Observations of SO2 and NO2 by mobile DOAS in the Guangzhou Eastern Area during the Asian Games 2010

F. C. Wu[1], A. Li[1], P. H. Xie[1], K. L. Chan[2], A. Hartl[2], F. Q. Si[1], J. G. Liu[1], W. Q. Liu[1] etc.

[1] Anhui Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, Hefei, China

[2] School of Energy and Environment, City University of Hong Kong, Hong Kong

Email：jgliu@aiofm.ac.cn

Abstract

Mobile Passive Differential Optical Absorption Spectroscopy measurements of SO_2 and NO_2 were performed in the Guangzhou Eastern Area (GEA) during the Guangzhou Asian Games 2010 from November 2010 to December 2010. The observations were carried out between 10:00 to 13:00 (local time, i.e. during daylight). Spatial and temporal distributions of SO_2 and NO_2 in this area were obtained and emission sources were determined using wind field data. The NO_2 vertical column densities were found to agree with OMI values. The correlation coefficient (referred to as R^2) was 0.88 after cloud filtering within a specific ground pixel. During the Guangzhou Asian Games and Asian Paralympics (Para) Games, the SO_2 and NO_x emissions in the area. For times outside the Games the average SO_2 emission was estimated to be 9.50±0.90 tons per hour and the average NO_x emission was estimated to be 5.87±3.46 tons per hour. During the phases of the Asian and Asian Para Games, the SO_2 and NO_x emissions were reduced by 53.50% and 43.50%, respectively, compared to the usual condition. We also investigated the influence of GEA on Guangzhou University Town, the main venue located northwest of the GEA, and found that SO_2 concentrations here were about tripled by emissions from the GEA.

Introduction

Population growth, industrial development, and heavy traffic lead to higher energy consumption and, therefore, an increase in the emission of pollutants such as SO_2, NO_2, and Volatile Organic Compounds (VOCs) into the atmosphere, if no measures are taken to counteract this development. In recent years, China has experienced a significant increase in atmospheric pollutant concentrations because of rapid industrial development, which has an important impact on ecosystems and human health.

The 16th Asian Games were held in the city of Guangzhou from November 2010 to December 2010. The pollutant sources were identified in order to alleviate air pollution for this occasion. In addition, strategies including emission control for factories, vehicle limitation, and so forth were employed by the Guangzhou government to reduce the air pollution problem during the Asian Games. The Guangzhou Eastern Area (GEA) was considered the most seriously affected region of the city because of the many pollutant sources present. Therefore, understanding the spatial and temporal distribution as well as the emission sources of air pollutants in GEA was important for environmental management during the Guangzhou Asian Games.

Instrument

A schematic diagram of the system is shown in the right of Fig.1. This system is based on a miniature spectrograph (wavelength range:290nm-420nm), a fiber cable coupled with a telescope which collects the zenith-sky sunlight and a portable computer which supplies power and collects data from the spectrograph through USB port. The system also includes a GPS receiver and a miniature weather station to record meteorological data.

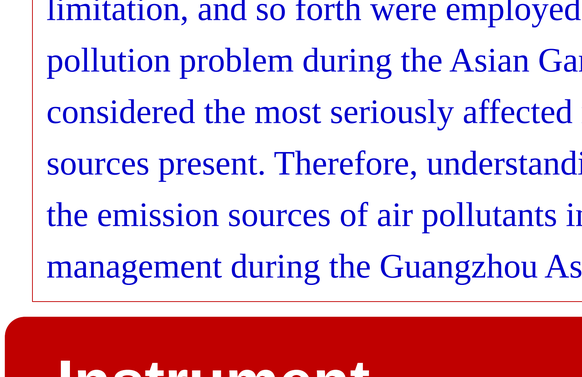
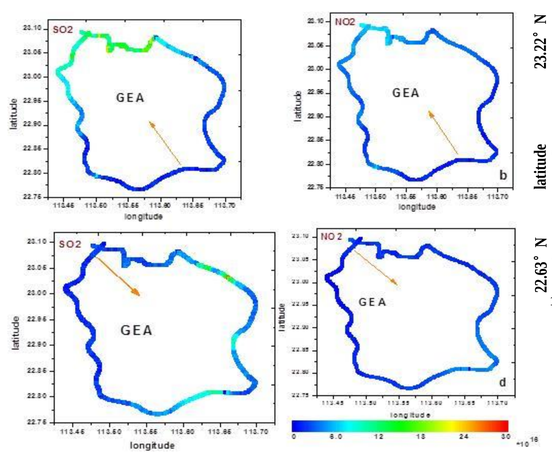


Fig.1 schematic diagram of mobile DOAS

Results and Discussions

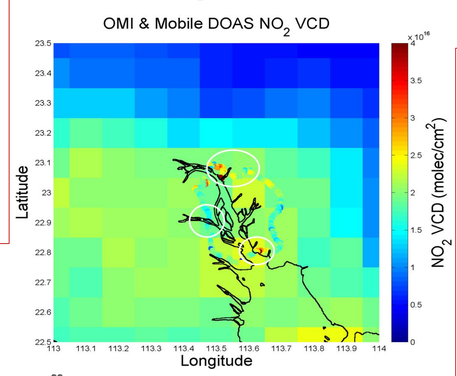
- **Identification of emission sources**



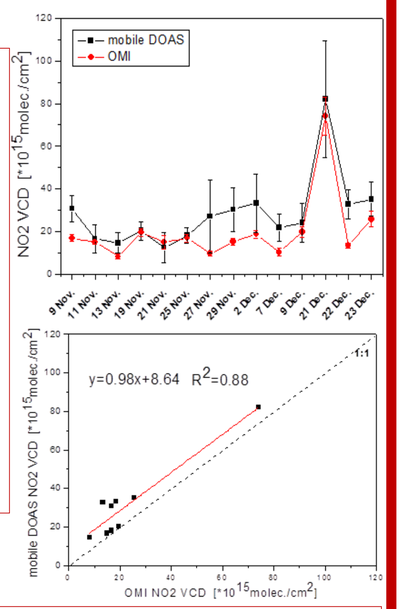
S1, S2, and S3: pollutant sources.
S1: northeast of GEA
S2: north and within the GEA
S3: Humne Bridge

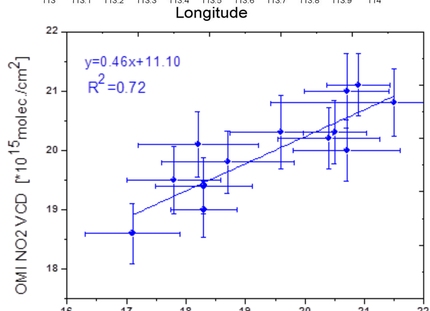
Possible emission sources were determined to explain these distributions using the information from different wind fields

- **Comparison with OMI NO2**



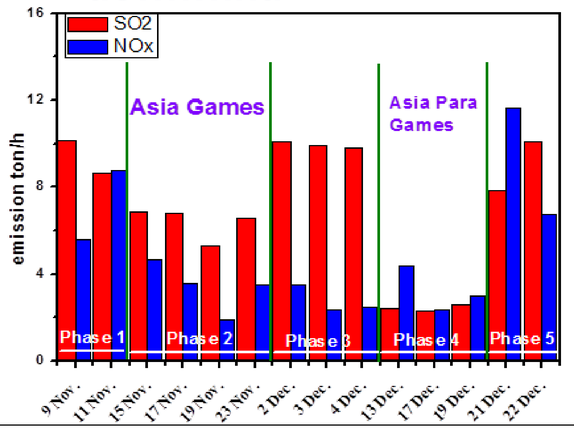
Both captured the high NO2 VCDs in the northern and southern part of the mobile DOAS route as well as low VCDs in the western part. The correlation analysis for these three areas suggested that both observations indeed agree reasonably well.





The correlation coefficient of the vertical columns after cloud filtering was 0.88 within a specific ground pixel

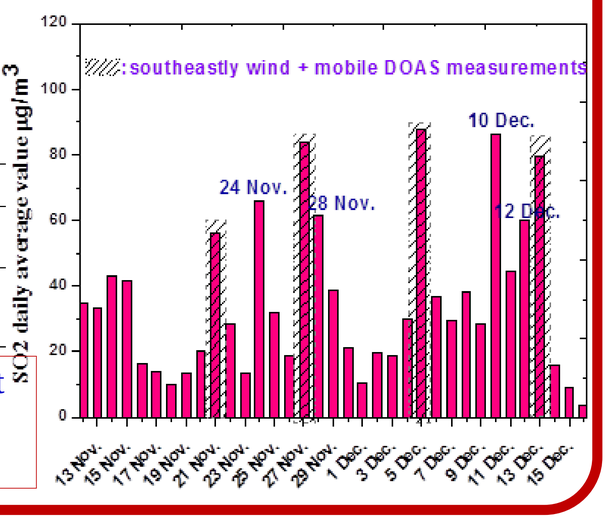
- **Emission of SO2 and NOx and Influence of SO2 emissions on the downwind**



Outside the Asian Games period, the average emissions of SO_2, NOx were estimated to be 9.50±0.90 and 5.87±3.46 tons per hour. During the Games, the emissions of SO_2 and NOx were reduced by 53.50% and 43.50%, respectively.

Emission ton/h

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 1+3+5
SO_2	9.39±1.06	6.38±0.72	9.93±0.15	2.45±0.15	8.97±1.58	9.50±0.90
NO_x	7.20±2.25	3.41±1.14	2.78±0.64	3.22±1.04	9.19±3.47	5.87±3.46



emissions from GEA were found to have a distinct impact on air pollution in this area for southeasterly wind. SO_2 concentrations were found to be about three times.

Reference

1. F. Wu, P. Xie, A. Li et al. Observations of SO2 and NO2 by mobile DOAS in the Guangzhou Eastern Area during the Asian Games 2010. Atmos. Meas. Tech. Discuss., 6, 1–41, 2013
2. Johansson, M., Galle, B., Yu, T et al. Quantification of total emission of air pollutants from Beijing using mobile mini-DOAS. Atmospheric Environment 42 (2008) 6926–6933.

The 6th International DOAS Workshop
Boulder, U.S.A, 2013