Course Form for PKU Summer School International 2025

Course Title	Title in English: Our Changing Planet
	Title in Chinese: 变化中的地球
Teacher	Prof. Mei Zheng（郑玫教授）
First day of classes	June 30, 2025
Last day of classes	July 25, 2025
Course Credit	2 credits

Course Description

Objective：

Due to anthropogenic activities, our planet is changing quickly with various environmental impacts including sea level rise, extreme weather, wildfire, ice melting in polar region etc. This course is intended for undergraduate students to examine key issues and topics that are related to major environmental issues. We will focus on global issues in the first part and environmental challenges especially air pollution in China in the second part. Sustainable pathways will be included. In the first part, we will cover the introduction of basic structure of earth system and major global environmental challenges. In the second part, we will introduce how China improves its air quality in recent years, including sources, formation mechanisms, health impacts, and policies that lead to effective reduction of $PM_{2.5}$ concentration and blue sky.

Pre-requisites /Target audience

Students wishing to enroll in this course are expected to be interested in environmental issues, impacts due to anthropogenic activities, sustainability of our planet, and how China solves its air pollution problem.

Proceeding of the Course

This course will be given primarily by lectures. Participation and discussions are important in this course. Students should complete the required readings and are expected to actively engage in class discussion. Attendance is mandatory and two absences without legitimate reasons will lead to failure in the course. Each student is expected to give presentation related to environmental pollution. The students will finalize topics after discussing with the course instructor.

Assignments (essay or other forms)

There will be two essays besides class presentation and final report.

Evaluation Details

Class participation (15%), mid-term presentation 30%, final presentation 25%, final report 30%.

Text Books and Reading Materials

1. *Our Changing Planet*, by Fred T. Mackenzie, fourth edition.
2. *The Earth System*, by Lee R. Kump, James F. Kasting, and Robert G. Crane, third edition.
3. Chan, C.K, and Yao, X. (2008) "Air pollution in mega cities in China." *Atmospheric Environment*, 42.
4. Han, Y., and Zhu, T. (2015) "Health effects of fine particles ($PM_{2.5}$) in ambient air." *Science China (Life Sciences)*, 58.
5. United Nations Environment Programme (UNEP) (2019) *A review of 20 years' air pollution control in Beijing*.
6. Zheng, M., Yan, C., and Zhu, T. (2020) "Understanding sources of fine particulate matter in China." *Philosophical Transactions Royal Society A*., 378.
7. The Intergovernmental Panel on Climate Change (IPCC) (2021) *Climate change 2021: The physical science basis*.

Academic Integrity (If necessary)

CLASS SCHEDULE

(Subject to adjustment)

Session 1: *Introduction to major global environmental challenges*

Topics to cover include global warming, ozone depletion, extreme weather, global sustainability, geoengineering, and international protocols to protect our planet including the Montreal Protocol and the Paris Agreement. The students will learn various evidence provided by the IPCC report, risk assessment, and adaptation to climate change.

Session 2: *Our changing planet: Atmosphere*

In this session, students will learn basic structure of atmosphere and atmospheric circulation as well as changes in atmospheric composition due to human activities. Topics to cover include greenhouse gases, climate in the past, measurement of CO_2, photochemical smog, etc.

Session 3: *Our changing planet: Ocean*

Students will learn about ocean structure and changes in ocean due to human activities. Topics to cover include ocean circulation, seawater properties, ocean acidification, eutrophication, ocean pollution, air-sea exchange, and atmospheric deposition.

Session 4: *Our changing planet: Land*

Topics to cover include the impact of human activity on land, deforestation, impacts on biodiversity as well as desertification. The impacts of global warming in polar regions will be discussed including how anthropogenic emissions such as black carbon impact ice melting in the Tibet Plateau, and how pollutants are transported to polar regions.

Session 5: *Earth system monitoring and modeling*

In this session, students will learn about different modern tools that scientists use to monitor

changes in the earth system, such as satellites, methods to study the ocean, monitoring networks on land, and major environmental databases. It also includes introduction of earth system modeling including major models that are used to model pollutants in global and regional scale.

Session 6: *Introduction of air pollution in China*
Topics include introduction of history of air pollution in China, pollutant types, emission sources and emission trends, key policies for reducing pollution, and major air pollution intervention programs.

Session 7: *Haze in China*
China has experienced severe haze due to its fast economic development. Therefore, China started to regulate $PM_{2.5}$ concentration in 2012. Topics include major sources and emission inventory in China, chemical and physical processes for haze formation, local and regional transport of haze, and effectiveness of different policies. In this session, students will learn how China deals with its haze problem and how it has improved its air quality through various efforts in the past decade.

Session 8: *Health impacts of pollutants in China*
Pollutants emitted by anthropogenic activities pose severe health impacts. In this session, students will learn about major types of pollutants that pose health risks, such as metals and organic pollutants, and identification of key sources which contribute to health impacts.

Session 9: *Emerging ocean science in China*
Ocean science has shown fast development in recent years as China has paid great attention and made much effort in ocean science in recent years. Topics include progress and development of ocean science in China, major research programs and research areas of ocean science, and ocean serving as a potential sink for greenhouse gas CO_2.

Session 10: *Carbon neutrality in China*
China has announced its goal to reach a peak in its carbon dioxide emission in 2030 and carbon neutrality in 2060. China is moving to clean energy in order to reduce CO_2 emission and improve its air quality. Students will learn about the energy structure in China and the challenges it faces. Topics such as energy structure reform, ways to quantify CO_2 emission, and pathways to reach carbon neutrality in China will be introduced to the students.

About the instructor

Mei Zheng is Boya Distinguished Professor of Peking University (PKU). She has served as former Vice Dean in the Institute of Ocean Research, Peking University. She is based in PKU's College of Environmental Sciences and Engineering. Prof. Zheng received her bachelor's degree from Sun Yat-sen University in 1990, master's degree from the Institute of Geochemistry, Chinese Academy of Sciences in 1993, and Ph.D. degree from the Graduate School of Oceanography, University of Rhode Island, USA in 2000. She has worked in Hong Kong University of Science and Technology before pursuing her Ph.D. degree in the United States. She was a postdoc at the Georgia Institute of Technology and a visiting postdoc at the University of Wisconsin-Madison, USA from 2000-2001. Prof. Zheng worked at the School of Earth and Atmospheric Sciences, Georgia Institute of Technology, for ten years

before she joined Peking University as a full professor in 2010. Her research interests focus on air pollution in urban area and health impacts of pollutants. She also developed projects related to ocean science, studying transport and deposition of air pollutants from land to sea. By now, Prof. Zheng has published 180 SCI papers, which have been cited more than 10000 times. She is the leading principal investigator of some key research projects of the National Natural Science Foundation of China. Prof. Zheng has been appointed by different organizations, including serving as the co-chair of the Global Engagement Committee of American Geophysical Union (AGU), the former Scientific Steering Committee member of International Global Atmospheric Chemistry (IGAC), and Committee member of Foreign Expert Committee in Peking University. Prof. Zheng is also currently serving as the Chair of IGAC China Young Working Group.