Using Google Earth Engine to map and track silvicultural activity

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Water Resources and GIS Committees
Southern Group of State Foresters
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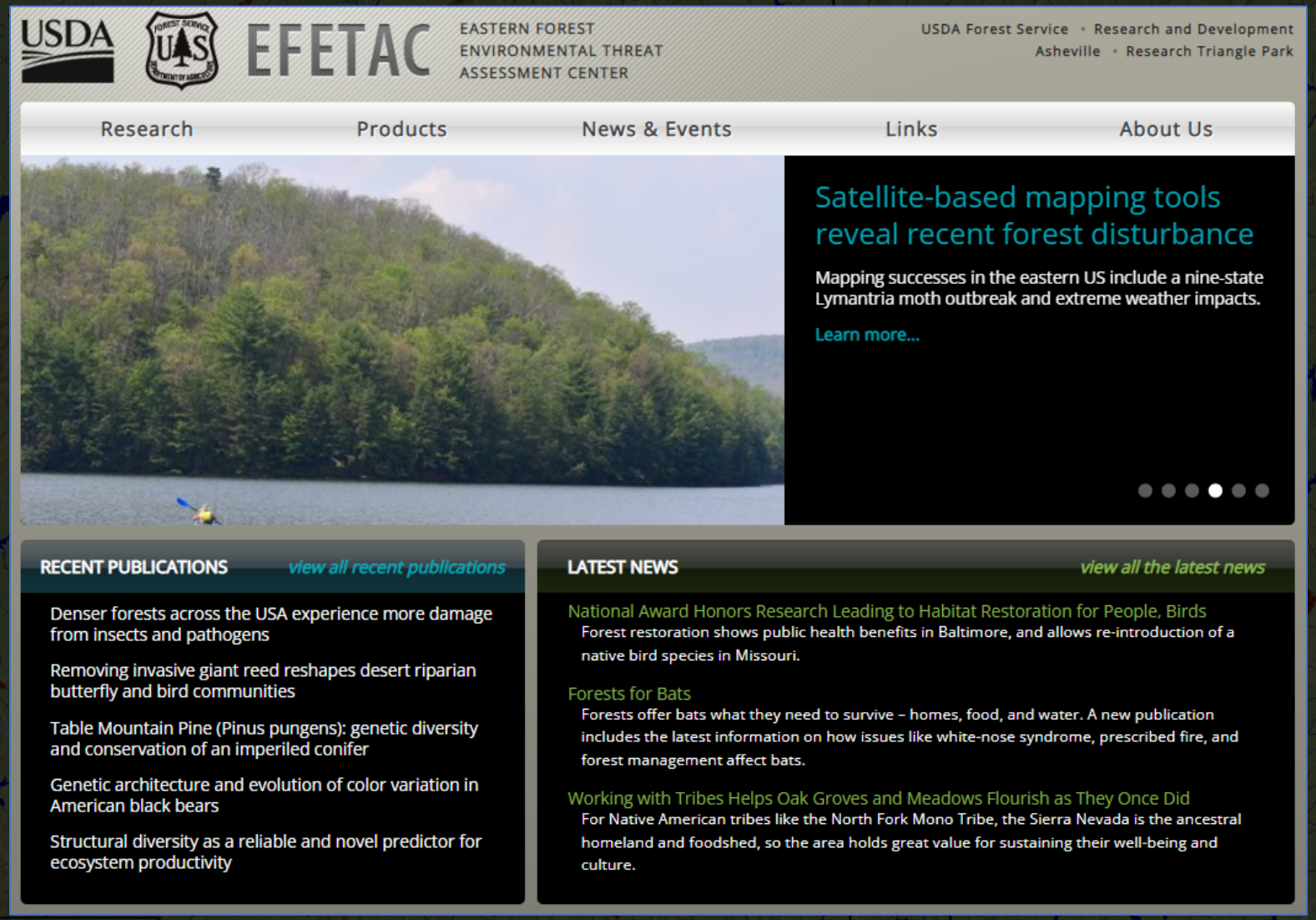
- virtual -

The mission of the Eastern Forest Environmental Threat Assessment Center is to generate knowledge and tools needed to anticipate and respond to environmental threats

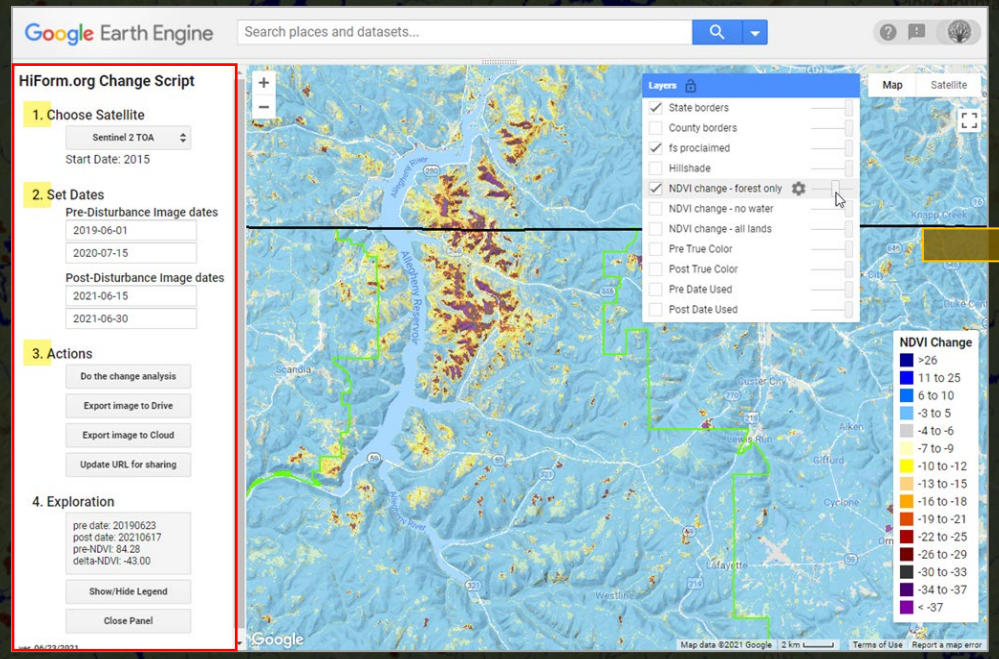


forestthreats.org

Terminology

HiForm
High-resolution forest mapping

'High-resolution Forest mapping'



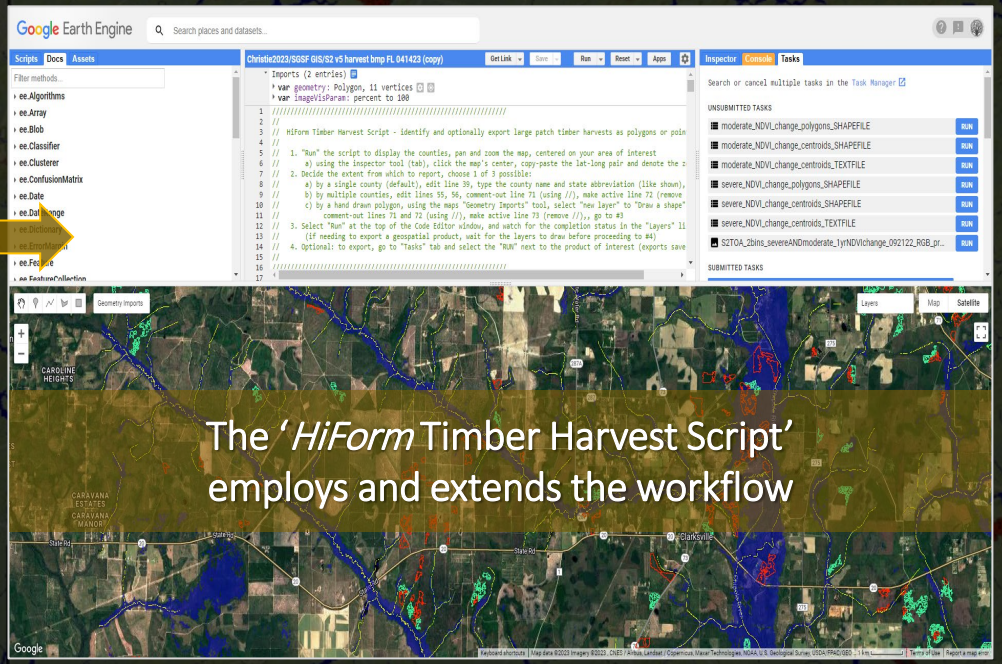
Provided a simplified 'Graphical User Interface' (GUI), it executes a customized workflow of specific mapping tasks, <u>difficult to modify</u>

The *HiForm* "<u>workflow</u>"

- *masking*
- *metrics*
- *methods*
- *visualization*

Google Earth Engine

HiForm Timber Harvest BMP Tool



No GUI, full development control with all capabilities available, <u>easily modifiable</u>

Why we prefer 10m Sentinel-2? (for BMP and everything else)

…compared to 30m Landsat

5-day repeat

9x better spatial resolution than Landsat

'near-tree-crown' resolution

Available the next day in GEE

7-day repeat

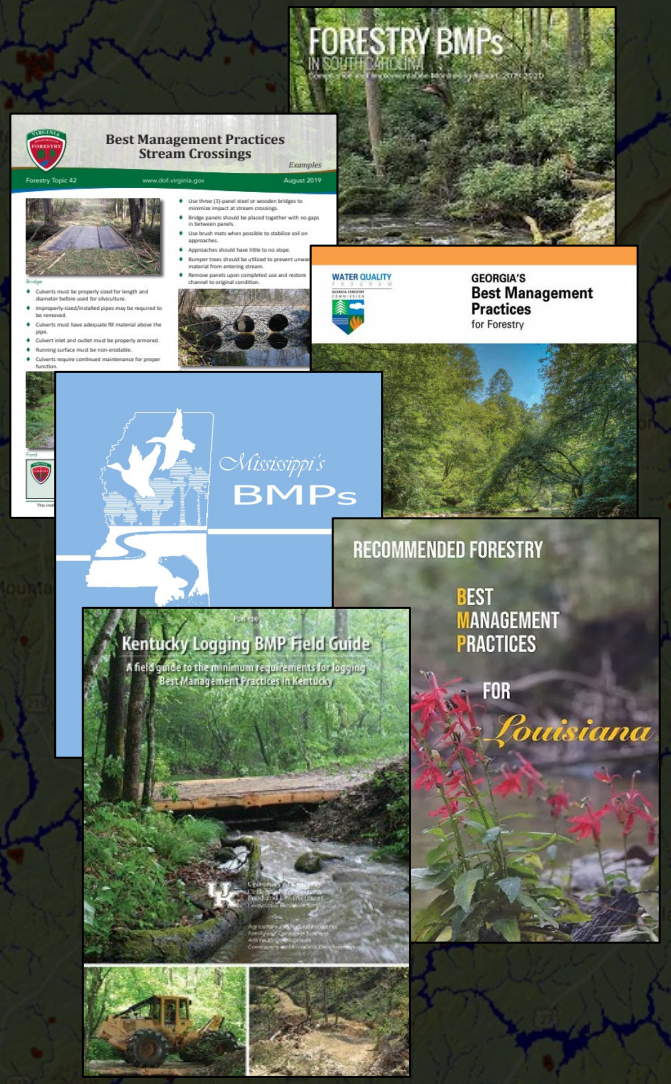
Often takes weeks for an image to become available in Earth Engine

Great for long term baseline NDVI change mapping at 30m

Sentinel-2 is sensor-of-choice for the ***HiForm*** BMP tool

The *HiForm* Timber Harvest Script

- NDVI change at 10m using Sentinel-2
- Requires little input from users
- Performs multiple scripting tasks at once
- Outputs two classes of NDVI decline (harvest and thinning)
- Fast, efficient, adaptable and repeatable
- Specific data layers add value for BMP monitoring
- Use of the tool is free, just request a free EE account

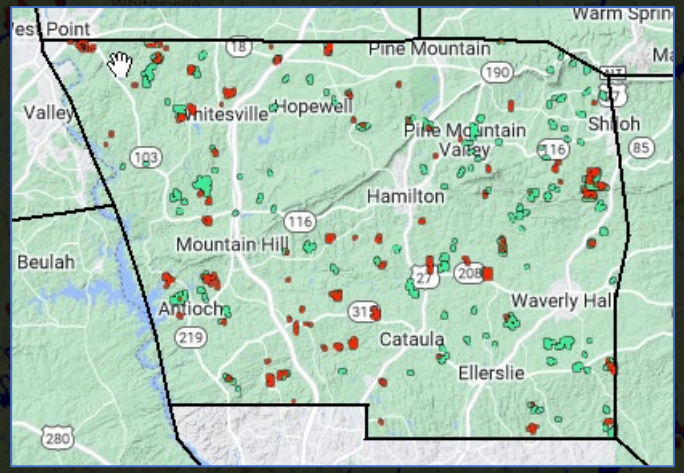


Why map timber harvest?

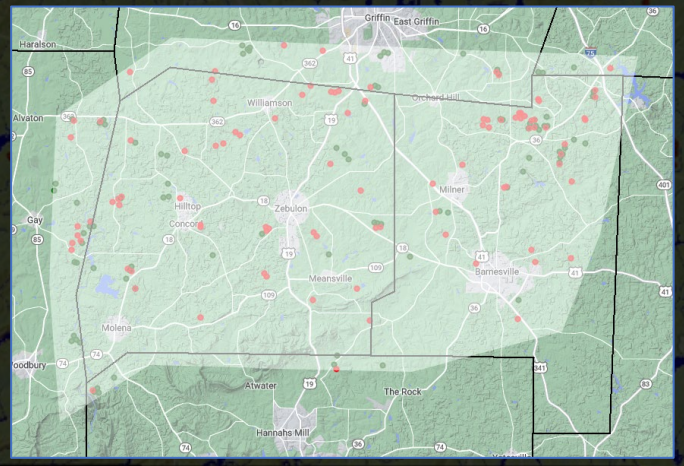
- 'Best Management Practice' (BMP)
  - Water quality and supply
  - Tracking implementation and compliance
  - Forested wetland status and trends
- Annual reporting and tracking
- Salvage logging from large disturbance events
- Others?

HiForm Timber Harvest Script (user input required)

by single county, polygon display



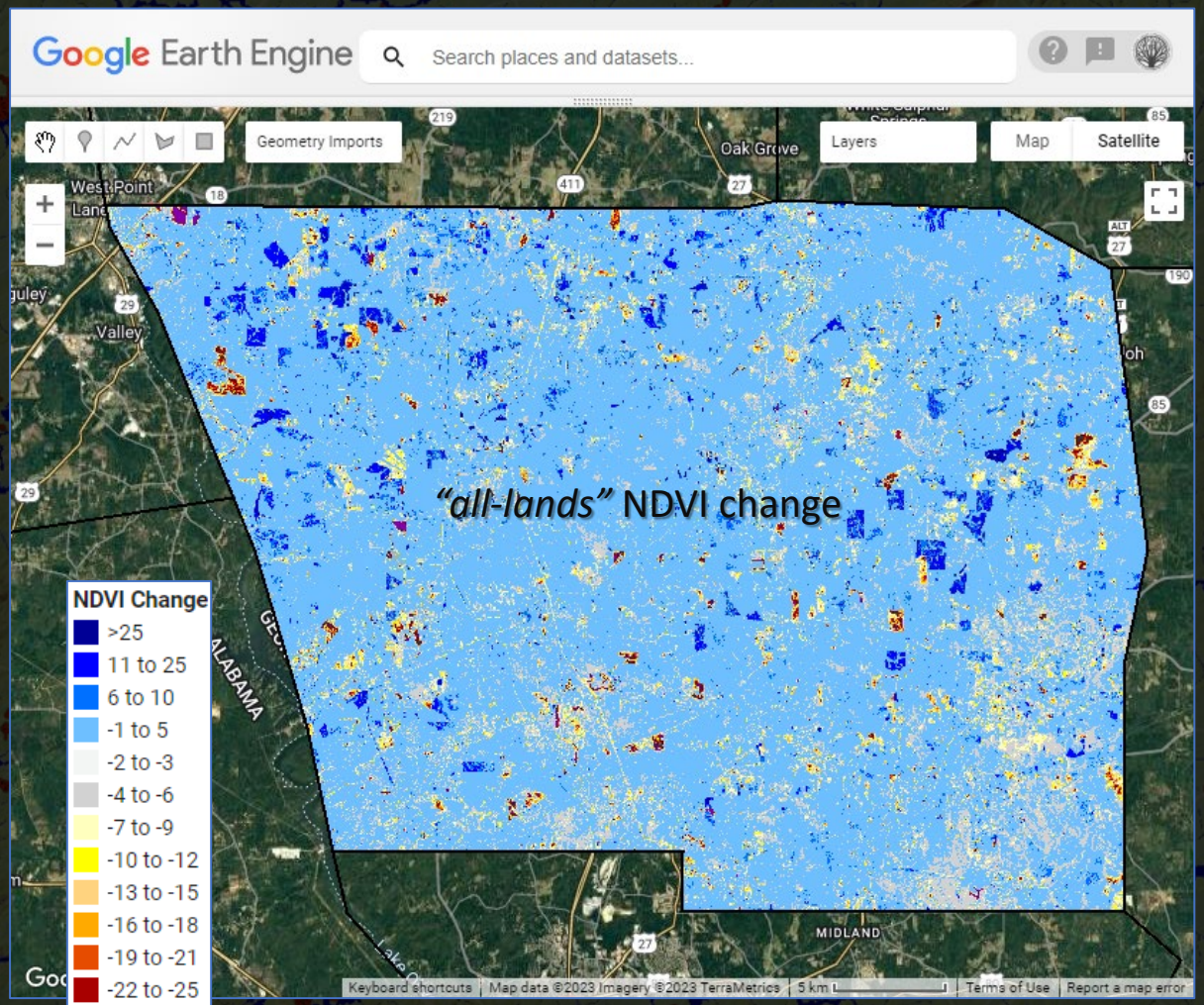
by hand-drawn polygon, centroid display



- Requires Chrome and a free Google Earth Engine account, now open to all users
- Your choice, report by **County**(**s**) or **hand-drawn polygon**
  - Pre-applies (pre- and post disturbance) dates to create the NDVI change product
    - Default - 1yr growing season (8-weeks) change using anniversary dates, or
    - Your own timeframe, within the same years' growing season (ex: 3-mo.), can be more cloudy
  - Auto-applies forest mask using 2019 NLCD and mean growing season NDVI
  - Auto-applies an NDVI filter for severe-, and moderate NDVI decline -20 NDVI change)
  - Auto-applies a 'large patch' filter to show only 0.5ha in size, and greater harvests
- Press '**Run**' to display results; use 'Inspect' to obtain a lat-long for navigation
  - Optional: Export (writes to Google-Drive)
    - Polygon or point shapefile
    - Point lat-long text file
    - NDVI change raster GeoTiff
      - For use on desktop, in AG Field Map or Avenza)

Generalized Workflow

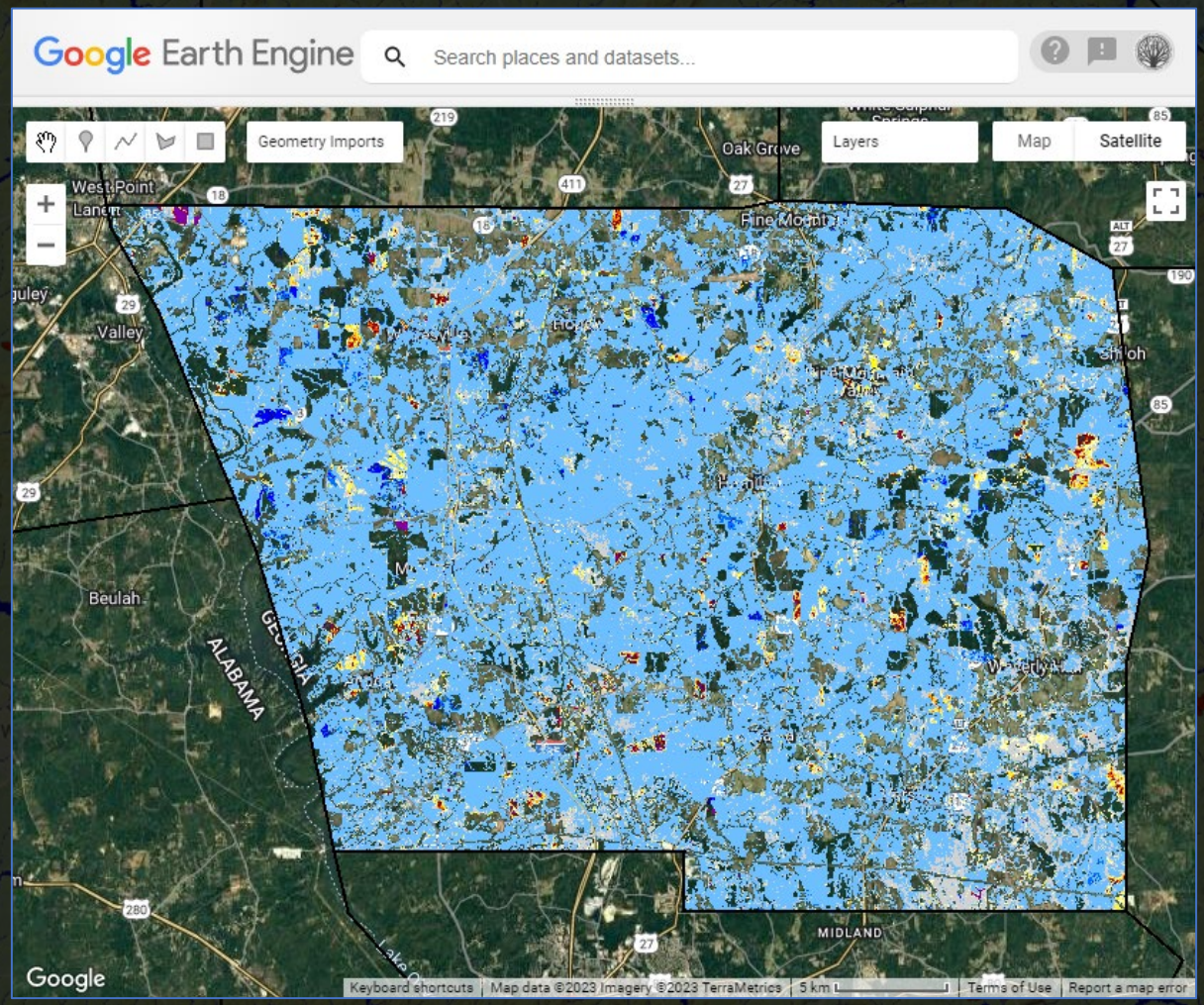
Starts with an 10m, 1yr NDVI change product (8-wk composite)



'Pre' date range – 05/21/2021 thru 07/21/2021

'Post' date range – 07/21/2022 thru 09/21/2022

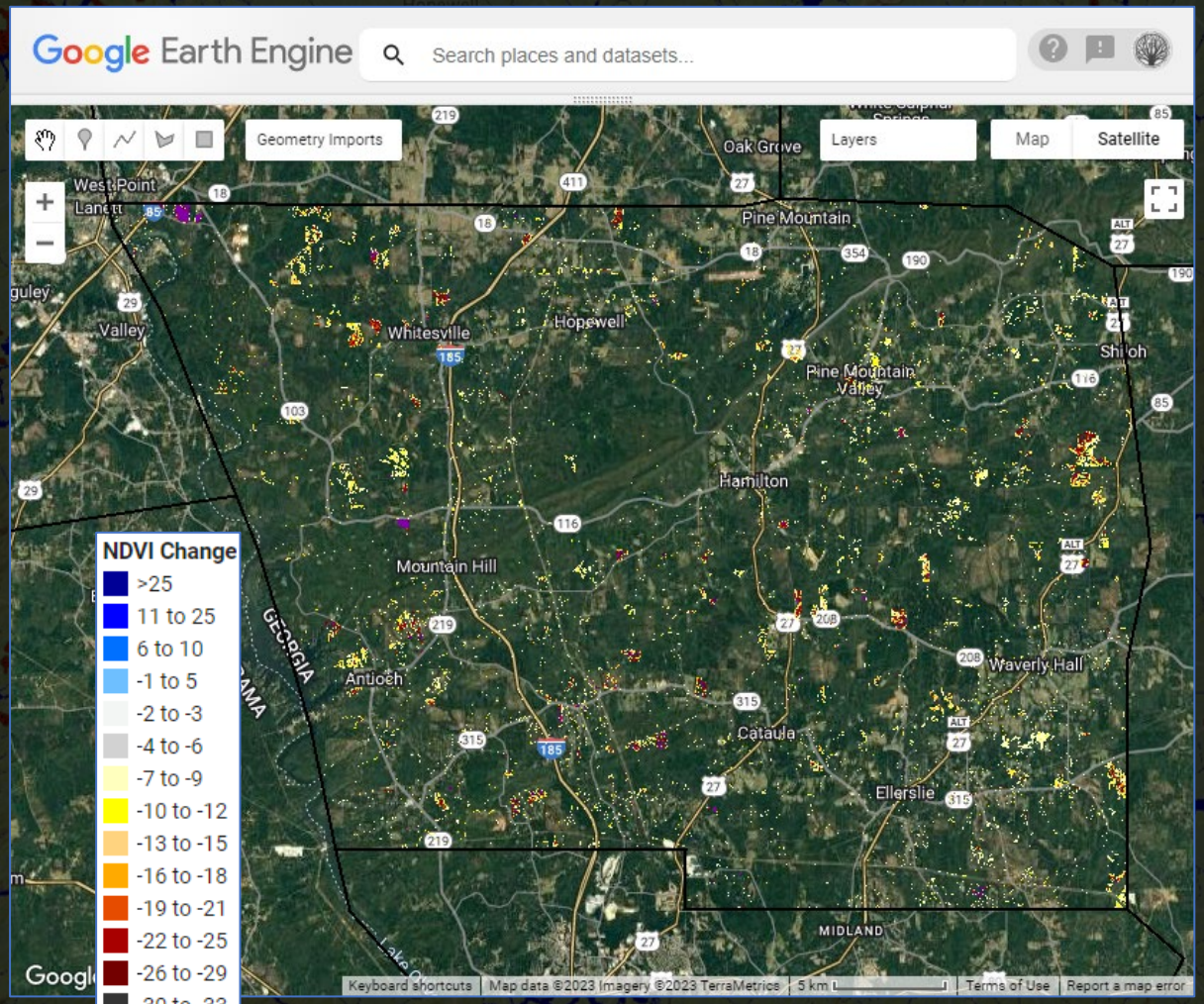
Mask to NLCD 2019 Forest and mean-range NDVI



RE: the second forest filter "mean-range NDVI" (GTE 45) is used because of two shortcomings of NLCD: (1) it's often outdated with respect to forest due to more harvesting after the date of the version used, and prior to the compositing period used, and (2) it's coarse at 30m, compared to the more precise 10m NDVI change product

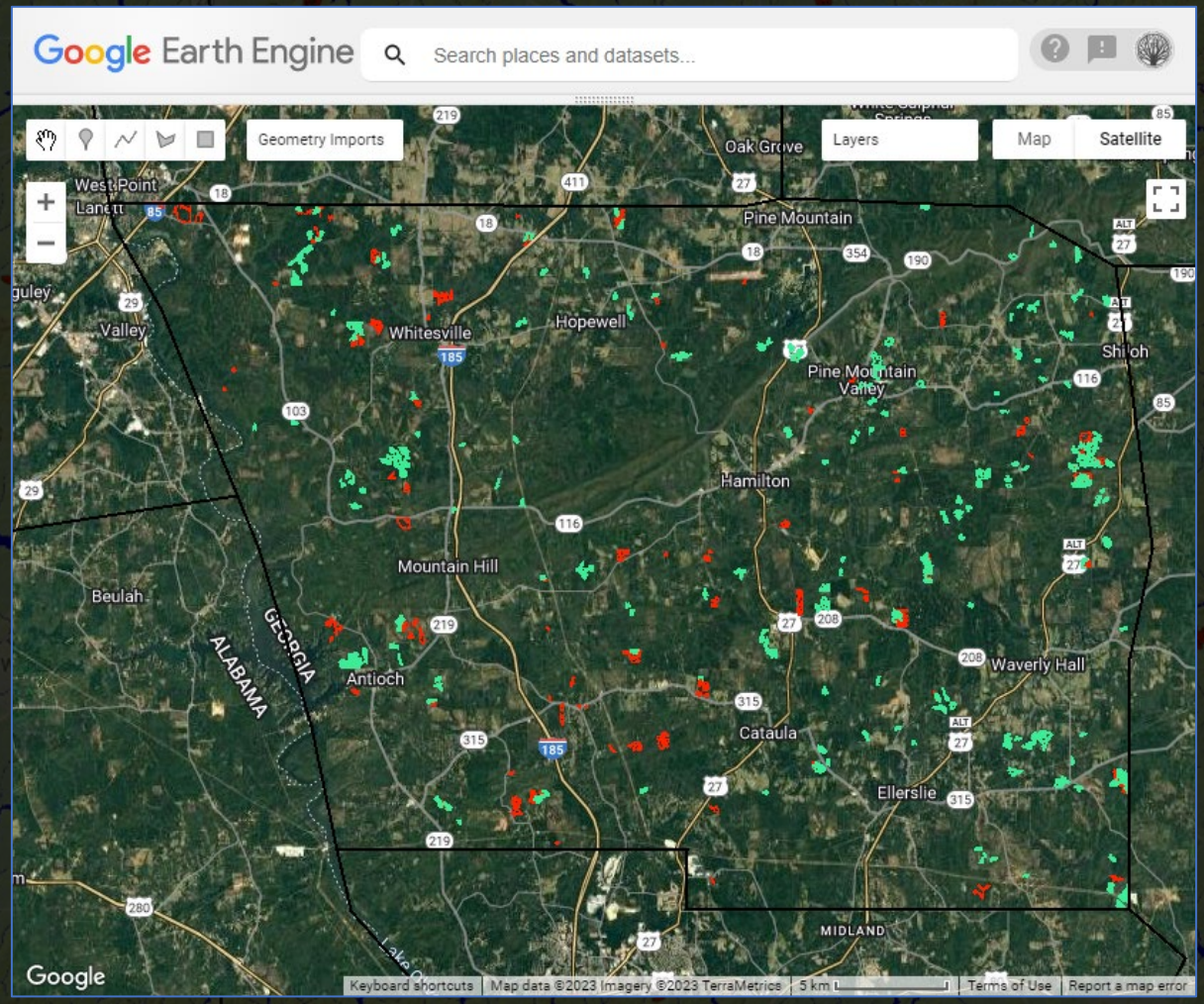
Generalized Workflow

Threshold forest-NDVI-change into 2-levels of decline



(1) High/severe NDVI decline, -20, and worse
(2) Moderate NDVI decline, -7 to -19

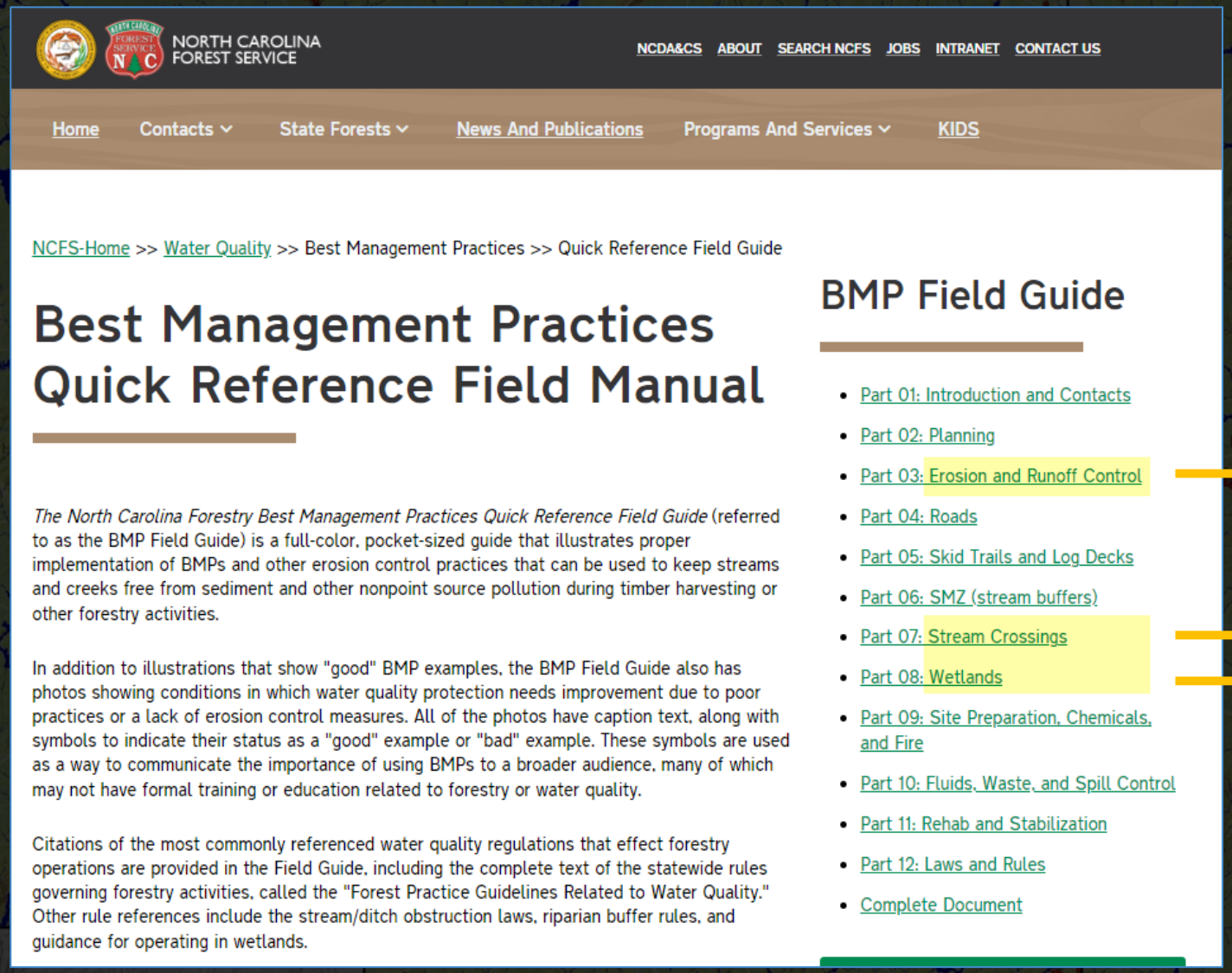
Filter for min. patch size, then convert to polygons & points



(1) High/severe NDVI decline, ≥ 2.5 acres (red polygons)
(2) Moderate NDVI decline, ≥ 5 acres (green polygons)

Add value to the Harvest Script by including BMP-related data layers

(to help assess potential impacts to water resources)



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NCFS-Home >> Water Quality >> Best Management Practices >> Quick Reference Field Guide

Best Management Practices Quick Reference Field Manual

The North Carolina Forestry Best Management Practices Quick Reference Field Guide (referred to as the BMP Field Guide) is a full-color, pocket-sized guide that illustrates proper implementation of BMPs and other erosion control practices that can be used to keep streams and creeks free from sediment and other nonpoint source pollution during timber harvesting or other forestry activities.

In addition to illustrations that show "good" BMP examples, the BMP Field Guide also has photos showing conditions in which water quality protection needs improvement due to poor practices or a lack of erosion control measures. All of the photos have caption text, along with symbols to indicate their status as a "good" example or "bad" example. These symbols are used as a way to communicate the importance of using BMPs to a broader audience, many of which may not have formal training or education related to forestry or water quality.

Citations of the most commonly referenced water quality regulations that effect forestry operations are provided in the Field Guide, including the complete text of the statewide rules governing forestry activities, called the "Forest Practice Guidelines Related to Water Quality." Other rule references include the stream/ditch obstruction laws, riparian buffer rules, and guidance for operating in wetlands.

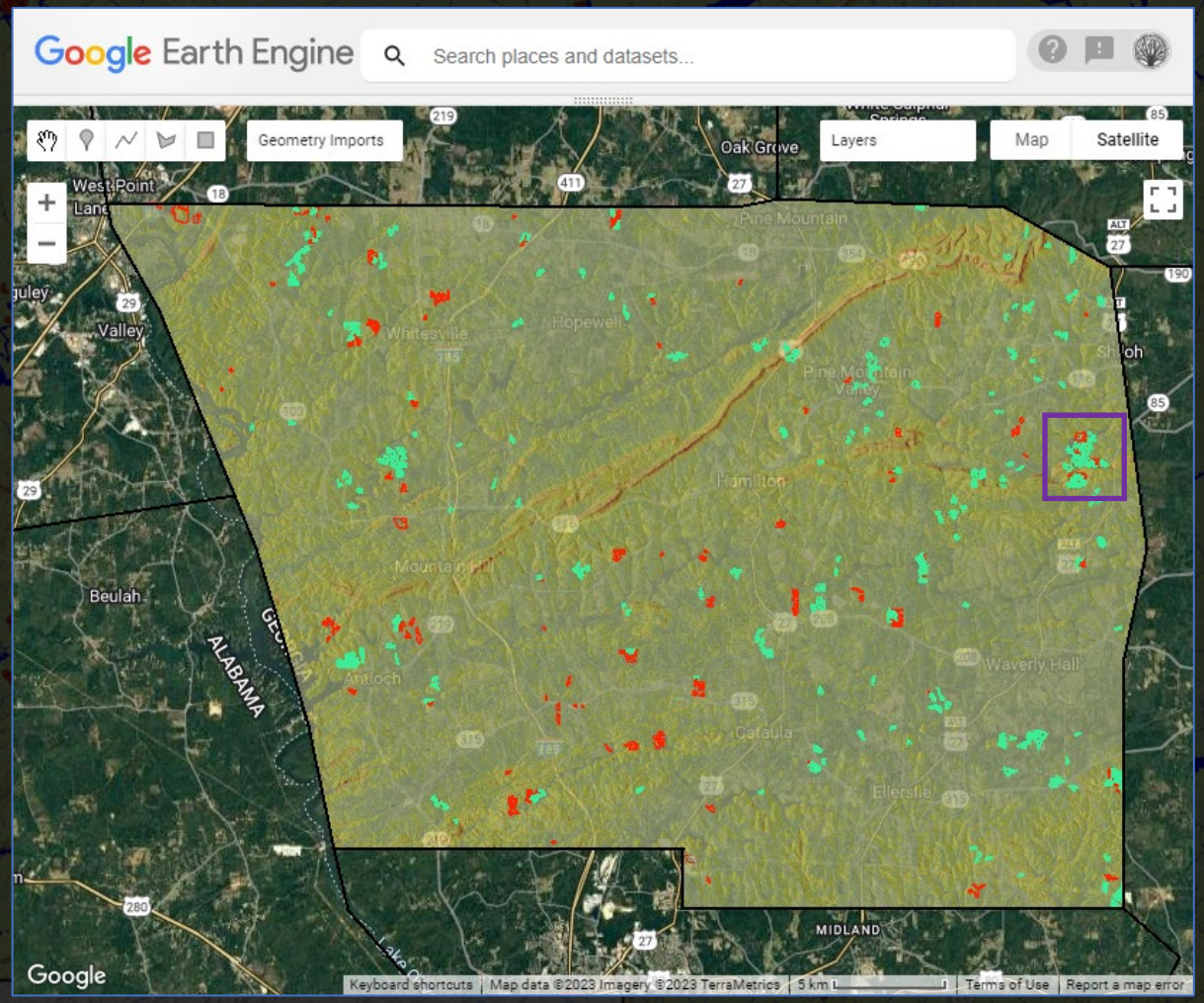
BMP Field Guide

- Part 01: Introduction and Contacts
- Part 02: Planning
- Part 03: Erosion and Runoff Control
- Part 04: Roads
- Part 05: Skid Trails and Log Decks
- Part 06: SMZ (stream buffers)
- Part 07: Stream Crossings
- Part 08: Wetlands
- Part 09: Site Preparation, Chemicals, and Fire
- Part 10: Fluids, Waste, and Spill Control
- Part 11: Rehab and Stabilization
- Part 12: Laws and Rules
- Complete Document

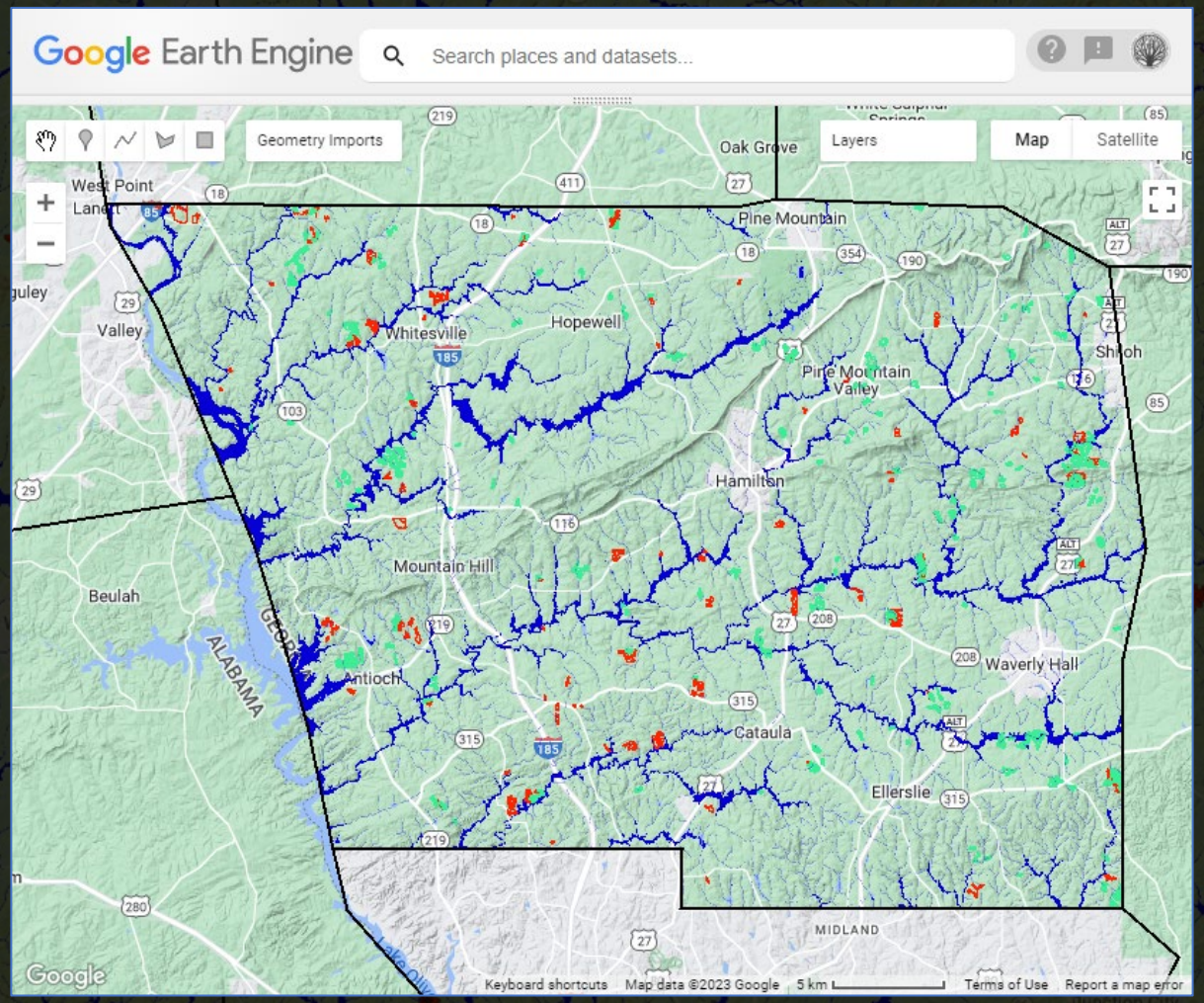
- Percent slope
- Detailed streams; 303(d) Impaired
- Floodplains (denotes bottomland hardwood wetlands, hydric soils)

BMP-related Data Layers

Erosion and Runoff Control -
Percent Slope from USGS 10m DEM

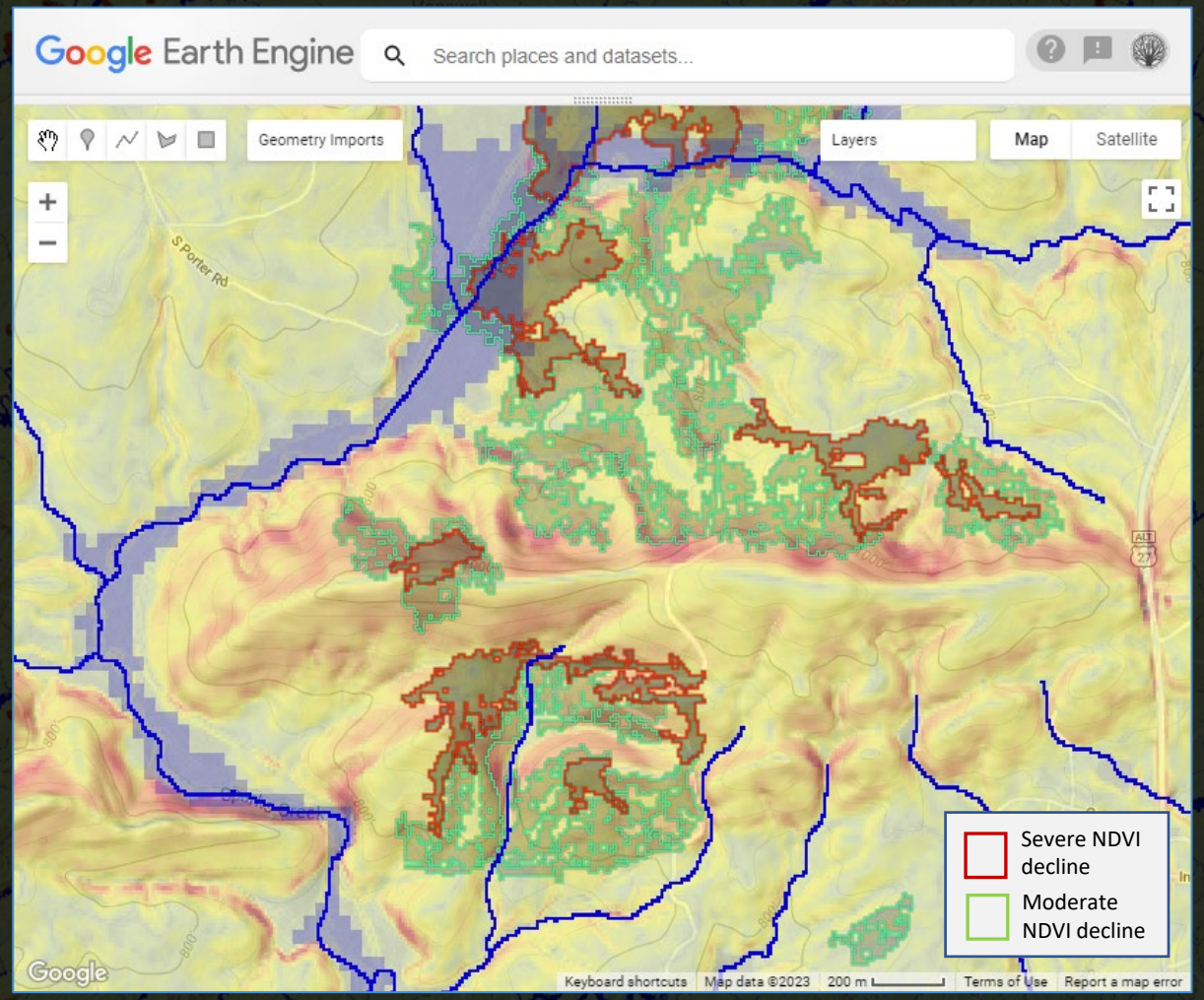


Stream Crossings and Wetlands -
Detailed USGS Streams and Floodplains

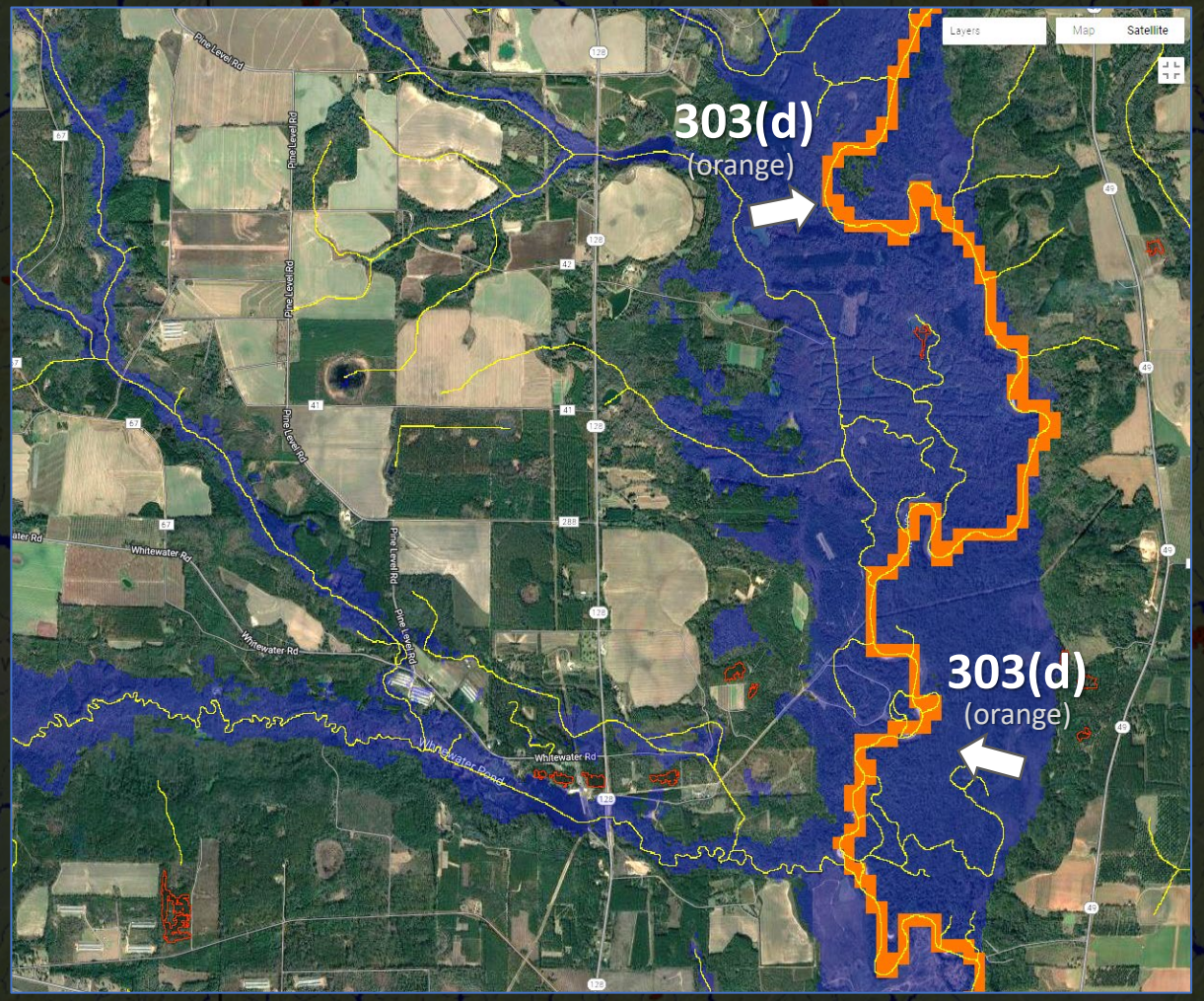


BMP-related Data Layers

Percent slope, detailed streams, floodplain wetlands and 303(d) Impaired streams



Harris County, GA



Oglethorpe County, GA

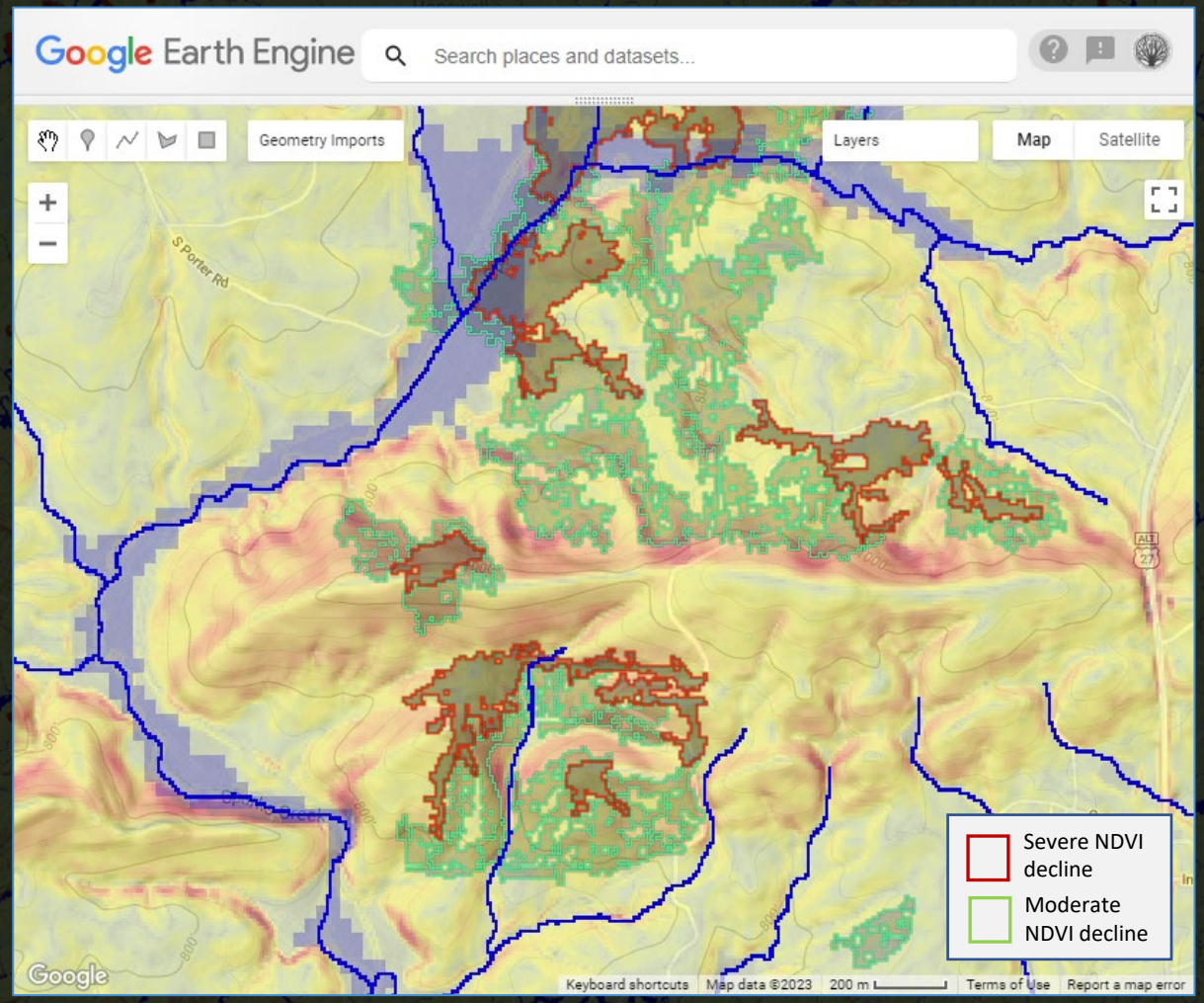
Guide to Interpretation – product use, vetting, confirmation of silvicultural activity

A beginner's guide to assessment

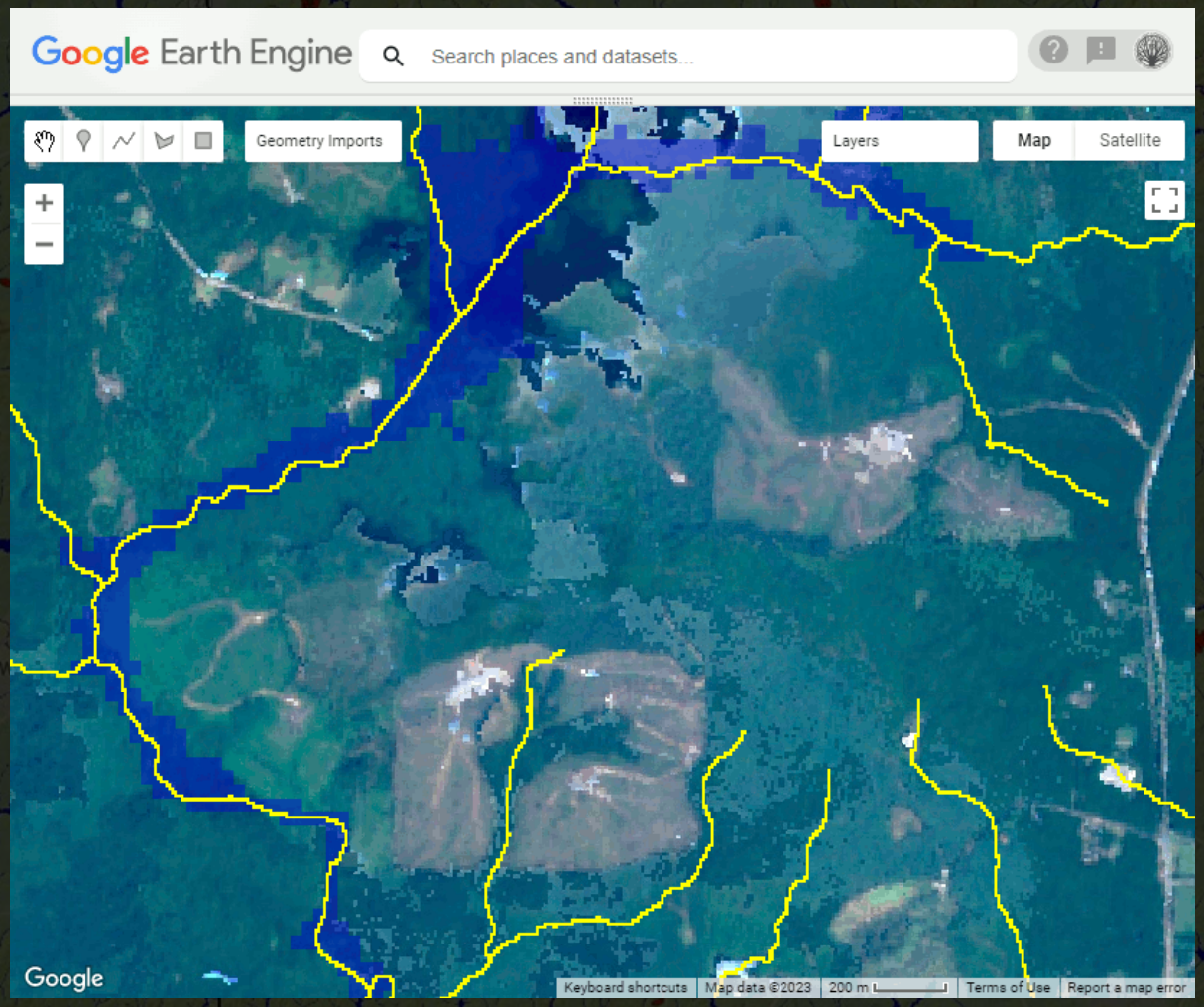
- SEVERE NDVI DECLINE POLYGONS *are the easiest to detect, it's the user's responsibility to assess cause and if silviculture-related, development, large-patch defoliation/mortality, severe weather, flooding, etc.*
  - Toggle the pre- and post-natural color images to assess and interpret caus
    - It's possible to remove clouds by adjusting the 'post' dates used to ca

- MODERATE NDVI DECLINE POLYGONS *are a result from a multitude of possible*
  - First, observe their proximity to the red 'severe' NDVI decline polygons
    - Close proximity - likely related to clear cut activity, just lower NDVI de
    - Disjunct, could indicate possible thinning, interpret the pre and post the character, and color of NDVI change, also view the 'forest-maske

Guide to Interpretation – product use, vetting, confirmation of silvicultural activity



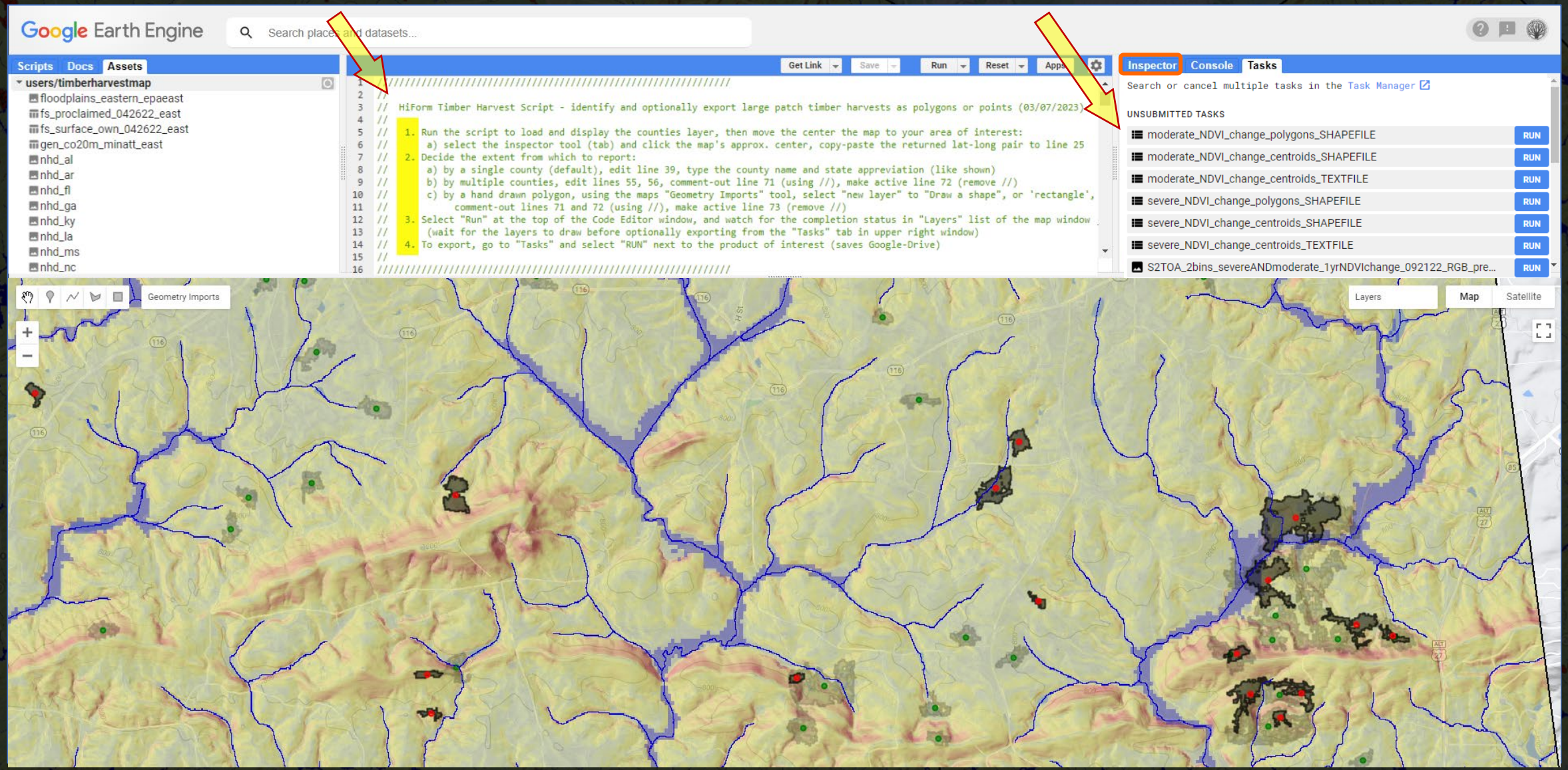
Use the post true-color to show the full extent of the harvest site



One can potentially remove the presence of clouds (in the 'post' image) by changing the timeframe of the default date range in the script (adaptive tool)

Step-by-step instructions

Exports are automatically created and staged



*** It’s not necessary to export anything, use the ’Inspector’ tool to get the lat-long, then paste to Google Maps for navigation ***

How to get started? (red - required user input)

Using Google Chrome, **sign-in** using an established Gmail acct, then request an EE account, https://earthengine.google.com

When approved, execute this script-link, **https://code.earthengine.google.com/7b8e5e528a85058af621ecd572428f7d**

Step-by-step instructions are provided at the top of the script

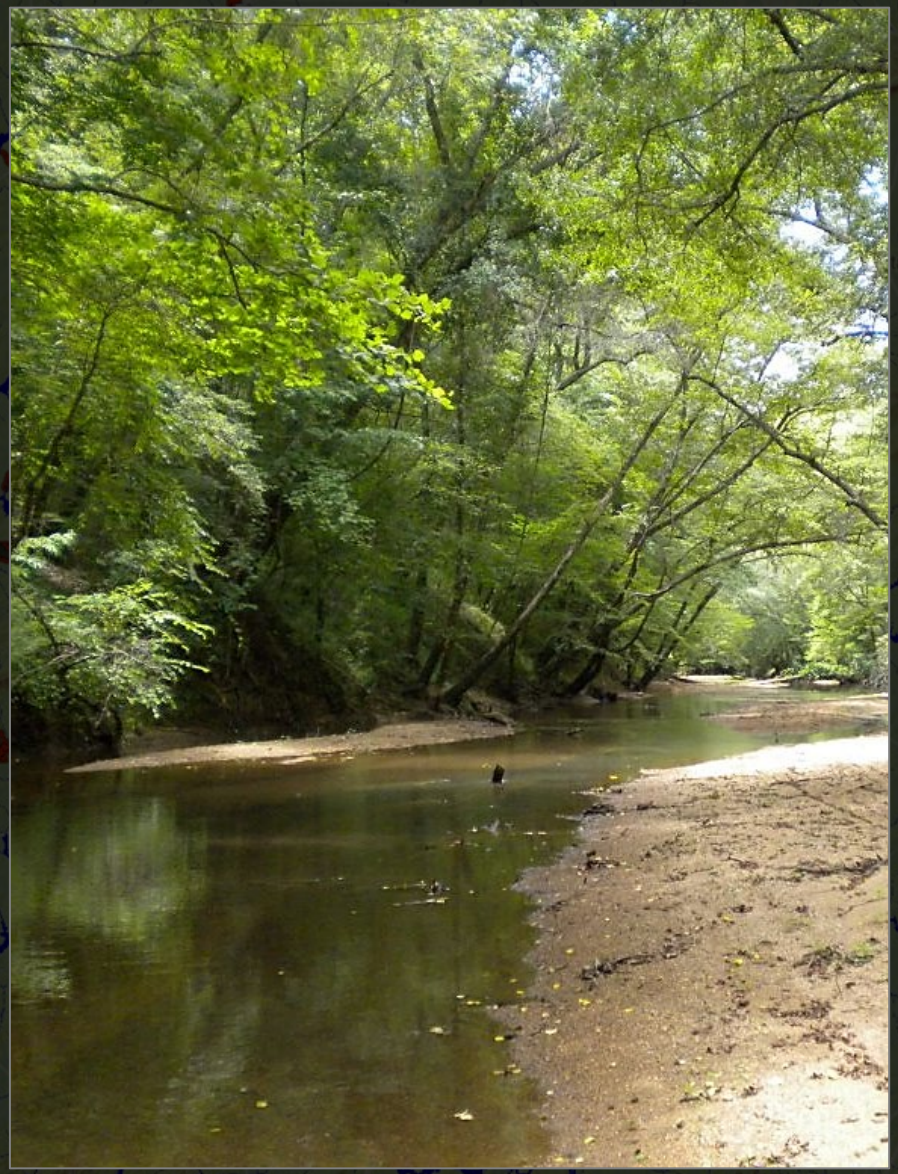
A. *Optional*: set the map center and zoom level

B. Decide the extent to map, choose 1 of 3

   1. Type-in a **single county name** (default)
   2. Type-in **multiple county name**s, or
   3. **Draw** on the screen

C. Select Run

D. *Optional*: export, Inspector tool for lat-long



South Carolina Forestry Commission

Questions and discussion

1. How does this compare with other approaches?
2. Have we captured broad harvest-related needs?
3. What do you like, not like, or need to make it better?
4. Going forward - *engage with GISC for input regarding the design of a 'user interface' for the HiForm BMP tool*

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steven.norman@usda.gov (Research Ecologist)

The *HiForm* website: https://hiform.org

Earth Engine sign-up: https://earthengine.google.com/

(create a new Gmail address to use for EE sign-up and work)