SAMPLE

Earth's Dynamic Systems: Sea Level Rise

The Rising Oceans

Aira Astralis

Free sample: Introduction & Chapter 1

putrabooks.github.io

Buy the full book:

Carousell carousell.sg/p/earth-s-dynamic-systems-sea-level-rise-ebook-pdf-1467849885

ElevenReader

Payhip

Contents

Introduction

Chapter 1: The Discovery of Sea Level Rise

Chapter 2: Understanding Sea Level Rise

Chapter 3: Key Characteristics of Sea Level Rise

Chapter 4: The Science Behind Sea Level Rise

Chapter 5: Observation and Measurement of Sea Level Rise

Chapter 6: Important Features of Sea Level Rise

Chapter 7: Sea Level Rise in Context

Chapter 8: Modern Understanding of Sea Level Rise

Chapter 9: Research and Exploration of Sea Level Rise

Chapter 10: Significant Discoveries About Sea Level Rise

Chapter 11: Challenges and Mysteries of Sea Level Rise

Chapter 12: Future Directions in Sea Level Rise Research

Chapter 13: Fun Facts and Trivia About Sea Level Rise

Chapter 14: Conclusion: The Significance of Sea Level Rise

Conclusion

This free sample contains the Introduction and Chapter 1. The complete book contains the full contents above.

Introduction

The sea level has generally been rising since the end of the Last Glacial Maximum, which was around 20,000 years ago. Between 1901 and 2018, the average sea level rose by 15-25 cm (6-10 in), with an increase of 2.3 mm (0.091 in) per year since the 1970s. This was faster than the sea level had ever risen over at least the past 3,000 years. The rate accelerated to 4.62 mm (0.182 in)/yr for the decade 2013-2022.

Climate change due to human activities is the main cause of this persistent acceleration. Between 1993 and 2018, melting ice sheets and glaciers accounted for 44% of sea level rise, with another 42% resulting from thermal expansion of water. Sea level rise lags behind changes in the Earth's temperature by decades, and sea level rise will therefore continue to accelerate between now and 2050 in response to warming that has already happened. What happens after that depends on future human greenhouse gas emissions.

If there are very deep cuts in emissions, sea level rise would slow down between 2050 and 2100. It could then rise by between 30 cm (1 ft) and 1.0 m (3+1?3 ft) between the early 2020s and 2100, or by approximately 60 cm (2 ft) to 130 cm (4+1?2 ft) from the 19th century to 2100. With high emissions it would instead accelerate further, and could rise by 50 cm (1.6 ft) or even by 1.9 m (6.2 ft) by 2100.

In the long run, sea level rise would amount to 2-3 m (7-10 ft) over the next 2000 years if warming stays to its current 1.5 °C (2.7 °F) over the pre-industrial past. It would be 19-22 metres (62-72 ft) if warming peaks at 5 °C (9.0 °F). The expected increase in flood hazard potential is often exceedingly large even for modest sea-level rise scenarios, ranging from 10 to 1000 for rises of 0.5?m or less. Rising seas affect every coastal population on Earth.

Chapter 1: The Discovery of Sea Level Rise

Without a sharp reduction in greenhouse gas emissions, this may increase to hundreds of millions in the latter decades of the century. Local factors such as tidal range or land subsidence will greatly affect the severity of impacts. For instance, sea level rise in the United States is likely to be two to three times greater than the global average by the end of the century.

Yet, of the twenty countries with the greatest exposure to sea level rise, twelve are in Asia, including Indonesia, Bangladesh and the Philippines. The resilience and adaptive capacity of ecosystems and countries also varies, which will result in more or less pronounced impacts. The greatest impact on human populations in the near term will occur in low-lying Caribbean and Pacific islands including atolls. Sea level rise will make many of them uninhabitable later this century. Societies can adapt to sea level rise in multiple ways.

Managed retreat, accommodating coastal change, or protecting against sea level rise through hard-construction practices such as seawalls are hard approaches. There are also soft approaches such as dune rehabilitation and beach nourishment. Sometimes these adaptation strategies go hand in hand. At other times choices must be made among different strategies. Poorer nations may also struggle to implement the same approaches to adapt to sea level rise as richer states.

Sea level rise has been studied through an environmental justice framework, as its impacts are not evenly distributed across populations. Research suggests that socially and economically vulnerable communities are often more at risk to coastal flooding and have fewer resources for adaptation or relocation. Sea level rise can also contribute to the displacement or relocation of coastal and island populations, including some Indigenous communities whose cultural practices are closely connected to ancestral lands.

Relocation efforts may involve challenges related to maintaining community organization and farming practices as well. Between 1901 and 2018, the global mean sea level rose by about 20 cm (7.9 in). More precise data gathered from satellite radar measurements found an increase of 7.5 cm (3.0 in) from 1993 to 2017 (average of 2.9 mm (0.11 in)/yr). This accelerated to 4.62 mm (0.182 in)/yr for 2013-2022. Paleoclimate data shows that sea level had never risen as fast over at least the past 3,000 years.

A research paper published in October 2025 updated the global sea level curve for the last 11,700 years, finding that global mean sea-level rise since 1900 is faster than in any century over at least the last 4,000 years. While sea level rise is uniform around the globe, some land masses are moving up or

down as a consequence of subsidence (land sinking or settling) or post-glacial rebound (land rising as melting ice reduces weight).

Therefore, local relative sea level rise may be higher or lower than the global average. Changing ice masses also affect the distribution of sea water around the globe through gravity. Several complementary approaches are used to project sea level rise (SLR) into the future. One is process-based modeling, where ice melting is computed through an ice-sheet model and rising sea temperature and expansion through a general circulation model, and then these contributions are added up.

The so-called semi-empirical approach instead applies statistical techniques and basic physical modeling to the observed recent sea level rise and reconstructions from the older historical geological data (known as paleoclimate modeling). It was developed because process-based model projections in the past IPCC reports (such as the Fourth Assessment Report from 2007) were found to underestimate the already observed sea level rise. By 2013, improvements in modeling had addressed this issue, and model and semi-empirical projections for the year 2100 are now very similar.

Yet, semi-empirical estimates are reliant on the quality of available observations and struggle to represent non-linearities, while processes without enough available information about them cannot be modeled. Thus, another approach is to combine the opinions of a large number of scientists in what is known as a structured expert judgement (SEJ). Some analyses suggest that if fossil fuel use continues indefinitely and all polar and mountain ice melts, global sea level could rise by as much as 216 feet. Variations of these primary approaches exist.

For instance, large climate models are computationally expensive, so less complex models are often used in their place for simpler tasks such as projecting flood risk in the specific regions. A structured expert judgement may be used in combination with modeling to determine which outcomes are more or less likely, which is known as "shifted SEJ". Semi-empirical techniques can be combined with the so-called "intermediate-complexity" models.

After 2016, some ice sheet modeling exhibited the so-called ice cliff instability in Antarctica, which results in substantially faster disintegration and retreat than otherwise simulated. The differences are limited with low warming, but at higher warming levels, ice cliff instability predicts far greater sea level rise than any other approach.

The study reports that sea level also is expected to grow by another 6.6 inches (169 millimeters) globally over the next 30 years if it follows this trend, which

will lead to 16.63 inches (42.25 centimeters) under a 1.75 °C warming by 2100. The Intergovernmental Panel on Climate Change is the largest and most influential scientific organization on climate change, and since 1990, it provides several plausible scenarios of 21st century sea level rise in each of its major reports.

End of free sample. The full book is available at putrabooks.github.io

ABOUT THE AUTHOR

Aira Astralis is a science writer specializing in astronomy and space exploration. Her work spans the full breadth of humanity's relationship with the cosmos -- from the earliest naked-eye observations to the engineering marvels of modern space missions.

Her books are built on a foundation of primary sources: peer-reviewed research, mission archives, and direct engagement with the scientific community. She writes for readers who want to understand not just what we know about the universe, but how we came to know it.

She believes that the most important frontier is not out there but in the gap between what scientists discover and what the public understands. Her books exist to close that gap.