Unless otherwise specified, "descriptions" referenced in the evidence statements could include but are not limited to written, oral, pictorial, and kinesthetic descriptions.

HS-ESS3-6

Students who demonstrate understanding can:

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.** [Clarification Statement: Examples of Earth systems to be considered are the hydrosphere, atmosphere, cryosphere, geosphere, and/or biosphere. An example of the far-reaching impacts from a human activity is how an increase in atmospheric carbon dioxide results in an increase in photosynthetic biomass on land and an increase in ocean acidification, with resulting impacts on sea organism health and marine populations.] [*Assessment Boundary: Assessment does not include running computational representations but is limited to using the published results of scientific computational models.*]

The performance expectation above was developed using the following elements from *A Framework for K-12 Science Education*:

Science and Engineering Practices

Using Mathematics and Computational Thinking
Mathematical and computational thinking in 9–12 builds on K–8 experiences and progresses to using algebraic thinking and analysis; a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms; and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Use a computational representation of phenomena or design solutions to describe and/or support claims and/or explanations.

Disciplinary Core Ideas

ESS2.D: Weather and Climate

- Current models predict that, although future regional climate changes will be complex and varied, average global temperatures 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. *(secondary)*

ESS3.D: Global Climate Change

- 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.

Crosscutting Concepts

Systems and System Models

- When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.

Observable features of the student performance by the end of the course:		
1	Representation	
	a	Students identify and describe* the relevant components of each of the Earth systems modeled in the given computational representation, including system boundaries, initial conditions, inputs and outputs, and relationships that determine the interaction (e.g., the relationship between atmospheric CO_2 and production of photosynthetic biomass and ocean acidification).
2	Computational modeling	
	a	Students use the given computational representation of Earth systems to illustrate and describe* relationships among at least two of Earth's systems, including how the relevant components in each individual Earth system can drive changes in another, interacting Earth system.
3	Analysis	
	b	Students use evidence from the computational representation to describe* how human activity could affect the relationships between the Earth's systems under consideration.