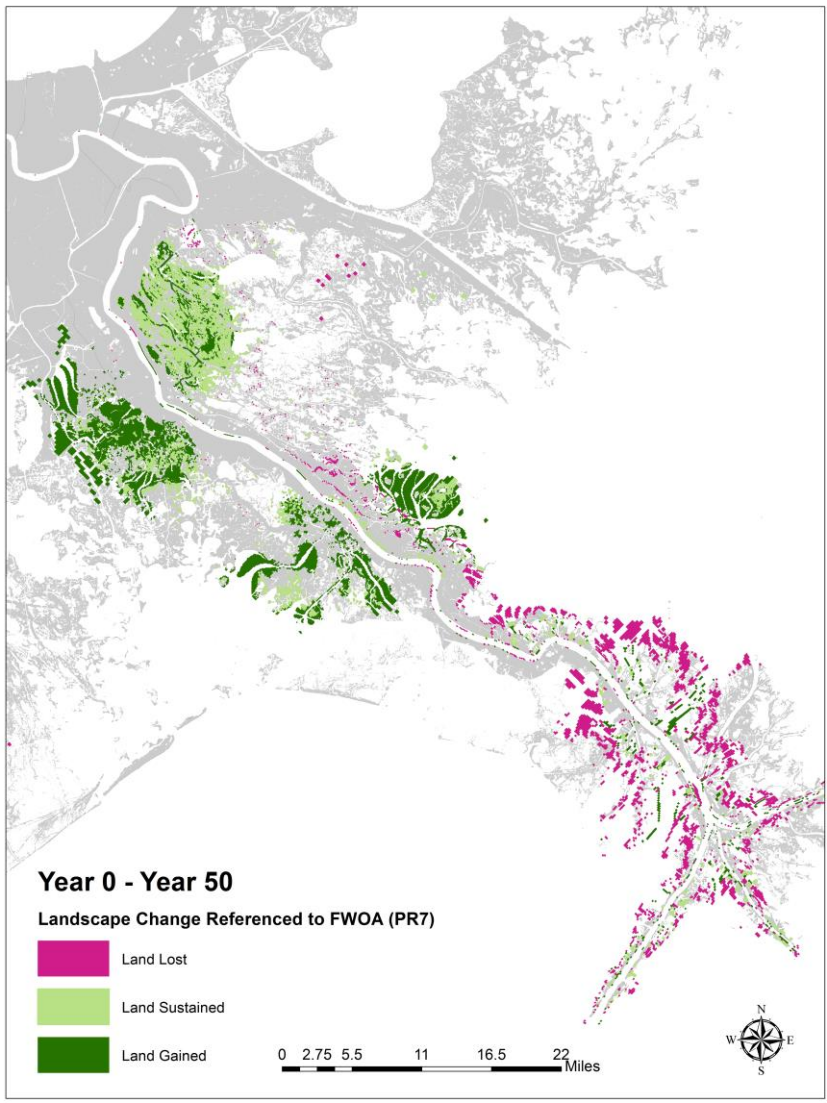
LAND BUILDING MAPS AT YEAR 50: PR3



LAND BUILDING MAPS AT YEAR 50: PR6



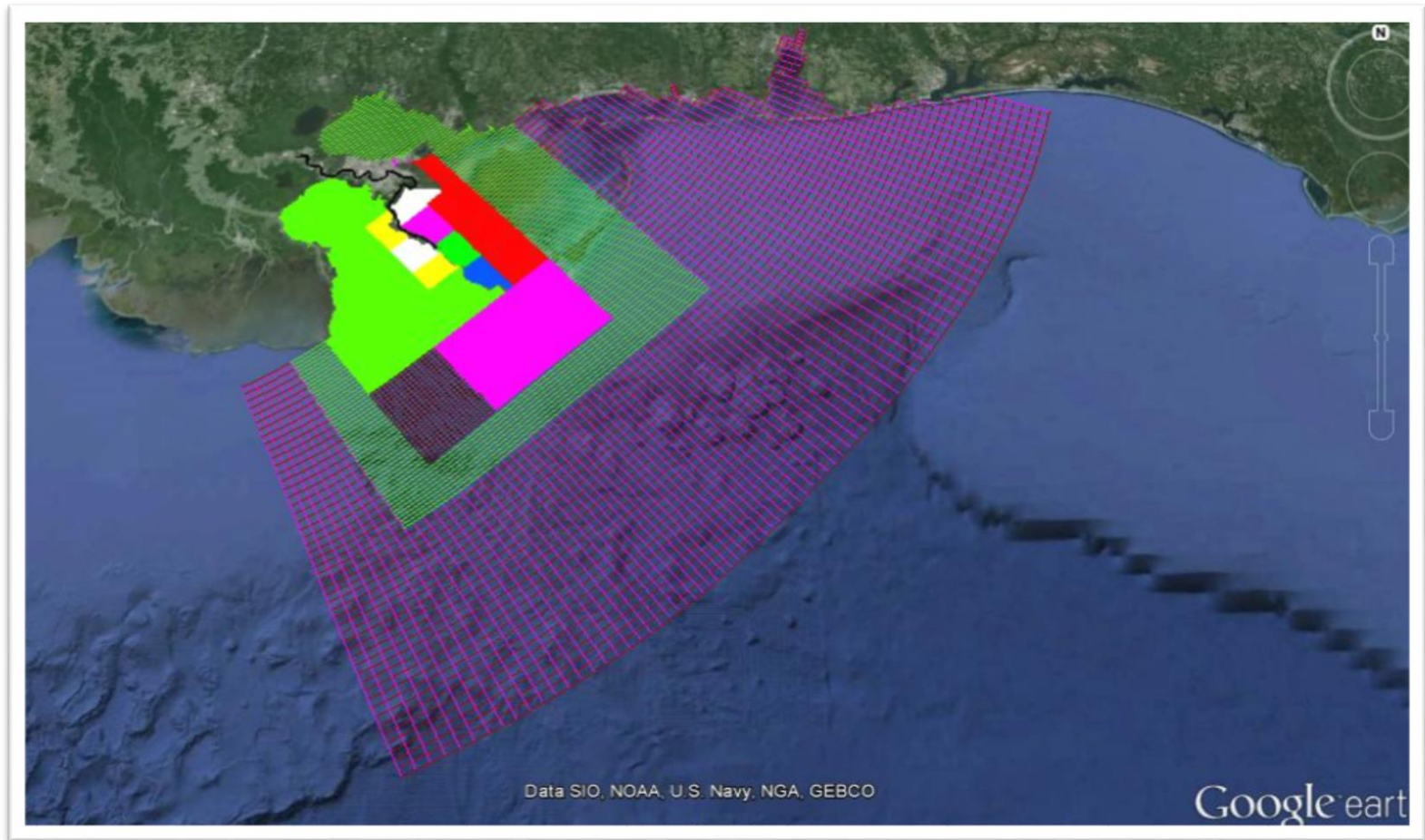
LAND BUILDING MAPS AT YEAR 50: PR7



EXTRA SLIDES



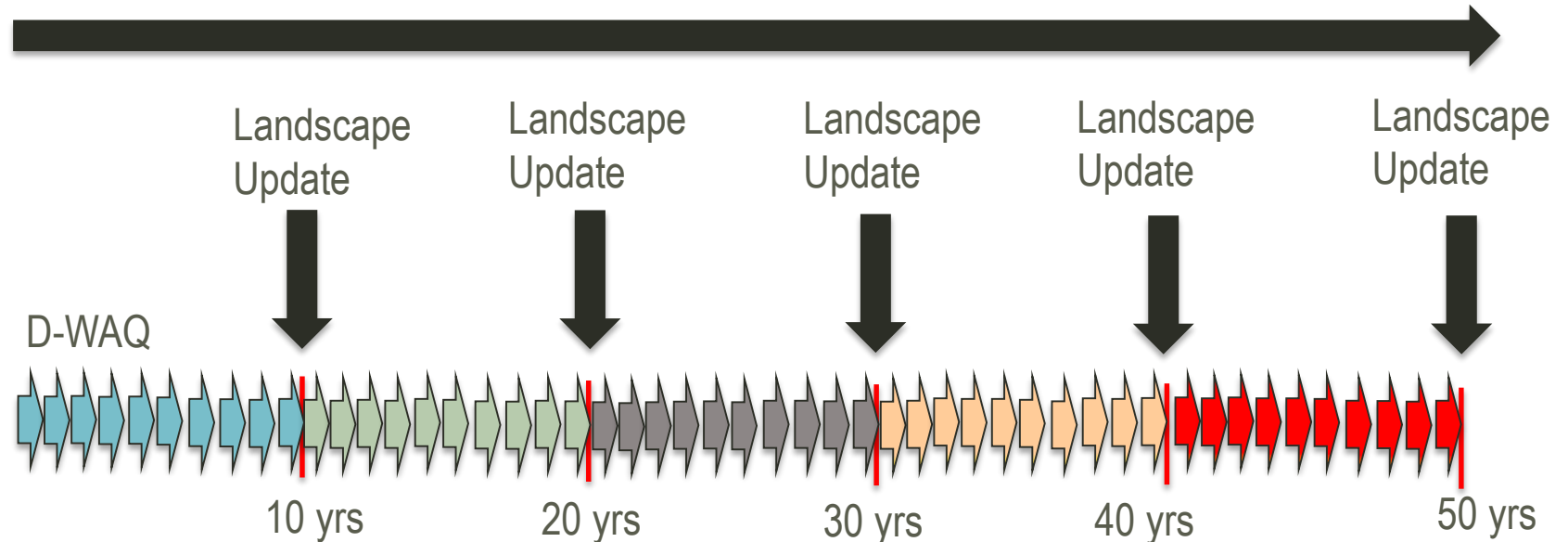
DELFT-3D MODEL DOMAIN AND GRID



MODEL COUPLING FOR PRODUCTION RUNS (SIMPLE)

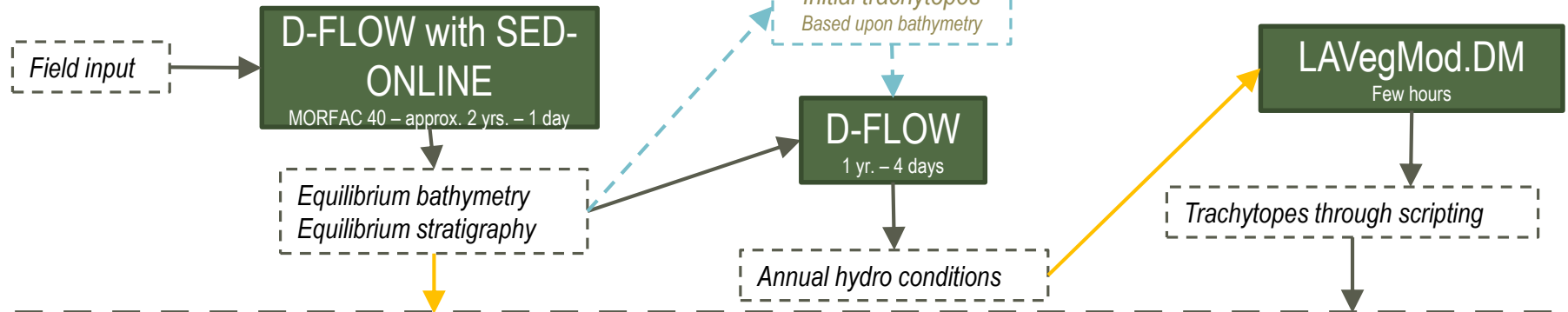
- 50 year runs, Year 2020 – 2070
- Batch 1: seven production runs

D-FLOW-SED-ONLINE



Initialization phase

* This runs outside the 1-month aim of the iteration phase (can be run long in advance, irrelevant any for scenarios)



Iteration phase

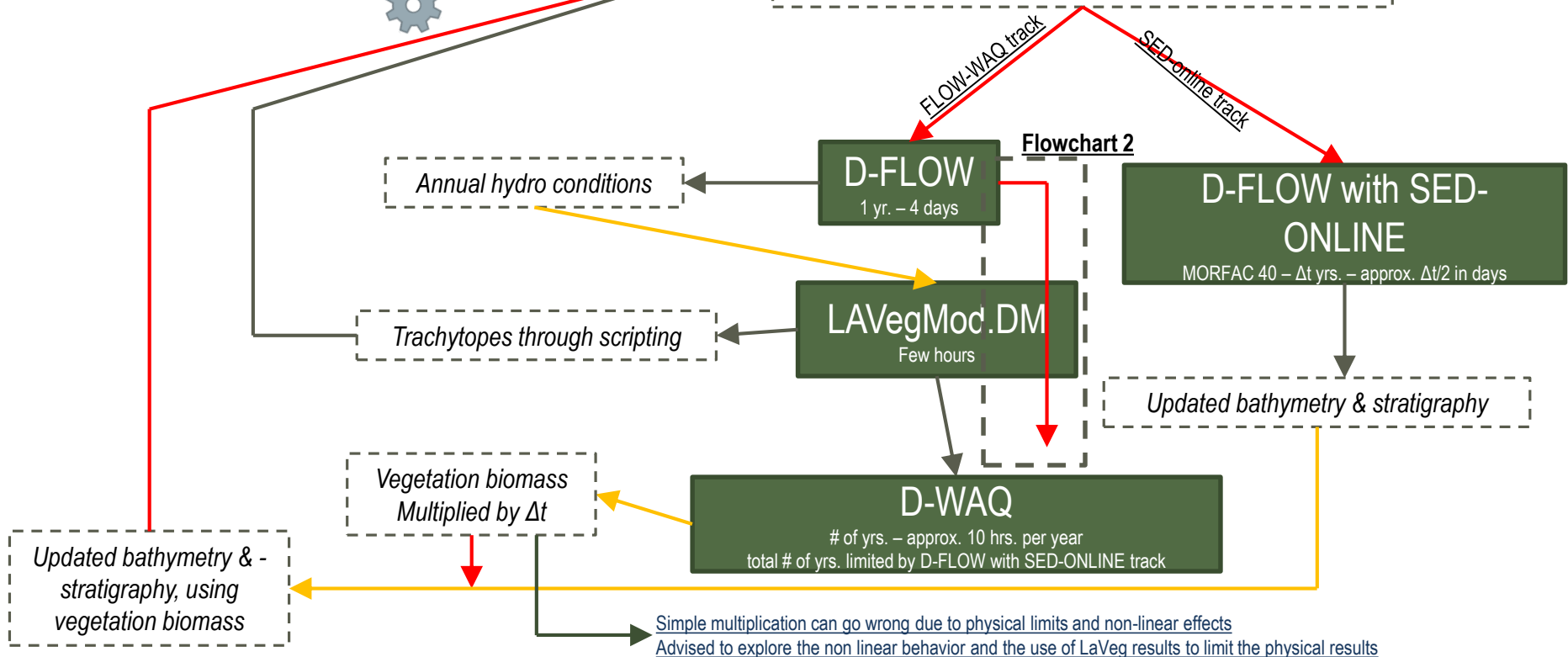
* Aim: 1 wall-clock-month to run 50 yrs. of combined D-FLOW, SED-ONLINE, D-WAQ & LAVegMod.DM modules

$T = 50 \text{ yrs.} = N * \Delta t$
Assumed $N = 5$ & $\Delta t = 10 \text{ yrs.}$

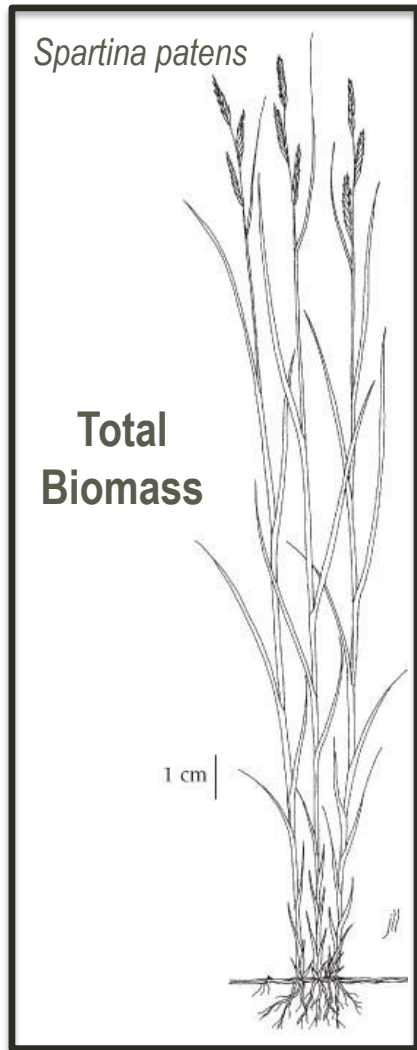


Updated initial conditions for each iteration, includes:

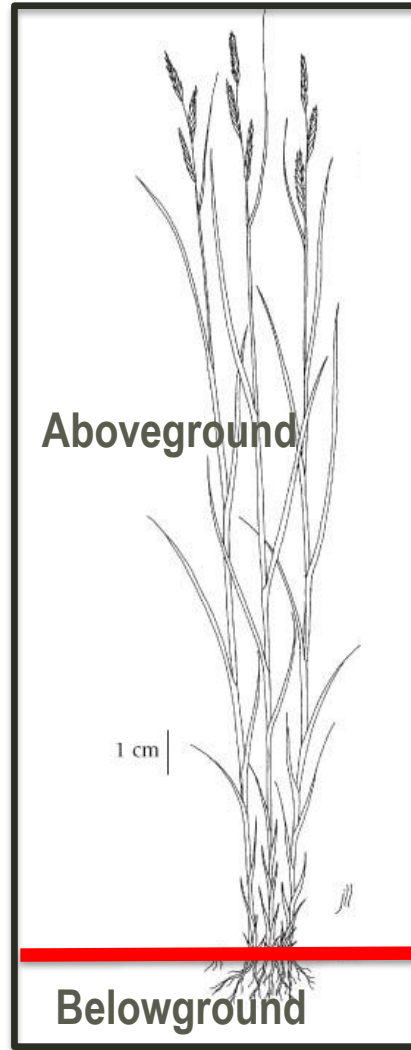
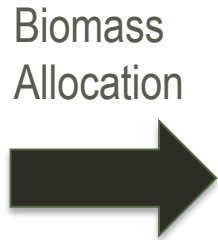
- Stratigraphy (& bathy)
- Trachytopes



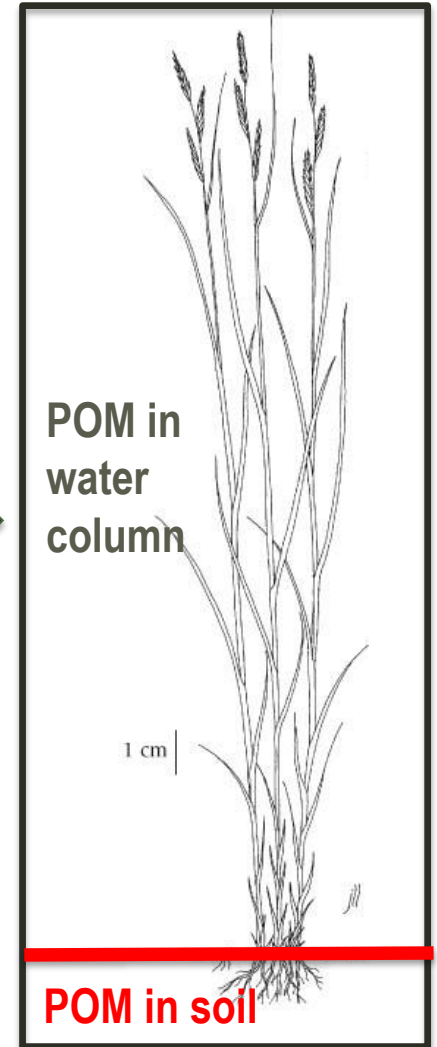
ORGANIC MATTER (POM) ACCUMULATION



(VEGMOD)



(LaVegMod.RootShoot)



(VEGMOD)

