

# GEOL 302: Oceans and Atmosphere Research Project

## El Nino Southern Oscillation and its Effect on Global Climate

### Assignment #1

1. **Locate, record and submit all TAO buoy data** required to fill out the supplied spreadsheet template.
2. **Produce and submit summary Excel graphs** illustrating the relationships between several variables over the time periods.
3. **Upload your spreadsheet and graphs to Canvas > Project Assignment #1**

**DUE WEDNESDAY, NOVEMBER 19, 2025**

### Data Collection from the TAO buoy web site

1. Collect data for the four periods shown in the spreadsheet template provided to you
  - One La Nina event
  - One El Nino event
  - Recent data
2. Record the following information for your assigned TAO buoy ocean site (already on the spreadsheet template)
  - Wind speed (*Wspd*)
  - Wind direction (*Wdir*)
  - Relative humidity (*RH*)
  - Air temperature (*Air T*)
  - Sea surface temperature (*SST*)
  - Water temperature at -50 m, -100 m and -200 m (below the surface) – use similar intervals if these are not available. (*T(z)*)
  - Dynamic height (*Dyn Ht*)
  - Sea surface salinity (*SSS*)

I have posted a blank spreadsheet for your data entry. Use the data you enter to create Excel graphs illustrating trends in the data.

**IMPORTANT!:** *Some of you will find some data missing. As long as you have a “nearly” full set of data, you will be fine. You need to have enough data to fully graph several variables and their trends across all time periods. If you are **missing large amounts** of data, let me know ASAP.*

### 3. Where to find the data

- TAO (Tropical Ocean Atmosphere) oceanographic data is collected from many buoys in the Pacific equatorial Ocean.
- The data is found at this website <https://www.pmel.noaa.gov/tao/drupal/disdel/>
- NOTE: If the map is blank, select **Non-Java Version** link near bottom of page.

- For definitions of the data variables (listed above), go to the bottom left of the web page.
- You will see this image of buoy sites (squares) – you will be focused on ONE

THE MAP LOOKS LIKE THIS:

## Data Display and Delivery

[Learn about TAO/TRITON](#)
[Show Instructions](#)
[Show Historical and Active Sites](#)

[TAO/TRITON \(Pacific\)](#)
[PIRATA \(Atlantic\)](#)
[RAMA \(Indian\)](#)

[Time Series](#)
[Profiles](#)
[Time Section](#)
[Lat Lon Map](#)
[Depth Section](#)

☒ One Variable
 ☐ One Site
 ☒ Separate Plots
 ☐ Overlay
 ☒ Subsurface Area
 ☐ Subsurface Lines

☐ SW Rad
 ☐ LW Rad
 ☐ Rain
 ☐ Wspd
 ☐ Uwnd
 ☐ Vwnd
 ☐ Wdir
 ☐ Wind Vec
 ☐ RH

☐ Air T
 ☐ SLP
 ☒ SST
 ☐ T(z)
 ☐ SSS
 ☐ S(z)
 ☐ SSD
 ☐ D(z)
 ☐ Heat

☐ Dyn Ht
 ☐ 20C
 ☐ Ucur
 ☐ Vcur
 ☐ Cur Vec
 ☐ Uadcp
 ☐ Vadcp
 ☐ Long
 ☐ Lat

1979 JAN 20 2025 SEP 17 5-Day

files by site ASCII Compression

[Definitions](#)
[Availability](#)
[Clear](#)
[Deliver](#)
[Display](#)

[FTP Access](#)
[Acknowledgment for use of data](#)
[Realtime High Resolution Data](#)  
 Send Questions to [oar.pmel.taotech@noaa.gov](mailto:oar.pmel.taotech@noaa.gov)

Image of TAO buoy data website. Each buoy is represented by a colored square. You will be assigned, and will collect data from one of these locations.

### 4. How to Collect the Data:

1. On the TAO webpage, you will see the map image shown above with options under it.
2. **“DE-SELECT SITES”** (click on box at left, bottom corner of map; all sites on map should turn blue)
3. **Click on buoy** location you have been assigned.
4. Select **“One Site”** and **“Separate Plots”** (options are below yellow and blue bars- make sure that **“Time Series”** is highlighted in bright yellow- *this is the default*).
5. **Select the variables** that are listed above. The variables are labeled as I have indicated in parentheses next to each (i.e. Air temperature = Air T).
  - a. I recommend to select the water temperature at depth (T(z)) separately – a *pop-up window will appear for you to select the depths that you want – click the blue boxes, red indicates which are selected, then close the window*.
6. **Select the time period** from drop-down menu (refer to page 1 for the assigned periods). This can also be done several ways. Options:
  - a. **Select only one day** (for each of the days you are interested in) and complete the remaining steps below, and repeat for each of the days you need to collect

b. **Select the entire range for each event.** This will result in large tables of data, with data for each day in your range. You can then go through and only record the data from the days in the provided excel spreadsheet. This option means you only have to generate the data once, but it is cumbersome to go through all of the data to only grab data from the days you want.

- ### What you will see:

For the 2010-2011 La Nina Event, I generated data for five days surrounding the date of interest 12/21/10, here is what it looks like:

Location: 2N 125W 19 Dec 2010 to 23 Dec 2010 ( 5 times, 1 blocks) Gen. Date Sep 19 2025

Units: Dynamic Height (0/500 db, dynamic-cm), -9.99 = missing  
Time: 1200 19 Dec 2010 to 1200 23 Dec 2010 (index 1 to 5, 5 times)  
Depth (M): 0 QUALITY  
YYYYMMDD HHMM DYN Q  
20101219 1200 95.52 2  
20101220 1200 95.03 2  
**20101221 1200 90.69 2** ← This is the day of interest, DYN is the data  
20101222 1200 89.46 2  
20101223 1200 87.49 2

## Wind speed (Wspd), wind direction (Wdir), air temperature (Air T), sea surface temperature (SST), and relative humidity (RH) data look something like this:

Location: 2N 125W 19 Dec 2010 to 23 Dec 2010 ( 5 times, 1 blocks) Gen. Date Sep 19 2025  
Units: Winds (m/s), W. Dir (deg), AirT (C), SST (C), Rel. Humidity (%), -99.9 = missing  
Winds Use Oceanographic Convention:(1,1) is NE at sqrt(2) m/s  
Time: 1200 19 Dec 2010 to 1200 23 Dec 2010 (index 1 to 5, 5 times)  
Depth (M): -4 -4 -4 -4 -3 1 -3 QUALITY SOURCE  
YYYYMMDD HHMM UWIND VWIND WSPD WDIR AIRT SST RH SDATH SDATH  
20101219 1200 -4.2 6.2 7.5 325.6 23.89 25.18 83.1 12112 55515  
20101220 1200 -5.1 7.4 9.0 325.7 23.81 25.12 83.4 12112 55515  
**20101221 1200 -6.8 6.7 9.6 314.5 23.57 24.63 82.9 12112 55515**  
20101222 1200 -5.3 6.1 8.1 319.0 22.95 23.12 82.0 12112 55515  
20101223 1200 -4.9 6.7 8.3 324.2 22.47 23.04 84.9 12112 55515

Again, the day of interest is highlighted, as well as the respective data.

## Sea surface salinity (SSS) data look something like this:

Location: 2N 125W 19 Dec 2010 to 23 Dec 2010 ( 5 times, 1 blocks) Gen. Date Sep 19 2025  
Units: Depth (Meters), Salinity (PSU), -9.999 = missing  
Time: 1200 19 Dec 2010 to 1200 23 Dec 2010 (index 1 to 5, 5 times)  
Depth(M): 1 INSTRUMENT QUALITY AND SOURCE INDICES  
YYYYMMDD HHMM SSS ID Q S  
20101219 1200 34.522 24 2 1  
20101220 1200 34.532 24 2 1  
**20101221 1200 34.476 24 2 1**  
20101222 1200 34.487 24 2 1  
20101223 1200 34.475 24 2 1

## Sea surface temperature (SST), and water temperature at depth (T(z)) data look something like this:

Location: 2N 125W 19 Dec 2010 to 23 Dec 2010 ( 5 times, 11 depths, 1 blocks) Gen. Date Sep 19 2025  
Units: Depth (Meters), Temperature (C), -9.999 = missing  
Time: 1200 19 Dec 2010 to 1200 23 Dec 2010 (index 1 to 5, 5 lines, 11 depths)  
Index: 1 2 3 4 5 6 7 8 9 10 11  
Depth(M): 1 20 40 60 80 100 120 140 180 300 500 QUALITY SOURCE  
YYYYMMDD HHMM SST TEMP TEMP TEMP TEMP TEMP TEMP TEMP TEMP TEMP TEMP QQQQQQQQQQ SSSSSSSSSSS  
20101219 1200 25.180 25.180 25.160 22.460 18.210 14.790 14.070 13.650 13.000 10.930 7.470 1111111121 11555555115  
20101220 1200 25.120 25.140 24.720 21.170 17.960 15.410 14.220 13.740 12.990 11.100 7.460 1111111121 11555555115  
**20101221 1200 24.630 24.630 23.570 19.900 16.040 14.270 13.740 13.400 12.890 10.770 7.380 1111111121 11555555115**  
20101222 1200 23.120 23.110 22.810 20.870 16.290 14.230 13.750 13.400 12.940 10.590 7.560 1111111121 11555555115  
20101223 1200 23.040 22.980 22.370 18.720 15.000 14.140 13.690 13.390 12.890 10.640 7.590 1111111121 11555555115

This one is a little more complicated since there is both a Depth (M) row, and then unit row below that to keep track of. We want data for SST (sea surface temp) and temperature at three depths. You will notice that the 50m and 200m readings are absent, in which case I am going to use the 40m (or you could use 60m) and 180m readings instead.

## ➤ Wind Direction Note:

- Wind direction data shown above is **TO the West**
- In other words: **270.0** = direction shown is degrees from 0 = North
- This is the **direction toward which the wind is blowing** – so a reading of 270.0 is directly toward the west, from the east.
- Do not ‘average’ the wind direction data—it will be meaningless
- It is generally **best to choose daytime wind direction**
- Before you plot wind direction, notice the wind velocity. Low velocities are often **variable** and not useful (still worth a try though).

➤ **Dynamic Height Note:**

- It might be best to plot DH for all 3 events on the same graph to detect variations. It will depend on the buoy location; some will show little change.
- Did you see the expected patterns? If not, any ideas why not?
- Look for research papers that might explain it...

➤ **Missing Data Note:**

These buoys go off line for a variety of reasons (maintenance, damage, weather...). Spot **check data to be sure enough data are available**. Some missing data is OK, as long as there is enough to identify trends. Note missing data in your spreadsheet. If you suspect too much is missing, ***let me know***.

## What Graphs to Make:

- Plot graphs to identify patterns or trends
- The most common graphs are variables against time (dates)  
...however you can plot lots of variables against one another - experiment!
- Please **do not include all graphs** in your final paper or the presentation
- **Note patterns** in the data and mention these in your **report**.

Start thinking about what the graphs mean! Think about the 'expected' patterns for El Nino and La Nina at your particular TAO site, and for your city location:

X-Y plots seem to work best; use symbols connected by lines

**Multiple y-axes are useful for showing different data sets together; it is useful to set the scales so that they do not begin at "0".** *For example, the best vertical scale for salinity might start at 30 ppt and end at 36 ppt, not 0 to 40 ppt! (it will be difficult to see the actual variations)*

**It will be helpful to use this color scheme convention:**

El Nino data = **bright red**

La Nina data = **medium blue**

Recent data = black

**Ultimately, you will make similar plots with your city data.**

What do you see in the data patterns?

The graphs you submit for Assignment #1 may be the same ones you submit with your final project

If you find something more interesting later, you may change them!

### **GRAPH HELP:**

**If you have not made many graphs, it is worth looking at some of these short videos that describe "how to":**

**Graphing with Excel (gr575)**

<http://www.youtube.com/watch?v=ojFGMMBuoZk&feature=related>

**Useful tutorial on x-y Scatter plots**

<http://mistupid.com/viewlets/excel/xlgraphs.htm>

**Useful video on x-y Scatter plots**

<https://www.youtube.com/watch?v=8B8kFVNzIQ8>

**Excel Magic Trick #654 – Charts: Line & X Y Scatter (video)**

<http://www.youtube.com/watch?v=38flC2xcktY>

**Adding a Secondary Y-Axis to a Chart (combining 2 types of chart to show information)**

<http://www.youtube.com/watch?v=6YteNM-Mn2s>

**Use your peers, ask for help, or come see me and I can help!**