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Future Climate Impacts of CBP BMP Efficiencies

A Modeling Sensitivity Study for Urban and Agricultural BMPs

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Project Overview

Goal: Quantify the performance of agricultural & urban BMPs in the Chesapeake Bay watershed under current and future climate scenarios

Tools: APEX for agricultural, SWMM for urban

Output: Pollutant removal efficiencies for different BMPs

Modeling Approach

Hydrologic regimes

1. Base (e.g., 1991-2000)
2. Future 1 (e.g., 2035)
3. Future 2 (e.g., 2065)

Watershed Settings

Physiographic Region (PR)	Land Use (LU): Row crops	Hay land	Pasture	Forest
Ridge & Valley	LU1 PR1	LU2 PR1	LU3 PR1	LU4 PR1
Appalachia	LU1 PR2	LU2 PR2	LU3 PR2	LU4 PR2
Coastal Plain	LU1 PR3	LU2 PR3	LU3 PR3	LU4 PR3
Piedmont	LU1 PR4	LU2 PR4	LU3 PR4	LU4 PR4

Test BMPs

1. Cover crops
2. Conservation tillage
3. More in progress

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BMP Selection (Initial Shortlist)

CBP's Top 20 Most Implemented BMPs + CBP's Top 20 Most Effective BMPs + Feasibility Analysis

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BMP	Land Use			
	Row Crops	Hay Land	Pasture	Forest
Grass Buffers	x	x	x	
Cover Crops	x	x		
High Residue Tillage	x			
Conservation Tillage	x			
Manure Incorporation	x	x		

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Site Representation in APEX

Input Files to be manipulated:

- Controls
- Site characteristics
- Soil
- Weather
- Operation schedule
- Subarea

Parameters defining region, land use, and climate

BMP-specific parameters

* Coordinating with CBP team to get input data

Scenarios

4	×	4	×	N	×	3	=	48*N
regions		land uses		BMPs*		climate regimes		scenarios

Multiple python scripts have been developed to automate file generation process

* Subject to change

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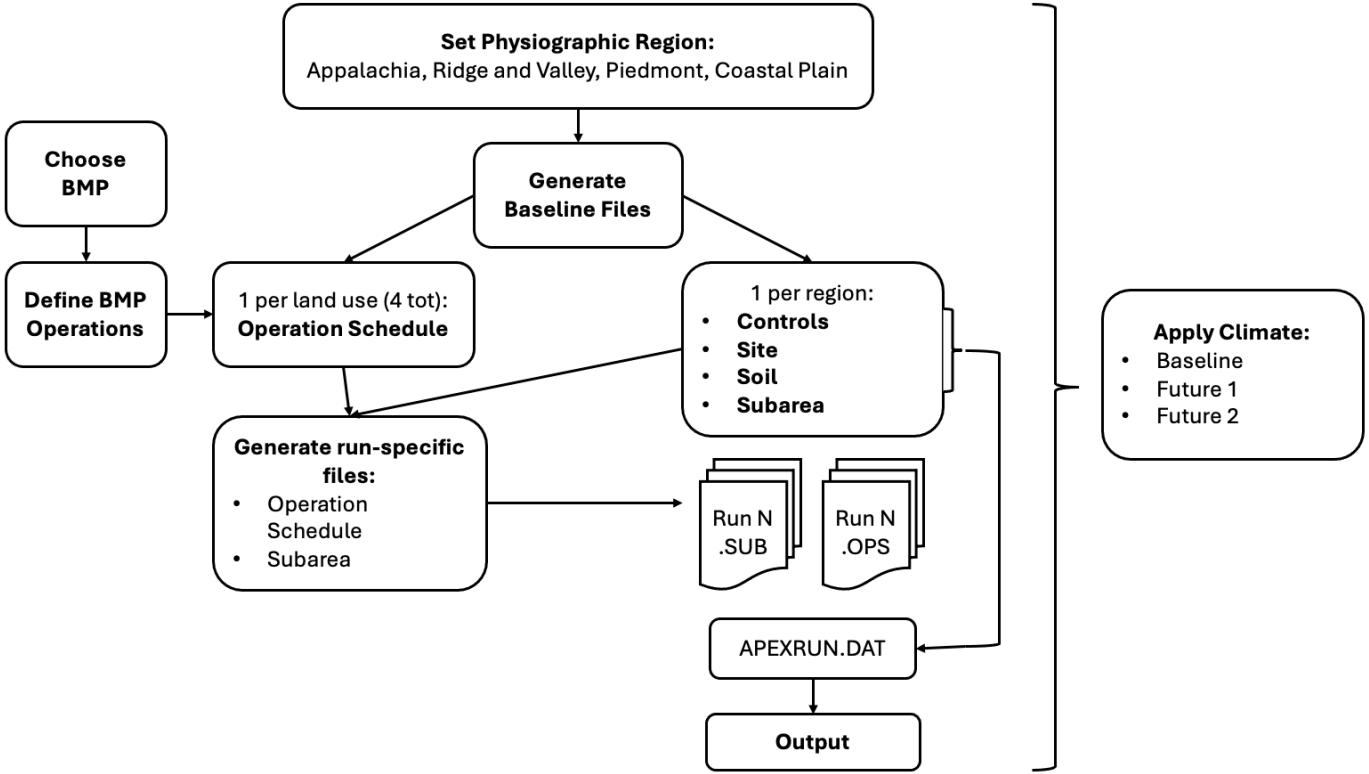
APEX Model Workflow



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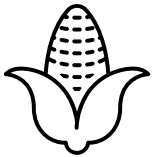
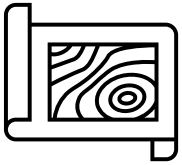
Trial Run: baseline (no BMP)



- Row crops: corn
- Simple operation (plant, harvest, kill)



- 5-ha field
- 0% slope

- 1, 20, 100-year simulations
- Daily and hourly weather data via NASA

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Trial Run: Outputs

- Flow ☑
- N concentration ☑
- P concentration ☑
- Sediment ☐

Run times: (hourly tbd)

- 1 year: <1s
- 20 years: 3s
- 100 years: 17s

```
    TOTAL N BALANCE (kg)

PER =-0.132292D-02  DF  =-0.132031D+01  BSN = 0.101505D+06  PCP = 0.239363D+03  DN  = 0.172802D+02  NFIX= 0.000000D+00
VOL = 0.157988D+04  FNO = 0.000000D+00  FNMN= 0.000000D+00  FNMA= 0.000000D+00  BURN= 0.000000D+00  DPKN= 0.265018D+02
PSON= 0.000000D+00  YNWN= 0.000000D+00  YN  = 0.000000D+00  WYLN= 0.314352D+03  YLN = 0.443902D+01  FSN = 0.998030D+05
TLMN= 0.000000D+00  TSMN= 0.000000D+00  TRMN= 0.000000D+00  TRON= 0.000000D+00  RSDN= 0.000000D+00


    FLOOD ROUTING SUMMARY WATERSHED OUTLET
    SUM QVOL =     0.128919E+06 mm  SUM HVOL =     0.246793E+04 mm


    TOTAL WATER BALANCE (m3)

PER = 0.415277D+03  DF  = 0.711873D+01  BSW = 0.328506D+05  BGWS= 0.250000D+03  BRSV= 0.000000D+00  BSNO= 0.000000D+00
BSWL= 0.000000D+00  PCP = 0.299204D+06  WYLD= 0.222011D+06  DPRK= 0.930987D+05  ET  = 0.171779D+05  IRG = 0.000000D+00
QIN = 0.000000D+00  PSOQ= 0.000000D+00  EVRT= 0.000000D+00  RSIR= 0.000000E+00  WLIR= 0.000000E+00  IRDL= 0.000000D+00
FSW = 0.171421D+01  FGWS= 0.102475D-03  FRSV= 0.000000D+00  FSNO= 0.846188D+01  FSWL= 0.000000D+00


    TOTAL SEDIMENT BALANCE

PER = 0.000000D+00  DF  = 0.000000D+00  BRSY= 0.000000D+00  YS  = 0.000000D+00  YW  = 0.000000D+00  DEP = 0.000000D+00
DEG = 0.000000D+00  RSYF= 0.000000D+00
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Next steps

1. Troubleshooting
    - Sediment simulation
    - Hourly data
    - Wind data
2. Data gathering/generalization
3. BMP simulation
    - Starting with cover crops

Cover crops via cover crop strategies

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