



## Applied Remote Sensing Training (ARSET) Program

### Sea Level Change Tools for Planning and Decision Support (2025)

## Homework Questions

### Question 1

Over the 31-year NASA satellite record, how much has global mean sea level increased in total?

Answers: (bold correct)

- a) 0.59 cm
- b) 10.5 cm**
- c) 20.0 cm
- d) 30.5 cm

Feedback:

Global mean sea level has been rising at about 3.3 mm per year, as measured by NASA satellites over the last 31 years. This rate is accelerating and has, thus far, led to 10.5 cm of global mean sea level rise.

### Question 2

What are the two primary processes that are causing global mean sea level to rise?

Answers: (bold correct)

- a. Vertical Land Motion & Ocean Warming
- b. Terrestrial Water Storage & Land Ice Loss
- c. Land Ice Loss & Tides
- d. Ocean Warming & Land Ice Loss**

Feedback:

Ocean warming and the loss of land ice are the two processes that are the biggest contributors to global sea level rise. Terrestrial water storage contributes, as well, but with a smaller magnitude. Although vertical land motion can have a big impact on relative sea level change (the height of the ocean relative to the height of the land), it is not a factor in global sea level change. Tides cause

water level changes over hours to years and, along with other short term year-to-year variations, storm surges, and waves, they exacerbate the impacts of global sea level rise.

### Question 3

What are some of the NASA satellite missions that have been used to measure sea level change and the contributing processes?

Answers: (bold correct)

- a) Sentinel-6B
- b) ICESat-2
- c) GRACE-FO
- d) All of the above**

Feedback:

NASA's fleet of Earth Science missions include several satellites that are used to measure sea level change and contributions from various parts of the Earth system. These include Sentinel-6B Michael Freilich, which continues a more than three-decades long record of sea level change, ICESat-2, which measures changes of the ice sheets, and GRACE-FO, which measures changes of glaciers and terrestrial water storage. Together, these provide a holistic view of total sea level change as well as the different processes that contribute.

### Question 4

What is the primary method that NASA satellites have used to measure global ocean surface topography and sea level over the last 3 decades?

Answers: (bold correct)

- a) Radar Altimetry**
- b) Laser Altimetry
- c) Tide Gauges
- d) Profiling Floats

Feedback:

Satellite radar altimetry has been the primary method that NASA has used to measure and understand global sea level change over the past 31 years. Laser altimetry is another satellite measurement method that has been used to monitor changes of the Earth's ice sheets and glaciers and their contribution to sea level. Tide gauges and profiling floats are not satellite based but, instead, take direct observations from Earth, measuring relative sea level change at coastal locations (tide gauges) and the ocean's temperature and saltness at different locations within the ocean (profiling floats).

## Question 5

Which of the following are consequences of mean sea level rise?

Answers: (bold correct)

- a) Loss of Habitat
- b) Damage to Infrastructure
- c) c: Erosion
- d) **d: All of the above**

Feedback:

All of these are potential impacts that can be caused by mean sea level rise. In addition, sea level rise can have social and cultural impacts, human health impacts, and other economic impacts.

## Question 6

Emissions scenarios, like the Shared Socioeconomic Pathway (SSP) scenarios, represent different possible futures for technological development, economic development, and climate policy, and their consequences for greenhouse gas emissions. Which of the following scenarios represents a future consistent with the Paris Agreement target, in which median projected warming stays below 2.0°C warming relative to 1850–1900, with implied net zero carbon dioxide emissions in the second half of the century?

Answers: (bold correct)

- a. **SSP1-2.6**
- b. SSP2-4.5
- c. C) SSP3-7.0
- d. D) SSP5-8.5

Feedback:

The IPCC Sixth Assessment Report, including its sea level projections, focuses on five SSP scenarios:

1. SSP1-1.9 is a very low emissions scenario that holds median projected warming to approximately 1.5°C above 1850–1900 in 2100 after slight overshoot, with implied net zero CO<sub>2</sub> emissions around the middle of the century.
2. SSP1-2.6 is a low emissions scenario that holds median projected warming below 2.0°C warming relative to 1850–1900, with implied net zero CO<sub>2</sub> emissions in the second half of the century.
3. SSP2-4.5 is an intermediate emissions scenario, approximately in line with current global climate policy. CO<sub>2</sub> emissions remain around current levels until the middle of the century. It results in a best-estimate warming around 2.7°C by the end of the 21st century relative to 1850–1900.

4. SSP3-7.0 is a high emissions scenario that is consistent with emissions trends in the first decade of the 21st century. CO<sub>2</sub> emissions roughly double from current levels by 2100.
5. SSP5-8.5 is a very high emissions scenario. CO<sub>2</sub> emissions roughly double from current levels by 2050. It implies a world focusing on rapid economic growth and energy-intensive lifestyles, with strong reliance on fossil fuels.

## Question 7

Scenario SSP2-4.5 puts us on track for about what level of warming by the end of the century?

Answers: (bold correct)

- a. 1.4 deg C
- b. 1.8 deg C
- c. **2.7 deg C**
- d. 3.6 deg C

Feedback:

The Shared Socioeconomic Pathways (SSPs) form the basis for climate model projections of future climate system changes. These SSP scenarios outline potential future developments using consistent assumptions about key factors like the pace of technological advancement. Climate projections also consider solar activity and the effects of volcanic eruptions.

## Question 8

Use the Contributions tab of the [Sea Level Explorer tool](#) to investigate sea level change in the Bahamas. How will the contribution of ice sheets and glaciers to sea level rise change between 2050 and 2100 under the SSP3-7.0 Scenario?

Answers: (bold correct)

- a. Decrease by 20%
- b. Increase by 20%
- c. **Increase by 6%**
- d. Decrease by 6%

Feedback:

Under the SSP3-7.0 scenario, the contribution from ice sheets and glaciers is expected to account for 11 cm or 54% of the total expected relative sea level rise in the Bahamas in 2050. In 2100, the contribution from ice sheets and glaciers increases to 39 cm, or 60% of the total expected relative sea level rise. This means that ice sheets and glaciers will account for an additional 6% of relative sea level change over the second half of the century.

## Question 9

Use the [IPCC AR6 Sea Level Projection Tool](#) to investigate future relative sea level change at Wilmington, NC, USA. How much additional relative sea level rise is expected in 2100 under the SSP3-7.0 scenario than under the SSP1-2.6 scenario, given the projected median values?

Answers: (bold correct)

- a. 1 cm
- b. 4 cm
- c. 12 cm
- d. **24 cm**

Feedback:

In 2100, under the SSP3-7.0 scenario, 84 cm of relative sea level rise is expected in Wilmington, NC, whereas under the SSP1-2.6 scenario, 60 cm is expected. This means that 24 cm of additional relative sea level rise is expected under the higher emissions scenario than under the lower emissions scenario at the end of the century.

## Question 10

Use the [Pacific Islands Flooding Analysis Tool](#) to investigate observed flooding at Funafuti, Tuvalu. How many times did water level exceed the 0.5 m above mean higher high water flooding threshold during the 44-year record of observations (1977–2021)?

Answers: (bold correct)

- a. 15 days
- b. **138 days**
- c. 1,429 days
- d. 2,883 days

Feedback:

Over the 1977-2021 time period, 138 days were observed when water level exceeded 0.5 m above mean higher high water in Funafuti, Tuvalu. In the future, this water level may be exceeded 279 days per year in the latter part of the century (years 2081-2100+), under a 3.0 degrees C warming scenario with 0.72 m of sea level rise relative to 1995-2014 in this location. This means that this location may be flooded for most of the year, highlighting how tidal flooding can exacerbate the impacts of sea level rise.