

## Activity S3\_A2: ENSO Impacts Over South America

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**Objective:** To examine El Niño and La Niña conditions from NOAA Climate Indices and assess Impacts on temperature and precipitation over South America.

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### There are four parts to this exercise:

- 1) Examine Climate Indices
- 2) Access and download surface temperatures from AIRS and rainfall from TRMM
- 3) Import the AIRS and TRMM data in to ArcMAP
- 4) Access MODIS Vegetation Index Anomalies

**We will have group discussion of results at the end of this exercise**

### Part 1: Examine Climate Indices

- a) Go to (<http://www.esrl.noaa.gov/psd/data/climateindices/>)

Choose the following:

**Time Series 1:** MEI (from the drop down menu) [(Multivariate ENSO Index is calculated from multiple data sets)]

**Time Series 2:** None

**Year Range ?:** 1998 to 2014

Scroll down to 'For all Actions:'

**Time Averaging:** Monthly

**Type of Data:** Anomaly

Scroll down and click 'Calculate Results'

You will get the MEI time series showing El Niño (positive MEI) and La Niña (Negative Anomaly) events

- b) Save the time series image to your computer.

Note down the following Information.

- 1) Two El Niño years (between 1998 – present) with the highest MEI anomaly
- 2) Two La Niña years with the lowest MEI anomalies.

- c) Now compare the results of your analysis of SST anomaly time series from IRI (**previous exercise Part-2a**). Do the El Niño and La Niña years match in both?

[Later on if you have time you can explore the NOAA Climate Indices in detail – there are many indices for ENSO and for climate variability on longer time scales].

## **Part 2: Access and download surface temperatures from AIRS and rainfall from TRMM**

We will use the 2019-10 warm event and the 2007-08 cold even to study ENSO impacts on surface air temperature and rainfall.

### **Surface Air Temperature Analysis**

Go to (<http://giovanni.gsfc.nasa.gov/giovanni/>)

#### **a) Make an air temperature surface map using AIRS**

**Keyword:**

AIRS Monthly (Search)

Select ‘Air temperature at Surface (Daytime/Ascending) (AIRX3STM V006)’

**Select Plot:**

Maps: Time Averaged Map

**Select Region (Bounding Box or Shapefile)**

Enter the following latitudes and longitudes in the box (these are 90W, 55S, 35W, and 15N)  
-90.0,-55.0,-35.0,15.0

*(note that west longitudes and south latitudes are denoted are written as negative numbers whereas east longitudes and north latitudes as positive numbers).*

**Click on ‘Show Map’ to see the region**

**Select Date Range (UTC):**

Select 2010 - 05 to 2010 – 07

Click on ‘Plot Data’ (at the bottom right)

You will get a map of surface air temperature over South America

Click on ‘Options’ (at the top right for the Plot)

Enter Minimum: 295

Maximum: 305

Click on ‘Re-Plot’ (at the bottom right)

#### **b) Save the file by selecting the following options**

**History (to the top right of the plot window):**

Select ‘Download’

Click on the NetCDF file (.nc) and save the file to your computer

#### **c) Make a second air temperature map and save the file**

Click on [‘Back to Data Selection’](#)

Change the [year/month](#)

[Select Date Range \(UTC\):](#)

Select 2007 - 05 to 2008 - 07

Repeat all the steps as above and save the NetCDF file

**You will have two NetCDF files from this section**

**Rainfall Analysis (Uses the same steps used with AIRS temperature above but for TRMM)**

Click on [‘Back to Data Selection’](#)

**a) Make an rainfall map using TRMM**

[Keyword:](#)

TRMM (Search)

Select Precipitation Rate (TRMM\_3B43 v7) (Monthly)

[Select Plot:](#)

Maps: Accumulated

[Select Region \(Bounding Box or Shapefile\)](#)

Enter the following latitudes and longitudes in the box (these are 90W, 55S, 35W, and 15N)  
-90.0.,-55.0,-35.0,15.0

*(note that west longitudes and south latitudes are denoted as negative numbers whereas east longitudes and north latitudes as positive numbers)*

**Click on ‘Show Map’ to see the region**

[Select Date Range \(UTC\):](#)

Select 2010 - 05 to 2010 - 07

Click on [‘Plot Data’](#) (at the bottom right)

You will get a map of surface accumulated rain over south America

Click on [‘Options’](#) (at the top right for the Plot)

Enter Minimum: 25

Maximum: 1500

Click on [‘Re-Plot’](#) (at the bottom right)

**b) Save the file by selecting the following options**

[History](#) (to the top right of the plot window):

Select [‘Download’](#)

Click on the NetCDF file (.nc) and save the file on your computer

**c) Make a second air rainfall map and save the file**

Click on [‘Back to Data Selection’](#)

Change the [year/month](#)

[Select Date Range \(UTC\):](#)

Select 2008 - 05 to 2008 – 07

Repeat all the steps as above and save the NetCDF file.

You will have two NetCDF files from this section.

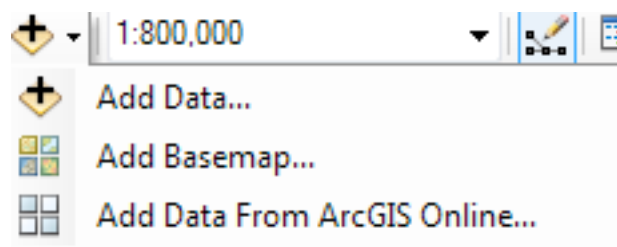
### 3) Import the AIRS and TRMM NetCDF files in to ArcMAP

Open ArcMap by double clicking on the Globe with a magnifying glass icon or by going to Start > **All Programs in Window Explorer > Click the ArcGIS folder > and select ArcMap.**

**When the ArcMap Getting Started window opens up, open an existing map or if this is a new map exercise, click cancel to open a blank map. This is an untitled map document (.mxd).** *Map documents do not actually store the map data. It does store what data to show and how to show it and where to find that data.*

Before we begin importing data into ArcMap, you will want to first add a basemap. A basemap is used for locational reference and provides a framework on which users overlay operational layers to visualize geographic information. The basemap serves as a foundation for all subsequent operations and mapping.

Open ArcMap and using the Add Data Icon



Click Add Basemap...

Choose the Basemap of your choice (Imagery or Imagery with Labels work well).

In order to add netCDF data to ArcMap, navigate to the Geoprocessing Tab, Open the ArcToolbox.

Locate the Multidimension Tools and open. Open the **Make netCDF Raster Layer** tool, choose the

#### **Make NetCDF Raster Layer tool**

The toolbox window will open. Within the **Make netCDF Raster Layer** tool:

For the field, Input netCDF File: Navigate to and click on the AIRS Surface Air Temperature files and TRMM Accumulated Rain saved above in Part 2. You will have to do this for each file separately. The remaining fields will fill in accordingly, KEEP the default values.

The variable value of the netCDF file is used to assign cell values to the output raster. This is the variable that will be displayed, such as temperature or precipitation.

For the X Dimension field, the default should be longitude (lon).

For the Y Dimension field, the default should be longitude (lat).

For the Output Raster Layer, you may change the output file name if you choose. In this case you could enter the month and year

Click OK to run the tool

Once imported, you can adjust the symbology of the geotiff file through through the layer properties, symbology tab.

Right click the layer, navigate to layer properties and the Symbology tab.

Within the Show window, the geotiff or raster file will be typically be displayed as a “Stretched” type. If you wish you are able to adjust the color gradients by navigating to the dropdown arrow next to the Color ramp.

Options to alter the way the data is displayed in ArcMap include

- a. selecting the box to **Invert** the color ramp
- b. selecting the box to **Display Background Value** of ‘0’ as No Color.
- c. choosing ‘**Classified**’ as the show type. Here you can choose the number of classes applied to the range of values, how the classes are grouped and adjust the color scheme applied to each.
- d. choosing ‘**Unique Values**’ as the Show type. Once again, you can adjust the Color Scheme and/or alter the colors assigned to each pixel value category by double clicking each color value and choosing a color that will make the file easier to see on the map.

You will notice within the Layer Properties of a netCDF file, there will be an additional tab ‘NetCDF’. Within this tab, you can toggle through the available variables that will be displayed in the map.

**Study the Temperatures and Rainfall maps by zooming over Colombia and note down the differences in their patterns and magnitudes between El Niño (2010) and La niña Year (2008).**

## 4) Access MODIS Vegetation Index

Go to (<http://glam1.gsfc.nasa.gov/>)

### Choose the Following Options:

Select Layers

Satellite Aqua

Layer NDVI

Year 2010

Start DOY : MM/DD Range

Using the down arrow go through the 8-day NDVI maps for July-August

Repeat the same for

Year 2008 and note which year has more vegetation over Colombia

Click on + sign at the top of the map window

Click on Colombia in the map

Under Query DB You will see an ID in Selected Shape ID's

Click on submit

You will see a time series of NDVI averaged over Colombia

Select years (2010 and 2008) (starting Month Jan)

Global Agricultural Monitoring

Linking U.S. Agriculture to the World FAS NASA

System Status  
● Normal

Select Layers

Satellite  
Aqua

Layer  
NDVI

Year  
2015

Start DOY : MM/DD Range  
121 : 05/01 - 05/08

Base  
 MapQuest-OSM  
 MODIS 8-day / NDVI

Overlays  
Shape  
 Show Info  
 None  
 Admin Level 1  
 Admin Level 2  
 Crop Reporting Districts  
 LIS 0.25 degree  
Crop Mask

Query DB

Dataset  
NDVI

Selected Shape ID's  
...

Submit

Configure:  
Starting Month: Apr  
No. of Months: 12  
Mean:   
Years:  2002  2009  
 2003  2010  
 2004  2011  
 2005  2012  
 2006  2013  
 2007  2014  
 2008  2015  
Update

