

Name:

Date:

Changes in Seasonal Albedo with Land Cover Class

Guiding question: How does albedo change over the seasons in different land cover classes?

Introduction. Now that you have completed the *Introduction to Albedo*, you are going to use your knowledge to compare seasonal changes in albedo for your location and for a location with a different land cover class. **** NOTE: In research, scientists often use *land cover classifications* instead of *biomes*. Land cover classes are similar to biomes; however, they also include human-created systems such as cropland and urban areas.**

1. From the table below, choose a land cover class that you are interested in investigating. Record your choice in your science notebook.
 - a. *Hint: you can change the Background layer to 'Google Satellite' to see what the landscape looks like by clicking on the 'Layers' tab, and click the box next to **Background**.*

Table 1. Land Cover Classes and Associated Lat/Lon

Land Cover Class	Latitude	Longitude
Evergreen Needleleaf	56.12633	-105.56888
Deciduous Broadleaf	37.56023	-82.26690
Open Shrubland	30.30779	-105.48374
Grassland	48.15119	67.13336
Permanent Wetland	61.81482	71.09848
Barren	24.47869	12.84022
Urban	40.78183	-74.28686

2. From the Data Tools page on the Student Climate Data website (http://studentclimatedata.unh.edu/data_tools.shtml), click on the 'Carbon Mapper' link.
3. Close the introductory pop-up window.
4. Click on the 'Zoom' tab (*at the top right of the page*) and in the boxes, enter the latitude and longitude from the table that are associated with the land cover type you chose. Set the **zoom level** to 3 in the drop down box, and click 'Go.'
 - a. In your science notebook, record what **country and state or province** does the X fall on the map.
5. Now zoom into the map until you have reached **Zoom Level 12** (*displayed at the bottom of the screen, this will allow you to view only one data point for your location*). Make sure your X is still visible on the screen.



6. Now click the box next to the **MODIS Albedo & Land Cover** Layer to view all of the MODIS layer options.
7. Click on the box next to **MODIS Land Cover** to display the land cover data on the map.
8. Click on the identify tool - the **i** icon - and then click on your location on the map (*If the X disappeared, just use the center of the screen*). The identify box should pop up. If the land cover class does not match what you chose above, re-check your latitude/longitude values.
(If you get the message: "Sorry, there was nothing that could be identified. Please select some more layers," try clicking in a slightly different spot on the map.)
9. Now click *off* the MODIS Land Cover layer, and click **Albedo 2013**, and then the box next to **Winter Albedo 2013**. The albedo data will now appear in grayscale.
10. Click on your location on the map again to view the identify box.
11. Create a data table in your science notebook that has two columns: **Season** and **Albedo**. Record the **winter albedo** value in the table. Make sure to include a **title** for your Table that includes the **land cover class** and **location**.
12. Un-click the box next to Winter albedo. One at a time, click on **Spring**, **Summer**, and **Fall** albedo for your location, making sure to un-click the previous layer. For each layer, click on you location on the map to access the identify box and record the albedo value in your data table.
13. In your science notebook, record any initial **questions** and **observations**, and respond to the following questions:
 - a. In which season is the most solar energy (sunlight) reflected from the vegetation?
 - b. What do you think causes the seasonal changes in albedo at your location?
 - c. Record one or two questions you have about albedo and land cover classes.

Step 2: How does albedo change in a different land cover type?

1. Reset the maps by Un-clicking the albedo layer that is on. Choose another land cover class from Table 1.
2. In your science notebook, record the **land cover class** you chose and **why** you chose that location. Follow the steps 4-13 in **Step 1**, to find the seasonal albedo for your second location.
3. In your science notebook, create a second **data table** that includes **Season and Albedo**. Fill in the table with the data you obtained from the Forest Mapper.
4. In your science notebook, record any other observations and/or questions that you have, including answering the questions:
 - a. What do you think causes the seasonal changes in albedo at location 2? Are these factors the same as at your first location? Why or why not?

Step 3: What impacts do different land cover classes have on seasonal albedo?

1. Using the albedo values from your data tables, draw a **bar graph** in your science notebook of the average **summertime and wintertime albedo** for your two land cover classes, with ‘Season’ on the x-axis (independent variable) and ‘Albedo’ on the y-axis (dependent variable). You may want to use different colors or shading to distinguish summer values from winter values. Be sure to **label your axes** and provide a **legend** if necessary.
2. In your notebook, record any further observations and/or questions, including answering the following questions:
 - a. Which location will reflect more solar energy in the summertime? Why?
 - b. Which land cover class has a greater difference between winter and summer albedo? Why?

Step 4: How does albedo change in *your* land cover type?

1. Reset the maps by Un-clicking the albedo layer that is on.
2. Now navigate to your location (the town your school is in) on the maps by clicking and dragging and/or using the zoom tool.
3. In your science notebook record the **name** of your location and it’s **latitude** and **longitude** (*this is displayed where it says ‘Location’ in the bottom-right corner of the map*).
 - a. Based on your knowledge from the previous two locations, how do you expect albedo to change seasonally in your location? Record your answer in your notebook.
4. Again, follow the steps 4-13 in **Step 1**, and record the data in a **data table** in your notebook.
5. In your science notebook, record any other observations and/or questions that you have, including answering the following questions, using Google Satellite view to determine what is on the Earth’s surface at your location:
 - a. Did the changes in albedo follow the pattern your expected? Why or why not?
 - b. What factors that could be impacting the seasonal changes in albedo in your location?

Final Thought Questions:

Respond to the following questions in your science notebook:

1. If you took your second location and converted it to one big parking lot, how would that affect the albedo of that location? What impact do you think this would have on the climate?

2. Currently, arctic tundra vegetation is dominated by dwarf shrubs, grasses, mosses and lichens. However, the tree line (the upper limit of tree growth in northern latitudes) in many areas has already moved northward (IPCC 2007). It has been predicted that, due to climatic warming, the growing conditions for trees and shrubs in this area will become more favorable in the future (IPCC 2007).
 - a. How would an increase in trees and shrubs change the albedo of the tundra?
 - b. If this change in albedo occurs, how will that influence the climate?
 - c. How will this further change in climate affect the vegetation that is able to grow in the tundra?
 - d. Is this an example of a positive or negative feedback loop?

