Overall Development Plan for Phase 7 WSM

Gary Shenk – CBPO

7/6/21

Modeling Workgroup

CBP Watershed Modeling Products

	Existing	Long term
TMDL tracking	CAST6-2017 CAST6-2019… CAST6-2025	CAST7-2025
Calibration, Estuarine loading Water supply	P6 Dynamic Model	P7 Dynamic Model
Fine-scale		P7 Pixel Model

2023 Prototype

Opportunity

… Geomorphometry

Land Use

Computing Power

New Science

Fine-scale tools (field doc)

Partnership Need

PSC directives

WQGIT needs

STAC recs

Other GIT needs

Water supply partners

P7
CAST
DM

Model
Data Set
Endpoint
Project/Decision

Complete

In Process

Not Started

Top …

Up

P7 CAST DM

Partnership Need

Model
Data Set
Endpoint
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Complete
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PSC directives

1. Reassess 2035 climate in 2025
2. Don’t change planning targets until 2025

Water supply partners

NHD100k hourly flow & temperature
Low flow extremes ; Reservoirs

Other GIT needs

CAST inputs and outputs at NHD100k or NHD24k
Time-averaged N, P, S, flow, temp characteristics

STAC recs

Finer scale
Better characterize sources and sinks
Uncertainty Quantification (including BMPs)
Formalized optimization of CAST calibration

Revolutionize sediment
Match with monitoring data
More models in ensemble

WQGIT needs

Science needs database – 1 science need: Finer Scale

1) refine urban phosphorus sensitivities
2) investigate the impact of urban BMPs using SWAT and/or SWMM models.

P7 CAST DM

Partnership Need

Model
Data Set
Endpoint
Project/Decision

Complete
In Process
Not Started

Top ...
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2021 2022
Hydrology
Sediment

- Inputs
- Structure

- Improvements

2022 2023
Nitrogen
Phosphorus

- Improvements
- Scale consistency

Leaving hydrology unfinished – will return once we have the full model

2024
Review
Refine

- STAC review
- Partnership review

- Refinements

2025
Apply

1. Reassess 2035 climate in 2025
2. Don’t change planning targets until 2025

PSC directives

2021 2022
Hydrology
Sediment

2022 2023
Nitrogen
Phosphorus

2024
Review
Refine

2025
Apply

- WQGIT gives priorities – October 2021
  - Climate change!
  - Scale?
  - Uncertainty?
  - Something else?

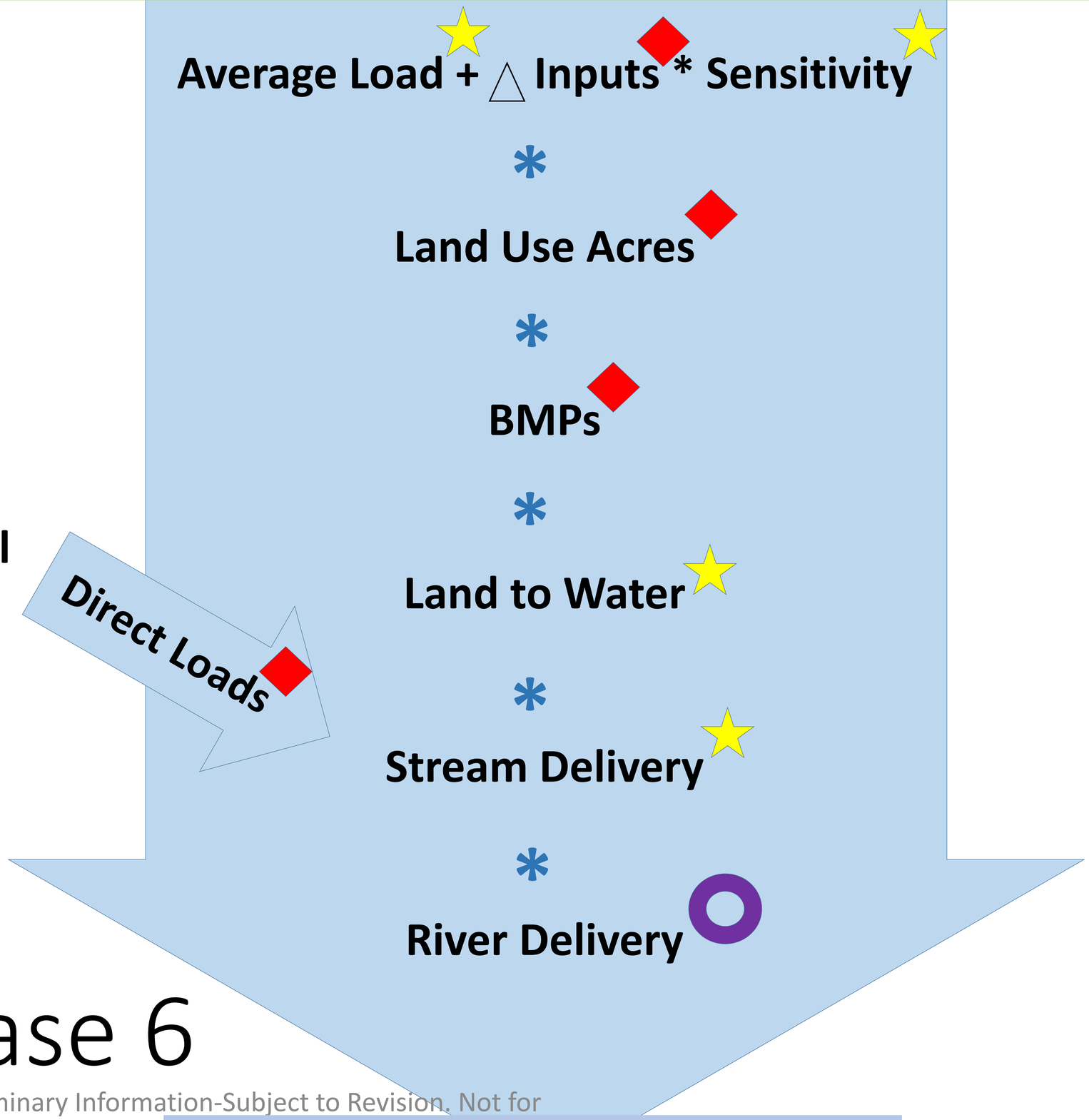
1. TMDL implementation deadline 2025
2. Reassess 2035 climate in 2025
3. Don’t change planning targets until 2025

PSC directives

Phase 6 Model Structure

Structure

- Specified by WQGIT
- Estimated by MWG
- Calibrated in dynamic model



Load by land-river segment and land use

Phase 6

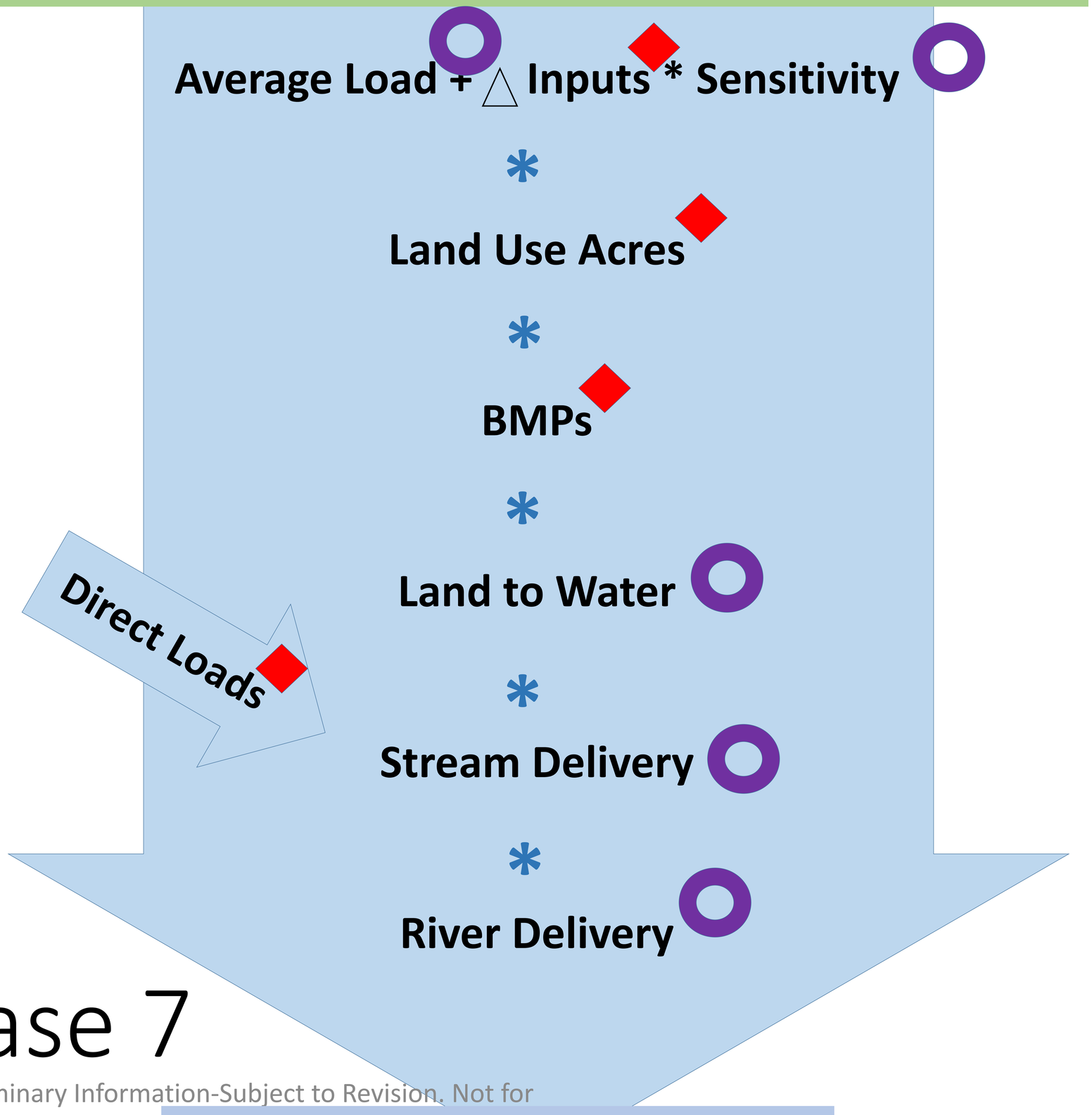
Preliminary Information-Subject to Revision. Not for Citati

Phase 7 Model Structure

Structure

◆ **Specified by WQGIT**

○ **Calibrated with estimated priors**



Load by NHD catchment and land use

Preliminary Information-Subject to Revision. Not for Citati

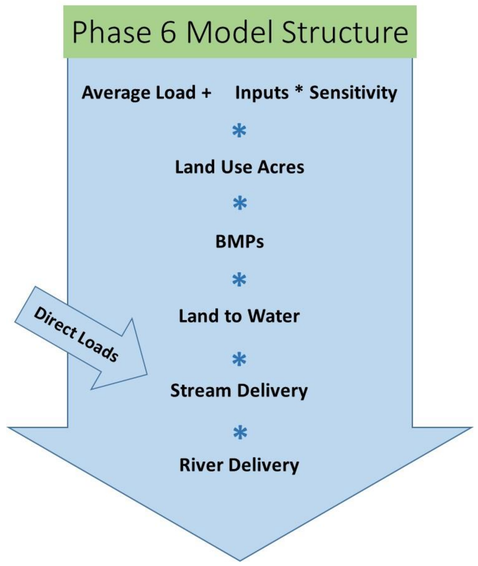
CBP **Phase 6** Model – Nutrient Scenario Mode

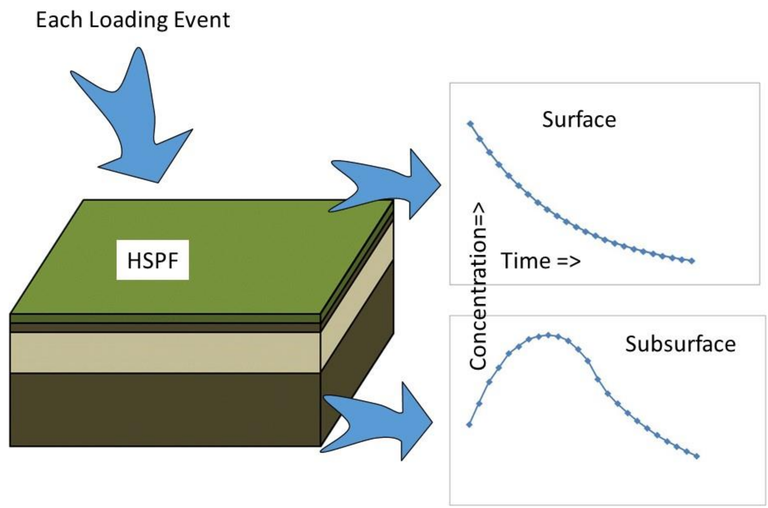
Land-river segment

Land-river segment

CAST 6

Dynamic Model 6





CAST determines CBP official scenario loads

CAST loads are temporally disaggregated for estuarine model

CBP **Phase 7** Model – Nutrient Scenario Mode

10m pixel

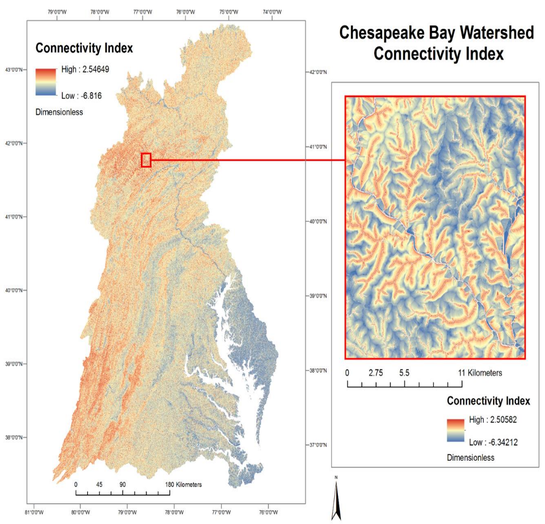
NHD 100k

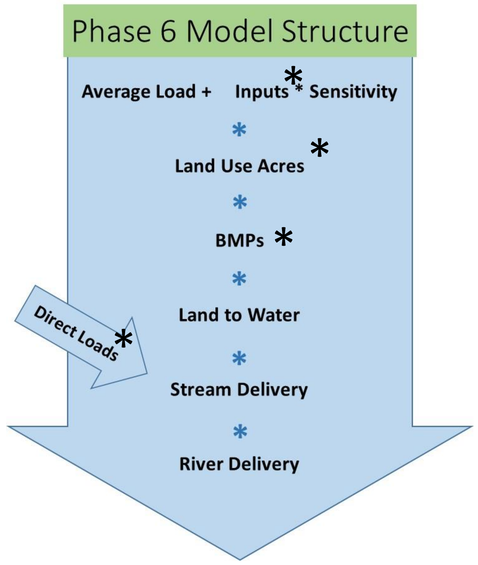
NHD 100k

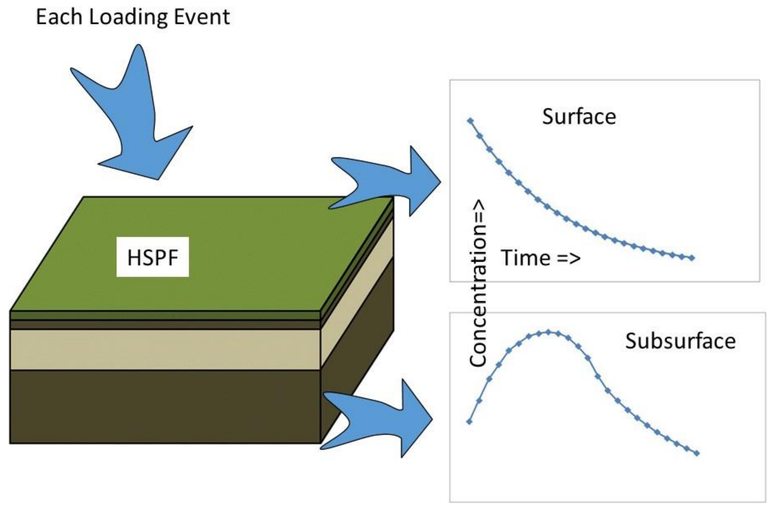
Pixel Model 7

CAST 7

Dynamic Model 7







CAST loads can be downscaled to finer scale to apply differential BMP crediting

(if credible methods are found)

CAST determines CBP official scenario loads

CAST loads are temporally disaggregated for estuarine model

CBP **Phase 6** Model – Flow Calibration Mode

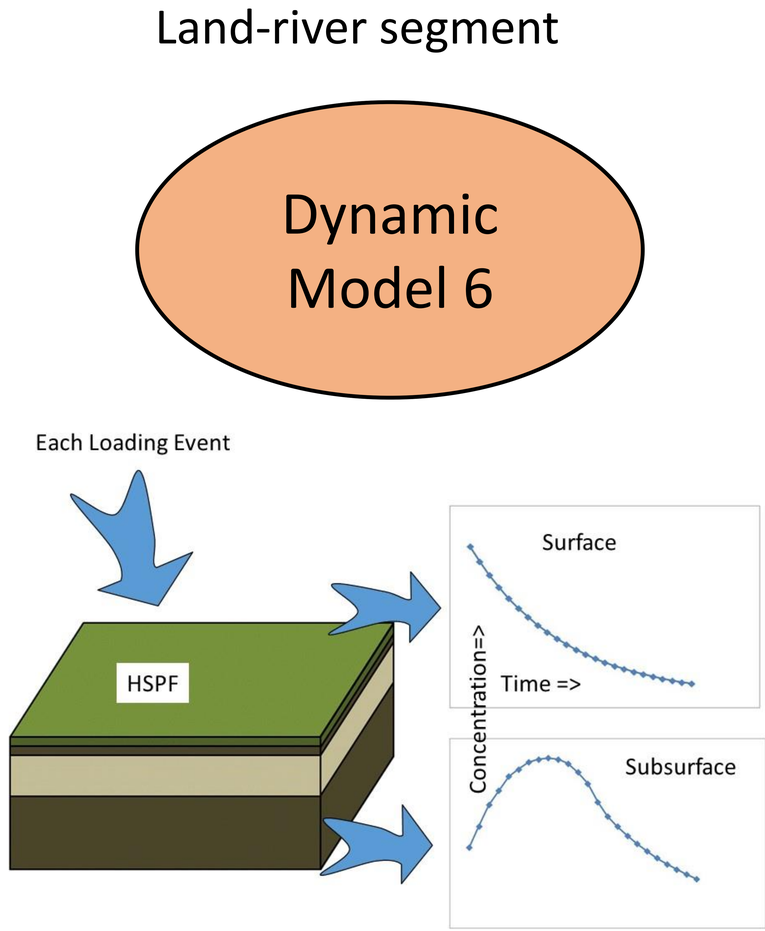
Hydrology completely calibrated in dynamic model

Calibrated Parameters

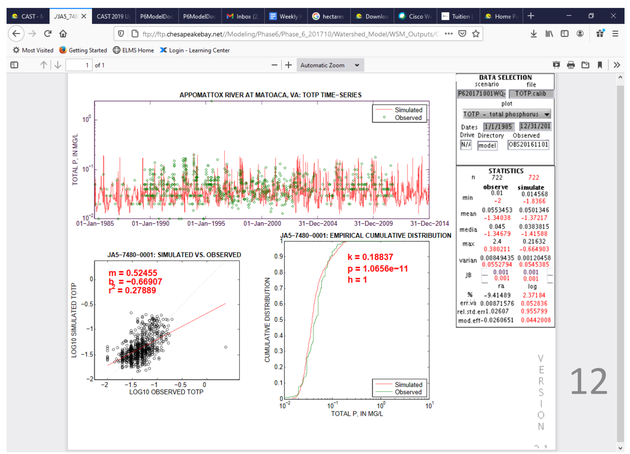
- **Potential Evapotranspiration**
- **stormflow-baseflow split**
- **recession of stormflow**
- **recession of baseflow**
- **seasonal storage**

Important products:

- **Average annual inches of stormflow by land use and county**
- **Daily flow to estuarine models**



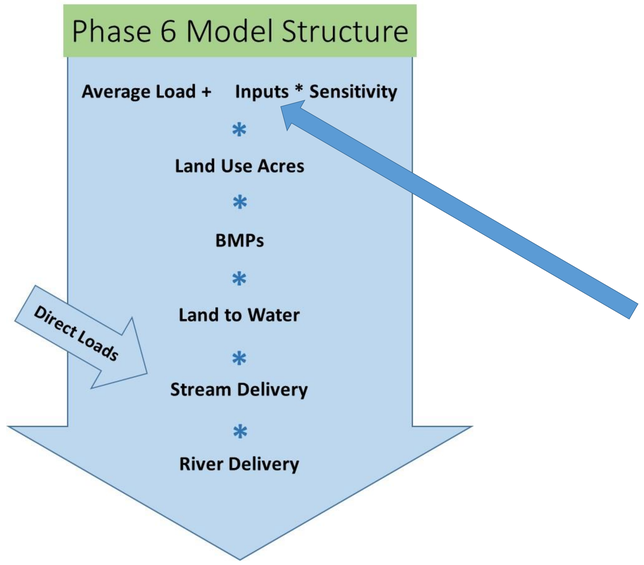
Temporal calibration



CBP **Phase 6** Model – Flow Calibration Mode

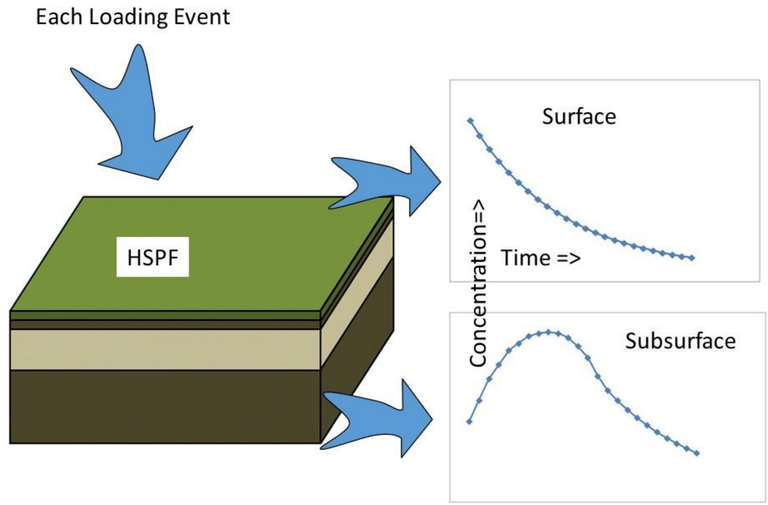
Land-river segment

CAST 6 Nutrient Model



Land-river segment

Dynamic Model 6



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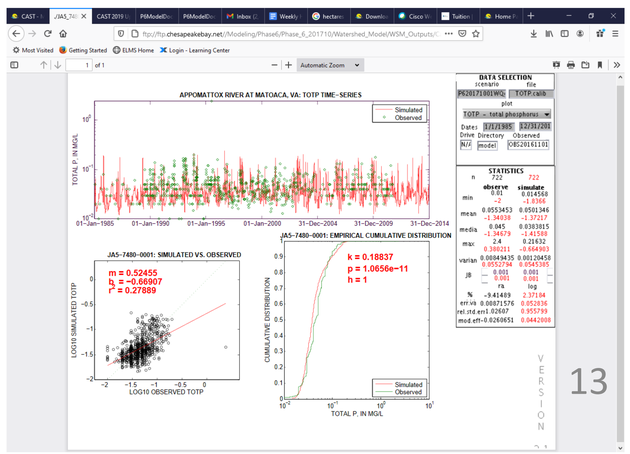


CBP **Phase 7** Model – Flow Calibration Mode

10m pixel

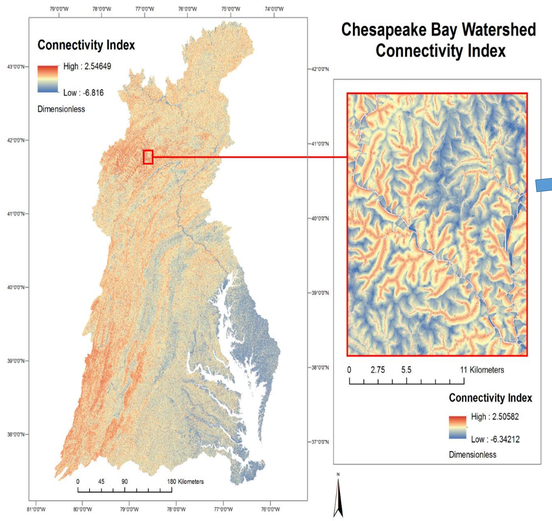
NHD 100k

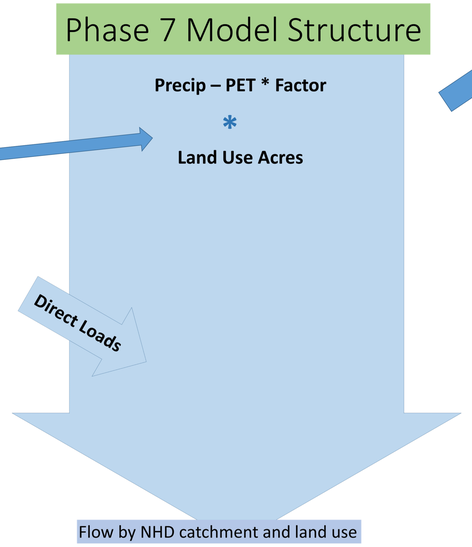
NHD 100k

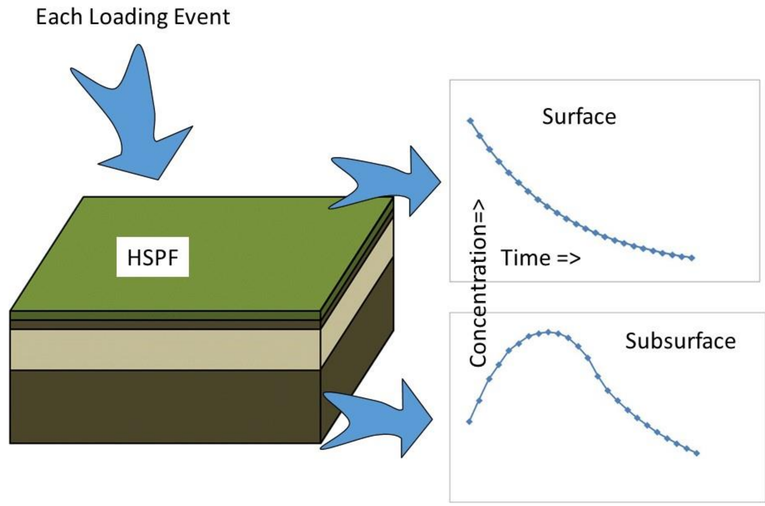
Pixel Model 7

CalCAST 7

Dynamic Model 7



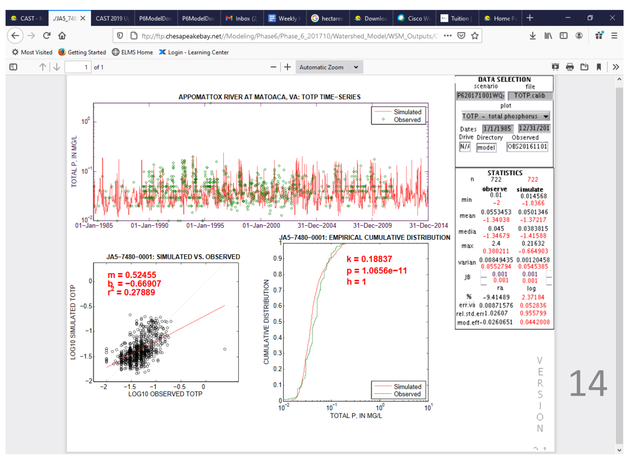




Effects of fine-scale landscape properties
- Potential to inform CalCAST

Calibration to spatial Flows
– Potential to inform dynamic model

Temporal calibration



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Average annual inches of stormflow by land use and county?

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CBP **Phase 7** Model – Flow Calibration Mode

If calibrated parameters are 'right for the right reason'

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We have a better chance of getting quality outputs

Important products:

- **Average annual inches of stormflow by land use and county**
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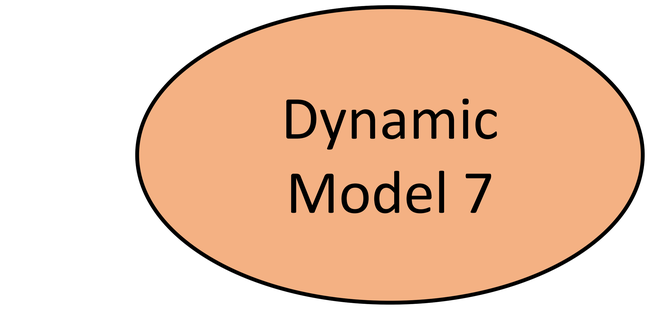
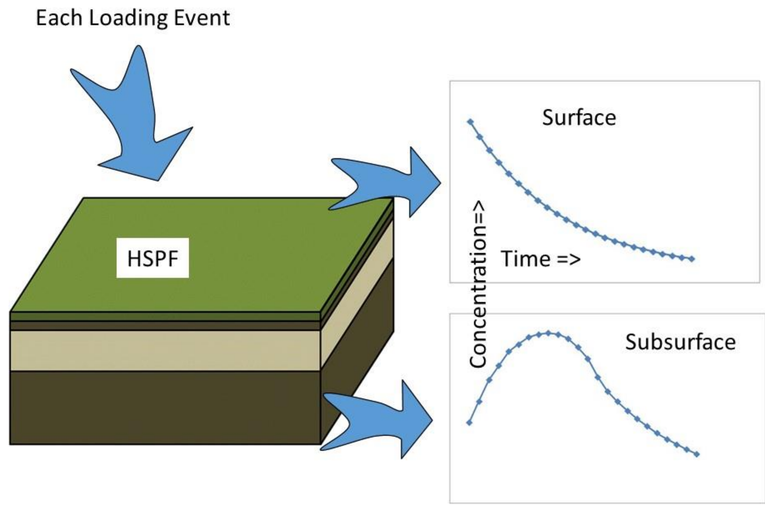
- **Change in hydrology due to climate change, land use, or BMPs**

NHD 100k





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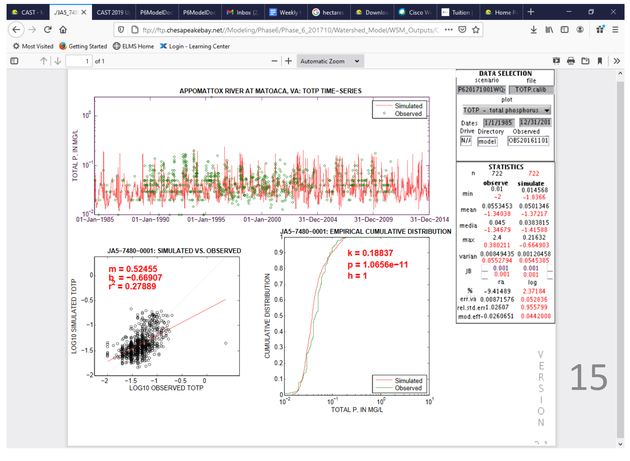

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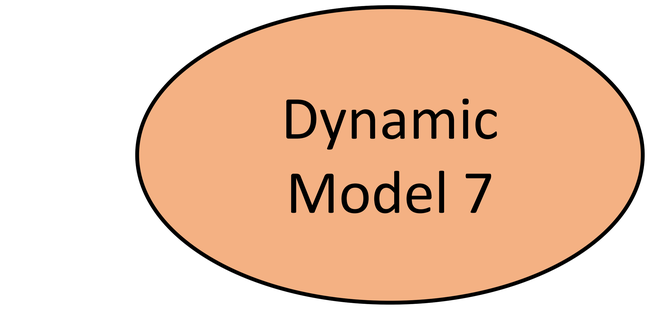

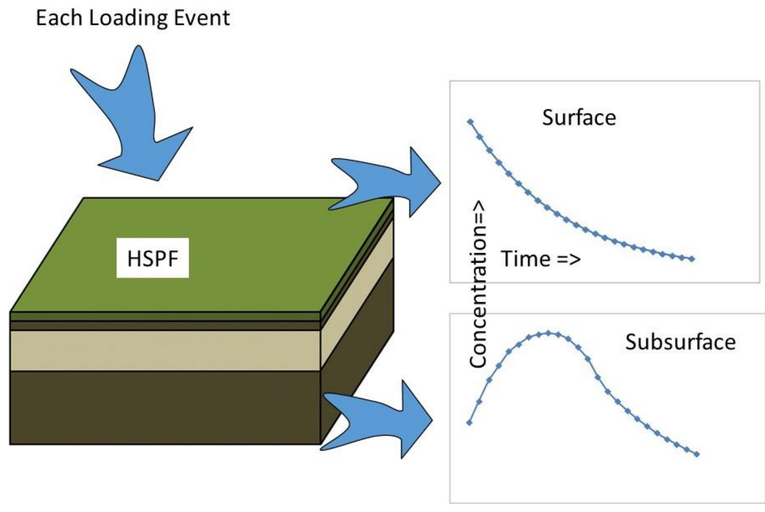

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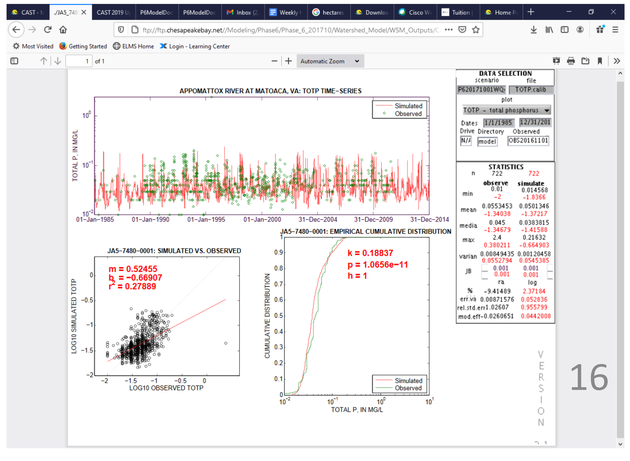


9:45 Phase 7 WSM Development – Gopal Bhatt (Penn State)

11:00 Comparison of Modeled and Monitored Nutrient Trends and Other Watershed Analyses – Isabella Bertani, UMCES

CBP **Phase 6** Model – Sediment Calibration Mode

10m pixel

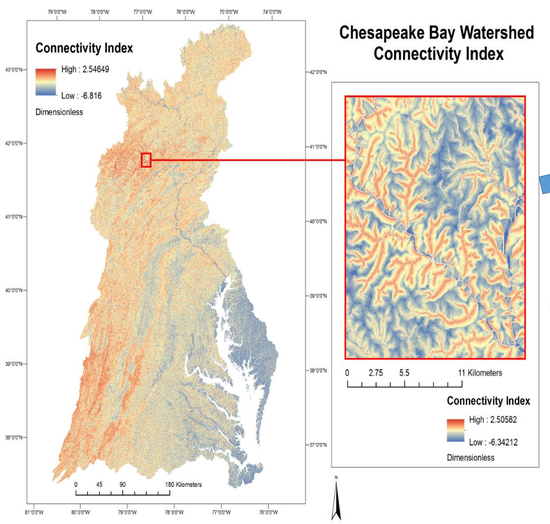
Land-river segment

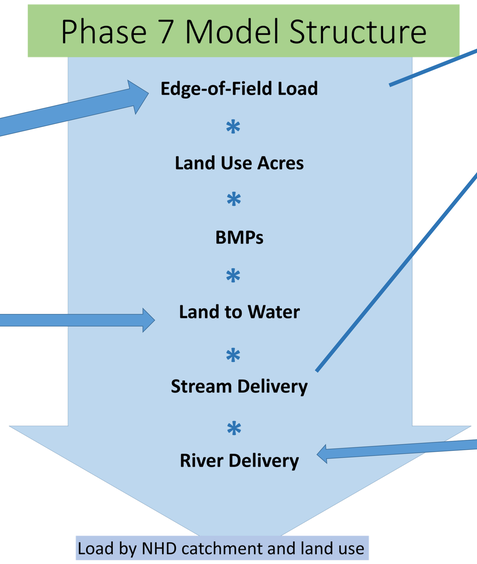
Land-river segment

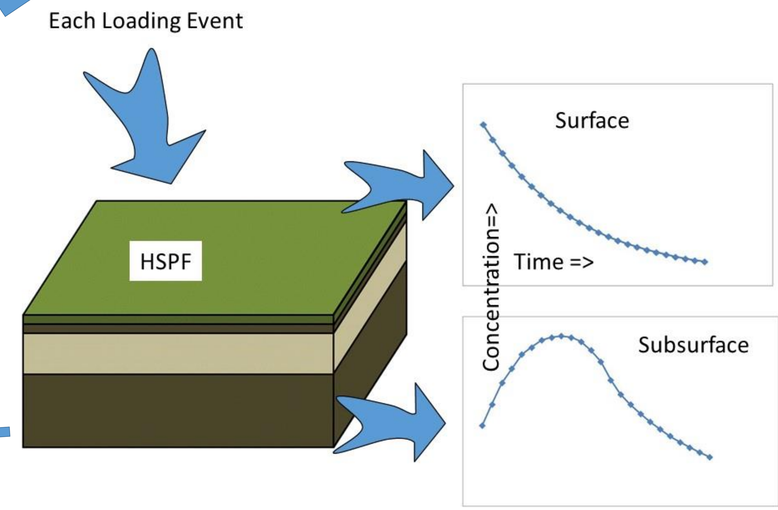
Sediment analysis

CAST 6

Dynamic Model 6







Calculation of washoff and transport coefficients

Land use
BMPs
Stream delivery

Temporal calibration

River delivery

CBP **Phase 7** Model – Sediment Calibration Mode

10m pixel

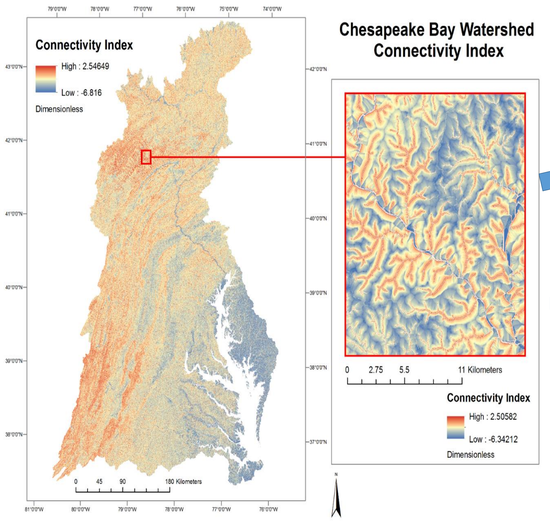
Land-river segment

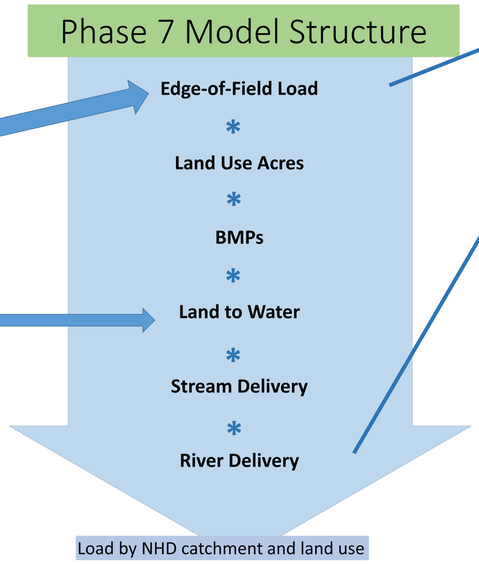
Land-river segment

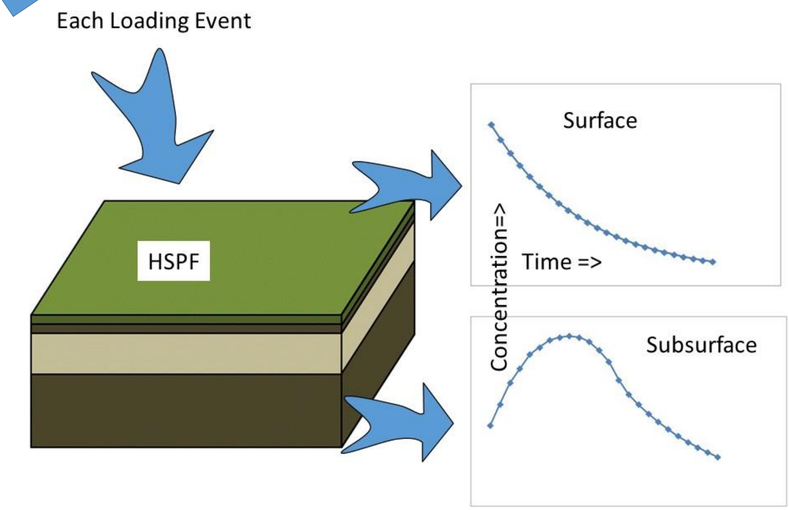
Pixel Model 7

CalCAST 7

Dynamic Model 7







Calculation of washoff and transport coefficients

Land use
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CBP **Phase 7** Model – Nutrient Calibration Mode

10m pixel

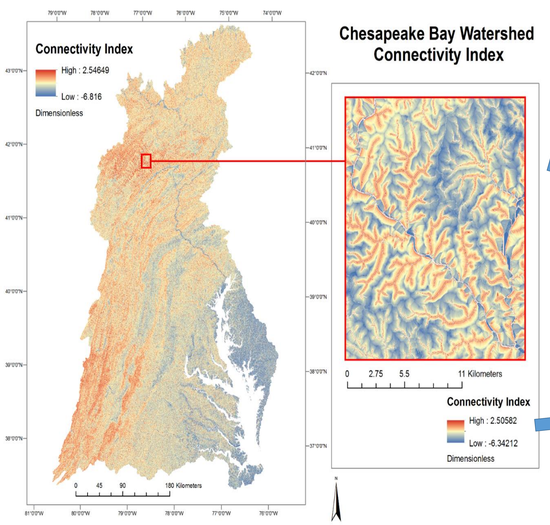
NHD 100k

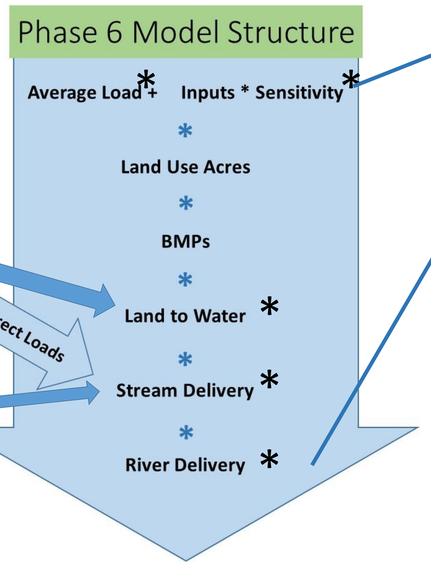
NHD 100k

Pixel Model 7

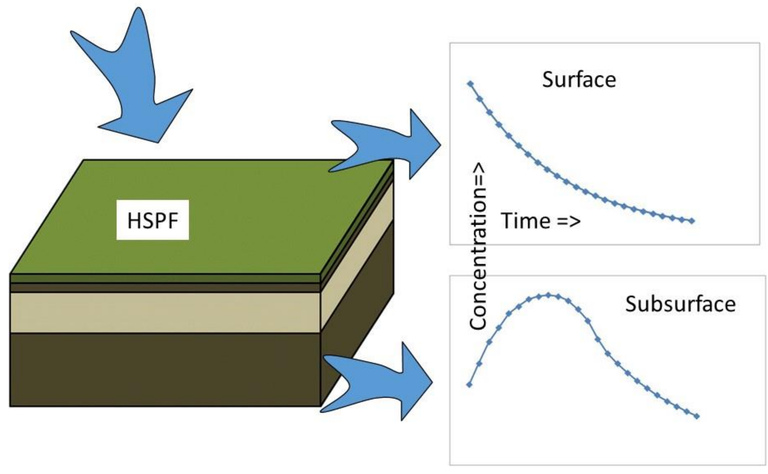
CalCAST 7

Dynamic Model 7





Each Loading Event

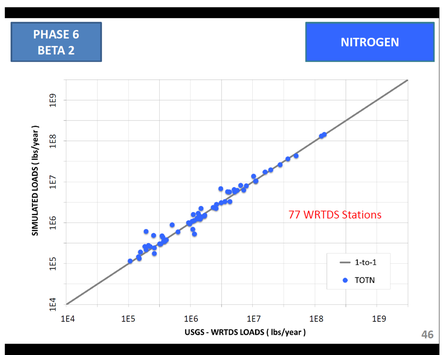


Calibration of meta-parameters to spatial loads

Temporal calibration

Generation of summarized loading parameters for flow, N and P

Potential feedback



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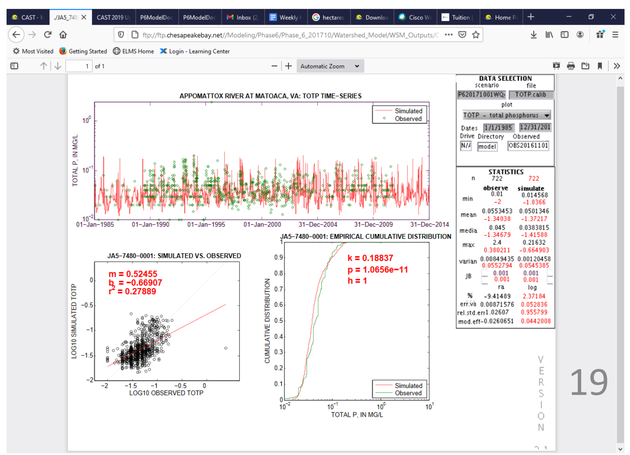
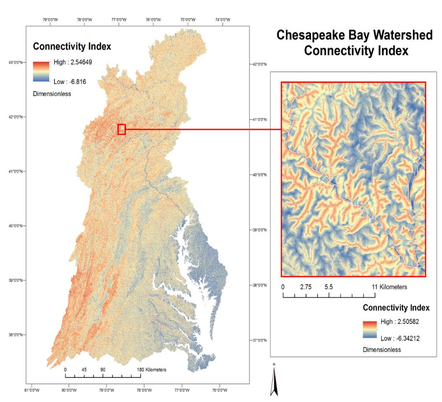


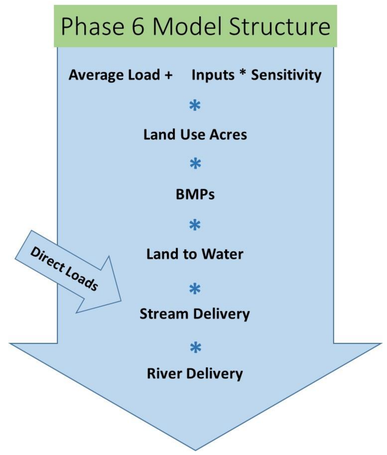
2021 Hydrology

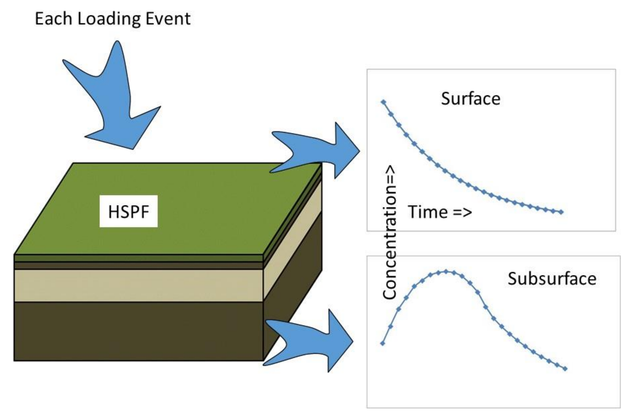
April

July

October







- NHD
- Data issues
- Database Structure
- “On the graph paper”

- Landscape and hydrologic feature effects on hydrograph

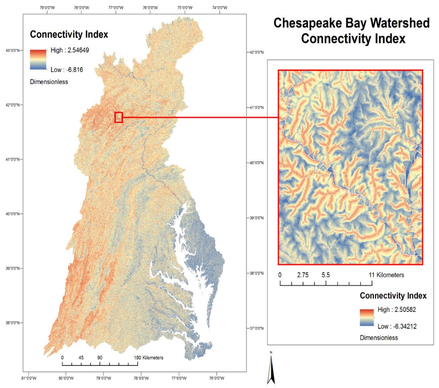
- Representation of flow at NHD scale
- Simulation of flow at river segment scale

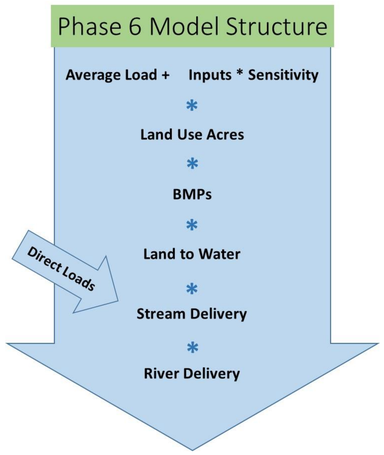
2021-2022 Sediment

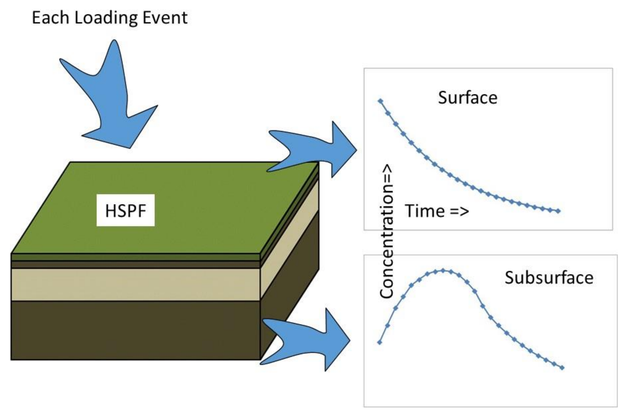
October

January

April







- RUSLE recalculation
- Interconnectivity metric
- Pond influence

- Stream/Floodplain
- Calibration to long-term loads

- Dynamic simulation
- Calibration to grab samples

- Reasonable, consistent 3-phase sediment simulation

2021 2022
Hydrology
Sediment

- Inputs
- Structure

- Improvements

2022 2023
Nitrogen
Phosphorus

- Improvements
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QUESTIONS AND COMMENTS

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Refine

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