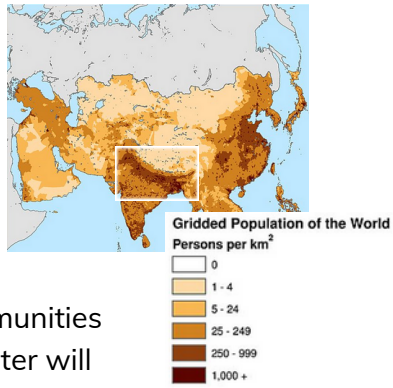
Will Communities Run Out of Meltwater?

Introduction



The river basins around the Himalayan Mountain Range are some of the world's most densely populated areas (see map). There are over 900 million people in the region, and they rely heavily on water from glaciers and snow from the mountains (meltwater) for drinking and to grow crops.

In recent years, there has been a huge increase in meltwater. Local communities are trying to figure out: Is this just part of a natural cycle and the meltwater will return to normal levels in future years? Or should they be worried that they will run out of meltwater in the near future?

In this task, you will analyze geoscience data to help local communities investigate the problem so they can better prepare for the future.

1. First, investigate what is happening to the sources of meltwater in the Himalayas. Use the data and the questions below to guide your analysis:

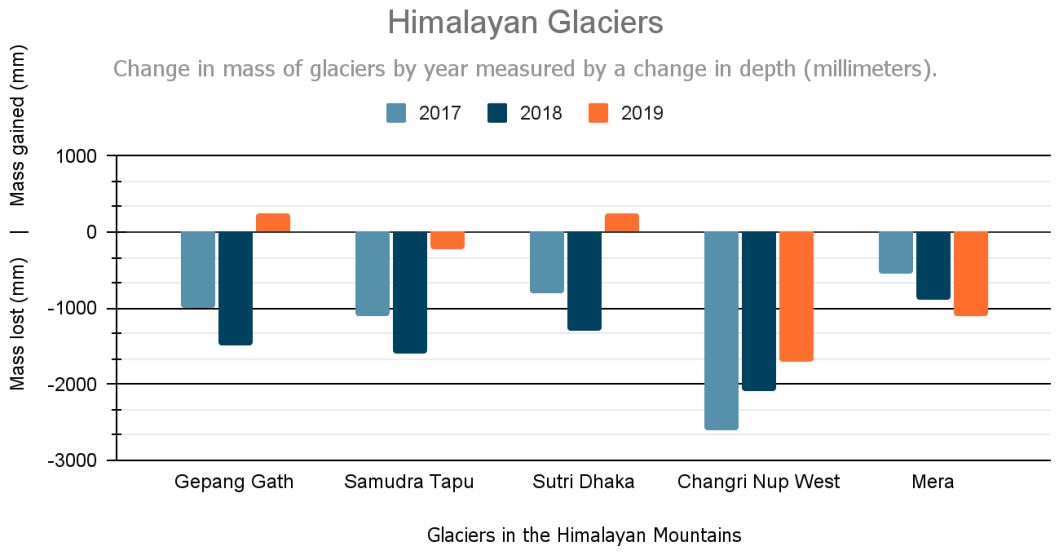


Figure 1. This chart shows the annual change in the mass of five different glaciers in the Himalayan mountain range in 2017- 2019. Source: World Glacier Monitoring Service.

Population density map from https://sedac.ciesin.columbia.edu

Annual Snow Cover from 1990 - 2001

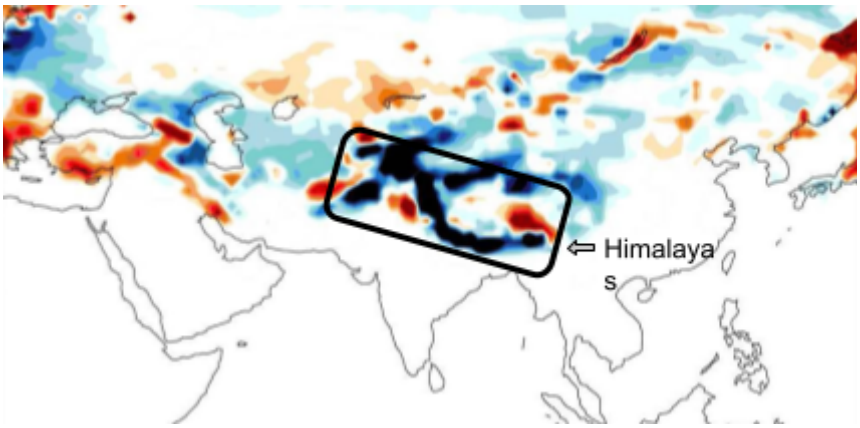
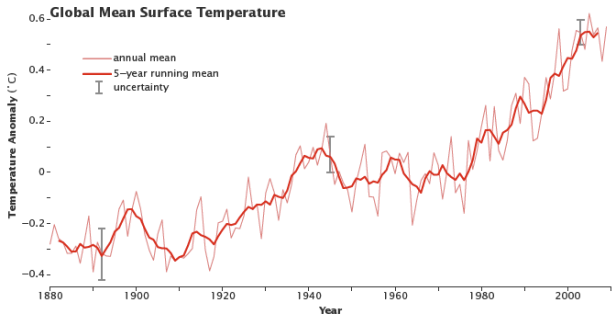
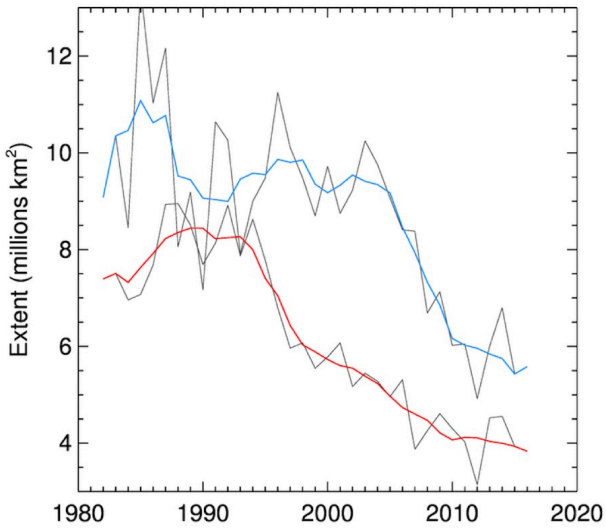


Figure 2. This map shows the change in the percentage of snow cover from 1990 to 2001. The darkest blue color shows 16% loss in snow cover (-16), white shows no change, and darkest red shows a 16% increase (16). The data were collected by the National Snow and Ice Data Center.

a. What has happened to the glaciers in the Himalayas in recent years? Use evidence from Figure 1 to support your response.

b. What has happened to snow cover in the Himalayas in recent years? Use evidence from Figure 2 to support your response.

2. Now that you have studied data showing changes in the sources of meltwater in the Himalayas, examine data that will help you learn about the recent increase in meltwater. Analyze each of the graphs below and record your analysis in the right-hand column.

Data Source	Your Analysis: What does this graph tell you?
Global Mean Surface Temperature, 1880 - 2000  Figure 3. This graph shows changes in the annual mean temperature of the surface of the Earth over time.	
Snow Cover Extent and Sea Ice Area, 1980 - 2020  Figure 4. Graph showing the amount of annual Arctic sea ice and snow cover over time. Upper line shows sea ice measured in September. Lower line shows sea ice measured in June.	

Albedo Trends, 1980 - 2012

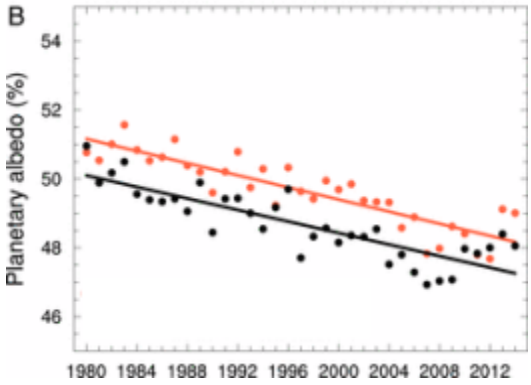
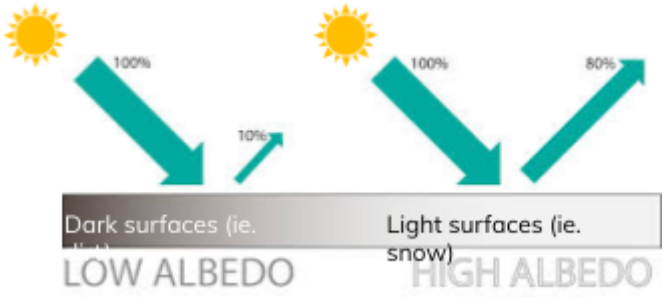
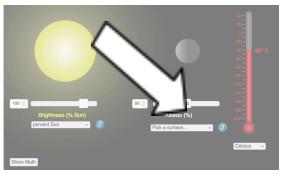


Figure 5. The graph shows the changes in the annual average albedo for Earth over time. Earth's albedo measures the amount of sunlight reflected by the Earth. Higher albedo means that the Earth reflects more sunlight and vice versa (see diagram below).



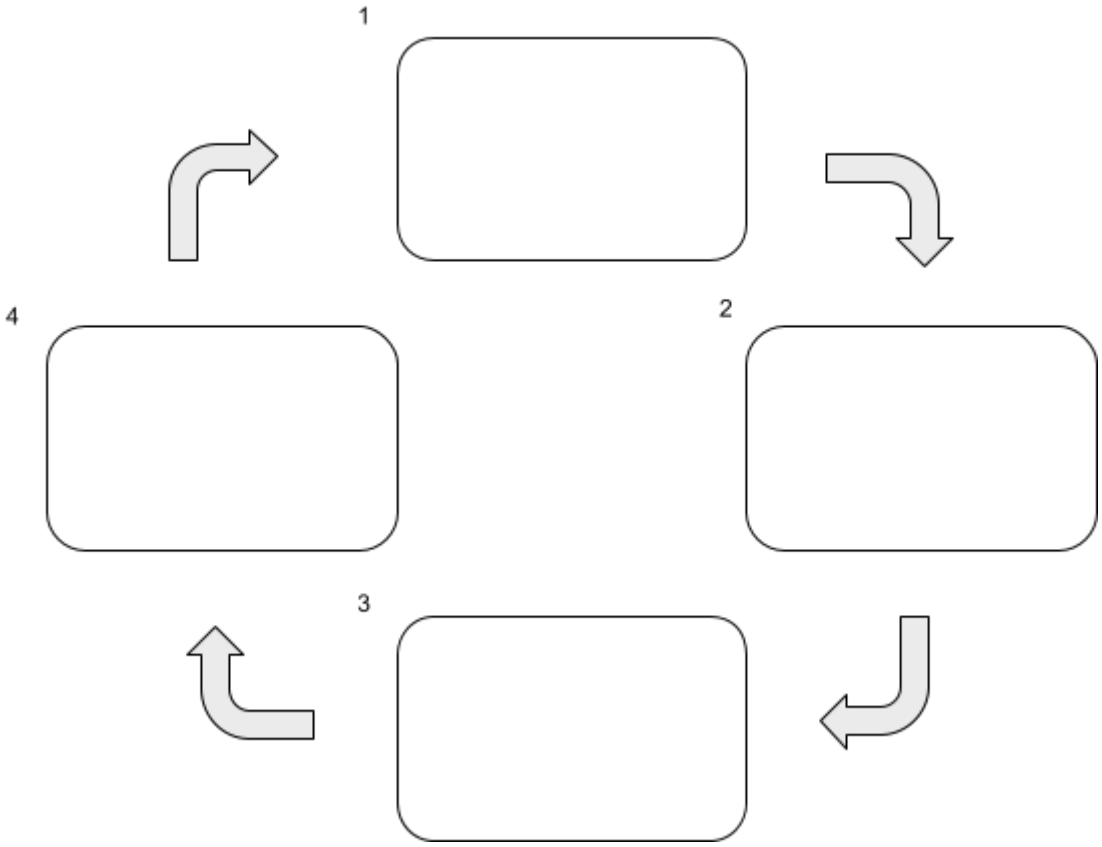
3. Use the computational model linked here to continue investigating the albedo. Experiment with the model by making changes to the albedo to see how the changes affect global air temperature (on the right).
    - The slider on the right allows you to change Earth's albedo.



a. How does changing the albedo affect global air temperature?

b. Why does changing the albedo have this effect on global air temperature?

4. What do the data tell you about the future of meltwater from the Himalayan mountains? Fill in the flowchart using the data from Figures 3, 4, and 5 and the computational model from Question 3 to help you make a prediction.



5. Based on your flowchart and your data analysis, should communities near the Himalayan mountains be worried that they will run out of meltwater in the future? Why or why not? In your explanation include the following:
   - Explain how increases in meltwater cause feedback effects
   - Discuss whether feedback effects stabilize or destabilize the climate system
   - Cite evidence from multiple figures, the computational model, and your flowchart model to support your explanation

Please provide any feedback you have for us about this assessment: What did you like? What was confusing? Etc.