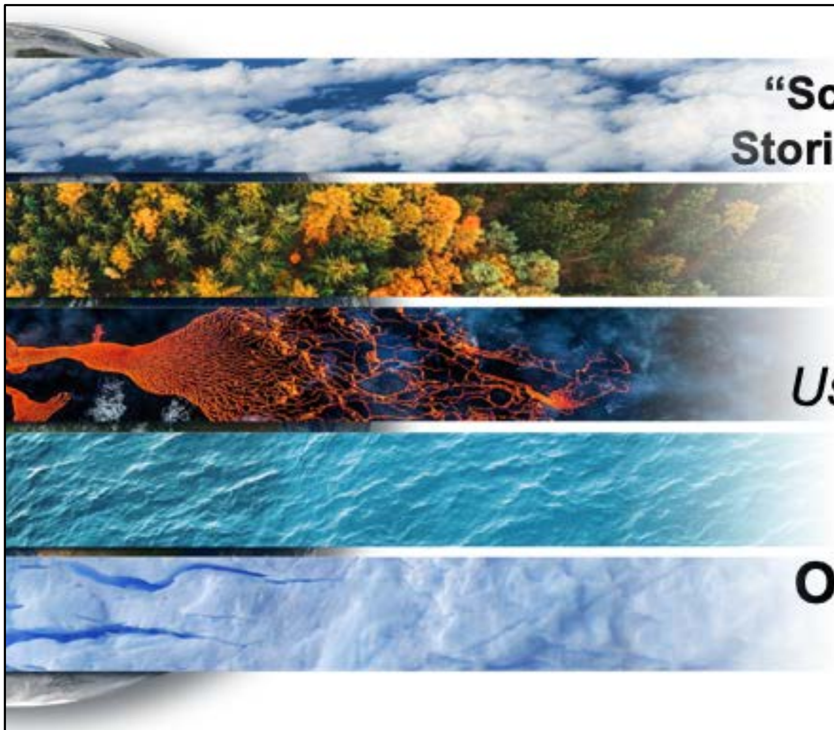
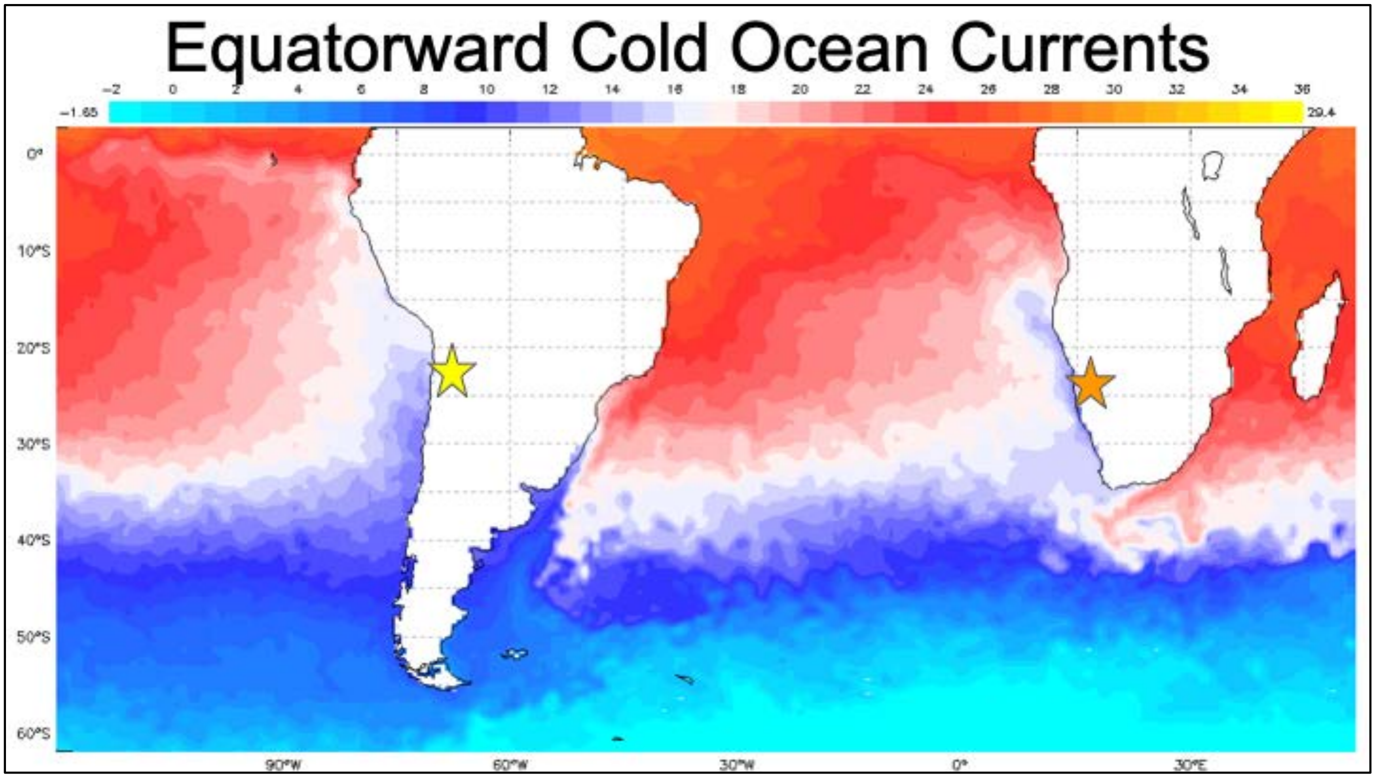


"Scientifically-Interesting Stories with *My NASA Data*"

Using NASA Data To understand…

Ocean Circulation



Teacher Talking Points:

This mapped plot from the Earth System Data Explorer shows Sea Surface Temperature observed on 9/1/2018 of the Southern Hemisphere. These sea surface temperature data show the temperature of the ocean at depths of 0-10 meters and are provided in units of degrees Celsius. (These data are provided by the Group for High Resolution Sea Surface Temperature (GHRSST) which is an open international science group that promotes the application of satellites for monitoring sea surface temperature.)

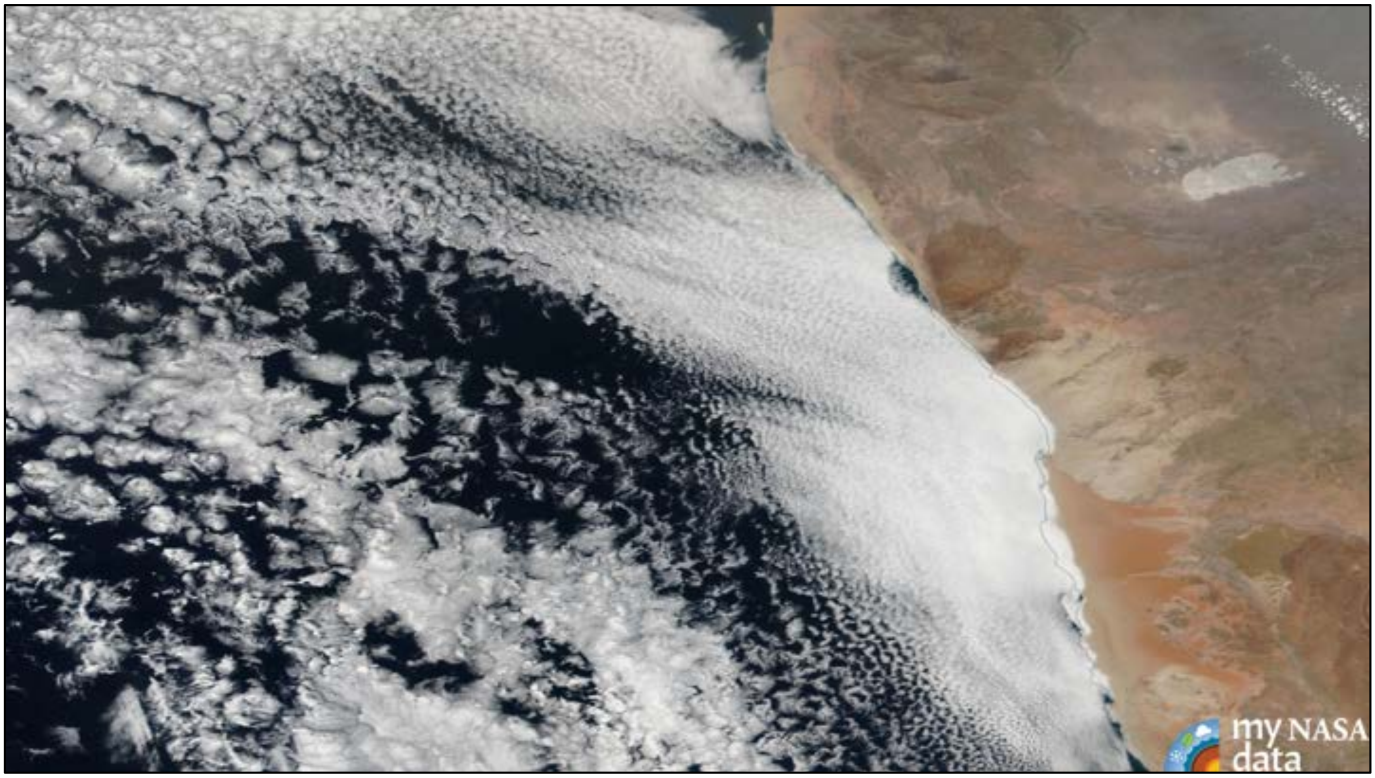
Notice the *yellow star* showing the general location of the Atacama Desert in Chile, while the *orange star* shows the Namib Desert in South Africa and Namibia.

Focus Questions:

1. What do these deserts have in common?
2. What effect do you think the cold ocean water has on these deserts?
3. What effect does the current have on other parts of the Earth System?

Related Resources: Consider using the My NASA Data Map Cube and Question Sheet with this map. See link for details.

Image Credit: Earth System Data Explorer (To visualize Sea Surface Temperature in the Earth System Data Explorer, visit this link.)



Teacher Talking Points:
Cold currents in the subtropics have the interesting effects on other parts of the Earth System.

<u>Focus Questions:</u>

1. How does this work?
   Air that originates over cold oceans is dry when warmed, so there is a lot less precipitation over land areas near cold ocean waters compared to warm ocean waters, especially in the subtropics. Cold currents cool air that moves from the land to saturation, forming clouds and shallow convection of the atmosphere.

Image credit: NASA Earth Observatory

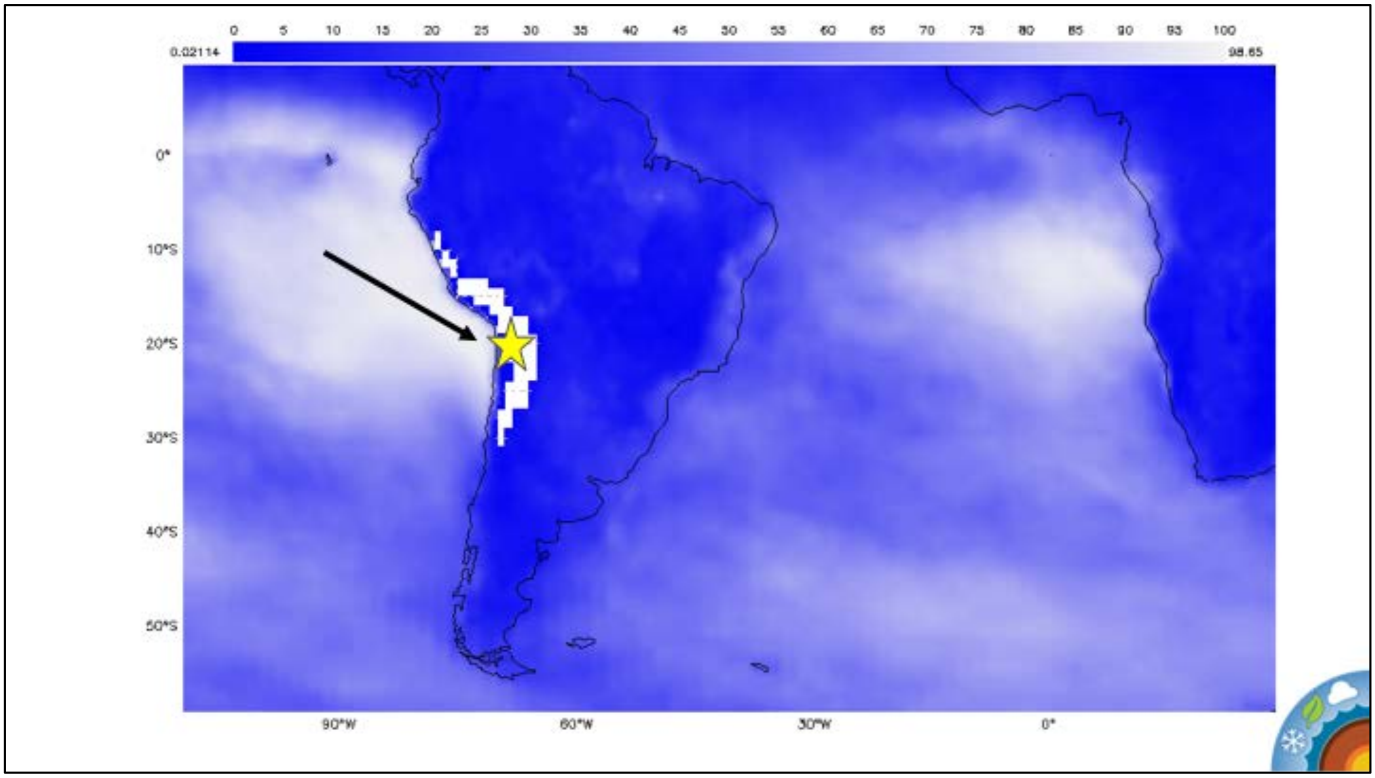
Teacher Talking Points:

The Namib Desert is one of the driest places in the world; yet its coast line is also one of the foggiest areas on Earth….thanks to the convergence of cold water from the Benguela Current and air circulating from the Hadley Cell. A fog belt is created as the water in the air above the ocean condenses due to the cold ocean current, creating fog. This fog is persistent and can stay around for nearly 180 days. Namib and Atacama deserts are 'fog deserts' meaning that they get their main source of water from the fog. Image 1 shows concentrations of shallow, low-level clouds and fogs (Image shows fog in the Namib desert).

Image Credit: The Atlantic

Teacher Talking Points:
It is no wonder that the Biosphere has adapted to this fog. The darkling beetle takes advantage of this phenomenon by climbing to the top of the sand dunes and raising its abdomen in the air allowing the water in the fog to condense and run down its back and into its mouth! That’s pretty clever.

Image Credit: Smithsonian Institution



Teacher Talking Points:

These data show Low-level Cloud Coverage data collected in September 2018 off the Chilean coast near the Atacama Desert. The Yellow Star marks the desert's location. This quantity describes the total percent cloud cover 0-3 km (0-1.9 miles) above the surface. Because stratus clouds typically form close to the surface, they are primarily found at this level. These data are presented in units of percent coverage; percent coverage is the amount of the sky that would be covered by these type of clouds if you were on the ground and you looked up.

<u>Focus Question:</u>

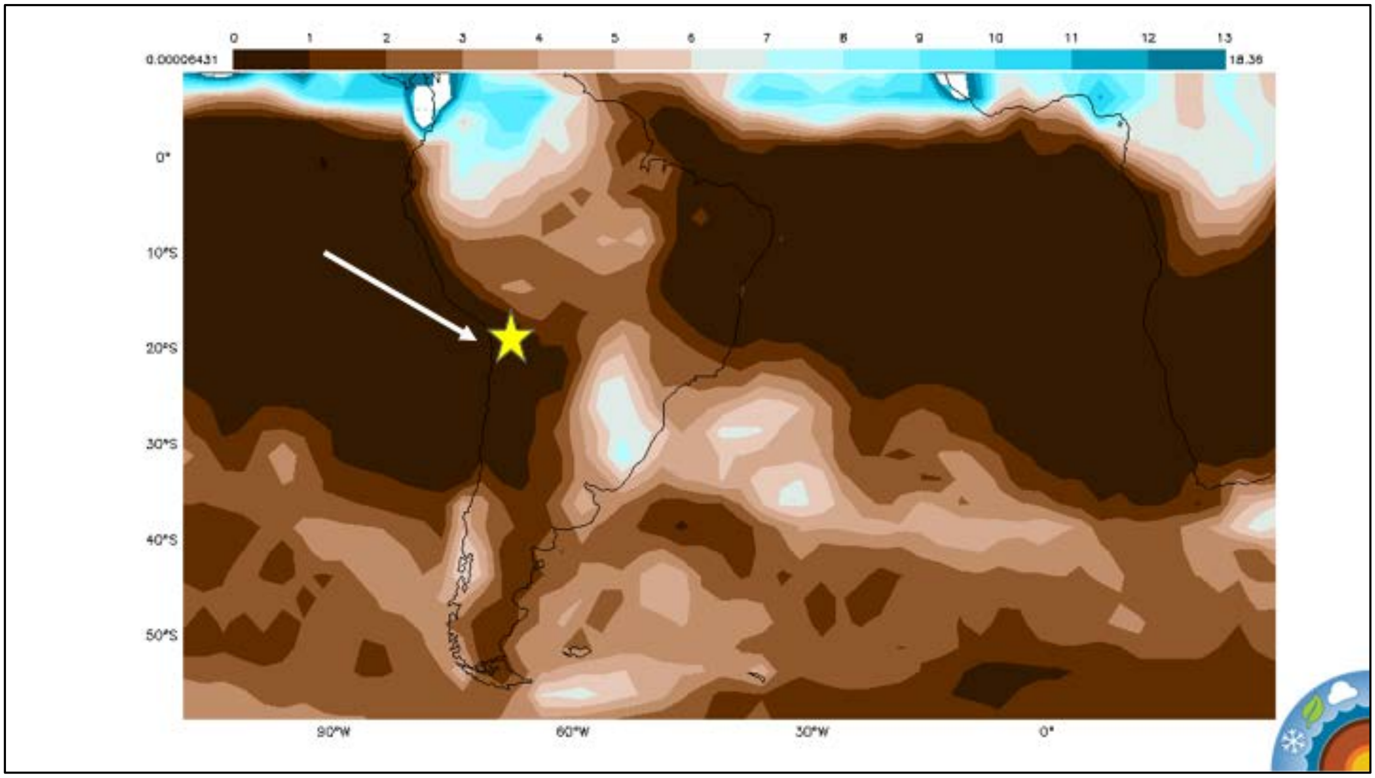
1. What do you observe about the cloud cover over the ocean near the coast line where the black arrow is pointed?

   Students should notice a high percentage of low cloud cover off South American (and African) coast.

Note: The blank pixels above the Atacama Desert indicate that data is missing from this region. The data shown here are percentages of low cloud cover. There are missing data in this part of South America, since the elevation of the surface is above the level of low clouds (defined in this data set as clouds up to 600 mb - about 4200 meters in elevation). This region is where the tallest peaks and plateaus of the Andes mountains are found.

Related Resources: Consider using the My NASA Data Map Cube and Question Sheet with this map. See link for details.

Image Credit: Earth System Data Explorer (To visualize Low-level Cloud Coverage in the Earth System Data Explorer, visit this link.)



Teacher Talking Points:

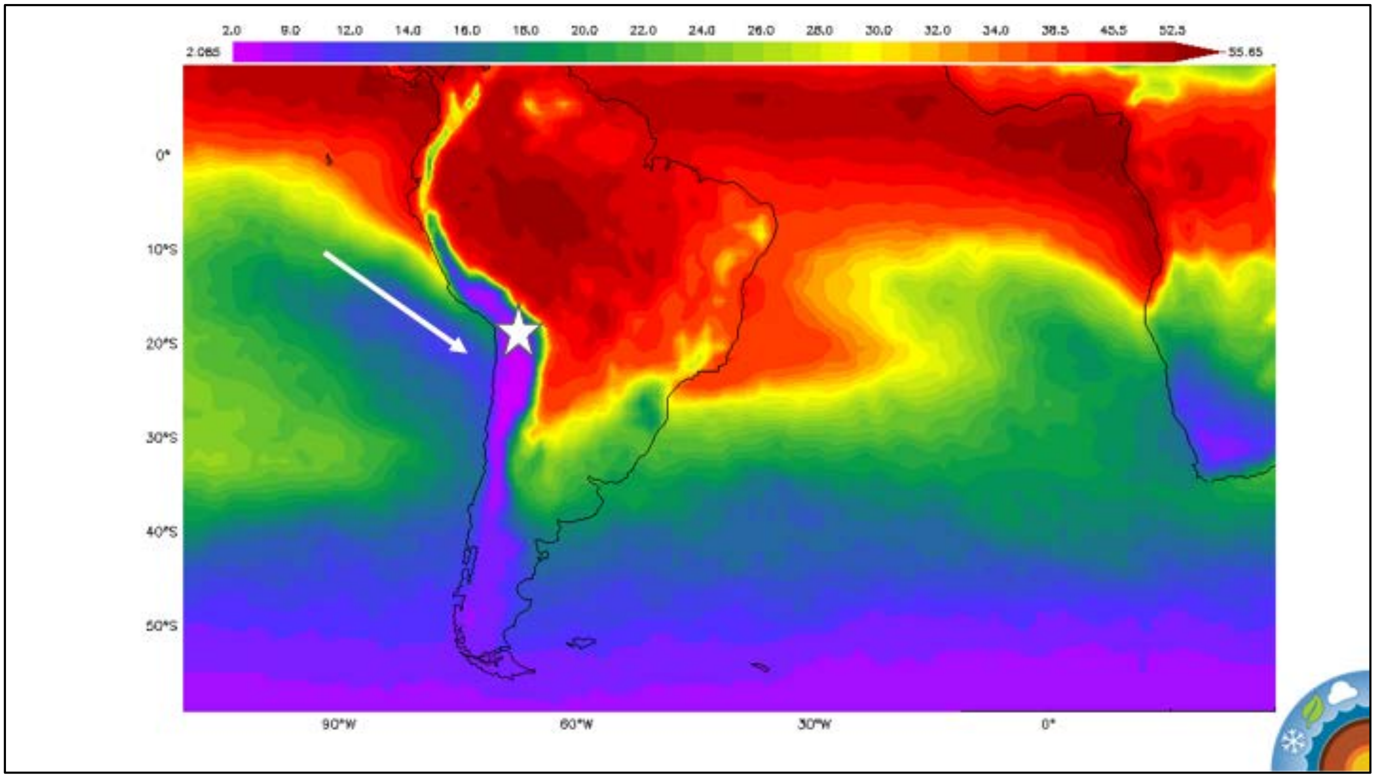
These data show Precipitation data collected in September 2018 off the Chilean coast near the Atacama Desert. This quantity describes the monthly average precipitation rate, calculated by taking the total precipitation that falls at a location and dividing the number of days in a month. It does not mean that precipitation consistently falls at this rate throughout the month at any location. The units of the precipitation rate are millimeters per day. If an inch of rain falls per day at a location, then the precipitation rate would be 25.4 mm/day. The Yellow Star marks the desert's location.

Focus Question:

1. What do you observe about the precipitation data over the ocean near the coast line where the white arrow is pointed.

   Students should observe no precipitation off South American (and African) coast.

Related Resources: Consider using the My NASA Data Map Cube and Question Sheet with this map. See link for details.
Image Credit: Earth System Data Explorer (To visualize Monthly Precipitation in the Earth System Data Explorer, visit this link.)



Teacher Talking Points:

These data show the average Atmospheric Water Vapor data collected in September 2018 off the Chilean coast near the Atacama Desert.

Recall that depending upon its temperature, water comes in three different forms: solid (ice), liquid (rain drops), and gas (invisible to human eyes). As water grows hotter it eventually changes from a liquid into a gas. This gas is called *water vapor*. Water vapor is a very important part of Earth's atmosphere because it traps heat near the surface and keeps our planet warm. Water vapor is also important because as it rises into the atmosphere it cools and turns back into water droplets. As more water droplets appear, they eventually form a cloud. Some clouds produce rain and snow, bringing fresh water back to the surface. So scientists monitor water vapor because it influences Earth's weather patterns, and because it is a very important part of our world's climate system.

The total atmospheric water vapor is the amount of water vapor in the column of air from the surface to the top of the atmosphere. The units of the data are the depth of a puddle, in millimeters, that would exist if all of the water vapor in the column was condensed into liquid water at the surface. The units of atmospheric water vapor are millimeters. A millimeter is a small unit of thickness. A millimeter is equal to the thickness of a stack of 10 sheets of printer paper. There are 25.4 millimeters in 1 inch.

The White Star marks the desert's location.

Focus Question:

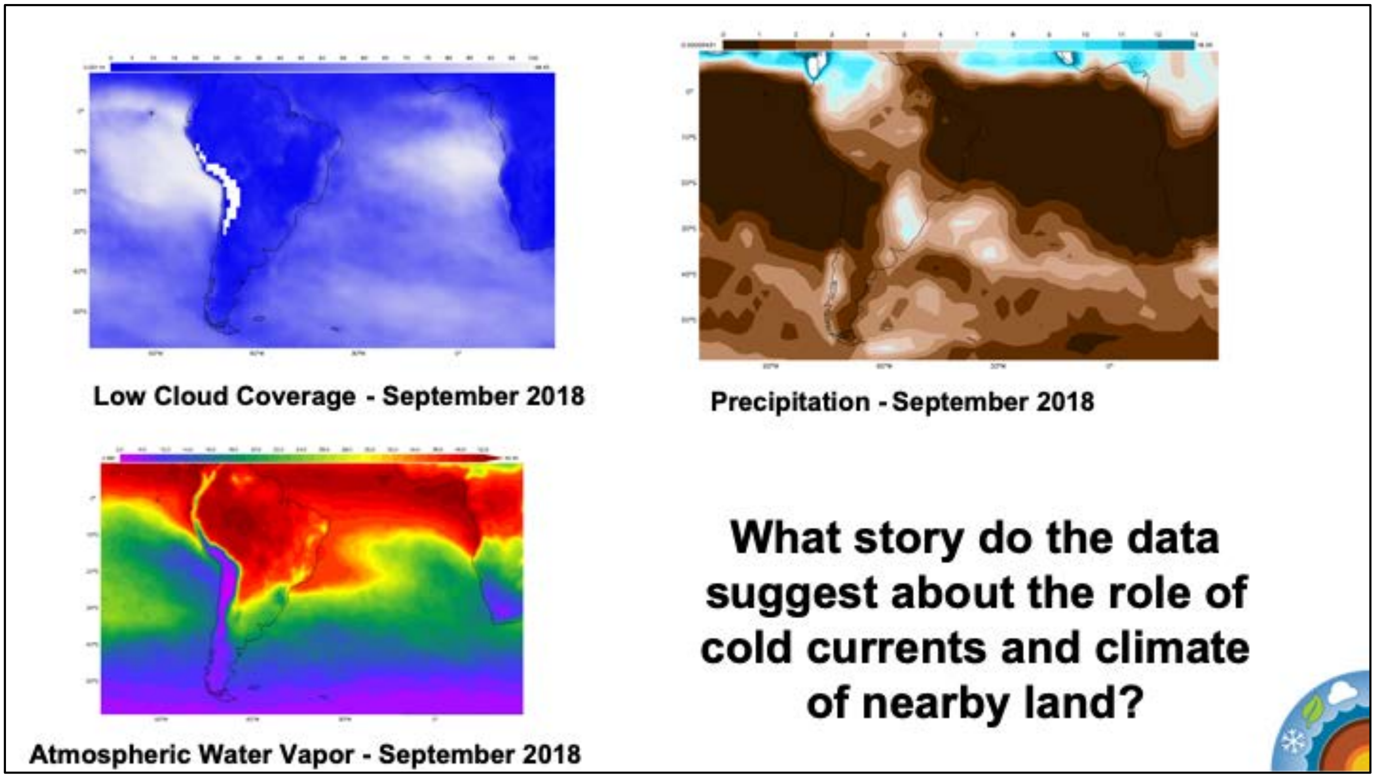
1. What do you observe about the water vapor data over the ocean near the coast line where the white arrow is pointed.

   Students should observe the lack of water vapor over cooler oceans off South American (and

African) coast.

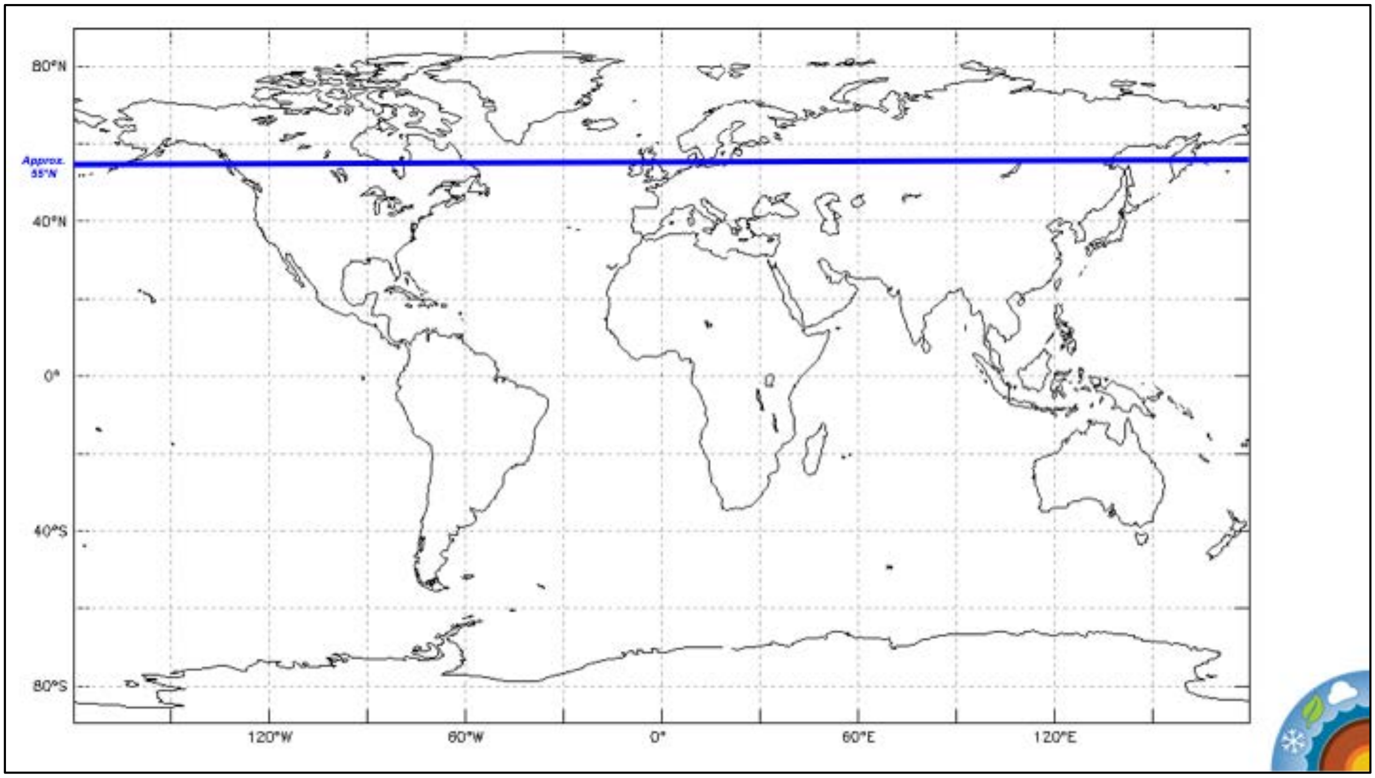
Related Resources: Consider using the My NASA Data Map Cube and Question Sheet with this map. See link for details.

Image Credit: Earth System Data Explorer (To visualize Atmospheric Water Vapor in the Earth System Data Explorer, visit this link.)



Teacher Talking Points:

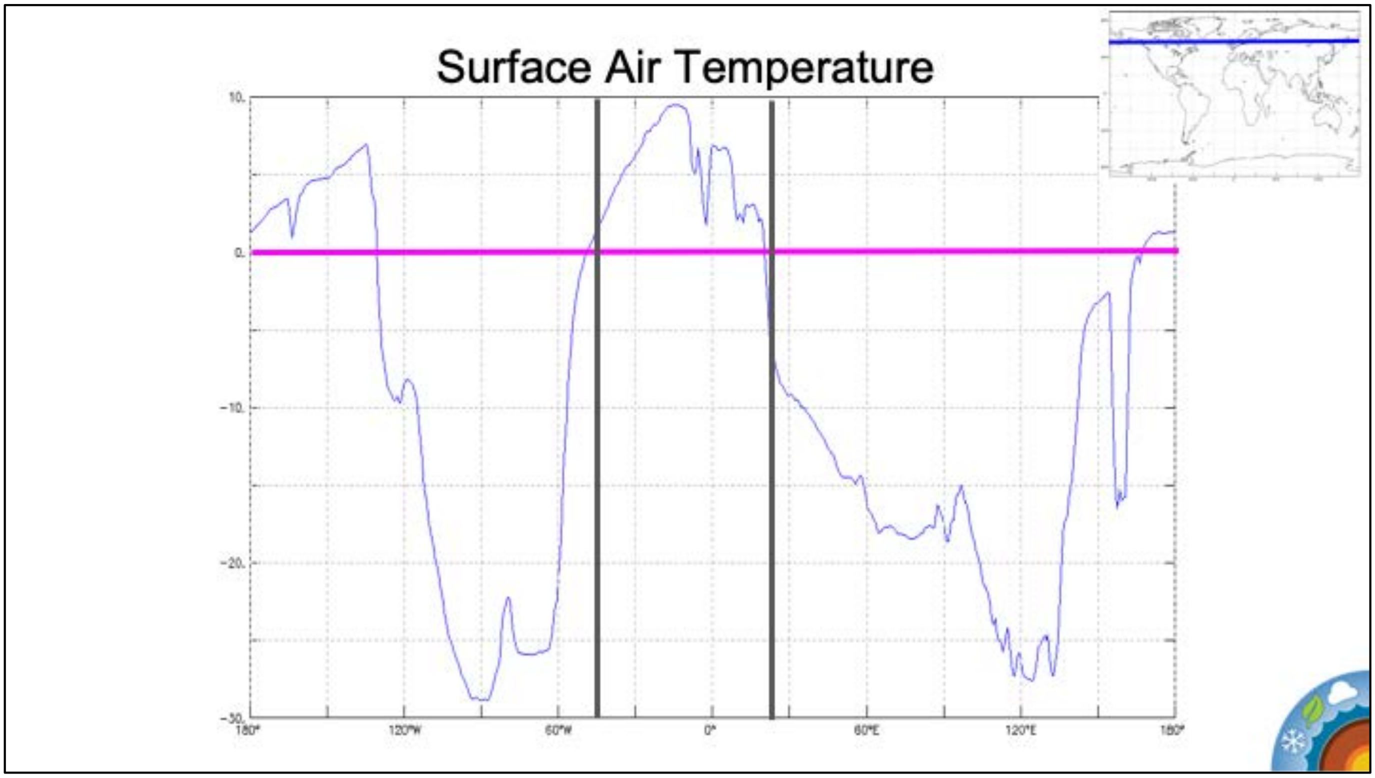
Cold currents off the coast of each of these deserts defines their climate. This is evidenced by a lack of precipitation over the regions with cold ocean waters offshore and high amounts of low cloud cover. For more information, visit the NASA Earth Observatory Story here.



Teacher Talking Points:

1. Draw students' attention to the 55°N
2. Have students identify landforms and ocean basins.
3. Students may predict where along the line they expect to find warm air temperatures, sea surface temperatures, and sea and ice concentrations.

55°N is the line of latitude featured in the following graphs.



Teacher Talking Points:

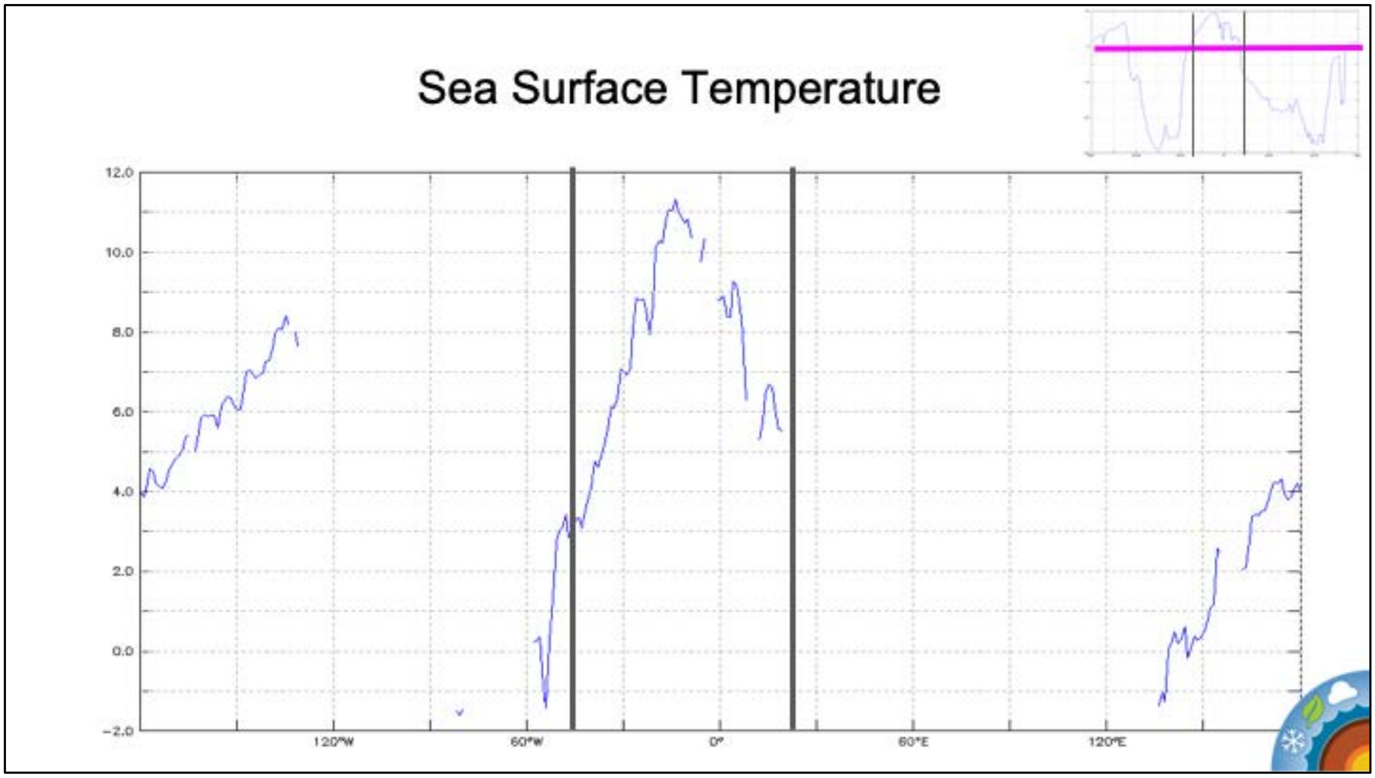
This plot shows Surface Air Temperature observed on January 2019 at **55°N** from the Earth System Data Explorer. The quantity describes the monthly average temperature of air close to the surface. This temperature is typically measured at 2 meters above the surface. The surface air temperature is different than the skin temperature, which is the temperature of the topmost layer of the land, ocean, or ice surface. During the daytime, especially over some types of land surfaces exposed to direct sun, the surface air temperature is less than the skin temperature. Surface air temperature is measured in degrees Celsius.

Focus Questions:

1. What does the pink line indicate? *Sea Surface Temperature equal to 0°C*
2. Which locations have the highest surface air temperature? *Approximately 180°W to 130°W, as well as near the bold gray lines approximately 45°W to 20°E, and 170 °E-180°E*
3. What geographic region do these warmer air temperatures belong?
   Approximately 180°W to 130°W - North Eastern Pacific Ocean
   Approximately 45°W to 20°E - North Atlantic Ocean
   Approximately 170 °E- 180°E - - North Western Pacific Ocean
4. What do you predict to cause the warmer air temperatures? *Accept all reasonable answers.*

Teacher Key: Nearby warm water keeps locations at this latitude much warmer compared to other locations near cold water and inland. In fact, notice that the temperature is above freezing at some longitudes compared to others. This is key for winter weather, the difference between rain and snow precipitation at ground level.

Image Credit: Earth System Data Explorer (To visualize Surface Air Temperature in the Earth System Data Explorer, visit this link.)



Teacher Talking Points:

This plot from the Earth System Data Explorer shows Sea Surface Temperature (SST) values of ocean currents that move water towards the North and South Poles (A.K.A. "poleward ocean currents") observed on January 1, 2019. The sea surface temperature is defined as the temperature of the ocean at depths of 0-10 meters and is given in units of degrees Celsius. The plot at the top right shows Surface Air Temperature observed on January 2019 at **55°N** from the Earth System Data Explorer.

<u>Focus Questions:</u>

1. How does Sea Surface Temperature vary across 55°N latitude?

   Students should observe the SST values increase from approximately 45 °W to approximately the Prime Meridian (0°) and begin to decline.

1. What do the missing data represent?

   Students should infer that these are areas of land, not ocean.

1. Which locations are near the coast?

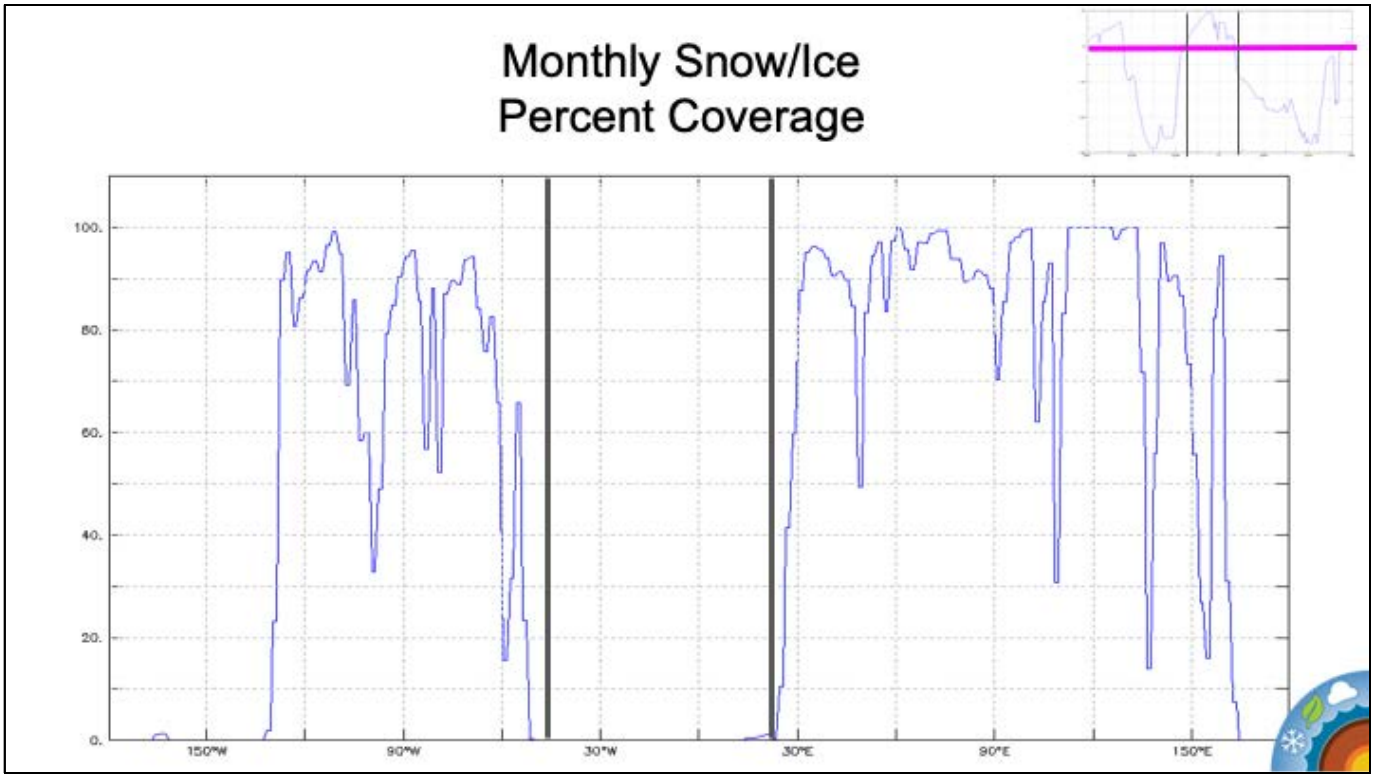
   Blue line plots adjacent to areas of missing data indicate the coastlines.

1. Notice the data between the two vertical lines. What do you notice about the data? How do they compare to the Surface Air Temperature data?

   Students should observe higher air temperatures are found where warmer sea surface temperatures are nearby.

Related Resources: Consider using the *My NASA Data* Graph Cube and Question Sheet with this map. See link for details.

Image Credit: Earth System Data Explorer (To visualize Sea Surface Temperature, visit here.)



Teacher Talking Points:

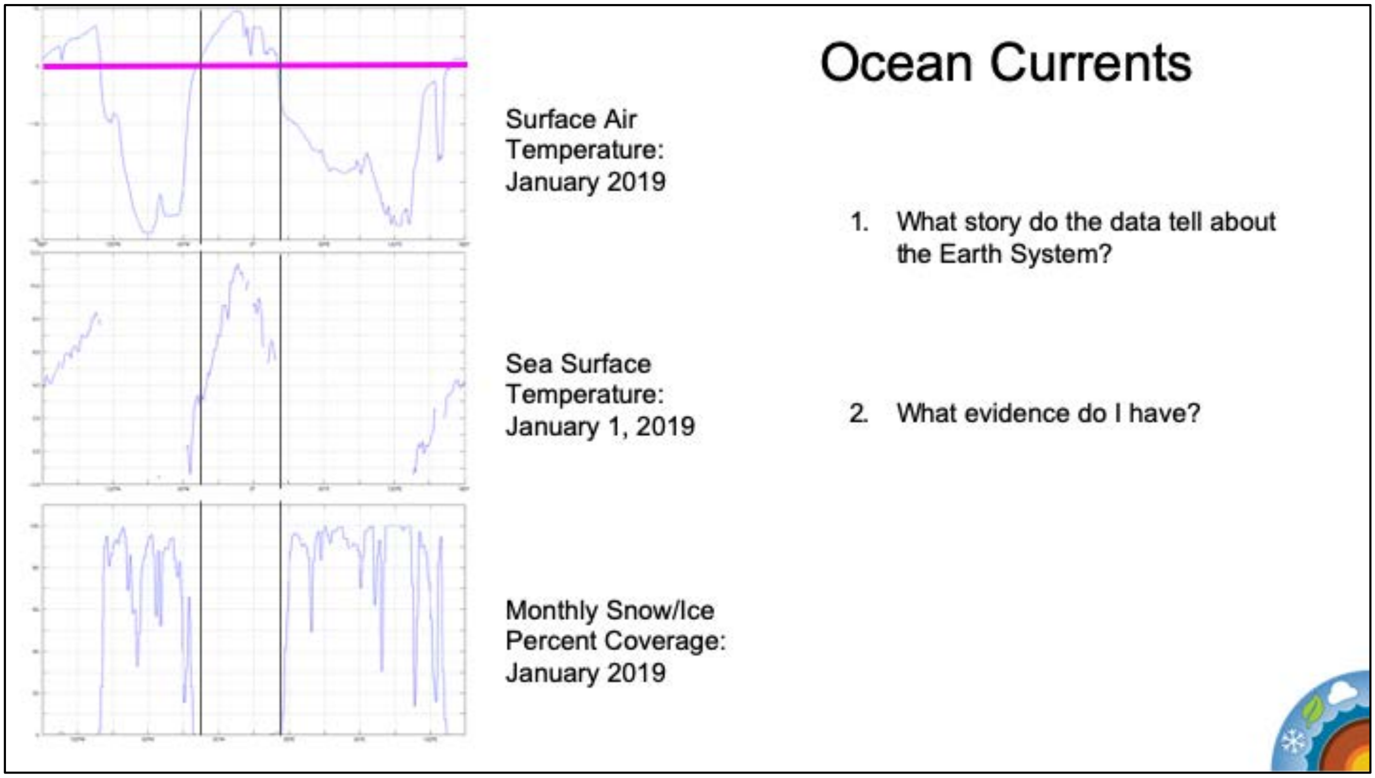
This plot from the Earth System Data Explorer shows Monthly Snow/Ice Percent Coverage observed on January 2019 at 55°N. The quantity measures the percent coverage of snow and ice in each pixel, including snow, land ice, and sea ice. This quantity is a measure of area coverage. A 30 percent coverage value means that snow and ice cover 30 percent of the land area at that location over the entire area of the gridbox. The plot at the top right shows Surface Air Temperature observed on January 2019 at 55°N from the Earth System Data Explorer.

Focus Question:

1. What is the relationship of sea surface temperatures and nearby snow and ice cover?
   a. *Students should observe a lack of snow/ice cover where warm water exists or is nearby.*
   b. *Longitudes with warmer SSTs have temperatures above freezing and little or no ice coverage.*

Related Resources: Consider using the *My NASA Data* Graph Cube and Question Sheet with this map. See link for details.

Image Credit: Earth System Data Explorer (To visualize Monthly Snow/Ice Percent Coverage, visit here.)



Teacher Talking Points:

<u>Focus Questions:</u>

1. What story do the data tell about the Earth System?

   Ocean transport of heat towards the pole can warm the air and be the difference between snow and no snow

1. What evidence do I have?
   a. *Longitudes with warmer SSTs have temperatures above freezing little or no ice coverage*

Warm poleward ocean currents keep locations warm. Locations from 60W to 20E longitude are kept above freezing and snow/ice-free because of the presence of warmer ocean water.