Using CODAP to analyze HAB data
2021 Feb 25

CODAP (Common Online Data Analysis Platform) is free educational software for data analysis. This web-based data science tool is designed for students in grades 6-14, but is useful for quick analysis of data by researchers of any age and experience. It can be found at codap.concord.org.

These instructions will show you how to use CODAP to analyze and visualize the data collected by ScienceHead's High Altitude Balloon (HAB) flights.

Download the HAB dataset

To be determined

Run CODAP

1. In your browser, goto to the URL codap.concord.org
2. Click on the "Try CODAP" link
3. Click on the "Create New Document" button
4. Click on the top left pull-down menu on title bar next to "Untitled Document" and select "Import"
5. Click within the box entitled "click here to select file."
6. Find the HAB dataset you downloaded, click on its name and then click the "Open"button.
7. Two windows will open. One shows a table of the data. The other text window shows the time and date the data was imported. Close this window by clicking on the title bar and then the "X" symbol.
8. Expand the data table by placing the cursor on the right edge. When the double arrow appears, click and drag it to show all the columns in the table.

Understanding the Data

Before mapping and plotting the data, you need to understand the dataset. It is organized in a table of rows and columns. Each row represents a point in time the measurements were taken. Each column contains the measurement at that point in time. The columns are labeled as follows:

- Index – The row number assigned by CODAP
- Date/Time – the date and time of the measurement
- Altitude – the balloon's altitude above sea level in feet
- Pressure – the atmospheric pressure in millibars?
- Rel Hum – the relative humidity in percentage
- Temp – the temperature in degrees Celsius
- Battery – the battery voltage
- lat – the latitude of the balloon's position in degrees decimal
- lng – the longitude of the balloon's position in degrees decimal
- speed – the speed of the balloon in miles per hour
- course – the compass heading of the balloon's direction of travel

You can view the data by using the horizontal and vertical scroll bars. You can also place the mouse cursor on any column and use the mouse wheel to vertically scroll thru the data.

Map the Data

In this exercise, you will show the path of the balloon on a map. CODAP recognizes the lat and lng columns in the dataset and will automatically create a map. You can then choose to color-code the path by any of the measurements.

1. Click the "Map" icon.
2. A map window appears showing the path of the balloon,
3. Grab the title bar to reposition the map on the screen.
4. To resize the map, grab the edges of the map and when the double arrows appear, move to the desired height or width.
5. To display a measurement on the map, go to the desired column heading in the data table. Click and drag the heading onto the map. In this example, drag the altitude heading onto the map.
6. The balloon's path will now be color-coded based on the altitude. Darker colors equate to higher altitudes.
7. Note the altitudes are divided into 5 ranges. The ranges are determined by Jenks Natural Breaks. This is a standard tool used by map makers to determine the best arrangement of values into different classes. For more information, view the Wikipedia entry at https://en.wikipedia.org/wiki/Jenks_natural_breaks_optimization
8. Click on one of the color bars. Notice how on the map, points at that altitude range will appear highlighted on the map. Also, note those values will be highlighted in the data table as well.
9. You can complete steps 1 thru 6 above to create additional maps to display other variables.
10. When you have multiple maps, you might want to change the color codes of each map. To do so, click the map's title bar. When the options menu appears on the right side, click the "layers" icon (fourth from the top). Click the two "Legend color" boxes to select the range of colors to signify the low to high values.
11. Click any blank space on the workspace to set the colors and close the options window.

Graph the Data

In addition to creating maps, you can also create graphs of the data. In this example, we will create a graph of the balloon's altitude color-coded by the balloon's speed of travel.

1. Click on the "Graph" icon.
2. Grab the title bar to reposition the graph on the screen.
3. To resize the graph, grab the edges of the graph and when the double arrows appear, move to the desired height or width.
4. On the horizontal X-axis at the bottom of the graph, click on "Click here". Select the Data/Time variable.
5. On the vertical Y-axis on the left side of the graph, click on "Click here". Select the variable to be displayed, for example: Altitude.
6. To change the color of the line, click on the "brush" icon to open the format window. Click on the desired color,. Then click any blank space on the workspace to close the format window.

7. It is possible to display a second variable on the right vertical axis. To do so, click and hold on the variable name in the data table. Drag it to the right side of the graph, drop it into the yellow box that appears, and release..
8. You can also color code the points based on the value of a variable. To do so, click and hold on the variable name in the data table. Drag it into the center of the graph and release. The points will be colorized based on the five ranges determined by the Jenks Natural Breaks and a legend will appear beneath the graph.

Saving Your Work

It's important to save your work; otherwise it will disappear when you close the browser window. You can save work to either your Google drive or on your local computer. Below are the instructions for using your local drive. Refer to CODAP help documentation here (TBD), for use of Google Drive and sharing your work with others.

1. To save your work on your local machine, click on the pull-down menu in the upper left corner of CODAP's title bar and select Save.
2. Click on Local File.
3. Enter a file name in the upper text box and click the “Download” button.
4. The file will be saved in your browser's download folder with the extension .codap

Opening a Previously Saved CODAP file

1. Click on the pull-down menu in the upper left corner of CODAP's title bar and select Open.
2. Click on Local File.
3. Click on “click here to select a file”.
4. Select the desired file with the .codap extension and click the “Open” button.

Exploring the Data

Thus far, you have created a map and a graph to explore the path, altitude, and speed of the balloon. But there are other measurements to explore. Attempting to place many variables on a map or chart can be confusing and thus CODAP doesn't allow it. But you can create multiple maps and charts with the CODAP workspace.

The data is synchronized across the dataset table, maps and charts. Click on any row in the dataset. Notice how the corresponding point is highlighted in the maps and charts. Likewise clicking on any point in a map or chart will highlight the corresponding point in the dataset table and other maps and charts.

Note how clicking on any of the bars in the Jenks legend will highlight the multiple points and rows that correspond to that Jenks range. Also note that hovering the mouse cursor over the legend displays the values of the range.

For More Information on Using CODAP

- While in CODAP, you can click the "Help" icon for brief instructions.
- Detailed instructions, How-to guides and videos can be found at codap.concord.org/help

Questions

Using the map and graph you created, at what altitude (or altitudes) was the balloon speed (and thus the wind speed) the greatest? Over what cities did this occur? (You might need to expand the map and zoom in to determine.)

If you were a pilot flying West along the balloon's path at 33,000 feet, what is the speed of the headwind?

At what time in the flight did the balloon burst? Over what city did the burst occur?

What happens to the temperature as the balloon ascends and descends?

What is the relationship of the temperature to the humidity? Create an additional graph to best illustrate this relationship.

What is the relationship of altitude to pressure? Create an additional graph to best illustrate this relationship.

Looking at the map, describe the balloon's course over time. Would you describe changes in the direction of travel smooth or sharp? Graph the course column. Do you notice any differences? Can you explain them? Hint: consider some of the other measurements.