

DataStreme Climate Science Learning Objectives

Unit 1: Earth's Climate System

- Distinguish between weather and climate.
- Examine the components and dynamics of Earth's climate system at local, regional, hemispheric, and global scales.
- Describe the major sources and sinks of carbon within the climate system.
- Describe the essential climate variables, how they are measured, and how they are used.
- Define basic statistical techniques for characterizing temperature and precipitation, including a definition of climate normals.

Unit 2: Earth's Energy Balance

- Examine the astronomical, meteorological, and geographical factors that determine the distribution of solar radiation on Earth's surface and the seasons.
- Explore the relationship between energy, heat, and temperature and the mechanisms of energy transfer.
- Describe how the climate system maintains overall energy balance and how perturbations in the system can lead the system to move toward a new equilibrium.
- Explain the greenhouse effect and how rising concentrations of carbon dioxide and other greenhouse gases enhance it.
- Discover how latitudinal variations in solar radiation drive surface temperature responses, heat storage, and heat transport.

Unit 3: Atmosphere and Oceanic Circulation

- Examine the features of global atmospheric circulation and semi-permanent pressure systems.
- Explain how wind-driven surface currents and thermohaline circulation redistribute Earth's heat.
- Model how the water cycle moves energy and moisture within the climate system.
- Explore climate oscillations, including the atmospheric and oceanic components of ENSO.
- Investigate the causes of local and regional climate patterns.

Unit 4: Introduction to Paleoclimate

- Relate Milankovitch cycles to their roles in long-term climate variation.
- Describe the natural and anthropogenic drivers of climate change.
- Explore proxy climate data sources and how they contribute to understanding atmospheric and geologic variables at different temporal resolutions.

Unit 5: Earth History

- Examine the major features of the geologic timeline.
- Correlate paleogeographic changes with regional and global climate variation.

- Investigate the causes of glacial and interglacial cycles, especially the last glacial transition.
- Analyze evidence for the causes of abrupt climate changes and mass extinction events.

Unit 6: The Cryosphere

- Describe how generating and restoring forces produce different types of ocean waves, including wind waves, tsunamis, and tides.
- Examine how changes in water depth and variable bathymetry affect wave movement.
- Analyze how constructive and destructive interference affect wave height.

Unit 7: Climate Variation Impacts

- Describe the contributions of thermal expansion, glacier melt, and other factors to sea level rise.
- Explain why local relative sea-level change is often different from the global mean.
- Evaluate the importance of glacier dynamics and ice sheet stability in predicting rapid sea level rise.
- Describe the impacts of climate change, including drought, flood, wildfire, agriculture, and ocean acidification.

Unit 8: Ice Core Field Exploration and Analysis

- Synthesize the complex logistics, engineering, and technology needed for drilling and coring in harsh polar regions.
- Investigate the use of ice drilling in collecting data on climate history, ice dynamics, and seismic activity.
- Discuss future drilling plans to collect deeper ice volumes and extend the ice core proxy record.
- Describe how ice drilling efforts are organized to achieve interconnected scientific research goals.
- Explore how ocean sediment cores help scientists understand the paleoclimate.

Unit 9: Ice Core Analysis and Paleoclimate

- Describe the differences between active and passive continental margins and how their bathymetry affects coastal characteristics and processes.
- Classify estuaries based on their geologic origin and water circulation patterns, and describe how they protect shorelines.
- Explain how coastal upwelling develops and evaluate its effects on nutrient availability, primary productivity, and fisheries.
- Interpret maps, satellite imagery, and coastal observations to explain how hurricanes interact with coastal environments and how coastal features influence storm impacts.

Unit 10: Earth System Modeling

- Describe major sources and types of marine pollution and their effects on marine ecosystems.
- Interpret maps, graphs, and other oceanographic data for trends in sea surface

temperature, sea level, and ocean acidification.

- Analyze the link between anthropogenic greenhouse gas emissions and trends in ocean heat content, sea level, dissolved oxygen concentrations, and pH.