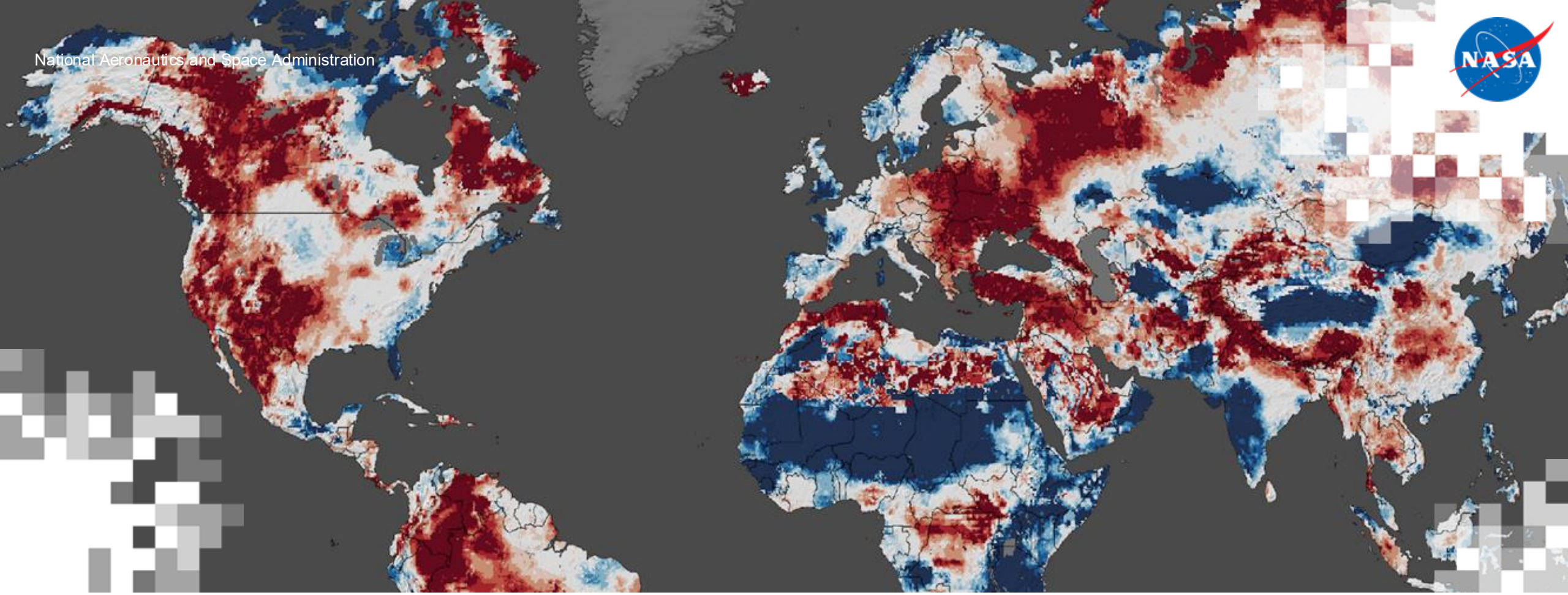


Monitoring Groundwater Changes for Water Resources Management

Exercise 3: Examine Maps and Time Series of OPERA Displacement Product

April 30, 2026

Prepare for the Exercise

- Register on NASA Earthdata
- Follow ARSET tutorial to install QGIS

Exercise 3

- Examine time series of OPERA DISP-S1 using Alaska SAR Facility Displacement Portal.
- Examine displacement maps using QGIS

  Case study Region: Mexico City

- **Note: You will save maps and time series to your computer. Your homework will include questions based on this exercise.**

Overview of OPERA Displacement Portal

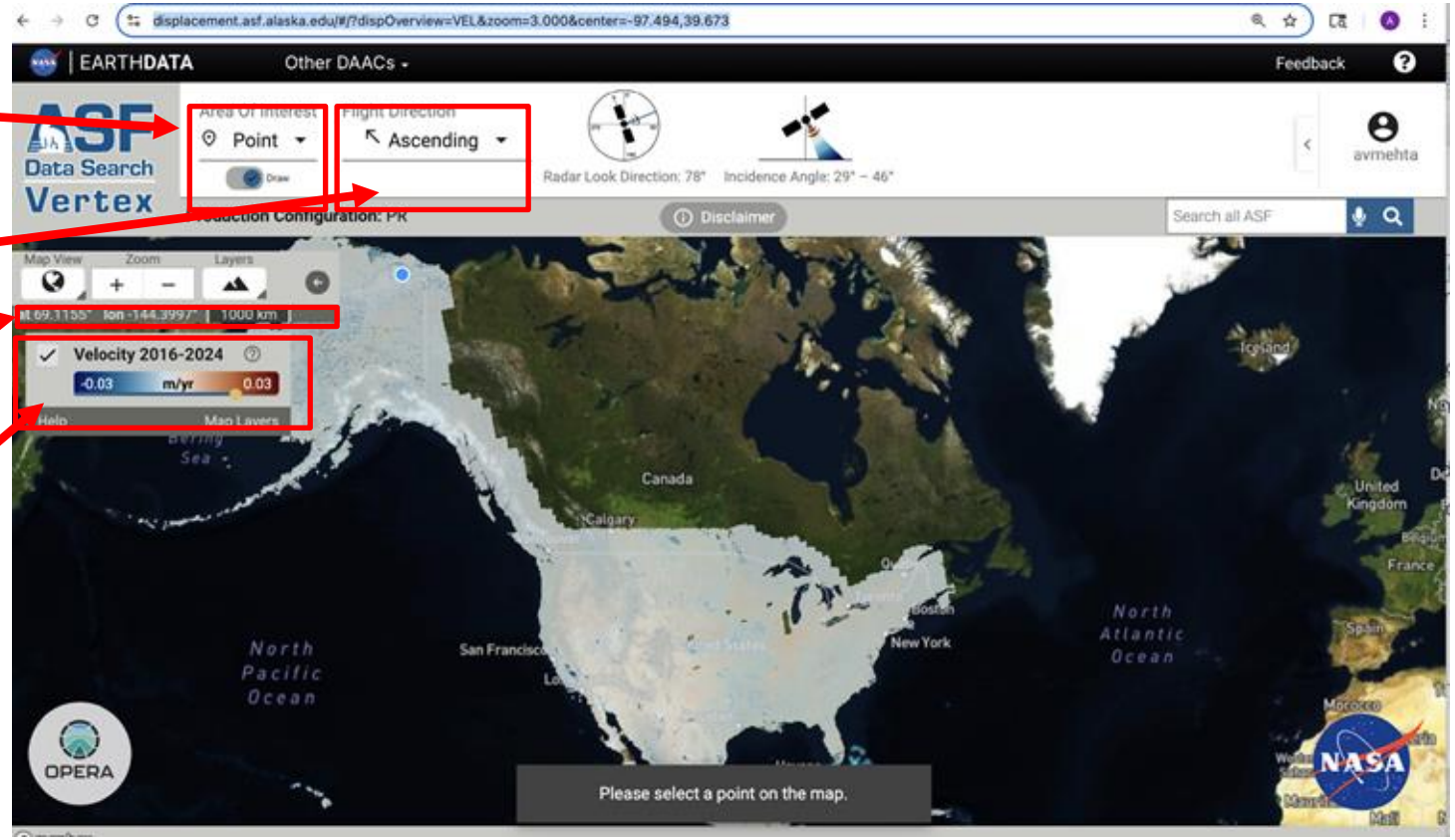
1. Go to OPERA DISP Portal : [Alaska SAR Facility Displacement Portal](displacement.asf.alaska.edu).
   Note: OPERA displacement searches are not available on mobile devices with small screens.

Point Selection by clicking on the map

Ascending /Descending Orbit Selection

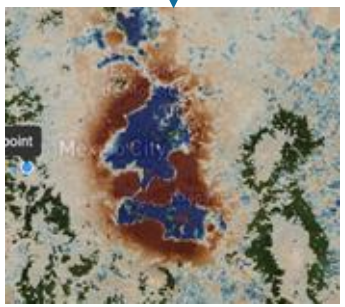
Point coordinates

Subsidence scale in m/year

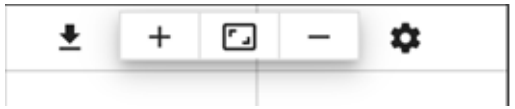


Select a Point in Mexico City and Make Displacement Time Series

2. Zoom on the map to Mexico City, Mexico, near lat = 19.4846 and lon = -99.0554



- Select **Flight direction → Ascending**
- Latitude and longitude of the point where the cursor hovers displays above the color scale.
- Hover to **lat = 19.4846 and lon = -99.0554** and click at that point. (You may select the closest point within 0.01 degree)
- In a few seconds you will get time series 1.
- In the time series window, at the top right you will see these options:



- Click the down arrow to **export the file as csv** to your computer.
- Click on the **gear symbol** and from the dropdown menu, select **Show Linear Fit** option.
- **Note down linear fit result from above the time series with slope and intercept values:**

1 **Displacement [m] = Slope [m/yr]*time – Intercept [m].**

Select Another Point in Mexico City and Make Displacement Time Series

3. Hover on the map to **lat = 19.5447 and lon = -99.1041** and click at that point.
   (You may select the closest point within 0.01 degree)

   - Repeat Step 2 and **save the csv file** and **note the linear fit equation** corresponding to this point (you may need to scroll to the right to see the full values for linear fit if you have a smaller screen)

Note: Save the csv file, slope, and intercept values for both the time series 1 and time series 2. You will get questions in your homework based on both time series sets of information: csv files, slope, and intercept values for both the time series1 and time series 2.

Open QGIS and Check for a Plugin

4. Open QGIS and start a new project

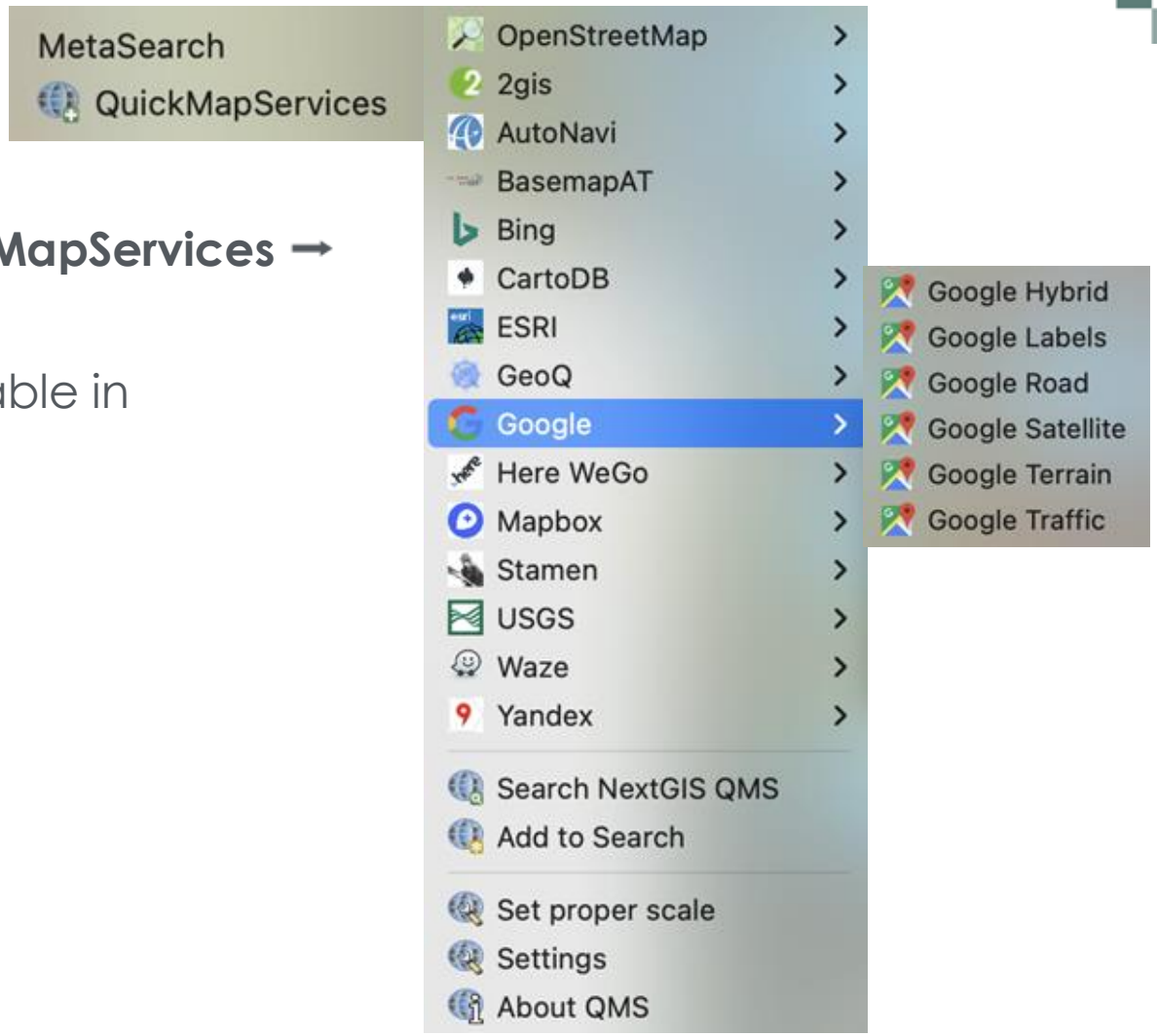
5. On the top menu bar, click on **Web** to check if you have the **QuickMapServices Plugin** (You should have this plugin installed if you completed Exercise 2.)

If you do not have the QuickMapServices Plugin:

- Select **Plugins** from the top menu, and choose **Manage and Install Plugins**
- You will get a window with options for Plugins
- Enter QuickMapServices in the search window
- Click on the **QuickMapServices Plugin** and press **Install** in the bottom right

Add Background Map

6. From the top menu bar, click on **Web**, select **QuickMapServices → Google → Google Road** as the background map
    - **Note**: you may use any other map option available in QuickMapServices



Add Displacement Raster

7. Download the raster file (GeoTIFF) from the [GitHub Training Repository/data:](#) MexicoCity-DISP_S1_F20688_20220327-20221005.tif

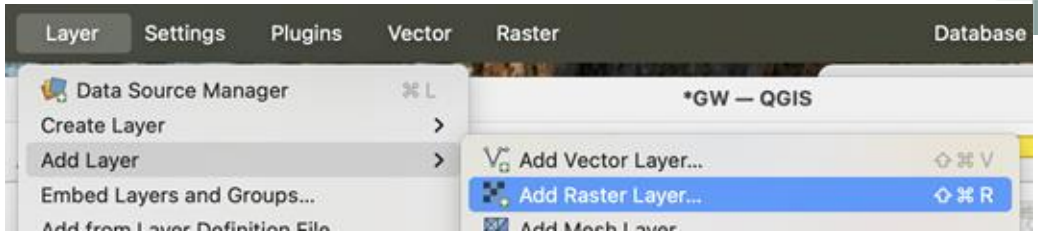
   Note: Click on tiff file and then ellipsis (...) next to file to download.

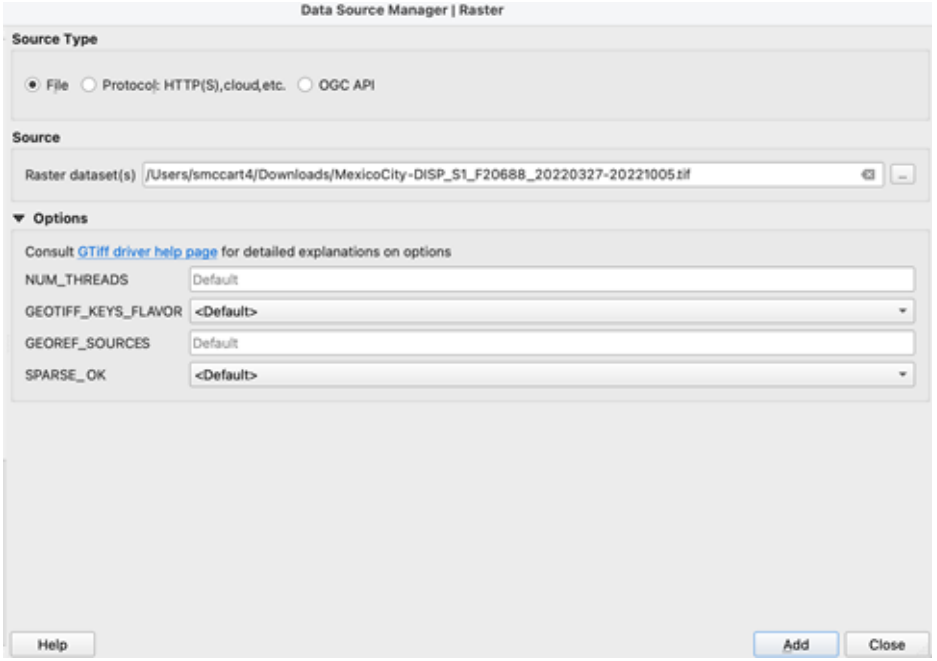
8. Click on **Layer (QGIS top ribbon) → Add Layer → Add Raster Layer**

9. From the **Data Source Manager | Raster** window, use the ellipsis button (under **Source)** and navigate to the GeoTIFF raster data saved on your computer. Select **Add** (bottom right), and then **Close**.

10. Right-click on layer and select **Zoom to Layer(s)**.

    Note: This is unfiltered displacement. You can also scroll down the list and find corresponding short_wavelength_displacement raster, quantity similar to what is shown in the ASF Displacement Portal.

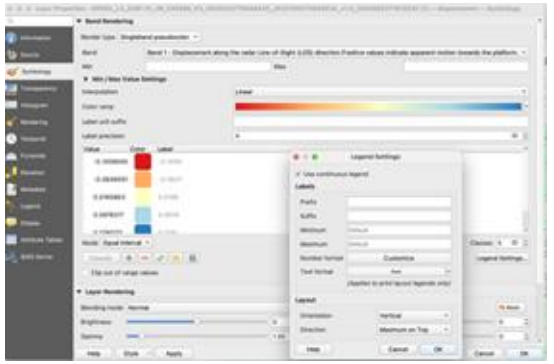




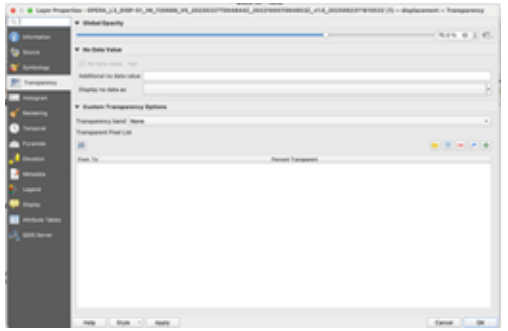
Add Symbology and adjust Transparency of the Displacement Raster Map

11. Right-click on the MexicoCity-DISP_S1 layer you loaded and go to **Properties → Symbology**

    - **Note down** the **min** and **max** displacement values
    - Select the **Render Type** as **Singleband pseudocolor**
    - Below the color display, change the **Mode** to **Equal Interval.**
    - Below **Classes** click **Legend Setting** and de-select **Use continuous legend** and click **OK, click OK** again to get the symbolized raster map.



12. Right-click on the MexicoCity-DISP_S1 layer again and go to **Properties → Transparency**
    - Change **Global Opacity** to 70% and click **OK**, so that the geographic areas under the layer are readable.
    - Zoom in to examine how the displacement velocity changes within the Mexico City area.



Save the QGIS Project

14. From the QGIS top ribbon click on **Project → Save** with a name of your choice to save on your computer.

    Note: You will get a question based on this QGIS project in the homework.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Thank You!