

MY NASA DATA Lesson: *See notes at the end of the lesson for data updates with the new Earth System Data Explorer*

Studying Snow and Ice Changes

Purpose:

To examine how snow and ice cover have changed on the Earth from 1994 to 2004, and to practice using some of the data analysis tools available at My NASA Data.



Image courtesy MY NASA DATA

Grade Level: 9 to 12

Estimated Time for Completing Activity: 1
– 2 periods

Learning Outcomes:

- Understand how calculations can be performed on data expressed as maps, such as averaging or subtracting.
- Observe changes in snow and ice over a 10-year period and draw conclusions about trends indicated by the observations.

Tools

- My NASA Data website
- Excel software
- Image display software (such as PowerPoint)

AP Environmental Science Topics

- Atmospheric circulation
- Climate shifts
- Greenhouse effect
- Greenhouse gases
- Impacts and consequences of global warming
- Reducing climate change
- Weather and climate

Vocabulary:

- [glacier](#)

Lesson Links:

- [Live Access Server](#)
- [Snow and Ice 1994 to 2004 plots \(PowerPoint\)](#)
- [Snow and Ice 1994 to 2004 data spreadsheet \(Excel\)](#)
- [Earth Observatory – articles on climate change and changes to snow and ice](#)

Background:

Scientists have recently been reporting that the average temperature of the Earth has been rising, usually referred to as 'global warming'. What is the evidence for this change? One piece of evidence could come from patterns of snow (on land) and ice (either sea ice floating on the oceans or glaciers on land) on the Earth – if the snow and ice are disappearing, it would indicate rising average temperatures. This exercise is meant to examine the pattern of snow and ice on the Earth to determine what trends are visible.

It is also worth noting that 'global warming' is a shorthand for 'global climate change'. This is because although a significant effect of climate change can be temperature increase, other changes may occur as well. Therefore, when we look at the snow and ice patterns on the Earth, we not only look for increases or decreases in the snow and ice cover, but we also look for changes in its distribution, which could be another indication of climate change.

Procedure: Please note that this lesson has not been updated for the new LAS system.**Procedure:**

In this lesson we will create time series plots that show the snow and ice amount for a particular location using the MY NASA DATA Live Access Server. This will be done for two different years, 1994 and 2004. Then we will compare the two plots and deduce if there is a difference between the two plots or years. With this information you will be able to make inferences about changes in the region over a ten year period of time.

1. Click on the link above in the Lesson Links section to the Live Access Server Advanced edition.
2. To begin manipulating the Dataset follow these instructions. If you are not automatically prompted with dataset choices click on the Choose dataset button at the top left of the page.
3. Select Cryosphere, then (the only one) Monthly Snow and Ice Amount. (Note this data is percent coverage of snow and ice, with values between 0 and 100. So, when looking for long-term trends we will be looking at averages, not sums.)
4. Generating a time series plot for snow and ice cover for 1994:
 - a. From the menu at the left of the screen select Time Series from the plot options menu.

- b. Using the Navigation menu at the top of the screen, click on the radio button to the right of the update plot. This will allow you to see the changes as you make them below.
 - c. Change the Date range to Jan 1994 to Dec 1994
 - d. Change the latitude to 61.33W and the Longitude to 89.14W
 - e. At this point you should be able to see a time series (line plot) for the selected latitude and longitude.
 - f. You will be comparing this plot to a second one that you will generate in the procedures to follow. To save this plot for later comparison, you can either right click and save as or control click and save as. Be sure to save the plot to a location that is easy to access.
5. Generating a time series plot for snow and ice cover for 2004:
- a. From the menu at the left of the screen select Time Series from the plot options menu.
 - b. Using the Navigation menu at the top of the screen, click on the radio button to the right of the update plot. This will allow you to see the changes as you make them below.
 - c. Change the Date range to Jan 2004 to Dec 2004
 - d. Change the latitude to 61.33W and the Longitude to 89.14W
 - e. At this point you should be able to see a time series (line plot) for the selected latitude and longitude.
 - f. You will be comparing this plot to the first one that you generated above. To save this plot for comparison you can either right click and save as or control click and save as. Be sure to save the plot to a location that is easy to access.
 - g. Answer the first two questions at the bottom of the lesson before proceeding.

Color Plot Analysis (Full Region)

6. Click on and download the PowerPoint file from the Lesson Links above for the three plots (two color plots and one difference plot) can you see increases or decreases moving from 1994 to 2004, and are these changes correctly shown in the differences map? Using the three plots answer questions 3-5 below in the Questions Section.
7. Take a quantitative look at the results (Excel File found in the lesson links section above): Examine the 3 numerical datasets to be sure the computer did what we expected, that is, if you subtract a 2004 value from the corresponding one (same location) in 1994, do you get the value in the difference table (there might be rounding differences that you can ignore)? If not, something might not have been set correctly in the procedure, and you may need to try it again. Notice, by the way, we haven't verified that the yearly averages are correct which would involve getting the 12 monthly datasets and checking them ourselves. A working scientist might do this to make sure his or her work is valid.

Questions:

1. How has the seasonal trend changed from 1994 to 2004 as seen in these two plots?
2. What implications can be made from the analysis of these two plots? By looking at these two plots, is it possible to make a claim as to how the climate in that region has changed?
3. What are some of the advantages of using the three plots next to each other?
4. What is the advantage of using the difference plot? Is it easy to interpret why or who not?
5. Suggest other ways to analyze the data to bring out other inferences.
6. Now that we think the data seems OK, what does it show?

- a. In what areas has the snow and ice cover increased and where has it decreased?
 - b. Does this pattern agree with what you have read regarding climate change?
 - c. Try to explain the causes for areas of significant gain or loss in snow and ice cover, especially anomalous ones that you haven't read about.
 - d. Ten years of snow and ice data is about all that is available from this source. What level of confidence would you have in conclusions resulting from this dataset?
7. How do the changes in the latitude longitude study compare to the changes seen in the color plot study?
8. What circumstances should each type of plot be used in a study?

Extensions:

This exercise compares averages for 1994 and 2004, but different years would have different averages, so other years in the datasets could also be compared. Of course, as the years get closer together, change might be harder to see and conclusions about the change would be more short-term. Note this exercise used close to a calendar year (e.g., Jan 1994 to Jan 1995), but it also could use a seasonal year, e.g., centering on northern hemisphere winter such as July 1994 to July 1995.

Questions:

1. Take a qualitative look at the results to see if they seem correct: Set up the 3 maps so they can be viewed on top of each other (could be in a photo editor, or PowerPoint or GIS), and compare them – can you see increases or decreases moving from 1994 to 2004, and are these changes correctly shown in the differences map? If so, good. If not, the next step will help verify the situation.
2. Take a quantitative look at the results: Examine the 3 numerical datasets to be sure the computer did what we expected, that is, if you subtract a 2004 value from the corresponding one (same location) in 1994, do you get the value in the difference table (there might be rounding differences that you can ignore)? If not, something might not have been set correctly in the procedure, and you may need to try it again. Notice, by the way, we haven't verified that the yearly averages are correct – which would involve getting the 12 monthly datasets and checking them ourselves. A working scientist might do this to make sure his or her work is valid.
3. Now that we think the data seems OK, what does it show?
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Once students understand from this exercise how the LAS can do calculations, they can do calculations with other datasets to look for changes.

Lesson plan contributed by Martin F. Schmidt, Jr., Owings Mills, MD

[Click here for Teachers Notes](#)



Data Notes from Dr. Brad (12/2018):

Up-to-date monthly snow and ice coverage data can be found on the Earth System Data Explorer at Cryosphere->All Data->Changes in Snow and Ice Extent->Monthly Snow/Ice Percent Coverage.