Summaries

Chapter 1

ENSO, or El Nino/Southern Oscillation is the second most important mode of climate variability, behind the seasonal cycle. Our understanding of ENSO has progressed greatly over time. ENSO is driven by a feedback loop between the Pacific ocean currents and air currents, where weakened tropical trade winds cause a reduction in upwelling in the eastern Pacific, which further weakens the trade winds, causing unusually warm waters in the equatorial Pacific. The first observation of ENSO was observations of variation in winter rainfall in South America by Spanish colonists. Organized research on ENSO began in the early 20th century, when Gilbert Walker was looking for a way to predict variations in South Asian flooding, and noticed that it was correlated with air pressure changes in and near the Pacific ocean. Later, Jacob Bjerknes confirmed these conclusions and linked Walker's discovery of the role of equatorial air movements to changes in ocean currents and upwelling. Following Bjerknes's research, NOAA and other research organizations embarked on projects to measure and predict ENSO with greater precision, as well as understand its mechanics in greater depth. We now know that ENSO events are triggered by a sudden strengthening and then weakening of the trade winds. We also know that ENSO events, come in 2 major flavors, Eastern and Central. Eastern ENSO events tend to be stronger and more common, and have the greatest warming in the eastern Pacific. Central events are weaker and less common, and are strongest in the central Pacific. Additionally, researchers have developed climate models to simulate the mechanics of the climate system to further investigate the workings of ENSO. Researchers are sure that human greenhouse gas emissions are driving a worldwide increase in temperature, which can only be partially averted by sudden and serious action. Scientists are still unsure how global warming will affect ENSO. A few studies predicted that ENSO may become more intense under global warming, but other studies question the validity of their results. The question of how global warming will affect ENSO is one of the biggest questions facing climatologists today.

Chapter 2

The Earth's climate is a very complex system. It is composed of the land, the atmosphere, the oceans, and sea ice. The oceans absorb large amounts of heat, slowing down changes to the atmosphere's temperature. The ocean also contains currents that transfer heat and affect atmospheric conditions. The land changes temperature very quickly, leading to very volatile weather. The atmosphere connects all the parts of the climate, and transfers heat through wind. Ice reflects light and absorbs heat while modifying ocean currents. The mechanics of ENSO are centered around the Pacific Ocean. In the equatorial Pacific, wind currents converge, resulting in large amounts of rain, while its angle towards the sun causes the equator to be very warm. The atmospheric winds blowing

east-to-west cause surface water to move in the same direction. This results in a large pool of warm water developing in the western Pacific, and cool water rising in the eastern Pacific from the deeper ocean. During an ENSO event, this balance is disrupted when the easterly winds suddenly weaken, causing the warm water pool to move eastward and upwelling to cease. This change causes extraordinary warm water temperatures in the eastern pacific, which further weakens the easterly wind currents while causing extreme rain in the Americas and drought in Southeast Asia. Eventually, the upper ocean cools down, and the easterly winds strengthen, leading to a La Nina, the cool phase of ENSO. ENSO events vary greatly, as some are stronger in the central Pacific and others are stronger in the eastern Pacific. ENSO affects many elements of the Earth's climate. For example, Atlantic hurricane activity is usually weakened during El Nino, the warm phase. Researchers have also shown that ENSO modifies climate variability in other ways too, such as by affecting air and water circulation in the North Atlantic and Indian oceans. The other main focus of this book is climate change. The most important things affecting climate today are volcanic eruptions and greenhouse gas emissions. Volcanic eruptions reduce surface temperature by blocking sunlight, but they cannot be predicted reliably. Humans are affecting the climate by releasing gasses such as carbon dioxide into the atmosphere by burning fossil fuels. These gasses prevent heat from being radiated after it strikes the surface, leading to a noticeable increase in global temperatures. ENSO has a critical impact on human society, in ways such as by controlling fish populations, creating flooding and droughts, and even affecting disease-carrying mosquito populations. Because of these impacts, it is very important to continue researching future changes to ENSO.