

MY NASA DATA Lesson:

Analysis of Atmospheric Conditions for a High Mountain Retreat

Purpose:

To examine the relationship between altitude, atmospheric pressure, temperature and humidity at a particular location.



Grade Level: 7-12

Estimated Time for Completing Activity:

60 minutes

Learning Outcomes:

- Students will explore correlations between atmospheric parameters.
- Students will practice science and math in real world application.
- Students will write reports detailing their scientific conclusions.

Prerequisite

- Lesson introduction to meteorology (pressure, temperature, humidity)
- Familiarity with computer Internet access
- Familiarity with spreadsheet software (extension activity)

Tools

- Computer with Internet access
- World Atlas or Map of Tibet
- Printer or graph paper
- Excel Spreadsheet

Vocabulary:

- [altitude](#)
- [atmospheric pressure](#)
- [Celsius](#)
- [ISCCP](#)
- [Kelvin](#)
- [relative humidity](#)
- [temperature](#)

Lesson Links:

- [Example of Best Fit Lines for Extension 1](#)
- [The Standard Atmosphere](#)
- [Journal Article for Extension 2](#)
- [Live Access Server \(Advanced Edition\)](#)
- [Weather balloon data \(radiosonde\) from NOAA](#)
- [Reading Skew T plots](#)
- [New ways to study the upper atmosphere](#)

Background:

In this lesson, weather data from ground-based and satellite observations are analyzed for a real world application — to plan a high mountain retreat in Tibet. The students will collect and construct graphs of the weather data from two sources. Weather balloon data, which provides a vertical profile of weather conditions, is available twice daily from the capital city, Lhasa (29.67 N, 91.13 E). Historical weather data for the region can be found on the MY NASA DATA Live Access Server. Note that the surface altitude (elevation) of Lhasa is 3,650 meters or 11,975 feet.

Before you begin, it may be helpful to review the link above titled The Standard Atmosphere. This document will provide the general relationship between altitude, pressure and temperature. Real measurements will deviate from the standard because many assumptions are made to produce this reference model. Additional general information about upper air research may be found in the document 'New ways to study the upper atmosphere'.(See Links section)

Read or hand out the following letter to the students.

Dear Students,

It has come to our attention that you are extremely brilliant scientists.

My company, BRAND Incorporated, wants to develop a High Mountain Tibetan Retreat (HMTR) for deep meditation. However, we want the retreat to be as comfortable as possible for those low-altitude sea shore dwellers. Could you please do an analysis of the air pressure, temperature and relative humidity at various altitudes in the region based upon weather data from the nearby capital city, Lhasa? My planning department would be grateful for any best-fit equations that could be developed and possible results between altitudes 12,000 feet and 28,000 feet.

We look forward to your report.

Sincerely,
Mr. Al G. Brand

Procedure:

Part I: Explore the Live Access Server to understand the historical weather conditions (climate) in Tibet.

1. Click the link above to access the Live Access Server (Advanced Edition).
2. If you are not automatically prompted, make sure to click on 'Choose Dataset' in the upper left hand corner then select Atmosphere, Atmospheric Pressure, Monthly Surface Pressure (ISCCP).
3. On the navigation map to the left, you can use a click and drag method to highlight the area that you would like to look at. After you select your region, make sure to click the radio button next to 'Update Plot' at the top left of the screen.
4. You can also use the lat-lon boxes to the right of the map to specify the region of Tibet. Use the atlas or world map to obtain the latitude and longitude of the Tibet region.
5. For your time range , use the drop-down menu to select the month and year you have chosen to investigate.
6. A color plot should appear in the next screen. Save or print out the color plot for use later.
7. Note how surface pressure is low in the mountainous region. This is due to higher elevation.
8. Click on 'Choose Datasets' found on the left side of the window.
9. Select Atmosphere, Atmospheric temperature, Monthly Near-Surface Air Temperature (ISCCP).
10. For the area to be studies select the same values as you used previously. Be sure the radio button next to 'Update Plot' is selected.
11. A color plot should appear. The temperature will be displayed in Kelvin. For display in Celsius, use the Evaluate Expression box found by clicking on 'Set Plot options' to

convert to degrees Celsius (click on the question mark icon for hints on how to do this). Save or print the color plot. (you will be typing in the dollar sign-273 to convert to Celsius)

12. Again, note that surface temperature is lower in the mountainous region as expected due to elevation.

Have students explore different months throughout the year to understand seasonal variations in the data. Discuss results.

Part II: Explore recent radiosonde data from Lhasa to understand the change in weather conditions with altitude in the region.

1. Click on the link above to access the NOAA Radiosonde Database.
2. Enter a date range or enter yesterday's date to get the most recent data. Click Continue Data Request.
3. In the text box for the WMO number (WMO stands for World Meteorological Organization), enter the number 55591 for Lhasa, Tibet.
4. First, print, read and discuss the description of the FSL output format by clicking on the link, Both FSL output formats.
5. Go back to the Radiosonde Dataabase Access, select FSL format (ASCII text) output, then continue. Optional: Try selecting Skew t Plot for a graphical interpretation. Refer to the link 'Reading Skew T plots' in the Links section for more information.
6. Print results and discuss.

Note: When looking at the output, remember the surface elevation is high, so the lower level data will always be missing (99999). Also note that dew point temperature may be compared to the temperature to examine relative humidity.

Questions:

1. What weather conditions do you think would make a good or poor retreat site? Does the weather data support these qualities? What other characteristics, such as precipitation, cloud cover, etc., would you examine?
2. What recommendation do you have? Complete a letter and report reply to Mr. Al G. Brand. Be sure to include an analysis of the relationship between altitude, pressure, temperature and humidity for your site.

Extensions:

1. Using Excel or other spreadsheet software, import a radiosonde data file into a worksheet. Develop best-fit equations and regression co-efficients for the data. Note that pressure decreases logarithmically with altitude while temperature decreases at linear rates. See the link above titled Example of Best Fit Lines.

2. Read the introduction of the journal article referenced in the Links section above ('Weather and Death on Mount Everest: An Analysis of the 'Into Thin Air' Storm', Bulletin of the American Meteorological Society, 2006). Ask the students to consider this real world event and relate it to their HMTR recommendation.

3. For Question 1 above, choose one of the 'other characteristics' that you suggested, then use the Live Access Server (Advanced) to produce a plot of this parameter for Tibet for the time period used in Procedure Part I. Would the results affect your recommendation letter? Explain using examples of data.

Lesson plan contributed by Laurissa Werhun, Toronto, Ontario, Canada

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