Rising Water Evidence

Use observations and model results to forecast sea-level impacts.

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..."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline each observed measurement, circle each model projection, and number the cause-and-effect links from warming to sea level. These marks will help you separate evidence from forecasts and trace an Earth-system impact.

Forecasting a Higher Ocean

1. Global mean surface temperature is a useful signal because it combines measurements from land and ocean stations around the world. Compared with 1850 to 1900, the average temperature for 2011 to 2020 was about 1.1 degrees Celsius higher. In recent decades, global surface temperature has risen at roughly 0.2 degrees Celsius per decade. Warming also affects sea level. Tide gauges and satellite altimeters show that global mean sea level rose about 20 centimeters from 1901 to 2018. Its average rise sped up from 1.3 millimeters per year during 1901 to 1971 to 3.7 millimeters per year during 2006 to 2018.

2. Climate models use physical laws to calculate how the atmosphere, ocean, ice, and land respond to changing greenhouse gas concentrations. Scientists test models by checking whether they reproduce past climate patterns. Model results depend on future emissions. In a very low emissions pathway, models project global mean sea level in 2100 to be 0.28 to 0.55 meters above its 1995 to 2014 average. In a very high emissions pathway, the projected range is 0.63 to 1.01 meters. These ranges are forecasts, not guarantees, because future emissions and some ice-sheet responses remain uncertain.

3. Sea level rises for more than one reason. Warmer seawater expands, adding volume to the ocean. At the same time, mountain glaciers and the Greenland and Antarctic ice sheets lose land ice, which adds water to the ocean. The observed acceleration in sea-level rise, together with continued warming in model results, supports a forecast that coastal flooding risk will increase during high tides and storms. The size of the future change depends strongly on emissions. Therefore, a responsible forecast names its emissions pathway, gives a numerical range, connects warming to sea level, and states an uncertainty rather than claiming one exact outcome.

2 ANSWER WITH EVIDENCE

Use the passage

1. What two observed measurements in the passage show that the climate system is changing? Include the numbers and units.

2. How did the observed rate of sea-level rise change from 1901 to 1971 to 2006 to 2018? Calculate the increase in millimeters per year.

3. Compare the 2100 sea-level projections for the very low and very high emissions pathways. What does the comparison show about emissions?

4. What future impact is forecast for coastal areas, and what two Earth-system processes cause sea level to rise?

3 YOUR TURN

Your own words

Write an evidence-based sea-level forecast in exactly three sentences and 55 to 75 words. Name one emissions pathway, use at least one observed measurement and one model range, explain why sea level rises, and state one uncertainty.

ANSWER KEY

Rising Water Evidence

HIGH SCHOOL · HS-ESS3-5

PART 1 · READ AND MARK

Underline each observed measurement, circle each model projection, and number the cause-and-effect links from warming to sea level. These marks will help you separate evidence from forecasts and trace an Earth-system impact. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	What two observed measurements in the passage show that the climate system is changing? Include the numbers and units.	**Global temperature for 2011 to 2020 was about 1.1 degrees Celsius above the 1850 to 1900 average, and global mean sea level rose about 20 centimeters from 1901 to 2018.**
2	How did the observed rate of sea-level rise change from 1901 to 1971 to 2006 to 2018? Calculate the increase in millimeters per year.	**The rate increased from 1.3 to 3.7 millimeters per year, an increase of 2.4 millimeters per year.**
3	Compare the 2100 sea-level projections for the very low and very high emissions pathways. What does the comparison show about emissions?	**The very low pathway projects 0.28 to 0.55 meters, while the very high pathway projects 0.63 to 1.01 meters above the 1995 to 2014 average. Higher emissions lead to a larger projected sea-level rise.**
4	What future impact is forecast for coastal areas, and what two Earth-system processes cause sea level to rise?	**Coastal flooding risk is forecast to increase during high tides and storms. Seawater expands as it warms, and melting land ice adds water to the ocean.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Because the recent observed sea-level rise rate is 3.7 millimeters per year, compared with 1.3 millimeters per year earlier, I forecast increasing coastal flood risk. Under the very high emissions pathway, global mean sea level could reach 0.63 to 1.01 meters above the 1995 to 2014 average by 2100. Warming expands seawater and land-ice loss adds water, but future emissions and ice-sheet responses create uncertainty.

Accept equivalent evidence-based forecasts that accurately use a named pathway, an observed trend, a matching model range, and a causal explanation. Students may choose either emissions pathway if their forecast and numerical range match that pathway.