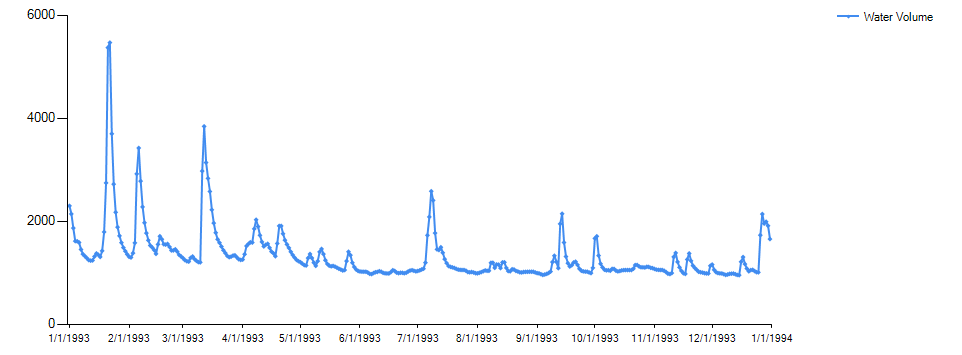
**Programmer test log – AQUATOXVolumeModel, JSON vs. AQUATOX 3.2**

**JSON test logs in the hms\_backend\Stream.Hydrology\AQUATOX\TEST folder**

12/20/2017, AQUATOXVolume model reproduces results from East Fork Poplar Creek TN from AQUATOX 3.2



Results from AQUATOX\_Volume\_Model\_PTest1.JSON above



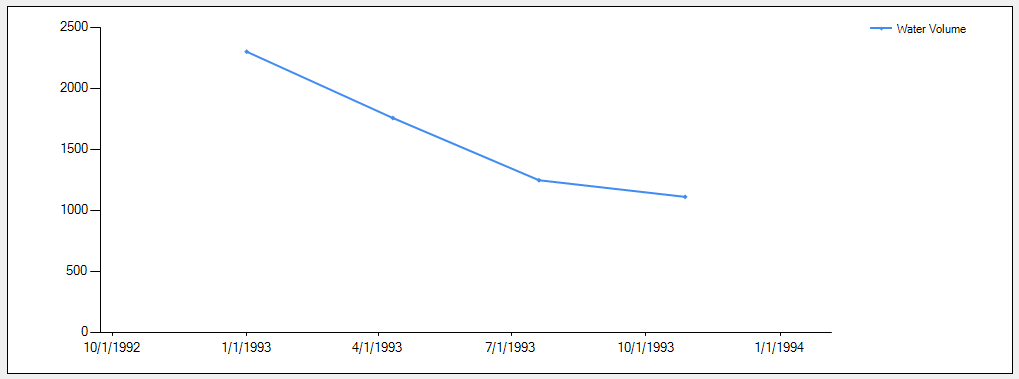
Results from AQUATOX 3.2

1/26/2018, testing of AQUATOX trapezoidal integration and instantaneous output

100-day timestep



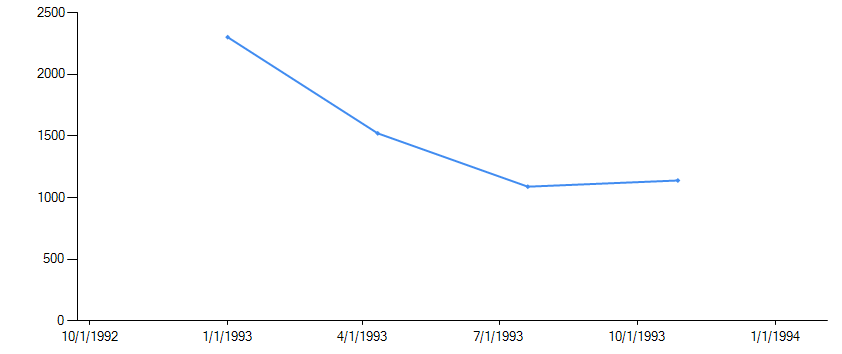
Results from AQUATOX\_Volume\_Model\_PTest2.JSON below



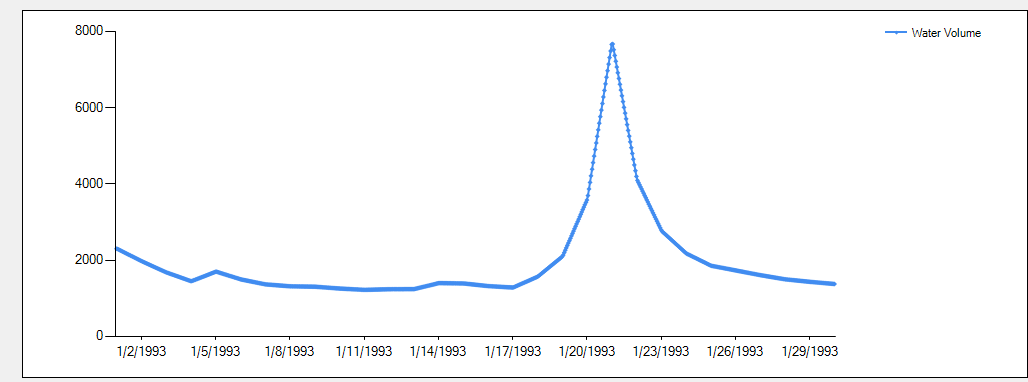
Results are essentially identical -- AQUATOX does print final time step though it does not have a 100-day averaging period.

1/26/2018, test instantaneous conc vs. AQUATOX output

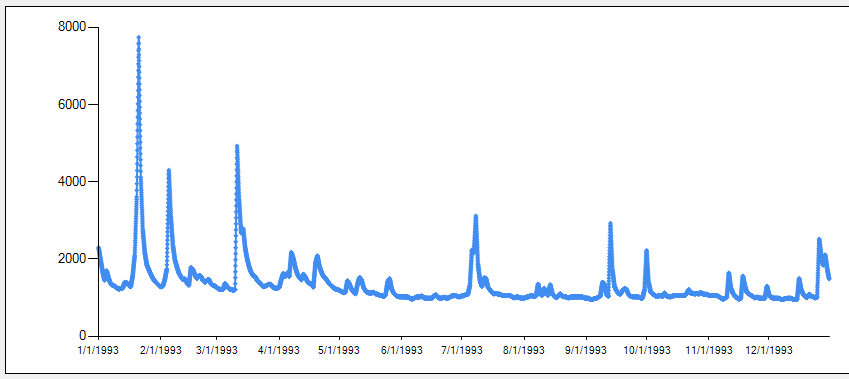
Results from AQUATOX\_Volume\_Model\_PTest3.JSON above (re-run 3/9/2018)



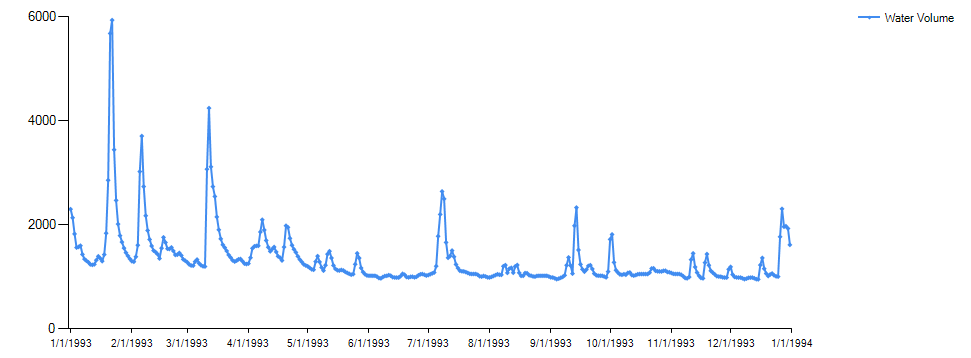
1/26/2018, test hourly output, run for two days – results evenly spaced and consistent with trapezoidal integration, (30 day test in AQUATOX\_Volume\_Model\_PTest4.JSON)



And with instantaneous concs (1 year test in AQUATOX\_Volume\_Model\_PTest5.JSON)



3/9/2018, Re run of AQUATOXVolume model using new JSON format (JSON.NET): Model reproduces results from East Fork Poplar Creek TN from AQUATOX 3.2



Results from AQUATOX\_Volume\_Model\_PTest1.JSON above **– re-run 3/9/18**



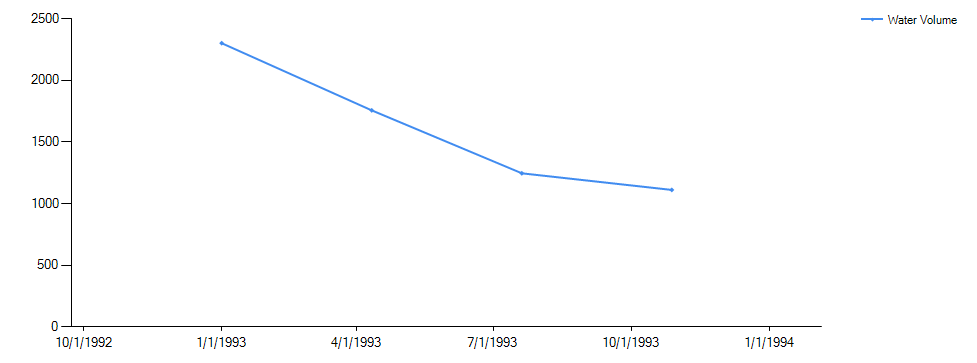
Results from AQUATOX 3.2

1/26/2018, testing of AQUATOX trapezoidal integration and instantaneous output

100-day timestep

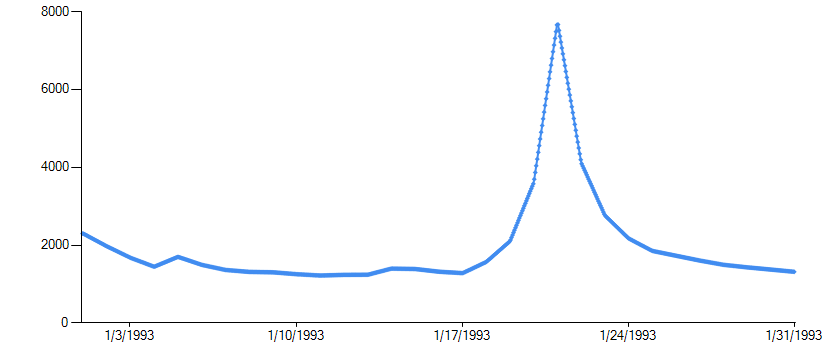


Results from AQUATOX\_Volume\_Model\_PTest2.JSON below **– re-run 3/9/18**

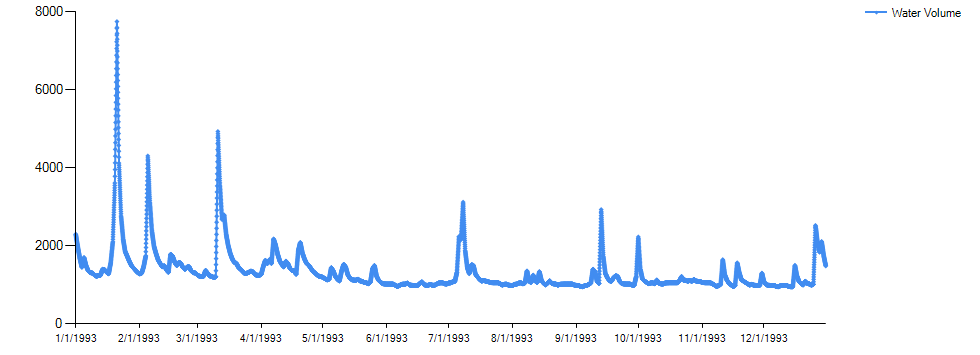


Results are essentially identical -- AQUATOX 3.2 does print final time step though it does not have a 100-day averaging period. HMS does not.

1/26/2018, test hourly output, run for thirty days – results evenly spaced and consistent with trapezoidal integration, (30 day test in AQUATOX\_Volume\_Model\_PTest4.JSON) **– re-run 3/9/18**

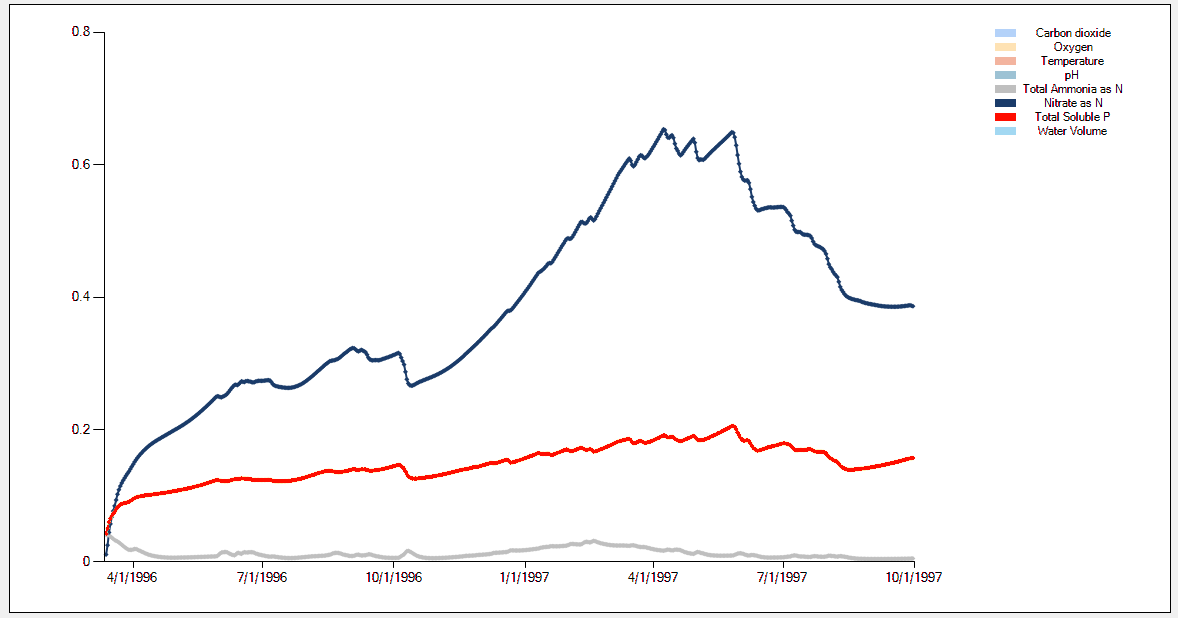


And hourly test with instantaneous concs (1 year test in AQUATOX\_Volume\_Model\_PTest5.JSON) **– re-run 3/9/18**



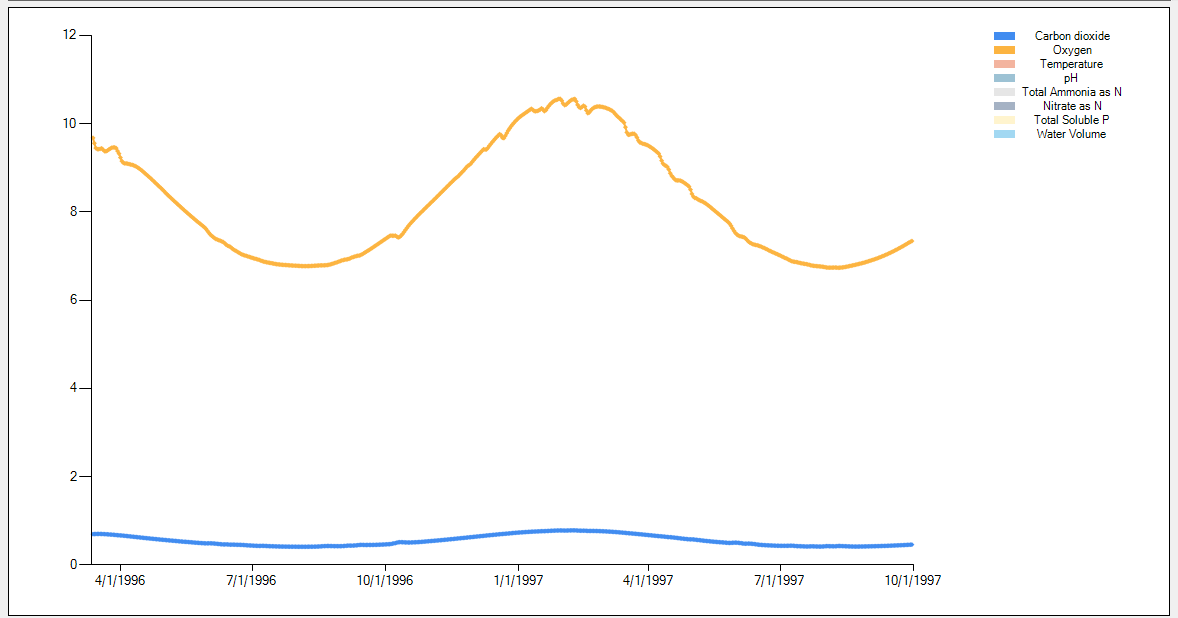
Lake Jesup FL Simplified\_NoResults.aps, Lake Jesup FL trimmed2.JSON





Ammonia, Nitrate, TSP Precisely matched 4/2/2018

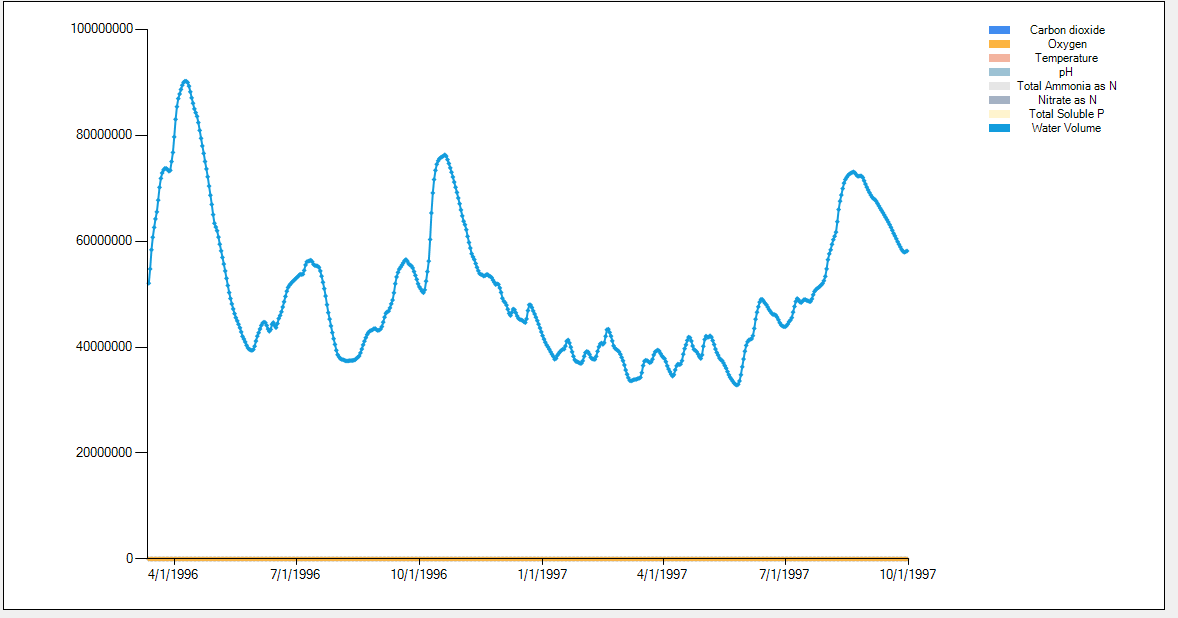
Lake Jesup FL Simplified\_NoResults.aps, Lake Jesup FL trimmed2.JSON



Oxygen, CO2 Precisely matched 4/2/2018

Lake Jesup FL Simplified\_NoResults.aps, Lake Jesup FL trimmed2.JSON



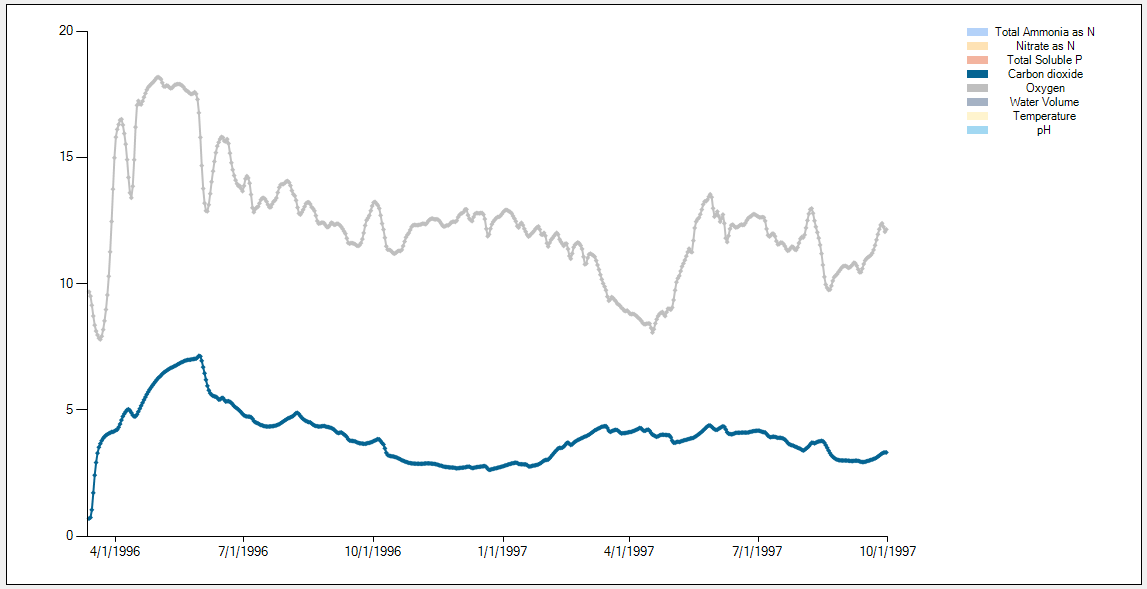


Water Volume Precisely matched 4/2/2018

Added linkages to AQUATOX animal / plant linkages:

* NH3 & NH4+ ASSIM\_JSONLINK (mg/L d)
* NH3 & NH4+ ANREMIN\_JSONLINK (mg/L d)
* NH3 & NH4+ PLREMIN\_JSONLINK (mg/L d)
* NH3 & NH4+ OMREMIN\_JSONLINK (mg/L d)
* NO3 ASSIM\_JSONLINK (mg/L d)
* TOT. SOL. P ASSIM\_JSONLINK (mg/L d)
* TOT. SOL. P ANREMIN\_JSONLINK (mg/L d)
* TOT. SOL. P PLREMIN\_JSONLINK (mg/L d)
* TOT. SOL. P OMREMIN\_JSONLINK (mg/L d)
* CO2 DETDECMP\_JSONLINK (mg/L d)
* CO2 RESPIRATION\_JSONLINK (mg/L d)
* CO2 CO2ASSIM\_JSONLINK (mg/L d)
* OXYGEN PHOTOSYN\_JSONLINK (mg/L d)
* OXYGEN RESPIRATION\_JSONLINK (mg/L d)
* OXYGEN NITRIFIC\_JSONLINK (mg/L d)
* OXYGEN CBOD\_JSONLINK (mg/L d)

Inputs are integrated over a day’s AQUATOX solution (stair-stepped) whereas when all state variables are included, inputs are included in sub-day timestep differential equations (4th & 5th order solutions)



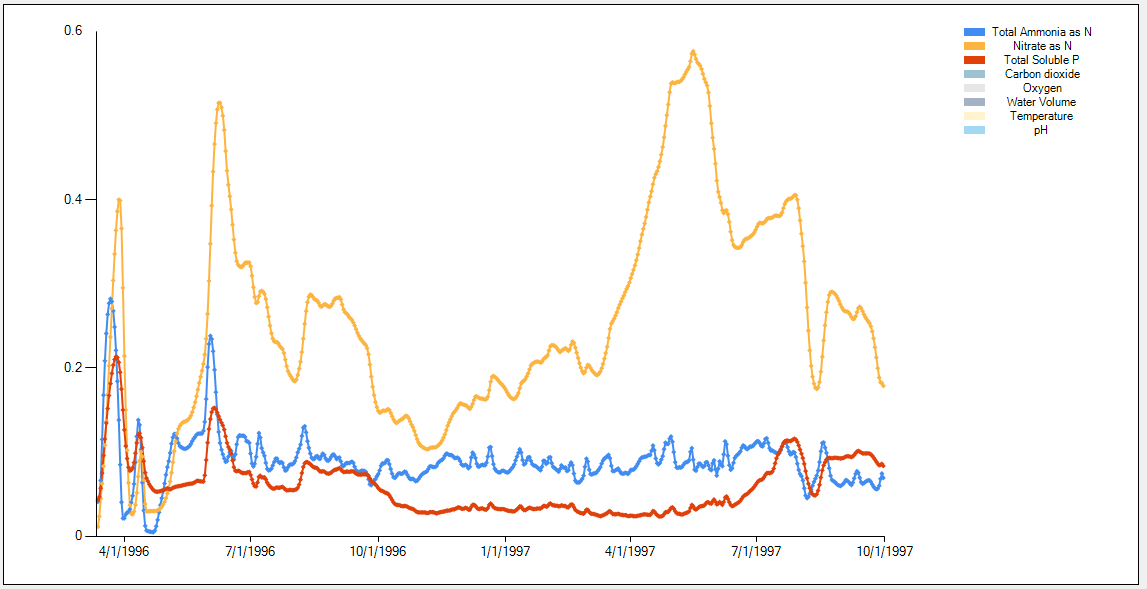
Oxygen and CO2 predictions are pretty much identical in magnitude and pattern

Top is LJ\_Complex2.JSON bottom is Lake Jesup FL.aps





Results are close but not precise, especially TSP and NO3. I will spend some time to determine if this is a function of step nature of derivative rates or another error.





This graph shows the lack of precision between NO3 and TSP results. I will run hourly simulations and save rates hourly to see if this increases precision.

Tested hourly time steps in both simulations-- no additional conformance. Passed hourly rates in – a good test of hourly-rate interface, but NO3 results are not significantly different: LJ\_Complex3\_hourlyNO3.JSON





Fixed a problem with JSON writing/reading loadings multipliers. This made results closer but still not precise. Looking into TSP discrepancy next.



Missing Calcite precipitation linkage. When added in, makes the results even closer!

4/4/2018: Confirmed that differences are caused by passage of daily data for intermediate derivative rates (e.g. assimilation rates for nutrients from algae). Switched to 1/10th of a day passage of data between AQUATOX 3.2 and AQUATOX HMS and the differences between the simulations disappear

(shortened simulation period as passage of data becomes burdensome.)

Lake Jesup FL\_0.1d\_rates.aps compared to LJ\_Complex3\_hourly\_rates.JSON