Alok Kumar Pandey, PhD
Rutherford Fellow | Newton-Bhabha Fellow | Inspire Fellow
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Research/Professional Experiences

University of Leicester — Leicester, UK
Consultant — May 2020 – Present

University of Edinburgh — Edinburgh, UK
Commonwealth Rutherford Fellow, School of Geosciences — Mar 2018 – Feb 2020

Central University of Haryana — Mahendargarh, India
Assistant Professor, Department of Environmental Sciences — April 2017 – March 2018

Coordinator
ISRO'S IIRS EDUSAT Programme @ Central University of Haryana — June 2017 – March 2018

Education

Jawaharlal Nehru University — New Delhi, India
PhD, Environment and Atmospheric Sciences — Thesis defense: February 2017
Thesis Title: ***Satellite Derived Spatio-Temporal trends of Air Quality over Indo-Gangetic Plain***
Funded by Department of Science & Technology (DST) - INSPIRE Fellow Scholarship Programme
Visiting Research Student of the University of Edinburgh, UK (January – June 2016)
Funded by India-DST and UK-British Council under Netwon-Bhabha Programme

Jawaharlal Nehru University — New Delhi, India
MPhil, Environment and Atmospheric Sciences (Course work only) — 2011

Patna University — Patna, India
Master of Science – Environmental Science and Management — *University Topper* (74.69%), 2008-2010

Academic Awards / Scholarships

- Commonwealth Rutherford Fellowship awarded by the Commonwealth Scholarship Commission (CSC), United Kingdom
- Newton – Bhabha PhD Programme awarded by the Department of Science & Technology (DST), India and British Council, United Kingdom
- INSPIRE Fellow Scholarship of the Department of Science & Technology (DST), India
- Qualified UGC-NET Examination in Environmental Sciences
- Qualified ARS-NET Examination in Environmental Sciences
- Qualified GATE Examination in Life Sciences
- Qualified CSIR-UGC NET & Junior Research Fellowship in Earth, Atmospheric, Ocean & Planetary Sciences

Technical Skills

Atmospheric Chemistry Modelling Skills

- Running global atmospheric chemistry models (UKCA v11.0) on UK supercomputing platform (ARCHER & JASMIN)
- Modifying model subroutines and altering the setup of the model
- Processing/analyzing large model and observational datasets in various file formats

Computational Skills

- Unix/Linux and Windows operating systems
- Python programming language and data visualization
- GIS software (QGIS, ENVI, ArcGIS)

Research Projects

Sponsored Research Project – Commonwealth Scholarship Commission, United Kingdom
Title: Evaluating the UK Earth System Model (UKESM) over the Indian Subcontinent Region
Amount: £45,000 Duration: ~Two Years

Publications

In Review

- Alok Pandey, Eloise Marais, Martin Van Damme, Lieven Clarisse, and Pierre-F. Coheur, "UK ammonia emissions estimated with satellite observations and GEOS Chem" Under Review - Journal of Geophysical Research: Atmospheres

In preparation

❖ Pandey Alok, David Stevenson, Alcide Zhao, Richard Pope, Martyn Chipperfield & Krishan Kumar, "Evaluating Tropospheric NO2 over South Asia in UKCA using OMI Satellite data"

❖ Pandey Alok, David Stevenson, Alcide Zhao, Luke Surl, Brian Kerridge, & Richard Pope, "Evaluating tropospheric ozone in UKCA model with aircraft, satellite and Ozonesonde observations over South Asia"

List of Publications (Best two papers are highlighted)

1) **Pandey, A. K., Singh, S., Berwal, S., Kumar, D., Pandey, P., Prakash, A., Lodhi, N., Maithani, S., Jain, V. K. and Kumar, K.: Spatio - temporal variations of urban heat island over Delhi, Urban Clim., 10(P1), 119–133, 2014** Impact Factor – 3.834

2) Pandey, A. K., Kumar, R. P. and Kumar, K.: Satellite and ground based seasonal variability of NO_2 and SO_2 over New Delhi, India, in Remote Sensing of Clouds and the Atmosphere XX, vol. 9640, p. 96400U., 2015

3) Berwal, S., Kumar, D., Pandey, A. K., Singh, V. P., Kumar, R. and Kumar, K.: Dynamics of thermal inertia over highly urban city: a case study of Delhi, in Remote Sensing Technologies and Applications in Urban Environments, vol. 10008, p. 100080E., 2016

4) Kumar, R., Pandey, A., Kumar, R., Kashyap, P. and Kumar, K.: Assessment of Source Profile of Nonmethane Hydrocarbon in the Ambient Air of Metro City Delhi, India, Curr. World Environ., 12(2), 326–338, 2017

5) **Pandey, A. K., Mishra, A. K., Kumar, R., Berwal, S., Devadas, R., Huete, A. and Kumar, K.: CO variability and its association with household cooking fuels consumption over the Indo-Gangetic Plains, Environ. Pollut., 222, 83–93, 2017** Impact Factor – 6.792

6) Bhardwaj, P., Pandey, A. K., Kumar, K. and Jain, V. K.: Seasonal variability of aerosols and their characteristics in urban and rural locations of Delhi-NCR, Proc. SPIE - Int. Soc. Opt. Eng., 10431, 2017

7) Bhardwaj, P., Singh, B. P. and Pandey, A. K.: Characterization and Morphological Analysis of Summer and Wintertime PM2.5 Aerosols Over Urban- Rural Locations in Delhi-NCR, Int. J. Appl. Environ. Sci., 12(5), 1009–1030, 2017

8) Kumar, R. P., Pandey, A. K., and Kumar, K.: A Review on the Atmospheric Non Methane Hydrocarbons (NMCHs) Study in India, Curr. World Environ., 12(2), 278–287, 2017

9) Bhardwaj, P., Pandey, A. K., Kumar, K. and Jain, V. K.: Spatial variation of Aerosol Optical Depth and Solar Irradiance over Delhi -NCR during summer season, Curr. World Environ., 12(2), 389–395, 2017.

10) Kumari, P., Pandey, A. K., Bhardwaj, P., Jain, V. K. and Kumar, K.: Seasonal variation in spectral global and direct solar irradiances over a megacity Delhi, in Remote Sensing Technologies and Applications in Urban Environments III, p. 7., 2018

11) Kumar, R. P., Kashyap, P., Kumar, R., Pandey, A. K., Kumar, A. and Kumar, K.: Cancer and non-cancer health risk assessment associated with exposure to non-methane hydrocarbons among roadside vendors in Delhi, India, Hum. Ecol. Risk Assess., 26 (5), 1285-1299, 2020

❖ Acted as a reviewer for journals: Remote sensing of Environment, Geo-Spatial Information Science, Water, Air & Soil Pollution

Consultancy Projects

Consultancy Research Project – University of Leicester, United Kingdom
Title: Assessment of UK ammonia emissions with IASI and GEOS-Chem

Teaching and Mentoring (@ Dept. of Environmental Sciences, Central University of Haryana)

Teaching Masters Courses: Physical Environment (SEES EVS 0102 07 C 4004 - Atmospheric Environment, Remote Sensing and GIS, Global Climate Change) and Natural Resources (SEES EVS 0101 02 C 4004)

Student mentoring/co-supervision: MSc dissertation on 1) Temporal variation of black carbon over urban environment, New Delhi, and 2) Spatio-temporal variability analysis of evapotranspiration in Haryana, India: a geospatial approach

Presentations

- ✓ Alok Pandey*, Eloise Marais, Martin Van Damme, Lieven Clarisse, and Pierre-F. Coheur; *Oral presentation*: "UK NH3 emissions derived with IASI and GEOS-Chem" at EOS-Chem Europe User's Meeting, virtually (1st – 2nd September 2020)
- ✓ **Alok Pandey**, David Stevenson, Alcide Zhao, Krishan Kumar, Luke Surl, Brian Kerridge, Richard Pope; *Oral presentation*: "Evaluating tropospheric ozone in UKCA model with aircraft (IAGOS), satellite (OMI) and Ozonesonde observations over South Asia" at the 4th Atmospheric Composition and the Asian Monsoon (ACAM) Workshop at University of Malaysia (UKM), Kuala Lumpur, Malaysia (26th – 28th June 2019)
- ✓ **Alok Pandey**, David Stevenson, Alcide Zhao, Krishan Kumar, Luke Surl, Brian Kerridge; *Poster Presentation*: "Evaluating Tropospheric Ozone over Southern Asia in UKCA using IAGOS, Ozonesonde and Satellite data" at the Composition Climate Interaction conference at Met Office, Exeter, UK (20th - 21st March 2019)
- ✓ **Alok Pandey**, David Stevenson and Krishan Kumar; *Poster Presentation*: "Seasonal Variability in the Vertical Profiles of NO_2, SO_2 and O_3 over Indo – Gangetic Plains Using UKCA Model Simulations" at the Atmospheric Science Conference 2018: Weather, Climate and Air Quality at the Exhibition Centre, University of York, York, UK (3rd - 4th July 2018)
- ✓ **Alok Pandey**, David Stevenson, Krishan Kumar; *Oral presentation*: "Comparison of satellite-derived and UKCA model-simulated air pollutants data over the Indo-Gangetic Plains" at Chemistry-Climate Model Initiative 2017 at the Centre International de Conférences of MétéoFrance, Toulouse, France (13th - 15th June 2017)
- ✓ **Alok Pandey**, Krishan Kumar; *Poster Presentation*: "Spatio-temporal air quality trends over the Indo-Gangetic Plain" at "UKCA Theory and Practice Workshop" at the Department of Chemistry, University of Cambridge, Cambridge, UK (4th – 08th January 2016) – Best poster award
- ✓ **Alok Pandey**, Ram Kumar, Krishan Kumar; *Oral Presentation*: "Satellite Based AOD, NO_2, SO_2 and HCHO Seasonal Variation over the Indo Gangetic Plain, India" at the Atmospheric Sciences and Application to Air Quality (ASAAQ) Conference Kobe, Japan (November 11th – 13th, 2015)
- ✓ **Alok K. Pandey**, Ram P. Kumar and Krishan Kumar; *Oral Presentation*: "Satellite and ground based seasonal variability of NO_2 and SO_2 over New Delhi, India" at the SPIE Remote Sensing Conference, Toulouse, France (21st – 24th September 2015)

Referees

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CO variability and its association with household cooking fuels consumption over the Indo-Gangetic Plains☆

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ABSTRACT

This study examines the spatio-temporal trends obtained from decade long (Jan 2003–Dec 2014) satellite observational data of Atmospheric Infrared Sounder (AIRS) and Measurements of Pollution in the Troposphere (MOPITT) on carbon monoxide (CO) concentration over the Indo-Gangetic Plains (IGP) region. The time sequence plots of columnar CO levels over the western, central and eastern IGP regions reveal marked seasonal behaviour, with lowest CO levels occurring during the monsoon months and the highest CO levels occurring during the pre-monsoon period. A negative correlation between CO levels and rainfall is observed. CO vertical profiles show relatively high values in the upper troposphere at ~200 hPa level during the monsoon months, thus suggesting the role of convective transport and advection in addition to washout behind the decreased CO levels during this period. MOPITT and AIRS observations show a decreasing trend of 9.6×10^{15} and 1.5×10^{16} molecules cm^{-2} yr^{-1}, respectively, in columnar CO levels over the IGP region. The results show the existence of a spatial gradient in CO from the eastern (higher levels) to western IGP region (lower levels). Data from the Census of India on the number of households using various cooking fuels in the IGP region shows the prevalence of biomass-fuel (i.e. firewood, crop residue, cowdung etc.) use over the eastern and central IGP regions and that of liquefied petroleum gas over the western IGP region. CO emission estimates from cooking activity over the three IGP regions are found to be in the order east > central > west, which support the existence of the spatial gradient in CO from eastern to the western IGP region. Our results support the intervention of present Indian government on limiting the use of biomass-fuels in domestic cooking to achieve the benefits in terms of the better air quality, household health and regional/global climate change mitigation.

1. Introduction

Indo - Gangetic Plains (IGP) has been one of the most densely populated regions of the world historically, due to its fertile alluvial soils being suitable for agriculture. Since a very large population is dependent on this region for sustenance, the IGP region is also a source of emissions of a variety of air pollutants (Beig and Ali, 2006; Kar et al., 2010; Mallik and Lal, 2014). Consequently, a large number of studies have been conducted on the subject of air pollution in the IGP region (Jethva et al., 2005; Tripathi et al., 2005; Gautam et al., 2007, 2009; Beig and Ali, 2006; Roy et al., 2008; Kar et al., 2008, 2009, 2010; Kulkarni et al., 2009). Being a major constituent of air pollution over the IGP region, aerosols emitted from various anthropogenic activities have been the focus of investigation in many of the studies mentioned above. It is now well established that there exists a persistent haze of pollution, alternatively called as the 'Atmospheric Brown Cloud' over the IGP region, having significant implications for regional climate (Ramanathan and Ramana, 2005). Not surprisingly, the IGP region has been identified as one of the major pollution hot spot regions in the world (Ramanathan et al., 2007; Lau et al., 2009). Other studies have indicated that pollution transported from the IGP region influences

☆ This paper has been recommended for acceptance by David Carpenter.

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Cancer and non-cancer health risk assessment associated with exposure to non-methane hydrocarbons among roadside vendors in Delhi, India

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ABSTRACT

This study estimates the cancer and non-cancer health risk among the roadside vendors in Delhi, the capital city of India. Air samples of selected NMHCs and their derivatives were collected from four different sites (one traffic intersection, one industrial, and two residential) in Delhi and were analyzed on Gas Chromatograph (GC) to obtain their atmospheric concentrations. At each site, a survey among the roadside vendors was also conducted to obtain information about their bodyweight and exposure to outdoor ambient air. The study reveals that hazard quotient of 1,3-butadiene is greater than one at all the sites, with its maximum value occurring at the industrial site. The major contributors to the workplace cancer risk (WCR) are found to be 1,3-butadiene and chloroform. The overall WCR is observed to be the highest (9.4×10^{-4}) at the traffic intersection site, followed by the industrial site (7.0×10^{-4}). Cancer incidence data and the population data are also used to estimate the growth of cancer risk in Delhi from 2009 to 2016. Comparison of the WCR values of the four sites with the cancer risk estimated from the cancer incidence data shows that NMHCs and their derivatives are significant contributors to the overall cancer risk in Delhi. Our results suggest that NMHCs and their derivatives need to be given due consideration in the National Cancer Control Programme of India.

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KEYWORDS
Non-methane hydrocarbons; health risk; workplace cancer risk; hazard index

1. Introduction

Poor air quality affects the human health adversely, and has become a cause of concern in modern times. Several epidemiological and toxicological studies have established the adverse impact on human health caused by exposure to different types of air pollutants (Brunekreef and Holgate 2002; Kampa and Castanas 2008). Thus, it becomes imperative to monitor the concentrations of different air pollutants in the ambient atmosphere. Non-Methane Hydrocarbons (NMHCs) are the group of air pollutants that has drawn considerable attention from researchers across the world. The concentration of NMHCs in the

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Spatial variation of Aerosol Optical Depth and Solar Irradiance over Delhi -NCR during Summer season

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Abstract

Present study shows the spatial variation of Aerosol Optical Depth (AOD), solar irradiance and their association at the urban and rural sites in Delhi and National Capital Region (NCR) during the summer season of the year 2015. Summer-time AOD data from the NASA's Terra satellite MODIS sensor has been used to study the spatial distribution of aerosols over Delhi and its surrounding rural area. The ground data for the direct and global solar irradiances was collected over this region at urban and rural locations in Delhi and NCR using a Fieldspec Spectro-radiometer. HYSPLIT model has been used for the air mass trajectory analysis. The AOD values were observed to be higher over Delhi compared to the relatively lower AOD in rural area of NCR. The NCR site observed higher average solar irradiances than Delhi during the summer season. This may be because of the higher aerosol concentration in Delhi as compared to its outskirts. Also, this region is affected by the severe dust storm events during the summer season which further increases the aerosol load in the atmosphere. HYSPLIT results show the influence of western Thar Desert air masses on the Delhi-NCR. Windblown as well anthropogenic aerosols play a major role in scattering and absorption of the incoming solar radiation and hence, in governing the micro-climatology of the region.

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Keywords:

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Introduction

Aerosol and air pollution play a crucial role in the urban climatology. Urbanization, industrial development, biomass burning and fossil fuel combustion processes due to growing anthropogenic activities have led to increasing the air pollution that also interferes in the microclimatology of a city [1,2,3]. Increasing aerosol loading has caused health related problems associated with air quality problems and has also impacts on the aviation safety due to reduction in the visibility[4]. Aerosols and other pollutants significantly reduces the incoming solar

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Seasonal Variation in Spectral Global and Direct Solar Irradiances over a Megacity Delhi

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ABSTRACT

The present study investigates the spectral distribution of global, direct ($E_{b\lambda}$) and diffuse ($E_{b\lambda}$) irradiances over Delhi with the help of handheld Field Spectroradiometer in the year 2014 – 2015. Seasonal variation in the solar irradiances as well as the diffuse-to-direct ratio ($E_{d\lambda}/E_{b\lambda}$) was studied during three seasons (post-monsoon, winter and pre-monsoon) having different atmospheric conditions. Observations were carried out under clear sky days during day time when solar zenith angle is low in order to get maximum solar radiation. The ratio $E_{d\lambda}/E_{b\lambda}$ is used as a function to measure the impact of aerosol load on incoming solar irradiance. NASA's Aqua satellite, MODIS (Moderate Resolution Imaging Spectroradiometer) AOD_{550} data has been used to evaluate the relationship between aerosol load and ratio ($E_{d\lambda}/E_{b\lambda}$) on incoming solar radiation. A strong dependence of measured diffuse-to-direct irradiance ratio ($E_{d\lambda}/E_{b\lambda}$) on wavelength was observed. It was found to be decreasing exponentially with wavelength. Value of $E_{d\lambda}/E_{b\lambda}$ was found to be maximum and minimum during Post-monsoon and Pre-monsoon seasons respectively. Also, the maximum values of $E_{d\lambda}/E_{b\lambda}$ ratio were observed at the shorter wavelengths in all the studied seasons. The AOD_{550} value was found to be maximum during post-monsoon followed by winter and Pre-monsoon seasons. Crop residue burning in addition to low wind speed was responsible for high aerosol load during the post-monsoon season where as inversion layer and calm wind conditions favored high aerosol load during winter season. A strong relation between the ratio $E_{d\lambda}/E_{b\lambda}$ and AOD_{550} is observed in all the studied seasons, indicating that high aerosol load was responsible for the attenuation of the incoming solar radiation in all the seasons

Keywords: Irradiance, Aerosol, MODIS, Megacity, Spectral

INTRODUCTION

Changes in land use/land cover, crop burnings, crackers burning, emission from transportation and industries all favor addition of pollutants into the atmosphere. Pollutants level varies spatially and temporally and it is increasing continuously with urbanization, has been reported around the world by many researchers, e.g. Accra [1], Istanbul [2], Montreal [3], Bursa [4], Delhi [5], [6].

This urbanization is adding more and more pollutants into the atmosphere and they attenuate incoming solar radiations by means of scattering and extinction. Since 1990s, many researchers reported that there was a reduction in surface solar radiation [7], [8], [9], [10]. So it is important to study the impact of aerosols on the solar irradiance reaching the earth's surface, in greater detail. The aerosol effect can be better understood by studying the spectral distribution in the polluted urban area rather than rural area. The spectral study of the radiation reaching to the surface is important as different components of the spectra have its own importance, such as near-infra red has crucial role in photosynthesis. Certain bands of the visible spectrum are important for circadian rhythms in the biological world, U.V is known to be mutagenic in nature[11].

Aerosol Optical Depth (AOD) is the degree to which aerosols prevent the transmission of light by absorption or scattering of light. Ground-based instrument or satellite-derived data can give measurement of atmospheric turbidity over a region [12]. Many studies have been carried out to investigate the role of aerosol in attenuation of solar radiation [13],

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Spatio – temporal variations of urban heat island over Delhi

Alok Kumar Pandey [a], Sachchidanand Singh [b], Shivesh Berwal [a], Dinesh Kumar [a], Puneeta Pandey [c], Amit Prakash [d], Neelesh Lodhi [b], Sandeep Maithani [e], Vinod Kumar Jain [a], Krishan Kumar [a,*]

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ABSTRACT

Temporal and spatial trends of the surface urban heat island (UHI) formation over Delhi are examined with respect to aerosol load and land-cover variations. The study reveals that temperatures over Delhi are higher than those over the surrounding regions almost through-out the year during the night time. The nocturnal heat island intensity is minimum (0–2 K) during the monsoon months and maximum during the month of March (4–6 K). The UHI trends during the day-time are however, significantly different. It is observed that a day-time cool island forms over Delhi twice during the year in the months of May–June and October–December. Analysis of temporal variations in urban heat island intensity (UHII) and aerosol load over Delhi reveals a significant negative correlation between UHII and aerosol optical depth (AOD). Spatial analysis of LST, land-cover and AOD for the months of March, May and November confirms the significant role of AOD along with land-cover variables such as percentage area under the classes built-up, rock, vegetation and bare soil. Comparative analysis of LST in the regions lying north, south, east and west of Delhi in relation to the prevailing land-cover suggests that thermal inertia is also a very important factor determining the urban-rural thermal structure.

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