U.S. Fish & Wildlife Service

Arthur R. Marshall
Loxahatchee National Wildlife Refuge

Model Equations and Structure

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Findings from the CMF Model
(Workshop 1)

- Chloride
  - modeled well as a conservative
- Sulfate
  - modeled using apparent settling rate, k_s
  - K_s varied spatially, approximated zero order removal
- Total Phosphorus
  - Used k-c* model
  - Followed transients in canal & peripheral marsh
  - Not reliable in interior, did not model transients well

MIKE-FLOOD/ECO Lab Equations

Rate of mass accumulation =

+ Mass inflow - mass outflow
+ Dispersion in – out
+ Production - disappearance

$$A_{cell}\frac{dhc}{dt} = Q_i c_i - Q_o c_o + disp + source - k_s c$$

Inflow – aerial deposition

Wet deposition = rain rate * rain concentration

Dry deposition = loading rate

Outflow – ET (evapotranspiration)

Evaporation = does not transport mass

Transpiration = ET * % Trans * C

Source-Sink: Chloride

- Chloride is assumed to be conservative and has no other source or sink terms

Source-Sink: Sulfate

- No internal source
- First order apparent settling at low concentration
- Constant disappearance flux rate (zero order) independent of *c* at high concentration
- Transition is modeled using Monod relationship with half-saturation constant

$$\frac{dhc}{dt} = (\ldots) - k_0 \frac{c}{k_{1/2} + c}; \qquad k_s = \frac{k_o}{k_{1/2}}$$

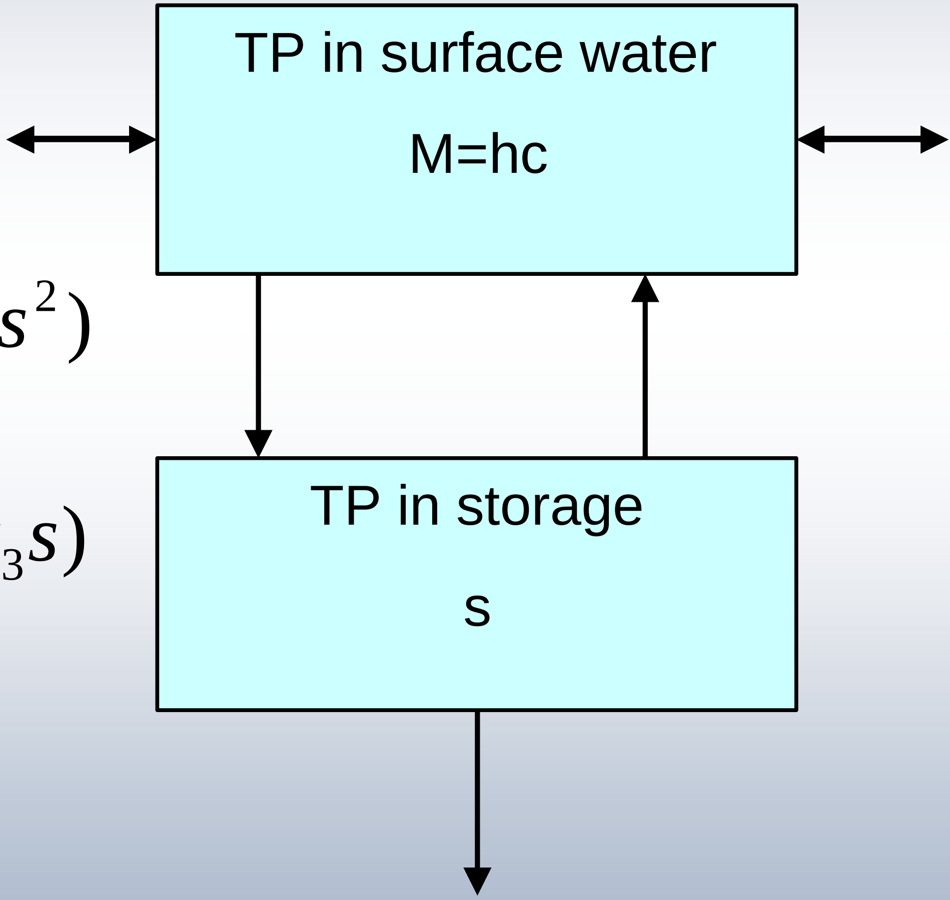
Source-Sink: Total Phosphorus (TP)

- TP is modeled using equations structured as in DMSTA (http://www.wwwalker.net/dmsta/index.htm)
- TP is assumed to have 2 state-variables
  - surface water component (transports)
  - storage component (stationary)
- TP moves into and out of storage
- TP in storage can be permanently lost to burial

TP Model Structure

$$\frac{dhc}{dt} = (\ldots) - (f_c f_z k_1 sc) + (k_2 s^2)$$

$$\frac{ds}{dt} = (f_c f_z k_1 sc) - (k_2 s^2) - (k_3 s)$$



TP Model Structure:

At steady-state this model can be re-parameterized to the k-c* model

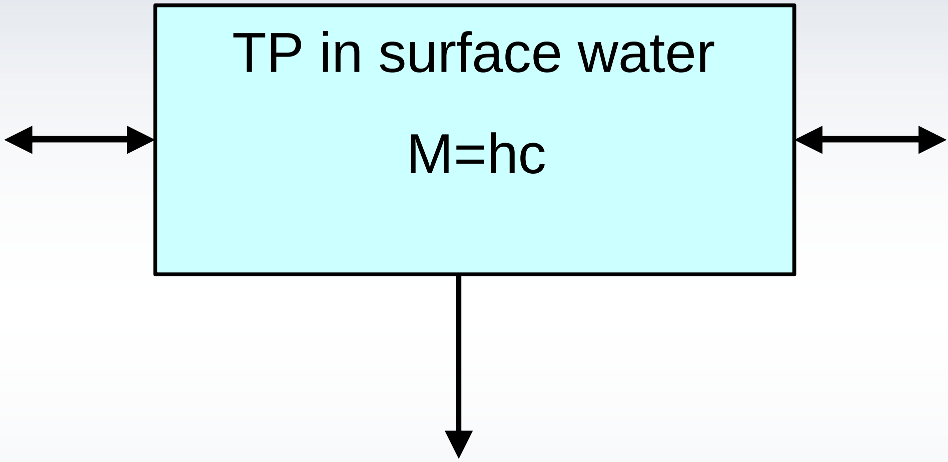
$$\frac{dhc}{dt} = (...) - k_S(c - c^*)$$

$$k_S = k_1 k_3 / k_2$$

$$c^* = k_3 / k_1$$

$$c_1 = (1000k_2 + k_3)/k_1$$

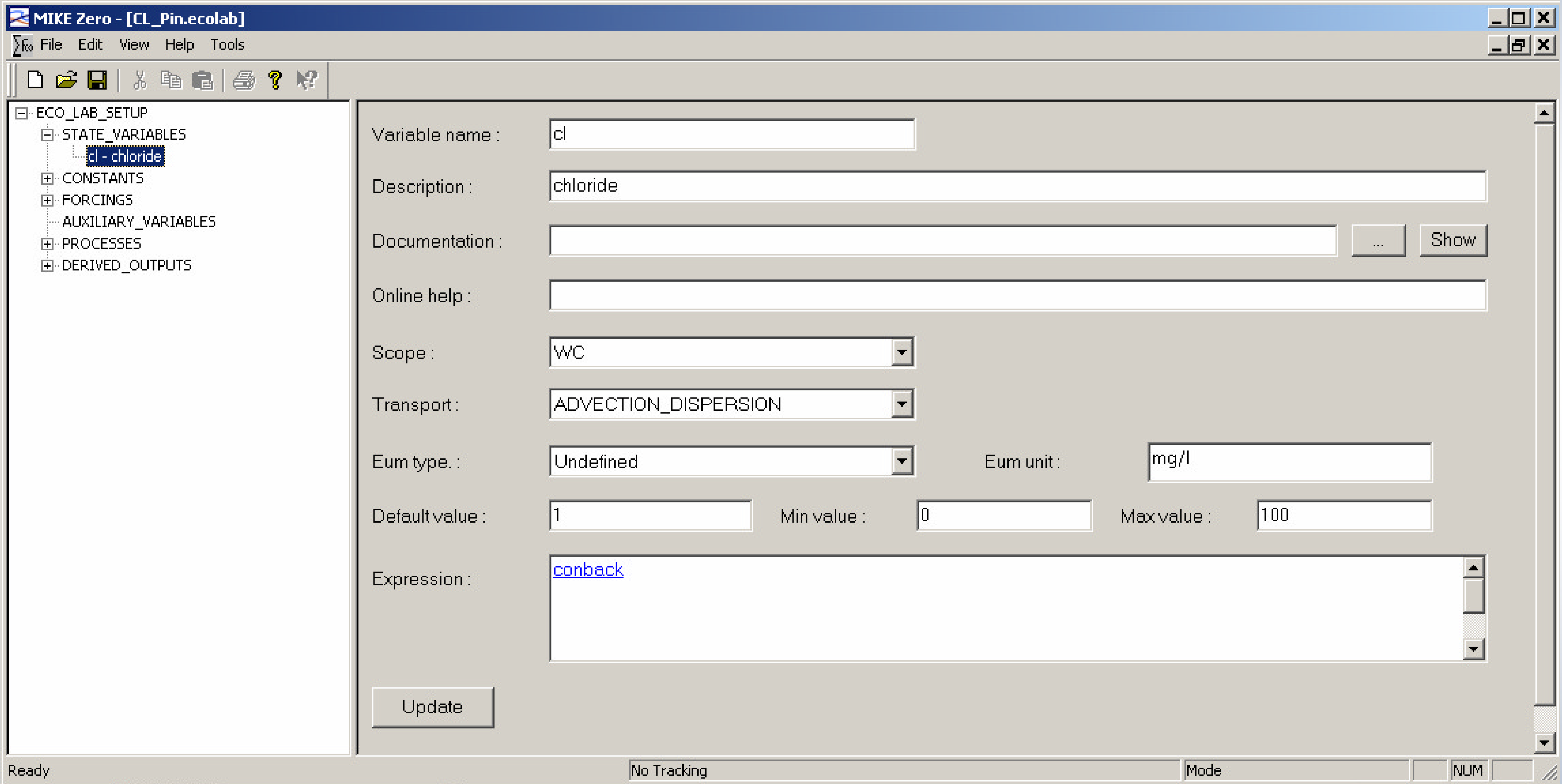
$$c_1 = steady - state\ c\ when\ s = 1000g/m^2$$



Eco LAB Setup

- State variables
- Constants
- Forcings
- Auxiliary variables
- Processes
- Derived outputs

EcoLab User Interface



Questions?