Water level forecasting and flood warning

Hydraulic model of Chaudière River : Calibration/Validation and parametric uncertainty analysis

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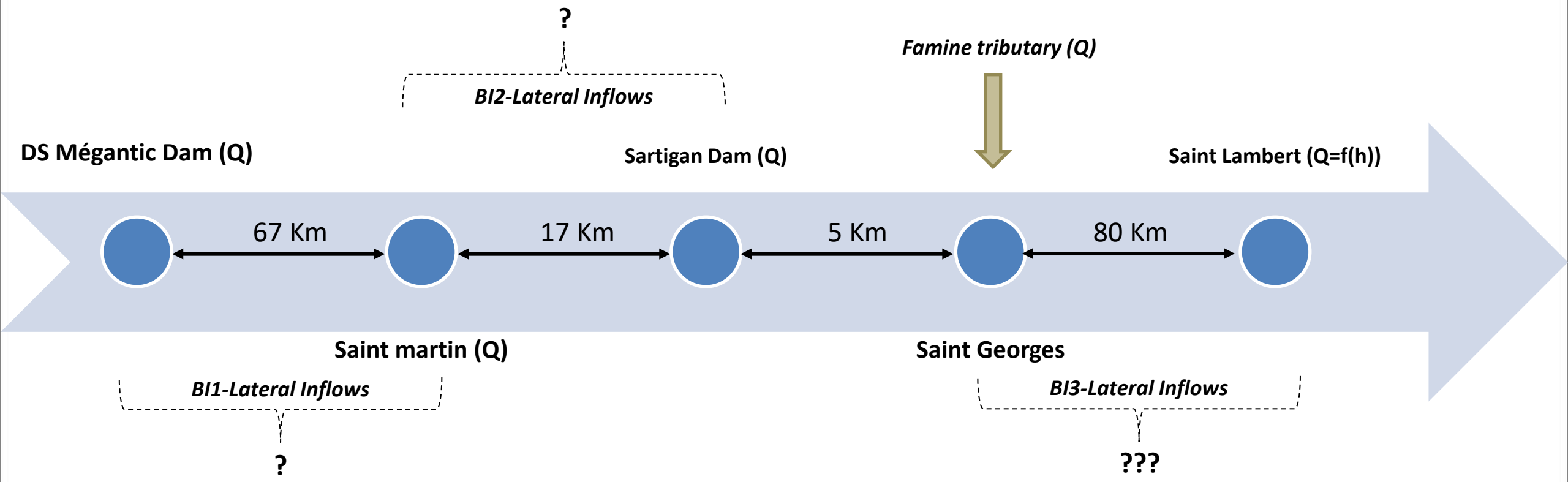
Director: F. Anctil

Co-Director: P. Matte (ECCC)

Montreal – June 27, 2017

Simplified River Model



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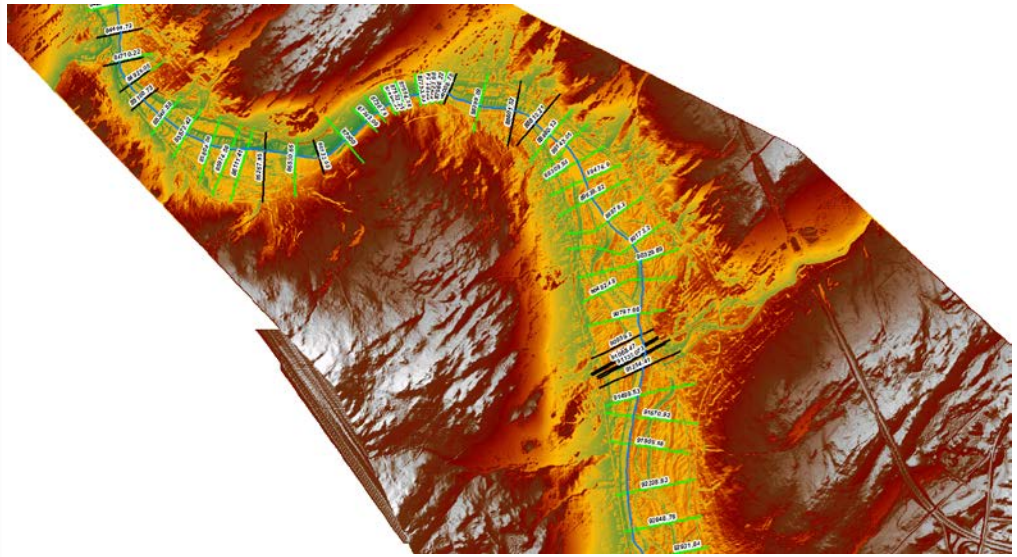
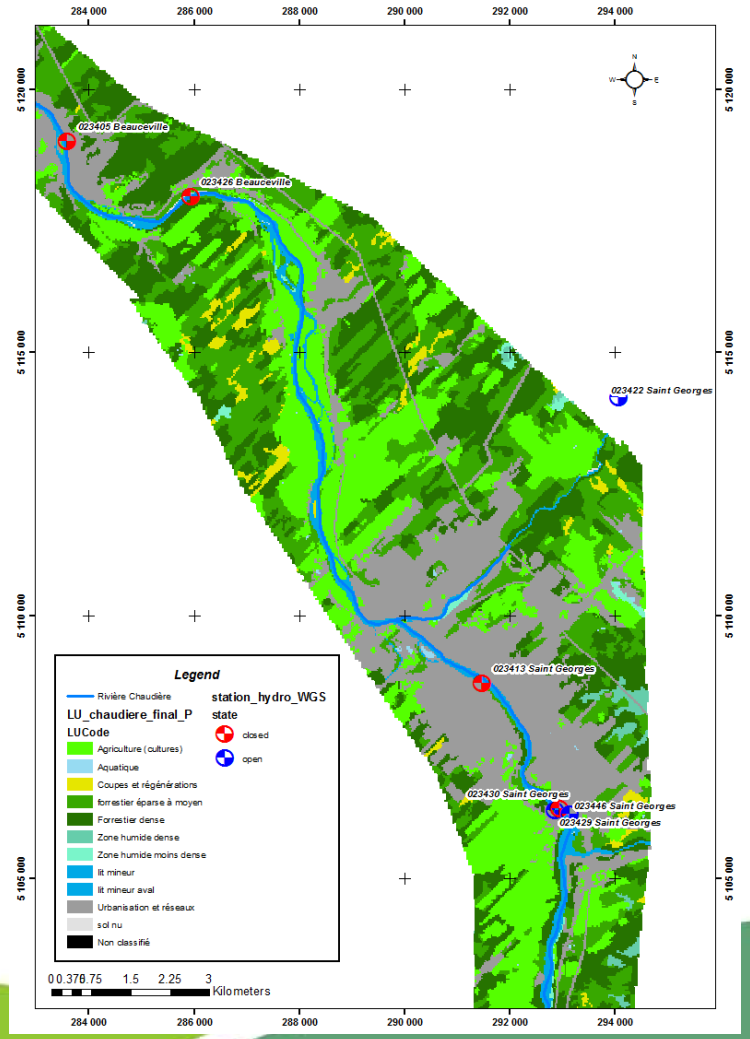
Physical Model

Lidar & Bathymetric Data



LU Data



- Agricultural
- Urban
- Aquatic
- Cuts and regenerations
- sparse forest
- dense forest
- Wet area
- bare soil and moorland

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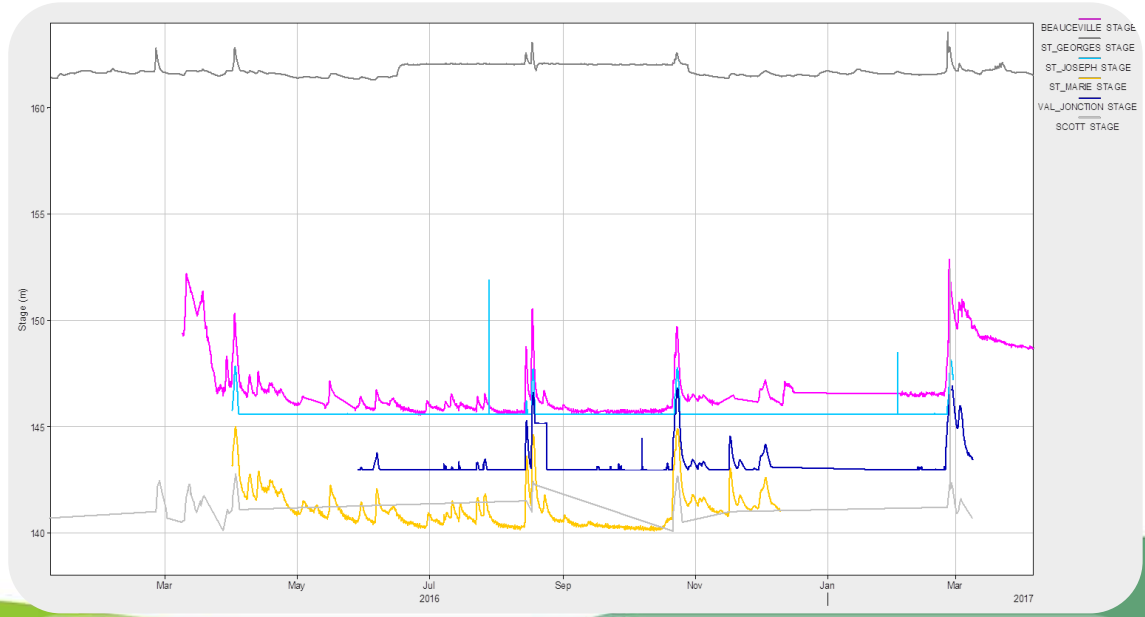
WL Data

Ste-Marie

Beauceville

- Cobaric's River Survey System (2016)
  - St-Georges
  - Beauceville
  - St-Joseph
  - Vallée Jonction
  - Ste-Marie
  - Scott

Vallée Jonction



WL-Obs series

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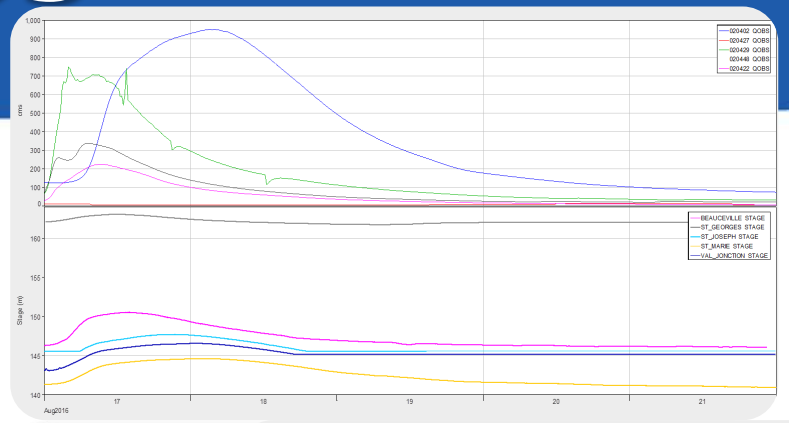
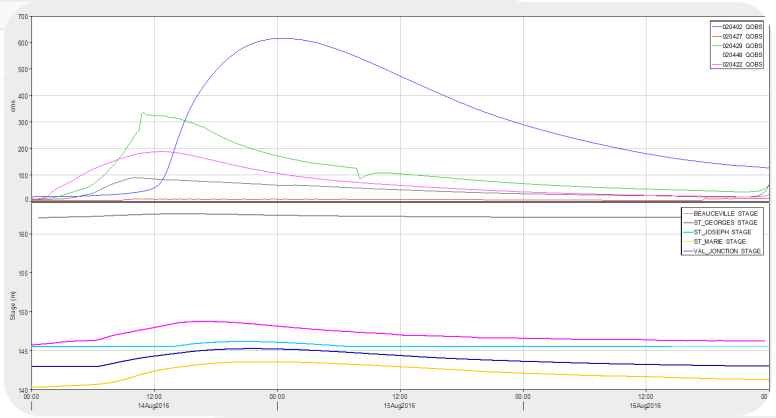
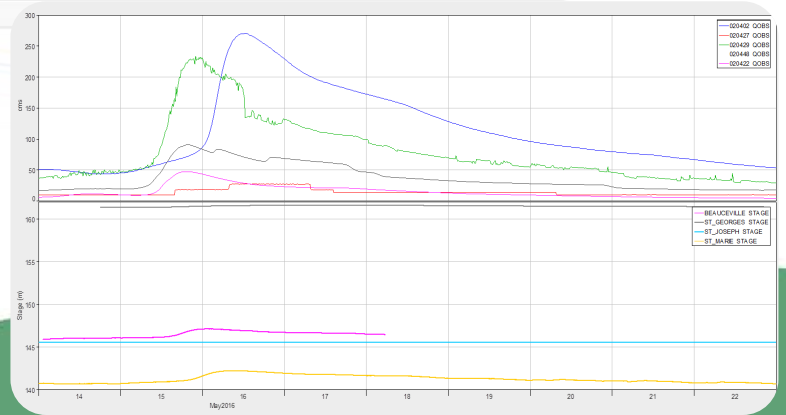
Analysis Scenarios

- **3 events**
  - High flow 17-21 Août 2016 (SCN1)
  - Moderate flow 14-16 Août 2016 (SCN2)
  - Low flow 14-22 Mai 2016 (SCN3)

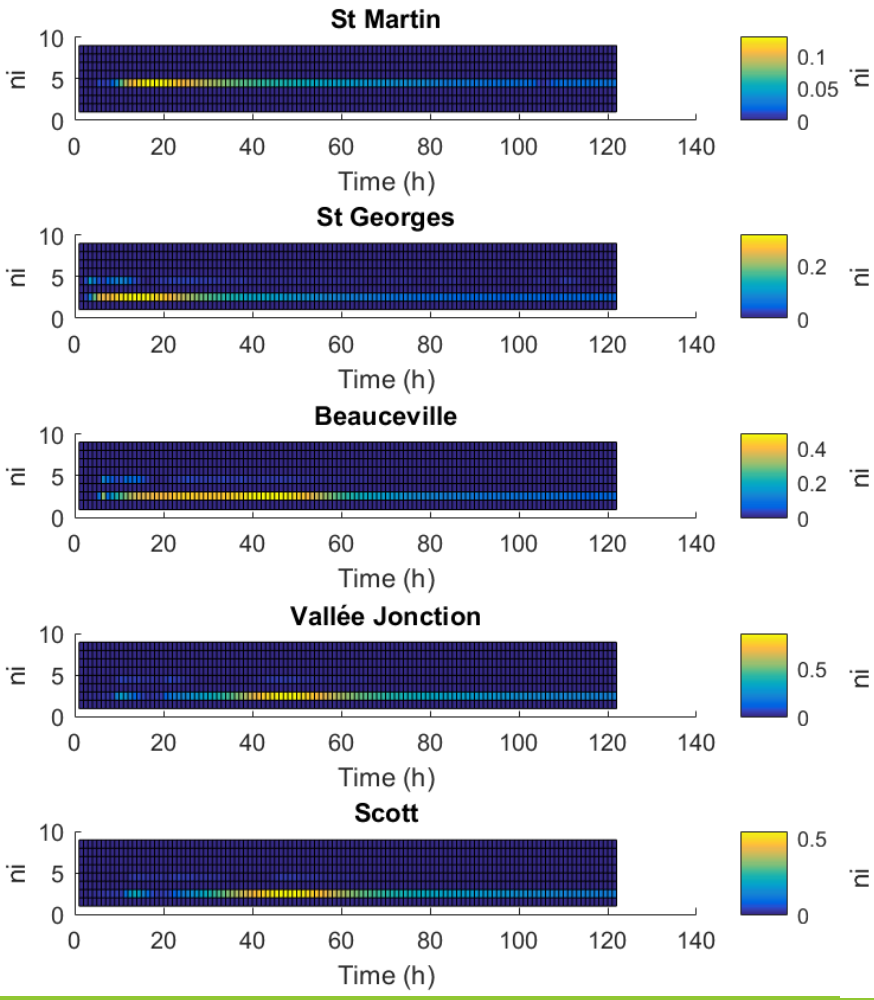




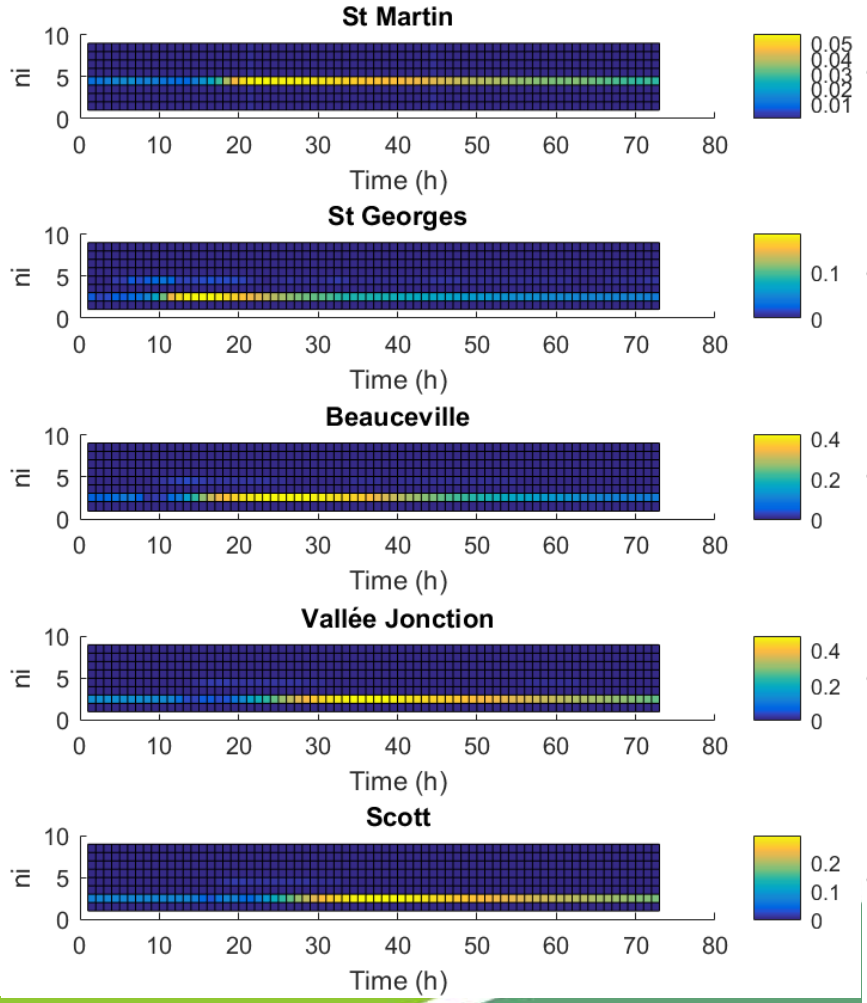


Sensitivity Analysis - Roughness

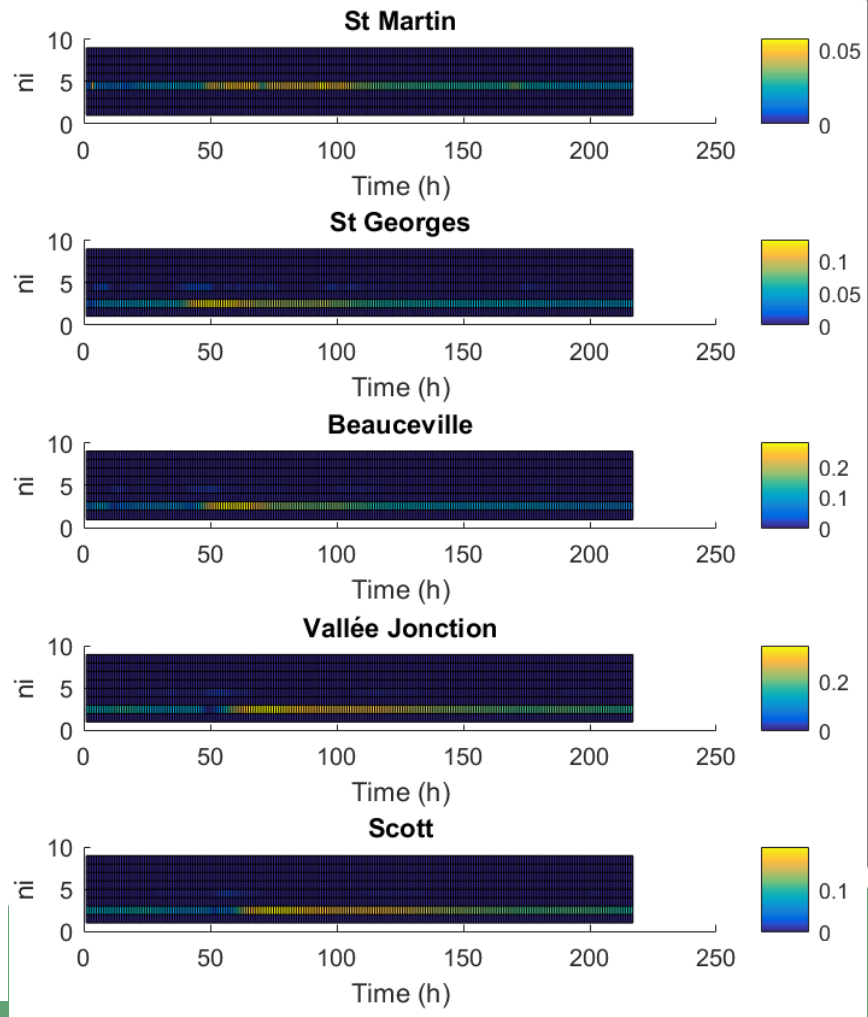
SCN1



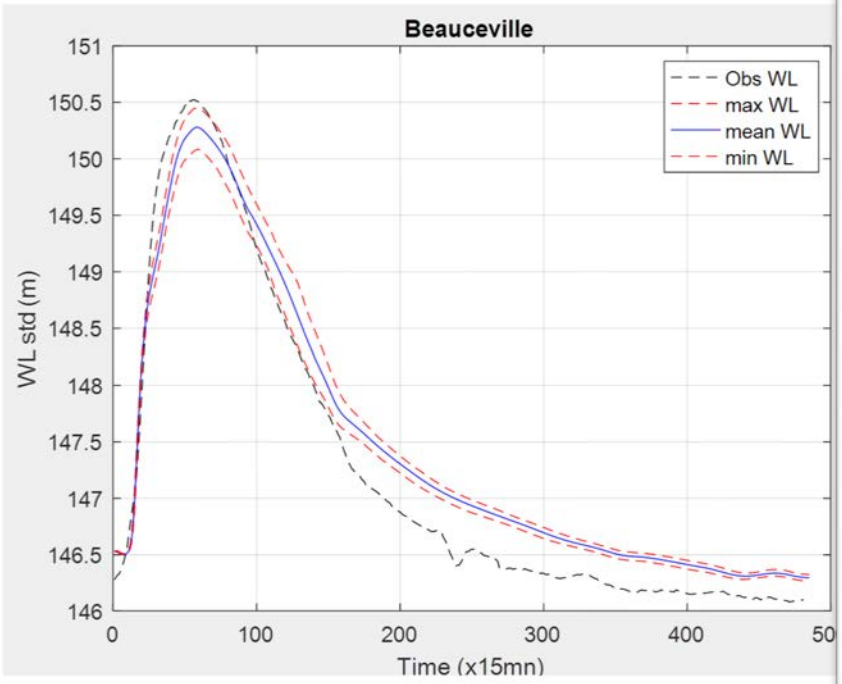
SCN2

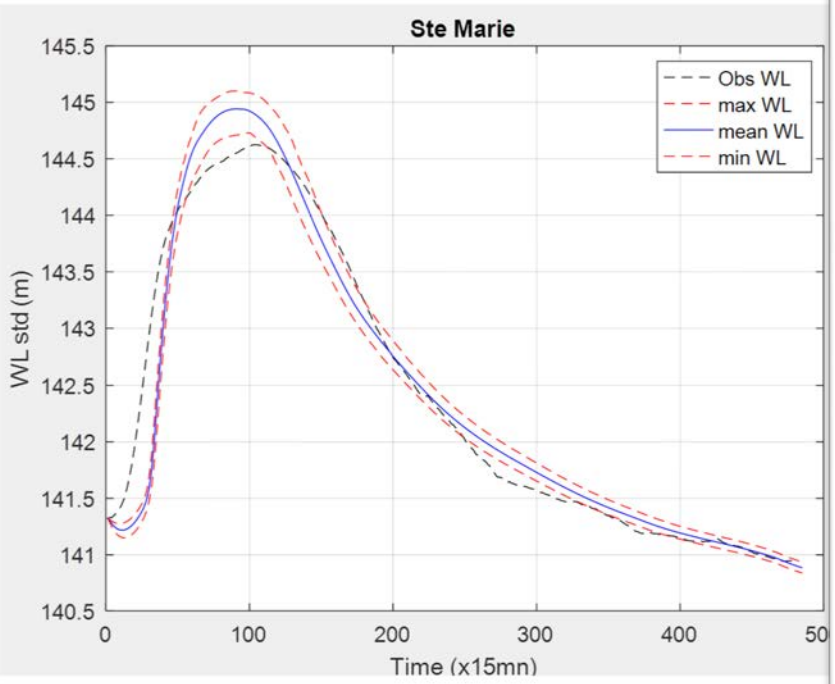


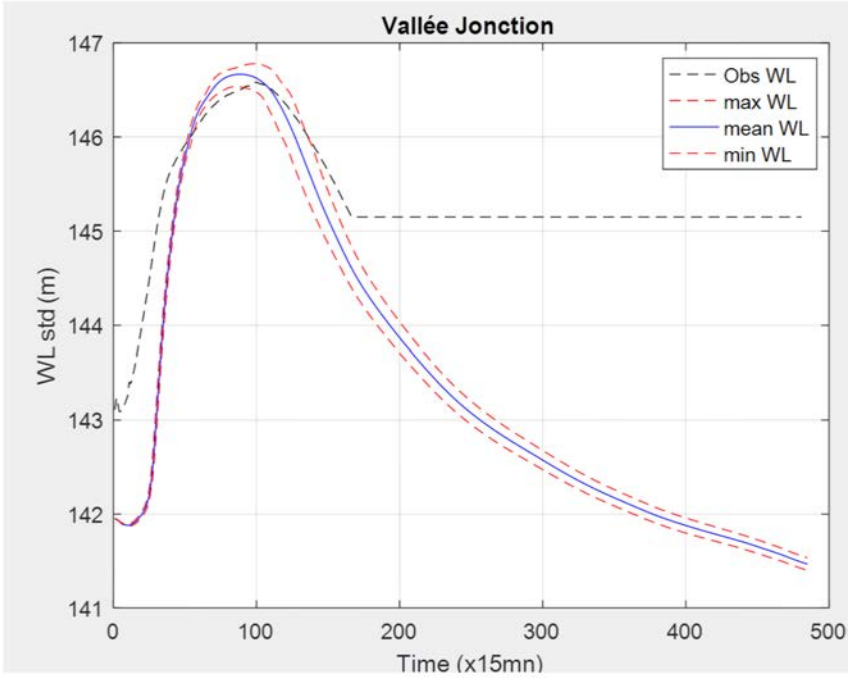
SCN3



Classic Calibration n_2 & n_4







SCN1

	BEAUCEVILLE	ST-GEORGES	ST-JOSEPH	ST-MARIE	VAL-JONCTION	ST-MARTIN
ME	-0.15	-0.02	-0.09	0.07	0.12	-2.16
MAE	0.26	0.16	0.18	0.14	0.29	10.99
RMSE	0.29	0.19	0.21	0.23	0.42	20.33
NS	0.96	0.80	0.89	0.97	0.29	0.95

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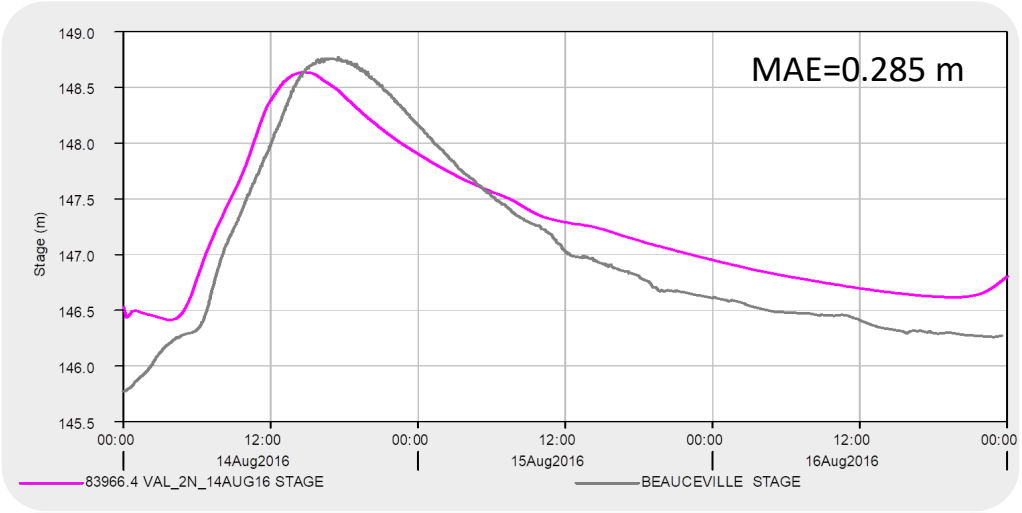
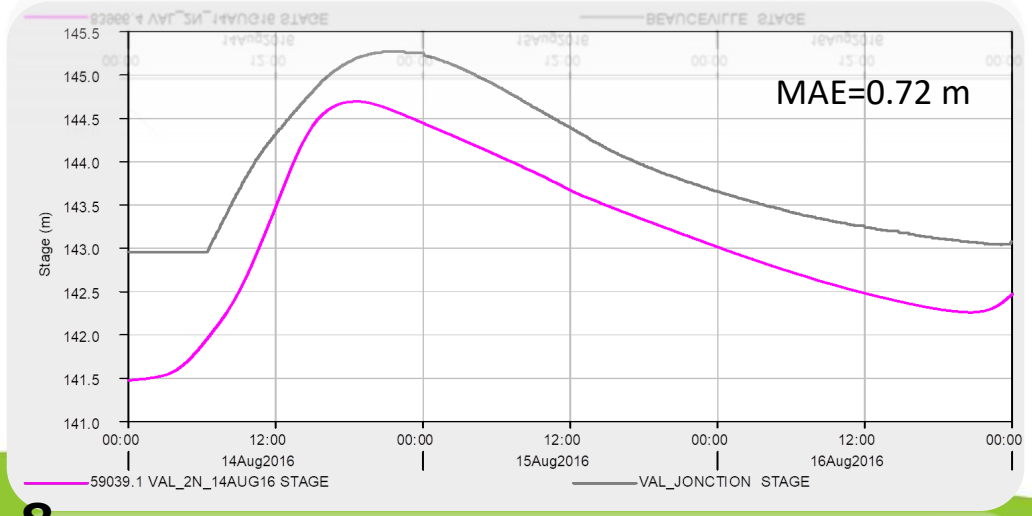
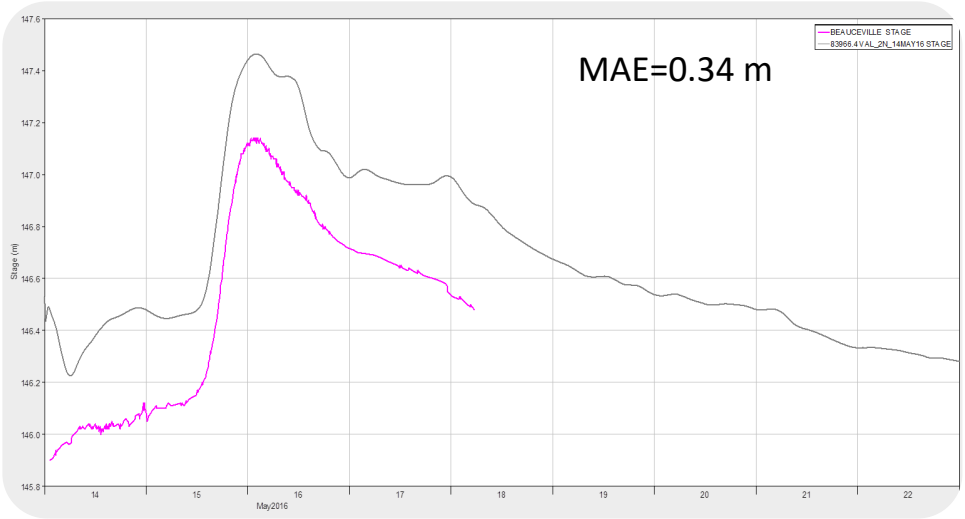
Classic Calibration n_2 & n_4

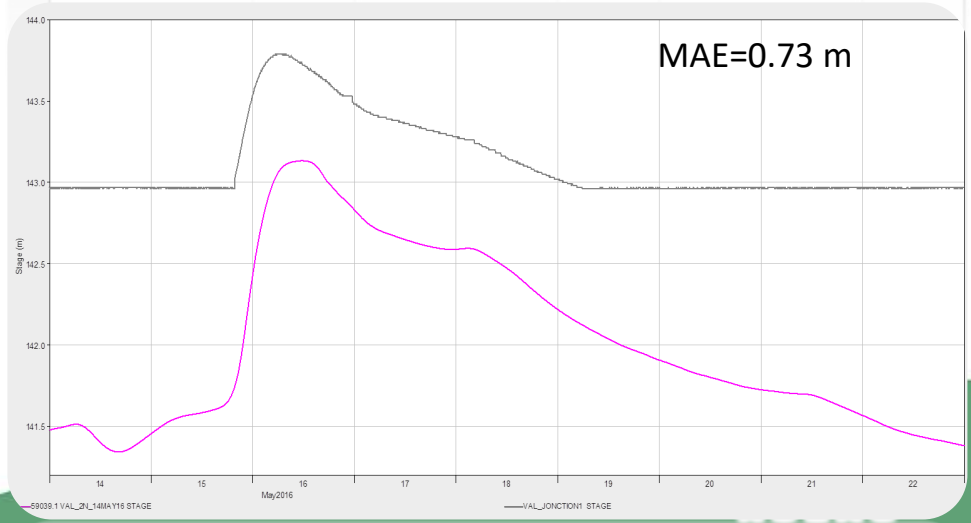
SCN2



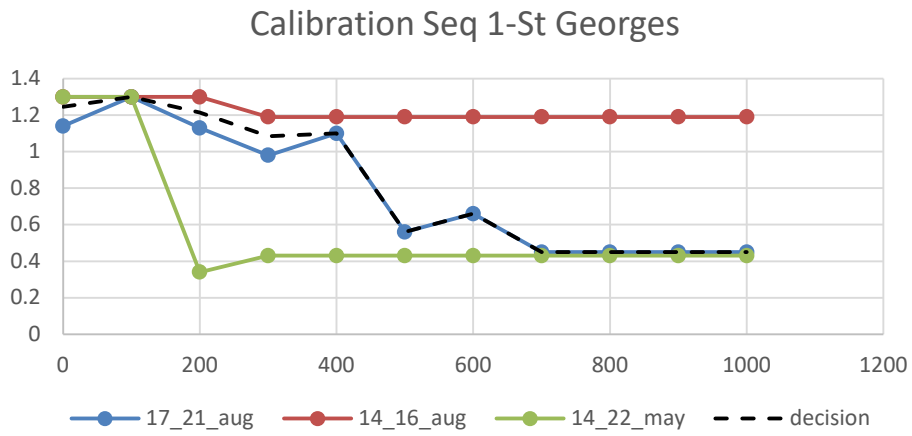


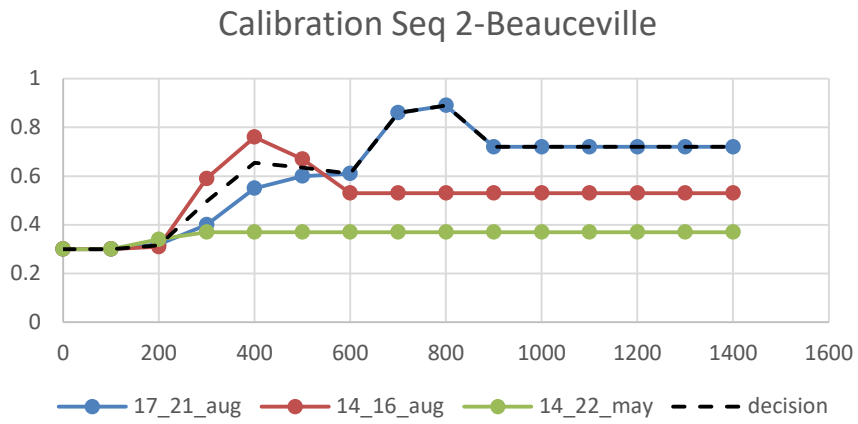
SCN3

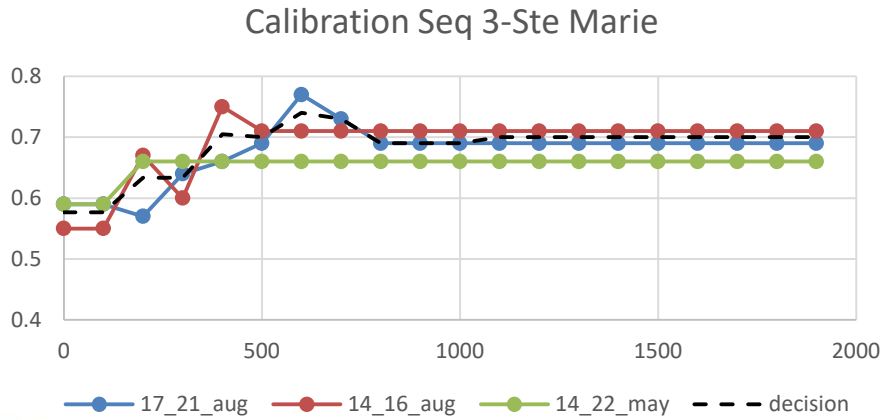




Dynamic Calibration n=f(Q)







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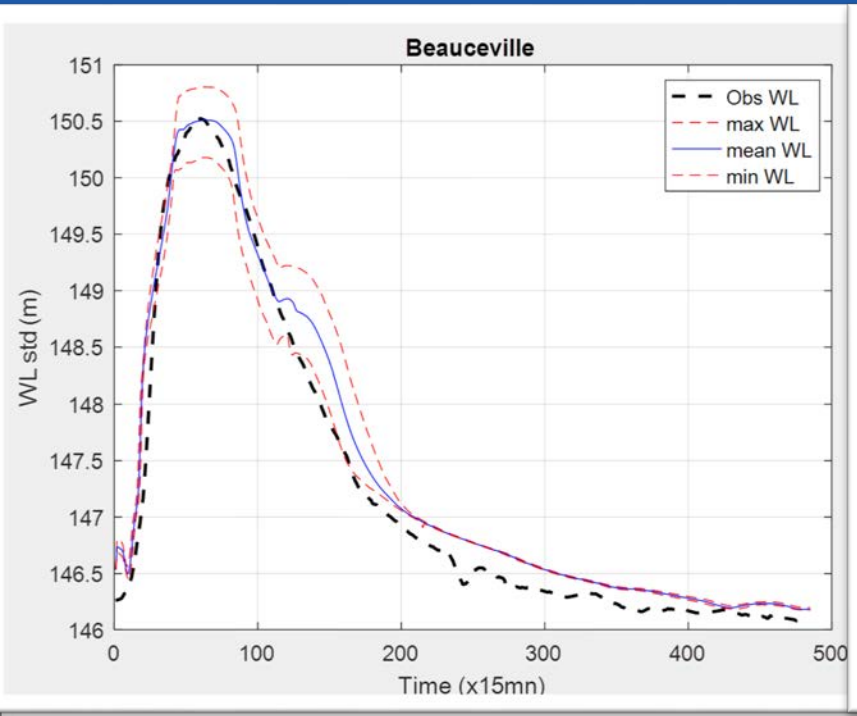
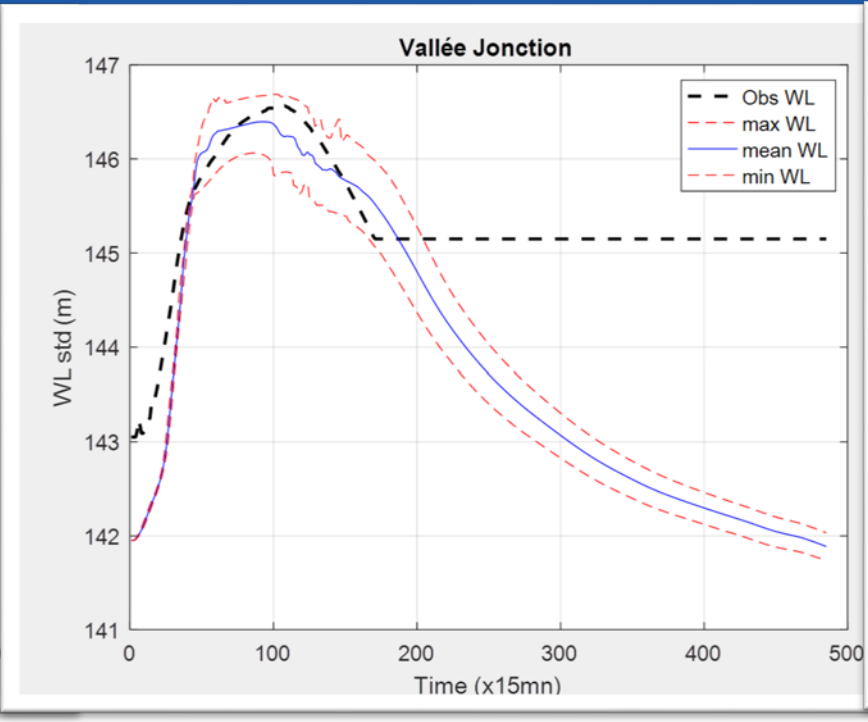
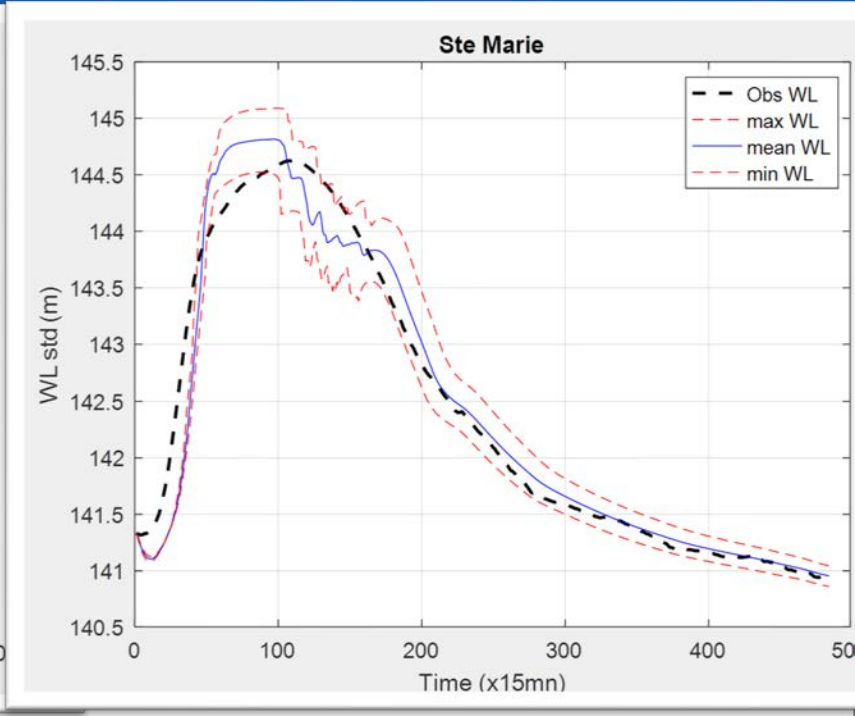
Dynamic Calibration n=f(Q)







	BEAUCEVILLE	ST-GEORGES	ST-JOSEPH	ST-MARIE	VAL-JONCTION	ST-MARTIN
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MAE	0.26	0.16	0.18	0.14	0.29	10.99
RMSE	0.29	0.19	0.21	0.23	0.42	20.33
NS	0.96	0.80	0.89	0.97	0.29	0.95

	BEAUCEVILLE	ST-GEORGES	ST-JOSEPH	ST-MARIE	VAL-JONCTION	ST-MARTIN
ME	-0.11	0.02	0.02	0.05	0.10	-2.83
MAE	0.18	0.08	0.25	0.14	0.22	6.92
RMSE	0.22	0.13	0.28	0.25	0.28	11.65
NS	0.98	0.91	0.80	0.96	0.67	0.98

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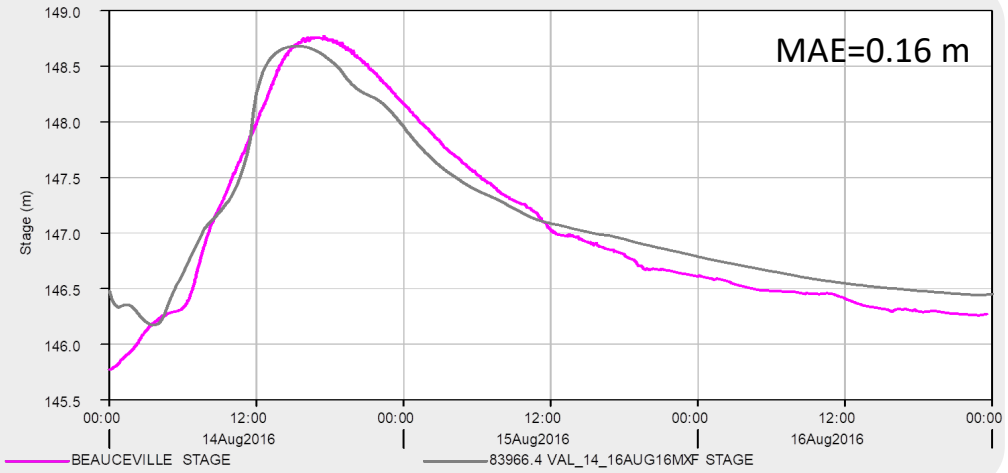
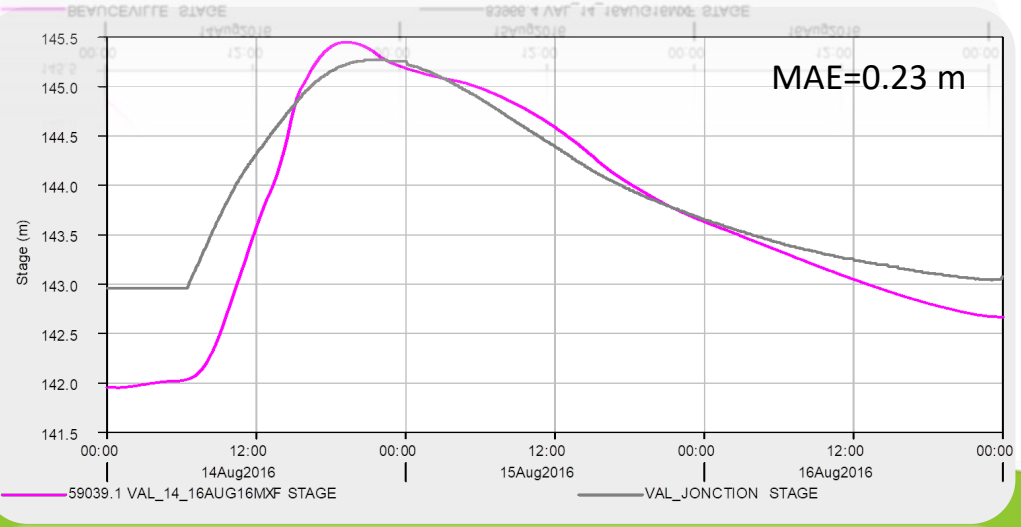
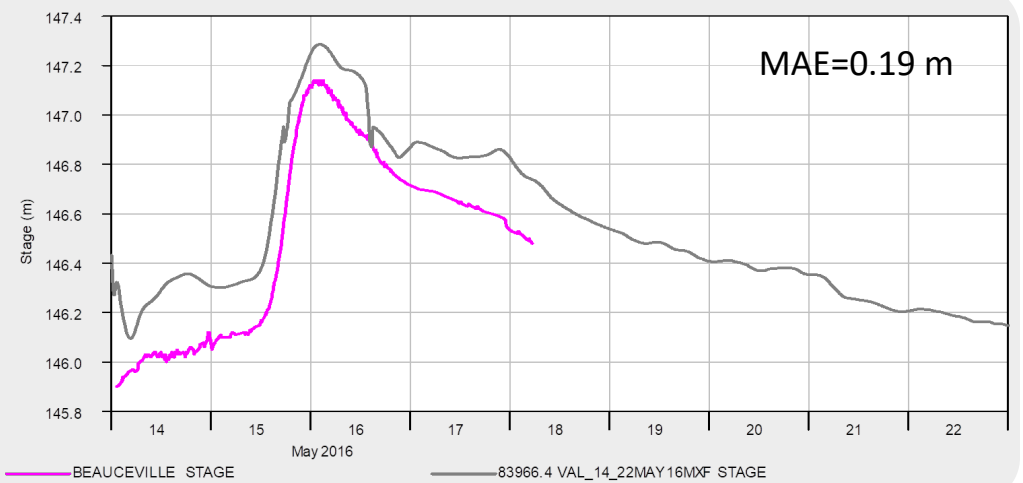
Dynamic Calibration n=f(Q)

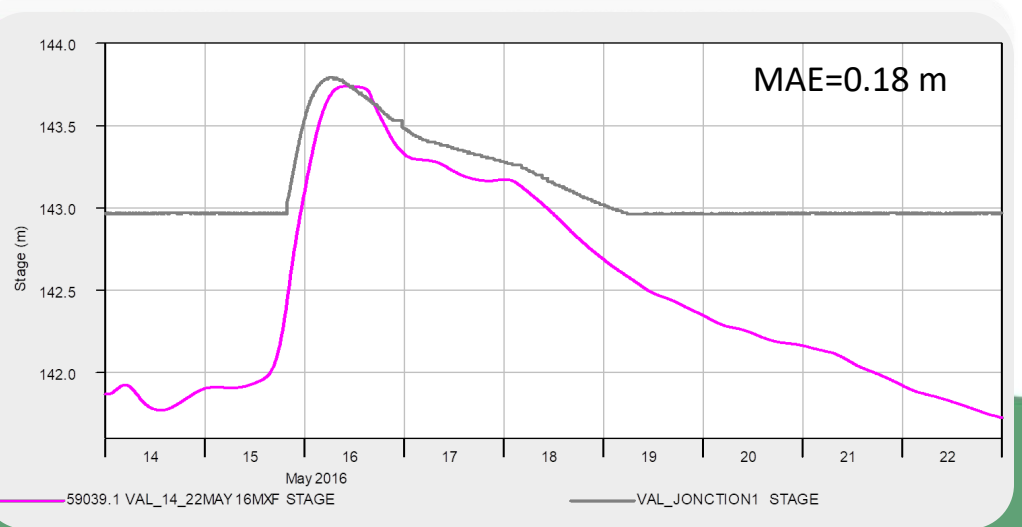
SCN2





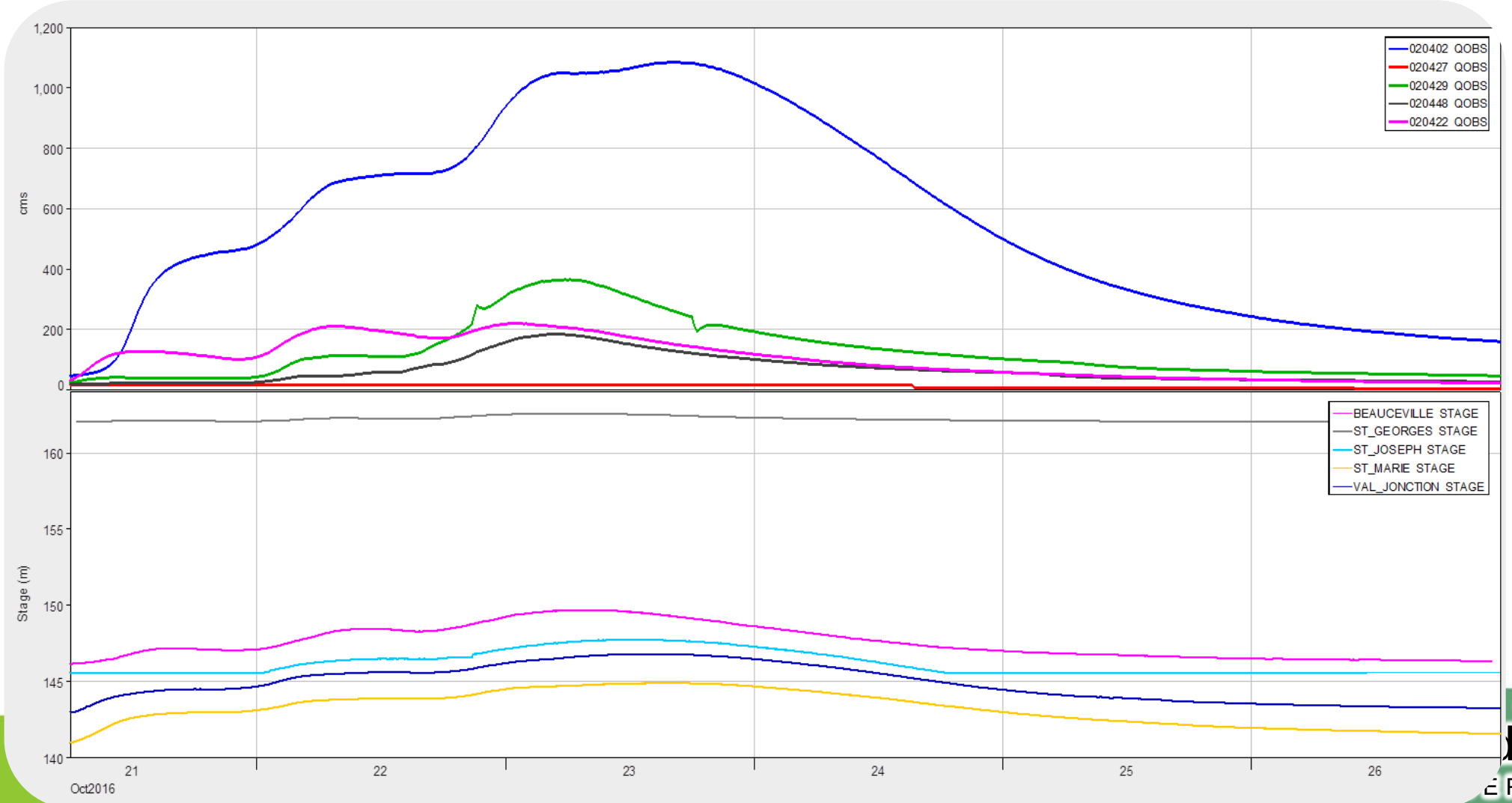
SCN3





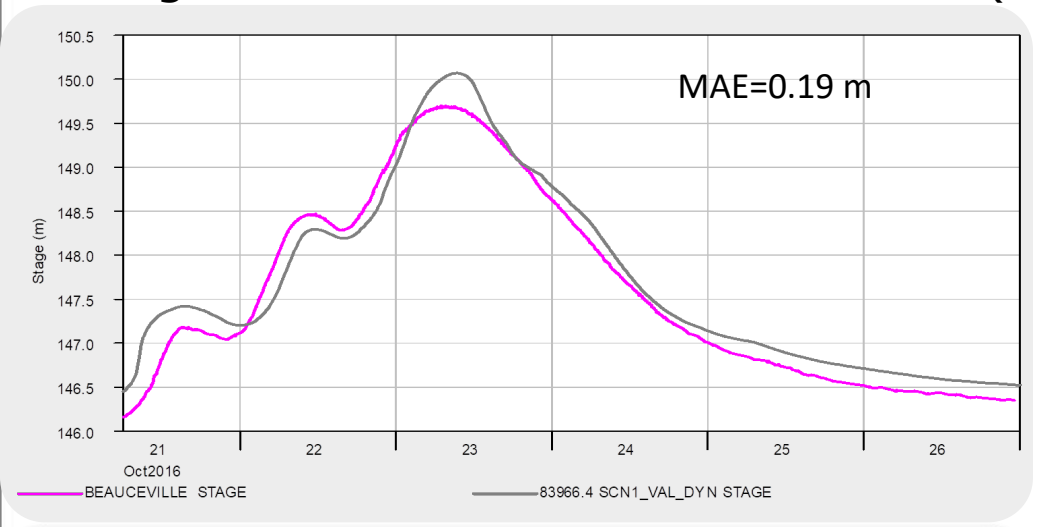
Validation Scenario

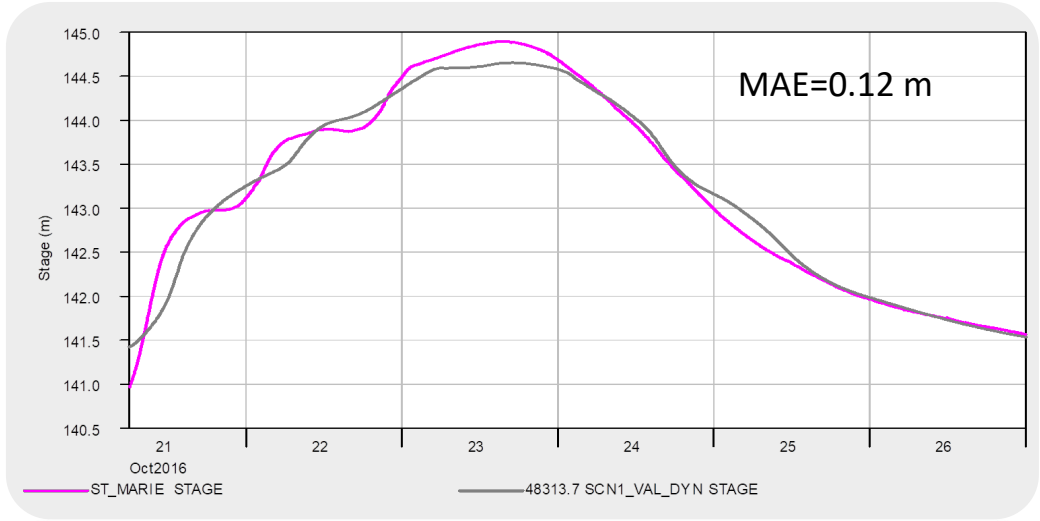
- High flow event 21-26 Octobre 2016 (SCN1)

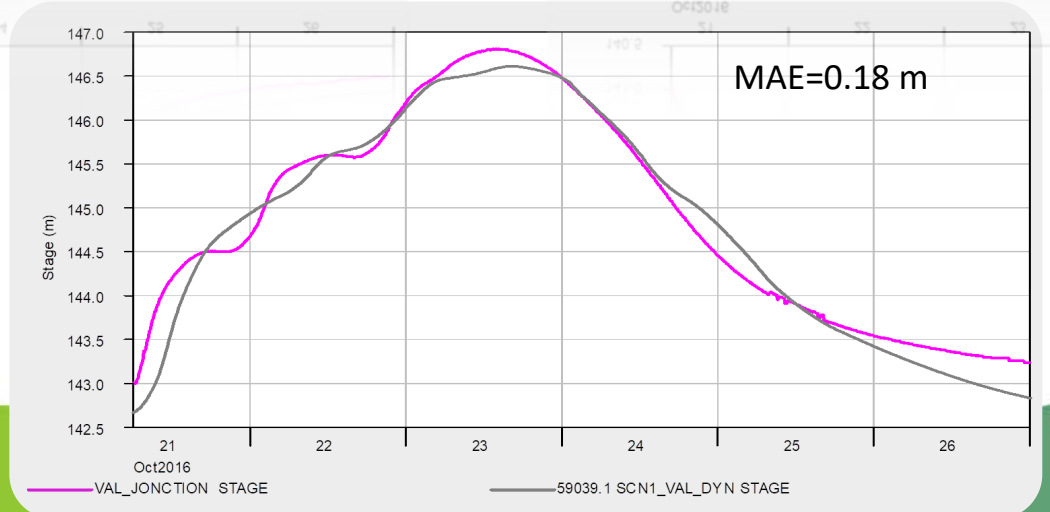


Validation Scenario

- High flow event 21-26 Octobre 2016 (SCN1)







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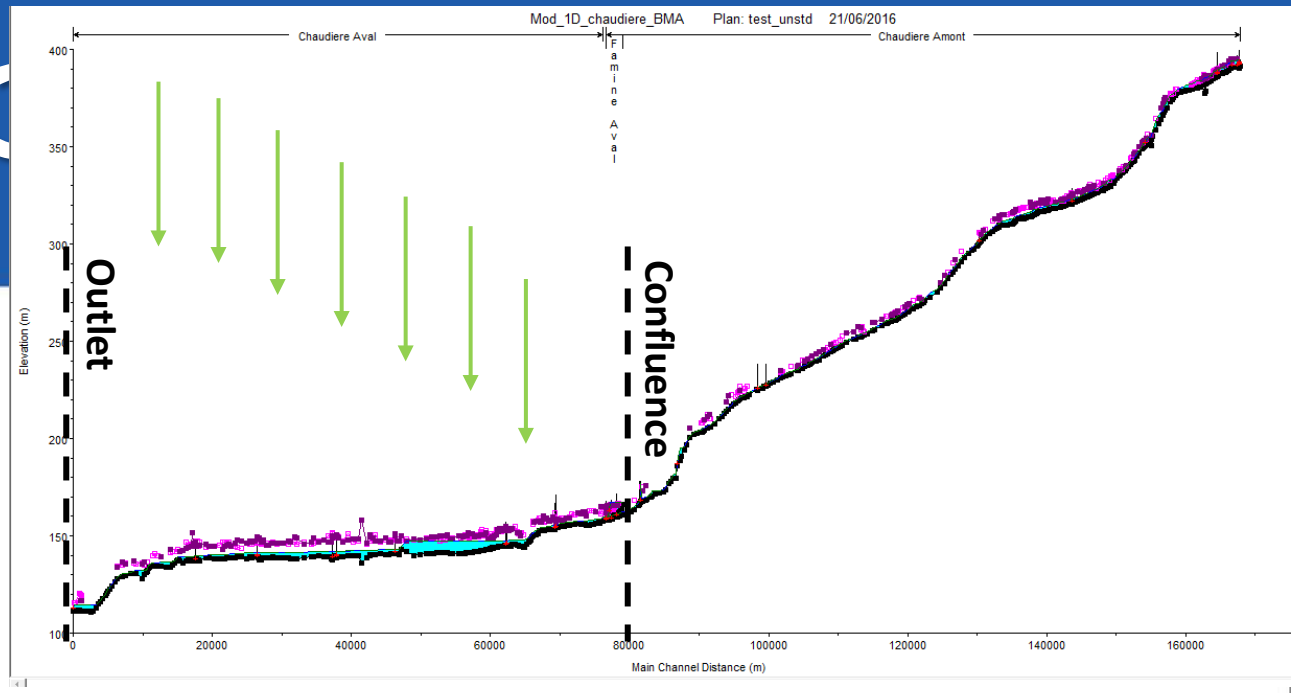
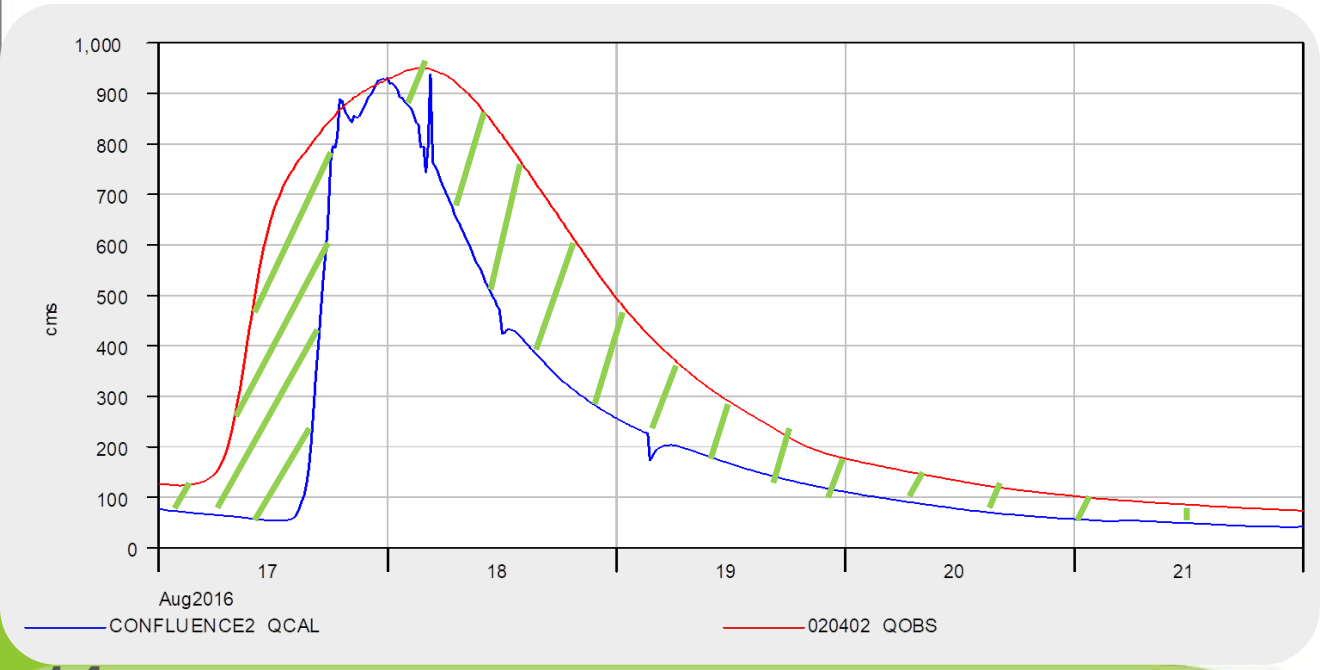
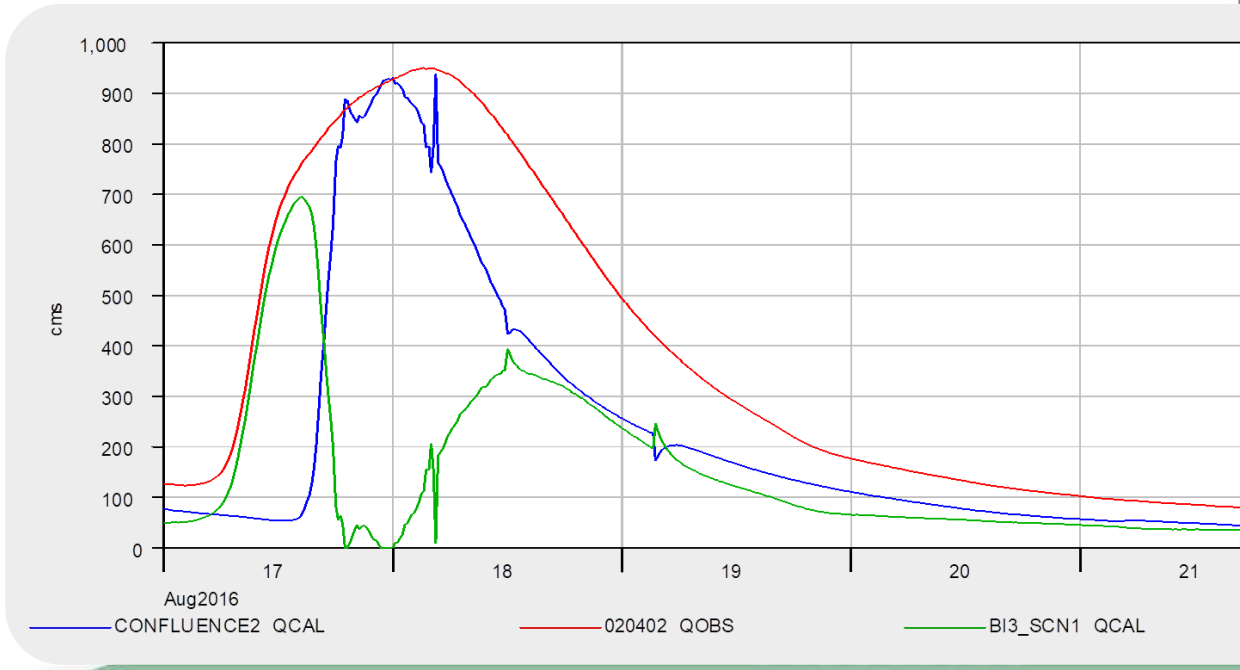
Lateral Inflow (BI

- Time travel
- Routing
- Volume control

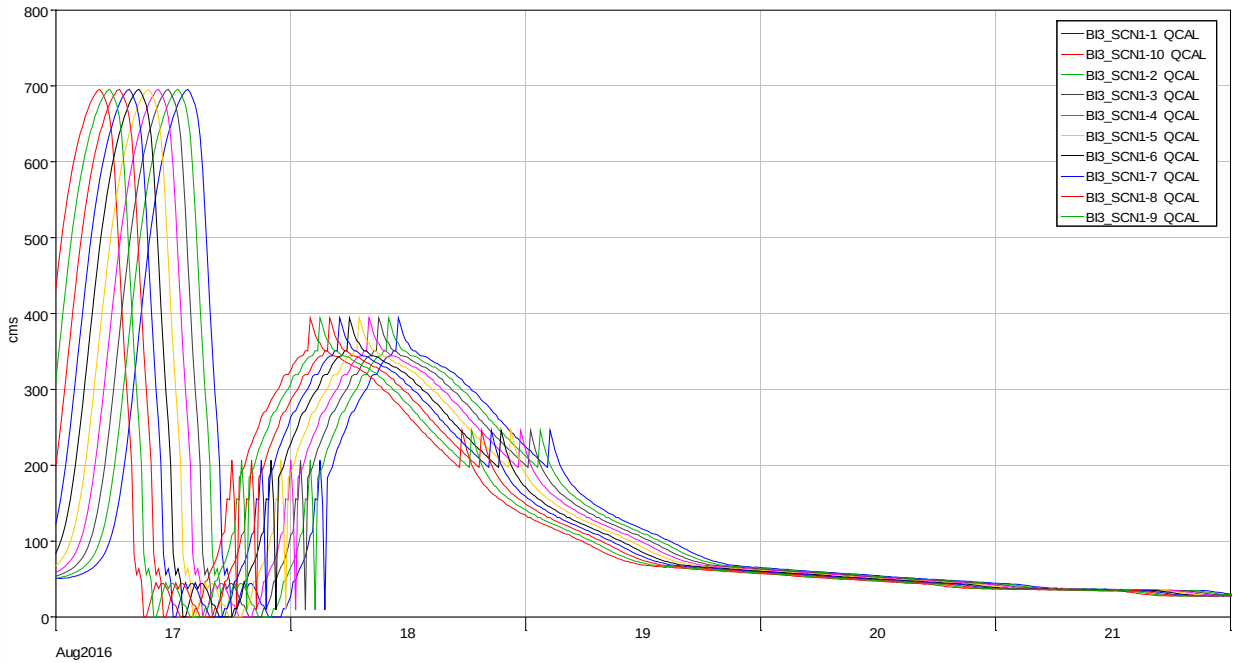




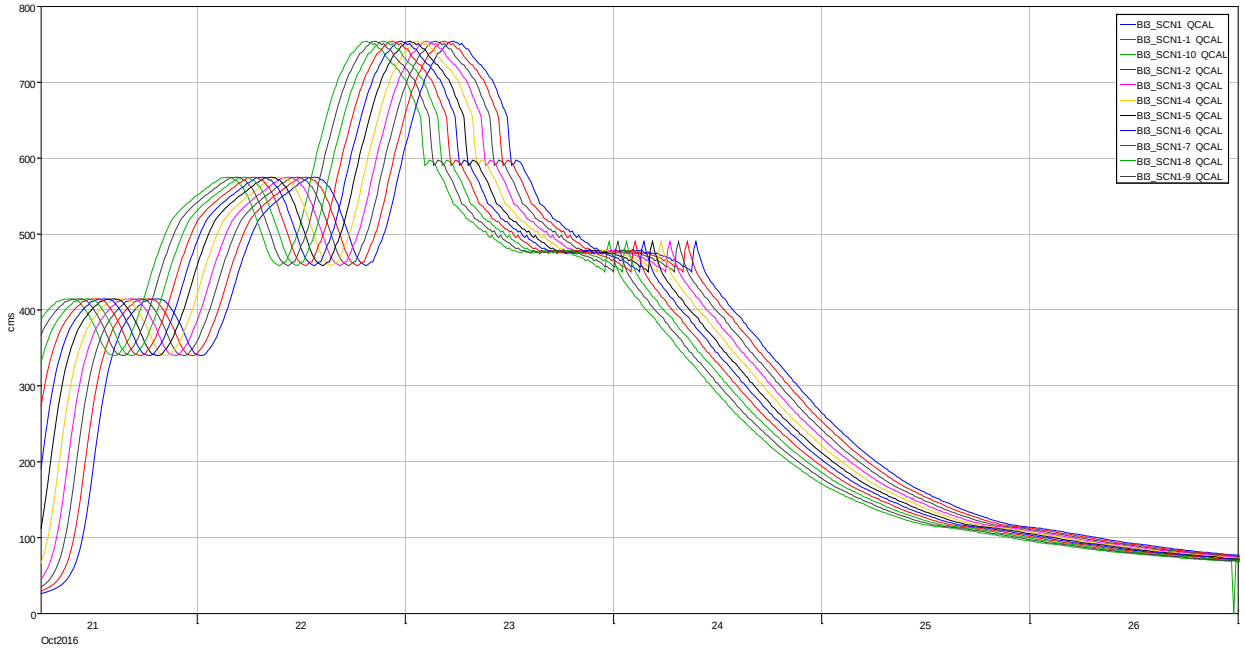


Lateral Inflow (BI3)

- Lateral Inflow Ensembles for BI3



SCN1-Calibration



SCN1-Validation

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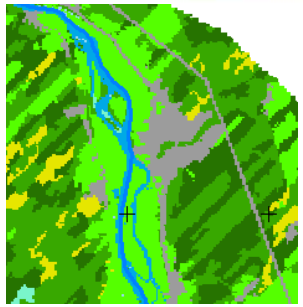
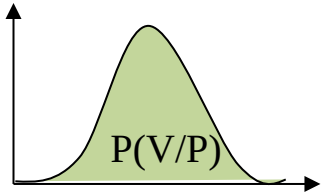
Parametric uncertainty analysis – Roughness & Lateral Inflows (BI3)

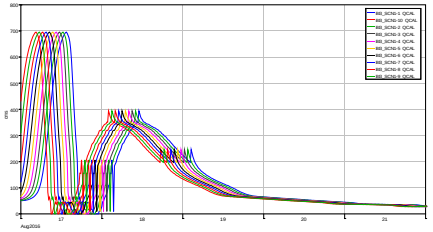


n Roughness coef. Values

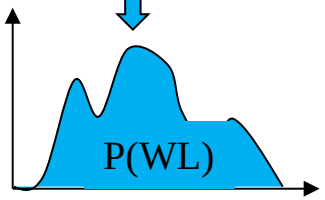


Ensemble generation [IC95%=+/-10% n-cal]

Hydraulic model (HM)



m LI hydrographs for BI3



WL Ensemble

Performance Calculations

(ME,MAE, RMSE, NS)

Observations WL/Q

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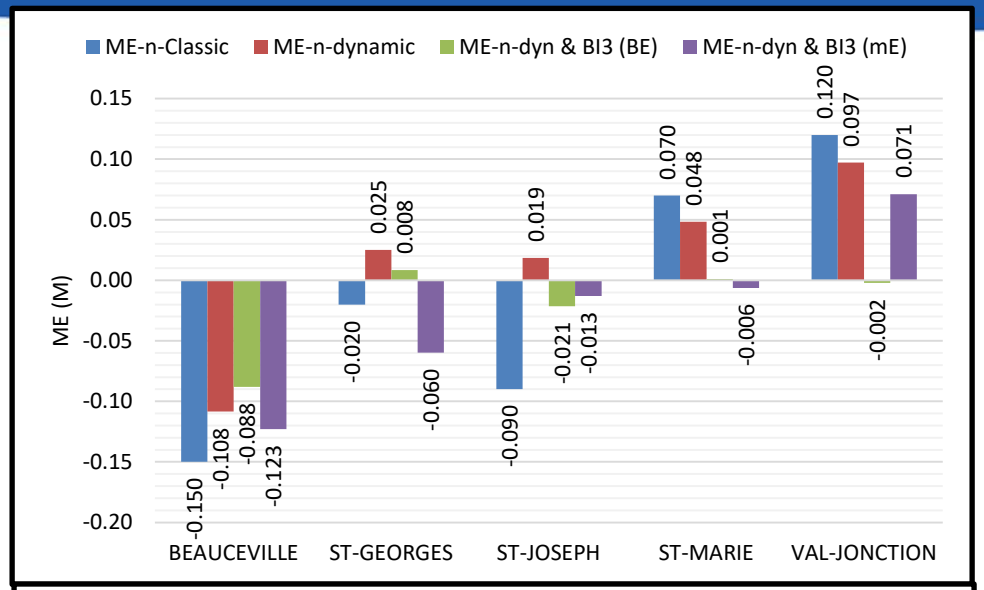
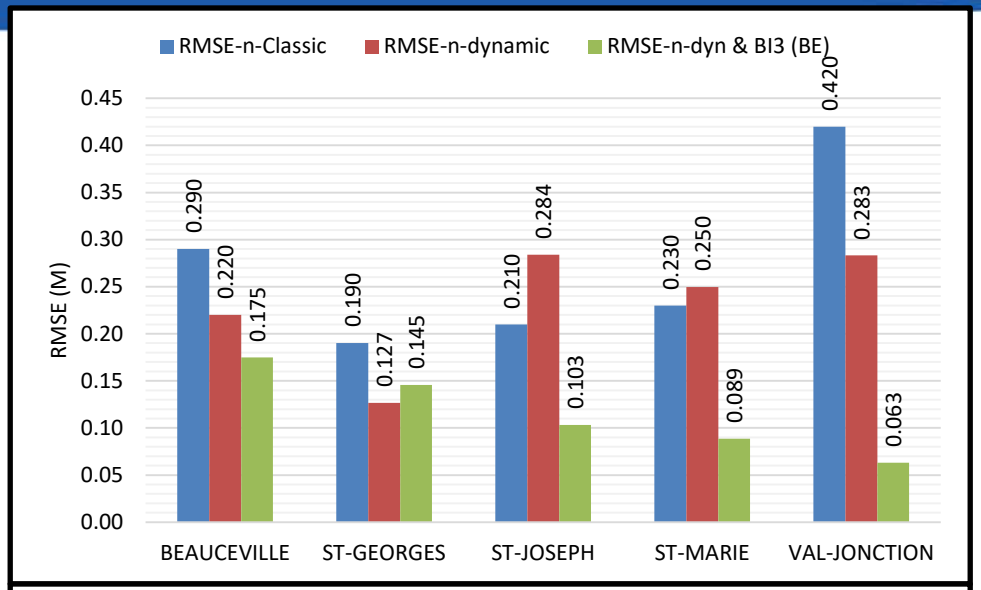
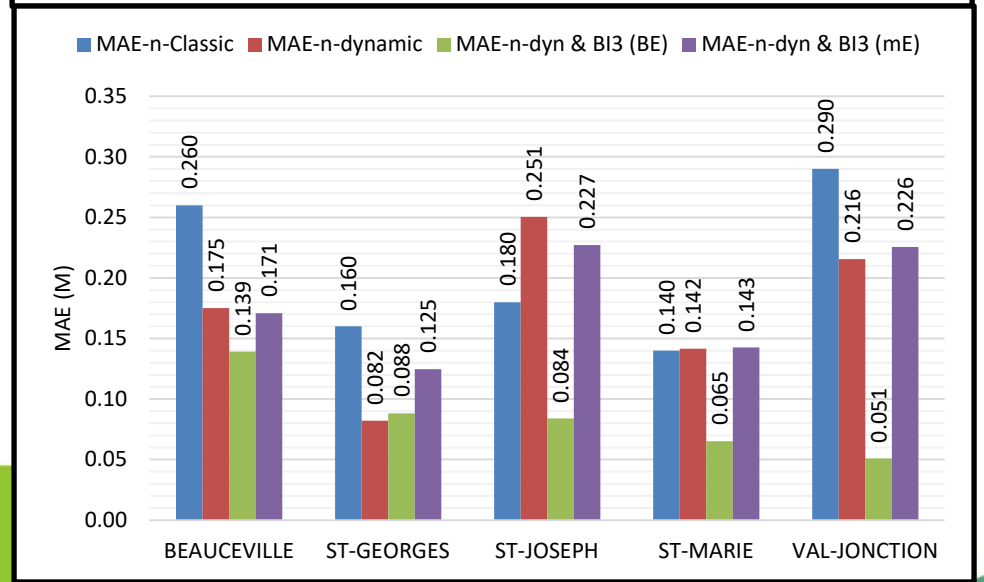
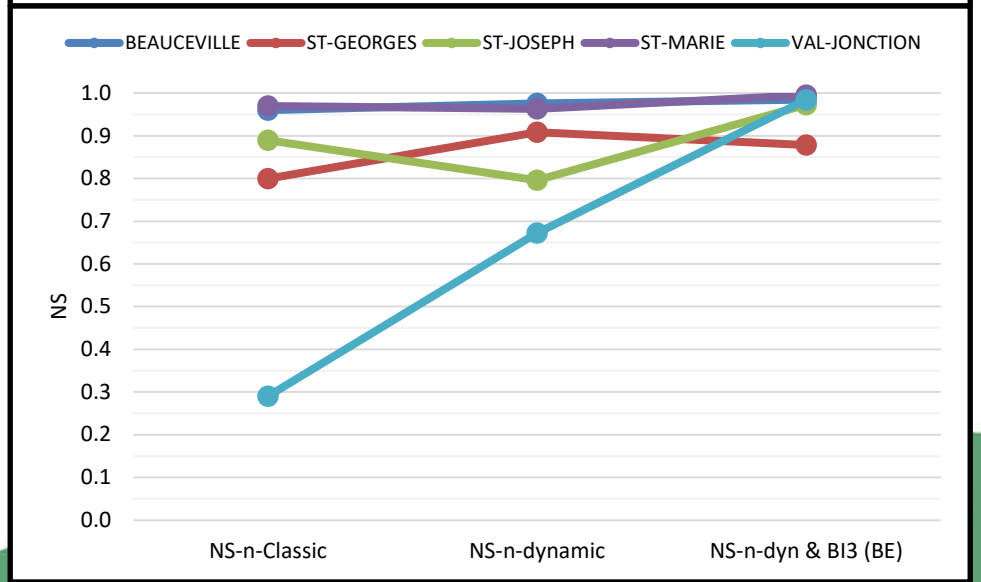
Parametric uncertainty analysis – Roughness & Lateral Inflows (BI3)

- SCN1-Cal



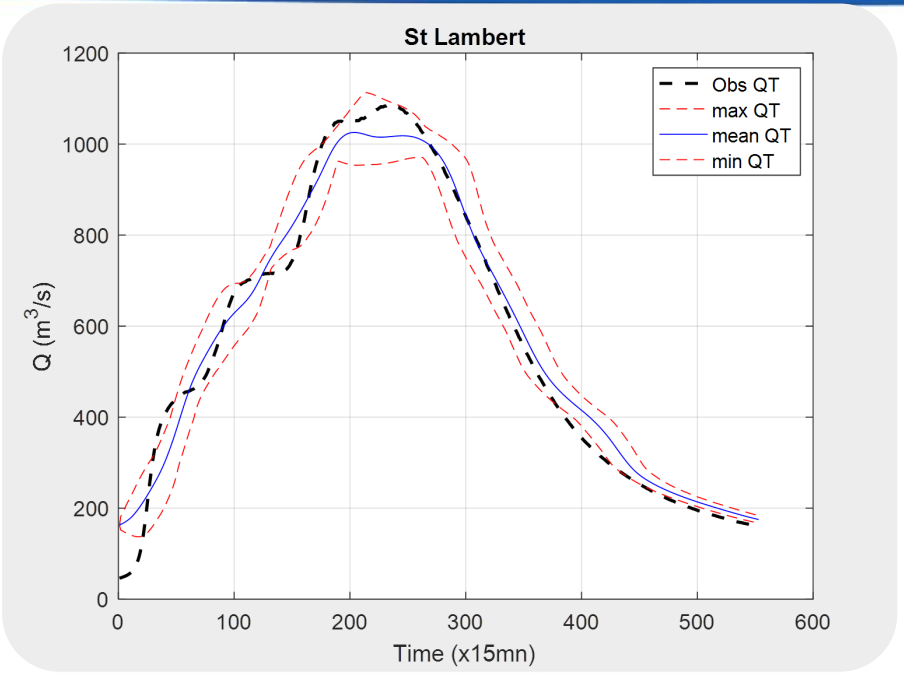


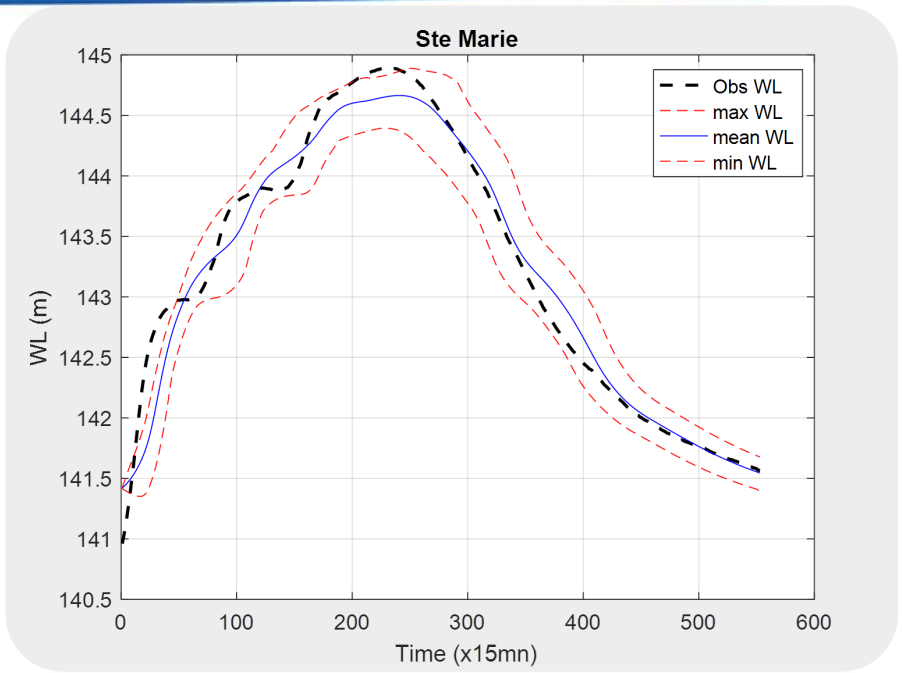




Parametric uncertainty analysis – Roughness & Lateral Inflows (BI3)

- SCN1-Validation





		WL (m)				Q (cms)		
		BEAUCEVILLE	ST-JOSEPH	ST-MARIE	VAL-JONCTION	ST-LAMBERT	AVAL BGE. SARTIGAN	ST MARTIN
Best Ensemble	ME	-0.059	-0.001	-0.001	0.048	-1.694	-5.819	-3.973
	MAE	0.165	0.086	0.112	0.176	30.269	11.630	7.279
	RMSE	0.210	0.111	0.156	0.225	39.452	19.290	11.733
	NS	0.963	0.969	0.981	0.964	0.985	0.958	0.935
ME (MeanEns)		-0.125	0.027	0.026	0.071	-8.232	-5.581	-3.800
MAE (MeanEns)		0.213	0.172	0.170	0.234	42.397	12.196	7.749

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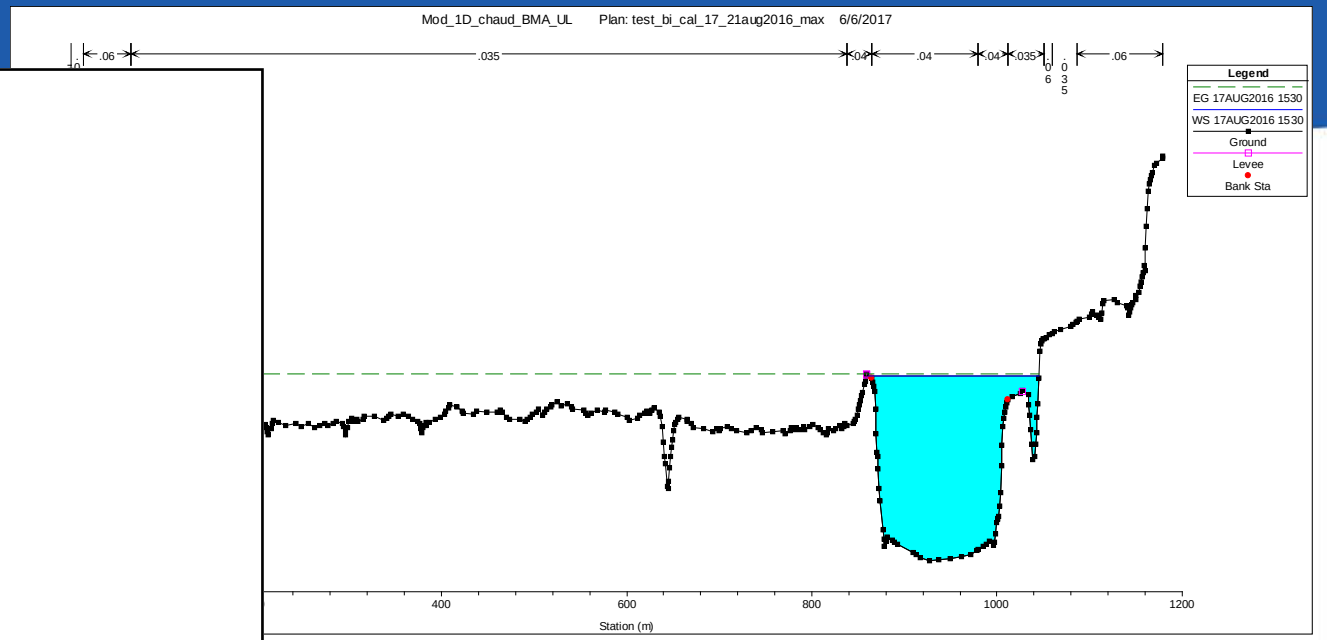
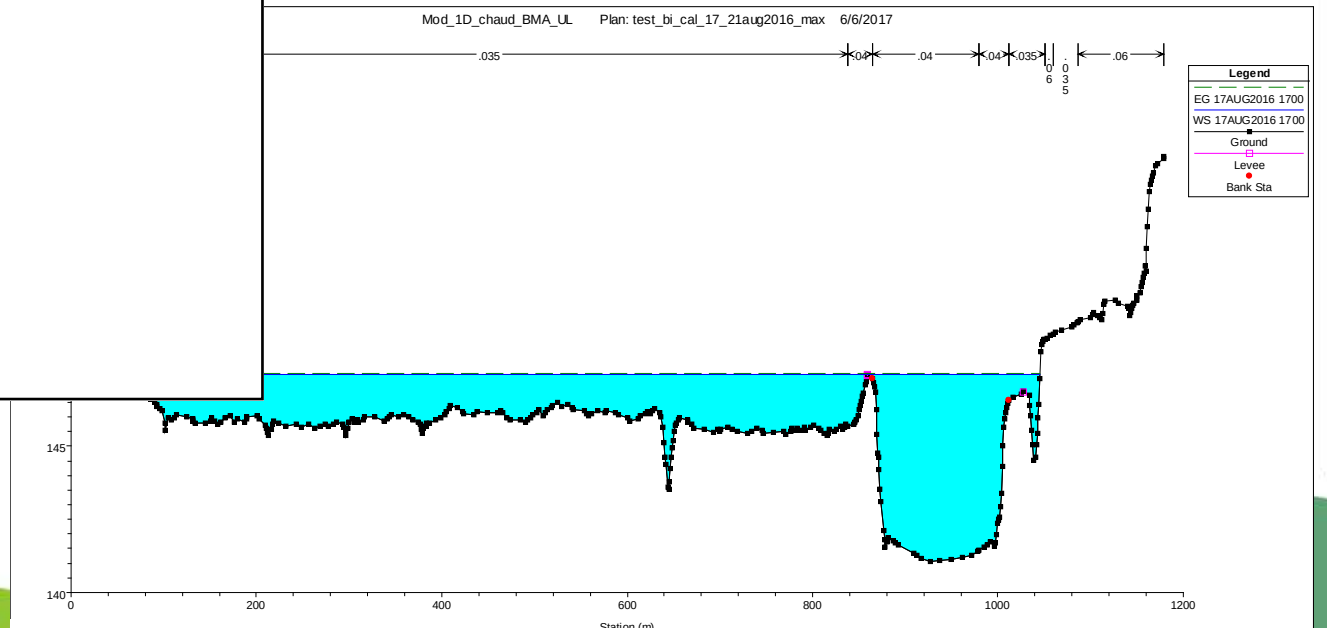
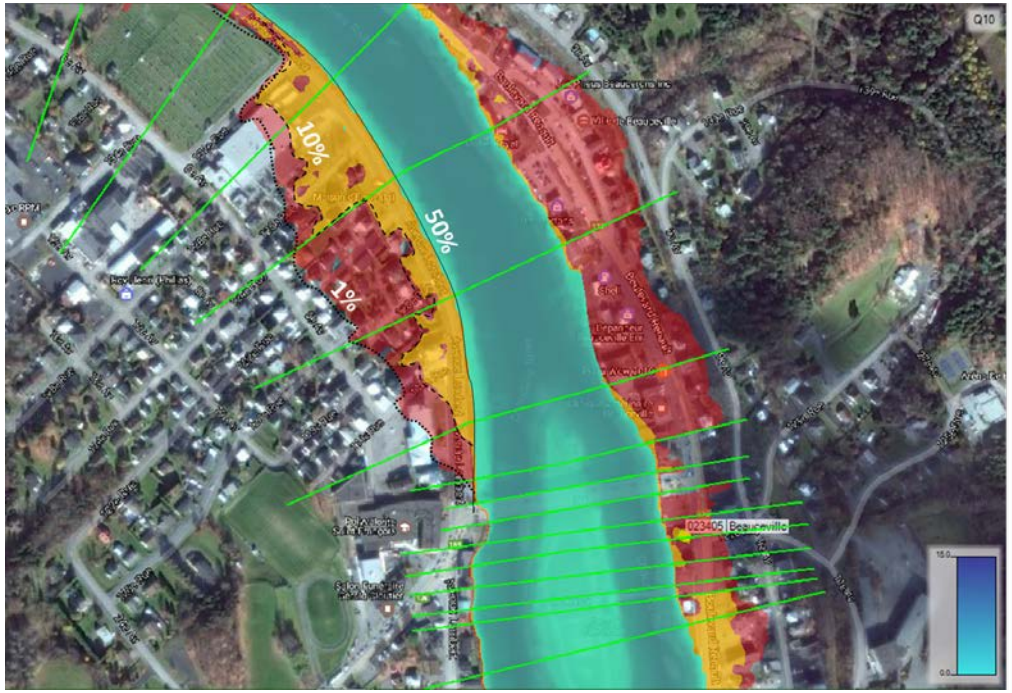
Some limitations





Conclusion

- 1D model calibrated & validated
- Parametric uncertainty (ensembles!) : Roughness & Lateral Inflows (BI3)
- Basic probabilistic approach for flood-mapping
- Working on 2D model to include structural uncertainty & improve flooding events results (maps)



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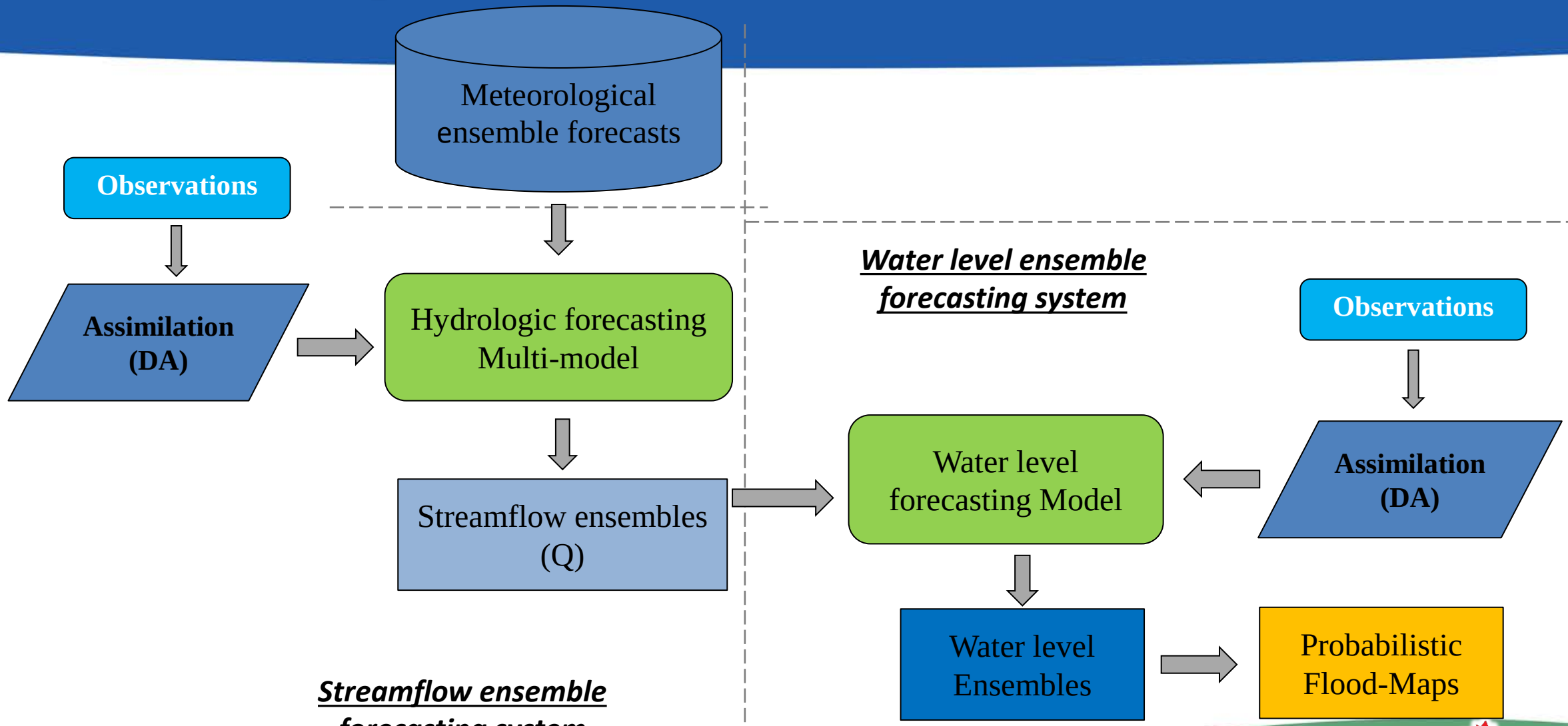
Next steps



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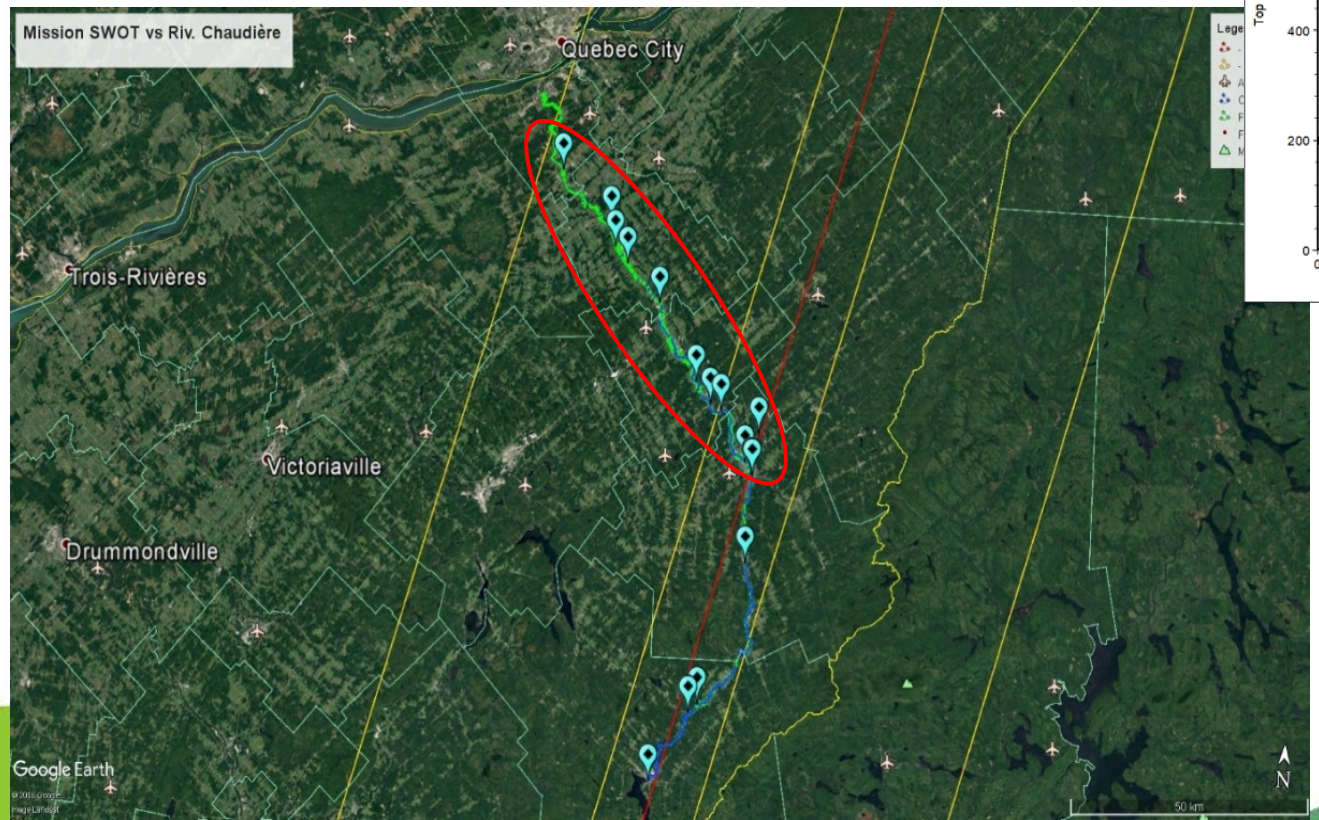
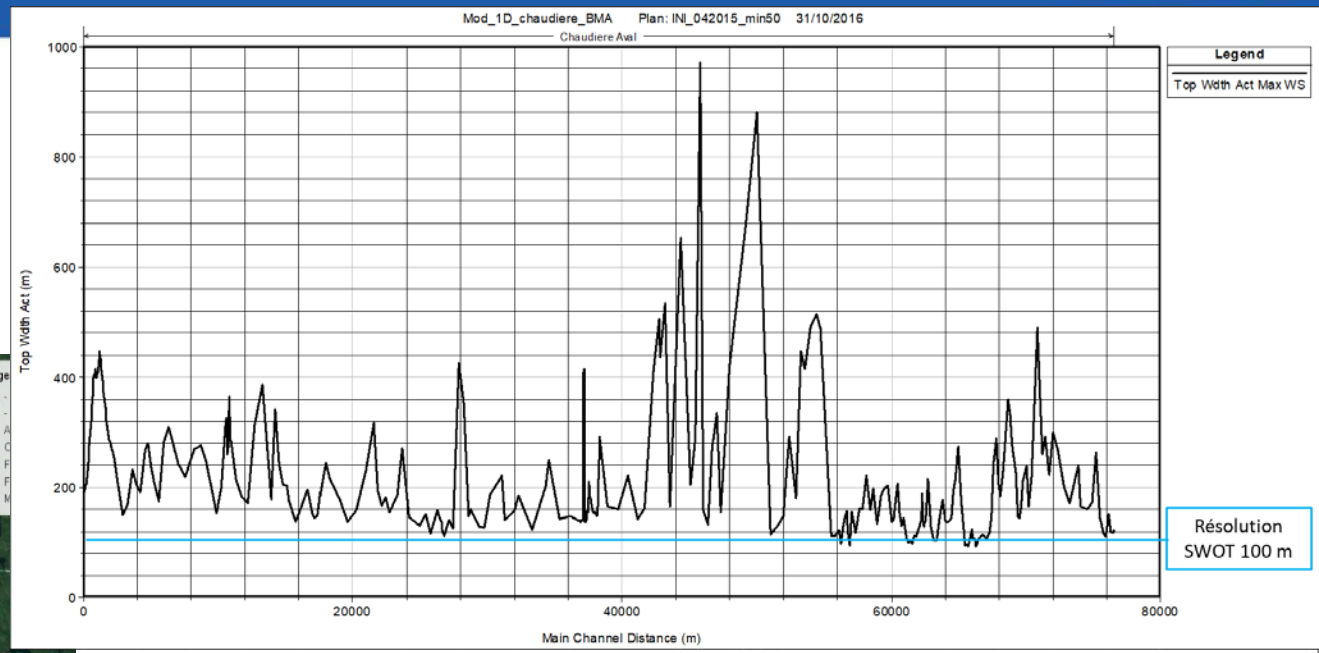
Satellite images for DA (SWOT)

- Spatial distribution
- Depends on image and DEM resolution
- Projet SWOT (2021) orbit covers the DS segment
- Collaboration with ECCC to access the simulator





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