DESIGN AND APPLICATION OF HAZE OPTIC THICKNESS RETRIEVAL MODEL FOR BEIJING OLYMPIC GAMES

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1. INTRODUCTION

From 1998 to the end of 2007, over 9 years, Beijing municipal government implemented 13 stages and more than 200 measures to reduce the pollutant emission from motor vehicles, coal fire units, construction sites and industrial pollution sites. Through such efforts, the days meeting the relevant standard has increased from 100 to 246 days. Since July 1, 2008, additional measures to improve air quality conditions have been implemented, including specific traffic controls for motor vehicles, and cessation of heavily polluting industries and construction sites. However, on the eve of the Olympic Games, because of low visibility on haze day, people have such a vague and uncomfortable feeling that air quality of Beijing had been extensively concerned by home and abroad.

Haze is defined as daily average visibility less than 10 km, relative humidity less than 80% and excluded other special events leading to low visibility. Remote sensing as a convincing method of monitoring atmosphere has been largely put into practices, but so far there is no report about haze distribution or haze optical thickness monitoring. The main reason is that it is difficult to wipe off the surface reflectance on haze day so that NASA MODIS Dense Dark Vegetation algorithm can not be applied on haze day (see Fig. 1).

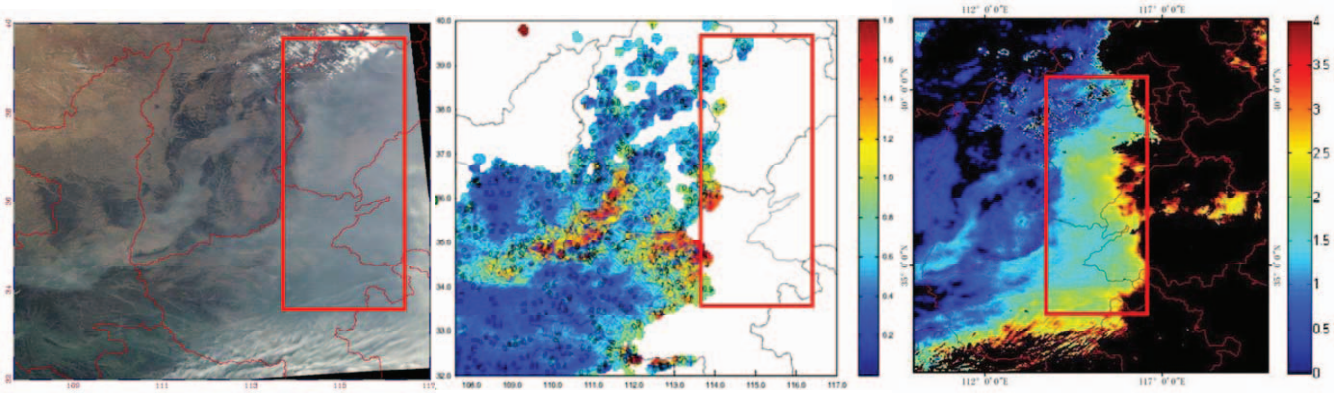
2. METHOD

We assume that the surface reflectivity changes very little in a relative short period (such as within 10 days). Through the atmospheric correction of sunny days which are mostly near the retrieval day, we obtained the combined surface reflectivity product of this period.

In the formation process of haze, acidic pollutants emitted by human activities integrated with local dust particles come into water-soluble salts such as sulfate, nitrate and ammonia-salts through a complex chemical reaction. Based on ground observations and analyzing these products of Beijing AERONET station, we set the volume fraction of water-soluble is in the range from 65% to 75%, soot almost 10%, and dust like between 10% and 20%, oceanic aerosol less than 5%. Then these lookup tables which are different from standard SRA aerosol modals are derived by 6S code.

3. APLICATION IN BEIJING OLYMPIC GAMES

From Mar. 1 to Sep. 30 2008, Haze model had been running to acquire haze distribution and intensity in Beijing and surrounding areas for Olympic atmosphere monitoring project. These results showed: Between Mar.9 and Mar.12, North China Plain occurred large-scale and continuous haze weather which brought serious air pollution in this region. From April to June, Beijing, Tianjin and Hebei province had sustained most overcast and rainy weather, the haze and cloudy day even affected the local climate (Fig. 1 showed Apr.6 2008 Central North China Plain aerosol optical thickness). On the eve of the Beijing Olympic Games, haze days occurred frequently. On July 2, 3, 4, 7, 10, 27, 28 and August 5, 6, 7, haze distribution in Beijing was more obvious and lead to poor visibility, high relative humidity, especially the serious particulate pollution such as PM10 and PM2.5.



a) b) c)

Fig1, Apr.6 2008 Central North China Plain Aerosol Optical Thickness (the red distinct is in haze day)
a) The original image b) NASA AOT product c) Haze aerosol optical thickness using our algorithm

4. VALIDATION AND ERROR ANALYSE

During Olympic atmosphere monitoring project, the ground equipment automatic sun tracking photometer (CE318) obtained a large amount of aerosol observation results. Though contrast between ground measure result and satellite, the effectiveness of haze algorithm was verified. The errors of haze aerosol retrieval are attributed mainly to distinguishing from cloud and fog, surface reflectance estimation and haze aerosol model.

5. CONCLUSION

Haze in NASA MODIS products is dealt as cloud and fog. We attempt to realize haze optic thickness retrieval model and validate its accuracy. The real-time monitoring in haze distribution and intensify for Beijing Olympic Games helped Beijing municipal government to carry out more measures to improve air quality conditions.

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