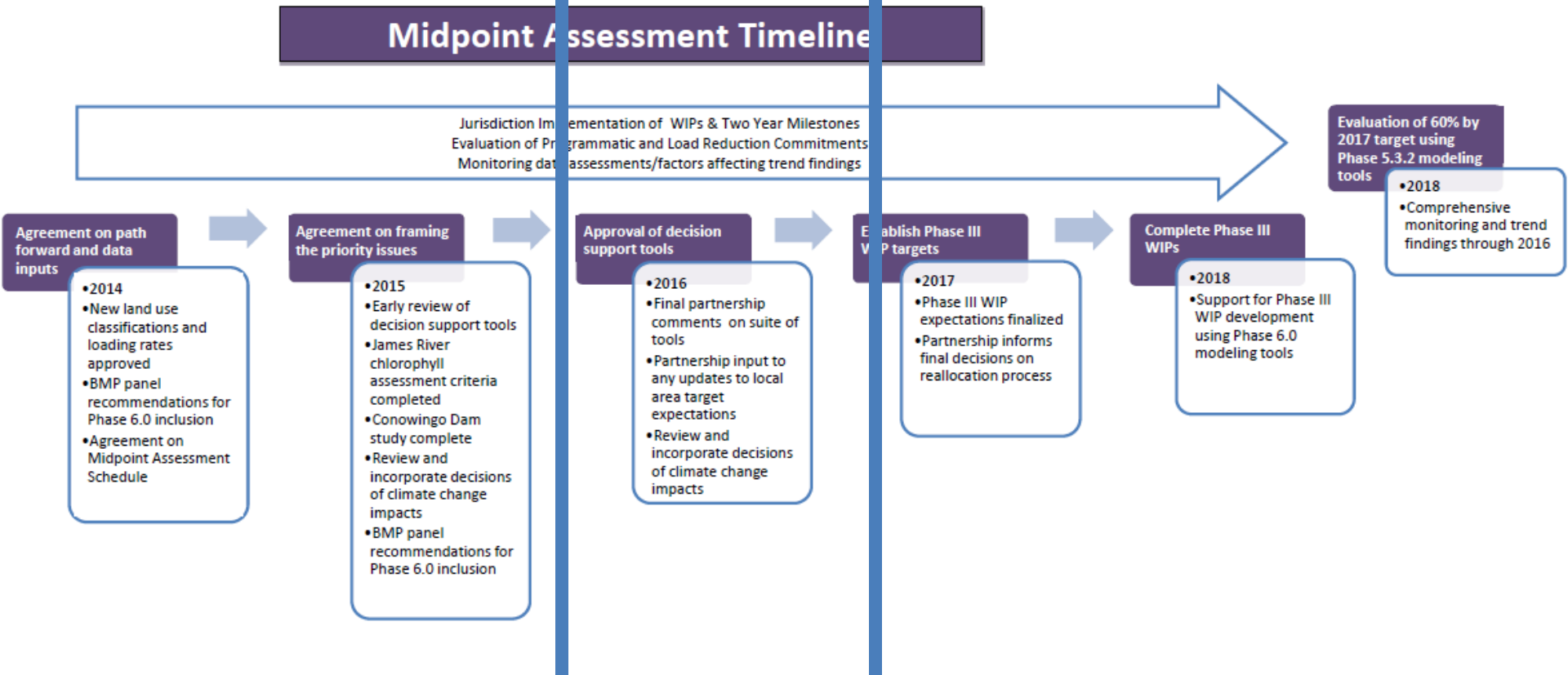
Scenario Builder and Watershed Model Progress toward the MPA

Gary Shenk, Guido Yactayo, Gopal Bhatt Modeling Workgroup 12/2/14

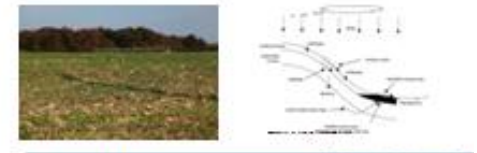


CREATE
The Models

REVIEW
The Models

USE
The Models

Phase 6



Nutrients

Can we estimate EOF loads directly based on available information?

Sediment

Should we update the sediment EOF estimates?

Can we estimate watershed delivery based on landscape parameters?

Can we estimate small stream effects?

Directly Simulated in HSPF for river averaging at least 100 cfs

Calibrated to WQ data

Who We Are
How We Work
How We're Organized
- Chesapeake Executive Council
- Principals' Staff Committee
- Management Board
- Citizens Advisory Committee
- Local Government Advisory Committee
- Scientific and Technical Advisory Committee
- Communications Workgroup
- Scientific and Technical Analysis and Reporting

Scenario Builder and Watershed Model Plan for the MPA

In preparation for the 2017 Mid-Point Assessment, the CBP Partnership has expressed priorities for the Phase 6 watershed model development which are detailed in documents under the 'Projects and Resources' tab on the Water Quality GIT page. Initial priorities were set in the October 2012 water quality GIT meeting. These priorities have been updated and refined by recommendations from subsequent workshops and CBP meetings. The MPA master schedule lists these priorities in a table format. Additional documents on the web page are specific work plans to accomplish these tasks.

Out of necessity, phase 6 development is occurring along multiple parallel paths. These must eventually meet in a draft phase 6 watershed model and scenario builder that will be ready for full partnership review beginning January 1 2016. These parallel paths encompass all of the CBP priorities.

This document summarizes the priorities and identifies lead researchers for each effort. The descriptions here are brief with links to more detailed workplans.

Efforts

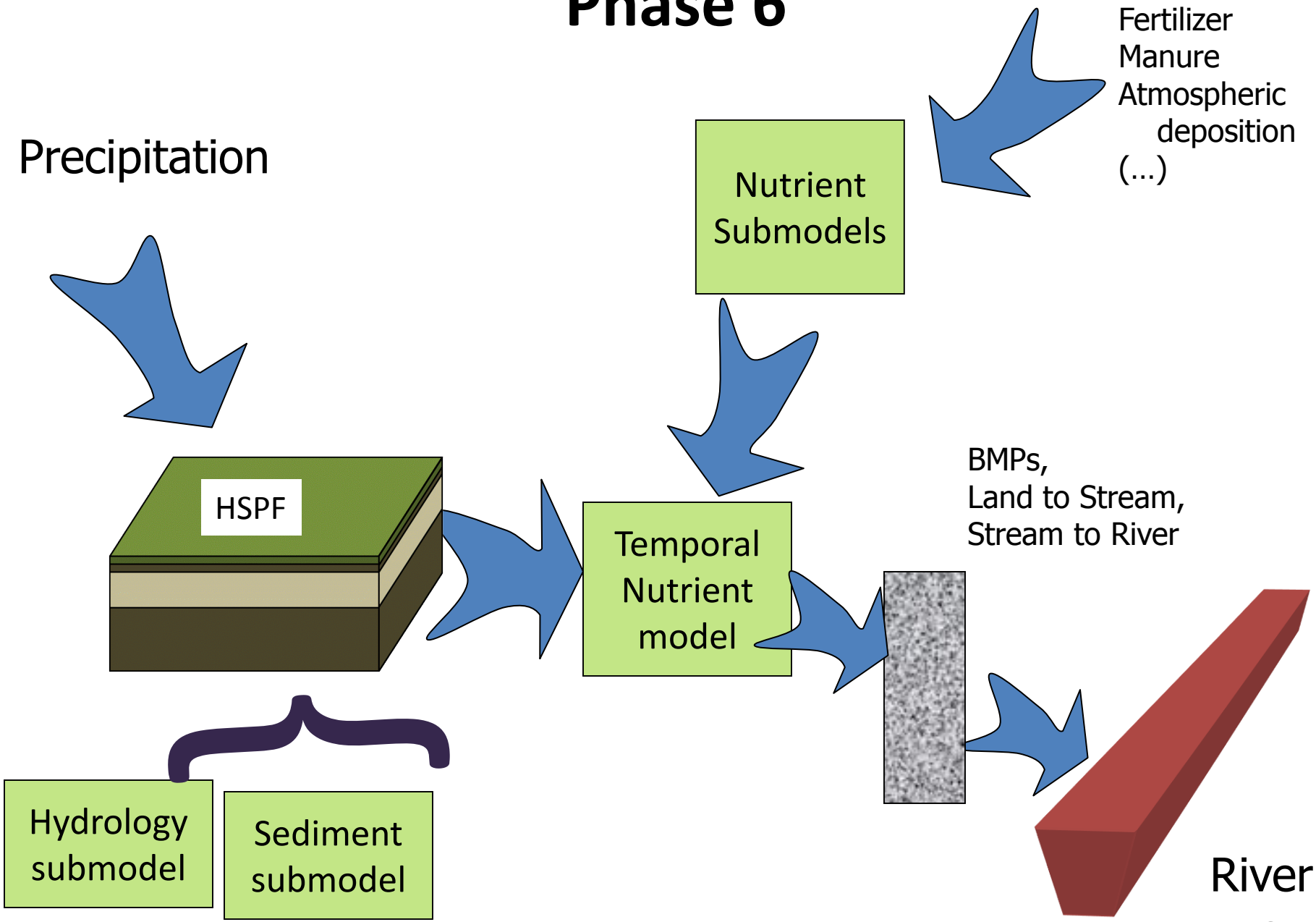
Below are the efforts related to the Scenario Builder and Watershed Model Plan for the Mid-Point Assessment

- **BMP effectiveness**
- **BMP Implementation Accounting**
- **Fertilizer and Manure Applications**
- **Land Use Types and Acreage**
- **Land Use Loading Rates**

1-Slide Status Report

- Land Use Types and Acreage
- Land Use Loading Rates
- Climate Change
- Scenario Builder Development and Code Versioning
- Watershed Model Development and Code Versioning
- Calibration Methodology
- Sensitivities to inputs
- Fine-scale Processes
- Atmospheric Data
- Groundwater Lag
- Better Representation of Reservoirs

Phase 6


Fertilizer
Manure
Atmospheric deposition
(…)
Precipitation
Nutrient Submodels
HSPF
Temporal Nutrient model
BMPs,
Land to Stream,
Stream to River
Hydrology submodel
Sediment submodel
River

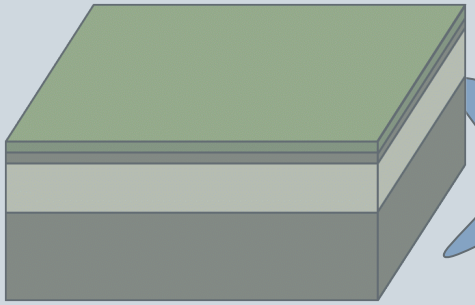
Phase 6

Fertilizer
Manure
Atmospheric deposition
(…)

Precipitation

Guido Yactayo

Nutrient Submodels



Temporal Nutrient model

BMPs,
Land to Stream,
Stream to River

Hydrology submodel

Sediment submodel

River

Recommendations for Phase 6-PQUAL Nitrogen Sensitivity

Guido Yactayo – UMCES
gyactayo@chesapeakebay.net

Objectives

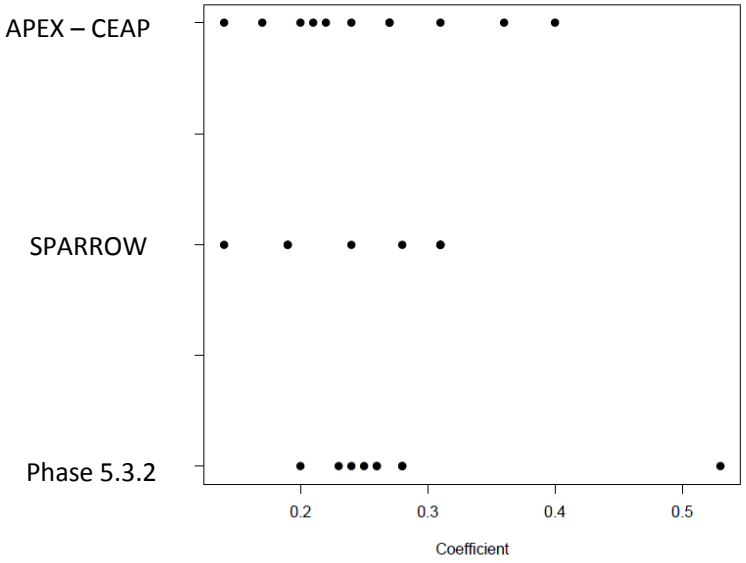
- To estimate multiple watershed models sensitivity to nutrient inputs in the Chesapeake Bay
- To develop, review and implement model sensitivities in the phase 6 version of the Chesapeake Bay Watershed model
- To decide on Phase 6-PQUAL nitrogen sensitivities

** The input-output relationship or the effect of changes in nutrient inputs on nutrient export is referred to in this analysis as sensitivity.*

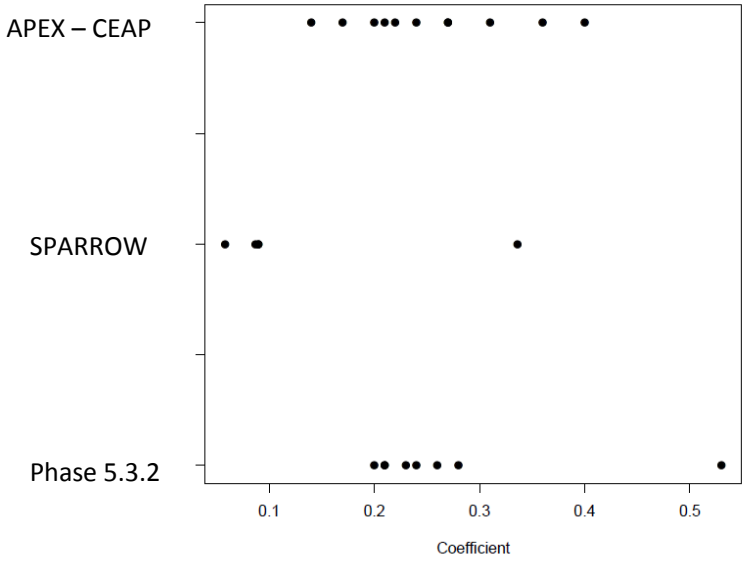
Sensitivities to total nitrogen inputs

- Following STAC recommendations of using multiple models, APEX, SPARROW, and P532-AGCHEM models were included in this analysis.
- The models sensitivities represent the relationship between nutrient predicted yields and input loads for cropland.

Sensitivity to fertilizer TN inputs



Sensitivity to manure TN inputs

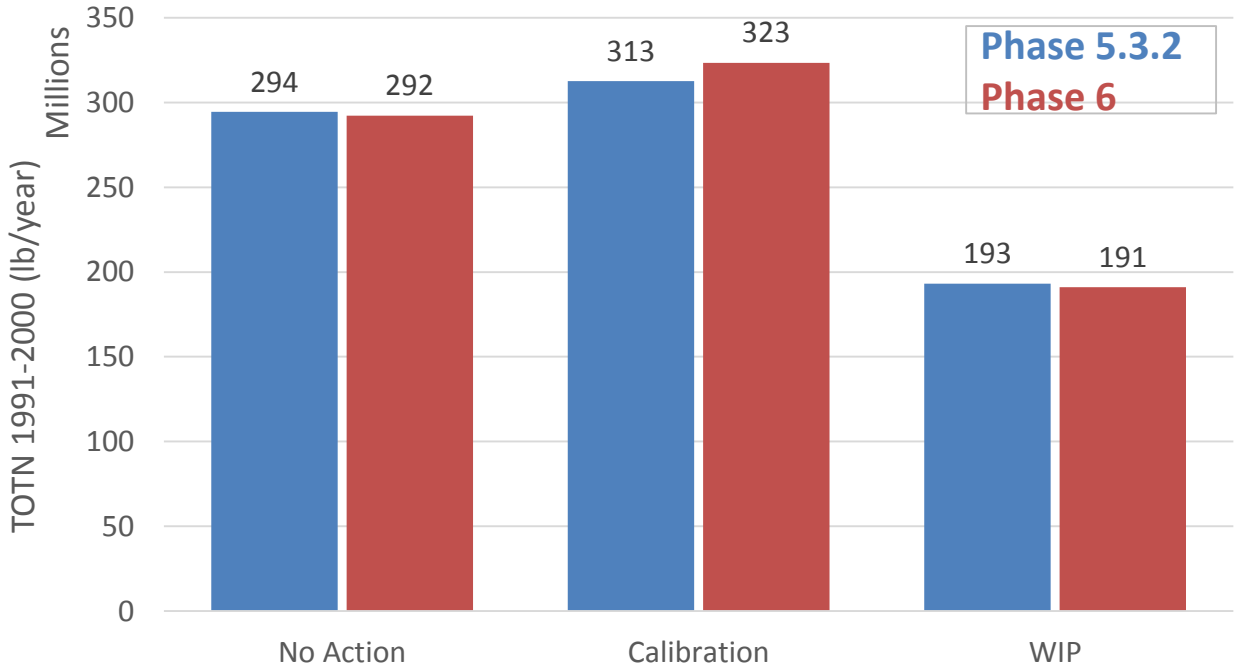


1. APEX – CEAP: Ratio between output and input (No-practice, 2006, and 2011 scenarios including all input sources in cropland areas)
2. SPARROW: source specific coefficient (Various studies in the Chesapeake bay and Northeastern and Mid-Atlantic regions) *
3. Phase 5.3.2: Ratio between input and output, slope of multivariate regression, and slope between output and input (14 scenarios , hwm, hom, lwm, alf, and hyw)

* Preston and Brakebill (1999), Ator et al. (2011), Moore et al. (2011), and Preston et al. (2011).

Sensitivity implementation on phase 6

- Total nitrogen sensitivities from other existing models support the Phase 532-AGCHEM findings.
- Phase 532-AGCHEM sensitivities are available not only for TN but also by nitrogen species.
- Phase 532-AGCHEM DIN and organic nitrogen sensitivities have been implemented in phase 6.

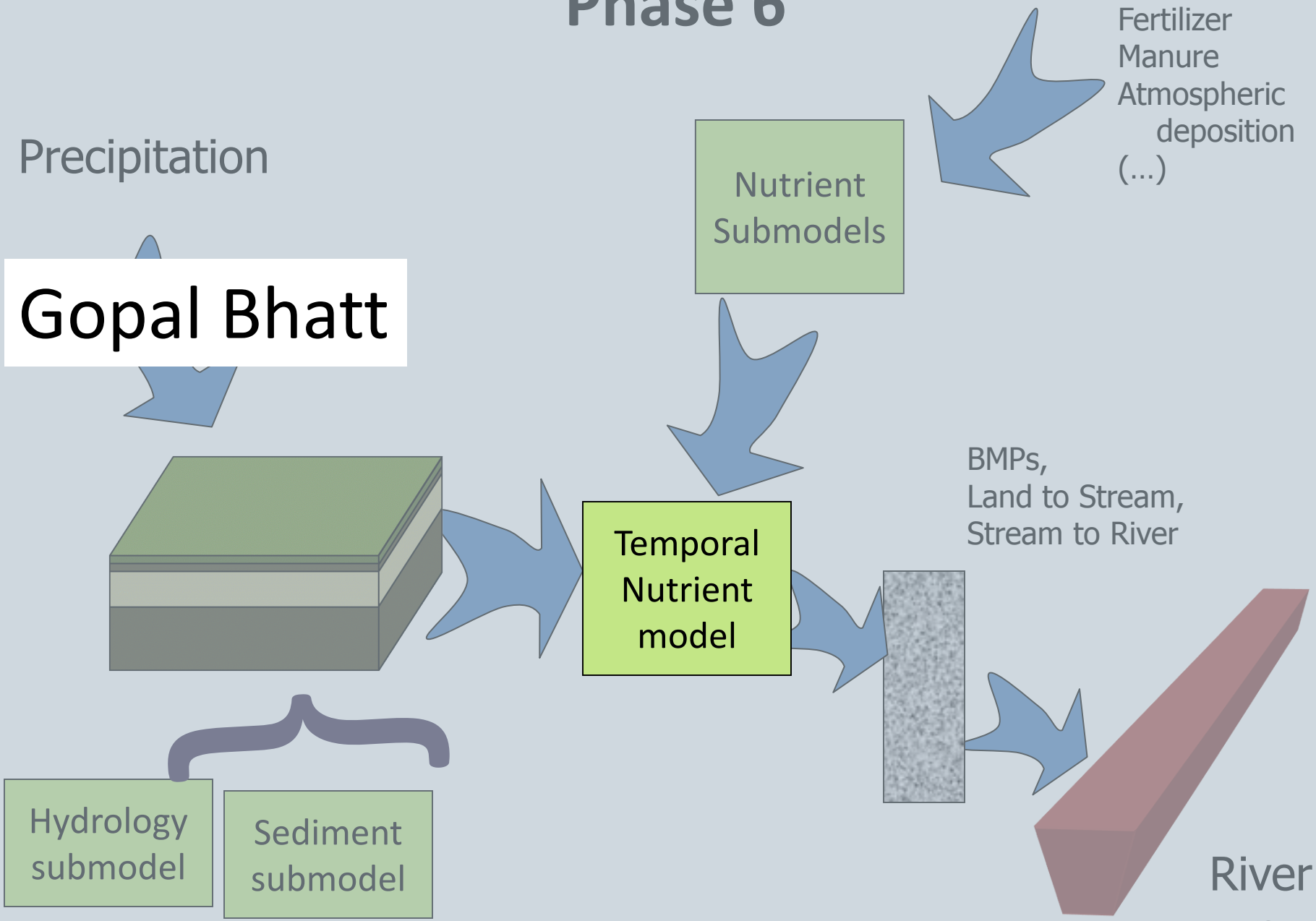


Decide on Phase 6 nitrogen sensitivities

- Phase 532-AGCHEM sensitivities are more extensive and robust than other models sensitivities.
- The new recommendation is to adopt the Phase 5.3.2 AGCHEM nitrogen sensitivities.
- Please review both the Phase 5.3.2 AGCHEM and multiple model sensitivity analyses in order to make a decision.

https://archive.chesapeakebay.net/Modeling/phase5/Phase532/Sensiti vity/

Phase 6


Fertilizer
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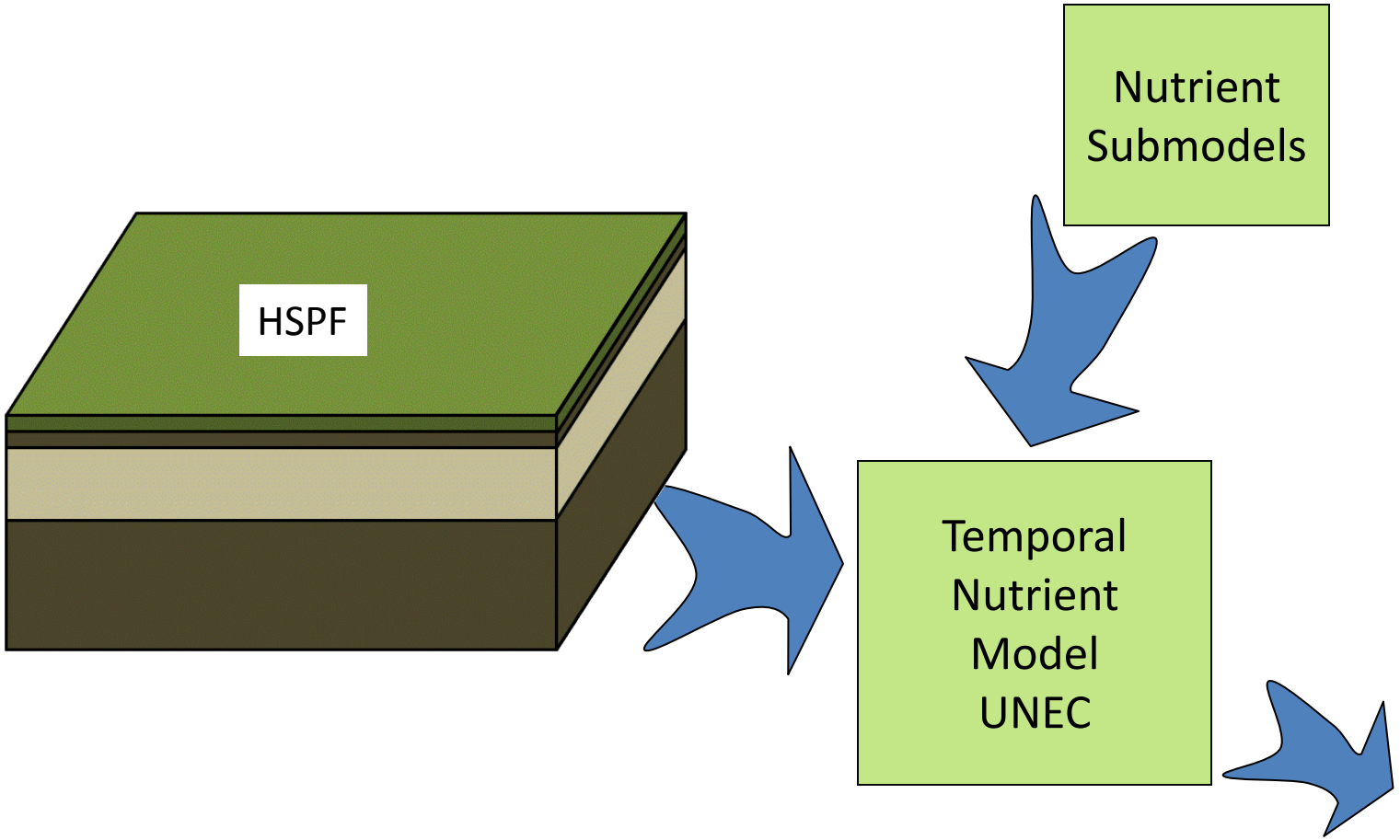
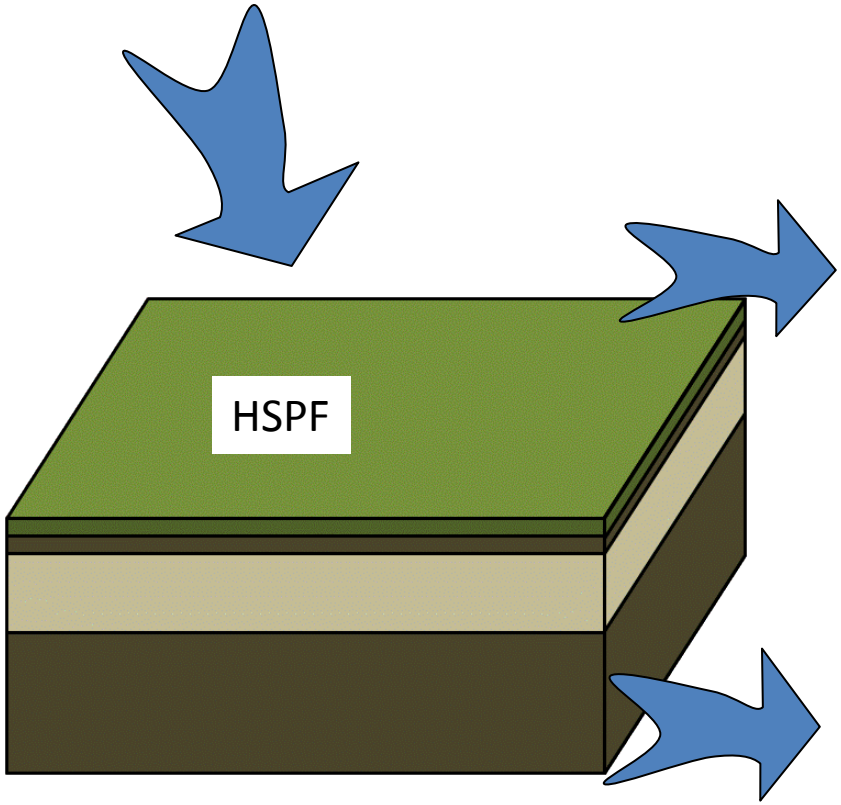
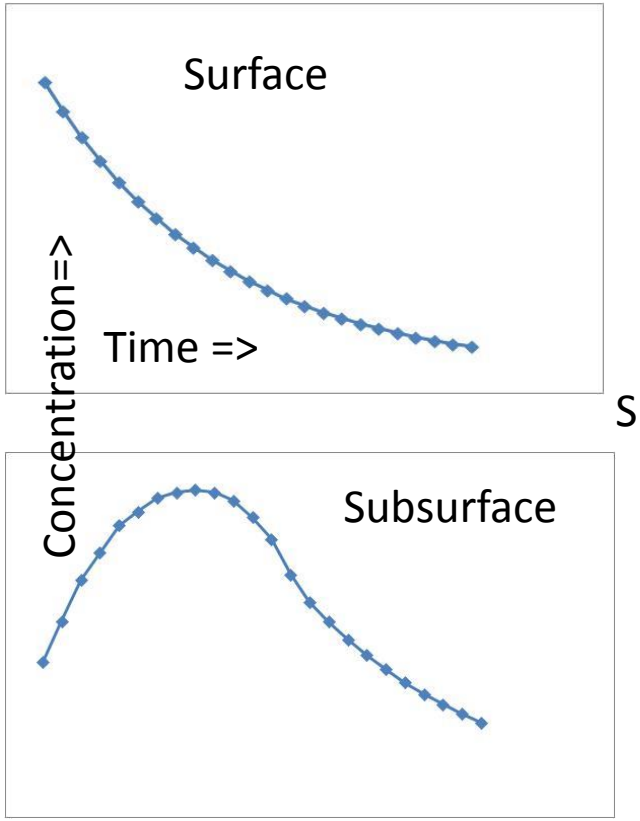
Phase 6



UNEC - Nitrogen

Each Loading Event



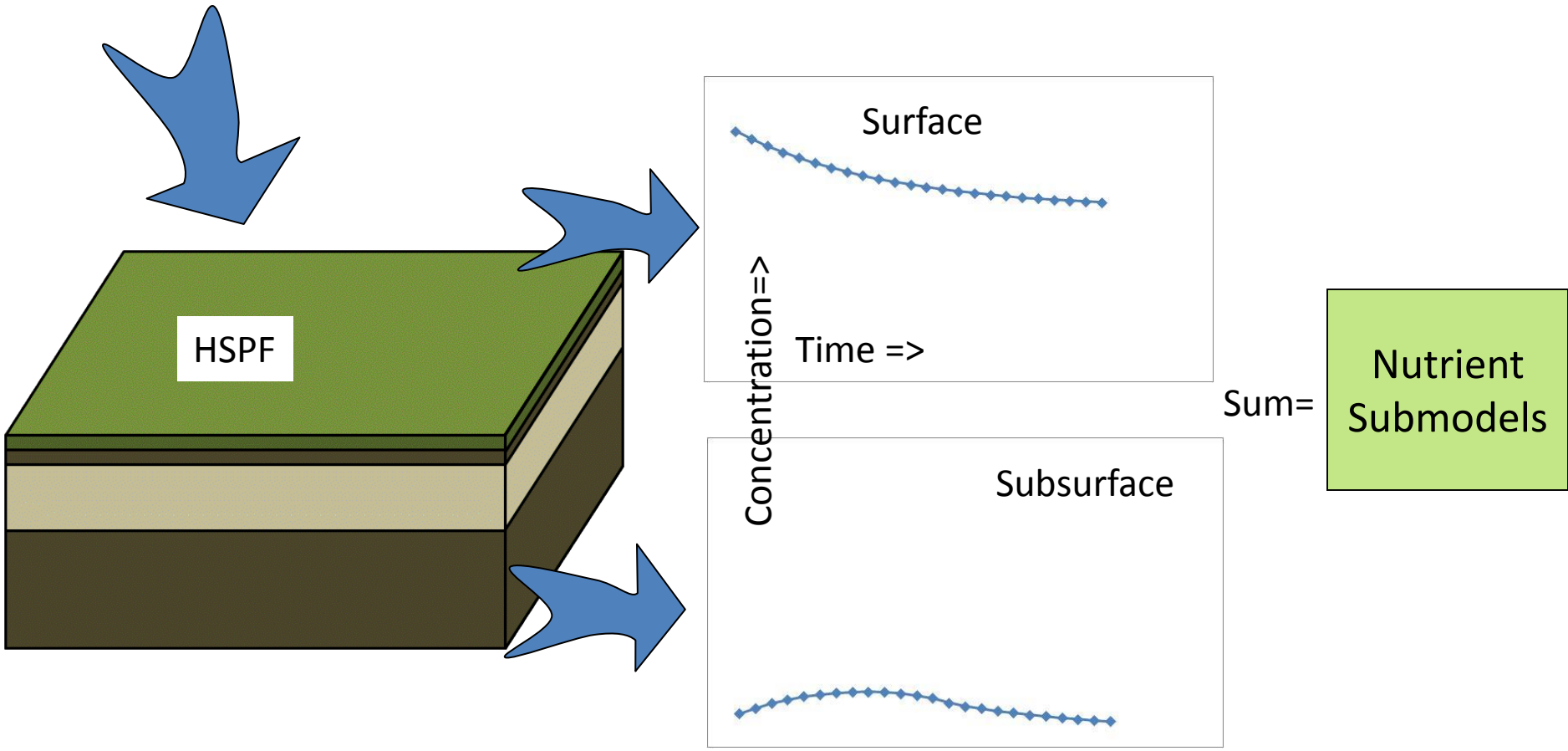


Sum=

Nutrient Submodels

UNEC - Phosphorus

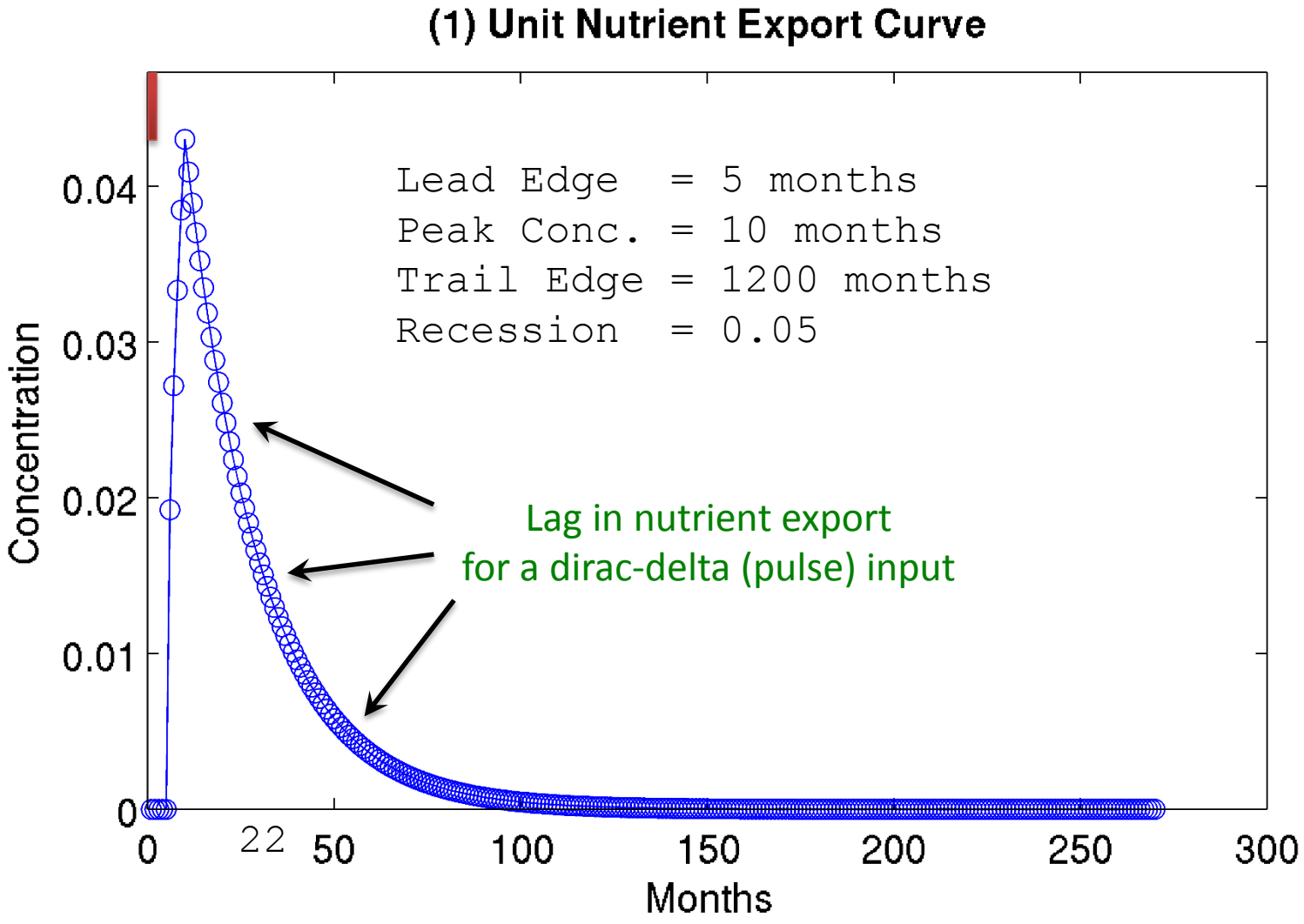
Each Loading Event



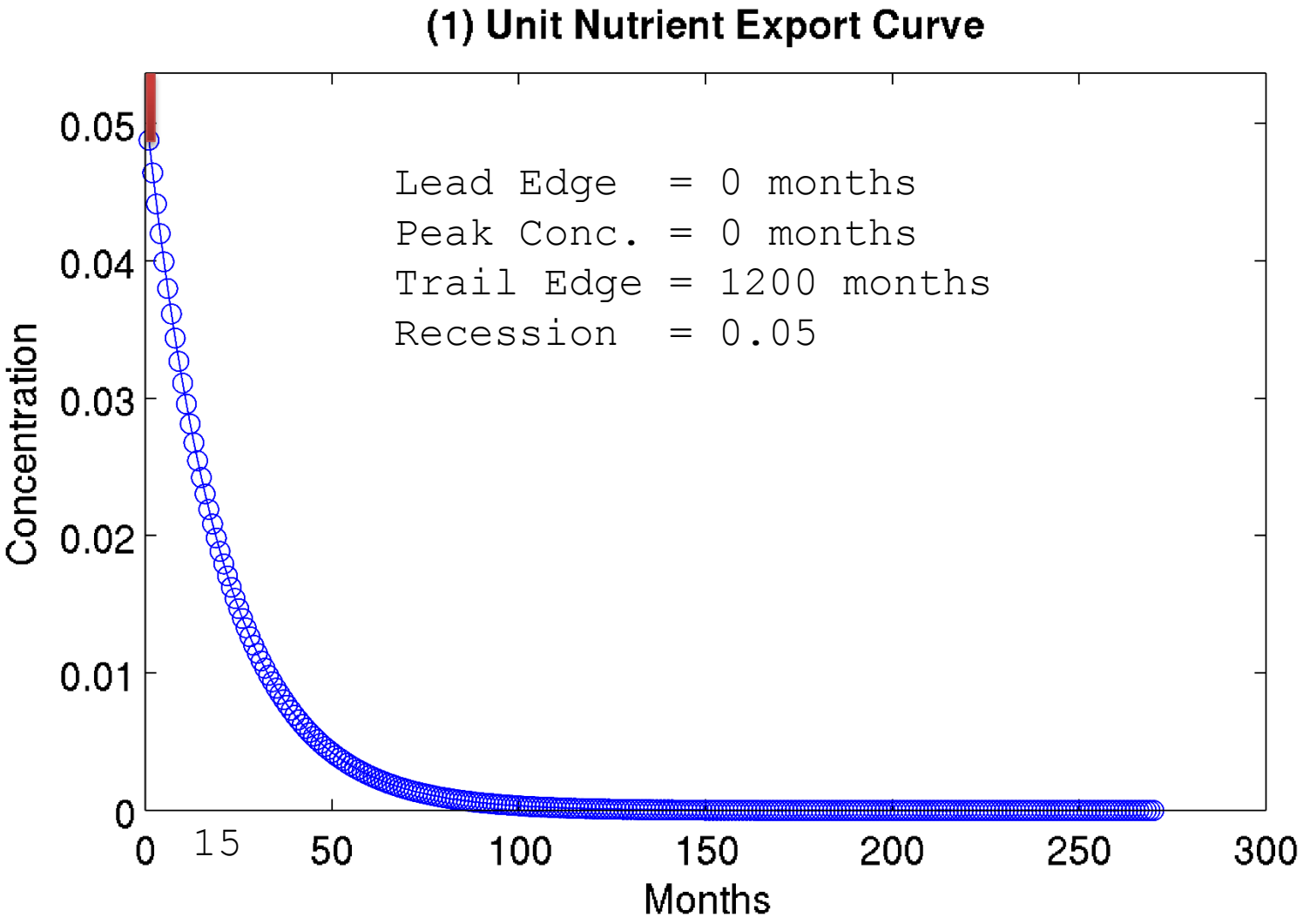
Unit Nutrient Export Curve (UNEC)

An examination of **transit time distribution**

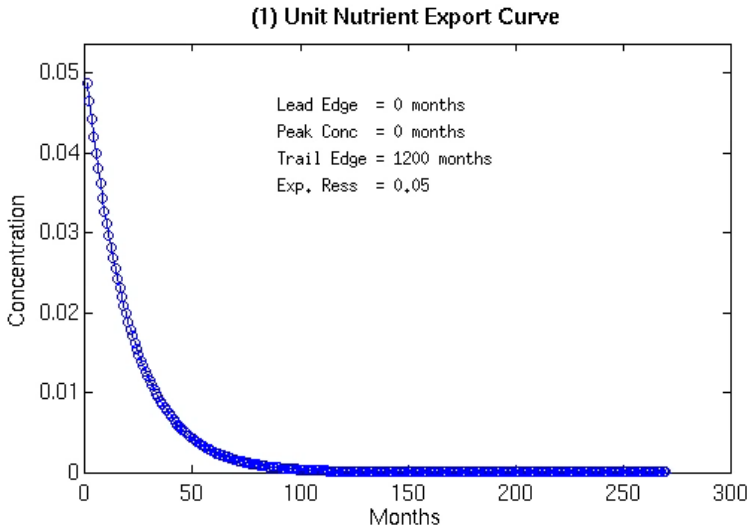
Unit nutrient export curve stochastically describes transport of nutrients as a probability density function. In other words, transit times are variable for inputs applied at same time.

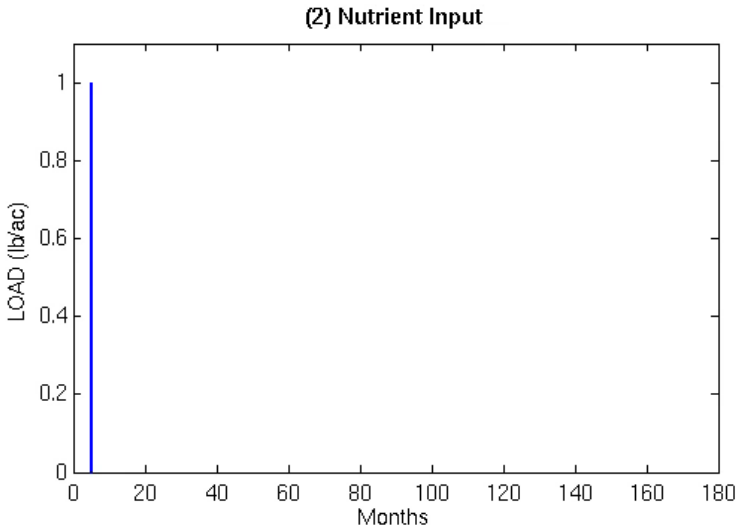


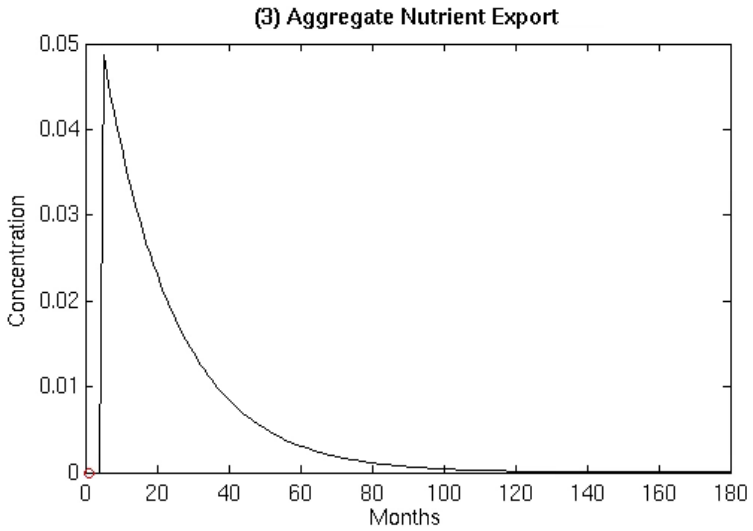
Here, a unit nutrient export curve is described using **one** parameter. This parameter would be obtained from mean transit times estimated from models (e.g. MODFLOW, APLE) and observations.

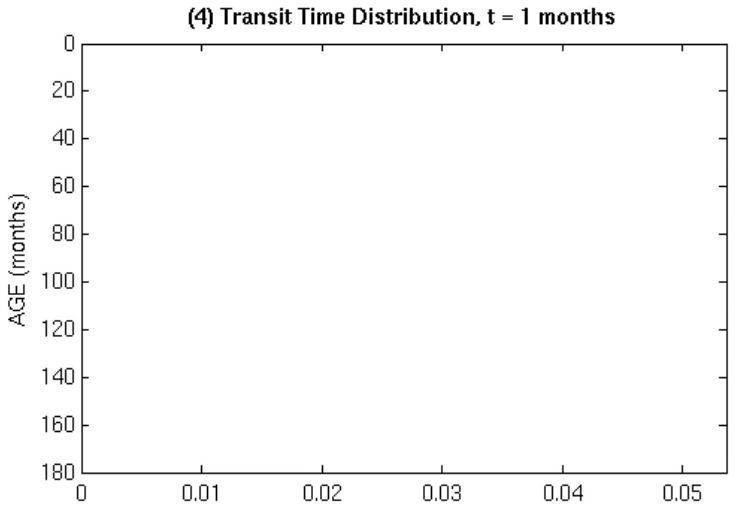


Dirac-delta / Pulse input



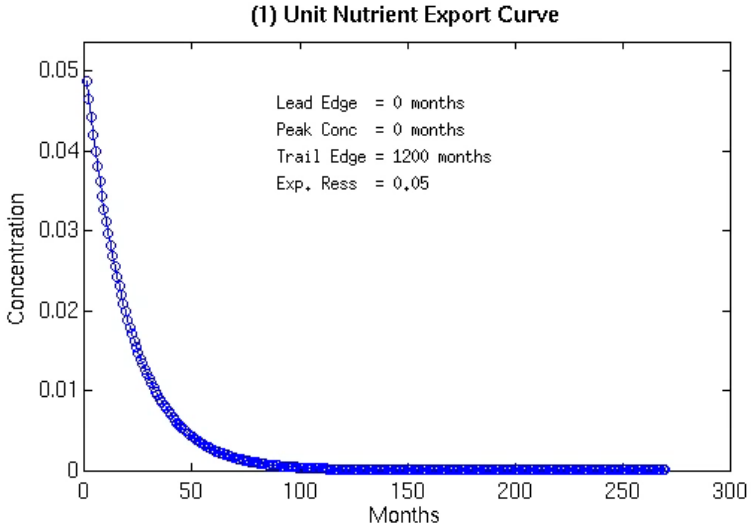


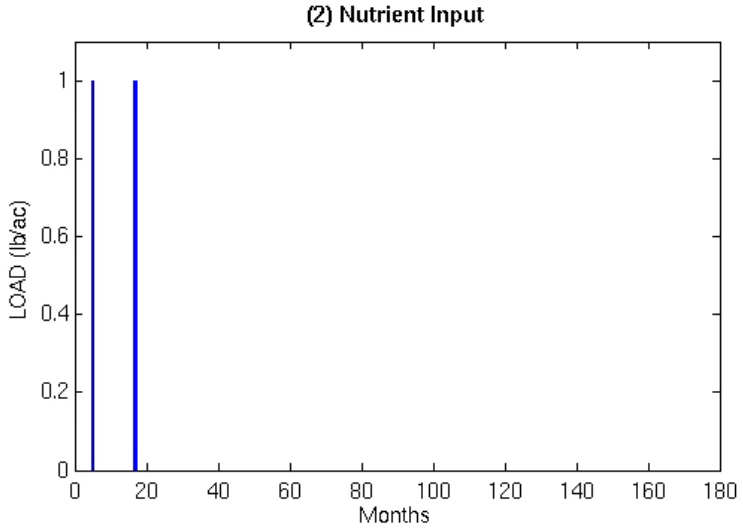


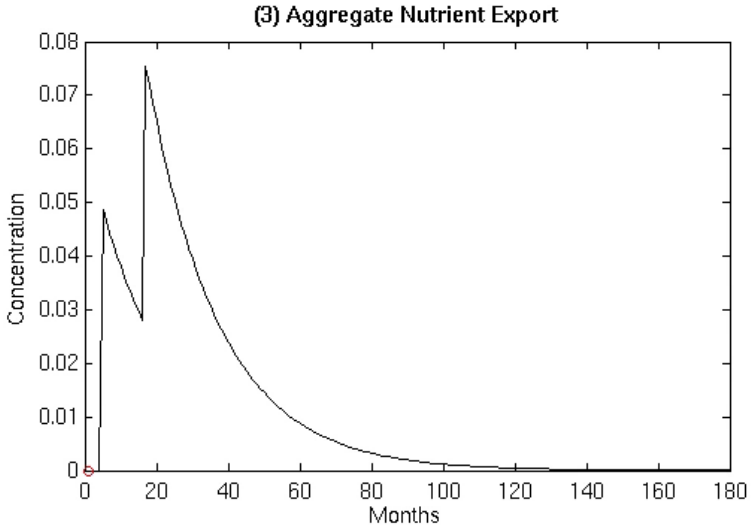


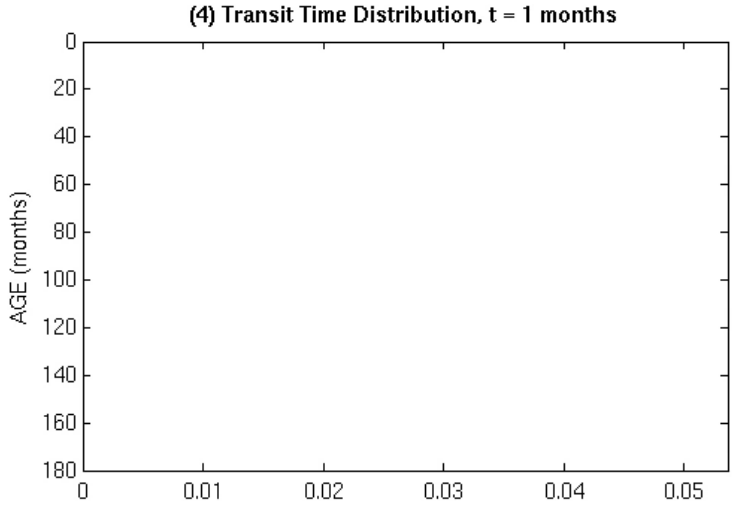
Dirac deltas / Pulse inputs

UNECs are superimposed to obtain the output as the convolutions of inputs.

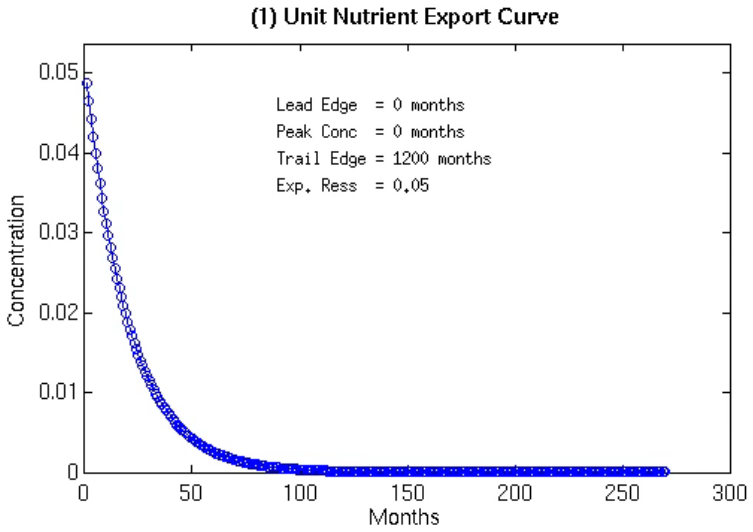


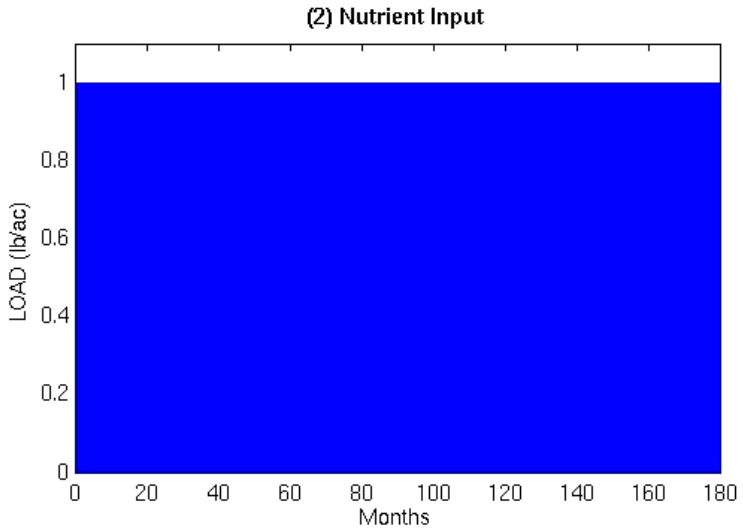


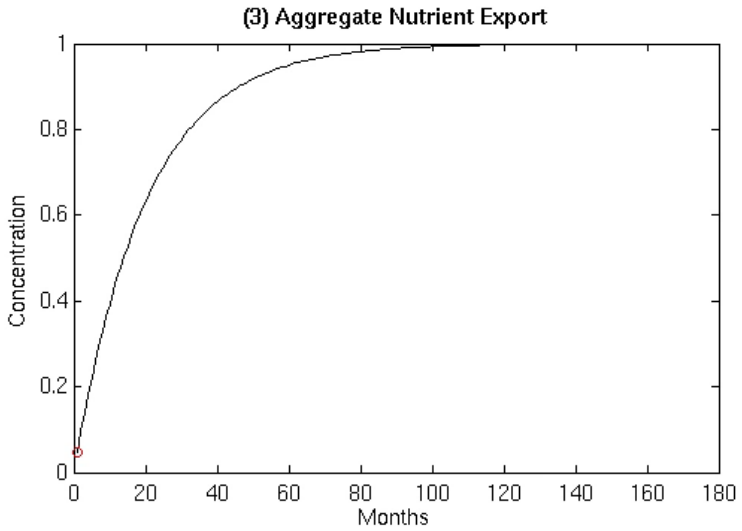


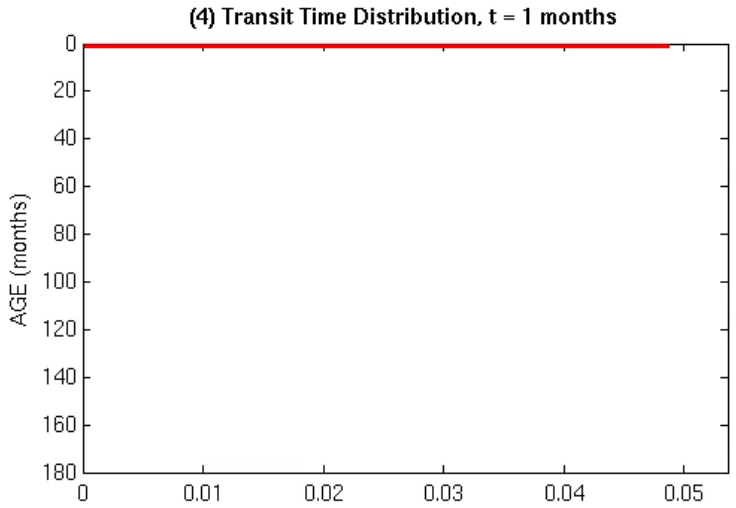


Continuous inputs









Sinusoidal inputs