

Exploring Confluence Runs

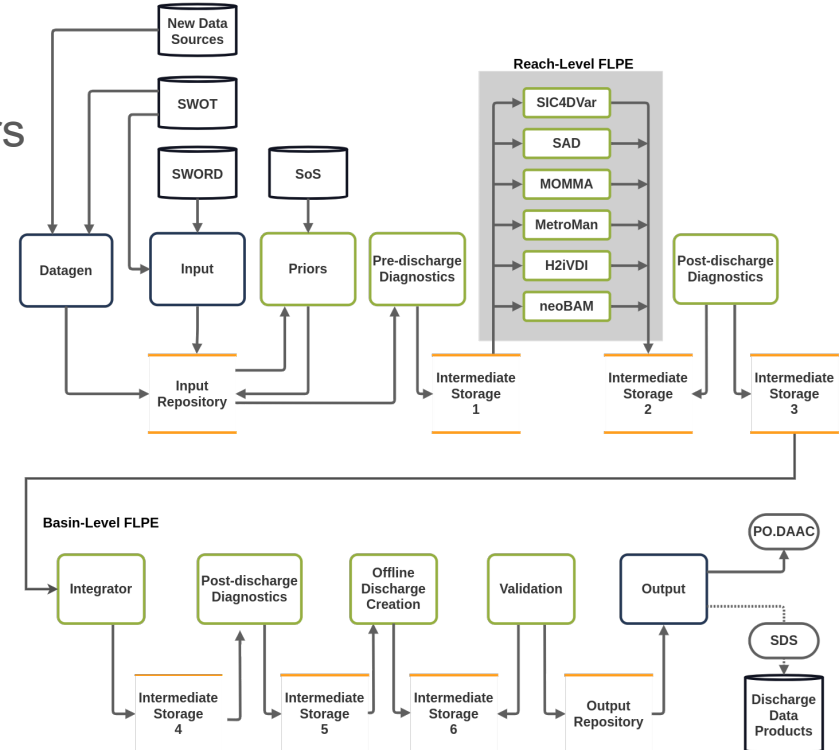
Steve Coss, Travis Simmons, Mike Durand, Colin Gleason,
Nikki Tibaldi, Rui Wei, Renato Prata de Moraes Frason

What Confluence does (Hydrologist Perspective)

Confluence Data Flow Diagram

A high level viewpoint.....

- WSE+slope+width → Flow law parameters
 > Discharge
- Prior datasets (models/gages)
 - Inform FLPEs and discharge estimates
- Validation
 - Validate SWOT discharge estimates



Details about the Confluence Run

Purpose: Verification that the pipeline is performing processes it was designed for

Time period spanned: ~June 5-July 9

The three passes run (13,9,16)

Branch: constrained only

What this talk is:

- An overview of a successful end to end run of the confluence pipeline
- Visualization of steps in the process driven with real SWOT data
- An assessment of the Confluence pipeline as a system

What this talk is not:

- An assessment of SWOT height width and slope accuracy
- An assessment of SWOT discharge accuracy
- Pepsi Challenge the final frontier
- Doing new hydrologic science with SWOT discharge

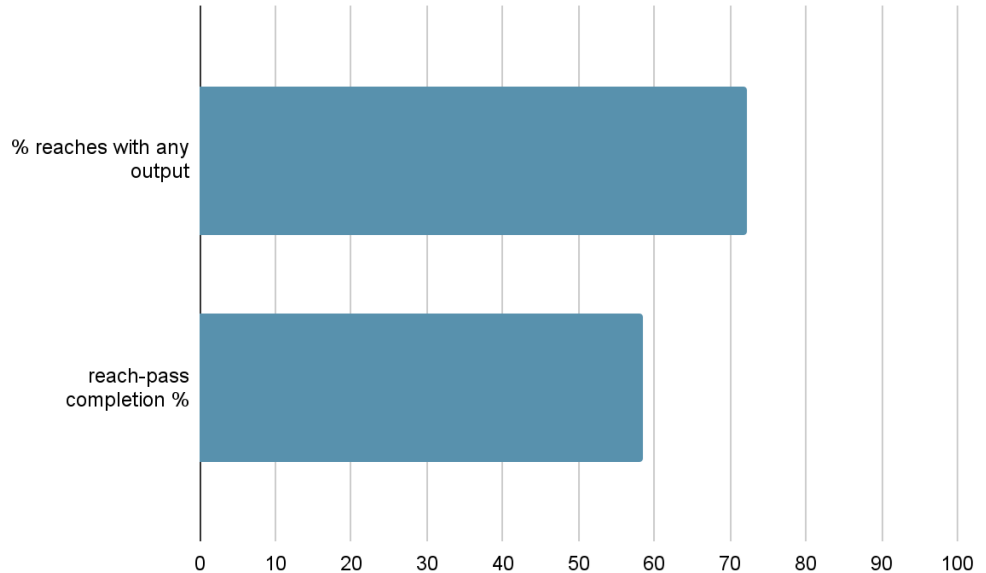
Run Status & Completion Metrics

How I will be defining completion rate (consensus in offline for all reaches)

- Percent of observation times with consensus output over total observations for all reaches

Consensus (requires all others)

- 1542 reaches attempted



Exploring latest Confluence Run

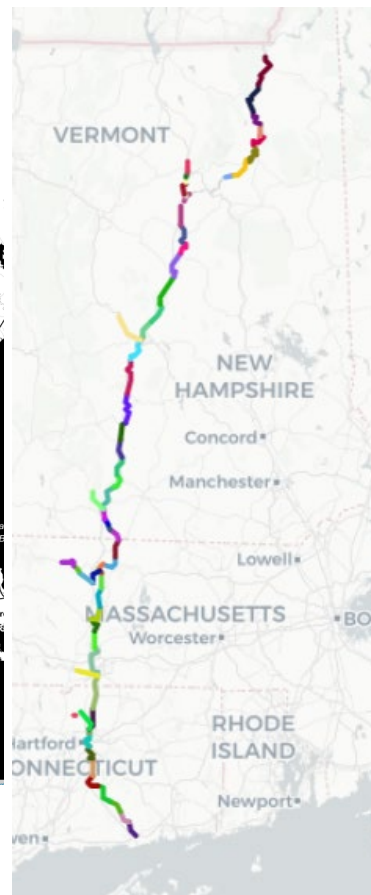
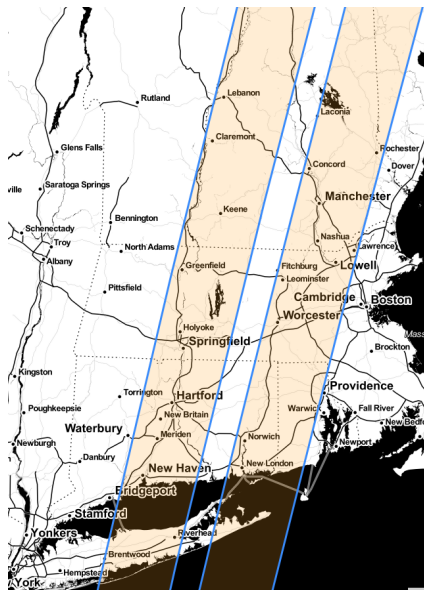
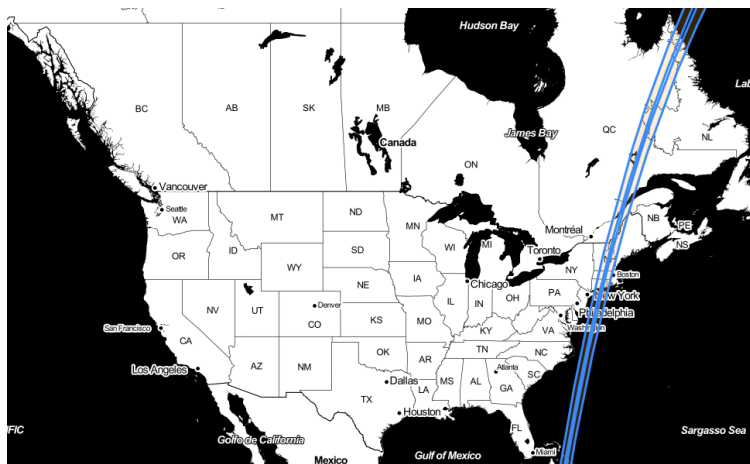
Areas to Explore:

1. Connecticut
2. Garonne



Exploring Connecticut

Connecticut site characteristics



Pass 9 in one-day orbit

Tier-1 cal/val site

Connecticut is L4 basin 7312 in SWORD

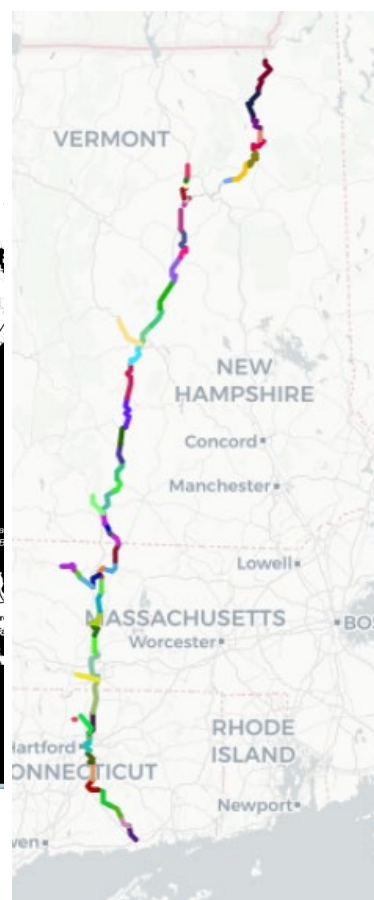
Connecticut site characteristics



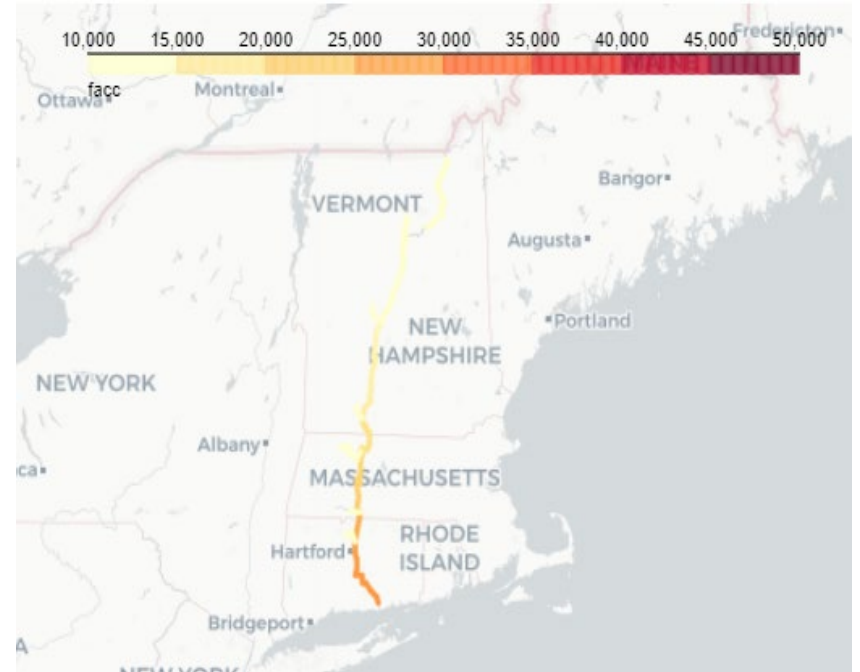
Pass 9 in one-day orbit

Tier-1 cal/val site

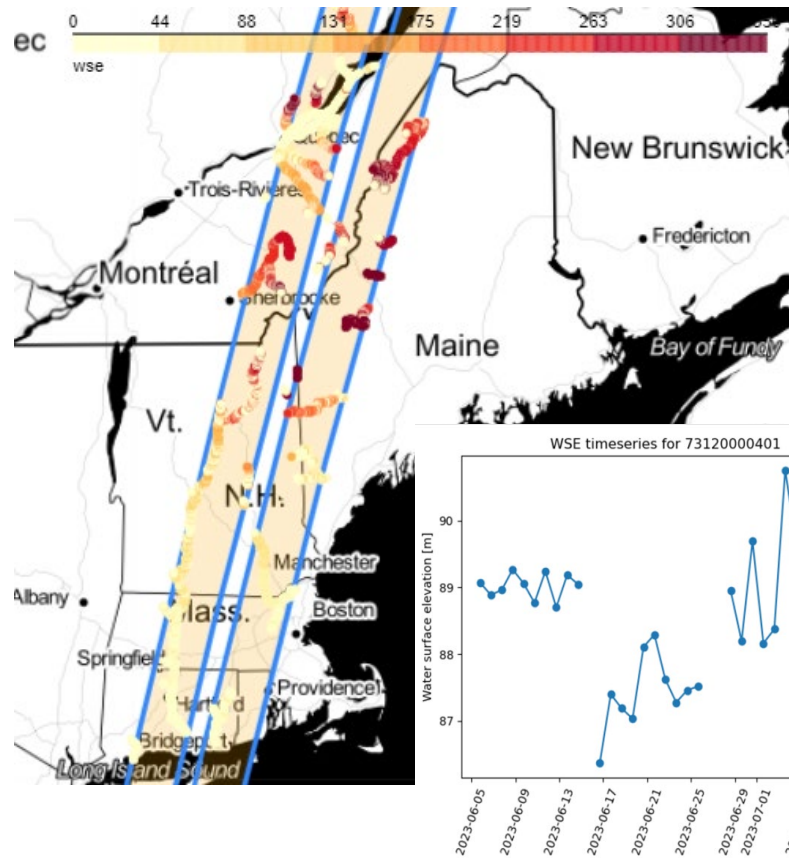
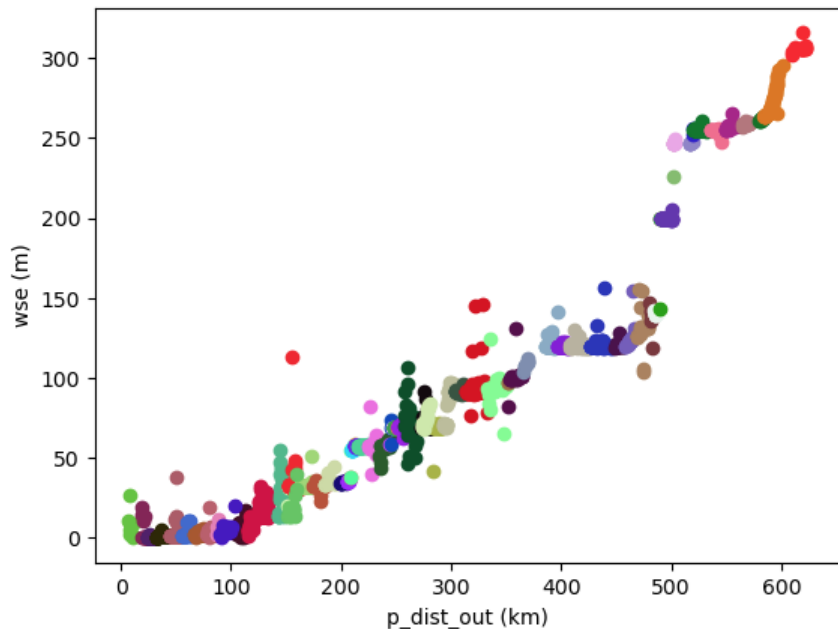
Connecticut is L4 basin 7312 in SWORD



Connecticut site characteristics (SWORD)



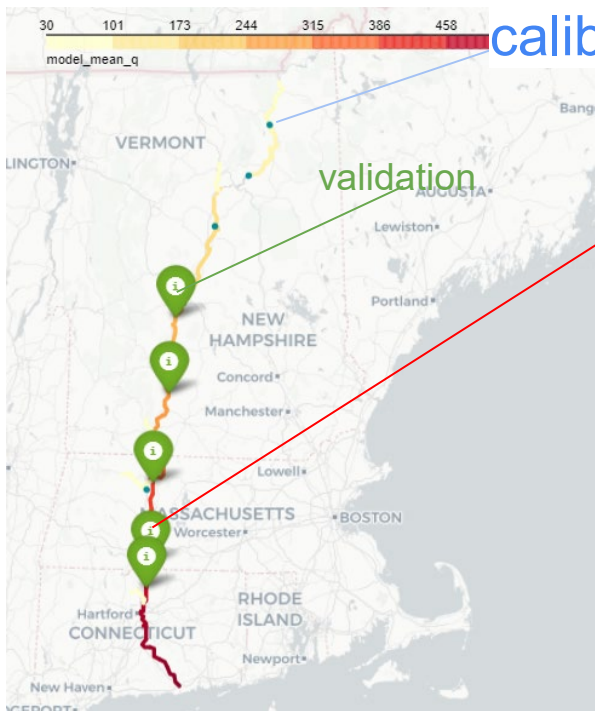
Connecticut SWOT datafiles



June 1 pass over the Connecticut. Node measurements shown in long profile and map. Reach level data in WSE time series.

Connecticut SoS

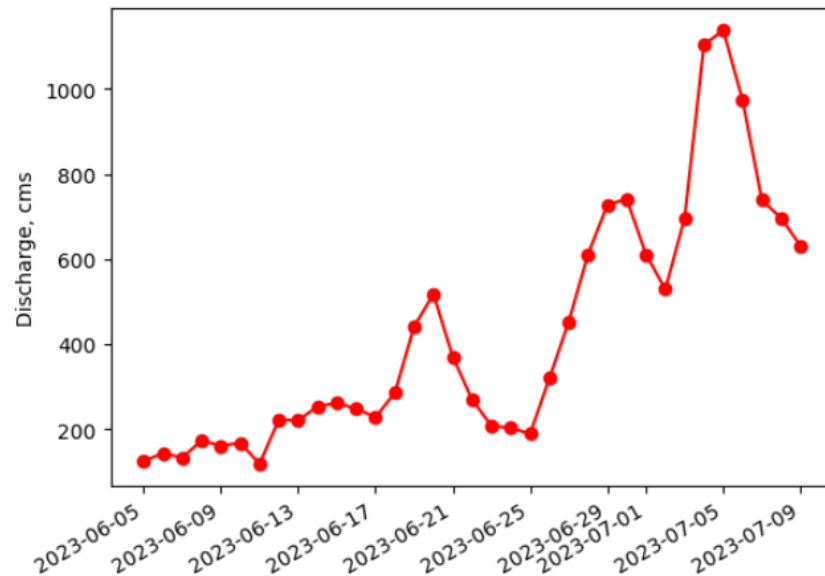
Priors pulls these data on every run



calibration

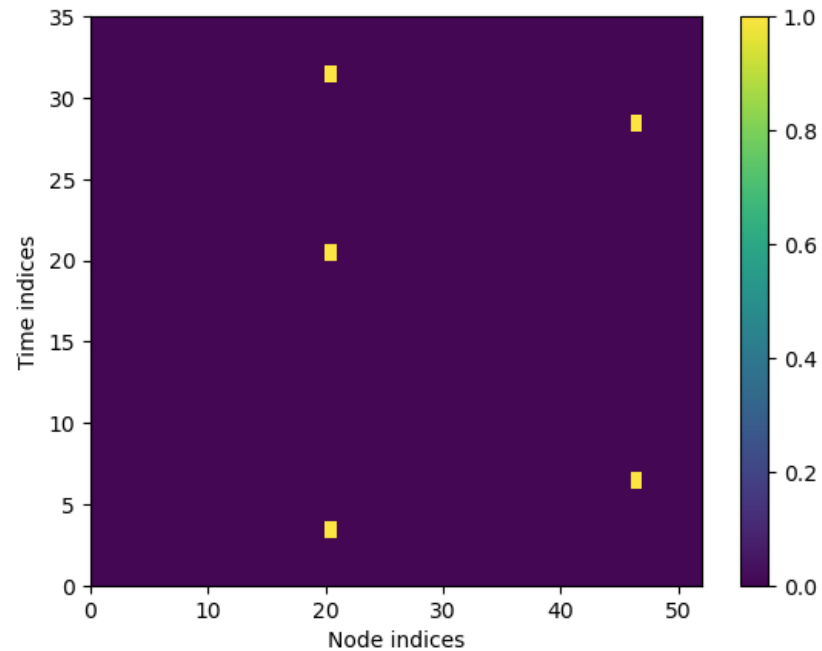
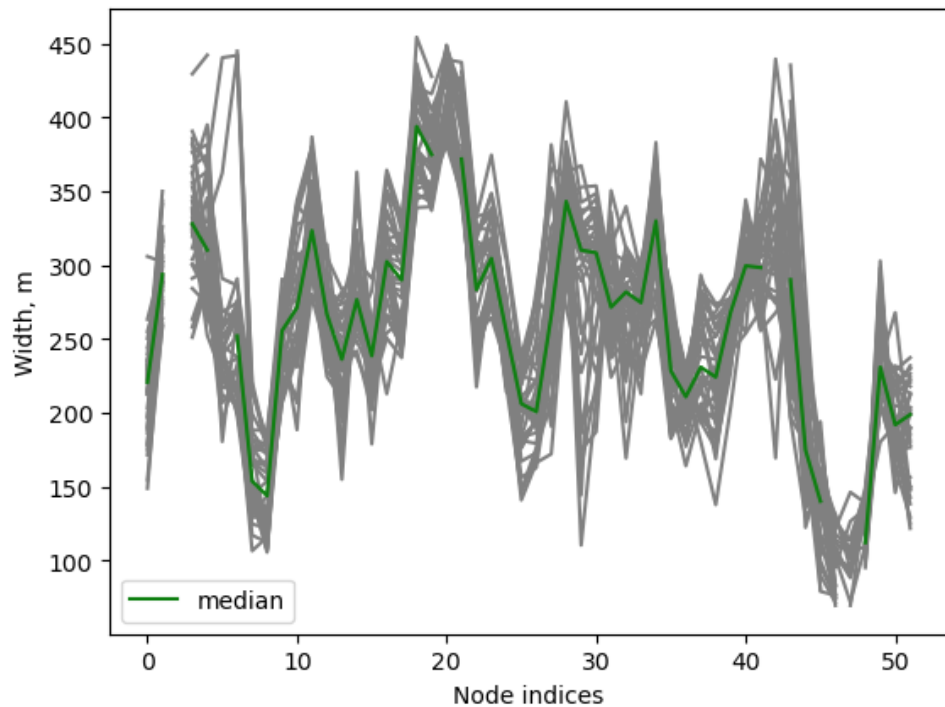
validation

reach 73120000131



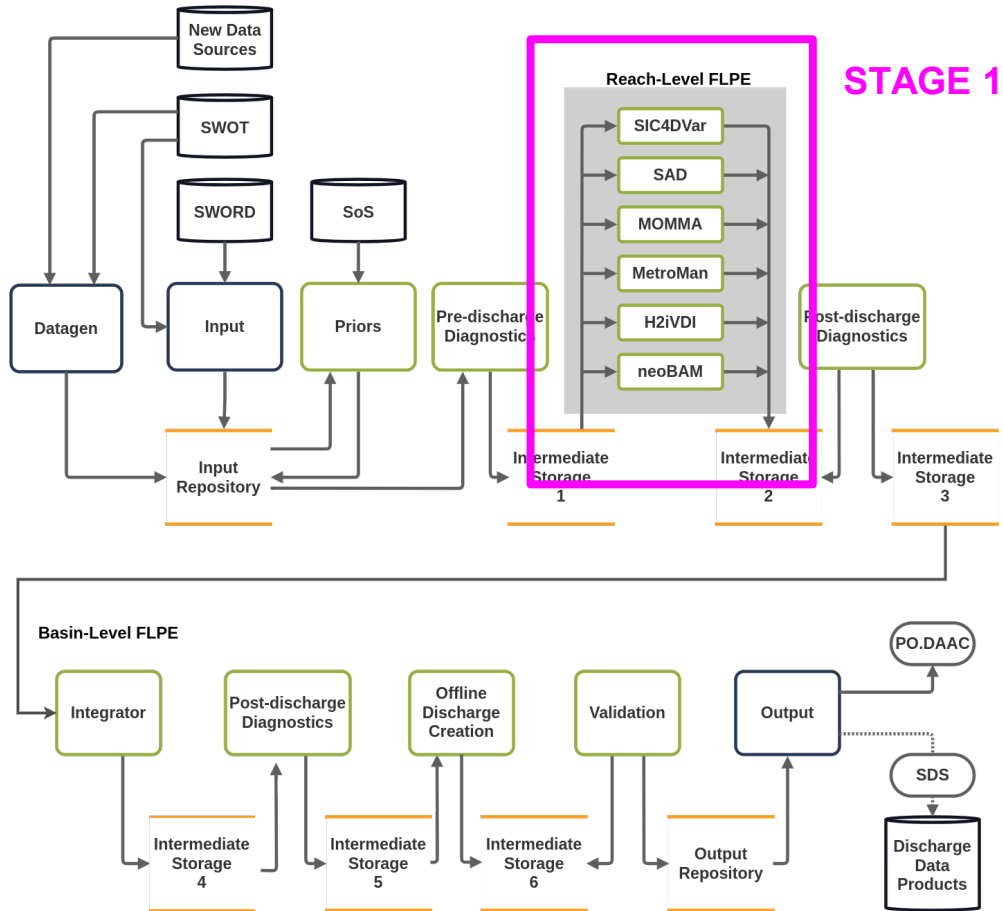
Mean flow from GRADES,
and gage locations

Connecticut Data flagging



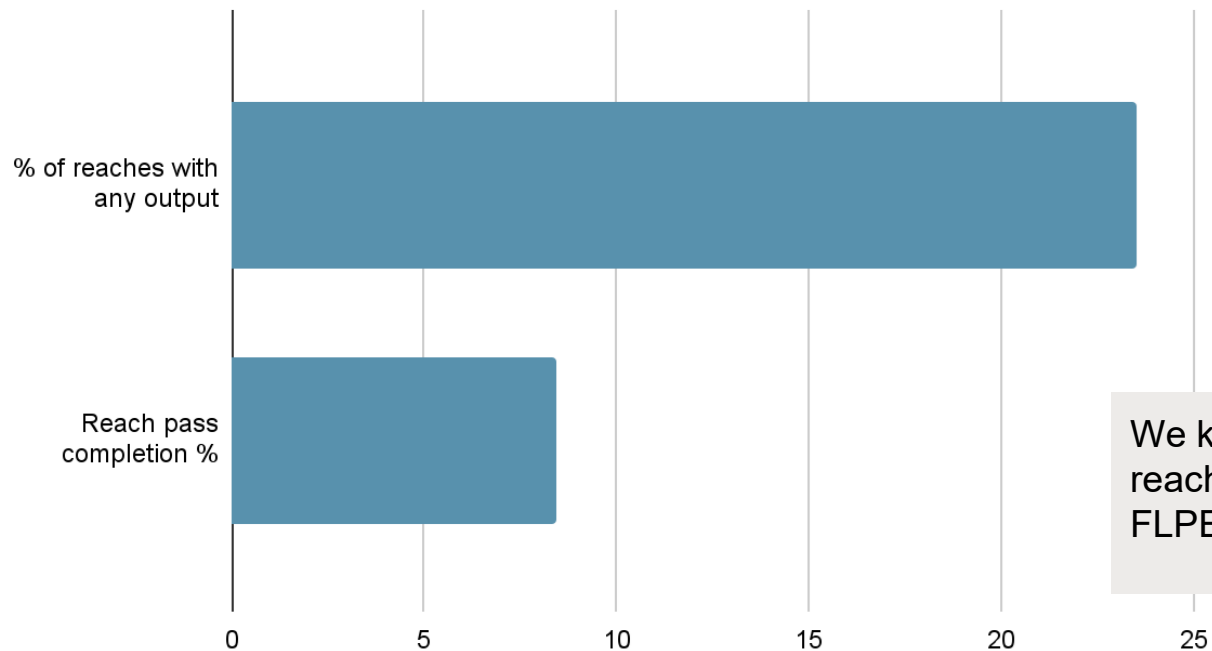
For reach 73120000401

Confluence Data Flow Diagram



FLPE stage 1

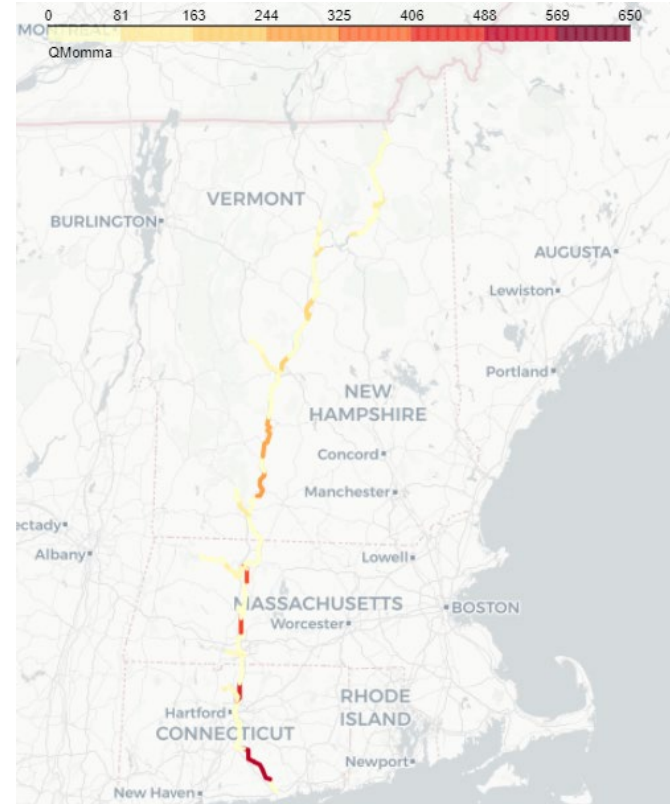
Mean Connecticut Stage 1 output (all FLPEs)



We know a substantial amount of reaches without output are from FLPEs choosing not to run

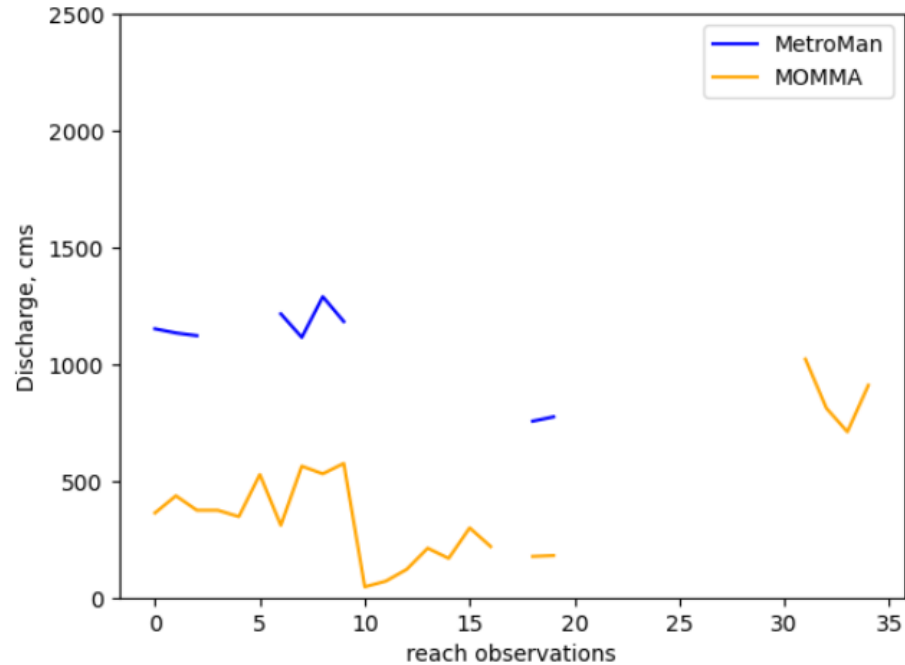
MOMMA reach average discharge

Stage 1 average discharge
from Momma in cms.



Let's take a look at a reach with multiple algorithm output

reach 73120000151

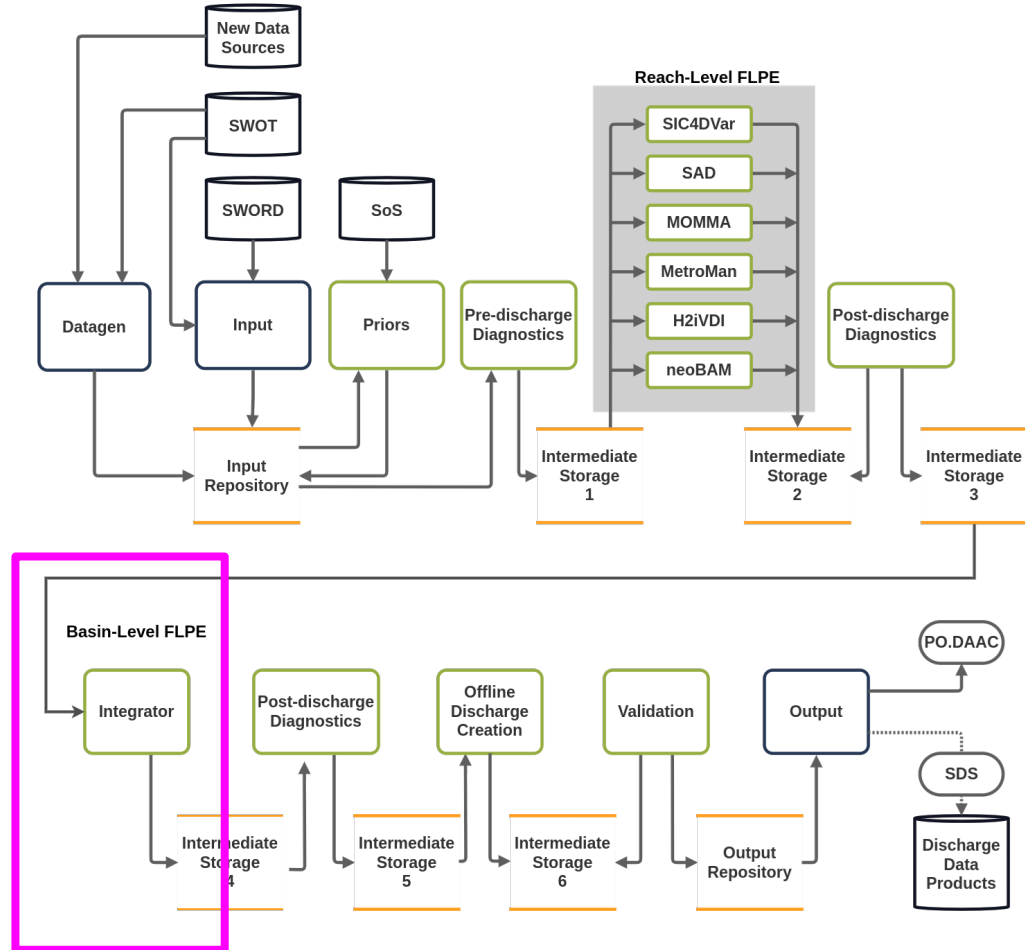


Confluence Data Flow Diagram

Stage 2 FLP

("mean optimization integrator" or MOI)

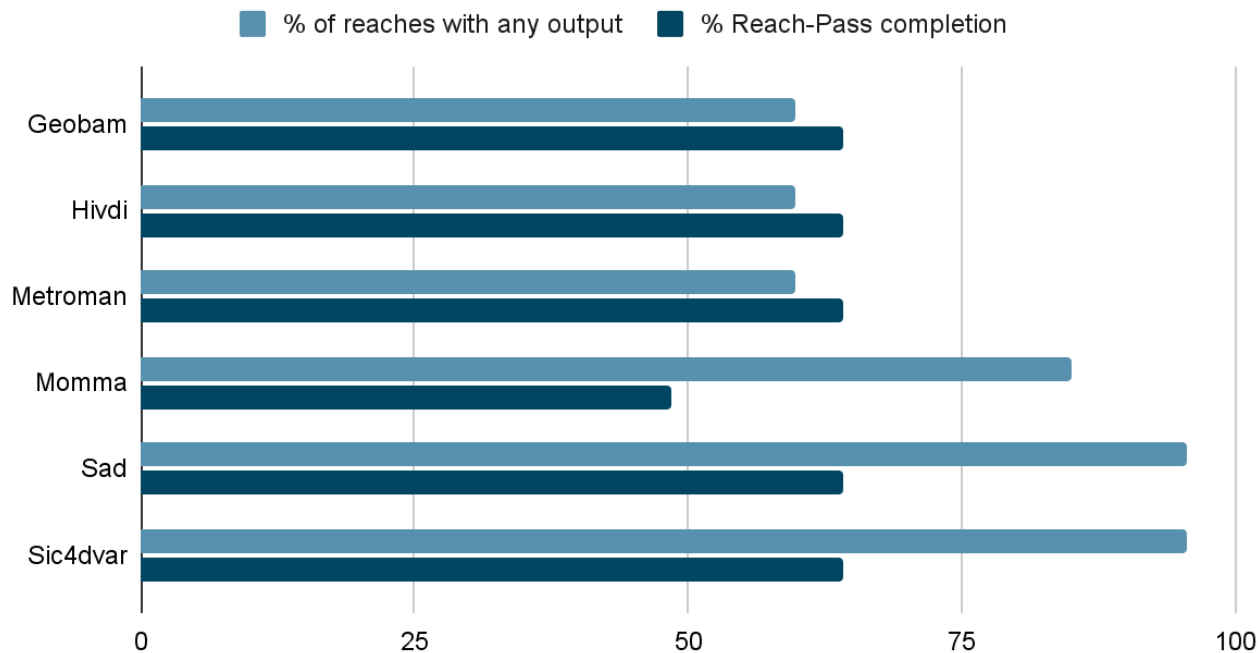
- Impose constraints
- Discharge conserved across sub-basins
- gages constrain the discharge values



STAGE 2

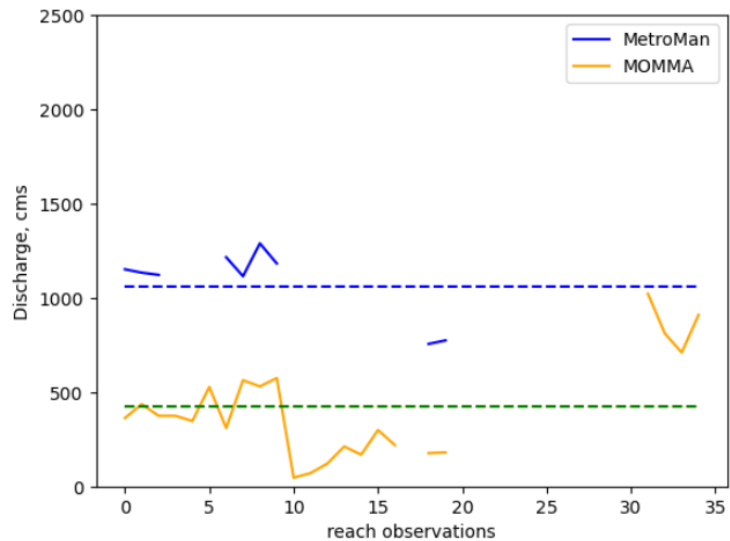
Let's look at overall output for stage 2 on the Connecticut

Connecticut Stage 2

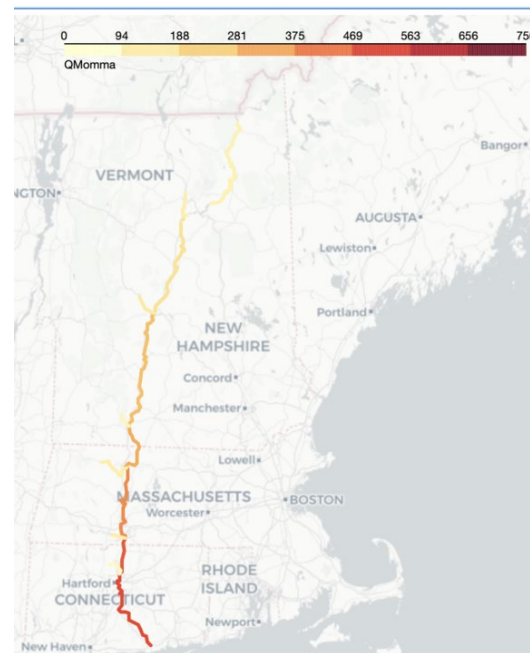


Some stage 2 visuals

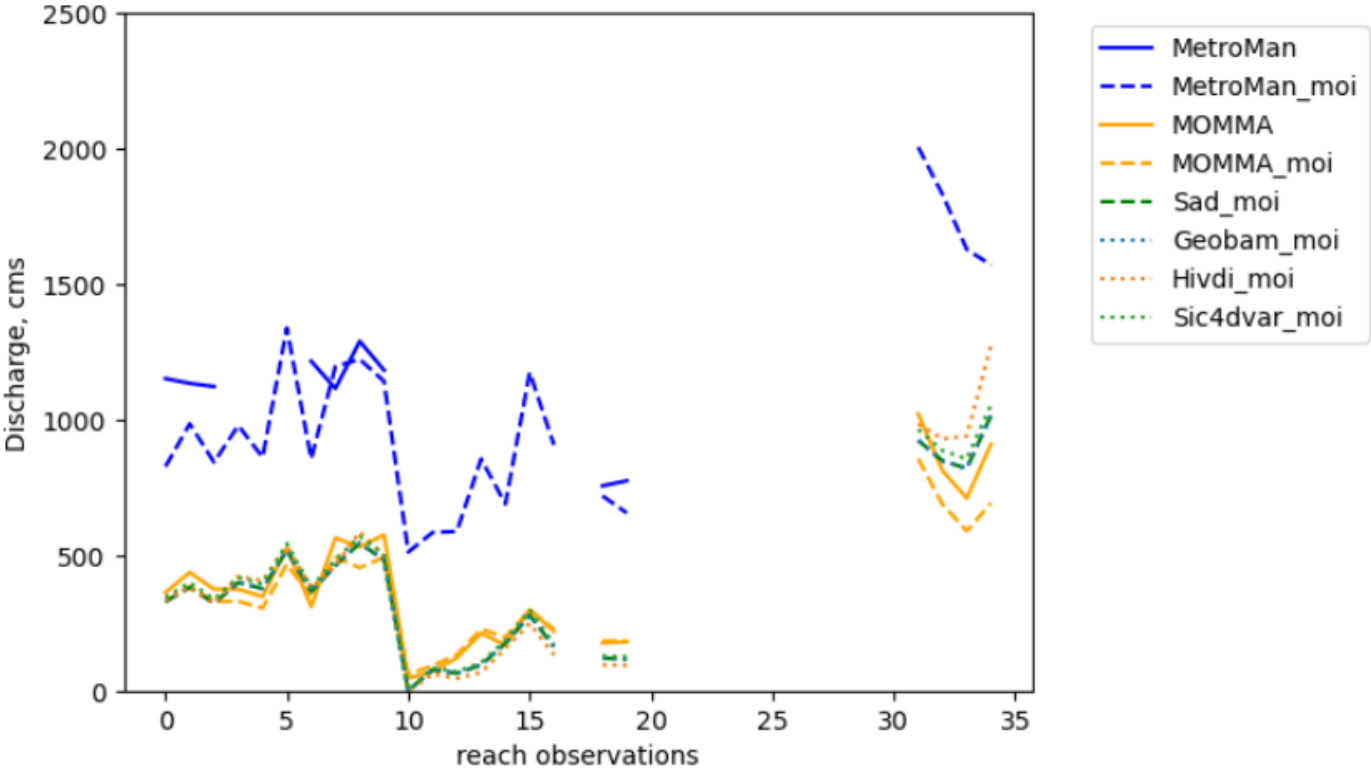
Lets see the stage 2 reach mean Q on the stage 1 plot above



Momma stage 2 mean reach Q (cms)



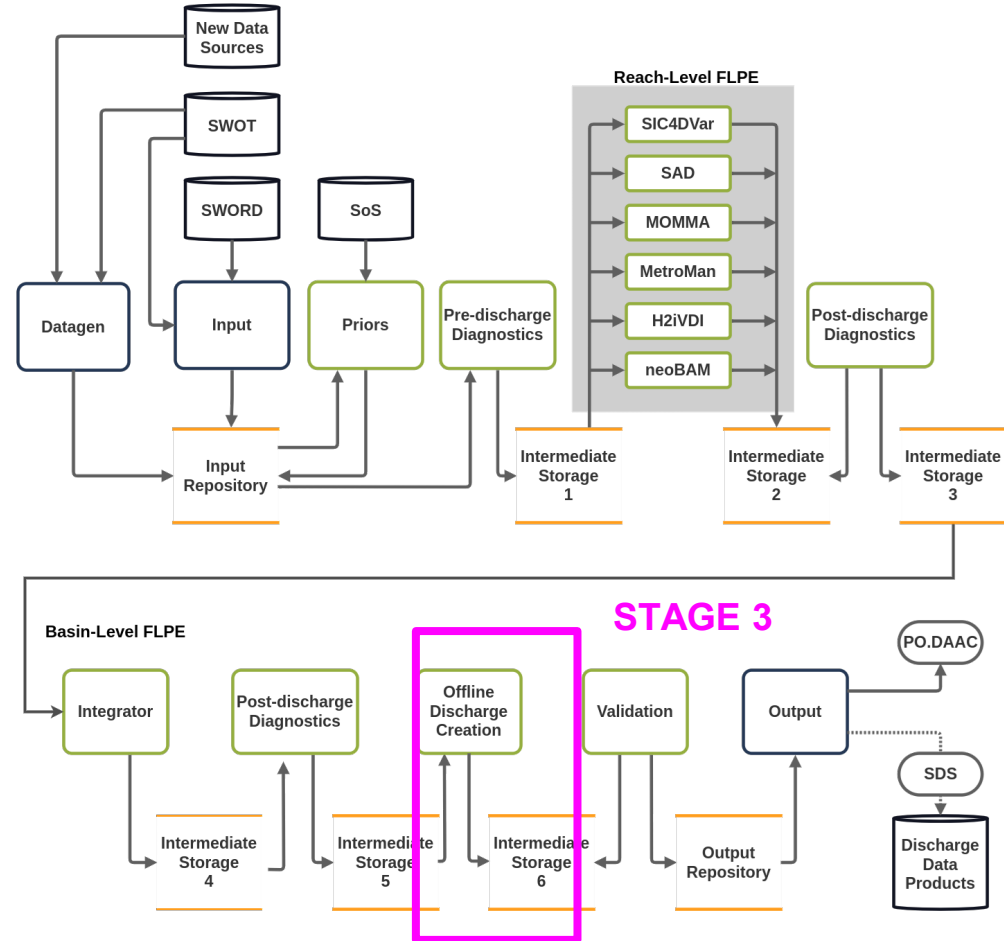
Stage 2 FLPE : discharge after integrator



Confluence Data Flow Diagram

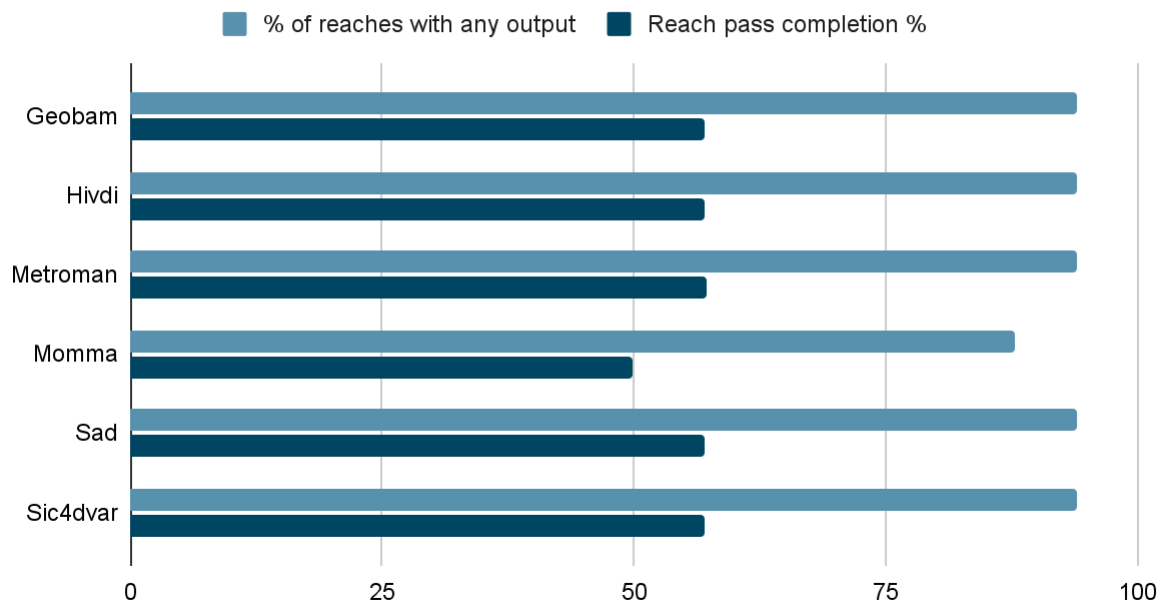
Stage 3 : Discharge output

- Recreate agency discharge from FLPE parameter estimations
- Run validation module

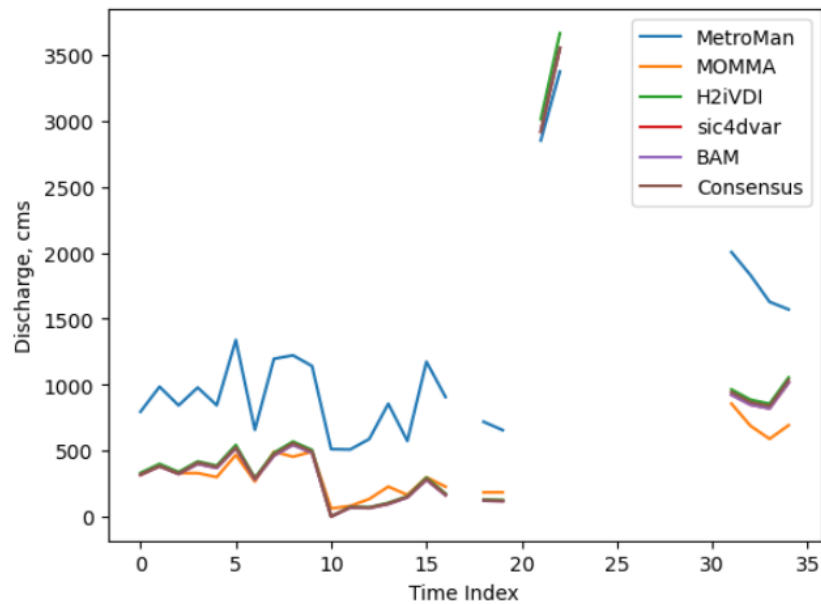


Post-processing for SWOT discharge on the Connecticut

Connecticut Stage 3



Our reach from above

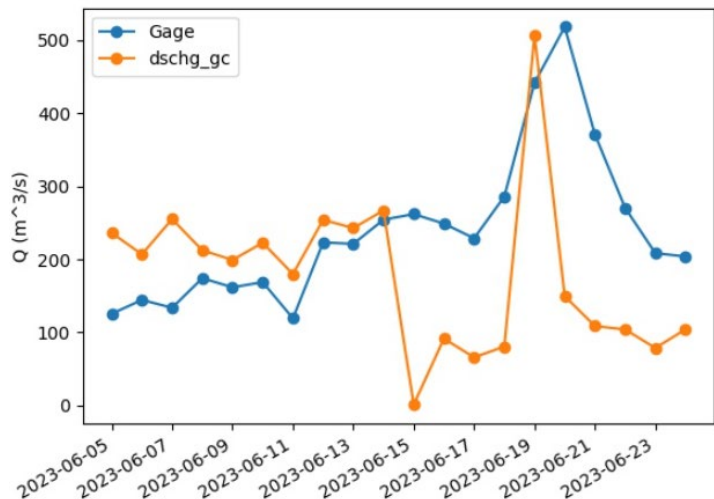


Validation on the Connecticut

Stats now include:

NSE, Rsq, KGE, RMSE, nRMSE, nBIAS, rRMSE, testn

Reach 73120000131



[22]:

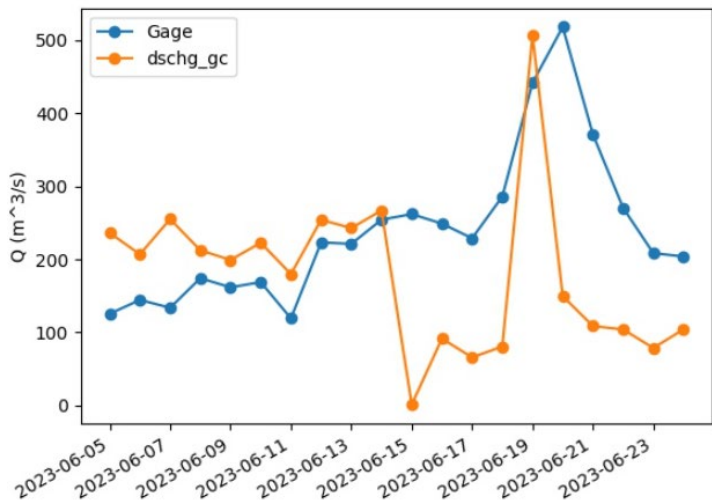
	Reach_id	Rsq	KGE	RMSE	nRMSE	nBIAS	rRMSE	testn
70	78220000031	0.125202	-15.868357	1239.463948	4.107814	2.089627	3.536608	32.0
71	78220000031	0.073425	-3.507731	545.709743	1.784792	1.475309	1.004464	30.0
72	78220000031	0.135417	-17.428697	1296.446180	4.164854	2.040860	3.630550	28.0
73	78220000031	0.132704	-19.771151	1379.988626	4.341849	2.091682	3.804802	26.0
74	78220000031	0.118644	-21.104362	1393.629684	4.290192	2.136080	3.720606	24.0
75	78220000031	0.116954	-22.312643	1456.466425	4.416203	2.216641	3.819601	22.0
82	78220000031	0.105701	-21.876116	1515.115266	4.560873	2.432551	3.858012	20.0
196	78230000043	0.660074	-0.426559	4739.342756	1.013174	-0.999993	0.162896	26.0
197	78230000043	0.011712	-0.671902	4914.152836	1.011485	-0.999998	0.152005	21.0
198	78230000043	0.005305	-0.775097	5021.334787	1.011051	-0.999999	0.149082	18.0
199	78230000043	0.785867	-0.116751	4839.679650	0.949841	-0.945728	0.088297	16.0
200	78230000043	0.741447	-0.420971	5230.747067	1.008625	-0.999991	0.131684	14.0
201	78230000043	0.725159	-0.419899	5359.951015	1.006836	-0.999637	0.120190	12.0
378	78220000231	0.004679	-23.262210	698.721768	4.034687	2.173466	3.399227	33.0
379	78220000231	0.009063	-28.589179	813.880755	4.676343	2.302759	4.070072	32.0
380	78220000231	0.004220	-39.590620	1610.208850	9.203710	7.458585	5.392382	31.0
381	78220000231	0.203460	-3.850611	195.118360	1.107278	0.852722	0.706350	27.0
382	78220000231	0.023965	-27.083222	713.888665	3.982979	1.915407	3.492183	27.0
383	78220000231	0.024185	-27.006708	716.709066	3.998715	1.965348	3.482403	27.0
390	78220000231	0.023912	-27.046588	714.892651	3.988580	1.935318	3.487595	27.0
448	73120000121	0.332482	-0.353750	663.511395	1.449086	0.550442	1.340472	21.0
449	73120000121	0.088333	-0.453633	292.209223	1.045379	0.260165	1.012488	15.0

Validation on the Connecticut

Stats now include:

NSE, Rsq, KGE, RMSE, nRMSE, nBIAS, rRMSE, testn

Reach 73120000131



[22]:

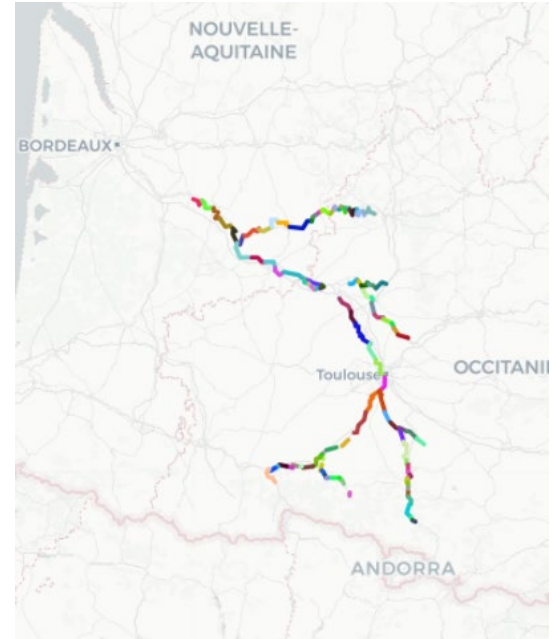
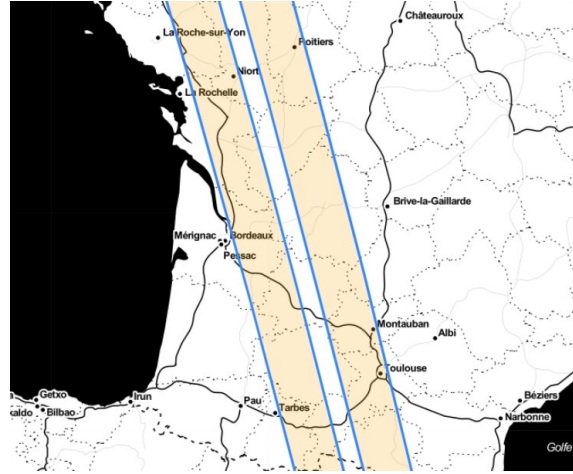
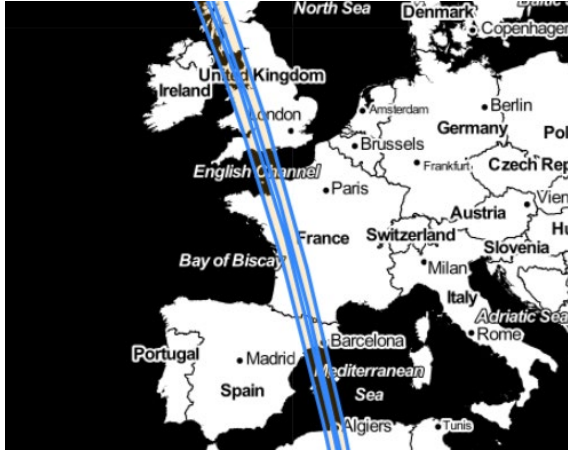
	Reach_id	Rsqr	KGE	RMSE	nRMSE	nBIAS	rRMSE	testn
70	78220000031	0.125202	-15.868357	1239.463948	4.107814	2.089627	3.536608	32.0
71	78220000031	0.073425	-3.507731	545.709743	1.784792	1.475309	1.004464	30.0
72	78220000031	0.135417	-17.428697	1296.446180	4.164854	2.040860	3.630550	28.0
73	78220000031	0.132704	-19.771151	1379.988626	4.341849	2.091682	3.804802	26.0
74	78220000031	0.118644	-21.104362	1393.629684	4.290192	2.136080	3.720606	24.0

Still well outside mission goals, but reasonable for no crossover calibration

199	78230000043	0.785867	-0.116751	4839.679650	0.949841	-0.945728	0.088297	16.0
200	78230000043	0.741447	-0.420971	5230.747067	1.008625	-0.999991	0.131684	14.0
201	78230000043	0.725159	-0.419899	5359.951015	1.006836	-0.999637	0.120190	12.0
378	78220000231	0.004679	-23.262210	698.721768	4.034687	2.173466	3.399227	33.0
379	78220000231	0.009063	-28.589179	813.880755	4.676343	2.302759	4.070072	32.0
380	78220000231	0.004220	-39.590620	1610.208850	9.203710	7.458585	5.392382	31.0
381	78220000231	0.203460	-3.850611	195.118360	1.107278	0.852722	0.706350	27.0
382	78220000231	0.023965	-27.083222	713.888665	3.982979	1.915407	3.492183	27.0
383	78220000231	0.024185	-27.006708	716.709066	3.998715	1.965348	3.482403	27.0
390	78220000231	0.023912	-27.046588	714.892651	3.988580	1.935318	3.487595	27.0
448	73120000121	0.332482	-0.353750	663.511395	1.449086	0.550442	1.340472	21.0
449	73120000121	0.088333	-0.453633	292.209223	1.045379	0.260165	1.012488	15.0

Exploring Garonne

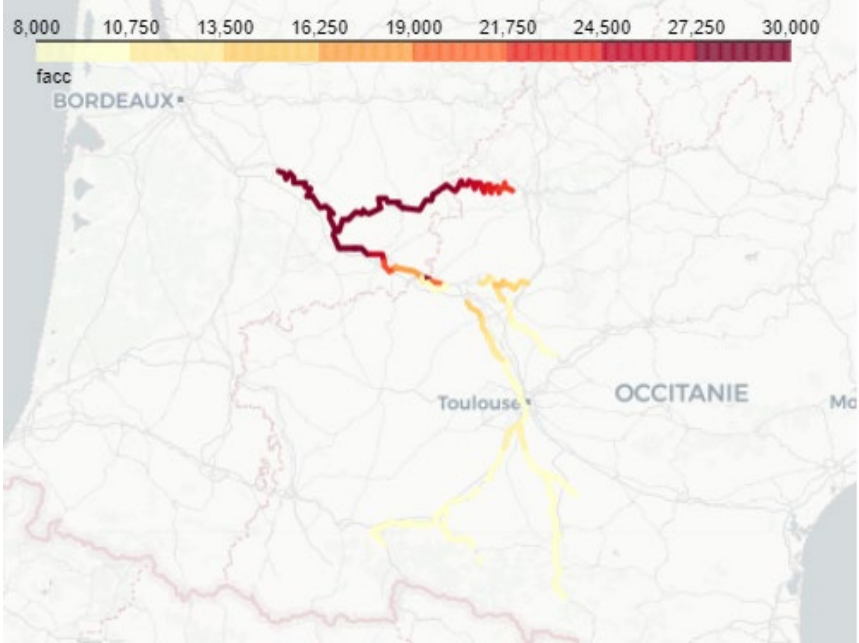
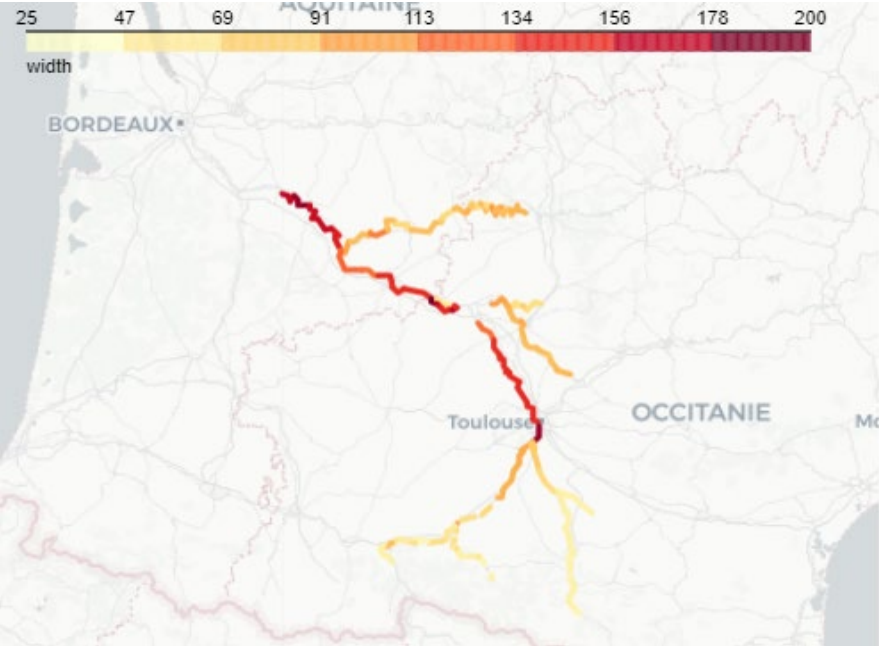
Garonne site characteristics



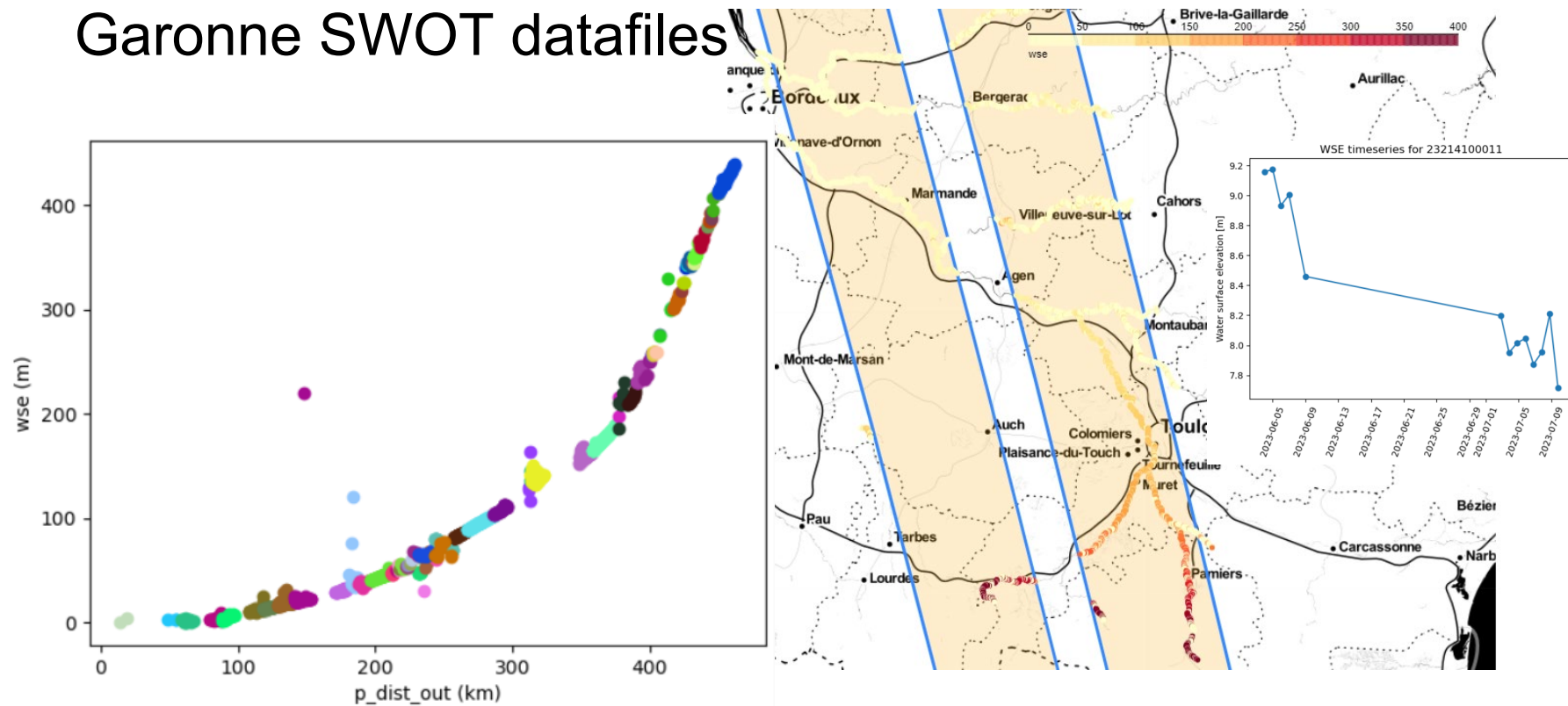
Pass 16 in one-day orbit

Garonne is L5 basin 23214 in SWOD

Garonne site characteristics

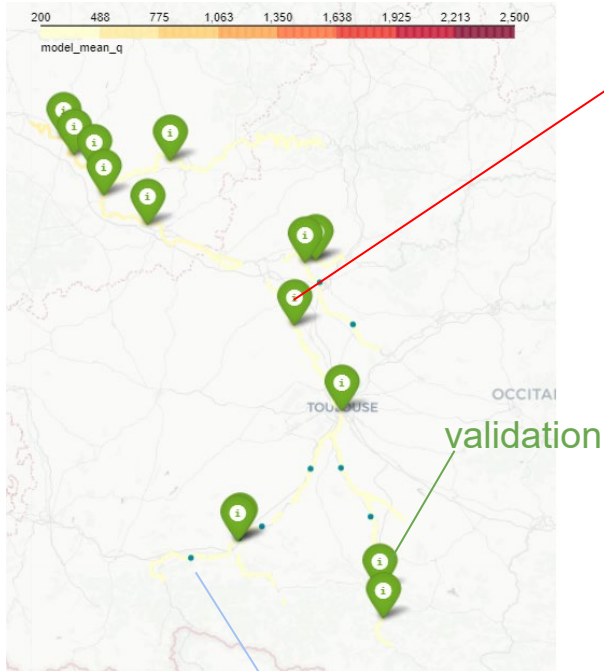


Garonne SWOT datafiles



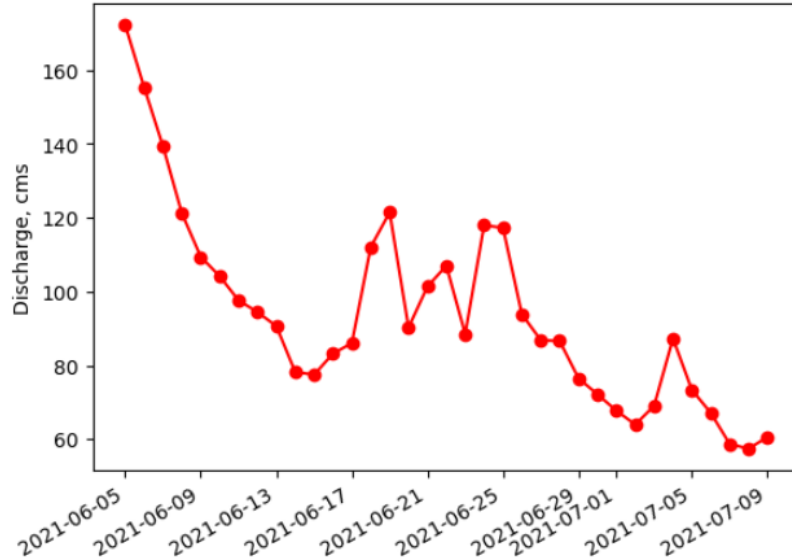
June 1 pass over the Garonne. Node measurements shown in long profile and map. Reach level data in WSE time series.

Garonne SoS



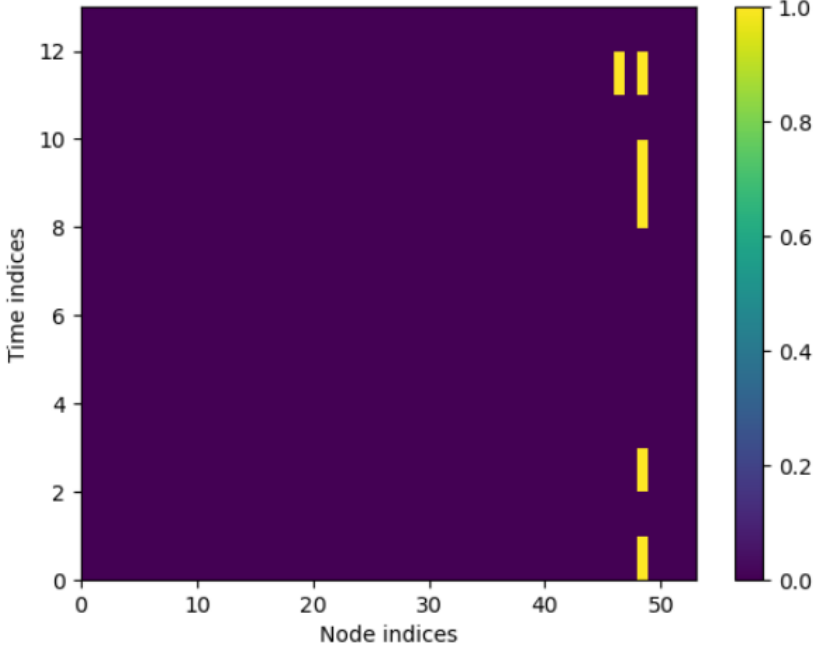
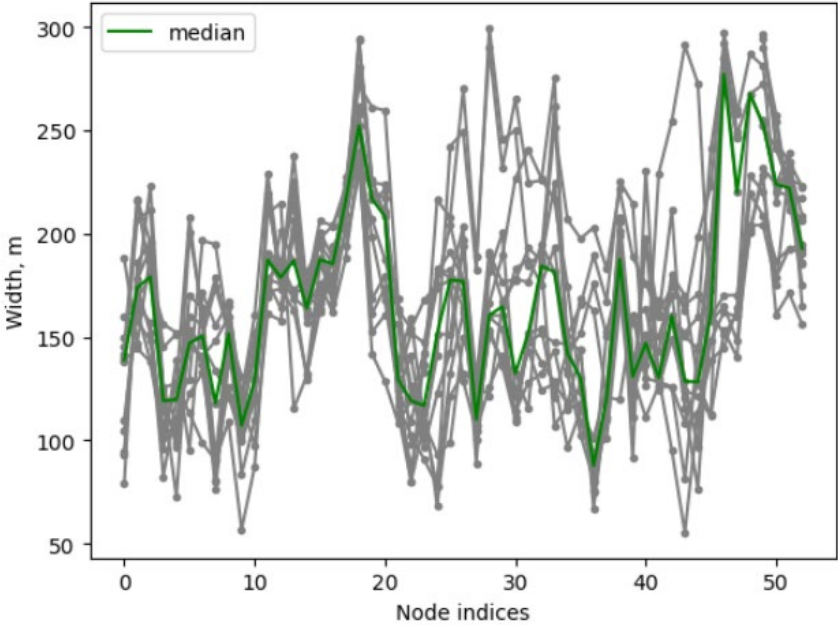
calibration

reach 23214400041



Mean flow from GRADES, and gage locations (blue for calibration green for Validation)

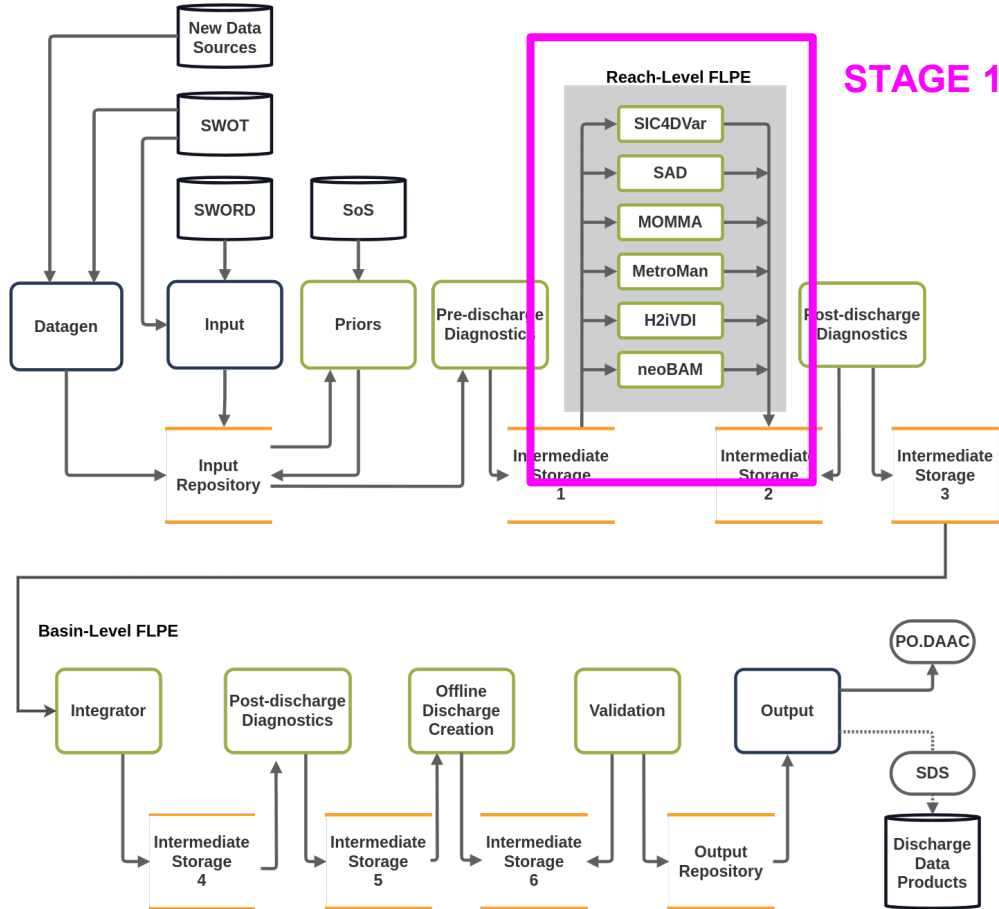
Garonne Data flagging



For reach 23214100011

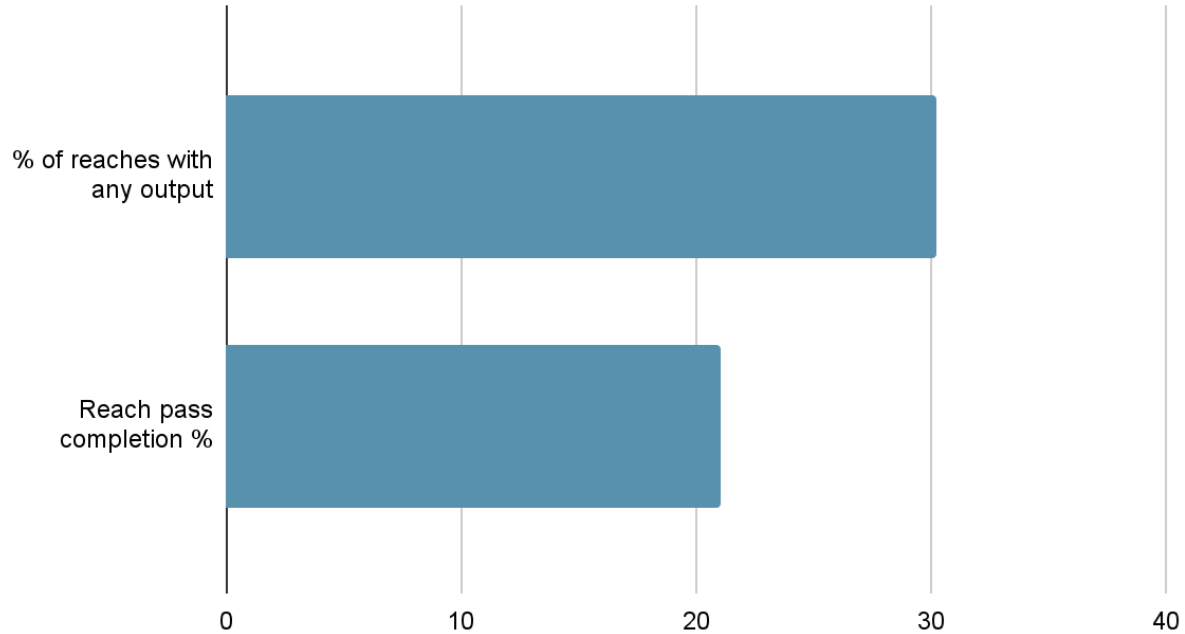
Yellow = flagged data

Confluence Data Flow Diagram



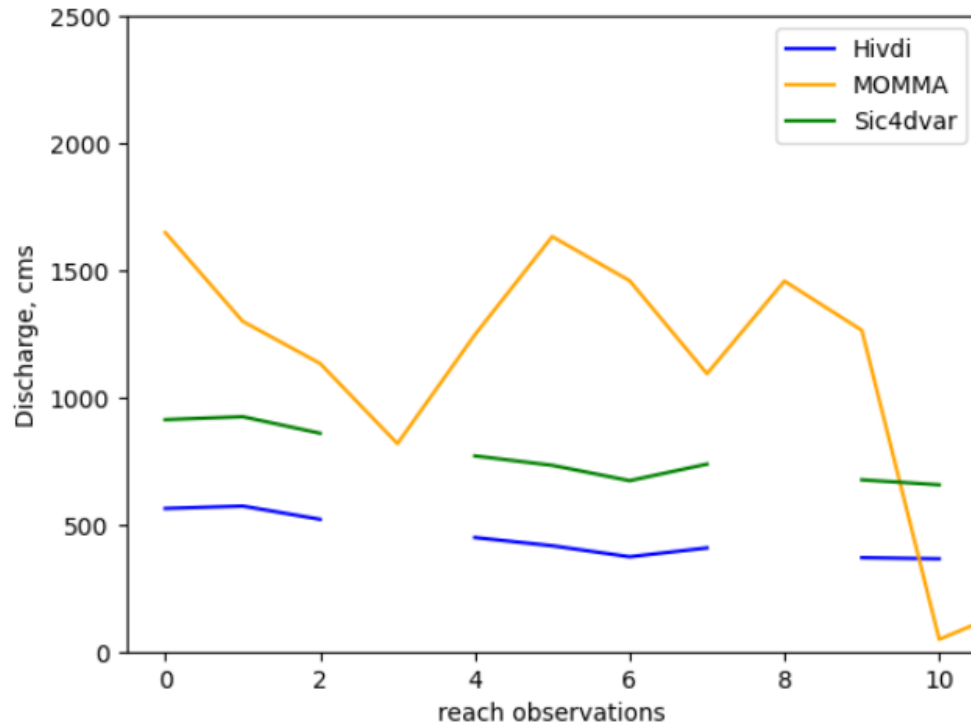
FLPE stage 1

Mean Garonne Stage one FLPE (all FLPEs)



Let's take a look at a reach with multiple algorithm output

reach 23214100011

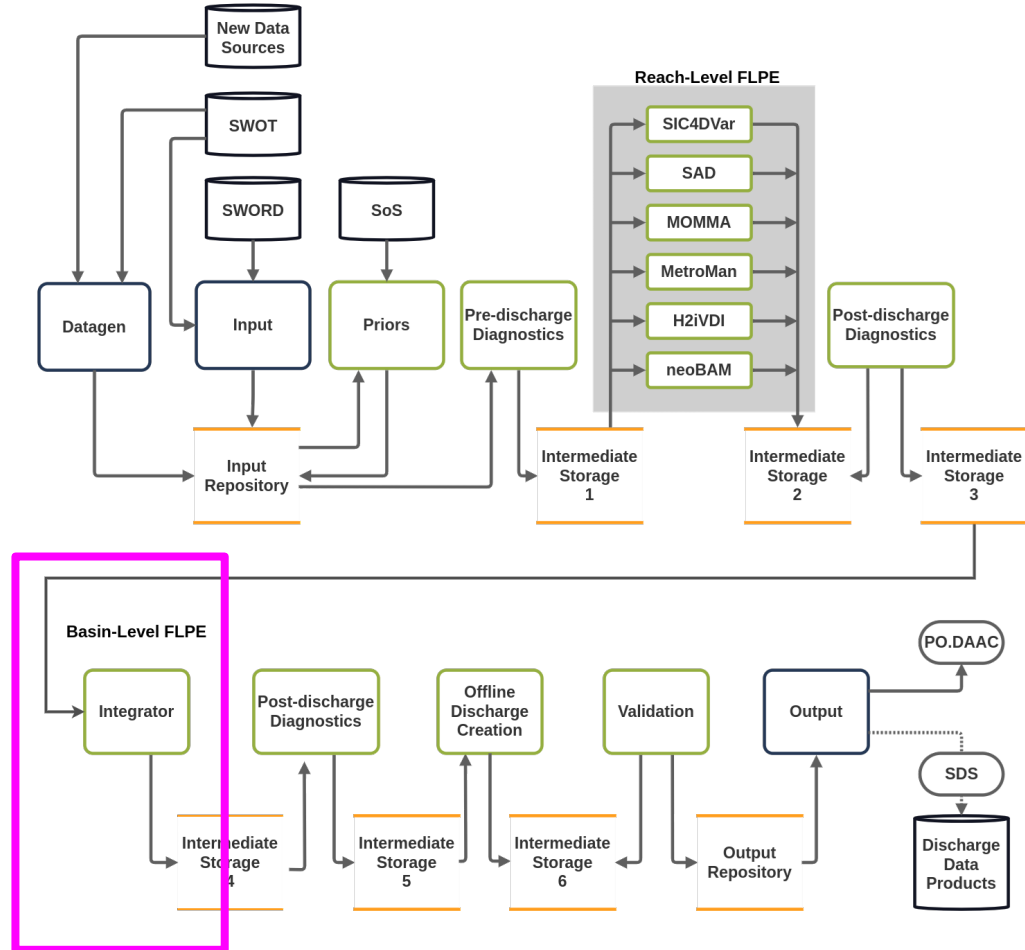


Confluence Data Flow Diagram

Stage 2 FLP

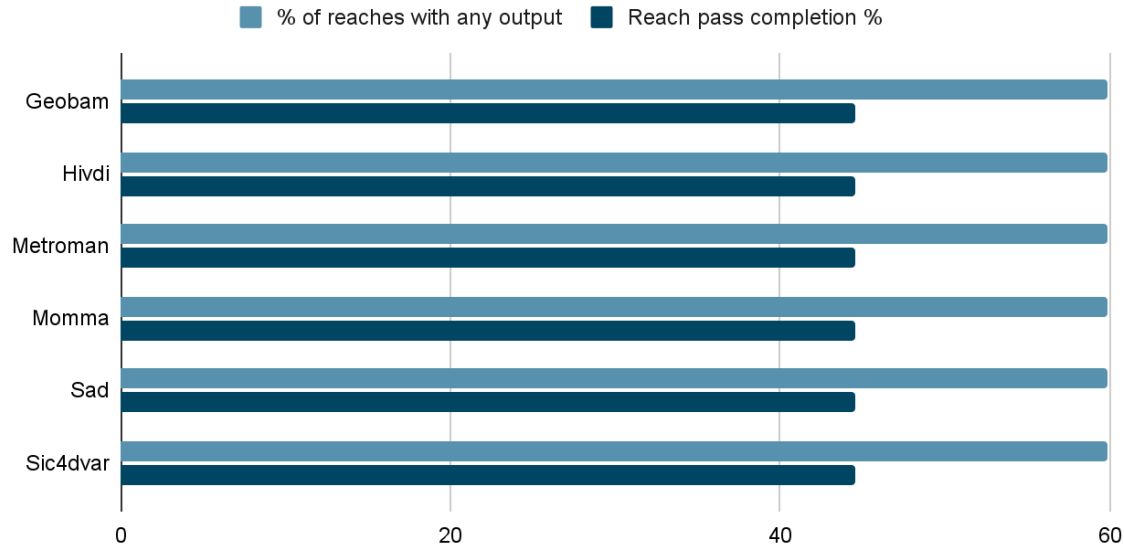
("mean optimization integrator" or MOI)

- Impose constraints
- Discharge conserved across sub-basins
- Gages constrain the discharge values



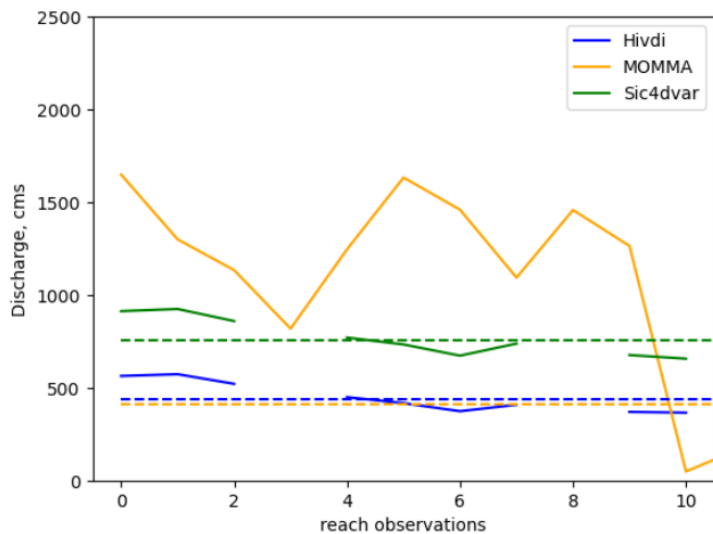
Let's look at overall output for stage 2 on the Garonne

Garonne Stage 2



Some stage 2 visuals

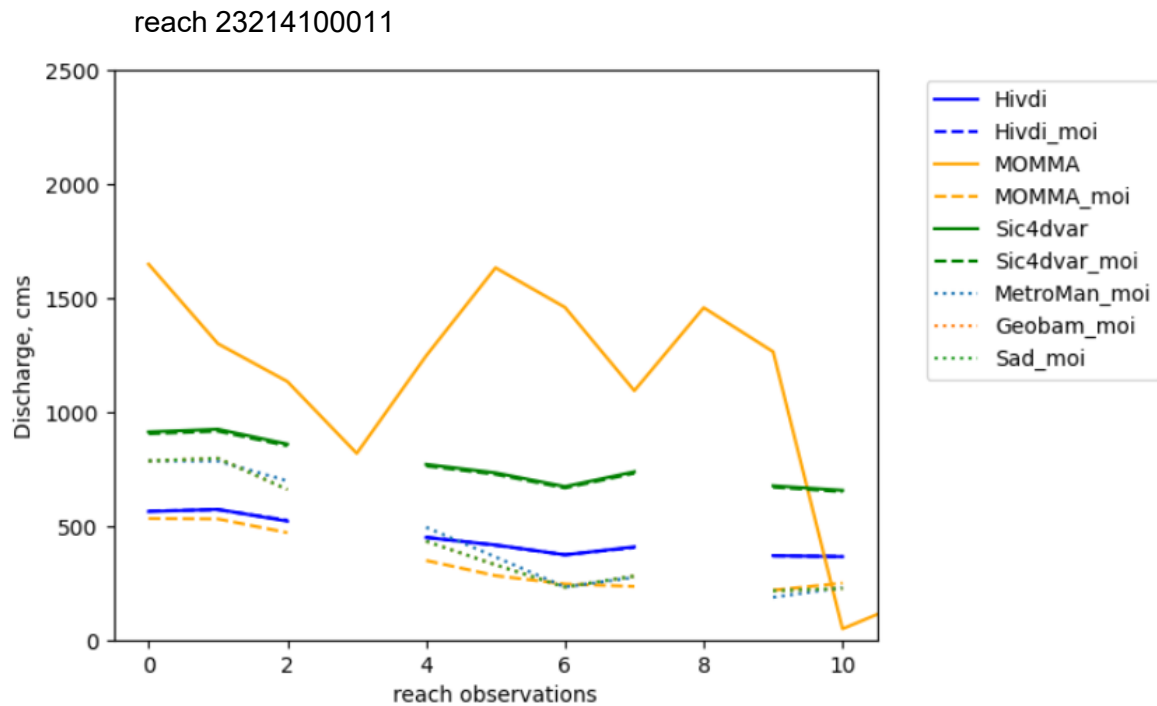
Lets see the stage 2 reach mean Q on the stage 1 plot above



Metroman stage 2 mean reach Q (cms)



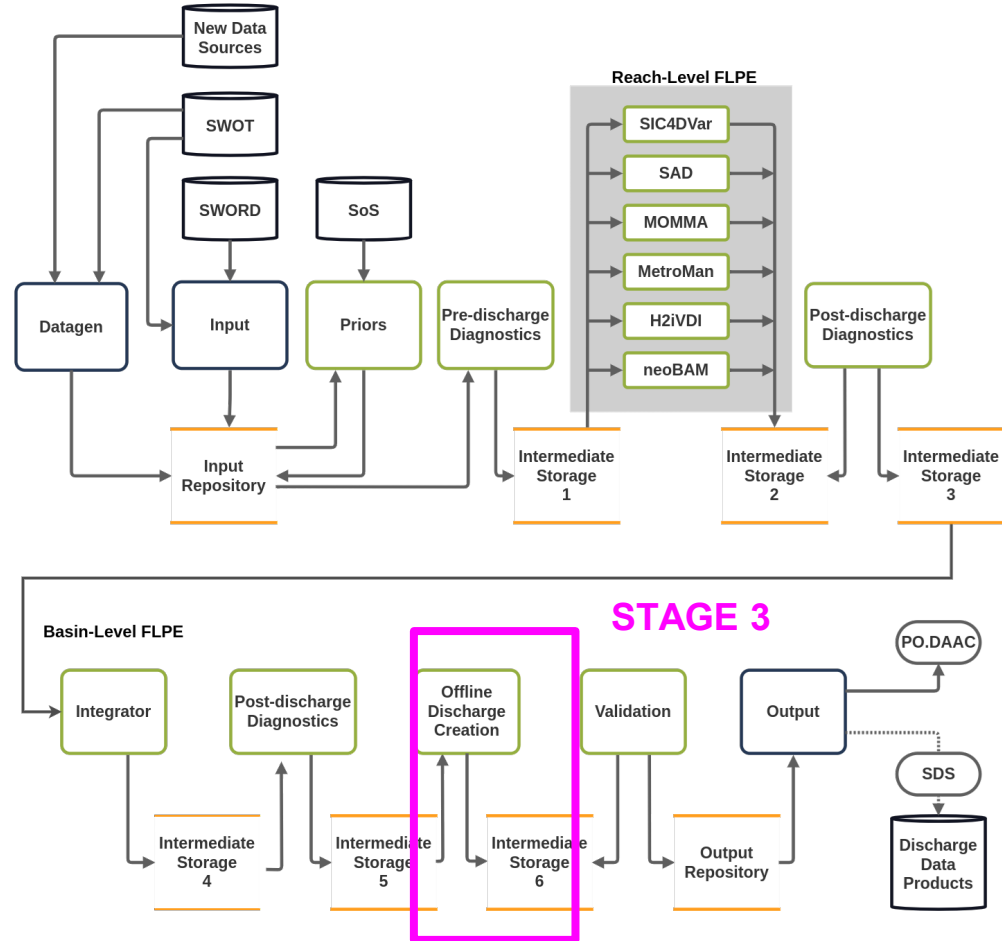
Stage 2 FLPE : discharge after integrator



Confluence Data Flow Diagram

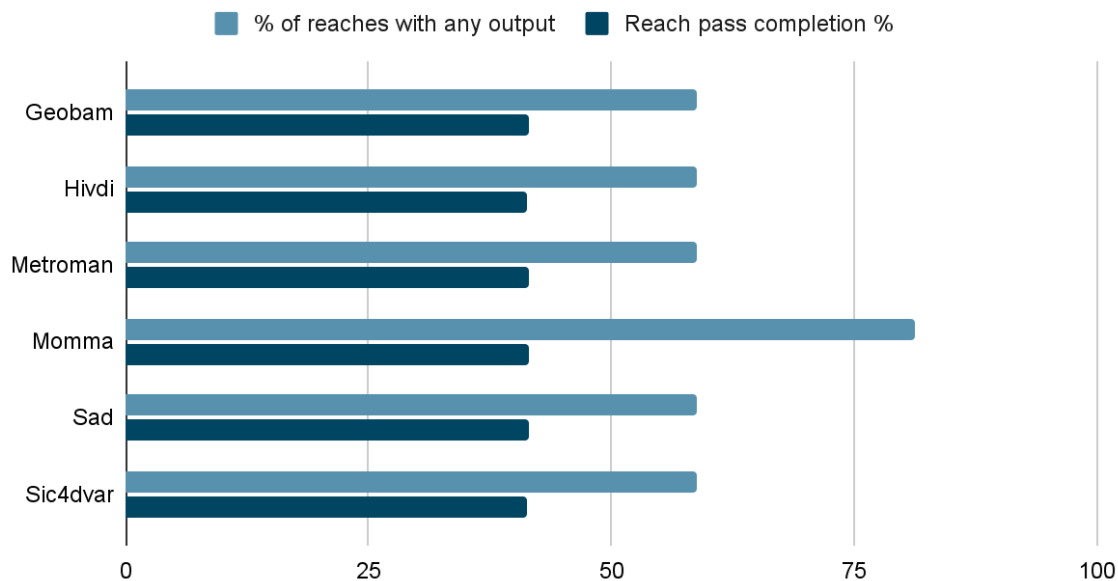
Stage 3 : Discharge output

- Recreate agency discharge from FLPE parameter estimations
- Run validation module



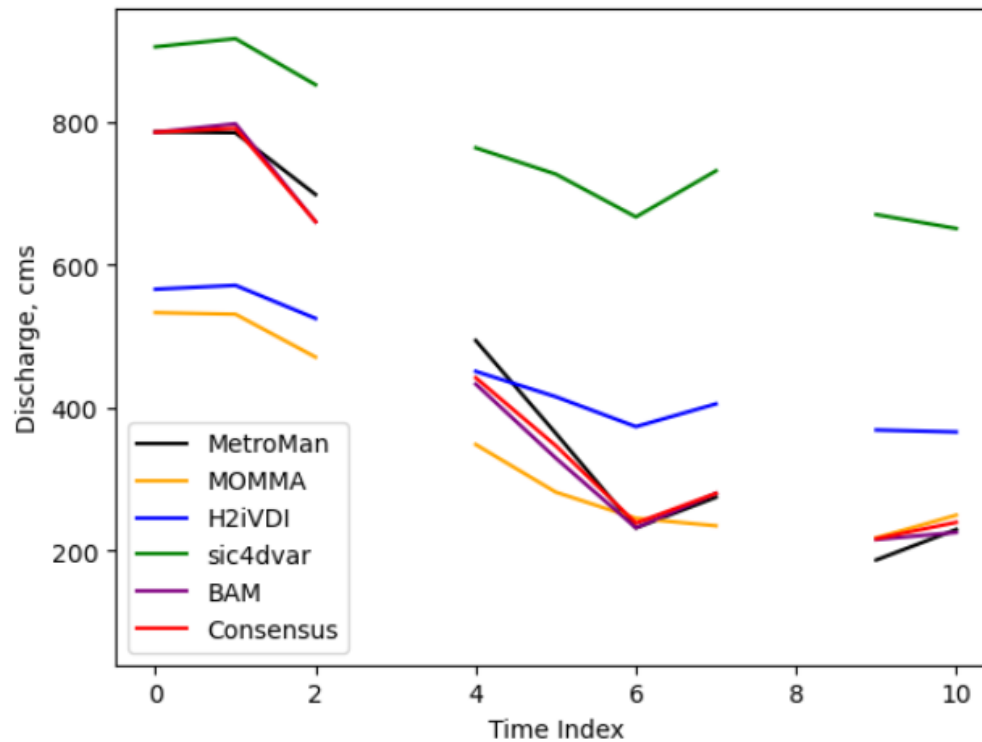
Post-processing for SWOT discharge on the Garonne

Garonne Stage 3



Our reach from above

reach 23214100011

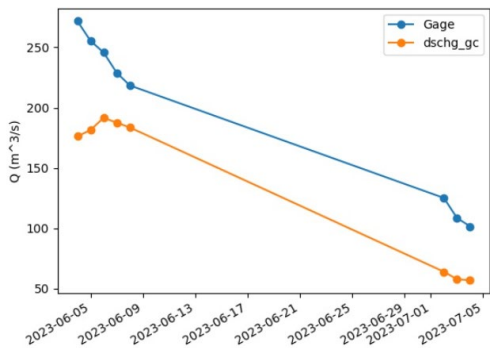


Validation on the Garonne

Stats now include:

NSE, Rsq, KGE, RMSE, nRMSE, nBIAS, rRMSE, testn

Reach 23214400041



```
# validation  
V_df.loc[V_df['testn']>9]
```

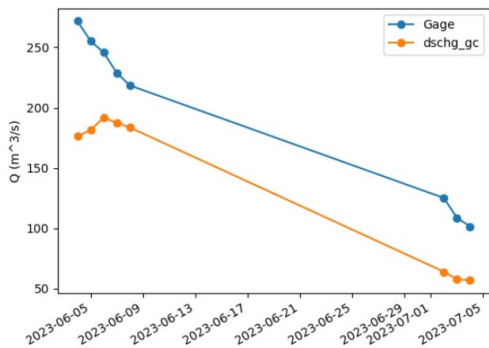
	Reach_id	algorithm	NSE	Rsq	KGE	RMSE	nRMSE	nBIAS	rRMSE	testn
0	23214100051	dschg_gb	-2.655095	0.852118	-1.870416	317.741205	1.176772	0.478394	1.075142	10.0
28	23214100031	dschg_gb	-21.490460	0.966802	-1.488420	404.267915	1.081449	0.704291	0.820674	11.0
29	23214100031	dschg_gh	-7.995114	0.901257	-1.666032	439.653467	1.133913	0.751999	0.848680	10.0
42	23214400041	dschg_gb	-0.968321	0.921523	0.657475	54.967237	0.327588	-0.301114	0.129013	11.0
56	23214700011	dschg_gb	-3.772990	0.655221	-1.267177	80.888859	0.925838	0.513037	0.770694	10.0

Validation on the Garonne

Stats now include:

NSE, Rsq, KGE, RMSE, nRMSE, nBIAS, rRMSE, testn

Reach 23214400041



```
# validation
V_df.loc[V_df['testn']>9]
```

	Reach_id	algorithm	NSE	Rsq	KGE	RMSE	nRMSE	nBIAS	rRMSE	testn
0	23214100051									10.0
28	23214100031									11.0
29	23214100031									10.0
42	23214400041									11.0
56	23214700011	dschg_gb	-3.772990	0.655221	-1.267177	80.888859	0.925838	0.513037	0.770694	10.0

Still well outside mission goals, but reasonable for no crossover calibration and a processing gap

Conclusion

- The Confluence development team is very pleased with our current progress and excited to run on new reprocessed data
 - Ahead of where we thought we would be
- We are confident that the majority of confluence algorithms are operating as intended
- Still well outside mission goals, but reasonable for no crossover calibration and a processing gap