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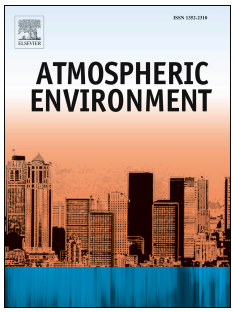

Spatio-temporal distribution of localized aerosol loading in china: A satellite view

Kun Sun, Xiaoling Chen

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Spatio-temporal distribution of localized aerosol loading in china: a satellite view

Kun Sun [a], Xiaoling Chen [a, b, *]

[a] *State Key Laboratory of Information Engineering in Surveying, Mapping and Remote Sensing, Wuhan University, Wuhan 430079, China*

[b] *The Key Laboratory of Poyang Lake Wetland and Watershed Research, Ministry of Education, Jiangxi Normal University, Nanchang 330022, China*

* Corresponding author: State Key Laboratory of Information Engineering in Surveying, Mapping and Remote Sensing (LIESMARS), Wuhan University, Wuhan, Hubei Province 430079, China.

E-mail addresses: bigdianya@foxmail.com (K. Sun); Xiaoling_chen@whu.edu.cn (X. Chen).

Abstract

In recent years, haze pollution and high concentrations of particulate matter frequently occur in many mega cities of China, which has seriously impacted the regional air quality, and further caused harm to human health. Although satellite observation provides a convenient way to evaluate air quality in space and time, satellite measurements do not separate between natural and anthropogenic aerosols. To discriminate anthropogenic aerosol contribution from satellite observations, we proposed the concept of Local Aerosol Optical Depth (LAOD) to describe the localized aerosol loading. A comparative analysis was performed between seasonal/monthly Mean AOD (MAOD), LAOD and ground measured PM2.5/PM10. The comparison results show that LAOD has better linear relationship with PM2.5/PM10 than MAOD in central and eastern China with persistent localized aerosol emissions. Based on the MODIS Deep Blue AOD dataset from 2001 to 2015, we analyzed the spatio-temporal distribution of LAOD over China. Spatially, high LAODs are mainly distributed in Sichuan basin, North China Plain, and central China; temporally, LAOD over China presents an upward trend (+0.003 $year^{-1}$) during 2001-2007 and a weak downward (-0.002 $year^{-1}$) trend from 2008-2015. LAOD was also found to be highly correlated with haze frequency over most areas of central and eastern China, especially in North China Plain with a correlation coefficient of 0.87 ($P<0.01$). It demonstrates the significant impact of local anthropogenic aerosol emission on regional haze pollution in China.

Keywords: aerosol optical depth, MODIS, anthropogenic aerosol, haze pollution

1. Introduction

It is well known that atmospheric aerosol plays a key role in global/local climate change, earth radiation budget and air quality (Haywood et al., 2000; Kaufman et al., 2002; Sun et al., 2016). Satellite and ground observations show that atmospheric aerosols over China have gone through enormous changes in both space and time during the past few decades (Che et al., 2007; Luo et al., 2001; Streets et al., 2008). From view of three aerosol-related parameters: aerosol optical depth (AOD), visibility and fine particulate matter (PM2.5) concentration, AOD over China shows a continuous upward tendency from 1980 to 2008 (0.001/decade 1980-1992, 0.01/decade 1996-2001, 0.004/decade 2000-2008) (Guo et al., 2011); the horizontal visibility and frequency of visibility >19 km decrease 2.1 km and 3.5% per decade from 1990 to 2005 respectively (Che et al., 2007); annual mean $PM_{2.5}$ concentration shows an increase of 1.97 $\mu g/m^3$ during 2004-2007 and a decrease of 0.46 $\mu g/m^3$ during 2008-2013 (Ma et al., 2016). Under the background of rapid growth of industrialization and urbanization during the past decades, there is no doubt that aerosol pollution over China has becoming increasingly severe (Wright et al., 2016).