Earth
Global Climate
Passport

Pages 1 - 20

Date _____

How does turning on a light bulb in Bremerhaven change the climate in Niger?

Between 2004 and 2006, Bremen-based architect Axel Werner undertook a journey to discover the global climate connections among locations along the 8th meridian, a line of longitude that runs through Bremerhaven, Germany.

Traveling with Israeli-American filmmaker B.Z. Goldberg, Werner talked to people on five continents as Goldberg captured the stories of people living along the 8th meridian. Throughout the journey, Werner and Goldberg focused on local climate and the effects of climate change on the local environment and people. Their documentary captured the unexpected and unintended consequences of human activities that affect climate on a global scale.

Goldberg's 81 documentary film segments are the focal points for exhibits at the Klimahaus, a unique interactive experience on the 8th meridian in Bremerhaven, Germany. Opened in 2009, Klimahaus interactive experiences are constantly updated to reflect the latest scientific findings. To do so, Klimahaus partners with some of the most prestigious climate research organizations in Germany, including the Max Planck Institute for Meteorology, the German Weather Service, and the Alfred Wegener Institute for Polar and Marine Research.

Visitors to the museum explore climate and climate change mechanisms. Although you will not be able to experience the Klimahaus in person, you can take a virtual tour.

Photo credit: Klimahaus

As you travel through the virtual tour, take notes. Pay close attention to climate, climate change, human impacts, and global connections. Use the tour as an inspiration for a journey you will be creating for a walk along the your longitude line.

Note that videos are in German and in the native languages of the people who live in the places featured in the videos. As you view the videos, focus aon the visual details. Listen carefully. You may be able to understand a few words or discern meaning by careful observation.

Itinerary

Bremerhaven, Germany

Isenthal, Switzerland

Seneghe, Sardinia, Italy

Kanak, Niger

Ikenge, Cameroon

Queen-Maud-Land, Antarctica

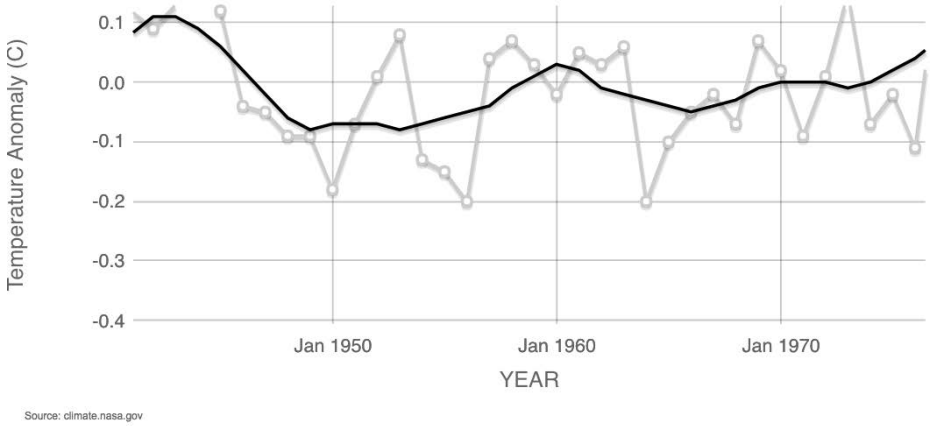
Satitoa, Samoa

Vambell, Alaska, USA

Halligen Langeness, Germany

Date _____

Earth's Surface Temperatures Changes (ºC)



Source: climate.nasa.gov

The dark solid line is a running five year average. An anomaly is a variation from normal. Normal is the 0.0 line on the left vertical axis. What questions do you have about Earth's surface temperature changes? Think like a scientist.

My Questions

Longitudes

8º E **171º W**

Explore the locations on the mp to discover how scientists are monitoring Earth's vital signs, and what's happening to climates at the local, regional, and global scale.

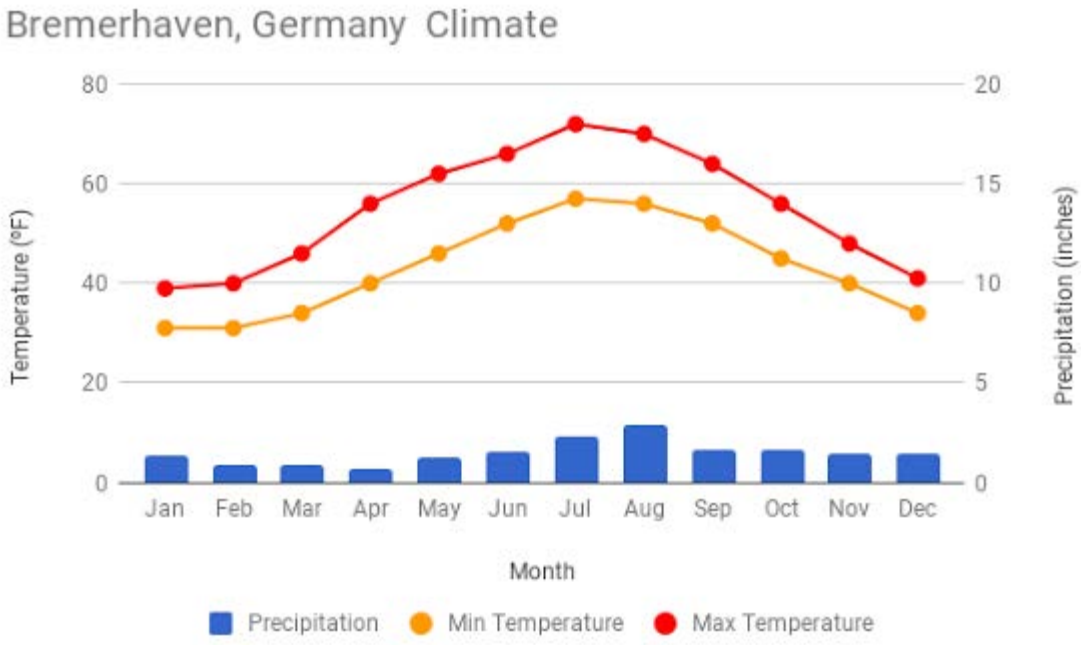
Date _____

Station 1. Bremerhaven

Longitude 8º 5' E Latitude 53º 53' N

Elevation: 6.5 feet Population: 110,121

Climate Type _____



Describe the climate of Bremerhaven using evidence from the graph.

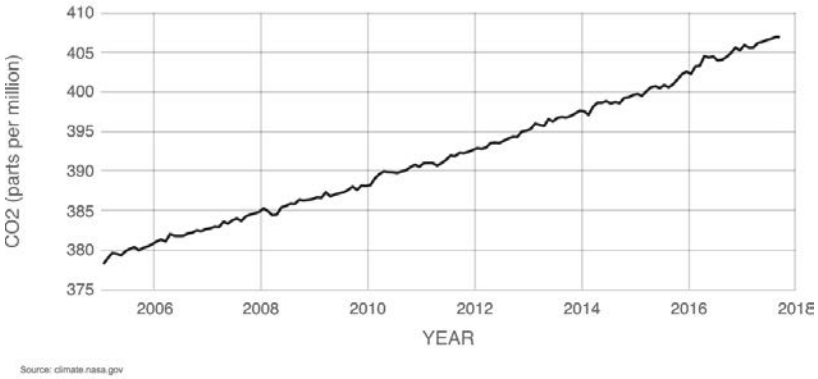
Analyze:
Evidence of Climate Change in Bremerhaven

Probable Effects of Climate Change in Bremerhaven

Date _____

Phenomenon Related to Climate

ATMOSPHERIC CARBON DIOXIDE DIRECT MEASUREMENTS: 2005-PRESENT



Atmospheric carbon dioxide is a greenhouse gas monitored by climatologists. Greenhouse gases warm Earth's atmosphere by stopping and absorbing aoutgoing infrared radiation

Ancient carbon is stored in fossil fuels - coal, gas, oil. Humans release ancient carbon as carbon dioxide through the burning of fossil fuels.

Data source: Monthly measurements (average seasonal cycle removed). Credit: NOAA

What is the trend in atmospheric carbon dioxide? Support your answer with data from the graph.

How do we know this trend is happing? Support your answer with examples from the readings.

How might the trend in atmospheric carbon diozide be related to changes in surface temperatures? Your answer may be in the form of a diagram or text.

Why would Bremerhaven focus on reducing dependence on fossil fuels as a climate ahnge strategy?

Continue your journey to find more information to help you answer the question:How does turning on a light bulb in Bremerhaven change the climate in Niger? Nexr stop Isenthal, Switzerland.

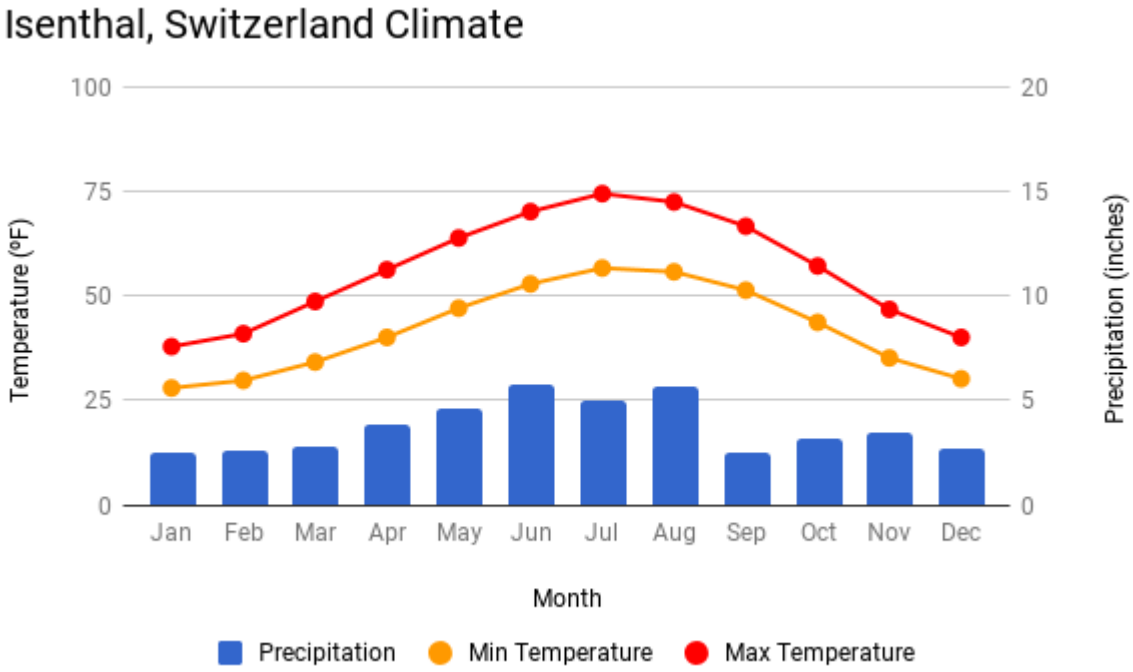
Date _____

Station 2. Isenthal, Switzerland

Longitude 8º 33' E Latitude 46º 55'N

Elevation: 2,530 ft Population: 503

Climate Type _____



Describe the climate of Insenthal using evidence from the graph.

Analyze:
Evidence of Climate Change in Isenthal

Probable Effects of Climate Change in Isenthal

Date _____

Phenomenon Related to Climate Change

Doldenhorn Glacier, Alps

1960

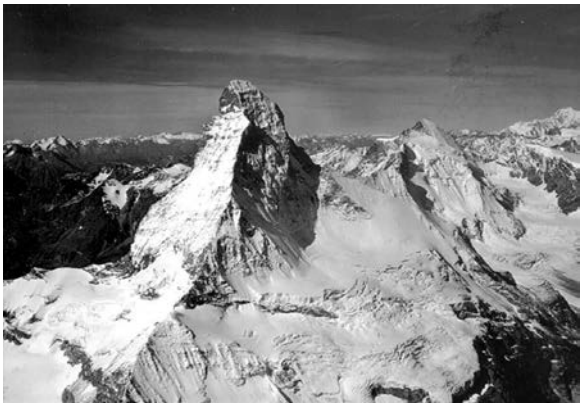
2007

Interpret the Images

Compare the Doldenhorn Glacier in 1960 to the same location in 2007. Describe changes.

Matterhorn Glacier, Alps

1960



2005

Interpret the Images

Compare the Matterhorn Glacier in 1960 to the same location in 2005. Describe changes.

What is the probable cause of the changes in Alpine glaciers?

How do glaciers affect climate?

Describe the effects of glacier changes on climate at the local and global scale.

Continue on your journey. Up next, Seneghe, Sardinia.

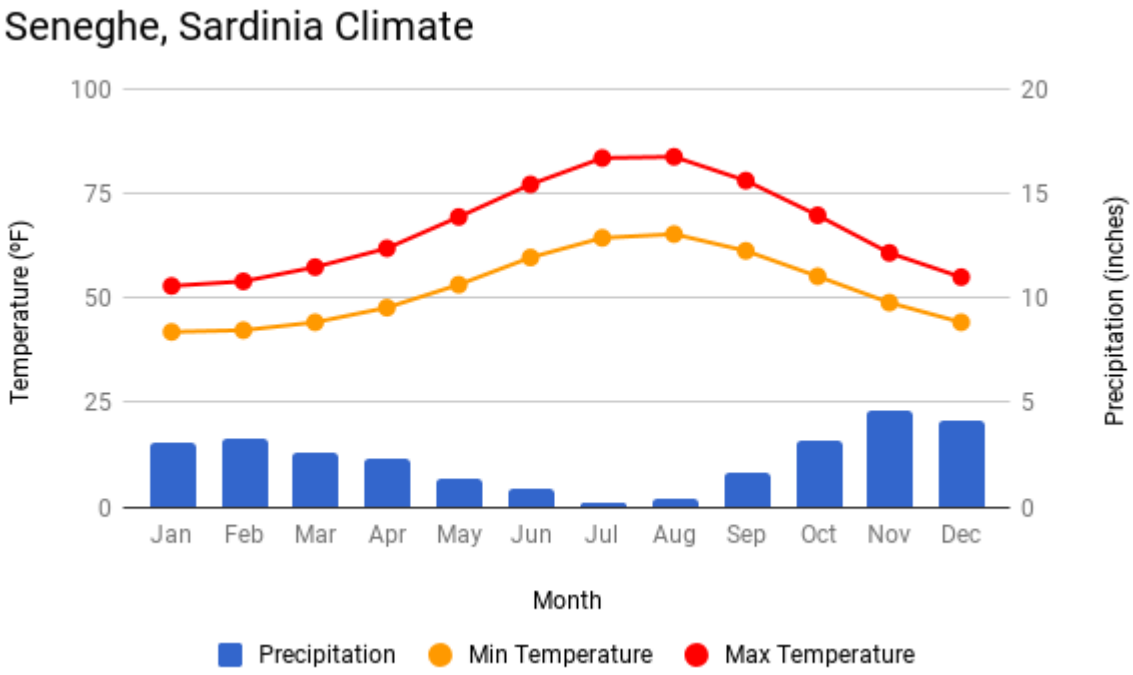
Date _____

Station 3. Seneghe, Sardinia

Longitude 8º 95' E Latitude 40º 8' N

Elevation: 997 ft Population 1,944

Type of Climate _____



Describe the climate of Seneghe using evidence from the graph.

Analyze:
Evidence of Climate Change in Seneghe

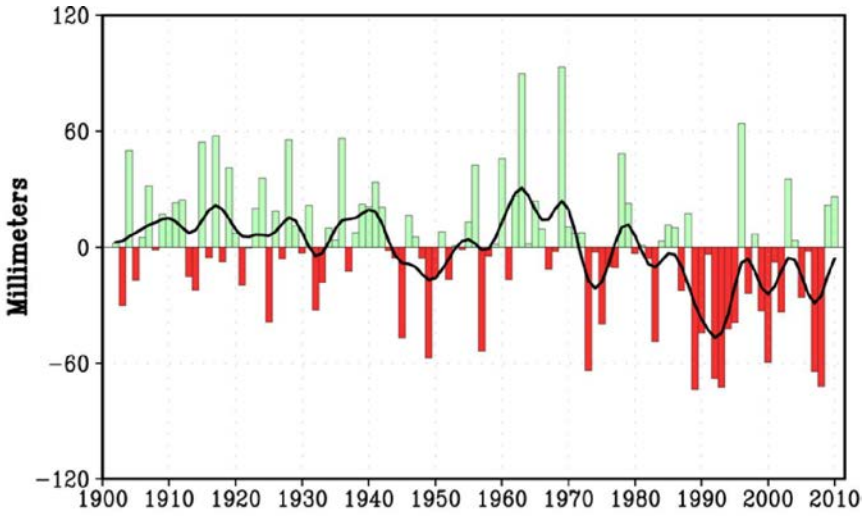
Probable Effects of Climate Change in Seneghe

Date _____

Phenomenon Related to Climate

Use the NASA Time Machine to observe a timeline of change in the Mediterranean.

Winter Precipitation Trends in the Mediterranean Region for the Period 1902 - 2010



The graph shows variations (anomalies) in winter precipitation in the Mediterranean region. The 0-line represents normal precipitation. Years with more than normal rainfall have bars above the normal line. Years with less than normal rainfall have bars below the normal line. The solid line is a running 5 year average.

Describe the trend in winter precipitation since 1990.

Why use a 5-year running average?

How do we know that precipitation is changing?

What might happen if Mediterranean winters continue to be drier than normal?**How has climate**

How could drier winters affect ecosystems in Seneghe?

ontinue on your journey. Next up Kanak, Niger.

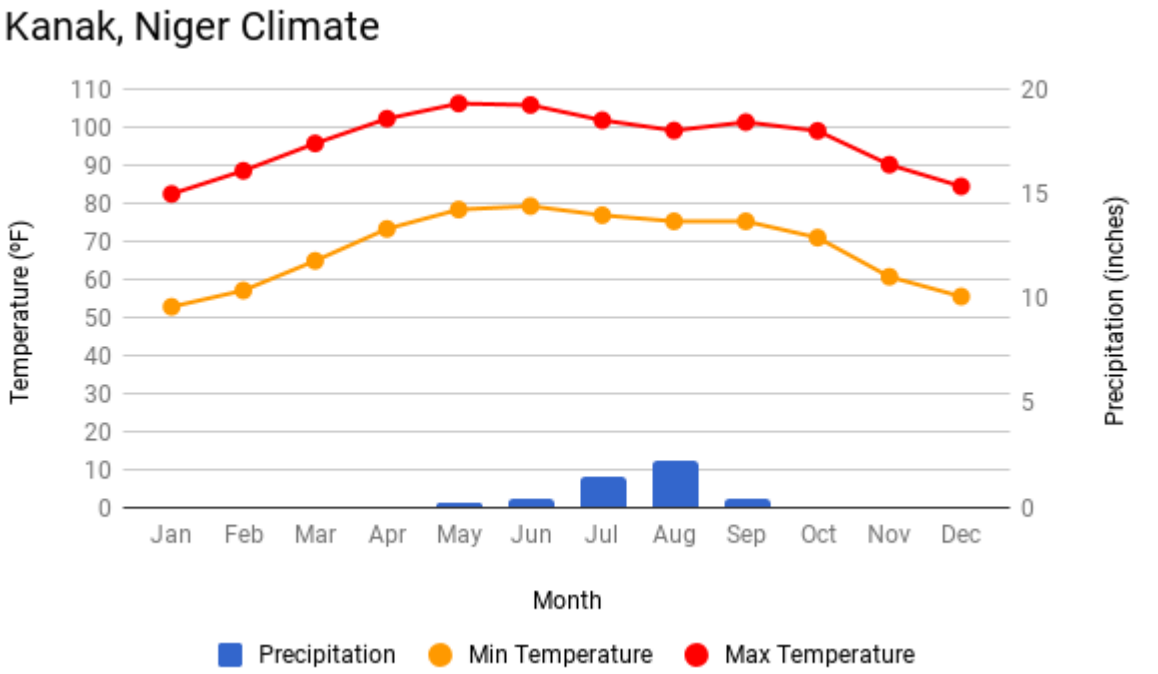
Date _____

Station 4. Kanak, Niger

Longitude 9º 2' E **Latitude 15º 31' N**

Elevation: 300 ft **Population** N/A

Climate Type _____



Describe the climate of Kanak using evidence from the graph.

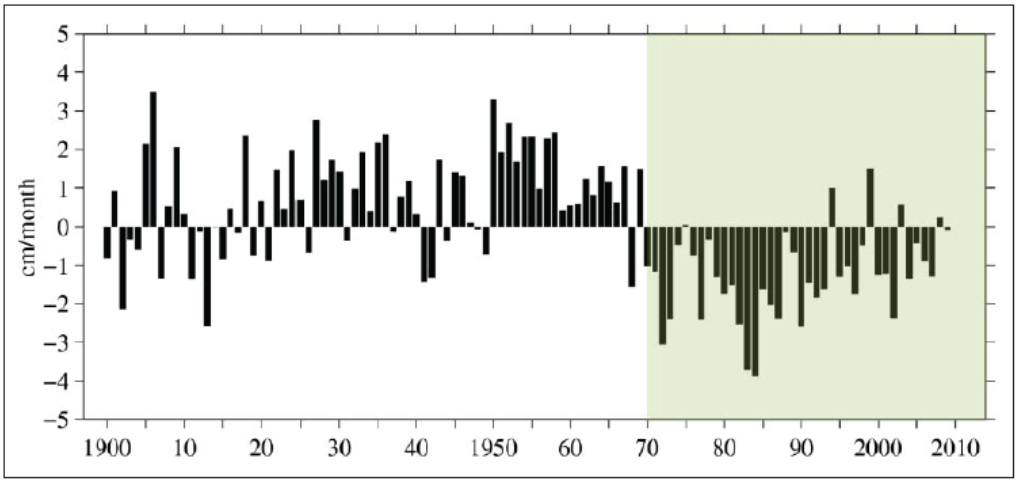
Analyze:
Evidence of Climate Change in Kanak

Probable Effects of Climate Change in Kanak

Date _____

Phenomenon Related to Climate

Figure 4. Mean seasonal rainfall in the region (1900-2009)



The graph shows variations in seasonal rainfall. The 0-line is the normal line. Years with higher than normal rainfall have bars above the line. Years with less than normal rainfall have bars below the line.

Source: NOAA

Describe the trend in seasonal rainfall in the Sahel region since 1970.

How do we know precipitation is changing?

What geographical factors make Niger prone to desertification?

How has climate change affected water si[[;oes in Niger?

Why is precipitation changing?

Why does turning on a light bulb in Bremerhaven affect climate in Niger”

How could reforestaation reverse desertification?

Continue on your journey. Next up Ikenge, Cameroon.

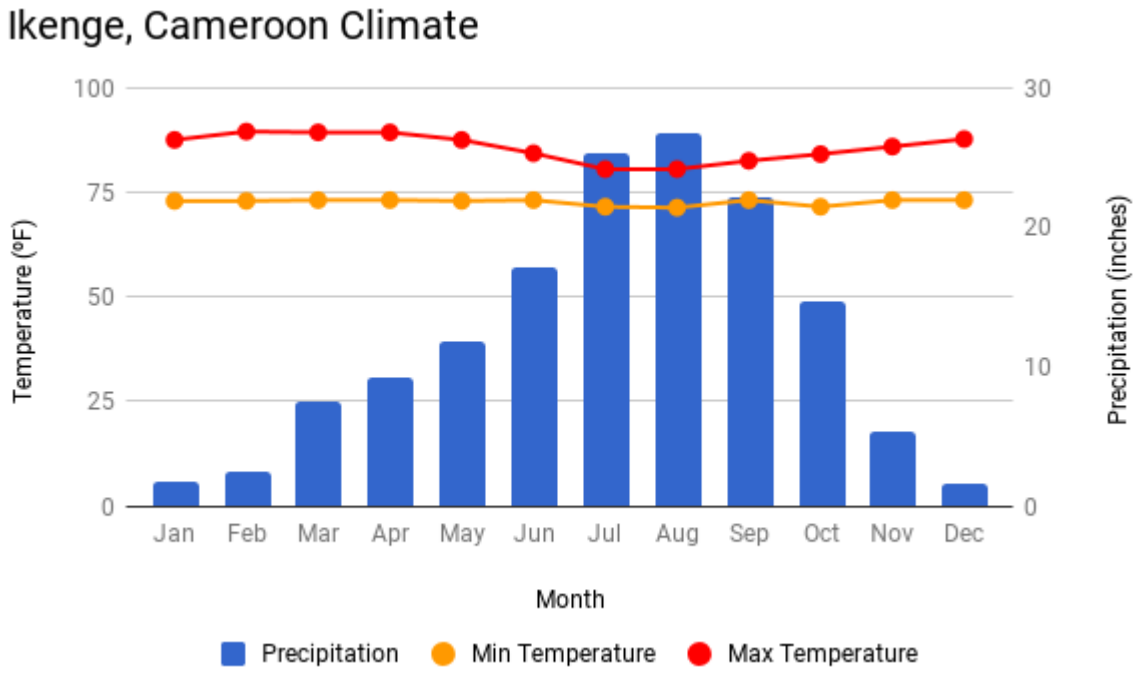
Date _____

Station 5. Ikenge, Cameroon

Longitude 9º 6' E **Latitude 5º 16' N**

Elevation: **1,500 feet** **Population N/A**

Climate Type _____



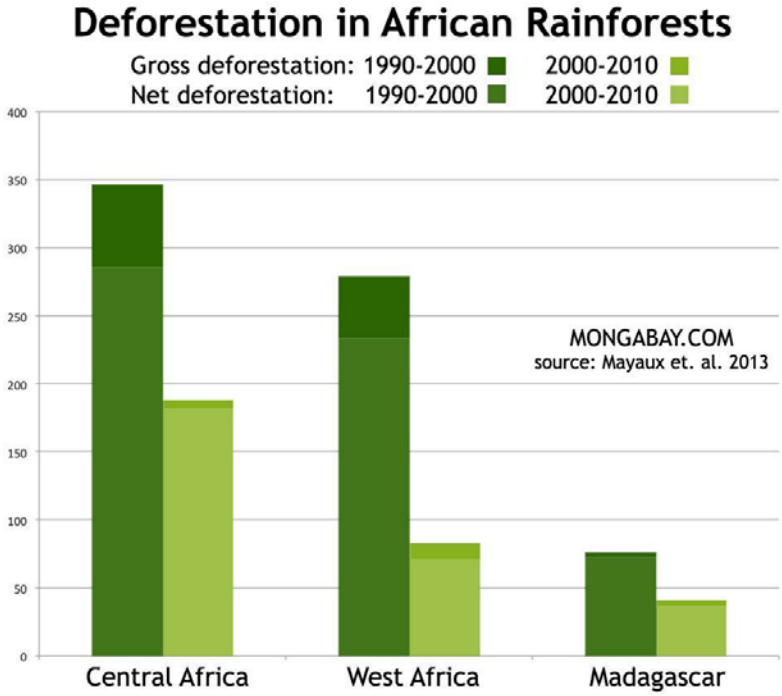
Describe the climate of Ikenge using evidence from the graph.

Analyze:
Evidence of Climate Change in Ikenge

Probable Effects of Climate Change in Ikenge

Date _____

Phenomenon Related to Climate



West African rainforests are being cleared for agriculture. Global demand for palm oil has spurred replacement of rainforests with plantations of palm oil producing trees.

Rainforests make their own rain. Plants take in water and carbon darbondioxide. Throught the process of photosynthesis, plants produce glucose and oxygen. Plants use glusose as a building material and as fuel for cell processes. Excess glucose is stored as starch. Water is produced during the conversion process. Plants maintain a their water balance by releasing extra water from their leaves. This process is call evapotransipiration

At the current rate of deforestation, the African rainforest my not be able to offset carbon dioide emission from the burning of fossil fuels. How do plants influence climate?

Predict what will happen to climate as the result of deforestation of African rainforests. Support your prediction with scientific reasoning.

Predict the outcome of reforestation efforts. Support your prediction with scientific reasoning.

Continue on your journey. Next stop !ueen Maud Land, Antarctica.

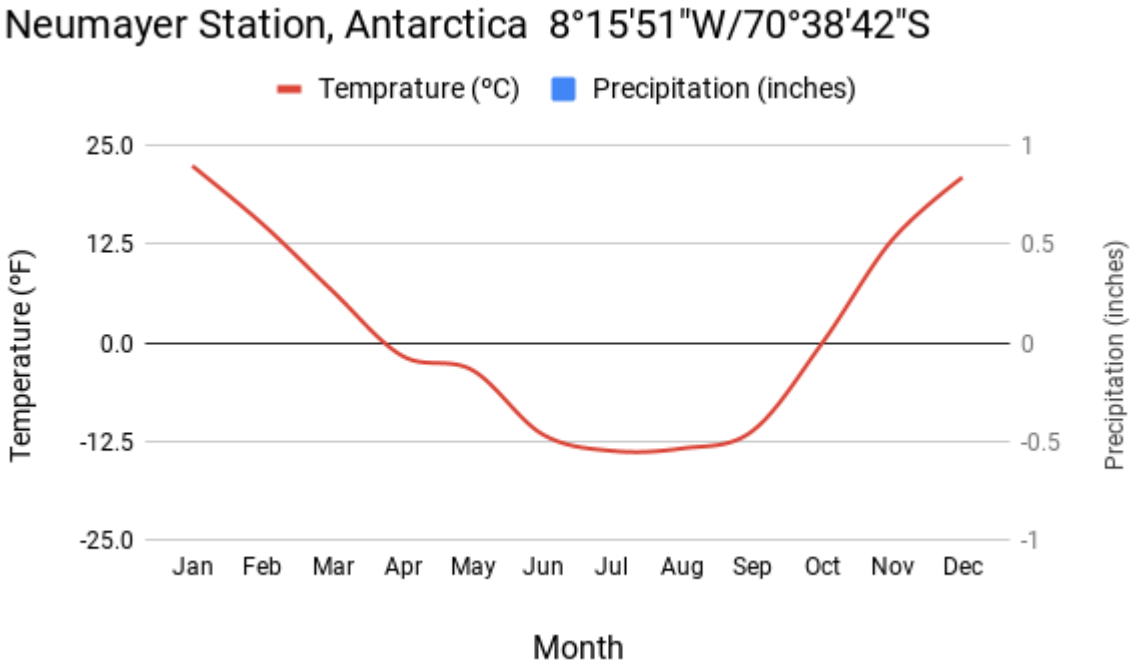
Date _____

Station 6. Queen Maud Land, Antarctica

Longitude 8º 34' E **Latitude 73º 30' S**

Elevation: 141 feet **Population** N/A

Climate Type _____



Describe the climate of Queen Maud Land using evidence from the graph.

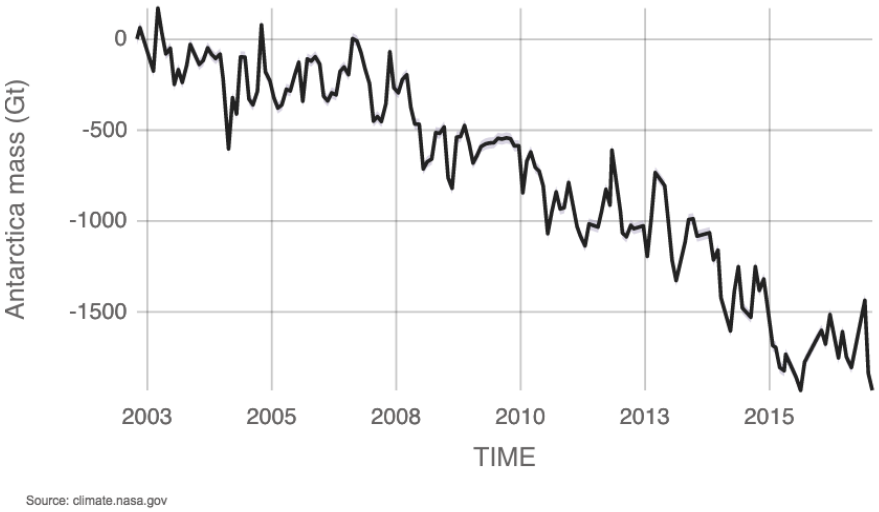
Analyze:
Evidence of Climate Change in Queen Maude Land

Probable Effects of Climate Change in Queen Mayd Land

Date _____

Phenomenon Related to Climate

ANTARCTICA MASS VARIATION SINCE 2002



The graph shows changes in the Antarctica ice mass.
Data source: Ice mass measurement by NASA's GRACE satellites. Credit: NASA

Describe the trend shown in the graph.

How do we know this is happening?

What is the probable cause of the phenomenon?

How does Antarctic ice mass affect climate on a local and global scale?

How are climate change in Antarctica and climate change in Bremerhaven related? Support your answer with evidence and scientific reasoning.

Continue on your journey. Next stop Satitoa, Samoa

Date _____

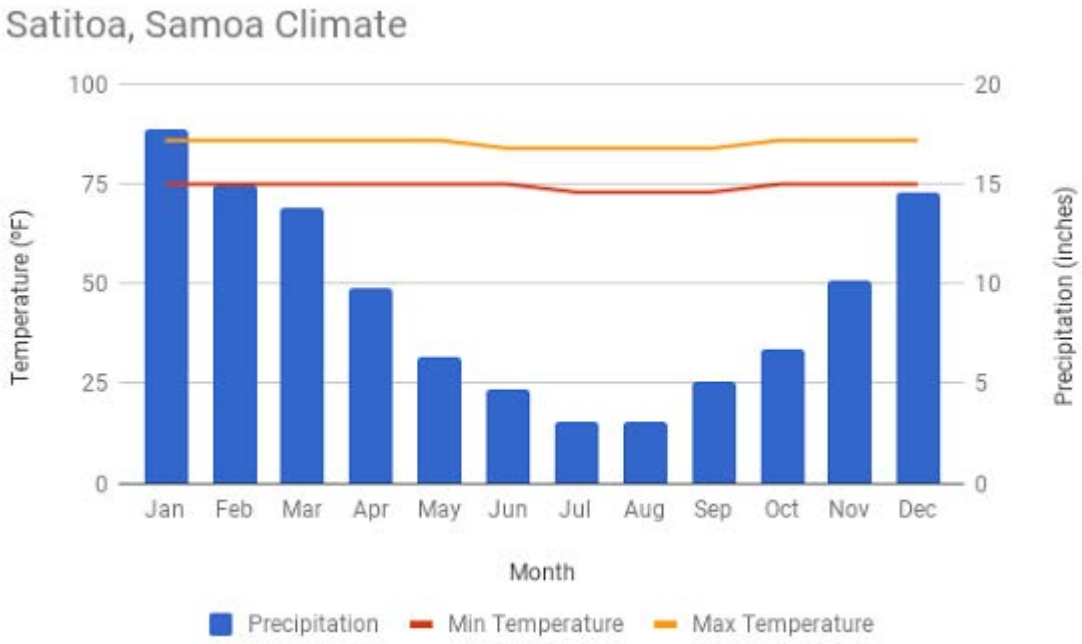
Station 7. Satitoa, Samoa

Longitude 171º 22' W Latitude 14º 1' S

Elevation: 3 feet Population 522

Climate Type

_____



Describe the climate of Satitos using evidence from the graph.

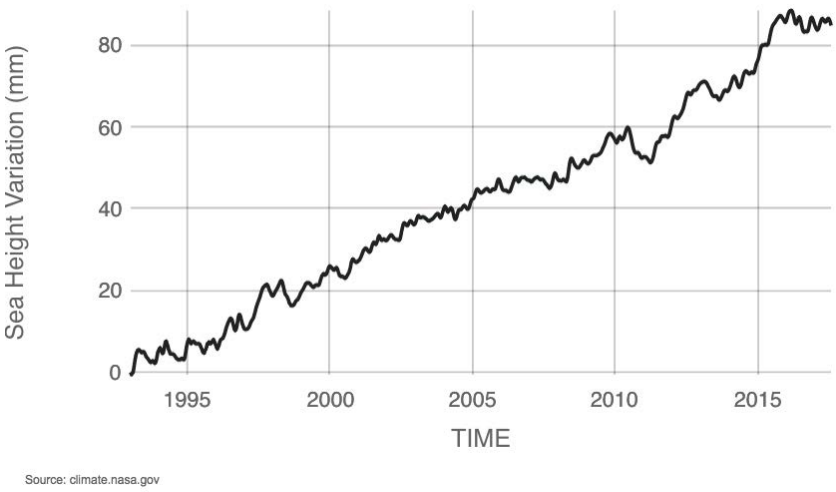
Analyze:
Evidence of Climate Change in Satitos

Probable Effects of Climate Change in Satitos

Date _____

Phenomenon Related to Climate

SEA LEVEL SATELLITE DATA: 1993-PRESENT



The graph shows the changes in sea level as measured by satellites since 1993. Melting land glaciers explain some of the sea level rise. Another contributing factor is seawater expansion. As ocean water becomes warmer, the molecules in seawater spread out increasing the volume and changing the density of the seawater and possibly ocean current circulation. Warmer seawater may also affect the atmosphere because it absorbs less carbon dioxide.

Data source: Satellite sea level observations.

Credit: NASA Goddard Space F

Describe the trend shown in the graph.

How do we know that sea levels are changing?

Use the Explore More links to collect more evidence.

Ise evidence to support or refute predicted impacts of climate change on S

Date _____

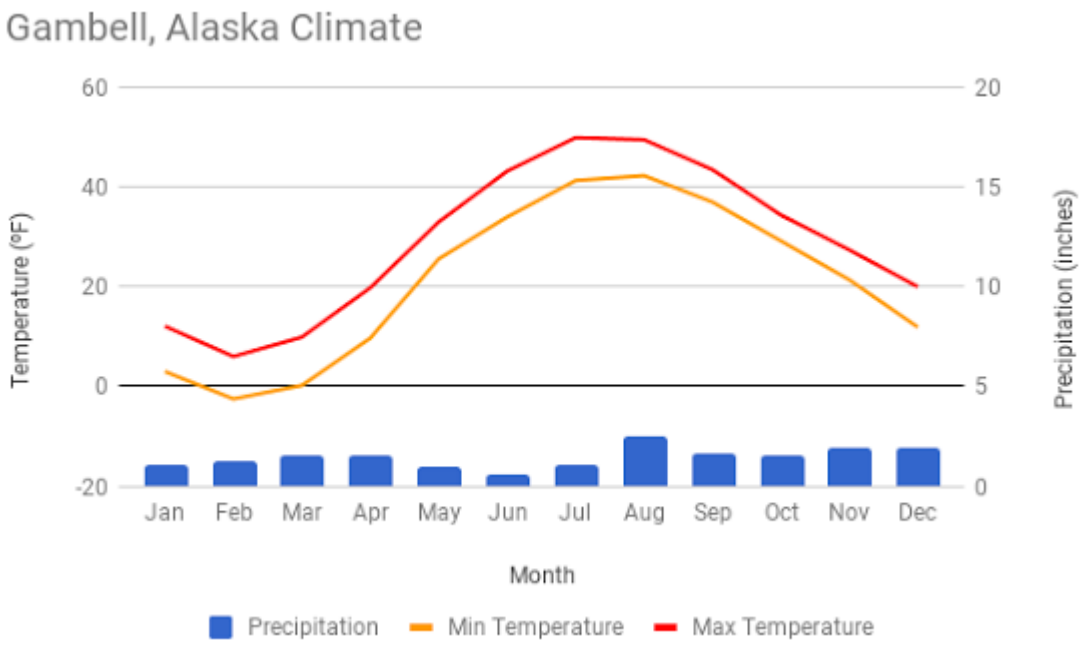
Continue on your journey. Next stop Gambell, Alaska, USA.

Station 8. Gambell, Alaska

Longitude 171º 44' W **Latitude 63º 46' N**

Elevation: 0 ft **Population 681**

Climate Type _____



Describe the climate of Gambell using evidence from the graph.

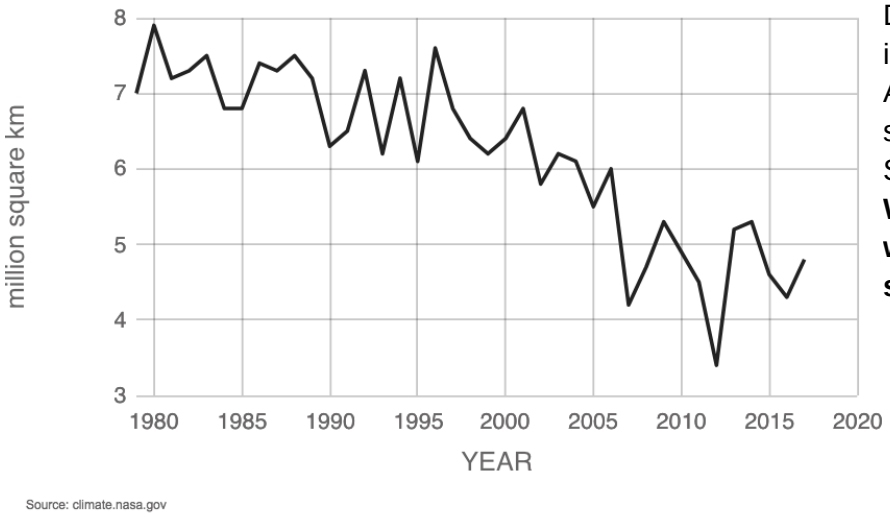
Analyze:

Evidence of Climate Change in Ganbell

Date _____

Phenomenon Related to Climate

Arctic Sea Ice Minimum Average September Extent



During the winter, Arctic sea ice increases. During the summer, Arctic sea ice decreases. Arctic sea ice reaches a minimum in September (autumnal equinox).

Why does sea ice increase in the winter and decrease in the summer?

Data source: Satellite observations.

Credit: NSIDC/NASA

Describe the trend in Arctic sea ice since 1990.

How do we know this is happening?

What is causing the change in arctic sea ice?

What are the effects of changing arctic sea ice?

How has changing sea ice affected life in Gamblell?

Continue to Halligen Langeness, Germany to exit the Klimahaus.
Next, check your understanding.

Date _____

Check Your Understanding

Climate is the result of complex interactions among Earth's atmosphere, land, and water. Turning on a light bulb in Bremerhaven was a metaphor for human activities that contribute carbon dioxide and other greenhouse gases to Earth's atmosphere. The concentration of greenhouse gases influences climate by changingfactors like temperature, precipitation, and sea level.

- Starting with the ;light bulb, create a diagram that **shows** interactions and impacts you explored during your journey.
- Focus on cause nd effect.
- **Include the following keywords:**
  atmosphere, land, water, carbon dioxide, greenhouse gases, surface temperatures, sea level rise, glacial retreat (land ice), rainforest deforestation, arctic sea ice, antarctic ice mass, seawater expansion, climate.

Sample Information Organizer for Planning

Casue	**Effect**	**Impact**	**Example**

.Questions I Still Have

Something I Want to Explore

Date _____

NSTA Engage Spring21
#33329: NMLSTA-Sponsored Session: Inspired by Germany—Understanding Global Climate Change to Take Local Action

Standard: Weather and Climate
https://ngss.nsta.org/DisplayStandard.aspx?view=topic&id=37

Presenter Contact Information
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Website Links

Exploring Global Climates http://bit.ly/421CHEN

Transatlantic Outreach Program https://www.goethe.de/ins/us/en/spr/eng/top.html

National Middle Level Science Teachers Association https://nmlsta.wildapricot.org/

Example of a Climate Story