**本科全英语课程采用如下英文版教学大纲**

**Syllabus of Fudan University**

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| **Department: Atmospheric and Oceanic Sciences Date:2024-03-01** | | | | | | | | | | | | | |
| **Course Code** | | ATMO110005 | | | | | | | | | | | |
| **Course Title** | | Climate Change and Extreme Weather | | | | | | | | | | | |
| **Credit** | | 2 | | **Experiment**  **(including Computer) Credit** | | | | 0 | **Practice Credit** | | 0.5 | **Aesthetic Education**  **Credit** | 0 |
| **Credit Hours Per Week** | | 2 | | **Education on The Hard-Working Spirit Credit Hours** | | | | 0 | **[Language of Instruction](http://www.baidu.com/link?url=47JJa4qk0LrDpLNqaOc5vq3QapQmx50Zq2Si4vRilP0LBh4dhC7LdZ11ucoXf4IUT8hpalC4TDsTvQgZFq5vOkmJp5rQO-DihNiIVE0Ui-SRoTDGpQwonRCT8aiX7pDO" \t "_blank)** | | ENG | **Honors**  **Course** | □Yes  ☑No |
| **Course Type** | | □Core General Education Course □Specific General Education Course □Basic Course in General Discipline  ☑Others | | | | | | | | 2+X Major：  □Professional Core Course  □Professional Advanced Course | | | |
| Non 2+X Major：  □Professional Compulsory Course □Professional Elective Course | | | |
| **Course Objectives** | | Upon completing this course, students will:   1. **Climate Systems:** Gain a foundational understanding of the components and processes that make up the Earth's climate system. 2. **Weather vs. Climate:** Differentiate between weather and climate, understanding the timescales and dynamics that distinguish short-term weather events from long-term climate patterns. 3. **Climate Variability:** Learn about the natural and anthropogenic factors that cause climate variability and change, including greenhouse gases, solar radiation, volcanic activity, and oceanic circulations. 4. **Extreme Weather:** Examine the science behind extreme weather events such as hurricanes, tornadoes, droughts, floods, and heatwaves, focusing on their cause, development, and impacts. 5. **Climate Modeling and Prediction:** Explore the principles of climate modeling and the use of statistical and dynamic models to predict climate change and extreme weather events. 6. **Scientific Inquiry and Data Analysis:** Develop skills in scientific inquiry and data analysis, using real climate and weather data to conduct basic research projects. 7. **Communicating Climate Science:** Enhance abilities to communicate complex climate science concepts effectively to a non-specialist audience, fostering greater public understanding and awareness. | | | | | | | | | | | |
| **Course Description** | | In "Climate Change and Extreme Weather," students embark on an investigative journey to demystify the science behind climate change and the increasing occurrence of extreme weather events around the world. Aimed at students from a variety of academic backgrounds, this introductory undergraduate course integrates fundamental atmospheric science principles with an examination of the dynamic systems that govern Earth’s climate. Through a blend of lectures, field study, and hands-on data analysis projects, students will delve into the mechanisms of climate change, the physical processes driving extreme weather events (such as typhoons/hurricanes, droughts, floods, heatwaves, wildfires, etc.), and the methodologies scientists use to model and predict these phenomena. Emphasizing critical thinking and problem-solving, students will also investigate the role of human activity in climate change and the strategies for mitigation and adaptation. By the end of the course, students will be empowered with the knowledge and skills to navigate the complex issues surrounding climate change and extreme weather, promoting a proactive and informed approach to one of the most pressing challenges of our time. | | | | | | | | | | | |
| **Course Requirements:**  None. All undergraduate students are encouraged to take this course. | | | | | | | | | | | | | |
| **Teaching Methods:**   * **Lectures and Presentations:** Key concepts, theories, and scientific principles will be introduced through lectures and multimedia presentations. These sessions will cover the fundamental science of climate change, the mechanics of extreme weather events, and the latest research findings. * **Case Studies:** Analysis of case studies will be a core component of the curriculum, enabling students to examine the impacts of extreme weather events and climate change on various regions and communities. This approach fosters critical thinking and application of theoretical knowledge to real-world scenarios. * **Group Project:** Students will collaborate on projects that analyze climate data and extreme weather events. These hands-on activities are designed to develop practical skills and deepen understanding of course concepts, as well as encourage teamwork, research, and presentation skills. * **Field Study:** A field trip to observe clouds on campus will be organized to offer experiential learning opportunities. Observing first-hand the evolving atmospheric composition in the field can significantly enrich the learning experience. * **Discussion and Debate:** Regular class discussions and debate sessions will be held to encourage dialogue on the ethical, social, and economic implications of climate change and extreme weather. This will help students develop their communication skills and form well-rounded viewpoints. * **Assessment and Feedback:** A variety of assessment methods (see Grading and Evaluation below), including in-class quizzes, exams, project reports, and presentations, will be used to evaluate student progress. Constructive feedback will be provided to support student learning and development.   These teaching methods are designed to engage students actively with the material, enhance their understanding of complex scientific concepts, and equip them with the skills and knowledge to address the challenges of climate change and extreme weather effectively. | | | | | | | | | | | | | |
| **Course Director's Academic Background:**  Dr. GAO Yuchao is a Research Scientist in the Department of Atmospheric and Oceanic Sciences. Her academic journey began with a B.A. in Earth and Planetary Sciences from Johns Hopkins University in 2013. She then continued her graduate studies at Columbia University, earning her M.A., M.Phil., and Ph.D. degrees in Earth and Environmental Sciences, while engaging in graduate research at NASA Goddard Institute for Space Studies. Prior to her return to China, Dr. Gao furthered her postdoctoral studies at the Massachusetts Institute of Technology (MIT), as well as through a joint appointment with Princeton University and the NOAA Geophysical Fluid Dynamics Laboratory. Dr. Gao’s work focuses on process-level atmospheric aerosol research and global climate model development. | | | | | | | | | | | | | |
| **Instructor's Academic Background:**  Professor ZHOU Wen currently serves as a Distinguished Professor in the Department of Atmospheric and Oceanic Sciences. Her educational journey took her from Sun Yat-sen University, where she earned her Bachelor's and Master's degrees in Atmospheric Science and served as a lecturer after college, to the City University of Hong Kong, where she completed her Ph.D. in Atmospheric Science in 2004. Professor Zhou's extensive research career includes positions ranging from a forecaster at the Meteorological Bureau of Zhongshan City after college to postdoctoral research at the Chinese Academy of Sciences, and eventually a professor at the City University of Hong Kong. Specializing in climate change and variability, climate prediction, monsoon dynamics, air-sea interaction, and tropical cyclones, her work has significantly contributed to advancing our understanding of the complex dynamics of Earth's climate system.  Dr. Gao’s background is listed above. | | | | | | | | | | | | | |
| **Members of Teaching Team** | | | | | | | | | | | | | |
| **Name** | | **Gender** | | | | **Professional Title** | | | **Department** | | **Responsibility** | | |
| ZHOU Wen | | Female | | | | Professor | | | Atmospheric and Oceanic Sciences | | Co-design the course curriculum; deliver lectures and facilitate class discussions; create assessments and provide feedback; offer guidance and support to students. | | |
| GAO Yuchao | | Female | | | | Research Scientist | | | Atmospheric and Oceanic Sciences | | Co-design the course curriculum; deliver lectures and facilitate class discussions; create assessments and provide feedback; offer guidance and support to students. | | |
| **Course Schedule** (Please supply the details about each lesson)**:**  **Week 1: Introduction to Climate Change and Extreme Weather**   * Overview of course objectives and key concepts in climate science. * Observations, data, and evidence for climate change.   **Week 2: Atmospheric Composition**   * Greenhouse gases, the greenhouse effect, and human contributions. * Aerosols: sources, types, and impacts on climate and weather.   **Week 3: Climate Feedback Mechanisms**   * Positive and negative climate feedback loops. * The roles of water vapor, ice-albedo feedback, and clouds in the climate system.   **Week 4-5: Ocean-Atmosphere Interactions**   * Ocean circulation patterns and their effects on climate. * Ocean's role in heat storage and redistribution, as well as sea-level rise.   **Week 6: Extreme Weather Phenomena I: Hurricanes and Tropical Storms**   * Formation and intensification processes of tropical cyclones. * The impact of sea surface temperatures and atmospheric conditions.   **Week 7: Extreme Weather Phenomena II: Droughts, Heatwaves, Wildfires**   * Causes and effects of prolonged droughts, heatwaves, and wildfires. * The role of atmospheric conditions in extreme heat events.   **Week 8: Extreme Weather Phenomena III: Floods and Heavy Precipitation**   * Mechanisms leading to heavy rainfall and flooding. * Influence of atmospheric patterns on precipitation events.   **Week 9: Extreme Weather Phenomena IV: Extreme Cold and Snow Storms**   * Formation of snow storms and extreme cold weather. * Impact of polar vortex on winter extreme weather.   **Week 10：Field Work: Visit Shanghai Meteorological Bureau**  **Week 11-12: Climate Models and Projections**   * Introduction to climate modeling, types of models, and prediction methods. * Hands-on activities with basic climate model output.   **Week 13: Policy and International Response to Climate Change**   * Overview of global climate agreements, policies, and negotiations. * Role of technology and policy in climate change mitigation. * Review of key concepts, discussion on integrating knowledge into action.   **Week 14: Climate Change Debate**   * Student groups debate on climate change topics, such as the pros and cons of geoengineering. * Critical evaluation of opposing viewpoints and arguments.   **Week 15: Future of Climate Research**   * Highlights of emerging research topics in climate science. * Carbon neutrality and other emerging topics: Emission reduction, carbon capture, and alternative energy solutions.   **Week 16: Final Exam** | | | | | | | | | | | | | |
| **The design of class discussion or exercise, practice, experience and so on:**  Several activities are planned both in and out of the classroom:   1. **Temperature Historical Data Analysis:** Leveraging online databases, students will analyze historical temperature data to identify trends, anomalies, and patterns. This activity aims to enhance their data analysis skills and understanding of long-term climate variability and change. 2. **Cloud Observations:** Participants will engage in cloud observation exercises, where they will analyze different cloud types and their implications for weather patterns. Students will be tasked with capturing a one-minute video of cloud formations and submitting it online as part of their assignment. 3. **Presentation on Recent Weather Extreme Events:** Students will research and present recent extreme weather events, exploring their causes, impacts, and the response measures. This will encourage them to apply their theoretical knowledge to real-world scenarios and improve their presentation and research skills. 4. **Climate Change Debate:** Engaging in debates on controversial topics such as geoengineering and its role in combating climate change. This activity is designed to foster critical thinking, argumentation skills, and a deeper understanding of the ethical, social, and scientific dimensions of climate change mitigation strategies.Top of FormBottom of Form | | | | | | | | | | | | | |
| **If you need a TA, please indicate the assignment of assistant:**  This course requires a TA whose responsibilities include: grading assignments, quizzes, and exams, providing assistance in organizing and leading the weather station field trip as well as other administrative tasks. | | | | | | | | | | | | | |
| **Grading & Evaluation** (Provide a final grade that reflects the formative evaluation process)**:**  The final grade calculation is structured as follows:  Homework and Assignments 20%  Project and Presentation 25%  Climate Change Debate 15%  In-Class Quizzes: 15%  Final Exam 25%  =100% | | | | | | | | | | | | | |
| **Usage of Textbook：**□Yes(complete textbook information form below) ☑No  **Textbook Information** (No more than two textbooks) **:** | | | | | | | | | | | | | |
| **Title** | **Author** | | **ISBN** | | **Publishing Time** | | **Publisher** | | **Type Ⅰ** | | | **Type Ⅱ** | |
|  |  | |  | |  | |  | | □Self-compiled Textbook (Published)  □Non-mainland Textbook  □Other Textbook (Published) | | | □National Planning Textbook  □Provincial and Ministerial Planning Textbook  □School Level Planning Textbook  □Others | |
|  |  | |  | |  | |  | | □Self-compiled Textbook (Published)  □Non-mainland Textbook  □Other Textbook (Published) | | | □National Planning Textbook  □Provincial and Ministerial Planning Textbook  □School Level Planning Textbook  □Others | |
| **Teaching References** (Including author, title, publisher, publishing time, ISBN)**:**  IPCC, 2021: *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*[Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, In press, doi:[10.1017/9781009157896](https://dx.doi.org/10.1017/9781009157896).  IPCC, 2022: *Climate Change 2022: Impacts, Adaptation, and Vulnerability.*Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. Cambridge University Press, Cambridge, UK and New York, NY, USA, 3056 pp., doi:[10.1017/9781009325844](https://dx.doi.org/10.1017/9781009325844" \t "_blank).  IPCC, 2022*: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA. doi: [10.1017/9781009157926](https://dx.doi.org/10.1017/9781009157926" \t "_blank) | | | | | | | | | | | | | |

Table column size can be adjusted according to the content.