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Data Integration and Synthesis Framework for Understanding the Phosphorus Cycling and Reduction Mechanisms in STA Flow-ways

FOR THE
#GATORGOOD

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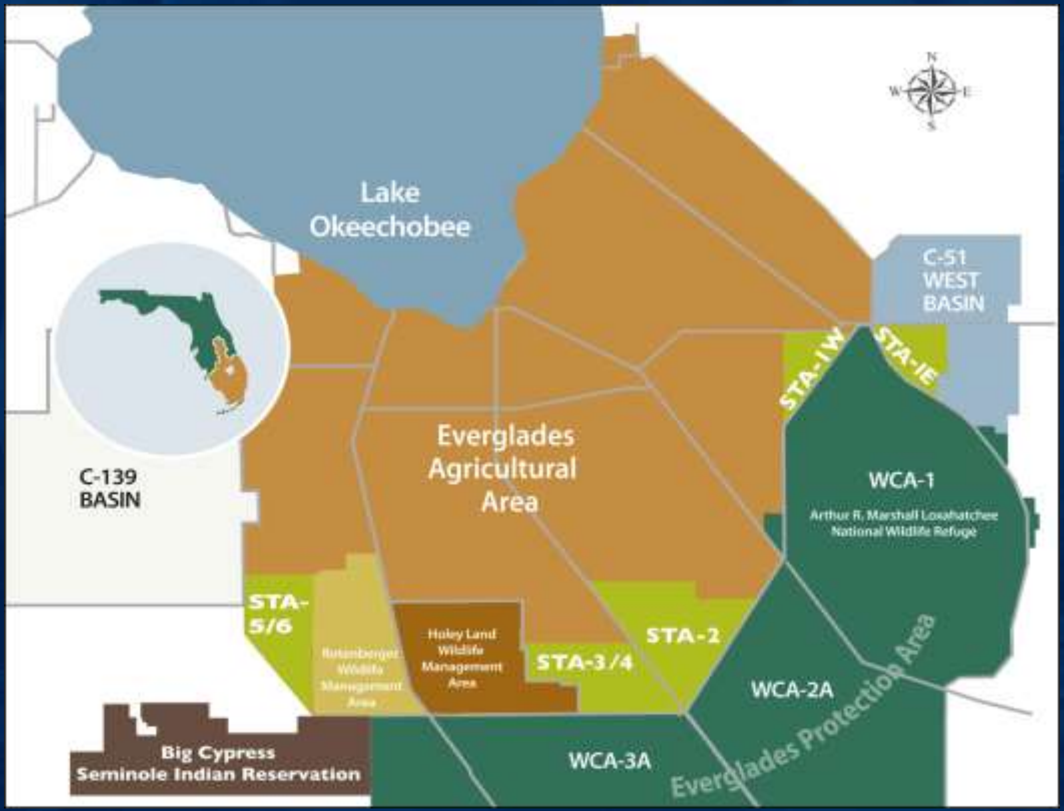
Stormwater treatment areas (STAs)



Conceptual Model of a STA

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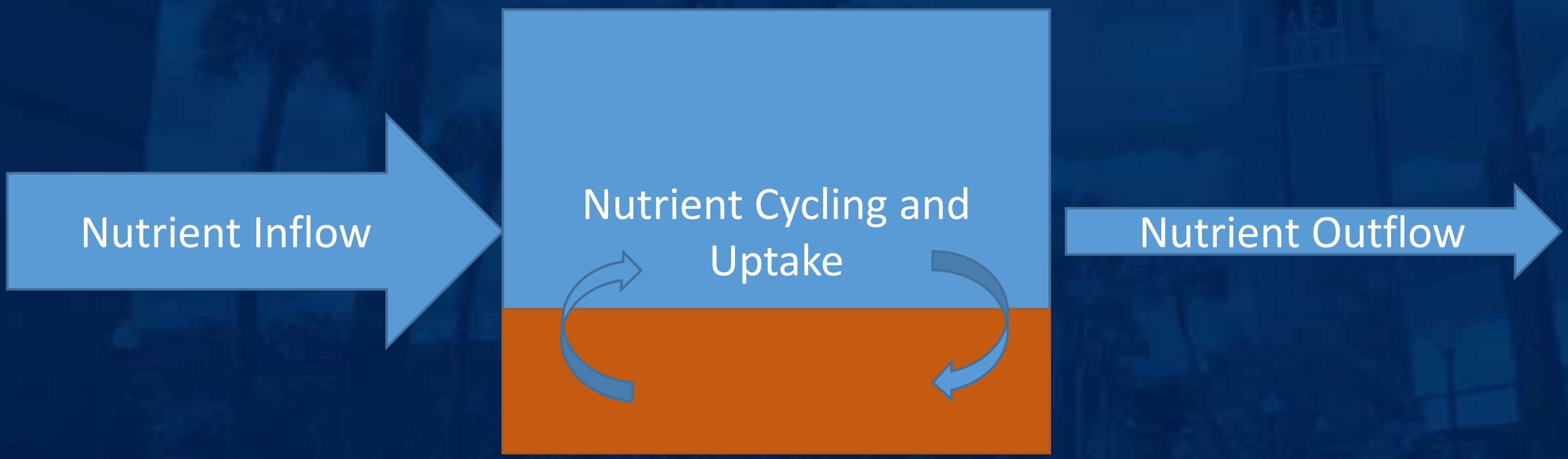
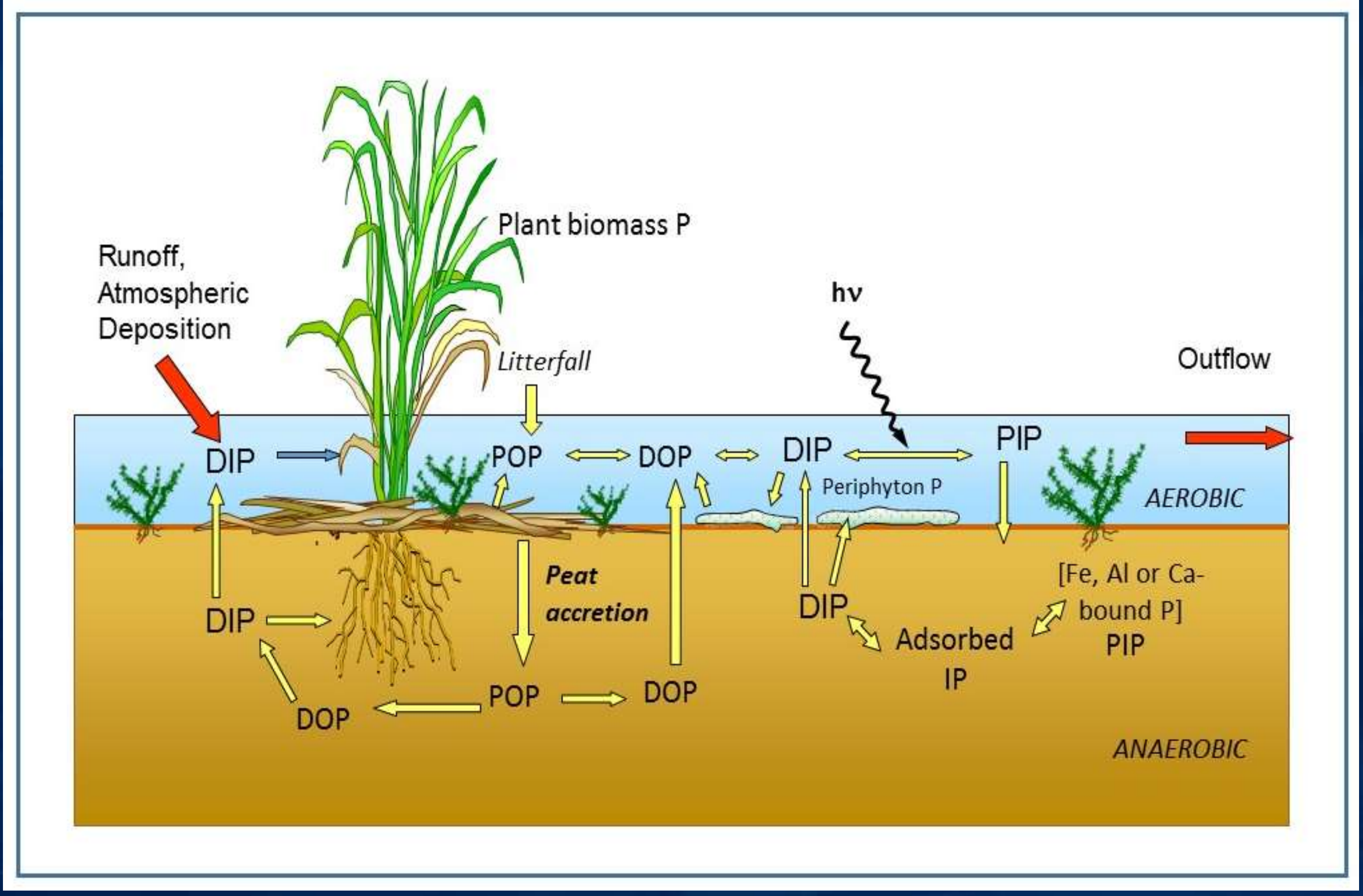
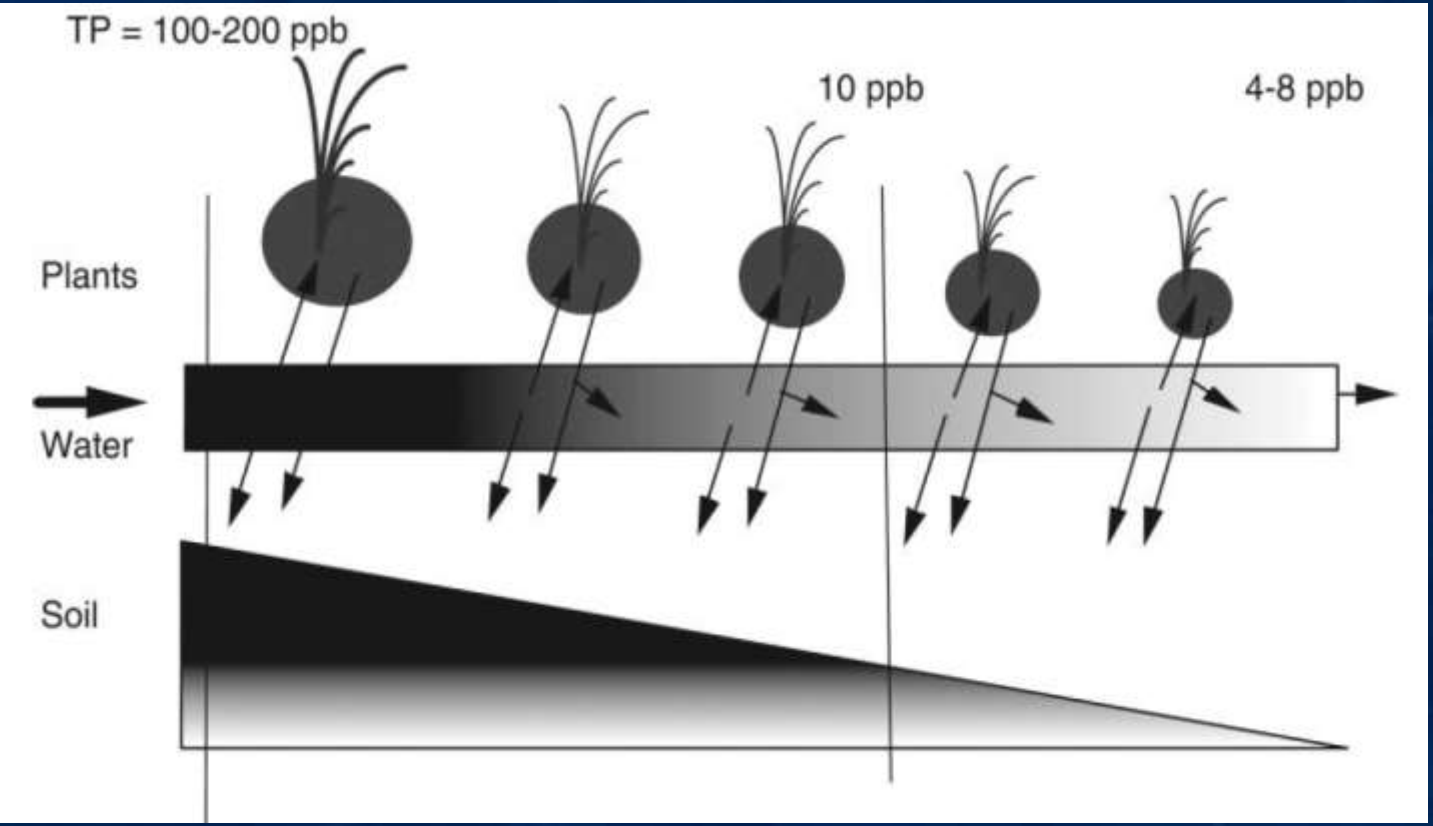


It’s more complicated …



Things change along the flow-way within an STA



Walker and Kadlec, 2011

Key Management Questions…

Can internal loading of phosphorus (P) to the water column be reduced or controlled, especially in the lower reaches of the treatment trains?

Can the biogeochemical or physical mechanisms be managed to further reduce soluble reactive, particulate and dissolved organic P concentrations at the outflow of the STAs?

…and associated scientific inquiries

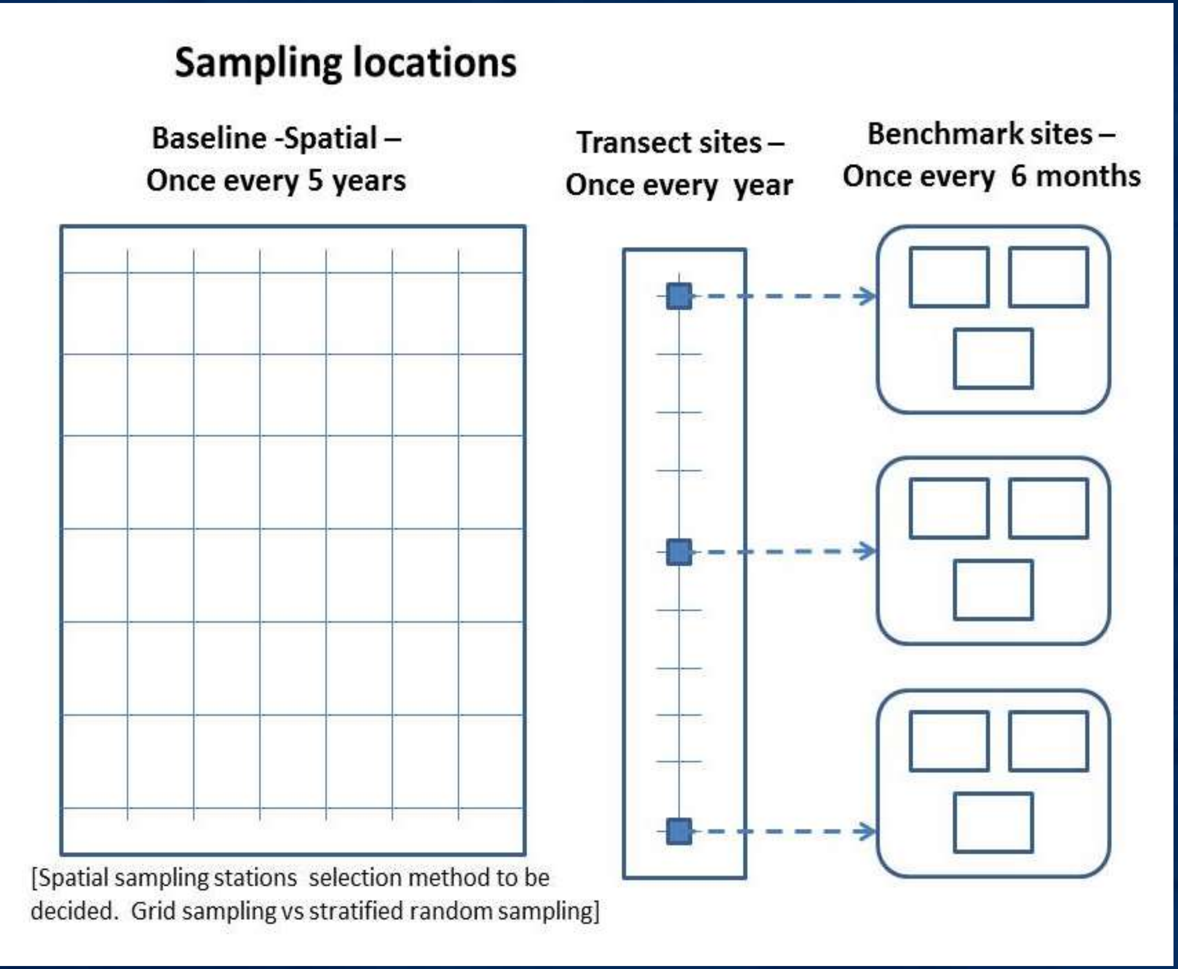
Can internal loading of phosphorus (P) to the water column be reduced or controlled, especially in the lower reaches of the treatment trains?

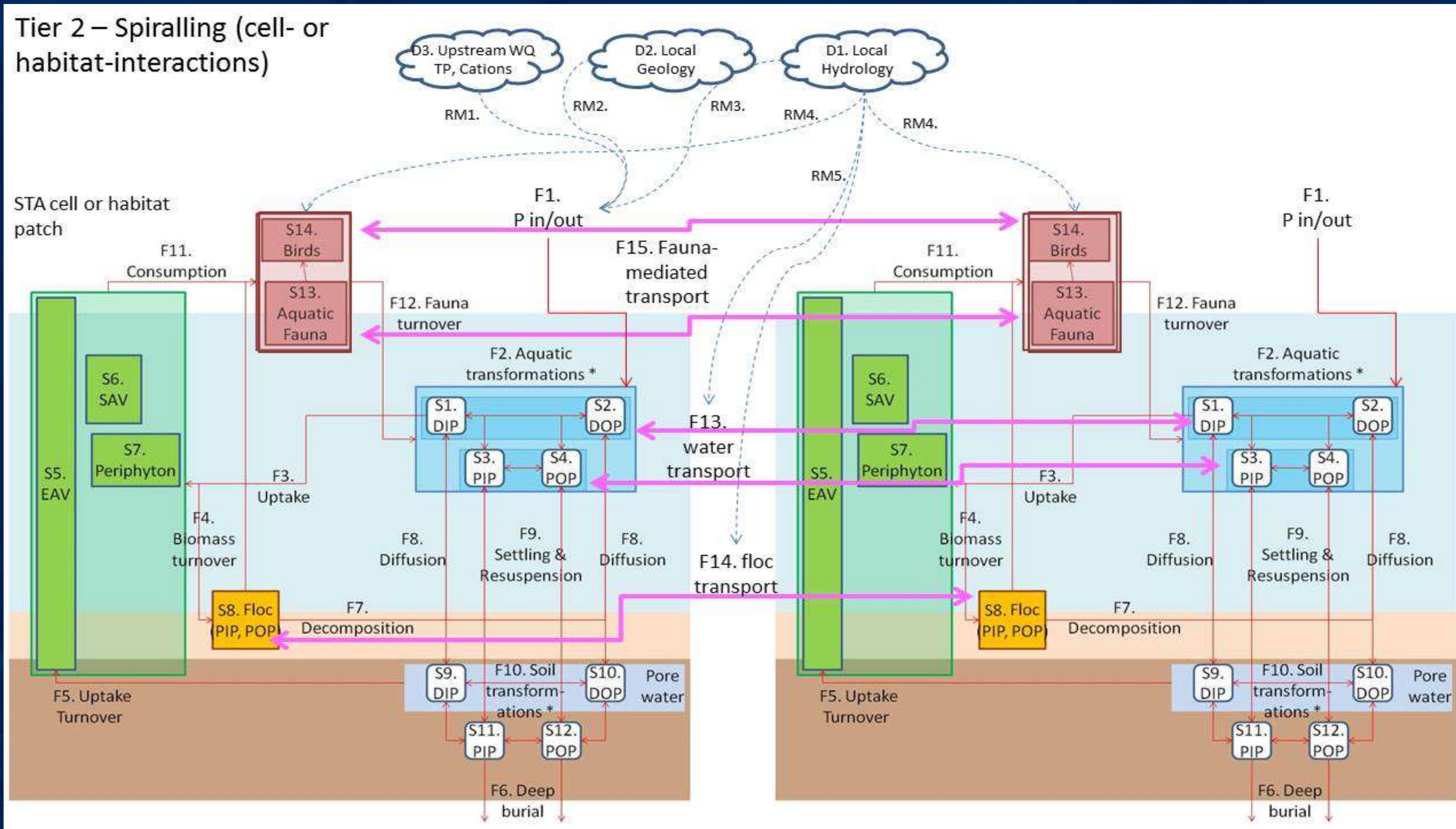
What processes contribute to internal load

Can the biogeochemical or physical mechanisms be managed to further reduce soluble reactive, particulate and dissolved organic P concentrations at the outflow of the STAs?

What factors control these processes?

Sampling along flowpath





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Data Integration

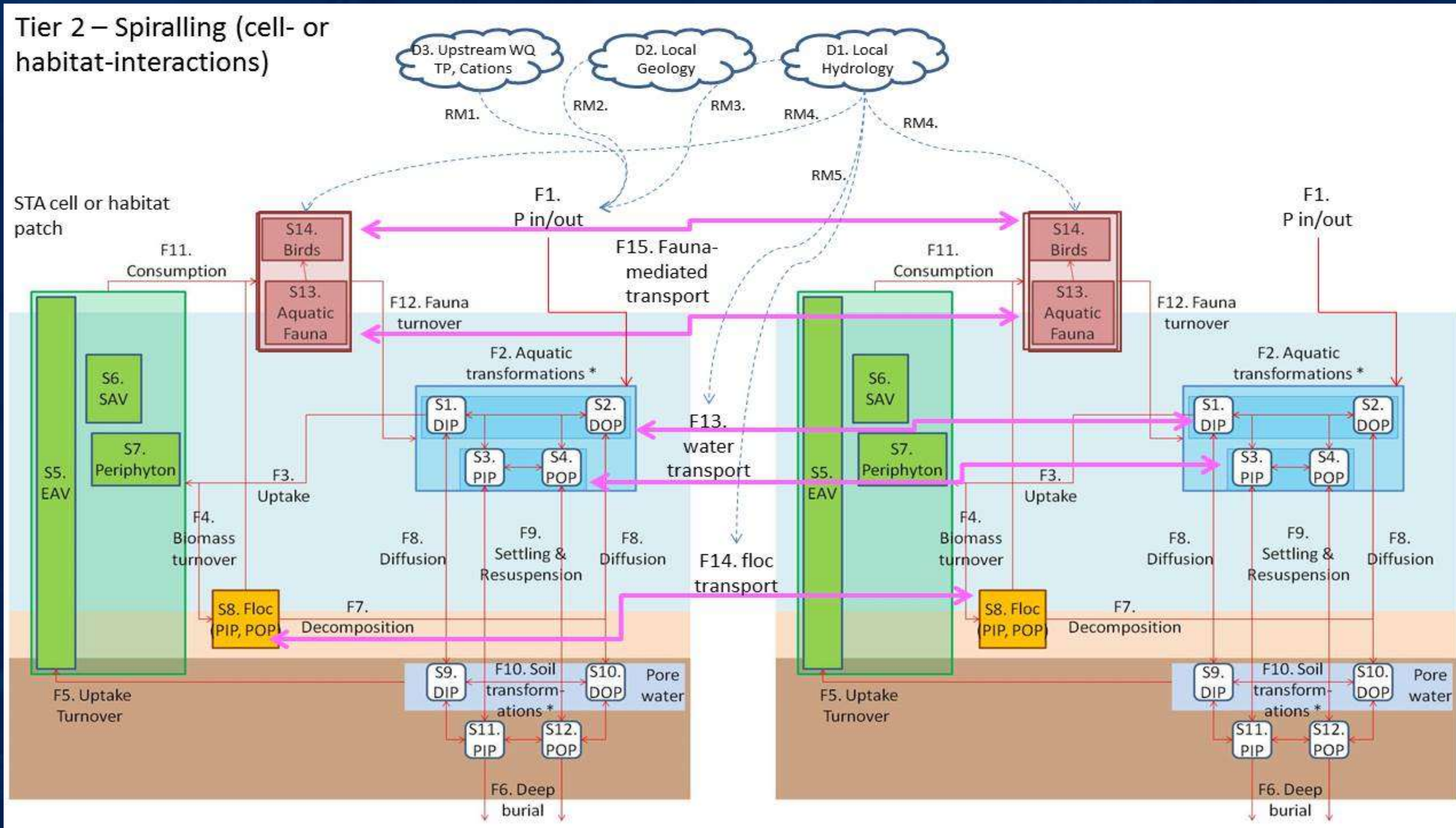
How can the different measured variables be linked to form a coherent picture?

Hypothesis Testing

Data Stream 1 ~ Data Stream 2

Forward (mechanistic) Modeling:

f(Drivers,Parameters) ~ Data



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Data Integration

System Understanding

f(Drivers,Processes) ~ Data

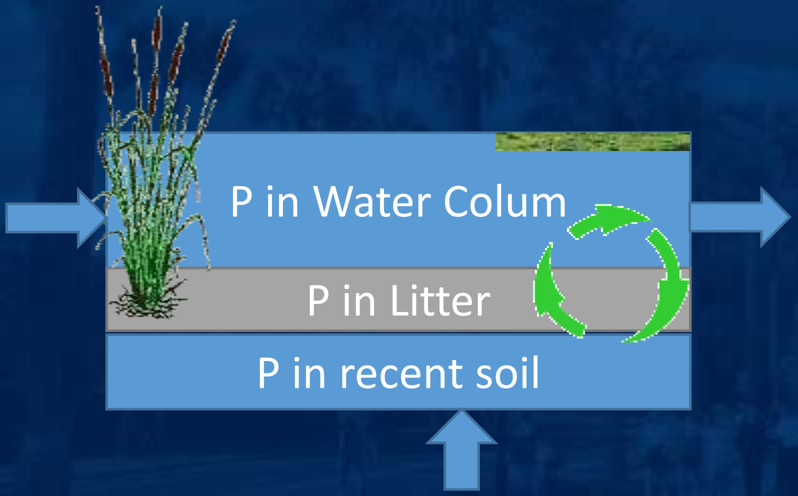
Model

f(Drivers,Parameters) ~ Data

Processes = g(parameters, model formulation)

“Mechanistic” model

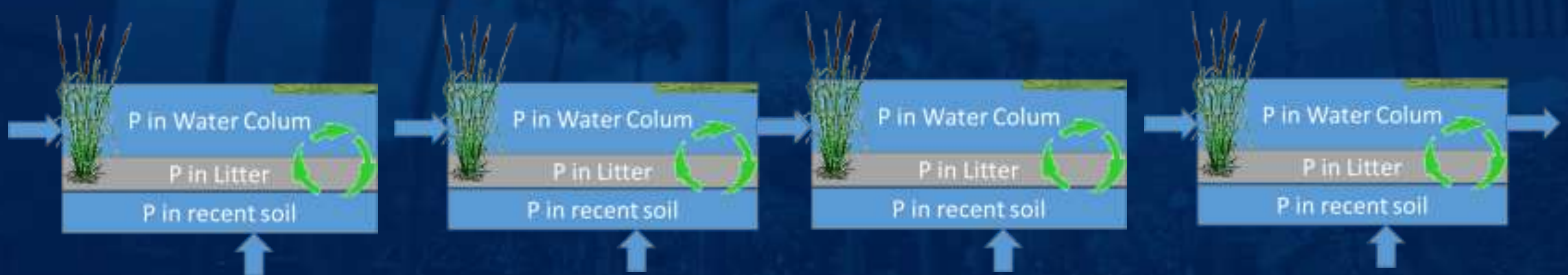
Simple 1 dimensional model allowing biogeochemical variables to change along flow-path: Nutrients in the water column exchange with local environment while being carried downstream (Spiraling).

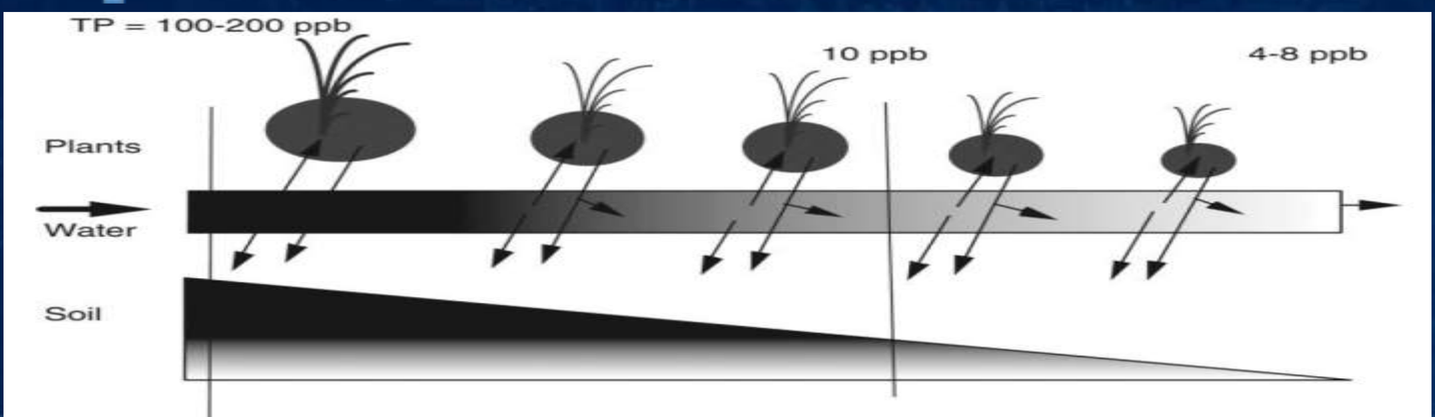


Overall uptake efficiency: sum of all individual efficiencies

Using mechanistic model

Simple 1 dimensional model allowing biogeochemical variables to change along flow-path: Nutrients in the water column exchange with local environment while being carried downstream (Spiraling).





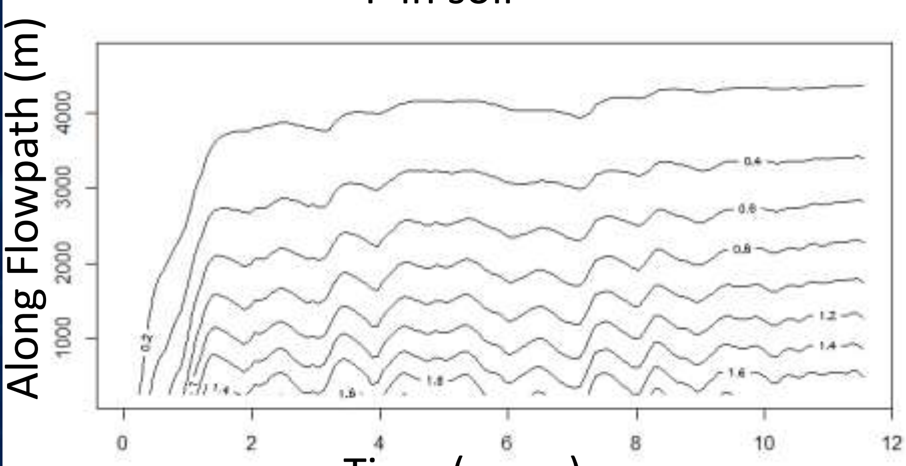
Spiraling Framework (bottom up)

$$dP_x/dt = -u_x * dP/dx + S_x/h - k/h * P$$

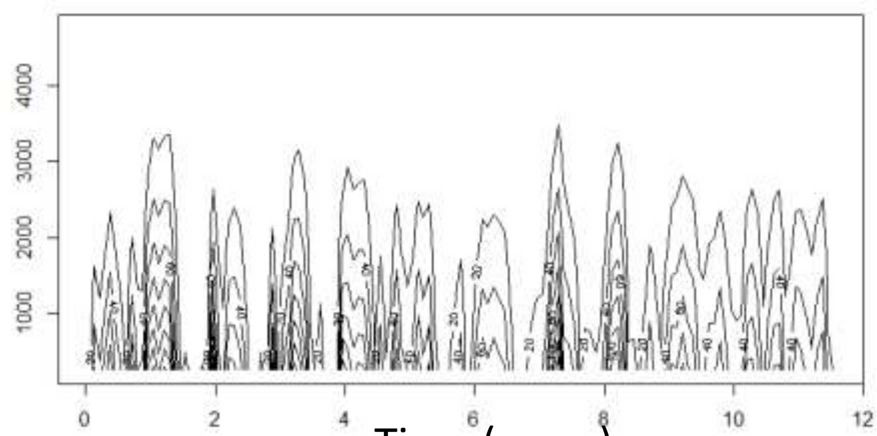
Change = Advection from upstream + local source – removal

Local source changes through time

P in soil



P in water column



Data Integration

Model

f(Drivers,Parameters) ~ Data

System Understanding

f(Drivers,Processes) ~ Data

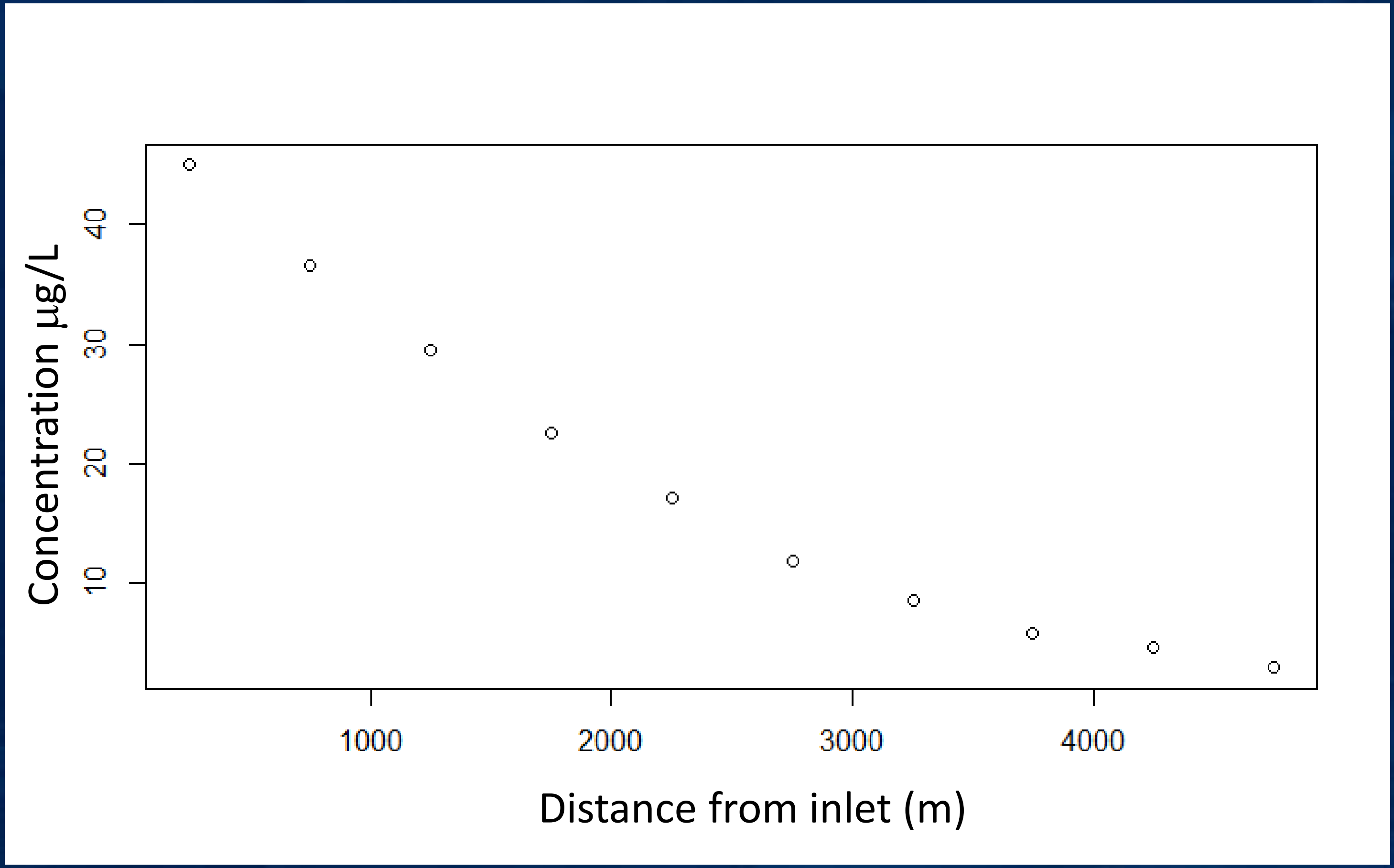
Processes = g(parameters, model formulation)

f(Drivers,Parameters) ~ Predictions **Sensitivity Analysis**

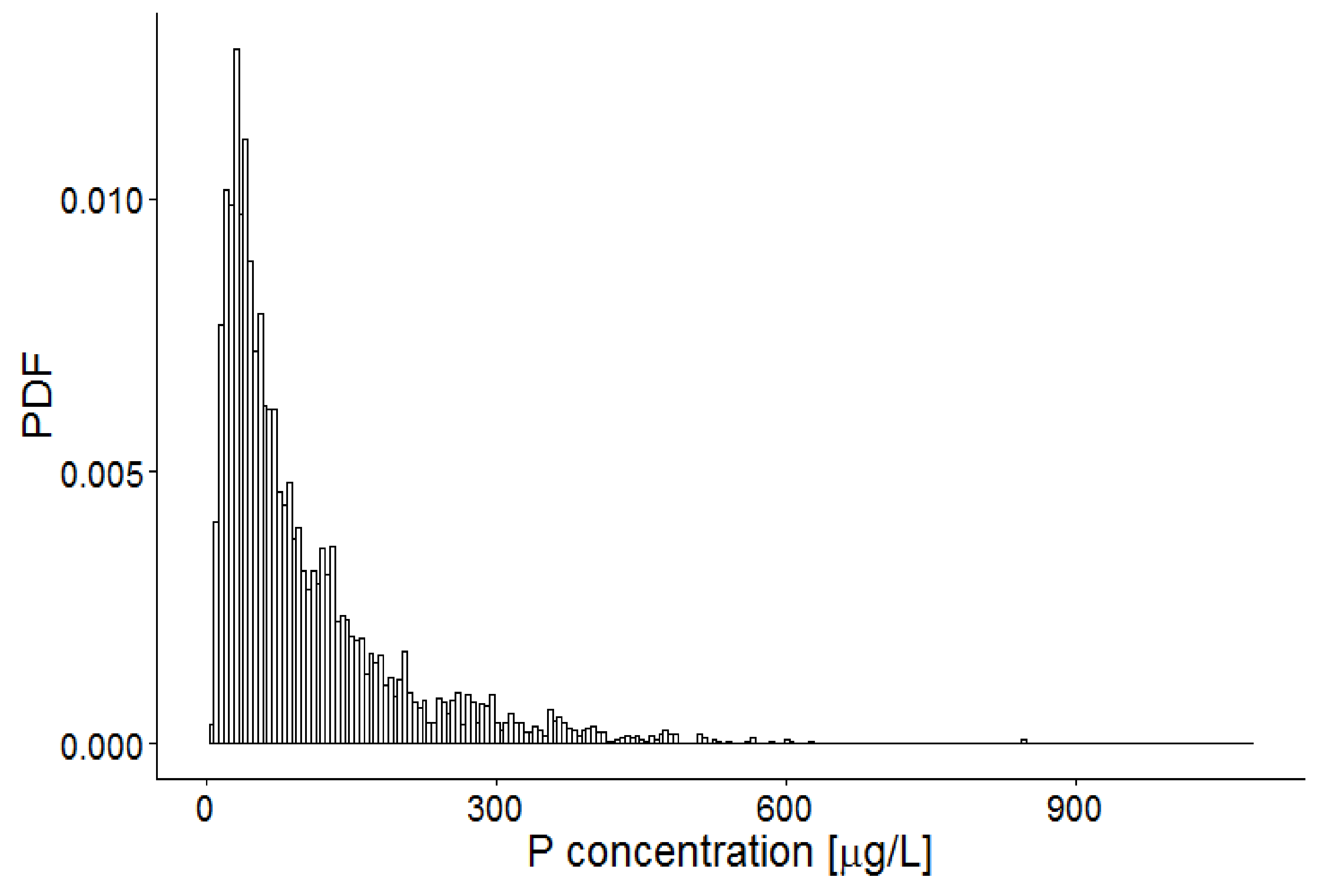
f(Drivers,Parameters)~Data | Parameters **Inversion**

f(Drivers,Parameters) – Data **What's missing**

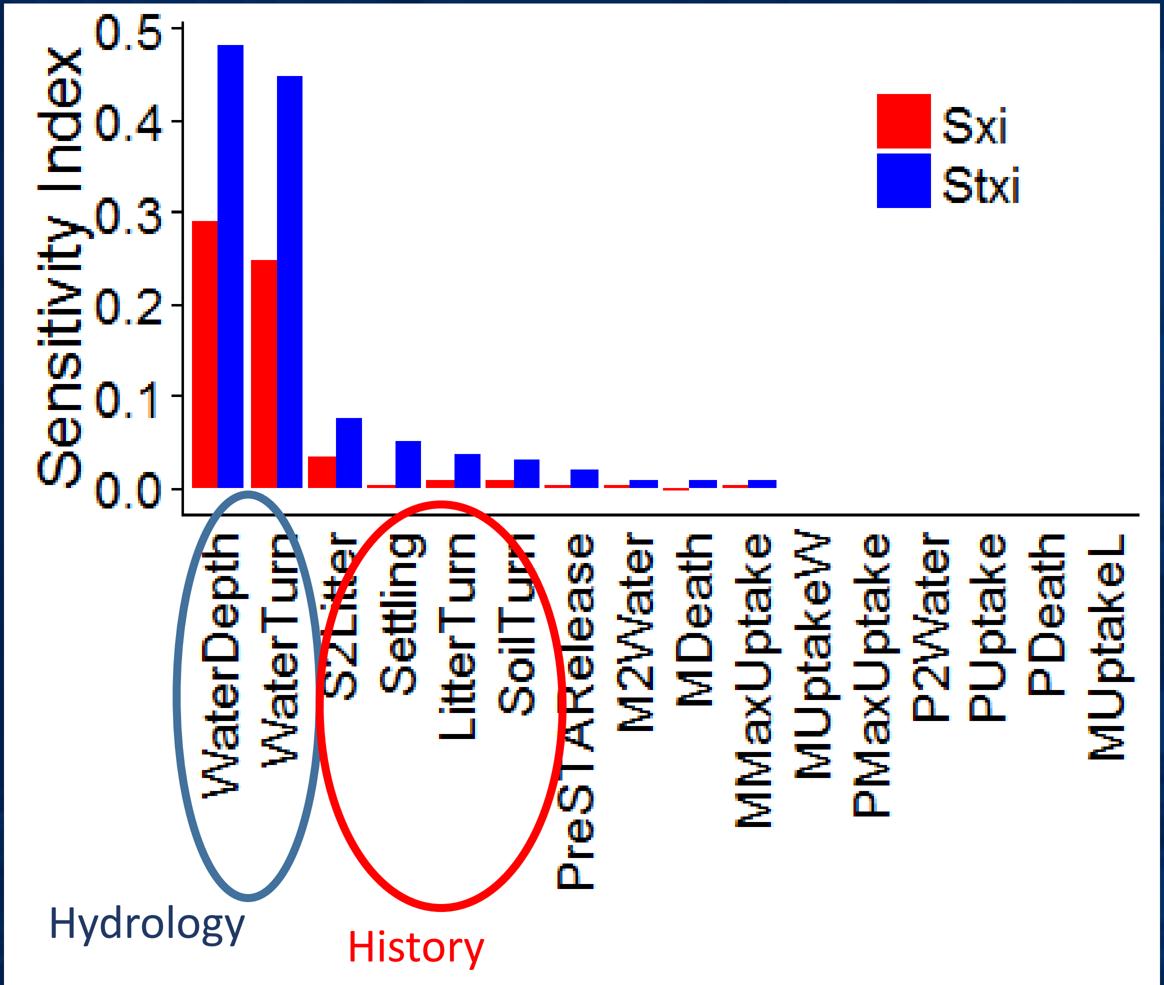
Forward Model



Sensitivity Analysis

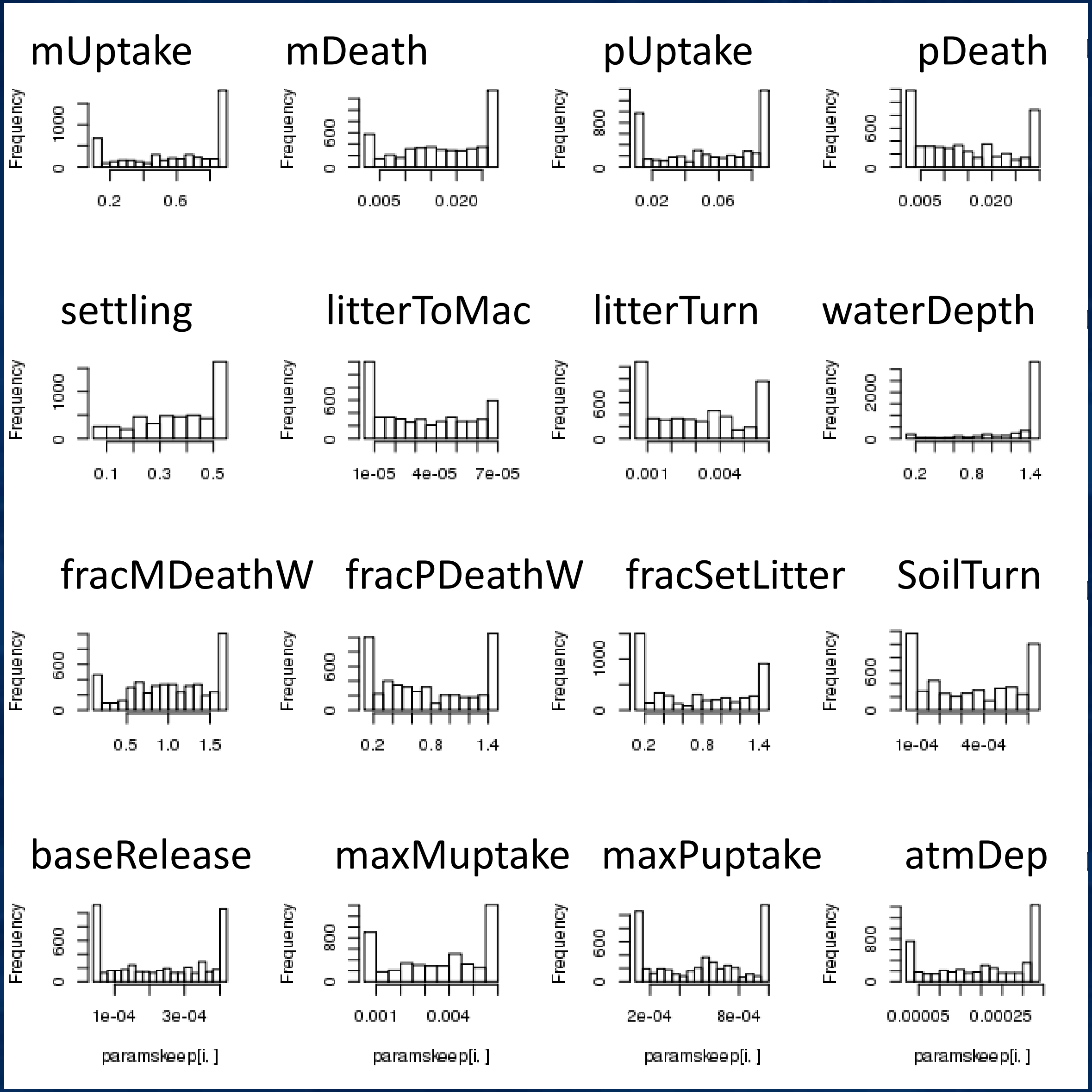


Sensitivity Analysis

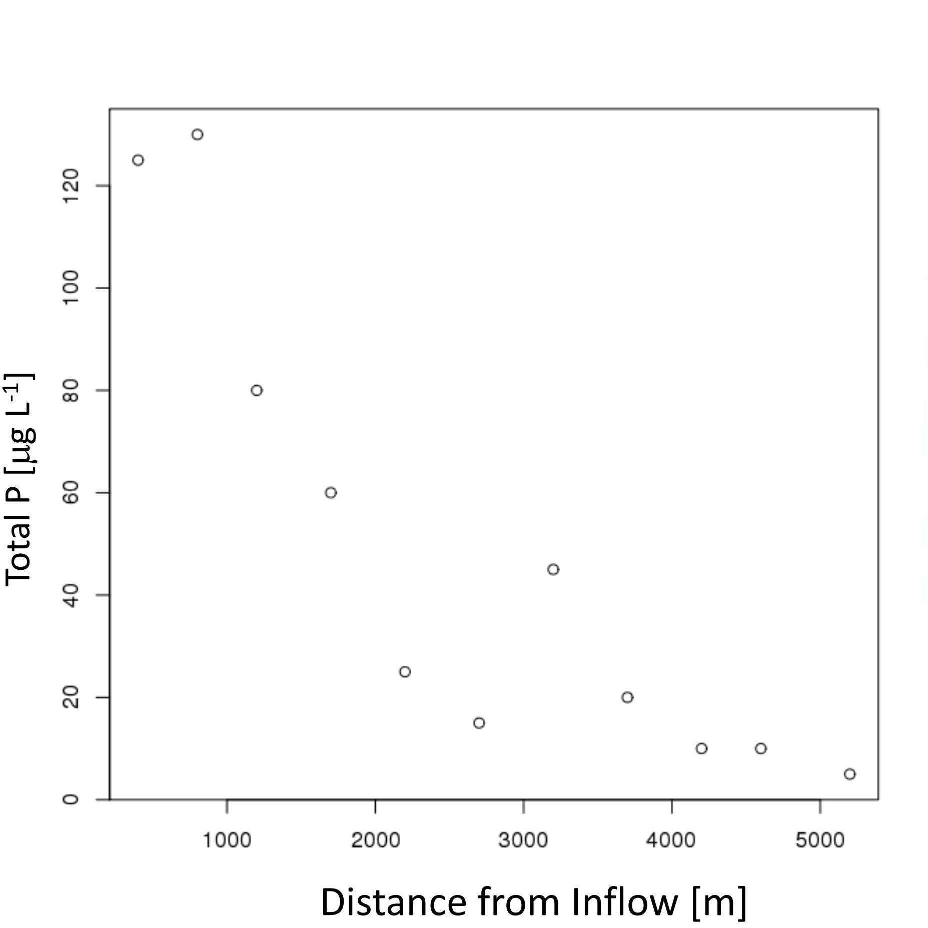


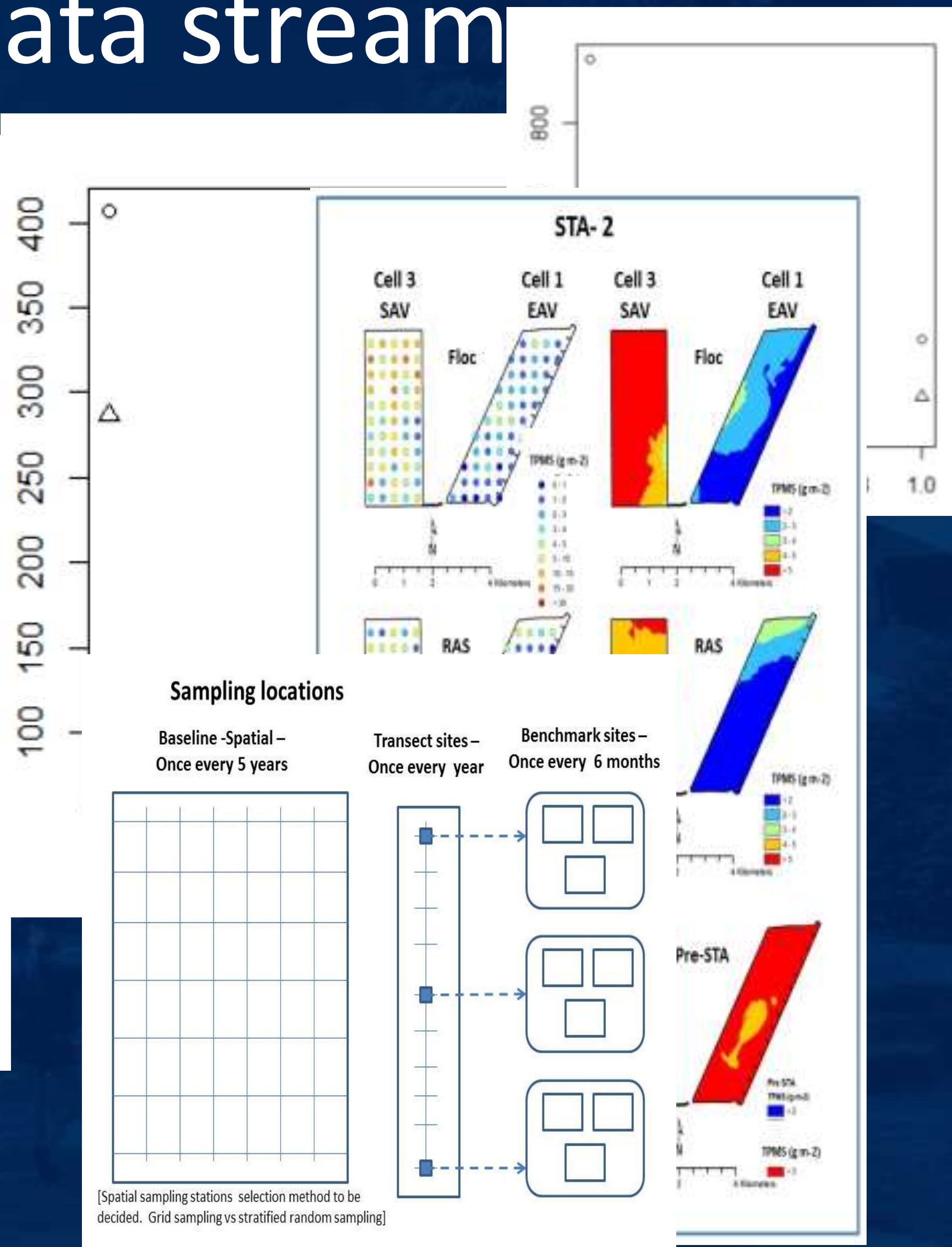
Check out Kalindhi Larios' Poster

Model inversion from 1 data stream- unconstrained



Including More data streams





Working hypotheses:

Gradients within STA do matter and tell us something about the system’s overall behavior

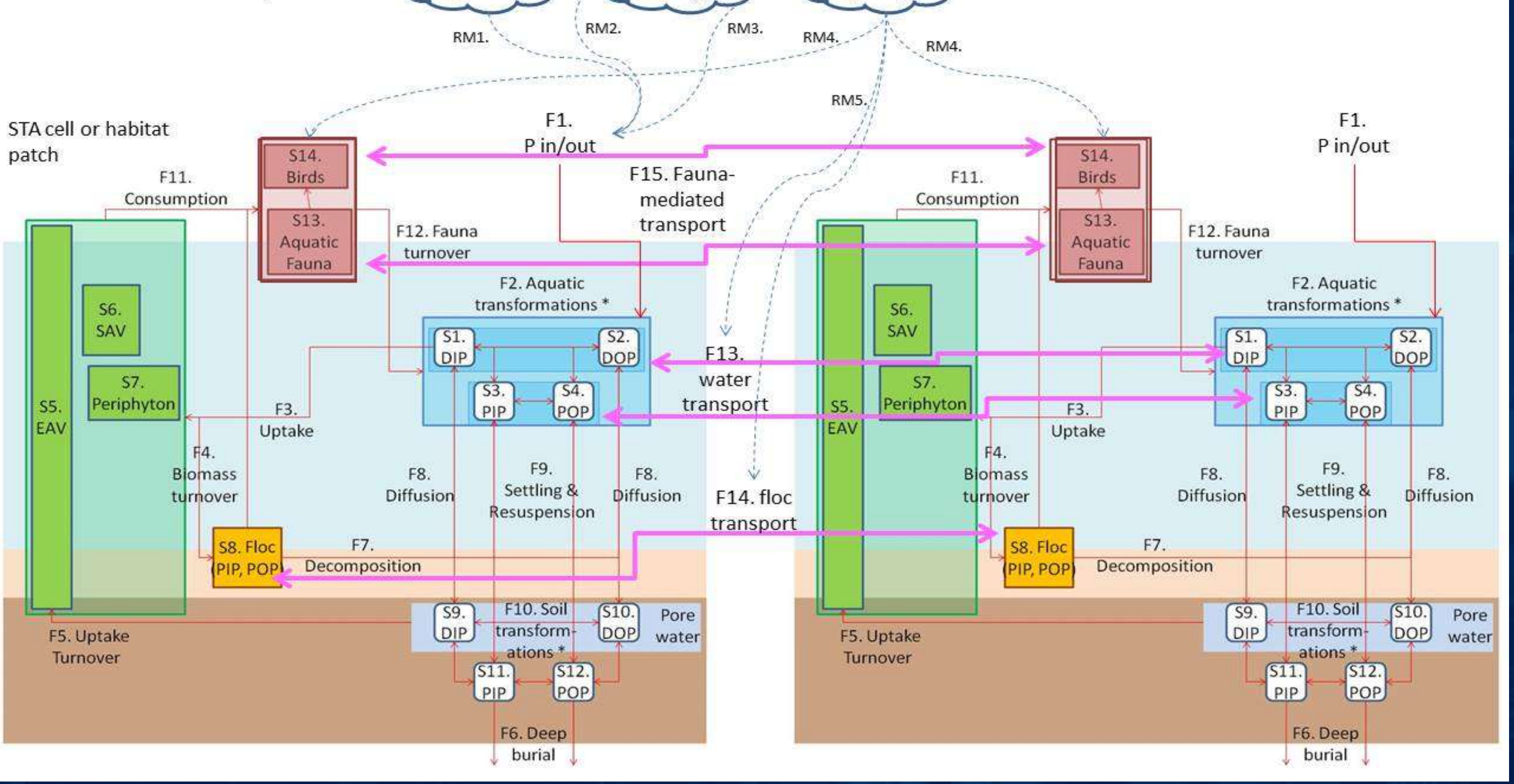
More vigorous nutrient cycling in the upper reaches of treatment areas because the bulk of historic loads has been deposited there

Nutrient cycling and storage = f(location, history, current conditions)

Conclusion: bottom up approach:

- Take advantage of gradients & include gradients (water column, soil) in data analysis
- Take advantage of time series (cumulative load) – *the past is the key to the present*
- Take advantage of prior knowledge of biogeochemical processes

Tier 2 – Spiralling (cell- or habitat-interactions)



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