Code	CIVL4480/ ENVR4480 (Spring 22-23)
Title of course	Climate Modeling and Risk Assessment
Instructor	Prof. IM EUN-SOON Dept. of Civil and Environmental Engineering / Division of Environment and Sustainability Room: 4602; email: ceim@ust.hk; phone: 2358-8190
Class Schedule	Monday and Wednesday 10:30-11:50 AM
Prerequisites	MATH 1003 or MATH 1012 or MATH 1013 or MATH 1014 or MATH 1020 or MATH 1023 or MATH 1024
Credits	3
Course Description	The primary aim of this course is to convey fundamental scientific knowledge of the Earth's climate system, to develop the technical skills for climate modeling and data analysis, and to understand the relationship between the impact of climate change and the strategies to manage the associated risks. Emphasis will be placed on the "practical exercise" for the simulation of future climate in response to anthropogenic greenhouse gases using the web-based global climate model (EdGCM) with a user-friendly interface that can be run on a laptop or desktop computer. Through this practice, students will learn full scientific processes related to climate modeling such as experimental design, running simulation, data analysis, and interpretation of results. On this foundation, the latter half of the course will be shifted to the topics for the identification and assessment of the risks from climate extremes. Eventually, students will have familiarity with climate modeling techniques and a better sense to grapple with a myriad of complex climate issues.
Assessment Weight	Final Exam 40% Report1 (Climate modeling and analysis) 30% Report2 (Risk assessment of extreme heat events) 25% Presentation of Report1 5%
Textbooks	Kendal McGuffie and Ann Henderson-Sellers (2005). A Climate Modelling Primer, 3 <sup>rd</sup> edition. John Wiley & Sons Ltd. [ <u>Available in the library</u> ] F. W. Taylor (2005). Elementary Climate Physics, 1 <sup>st</sup> edition. Oxford University Press [ <u>Available in the library</u> ]
References	<ol> <li>IPCC Sixth Assessment Report Climate Change 2021: The Physical Science Basis (https://www.ipcc.ch/report/sixth-assessment-report-working-group-i/)</li> <li>IPCC Sixth Assessment Report Climate Change 2022: Impacts, Adaptation and Vulnerability (https://www.ipcc.ch/report/sixth-assessment-report-working-group-ii/)</li> </ol>
Course Objectives	<ol> <li>To introduce the fundamental principles governing the climate system</li> <li>To develop the technical skills for climate modeling and data analysis</li> <li>To understand the relationship between the impact of climate change and the strategies to manage the associated risks</li> </ol>
Topics	<u>Climate system and global warming</u> - The component of the climate system - Zero-dimensional and One-dimensional Energy Balance Model - Natural and anthropogenic greenhouse effect - The evidence and cause of global warming <u>Introduction to Climate Model</u> - Basic structure of climate model - Dynamic core

	<ul> <li>Physical parameterizations</li> <li>Concept of input/output</li> <li><u>Practice of Climate Modeling</u></li> <li>Concept of control and sensitivity experiments</li> <li>Experimental design</li> <li>Analysis of output using basic statistics</li> <li>Understand the spatial and vertical structure, temporal evolution of major climate variables</li> <li><u>Climate Change Risk Assessment</u></li> <li>Understand the metrics to determine the risk due to climate change</li> <li>Dimensions of vulnerability, exposure and nature hazards</li> <li>Case studies for risk assessment (European heat waves, Pakistan floods, California drought)</li> </ul>
Course Intended Learning Outcomes (CILOs) of this course	<ul> <li>CILO-1: demonstrate a solid understanding of the Earth's climate system</li> <li>CILO-2: describe the greenhouse effect and its association with global warming</li> <li>CILO-3: describe the structure of climate model and general procedure of climate modeling</li> <li>CILO-4: describe how to analyze the performance and uncertainty of climate simulations</li> <li>CILO-5: understand the limited reliability of climate model and interpret the simulation results based on the basic principles governing climate system</li> <li>CILO-6: describe the key concepts and definitions relating to disaster risk management and adaptation to climate change</li> <li>CILO-7: identify and assess the risk as a function of vulnerability and exposure</li> <li>CILO-8: understand the approaches for reducing and managing disaster risk in a changing climate.</li> <li>CILO-9: gain integrated insights from specific case studies and synthesize the important progress in managing risk from climate extreme</li> </ul>
Relationship to the program objective	<ul> <li>This course contributes to the following program objectives:</li> <li>1. Provide professional skills in awareness of environmental sustainability This course provides fundamental knowledge of climate modeling and its applications for the study of climate change and environmental sustainability.</li> <li>2. Train students with good communication skills This course requires students to present their simulation results in a concise and clear way.</li> <li>3. Stimulate self-learning and innovative problem solving skills This course provides the essential skills/knowledge in simulating future climate information and stimulates the students to have an attention to anthropogenic climate change.</li> <li>4. Expose students to real projects and cutting edge research. This course raises the awareness of human impact on climate change and the environment, and provides the information about the state-of-the-art climate modeling technique.</li> </ul>
Relationship to program outcome	<ul> <li>The course contributes to the following program outcomes:</li> <li>1. Obtain fundamental knowledge in mathematics and science</li> <li>Students will learn the fundamental laws of fluid mechanics and thermodynamics, which govern the motions of the atmosphere.</li> <li>3. Conduct experiments and analyze results</li> <li>Students will conduct climate change simulations and analyze results to understand the impact of greenhouse gas emissions on earth climate system.</li> <li>5. Formulate environmental problems and propose feasible solution</li> </ul>

Students will develop the capability to recognize the main cause of global warming, to formulate hypothesis for simulations, and to seek out available solutions.
8. <b>Obtain in-depth knowledge in at least one specialized area</b> Students will learn in-depth knowledge in climate modeling and global warming.
12. <b>Stay abreast of contemporary issues</b> Students will aware the impact of climate change and the environment issues.