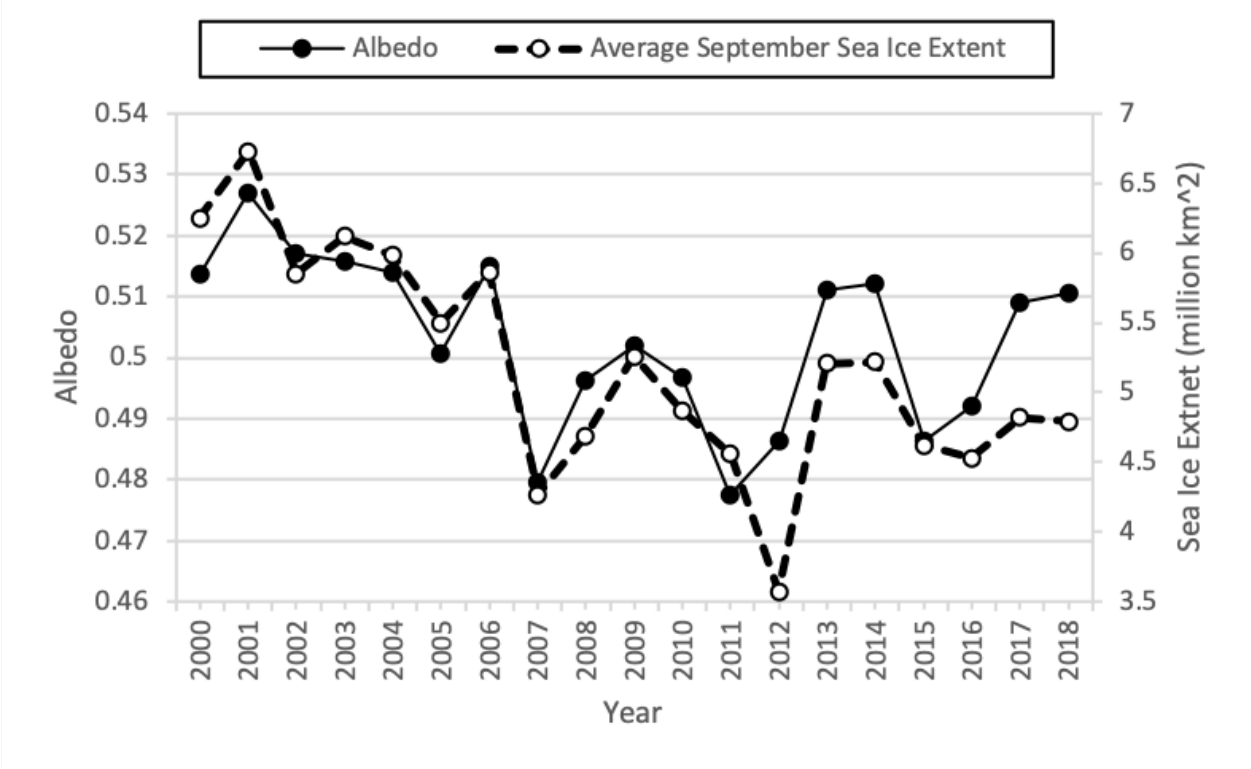
“Model Testing” Answer Key

Model Testing

Part 1: Albedo and Sea Ice
Instructions:
Step 1. Plot albedo data (see Table 1) from the Arctic onto the graph below. Compare patterns and trends between the albedo and sea ice extent datasets.
Step 2. Refer to the graph to answer the analysis questions.



Data source: Sea ice extent and albedo data from NASA.

Analysis Questions:

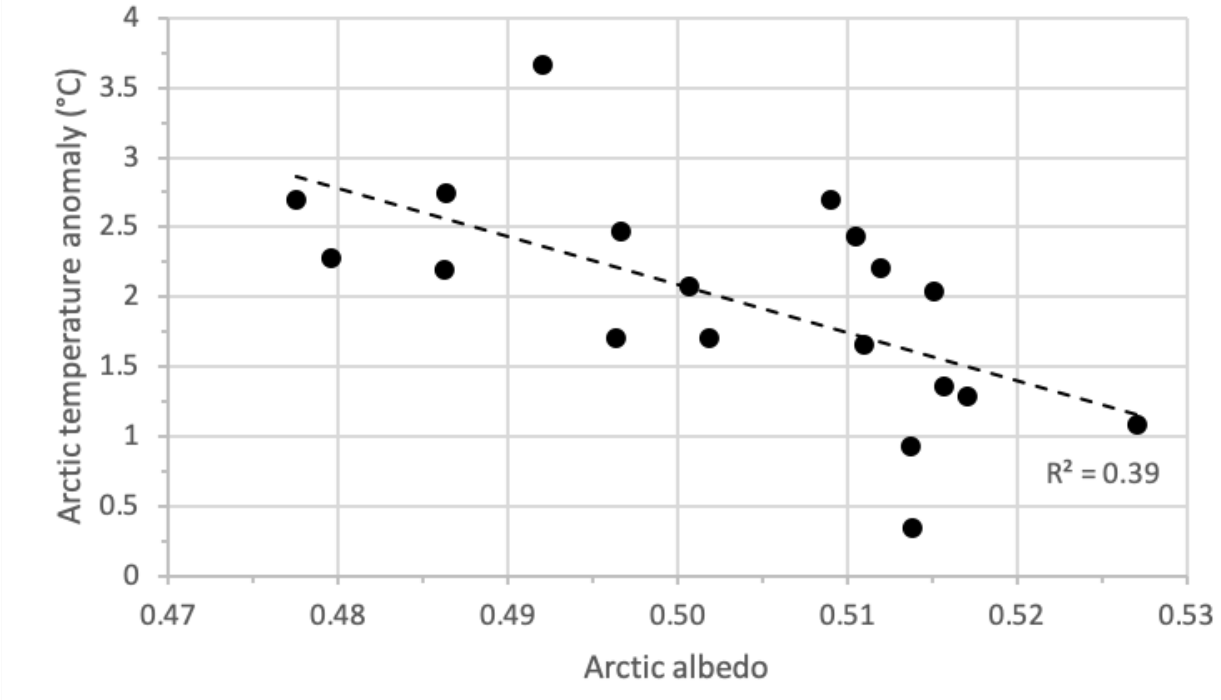
1. What patterns do you observe when comparing the albedo and sea ice extent datasets above?
   Arctic albedo and Arctic sea ice extent are directly related.

2. How can you example the pattern(s) you identified in the previous question?
   The white surface of sea ice is highly reflective. Therefore, the more sea ice, the higher the albedo for that region. A decline in sea ice would lead to a corresponding decline in albedo.

Part 2: Albedo and Temperature

“Model Testing” Answer Key

Instructions:
Step 1. Construct a scatter plot on the graph below using the albedo and Arctic temperature data provided (see Table 2).
Step 2. Add a trendline to fit the data.
Step 3. Refer to the graph to answer the analysis questions.



Data source: Arctic temperature anomaly from NOAA. Albedo data from NASA.

Analysis Questions:

1. What pattern(s)/trend(s) do you observe in the graph above?
   An increase in albedo corresponds with a decrease in Arctic temperatures.

2. How can you explain the pattern(s)/trend(s) you identified in the previous question?
   The higher the albedo, the more incoming shortwave energy is reflected from the Arctic. The lower the albedo, the more incoming shortwave energy is absorbed by the Arctic leading to increased temperatures.

3. Describe the relationship between sea ice, albedo, and temperature.
   Diminishing Arctic sea ice has reduced the albedo in the region. As a result, more shortwave energy is absorbed rather than reflected, increasing Arctic temperatures.

Part 3: Wrap up Questions - Bringing the unit together from beginning to end…

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1. Why are <u>global</u> temperatures increasing?
   Global temperatures are increasing because of an enhanced greenhouse effect. The burning of fossil fuels is contributing to increased atmospheric greenhouse gas concentrations. Greenhouse gases allow shortwave radiation to pass through Earth’s atmosphere, but can absorb and reemit outgoing longwave radiation, effectively trapping the longwave radiation (heat) in Earth’s atmosphere. Increased atmospheric greenhouse gas concentrations lead to increased global temperatures.

   Evidence (lesson/activity): Greenhouse Effect Lesson, “Molecules and Light” PhET simulation, “Our Shared Climate Future” video.

2. How have rising <u>global</u> temperatures affected Arctic sea ice?
   Rising global temperatures have contributed to a decline in Arctic sea ice.

   Evidence (lesson/activity): MOSAiC Distributed Network Google Expedition

3. How has the decline in Arctic sea ice affected the albedo of the Arctic?
   The decline in Arctic sea ice extent has decreased the albedo of the Arctic. Reduced sea ice cover exposes more of the dark ocean. The dark ocean reduces the albedo (reflectivity) of the Arctic and causes more incoming shortwave energy to be absorbed.

   Evidence (lesson/activity): Model Testing Lesson, Ice-Albedo Feedback lesson, Albedo Lesson, Albedo vs. Sea Ice Extent line graph, “Arctic Feedbacks” video

4. What is the ice-albedo feedback and how has it contributed to amplified warming in the Arctic?
   - A decline in sea ice leads to more sea ice loss. As sea ice melts, the albedo for the region decreases. A decrease in albedo means more shortwave (solar) energy is being absorbed, leading to an increase in ocean and air temperatures. The increase in temperatures causes more sea ice to melt, and the cycle continues...

   Evidence (lesson/activity): Ice-Albedo Feedback lesson, Albedo Lesson, Calculating Albedo of Arctic Maps A and B, “Arctic Feedbacks” video