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Abstracts

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SESSION A1

ABSTRACT 45

Photoenhanced Uptake of NO_2 and HONO Formation on Urban Grime

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Abstract

Photolysis of HONO is the most important primary source of hydroxyl radicals (OH) in the air of large urban agglomerates. Therefore, the accurate quantification of HONO is of paramount importance regarding the OH concentrations and thus the oxidative capacity of the atmosphere.

Recent observations pointed out that neither a photostationary state model (PSS) nor a more complete photochemical model (Master chemical mechanism (MCM)) containing currently known and postulated sources of HONO (relevant for urban environment) can reproduce the daytime HONO levels measured in dense urban area; hence, any missing HONO source in models can lead to an underestimation of the oxidative capacity of the atmosphere.

To shed new insights into the chemistry of this complex system, here we suggest that light-induced heterogeneous NO_2 processing on authentic urban grime collected in downtown Guangzhou, can be an important additional source of HONO in large agglomerates where most of the population live. The preliminary results show that the reactive uptakes of NO_2 on real urban grime under light irradiation are largely enhanced from $1.7 \cdot 10^{-7}$ in absence of relative humidity (RH) to $9.3 \cdot 10^{-7}$ at 90 % RH. The rates of HONO production by light-induced heterogeneous conversion of NO_2 on urban grime were enhanced about one order of magnitude from $1.5 \cdot 10^{9}$ molecules cm^{-2} s^{-1} at RH 0%, to $1.0 \cdot 10^{10}$ molecules cm^{-2} s^{-1} at RH 90%.

We suggest that this photo-induced HONO production on urban grime could have a potentially significant impact on the renoxification process in the urban atmosphere.

Keywords: heterogeneous reactions, renoxification, oxidation capacity

Conference Theme: Atmospheric chemistry

ABSTRACT 14

Chemical Characteristics and Health Risks of Trace Metals in PM2.5 from Firework/Firecracker Burning during the Spring Festival in North China

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Abstract

Fireworks burning can significantly deteriorate air quality during the Spring Festival (SF) in China, whereas little is known about the evolution of elemental compositions and related health threats. Fine particles ($PM_{2.5}$) and trace elements were characterized based on a multi-site campaign at Chifeng city, North China from January to February 2016. The results showed that $PM_{2.5}$ daily levels during the SF could be up to 139.40 μg m^{-3}, nearly two times of the China National Air Quality Standard. Distinctive elemental compositions were found during the SF with steadily enhanced loading on $PM_{2.5}$, which was over 3 times compared to normal days. The most abundant species were observed as K and Al especially in Chinese New Year' Eve comprising ~40% of $PM_{2.5}$ concentrations, linking to the emissions of firework/firecracker chemicals. The color-generating species Sr, Ba enriched 23.71 times, 30.33 times, respectively, further evidencing the influences of fireworks burning. The positive matrix factorization (PMF) identified that firework burning was the dominated source (58.62%) to $PM_{2.5}$-bound metals, while the contribution of fugitive dust reduced 2.24 times. $PM_{2.5}$-bound metals raised significantly higher non-cancer risks for children (8.59), adults (1.21) and cancer risks (4.45×10^{-5}) posed to public during the SF. Among those toxic metals, As and Cd played the prominent roles to those elevated threats with coal combustion contributed the most. The firework burning was also one major source from the view of health risks due to the high contributions on Cu (46.56%) and Cr (37.89%), highlighting the importance of firework/firecracker restrictions during the SF.

Keywords: PM2.5, Trace metals, Source apportionment, Risk assessment, Firework/Firecracker

Conference

Theme: Atmospheric chemistry

ABSTRACT 28

Analysis of A 15-Year Time Series of C2-C11 Non-Methane Hydrocarbons in A Subtropical Area: Interannual Variability and Trends

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Abstract: Speciated C2-C11 non-methane hydrocarbons (NMHC) have been measured online on an hourly basis at Lake Jackson, Texas, close to the Gulf of Mexico. Altogether 48 NMHCs along with NO, NO2, NOx, O3 have been collected continuously from January 2004 - December 2018 under the auspices of the Texas Commission on Environmental Quality.

Based on HYSPLIT back trajectories data was screened for background conditions representing marine wind sectors. The data set represents a combination of marine air masses mixed with local biogenic emissions. The data analysis addresses photochemical processing of air masses as reflected in the relationship of ln(n-butane/ethane) vs. ln(propane/ethane) and ln(i-butane/ethane) vs. ln(n-butane/ethane). In addition, key NMHC relationships for radical chemistry, e.g. i-butane vs n-butane for OH and Cl chemistry and i-pentane vs. n-pentane for NO3 chemistry, are discussed.

Seasonal analysis revealed a clear trend with maximum NMHC mixing ratios in winter time and lowest mixing ratios in summer reflecting the impact of photochemical processes in summer. Propene equivalents were highest during summertime, with significant contributions from alkenes, including isoprene. The relation of propane/ethane vs ethane indicates seasonal variation with lowest values (i.e. most aged air masses) in winter.

An analysis of the atmospheric oxidation capacity using daily summer-time data (the time of maximum OH impact) and an analysis of the temporal trend of potential NMHC emission changes using daily night-time winter data (the time of minimum OH impact) will be presented.

Keywords: non-methane hydrocarbons, photochemistry, marine background, trend analysis

Conference Theme: Chemistry in the troposphere

ABSTRACT 46

Oligomers Formation from Cross-Reactions of Carbonyl Compounds in the Atmosphere: An Insight at a Molecular Level

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Abstract

Though it has been widely recognized that the aqueous-phase chemistry of carbonyl compounds in the atmosphere is dominated by photochemical processes driven by hydroxyl radical (OH), increasing evidence suggests that photosensitized chemistry also have a significant impact on the transformation of carbonyl compounds, especially into secondary organic aerosols (SOA) through photo-induced generation of high molecular weight compounds. However, these oligomers are mostly unexplored due to the demanding challenge for analyzing the broad and complex intermediates/products, not to mention the formation mechanism of SOA.

In this study, the photosensitized reaction of carbonyl compounds was investigated at the molecular level by means of two state-of-the-art, ultrahigh-resolution mass spectrometric instruments: Orbitrap Fusion Trihybridmass Spectrometer (ORBITRAP) and Ultrahigh-Resolution Electrospray Ionization Fourier Transform Ion Cyclotron Resonance Mass Spectrometer (FT-ICR-MS). Glyoxal (GL), a typical carbonyl compound and pyruvic acid (PA), an extensively studied photosensitizer, were selected as probe compounds.

An unexpected large number of highly oxidized multifunctional organic compounds were unambiguously identified, which illustrates the progression from C3 to C20 molecules. The possible transformation mechanism investigated by quantum-mechanical calculations using density functional theory (DFT) by the Gaussian 03 suite of programs, suggests that the oligomers are thermodynamically more likely from the cross-reactions between PA and GL rather than from the self-reactions of PA. We are confident that the better understanding in the formation mechanism of GL into these oligomeric products, as shown here, will provide a new insight into the change in the physical-chemical properties of the atmospheric aqueous phase and also the sources of SOA.

Keywords: mass spectrometry, quantum mechanical calculations, cross reactions, high molecular weight compounds

Conference Theme: Atmospheric Chemistry

ABSTRACT 80

Rainwater Analysis from an Urban Site in Taiwan and a Remote Site Upstream: Scavenging Impacts and Implications for Urban Precipitation Chemistry

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Abstract

Polluted air masses arriving to Southeast Asian countries from continental Asia via the northeast monsoon often bring acidic aerosols laden with elevated levels of particulate sulfate and varying levels of particulate nitrate along with water-soluble gases, all of which are locally scavenged by precipitation. This study uses precipitation datasets from an urban area in northern Taiwan and an upstream remote island site to determine the impact of scavenging on the long-range transported pollution vs locally derived pollution. The SO_4^{2-}/NO_3^- ratio, and NH_4^+ and Na^+ concentrations are used to characterize the contributions from long-range transport and local pollution. The temporally co-located data from the two sites reveals the scavenging impacts preceding arrival to the urban area is substantial, but dependent on the weather system in place, where a frontal system tends to more efficiently scavenge the incoming air mass. Local pollution contributes significant levels of NH_4^+ and NO_3^- and in general leads to less acidic rainwater. The temporally distinct data provides a range of possible impacts from long-range transport on urban rainwater chemistry. These findings are also interpreted for future implications under a weakening northeast monsoon.

Keywords: Precipitation chemistry, acid rain, scavenging, long-range transport

Conference Theme: Atmospheric Chemistry - Acid Air Pollution

ABSTRACT 99

BTEX Emissions, Spatio-Seasonal Variability and its Associated Health Risks on Human Health in Outdoor Air of Delhi

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Abstract

Benzene, toluene, ethylbenzene and xylene (BTEX) are classified as hazardous compounds and their toxic effects on hu man health are well documented. These compounds are volatile in nature and also play an important role in atmospheric chemistry as they react with nitrogen dioxide to form secondary air pollutants like ozone. These compounds are emitted into atmosphere by various anthropogenic sources including motorized transport run on gasoline and diesel, fuel wood combustion, furniture materials and many other consumerism processes also contribute. In this study, we have selected a major connectivity hub location for the sampling of BTEX. The BTEX samples were obtained through activated charcoal tube using passive method of sampling a nd were subjected for analysis using GC-FID from November, 2017 to June 2018. It has been observed that the levels of BTEX were found higher for autumn season followed by winter, spring and least during summer season. The associated cancer and non-cancer risks were calculated using the USEPA methodology for health risk assessment. The levels of toluene were higher than xylene followed by ethylbenzene and benzene. The standard for benzene proposed by Central Pollution Control Board is 5 µg/m^3 but in this work the levels were observed higher than the standard value. It has been found that the levels of toluene were 3-4 times higher during the traffic period in comparison with non-traffic period. The estimated cancer risks of benzene were observed to be higher than the prescribed standard value by World Health Organization. These high levels of emissions and their associated health risks is a matter of concern for the public health.

Keywords: Health risks, air quality, BTEX, ambient air, Delhi

Conference Theme: Atmospheric Chemistry

ABSTRACT 106
Removal of VOC Gas by Ultrasonic Irradiation

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Abstract

Ultrasonic irradiation in water, which has been applied only to the waste water treatment by pyrolysis inside the cavitation bubbles and the reaction with OH radicals generated by the pyrolysis, was applied to the removal of volatile organic compounds gases (VOCs). Gaseous toluene was introduced into a batch reactor as a model VOC gas, and ultrasonic waves with a frequency of 200 kHz were irradiated from the bottom of the reactor into water. Without ultrasonic irradiation, gaseous toluene was slowly dissolved in water by gas-liquid equilibrium, and the removal ratio of toluene was only 57.4% due to the dissolution of gaseous toluene in water. On the other hand, when using ultrasonic irradiation, it was found that the removal ratio of toluene was significantly improved to 91.0 %. The addition of KI and tert-BuOH as OH radical scavengers inhibited the removal of toluene meaning that ultrasonic irradiation not only promoted the dissolution of gaseous toluene into water, but also caused the decomposition of toluene. In addition, it was also revealed from the TOC analysis that the degradation products formed by the decomposition of toluene were captured in water. Furthermore, the batch reactor was changed to a flow system to evaluate the toluene removal capacity in the flow volume ranged from 0.25 L/min to 1.0 L/min. The removal ratio of toluene was decreased with increasing the flow volume, however removal mass of toluene did not decrease. From these results, it was considered that the removal ratio of toluene depended on the residence time of gaseous toluene in the reactor, and a large amount of OH radicals that can sufficiently react with toluene was generated in water by ultrasonic irradiation.

Keywords: Volatile organic compounds gases, Ultrasonic wave, Advanced oxidation process, Air purification

Conference Theme: Control and remediation

ABSTRACT 107

Understanding the Chemistry of C and N Air Pollutants for Sustainable Environmental Solutions in East Bihar Region

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Abstract

Nitrogen is an element essential for building fundamental blocks of life. When present in excess amount, it causes number of negative effects to the environment as well as to the human health. The chemical composition of rain water is an indicator of the levels of different air pollutants in the region. The present study reports the concentrations of Dissolved Organic Carbon (DOC) and the reactive nitrogen species (NO_3^- and NH_3) in rain water at an urban site located in the Saharsa district of Bihar. The sampling was carried out for the period of four months i.e. July 2018 to October 2018. Total 18 samples were collected during this period. DOC is one of the major components of continental rain. In the present study, the major pathway of removal of organic carbon from the atmosphere as wet deposition is assessed. Organic carbon is considered to be an important factor that affects climate and air quality. Shimadzu TOC analyzer was used to determine the concentration of DOC. Apart from DOC, total carbon (TC), total nitrogen (TN) & inorganic carbon (IC) were also analyzed by this instrument. The presence of NH3 was major contributor to the TN content. The results showed that both anthropogenic and natural sources contributed to the dissolved organic carbon (DOC) in rain water.

SESSION A2

ABSTRACT 6

Analysis of PM10 In Urban and Rural Environment in Sumatra Island over the Past Half-Decade

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Abstract

Particulate Matter 10 (PM10) is an inhalable particle with a diameter smaller than 10 μm that disrupt the health of human respiratory. The distribution of PM10 varies depending on the region. This study aims to analyze the temporal distribution of PM10 in Sumatra Island, Indonesia, as one of the forest fires prone areas that affect neighboring countries, over the past half-decade, in Pekanbaru, Medan, and Palembang represent urban; and Jambi, Batam, and Indrapuri as rural areas. The results showed that the average PM10 concentration throughout the past half-decade was below the value threshold in all regions. The monthly PM10 concentration in rural areas is below the threshold except in Jambi, a monthly concentration above the threshold is in September. While the trend is rising in all locations, except in Indrapuri. While the monthly PM10 concentration in urban areas tends to be above the threshold except for Medan. The monthly concentration of PM10 above the threshold occurs in Pekanbaru in May and Palembang in October. For trends in the urban area, it tends to decrease in all locations except Medan. For diurnal, the hourly average value tends to have the same pattern for both urban and rural area. PM10 concentrations in urban areas tend to be low in the morning and high during the day and rise again at night. Whereas, rural areas tend to be stable and has a slight high concentration at night. The frequency of above the threshold which is under 1% occurrences is only in Batam and Indrapuri.

Keywords: PM10 concentration, forest fires prone, Sumatra, neighbouring countries

Conference Theme: PM10 concentration, forest fires prone, Sumatra, neighbouring countries

ABSTRACT 7

Analysis of PM2.5 Particulate Concentration before and after Eid Al-Fitr Holiday in June 2017 at Jakarta Megacity, Indonesia

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Abstract

This research was conducted to determine the effect of Eid Al-Fitr Holiday on June 2017 to the concentration of particulate matter ($PM_{2.5}$) at Jakarta along with the decreasing of human activities such as city dwellers, motor vehicles and industries. The research was carried out by analyzing $PM_{2.5}$ concentration at two sites of measurement located at Central-and South Jakarta during June 2017 in which Eid Al-Fitr Holiday took place on June 24-25, 2017. The data were obtained from $PM_{2.5}$ monitoring of BMKG (in Central Jakarta) and the United States Embassy (in South Jakarta) used fix stations. The data were proceeded to see the pattern of $PM_{2.5}$ concentration during June 2017, the pollution rose describes distribution of particulate $PM_{2.5}$ concentration. The map describes where the data took place. The research shows the relationship between the condition before and after Eid Al-Fitr Holiday with the concentration of $PM_{2.5}$ in Jakarta, where the influence is mutually reinforcing regarding of the reductions of motor vehicles, population, and human activities since June 23, 2017. $PM_{2.5}$ concentration began to decline and the peak was on June 24 and 25, 2017. Then on June 29, 2017, $PM_{2.5}$ concentration began to increase again as the number of human activities started. It means that the ups and downs of the concentration are closely related to anthropogenic factors. The pattern of the influence is also seen generally on weekends. Other factors such as rainfall and temperature also affect the leaching of pollutants concentration in the morning, noon and night.

Keywords: PM2.5 concentration, Eid Al-Fitr Holiday, Pollution rose, anthropogenic source

Conference Theme: Monitoring, detection and spatial environment

ABSTRACT 12

The Study on Characteristics of Regional Air Pollution Change in Northeast China

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Abstract

Based on the monitoring data of the air quality of cities in northeast China in the past five years, this paper analyzes the spatial and temporal distribution characteristics of regional polluted weather. The results indicate: Pollution intensity took a circle around Harbin city in heavy and moderate pollution level, and weakened in surrounding areas. In Liaoning central area had also a pollution intensity next center. Moreover, pollution intensity showed a line along Harbin, Changchun, Shenyang and Jinzhou in moderate pollution level. In addition, pollution intensity took a center around Shenyang city in light pollution level. From 2014 to 2017, regional polluted weather presented totally to reduce trend. Regional polluted weather usually appeared during October to next March, and January and December accounted for 50% respectively. Harbin city had a long period heavy polluted weather in December every year. Changchun and Harbin often appeared heavy polluted weather in October, while Shenyang and Dalian appeared in December. In different seasons, different cities had a different polluted weather, Harbin had no polluted weather in August and September. Others appeared different polluted weather in every month. In fall and winter, there were 4 polluted weather situations in northeast china: high pressure, short wave trough before ridge, low pressure, high pressure in north and low pressure in south. Pollutants can be transported downstream along wind direction during a polluted weather.

Keywords: Characteristics, polluted weather, northeast china region

ABSTRACT 13

A Geographical Review of Air Quality in Klang Valley, Malaysia

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Abstract

Air pollution is a major problem affecting metropolitan cities around the world, and South East Asia has been experiencing increasing air pollution in urban areas. The Klang Valley in Selangor Malaysia is one of such urbanized and populated areas experiencing increasing air pollution. It's the unique geographical location of being surrounded by mountains causes a canyon effect in the movement of air masses. This paper reviews the sources of air pollution and some major events and trends in air pollution in the Klang Valley Malaysia. The study also discusses controls and policy implementations adopted by government in recent years to address air pollution in the region. Klang valley is the most urbanized and industrialized region of Malaysia and is affected by yearly transboundary haze pollution that raises poor air quality to alert levels. During non-haze period the sources of poor air quality are the combustion of fossil fuels from motor vehicles, industries and agricultural activates. Among others, five main pollution indicators NO2, CO, PM10, SO3 and O3 constitute the air quality monitoring process in the region. The review revealed that these indicators vary spatially and periodically when bench marked to the Malaysian Ambient Air Quality Guidelines (MAAQG) standards at certain periods in time and certain locations in the Klang valley. Interesting geographical trends in the distribution of pollution in the region are also revealed.

Keywords: Air Quality, Klang Valley, Pollutant Source, Trends.

Conference Theme: Monitoring, Detection and Spatial Environment.

ABSTRACT 30

Impacts of Peat-Forest Smoke on Size-Resolved Aerosols in Tropical Urban Environment

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Abstract

To examine how recurrent transboundary peat-forest (PF) smoke in Maritime Continent affects the size segregated physicochemical characteristics of aerosols in warm and humid tropical urban environment, a total of >60-day samples in five size stages (<0.25, 0.25–0.5, 0.5–1, 1– 2.5, >2.5 µm) were collected using personal cascade impactor samplers during July–October 2015. As expected, sulfate was the most abundant ion in the three smallest stages, and nitrate the largest two stages. Although sulfate was followed by ammonium and oxalate in PM0.5, in PM0.5–1, it was followed by ammonium during smoke-dominant (SD) days, instead of nitrate in the non-smoke dominant (NSD) receptor environment. This is because the transboundary PF smoke significantly elevated ammonium concentration in PM0.5–1 by >10 times, changing this size range from ammonium poor to ammonium rich with a $[NH4^+]/[SO4^{2-}]$ molar ratio of 2.2. In fact, more ammonium in PM1–2.5 also increased the $[NH4^+]/[SO4^{2+}]$ molar ratio (1.7) by a factor of ~3. Although in NSD samples, oxalate and non-sea-salt (nss) sulfate exhibit little correlation in coarse particulates (>2.5 µm), both ionic species showed a much stronger linear correlation (r=0.90) under dominant PF-smoke influence in the urban environment. Similarly, the transboundary PF smoke linked a more noticeable linear correlation (r=0.72) between potassium and chloride concentrations in PM0.5–1. More results on how the transboundary PF smoke affected the variation in condensation- and droplet-mode aerosols, and size segregated in-situ pH as well as liquid water content in the receptor urban environment will be presented.

Keywords: Water soluble inorganic ions, Size-fractionated aerosol, Trans-boundary smoke, Aerosol acidity

Conference Theme: Long-range and cross-boundary transport in this region**,** urban air quality and environment

ABSTRACT 47

Sessional Variation of PM2.5 in Relation to Meteorological Characteristics in Dhaka City, Bangladesh

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Abstract

The main objective of this study is to assess the concentration of $PM_{2.5}$ and its relation with meteorological parameters. Secondary data has been collected from the AirNow Department of State (AirNow DOS). They provide maps of real-time hourly Air Quality Index (AQI) and daily AQI forecasts. The $PM_{2.5}$ instrument installed at the U.S. Embassy in Dhaka is a beta attenuation monitor BAM-1020 PM-Coarse System. Study observed that 31.9% of hourly AQI category were Unhealthy while the percentage of Good was very few. The maximum monthly average concentration was found 192.97±89.30 µg/m^3 in the month of January while minimum average concentration was found 29.98±19.37 µg/m^3 in July. Besides, analysis of seasonal variation found that, winter season in more polluted than other. The annual concentration was found 79.94±75.55 µg/m^{3}in 2017 which exceed the NAAQS and WHO standard. A number of meteorological factors are affecting to this variation in a year. Study shows that, rainfall is negatively strong and significantly correlated with concentration of $PM_{2.5}$. It is found that, during the rainy season ambient dust are being settle down in the lithosphere which lead to the reduce pollution level in monsoon season. It can be concluded that, the annual concentration of $PM_{2.5}$ was 5 times higher than standard level. It is necessary to set up more CAMS in the city, so that air quality of the city can be monitored at different location precisely. Particulate matter concentration may be significantly reduced by taking brick field far away from the city and covering uncovered road.

Keywords: Air Pollution, Particulate Matter, Variation, Bangladesh.

Conference Theme: Urban air quality and environment

ABSTRACT 50

Evaluation of the Effectiveness of Mitigation Measures on General Air Quality and Road Traffic Pollution in Beijing

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Abstract

Beijing- one of the world's largest megacities- has often suffered heavy winter haze events (daily levels of PM2.5 ≥ 150 µg m^{-3}) which cause serious harmful health effects amongst the more than 20 million people living there. In order to combat this severe air pollution issue, Beijing's government has implemented a series of policies and regulations through a new "Pollution Prevention and Control Action Plan" in which road traffic emissions mitigation was identified as one of the key policy measures. Control measures have also been applied to other emissions sectors. Evaluation of the efficacy of these policies is highly challenging because of the co-impacts of meteorological conditions. This study firstly develops a new decision tree-based random forest regression approach to assess the impacts of traffic emissions mitigation measures and meteorology on the improvement of Beijing's air quality. It then analyses the weather-normalized long-term trends (2014-2018) of six major air pollutants collected from 35 monitoring stations in Beijing. This study found significantly higher levels of air pollutants (except ozone) at roadside monitoring sites. Road traffic increments of CO, NO2, SO2, PM2.5 and coarse particles averaged 145 µg m^{-3}, 19 µg m^{-3}, 3.1 µg m^{-3}, 5.4 µg m^{-3} and 2 µg m^{-3}, respectively. It also highlights the important role of meteorological conditions in monthly concentration variations of air pollutants and especially in winter haze formation. After removing the effects of meteorology, considerable improvements are found in general air quality over the period 2014-18, and also specifically in the contribution of road traffic to air pollution. Some of the policy measures responsible for this improvement are discussed.

Keywords: Mitigation; air pollution control; machine learning; road traffic; policy measures

Conference Theme: Monitoring, detection and spatial environment

SESSION B1

ABSTRACT 32

Effects of Lost Semi-Volatile Inorganics on In Situ Acidity and Water Content of Urban PM2.5

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Abstract

This study investigates effects of sampling artifacts of three semi-volatile (SV) inorganic species (nitrate, chloride, and ammonium) on aerosol acidity (*in situ* pH) and liquid water content (LWC) of more than 220 urban bulk $PM_{2.5}$ collected over multiple years during 2011–2015. We employed E-AIM model (forward mode) and evaluated how the properties of smoke-dominant (SD) $PM_{2.5}$, which were significantly affected by transboundary peat-forest (PF) smoke, differ from non-smoke-dominant (NSD) ones. Nitrate carries the largest negative sampling artifact (1.1±0.8 g/m^3), which is on average 71% of its authentic concentration, followed by chloride (0.5±0.2 g/m^3, 69%) and ammonium (0.4±0.3 g/m^3, 25%). Compared to authentic *in situ* pH (average 2.0) and LWC (average 12 g/m^3) with corrected SV inorganics, partial or no correction of these lost SV inorganics generally leads to significant overestimation ($p<0.05$) of aerosol acidity (or underestimated *in situ* pH), and underestimation ($p<0.05$) of LWC of urban $PM_{2.5}$. Partial correction of sampling artifacts yields the worst underestimation, lowering *in situ* pH by as much as 2.3 and LWC 45 g/m^3. Such under-representation can significantly affect simulation in aqueous-phase reactions and physical properties (e.g. scattering capability) of fine particulates. Strong influence of transboundary PF smoke enhanced both the in situ pH (2.1, a lowered acidity) and LWC (13 g/m^3) in the SD $PM_{2.5}$, neutralizing the NSD $PM_{2.5}$ (pH=1.9, LWC=10 g/m^3). In addition to higher LWC, a pronounced enrichment in ammonium concentration can also contribute to the higher in situ pH. It is worth to note correction of lost SV inorganics exerts greater impacts on the estimated in situ pH and LWC in SD $PM_{2.5}$ than in NSD samples. Findings demonstrate the importance of correcting lost SV inorganics during aerosol sampling and automated monitoring for objective assessment of physicochemical characteristics of fine particulates.

Keywords: Sampling artifact, biomass burning, peat forest, receptor urban $PM_{2.5}$, transboundary

Conference Theme: Atmospheric Chemistry; Monitoring, detection and spatial environment; 7SEAS

ABSTRACT 56

Heterogeneous So_2 Oxidation in Sulfate Formation by Photolysis of Particulate Nitrate

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Abstract

Heterogeneous oxidation of sulfur dioxide (SO_2) is suggested to be one of the most important pathways for sulfate formation during extreme haze events in China. Yet, the exact mechanism remains highly uncertain. We propose a much less explored pathway for aqueous-phase SO_2 oxidation to form particulate sulfate by NO_2 and OH radicals produced from photolysis of particulate nitrate. Reactive uptake experiments of SO_2 by ammonium nitrate particles under UV irradiation show the measured SO_2 uptake coefficients of ~10^{-5}. Model calculations of sulfate production rates, comparing known oxidation mechanisms by O_3, NO_2, H_2O_2, and transition metal ions, and the nitrate photolysis mechanism suggest that the nitrate photolysis pathway could contribute significantly to the overall sulfate production at pH = 4 to 6. The present study provides a new insight into the current debate on sulfate production pathways under typical haze conditions in China.

Keywords: nitrate photolysis, heterogeneous reaction, sulfate, haze

Conference Theme: Atmospheric chemistry

ABSTRACT 57

Electrospray Surface-Enhanced Raman Spectroscopy (Es-Sers) for Studying Organic Coatings of Atmospheric Aerosol Particles

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Abstract

Heterogeneous reactions between atmospheric aerosol particles and gaseous pollutants, such as those forming brown carbon (BrC), represent an important mechanism. These reactions alter the particle chemical compositions and aerosol-climate interactions. While most studies assume homogeneous particle compositions, organic coatings can be formed on solid or highly viscous particles due to heterogeneous reactions but the underlying mechanism is relatively less examined. We used electrospray surface-enhanced Raman spectroscopy (ES-SERS) to directly probe the formation of BrC coatings on methylaminium sulfate, nitrate, and chloride particles from heterogeneous reactions with gas-phase glyoxal. To create BrC coatings on particle surfaces, heterogeneous reactions were performed under low relative humidity (RH) conditions (i.e. 10 or 30% RH). The reacted particles fluoresced when irradiated at 532 nm in normal Raman analysis, indirectly suggesting the presence of light-absorbing species in them. Further ES-SERS analyses showed Raman bands of 1,3-dimethylimidazole, one of the major known products of reactions of glyoxal with methylaminium, from all the reacted particles at 30% RH. However, only methylaminium sulfate particles showed the formation of BrC coatings at 10% RH. We speculate that methylaminium sulfate particles may have more surface adsorbed water (SAW) than the other particle samples to initiate the formation of BrC coatings detectable by ES-SERS. The present study highlights the surface sensitivity of ES-SERS as well as the potential importance of SAW in heterogeneous reactions of atmospheric particles with gaseous pollutants.

Keywords: ES-SERS, brown carbon, organic coating, surface adsorbed water, amine

Conference Theme: Atmospheric chemistry

ABSTRACT 68

Changes of Soot Particle Properties Induced by Oxygen along with Ultraviolet

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Abstract

Soot particles originated from numerous anthropogenic and natural sources have the capability of absorbing sunlight, which makes them become an important role in influencing the weather system. Furthermore, soot particles continuously react with various oxidative matters during long-range transportation, subsequently lead to changes in their morphology, microstructure, hygroscopicity and optical and chemical properties. These reactions, as known as particle aging processes, result in changes in soot particles' role in affecting climate and human health. Nevertheless, the changes of soot particles during the aging processes remain unclear. These uncertain but potentially significant changes necessitate the research in soot particles aging processes. Hence the objective of this study is to investigate changes of soot particles after aging processes.

Most of the present studies focus on ozone-related oxidation mechanisms. Yet few studies state that oxygen along with sunlight, which, however, also can drastically enhance the aging processes of soot particles than ozone. Therefore, to simulate the particle aging processes caused by oxygen along with ultraviolet, we vent air into an ultraviolet soot aging chamber and use butane burner as a soot particle generator. Fourier-transform infrared spectrometer is applied to determine whether the soot particles have been aged. The aerosol particle mass analyzer (APM; KANOMAX, Japan), cloud condensation nuclei counter (CCN-100; DMT, USA), scanning mobility particle sizer spectrometer (SMPS; Model 3936; TSI Inc., USA) and printed optical particle sizer (POPS; Handix SCIENTIFIC, USA) are also applied to measure changes on mass and density of soot particles, hygroscopicity and activity of cloud nucleis, soot particle size distribution, and optical property respectively.

Keywords: Soot particle, Aging Processes, Oxidation, Ultraviolet aging chamber

Conference Theme: Atmospheric chemistry

ABSTRACT 100

Characterization of Atmospheric Fine Particulate Matter at Indoor Environment of Several Residential Homes in Dhaka, Bangladesh

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Abstract

This study surveyed the characteristics of ambient PM2.5 (particulate matter with an aerodynamic diameter of ≤ 2.5 μm) in order to assess the Indoor Air Quality (IAQ) at different residential houses in Dhaka, Bangladesh. Dual Channel Dust Sampler (Model: IPM- FDS 2510) was used to collect indoor PM2.5 samples from living rooms for a duration of over 15 hours for three consecutive days at four different locations- Dholaipar, Khilkhet, Mirpur and Rampura during August to October, 2017. FTIR spectroscopic analysis of the samples revealed the presence of -O-H, -C-H, aromatic C=C, $-CH_3$ and -C-O-H groups in the indoor PM2.5.Using Scanning Electron Microscope (SEM) technique it was found that, the indoor PM2.5 is less aggregated and more distributed in Rampura whereas that in Dholaipar is more aggregated and less distributed. The samples were also analyzed for several inorganic ions (Na^+, K^+, Ca^{2+} and $SO4^{2-}$) and total organic carbon (TOC) using Flame photometer, UV-Visible spectrometer and TOC analyzer respectively. Enrichment factor and source contribution showed that both sea salt spray and crustal sources contributed to the presence of sodium and potassium ions in indoor PM2.5 whereas earth's crust was assumed to be the major source of calcium ion. On the contrary, over 99% of sulphate originated from anthropogenic sources at all the sampling locations. Total hazard ratio was found to be the highest (3.69) in Khilkhet and lowest (2.33) in Mirpur. A positive correlation between the concentration of indoor PM2.5 and total hazard ratio was also found. As fine particulate matter can penetrate deeper into the lungs, necessary measures should be adopted to improve the indoor air quality by reducing its emission.

Key words: Fine particulate matter, Indoor air, Surface morphology, Inorganic ions, Total organic carbon, Hazard ratio

Conference theme: Atmospheric chemistry

ABSTRACT 121

Aerosol Characteristics over Northwestern Part of India: Impact of Biomass Burning

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Abstract

Biomass burning is a common source of atmospheric pollution and poor air quality that has adverse impacts at local, regional, and global scales with short and long term climate implications and serious risk to human health. The present study examines the impact of paddy residue burning emissions on aerosol properties over Patiala (30.33°N, 76.40°E, 250 m a.s.l.), situated in the north-west part of India during the post-monsoon (Autumn; October–November, 2015). Every year, during autumn, extensive paddy residue burning takes place in the Indo-Gangetic Plains (IGP), mainly in the northwestern Indian states of Punjab, Haryana, and western Uttar Pradesh. The emissions from the burning locations travels hundreds of kilometres got Internal or external mix with other anthropogenic and natural aerosols results in solar dimming, atmospheric heating etc. The mass concentration of the total suspended particulates (TSP) varied from 88 to 359 μg m^{-3}, with PM10 accounting for ~60% during study period. High fraction of PM10 indicates abundance of fine mode particles during paddy residue burning emission over the study site. Biomass burning injected enormous amount of black carbon (BC) aerosols which is one of the climate forcing agent after CO_2. During study period, the daily average BC mass concentration ranging between 3.0 to 13.0 μg m^{-3}. Aerosol optical depth (AOD) shows the high values (AOD_{500nm} > 0.6) and strong wavelength dependence with Ångström exponent ($a_{380–870nm}$ > 1.0). This attributed to the presence of large amount of fine mode particles (BC aerosols) due to extensive biomass burning activities around the study region. SBDART model is used to compute aerosol radiative forcing (ARF). The strong and positive atmospheric forcing (+32.5 Wm^{-2}) due to agriculture waste burning indicate warming state of the atmosphere due to aerosols and has potential to perturb the regional climate.

Keywords: Total Suspended particulates (TSP), Black Carbon (BC), Aerosol Optical depth (AOD), Aerosol radiative forcing (ARF).

Conference Theme: Atmospheric Chemistry.

ABSTRACT 122

Association of Ambient Viable Bioaerosol and Air Pollutants in Bengaluru Urban, Karnataka, India: a Five-Year Study

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Abstract

The relationships between viable bioaerosol (bacteria and fungi) and air pollutants were investigated in the Bengaluru urban area. The five-year study on ambient bioaerosol during the year 2010 to 2014, it was observed that highest annual mean concentrations of airborne fungal aerosols were 47,734 CFU/m^3 and airborne bacterial aerosol were 59,199 CFU/m^3 was recorded during the year of 2011. Minimum was recorded during the year 2013 which was found to be 32,301 CFU/m^3 and 43,402 CFU/m^3, respectively. Total fungal concentrations were positively correlated with PM10, and bacterial aerosol positively correlated with hydrocarbons. Sub-micron particles correlation analysis indicated that the bacterial aerosol strongly correlated with 0.5 microns size particles (0.4) and less correlated (0.3) with 0.4 and 0.6 micron particle. The regression analysis of bacterial aerosol showed that oxides of sulpur showed significant correlation with bacterial aerosol (R^2=0.1541). Whereas, fugal organisms had moderate correlation with oxides of nitrogen (r=0.044) and negatively correlated with oxides of sulphur (r= -0.0923). The results demonstrated that airborne viable bio aerosols are strongly correlated with air pollutants. The complex dynamic interactions were indicating air pollutants may support the occurrence of viable bioaerosols in air.

ABSTRACT 5

Characteristics of Atmospheric Photochemical Pollution at a Comprehensive Site in Guangzhou, China

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Abstract

Guangzhou, one of China's megacities, is beset with frequent occurrence of atmospheric photochemistry events. In this study, online instruments were used to simultaneously monitor VOCs, NO*x* and O_3 at Guangzhou Panyu Atmospheric Composition Station of the China Meteorological Administration, from June 2011 to May 2012, in order to obtain their characteristics, VOCs reactivity and the control strategies for atmospheric photochemistry. The results showed that during the observation period, the seasonal variation of O_3 concentration was lower in spring and winter compared to summer and autumn, which was opposite that for VOCs and NO*x*. In terms of VOCs, aromatics had the largest O_3 formation potential, among which toluene, xylenes, ethylbenzene, 1,2,4-trimethylbenzene and 1,3,5-trimethybenzene were the most important species, with a total contribution of about 44%. The increase of biogenic NMHCs emissions at midday reverses the sensitivity of O_3 production from NMHCs-sensitive to NO*x*-sensitive. Our results show that high-reactive NMHCs and NO*x* control can be effective for reducing peak O_3 mixing ratios in Guangzhou. Further investigation based on numerical models is required to reach more robust conclusions.

ABSTRACT 34

Assessment Ambient Ozone Sources and Distributions in Kuwait: Gis Approaches

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Abstract

Ambient ozone (O_3) is considered significant phytotoxic pollutant, and its spatial distribution is becoming essential. The development of Geographic Information Systems (GIS) approaches has opened up a wide range of methods for air pollution exposure assessment. In this thesis, GIS technology was utilized to locate ozone sources and study the distribution across Kuwait. The GIS capabilities will enable us to map the spatial distribution of ozone in Kuwait. The aim of this study is to identify the sources and the spatial distribution of tropospheric ozone over the state of Kuwait. The monitored ground level of ozone during the five years from 2008 to 2012 was collected from air quality monitoring laboratories. Both geographic and attribute data were managed, analyzed, and mapped along with the meteorological parameters in order to study the sources and the spatial distribution of ozone. Our results indicate that a high correlation linking ozone with NO_2, UVA, UVB, VOCs, CH_4, NCH_4, and wind speed. Summer season recorded the highest ozone concentration among other seasons.

Keyword: Ambient ozone; Atmospheric conditions; air quality laboratory; GIS

ABSTRACT 89

Spatial-Temporal Variation of PM2.5 and Ozone Concentration in Beijing and Their Health Risk Assessment

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Abstract

The aim of this study is to analyze the temporal-spatial variation of PM2.5 and Ozone in Beijing, China using national monitoring data from 2014 to 2017, to estimate the mortality exposure to PM2.5 and Ozone. Since 2013, the concentration of PM2.5 decreased rapidly in whole China. The most serious area of PM2.5 pollution was located in the East-Central of China. The PM2.5 still increased significantly in the North-Center region from 2015 to 2017 in China. The PM2.5 concentration was higher in winter and lower in summer in Beijing, Tianjin and Hebei (BTH) region. The wind speed and relative humidity has negative effect and significant positive effect on PM2.5 concentrations respectively in winter, so the liquid reaction may play important role for haze pollution during winter in BTH. The premature mortality due to PM2.5 was much higher than O3 in BTH region. The premature mortality due to PM2.5 declined from 2015 to 2017 in BTH region, however, the mortality due to O3 still increased in recent three years in Tianjin and Hebei. The premature mortality due to exposure of both of PM2.5 and Ozone was higher in the urban area of Beijing and Tianjin city due to high density of population and also south area of Hebei province because of higher PM2.5 concentration. Case-specific morality in Hebei province was highest, followed by Beijing city and Tianjin city. The mortality of the chronic obstructive pulmonary disease and lung-cancer mortality due to PM2.5 were more serious health risk.

Keywords: PM2.5, Ozone, Mortality, Beijing

ABSTRACT 44

Ionic Strength Effects on The Reactive Uptake of Ozone on Organic Compounds: Implications for Air-Sea Ozone Deposition

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Abstract

The ionic strength can affect the kinetics and products distribution within the aerosol deliquescent particles and at the sea surface microlayer. However, the ionic strength effects on aqueous phase reactions of atmospheric relevance have been barely studied in the past.

In this work, we have leveraged our knowledge on ionic strength effects on the reactive uptakes of gas-phase ozone on aqueous pyruvic acid (PA) by the vertical wetted wall flow tube technique.

A relatively weak dependence was observed between the uptake coefficients of O^3 and the concentration of Br in the absence of organics. The uptake coefficients of ozone increased markedly at elevated bromide concentrations in presence of pyruvic acid or humic acid. This finding clearly indicates that the dry deposition of ozone to the sea surface could be significantly enhanced by carbonyl compounds that occur at the bromide-rich sea surface microlayer.

Based on the observed uptake coefficients, the estimated deposition velocity of ozone for nM-range PA concentrations is $9.7 \cdot 10^{4}$ m s ^{1}, in the same order as the upper-limit ozone deposition velocity due to the ozone reaction with chlorophyll ($1 \cdot 10^{5}$ m s ^{1} to $1 \cdot 10^{3}$ m s ^{1}), and higher than the deposition velocity of $1.2 \cdot 10^{4}$ m s ^{1} assessed for the reaction of ozone with a mixture of DOM and iodide. The data obtained in this study can improve the global climate–chemistry models of the ozone budget in the marine boundary layer of the atmosphere, close to the ocean surface.

Keywords: ionic strength, heterogeneous reactions, ozone, sea surface microlayer

Conference Theme: Atmospheric chemistry

SESSION B2

ABSTRACT 26

Anatomy of a Severe Ozone Smog Episode in Mexico-City

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Abstract

In March 2016 Mexico-City experienced its most severe smog episode for almost a decade. The Metropolitan Index of Air Quality (IMECA) for Mexico-City surpassed the value of 200, indicating an extremely bad situation. Hourly peak values for both, NO2 and O3, exceeded 200 ppb, while for CO more than 2 ppm were observed. Restrictions on traffic and industrial activities, among other emergency measures, were imposed. This presentation will describe the anatomy of this severe air quality episode and will look into the specific synoptic and boundary layer meteorological environment favoring this episode as well as the photochemical conditions in the basin of Mexico-City. This study presents temporally highly resolved boundary layer heights (CBL, RL, SBL) derived from potential temperature and humidity profiles measured continuously by a microwave radiometer together with wind profiler measurements at a monitoring site in Mexico City in conjunction with air quality data within the basin and surrounding elevated sites. Those elevated sites measured the atmospheric conditions representative for inflow/background conditions, but also night-time conditions representative for the RL environment. The partitioning of Ox indicates significant photochemical production within the basin with Ox increasing about 100 ppb from the surrounding areas toward the inner area of the basin. Background and RL variations of Ox vary little during this episode (increase by about 15-20 ppb). On top of this photochemical environment strong boundary layer variations in combination with recirculation critically influence the air quality in Mexico City.

Keywords: urban air quality, air pollution, photochemistry, boundary layer, Mexico City

Conference Theme: Meteorology related to Air Pollution

ABSTRACT 67

Air Quality Monitoring at Tai Mo Shan Summit, the Highest Point in Hong Kong

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Abstract

In the past decades, Hong Kong has implemented a wide range of control measures to alleviate its air pollution problem. Much effort has been applied to understand more about pollutant formation and transport. A monitoring network has been set up near ground level to provide comprehensive air quality information. However, pollutants transported at higher altitude would not be captured by the network. This project aimed to determine the air quality and its correlation with meteorological factors at 957m above sea level: the summit of Tai Mo Shan (TMS), the highest point in the city. Major pollutants - NO_x, O_3, SO_2, CO, PM2.5 and PM10 - have been measured at TMS since 2011. This paper compared the TMS pollution levels with those recorded at a background monitoring station and a nearby urban station. The lack of pollution source at the summit led to low concentrations of most pollutants, as expected. There were also numerous incidents that pollution levels were significantly higher than those found at the foot of the mountain. The dirty plume did not necessarily affect environment in the lower altitude. The low-level NO_x translated into high O^3 concentrations. The high altitude of the site also posed significant challenge to the monitoring equipment and facilities.

Keywords: high altitude, pollution monitoring, criteria pollutants

ABSTRACT 69

Seasonal Discrepancies in PM2.5 Mass Concentration Measurement by Beta Attenuation Technique

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Abstract

Near real-time atmospheric particulate matter (PM) monitors are extensively used in air quality networks given their ability to provide continuous measurements with minimal attention by the operator. Their principle of operation is based on measurement of a physical parameter that is quantitatively linked to the PM mass concentration. Significant discrepancies between these measurements and those obtained by the reference gravimetric method, conducted in regions with diverse climatic conditions have been reported in the literature. In this study we compare systematic PM2.5 gravimetric and beta attenuation measurements performed at an urban representative site of India. However, these measurements (especially beta attenuation) are reported to be dependent on the ambient conditions, e.g. humidity, high particle mass loading, etc, and in India, being a tropical country, humidity and temperature varies from 40 to >95% and minus degree to >45 C, respectively. It was found that the PM2.5 concentration measured by beta attenuation monitor (BAM) exceeds gravimetric method (GMM) during winter season, where the correlation between them was good. At high relative humidity, the deliquescent point of aerosols most probably gets exceeded and cause inorganic aerosol particles to absorb water leading to an overestimation of PM concentrations of the monitor compared to the manual sampler. So this study will be helpful in understanding the effect of water content and chemical composition of particulate matter in different seasons leading to variability in the mass concentration measurements. Therefore, a detailed understanding of different parameters that affect the PM2.5 measurements in Indian conditions will ensure optimal application of the instrument and accurate interpretation of the result to chalk out the policies.

Keywords: Beta attenuation method, Gravimetric method, Water content, Humidity

Conference Theme: Urban air quality and environment

ABSTRACT 72

Allocating Optimum Sites for Air Quality Monitoring Stations Using GIS Suitability Analysis

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Abstract.

Effective air quality monitoring programs are in high demand for the sustainable urban environment, especially with the extensive anthropogenic activities associated with rapid urban expansion and the sharp increase in urban populations during the last several decades. One key factor in establishing effective air quality monitoring programs is allocating the optimum location for monitoring stations. This study applied suitability analysis approach to establish representative air quality monitoring stations based on five criteria (population, wind direction, and spatial proximity to roads, industries, and high-traffic areas) believed to be the most significant criteria in allocating optimum locations for monitoring stations. The analysis consisted of five main steps: criteria determination, input layer determination and preparation, layer rank and weight, suitability map production, and model output evaluation. Most of the study area obtain lower suitability score, whereas the optimum sites for air quality monitoring stations occupied only about 2.5% of the study area. These sites were widely distributed over the study area. The study findings revealed that due to its flexibility and efficiency the suitability analysis model can be an effective tool for improving existing air quality monitoring networks and drawing the optimum routes for future expansions in monitoring air quality within urban areas.

Keyword: GIS, environmental planning, geography, air pollution, environmental equality**.**

ABSTRACT 77

Seven Months Observations of Indoor Air Pollution in Kigali Rwanda

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Abstract

World Health Organization (WHO) reported that 3.8 million people in a year die prematurely from illness attributable to the household air pollution caused by the inefficient use of solid fuels and kerosene for cooking. Particularly, approximately 1 million people prematurely death in African countries in a year is caused by jointed effect of indoor and outdoor air pollution. Japan Weather Association (JWA), Yaguchi-densikogyo Co., Ltd, Keio University, The University of Electro-Communication, Rwanda Environment Management Authority (REMA) and Rwanda Biomedical Center jointly conducted survey of indoor PM concentration for seven months (from July 2018 to January 2019) at five families in Kigali, Rwanda. PM2.5 and PM10 were monitored with pocket PM 2.5 sensor (Pocket PM2.5 sensor, Yaguchi-densikogyo Co.,Ltd), which is low cost and connectable to smartphone. The cooking fuels of these families were firewood, charcoal and town gas. The concentration of PM2.5 was ranged between 30 and 300 ugm-3 in one-hour average, and the concentration in a family using town gas was the lowest and that using both of firewood and charcoal was the highest. In addition, cooking time and other conditions of cooking facilities were interviewed to estimate exposure-dose. The result suggests that one of the reasons for high concentration of indoor PM is stagnant air flow in cooking room and ventilation should be improved, considering out-door concentration of PM2.5 was relatively low (moderate level), in addition to improved use of cooking fuels.

Keywords: PM2.5, Indoor air pollution, Pocket PM sensor

ABSTRACT 83

An Environmental Impact Estimation of a Vehicle Inspection and Maintenance Program in Urban Centers - Monterrey as a Case Study

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Abstract

The mobile sources are the main emitters of CO (96%) and NOX (68%) in the Metropolitan Area of Monterrey. Therefore, this study aims to provide a methodology, based on remote sensing campaigns, to i) Evaluate the potential environmental impact of a vehicle inspection and maintenance program as a strategy to improve the air quality in urban centers, and ii) To help delimitating the vehicle technologies whose real-world environmental performance is beneath the reported by manufacturers, thus failing to comply with national emission regulations. For this purpose, a remote sensing monitoring campaign was performed in Monterrey-México, during the month of March in 2018. Four different sectors in the city were selected, sampling approximately 0.5% of the total of vehicles registered in the Metropolitan Area. The results indicate that 54.5% of the registered vehicles do not comply the current national regulations, being 15.4% due to CO, 15.1% to NO and 53.7% to HC. With a conservative assumption, a vehicle inspection and maintenance program limited to the current national regulations will reduce 81%, 29% and 15% in mass of the current HC, CO, and NO emissions, respectively.

Keywords: Remote Sensing; Road Transportation; Real World Emissions

Conference Theme: Monitoring, detection and spatial environment

ABSTRACT 90

Modelling of Land-Use/Land-Cover Change and Its Impact on Local Climate of Klang River Basin

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Abstract

Land-use change has significant effect on local climate variables such as temperature and rainfall and consequently results in increasing runoffs, landslides and other natural disasters. Climate scientist predict land-use/land-cover (LULC) change will have a significant impact on climate change. Trend analysis of precipitation and temperature were carried out for the Klang river basin to determine the changes in precipitation amount and intensity and temperature. Data was tested using Mann-Kendall statistics based on two precipitation indices and two temperature indices, the simple day intensity index (SDII) and R95p indices for precipitation and the Monthly maximum value of daily maximum temperature (TXx) and the Monthly maximum value of daily minimum temperature (TNx) indices for temperature. The monsoons and inter-monsoon periods from 1975-2015 was used for precipitation and for temperature the period 1995-2018 was used. ArcGIS was used for modelling spatio-temporal change in LULC of Klang river basin using multi-temporal LandSat dataset (1999, 2006, 2017). The LULC modeling showed an increase in urban area of 32.2% from 1999 to 2006 and 13.1% from 2006 to 2017, with an overall increase of 35.9%. The results of precipitation analysis showed both positive (increasing) and negative (decreasing) trends for stations in the tests, and for temperature trends there was positive significant and non-significant trends. The relationship between precipitation and temperature change with LULC change shows there is an increasing trend in precipitation and temperature in areas where urbanization has been increasing.

Keywords: Monsoon, Man-Kendall Test, Indices, Land-use Change, GIS.

Conference Theme: Monitoring, Detection and Spatial Environment.

ABSTRACT 92
Macao Air Quality Forecast Using Statistical Methods

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Abstract

The levels of air pollution in Macao often exceeded the levels recommended by World Health Organization (WHO) Air Quality Guidelines (AQG). In order for the population to take precautionary measures and avoid further health risks under high pollutant exposure, it is important to develop a reliable air quality forecast. Statistical models based on multiple regression (MR) analysis and classification and regression trees (CART) analysis were developed successfully for five air quality monitoring stations in Macao to predict the next day concentrations of nitrogen dioxide (NO_2), ozone (O_3) and particulate matters (PM10 and PM2.5). Each of the station has its own model for the corresponding pollutants. All the developed models were statistically significantly valid with a 95% confidence level with high coefficients of determination (from 0.79 to 0.93) for all pollutants. The models utilized meteorological and air quality variables based on five years of historical data from 2013 to 2017 of five stations. Data from 2013 to 2016 were used to develop statistical models and data from 2017 were used for validation purposes. A wide range of meteorological and air quality variables were identified, and only some were selected as the significant dependent variables. Meteorological variables were selected from an extensive list of variables, including geopotential height, relative humidity, atmospheric stability, and air temperature at different vertical levels. Air quality variables translate the resilience of the recent past concentrations of each pollutant and usually are maximum and/or the average of latest 24 hour levels. The models were applied in forecasting the next day average daily concentrations for nitrogen dioxide and particular matters and maximum hourly ozone levels for five air quality monitoring stations, including background and traffic location within area of Macao (32.9 km2). The results are expected to be the basis for an operational air quality forecast for the region.

Keywords: Air quality, Modelling, Monitoring, Management, Air pollutants, Particulate Matter, Ozone, Nitrogen Dioxide

ABSTRACT 94

Performance Assessment of Air Quality Monitoring Networks in the Three Major Metropolitan Areas of Mexico

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Abstract

The aim of this study is to assess the performance of three air quality monitoring networks of Mexico. Emphasis is placed on an ensemble method to combine the results of the different clustering techniques: Principle Component Analysis, Hierarchical Clustering and k-means. The specific objectives of this paper are: (i) finding similar and redundant stations using the ensemble method and (ii) giving a physical meaning to groups of similar stations by evaluating additional information like emission sources, meteorology and topography of the area of interest. The study was applied on time series data of particulates that have aerodynamic diameters less than or equal to 10 µm (PM10) and ozone (O_3), acquired from the air pollutant monitoring systems in the metropolitan areas of Mexico City (MCMA), Monterrey (MMA) and Guadalajara (GMA), from the years 2012 to 2013 for the MMA and 2014 to 2016 in the MCMA and GMA. These three conurbations are characterized by diverse meteorological and geographical conditions. The findings show that the GMA has a well distributed air quality network with the fewest number of similar stations. The MMA presents the same clusters of stations for PM10 and O3, while in the MCMA a cluster of possible redundant stations is found. Results confirm that the clustering ensemble method is a confidence tool to identify similar stations.

Keywords: Principle component analysis, ozone, particulate matter, clustering ensemble method, cluster analysis.

Conference Theme: Monitoring, detection and spatial environment

Abstract 97

Source Apportionment of Refractory Black Carbon in Aerosols during Period of The Harvest Season in Suburban Area in Japan

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Abstract

Biomass burning (BB) is one of the major sources of atmospheric aerosols. Open burnings of agricultural residues are not completely prohibited in Japan, and intentional open burnings are often conducted in rice field in harvest season. We conducted the one-month period atmospheric observation in harvest season in Tsukuba, Japan, where surrounded by a residential area and by rice field. Then, apportionment of aerosols generated from open burning of agricultural residues was assessed by positive matrix factorization (PMF) method using high resolution mass spectrum data of soot particle aerosol mass spectrometer.

Averaged over whole period, organic aerosols (OA) and refractory black carbon (rBC) in PM1.0 were 5.8 μg/m^3 and 0.53 μg/m^3 and fractions to major chemical species were 60% and 5%, respectively. On 10 Oct, PM2.5 largely increase and concentration was reached up to 100 μg/m^3, and concentrations of OA and rBC were also increase about 5 times whole period average. The ions of $C2H4O2^+$ and refractory K^+ which are tracers of open burning of agricultural residues were also enriched at that time, thus suggested largely affected by plume of BB.

PMF analysis was applied to OA data that taken at laser vaporizer off and to OA and rBC data that taken at laser vaporizer on, respectively. Factor related to BB was attributed by the similarity to mass spectrum of emission source data of rice straw burning and similar temporal variation BB tracers. The average contributions of BB during the observation period were about both 25% in OA and in rBC. On the other hand, on 10 Oct, the contributions of BB were increase to twice, and concentrations of BB factors increase about 8 times whole period average. Further, we will discuss the possibility of source identification of rBC using carbon cluster ions.

Keywords: biomass burning; rice straw; refractory black carbon; soot particle aerosol mass spectrometer; positive matrix method; carbon cluster ion

Conference Theme: Monitoring, detection and spatial environment

ABSTRACT 103

Half-Decadal Trend of Particulate Matter over Different Micro– Envrionments in Pune, India

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Abstract

The half decadal trend of PM_{10} and $PM_{2.5}$ mass concentrations obtained from the air quality monitoring stations established at nine different micro - environments of Pune, India is analyzed (for the period 2014 to 2018). Amongst these environments the PM_{10} concentrations showed a significant decreasing trend at all locations (Except Katraj: an urban complex area). However, the $PM_{2.5}$ concentrations showed an increasing trend in majority of the locations within the city. Two locations viz. Pashan (green environment) and Manjri (close to agricultural land) showed a decreasing trend of $PM_{2.5}$ concentrations with a decrease of 4.2% and 6% respectively. The highest half decadal increase of $PM_{2.5}$ concentrations of 38 % is observed at Bhosari (a location in the proximity of industries in Pune). The half decadal trend of meteorological parameters like temperature, wind speed and relative humidity also were analyzed. Temperature and wind speed did not show any significant trend during the period (Wind speed showed increase at certain environments in the city, which is not very significant). On analyzing the half decade trend of PM_{10} and $PM_{2.5}$ it was found that at certain locations there was an increasing trend during some seasons and decreasing in the other localities. The highest increasing trend of both PM_{10} and $PM_{2.5}$ is observed in the urban locality of Katraj in the winter season. On a whole, coarser particles show a declining trend whereas finer particles show an increasing trend over the time span of 5 years which can be attributed to increasing anthropogenic emissions.

Keywords: PM_{10}, $PM_{2.5}$, Half-decadal trend, micro - environments

Conference Theme: Monitoring, detection and spatial environment (Urban air quality and environment)

ABSTRACT 131

A Typical Derivate and Byproduct of Tetrabromobisphenol a: Development of Novel High-Throughput Immunoassays and Systematic Investigation of Their Distributions in an E-Waste Recycling Area in Eastern China

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Abstract

Environmental distribution and concentration of tetrabromobisphenol A bis(2-hydroxyethyl) ether (TBBPA-DHEE) and tetrabromobisphenol A mono(hydroxyethyl) ether (TBBPA-MHEE), are obscure due to lacking available analytical methods. Here two novel immunoassays were established for systematically investigate their distributions in Taizhou, Eastern China. Five monoclonal antibodies against pollutants were generated with two designed haptens through animal immunization. After matched with different coating antigens/antibodies, ELISAs were established (LOD for TBBPA-DHEE, 0.12 ng/mL, based on OVA-M3/mAb-D4G6; LOD for TBBPA-MHEE, 0.79 ng/mL, based on OVA-M3/mAb-D2G6) and applied for investigation of their occurrences at a typical e-waste recycling area after 2-year sampling, where the total 33 water, 32 soil and 16 biological samples were collected with the highest concentrations of 3.46 ng/mL, 2.76 ng/g (dry weight, dw) and 5.01 ng/g (dw), respectively. Meanwhile, our study also indicated that at the centralizing e-waste recycling sites the serious pollution for both chemicals still existed despite of various efforts. Besides, obvious improvements were observed at an abandoned e-waste recycling region treated and remedied for many years by the local Chinese government. These findings highlight the importance of policy decisions in treatment of pollutants to reduce organic pollutant-related health risks.

Keywords: Immunoassay Environmental investigation Environmental distribution

Conference Theme: Monitoring, detection and spatial environment

7-SEAS Workshop

ABSTRACT 64

AERONET Dragon Campaigns: Potential Contributions to High Resolution Satellite and Regional Aerosol Model Validations in Mountainous Regions

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Abstract

Since the SEAC4RS campaign of 2012 in SE Asia, AERONET has implemented a series of intense campaigns to measure spatially and temporally aerosol properties from AERONET Cimel stations at a mesoscale of 10s of km between stations which is called Distributed Regional Aerosol Gridded Observation Network (DRAGON). This has afforded the opportunity to assess to greater accuracy the dynamics of aerosol process while providing an extremely accurate database for validation of satellite retrievals of aerosols and model estimates and forecasts. The majority of these campaigns have emphasized the dynamics in relatively flat and more predictable regions and avoiding the complexity of mountainous terrain and multiple land-use cover types. Recent efforts and plans to manage DRAGON campaigns in mountainous areas will be discussed with emphasis placed on the paucity of data over SE Asia in the 7-SEAS countries and the opportunity to begin such campaigns.

Keywords:

AERONET, Aerosol, 7-SEAS, DRAGON Campaign

ABSTRACT 126

The NASA Micro Pulse Lidar Network (MPLNET): Update on Version 3 Release and Activities in 7SEAS Region

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Abstract:

The NASA Micro-Pulse Lidar Network (MPLNET) is a global federated network of polarized Micro-Pulse Lidar (MPL) systems running continuously. Most sites are co-located with AERONET providing joint data on column and vertically resolved aerosol and cloud information. MPLNET began in 2000, and there have been over 70 sites deployed worldwide, with 23 sites currently active and a few more planned over the next year. Seven of the long-term sites have 10+ years of data, and many more have 5+ years. This presentation will provide an overview of the new Version 3 MPLNET data to be released in fall 2019. All sites in the network are now polarized, providing information on particle shape. Other changes include enhanced cloud products, a new PBL height product, and inclusion of the AERONET lunar AOD into MPLNET aerosol retrievals. A new quality flag process will be used to better describe the data products. A new data portal will provide near-real-time (NRT) access to all data products, including new quality assured NRT L1.5 products. Custom products developed for model specific applications will also be provided. Finally, a discussion of active and planned MPLNET sites in the 7SEAS region will be provided.

Keywords: Aerosol, cloud, lidar, network

ABSTRACT 71

7-Seas: An Overview of Spring 2020 Baseline Studies on Aerosol-Cloud Interactions

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Abstract

Earth's planetary boundary layer (PBL), besides influencing air quality and human health, is at the heart of various atmospheric science challenges – extending from the fundamental exchanges of carbon, water and energy between the oceans, land, cryosphere, and atmosphere. These exchanges are facilitated by turbulent fluxes, which are feedback responses of moist convection initiated in the PBL. During boreal spring in Southeast Asia, biomass-burning aerosols from natural forest fires and slash-and-burn agricultural practices modulate atmospheric composition in the PBL and alter region's pre-monsoon cloud and rain system through radiative and physicochemical effects. Aerosol-cloud interactions represented in the physics-based models require not only appropriate measurements for physicochemical parameterizations governing aerosol-cloud-precipitation evolution, but also the availability of adequate observations to constrain and evaluate these models. Thus, the 7-SEAS/BASELInE observation strategy is designed to achieve these goals. Combined observations from spaceborne passive and active sensors provide an unprecedented yet partial view of the PBL aerosols and water cycle in action. However, near-surface measurements remain challenging. Remote sensing and *in-situ* observations from suborbital and ground-based platforms, though spatially limited, can supply information on evolving properties of aerosols and light rainfall at low levels and near the earth's surface, thereby filling satellite observational gaps and providing additional constraints on model microphysics. These measurements are crucial not only for studying aerosol impact on air quality and human health but also for evaluating and improving microphysical process representation in models to better understand aerosol-cloud interactions and the relationships between in-cloud and surface precipitation characteristics.

Keywords: 7-SEAS, BASELInE, Biomass-burning, Stratocumulus, Aerosol-cloud Interaction

Conference Theme: 7-SEAS Workshop

ABSTRACT 117

Features and Characteristics of the New NASA Micropulse Network (MPLNET) Automatic Rain Detection Algorithm

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Abstract

The water cycle strongly influence life on Earth. In particular, the precipitation modifies the atmospheric column thermodynamics through the process of evaporation and serves as a proxy or latent heat modulation. For this reason, a correct precipitation parameterization (especially low-intensity precipitation) at global scale, bedsides improving our understanding of the hydrological cycle, it is crucial to reduce the associated uncertainty of the global climate models to correctly forecast future scenarios in order to apply fast mitigation strategies. In this manuscript we illustrate the development of an algorithm to automatically detect precipitation from lidar measurements obtained by the National and Aeronautics Space Administration (NASA) Micropulse lidar network (MPLNET) observations. The algorithm, once full operational, will deliver in Near Real Time (latency 1.5h) a new rain mask product that will be publicly available on MPLNET website as part of the new Version 3 Level 1.5 data. The methodology, based on an image processing technique, can detect only light precipitation events (defined by intensity and duration) as the morphological filters used through the detection process are applied on the cross-polar lidar range corrected composite images, i.e. heavy rain events are unusable as the lidar signal is completely extinguished after few meters in the precipitation or no detected signal because of the water accumulated on the receiver optics. Results from the algorithm, besides filling a gap in precipitation and virga detection by radars, are of particular interest for the scientific community because will help to better understand long term aerosol-cloud interactions and aerosol atmospheric removal (scavenging effect) by rain as multi-year database being available for several MPLNET permanent observational sites across the globe. The developed algorithm can be then easily applied to any other lidar and/or ceilometer network infrastructure in the frame of Global Aerosol Watch (GAW) aerosol lidar observation network (GALION).

ABSTRACT 24

Evaluation of Solar and Lunar AERONET Aerosol Products in the 7-Seas Region

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Abstract

Recent significant advancements were made in the near real-time automatic cloud screening and quality control of solar and lunar aerosol optical depth (AOD) in the Aerosol Robotic Network (AERONET) Version 3 data release. The Maritime Continent and Southeast Asia within the 7-SEAS region have episodic aerosol loading attributed mainly to biomass burning smoke and urban pollution in addition to extensive cloudiness complicating passive remote sensing measurements of the Sun or Moon used to compute AOD. For example, the AERONET solar AOD algorithm uses unique measurements of the solar aureole region that allows for improved identification of optically thin cirrus and significantly reduces the AOD contaminated by clouds over the 7-SEAS region. Highly variable biomass burning smoke and urban plumes are better characterized resulting in fewer aerosol data misidentified as clouds compared to previous versions. The AERONET lunar AOD product implements similar quality assurance algorithms as the solar AOD; however, the lunar AOD have some differences in calibration technique, cloud screening, and quality controls. The AERONET solar and lunar AOD measurements and sky retrievals are evaluated for 7-SEAS region sites.

Keywords: AERONET, aerosols, smoke, pollution

Conference Theme: 7-SEAS Workshop

ABSTRACT 65

Coupling Remote Sensing, Models, and Mathematics to Constrain and Attribute Extreme Pollution Events in Southeast, East, and South Asia

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Abstract

Given the increases of economic development, urbanization, energy consumption, and agricultural use throughout Asia, there have been rapid changes in the amount and location of primary emissions of aerosols and trace gasses that are harmful to people's health, the environment, and the climate. One of the most important impacts of these changes have been extreme pollution events, that occur due to intense but relatively short-lived emission events such as biomass burning, changes in the regional meteorology, and urban-radiative-boundary feedbacks from land use change and high loadings of aerosol pollutants.

This work uses measurements of AOD from MODIS, vertical heights from MISR, NO2 from OMI, and CO from MOPITT to understand and constrain the changes in air pollution sources and long-range transport that occur throughout Southeast, East, and South Asia. A variance-maximization technique is applied to understand and attribute short-term but intense events, long-term changes, long-range transport, and stable conditions. These are then used to form a new a-priori emissions dataset, which is in turn used in a Kalman Filter inversion to constrain the new magnitudes of BC and primary trace gasses emitted.

The modeled results are compared with separate measurements, such as ground networks and AERONET, to demonstrate independently their improved performance. We now understand and successfully model 30% to 50% more extreme air pollution days, have improved our estimation of emissions from biomass burning (an increase of 40% to 80% per annum), and can attribute annually-occurring long-range transport from sub-continent to sub-continent.

Keywords: Remote Sensing, Black Carbon, Trace Gasses, Variance-Maximization, Extreme Events, Long-Range Transport, Inverse Modeling, Emissions

Conference Theme: Monitoring, detection and spatial environment; Modelling and technologies; 7-SEAS Workshop (Possibly relevant to any of these three)

ABSTRACT 53

Cross-Boundary Aerosols: A Case Study of Aerosol Problem in Bangkok during January-February, 2019

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Abstract

During January-February, 2019, Bangkok faced a serious problem of air quality. The problem was demonstrated in the form of high level of PM 2.5 in Bangkok and its sub-burb, which adversely affected human health. The causes of the high level of PM2.5 in this period were investigated. In the investigation, fire spots from MODIS, aerosol properties obtained from sunphotometers of AERONET, wind maps from Thai Department of Meteorology and height of the boundary layer from LIDAR of MPLNET were analysed. In that period, data from MODIS revealed high density of fire spots in Cambodia and there was eastern wind blowing from the fire-spot area to Bangkok. In addition, AERONET data showed that fine mode of aerosols was dominated and the height of the boundary layer was very low. These results imply that cross-boundary aerosols from biomass burning in Cambodia likely contributed to the problem of high level of PM2.5 in Bangkok, and conceptual model of the mechanism of this contribution was proposed.

Keywords: PM2.5, Bangkok, biomass-burning, cross-boundary, aerosols

Conference Theme: 7-SEAS workshop

ABSTRACT 78

Mountain Aerosol Chemical Characteristics Contrasted between Atmospheric Background and Pollution Events

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Abstract

The atmospheric aerosol is known to have radiative effects of solar radiation on the Earth. Mountain aerosols are usually under the influences of various air masses carrying over mixed source fingerprints. This study collected PM2.5 filter samples for chemical characterization at Mt. Bamboo (25.18°N, 121.53°E, 1,103 m a.s.l.) in autumn 2016 and Mt. Lulin (23.47°N, 120.87°E, 2,862 m a.s.l.) in autumn 2016 and spring 2017 in Taiwan. PM2.5 mass concentrations were 7.5 ± 8.2 μg m^{-3} and 2.7 ± 1.2 μg m^{-3} at Mt. Bamboo and Mt. Lulin, respectively, in autumn 2016. For sources of the air masses, Mt. Bamboo was under the combined influences of Taipei metropolis and transboundary pollution, while Mt. Lulin stayed in atmospheric background condition most of the time. In contrast, PM2.5 mass concentration was 8.6 ± 4.8 μg m^{-3} at Mt. Lulin under the influences of long-range transports from Indochina and China Mainland in spring 2017. Although PM2.5 major chemical components were the same at Mt. Lulin, the fractions of $SO4^{2-}$, $NO3^{-}$, $NH4^{+}$, and OC3 (evolved at 480°C) in PM2.5 varied in the two seasons. During the spring period, enhanced levoglucosan, K^{+}, and various carbonaceous components were observed under the influence of biomass-burning plume transport. For the assessment of atmospheric optics, this study adopted the revised IMPROVE algorithm to compute light extinction coefficients of the atmospheric species. The dominance of atmospheric species on light extinction changed over with the aerosol mixing ratio in the atmosphere. Raleigh scattering influenced atmospheric optics the most in atmospheric background condition; however, (NH4)2SO4 gained its dominance in the spring pollution events. This study demonstrated that the optical effects of atmospheric species shifted from atmospheric background condition to pollution events.

Keywords: Mountain aerosol, Aerosol chemical characteristics, Aerosol optical effects

Conference Theme: 7-SEAS workshop

ABSTRACT 63

Influence of Springtime Biomass Burning on Volatile Organic Compounds in Continental Southeast Asia

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Abstract

Springtime biomass burning (BB) emissions in Southeast Asia can perturb the air quality over East Asia. The characteristics of volatile organic compounds (VOCs) were investigated at Doi Ang Khang (DAK, 19.93°N, 99.05°E, 1536 m a.s.l.) in the BB source region of northern Thailand. Twenty-six whole air samples were collected when carbon monoxide (CO) reached a threshold of 1 ppm to capture BB plumes in March, 2014. Three extra samples were collected manually and considered as background value when BB was inactive. The air samples were subsequently analyzed in-lab by gas chromatography/mass spectrometry/flame ionization detection (GC/MS/FID) and cavity ring-down spectrometry (CRDS) for VOCs and greenhouse gases, respectively. Modified combustion efficiency (MCE) was calculated for each sample to evaluate its relationship between VOCs. However, most VOCs does not response to MCE except for ketones which showed an anti-correlation with MCE, implying that ketones were produced preferably in smoldering condition. To post a contrast to the BB VOCs, 24 roadside samples collected in Taipei (TPE, within 24.95 – 25.11°N, 121.45 – 121.65°E) in April 2014 were used. Although the average concentration of total VOCs measured at DAK (69.0 ppbv) was only ~62% of the TPE samples (110.6 ppbv), significant contribution from ketones (~16.7%) was found in the BB samples compared to those collected in urban environment with large traffic emissions (~5.7%), revealing a possible pathway to produce oxygen-rich species. Ethyne was found to exhibit good correlation with CO (R^2 = 0.82) with a mean ethyne/CO of 3.95 ppbv/ppmv, suggesting a clear relationship in the BB source region.

Keywords: biomass burning, VOC, MCE, ketones

Conference Theme: 7-SEAS workshop

ABSTRACT 40

Estimating and Discussing the Contribution and Transport Mechanism of Haze from Three Major Industrial Parks in China Mainland to Taiwan

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Abstract

The Asian haze has been attracting notice in recent years. For downstream areas, it is meaningful to find which upstream emissions could be the crucial sources. The present study focused on the biggest three industrial bases in Asian continent: Bohai Rim industrial base (BRIB), the Yangtze River Delta industrial base (YRDIB), and the Pearl River Delta industrial base (PRDIB), evaluated the impact of sources in these three areas on the PM2.5 in Taiwan, and discussed the transport mechanism. The simulation results revealed the monthly average PM2.5 contributions from BRIB and YRDIB were 0.7-1.1 μg m^{-3} and 1.2-1.9 μg m^{-3}，(5 % and 7.5% of total concentration) in January 2017. When the cold anticyclone moved from Asian continent to the West Pacific (called high pressure pushing), the contributions of BRIB and YRDIB to norhtern Taiwan (BQ city) could reach 6-8 and 9-12 μg m^{-3}. Meanwhile, the major positive contribution was horizontal advection (HADV), followed by aerosols processes (AERO); and the negative effects were vertical advection (ZADV) below 400 m. While above 400 m, the major positive contributions were vertical diffusion (VDIF), ZADV, and cloud processes (CLDS); and the negative contributions were HADV and AERO. For central (ZM city) and southern (CY city) Taiwan, the influence from BRIB and YRDIB is not significant. The contribution of processes was not stable. On the other hand, althoug the influence of PRDIB is minor, it is obvious that the positive contirbution was VDIF during the period of serious events from BRIB and YRDIB It explains the pollutants from PRDIB could transport to aloft and then diffused to ground over Taiwan. Also, the high pressure pushing from BRIB an YRDIB and the aloft transport from PRDIB co-occurred.

Keywords: PM2.5, LRT, industrial bases, air quality modelling

Conference Theme: Monitoring, detection and spatial environment

ABSTRACT 74

Optimizing the Prediction of Biomass Burning Plume Dispersion in Southeast Asia

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Abstract

The paper attempted to improve the simulation of biomass burning (BB) plumes transport during boreal spring from northern Indochina to the Lulin Atmospheric Background Station, Taiwan (LABS; 2862m AMSL; 23°28'07'' N, 120°52'25'' E) using the CMAQ v5.2 (Community Multiscale Air Quality) model. The mountainous terrain in northern Thailand complicates the dispersion of BB emission from the valley pockets. Previous modeling work has calibrated the emission inventory through satellite fire product to obtain the reasonable model output to the intended region. This method is quick and straightforward, but it is limited to the studied case and might not answer the true science questions when transport of plumes is concerned. More, the conventional inline plume rise in CMAQ is discovered that the heat content of fire is much larger to be accounted solely by the Brigg's atmospheric stability algorithm. Therefore, the plume initial injection height is optimized through various alternatives, including a comparison of CALIOP extinction profile and empirical buoyancy efficiency algorithm by WRAP. The two popular emission inventories (FINN v1.5 and GFED v4.1s) are compared and it is expectedly discovered that FINN BB emission is larger over the northern Indochina. The incorporation of FINN into the inline plume rise model has reproduced both CO and PM10 well at the burning site in northern Thailand as well as their transport to LABS site. The optimized model is then used to study the biomass burning plumes transport dynamics during years of different ENSO anomalies.

Keywords: Biomass burning plumes, plume rise, injection height, CMAQ model, Southeast Asia

Conference Theme: 7-SEAS Workshop

ABSTRACT 137

Air Quality Monitoring and Health Risk Assessment during Smoke Haze Season 2019 in Northern Thailand

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Abstract

The air quality monitoring project in upper northern Thailand aims to monitor ambient PM2.5 (particulate matters with aerodynamic diameter less than or equal to 2.5 μm) from two urban sites (traffic congestion area) and 2 rural sites (agricultural area) for analysis of their chemical composition for source identification and health risk assessment. Average PM2.5 concentrations obtained from those two urban sites during smoke haze period of year 2019 were significantly different due to different traffic volumes and distance of the samplers to the road. The PM2.5 concentration in LP city (125.98 ± 34.44 μg m^{-3}) was significantly higher than that in CM city (77.24± 41.42 μg m^{-3}). The average PM2.5 concentrations in rural sites, located near open burning source, were not much different (116.45 ± 49.81 μg m-3 (CD) and 97.72 ± 31.67 μg m^{-3} (MS)). Polycyclic aromatic hydrocarbons (16-PAHs) contained in PM samples (24-hr sampling on daily basis) were analyzed and calculated for toxicity equivalent (TEQ) and inhalation cancer risk (ICR). Average concentrations of total 16-PAHs of both sites in urban area were not significantly different (4.56 ± 2.90 ng m^{-3} (CM) and 5.72 ± 2.68 ng m^{-3} (LP)) and lower than those of the rural area (8.85 ± 4.70 ng m^{-3} (CD) and 6.62 ± 4.72 ng m^{-3} (MS)). The highest TEQ value was also found in CD's samples (rural area) and referring to ICR value of 1.26×10^{-4}, corresponded to high cancer risk. The values of ICR found in the other sites were in the range of 6.18×10^{-5} to 9.21×10^{-5}, which revealed medium risk of inhalation.

Keywords: PM2.5, PAHs, air pollution, biomass burning, inhalation cancer risk

Conference Theme: 7-SEAS Workshop

ABSTRACT 138

Outdoor Air Quality Monitoring by a Commercial Light Scattering Particulate Matter Sensors in Upper Northern Thailand

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Abstract

A commercial light scattering particulate matter (PM) sensor was selected for air quality monitoring in this study with a specific focus on Honeywell HPMA115S0 sensor to find out its usability at outdoors and long-term tests including smoke haze period. The sensor was compared with a beta attenuation monitoring (BAM) of the Pollution Control Department (PCD) for reference monitoring PM2.5 and PM10. The light scattering particulate matter sensor was used in AirEnvi monitoring systems, which were developed impactors for long term monitoring. This work presents a field test in nine locations: rural site (five locations) and roadside (four locations) in upper northern Thailand. The location for comparison between BAM detector and light scattering AirEnvi was installed at Tambon Sri Poom, Chiang Mai city. The PM monitoring was operated from March 9 to April 4, 2019. The 24-hrs average was between 10.35 to 190.72 and 15.93 to 215.43 μg/m^3 for PM2.5 and PM10, respectively. The PM2.5 concentration in Chiang Mai Province (190.72 ± 38.65 μg/m^3) was significantly higher than in other locations. The 24-hrs average of PM2.5 and PM10 between BAM and AirEnvi had a high correlation (r=0.9704 and r=0.9689, respectively) in the smoke haze period. This high correlation indicates that the light scattering technique device is suitable for measuring airborne particulate matter PM2.5 and PM10 in this area. The result of this study will be useful for the regulatory action of air quality management in the region.

Keywords: air quality monitoring, PM2.5, PM10, light scattering sensors, smoke haze

Conference Theme: 7-SEAS Workshop

ABSTRACT 81

Variability of Aerosol Types and Chemical Components over Indochina Based on AERONET Data

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Abstract

Aerosol chemical components (i.e., black carbon (BC), brown carbon (BrC)) regulate the optical properties of aerosol, which are highly sensitive to atmospheric radiative forcing estimation. Previously, through an intensive international field experiment, i.e. The 7 SEAS project, the complex aerosol environment of Indochina was investigated. However, the role of absorbing aerosols during biomass burning season on the environment is still unclear. In this paper, the long-term cimel sunphotometer AERONET (Aerosol Robotic Network) measurements and its inversion products from 6 sites in Indochina have been studied to understand the seasonal and spatial characteristic differences in aerosol optical properties and the mixture of BC with other aerosol components in smoke haze.

The long-term data analysis revealed that the monthly mean aerosol optical depth (AOD) was higher in the months of March and April than the rest of months observed by all AERONET sites in the region, inferring the influence of regional biomass-burning activities. From the aerosol size distribution, the number of small particles was even larger than large particles during dry period. Due to the spatial differences in geographic and land use patterns, the AERONET sites in northern Indochina show a higher AOD compared to that of in southern Indochina. In comparison to the yearly-mean aerosol optical properties, a lower single-scattering albedo (SSA) and higher fine-mode fraction (FMF) values in February and March, suggested the domination of smaller and stronger absorbing particles during this period.

Two methods (i.e., aerosol type cluster and aerosol component retrieval) had been applied to determine the aerosol type and chemical components during the biomass-burning season. The correlation coefficient between component retrieval and chemical sampling was 0.6 at DAK site. For Chiang Mai site (northern Indochina), the cluster method revealed biomass-burning aerosol type in February and March, when a large fraction of absorbing aerosols (BC 5% and BrC 40%) were also observed according to the result from aerosol component retrieval. As contrast, a mixed aerosol type with low absorbance was determined at the Bac Lieu site (southern Indochina). Our research provides a new aspect of the peak of biomass burning month (i.e. March) in northern Indochina may not necessary with lowest SSA once dust particles are mixed.

Furthermore, we categorized the days into event days and non-event days based on AOD value during biomass-burning months (March in 2014 and 2015). As a results, the tendency of aerosol optical properties between DAK and CM site showed similar pattern, which suggested that aerosol spatial distribution was more homogeneous during non-event days. As contrast, AOD and AE tendency were different at DAK and CM site during non-event days. We suggested that the peak AOD value of event day at CM site was due to aerosol accumulation from previous day. For DAK site, the peak AOD value of event day happened in the afternoon may due to close to source region of biomass burning. There was no specific tendency of BC fraction during non-event days; BC fraction was high and BrC fraction got lower on event day at CM and DAK site. The difference of geographic location and altitude might be one of the reasons that caused these situations.

Keywords: Biomass Burning, Aerosol Optics, Aerosol composition, Black Carbon, AERONET

ABSTRACT 73

Seasonal Analysis of Aerosol Optical Depth, PM2.5, Relative Humidity and PBL Height for Years 2015-2018: Implications for Satellite Retrievals of PM2.5

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Abstract

South-East Asia (SEA), due to its vast geography is fully dependent on satellite remote sensing for infrastructure development, disaster monitoring and more recently for air and water quality. From an air quality perspective, for the last three decades, the SEA region suffers from yearly episodes of small and large scale episodes biomass burning, especially during the dry periods of August to November. This burning activity is the result of small and large scale land clearance from small land holders to large industrial plantations. This activity has resulted on

large scale trans-boundary smoke emissions such as 1997, 2006, 2010, 2013 and more recently in 2015. Monitoring such as events from remote sensing satellites are the first line of action for local and regional stake holders. However, satellites do not provide a direct measure of ground particulate matters mass concentrations or PM2.5/10 but its proxy, the so-called aerosol optical depth (AOD). Years of observations of PM2.5 and AOD (from satellites and ground instruments such as sun-photometers) has provided a clear insight that there is a close relationship between both parameters. However, such a relationship is intrinsically dependent on the local meteorology, geography and seasonality thus, understanding the seasonal variation that influences the AOD vs PM relationship is paramount. In this work, we present a two year statistical analysis of AOD, PM2.5, %RH and PBL height observed over Singapore and analyze its seasonality and the physical relationship between AOD and PM2.5. Finally, we build a set seasonal correlation parameters relating AOD and PM2.5 and its dependency on local %RH and PBL height.

ABSTRACT 87

Source Apportionment of Pollutants in Port Klang, Malaysia During Haze ind Non-Haze Episodes in 2015

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Abstract

Long-term pollution analysis in Malaysia has identified Port Klang as one of the pollution hot spots in the country and characterised by local and transboundary sources. This study aims to characterise the seasonal variations and sources of pollutants in Port Klang during the haze and non-haze episodes in 2015, which coincident with the strongest El-Nino events in the region. Temporal variation of pollutants for the whole year were analysed and potential associated sources were examined using trajectory analysis. In identifying the source apportionment of pollutants in Port Klang, this study was using Positive Matrix Factorization (PMF) 5.0, both during hazy (September-October 2015) and non-hazy (whole year 2015) scenarios, using data obtained from the Department of Environment (DOE). Four factors were evaluated for the source apportionment namely from shipping emission, vehicular exhaust, industrial emission and biomass burning. Results have shown that during non-hazy scenario (whole year 2015), pollutants source in Port Klang is dominated from industrial activities, followed by on-land transportation, biomass burning and maritime transportation. During hazy episode, pollutants were largely attributed by trans-boundary pollution from large and intense biomass burning in Sumatera, Indonesia. During this period, high concentrations of particulate matter (PM_{10}) and carbon monoxide (CO) were measured at Port Klang. The high variability of pollutants in Port Klang was strongly influenced by meteorological factors and highly seasonal.

Keywords: Air Pollutants, Biomass Burning, Haze, PMF Model, Source Apportionment, Trans---boundary

Conference Theme: Monitoring, detection and spatial environment

ABSTRACT 2

Impacts of Large Amount of Access Aerosol on the Air Quality: Southeast Asia during 2015 Biomass Burning Haze Event

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Abstract

Severe haze events and their radiation feedbacks exert a profound impact on the regional climate system. Using the Weather Research and Forecasting (WRF-ARW) model, this study investigates the impacts of direct aerosol-radiation feedbacks on local air quality (i.e. particulate matter) during a severe haze episode in Southeast Asia (mainly Malaysia and Indonesia) in 2015. Pronounced radiation feedbacks are found for the predictions of selected meteorological variables. In response to the influence of radiative forcing of scattered dominant anthropogenic haze aerosols, the instantaneous irradiance and temperature at the surface gets lower, respectively, leading to a reduction of boundary layer height and vertical wind speed during the haze event that effects the rainfall significantly. Such a stable atmosphere favors the accumulation of fine particles and NO2 in the urban pollution plume. The weaker turbulent mixing and photochemical activity associated with the enhanced titration loss and reduced downward radiation and results in reduction of near-surface ozone. The simulations highlight how the aerosol-radiation feedbacks play an important role in the atmospheric transport and chemistry of large pollution plumes.

Keywords: haze, aerosol, radiative forcing, ozone, Southeast Asia, WRF-ARW.

Conference theme: Modelling and technologies

ABSTRACT 82

Fine Particulate Matter: Composition and Potential Sources in Jakarta during Wet Season

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Abstract

Atmospheric Fine Particulate Matter (FPM) is one of the major pollutants concerned in the ambient air due to the effect of material to human health. FPM were measured in Jakarta during wet season 2018-2019 in Kebun Jeruk and Lubang Buaya areas. Kebun Jeruk is represent residential area in west Jakarta, while Lubang Buaya is at the east site of Jakarta. Samples on each location were collected over one or two days-time periods during wet season using two Mini Volume Samplers run simultaneously using two different filters which are quartz and Teflon filters. Quartz filter were analyzed for OC and EC, while the PTFE Teflon filter were analyzed for elements and Ions. Meteorological conditions were also measured simultaneously in the sampling locations. Total of 35 samples were collected from Kebun Jeruk and 10 samples were collected from Lubang Buaya sites. Samples were further analyzed to determine concentrations of particulate mass, OC, EC, Black Carbon, elements (Na, Mg, Al, Si, K, Ca, Cd, Br, Co, Ti, Cr, Mn, Fe, Ni, Cu, Pb, Zn) and ions ($NH4^{+}$, Na^{+}, K^{+}, Ca^{+2}, $SO4^{-2}$, $NO3^{-}$, Cl^{-}, F^{-}). The results show that the average fine particulate matter concentrations were 31 and 67 g/m3 for Kebun Jeruk and Lubang Buaya respectively. While the Indonesia Ambient Air Quality Standards is 65 µg/m^3. The highest component contribute to FPM in Jakarta were Organic Carbon (OC), Elemental Carbon (EC), nitrate, Sulfate and Ammonium. Concentration of OC, EC, Nitrate, Sulfate, Ammonium and elements in Kebun Jeruk were 14.7, 3.7, 3.6, 1.3, 0.94 and 1.7 µg/m^3 respectively. While in Lubang Buaya the average concentrations of OC, EC, Nitrate, sulphate, ammonium and elements were 20.6, 4.6, 3.45, 1.8, 1.47, and 5.9 µg/m^3 respectively. From the carbon fraction (OC1, OC2, OC3 and OC4 as well as EC1, EC2 and EC3) analysis, indicated that the potential source of FPM in Jakarta were from transportation sector, and combustion process.

Keywords: Fine particulate, OC, EC, Sulfate, Nitrate, ammonium**,** elements

Conference Theme: Atmospheric chemistry (aerosol) and 7 SEAS

SESSION C

ABSTRACT 108

Design and Performance of a Low-Cost Atmospheric Composition Monitor for Deployment in Extreme Environments

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Abstract

The Arctic is one critical environment for monitoring climate change as well as variations in background concentrations of atmospheric components. The associated logistic difficulties, though, make hard to deploy an extensive monitoring network of sensors, limiting long time-series to only sparse and costly point observations. Low-cost sensors are knowing a wide spread in research and monitoring applications and could be an interesting tool to deploy spatialized monitoring networks even in extreme environments. In this context, two CNR Labs (IBE and ISAC) made a long-term deployment of a prototypal low-cost sensor for atmospheric composition monitoring in the polar research village of Ny-Ålesund (Svalbard, Norway). In about one year of measurements the low-cost sensor showed: i) a good consistency in the data series with minimal data loss, ii) no significant requirements for maintenance and iii) the capability of capturing the main atmospheric trends of the Arctic lower troposphere.

Keywords: Atmospheric composition; Extreme environment; Low-cost stations

Conference Theme: Monitoring, detection and spatial environment

ABSTRACT 109

Innovative Low-Cost Air Quality Stations to Support Road Traffic Regulations in Urban Areas

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Abstract

Industrial activities, road traffic and heating systems are main emission sources significantly increasing the levels of atmospheric pollutants as particulate matter, ozone, and nitrogen oxides. Local administrations monitor these harmful gases by means of reference monitoring stations provided by regional/national environmental protection agencies. These stations, however, have limitations due to coarse spatial coverage of the whole municipality, low time-frequency, and high costs. In this framework, CNR-IBE, University of Florence – DAGRI, Tuscany Region Environmental Protection Agency (ARPAT) and epidemiologists of the Pisa University promoted an initiative to create an environmental "Living Lab" aimed at monitoring air quality and assessing the impacts of anthropogenic activities on citizen's exposure. Two study areas located in the Tuscany region (Italy) were chosen: the rural town of Capannori was selected since it lies within a critical area affected by a variety of emission sources and winter weather conditions unfavourable to pollutant dispersion. The city of Florence was chosen for assessing urban air quality following a possible traffic reduction due to creation of new tramway lines. The air quality analysis was carried out by means of a monitoring network comprising innovative low-cost stations (AIRQino). PM concentrations were mainly considered for providing indicative air quality measurements. Preliminary results indicated that: i) low-cost stations, after calibration and validation against more than one-year observations from a reference air quality station, confirmed their reliability in measuring air quality; ii) AIRQino data can supplement air quality information from reference stations and may be used to help traffic regulation actions at urban scale.

Keywords: Air quality; Urban area; Low-cost stations; PM concentrations; Road traffic

Conference Theme: Monitoring, detection and spatial environment

ABSTRACT 114

A Study of Indoor Carbonaceous Aerosols and the Socio-Economic Parameters in a Rural Area of Himachal Pradesh, India

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Abstract

Solid Biomass Fuel (SBF) burning is one of major reasons for the indoor air pollution and high disease burden in rural areas of India. This study has made an effort to find out the association of carbonaceous aerosol (CA) emissions with the socio-economic factors in the households of a rural village, Baggi in Himachal Pradesh, India. Also, the emissions of Organic Carbon (OC) and Elemental Carbon (EC) were evaluated for different types and combination of fuel combustion for cooking and heating purposes. Enhanced average concentrations of OC (240 µg/m3) and EC (118.4 µg/m3) were found with sole biomass burning (wood) on the Chullah (traditional low-budget cookstoves) due to inefficient and incomplete combustion. Although, there was a significant reduction of 53% and 41% in OC and EC respectively when a combination of biomass and Liquefied Petroleum Gas (LPG) was used for cooking. With LPG, the concentrations of OC and EC significantly declined to as low as 38.1 µg/m3 and 31.6 µg/m3 respectively. Also, an excellent inter-relationship was identified between the socio-economic parameters such as the kitchen's ventilation, education, financial status, etc. and CA emissions. In the house with very good ventilation (2 wide windows), the total CA emissions were as low as 86.7µg/m3. Also, the family members were educated and financially affluent. On the other hand, the total CA emissions were escalated by a significant 75.9% where the ventilation facility was extremely poor (small window and slit in the roof), the family was limitedly educated, and financial status lied below poverty line. On an average, the women in this village were found to spend 5 hours per day in the kitchen area. The socio-economic parameters are necessarily important towards the mitigation indoor air pollution and hence carbonaceous aerosols.

ABSTRACT 118

Variations in Surface Ozone and its Precursors at Coastal City Mumbai

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Abstract

Measurements of surface ozone (O_3) and its precursor oxides of nitrogen (NOx), carbon monoxide (CO) and volatile organic compounds (VOC) have been made over coastal city Mumbai (19.07^0N,72.87^0E) for a period January 2016 to December 2017 using SAFAR which is the ground-based continuous air quality monitoring network. The aim of this study was to understand the diurnal, daily and seasonally variation of ozone and its precursors NOx, CO and VOC with meteorological parameters at different microenvironments of the city including industrial, residential, background/cleaner, urban complex. Surface ozone (O_3) is not emitted directly into the atmosphere but is produced by chemical reactions of NOx, CO, and VOCin the presence of sunlight, therefore, it is important to understand the relation between O_3 and its main precursors. During the observation period, O_3 concentrations were high in the winter season and it starts to increase from October month. At all AQMS location, the diurnal concentration of O_3 start to increase from 10 hr and shows a peak at 12 – 15hrs and thereafter it decreases slowly, the amplitude of diurnal variation is least in the monsoon months and the diurnal pattern was weak. O_3 concentrations were high during the winter season (December to January) it starts increasing from October month. Highest annual concentration was observed 42 ppb in 2016 and 47 ppb in 2017 at Bhandup and lowest O_3 level was found at Worli. The positive correlation found between O_3 and NOx, CO, VOC at all AQMS locations.

Keywords: Surface ozone, precursor, air quality

Conference theme: Monitoring, detection and spatial environment (Urban air quality and environment)

ABSTRACT 119

Characteristics of Carbonaceous Aerosols in Hanoi, Vietnam

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Abstract

Atmospheric particulate matter (PM) has a large impact on air quality and human health. We simultaneously collected fine particles (PM2.5) and ultrafine particles (PM0.1) in Hanoi, Vietnam during the hot rainy wet season (from July 13 to August 2, 2015) and the cooler dry season (from March 2 to 16, 2016) to characterize the chemical components of each particle size. We measured organic carbon (OC), elemental carbon (EC), water-soluble organic carbon (WSOC), and water-soluble inorganic ions (WSIIs) in the PM2.5 and PM0.1 samples collected in Hanoi during each season. The average mass concentrations during the wet and dry seasons were 10.91 ± 7.46 (average ± standard deviation) and 14.75 ± 9.38 g m^{-3} in the PM2.5 samples and 1.88 ± 0.68 and 2.14 ± 0.73 g m^{-3} in the PM0.1 samples, respectively. For PM2.5, WSIIs was a major chemical component in the wet and dry seasons, whereas for PM0.1, organic matter (OM) was a major chemical component. These results show that the different chemical components in PM2.5 and PM0.1 reflect different their emission sources. The average OC/EC ratios during the wet and dry seasons were 3.19 ± 1.12 and 3.20 ± 0.77 in the PM2.5 and 6.15 ± 1.75 and 8.70 ± 2.88 in PM0.1, respectively. The high OC/EC ratios for PM2.5 and PM0.1 during the wet and dry seasons imply that secondary OC (SOC) present during the sampling period. We used EC-tracer method to clarify the contribution of SOC and primary OC. The results show that SOC account for 41.2 ± 14.2% and 35.8 ± 13.9% of OC in PM2.5, whereas, account for 37.1 ± 15.2% and 47.4 ± 15.7% of OC in PM0.1, respectively.

Keywords: Fine particles, Ultrafine particles, Carbonaceous aerosol, Hanoi

Conference Theme: Monitoring, detection and spatial environment

ABSTRACT 124

Air Quality Modelling Using ADMS-Urban for Kuala Lumpur Urban Environment

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Abstract

Serious health and environmental problems due to urban air pollution can be attributed to emissions from transportation and industrial activities. This study has been carried out to model street-scale resolution air quality concentrations using the Atmospheric Dispersion Modelling System for the urban environment (ADMS-Urban). Model inputs were derived from data provided by the Department of Environment, Kuala Lumpur City Hall, Ministry of Work and Malaysian Metrological Department (MMD), specifically: estimates of road traffic and industrial emissions; background pollutant concentration levels; and meteorological data. Validation and evaluation of the statistical performance was performed by comparing modelled concentrations with air quality monitoring stations in the Kuala Lumpur urban environment, Malaysia. Predictions of hourly PM10, O3, NOx, and NO2 concentrations for the year of 2014 were compared to observed data at three air quality monitoring stations within Kuala Lumpur city boundary. The calculation of statistical parameters indicated a good ADMS-Urban performance for the prediction of PM10, NO2 and NOx and slightly under predicted for O3. The high-resolution maps for daily average concentrations of air pollutants (PM10, NO2 and O3) were also presented. The results are expected to lead to a better understanding of the local nature of pollutants concentrations and its respective temporal behaviour for improving resilience to atmospheric hazards. In addition, the result allows for forecasting of air quality studies and decision making in the urban environment with regards to air quality.

Keywords: Air pollution, Air Dispersion Modelling, ADMS-Urban, Kuala Lumpur

Conference Theme: Modelling and technologies

ABSTRACT 127

Traffic-Related PM2.5 Generated from Vehicle Idling Activities in Proximity of Drop-Off and Pick-Up Zone at a Primary School in Malaysia

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Abstract

An operating vehicle is known to emit an increase concentration of particulates closer to the road from its tailpipe. There has been little study reported on vehicle idling emissions near schools in the upper-middle-income countries where the population of motor vehicle increases and the health impact among children has become a major concern. This study aims to assess the levels of PM2.5 from vehicle idling emissions activities in an urban primary school in Malaysia. Air sampling of PM2.5, traffic count and meteorological measurements (wind speed, temperature and relative humidity) were carried out during morning and afternoon both on the weekdays and weekends at drop-off and pick-zone near the school entrance. Respiratory exposure assessments were also conducted to the school children aged 10-11 years old (n =91) with questionnaire distribution and lung function test. Results showed that PM2.5 levels were higher 78% during drop-off time (morning) compared to pick-up time (afternoon). The traffic count for the weekdays were 10 times higher compared to the weekends indicating higher density of traffic volumes and vehicle idling activities. There were significant association between PM2.5 levels and lung function of children where FEV1% predicted (p=0.05), FVC/FEV1% predicted (p=0.029). Our preliminary findings suggest that school children have greater risk to respiratory health outcomes after being exposed to PM2.5 from vehicle idling activities at drop-off zone. More details on idling emission factors within school areas and develop strategies to reduce exposure to school children deserved further investigation.

Keywords: Urban Air Quality, Vehicle Idling, School Children, Personal Exposure

Conference Theme: Monitoring, detection and spatial environment

ABSTRACT 128

Air Quality Modeling and Forecasting in a Coastal Urban Environment Under a Hot Desert Climate

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Abstract

Air quality in the greater area of the Eastern Mediterranean and Middle East (MENA) is changing due to extensive land conversion, intense industrialization and rapid urban population growth in recent years. High ozone levels affected by long range transport and local production in large metropolitan areas of the region are of major concern. At the same time the region of the Arabian Peninsula is affected by frequent dust storms that further increase the anthropogenically-induced particulate matter levels in large urban environments. We have applied the online-coupled meteorological and chemical transport Weather Research and Forecasting/Chemistry (WRF-Chem) model over the Middle Eastern domain in both retrospective simulations and in forecasting mode, to simulate the concentration of gases and aerosols with a special focus over the state of Qatar and the metropolitan area of Doha. A triple-nested domain configuration was used with a high grid resolution (2x2 km2) over the state of Qatar. Model predictions are evaluated against intensive measurements of meteorological parameters (temperature, relative humidity and wind speed) as well as particulate matter and ozone taken from various measurement stations throughout Doha. The ability of the model to capture the temporal and spatial variability of the observations is assessed and possible reasons for the model bias are analyzed. Furthermore, we examine the performance of the model to reproduce the onset, intensity and duration of major dust events of the Middle East. The anthropogenic emission inventory is updated for fast-changing urban environments such as that of Doha, Qatar.

ABSTRACT 130

Analyses of Atmospheric Impact in Korea From Dustfalls Associated with Two Weak Sandstorms in Mongolia In January and February 2019

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Abstract

In January and February 2019 Korea experienced two episodes of dustfall associated with sandstorms that originated in Mongolia. The first episode occurred from a sandstorm in eastern Mongolia from January 27 to 28, while the second dustfall from another sandstorm occurred from February 2 to 3. Our observation site in west Cheongju, central Korea is over 1,800 km downstream from the sandstorms in Mongolia. Maximum hourly dust concentrations from the transport of the first duststorm from January 28 to 29 were 133~144 μgm^{-3} in PM10 and 177~187 μgm^{-3} in TSP, while PM2.5 values were in the range of 30~35 μgm-3. The maximum hourly concentrations produced by the second duststorm from February 4 to 7 were 150~171 μgm-3 in PM10 and 200~220 μgm^{-3} in TSP with 50~60 μgm^{-3} in PM2.5. These two duststorms were relatively weak compared with moderate and intense duststorms over the past two decades which registered PM10 concentrations between 500~3,006 μgm^{-3}. Furthermore, in west Cheongju a great distance from Mongolia, weak odours of animal droppings and dried manure could be detected during the evening hours of January 28. In Mongolia there are over 66.5 million livestock animals including sheep, goats, cattle, horses and camels. Detailed impact analyses on the transport of dust particles from the source region to the downstream side in central Korea is discussed.

ABSTRACT 25

Long-term Measurement of CO_2 Flux and Micro Meteorology at the Central Mountainous Area in Japan

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Abstract

Since 1993, the AIST has conducted a flux tower measurement in a cool temperate deciduous broadleaf forest at Takayama (137.423°E, 36.146°N, 1420 m a.s.l.) in central mountainous area in Japan (AsiaFlux site code: TKY). In spite that the site is surrounded by complex terrain, CO_2 flux and other micro meteorological variables are stably measured. Temperature varies between -15°C in winter and 25°C in summer, mean temperature is 6.5°C, and averaged annual precipitation is approximately 2300 mm, which is rather large value in Asian Monsoon region. Snow season is from the end of December to April and its maximum depth is often over 1 m. In spite of higher elevation wind is not so strong, but typhoons sometimes attack the site and affect CO_2 budget and phenology. Foliation stage starts early May and end in late October. After 1998 eddy co-variance method was introduced. Results and inter annual trends during 20 years after 1998 was mainly presented. Among those variables downward short wave radiation is continuously increasing, suggesting air-quality around Japan has been persistently improved.

Keywords: CO_2 flux tower measurement, inter-annual variation, complex terrain, interaction of phenology and micro meteorology

ABSTRACT 35

Effects of Transboundary Peat-Forest Smoke on Urban Environment in Maritime Continent: Multi-Year Observations

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Abstract

This study investigates effects of transboundary peat-forest (PF) smoke on the chemical properties of over 220 urban bulk $PM_{2.5}$ during 2011–2015. Overall, transboundary PF smoke increases total carbon (TC) by up to 14 folds from on average, 6 μg/m³ in non-smoke-dominant (NSD) $PM_{2.5}$ to 15 μg/m³ in smoke-dominant (SD) samples, and up to 98 μg/m³ in six episodic samples collected in June 2013. Organic carbon (OC) dominates over elemental carbon (EC) in both SD and episodic $PM_{2.5}$, accounting for on average 80% and 94% of TC, respectively. Furthermore, SD $PM_{2.5}$ contains more char-EC than soot-EC (p<0.05), unlike NSD samples. Among all inorganic ions, ammonium displays the largest enrichment in SD $PM_{2.5}$, increasing by 71% compared to NSD samples, exceeding the increment of sulfate (54%). This is corroborated by a 40% enhancement in NH_3(g), which is the greatest among all the measured gases (SO_2, HNO_3 and HCl) during SD period. In fact, the episodic transboundary smoke in June 2013 surged the average concentration of NH_3(g) by a factor of 8.9, up to 22.2 μg/m³. From 2012 to 2015, SD $PM_{2.5}$ shows reduced char-EC but increased soot-EC, ammonium and sulfate, indicating alterations in PF burning from smoldering-dominant to flaming-dominant. This can be likely attributed to land cover changes with time, converting pristine PF typically with higher moisture to managed land and increasing drainage of soil with overall reduced moisture of the land, thus favoring flaming-dominant combustion. More results will be presented to demonstrate how progressive changes at emission sources can be inferred through long-term observations at receptor sites.

Keywords: Biomass burning, peat forest, smoldering, flaming, land use, receptor

Conference Theme: Monitoring, detection and spatial environment (Long-range and cross-boundary transport in this region); 7SEAS

ABSTRACT 76

Improvement of Simulating the Long-range Transport of East Asian Dust to Taiwan

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Abstract

The East Asian dust storms of dense mineral particles emitted from the desert region in the northern China and Mongolia, could bring adverse impact, such as poor air quality, visibility reduction and health effect, towards the downwind areas, i.e. East China, Japan, Korea and Taiwan. However, the dust emission strength and meteorological condition play the key role of driving the transport pathway and determine the degree of aforementioned impacts. The present study attempt to utilize a new windblown dust emission scheme modulated by Foroutan et al. (2017) in the modeling system of the Weather Research Forecast (WRF) and the Community Multiscale Air Quality (CMAQ) model version 5.2 for improving the long-range transport simulation of dust events over East Asia. For a case study of April 2018, the model evaluation suggested that CMAQ simulation show better performance with the new dust module when simulating the PM10 in receptor sites with a normalized mean bias (NMB) of -1.66%, compared with -21.11% by the default settings. The simulated maximum PM10 level of 2,200 μg m^{-3} arose when the dust plume reached around Lanzhou. However, the PM10 level was reduced to around 160 μg m^{-3} in the northern Taiwan particularly due to the mixing with clean ocean air after the transport of dust plume to the East China Sea. Meanwhile, the wet deposition also removed the mineral particles from the dust plume in the course of transport. Moreover, the model suggested that the dust particles were uplifted to the height of 2 - 4.5 km above the ground level over the source region, resulting in their long-range transport, for instance, to the northern Taiwan.

Keywords: Air quality modeling, East Asian dust, long-range transport.

Conference Theme: Modelling and technologies

SESSION D

ABSTRACT 4

Determining Ground Level Composition and Concentration of Particulate Matter Across Regional Areas Using the Himawari-8 Satellite

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Abstract

Regional air quality is often poorly measured because of cost and infrastructure demands. While remote sensing has the potential to monitor air quality, it has historically faced numerous challenges that include: (i) the lack of temporal resolution from polar-orbiting satellites; (ii) the use of visible spectra is inadequate - as it provides daytime only data; and (iii) cyclical assumptions in the aerosol model lookup tables have limited aerosol types to a database best match.

Sub-hourly, thermal infrared, geostationary data, such as the ten-minute data from Himawari 8, is required to ensure that sporadic dust events can be continually observed and quantified. Newer quantification methods using geostationary data have focussed on detecting the presence, or absence, of a dust event. Limited attention has been given to the determination of composition and particle size, using thermal infrared (TIR) wavelengths exclusively. More appropriate TIR methods are required to quantify and classify aerosol composition (such as sulphates, black carbon, organic matter, sea salt and mineral dust) in order to improve the understanding of source impacts.

Four key research areas will be presented: (i) how fast does remote sensing need to be to detect sporadic aerosol incidents such as fires and dust storms; (ii) which TIR wavelengths best represent changing aerosol composition; (iii) how to identify aerosol concentration, composition, and particle size amongst atmospheric changes (such as wind, humidity and clouds); and (iv) the development of an integrated approach to assessing aerosol risk in a regional area with limited surface monitoring.

Keywords: Remote sensing of air pollutants, aerosols, sandstorms, dust indices, thermal infrared absorption, Himawari-8, meteorology related to air pollution, long range transport of air pollutants

Conference Theme: Monitoring, detection, and spatial environment

ABSTRAT 19

Applications of Telescoping Spume Sampling Device on a Drone to Extract Airborne Organic Vapors

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Abstract

A quadrotor drone was equipped with an active solid phase microextraction (SPME) sampling device, called a needle trap sampler (NTS), to extract airborne volatile organic compounds (VOCs). The NTS, which has a 22 gauge stainless steel needle that is manually packed with 60–80 mesh divinylbenzene (DVB) adsorbent particles, was attached to a telescoping shaft to extend the sampling distance outside the strong downward stream that flows across the propellers of a hovering drone. The optimal location of the end of the NTS inlet to extract VOCs in the air was below the head of the drone, as determined using SoildWorks, which is a flow simulation software. The feasibility of using a telescoping SPME sampling device on a quadrotor drone to collect toluene, ethylbenzene and p-xylene matrix vapor using a pilot VOC exhaustion system, was confirmed. The mobile sampling drone, with an NTS on its telescoping shaft, is recommended for use in sampling polluted air that is emitted from industrial factories.

Keywords: solid phase microextraction; needle trap sampler; drone; volatile organic compounds; air pollution

Conference Theme: Monitoring, detection and spatial environment-Remote sensing of air pollutants

ABSTRACT 43

Spatio-Temporal Variation of Brick Kilns and its Relation to Ground-Level PM2.5 Through Modis Image at Dhaka District, Bangladesh

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Abstract

This study is aimed to identify the spatiotemporal variation of brick kilns in Dhaka City and its relation to the PM2.5 concentrations. This study has been conducted in three upazila of Dhaka district. Secondary data have been collected from Google earth in different time frames for spatiotemporal analysis of brick kilns. MODIS data for PM2.5 were collected from NASA online database. ArcGIS 10.2.1 tool was used for analyzing the spatiotemporal and PM2.5 concentrations. The result shows that, the number of brick kilns was 307, 497 and 551 in the year of 2006, 2010 and 2018, respectively, which is portraying the increase in number of brick kilns in the surrounding Dhaka city. In addition, the PM2.5 maximum annual concentrations were found as 64.8 µg/m^3 in 2016 at Dhamrai upazila where the minimum concentration was 58.2 µg/m^3 in 2010 at Savar upazila respectively. The concentrations were three to four times higher than the limit of Bangladesh and WHO Standard. The results are also showing that, PM2.5 concentrations are increasing in relation to the number of brick kilns. It is concluded that, brick kilns have adverse impact on air quality of Dhaka district which may be an important impediment for achieving SDGs for Bangladesh. So, this study strongly recommended that, by considering fuel efficiency, cost and health benefits it is necessary to standardized the kiln efficiency through improved combustion techniques by provisioning the advanced technology.

Keywords: Spatiotemporal; Brick Kilns; Particulate Matter; Bangladesh; Pollution.

Conference Theme: Remote sensing of air pollutants

ABSTRACT 88

Monitoring of Glyoxal Column Densities in Different Forest Types Of Pakistan by Using MAX DOAS

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Abstract

Forests act as a contributor to the global emissions of biogenic volatile organic compounds (BVOCs). Measurements of their oxidation products, such as glyoxal (CHOCHO), provide useful indicators of fast photochemistry occurring in the lower troposphere. However, measurements of these species in forests location are extremely limited. Air pollution has become a serious issue in Pakistan and Forest also contribute in degrading the ambient air quality, therefore, air quality in forest ecosystem must be monitored continuously to understand the likely impacts of air pollutants on the atmosphere, environment and particularly human health. To address this, CHOCHO concentrations was measured using the multi-axis (MAX) differential optical absorption spectroscopy (DOAS) techniques in different Forest types, and Capital city of Pakistan.

Glyoxal being the tiniest α-dicarbonyl forms during VOC oxidation reactions. It has residence time of few hours determined by photolysis and hydroxyl radical reactions during day time. In the presence of NOx, glyoxal photolysis results in the formation of secondary organic pollutants along with the tropospheric ozone. This is a pioneer study for glyoxal retrieval in Pakistan's Forest. It presents a comparison of glyoxal retrieval from mini MAX-DOAS measurements at different monitoring sites of Pakistan Forest which include, Sub-Tropical Chir-pine Forest, Himalayan Moist Temperate Forest, Himalayan Dry Temperate Forest, Sub-Alpine Pasture and Alpine Pasture.

At first CHOCHO data was obtained during Field campaigns. Next data set was generated from ground-based MAX-DOAS observations at IESE-NUST (Institute of Environmental Sciences and Engineering - National University of Sciences and Technology), Islamabad, Pakistan. Glyoxal differential slant column densities (DSCDs) were retrieved using DOAS (differential optical absorption spectroscopy) technique. And by using geometric air mass factor approach, tropospheric vertical column densities (VCDs) were derived from measured DSCDs. The retrieved glyoxal was compared over the all Forest sites in respective years. Diurnal, Weekly and Annual Seasonal cycle of glyoxal was investigated for data set of IESE from September-2016 to August-2018. Results showed that CHOCHO concentrations was higher in morning and evening but lower in the noon due to photolysis. It was also observed that CHOCHO was lowest on Friday, while annual seasonal cycle of CHOCHO shows highest average concentrations in summers and lowest in winters over Islamabad. During field campaigns of different forest types, the CHOCHO concentrations were found to be maximum at Alpine Pasture and lowest at Chir-pine Forest.

Keywords: Air Quality, Forest types of Pakistan, capital city of Pakistan, BVOC-biogenic volatile organic compounds, CHOCHO-Glyoxal, MAX DOAS-Multi Axis Differential Optical Absorption, Spectroscopy, DSCD-Differential Slant Column Densities, VCD- Vertical Column Densities

ABSTRACT 93

First Experiment on High-Detailed Mapping of Tropospheric NO_2 in Polluted Areas of China Using Hyperspectral Imager Onboard Resurs-P

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Abstract

A series of Russian satellite Resurs-P operate since 2013 in sun-synchronous orbit. A hyperspectral imager GSA is mounted on its board, which resolves more than 230 spectral bands from 400 nm to 1000 nm. The main goal of the instrument is natural resource investigation. We developed an algorithm which use GSA/Resurs-P data for determing the content of NO2 in the lower troposphere on a grid with a step of 120 m. NO_2 retrieval error become comparable to ones obtained by other satellite instruments (OMI, TROPOMI), when resolution of GSA/Resurs-P is about 2 km, while the most modern instrument for NO_2 measurement, TROPOMI, currently has a resolution of 7x7 km. NO_2 on the grid with a 120 m step provide additional opportunities for detection of NO2 local emissions and estimation their power.

For the first time, the high spatial resolution of the new method makes it possible to identify local sources of pollution and their plumes. We compare obtained high-detailed NO2 field with low-resolution (13x24 km) NO_2 field of OMI and high-resolution field of chemical transport simulation. High-resolution simulation is achieved on the basis of the development and use of the methods of asymptotic analysis of multidimensional singularly perturbed problems for the nonlinear heat and mass transfer equation, as well as the use of effective numerical methods for solving problems for the nonlinear heat and mass transfer equation. The paper presents the first results of the comparison for measurements performed in 2016 over Hebei province of China which is one of the most NO_2 polluted regions in the word. The study was partially supported by RFBR with grants 18-29-10080 and 18-35-00682 and by RSF by grant 26-17-10275.

Keywords: nitrogen dioxide, satellite measurements, chemical-transport simulation

Conference Theme: Monitoring, detection and spatial environment - Remote sensing of air pollutants

ABSTRACT 101

Spatio-Temporal Variation of Aerosol Optical Depth and Rainfall Over India

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Abstract

The anthropogenic and natural activities increase the high level of aerosols in atmosphere, not only harmful for human beings but also for its impact on weather. The present study is spatio-temporal variation of AOD and rainfall for 18 years period (2000–2017) over Indian region. Study revealed that the spatial variation of AOD during pre-monsoon season is high over eastern, smaller region of west and northern part of India. The central part of India shows moderate AOD, the western India shows a high AOD during pre-monsoon because of an effect of Thar Desert in its northeast region and also transport of dust from Middle East. Time series of AOD during monsoon season over India show that the year 2002 which was a drought year in which the northern belt suffered from low rainfall whereas AOD is much higher in east part and east coast during this period. The spatial variation of rainfall during pre-monsoon is less over southern part and few places of India because of intense heat and aerosol loading transported from western coast of India. During monsoon season the southern part of India receives highest rainfall whereas northern part of India receives less rainfall. The rainfall during post-monsoon is highest over west coast of India due to tropical cyclones in the Bay of Bengal.

ABSTRACT 120
Trends of Climate Variables and Aerosol optical Depth in Thailand

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Abstract

This study analyzed climate variables data in four regions over Thailand. Aerosol optical depth (AOD) obtained from MODIS were also determined the trends in different parts of Thailand. The linear regression, Mann-Kendall trend, and Sen's slope tests were applied. Rain (R) gave higher values in July to October for most regions except in the South. Amount of R increased in all regions. Rainy season is caused by the Southwest monsoon, which is a normal occurrence in Thailand from June to September. However, this monsoon tended to begin earlier and last longer (May to December) than expected. Mean temperature (T_{mean}) values were found to be significantly higher from March to May and increased in all regions. The highest significant increases of annual T_{mean} was found in the South. There was no significant trend in annual R at 1% and 5% significance level in all regions. The AOD values were likely to increase in all regions. The highest significant increase of AOD was found in the Northeast.

Keywords: climate variables, trends of climate variables, climatology, weather, aerosols optical depth

Conference Theme: Meteorology related to air pollution

ABSTRACT 132
Satellite Remote Sensing of Particulate Matter Air Quality: Progress and Potential

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Abstract

Epidemiologic studies worldwide continue to link exposure from ambient fine particulate matter to adverse health outcomes including respiratory and cardiovascular illnesses. Historically, characterizing the spatiotemporal patterns of PM2.5 and studying its health impact have relied on ground measurements. Innovative techniques exploit the synergy between satellite, ground-based, modelling using various statistical approaches to estimate PM2.5 for epidemiological and other studies. In this paper, we review the progress and potential of satellite data, including some of the future missions that will enable further research.

Keywords: Particulate matter, Satellite data, epidemiology, PM2.5

Conference Theme: Meteorology related to air pollution

ABSTRACT 129
On Estimation of Cloudiness Characteristics and Parameters of DOAS Retrieval from Spectral Measurements Using a Neural Network

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Abstract

Cloudiness and aerosol have a significant impact on the ability to retrieve the content of small gases (NO2, H2CO, etc.) in the lower troposphere by the methods of differential spectroscopy (DOAS). Since there is a large amount of optical observations performed by DOAS methods that are not accompanied by direct measurements of their characteristics, solving the problem of determining the cloudiness and aerosol properties from spectral measurements themselves could improve the accuracy of measuring small gases. The paper discusses the problem of determining the characteristics of clouds (lower boundary, optical thickness, etc.) and aerosol (optical thickness, the vertical distribution, etc.) according to the characteristics of measured diffuse solar radiation (O4 optical thickness, color index, absolute intensity, etc.). Besides that approaches to estimation of the air mass factors used for the transfer of the slant column depth to the vertical column of gases are discussed. The neural network is used as a method for solving the emerging nonlinear estimation problems, the accuracy of the estimation is determined on the training sample, and the control sample is used to characterize the agreement of the assessment results (that is, how much you can trust the parameter estimates and its errors). This work was supported by the Russian Science Foundation by grant 16-17-10275 and the Russian Foundation for Basic Research, grants 19-01-00790 and 18-35-00682.

Keywords: DOAS technique, differential spectroscopy, remote sensing of aerosol and cloud characteristics, neural networks

Conference Theme: Monitoring, detection and spatial environment - Remote sensing of air pollutants

ABSTRACT 133

Discrete Ordinate Method for The Estimates of Downward Solar Flux in Penang, Malaysia

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Abstract

Downward shortwave solar energy is a very important parameter for the surface energy balance, which affects human life and other activities of the ecosystem. It is also one of the critical terms in the study of climate change that requires consistent contributions from different researchers. In this paper, we proposed the use of Discrete Ordinate Radiative Transfer method (DISORT) to estimate the downward Total Solar Flux (TSF) in Penang, Malaysia. The measured aerosols optical properties obtained from the ground-based Aerosol Robotic Network (AERONET) data were used as inputs to the DISORT codes. Data of the pyranometer ground-based measurements of TSF were also used for validation of the simulated results from this study. The results for two days, 17 January 2015 and 1 February 2015, have been used to test the performance and accuracy of the method. It is found that there is good agreement between the results from this study and the ground-based measurement results available from AERONET. The validation results show that for the first day (r = 0.9968), (R2 = 0.9936), root-mean-square error (RMSE) of 36.66 and mean absolute percentage error (MAPE) is 16%. For the second day (r = 0.9986), (R2 = 0.9971), (RMSE = 33.06), (MAPE = 12%). The small variation between the two results was due to error that might have arose because of the model imperfection, and from the small inefficiency of the pyranometer and sunphotometer. Nevertheless, this study shows that, the proposed integration of ground-based and model simulation is an excellent and a valid alternative, for the estimates of solar radiation and the study of the impact of aerosols on the TSF everywhere and at all times, particularly when the results from other sources are not available.

Keywords: Broadband solar flux, optical depth, single scattering albedo, asymmetry factor, surface albedo.

Conference Theme: Meteorology related to air pollution

ABSTRACT 139
Comparison of Measured And Simulated NO_2 Integral Content in the Lower Troposphere in Moscow Region

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Abstract

We presented preliminary results of a comparison of the NO2 integral contents (IC) measured by the DOAS technique and simulated by the COSMO-Ru7-ART chemical transport model at Zvenigorod Scientific Station (ZSS) located in 38 km west from Moscow. The comparison covers January and July of 2014 when background and polluted by Moscow air masses were observed at ZSS. The measured NO2 IC in the ABL observed at ZSS does not exceed 0.5×1016 molec×cm-2 in background conditions of the atmosphere when non-east wind direction dominated. It grows up to 5.4×1016 molec×cm-2 when polluted air masses come from Moscow megacity. Simulated NO2 IC has similar behaviour. As a whole, a good agreement between measured and simulated datasets is observed. Some overestimation of the NO2 emission presents for sources located to the south and north-east from ZSS. Underestimation of the NO2 emission presents for sources located inside of Moscow megacity and located to south-west from ZSS.

Keywords: Nitrogen compounds, nitrogen dioxide, DOAS technique, COSMO-Ru7-ART, atmospheric pollutions, megacity ecology

Conference Theme: Meteorology related to air pollution

SESSION E1

ABSTRACT 21

Speciated NMVOCs Emission Inventories from Industrial Sources in China ad Spatial Patterns of Ozone Formation Potential In 2016

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Abstract

This paper compiled a new speciated NMVOCs emission inventory for the industrial sources at county-level by using an approach of combining bottom-up with top-down in 2016, as well as estimated the ozone formation potential (OFP) and investigated its spatial characteristics in China. Results indicated that the total NMVOCs emissions from industrial sources estimated as 21.04 Tg in 2016. The five major source categories including "production of VOCs", "storage and transportation", "industrial processes using VOCs as raw material", "processes using VOCs-containing products", and "industrial fossil fuel combustion processes" generated 1.92 Tg, 0.94 Tg, 6.54 Tg, 10.04 Tg, and 1.60 Tg VOCs, respectively, in 2016. According to our estimates, aromatics were the largest contributor of industrial NMVOCs emissions in 2016, accounting for 36% of total NMVOCs, followed by Alkanes (29%), OVOCs (22%), Alkenes (7%), Halocarbons (4%), and Alkynes (2%). Styrene, m/p-xylene, ethylbenzene, toluene, and ethyl acetate were the top five VOCs species from industrial sources in terms of abundance in 2016. Aromatics have a high potential for ozone formation, and accounted for 70% of total OFP, followed by Alkenes (14%), Alkanes (10%), and OVOCs (6%). Styrene, p-xylene, toluene, ethylbenzene, 1,3-butadiene were the five species that had the largest potential to form ozone, and plastic industry, coke industry, household appliances industry, and architectural decoration were the key contributing sectors. The emissions displayed distinct spatial characteristics, with significantly higher emissions and OFPs in Beijing-Tianjin-Hebei region, Pearl River Delta, Yangtze River Delta, and Cheng-Yu region than in other areas.

Keywords: Industrial NMVOCs; Emission Inventory; Species and OFP; Spatiotemporal variation

Conference Theme: Modelling and technologies

ABSTRACT 61
2017 Hong Kong Emission Inventory

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Abstract

The Environmental Protection Department (EPD) compiles a local emission inventory every year following the international guidelines and handbooks with a view to analyzing the quantity of local air pollutant emissions from major emission sources and supporting the formulation of effective air quality management strategies in Hong Kong. It estimates six key air pollutants, namely sulphur dioxide (SO2), nitrogen oxides (NOx), respirable suspended particulates (RSP or PM10), fine suspended particulates (FSP or PM2.5), volatile organic compounds (VOC) and carbon monoxide (CO), from different sources.

The major emission sources in Hong Kong include power plants, vessels, motor vehicles, civil aviation, other combustion sources and non-combustion sources. In the other combustion sector, non-road mobile machineries operating in construction sites and container terminals are major emitters. Non-combustion sources are defined as those remaining sources that do not involve combustion, from which only VOC, RSP and FSP emissions are significant. In this category, the major emission sources for VOC include paints and associated solvents, consumer products and printing, whereas those for RSP and FSP include paved road dust and cooking fumes.

The analyses cover the emission inventory by source category in 2017, emission trends from 2001 to 2017 for the six major air pollutants and sectoral analysis for each emission source category.

Keywords: Emission Inventory, Air Quality, Air Pollutants

Conference Theme: Modelling and technologies

ABSTRACT 79

Emission Inventory Of Pollutant CO, SO_2, PM2,5, NO_x and BC In Jakarta City Using Gain Model

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Abstract

Emission inventory of pollutants (CO, SO_2, PM2,5, NOx as well as BC) from various sectors included power plants, road transportation, Industry, and residential and commercial was conducted in Jakarta for the year 2005-2015. Emissions load of these pollutants were calculated using Gains (Greenhouse gas model - Air pollution Interactions and Synergies) model, based on fuel consumption or top down approach. Control technology was also applied for pollutants emitted from power plant, industry as well as residential and commercial, while control of EURO And EURO III were considered for transportation sector. Emission inventory result shows that in 2015, the total emission load for NO_x, CO, and BC were estimated around 52.9 kton, 143.9 kton, and 1.2 kton, respectively. The biggest contributor to these pollutants were from road transportation sector which contributed of 57%, 93% and 75%, for NO_x, CO and BC respectively. From transportation sector, the heavy duty vehicles is the biggest contributor of NO_x and BC emission, while for CO is mostly emitted from motorcycles. While total emission load for PM2.5 in Jakarta is about 4.6 kton, and it is mostly emitted from road transportation and Industrial combustion sectors which are 2.1 kton (46%) and 0.4 kton (43%), respectively), where the heavy duty vehicles was still the highest contributor of PM2.5 emission in the transport sector. The total SO2 emission load is 19.7 kton, and it is mostly released from industrial combustion that contribute almost 67% of total emission.

Keywords: Emission inventory, CO, SO2, PM2,5, NOx , BC, power plant, GAINS

Conference Theme: Modelling and Technologies (Emission Inventories)

ABSTRACT 110

Distinguish Potential Source Areas of PM2.5 and PM10 by Statistical Data Analysis

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Abstract

Power plant from biomass in community area has been complained as emission source of many pollutants such as wastewater, noise, odor and polluted air. For air pollution, total suspended particulate (TSP) and PM10 from rice husk energy process is quite large. Roied is a province located in Northeast of Thailand which obtains 4 power plants using rice husk as fuel in the process. Due to the pattern of community area of Roied, it revealed that there are many sources of air pollution. This study selected the statistical techniques to distinguish the potential source area influencing the high PM2.5, PMcoarse, PM10 which caused the health effects of people around the rice husk power plants. Hourly PM10 and PM2.5 data during monitoring were analysed by time series, bivariate polar plot, and Conditional Bivarate Probability Function (CBPF). Results showed that increasing the concentration of PM10 and PM2.5 were observed in the duration of low wind speed. However, daily average of PM10 was not more than National Ambient Air Quality Standard (NAAQS) which is 120 g/m^3. In contrast, results showed that daily average of PM2.5 performed over NAAQS of 50 g/m^3 in the 20th -22nd December 2018 that high pressure cover Thailand. While sources of these particulate matters could be distinguished into 3 directions based on mobile air quality monitoring station point which were 1) East and 2) Northwest which regarded as community and traffic areas and 3) Northeast which regarded as power plants area. Results revealed that PM10 was the major pollutants dispersed from Northeast direction that power plant was the major source whereas traffic and community were the main point source of PM2.5 from East and Northwest direction of mobile air quality monitoring station point. Therefore, discrimination of each point source could be done firstly before implementing to control and manage the air pollution effectively.

Keywords: PM10, PM2.5, Bivariate polar plot, CBPF, rice husk power plant

Conference Theme: Modelling and technologies

ABSTRACT 113

Application of a Next Generation Biogenic Emission Model (MEGAN3) in the Yangtze River Delta Region – Model Parameterizations, Drought Response and the Impact on the Formation Potential of Ozone and Secondary Organic Aerosols

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Abstract

Biogenic emissions play an important role in atmospheric chemistry due to their large quantities and high reactivity. This study applied the latest version of the Model of Emissions of Gases and Aerosol from Nature (MEGAN3) to simulate biogenic emissions over the Yangtze River Delta region, which suffered from serious ozone and haze problems due to rapid urbanization and industrialization. Four simulation scenarios were conducted to investigate the influences of two newly incorporated features in MEGAN3 (i.e. the choice of emission factor quality, drought response and parameterization) on predicted biogenic emissions. Results show that annual average biogenic emissions are estimated to be 5.1×10^5 tons in the base case scenario, of which isoprene, monoterpene, sesquiterpenes are the main components. Choosing emission factor data of either high quality (J=4) or low quality (J=0) only leads to 4% differences in estimated biogenic emissions. On the contrary, turning on the drought response algorithm as well as using different values of wilting point for drought response parameterization exhibit significant impacts on modeled emissions. Compared with default drought stress parameterization, turning off the drought response algorithm results in 131% higher biogenic emissions and using an alternative set of wiling point values leads to 51% higher. Consequently, estimated formation potential of ozone and secondary organic aerosols showed large differences due to different drought response parameterization. Our results suggest large uncertainties of estimated biogenic emissions associated with the drought response parameterization and further studies are needed to retrieve localized parameters in order to better simulate drought response of biogenic emissions.

Keywords BVOCs, MEGAN3, drought response, Ozone, SOA

ABSTRACT 1

Effects of Ocean-Atmospheric Dynamics on Temperature and Precipitation Anomalies Over Southeast Asia During Biomass Burning of 2015

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Abstract

The Maritime Continent (MC) is positioned between the Asian and Australian summer monsoons zone. The complex topography and shallow seas around it are major challenges for the climate researchers to model and understand it. It is also the center of the tropical warm pool of Southeast Asia (SEA) and therefore the MC gets extra attention of the researchers. The monsoon in this area is affected by inter-scale ocean-atmospheric interactions such as the El-Niño Southern Oscillation (ENSO), the Indian Ocean Dipole (IOD), and the Madden-Julian Oscillation (MJO). Monsoon rainfall in the MC (especially in Indonesia and Malaysia) profoundly exhibits its variability dependence on ocean-atmospheric phenomena in this region. This monsoon shift often introduces to dreadful events like biomass burning (BB) in Southeast Asia (SEA) in which some led to severe trans-boundary haze pollution events in the past. In this study, the BB episode of 2015 in the MC is highlighted and discussed. Observational satellite datasets are tested by performing simulations with the numerical weather prediction (NWP) model WRF-ARW (Weather Research and Forecast - Advanced research WRF). Observed and model datasets are compared to study the surface air temperature and precipitation (rainfall) anomalies influenced by ENSO, IOD, and MJO. Links amongst these influences have been recognized and the delayed precipitation of the regular monsoon in the MC due to their influence during the 2015 BB episode is explained and accounted for, which eventually led to the intensification of fire and a severe haze.

Keywords: monsoon, maritime continent, ocean-atmospheric phenomena, Southeast Asia, biomass burning, sea surface temperature, humidity, rainfall.

Conference theme: Modelling and technologies

ABSTRACT 9

The Impact of Ammonia Emissions on Secondary Aerosol Over the Yangtze River Delta Region

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Abstract

The ammonia emissions have significant impact on the prediction of secondary ammonia. However, the emissions estimation has high uncertainty. In this paper, we evaluated the influence of ammonia emissions amount, the temporal profile and spatial allocation on the model prediction of secondary ammonia over spring, summer, autumn, and winter seasons in the Yangtze River Delta region. Several scenarios regarding ammonia emissions adjustment have been used as input to WRF-CMAQ modeling system to predict the influence.

Keywords: Ammonia, WRF-CMAQ, YRD

Conference Theme: Modelling and technologies-Measurement and modelling of ozone, PM2.5, greenhouse gases and other air pollutants

ABSTRACT 8

An Automatic City Mesh Generator for Turbulent Urban Flow Simulation

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Abstract

The understanding and prediction of flow patterns and pollution transport is crucial to find solutions to poor air quality in cities. Computational Fluid Dynamics (CFD) is usually used to asses them. Performing CFD simulations starts with the generation of the geometry and the mesh of the area of interest. When considering small scales (road intersection) general purpose meshing tools can be employed. For larger scales, the process of meshing accurately urban geometries is a challenging task. For CFD, the geometry and subsequently the mesh need to be watertight constituted by well-shaped elements without any gaps and overlaps, while keeping a correct representation of the buildings and the terrain. An in-house city mesh generator Urban-Terreno (UT) coupled with Fluidity, an open-source CFD software, is presented as a novel automatic tool to answer this need. Using geographical information systems (GIS) data, UT generates automatically and in parallel a 3D watertight unstructured mesh of any complex urban environment. The level of accuracy, in terms of building features, can be specified by the user such that the outlines of the buildings is simplified to avoid the generation of too small elements. The topography of the terrain can also be taken into account. Fluidity is then used to perform CFD simulations using a Large Eddy Simulation approach ensuring a high spatial and temporal resolution. The novelty of Fluidity resides in its mesh adaptivity capability. The mesh is refined automatically, during the simulation, in regions where important physical processes are happening, while keeping coarser mesh elsewhere, allowing to speed-up simulations. The coupling between UT and Fluidity is presented based on a real urban environment located in Elephant and Castle, London, UK.

Keywords: Mesh generation, Adaptive mesh, CFD, Urban Flow, Urban Environment, Pollution transport.

Conference Theme: Modelling and technologies.

ABSTRACT 10

Asymptotic Approximations of Stratified Shear Flows with Horizontal Eddy Coefficient of Turbulent Viscosity

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Abstract

We consider linearized equations of perturbed mean flow under the Boussinesq approximation with the presence of eddy coefficients of turbulent viscosity but with the absence of turbulent diffusivity. By including both the horizontal and vertical eddy viscosity, an equation for the vertical velocity perturbation leads to a fourth-order Taylor-Goldstein equation. In the absence of vertical eddy viscosity, a modified Taylor-Goldstein equation is obtained, an extended version of the inviscid case but at the same order. Under an assumption of slowly varying background horizontal velocity and Brunt-Väisälä frequency, we present asymptotic solutions using the WKB method for the latter, where both geometrical and physical optics approximations can be obtained. Furthermore, using the method of Frobenius and again by means of asymptotic approximations, we also investigate the behavior of a gravity wave near a critical level, a height where the background velocity is equal to the horizontal phase speed. The vertical velocity perturbation, which now consists of upward-moving and downward-moving waves, takes a different form depending whether it locates above or below the critical level, as well as whether the wind shear near the critical level takes a positive or negative value.

Keywords:

stratified flow, velocity perturbation, eddy viscosity, Taylor-Goldstein equation, WKB approximation, critical level, Frobenius method

ABSTRACT 20

Influence of Dry Deposition Velocity To The Ground in the Dispersion Of the Air Pollutants

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Abstract

The uptake of the pollutants at the Earth's surface, either by soil, water, or vegetation, reduces airborne concentration levels at locations far downwind, while potentially increasing exposure levels at nearby locations due to the deposited material. The gases and particles transfer to the surface occurs through two pathways: wet and dry deposition. Heavy particles fall to the surface by gravity effect also.

Wet deposition involves precipitation. Dry deposition refers to the transfer of air pollution (gas and particles) to the ground, where it is removed. Dry deposition occurs as trace gases and particles are adsorbed or react on objects (plants, soil, water, buildings, etc.) at the Earth's surface. The various transfer mechanisms leading to dry deposition are complex and involve micrometeorological characteristics of the atmospheric surface layer including the atmospheric turbulence intensity, the nature of the gas and particles and of the surface itself.

In this work, in order to study influence of the dry deposition on air pollution concentrations by analytical formulae, we solve the two-dimensional, steady-state advection-diffusion-deposition equation by the ADMM (Advection-Diffusion Multi-layer Method) method. The model is based on a discretization of the ABL in N sub-layers, where in each sub-layers the advection-diffusion equation is solved by the Laplace transform technique, considering an average value for eddy diffusivity and the wind speed.

Simulations of the dispersion of pollutants in different turbulent scenarios are performed, and the effect of dry deposition on pollution concentrations is analyzed.

Keywords: Advection-Diffusion Equation, Air Pollution Dispersion, Dry Deposition.

Conference Theme: Measurement and modelling of ozone, PM2.5, greenhouse gases and other air pollutants

ABSTRACT 136

Air Dispersion Modelling: A Study on Estimation of Dispersion Coefficients of PUFF

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Abstract

Pollutants emitted into the atmosphere get mixed with the surrounding air and diluted by atmospheric dispersion. To estimate the source strength and its concentrations at different places down-stream, different modeling techniques are available. Air quality modeling plays an important role in the design of an environmental program. Modeling is needed to predict the pollution levels and to plan to protect the environment from their harmful effects. Air pollution modeling mainly depends on Gaussian Plume Model, which has several limitations.

Most diffusion models use the Gaussian plume model, which is a material balance model. Gaussian plume model determines the concentrations of the pollutant released into the atmosphere from a plume (continuous release).

The main objective of the present work is to develop a dispersion coefficients for a puff (instantaneous release) which differs from plume by being intermittent and instantaneous where as a plume is a continuous release and to establish dispersion coefficients for different stability conditions i.e from A to F for a puff.

Conference Theme: Measurement and modelling of ozone, PM2.5, greenhouse gases and other air pollutants

ABSTRACT 31

Contributions of Local and Long-range Transported Emissions to PM2.5 in Taiwan under Different Weather Patterns using CMAQ-ISAM

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Abstract

In Taiwan, the local emissions, such as industrial emissions, vehicle exhausts and burnings of agriculture wastes, often cause the high pollution events, especially in autumn and winter. Besides, the Asia continental anticyclone with northeasterly monsoonal flow can transport pollutants from China and affect Taiwan's air quality. Integrated Source Apportionment Method (ISAM) is a tool that can calculate the contributions of precursors from specific regions and emission sources. This study utilized CMAQ-ISAM to investigate the impact of local and long-range transported (LRT) emissions on PM2.5 concentration in Taiwan under different weather conditions. The study episode is from March 26 to April 2, 2017 and divided into three periods according to the different synoptic weather patterns. During the study episode, there were two LRT air pollution events occurred in Taiwan, the second event was more serious than the first event.

In the first period (3/26-3/27), the prevailing wind in Taiwan was dominated by the northeasterly monsoonal flow, 50-60% of the PM2.5 in northern and central part of western Taiwan are contributed from the LRT emissions. With the eastward moving of the Asia continental anticyclone, the prevailing changed to the easterly direction during 3/28-3/31, and the western Taiwan is located in lee-side of the mountain. The contributions of LRT emissions gradually decreased while the local emissions contribute to about 70-90% PM2.5 concentration. For the last period (4/1-4/2), higher than 70% of the PM2.5 in western Taiwan are contributed from the LRT emissions. Due to the stagnant wind condition occurring in northern China plain on 3/31, air pollutants were likely to be accumulated near the emission source region and the accumulation was more serious compared to the 3/25. With the stronger northeasterly monsoonal flow, the air pollutants were transported to Taiwan and leaded to the severe LRT event in Taiwan.

Conference Theme: Measurement and modelling of ozone, PM2.5, greenhouse gases and other air pollutants

SESSION E2

ABSTRACT 11

Cuban's Energy Strategy Into 2030: General Design Features Toward a Sustainable Transition

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Abstract

In this study different scenarios are explored for a reliable energy transition in Cuba. The energy fluxes between final energy demand and resources are computed for the year 2015. Then, the energy demand is projected to 2030 and a set of scenarios based on different mix of energy resources and technologies are designed to fulfil this demand. These scenarios are compared according to three criteria that seems the most relevant for Cuba given its geopolitical and economic situation: energy security, energy sustainability and air quality impacts. The results show that when wind and solar energy fulfil 20% of the electricity demand, the fossil fuel requirements are significantly reduced. Once this penetration reaches 50%, Cuba can achieve complete independence from energy imports. The scenario fulfilling 100% of electricity demand from wind and solar resources shows the maximum sustainability. The comparison of different scenarios also show that the use of renewable resources lead to an air quality improvement.

Keywords: Energy strategy, air quality strategy, Cuba

Conference Theme: Control and remediation - Improvement of air quality in developing countries.

ABSTRACT 37

Technological Challenges and Possibilities on The Production of Bio-Oil, Char and Syngas From Biomass Resources

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Abstract

Biomass, the gold of the twenty-first century amidst the energy scenario in the global community as a carbon-neutral fuel. Climate change is gradually becoming a history by the introduction of renewable energy into the stream of a world energy project. This study focuses on the inefficiencies and prospects of the thermochemical processes such as Bubbling fluidized bed, circulating fluidized bed, conical spouted bed, recovery cone, ablative and auger reactors. The challenges are complexities of the technology and some important parameters for the effective and efficient process operations such as particle size of feed, feed rate (kg/hr), heating system, temperature, condenser, inert gas. Results for more efficient and effective process operations deduced are particle size ≤ 3 mm, feed rate ≤ 25 kg/hr depending on its capacity, multiple adjustable electric heaters, commonly with an operating temperature of ≤ 600 ℃, Nitrogen gas (N2) purge flow rate ≤ 35 mL/min depending on the feed rate. The summary of the bio-oil yield for BFB, CFB, CSB, RC, AR and A-R are at an average of 51-60 wt.%, 60-67 wt.%, 65 – 77 wt.%, 54 – 70 wt.%, 48-68.3 wt.%, 52 – 81 wt.% respectively. The first two technologies are often used, while the last four shows the highest oil yield. The gas yield observed in the bubbling fluidized bed, and rotary cone reactors were at an average of 60%, the process could be further optimization. The most promising technology among the six (6) is the Ablative technology with the data collection indicate about 90% prospect. Therefore, a techno-economic analysis of the recent advances in thermochemical technologies be employed for equipment selection, higher efficiency determination, reduce plant complexity; determination of optimum yield, reduced operating and maintenance cost etc.

Keywords: Ablative, auger, biomass, bubbling fluidized bed, bio-char, circulating fluidized bed, rotary cone, spouted conical & syngas.

Conference Theme: [Climatology, impact and policies]

ABSTRACT 75

Climate Change Adaptability Evaluation Based on Coupling Model of Regional Climate and Urban Development – An Example from Sichuan (China)

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Abstract

Economic, social and natural environments are inseparable, so climate change will directly or indirectly affect economic, social, environmental and many other aspects. Through comprehensive zoning and climate change adaptation assessment, we can more clearly grasp the spatial pattern of climate change and internal laws, and carry out differentiation and more effective management to promote sustainable urban development. By analyzing the daily temperature and precipitation data of Sichuan Province from 1980 to 2017, this paper comprehensively zoning the climate change in Sichuan Province and found that the region with the highest comprehensive climate change rate in Sichuan Province involves Guangyuan City, Suining City, Nanchong City, Guang'an City, Bazhong City and Dazhou City. Using the coupled model of urbanized integrated ecological environment, the most intuitive temperature changes are selected to characterize regional climate change. At the same time, economic system, agricultural system, social system and resource environment system are used as subsystems of urban development, and a coupling model of regional climate and urban development is constructed to evaluate the climate change adaptability of the above six cities from 2000 to 2018. The research shows that in the context of climate change, the agricultural system, social system, resource and environmental system of Guangyuan City, Dazhou City and Nanchong City all show incompatibility. The economic system of Guangyuan City and Dazhou City showed a decline, while the economic system of Nanchong City was less affected by climate change. For the four systems, Guang'an City and Suining City have shown stable adaptability, except that Guang'an City is not adaptable to the resource and environment system. Bazhong City is adaptive and unstable to the agricultural system and shows stable incompatibility to the other three systems.

Keyword: comprehensive zoning; regional climate change; urban development; fitness; coupling

Conference Theme: Climatology, impacts and policies

ABSTRACT 116
An Ozone-Climate Penalty in Greater Kuala Lumpur?

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Abstract

Ozone (O3) is an important ground-level pollutant that is commonly correlated with temperature (T). High T is linked to various processes – meteorological, biophysical and chemical – that can increase O3. The idea that increased T owing to anthropogenic climate change can increase O3 pollution is often referred to as an "ozone-climate penalty". Research on such a penalty has been largely confined to North America and Europe but its importance may be greater for tropical regions, where rapid population growth and urbanization, along with year-round meteorological conditions promoting high O3 levels, can increase exposure. Here we analyze a long-term (10 year; 2007-2016) record of O3 and T observations from a large tropical city – Greater Kuala Lumpur (GKL) – to explore the importance of T, and increases in T, for O3. A major finding is that while average O3 levels in GKL have changed little over the 10-year period of analysis, O3 in fixed temperature bins has tended to decrease, offering a clear indication that increases in T are indeed exerting an upward pressure on O3. We also show that in GKL a strong O3-T relationship is not confined to a summer "ozone season", as in temperate regions, but exists year-round. Finally, we assess the co-occurrence of high O3 and T within episodes lasting days and focus on an extreme episode in March-May 2016. This latter episode of elevated combined health threats from heat and air pollution in GKL underscores the need to improve understanding of the O3-T relationship in tropical cities.

Keywords: Ozone, air pollution, temperature, climate change, Greater Kuala Lumpur

Conference Theme: Climatology, impacts and policies

ABSTRACT 115

Public Perceptions of Air Pollution and its Health Impacts in Greater Kuala Lumpur, Malaysia

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Abstract

Air pollution causes wide-ranging health problems but its risks may be overlooked by many people. Malaysia is not excluded from this, with the country facing both local and transboundary air pollution. Efforts to reduce health impacts would benefit from improved understanding of peoples' knowledge, perceptions and behavioral responses related to air pollution. Our study thus aims to investigate these topics in Greater Kuala Lumpur (KL), the urban area with highest pollution levels in Malaysia. We used an online survey created using Qualtrics to obtain data from 165 residents of Greater KL on perceptions of air pollution, perceptions of health risks and actions taken in response to air pollution. Publicly available information on air quality (expressed as the Air Pollution Index, or API) was also obtained from the Malaysian Department of Environment's website for comparison with the survey responses. Our results are in three main areas: (1) how people perceive air pollution at their home and at their place of work or study, and how that relates to the API (2) the public's knowledge of the health impacts of air pollution and their perception of its risk to health and (3) the extent of their self-protective and coping actions. We also explore relationships between these areas.

Keywords: air pollution; public perception; health risk

Conference Theme: Climatology, impacts and policies

ABSTRACT 15

The Characteristics of High-Resolution Satellite Retrievals Of Cloud Condensation Nuclei And Its Relation With Pm2.5 In Eastern China

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Abstract

Due to frequent human activities, the eastern China has important influences on air quality and environment, climate change and disastrous weather. According to the retrieval methodologies of cloud microphysical properties by high-resolution VIIRS (Visible Infrared Imaging Radiometer Suite) on board the Suomi NPP (National Polar-orbiting Partnership) satellite, the spatial and temporal distributions of convective clouds' cloud condensation nuclei (CCN) in eastern China during the summer from 2013 to 2018 has been obtained. The distribution of CCN in convective clouds is mainly influenced by aerosols and meteorological factors. Convective cloud CCN shows obvious weekly variation by human activities, and there are obvious differences in different regions. By fitting the relationship between aerosol and CCN, the influence of aerosol on precipitation is quantitatively evaluated, which provides scientific basis for fine weather prediction.

Keywords: Eastern China, Cloud Condensation Nuclei, Aerosols, VIIRS, Convective Cloud

Conference Theme: Climatology, impacts and policies

ABSTRACT 29

Wind Turbine Technology: A Strategy to Mitigate Air Pollution through Utilising Wind Energy

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Abstract

The drive to increase the implementation of alternative sustainable sources is a continuous challenge. The rising awareness of environmental impacts has lead the public to demand the development of eco-friendly and dependable long-term solutions. Wind energy is acknowledged as among the best renewable energy sources with proven capabilities. The key contributing factor in defining the harnessing effectiveness is the wind availability and efficiency of the wind turbines at the specific wind conditions. But due to the non-uniform wind distribution and the limitations of the existing wind turbines at low wind speeds, countries with lower wind speed are still far away from exploiting wind energy.

According to the World Energy Commission, the use of one million kWh of wind power can save 600 tonnes of CO2 emission. An examination into current energy data for Malaysia indicates that only 0.23% of the wind and solar power combined is employed for electricity production as of 2017. This is due to very low wind speed in this region throughout the year. It is also a leading factor to air-pollutants being suspended in the atmosphere for a longer period. It will impact an imbalance in the environmental conditions, such as acid rain, global warming, rise in sea-level and fluctuating sea levels.

This paper reports our investigation into the potential impact of utilizing the advantages of wind energy technology in low speed wind regions as an air-pollutant free energy source, to contribute to the overall reduction of the Air Pollutant Index (API) in localised, impacted areas of Malaysia. This research conducted presents the strategy to utilise low speed wind turbines to decrease air pollution while the system is either On-grid or Off-grid.

Keywords: Malaysia, Air pollution, Wind Energy, Environment

Conference Theme: Adaptation technology to global and local climate change

ABSTRACT 54

Manifestation of the Urban Physical Structures Factors in Wind Loading Fluctuation

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Abstract

Windstorm events have caused deaths and urban structure damages. Due to this, thousands of Ringgits are accustomed annually to refurbish the damages as well as compensation for the victims. Urban morphology characteristics influence wind loading magnitude which leads to the occurrence of windstorm. The wind load is not only vary with the height of structure, but also depend on topographic and terrain characteristic. This study aims to investigate the impacts of the urban physical structure towards wind loading magnitude in the urban area of the Shah Alam City. Using the Weather Research and Forecasting (WRF) simulation model, the wind speed and direction within two monsoon phases (December – March and June – September) were retrieved. These periods were chosen because the high number of windstorm events occurred. The urban morphology data, such as, urban zoning area, building orientation, building high and density from Majlis Bandaraya Shah Alam (MBSA), were used to represent the impact of wind speed and direction to the formation of wind load. Power Law by Crawley was used to analyze the wind load occurrence to the physical structure that causing damage and loss. From the study, there were differences in the readings of wind load within urban areas with the physical structure heights of less than 10 metres as compared to the areas with physical structure heights that exceed 10 metres. Based on the results, the height of the buildings which exceed 10 meters will cause high wind load that resulted as windstorm events in the commercial area of Seksyen 2, Seksyen 7, Seksyen 14 and Seksyen 9 in the Shah Alam City. As compared to the buildings with the heights below 10 meters, wind load incidence is lower that caused less windstorm events such as in residential areas in Seksyen 18, Seksyen 19 and Seksyen 20, Shah Alam. It shows that, precautions regarding the building heights should be considered by related stakeholders. The existing guidelines of the urban development should be looked back since the windstorm formation is directly influenced by the urban physical structure characteristics, so that, the factors of the damages can be apprehended.

Keywords: Wind Load, Windstorm, Urban Morphology, WRF-ARW, GIS

Conference Theme: Assessment for Atmospheric Environmental Impact

ABSTRACT 66

Observation in A Numerical Sandbox of Neutral Atmospheric Boundary Layer

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Abstract

A wind tunnel experiment has been widely used to study atmospheric dispersion phenomena and to evaluate environmental impact to atmosphere caused by thermal and nuclear power plants. The wind tunnel experiment and numerical model which mimics wind tunnel experiment using computational fluid dynamics have been established as a standard method to evaluate atmospheric dispersion in neutral condition of atmospheric stability. Nevertheless, a wind tunnel experiment in stable and unstable condition of atmospheric stability is very difficult due to requirement of extremely low wind velocity from a similarity law for Reynolds number and Archimedes number (often called as Froude number). Furthermore, lack of basic information about non-neutral boundary layer flow such as typical vertical distribution of mean wind, turbulent intensity and dispersion width of plume in long time period makes more difficult to adjust a flow and dispersion characteristics in the wind tunnel. Arduous observations in real atmosphere is the simplest way to resolve the problem, however, flow condition and atmospheric stability is not controllable in the real atmosphere. For this reason, we developed a numerical sandbox which has equivalent mechanical system in the real atmosphere. Flow in atmospheric boundary layer is result of equilibrium of fundamental three forces which are pressure gradient, ground surface friction and Coriolis force. The numerical sandbox is the computational fluid dynamics code with these fundamental three forces. As a first step of the study, we observed a flow and dispersion characteristics in neutral atmospheric boundary layer.

Keywords: Numerical sandbox, Large eddy simulation, Atmospheric boundary layer, Ekman spiral, Turbulent dispersion

Conference Theme: Climatology, impacts and policies. Meteorology related to air pollution

ABSTRACT 84

Effects Of Atmospheric Stability Conditions on Pollutants Dispersion Near Roads

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Abstract

Predicting the pollutant concentration near roads requires an accurate representation of the atmospheric boundary layer. Traditional models are capable to accurately predict the pollutant concentration only under neutral atmospheric conditions. It is of interest to study the complex interactions between solar radiation, earth surface, local air flows, meteorology conditions, emission sources and how they affect the human health. When setting the appropriate boundary conditions, CFD allows solving the equations that govern the dispersion phenomena as well as heat and mass transfer at the microscale level.

This manuscript studies the effect of atmospheric stability conditions in the dispersion of atmospheric pollutants near roads. For the first time is presented a sensitivity analysis of our CFD model under different atmospheric stability conditions. Seasonal effects and sedimentation phenomena are also included in our model.

Using a dimensional analysis, we define the pollutant concentration considering different atmospheric stability conditions. Then we compare our CFD results with a validated neutral condition model, where significant differences were observed, most of them near to the emission source. Those differences show the relevance of including the heat transfer effect into the numerical simulation models in order to accurately quantify the exposure level of the population living near the roads, identifying prevention measures and representing the atmospheric boundary layer accurately.

The proposed model is limited to the available turbulence modules in the commercial Fluent CFD software, nevertheless, its accuracy to neutral atmospheric condition validated model (R^2>0.93). This study demonstrates the relevance of CFD to model the heat transfer effect in atmospheric pollutants. It is required to improve the available radiation modules and their extension to include chemical reactions.

Keywords: TSP dispersion, Atmospheric Stability Conditions, Air quality modeling, Computational Fluid Dynamics.

Conference Theme: Meteorology related to air pollution

ABSTRACT 96

Estimation of Seasonal Variation In PM2.5, Total Carbon & Organic Carbon Content Emanating from Biomass Burning

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Abstract

Generally, the large spatial and temporal variations in India are contributed from widely used biomass burning in majority parts of India. Here emissions from Biomass Burning have been estimated to understand their effects on the climate and atmosphere on a global scale.

The highest and lowest monthly fire counts values were found during the months of March-May and July-September respectively over three densely populous regions of India. Almost 60% of India's mean weighted population PM2.5 concentration are emanating from anthropogenic sources, while the remaining is contributed by 'other' sources, extra-regional sources and wind blown dust. Leading contributors being industrial coal burning, residential biomass combustion and open burning of agricultural residue, are proving to be noxious for Human health, thereby increasing the respiratory and pulmonary diseases by 47% in the rural parts of India. Therefore, effective mitigation of future noxious emissions in India require adoption of aggressive prospective regulation. However at present, despite of most active reduction of emissions envisioned; the year 2020 mean exposure (excluding the wind blown mineral dust impacts) is estimated to be nearly 4 times higher than the World Health Organisation Air Quality guidelines.

In this study we examine the influence of trace metals, organic & inorganic components along with the total organic carbon content present in the Biomass burning emissions from year 2015-2018. Biomass burning emits particulate matter (PM) and gaseous pollutants in the atmosphere among which carbonaceous species (Black Carbon-BC, Brown Carbon-BrC & Organic Carbon-OC) are of uttermost importance. Atmospheric Brown Carbon could contribute nearly 19% of the total absorption by Anthropogenic aerosols whereas it has been studied that nearly 73% is attributed to that from Black Carbon. Various different biomass species e.g. Mangotree-Mangifera Indica, Jackfruit tree , cow dung and dry leaves of Mahogany tree samples were collected from the three sampling sites, where these biomass species were burnt in the cooking stove. Upon individual burning of biomass species(50gm) , particulate matter was deposited in the 32mm quartz filter and then the mass was calculated from the difference between the Particulate Matter loaded and unloaded filters. The volume of air was recorded from the difference between initial and final gas meter reading. TOC analyser was used to determine the Total organic Carbon content, whilst Rigaku-X-ray Fluorescence Spectrometer gave percentage elemental contribution (Weight percent). The total organic carbon concentration was found to be 2.86ppm on average. For Trace Metals , the elevated level concentration of the trace metals were observed in the sequence: Fe>Al>Mg>Ca>Cr>K>Cl>Cu whereas Co, Mn and P were below the detection limit. However, emission of trace metals in biomass also followed the sequence. Dry leaf of Mahogany tree> Cowdung>Mahogany Tree>Mango Tree>Jackfruit Tree.

Keywords: PM2.5, XRF,BrC,BC,Trace Metals

Conference Theme: Climatology, impacts and policies

ABSTRACT 112

Size-Segregated Chemical Characteristics of Atmospheric Suspended Particles in Hanoi, Vietnam

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Abstract

In order to clarify the size-segregated chemical characteristics, atmospheric particulate matter (PM) was collected using Nanosampler which can classify PM into five stages and collect ultrafine particles (PM0.1) under atmospheric pressure, from October 17, 2017 to October 26, 2017 at urban, suburban and rural sites located in northern Vietnam.

Chemical components of EC, OC, WSOC and ions were measured at each particle size. The ion balance ($(Cl^- + SO4^{2-} + NO3^-) / (Na^+ + NH4^+ + K^+ + Mg^{2+} + Ca^{2+})$) were different in each particle size, and the ratios in coarse particles and ultrafine particles were less than 1 at the three sites, meaning that the presence of undetected $CO3^{2-}$ and $HCO3^-$ ions in mineral dust and the presence of water-soluble organic anions, respectively. On the other hand, the ratio of two ranges of fine particles (0.5-1.0, 1.0-2.5 µm) were nearly 1 during most sampling periods at the three sites. From this result, it became clear that atmosphere fine particles in Hanoi were almost neutralized. However, the ratio of ions on October 25 and 26, when PM concentration was very high, was higher than 1 at urban and suburban sites by increasing secondary ionic species ($NH4^+$, $SO4^{2-}$, $NO3^-$), especially $NO3^-$. It increased 11% and 10% in urban and suburban sites, respectively. It was suggested that in high concentration pollution, a large amount of NOx from vehicles would be present in urban site, and the formation of $NO3^-$ from NOx would be promoted by photochemical and other process, and the neutralization of $NH4^+$ would not be in time. Furthermore, positive correlation between other components (OC, EC and WSOC) and ionic species in the fine particles at the three sites were confirmed in fine particles rather than PM0.1. From this result, it was suggested that fine particles present in Hanoi grew to form stable particles by mixing with various components under high concentration of polluted air, and the observation of PM0.1 was very useful for source evaluation

Keywords: Atmospheric PM, Hanoi, Size-segregated chemical characteristics, Ion balance

Conference Theme: Urban air quality and environment

SESSION F1

ABSTRACT 41

Time Series Modeling Of PM2.5 Concentrations with Residual Variance Constraint in Eastern Mainland China During 2013-2017

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Abstract

Satellite-based mapping has been proven to be an effective method to disclose the spatiotemporal variations of PM2.5 distributions. However, most of satellite AOD (i.e. aerosol optical depth) related statistical models are suffering with the unstable accuracy over long time span. This study thus aims to propose an accurate and stable method for PM2.5 concentration estimations in time series. Specifically, a three-step residual variance constraint method (RVCM) is developed to simulate PM2.5 concentrations from January 2013 to December 2017 with aid of AODs and other auxiliary data. Results show that, the five-year fitting R2 and cross-validation R2 of RVCMs improved from 0.77 to 0.88 and 0.71 to 0.84, compared to those models without residual variance constraint (WO-RVCM). Meanwhile, RVCMs demonstrated more stable performance on time series simulation of PM2.5 concentrations than WO-RVCM, with the yearly fitting R2 of 0.89, 0.88, 0.85, 0.87 and 0.88, and corresponding cross validation R2 of 0.85, 0.84, 0.80, 0.82 and 0.83, respectively. Moreover, accuracy verification of removed outliers in residual variance constraint modeling also further confirmed the credibility of RVCMs in outliers' simulation compared to WO-RVCM models. Additionally, RVCM aided estimations of time series PM2.5 concentrations and associated premature deaths in east of Hu-Line in mainland China revealed their gradually annual decrease at 35.21% and 21.57%, along with the excellent air quality days increased from 7% to 35%. These findings suggest that residual variance constraint is effective and could be a reliable solution to the time series AOD-PM2.5 modeling with stable accuracy over long time span.

Keywords:

Satellite mapping, Air pollution, AOD

ABSTRACT 85

Characteristics of Nonlinearity Between Climatology and Perturbation Components

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Abstract

This study investigates characteristics of nonlinear effects between mean state component and deviation from the mean state (referred to as the perturbation component), in regard to the downscaling method that evaluates factors of regional climate change by dividing a large-scale atmospheric climate change into the two components. The pseudo-warming method is one of downscaling methods. The method takes over weaknesses of the ordinary downscaling approach by considering only changes in the mean state component. Specifically, the pseudo-warming method has following advantages. (1) The model bias of general circulation model can be reduced by using reanalysis data for present climate, (2) The long integration period is not necessary, and furthermore (3) the method can evaluate regional climate response to a certain experimental condition: that leads to an understanding of the mechanism of regional climate change. On the other hand, the pseudo-warming method does not consider the future changes in perturbation component. There are two concerns raised by this assumption. One is the importance of the future changes in the perturbation component. Although the importance of perturbation components depends on the area, it will have an influence on areas where tropical and midlatitude cyclones are projected to change in the future climate. The other is the influence of nonlinearity between the mean state component and the perturbation component; the nonlinear effect is not well understood. In this study, we investigate the characteristics of non-linear effects between the two components using output from downscaling experiments for summer in western Japan.

Key words: Dynamical downscaling method, Regional climate projection, Regional climate model, nonlinear effect, Pseudo-warming method

Conference Theme: Modelling and technologies

ABSTRACT 95

Statistical Time Series Forecasting of Maximum Ozone Concentrations in The Metropolitan Area of Monterrey, Mexico

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Abstract

Statistical time series forecasting is a useful tool to predict pollutant concentrations, especially in urban areas of emerging economies where complex 3D air quality models have limitations to be implemented. In this study a general Multiple Regression with Seasonal Autoregressive Moving Average (SARMA) Errors model was estimated and implemented to forecast maximum ozone concentrations in a short time resolution: overnight, morning, afternoon and evening, in five air quality monitoring sites of the Metropolitan Area of Monterrey (MMA), Mexico. The model was designed including the effects of meteorological variables in the ozone level and considering the appropriated transformation of meteorological variables to linearize the relation with maximum ozone concentrations. This approach allows a physical interpretation of the model results identifying the meteorological variables that significantly influence the maximum ozone levels during the day and among the seasons within the MMA. The resulting model proves to be consistent with the general dynamics of ozone formation and provides a suitable device for forecasting, presenting similar or better performance measures compare to other studies. The contributions of this study were used by the Secretariat for Sustainable Development of the Nuevo Leon State to notify the community about possible pollution events.

Keywords: Seasonal ARMA, air quality modeling, seasonal variation, meteorological variables.

Conference Theme: Modelling and technologies.

ABSTRACT 123

Sensitivity Of WRF-Chem Model Resolution in Simulating Tropospheric Ozone in Southeast Asia

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Abstract

In this study, WRF-Chem model response to horizontal resolution has been studied in simulating regional ozone distribution during an intense biomass burning across Southeast Asia. Model resolution was varied between 100 km and 20 km. Enhanced fire emissions was also considered in the 20 km resolution simulation. Evaluations were made against observed meteorology such as temperature, relative humidity, wind speed and direction. Spatio-temporal distribution of ozone precursors such as NO2 and CO at the surface retrieved from OMI and AIRS instruments respectively, were compared against model outputs. In addition, ozonesonde datasets for ozone profile from SHADOZ campaign at Java, Hanoi and Kuala Lumpur were used in evaluating simulated results. All the model simulations adequately represented the observed meteorology. Except in Java where ozone levels were overrepresented, the levels in other locations such as Kuala Lumpur and Hanoi were captured adequately. For model simulations using low-resolution, high-resolution and high-resolution with enhanced fire emissions, normalized bias factor was around -0.06, 0.21 and 0.07; 0.01, 0.27 and -0.08, and; 1.20, 3.36 and 3.21, in Hanoi, Kuala Lumpur and Java respectively.

ABSTRACT 36

Numerical and Experimental Analysis of Flow and Particulate Matter Dispersion in Indoor Environment

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Abstract

The study of particle dispersion in indoor environments is a a topic of primary importance in that population live mainly in indoor environment spending only 4% of their time outdoors. CFD simulations, supported by experimental data, allow us to investigate complex indoor environments and critical phenomena due to external fluid dynamics conditions. In particular, high-resolution fluid dynamics simulations are fundamental to properly evaluate dispersion of fine and ultrafine particles and to improve the knowledge on how indoor and outdoor environment interact, in terms of both pollutant load and fluid dynamics. In this work, fluid dynamics field within a confined real environment, i.e. a classroom of the University of Rome "La Sapienza", was analyzed from the numerical and experimental point of view in the framework of the VIEPI (Integrated Evaluation of Indoor Particulate Exposure) project. In detail, numerical simulations were carried out by means of the ANSYS Fluent model considering different geometrical configurations, i.e. doors and windows openings, and imposing boundary conditions, i.e. wind velocity and direction, derived in the same campaign. The aim was to obtain velocity and turbulent kinetic energy fields to be used as input data dispersion models. Ultrafine particle dispersion has been evaluated by means of ANSYS Fluent and a Lagrangian stochastic model developed by the authors. Fluid dynamics simulations results and particulate matter concentration fields compare well with experimental data collected in the field campaigns.

Keywords: indoor environment, I/O concentration, fluid dynamics modelling, particle dispersion modelling

Conference Theme: Modelling and technologies

ABSTRACT 27

The Indoor Built Environment Response to Haze in Malaysia

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Abstract

Transboundary haze pollution in South East Asia is posing a threat to conventional design of buildings. Over the years in Malaysia, indoor air pollution has received less attention compared to pollution in the outdoor environment however, given the large amount of time people spend indoors during haze episodes, indoor air quality (IAQ) has now become a matter of increasing public concern. Some studies in neighbouring Singapore have already shown that the air filters currently used in several mechanical ventilation systems are not only insufficient in protecting building occupants from high exposures to fine particles of outdoor origin but are also energy intensive due to the pressure drops of air going through them thus drawing more power during operation. Improving indoor air quality without compromising thermal comfort and optimal energy use requires engineers to understand particulate matter (PM) fluid dynamics indoors in relation to temperature, humidity, air exchange rates and occupant behaviour. Some of the studies in this context are expensive and sometimes infeasible to achieve in real field experiments which partly explains the reluctance of the Malaysian research community in this domain however, Computational Fluid Dynamics (CFD) simulations utilizing Building Information Modelling (BIM) can be used to alleviate these limitations to a lesser extent. This paper therefore discusses how CFD integrated with a rich Building Information Model provides building designers in Malaysia with a better understanding of the degree of protection provided by buildings from PM pollution of outdoor origin.

Keywords: Building Information Modelling, Indoor Air Quality, Particulate Matter, CFD, Fluid Dynamics, Built Environment, Indoor pollution

Conference Theme: Modelling

ABSTRACT 39

Analysis of Health Impact Assessment to Outdoor and Indoor Air Pollution

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Abstract

People spend major part of their time inside places such as homes and offices, so it is very important to know the indoor and outdoor pollution in this type of studies. The atmospheric dispersion model WRF/Chem is used to know the outdoor pollution and meteorological conditions with high spatial (1 km) and temporal (1 hour) resolution and the building energy model EnergyPlus to simulate the indoor contaminants. EnergyPlus model is used to investigate the dynamic behaviour of pollutants with a single package using a multizone approach. 2016 year is used for the simulations with hourly outputs. Outdoor and indoor pollutions are linked to through the simulated infiltration process. The evaluation of outdoor, indoor air quality and human health effects was carried out considering different exposure profiles, for people working and living in an office and house located in the same building in the Madrid city center. The study takes into account different ventilation modes in the building and indoor emission scenarios (oven for heating, cooking, photocopy machine, smoke cigarettes). Health impact assessment considered mortality and hospital admissions, associated with exposure to PM2.5 and NO2 taking into account the differences between the exposure profiles which have been used to describe the time activity patterns of the people. The health impacts of emitting sources are highest in the warm months due to the operation of the air conditioning system. The health impact of indoor emission sources is higher than the outdoor pollution. People in the zone where the emitting sources are located would experience a mortality and morbidity of 2.5 times more than in the non-emitting zones.

Keywords: Indoor Pollution, exposure, health impact, buildings.

ABSTRACT 38

A Simplified Analytical Model of Ultrafine Particles Concentration Within an Indoor Environment

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Abstract

Exposure to fine and ultrafine particulate matter has been recognised as a fundamental health and environmental problem as most people spend 85-90% of their time in indoor environments. Exposure depends on various factors, e.g. indoor and outdoor sources, ventilation and particle size distributions. Despite many experimental studies concerning indoor and outdoor particle concentration have been conducted, the relationship between the two is still an open issue. In this work, experimental data derived from field campaigns conducted in a confined real environment, i.e. a classroom of the University of Rome "La Sapienza", have been used to understand physical mechanisms governing indoor-outdoor exchanges in different operating conditions. Indoor and outdoor ultrafine particles concentration have been analized considering both natural ventilation, i.e. open windows, infiltration, i.e. leakages. A simplified analytical model, based on mass balance of particulate matter within an indoor environment, is proposed to estimate indoor fine and ultrafine concentration. I/O ratio, air exchange rate and penetration factor have been estimated from various field campaigns. These parameters have been related to measured fluid dynamic quantities, i.e. outside wind velocity and direction and differential pressure at the openings (doors and windows).

Keywords: indoor particle concentration, I/O ratio, air exchange rate, penetration factor, analytical model

Conference Theme: Modelling and technologies

ABSTRACT 134

Biomass Char Gasification with Carbon Dioxide as an Alternative Energy

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Abstract

Currently, the main energy source are fossil based fuel. Utilisation of conventional fossil fuel is contributing to greenhouse gas emissions which causes climate change. Attention to renewable energy sources has increased nowadays to reduce the high dependence on fossil fuel which is considered not renewable. Biomass seems to be a promising and environmental friendly feedstock that can be converted into useful products (biochar, bio-oil and syngas). One of the method to convert biochar to syngas is through the gasification technology. When biochar is reacted with gasifying agent like CO2 and H20 at high temperatures, syngas which is rich in hydrogen can be produced. The main objectives of this work are to study the gasification behaviour of pineapple peels in Thermogravimetric Analyzer (TGA) using CO2 as its gasifying agent. The effect of temperature towards char reactivity and carbon conversion were determined. In conclusion, this study provides information on utilisation of biomass waste as an energy source through gasification technology.

Keywords: Biochar, Biomass, Char reactivity, Carbon conversion, Gasification

Conference Theme: Modelling and technologies

ABSTRACT 135

The Projected Deposition and Removal of Particulate Matter by Green Façade Drapes: A Case Study At SAINTGITS

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Abstract

The hazardous sub-micron particulate matter (PM2.5) that goes deep in to the respiratory system causes significant threat to the life expectancy of humans. The atmospheric wind and the diurnal dry bulb temperature are the main factors which govern the pollutant dispersion. This work quantifies the wind assisted deposition of PM2.5 and the natural atmospheric cleansing by a massive green façade drape. The proposed leaf foliage covers the entire South and the West facing walls of a six storied built structure (Visvesvaraya Block) at SAINTGITS, a prominent Technological Institution at Kottayam, Kerala State, India. Whilst the south blowing winds assist the deposition of PM2.5 on to the façade foliage, the removal rate of the pollutants is directly proportional to the stomata opening and the humidity. This case study clearly depicts the natural capability of green façade retrofits to cleanse the atmosphere, thus helps to attain one of the seventeen Sustainable Development Goals (SDGs) of UN.

Keywords: Sustainable, Green façade, Atmosphere cleansing, SAINTGITS, Particulate Matter

Conference Theme: Modelling and technologies

SESSION F2

ABSTRACT 18

Numerical Modelling of Ozone Damage to Plants and its Effects on Atmospheric CO_2 in China

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Abstract

Tropospheric ozone (O_3) is known to damage plant cells and suppress leaf photosynthesis, which can further reduce land carbon uptake and leave more carbon dioxide (CO2) in the atmosphere. While recent studies have assessed the effects of O_3 on land carbon fluxes, the potential impacts on atmospheric CO_2 concentrations have not been quantified. Here, we use the regional climate model (RegCM-CHEM4) coupled with a terrestrial biosphere model (the Yale Interactive terrestrial Biosphere model, YIBs) to estimate the effects of O_3 exposure on atmospheric CO_2 over China. Compared to simulations without O_3 effects, sensitivity experiments with O_3 damaging show a significant reduction (12.1±4.4%) in gross primary productivity (GPP), up to 35% in summer. Meanwhile, land carbon sink is suppressed by 0.11±0.02 Pg C a-1 at the national level. Strong inhibitions of O_3 on carbon flux are found in North, Northeast and South Central China, where O_3 levels are high. Consequently, we find a significant increase in atmospheric CO_2 concentrations due to reduced plant productivity by O_3. The increases of CO_2 are more evident in growing season such as spring and summer. The maximum CO_2 enhancement reaches as high as 6 ppm in Yunnan and Guizhou provinces. Our assessment indicates that tropospheric O_3 has a detrimental impact on plant carbon uptake and leads to an increase in atmospheric CO_2 concentrations. Such indirect impact of O3 should be taken into account in global carbon cycle and future climate change.

Keywords: O_3 exposure, CO_2 concentration, Land carbon flux, China

ABSTRACT 42

Mitigating Air Pollution Exposure Risk in China: State Responsibility Versus Individual Efforts

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Abstract

China has made great efforts towards air pollutant concentration control during past five years, which has led to positive outcomes. However, air pollutant concentration focused efforts were considered separately from human exposure risk. And this might result in a misunderstanding that mitigating exposure risk can only relies on the national level air pollutant control measures. This study thus integrates the first Chinese survey of human activity patterns and the spatially continuous high-resolution PM2.5 concentration maps to reveal the spatial and temporal variations of China's air pollution exposure risk from 2013 to 2017. More important, effects of the reductions of ambient PM2.5 concentrations by national responsibility and changes of personal behavior patterns by individual efforts on risk mitigation from multi-scale and multi-object perspectives are deeply investigated. Results show that the reductions of PM2.5 concentration and associated exposure risk are 40% and 35.7% from 2013 to 2017, respectively. It also showed that both the reduction of PM2.5 concentrations and change of personal behavior patterns were effective for risk mitigation when China's total PM2.5 exposure risk was higher than 1.58. However, only individual behavior changes (e.g. exercise changes) contributed to risk reduction for scenarios with state-level risk value below 1.58. For regional strategies, threshold values for PM2.5 exposure risk control differentiating national responsibility or personal efforts are spatially and temporally dependent. The role of personal behavior changes on PM2.5 exposure risk reduction is growing in recent five years with rapidly increasing regions. The findings suggest that people-centered air pollution exposure risk prevention not only depends on government management for air pollution control, but also on individual changes of activity pattern. Efforts from state and individuals are both essential for mitigating air pollution exposure risk in China, especially growing individual efforts are needed in more regions with the decreasing air pollutant concentrations in the coming future.

Keywords: air pollution, exposure risk assessment, environment management

ABSTRACT 52

Traffic Loads Effects on Ambient Temperature in The Kuala Lumpur City

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Abstract

The combustion of fuels in automobiles not only produces harmful gaseous but also releases anthropogenic heat in which, able to alter the urban microclimate. The heat released in the atmosphere contributes to the rise in ambient temperature, causing thermal discomfort towards urban dwellers, especially in hot and humid climate regions such as the Kuala Lumpur City. Due to urbanization, more vehicles are found within this city which leads to heavy traffic loads. This study aims to investigate the contribution of the traffic loads on the ambient temperature of the Kuala Lumpur City. Using the Weather Research and Forecasting (WRF) simulation model, the ambient temperature of the city was regenerated within two intermonsoon phases (April and October) in the year of 2018. These periods were chosen to reduce the synoptic forcing. The automobiles traffic data provided by Tomtom Navigation were used to represent the traffic loads within the city. Hourly traffic data were utilized to analyse the daily pattern of the traffic loads as well as its dynamics using Geographical Information System (GIS). Based on Spearman correlation test and Kruskall Wallis test, it has been determined that, the traffic loads within the city has significantly affected the ambient temperature causing thermal discomfort towards the urban dwellers especially during the day. Three periods were identified as peak hours of traffic loading which are in early morning (7am-9am), in the afternoon (12pm-2pm) and in the evening (5pm-7pm). These peak hours were caused by working people travelling to the workplaces and their homes. Therefore, the mitigation measures introduced by national policy such as “Low Carbon Cities”, “A Day Without Private Vehicles” carpooling and encouraging public transport usages should be seriously considered by the urban dwellers in supporting the government efforts.

Keywords: traffic loads, ambient temperature, urban microclimate, WRF-ARW, GIS

Conference Theme: Assesment for Atmospheric Environmental Impact

ABSTRACT 86

Dust Concentration and Awareness of Safety and Health Among Orthopedic Clinic Staff in Hospital Kuala Lumpur, Malaysia: A Cross-Sectional Study

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Abstract

The study was carried out to determine the concentration level of dust from the orthopedic casting materials exposed to personnel and working area. The determination of knowledge, attitude, and practices (KAP) regarding occupational safety and health aspects also conducted. Increase dust concentration above the permissible limit (PEL) would decrease the health status among the workers. Methods: This cross-sectional study was conducted between February 2017 and December 2017 in the casting room Hospital Kuala Lumpur, Malaysia. Determination of dust exposure was using a Niosh Manual of Analytical Method (NMAM 0501) for 8 hours from 9.00 am to 4.00 pm. A set of questionnaires for assessing the level of knowledge, attitude and practice related to occupational safety and health at the Orthopedic Clinic was distributed to 40 Orthopedic Clinic staff. Results: The results of total dust concentration in the casting room are 3.402 ± 0.003 mg/m³ from area sampling and for the personal air sampling is 5.573± 0.040 mg/m³ which are below than 15 mg/m³ of OSHA (US) (2005) permissible exposure limit (PEL). Percentage of knowledge, attitude and practice level of occupational safety and health in the Orthopedic Clinic indicates knowledge (96.75%), attitude (83.7%) and practices (82.85%) respectively. Conclusion: The risk of dust exposure is most likely low, however, some literature suggested duration of exposure-response plays an important role even though in the low exposures of the health-related occupational illnesses. Medical health surveillance should be implemented in every 6 months to monitor staff's health status.

Keywords: Dust, orthopedic casting, NMAM 0501, Permissible Exposure limit

ABSTRACT 91

Seasonal Sources of Inorganic Nitrogen in Wet Deposition Over Different Land-Use Types in Southwest Mountain Region of China

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Abstract

To identify seasonal fluxes and sources of inorganic nitrogen (N) in wetdeposition, concentrations and $\delta^{15}N$ signatures of nitrate ($NO3^-$) and ammonium (NH_4^+) in precipitation were measured at four typical land-use types in a mountain region of southwest China for one-year period. Higher dissolved inorganic nitrogen (DIN) fluxes were in spring and summer and their total fluxes (averaged 7.58 kgN ha^{-1}) were similar to the critical loads in aquatic ecosystems. Significant differences of precipitation $\delta^{15}N$ were observed for NH_4^+-N between at town and wetland type in spring and at urban and rural type in summer while those for NO_3^--N between at town and rural type in spring and at urban and town type in autumn, respectively ($p<0.05$). Quantitative results of NO_3^--N sources showed that both biomass burning and coal combustion had higher fluxes at urban type especially in winter (0.18±0.09 and 0.19±0.08 kgN ha^{-1}), which were about three times higher than those at town type ($p<0.05$). A similar finding was observed for soil emission and vehicle exhausts in winter. On the whole, DIN wet deposition averaged at 12.13 kgN ha^{-1} yr^{-1} with the urban type as the hotspot (17.50 kgN ha^{-1} yr^{-1}). Regional NO_3^--N fluxes showed a significantly lower seasonal pattern in winter ($p<0.05$). The annual contribution to NO_3^--N wet deposition of biomass burning was 25.8±14.0% and became the second dominated factor in the region. Thus, some measures should be implemented to reduce N emissions from biomass burning, coal combustion and vehicle exhausts especially in spring and summer in order to ensure sustainable development especially for protecting water quality in the southwest mountain region.

Key words: inorganic nitrogen; nitrogen isotope; wet deposition; source appointment

ABSTRACT 111

Air-Quality Assessment Over the World's Most Ambitious Project, NEOM in Kingdom of Saudi Arabia

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Abstract

NEOM is an under-development transnational city and economic zone spreading over an area of 26,500 Km^2 along the northern Red Sea coast of Saudi Arabia, bordering Jordan and Egypt. This work analyzes the meteorological parameters and air pollution dispersion over the NEOM region based on observations and air-quality dispersion modeling. The Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) model was implemented to simulate air parcel trajectories, as well as transport, dispersion, chemical transformation, and deposition. To drive HYSPLIT, high-resolution meteorological data generated at 600 m resolution by downscaling ECMWF global reanalysis using the Weather Research and Forecasting (WRF) were used. The United Sates Environmental Protection Agency Air Pollutant Emission Factors 42 emission inventory was used to initialize HYSPLIT. A continuous three-year meteorological and air-quality data from WRF-HYSPLIT model is used to analyze the spatial and temporal distributions of air pollutants' concentration over the NEOM region.

Strong land and sea breezes resulting from the differential heating dominates the diurnal dispersion and distribution of pollutants in the NEOM region. The spatial distributions of the mean seasonal ambient air pollution dispersion show similar patterns, with relatively higher concentrations in spring and winter. This is more pronounced in the spatial distributions of the maximum concentrations of different pollutants, which show the maximum concentrations in the spring and winter due to lower boundary layer heights. The predicted maximum concentrations of NOX (~40 g/m^3), SO2 (~25 g/m^3), CO (~10 g/m^3), VOC (~0.05 g/m^3), and PMT (~4 g/m^3) over the study region remain well below the National Air Quality standards recommended by the Saudi General Authority for Meteorology and Environment Protection and the Royal commission. Our analysis provides needed information to understand the state of the air quality over the NEOM region, providing fundamental contribution to the environment impact assessment and planning in the region.

Keywords: NEOM, Red Sea coast of Saudi Arabia, HYSPLIT, high-resolution, Air-quality assessment, impact assessment

Conference Theme: Climatology, impacts and policies

ABSTRACT 125

Investigation of Gaseous (NO_2, TVOC, CO_2) Indoor and Outdoor Air Pollution and Health impact in Different Schools in Dhaka City, Bangladesh

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Abstract

Children are by far more susceptible to the negative effects of air pollutants than adults. There is a correlation between exposure to air pollutants in the school environment and the performance of students. This study aimed to evaluate continuously the concentrations of gaseous pollutants (NO_2, TVOC, CO_2) and in ten different schools in Dhaka city and to assess the potential health hazards on school children. The measurements were performed using Aeroqual 500 series sampler from April 2018 to November 2018. The mean concentrations of NO_2, TVOC and CO_2 were 0.0792±0.012 ppm, 734.40±414.24 ppm, 672.275±42.35 ppm respectively. Indoor/ Outdoor concentration ratio was determined and it was found that most of the schools had higher indoor concentration than outdoor. Average concentration of NO_2 exceeded the EPA National Ambient Air Quality Standard 0.053 ppm as the average 24 hour limit for NO_2. In case of TVOC, concentration of TVOC in Mugda, Shukrabad, University of Dhaka, Khilgaon, Motijheel and Wari and Khilgaon were found 2 to 3 times higher in indoor compared to threshold value (100ppb). All the schools showed higher concentration of CO_2 in the morning due to lack of ventilation (closed windows). Hazard Quotient (HQ) was measured for NO_2 and CO_2. Highest HQ values were obtained from Wari (1.23) for CO2 and lowest was Motijheel (1.06). For NO_2, Maniknagar had the highest HQ value (1.92) and Khilgaon had the lowest (1.15). Overall, all the schools had HQ greater than 1 for both NO_2 and CO_2 indicating potential health impact on school children.