A more complex Lakeshore example using all ArcNLET-Py modules

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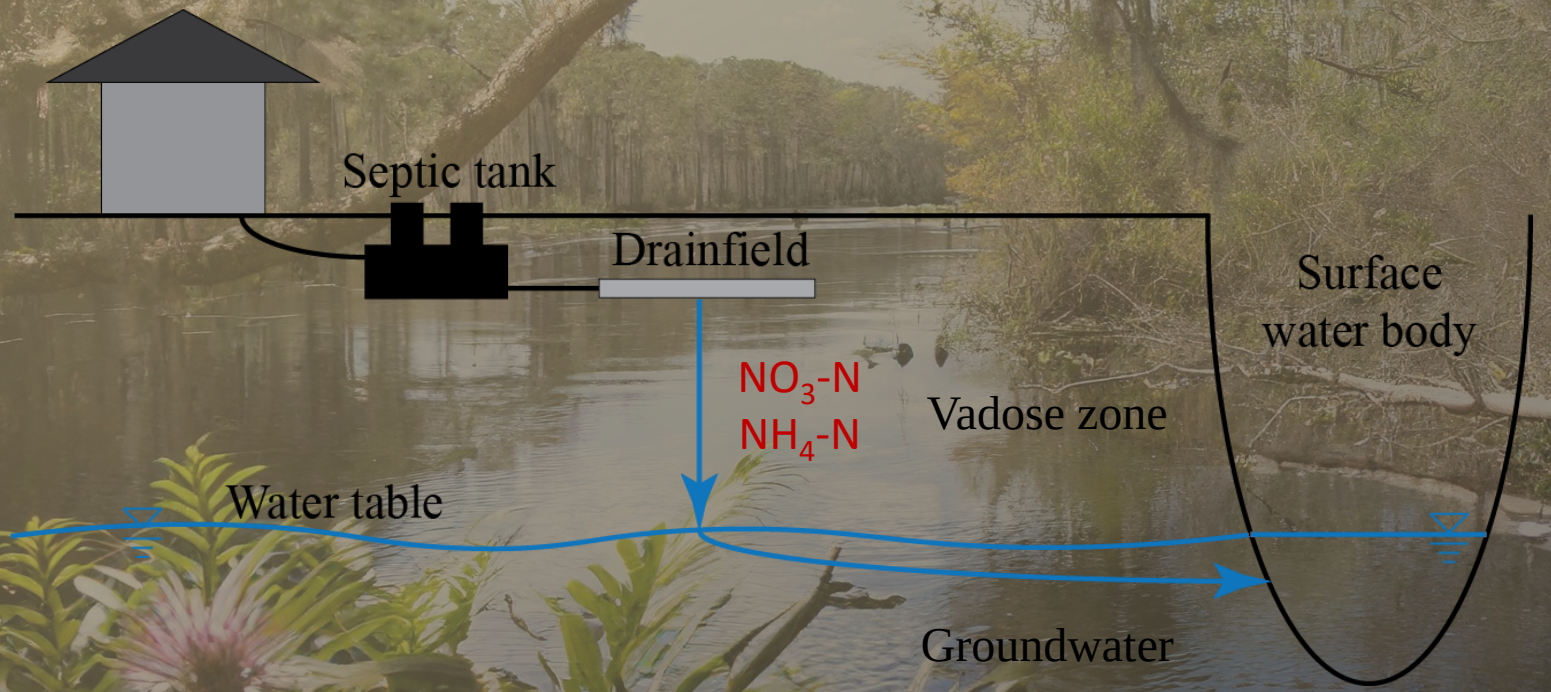
- A more complex Lakeshore example using all ArcNLET-Py modules



Model reactive transport of NH_4-N and NO_3-N in both vadose zone and groundwater

1 Introduction

This is a complex example for advanced users

- Training videos on Youtube:

  https://www.youtube.com/@mingye9168/videos

- Source code on GitHub and online User's manual:

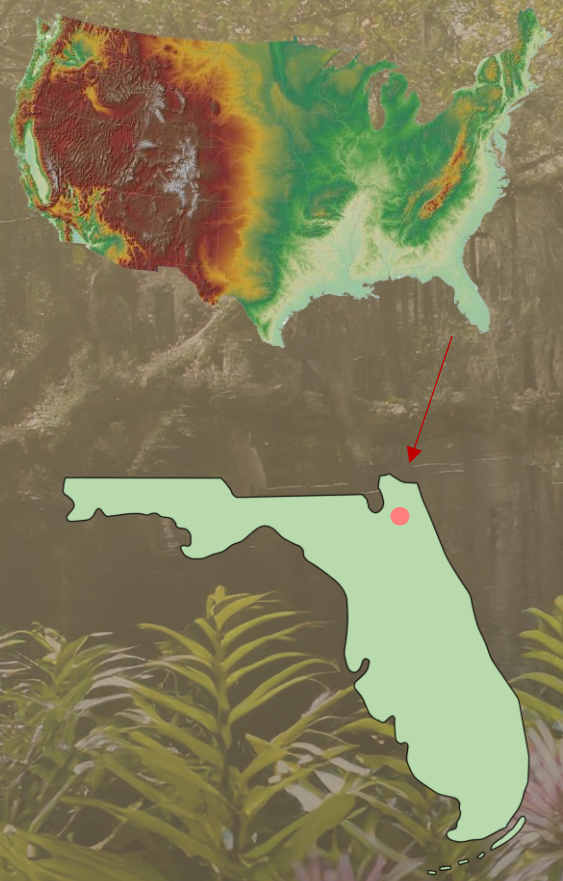
  https://github.com/ArcNLET-Py/ArcNLET-Py

- FSU Website:

  https://atmos.eoas.fsu.edu/~mye/ArcNLET/

2. Lakeshore example

2.1 Study area



265 septic tanks

2.2 Data prepare

- Study area – shapefile with one polygon
- DEM – raster
- Location of septic tanks – multi-point shapefile
- Waterbodies – shapefile

https://github.com/ArcNLET-Py/ArcNLET-Py/tree/main/Examples

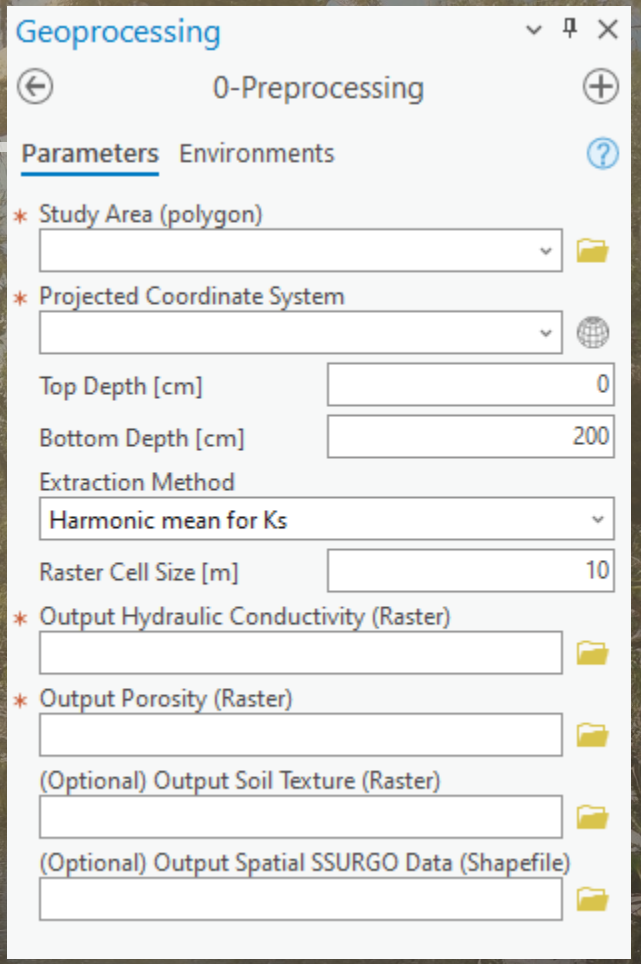
All input files need to use the same projected coordinate

2.3 Structure of ArcNLET-Py

- ArcNLET-Py modules
  - 0-Preprocessing
    - Extracts data (hydraulic conductivity, porosity, and soil types) from SSURGO database
  - 1-Groundwater Flow
    - Analyzes groundwater velocity and velocity direction based on DEM and soil data
  - 2-Particle Tracking
    - Simulates water particle movement from sources (septic tanks) to waterbodies
  - 3-VZMOD (Optional)
    - Models nitrate and ammonium concentrations in the Vadose Zone
  - 4-Transport
    - Models nitrate and ammonium plume transport in the groundwater
  - 5-Load Estimation
    - Estimates mass loading to surface waterbodies

2.4 Preprocessing module

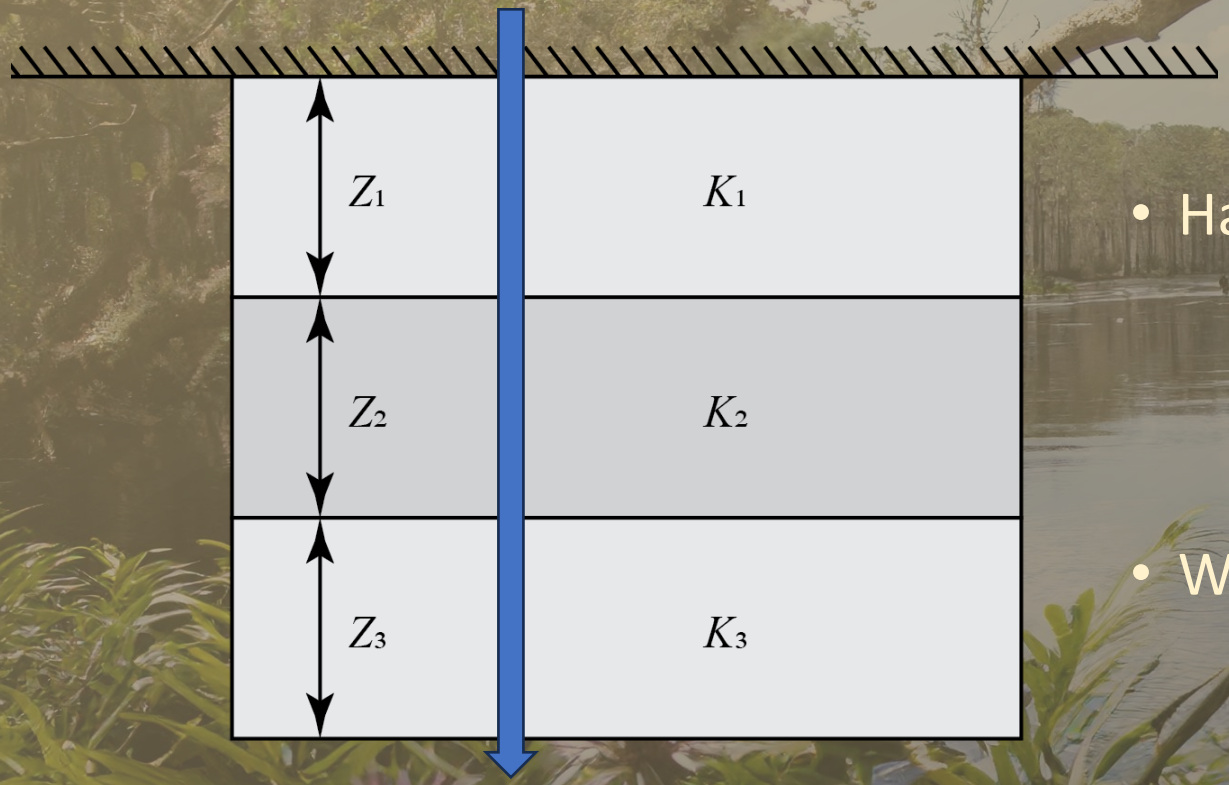
- Inputs
  - Study area
- Outputs
  - Hydraulic conductivity
  - Porosity
  - Soil types



Beaudette, D., Skovlin, J., Roecher, S., Brown, A. soilDB: soil database interface. https://cran.r-project.org/web/packages/soilDB/index.html

2.4 Preprocessing module

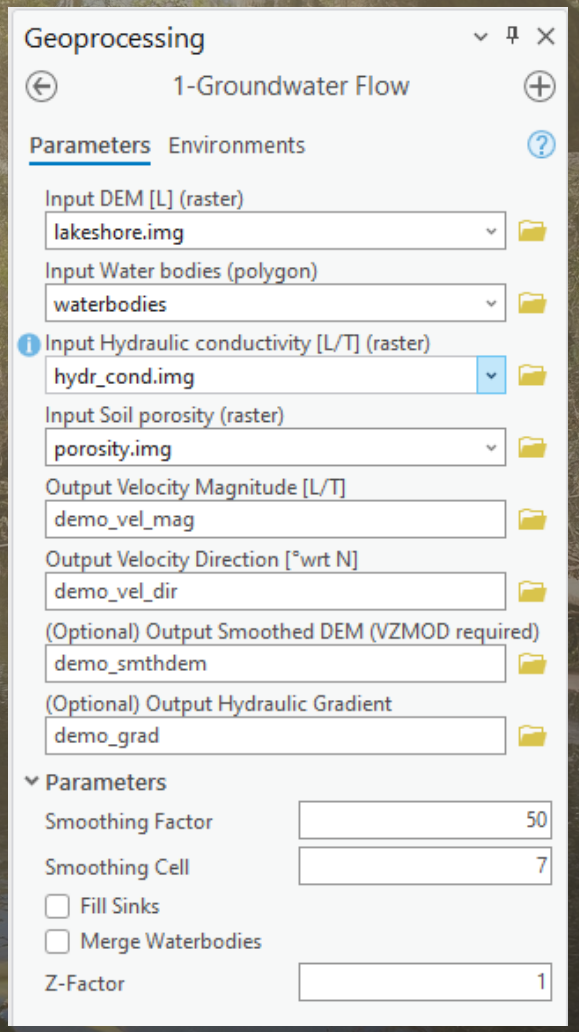
Water movement



- Harmonic mean $$K = \frac{Z_1 + Z_2 + Z_3}{\frac{Z_1}{K_1} + \frac{Z_2}{K_2} + \frac{Z_3}{K_3}}$$
- Weighted average $$K = \frac{Z_1K_1 + Z_2K_2 + Z_3K_3}{Z_1 + Z_2 + Z_3}$$

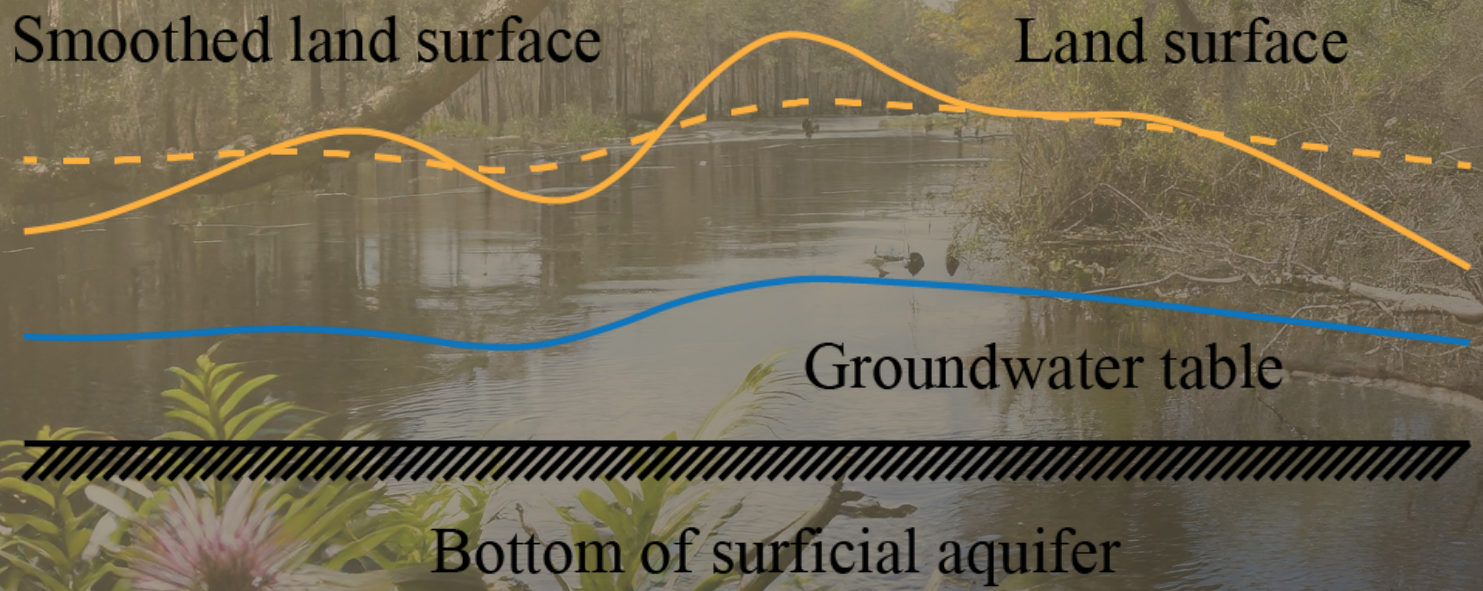
2.5 Groundwater flow module

- Inputs
  - DEM,
  - Waterbodies
  - Hydraulic Conductivity
  - Porosity
- Parameters
  - Smoothing Factor
  - Z-Factor
- Outputs
  - Velocity Magnitude and Direction
  - Hydraulic Gradient
  - Smoothed DEM

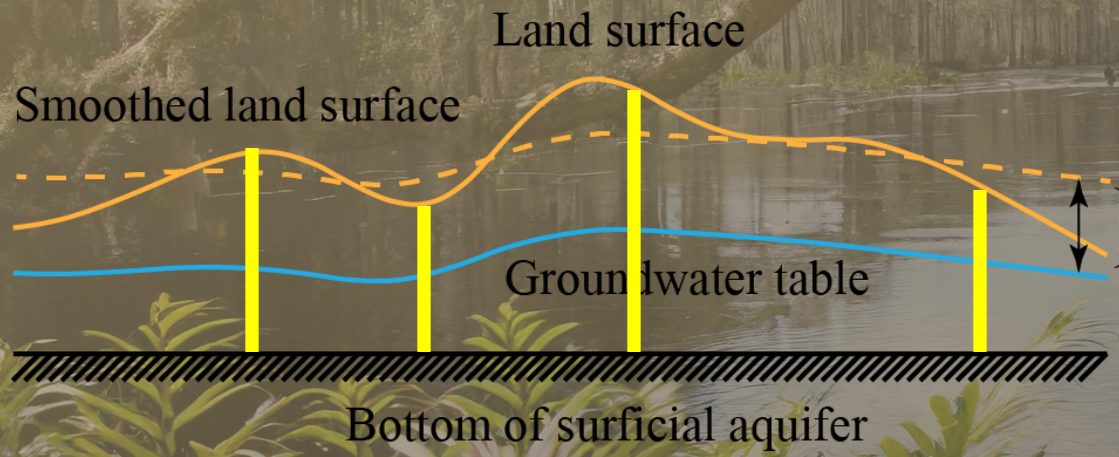


2.5 Groundwater flow module

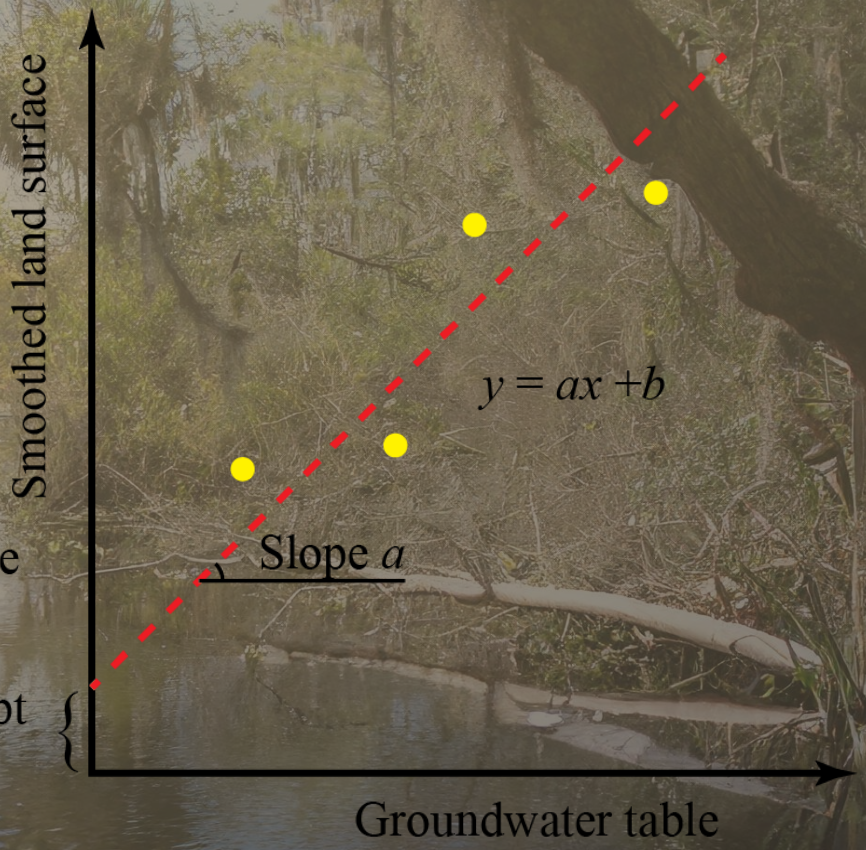
How the Groundwater Flow Module Work?



2.5 Groundwater flow module

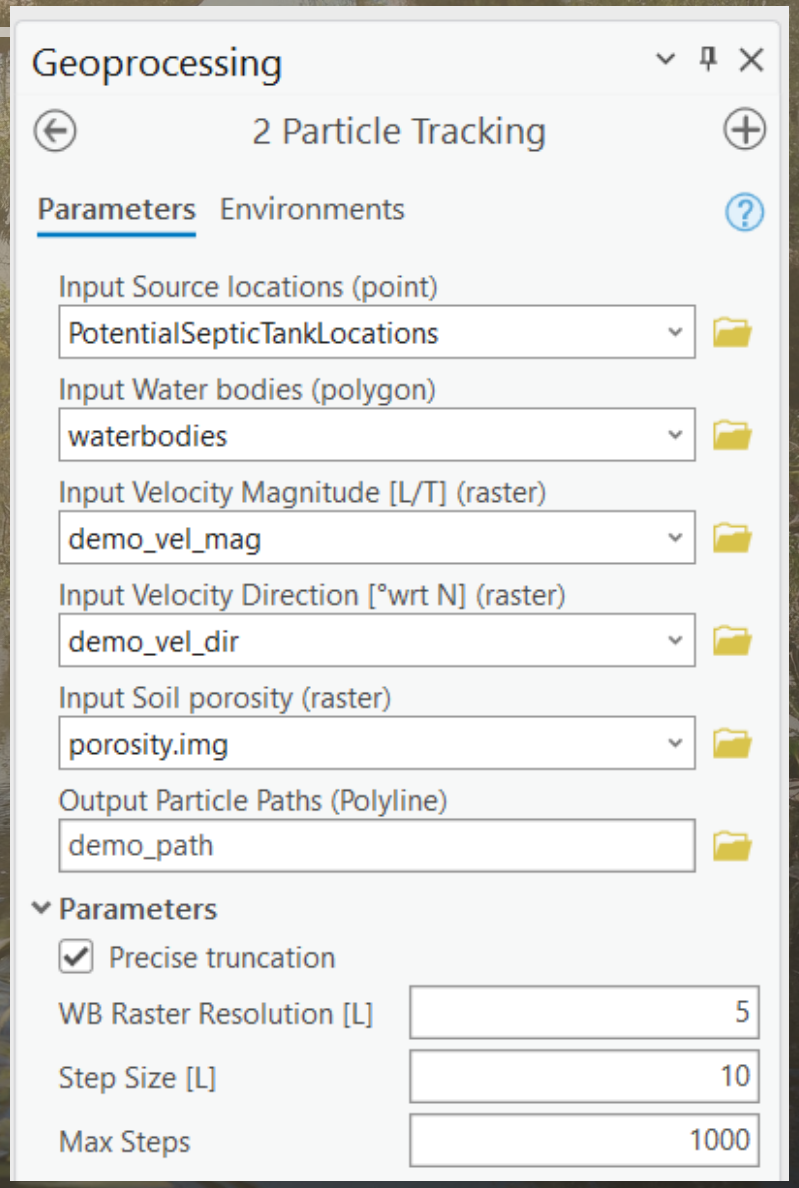


Distance
=
Intercept
b



2.6 Particle Tracking module

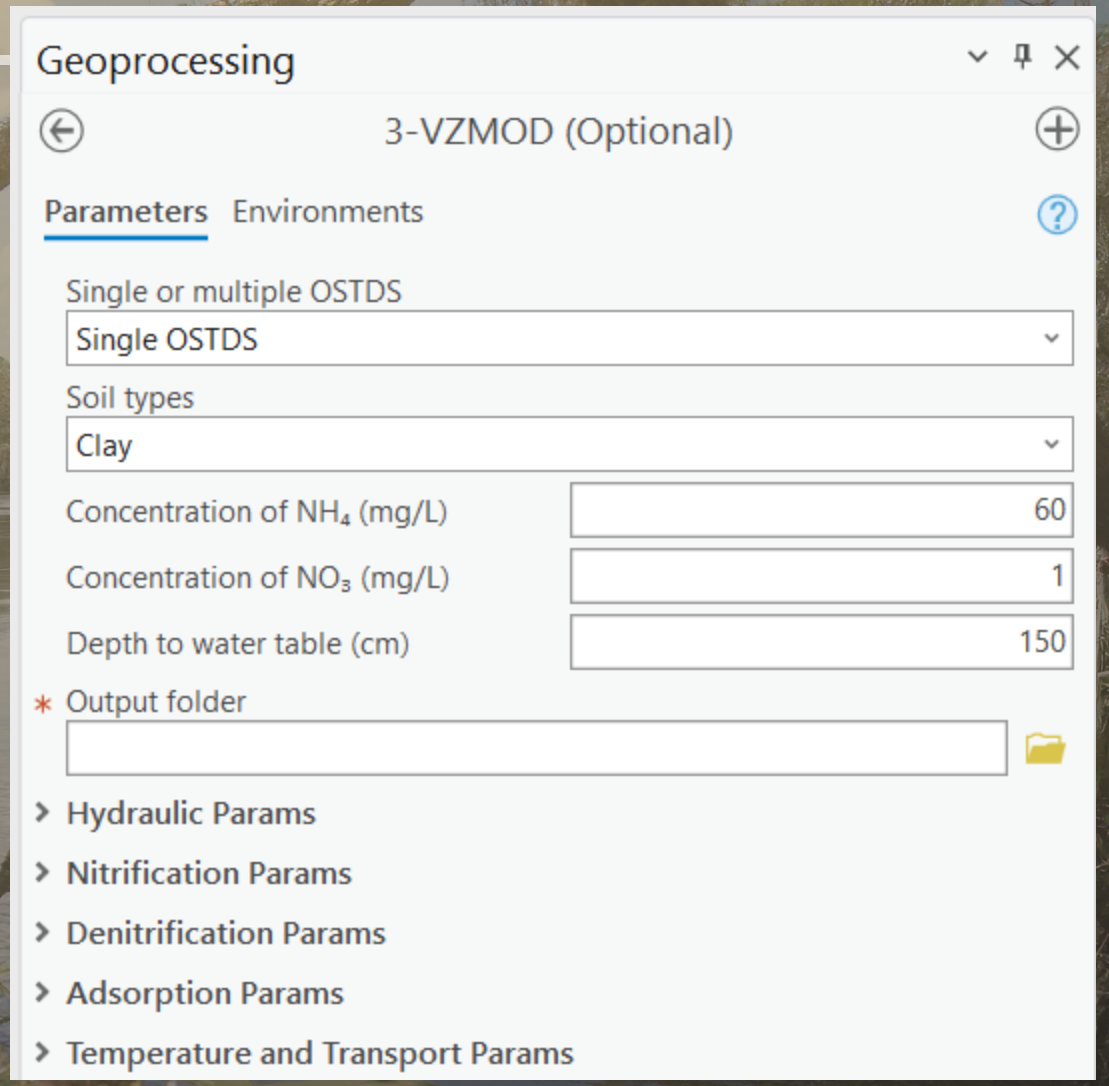
- Inputs
  - Velocity Magnitude and Direction
  - Source locations
  - Waterbodies
  - Porosity
- Outputs
  - Particle paths of potential contaminant travel routes



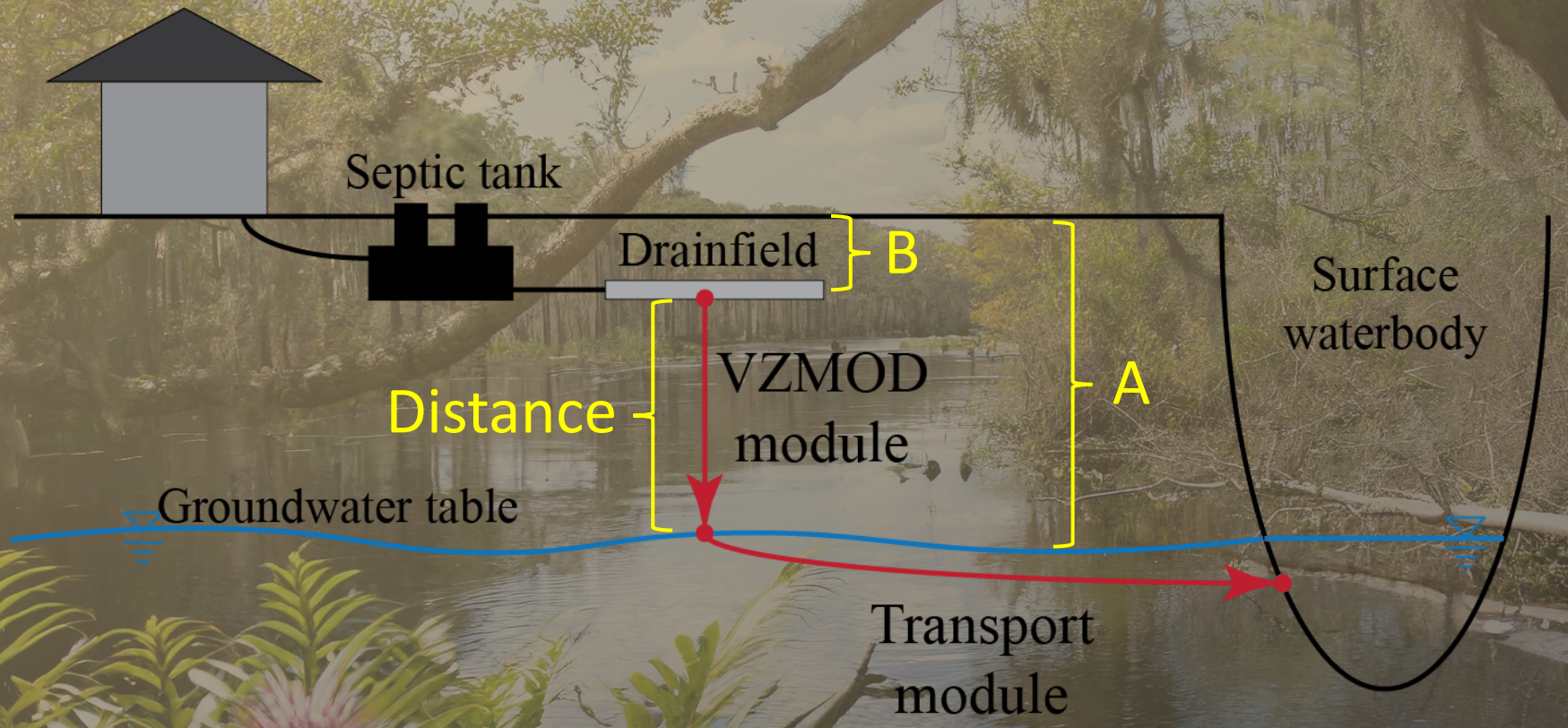
2.6 Particle Tracking Module

2.7 VZMOD Module

- Ammonium and nitrate transport with sorption, nitrification, and denitrification in vadose zone

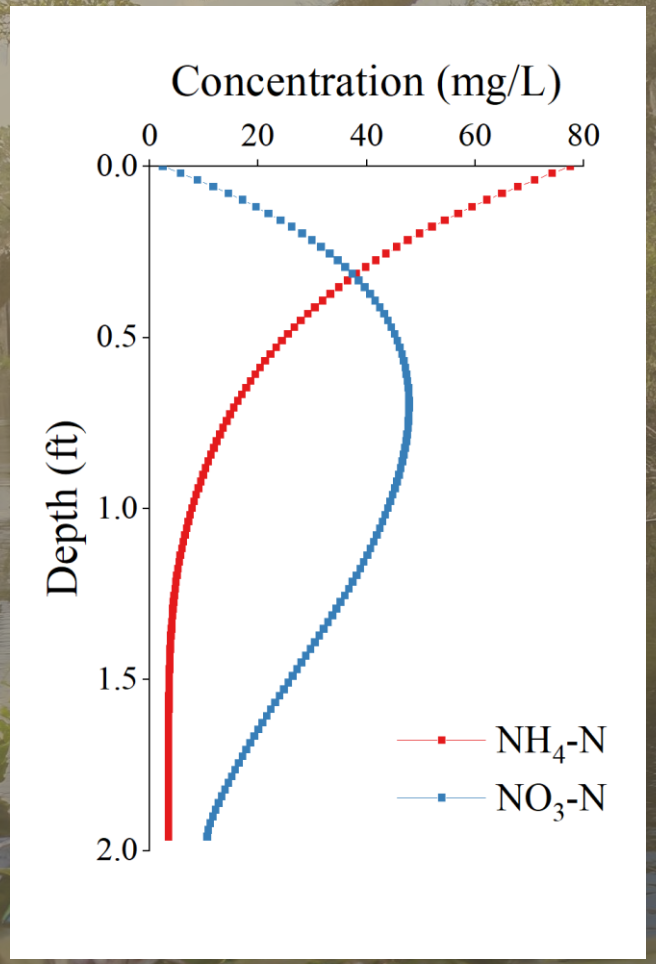


2.7 VZMOD Module



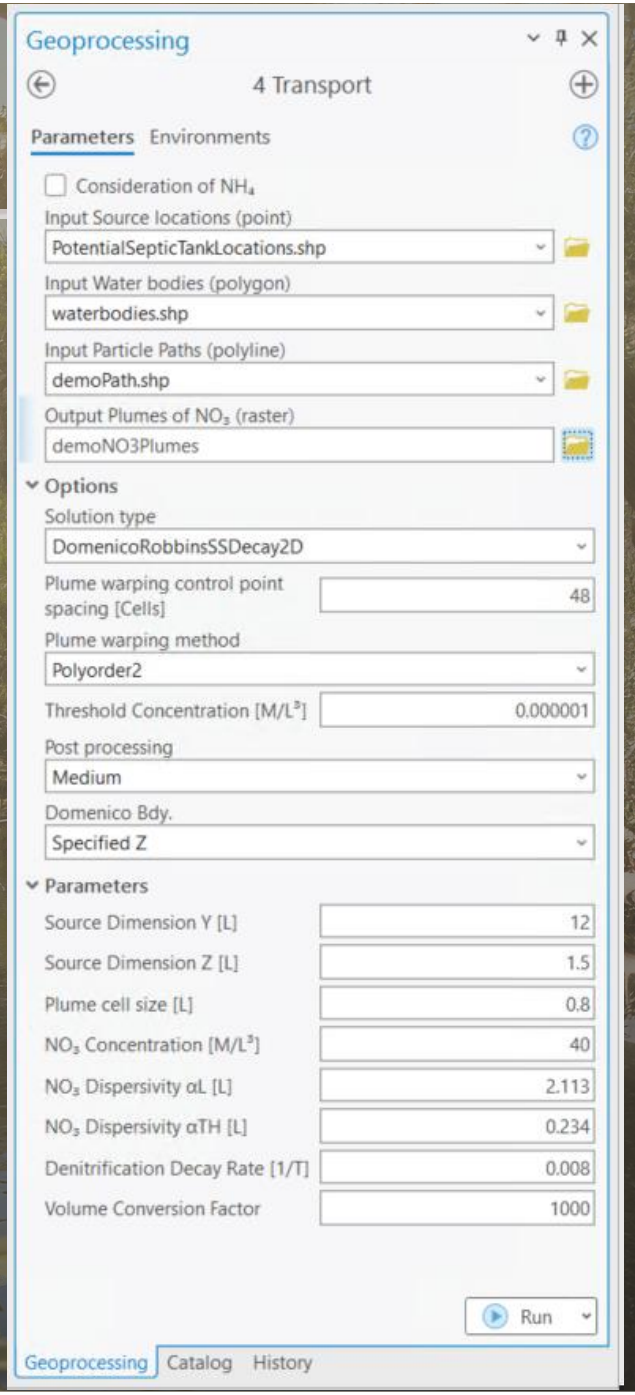
Distance = A - B

2.7 VZMOD Module

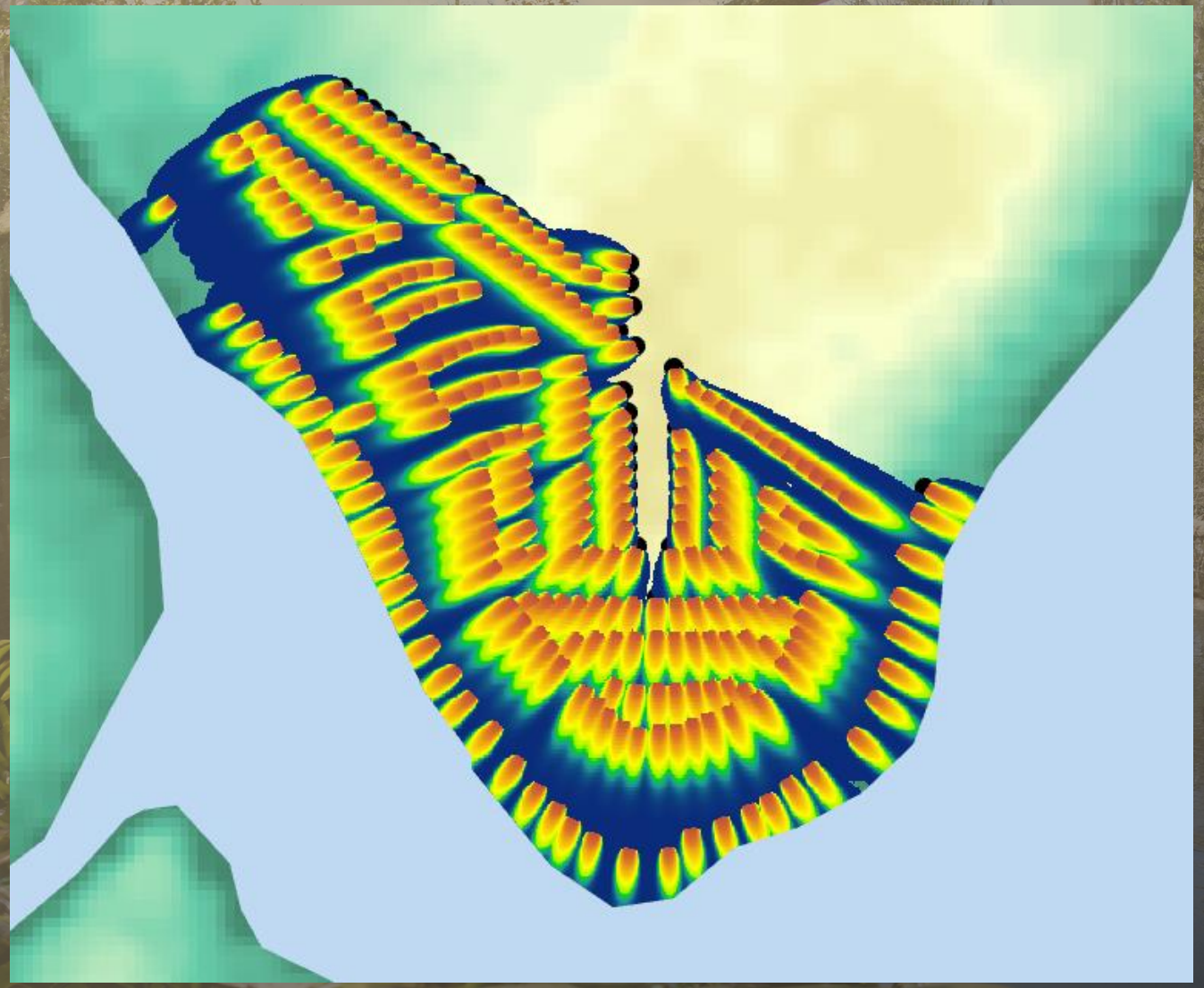


2.8 Transport Module

- Predicting nitrate and ammonium plumes in groundwater
- Inputs
  - Source locations
  - Waterbodies
  - Particle paths
- Outputs
  - Plume raster of concentration distribution
  - Plume info shapefile

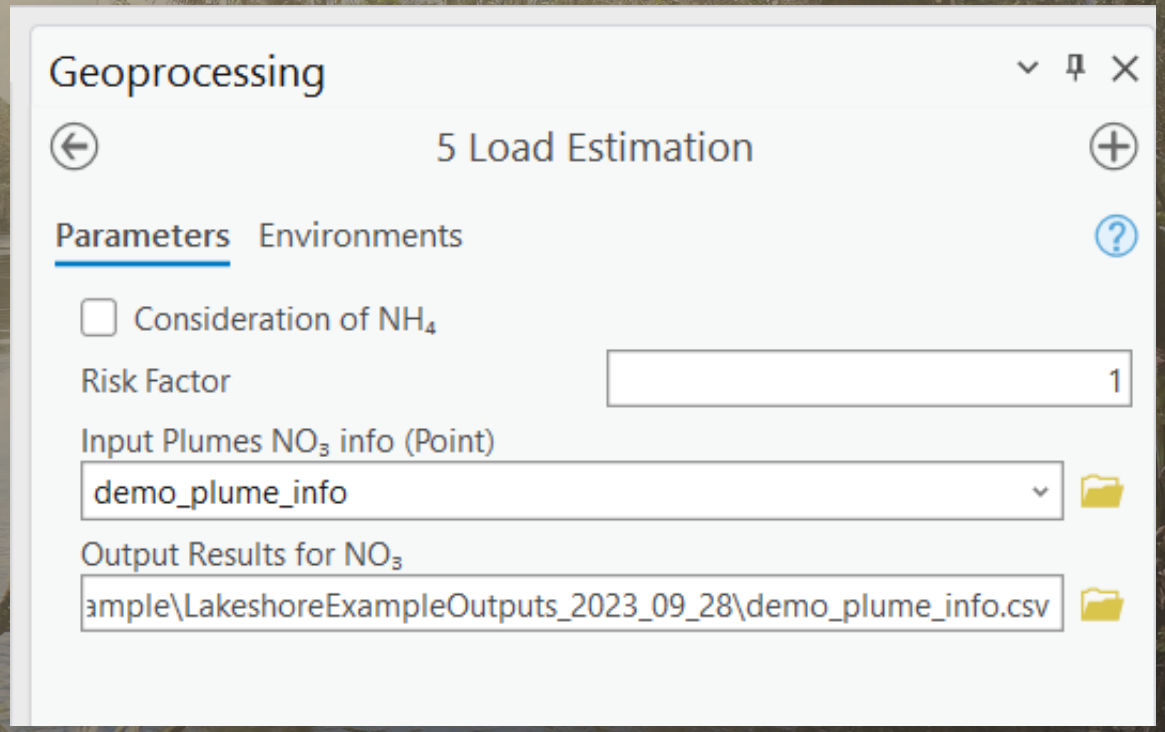


2.8 Transport Module



2.9 Load Estimation Module

- Calculates the removal rate of nitrate and ammonium via denitrification
- Inputs
  - Plume info shapefile from the 4-Transport module
- Outputs
  - CSV
  - Mass output load
  - Mass removal rate
  - Mass input load




THANK YOU!