SN IN HIGH SCHOOLS

February 18, 2017

2016 shattered Earth's heat record

Article-Based Observation

Directions: Read the recent article "2016 shattered Earth's heat record" and then answer these questions:

1. **What was significant about Earth's surface temperature in 2016?**

2. **The graphic titled "Temperature difference in 2016 compared with 1891–2010 average" on Page 9 (also on Blackline Master 2) compares the temperature in 2016 with the 1891–2010 average. What does the graphic show and how does it lead to the conclusion that 2016 broke the heat record?**

3. **What other record was set in 2016 and early 2017?**

4. **The graph titled "Vanishing ice: 1978–2017" on Blackline Master 2 shows daily fluctuations in global sea ice extent from 1978 to 2017. What general trend occurs over the course of a year? What does the gray-shaded region indicate? How does the global sea ice extent at the beginning of November 2016 compare with the gray-shaded region for that time?**

5. **According to climate scientist Kevin Trenberth, what factors have caused warmer temperatures in 2016?**

6. **What metaphor is used by Kevin Trenberth to describe global temperature changes? Use the metaphor to explain his predictions about future global temperatures.**

7. **Give two examples of supporting data from the article's text that indicate global warming in recent years.**

8. **Come up with another catchy title for the article that summarizes the content.**

SN EDUCATOR GUIDE

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2016 shattered Earth's heat record

Responses to Article-Based Observation

1. **What was significant about Earth's surface temperature in 2016?** Possible student response: 2016 was the warmest year on record since record-keeping began in 1880.

2. **The graphic titled "Temperature difference in 2016 compared with 1891–2010 average" on Page 9 (also on Blackline Master 2) compares the temperature in 2016 with the 1891–2010 average. What does the graphic show and how does it lead to the conclusion that 2016 broke the heat record?** Possible student response: Blue areas indicate places where the average temperature in 2016 was cooler than the long-term average temperature (from 1891 to 2010), and red areas indicate places where the 2016 average was warmer than the long-term average. There appear to be many more red areas than blue areas (a rough estimate might indicate about 90% red and 10% blue—not including the gray area).

3. **What other record was set in 2016 and early 2017?** Possible student response: Global sea ice extent was at its smallest area in potentially thousands of years, according to data from the National Snow and Ice Data Center and sea ice reconstructions.

4. **The graph titled "Vanishing ice: 1978–2017" on Blackline Master 2 shows daily fluctuations in global sea ice extent from 1978 to 2017. What general trend occurs over the course of a year? What does the gray-shaded region indicate? How does the global sea ice extent at the beginning of November 2016 compare with the gray-shaded region for that time?** Possible student response: Global sea ice extent fluctuates throughout the year in a consistent pattern—sea ice extent is generally lowest in late February and highest in early November. The gray-shaded region shows two standard deviations from the average daily sea ice extent. The global sea ice level at the beginning of November 2016 is a little less than 24 million square kilometers, which is about 2 million square kilometers less than the lowest extent of the gray-shaded region and about 4 million square kilometers less than the highest extent of the gray-shaded region.

5. **According to climate scientist Kevin Trenberth, what factors have caused warmer temperatures in 2016?** Possible student response: Human fossil fuel consumption was partly to blame. But one of the three strongest El Niño occurrences on record also raised global temperatures, by releasing heat from the ocean into the atmosphere.

6. **What metaphor is used by Kevin Trenberth to describe global temperature changes? Use the metaphor to explain his predictions about future global temperatures**. Possible student response: Kevin Trenberth says that "the temperature record is like going up a staircase," and the 2015 and 2016 temperatures have gone up to the next "step." While he thinks oscillations around these new high temperatures are likely, he doesn't think that average global temperature will go back down the stairs to the temperatures of previous years.

7. **Give two examples of supporting data from the article's text that indicate global warming in recent years.** Possible student response: The 2016 global average surface temperature was 0.94 degrees Celsius higher than the 20th century average. The 2015 global average surface temperature was 0.90 degrees Celsius higher than the 20th century average. All 16 years of the 21st century are among the 17 warmest years on record.

8. **Come up with another catchy title for the article that summarizes the content.** Possible student response: "Climbing climate change—the 2016 heat record reports."

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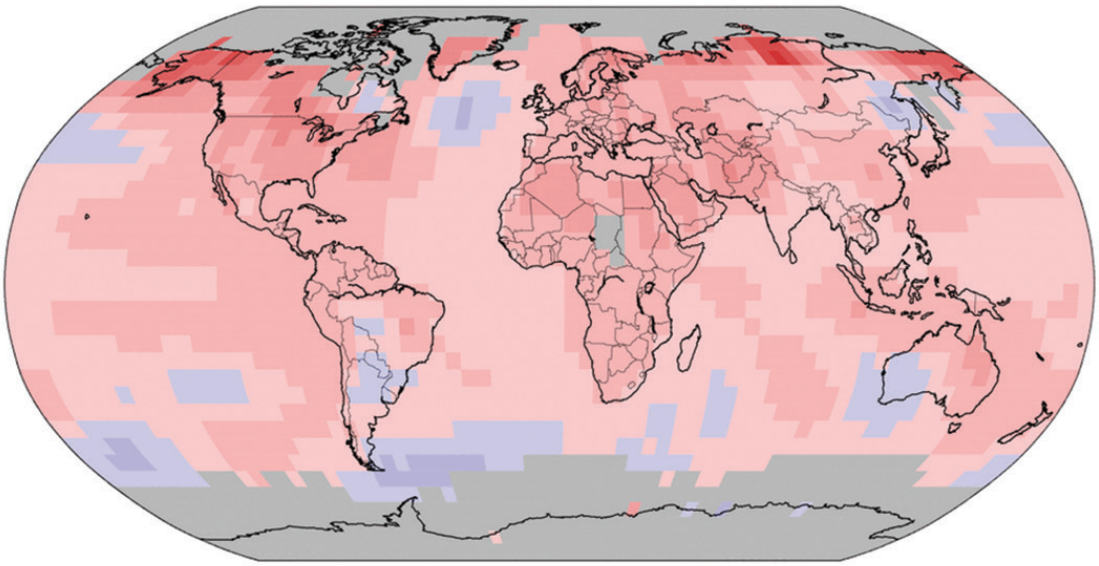
Article-Based Observation

Directions: Use the graphics from "2016 shattered Earth's heat record" to answer the related questions.



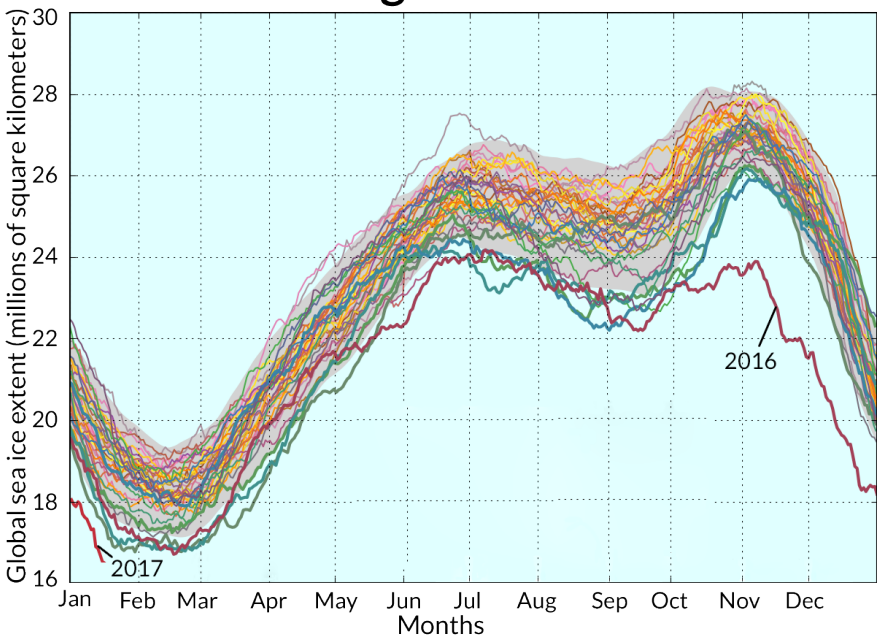
Temperature difference in 2016 compared with 1891–2010 average

−5 −4 −3 −2 −1 0 1 2 3 4 5

Degrees Celsius

SOURCE: NOAA

Vanishing ice: 1978–2017



SOURCE: NSIDC