

Details



Completion Time: About one period

Permission: Download

Global Snow Cover Changes

Overview

This lesson allows students to use online mapping tools to investigate global snow cover changes. Students develop a problem statement about global snow cover and then use mapping tools to investigate their problem or question.

Objectives

Students will become familiar with the data and tools used to analyze snow cover changes in order to answer questions pertaining to snow data.

Lesson Preparation

Students should have a basic understanding of meteorology and climatology concepts before starting this exploration. Refer to <http://climate.rutgers.edu/snow-cover/> for more information. See Resources section for a list of terms to know.

Background information:

Since the dawn of the satellite era in the 1960's, Northern Hemispheric snow cover has been monitored by NOAA (National Oceanic and Atmospheric Administration). Studying snow cover from satellite imagery has its benefits over ground measurements since there are numerous inherent issues with surface observations related to topography, instrumentation, etc. Initially there were errors in the identification of land and water in the satellite images, which meant that the amount of snow in the northern hemisphere was miscalculated. With the development of software by the Rutgers University Global Snow Lab, these errors were corrected and new maps are generated on a regular basis. The team at the Global Snow Lab has since created an accurate grid cell product which details Northern Hemisphere snow cover data over the last 42 years. The cell resolution of these maps ranges from 16,000 to 42,000 square kilometers, and where a cell is 50% or more snow covered, the

Materials

- Computer Access
- Global Snow Lab website (refer to Procedure section for website)
- Maps of the Northern Hemisphere that shows topographic features

entire cell is considered snow covered; whereas if the cell is less than 50% snow covered, it is considered snow free. The North America Blended Charts contain charts that are higher resolution incorporating visible light, microwave remote sensing data, and station data. The “3-way” Pentads (pentad = five day) provides a comparison of the data sources.

Procedure

Students will access the Global Snow Lab website: <http://climate.rutgers.edu/snowcover/index.php> and answer the questions on the attached worksheet.

Extension

N/A

Resources

Terms:

Satellite Imagery – view of the Earth from above. Satellites vary in their orbits above the Earth’s surface, thus providing varying degrees of resolution in their imagery. The imagery used for this application has a resolution of 1.1km x 1.1 km.

Monthly Departure – the colors in the maps demonstrate snow cover changes from the previous time period you are currently viewing (day, month or year). Colors show the percentage of time each cell is considered snow covered in a given month over the period of record 1966-1999.

Monthly Climatology – Colors show the percentage of time each cell is considered snow covered in a given month over the period of record 1966-1999.

Anomaly – When analyzing the data, there may be differences from the mean values from one time period to another. These differences (departures) are called anomalies.

Pentad – Refers to a 5 day interval and the charts are five-day snow charts were generated by examining the snow depth in each 1° x 1° cell for each day. A pentad cell was considered snow covered if three or more days in the pentad had a snow depth of more than 1.27 cm (one half inch).

89x89 grid cell – The maps are digitized by overlaying a grid on the polar stereographic maps. The cells number 89 by 89 with the corners of the square touching the equator.

N.H. – Northern Hemisphere

Assessment

The completed worksheet questions can be used for assessment.



Credits

Missy Holzer, mholzer@monmouth.com

National Science Education Standards (NSES):

Content Standards, Grades 5-8

Content Standard A: Science As Inquiry

- a. Abilities necessary to do scientific inquiry
- b. Understandings about scientific inquiry

Content Standard E: Science and Technology

- b. Understandings about science and technology

Content Standard F: Science In Personal and Social Perspectives

- e. Science and technology in society

Content Standard G: History and Nature of Science

- a. Science as a human endeavor
- b. Nature of science

Content Standards, Grades 9-12

Content Standard A: Science As Inquiry

- a. Abilities necessary to do scientific inquiry
- b. Understandings about scientific inquiry

Content Standard E: Science and Technology

- b. Understandings about science and technology

Content Standard F: Science In Personal and Social Perspectives

- f. Science and technology in local, national, and global challenges

Content Standard G: History and Nature of Science

- a. Science as a human endeavor
- b. Nature of scientific knowledge

Other Standards:

N/A

Global Snow Cover Worksheet

1. Go to the Global Snow Lab website (<http://climate.rutgers.edu/snowcover/>) and begin your survey of available data resources by clicking on "Northern Hemisphere Visible Satellite Charts - Daily."

What date are you looking at? _____

Describe the map output: (what do the colors mean, where is the greatest snow cover, etc).

Use the arrow keys to search previous days. Click back 5 days and describe any changes: (be sure to provide the location of these changes.

2. While you are looking at the Northern Hemisphere Snow Cover, click on "Viewing Departure."

What do the colors mean?

Describe the departures you see for the date listed above.

Next, click on "See Full Climatology." Refer to "Monthly Climatology" listed above under "Terms" to determine what the colors refer to, and click on "Documentation" to learn even more about how these maps are created.

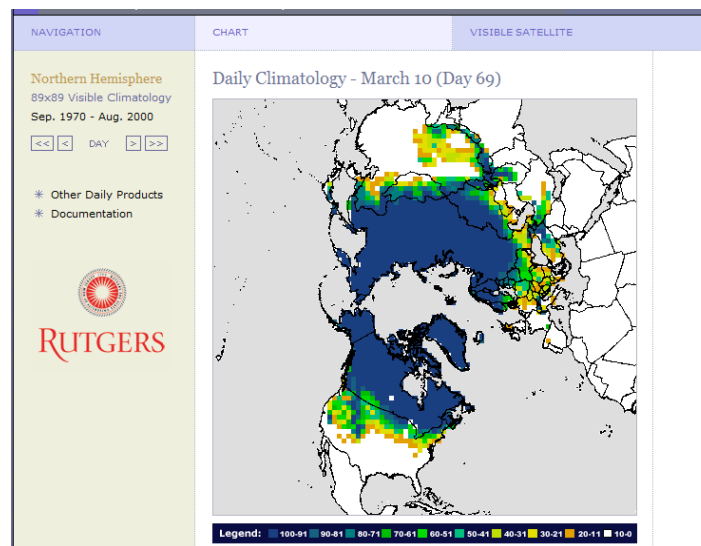


Figure 2. Example of Full Climatology output.

Describe the changes in your map over the data period. (ex: has the N.H. snow extent increased or decreased over the study period and if so, note the locations that have experienced changes)

3. Go back to the homepage, and under Northern Hemisphere Visible Satellite Charts explore the Weekly N.H snow charts. Use the back arrows to explore a time series for the weekly charts. Select a time period of at least 6 weeks, and explore the charts for that time period.

What was the time period you explored? _____

What changes did you see over that time period?

4. Go back to the homepage, and under "Northern Hemisphere Visible Satellite Charts" explore the Monthly N.H snow charts. Use the back arrows to explore a time series for the monthly charts. Select a time period of at least 12 months, and explore the snow extent, departures, and climatology chart for that time period.

What was the time period you explored? _____

What changes did you see over that time period? (be sure that you understand the color scales in the legend!)

5. Go back to the homepage and under "Graphs" click on "Snow Anomalies." Toggle among the Northern Hemisphere, Eurasia and North America graphs.

What do the colors on the maps refer to?

Describe the vertical axis of the graphs.

List 3 specific observations of the Northern Hemisphere graphs

1.

2.

3.

Compare and contrast the Eurasia & North American graphs

Compare:

Contrast:

6. Go back to the homepage and under "Tabular" click on "Weekly." While here look at the data for this year and half of last year and note the changes over this time period in each of the locations. Note that the data is in millions of square kilometers.

What is the general trend in data over this time period for each of these locations? Which of the locations in the Northern Hemisphere appears to show the greatest change over time?

7. Go back to the homepage and under "North America" click on "Station Pentads." Once you are there click on "Documentation." Read the description on the data used to create these charts. Use the space below to briefly describe the how these charts are created.

Go back to the charts under Station Pentads and explore Interpolated Station, Blend Interpolated, Gridded Station, Blend Gridded charts. Note the color scales and chart legends. Describe each of the charts selecting the same date for each.

What date did you choose? _____

Describe the characteristics of the Interpolated Station chart.

Describe the characteristics of the Blend Interpolated Station chart.

Describe the characteristics of the Gridded Station chart.

Describe the characteristics of the Blend Gridded Station chart.

8. Select one of the above charts, and explore a time series of 10 pentads (1 pentad is the same as a 5 day period) for that chart. What are the dates of your time series?

Start date & pentad number: _____

End date & pentad number: _____

Describe the changes you see:

9. Now that you've explored the available data in chart, graphs, and tabular forms for different lengths of time and over different regions in the Northern Hemisphere, answer the following questions. Refer back to the appropriate resource for assistance.

In which season did you see the greatest changes over time? _____

Explain. Which data did you use to support your answer?

In which region in the Northern Hemisphere did you see the greatest changes over time? _____

Explain. Which data did you use to support your answer?

From your knowledge of global climate, suggest & explain at least 3 separate reasons for the differences you stated above.

1.

2.

3.

Problem Exploration:

10. You are a climate scientist and have been asked to prepare a statement about changes in the snow cover in the United States over the past 10 years. You remember that the Rutgers University Global Snow Lab has a high resolution data in charts, graphs, and tabular forms. Which datasets from this resource will you use and why? Explain your procedure for creating this report. (You do not have to create the report!)

Analysis:

Now it is your turn to use the data to answer a question that you have developed related to changes in the Northern Hemispheric Snow Cover over time. Type your responses on a separate piece of paper.

- My question is:
- I will use the following data to answer my question:
- I will be examining these dates:
- Analyze your data in relationship to your question.
- Draw a conclusion from your analysis.
- What could you do next to further explore your question?
- You have only explored data from one resource. What other data resources could you use to explore your question or another global snow cover