Hands-On Exercise #3: Q2K Simulation of Boulder Creek for N, P and Plants

The present hands-on example is intended to show you how nutrients (nitrogen and phosphorus) and floating (phytoplankton) and bottom (periphyton) plants (phytoplankton) are added to the model.

Getting Started

- Get Q2K up and running on your computer.
- Open the file: HOQ2KNPPhyto.q2k.
- Change the directory where the file is saved (cell B10 on the QUAL2K Worksheet) to the appropriate directory on your computer.
- Change the saved file name (cell B9 on the QUAL2K Worksheet) to HO3Q2KXXX, where XXX are your initials.
- Run the program.
- Look at the following spatial plots: Organic N, Organic P, Inorganic P, and Phytoplankton. Notice that all of these are zero.

Adding nitrogen and phosphorus boundary conditions and loadings

- Go to the Headwater Worksheet. Add the following constant boundary conditions:

  Organic Nitrogen = 1651 μgN/L
  NO3-Nitrogen = 166 μgN/L
  Organic Phosphorus = 39 μgP/L
  Inorganic Phosphorus (SRP) = 50 μgP/L

- Go to the Point Sources Worksheet. Add the following concentrations for the loading for the Boulder WWTP:

Pollutant	Mean	Range/2	Time of Max
Organic N	5000		
Nitrate	2390		
Organic P	550		
Inorganic P	3931		

- Run the program. Look at the organic N, ammonium N, nitrate N, organic P and inorganic P spatial plots. Do you anticipate that this system is limited by nitrogen, phosphorus or neither?

Adding phytoplankton to the system

- Go to the Headwater Worksheet. Add a phytoplankton boundary condition of 40 μgA/L (By the way, that's a lot of phytoplankton. About the only way that such high levels would occur

Run the program. Look at the phytoplankton plot.

Look at the organic N, ammonium N, nitrate N, organic P and inorganic P spatial plots.

Finally, look at the oxygen plots (both spatial and diel).

Are the phytoplankton having a big effect on this system?

Try a sensitivity analysis. Increase the phytoplankton growth rate to 5/d (which is a very high rate) and set the phytoplankton settling velocity to zero. Are you growing plants? Also recheck the oxygen plots to see if the changes have had any major impact on the DO.

Before proceeding set the growth rate back to 2.5/d and the settling velocity back to 0.25 m/d.

Adding periphyton to the system

Up to this point, there are no periphyton in the simulation. This is because we have set their growth rate to zero.

- Go to the Rates Worksheet. In cell B79, set the maximum growth rate for the bottom algae as 300 mgA/m^2/d. Run the model.

- Look at what has happened to the dissolved oxygen (look at both the spatial and diel plots).

- In addition, look at the plots for bottom algae and the nutrients.

- Just for “hah-has,” switch the reaeration model on the Rates sheet to the Internal option and check out oxygen. Pretty sobering, huh!?!?