



Committee: Environment Sub-Commission 1

Issue: Air pollution and weather interaction in East Asia

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INTRODUCTION

Air pollution is one of the biggest challenges that humans have faced and will be facing for years to come. It's a difficult issue to overcome for all countries, and especially for those with high population densities, like China. High concentrations of air pollution can cause negative effects on the health of humans, plants and the ecosystem. The World Health Organization (WHO) has listed air pollution as one of the greatest environmental risks to human health¹.

As being the region with the most intense human activities in the world, East Asia experiences a complex type of Air Pollution. Some sources of this air pollution come from anthropogenic carbon emissions, biogenic emissions, dust storms and biomass burning. A mixture of these fumes can cause different 'types' of air pollution under various types of weather conditions.

Meteorological conditions are one of the biggest factors that influence day-to-day air quality. Factors that influence the air quality are radiation, air temperature, and humidity. Emissions, chemical reactions and the transportation and deposition of air pollutants are one of the few processes that form air pollution. Generally, East Asia has been suffering from poor air quality because of intense emissions from large energy consumptions linked with expeditious industrialization and urbanization. There have been multiple events of high concentrations of air pollutants observed in this area. These

¹ Oxford – Environmental Science – Air Pollution and Weather Interaction in East Asia

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events cause negative impacts on human health and the ecosystem's sustainability.

DEFINITION OF KEY TERMS

Air Pollution²

Air pollution is a broad term applied to any chemical, physical (particulate matter), or biological agent that modifies the natural characteristics of the atmosphere.

Climate Change³

A long-term change in the earth's climate, especially a change due to an increase in the average atmospheric temperature.

Greenhouse Effect⁴

The phenomenon whereby the earth's atmosphere traps solar radiation, caused by the presence in the atmosphere of gases such as carbon dioxide, water vapor, and methane that allow incoming sunlight to pass through but absorb heat radiated back from the earth's surface.

Meteorological Processes⁵

Relating to the branch of science concerned with the processes and phenomena of the atmosphere, especially as a means of forecasting the weather.

NGO⁶

A non-governmental organization is any non-profit, voluntary citizens' group which is organized on a local, national or international level. Task-oriented and driven by people with a common interest, NGOs perform a variety

² ScienceDaily – Air Pollution

³ Dictionary.com – Climate Change

⁴ Dictionary.com – Greenhouse effect

⁵ Oxford Dictionaries – Meteorological

⁶ Ngo.org

of service and humanitarian functions, bring citizen concerns to Governments, advocate and monitor policies and encourage political participation through provision of information.

Biogenic Emissions⁷

Biogenic emissions are emissions from natural sources, such as plants and trees. Some emissions of biogenic volatile organic compounds come from vegetation for natural areas, crops, and urban vegetation.

Anthropogenic Carbon Emissions⁸

Anthropogenic carbon emissions are the emissions of various forms of carbon, the most concerning being carbon dioxide, associated with human activities.

Biomass Burning⁹

Biomass burning is the combustion of organic matter. Burning can be from natural or man-made fires. Examples are the burning of crop stubble, forest residues and vegetation burnt for land clearing.

Synoptic Weather¹⁰

Synoptic simply means a ‘summary’ of the current situation. In weather terms, synoptic weather means the pressure pattern, fronts, wind direction and speed and how they will change and evolve over the coming few days.

Cyclogenesis

It is the development or strengthening of an area of low pressure in the atmosphere, resulting in the formation of a cyclone.

⁷ California Air Resources Board – Biogenic Emissions Inventory

⁸ Energy Education – Anthropogenic carbon emissions

⁹ Australian Government – Departments of the Environment and Energy – Biomass Burning

¹⁰ Met Office UK – How to read synoptic weather charts

BACKGROUND INFORMATION

Characteristics of Air Pollution and Its Sources

Air quality in Eastern Asian countries has experienced different stages over the last two decades. This is because there is a different level of progression in terms of industrialization and urbanization between the countries. One example of this difference is the comparison between China and Japan. In Japan, air pollution isn't such a big environmental issue any longer because of their relatively few high-emission industries and earlier applications of clean technology. Therefore, because of their applications of clean technology, there have been only occasional appearances signs of air pollution and which only happen in megacities under specific meteorological conditions. On the other hand, China suffers from poor air quality due to intense emissions from fossil fuel combustions related to economic development.

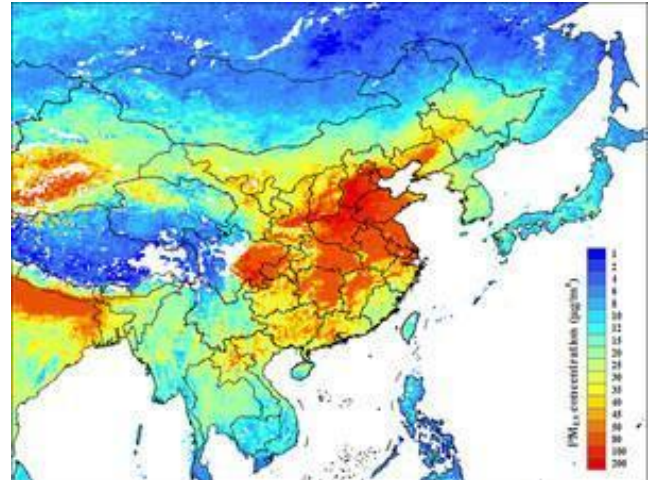


Figure 1. Average satellite-retrieved concentrations in East Asia (2010–2012) Data from Socioeconomic Data and Applications Center (SEDAC) of NASA (van Donkelaar et al., 2015).

East Asia is also influenced by other complex pollution sources. One of these sources is biomass burning, which happens mostly during springtime. One example of biomass burning is when farmers burn sugar canes (which release tons of hazardous pollutants in the air). Figure 2 represents the distributions of the different emissions sources in Asia. (a) Black carbon annual emissions from anthropogenic sources (b) biomass-burning sources (c) isoprene emissions from biogenic sources (d) soil and sand fractions. Another important seasonally varying natural pollution source in Asia is dust storms (as shown before in figure 2 (d)). The wind-blown dust, which originated from the Taklimakan and Gobi deserts in northwestern China in spring, could be transported by circulation mainly to East China, and even wider regions in the Northern Hemisphere, such as the Pacific Ocean and North America.

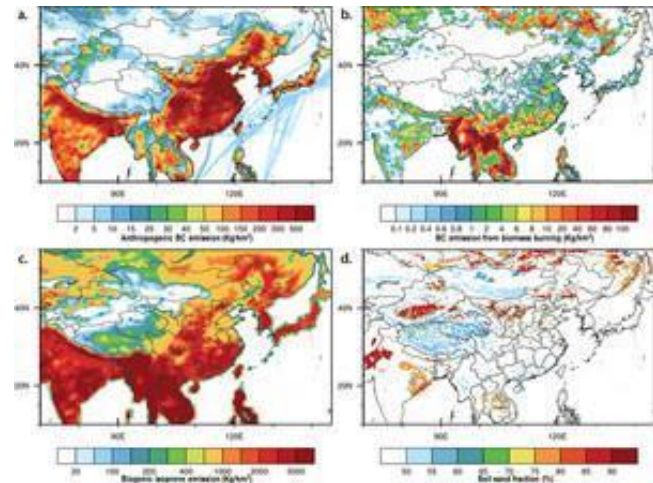


Figure 2. Distributions of different emission sources in Asia in 2010. (FAO/IIASA/ISRIC/ISS-CAS/JRC, 2009).

The distribution of these different emissions results in a complex environment for the formation of air pollutants in East Asia. Meteorological processes can cause a substantial mixing of the air pollutants and can be a cause of the chemical formation of some secondary pollutants. Both dust and biomass burning can be radioactive and could have radioactive effects in the modification of meteorological parameters; making East Asia a unique region with its complex air pollution.

Weather Influencing Air Pollution

The formation of air pollution has been affected widely by multiple meteorological variables and processes. One example is temperature, as it influences the emissions and the chemical reactions. In Eastern Asian countries, people experience very hot summers and cold winters which is a huge problem for air pollution. Because of these weather conditions citizens use a lot of electricity to power their heaters and air conditioners (for winter

and summer) which can be damaging to the environment. Precipitation and clouds can also influence the wet deposition of water-soluble air pollutants, and winds and circulations are the important factors controlling the multiscale transport of air pollutants.

Although there are various types of synoptic weather, their influences on air quality in a specific city or a region could be connected with two conditions: (a) the impact of local air pollutant accumulation or removal process, and (b) the influence of long-range transport. East Asia is the region with the most frequent cyclogenesis in the world, meaning that it experiences cyclones and anti-cyclones very frequently. A cyclone, associated with strong wind, more clouds and precipitation, less radiation, and cool air temperature, generally favours the removal of air pollutants and results in somewhat good air quality. On the other hand, an anticyclone generally favours the formation of air pollution because of strong solar radiation, high air temperature, and weak surface wind. An anti-cyclone can be the cause of the long-range transport of air pollutants. There is one more type of cyclone that affects air quality in Eastern Asia, called the tropical cyclone. The tropical cyclone, also known as a typhoon contains heavy rains and strong winds and is favourable for good air quality.

Implications and Challenges

Throughout the study guide, I have clearly demonstrated that air pollution is strongly linked with the weather and climate in East Asia from several aspects: (a) the influence of multiscale meteorological processes on the formation, transport, and removal of air pollutants; (b) the roles of air pollutants, in modifying meteorological parameters, regional climate, and even synoptic weather; and (c) the mechanism of enhanced air pollution in megacities through air pollution–PBL–weather interactions. These issues could potentially have strong implications for air quality forecasting and weather

forecasting and should be considered in policy making for the mitigation of air pollution and climate change in this region.

Given the importance that air pollution and weather interactions have in modifying weather and enhancing air pollution, shows that they play a big role in the health of every citizen in that region. These processes should be considered as operational air quality and weather forecasting models. Currently, most operational models for air quality forecasting and weather forecasting have not yet included meteorology and chemistry.

From the perspectives of air quality control policy, the air pollution–weather interactions also should be considered. As meteorological parameters and synoptic weather strongly influence air pollution, the change of monsoon climate and synoptic weather types should be considered in understanding the variation and the long-term trend of air quality. Considering the role of black carbon in air pollution–weather interactions, more restricted control measures for reducing the emission of black carbon could be the most efficient way to mitigate extreme haze pollution in megacities in China because reducing black carbon will give a rapid improvement of air quality.

However, the current understanding of air pollution–weather interactions is still limited because of many uncertainties related to the interactions between chemical and physical processes. Besides the ground measurements, more vertical observations based on aircraft and sounding platforms are needed to give a clearer picture about the three-dimensional perspectives of air pollutants and to gain in-depth insight into the interaction of air pollution and meteorological processes above the ground surface.

Another key challenge is the development of numerical models. Only with the joint effects of field measurement and numerical modelling we could gain a more holistic understanding of air pollution–weather interactions and reach a final solution to air pollution issues in this region. To achieve these, the community needs to meet the challenge of a high level of



interdisciplinary/cross-disciplinary research with more collaboration between environmental scientists and meteorologists.

MAJOR COUNTRIES AND ORGANISATIONS INVOLVED

China

China's fight to "make the skies blue again" has been going on for multiple years. The Congress wanted to take action to tackle one of China's biggest problems, air pollution. Air pollution in China kills about 1.1 million people a year, immediately indicating that it is an issue that should be solved instantly. They reduced the production of steel and coal-fired electricity, and to replace them they invested heavily in wind and solar power. Officials have also ordered that vehicles should receive higher-quality gasoline and diesel. Over the past few months, China has ordered the closure of 103 coal-fired power plants, which economically was a huge loss, but it was a huge benefit for the environment.

South Korea

South Korea also experiences a type of complex air pollution, which they consider it a big problem for their country. South Korea has shown its involvement in the area of air pollution. There are many laws that prevent schools from teaching whenever there are hazardous levels of air pollution. Schools are also forced to reduce normal hours or cancel classes on the day. Despite these laws, in 2017 South Korea unveiled a five-year, \$6.3 billion plan to close down old coal plants, curb polluting emissions from industrial plants, ships and construction sites and to get diesel vehicles off the road. Officials are hoping that this plan will reduce emissions by 30%, by the year 2022. The country has also spent billions on speeding up the adoption of electric cars to replace diesel.

World Health Organization (WHO)

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The WHO is the directing and coordinating authority for health within the United Nations system. It is responsible for providing leadership on global health matters. Air pollution has a direct and adverse impact on health. For this reason, the WHO has become involved in trying to limit air pollution in East Asia and has carried out many campaigns to enforce the usage of renewable energy.

Greenpeace (East Asia)

Greenpeace is one of the leading NGOs working on campaigns to reduce sources of air pollution in East Asia¹¹. Greenpeace carries in-depth investigations and original reportage on the urgent issue of air pollution in this region. Greenpeace also campaigns heavily on China's biggest cause of air pollution – coal. The organization also campaigns for multiple cities to adopt greater energy efficiency renewable energy standards. In the past, Greenpeace has also launched surveys and online petitions to push the government to review and update its Air Quality Objectives¹².

TIMELINE OF EVENTS

29 June 2002	Cleaner Production Law: This Law was enacted to promote cleaner production, increase the efficiency of the utilization rate of resources, reduce and avoid the generation of pollutants, protect and improve environments, ensure the health of human beings and promote the sustainable development of the economy and society.¹³
28 June 2003	Prevention and Control of Radioactive Pollution Law: This Law is enacted to prevent and control radioactive pollution, protect the environment, ensure human health, and

¹¹ Greenpeace – East Asia – What we do

¹² Greenpeace – East Asia – What we do about air pollution

¹³ "[Archived copy](#)" (PDF). Archived from [the original](#) (PDF) on 2010-11-17. Retrieved 2014-01-07.

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	promote the development and peaceful use of nuclear energy and technology. ¹⁴
29 December 2004	Prevention and Control of Environmental Pollution By Solid Waste Law
March 2008	Ministry of Ecology and Environment at People's Republic of China
6 December 2013	China "declares" war on pollution

UN INVOLVEMENT: RELEVANT RESOLUTIONS, TREATIES AND EVENTS

Asia Pacific Clean Air Partnership Joint Forum - 2018

The Asia Pacific Clean Air Partnership aims to promote better air quality management in Asian countries. The targets are: a) reduce air pollution and its associated health impacts b) improve agricultural productivity c) contribute to other co-benefits such as conservation of biodiversity and climate change. This year's forum acted as a follow up to 2015's Joint forum. This year they discussed the science, evidence, and impacts of air pollution, shared practical, innovative solutions featuring finance, technology, and policies.

POSSIBLE SOLUTIONS

Raising Awareness through Campaigns and Advocacy

Awareness creation is the number one factor to consider as a solution because it will make people comprehend and recognize the sources and effects of air pollution. From this point, it makes it straightforward for people to take personal or collective actions to reduce air pollution. Through campaigns countries can encourage citizens to act upon their own accord, using all sorts of

¹⁴ "Laws of the People's Republic of China." *AsianLII*, www.asianlii.org/cn/legis/cen/laws/pacorp1507/.

means to reduce air pollution. Multiple ways can be used at the individual level to reduce air pollution. Individuals who are aware of the causes and effects of air pollution can encourage colleagues, friends, and family to use the bus, train or bike when moving from one place to another. By doing so, there will be lesser vehicles on the road which results in less emission.

Laws and Regulations

Some national or international policies can be used to control air pollution effectively. Legislation and regulations towards this issue have always offered (in other countries) a practical yet long-term measure for tackling air pollution. This means that newly forged laws may help the countries in the region of East Asia counter air pollution.

Many cities and countries that were once heavily polluted have considerably obtained clean air mainly due to the implementation of anti-pollution laws that the country has carried out. The government can: **a)** tighten the controls for power plant emissions **b)** introduce cleaner fuel requirements and could switch to electric vehicles **c)** prohibit the construction of power plants and other energy-intensive industries near residential/populated areas **d)** introduce a national coal consumption cap¹⁵ **e)** strengthen supervision efforts **f)** Shutdown inefficient coal-fired industrial boilers.

Use of Renewable or Green Energy Sources

Using renewable energy sources to produce power results to a practical and feasible solution to air pollution. Renewable energy sources include geothermal energy, wind energy, hydropower and solar energy. If people can exploit the variety of these energy sources rather than depending on fossil fuels or coal energy, air pollution can be reduced more than three times.

Natural gas, batteries and fuel cells can also substitute the use of fossil fuels as cleaner energy sources. Although some of these different energy sources come with advantages, it is also important to assess correctly because

¹⁵ Greenpeace – East Asia – The Solutions to Air Pollution

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some of them come with different environmental and economic costs. Generally, investing more in renewable and sustainable energy sources reduces pollution and yet at the same time protects the future of the environment¹⁶.

Developing new energy technologies are important in promoting energy efficiency, improving access to energy, reducing greenhouse gas emissions and air pollution¹⁷. The Government can also promote the usage of energy efficient lights to be used around homes. Energy efficient lights consume less electricity in comparison to other normal lights. They consume less electricity, thus lowering electricity bills, last longer and can also help citizens to reduce pollution by consuming less energy

Investment and Infrastructure

One other solution to air pollution is to improve urban planning in order to increase green spaces¹⁸ (planting of trees, the creation of parks etc.) It is also important to take air quality into consideration when operating environmental assessments for major projects that are related to highways and flyovers, which should be far away from residential areas. The Government can also establish legally binding and regional coordinated plans to reach national air quality standards that include clear timelines.

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¹⁶ Earth Eclipse – 5 Brilliant Solutions to Air Pollution

¹⁷ The UN – Energy for a Sustainable Future

¹⁸ Green space - an area of grass, trees, or other vegetation set apart for recreational or a esthetic purposes in an otherwise urban environment. (dictionary.com)



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