E-COURSE:

Atmospheric dynamic process – Air pollution risk assessment

Host institution	National University of Mongolia, School of Engineering and Applied Sciences
Credits	6 ECTS (optional course)
Lecturers	Byambaa Batdelger (National University of Mongolia)
Level	MSc and PhD course
Course duration	16 classes
Type	Research
OpenEDX link	http://online.num.edu.mn/courses/course-v1:NUM+ENVI+2021t1/about

Summary

This course examines the causes of any atmospheric process, the ambient climate, the climate, the sources and effects of air pollution, the assessment of risks to human health, and the methodology for estimating sources. The course is more relevant to the master's and doctoral programs in science, policy planning, management, and basic social concepts of the environment, including atmosphere and air pollution reduction management. In addition, it introduces students to urban environmental pollution management, and integrated air pollution reduction management. The course includes data collection, data analysis, individual and group exercises, field work, seminar and report writing.

Target student audiences

MSc and PhD students in environmental science, hydrology and water management

Prerequisites

Required courses (or equivalents):

- Environmental science
- Environmental monitoring

Aims and objectives

The purpose of this course is to provide students with knowledge on the causes of any atmospheric process, the weather, the climate, the sources and effects of air pollution, and the methods for assessing and estimating risks to human health. The course consists of the following three parts.

1. provide students with knowledge the concept of atmospheric dynamics process
2. provide students with knowledge the concepts of air quality and pollution
3. provide students with knowledge on methods for assessing human health risks from the effects of air pollutants

In addition, you will learn about the importance of air pollution and risk reduction management.

General learning outcomes:

By the end of the course, successful students will:

- understanding the dynamic processes of the atmosphere
- atmospheric circulation and the interrelationships between them
- atmospheric circulation results and climate
- impact of human factors on the atmosphere
- air quality, pollution, and contaminants
- air quality assessment
- air pollution risk assessment for human health

Applicable learning outcomes:

- understand the interrelationships between any process in the atmosphere
- conduct air pollution impact analysis
- assess human health risks due to air pollution
- writing reports, group discussions, and interviews

Overview of sessions and teaching methods

The course will make most of the interactive and self-reflective methods of teaching and learning and where possible, avoid standing lectures and presentations. It will start with an overview of the atmosphere dynamic process and urban air pollution, its application worldwide. Then it will continue with exercise on different components of air quality and pollute such as $PM_{2.5}$, PM_{10}, NO_2, SO_2, CO_2, CO, O_3, and PAHs of collecting relevant data from different sources and the collection will be used to assess the different components of air pollution, and intermediate results will be reported and presented. Most interestingly, field work to visit different stakeholders of the air pollution sector in your city will organize (if online learning, it will be organized student itself) to understand real situation, visual interpretation, to collect vital information and datasets. It will continue 1-2 days depending on the availability and willingness of stakeholders. Finally, full picture of air pollution reduction management, governance of student's city will be assessed by USEPA, WHO guide, and final results will be reported and presented.

Course workload

The table below summarizes course workload distribution:

Activities	Learning outcomes	Assessment	Workload (hours)
In-class activities			
Lectures	Understanding theories, concepts, methodology and tools	Class participation	10
Moderated in-class discussions	Understanding various policy and management contexts and common problems in communication in urban water issues	Class participation and preparedness for discussions	10
In-class assignments	Understanding various policy and management contexts and common problems in communication in urban air pollution issues	Class participation and preparedness for assignments	10
Independent work			
Paper review and discussion	Familiarity with and ability to critically and creatively discuss key concepts, tools and methods as presented in the literature	Class participation creative and active contribution to discussion	30
- Application Atmospheric dynamic process - Application Air pollution components - Application Health risk assessment parameters	- to understand the Atmospheric dynamic process and its components. This will include a collection of data, calculations, report writing, and make presentation. - to understand Air pollution components and its components. This will include a collection of data, calculations, report writing, and make a presentation. - to understand Health risk assessment parameters, and its application, components. This will include a collection of data, calculations, report writing, and make a presentation.	Self-work Individual report and presentations	30
Field work	Familiarity with real situation, communicate with field experts, photo taken, collect relevant data and information	Class participation and preparedness for discussions	30

Application of USEPA guide and WHO standard	To understand the USEPA guide and WHO standard, and air pollution reduction management issues of own city. This will include analysis results of air pollution, and air pollution reduction management, report writing, and make a presentation.	Class participation and preparedness for discussions	30
Total			150

Grading

The students' performance will be based on the following:

~ Level of preparedness for participation in class discussions and seminars (30% from 100% for active participation and demonstrated familiarity with the course readings to 0% for completely ignoring in-class discussions);
~ Contribution to group assignments and demonstration of individual work (30% from 100% for clearly demonstrated input to 0% for non-participation);
~ Quality of the approach application and reporting and presenting (40% from 100% for clearly shown the report and presentation to 0% for non-participation);
  - correct application of the approach +20%
  - write report +10%
  - make presentation +10%

Course schedule

Class	In-class hours	Topic	Type
1	4	~ Introduction the about atmospheric dynamic process	Lecture Seminar
2	4	~ Solar reactions and solar radiation	Lecture Seminar
3	4	~ Air pressure distribution on the Earth's surface	Lecture Seminar
4	4	~ Pressure horizontal gradient and wind	Lecture Seminar
5	4	~ Atmosphere mass	Lecture Seminar
6	4	~ Atmosphere temperature	Lecture Seminar
7	4	~ Humidity and humidity parameters	Lecture Seminar
8	4	~ Precipitation	Lecture Seminar
9	4	~ Mathematical statistical method for weather forecasting	Lecture Seminar
10	4	~ Forecast weather conditions for air pollution	Lecture Seminar
11	4	~ Predict the background conditions of urban air pollution	Lecture Seminar
12	4	~ Air quality and standards, and to evaluate the air pollution level by air quality index	Lecture Seminar
13	4	~ Air pollution and its indicators	Lecture Seminar
14	4	~ Air pollution and aromatic hydrocarbons	Lecture Seminar
15	4	~ Polycyclic aromatic hydrocarbons analysis	Lecture

			Seminar
16	4	~ Evaluation results and comparison	Lecture Seminar

Course assignments

Course assignments will constitute a multi-part project:

- ~ Assignment #1 – Atmospheric dynamic process: Short report in class 8
- ~ Assignment #2 – Air pollution and it's component: Short report in class 13
- ~ Assignment #3 – Polycyclic aromatic hydrocarbons analysis: Short report in class 16

Assignment #1 will require a greater level of self-organised work from students. It will help students to understand Atmospheric dynamic process, and its components. This will include collection of data, calculations, report writing and make presentation. Maximum 5 pages of the Atmospheric dynamic process need to prepare as a report and must submit their report prior to class 9, and the result will be discussed during class 8.

Assignment #2 will require a greater level of self-organized work from students. It will help students to understand the air pollution components. This will include a collection of data, calculations, report writing, and make presentation. Maximum 5 pages of the air pollution assessment results need to prepare as a report and must submit their report prior to class 15, and the result will be discussed during class 14.

Assignment #3 will require a greater level of self-organized or group work from students. It will help students to understand the human health risk assessment of the polycyclic aromatic hydrocarbon compounds and its components. This will include an interview with stakeholders, collection of data, report writing, and make a presentation. Maximum 5 pages of the human health risk assessment of the polycyclic aromatic hydrocarbon compounds and its components need to prepare as a report and must submit their report prior to class 16, and the result will be discussed during class 15.

Literature

Compulsory:

1. Batchuluun.E, World science, 2012
2. Natsagdorj. L, Synoptic meteorology, 2017
3. Garamjav. D, Turbulence phenomena in the World, 2007
4. Batdelger Byambaa, Lu Yang, Atsushi Matsuki, Edward G. Nagato, Khongor Gankhuyag, Byambatseren Chuluunpurev, Lkhagvajargal Banzragch, Sonomdagva Chonokhuu, Ning Tan[4] and Kazuichi Hayakawa "Sources and Characteristics of Polycyclic Aromatic Hydrocarbons in Ambient Total Suspended Particles in Ulaanbaatar City, Mongolia" *Int. J. Environ. Res. Public Health* 2019, *16*(3), 442; https://doi.org/10.3390/ijerph16030442
5. Chonokhuu Sonomdagva, Byambaa Batdelger, and Chuluunpvrev Byambatseren. "Characteristics of PM_{10} and $PM_{2.5}$ in the Ambient Air Ulaanbaatar, Mongolia", in International Journal of Environmental Science and Development "IJESD" editor prof. Richard Haynes, Vol.7, No.11 November 2016, ISSN: 2010-0264. pp. 827-830
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7. Kottek, M.; Grieser, J.; Beck, C.; Rudolf, B.; Rubel, F. World Map of the Köppen-Geiger climate classification updated. Meteorol. Z. 2006, 15, 259–263.
8. Huang, Y.K.; Luvsan, M.E.; Gombojav, E.; Ochir, C.; Bulgan, J.; Chan, C.C. Land use patterns and SO2 and NO2 pollution in Ulaanbaatar, Mongolia. Environ. Res. 2013, 124, 1–6.
9. Yang, D. Levels, sources and potential risks of polycyclic aromatic hydrocarbons (PAHs) in multimedia environment along the Jinjiang River mainstream to Quanzhou Bay, China. Mar. Pollut. Bull. 2013, 76, 298–306.
10. Tsapakis, M.; Stephanou, E.G. Occurrence of gaseous and particulate polycyclic aromatic hydrocarbons in the urban atmosphere: Study of sources and ambient temperature effect on the gas/particle concentration and distribution. Environ. Pollut. 2005, 133, 147–156.

11. Sin, D.W.; Wong, Y.C.; Choi, Y.Y.; Lam, C.H.; Louie, P.K. Distribution of polycyclic aromatic hydrocarbons in the atmosphere of Hong Kong. J. Environ. Monit. 2003, 5, 989–996.
12. Nielsen, T.; Jørgensen, H.E.; Larsen, J.C.; Poulsen, M. City air pollution of polycyclic aromatic hydrocarbons and other mutagens: Occurrence, sources and health effects. Sci. Total Environ. 1996, 180, 41–49
13. Hayakawa, K. Environmental Behaviors and Toxicities of Polycyclic Aromatic Hydrocarbons and Nitropolycyclic Aromatic Hydrocarbons. Chem. Pharm. Bull. 2016, 64, 83–94.

Recommended:

14. The World Bank Group. MONGOLIA: Heating Stove Market Trends in Poor, Peri-Urban ger Areas of Ulaanbaatar and Selected Markets outside Ulaanbaatar; With Generous support from the Australian Government; The World Bank Group: Washington, DC, USA, 2011; 87052p.
15. Guttikunda, S. Urban Air Pollution Analysis for Ulaanbaatar; The World Bank Consultant Report: Washington, DC, USA, 2007.
16. U.S. Environmental Protection Agency. Supplementary Guidance for Conducting Health Risk Assessment of Chemical Mixtures; Risk Assessment Forum Technical Panel EPA/630/R-00/002; U.S. Environmental Protection Agency: Washington, DC, USA, 2000.
17. Minnesota Department of Health. Guidance for Evaluating the Cancer Potency of Polycyclic Aromatic Hydrocarbon (PAH) Mixtures in Environmental Samples; Minnesota Department of Health: Saint Paul, MI, USA, 2016.
18. International Agency for Research on Cancer. IARC Monographs on the Evaluation of the Carcinogenic Risks to Humans; International Agency for Research on Cancer: Lyon, France, 2014; Volume 100.