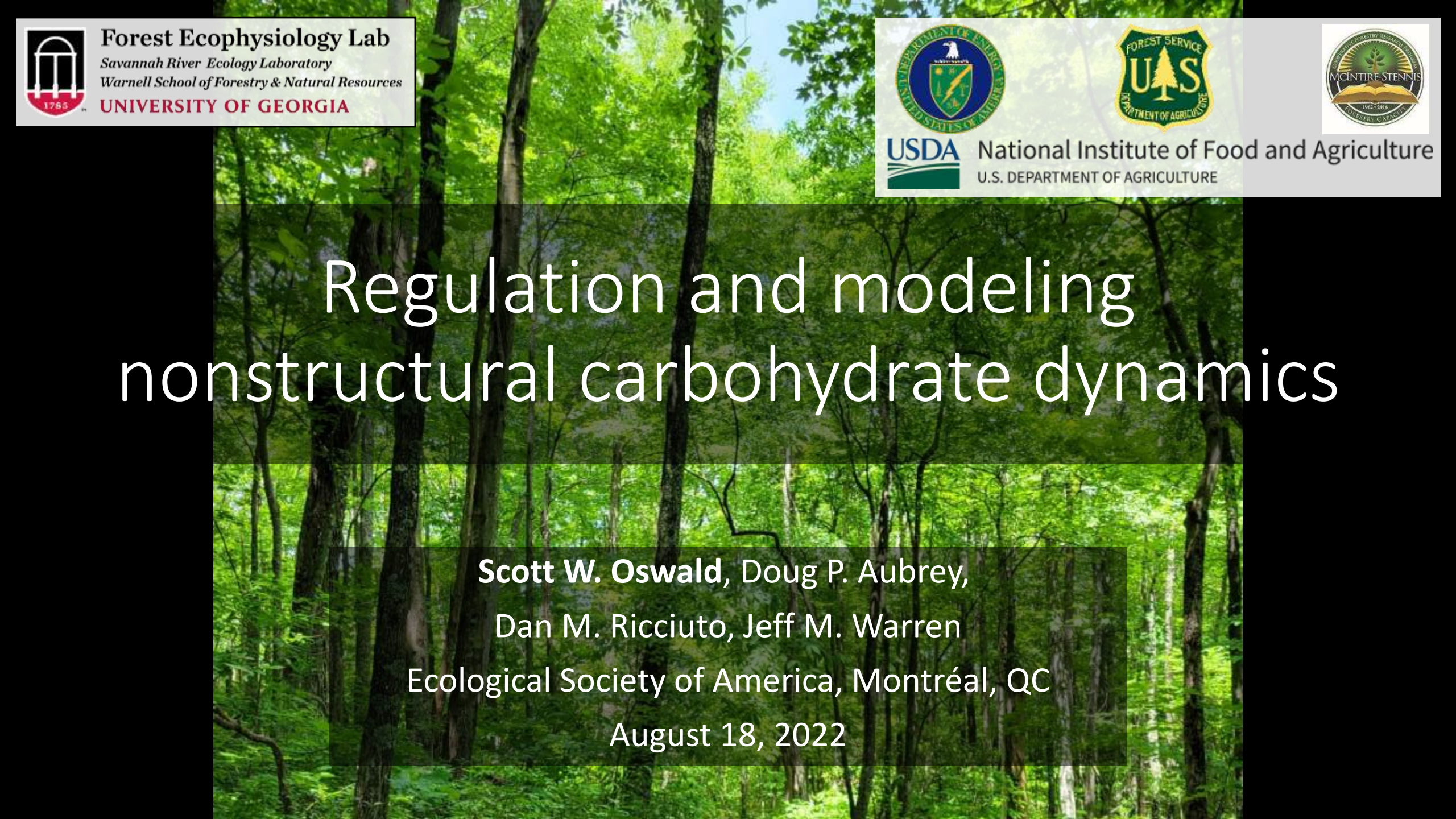

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# Regulation and modeling nonstructural carbohydrate dynamics

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Dan M. Ricciuto, Jeff M. Warren

Ecological Society of America, Montréal, QC
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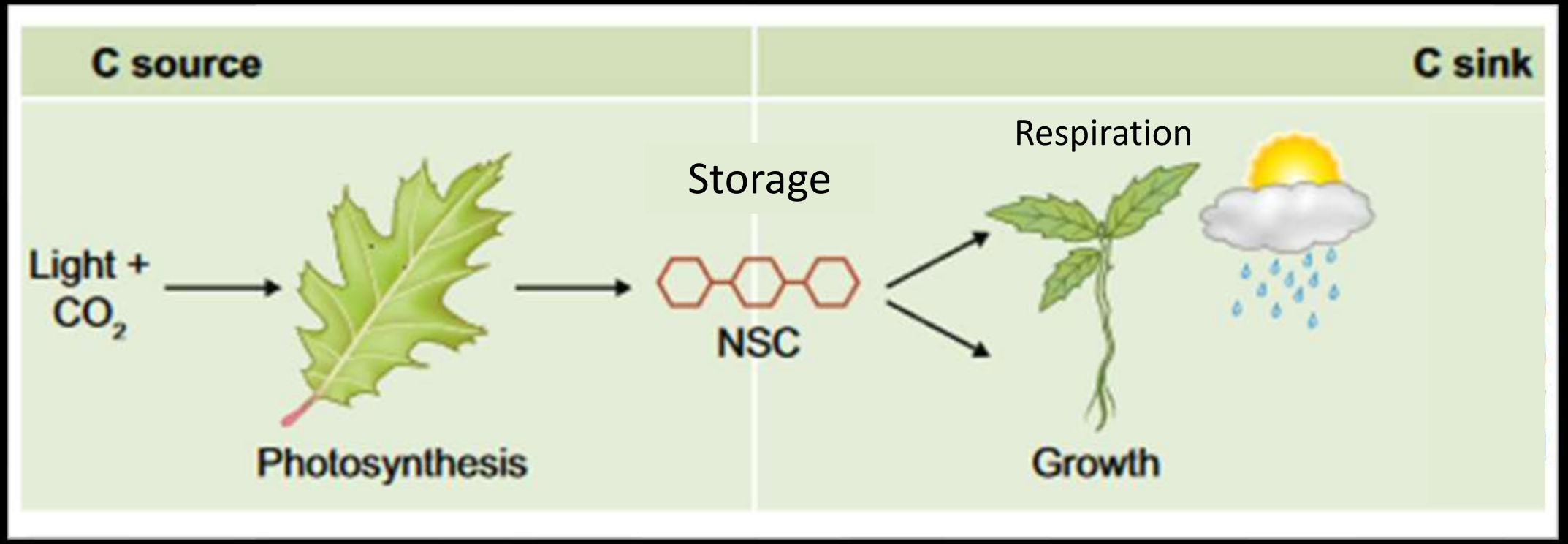
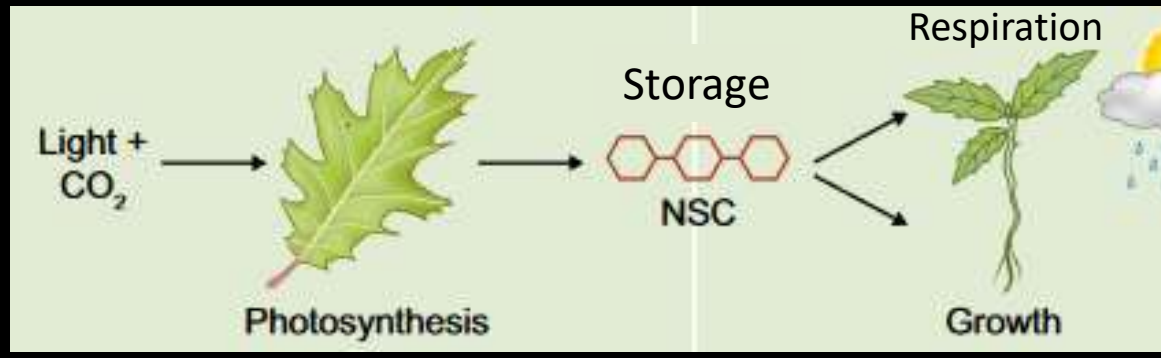
Fig 1. Fatichi et al. 2019

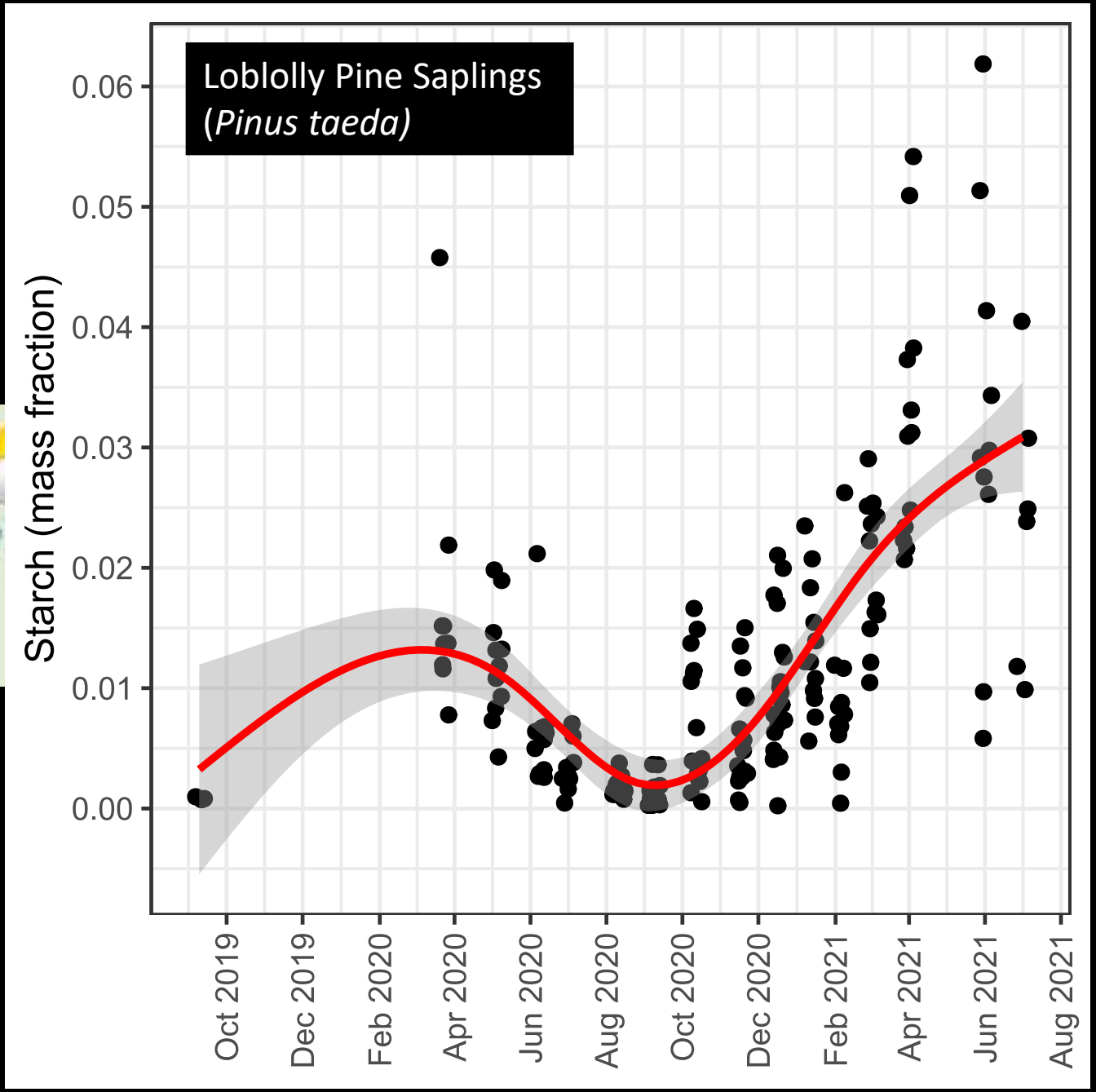



Nonstructural carbohydrates = NSC = sugars + starch

# From here to there…

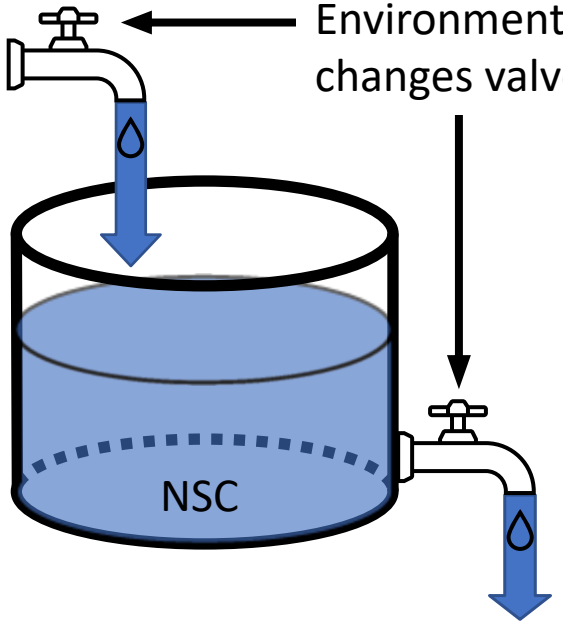
- From processes to dynamics



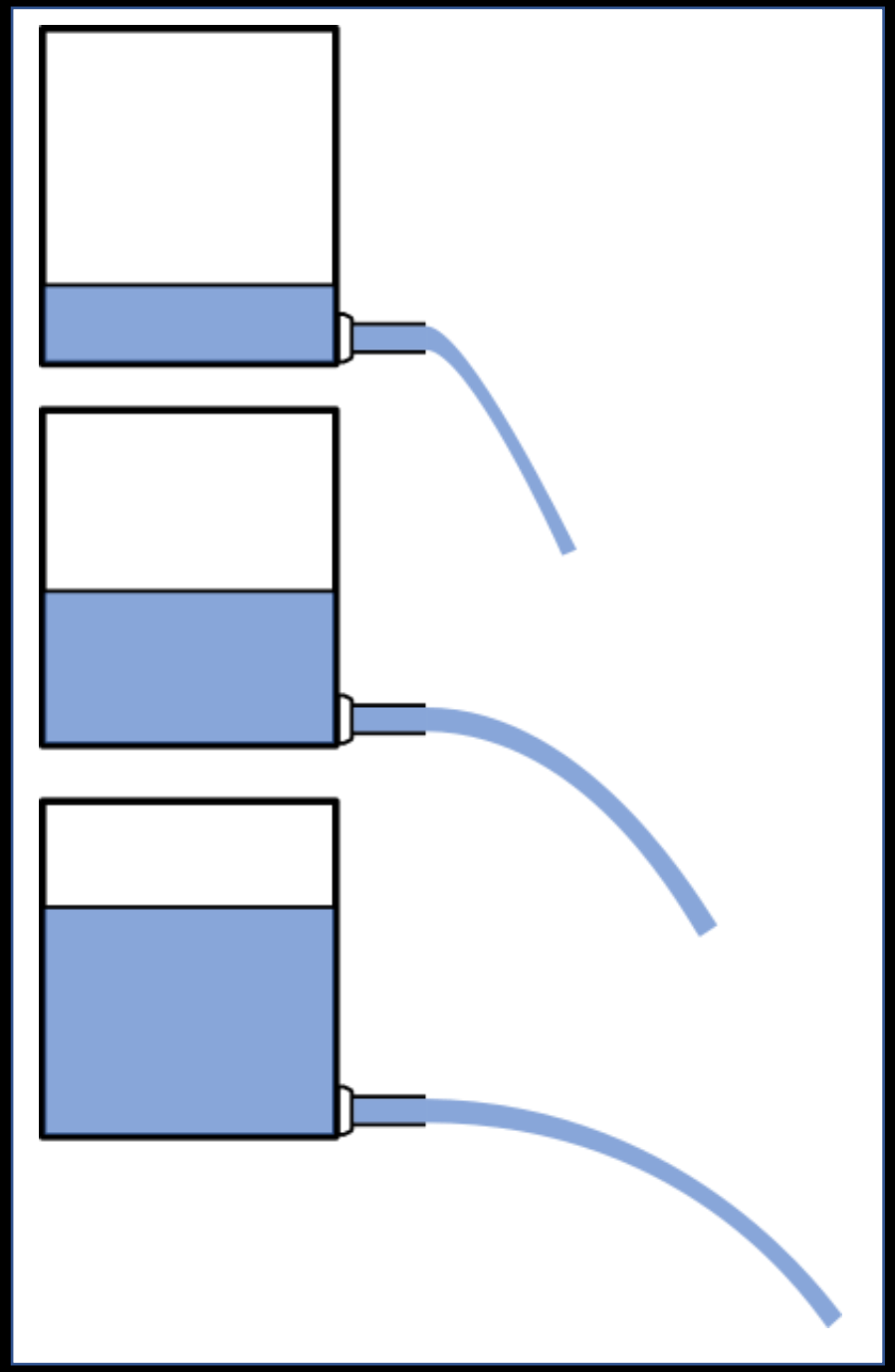
# Carbon mass balance analogy

## Photosynthesis = NSC supply

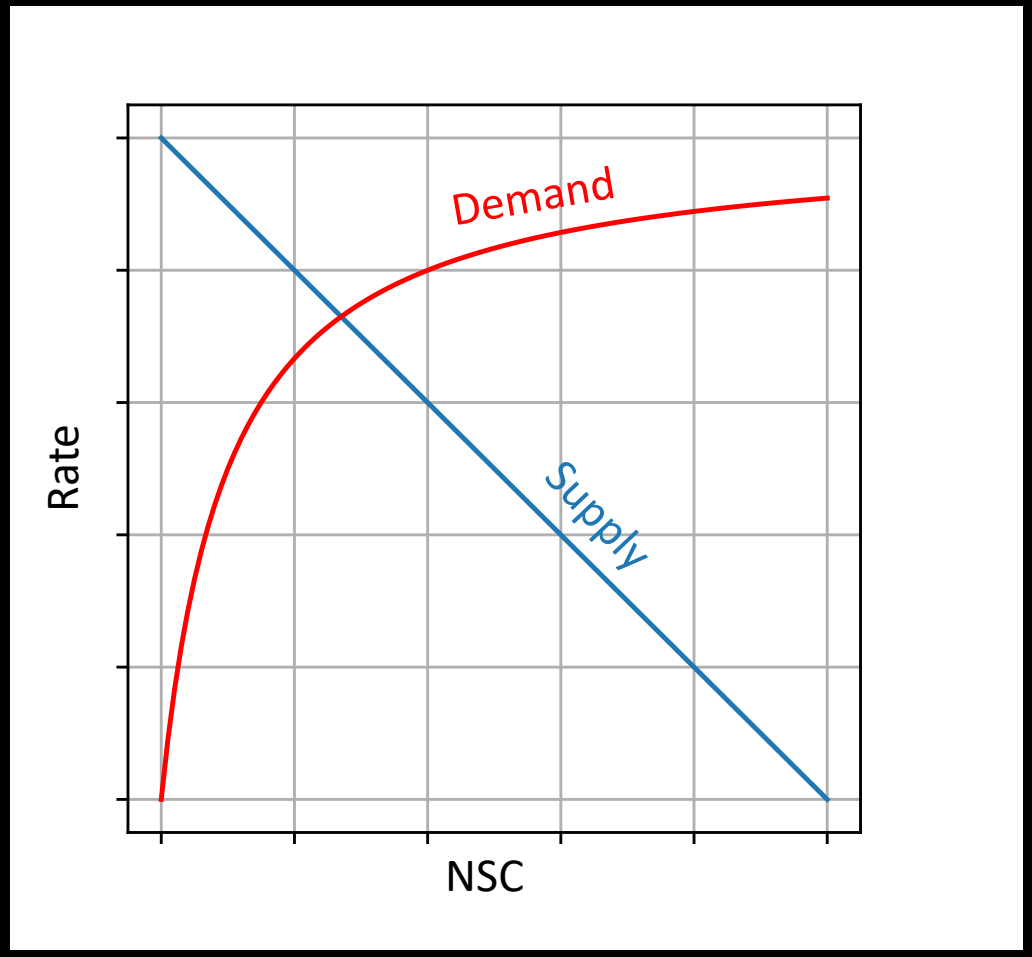


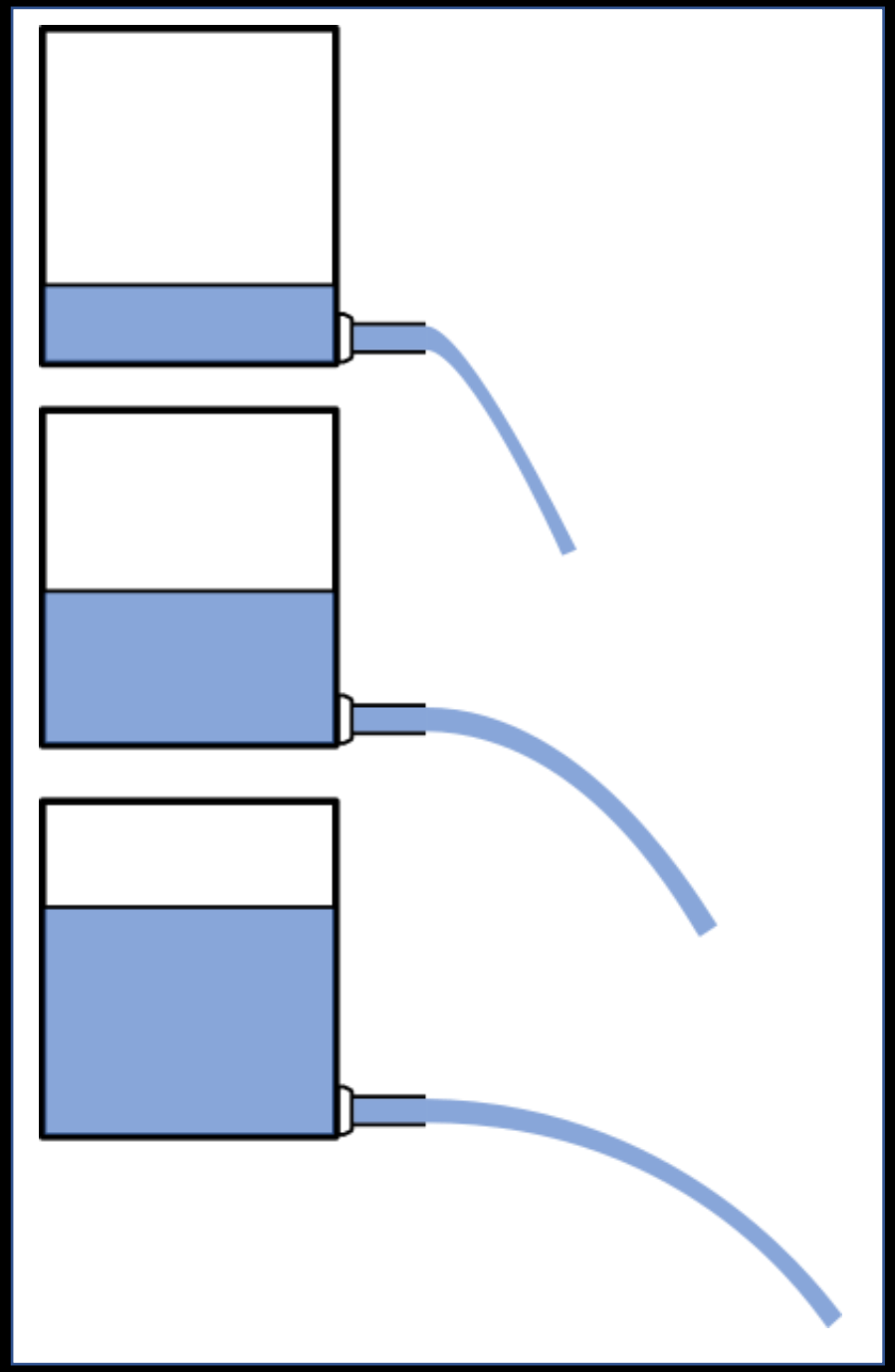

Respiration + Growth = NSC Demand

$$\frac{d}{dt}[\mathrm{NSC}] = \mathrm{supply} - \mathrm{demand}$$

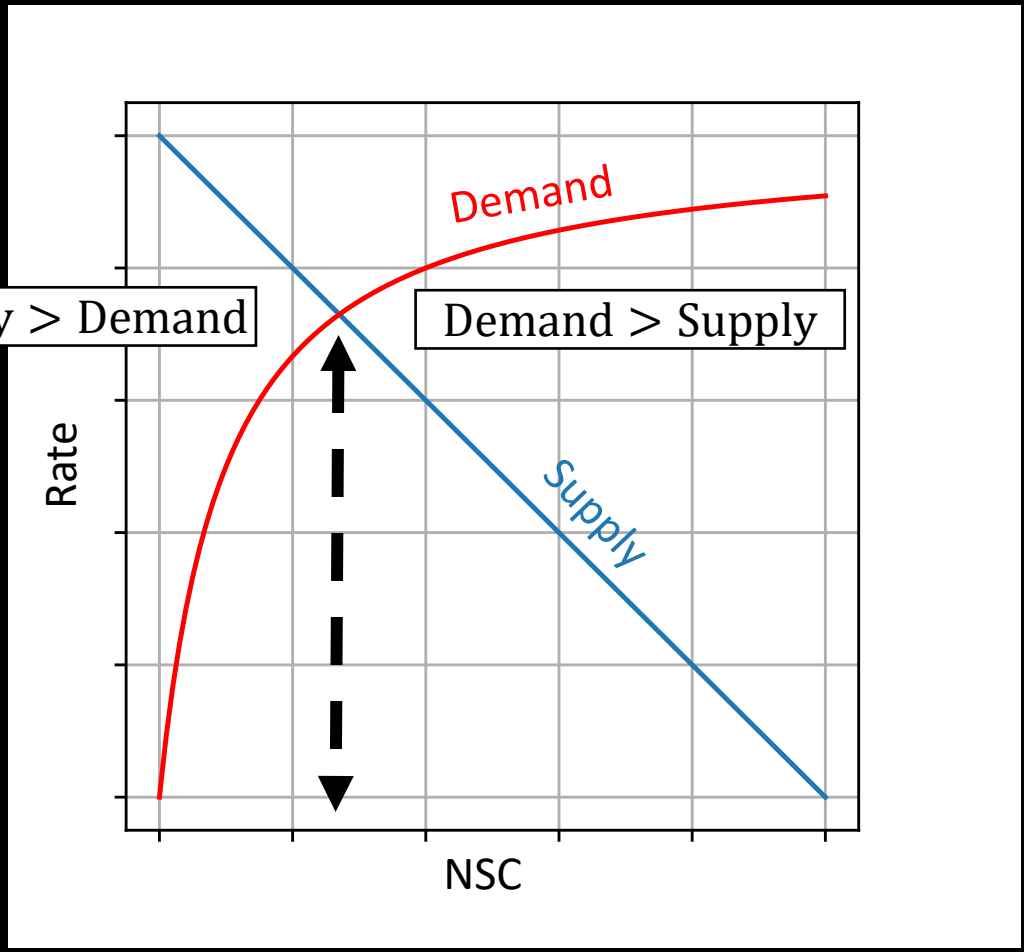


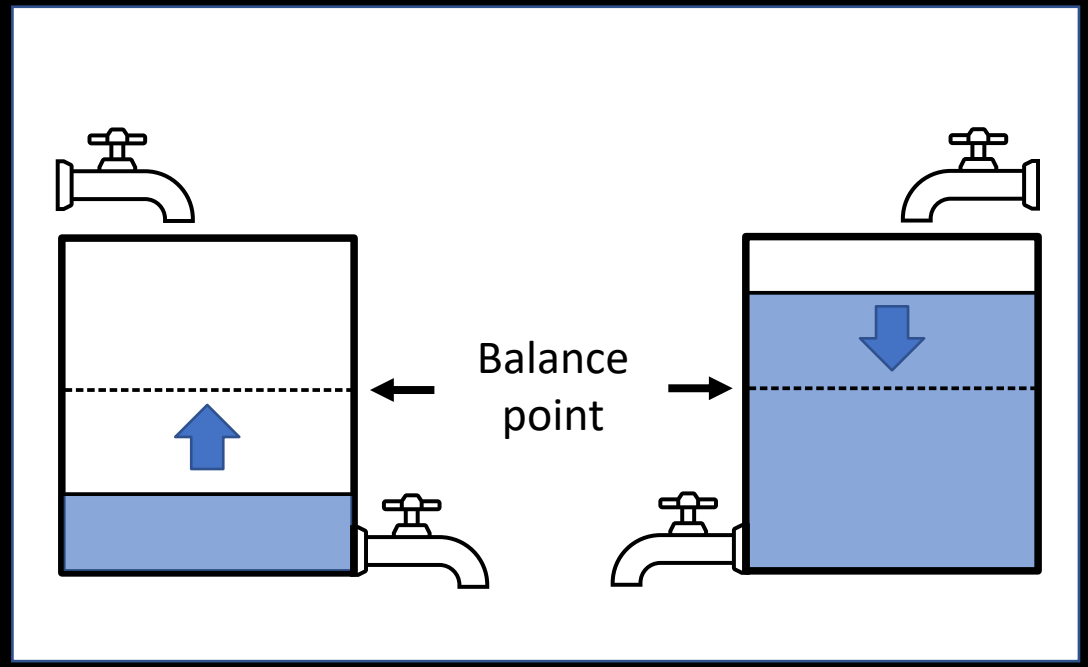
# Supply and demand feedback = how inflow and outflow depends on NSC

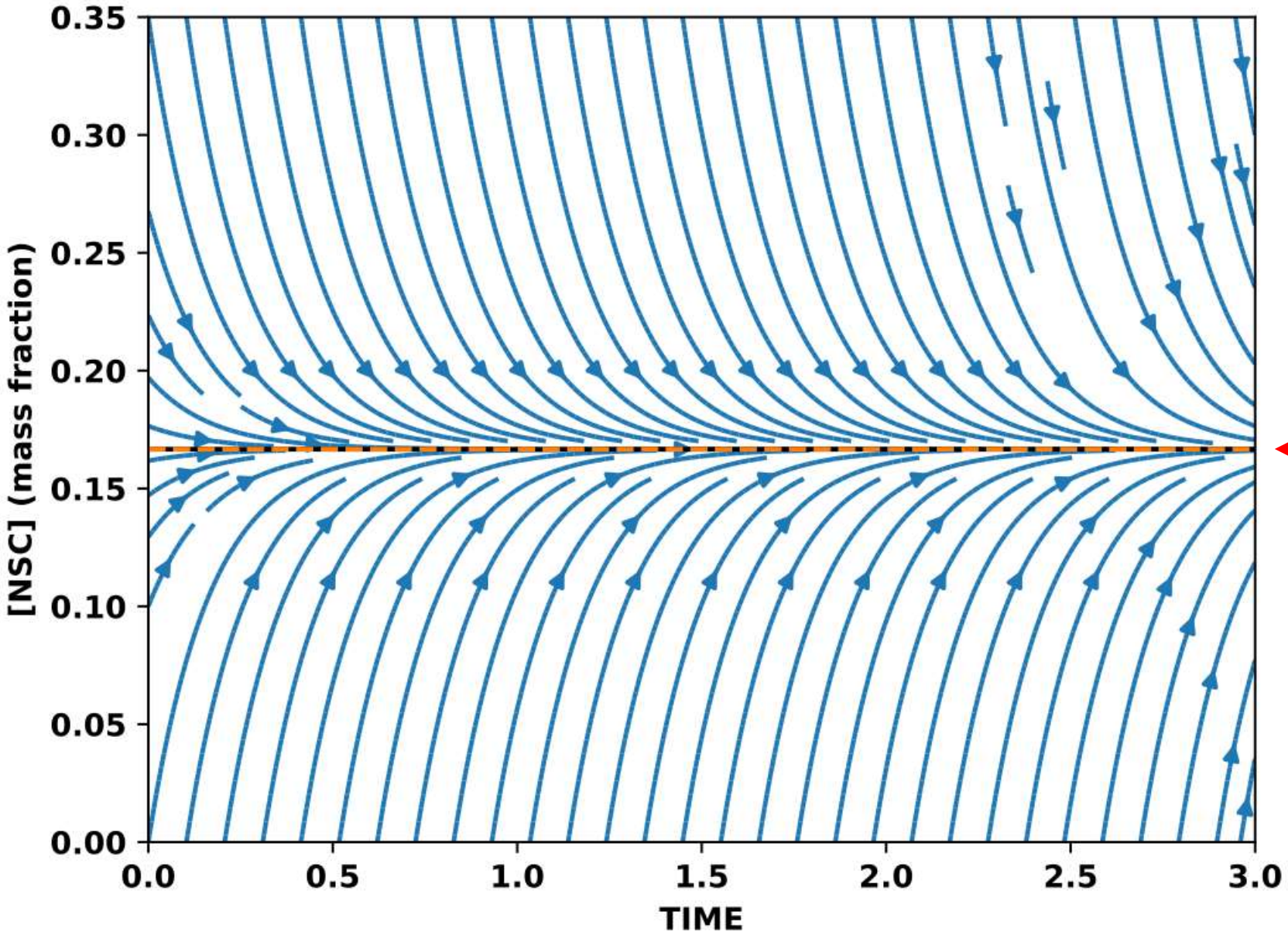


In constant environment
NSC supply and demand
feedback determines response + dynamics



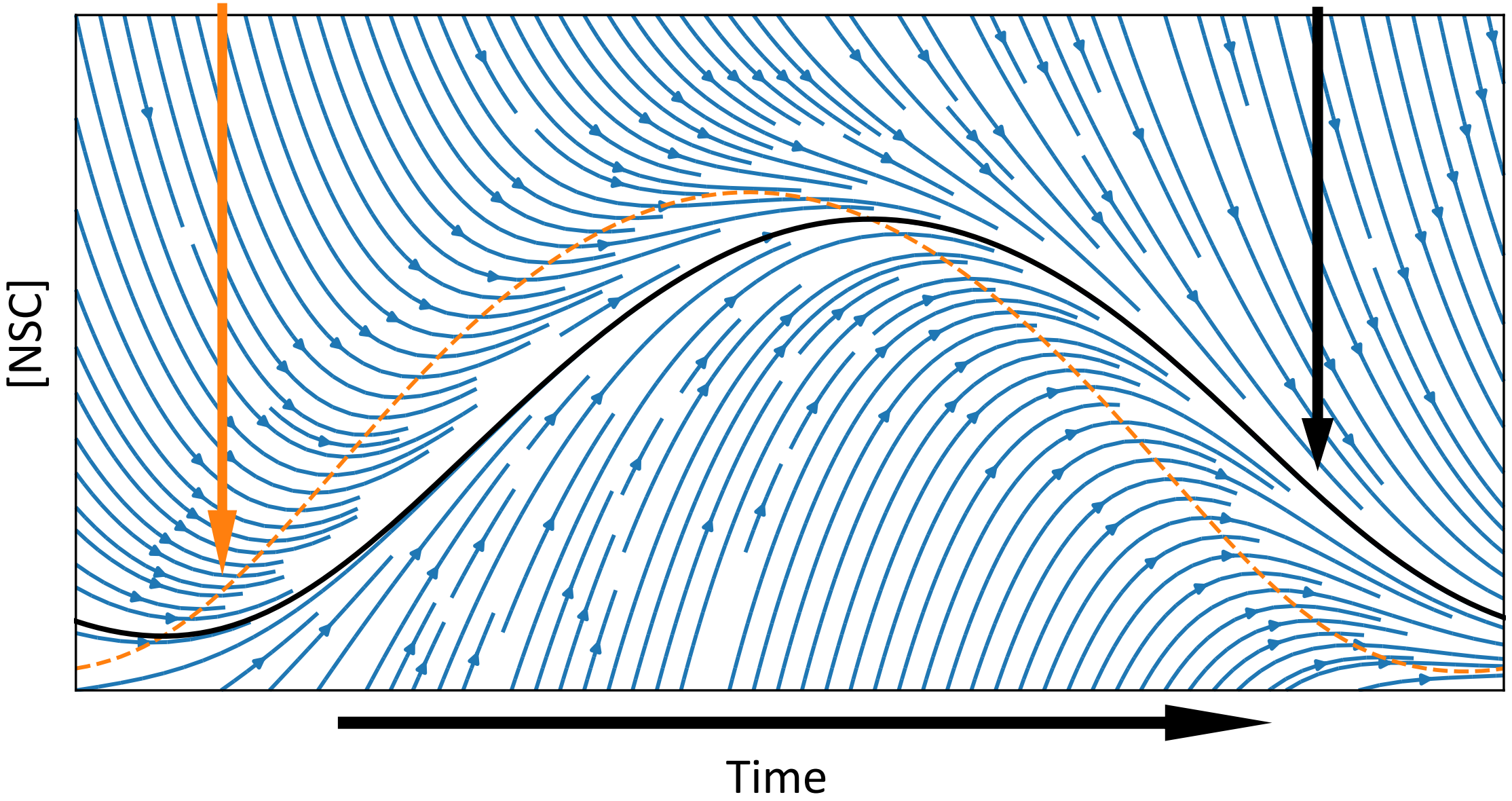






Balance point
=
Long-term NSC response
=
Attractor

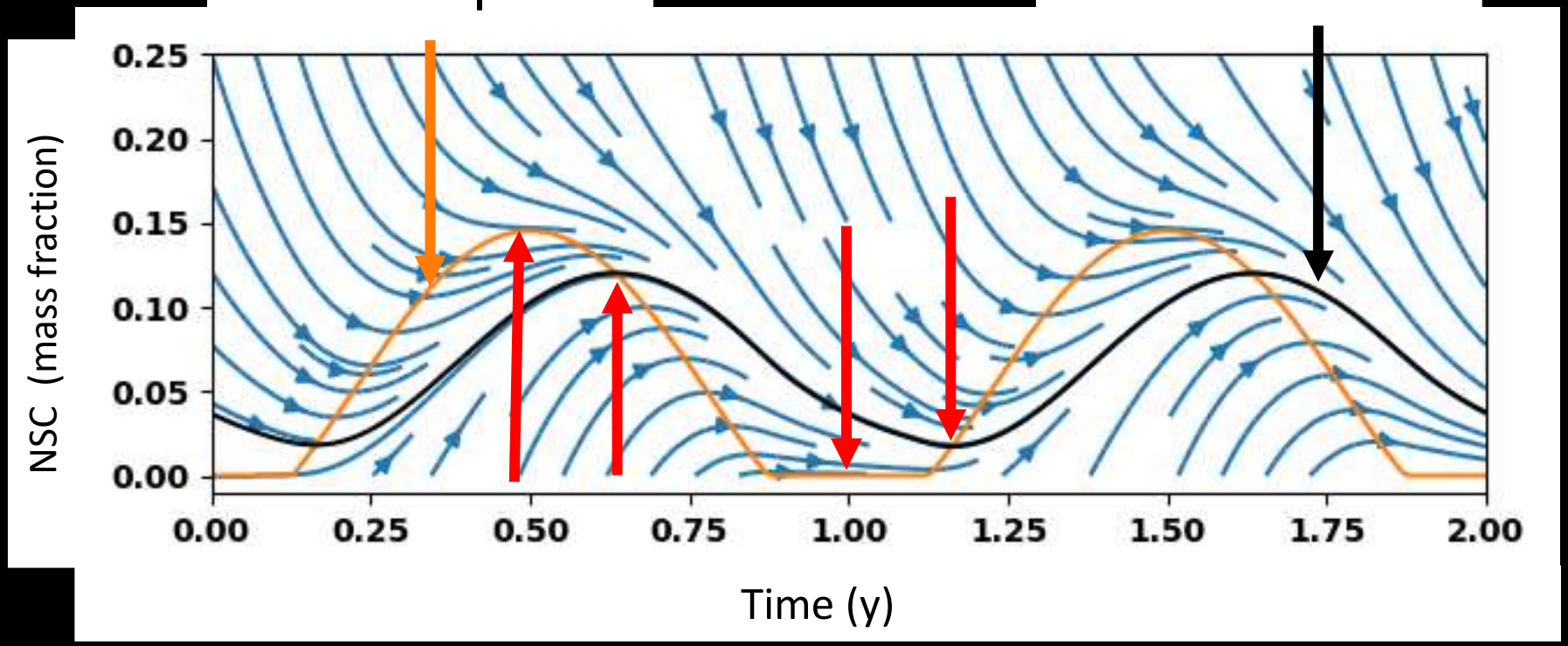
Changing environment changes
Balance point

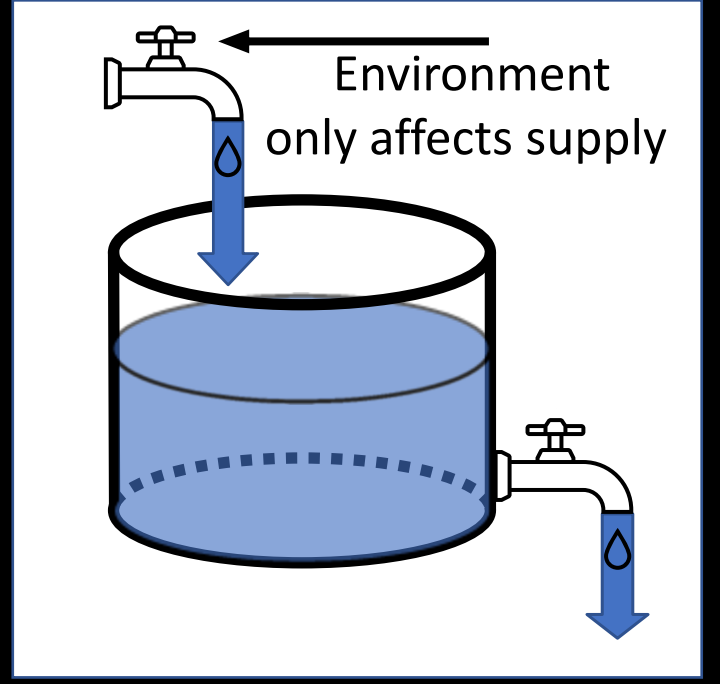
Long-term NSC response =
Attractor

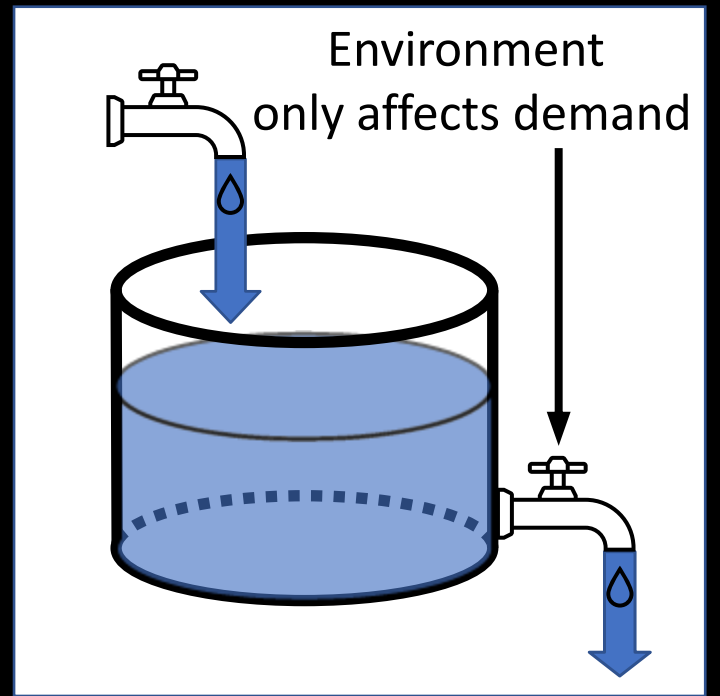


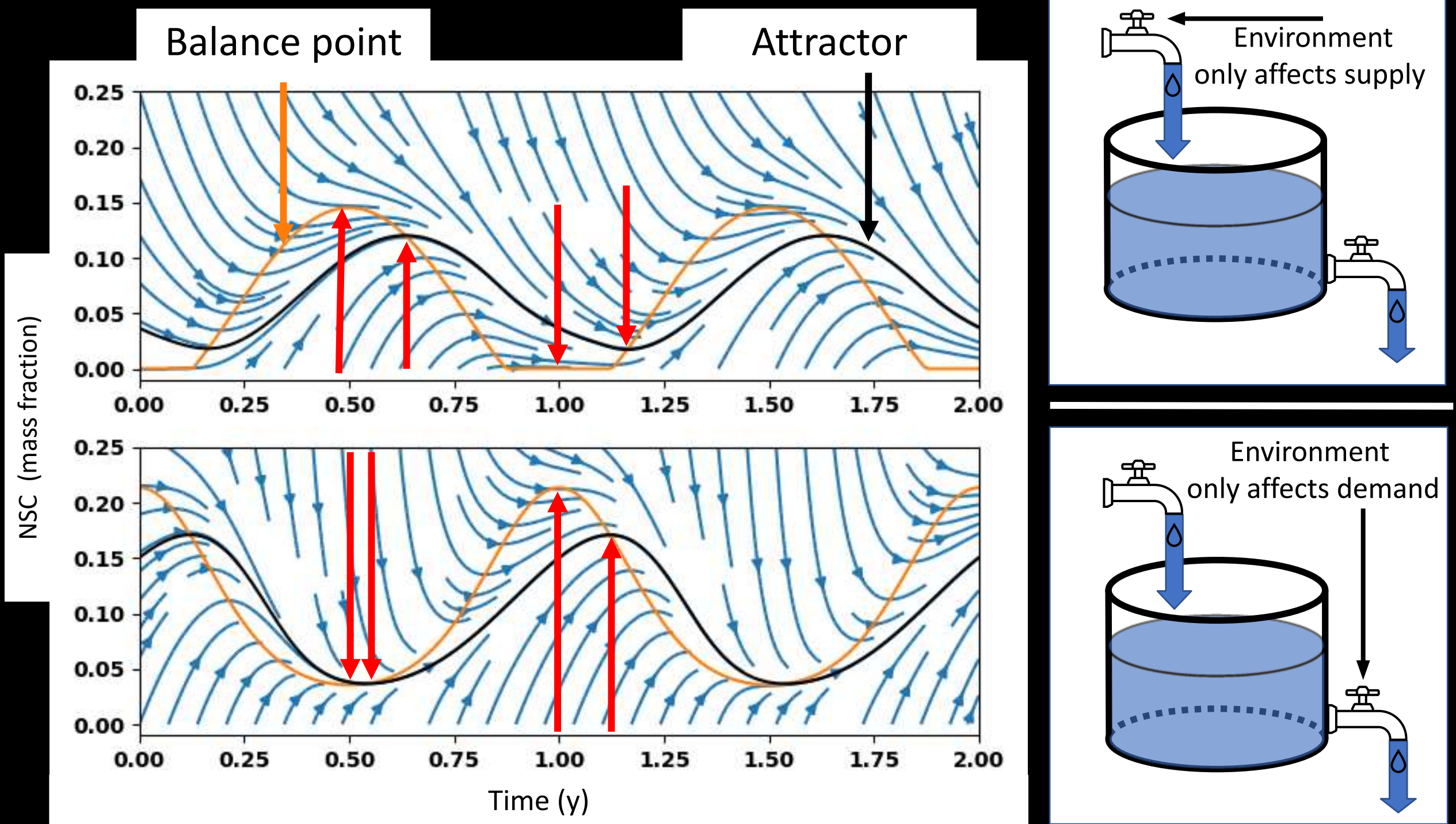
Balance point

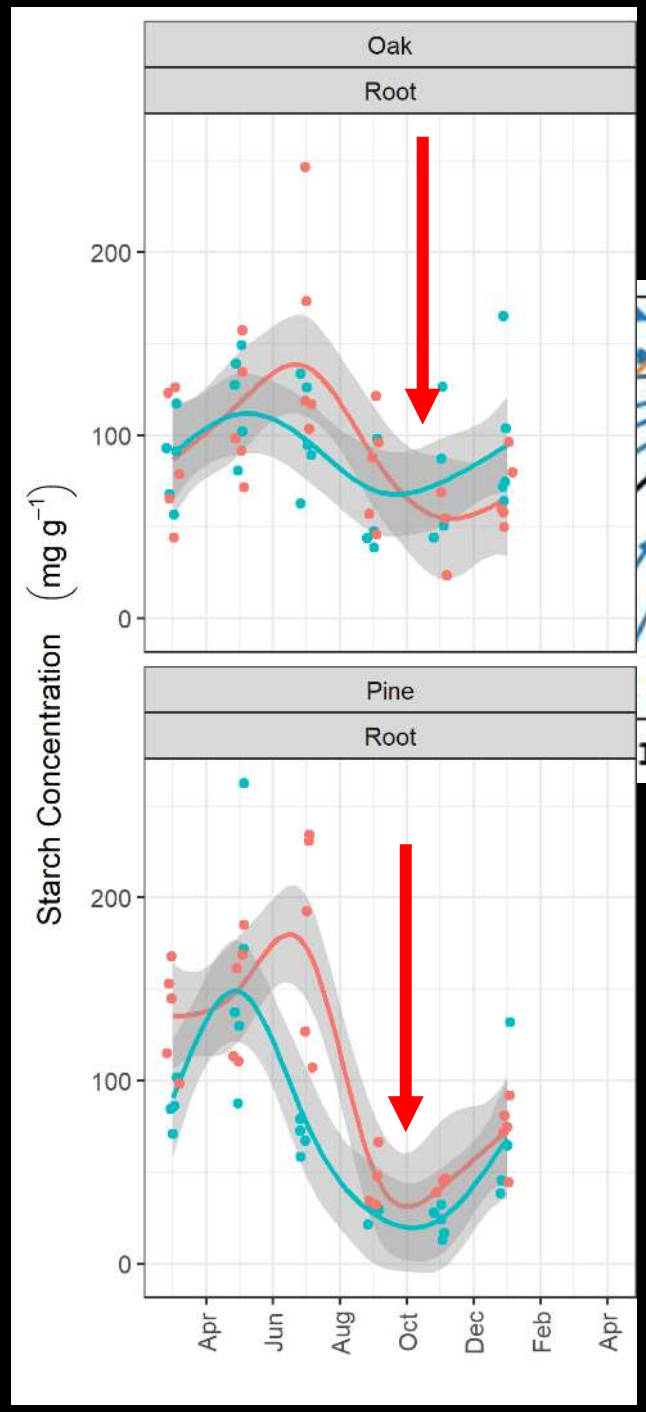
Attractor



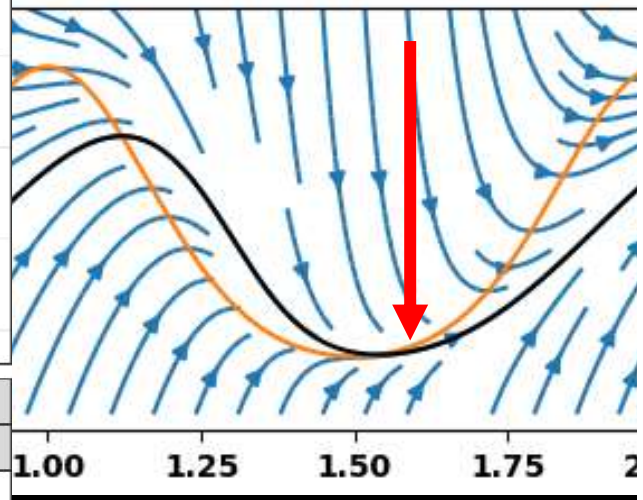



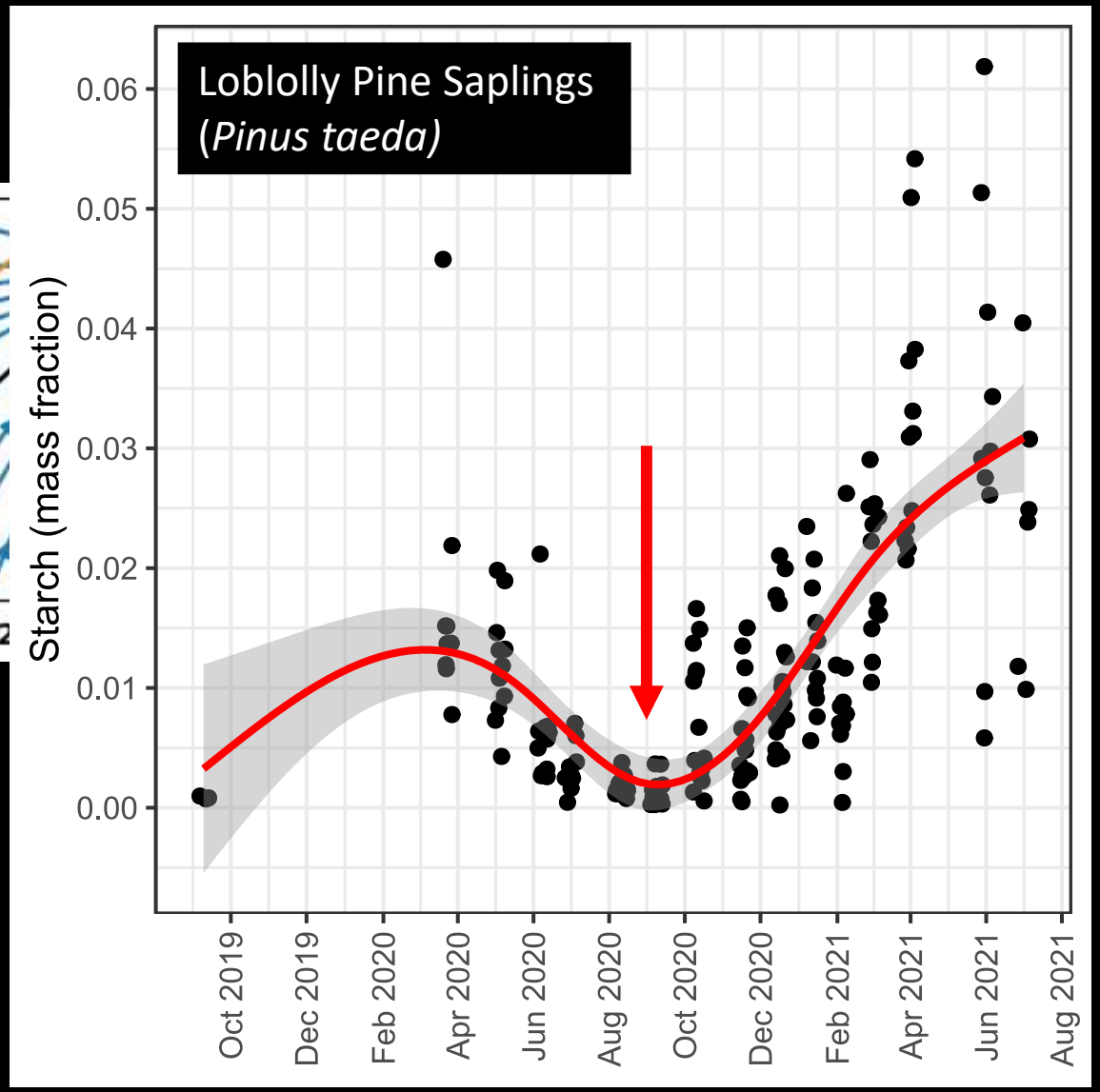

Balance point
Attractor
NSC (mass fraction)
0.25
0.20
0.15
0.10
0.05
0.00
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
Time (y)
Environment
only affects supply
Environment
only affects demand




Mature Turkey Oak
(*Quercus laevis*)




Mature Longleaf Pine
(*Pinus palustris*)



# Summary

- Complex dynamics possible with simple regulation
- Regulation form determines balance point and attractor

Questions? Comments?
Hiring? Vous engagez?

**leaves.and.lemmas@gmail.com**