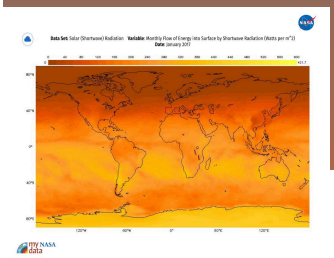
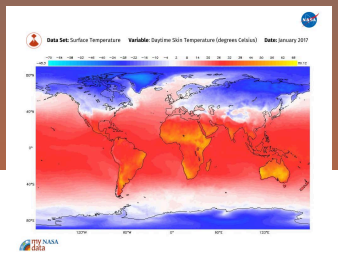
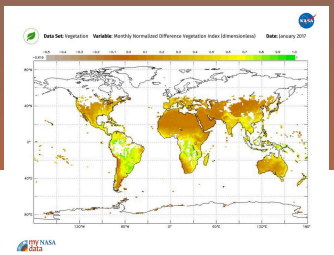
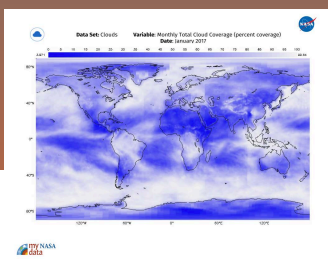
GLOBE Digital Earth System Poster

Implementing the NGSS Grades 9-12

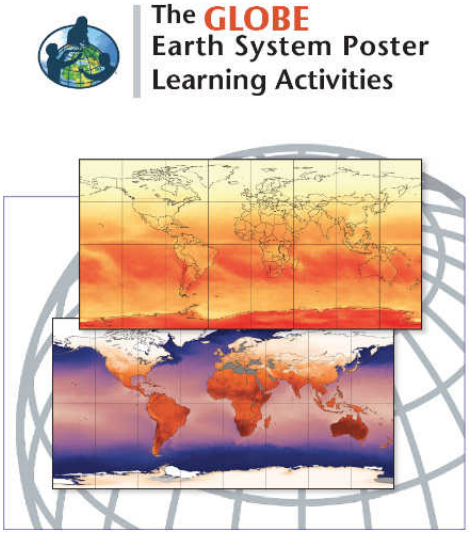
http://mynasadata.larc.nasa.gov/globe/

In the Classroom:

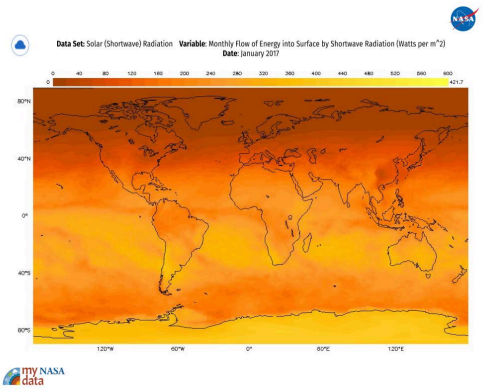
The *GLOBE Digital Earth System Poster* available on My NASA Data provides teachers and students opportunities to explore data and identify relationships between/among the different components of the Earth system. The animations and printable poster cards help the learner visualize how the different Earth science variables change over time, make comparisons between years to establish cause/effect relationships for a specific variable, identify patterns, and determine relationships between variables.

Teachers, consider using the Digital Poster, poster cards and the Learning Activity Guide as tools to support NGSS Science Practices, Disciplinary Core Ideas, and Crosscutting Concepts as they relate to Earth Science Performance Expectations.



Activities to accompany the GLOBE Earth System Poster
"Exploring Connections in Year 2007"

Visit https://mynasadata.larc.nasa.gov/
for Animations, Printable Poster Cards, Lesson Plans,
and the GLOBE Earth System Poster Card Activity Guide.

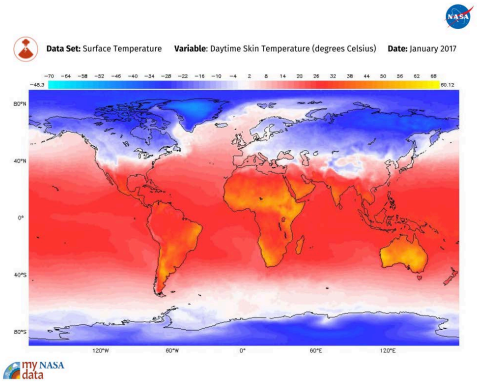


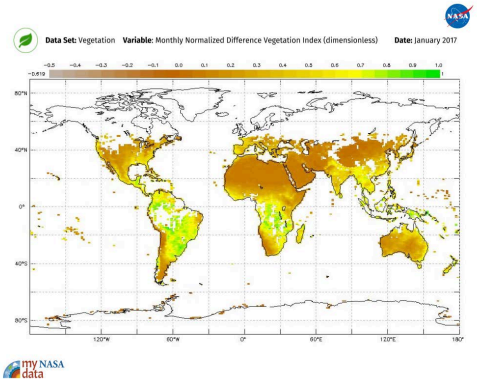
HS-ESS2-2 Analyze geoscience data to make the claim that one change to Earth's surface can create feedback that cause changes in other Earth systems.

- Students work in small groups to examine animations for each of the six variables (i.e., solar (shortwave) radiation, surface temperature, cloud fraction, precipitation, aerosols, and vegetation) and identify patterns.
- Using their observations as evidence, students make predictions (or a claim) about how the variables are related.
- Students identify cause/effect relationships based on the data contained in the animations to use as evidence to support their predictions.
- Students then compare their findings across different years to determine if their predictions are supported.

HS-ESS2-4 Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.

- Students examine animations of surface temperature and solar (shortwave) radiation across different years and compare those to those of the vegetation.
- Guiding questions may include:
  - What types of relationships do they observe between the variations in energy flow into and out of Earth's system?
  - What patterns do students observe about changes of climate across different regions?
  - What types of cause/effect relationships appear to exist between the flow of energy and climate?



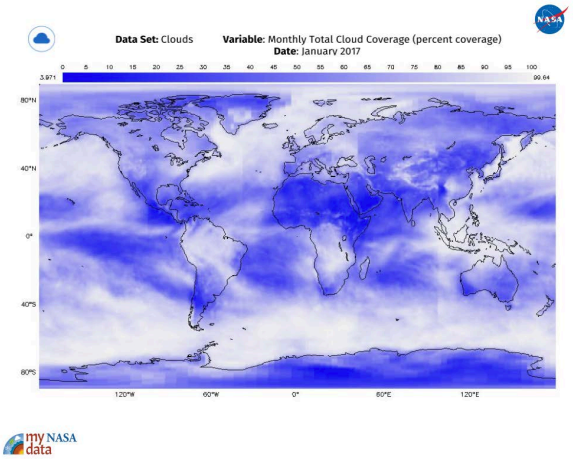


HS-ESS3-5 Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.

- Students work in teams to examine the surface temperature animations across multiple years.
- Students gather data related to the changes that are occurring in temperature and display it an appropriate graph.
- Using the data they have collected, students compare them to the changes they observe in the vegetation animations.
- Ask students to identify other data that would increase the validity of their predictions.
- Students develop an evidence-based prediction for what they expect to happen to the rate of global climate change in the future based on the data they have available.

HS-ESS3-6 Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

- Students examine the animations for solar (shortwave) radiation, surface temperature, cloud fraction, precipitation, aerosols and vegetation.
- Based on the changes students observe in the data, they develop a prediction related to the impact of human activity as evidenced by increases in aerosol and surface temperature as they relate to the changes that are occurring in Earth's climate.
- From these predictions, students develop a computational representation that illustrates their findings.



9-12 NGSS Performance Expectations Using the GLOBE Digital Poster:

HS- ESS2- 2 **Analyze geoscience data to make the claim that one change to Earth's surface can create feedback that cause changes to other Earth systems.**

HS- ESS2- 4 **Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.**

HS- ESS3- 5 **Analyze geoscience data and the results from global climate models to make an evidence--based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.**

HS- ESS3- 6 **Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.**

Science and Engineering Practices

Developing and Using Models

- Use a model to provide mechanistic accounts of phenomena. (HS-ESS2-4)

Analyzing and Interpreting Data

- Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. (HS-ESS2-2)
- Analyze data using computational models in order to make valid and reliable scientific claims. (HS- ESS3-5)

Using Mathematics and Computational Thinking

- Use a computational representation of phenomena or design solutions to describe and/ or support claims and/or explanations. (HS-ESS3-6)

Scientific Knowledge is Based on Empirical Evidence

- Science arguments are strengthened by multiple lines of evidence supporting a single explanation. (HS-ESS2-4, HS-ESS3-5)
- Science knowledge is based on empirical evidence. (HS-ESS3-5)

Scientific Investigations Use a Variety of Methods

- Science investigations use diverse methods and do not always use the same set of procedures to obtain data. (HS-ESS3-5)
- New technologies advance scientific knowledge. (HS-ESS3- 5)

Disciplinary Core Ideas

ESS1.B: Earth and the Solar System

- Cyclical changes in the shape of Earth's orbit around the sun, together with changes in the tilt of the planet's axis of rotation, both occurring over hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the earth. These phenomena cause a cycle of ice ages and other gradual climate changes. (HS-ESS2-4)

ESS1.B: Earth and the Solar System

- Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes feedback effects that can increase or decrease the original changes. (HS-ESS2-1, HS-ESS2-2)
- The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles. (HS-ESS2-4)

ESS2.D: Weather and Climate

- The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. (HS-ESS2-2)(HS-ESS2-4)
- Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2-6),(HS-ESS2-4)
- Current models predict that although future regional climate changes will be complex and varied, average global temperature will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. (HS-ESS3-6)

ESS3.D: Global Climate Change

- Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. (HS-ESS3-5)
- Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. (HS-ESS3-6)

Crosscutting Concepts

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-ESS2-4)

Stability and Change

- Feedback (negative or positive) can stabilize or destabilize a system. (HS-ESS2-2)
- Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (HS-ESS3-5)

Connections to Engineering Technology and Applications of Science

Influence of Engineering, Technology, and Science on Society and the Natural World

- New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology. (HS-ESS2-t2)