

## CHAPTER 1

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# INTRODUCTION

This is the introductory material to a monograph on *Climate Change*. More than in any other developed country in the world, the phenomena happening throughout the globe, and documented by the Intergovernmental Panel on Climate Change (IPCC), a body under the patronage of the United Nations, have been denied by many in the United States.

After graduation from Case Western Reserve University, Cleveland, Ohio, with a PhD in mechanical engineering, I obtained a position as assistant professor at the University of Miami in 1979, and started research in an environmental topic immediately. I also became a member of the American Geophysical Union (AGU) in 1980 and continue to be a life member of the respected institution. Even though I personally did not perform climate change research in the 1980s, I kept up with the AGU weekly newsletter, which did include articles about climate change, starting at least from this early date. Hence, when the debate about climate change heated up in the United States in recent years, it was natural for me to fall in line more with one group owing to scientific evidence rather than the other.

As a precaution to prevent the current monograph from being biased, many of the chapters of the book are published papers. Academic journal papers are peer-reviewed and have any partiality removed from the text. The many and varied reviewers require that. Six of the chapters in this book are academic papers already published elsewhere.

The book starts with this Introduction, followed by the theories of climate change, in Chapter 2. This background information allows the critical thinking reader to evaluate whether the theories tell us anything real about climate change, and whether any of their predictive capabilities will be helpful or not. The third chapter is about the Second Law of Thermodynamics, and how this law essentially tells us that all human activities are eventually dissipated as heat into the global environment.

The fourth chapter explains the greenhouse effect based on the molecular theory of matter. Quantitative tabulation and discussion of all the major heat contributions from human activities are presented in the next chapter. Cattle and other livestock are considered as sourced by humans. Chapter 5 is a reproduction of a journal paper published in the December 2012 issue of the American Society of Mechanical Engineer's (ASME) *Journal of Energy Resources Technology*. Chapter 6, by an invited author, is an interesting account of the various phenomena recognizable as a consequence of climate change.

Sea level rise is one of the many consequences of climate change, as documented by the IPCC. The seventh chapter is a discussion about the mitigation and adaptation responses to sea level rise. The Netherlands and Singapore have taken exemplary steps. Even the local authorities in South Florida, United States have carried out initial steps toward meeting this challenge.

Chapter 7 is a reproduction of an academic journal article published in June 2015 in the *Open Hydrology Journal*, Bentham Science Open. Chapter 8 is about freshwater discharges into the oceans. Nature's reservoirs of freshwater are the ice glaciers in the two Polar regions, and the Third Pole, the Himalayas. When these reservoirs of freshwater melt, what could be done has to be planned and engineered in place. If the freshwater escapes unchecked into the salty sea, fresh water reserves are going to be lost. In Chapter 9, the wealth of the oceans is discussed. In the scenario of ever-increasing human population and diminishing natural resources, the oceans remain as a relatively untapped resource. This chapter is also a reproduction of an academic journal article published in June 2015 in the *Open Hydrology Journal*, Bentham Science Open.

The tenth chapter is an ode to forests and jungles, and explains their importance and role in the health of the environment. Chapter 11 details the various engineering processes and systems that are being employed and studied for abatement of atmospheric carbon dioxide. There is a review and discussion of technologies, including new ones, effective ones as well as not so effective ones. Chapter 12 deals with the use of satellite images for observational and quantitative analysis of urban heat islands around the world. "Heat islands" are urban areas all over the world, for example, Miami, Florida, which become significantly hotter than the surrounding countryside in the summer because of all the waste heat discharged by the air-conditioners. Long before there was "climate change" recognition, ordinary people knew that cities were warmer than the countryside. A simple and innovative way to confirm that such a heat island does exist at any one time for any big city, so that the government

may warn the public to save lives, for example, by reducing the mortality rate among the elderly. Enough details are given to carry out this analysis by local municipal authorities. This chapter is a reproduction of a juried conference paper presented at the International Mechanical Engineering Congress and Exposition (IMECE), held in Houston, Texas, in November 2012. This annual congress is run by the ASME.

Chapter 13 is about how climate change aggravates the energy–water–food nexus. Because of extreme weather conditions and calamities caused by weather, the water–food nexus rears its ugly head as problems including food shortages. The energy connection in the energy–water–food nexus is a more permanent one produced by the fact that about 90 percent of the world’s electric power is being generated via the classical thermodynamic Rankine cycle that requires much waste heat to be removed by water (and more recently by air). A brief historical view is also presented about what happened in the Indus River valley of India and Pakistan. This chapter is a reproduction of a juried conference paper presented at the ASME IMECE 2014 in Montreal, Quebec, Canada.

The fourteenth chapter is regarding innovations related to hydrology in response to climate change. This is the third academic journal article published in June 2015 in the *Open Hydrology Journal*, Bentham Science Open. The last, but hardly the least, chapter is to urge all students and the public in general to keep an open mind, and listen to all the information presented, and critically evaluate whether climate change is a happening phenomenon.

