Urban Air Pollution Monitoring by Ground-Based Stations and Satellite Data

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Multi-season Characteristics from Lanzhou City, China

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Preface

In China the past 20 years have been characterized by rapid economic growth and urbanization. The concentration and intensification of human activities are so significant that the natural environment has ceased to conform to the normal conditions of human life.

Modern Chinese cities are powerful systems, and every city has changed, both within its own territory and far beyond. At the same time, the atmosphere, the geographical environment of Earth that is the most mobile and sensitive to contamination, has been subjected to significant human impact. High concentrations of pollutants in the atmosphere of the cities and industrial centers causes great harm to public health, as well as damage to agriculture, industry, residential buildings, technical facilities, and historical monuments. The fact that regional environmental problems have become particularly acute in China in recent years is no coincidence.

Lanzhou City, in Northwestern China, is currently facing a serious air quality problem, with key factors such as particulate matter in the air leading to serious and increased urban pollution. Thus, it is vital to control the pollution level and the various atmospheric pollutants in the city and to evaluate its air quality; accordingly, reasonable prediction methods must be found to control its air quality. Therefore, in this book we aimed to study the role of natural and anthropogenic factors in the formation of air pollution in Lanzhou City, the main industrial center of Northwestern China. We used the following methods: mathematical statistics, the hybrid single particle Lagrangian integrated trajectory model (HYSPLIT), and Cloud-Aerosol Lidar and the Infrared Pathfinder Satellite Observations (CALIPSO), as well as the ozone monitoring instrument (OMI) method of predicting aerosol pollution by the Navy Aerosol Analysis and Prediction System (NAAPS), utilizing the data obtained from ground-based air quality monitoring stations and the MODIS (Terra) and Landsat-8 satellites. The study is based on data obtained from January 1, 2003, to December 31, 2016, covering different seasons.

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This book can be used as a reference for graduates and researchers who are interested in ecology and air pollution, especially dust air pollution and atmospheric particulate matter $(PM)_{2.5}$ or PM_{10}. Any comments and suggestions regarding this book will be greatly welcomed and appreciated.

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Abbreviations

°C	Degrees Celsius
μg/m³	Micrograms (1-millionth of a gram) per cubic meter air
μm	Micrometer
τ	Optical depth or optical thickness (usually taken to mean "aerosol" optical depth, AOD, or optical thickness, AOT). May have subscripts to symbolize wavelength or measured by which instrument (e.g., $\tau_{0.55}$)
a.m.	Indicating the time period from midnight to midday (ante meridiem)
AAI	Absorbing aerosol index
AOD	Aerosol optical depth
AOT	Aerosol optical thickness
API	Air pollution index
AQI	Air quality index
CALIPSO	Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations
HYSPLIT	Hybrid Single Particle Lagrangian Integrated Trajectory model
K'	Meteorological self-cleaning capacity of the atmosphere
km	Kilometer
LST	Land surface temperature
m/s	Meter per second
MEP	Ministry of Environmental Protection of the People's Republic of China
mg/m³	Milligrams (1-thousandth of a gram) per cubic meter air
mm	Millimeter
MODIS	Moderate-Resolution Imaging Spectroradiometer
NAAPS	Navy Aerosol Analysis and Prediction System
NAAQS	National Ambient Air Quality Standard
NDVI	Normalized difference vegetation index
nm	Nanometer
NO*x*	Nitrogen oxides
OMI	Ozone Monitoring Instrument
p.m.	Indicating the time period from midday to midnight (post meridiem)
PAP	Potential atmosphere pollution

PM_{10}	Concentration of particulate matter less than 10 μm in diameter
$PM_{2.5}$	Concentration of particulate matter less than 2.5 μm in diameter
r	Pearson's linear correlation
R^2	Coefficient of determination
RH	Relative humidity (%)
RMA	Reduced major axis
r_s	Spearman's rank correlation coefficient
T	Temperature (°C)
UHI	Urban heat island
UTC	Coordinated universal time
UV	Ultraviolet
V	Visibility (km)
VOC	Volatile organic compounds
WHO	World Health Organization
WS	Wind speed (m/s)