Introduction to the Google Earth Engine Workshop

This workshop will introduce the user to the Graphical User Interface (GUI) version of the Google Earth Engine. It assumes the user has a basic understanding of the field of remote sensing and satellite imagery.

Navigate to the Earth Engine site at: <u>http://earthengine.google.org/</u> and **Sign in** using the link on the upper right of the page.

After reading the site description you should explore a few of the Featured Sites, especially the Landsat Annual Timelapse views. Click the **Home** button (upper right) to return to the main page

Exploring the Data Catalog

One of the strengths of the Earth Engine is the ability to access and view a large amount of data over time and space. Let's begin by browsing the Data Catalog (upper right).



You are presented with a series of popular tags, several data collections, and a search bar (at the top). Click on several of the tags to see some of the types of data available. For now **do not** click on the link to Open in workspace, we will get to that later. The **usgs** tag has a large number of datasets for your use. Click on the dataset *name* and you can view detail information about the data. Enter "**NDWI**" into the search bar to see the various Normalized Difference Water Index datasets available to the Earth Engine.

Using the Workspace

Click on the Workspace button in the upper right to access the workspace. If this is your first time using this tool it should show a map of the world. You can use the mouse roller or the slider in the upper right to zoom in and out. Left-click and drag to pan around the image. Also in the upper right you can change the background image from **Map** (with or without Terrain) to **Satellite** view (with or without Labels).



Zoom to an area roughly the size of the continental US states. In the Search Bar enter MODIS NDVI and select the **MODIS 16-Day NDVI** to load into your Workspace. The Table of Contents section on the left now lists the dataset name that you are viewing. Click on the Visibility Tool (eye icon) to toggle the data layer on or off.

Now click on the layer name to open the Layer Settings window as shown to the right. Use the slider to select a different date and click Apply. You can also use the Jump to date feature to quickly view data from prior years. The Opacity slider allows you to visualize the underlying background map or other data layers. You can adjust the data enhancement display range and display palette (more later). Use the three icons in the lower right to delete the file, download the active data layer, or access metadata. Click on the data name and change this to show the date of the data layer. Click Done to update the



name in the Table of Contents. Click Save to keep any changes you have made.

Next, search for **Temperature** to find the **MODIS Land Surface Temperature** dataset. Open this into your workspace. This should load over the NDVI layer as a gray scale image. Use the Layer Setting window to select the same date as the displayed NDVI layer.

Now you will create a color ramp to improve the display. Click on the **Palette** radio button to identify the method of displaying the data. Next, click on the **+** symbol to open the Color Chooser. The first entry will represent the lowest data values. Select a shade of dark blue. Expand the color ramp by adding two or three more colors, ending with a shade of red for the highest data values. Click Apply and see the result. You can change colors and add or delete palette entries as necessary.

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Now toggle on and off the Temperature layer to visualize how vegetation and temperature are related over space. You should see different seasonal relationships between the northern and southern hemispheres.

Workspace Management

Before moving on you should learn how to manage your workspace. Click on the Manage workspace button to bring up a series of options.

- Click on **Save now** to save the current image and data layers.
- Turn off one layer and pan to a different region.
- Click Restore saved workspace to return to where you last saved
- Clear workspace will remove all datasets but leave you at the same location and zoom level
- Import/Export works a bit differently. This opens a window displaying the JSON code used to construct the active display. To export the workspace select and copy all of the text, then paste

it into a text file. To Import a previous workspace replace this text with previously spaced JSON code and click Import. You could also manually edit the code if you want to live dangerously!

- Share workspace generates a URL that other Earth Engine users can load into their own instance of Earth Engine. Users must be logged in for this to work.
- Paste this link it into your browser to see a small workspace in Panama. <u>http://earthengine.google.org/#workspace/CpMtYpb1esR</u>

Image manipulation

In the late summer of 1988 Yellowstone National Park had the largest forest fire in its history. We will examine this event using Landsat NDVI data. If you have not done so already, **clear your workspace** then zoom in to the area of Yellowstone NP in Wyoming. Center your workspace on Yellowstone Lake and load the *Landsat 5 Annual Greenest Pixel TOA Reflectance* dataset. Use the Layer Setting to select the year 1987 and change bands to a 543-RGB display. The fire happened in 1988 so change the year to 1988. The image is still pretty green since this represents the greenest pixels for the year. Now change to 1989. You should see the most sever burn scars still on the landscape.

Next add the *Landsat 5 32-Day NDVI Composite* dataset and Jump to Date range Aug 13, 1987 – Sep 14, 1987. Add the dataset a second time and Jump to Date Aug 12, 1988 – Sep 13, 1988, the peak of the fires. Edit the Layer Settings to label each NDVI year. Toggle between these images to examine the extent of the forest damage.

Now we will create a difference image, subtracting the 1988 NDVI from the 1987 NDVI. Click on Add computation located under the data layers on the left side of the screen. As you can see, there are a number of functions that you can apply to data. For this exercise select Expression in the Per-Pixel Math category. Select the 1987 32-day composite for the first image and the 1988 32-day composite for the second image. Enter **img1 – img2** as the Expression and click Apply.

This should produce a grayscale image of the scene differences in NDVI. Brighter areas had migher NDVI values in 1987 and the darkest values were higher in 1988. You can improve this display by creating a new palette under Layer Settings. Select a bright green color for the first color. Follow this with a grayblue color then a red color for the last value. All of the red regions show lower NDVI values for 1988, much of this due to the extensive forest fire.

Downloading data

If you like this image you can download it to use in ENVI, ArcGIS, PowerPoint or other application. All data layers are combined into a .ZIP file. Note that you are only able to download one file at a time. For timeseries data such as NDVI composites you are only downloading the layer that is actively displayed.

Click on the Down Arrow in the lower right of the Layer Settings window. You can/should change some of the default parameters when you download data. These are:

• Region – Default is the Viewport, or area being displayed by the application. You can draw a rectangle or polygon to select a different area.

- Format Default is GeoTIFF. You want this for geospatial applications but may want PNG or JPG if your target application is Word or PowerPoint
- Bands Default is all bands. Each data layer is treated as a separate TIFF
- Projection Default is Native (EPSG4326). Data are latitude/longitude, commonly referred to as "geographic" projection. You can select other projections if you wish.
- Resolution Default is 500m. For Landsat data you probably want to change this to 30. Be advised if you are zoomed out to a large region you should NOT switch to 30m.

Classification

Clear your workspace and navigate to New Haven, Ct. Under Analysis select Train a classifier.



Click Add data and select the **Percentile Composite Landsat 7 Reflectance** file. In the Layer Setting dialog select Annual, 1-Year, 2002 and under Visualization set the display for 543-RGB and Save.

Create training regions

Click in the Search Bar and under the Vectors section select **Hand-drawn points and polygons**. This adds a new section on the left **Classes** and places three new icons in the upper left of the display window to create shapes and points (called Add a marker) and stop drawing.

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Select Add class and create four new classes labeled; **Water, Urban, Forest, Agriculture** giving each a unique color. Select the **Water** class then the click Shape icon and draw one or more polygons in water. Next select **Agriculture** and use the Marker tool to place points in various areas that are agriculture or golf courses. If you make a mistake you can stop drawing then click on the marker or polygon and either move or delete the feature. When you have completed selecting features for each class you can run the classifier. Use the default *Fast Naïve Bayes* classifier and click **Train classifier and display results** to generate a classified image. Notice that as you pan to other areas, or zoom out, these new regions are automatically classified.

If time permits try other classifiers and add a new class or two. Perhaps your results will improve if you adjust the original shapes and markers?

This completes the workshop.