

# ClimateSERV Module 2

## Exploring Soil Moisture Data in ClimateSERV

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Prepared for "Quantitative Remote Sensing of Vegetation Parameters" at ITC  
Quartile 1 2022 - 2023



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# Prerequisites and Requirements

For this module, you will need...

- A computer
- Access to the internet
- Familiarity with ClimateSERV's Graphical User Interface (GUI). It is recommended that you take SERVIR's ClimateSERV Module 1 prior to taking this module. [Click here to see ClimateSERV Module 1.](#)

## Learning Objectives

By the end of this module, you will be able to

- Investigate how soil moisture data varies across time for a region of interest
- Investigate how soil moisture varies across a region of interest for a specific point in time
- Investigate how soil moisture data varies simultaneously over both space and time
- Import soil moisture data from ClimateSERV to your computer

# Introduction

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This module will explore how to visualize, analyze, and download soil moisture data for a specific study area using ClimateSERV, a SERVIR tool.

For this module, you will be working with the SMAP (Soil Moisture Active Passive) dataset produced by the United States Department of Agriculture. To learn more about this dataset, visit the ClimateSERV Dataset Encyclopedia. [Click here to view the ClimateSERV Dataset Encyclopedia](#). We will visualize how surface soil moisture data varies across space and time using ClimateSERV's GUI. Then, we will download the data from ClimateSERV and further analyze it within different geospatial analysis platforms.

# Exercise 1: Spatial Analysis

In this section, we will explore how soil moisture varies across a region of interest during a constant point in time. For this example, we will use the Karnali Region of Nepal (indicated by the red arrow in the image below).

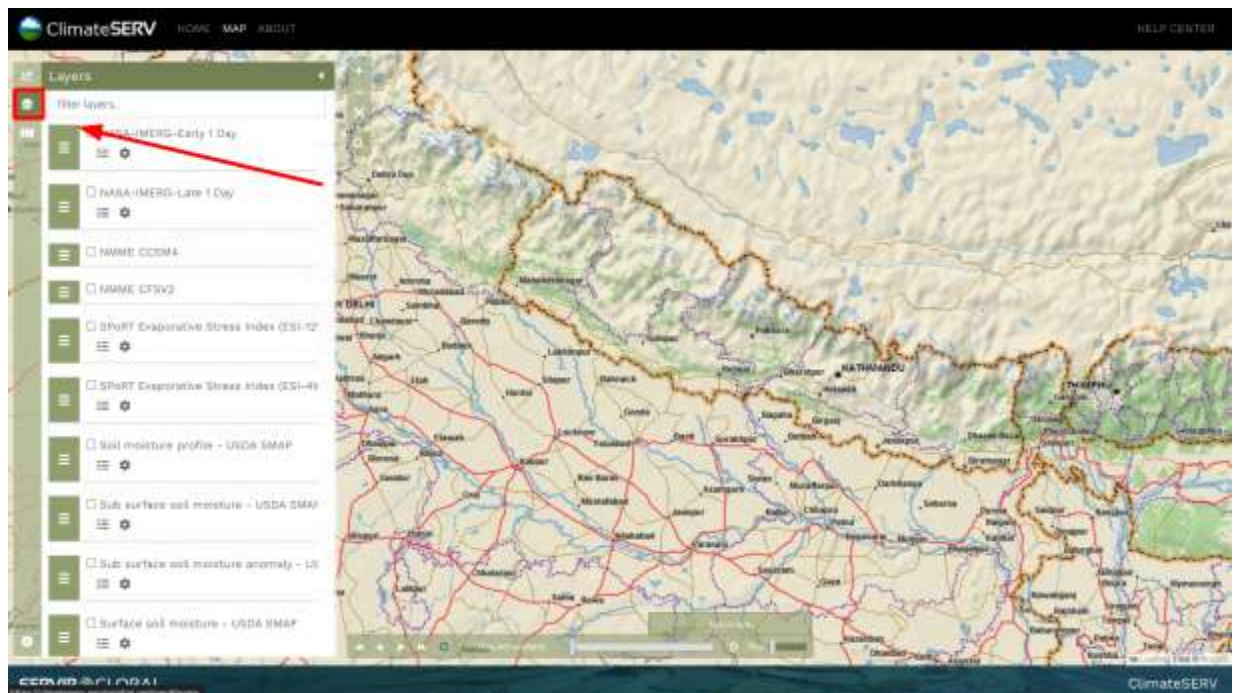


First, use the Basemaps Panel to turn on the DeLorme basemap. This will allow us to visualize the Nepali provincial boundaries during our data analysis. Access the basemaps icon on the left side of the screen (indicated by the arrow in the image below), then click the DeLorme basemap at the bottom of the panel. After clicking on the DeLorme basemap, your map interface will appear the same as shown in the image below.



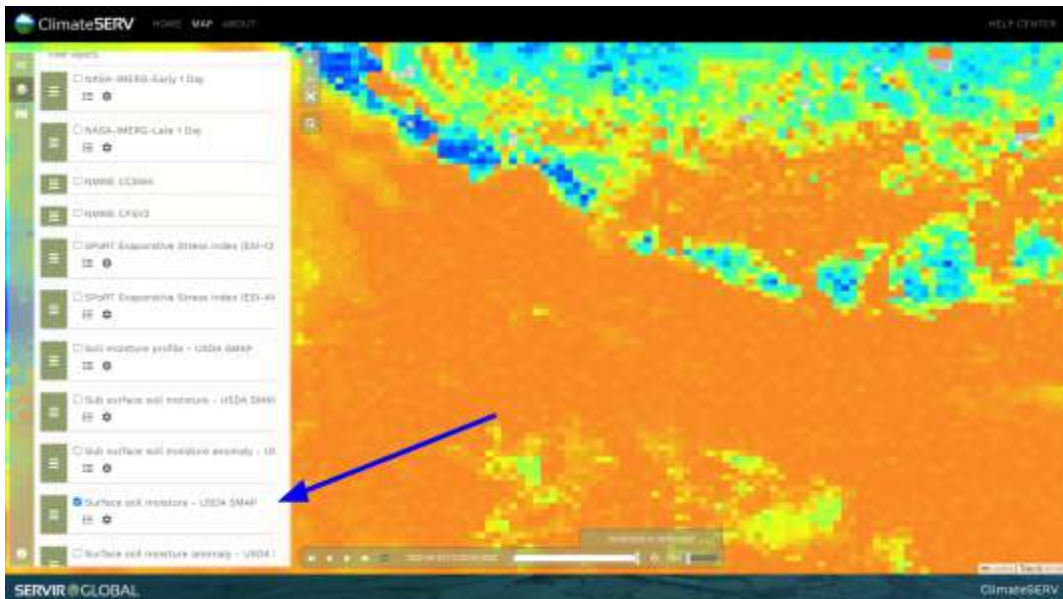
Now that we have our desired basemap, we must decide what dataset we want to analyze within ClimateSERV. We want to examine soil moisture, but there are various soil moisture datasets within ClimateSERV. These include different subsets of SMAP soil moisture data provided by the United States Department of Agriculture, such as the soil moisture profile, surface soil moisture content, subsurface soil moisture content, surface soil moisture anomaly, and the subsurface soil moisture anomaly.

For more information regarding the SMAP dataset, see the ClimateSERV Dataset Encyclopedia. [Click here to view the ClimateSERV Dataset Encyclopedia.](#) We can visualize these datasets within the Layers Panel on ClimateSERV, which we can view by clicking on the icon indicated by the red arrow in the image below.

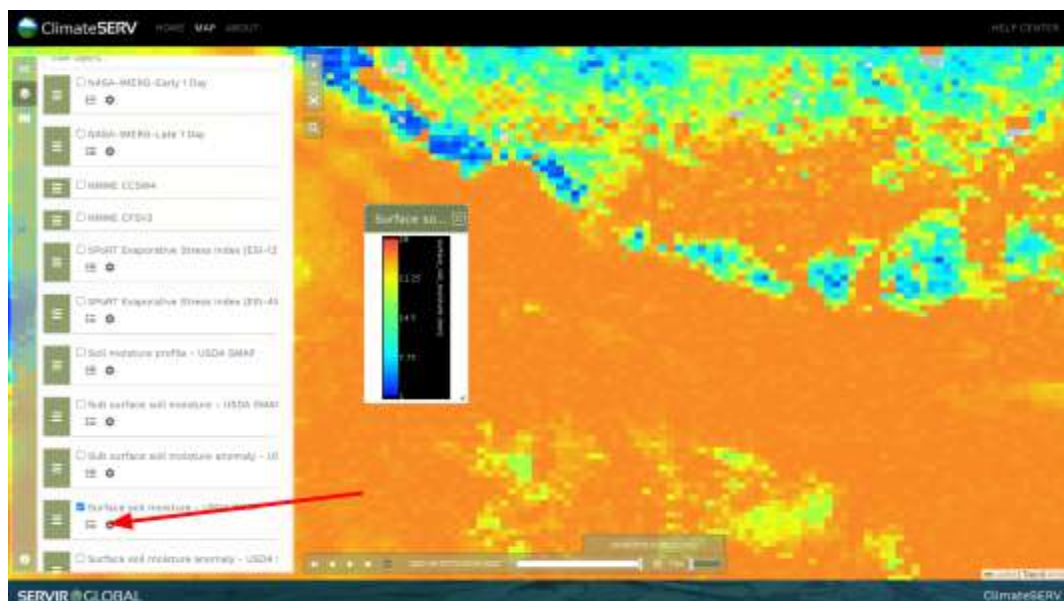


For this module, we will be working with surface soil moisture content. First, navigate to the country of Nepal as shown above (North-Northeast of India, South of China). Next, we can tell ClimateSERV to display our soil moisture data on our map by clicking the box next to **“Surface soil moisture - USDA SMAP”** (indicated by the arrow below) within the Layers Panel on the left side. After clicking this box, there will be a checkmark within the box and ClimateSERV will overlay the data on your basemap as shown in the image below.

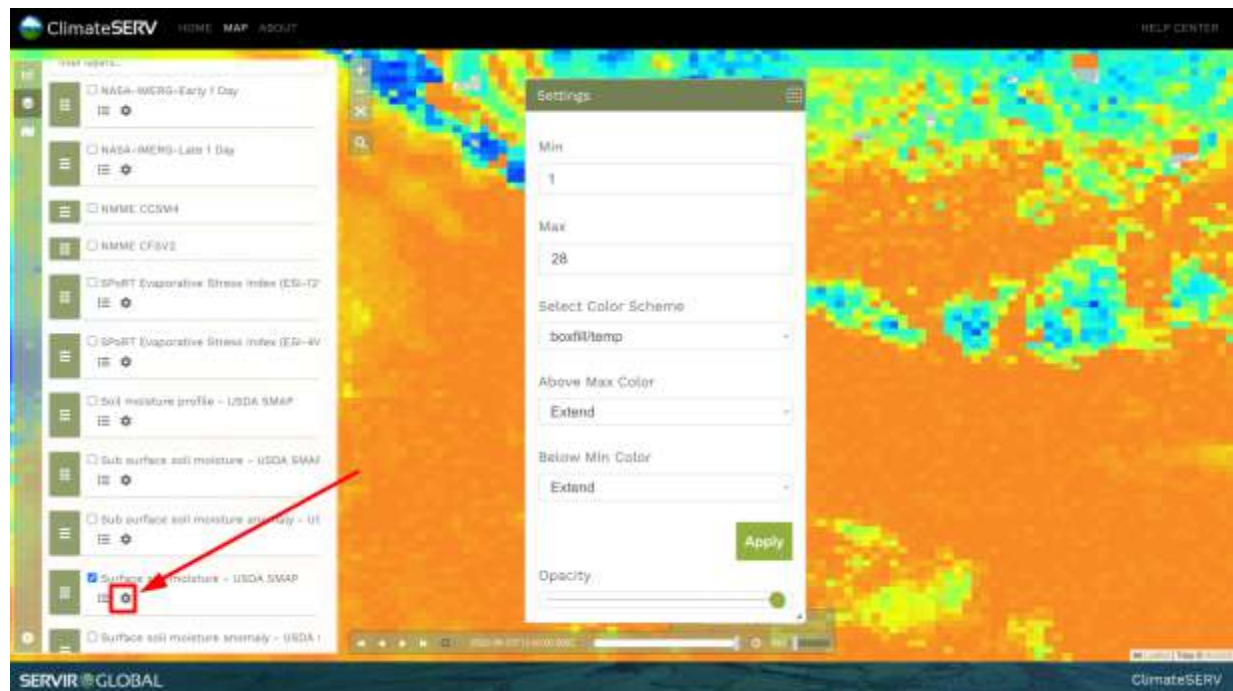




To see what color scheme ClimateSERV is using to display the data, click the icon with three horizontal lines (indicated by the red arrow in the image below) under the panel that says **“Surface soil Moisture - USDA SMAP”**. This will display the color scheme used on the map as shown in the image below. In this case, “warmer” colors (like orange and red) indicate moist soil, whereas “cooler” colors (like green and blue) indicate dry soil. You can then click the **“x”** in the upper right corner of the panel to close this window.

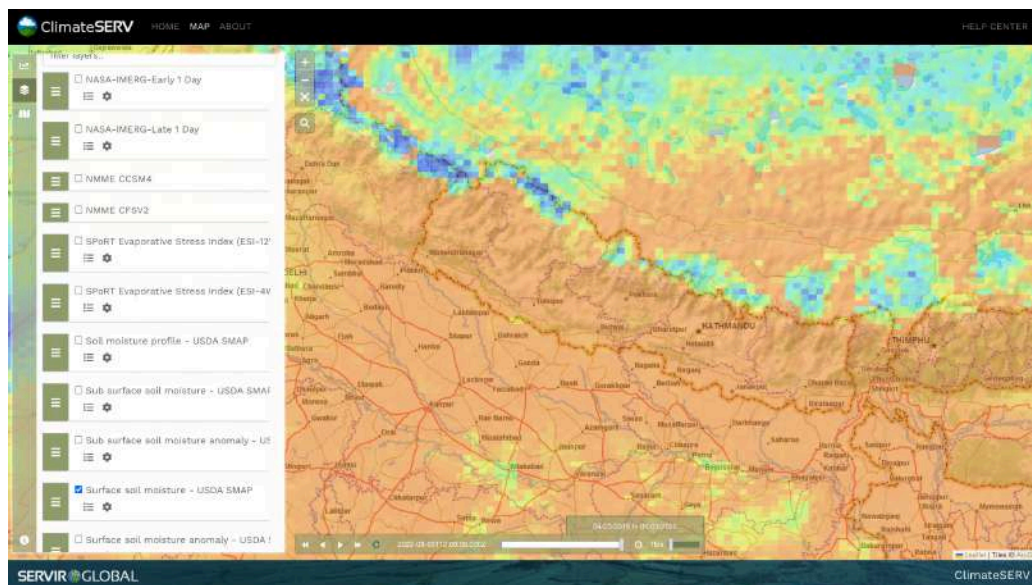


You may have noticed we can no longer see the basemap below our data, and thus can't tell where our region of interest is. To fix this issue, we can change the opacity of the soil moisture dataset. Do this by clicking the settings icon – indicated by the red arrow in the image below – underneath the Surface Soil Moisture Dataset. This will display a settings panel. At the bottom of this panel, lower the opacity slider to a point where you can see both the data as well as the underlying basemap (usually about halfway). Then click the green **“Apply”** button.





After following the steps above, close the settings panel by clicking the “x” in the upper right corner of the panel. Now the GUI will look like the following picture; we can now visualize the data and the underlying basemap simultaneously.

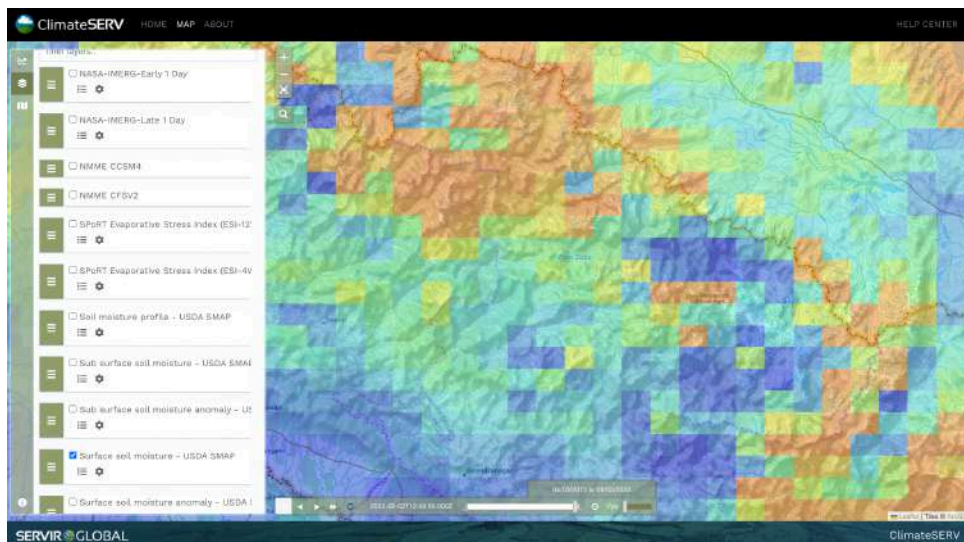


ClimateSERV automatically populates the map interface with the most recent data for your selected dataset, which for USDA SMAP data is near present day (with a latency of about a month). We can see the date ClimateSERV has obtained this data from on the panel at the bottom of the page (see below image). *Note that ClimateSERV displays the date in YYYY-MM-DD format.*

We can adjust the date ClimateSERV pulls the data from by adjusting the slider at the bottom of the page (see below image). We can adjust this slider by either dragging and dropping the slider or using the fast-forward and rewind buttons (indicated by the arrows in the image below). The fast-forward button (indicated by the image below) will display the data from the next available day, whereas the rewind button will display the data from the previous available day.



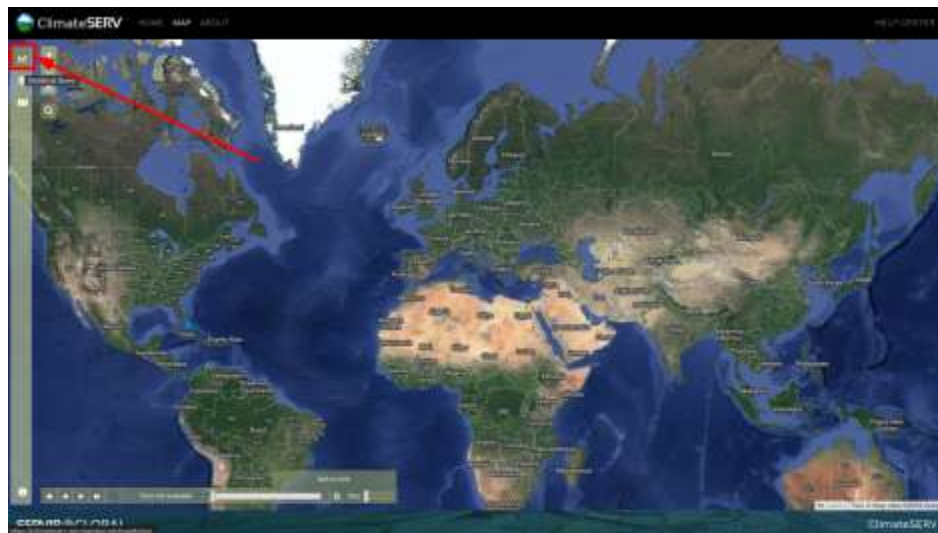
Now let's zoom in on the province of Karnali (see page 5 to locate Karnali) and view how soil moisture varies across the region for May 02, 2022 (will appear as 2022-05-02 within ClimateSERV). Your screen should now appear similar to the image below.



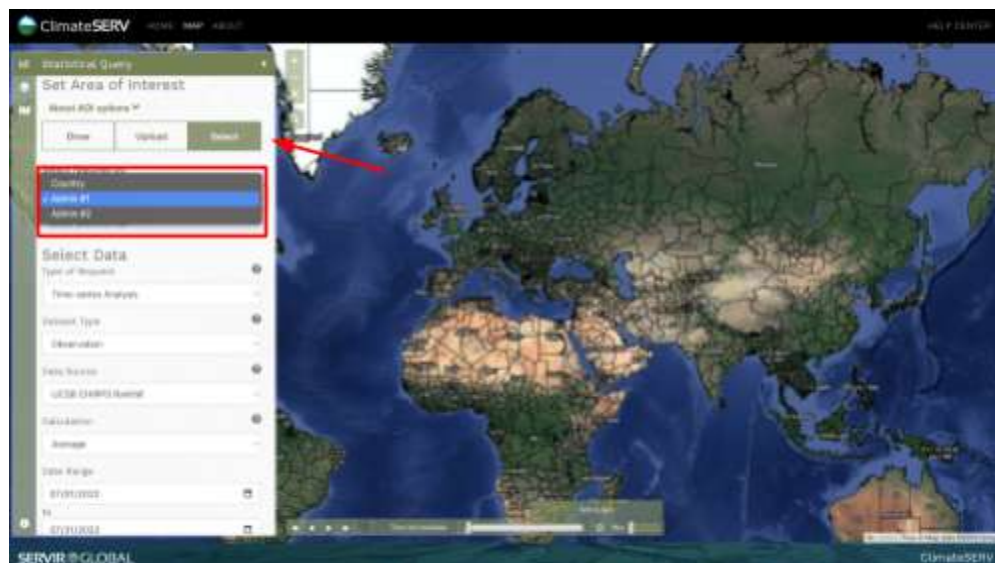
Explore how the soil moisture varies within the region, noting the different values in each of the grid cells (the spatial resolution of these cells is 10 km). You can modify these settings by clicking the gear icon under the text that says **"Surface soil moisture - USDA SMAP"** and changing them.

## Exercise 2: Temporal Analysis

In this section, we will explore how soil moisture varies across a time period of interest for a specific region. Our first step is to navigate to the **Statistical Query Tab** in ClimateSERV, which we can do by clicking on the Statistical Query icon (indicated in the image below by a red square) at the top of the taskbar on the left hand side of the webpage.

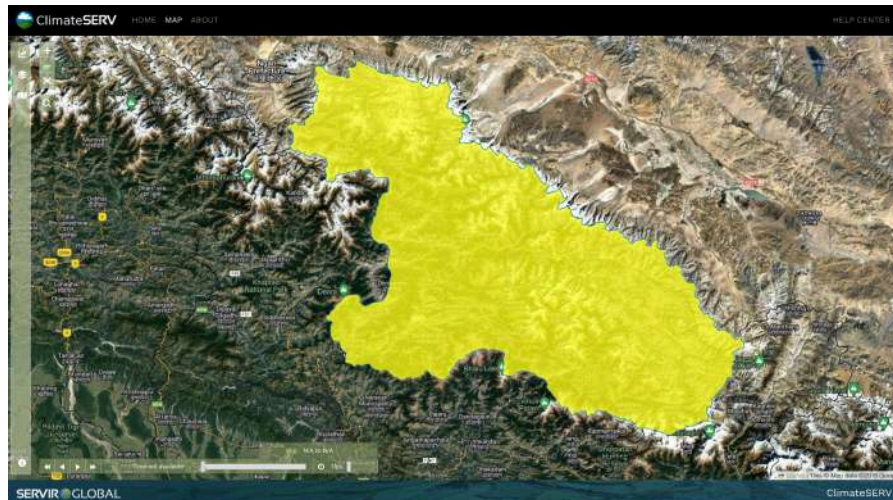


Clicking this icon will expand or collapse the Statistical Query tab. After expanding the Statistical Query tab, click the **"Select"** button (indicated by the arrow below) under the text that says **"Set Area of Interest"**. Then, under the text that says **"Select features by:"**, select **"Admin #1"** from the dropdown menu (shown in the red box in the image below).





As we did in Exercise 2, we will be working again within the Karnali Province of Nepal. Zoom in on Nepal, and click on the Karnali Province (reference the map on page 5 to locate the Karnali Province). ClimateSERV will then highlight the province in yellow, as shown below.



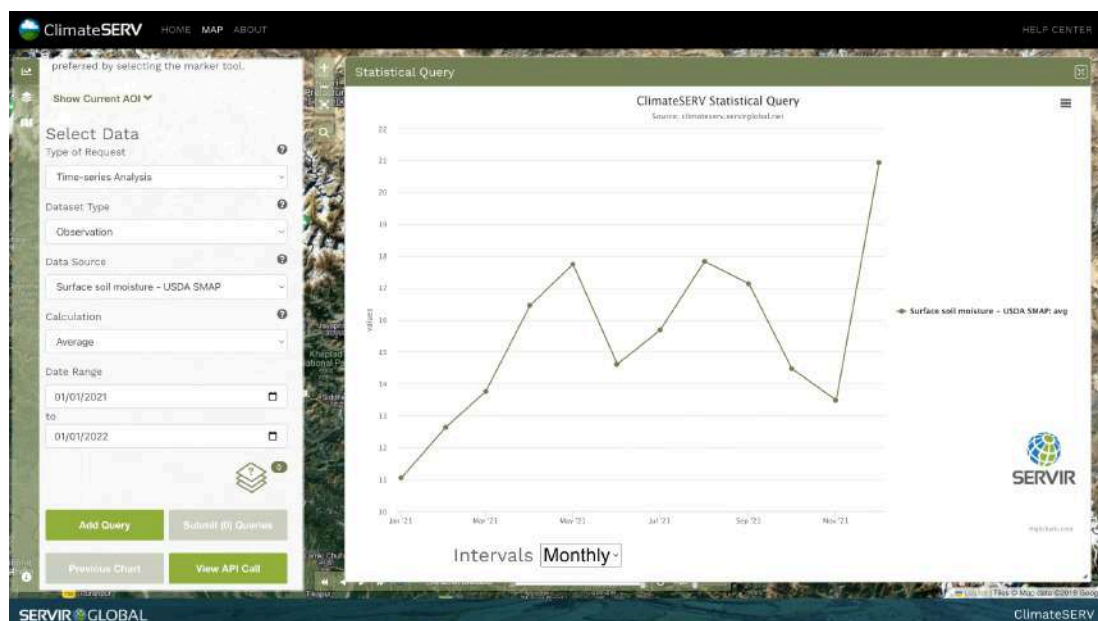
Next, go through the following steps to visualize this data

1. Below the text that says **"Type of Request"**, open the dropdown menu and click **"Time-Series Analysis"**
2. Under the text that says **"Dataset Type"**, open the dropdown menu and click **"Observation"**.
3. Under the text that says **"Data Source"**, open the dropdown menu and click **"Surface soil moisture - USDA SMAP"**.
4. Under the text that says **"Calculation"**, open the dropdown menu and select **"Average"**. This will average all of the values for each grid cell so we get one soil moisture value for each date that will represent the Karnali region.
5. Under the text that says **"Date Range"**, select the entire month of 2021 (Start Date: 2021/01/01; End Date: 2022/02/01). Then, click the green **"Add Query"** Button. Finally, click the green **"Submit (1) Query"** button.

After following the above steps, ClimateSERV will display the same graph shown in the image below.



We can see each of the values by hovering over the graph. The data seems pretty noisy, so let's change the intervals option. Using the **"Intervals"** option towards the bottom of the screen, we can open the dropdown menu and click **"Monthly"** instead of **"Default"**. This will make it so that ClimateSERV averages the available data for each month rather than displaying the data from all available dates.



You are now able to investigate how data varies over time for a specific region of interest! Now repeat this exercise for a different region of interest.

## Exercise 3: Spatiotemporal Analysis

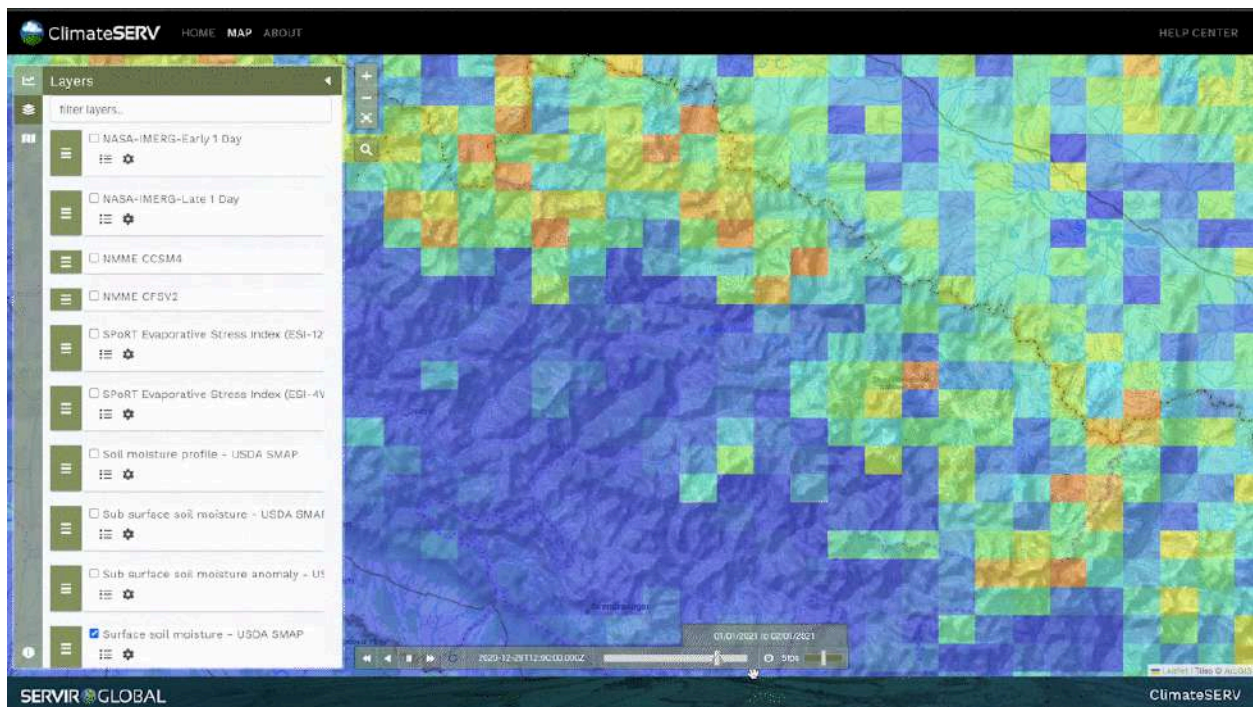
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Now you can analyze how soil moisture varies in time alone and how it varies in space alone. However, in some cases we want to understand how the soil moisture in our study region varies in both space **and** time. To do this, we will use the animation feature within ClimateSERV by following the steps below. If you cannot recall how to do one of the steps, references are provided to ClimateSERV Module 1. [Click here to see ClimateSERV Module 1.](#)

1. Navigate to the Basemaps panel in ClimateSERV
  - a. See Page 31 of ClimateSERV Module 1 if you do not recall how to get to the basemaps panel.
2. Select the DeLorme Basemap
  - a. See Page 31 of ClimateSERV Module 1 if you do not recall how to select different basemaps.
3. Navigate to the layers panel in ClimateSERV
  - a. See Page 23 of ClimateSERV Module 1 if you do not recall how to navigate to the layers panel.
4. Select the **“Surface soil moisture – USDA SMAP”** dataset for visualization. Click the box next to this dataset to have ClimateSERV display the data on your map.
  - a. See Pages 23-24 of ClimateSERV Module 1 if you do not recall how to display datasets in ClimateSERV.
5. In the layer settings panel, lower the opacity to half.
  - a. See Pages 26 - 28 of ClimateSERV Module 1 if you do not recall how to change the opacity of a dataset.
6. Zoom in on the Karnali province in Nepal.
  - a. See Page 5 of this document to locate Karnali.
7. Use the Range Picker to change the bounds of your visualization to 2021/01/01 - 2021/02/01.
  - a. See Page 30 of ClimateSERV Module 1 if you do not recall how to use the Range Picker.
8. Change the fps (frames per second) slider to 5 fps. Then click the play button. You should see the same animation as shown below.
  - a. See Page 30 of ClimateSERV Module 1 if you do not recall how to change the fps.



After following these steps, your screen will show the same animation as shown by the GIF below.



# Importing Data

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Finally, we will investigate how to export our data from ClimateSERV to be on our personal computer. We can then further analyze the data in our favorite geospatial analysis platform (such as Google Earth Engine or QGIS). To do this, follow the steps below. If you get lost, reference pages 18-21 of SERVIR's ClimateSERV Module 1, which covers how to download data from ClimateSERV. [Click here to view ClimateSERV Module 1.](#)

1. Navigate to the Statistical Query tab.
2. Under the text that says **"Area of Interest"**, Click the **"Select"** button.
3. Under the text that says **"Select features by:"**, open the dropdown menu and click **"Admin #1"**.
4. Select a province for a country of your choice by clicking it. The province will then be highlighted in yellow.
5. Under the text that says **"Type of Request"**, open the dropdown menu and click **"Download Raw Data"**.
6. Under the text that says **"Dataset Type"**, open the dropdown menu and click **"Observation"**.
7. Under the text that says **"Data Source"**, open the dropdown menu and click **"Surface soil moisture – USDA SMAP"**.
8. Under the text that says **"Download Format"**, open the dropdown menu and click **"NetCDF"** or **"TIF"**, depending on the file format you would like to download your data as.
9. Under the text that says **"Date Range"** set your start date to be "06/01/2021" and your end date to be "09/01/2021".
10. Click **"Submit Query"**.
11. After the progress bar loads, click the text that says **"Click here to Download File"**.  
After clicking, the tifs will be downloaded in a zip file (.zip). After extracting the files from the zip file, each .tif file will appear with the name representing the date the data was obtained (in YYYY/MM/DD format).
12. Import your data within another geospatial analysis platform such as Google Earth Engine or QGIS.

Congrats – you can now use ClimateSERV to investigate how soil moisture varies across both time and space in any region worldwide! Now repeat the steps above for your own region and time period of interest.

# Appendix

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- External Link 1: Module 1 – Getting Started with ClimateSERV. [Click here to visit Module 1.](#)
- External Link 2: ClimateSERV Dataset Encyclopedia. [Click here to visit the ClimateSERV Dataset Encyclopedia.](#)