Lakeshore example for ArcNLET-Py

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Contents

I. Introduction

1.1 Model History

Jun 2011
ArcNLET Version 1.0
Developed for ArcMap 9.x

Aug 2011
ArcNLET Version 1.1
Add ArcMap 10 compatibility

Mar 2012
VZMOD

Jul 2013
ArcNLET Version 2.0
Add a new function of
Monte Carlo simulation

Feb 2015
ArcNLET Version 3.0
Can simulate reactive transport
of both ammonium and nitrate

Dec 2023
ArcNLET-Py
Python version for
ArcGIS Pro

1.2 ArcNLET resources

- 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:

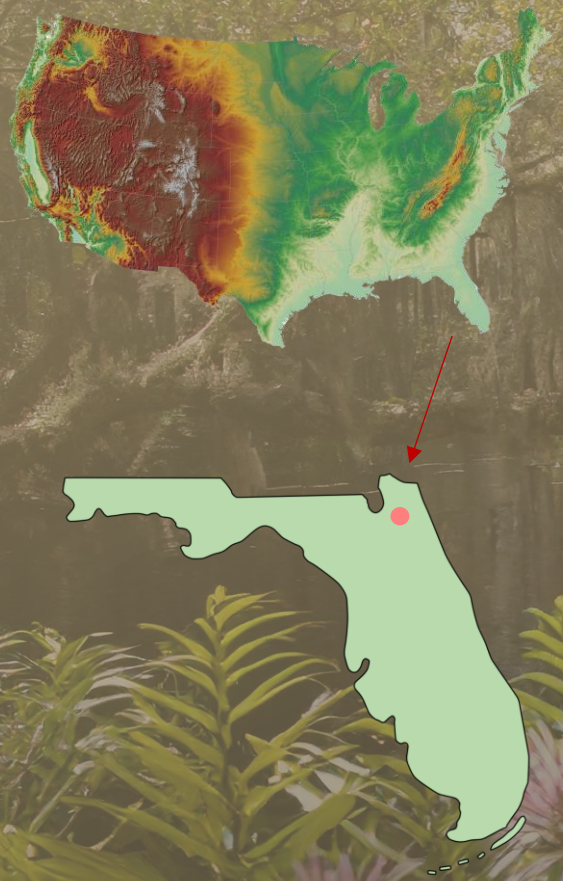
  https://atmos.eoas.fsu.edu/~mye/ArcNLET/

1.3 Purpose

- Describe how to complete a simulation using ArcNLET-Py
- This is only a demo for the new version. For the principles and algorithm behind the software, please see Dr. Ye's video, or the technical manual
- If there are any questions, please submit a new issue on GitHub or contact us directly

2. Lakeshore example

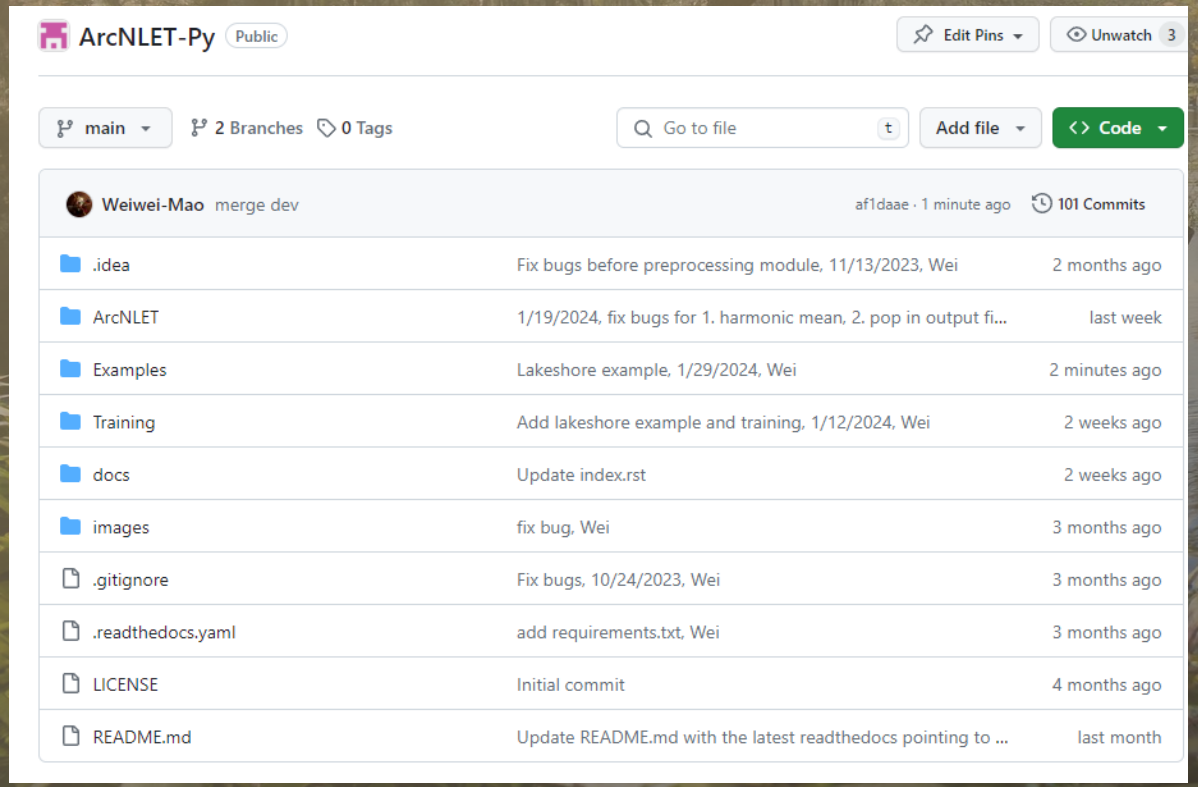
2.1 Study area



265 septic tanks

2.2 ArcNLET-Py preparation

- https://github.com/ArcNLET-Py/ArcNLET-Py
- Understanding repository structure is key



ArcNLET-Py Public

Edit Pins | Unwatch 3

main | 2 Branches | 0 Tags | Go to file t | Add file | Code

Weiwei-Mao merge dev — af1daae · 1 minute ago — 101 Commits

.idea	Fix bugs before preprocessing module, 11/13/2023, Wei	2 months ago
ArcNLET	1/19/2024, fix bugs for 1. harmonic mean, 2. pop in output fi...	last week
Examples	Lakeshore example, 1/29/2024, Wei	2 minutes ago
Training	Add lakeshore example and training, 1/12/2024, Wei	2 weeks ago
docs	Update index.rst	2 weeks ago
images	fix bug, Wei	3 months ago
.gitignore	Fix bugs, 10/24/2023, Wei	3 months ago
.readthedocs.yaml	add requirements.txt, Wei	3 months ago
LICENSE	Initial commit	4 months ago
README.md	Update README.md with the latest readthedocs pointing to ...	last month

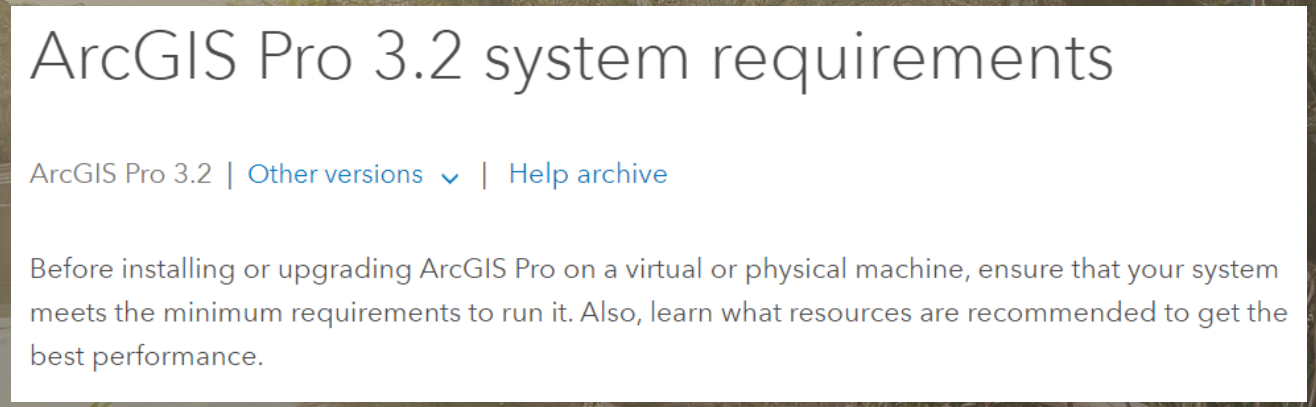
2.2 ArcNLET-Py preparation

- Organizations of files on GitHub

ArcNLET	Python Source Code
Examples	Lakeshore example and data
Training	PDF files for training
Docs and images	Source files for online manual
Readme.md	Provide orientation for first-time users

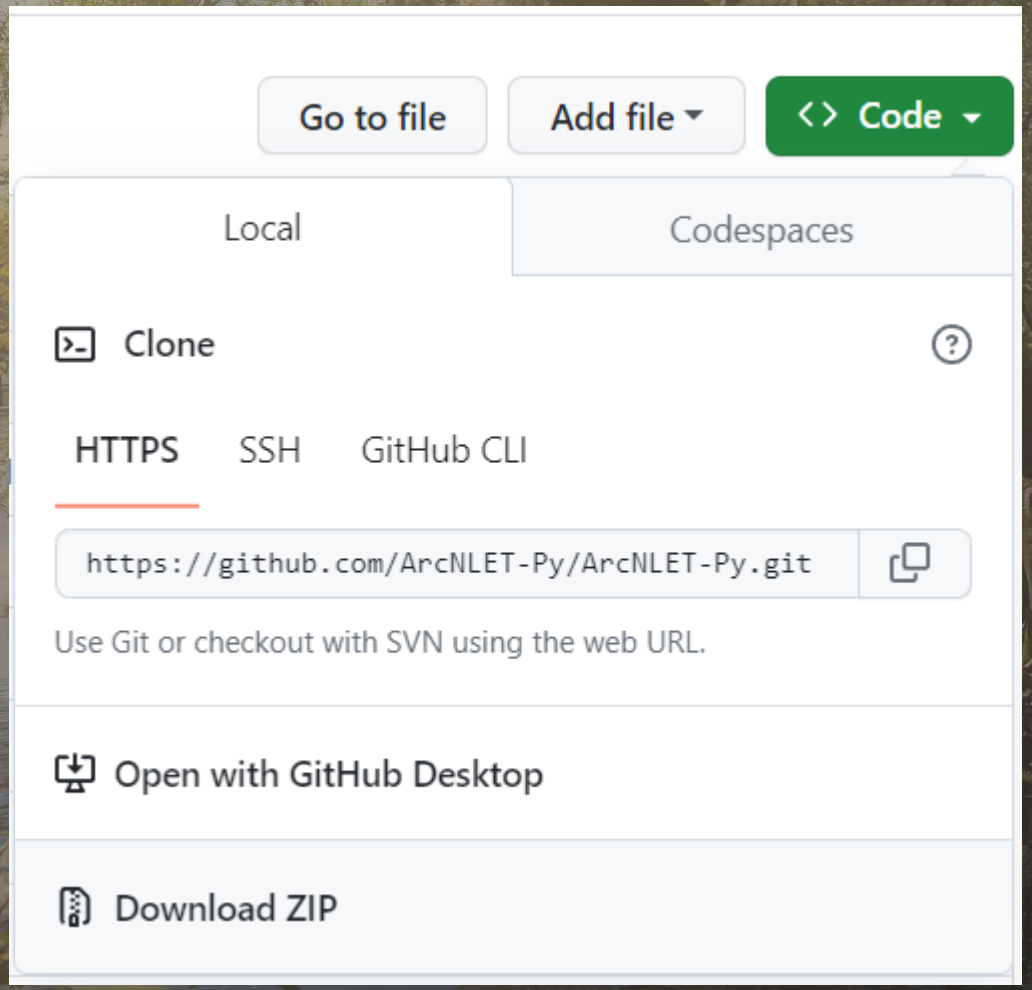
2.3 Procedures 1 – Installation Prerequisites

- Is ArcGIS Pro installed and up-to-date?
- Spatial Analyst license active
- Create an ArcGIS Pro Project File for ArcNLET-Py
- Project files help organize workflows



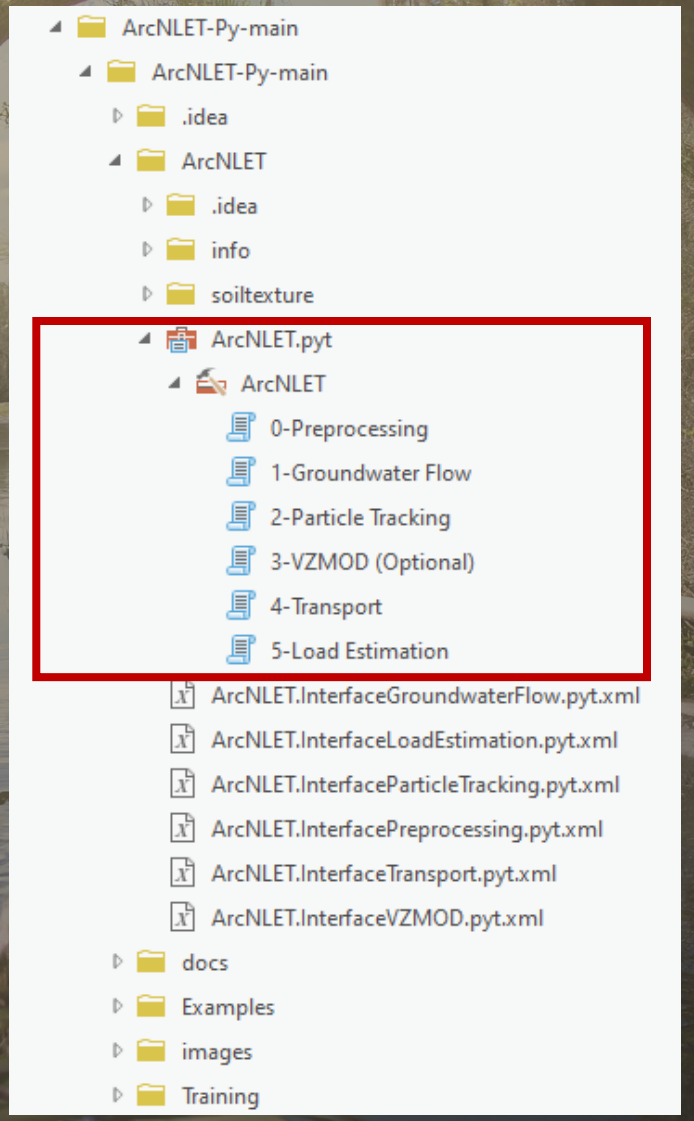
2.4 Procedures 2 – ArcNLET-Py Download

- Access the latest version (dev branch)
- ‘Download ZIP’ for the ArcNLET-Py repository
- Unzip the ‘Download ZIP’



2.5 Procedures 3 – Accessing Python Toolsets

- Access the ArcNLET-Py Python toolbox
  - Catalog Pane/View

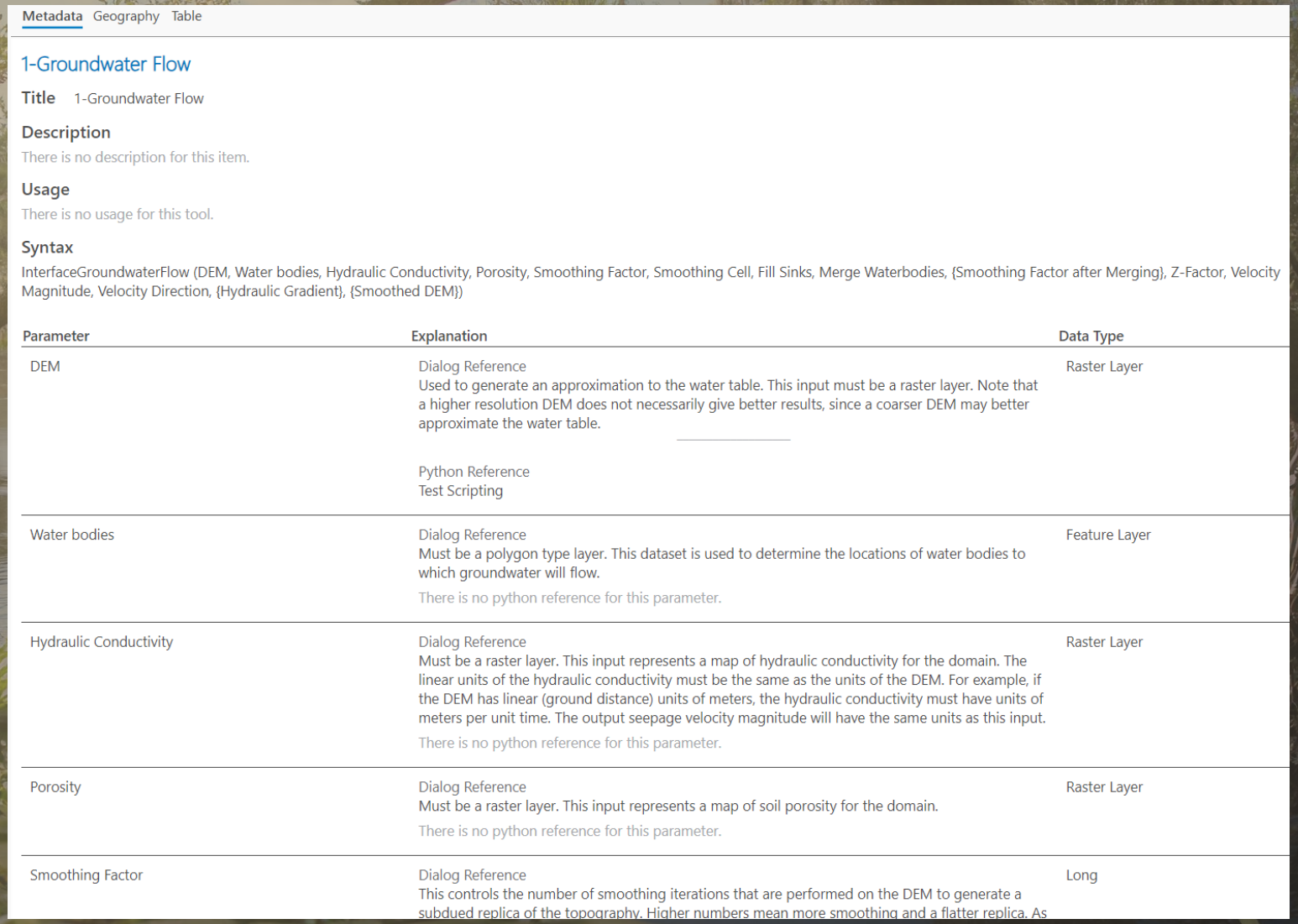


2.5 Procedures 3 – Structure of ArcNLET-Py

- Tools are organized into modules
  - 0-Preprocessing
    - Extracts data (hydraulic conductivity, porosity, and soil types) from SSURGO database
  - 1-Groundwater Flow
    - Analyzes groundwater velocity 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 waterbodes

2.5 Procedures 3 – Metadata

- Metadata within each toolset highlights the purpose and functionality
- Blue ‘i’ icon help messages help users
- Custom warnings and error indicators guides workflows



Metadata Geography Table

1-Groundwater Flow

Title 1-Groundwater Flow

Description

There is no description for this item.

Usage

There is no usage for this tool.

Syntax

InterfaceGroundwaterFlow (DEM, Water bodies, Hydraulic Conductivity, Porosity, Smoothing Factor, Smoothing Cell, Fill Sinks, Merge Waterbodies, {Smoothing Factor after Merging}, Z-Factor, Velocity Magnitude, Velocity Direction, {Hydraulic Gradient}, {Smoothed DEM})

Parameter	Explanation	Data Type
DEM	Dialog Reference Used to generate an approximation to the water table. This input must be a raster layer. Note that a higher resolution DEM does not necessarily give better results, since a coarser DEM may better approximate the water table. Python Reference Test Scripting	Raster Layer
Water bodies	Dialog Reference Must be a polygon type layer. This dataset is used to determine the locations of water bodies to which groundwater will flow. There is no python reference for this parameter.	Feature Layer
Hydraulic Conductivity	Dialog Reference Must be a raster layer. This input represents a map of hydraulic conductivity for the domain. The linear units of the hydraulic conductivity must be the same as the units of the DEM. For example, if the DEM has linear (ground distance) units of meters, the hydraulic conductivity must have units of meters per unit time. The output seepage velocity magnitude will have the same units as this input. There is no python reference for this parameter.	Raster Layer
Porosity	Dialog Reference Must be a raster layer. This input represents a map of soil porosity for the domain. There is no python reference for this parameter.	Raster Layer
Smoothing Factor	Dialog Reference This controls the number of smoothing iterations that are performed on the DEM to generate a subdued replica of the topography. Higher numbers mean more smoothing and a flatter replica. As	Long

2.5 Procedures 3 – Structure of Data

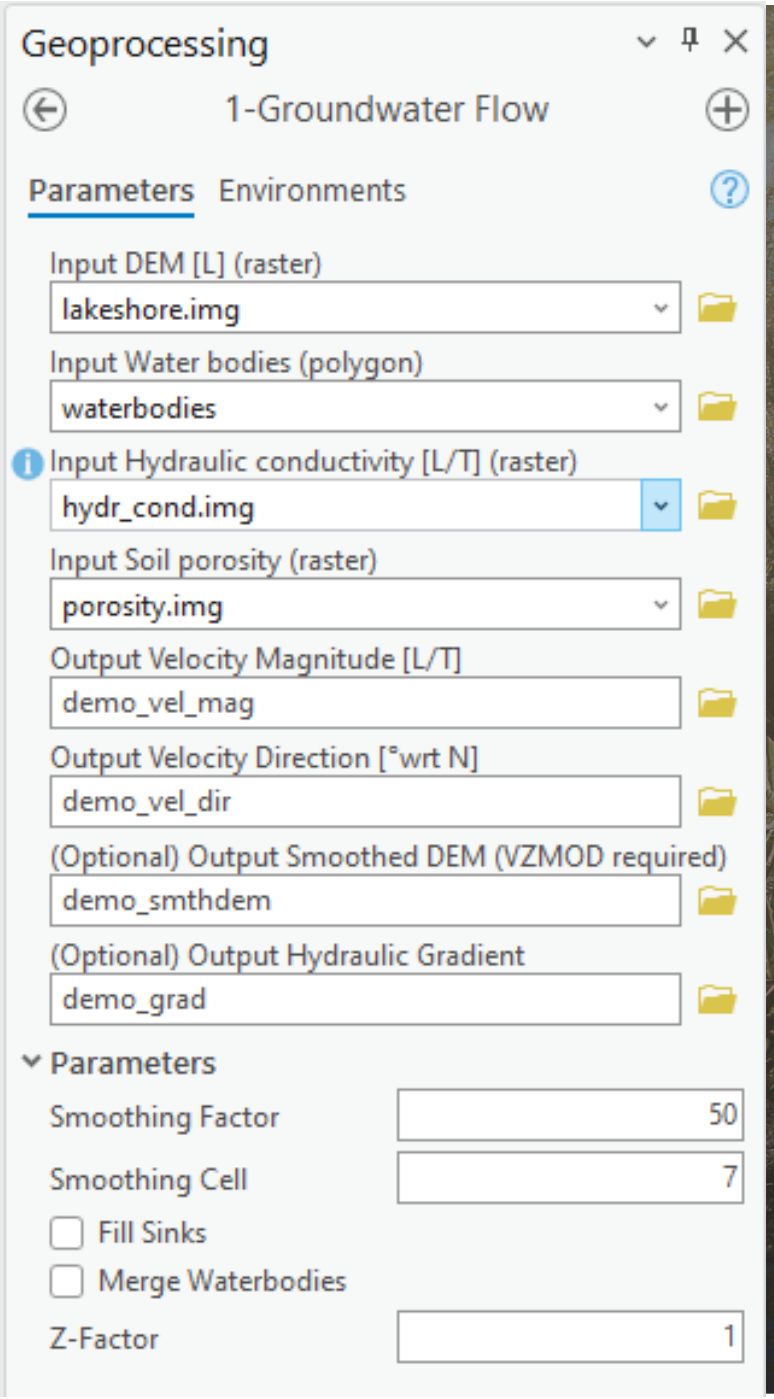
- Data needed GitHub/Examples/lakeshore_example.zip Remember unzip

Lakeshore_example.aprx	ArcGIS Pro project file
Example_Inputs	Demo input data
Example_Outputs	Demo output data
Preprocessing_module	Data for preprocessing module
Original_Data	Downloaded original data for the study site

2.6 Procedures 4

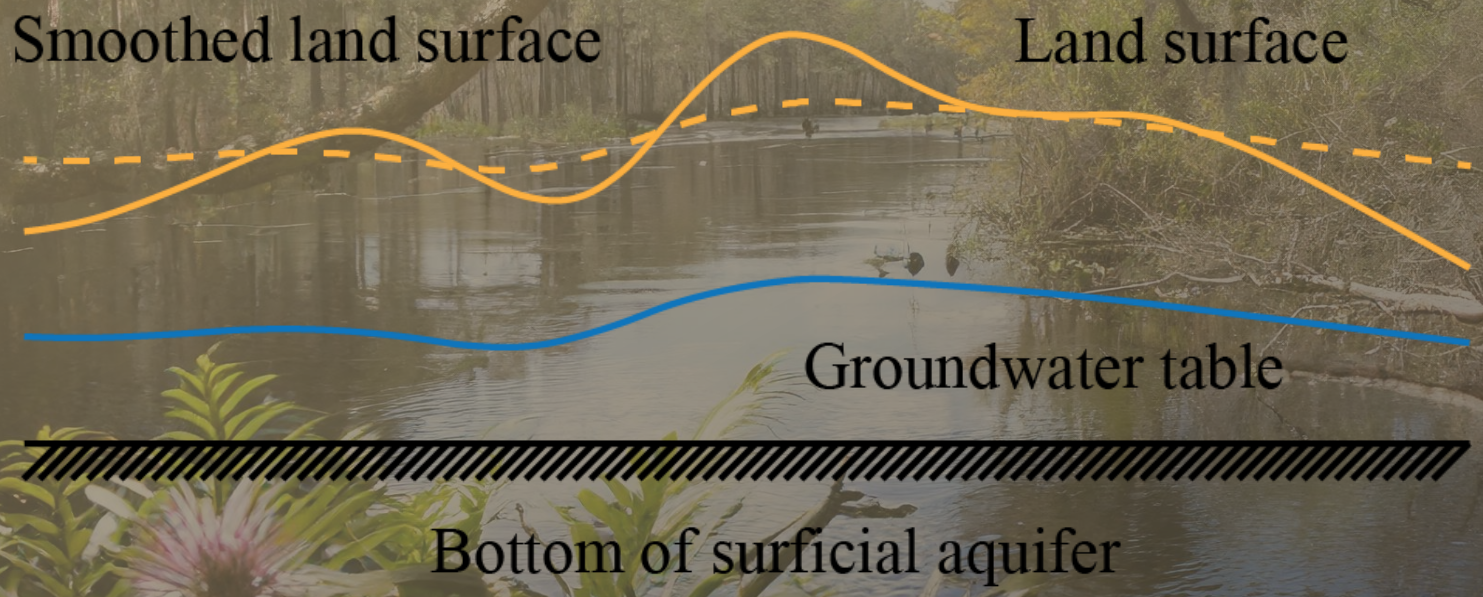
Groundwater Flow Module

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



2.6 Procedures 4

How the Groundwater Flow Module Work?

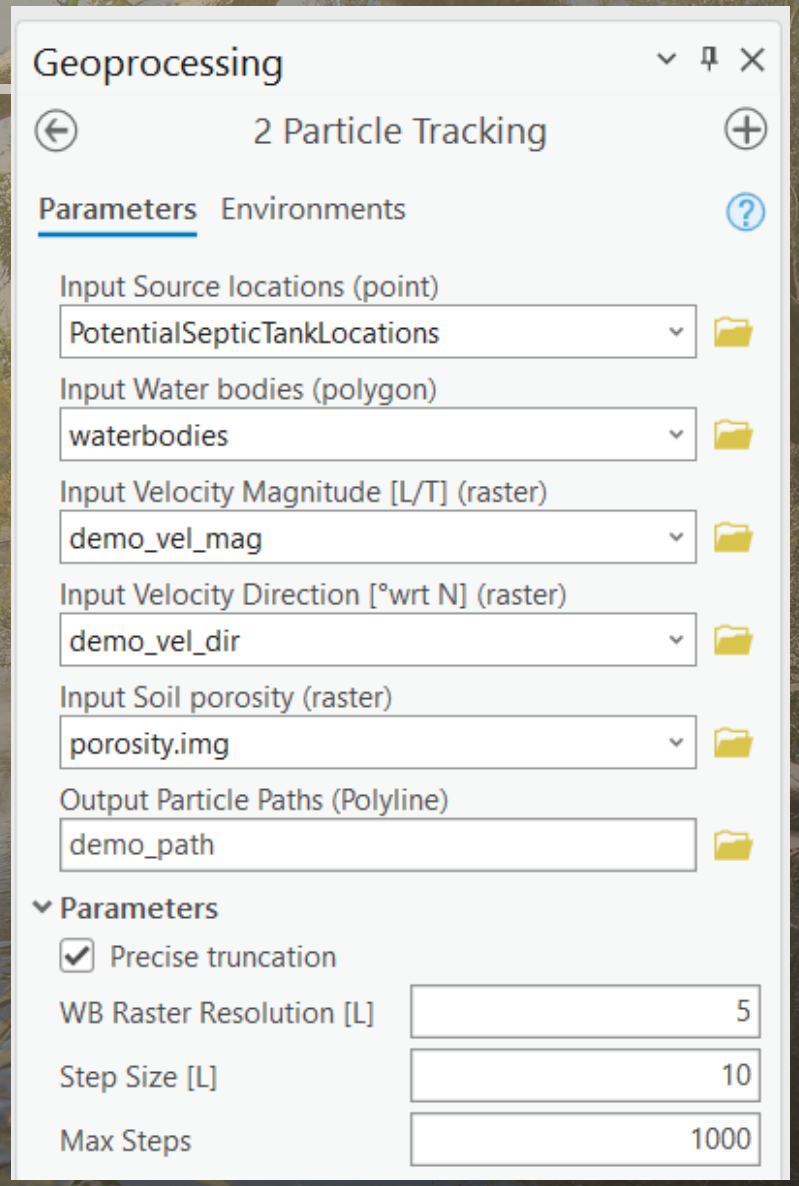


See Youtube video or technical manual for details

2.7 Procedures 5

Particle Tracking Module

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



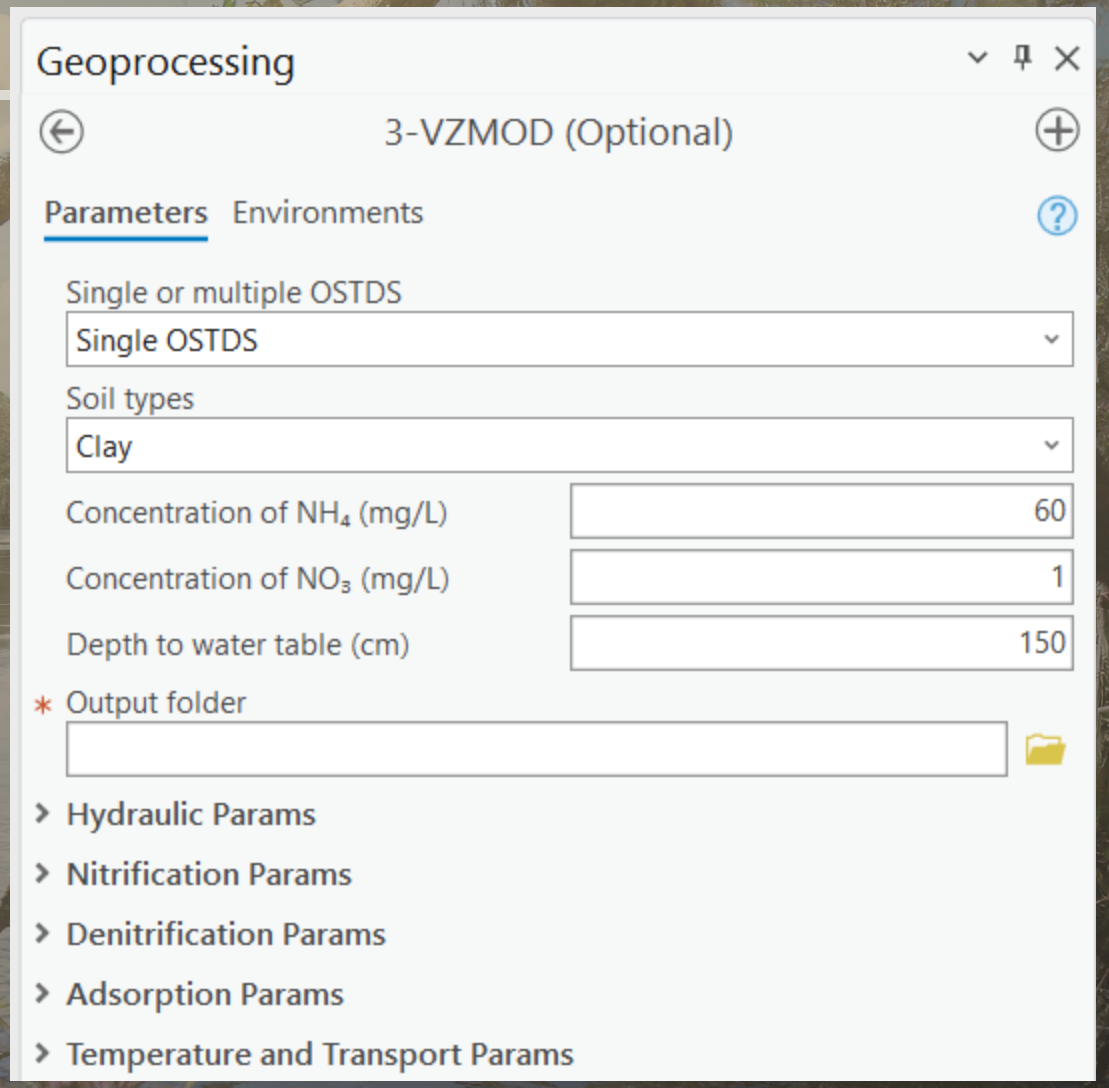
2.7 Procedures 5

Particle Tracking Module

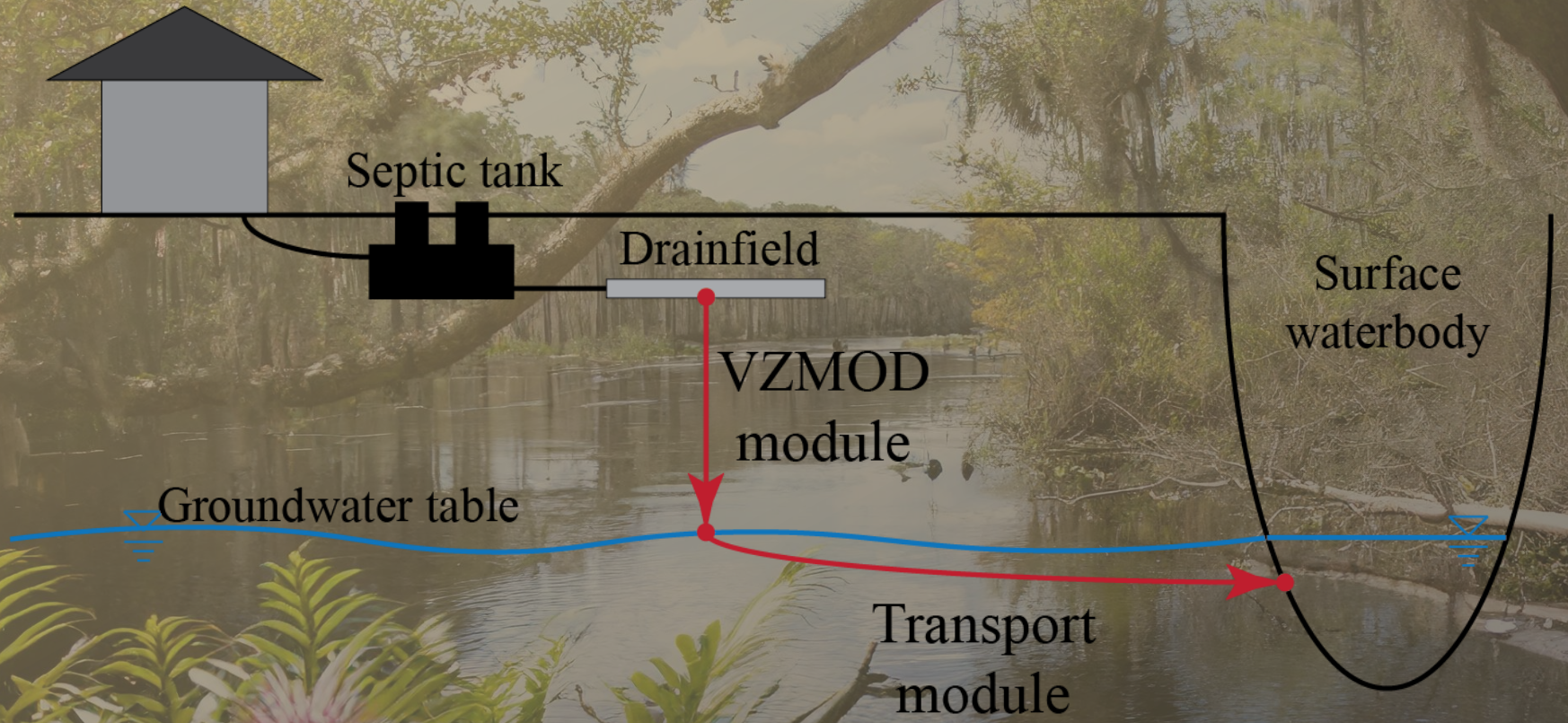
2.8 Procedures 6

VZMOD Module

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



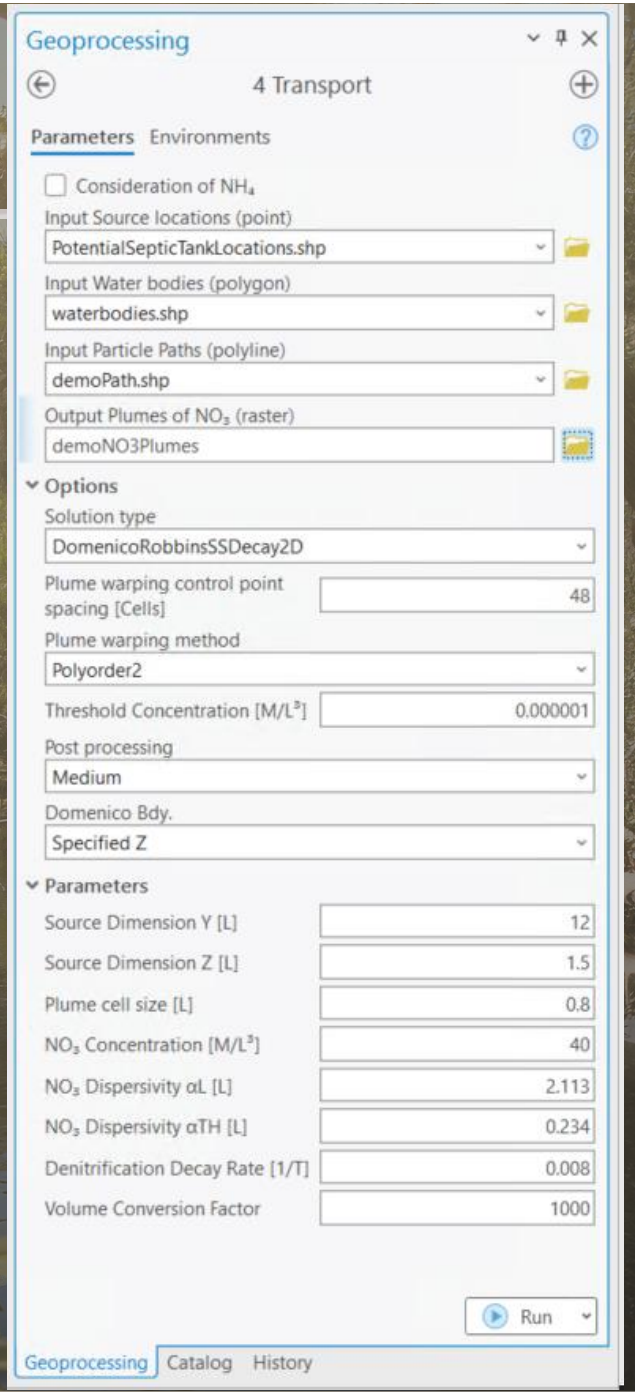
2.8 Procedures 6



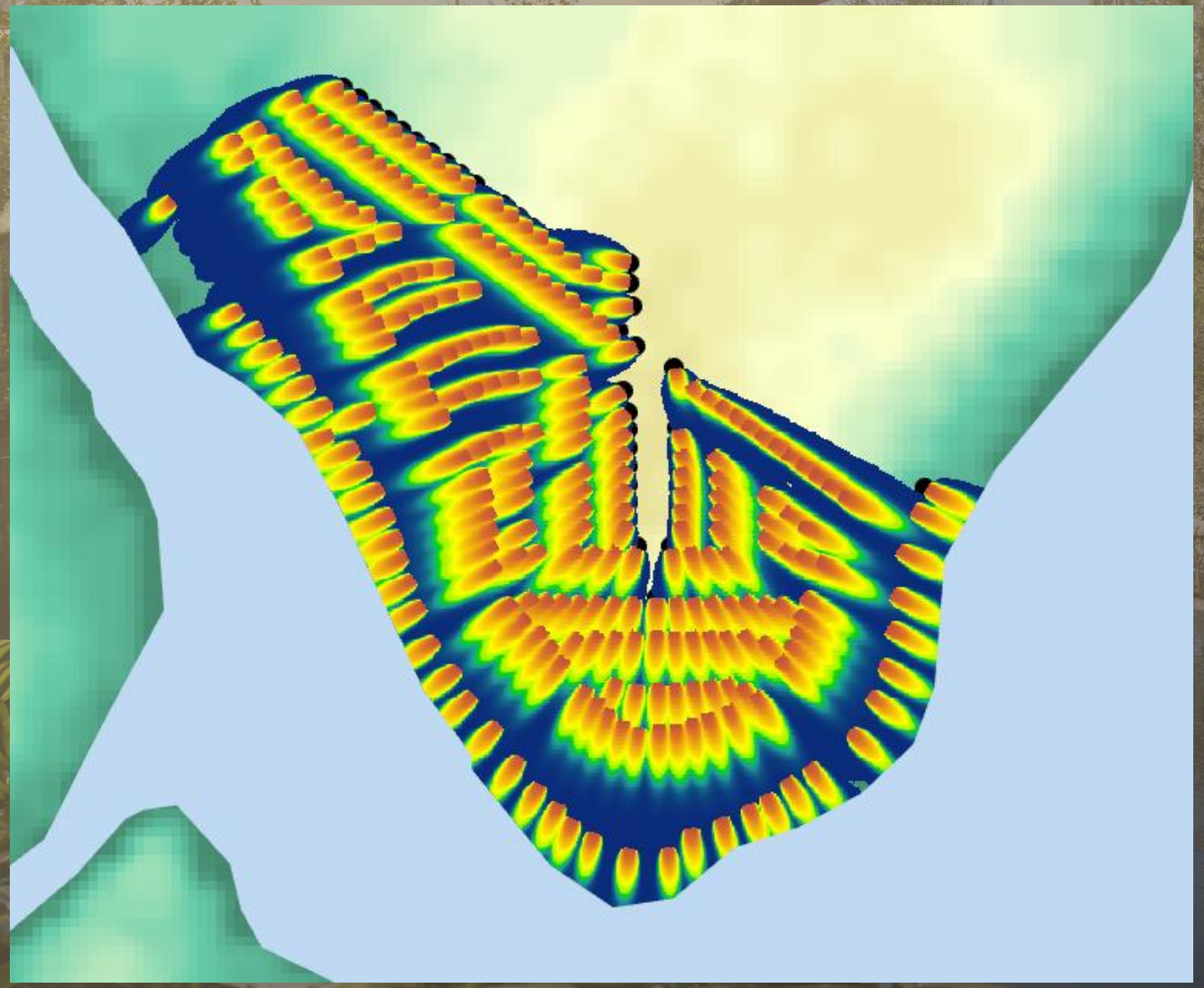
2.9 Procedures 7

Transport Module

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

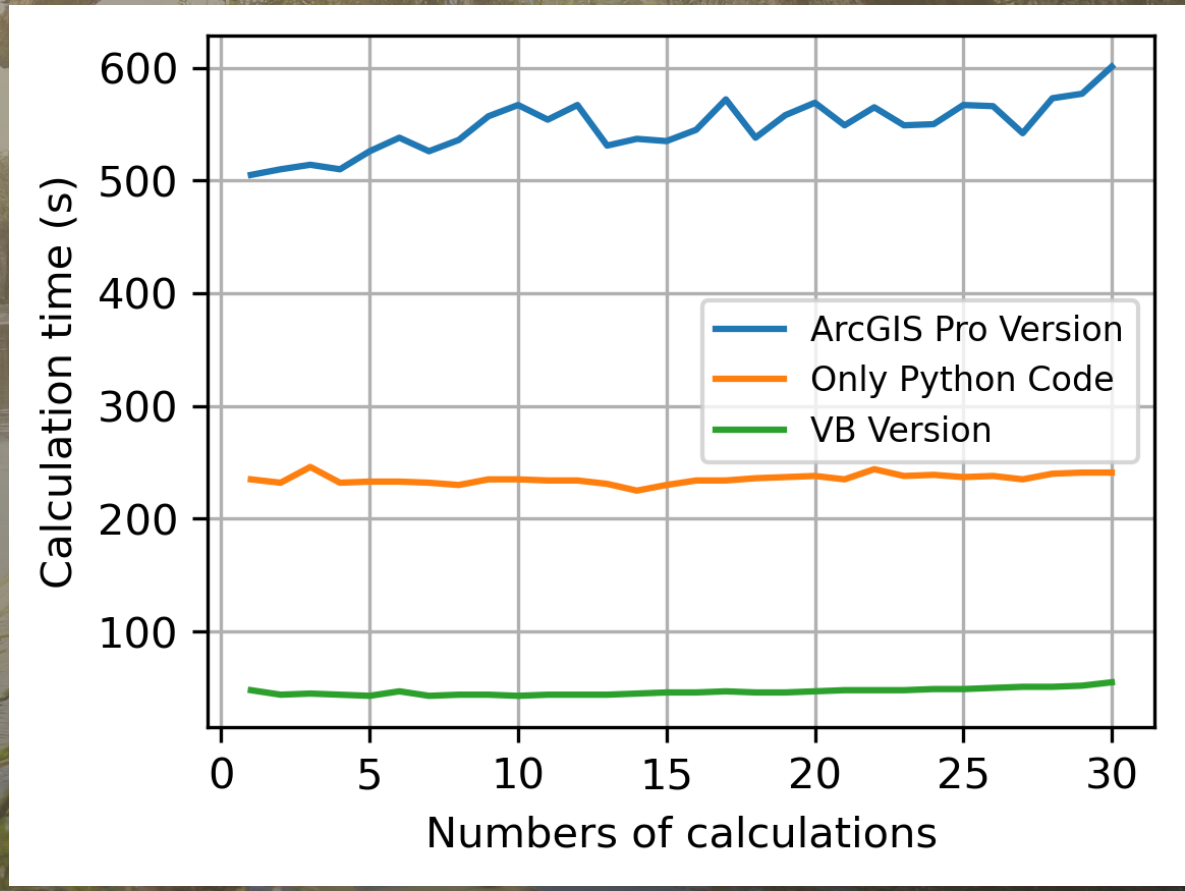


2.9 Procedures 7



2.9 Procedures 7

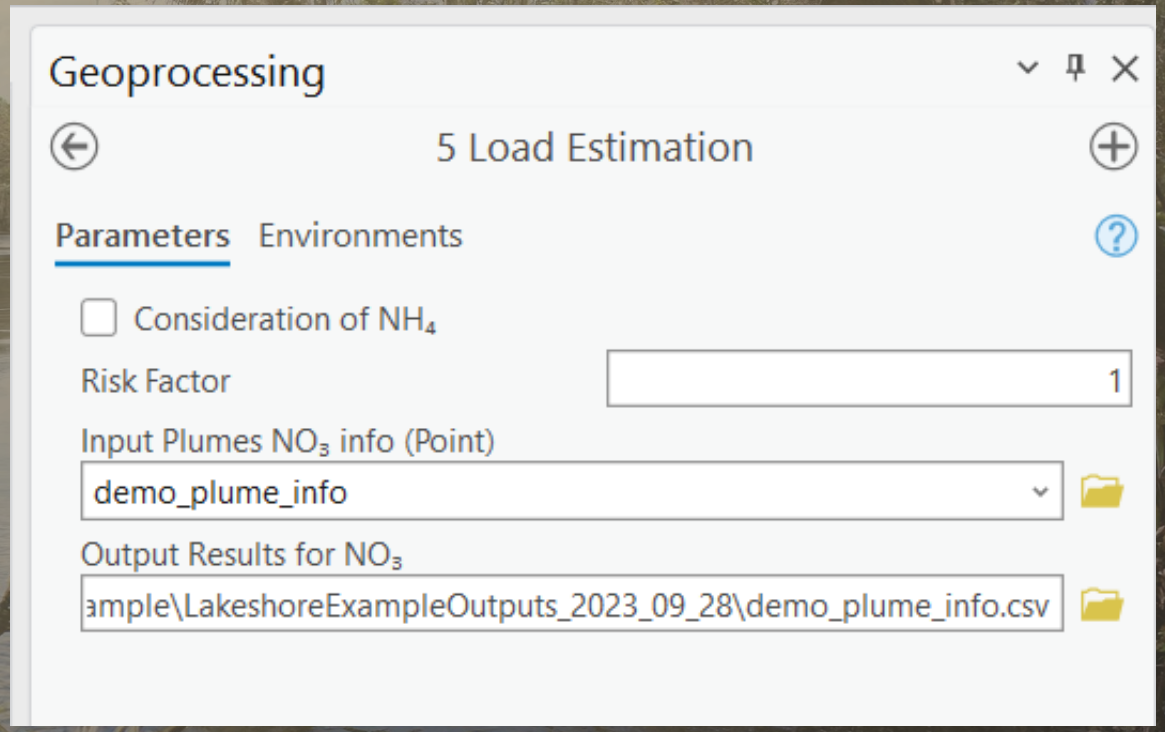
- The transport module has a long computation time. On the one hand, Python inherently runs slower than VB.NET. On the other hand, Python environment in ArcGIS Pro may be affected by the software, such as GUI interface and diagnostic monitoring in the software



2.10 Procedures 8

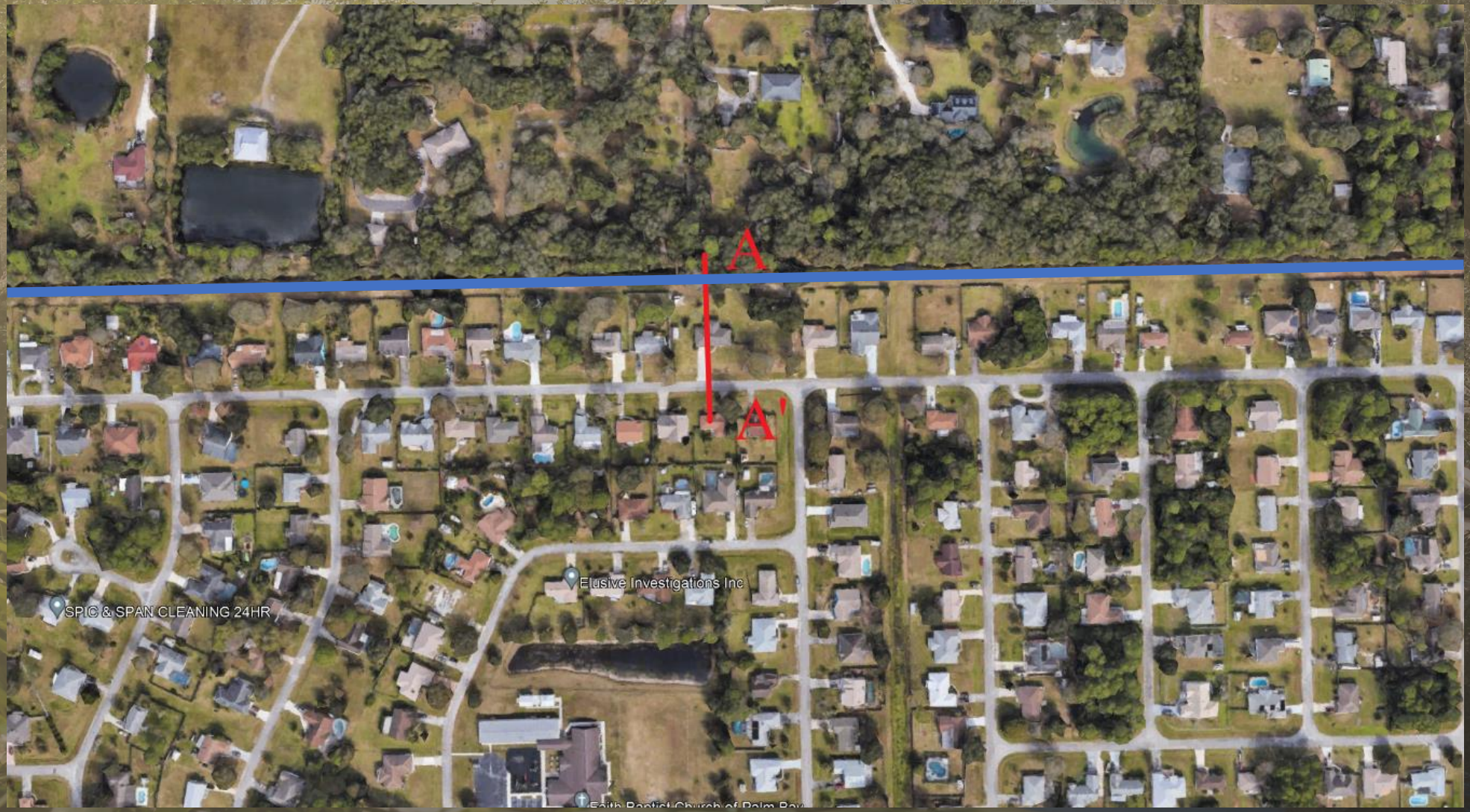
Load Estimation Module

- 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

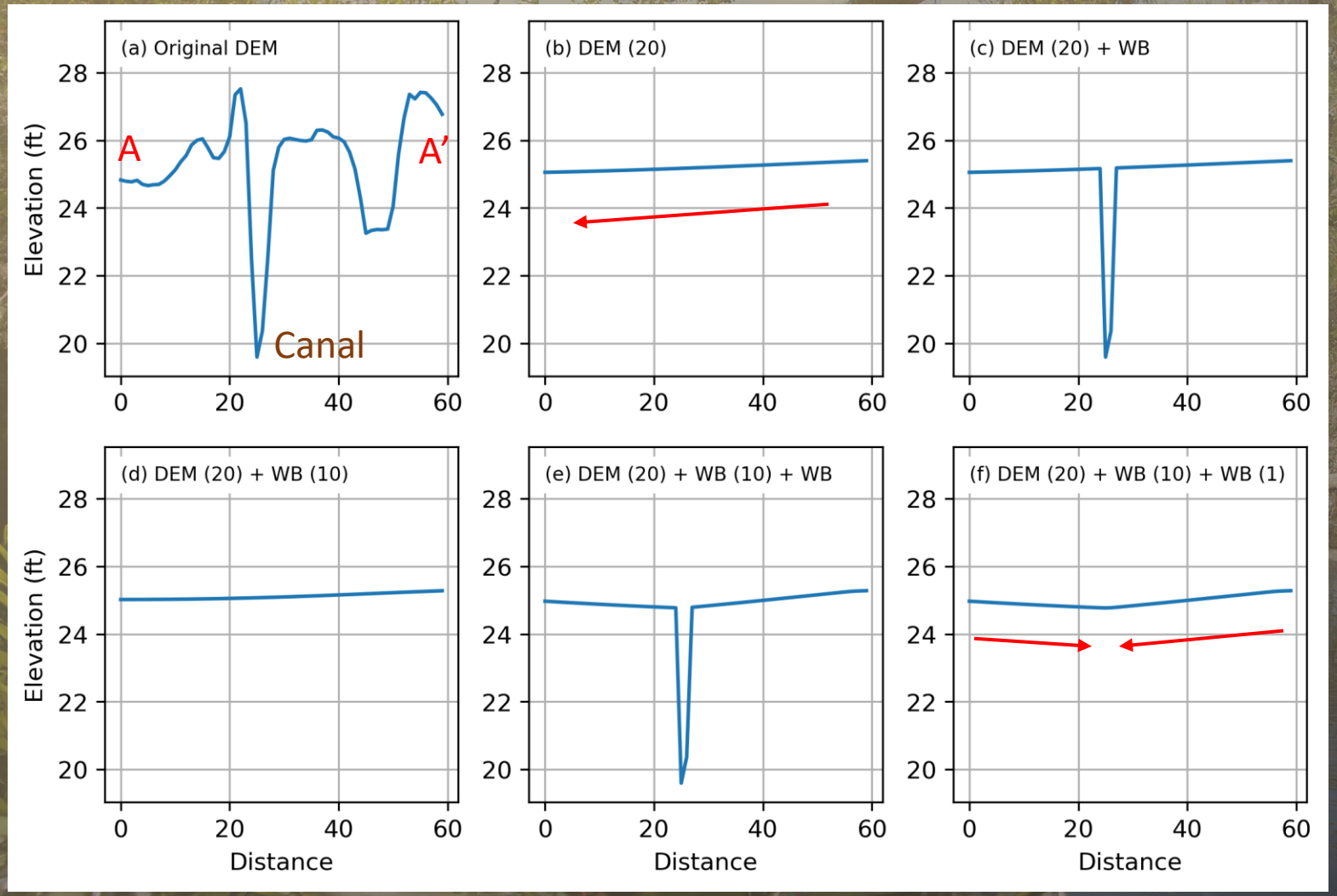


3. New Features

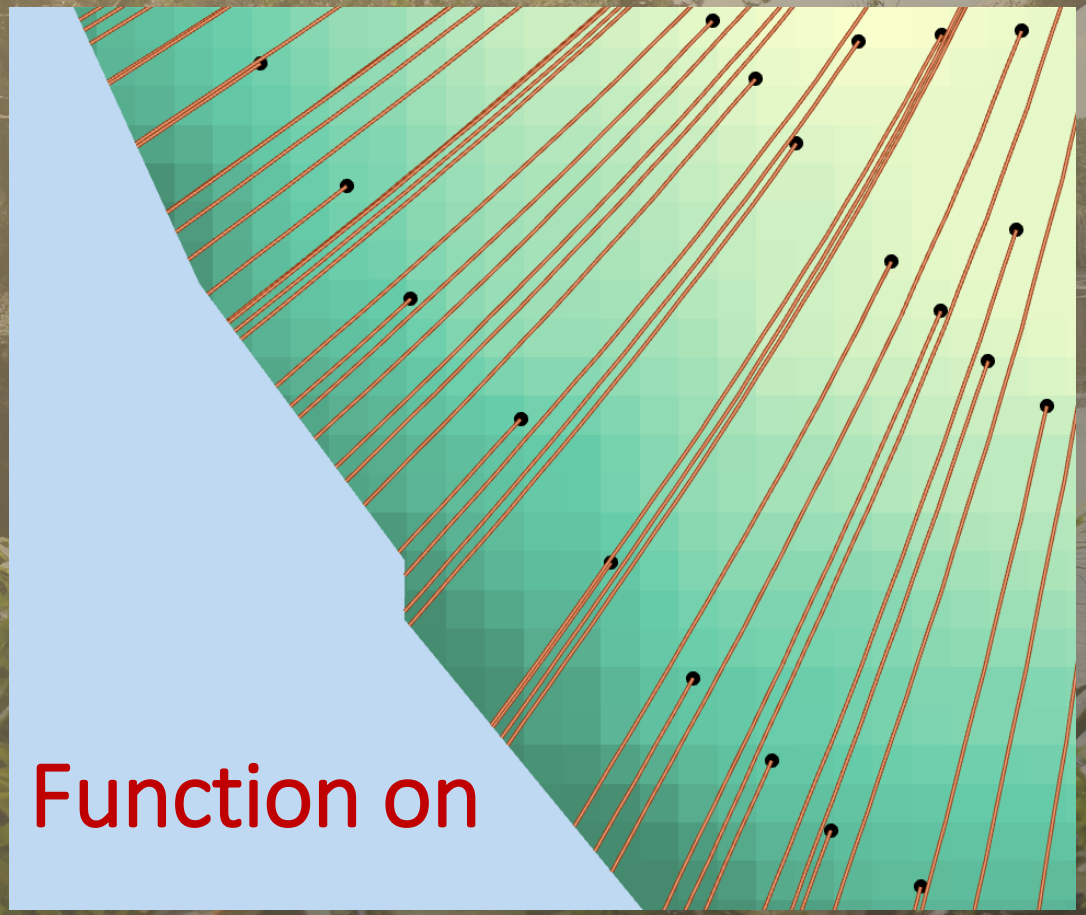
3.1 Merge Waterbodies

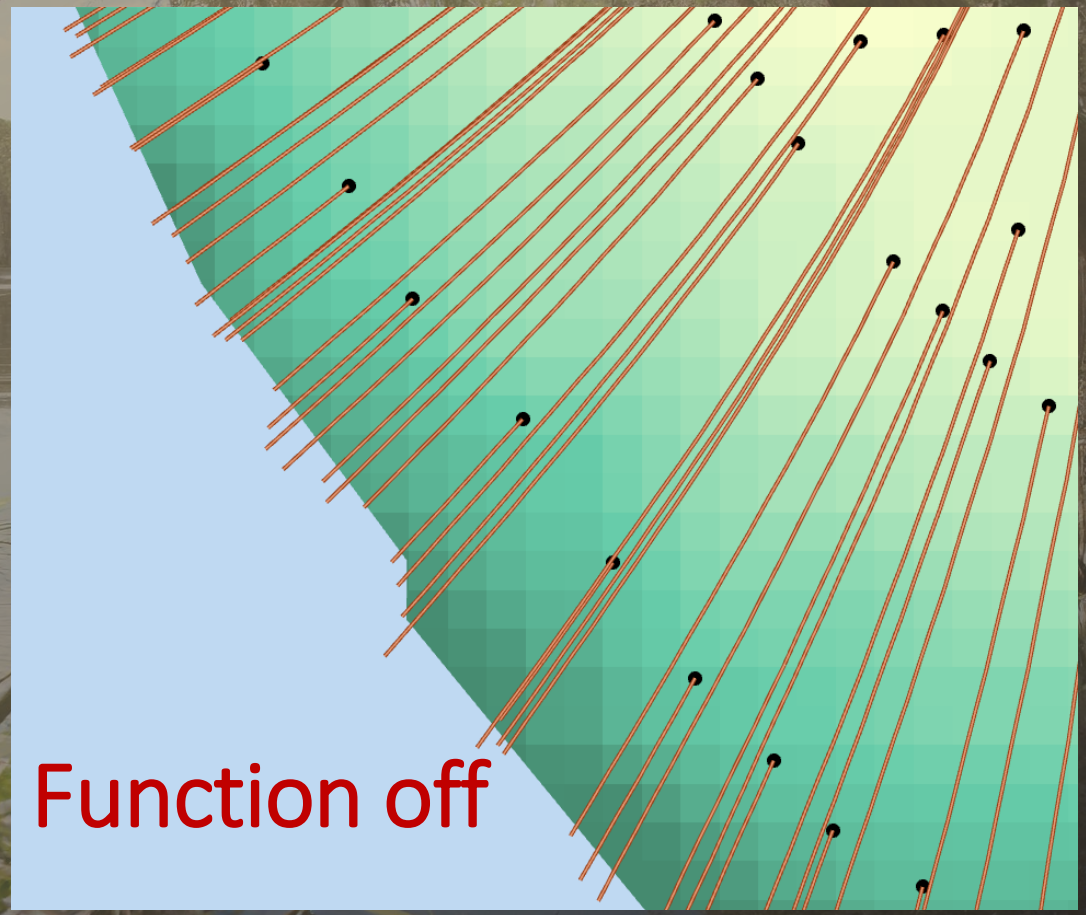


3.1 Merge Waterbodies

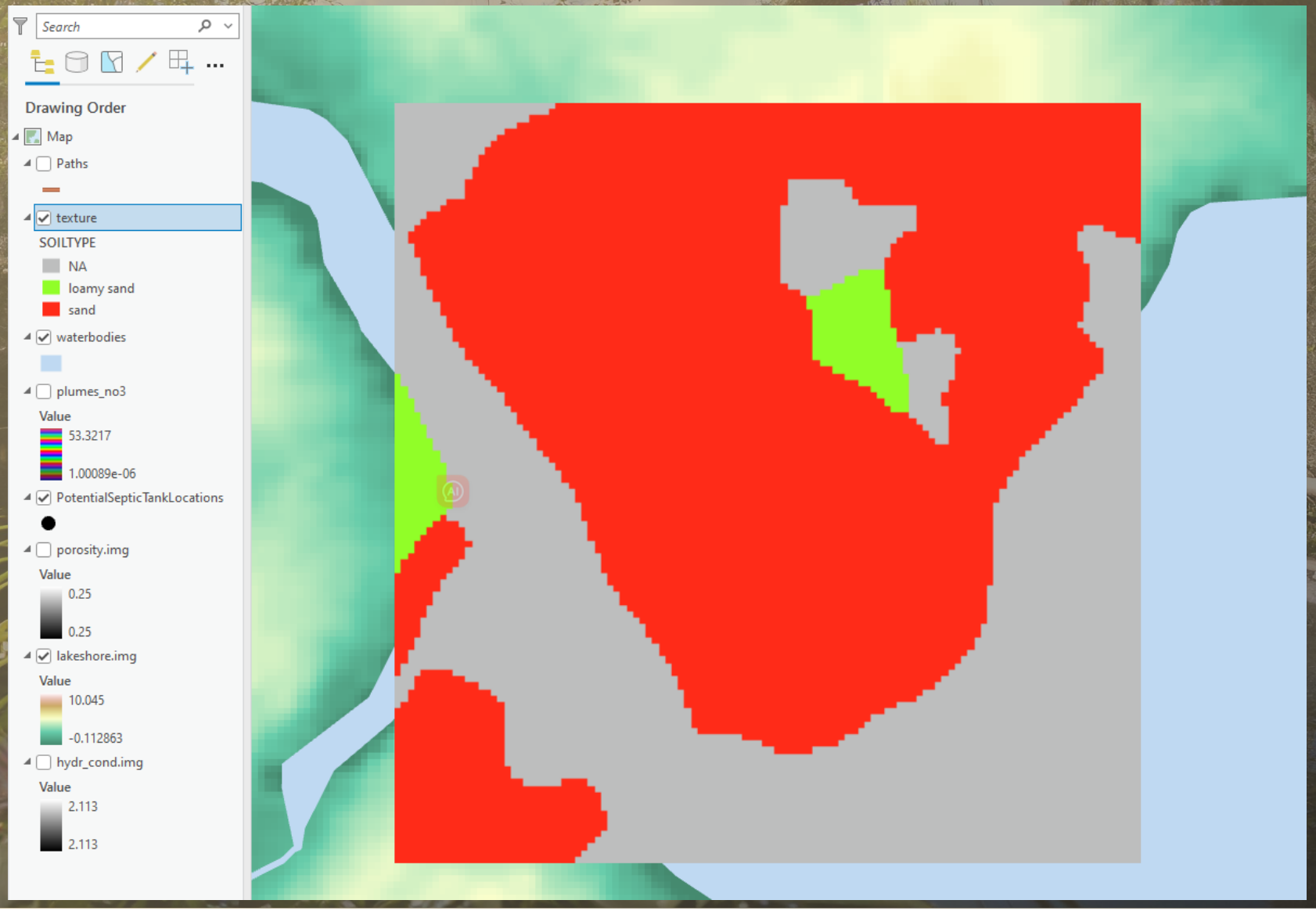


3.2 Flow Path Truncation





3.3 Preprocessing Module




THANK YOU!